

Curriculum Guide 2018-2019

Computer Science Fundamentals



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Welcome to Computer Science Fundamentals, the Code.org® curriculum designed for students in grades K-5! This guide has been created to help you navigate the lessons in Courses A-F. It begins with an introduction to the CS Fundamental curriculum, provides a look into our core values and methods, and closes with a detailed overview of each course offering. After this valuable information, you will find customized implementation solutions for many different classroom situations.



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Are you ready to put the FUN in Fundamentals?

Curriculum Introduction

Who Made This Suite?

Launched in 2013, Code.org is a non-profit organization dedicated to expanding access to computer science, and increasing participation by women and underrepresented students of color. Our vision is that every student in every school has opportunity to learn computer science. We believe computer science should be part of core curriculum, alongside other courses such as biology, chemistry, or algebra.

Code.org increases diversity in computer science by reaching students of all backgrounds where they are — at their skill-level, in their schools, and in ways that inspire them to keep learning. [Read about our efforts to increase diversity in computer science](https://code.org/diversity) [https://code.org/diversity]. In order to support this vision of diverse and meaningful access to computer science, Code.org has developed a full pathway of learning opportunities that span K-12. The CS Fundamentals curriculum is specifically designed to meet the needs of elementary school students and teachers along that pathway.



At Code.org, we believe in teamwork. That's why we've partnered up with some of the most innovative elementary computer science educators in the country to create CS Fundamentals. Our curriculum kick-off crew included Alana Aaron and Lionel Bergeron from the New York City Department of Education, as well as Bryan Twarek from the San Francisco Unified School District, Grant Smith of Emerald Data Solutions, Joel Spencer from the Little Rock School District, and Michael Harvey from Falmouth Elementary School...and that was only the beginning!

Over the course of one year we successfully designed, implemented, and piloted six modified courses. Our pilot was open to our dedicated Computer Science Fundamentals Facilitators, as well as thousands of engaged educators from around the world. With their help, we were able to create this course in a way that benefits schools of all different shapes and sizes.

The CS Fundamentals curriculum continue to include lessons on Internet Safety and Digital Citizenship, thanks to our friends at Common Sense Education.

As always, it is thanks to our generous donors that we were able to develop and offer this curriculum at no cost to schools, teachers, or students: Microsoft, Infosys Foundation USA, Facebook, Omidyar Network, Google, Ballmer Family Giving, Ali and Hadi Partovi, Bill Gates, The Bill and Melinda Gates Foundation, BlackRock, Jeff Bezos, John and Ann Doerr, Mark Zuckerberg and Priscilla Chan, Quadrivium Foundation, Amazon Web Services, The Marie-Josée and Henry R. Kravis Foundation, Reid Hoffman, Drew Houston, Salesforce, Sean N. Parker Foundation, Smang Family Foundation, Verizon.

Who is This For?

CS Fundamentals was built with elementary school educators and students in mind. Courses A-F have been specifically tailored to students in Kindergarten through 5th grade, and no prior experience is assumed.

The lessons in CS Fundamentals are presented with the understanding that many teachers will not have any previous computer science training, and educators are therefore encouraged to learn along with their students.

Which Course is For Me?

CS Fundamentals, Courses A-F

CS Fundamentals is made up of 6 courses — one course for each grade, K-5. This grade alignment allows for the most robust content along the entire elementary pipeline, while also allowing for students and teachers to enter the pathway at any point.

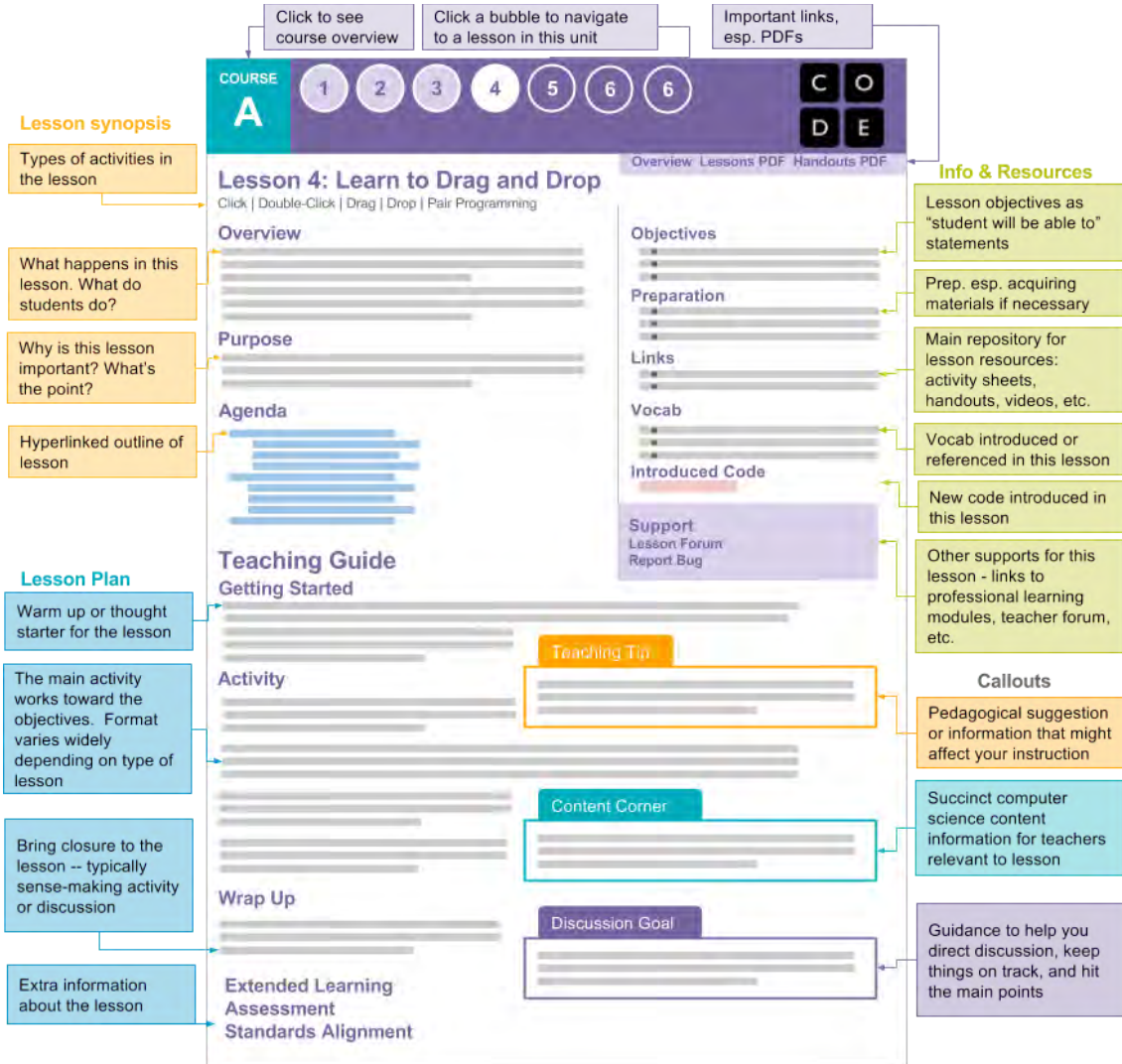
Course A	Course B	Course C	Course D	Course E	Course F
<i>Designed for Kindergarten</i>	<i>Designed for 1st Grade</i>	<i>Designed for 2nd Grade</i>	<i>Designed for 3rd Grade</i>	<i>Designed for 4th Grade</i>	<i>Designed for 5th Grade</i>

Ideal entry points exist at kindergarten, first, and second grades. Suitable entry points have been created in grades 3, 4, and 5 with the addition of age-appropriate introduction lessons that present content from previous courses at an accelerated pace (called “ramp up” lessons).

The core content of these courses range from approximately 12 lessons in A & B, to nearly 20 lessons in Course F, with additional lessons available on the Code.org website to further support specific concepts.

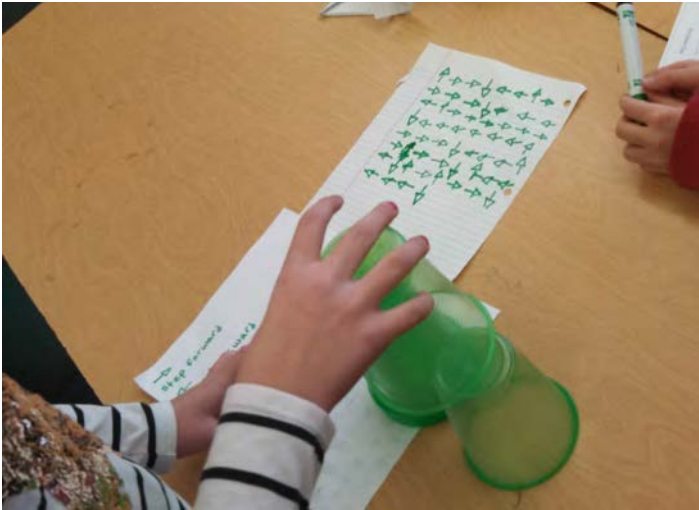
Lesson and Course Structure

Every lesson plan has a common structure that should make it easy to find what you need. Planning for a lesson starts by looking at the overview, then reviewing the core activity to get a deeper sense of what it is and how long it might take.



Lessons in CS Fundamentals are written for a wide variety of classrooms. An individual lesson might take one classroom between 30-45 minutes, while another classroom will choose to complete it over several days. Many lessons include time estimates, the usefulness of those estimates will vary based on the age of your students, their background with the material, and their interests.

In Code.org curriculum, we refer to activities where students are not on the computer as “unplugged” lessons. Lessons where they are on the computer are called “plugged”, or online puzzles. When writing the curriculum, we planned the progression of unplugged and plugged lessons to build on each other. Often something that is done in an unplugged environment is setting the stage for or reviewing a concept done in a plugged environment. Both are vital pieces of the curriculum as they build student knowledge and understanding in different ways.



Unplugged Lessons

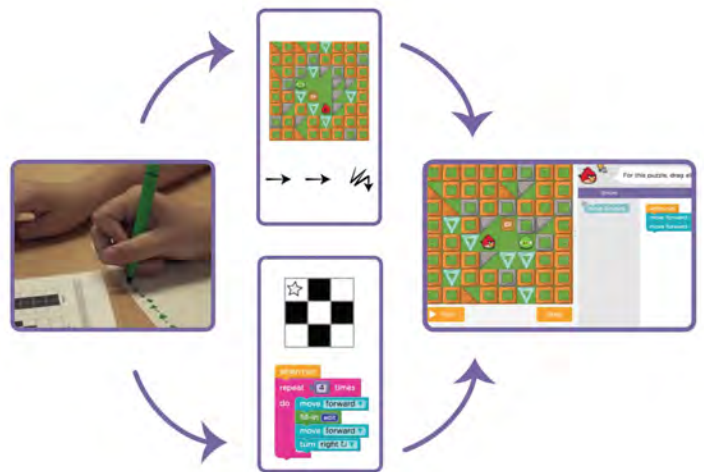
Unplugged activities are more than just an alternative for the days when the computer lab is full. They are intentionally-placed kinesthetic opportunities that help students digest complicated concepts in ways that relate to their own lives. Unplugged lessons can help you build and maintain a collaborative environment in your classroom, and can be a good way to check for student understanding. While these lessons sometime involve more advance preparation, they provide a shared and concrete context that can be referenced during plugged lessons. For a list of all unplugged activities covered in the CS Fundamentals curriculum (plus a few extras!) visit:

<https://code.org/curriculum/unplugged>

Bridging Activities

In the Computer Science Fundamentals curriculum, we refer to activities that mix online and offline elements as “bridging activities.” Bridging activities connect our unplugged activities to our online lessons in a real and concrete way. They often exist as a method of turning an abstract concept or idea learned through unplugged play into an actionable tool for the plugged puzzles.

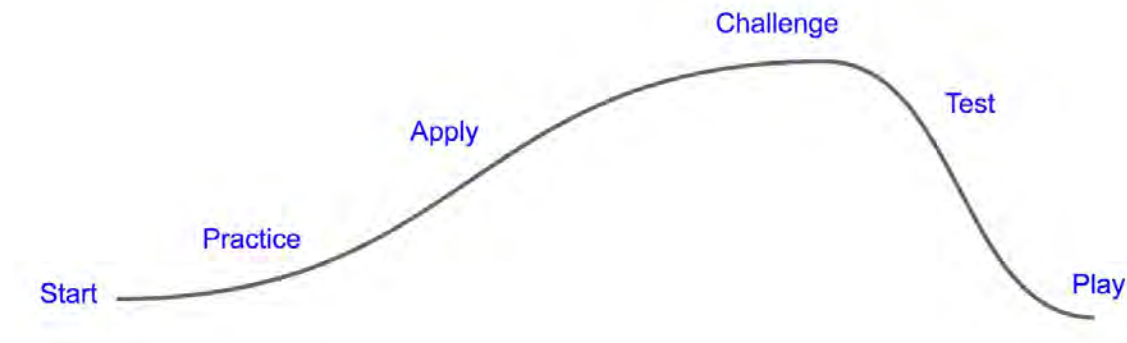
You will find a bridging activity as the “warm up” in the first plugged lessons following each unplugged lesson. As you become more comfortable with the curriculum, feel free to come up with your own online/offline blends to keep the curriculum relevant to your classroom.



Plugged Lessons

Most of our online or “plugged” lessons are designed with an overarching lesson architecture where concepts are carefully introduced using a structure that has been tailored to set classrooms up for success. These puzzle progressions start by introducing ideas in a step-by-step manner, then proceed to a brain-bending challenge before setting students gently back into a puzzle that perfectly represents the level of understanding that was intended for that series.

See the diagram below to get a better idea of how complexity changes over the course of an online lesson.



Once a topic has been introduced, it might be further explored through additional lessons that focus less on skill building and more on creative problem solving using the concept. As an example, these lessons might include puzzles with less obvious pathways, a complex use of concepts, or multiple correct solutions.

Conceptual Chunks

The unplugged and online puzzle lessons are chunked together by shared concepts, where the unplugged lesson serves as a fun and gentle introduction to a computing concept that is further explored through coding exercises. This allows each “chunk” to be separated into groups of lessons that can be taught within a defined time period or as a sub-unit.

See this example from Course C in which the unplugged lesson, Getting Loopy, precedes three online lessons:

- ▶ **Lesson 7: Getting Loopy**
- ▶ **Lesson 8: Loops with Rey and BB-8**
- ▶ **Lesson 9: Sticker Art with Loops**
- ▶ **Lesson 10: Harvesting Crops with Loops**

Loops Conceptual Chunk from CS Fundamentals, Course C

End of Course Projects (Courses E & F)

While each course offers the opportunity for students to take what they’ve learned at the end of a lesson and put it together into a unique project that represents their own creativity, Courses E & F take student projects to a whole new level.

In the final two courses in the series, project development takes the stage. Here, students are encouraged to plan, build, revise, and present projects of their own. Following a project from inception to delivery offers an inside look at the software development cycle. This guided project offers scaffolded rubrics for the benefit of both student and teacher.



Student Practices and Skills

Lessons in CS Fundamentals help students work in a wide array of contexts, but these experiences are tied together by a core set of practices and skills they develop throughout the course. These student practices provide coherence and serve as helpful reminders of the high-level skills and dispositions they should be continually developing.

Problem Solving	<ul style="list-style-type: none"> ● Use a structured problem solving process to help solve new problems ● View challenges as solvable problems ● Break down larger problems into smaller components
Persistence	<ul style="list-style-type: none"> ● Value and expect mistakes as a natural and productive part of problem solving ● Continue working towards solutions in spite of setbacks ● Iterate and continue to improve partial solutions ● Keep track of elements that worked and elements that did not to avoid repeating mistakes
Creativity	<ul style="list-style-type: none"> ● Incorporate your own interests or ideas into your work ● Experiment with new ideas and consider multiple possible approaches ● Extend or build upon the ideas and projects of others
Collaboration	<ul style="list-style-type: none"> ● Work with others to develop solutions that incorporate all contributors ● Mediate disagreements and help teammates agree on a common solution ● Actively contribute to the success of group projects
Communication	<ul style="list-style-type: none"> ● Structure your work so that it can be easily understood by others ● Consider the perspective and background of your audience when presenting your work ● Provide and accept constructive feedback in order to improve your work

Curriculum Values

While Code.org offers a wide range of curricular materials across a wide range of ages, the following values permeate and drive the creation of every lesson we write.

Computer Science is Foundational for Every Student

We believe that computing is so fundamental to understanding and participating in society that it is valuable for every student to learn as part of a modern education. We see computer science as a liberal art, a subject that provides students with a critical lens for interpreting the world around them. Computer science prepares all students to be active and informed contributors to our increasingly technological society whether they pursue careers in technology or not. Computer science can be life-changing, not just skill training.

Teachers in Classrooms

We believe students learn best with the help of an empowered teacher. We design our materials for a classroom setting and provide teachers robust supports that enable them to understand and perform their critical role in supporting student learning. Because teachers know their students best, we empower them to make choices within the curriculum, even as we recommend and support a variety of pedagogical approaches. Knowing that many of our teachers are new to computer science themselves, our resources and strategies specifically target their needs.



Student Engagement and Learning

We believe that students learn best when they are intrinsically motivated. We prioritize learning experiences that are active, relevant to students' lives, and provide students authentic choice. We encourage students to be curious, solve personally relevant problems and to express themselves through creation. Learning is an inherently social activity, so we interweave lessons with discussions, presentations, peer feedback, and shared reflections. As students proceed through our pathway, we increasingly shift responsibility to students to formulate their own questions, develop their own solutions, and critique their own work.

Equity

We believe that acknowledging and shining a light on the historical inequities within the field of computer science is critical to reaching our goal of bringing computer science to all students. We provide tools and strategies to help teachers understand and address well-known equity gaps within the field. We recognize that some students and classrooms need more supports than others, and so those with the greatest needs should be prioritized. All students can succeed in computer science when given the right supports and opportunities, regardless of prior knowledge or privilege. We actively seek to eliminate and discredit stereotypes that plague computer science and lead to attrition of the very students we aim to reach.

Curriculum as a Service

We believe that curriculum is a service, not just a product. Along with producing high quality materials, we seek to build and nourish communities of teachers by providing support and channels for communication and feedback. Our products and materials are not static entities, but a living and breathing body of work that is responsive to feedback and changing conditions. To ensure ubiquitous access to our curriculum and tools, they are web-based and cross-platform, and will forever be free to use and openly licensed under a Creative Commons license.



Pedagogical Approach To Our Values

When we design learning experiences, we draw from a variety of teaching and learning strategies all with the goal of constructing an equitable and engaging learning environment.

Role of the Teacher

We design curriculum with the idea that the instructor will act as the lead learner. As the lead learner, the role of the teacher shifts from being the source of knowledge to being a leader in seeking knowledge. The lead learner's mantra is: "I may not know the answer, but I know that together we can figure it out." A very practical residue of this is that we rarely ask a teacher to lecture or offer the first explanation of a CS concept. We want the class activity to do the work of exposing the concept to students, allowing the teacher to shape meaning from what the students have experienced. We also expect teachers to act as the curator of materials. Finally, we include an abundance of materials and teaching strategies in our curricula - sometimes too many to use at once - with the expectation that teachers have the professional expertise to determine how to best conduct an engaging and relevant class for their own students.

Discovery and Inquiry

We take great care to design learning experiences in which students have an active and equal stake in the proceedings. Students are given opportunities to explore concepts and build their own understandings through a variety of physical activities and online lessons. These activities form a set of common lived experiences that connect students (and the teacher) to the course content and to each other. The goal is to develop a common foundation upon which all students in the class can construct their understanding of computer science concepts, regardless of prior experience in the discipline.

Materials and Tools

Our materials and tools are specifically created for learners and learning experiences. They focus on foundational concepts that allow them to stand the test of time, and they are designed to support exploration and discovery by those without computer science knowledge. This allows students to develop an understanding of these concepts through "play" and experimentation. From our coding environments to our non-coding tools and videos, our resources have been engineered to support the lessons in our curriculum, and thus our philosophy about student engagement and learning. In that vein, our videos can be a great tool for sensemaking about CS concepts and provide a resource for students to return to when they want to refresh their knowledge. They are packed with information and "star" a diverse cast of presenters and CS role models.

Creation and Personal Expression

Many of the projects, assignments, and activities in our curriculum ask students to be creative, to express themselves, and then to share their creations with others. While certain lessons focus on learning and practicing new skills, our goal is always to enable students to transfer these skills to creations of their own. Everyone seeks to make their mark on society, including our students, and we want to give them the tools they need to do so. When computer science provides an outlet for personal expression and creativity, students are intrinsically motivated to deepen the understandings that will allow them to express their views and carve out their place in the world.

The Classroom Community

Our lessons almost always call for students to interact with other students in the class in some way. Whether learners are simply conferring with a partner during a warm up discussion, or engaging in a long-term group project, our belief is that a classroom where students are communicating, solving problems, and creating things is a classroom that not only leads to active and better learning for students, but also leads to a more inclusive culture in which all students share ideas and listen to ideas of others. For example, classroom discussions usually follow a Think-Pair-Share pattern; we ask students to write computer code in pairs; and we strive to include projects for teams in which everyone must play a critical role.

Classroom Practices and Instructional Strategies

The “classroom practices” for CS Fundamentals are strategies used repeatedly in many different lessons and units. These classroom practices are at the core of the ways the curriculum is designed, as we believe these are critical to positive classroom culture and ultimately student learning.



Lead Learner

What is it?

The curriculum has been written with the idea that the instructor will act as the lead learner. As the lead learner your role shifts from being the source of knowledge to being a leader in seeking knowledge. The lead learner’s mantra is: “I may not know the answer, but I know that together we can figure it out.” The philosophy of the lead learner is that you don’t have to be an expert on everything; you can start teaching CS Fundamentals knowing what you already know, and learn alongside your students. To be successful with this style of teaching and learning, the most important things are modeling and teaching how to learn.

How does it connect to the curriculum?

One of the Code.org curriculum values is developing teachers who are new to computer science. In order to support those teachers, the curriculum is set up to create an engaging and relevant class that helps students uncover and develop the knowledge they need. This makes it possible for a teacher to lead the course without knowing all of the answers at first, as long as they embrace the lead learner role. In addition, it is not possible to have complete command over every rapidly-changing facet of computer science, no matter how much experience you have. Rather than feeling daunted, the lead learner welcomes this fact.

We believe that the lead learner technique represents good teaching practice in general. Acting as the lead learner is an act of empathy toward your students and the challenges they face in learning material for the first time. One important job of the teacher in the CS Fundamentals classroom is to model excitement about investigating how things work by asking motivating questions about why things work the way they do, or why they are the way they are. With your guidance, students will learn how to hypothesize; ask questions of peers; test, evaluate, and refine solutions collaboratively.

How do I use it?

- Allow students to dive into an activity without front loading the content first
- Encourage students to rely on each other for support
- Don't give the answer right away, even if you know it
- Feel open to making mistakes in front of students so that they see it is part of the learning process
- Ask students questions that direct their attention toward the issue to investigate without giving away what they need to change
- Model the steps you would go through as a learner of a new subject. Explain the different questions you ask yourself along the way and the ways you go about finding answers

Pair Programming

What is it?

Pair programming is a technique in which two programmers work together at one computer. The "driver" writes code while the "navigator" directs the design and setup of the code. The two programmers switch roles often. Pair programming has been shown to:

- improve computer science enrollment, retention, and students' performance
- increase students' confidence
- develop students' critical thinking skills
- introduce students to a "real world" working environment



How does it connect to the curriculum?

In CS Fundamentals there are many lessons on the computer (plugged lessons) during which students develop programming skills. Pair programming can help to foster a sense of camaraderie and collaboration, and can promote diversity in the classroom by reducing the "confidence gap" between female and male students, while increasing the programming confidence of all students.

How do I use it?

To get students pair programming:

1. Form pairs
2. Give each pair one computer to work on
3. Decide upon initial roles
4. Have students start working
5. Ensure that students switch roles at regular intervals (every 3 to 5 minutes)
6. Ensure that navigators remain active participants

It can be hard to introduce pair programming after students have worked individually for a while, so we recommend that teachers start with pair programming in the first few plugged lessons. Just like any other classroom technique, you may not want to use this all the time as different types of learners will respond

differently to working in this context. Once you have established pair programming as a practice early on, it will be easier to come back to later.

Pair Programming Resources

Code.org also has a feature to help both students get “credit” on their accounts for the work they do together. Check out the blog on Pair Programming: <https://goo.gl/MorPnx>. Explore videos outlining how to pair program with Code.org: Teachers: <youtu.be/sxToW3ixrwo> | Students: <youtu.be/vgkahOzFH2Q>

The National Center for Women & Information Technology (NCWIT) has a great resource about the benefits of pair programming. Check it out at:

www.ncwit.org/resources/pair-programming-box-power-collaborative-learning

Authentic Choice

What is it?

Authentic choice is the practice of allowing students to decide on the focus of their creation when they are working on a project. This can be scoped in different ways with different projects, but the central point is to allow students to work on something they are personally invested in.



How does it connect to the curriculum?

In the curriculum, we give students many opportunities to work on projects that we hope will feel personally relevant. Whether it be a small freeplay level at the end of a lesson, or a course project designed by students in older elementary, every student should get ample opportunity to develop creations of their own.

In addition, we encourage teachers to help students utilize their new skills in creative ways at the end of each lesson, using the Lesson Extras option. There, students will find challenge puzzles and open-canvas projects to use for deeper learning and self-expression.

How do I use it?

- Give students time to get creative and find something they are passionate about in the project that they are working on
- Encourage students to find personally relevant contexts for the work they do
- Try to keep the projects as open to students’ interests as possible while still keeping them focused on the learning at hand

Journaling

What is it?

In CS Fundamentals, students are encouraged to keep a journal nearby to write down thoughts and answer questions.

How does it connect to the curriculum?

Courses A-F of Computer Science Fundamentals were written with the importance of journaling in mind. Journaling for reflection is a popular tool in education, but we take that one step further. Like a chemist would

catalog strategies and solutions, so do we ask our budding computer scientists to take notes on their trials and achievements. Journals are useful as scratch paper for building, debugging, and strategizing, and they offer a fantastic resource for referencing previous answers when struggling with more complex problems.

How do I use it?

- Encourage students to keep their journals beside them at all times when coding
- Remind students that they can write solutions out longhand, then circle patterns to find prime opportunities for loops and functions
- Have students copy down answers to puzzles that they might need in future levels
- Ask students to draw emoticons at the top of the pages to help them identify how they're feeling about concepts
- End each lesson with a thought or question that students can answer in writing as a way of reflecting on their growth for the day

In addition to the strategies above, consider the following tips for keeping your CS Fundamentals course active and engaging:

<h3>Ditch the Uniformity</h3>	<p>Students learn at different rates. They also come into technology with vastly different skills. Trying to keep everyone on the same page will alienate both the bottom third and top third of learners. Take the pressure off of everyone by having a list of “approved” activities to focus on when they’ve finished their class exercise. These should include the Lesson Extras at the end of each CS Fundamentals lesson.</p>
<h3>Frequent Breaks</h3>	<p>Teachers are used to helping their class get very focused and encouraging students to work quietly until an activity is done. In computer science, students often benefit from small and frequent breaks, even if it’s just switching to a new activity for a few minutes. Try having a student write a sentence or two about what they’re trying to do or keep a notebook, like a biologist or chemist might.</p>
<h3>Collaborate</h3>	<p>It’s really hard for a programmer to “cheat”. Collaboration is a requirement out in the real world. This means helping one another solve problems, researching issues on the internet, and looking at what others have done in similar situations. The only bad method is claiming another’s work as your own.</p>
<h3>Don’t be a Know-It-All</h3>	<p>We often think that being a teacher means being an expert. In computer science, it’s really much more important to be a cheerleader. Let the students know that it’s possible for them to quickly become better at this than you are. Foster determination. Encourage students to monitor themselves and find answers for one another. Let them figure things out for themselves, then let them teach you.</p>

Course Overviews and Lesson Outlines

Course A: Overview

Course A offers computer science curriculum for beginning readers in early elementary grades. Students will learn to program using commands like loops and events. The lessons featured in this course also teach students to collaborate with others meaningfully, investigate different problem-solving techniques, persist in the face of difficult tasks, and learn about internet safety. By the end of this course, students create their very own custom game in Play Lab.

Core concepts:

- Sequencing
- Loops
- Events
- Digital Citizenship

Attitudinal goals:

- Programming is fun
- It's okay not to get it right the first time
- I can solve problems if I keep trying

Key teaching tips:

- Use the stories as a read-aloud and discuss the scenarios as a class
- Work through sample problems with students as a class
- Connect unplugged lessons to the online lessons using “bridging activities”
- Celebrate persistence as well as successes
- Honor the humor in the lessons and add more where possible

Course A: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	Unspotted Bugs	Students will learn the mantra: "What happened? What was supposed to happen? What does that tell you?"
2	Stevie and the Big Project	Here, frustration is presented as a step in the creative process, rather than a sign of failure.
3	Plant a Seed	Students will relate the concept of algorithms back to everyday, real-life activities by planting an actual seed.
4	Sequencing with Angry Birds	This begins with a brief discussion on computer lab manners, then will progress into using a computer to complete online puzzles.
5	Happy Maps	This activity will help students gain experience reading and writing in shorthand code.
6	Programming with Angry Birds	In this set of online puzzles, students will build on the understanding of algorithms, debugging, and general computer literacy.
7	Programming with Harvester	Students will apply the programming concepts that they have learned to the Harvester environment.
8	Going Places Safely	Students find out that they can go exciting places online, but they need to follow rules to remain safe. [Common Sense Education]
9	Happy Loops	Students will be driven to want an easier way to solve mundane problems.
10	Loops with Harvester	Building on the concept of repeating instructions, this stage will have students using loops to more efficiently get to the veggies.
11	Loops with Laurel	Continuing practice with loops, students will help Laurel the Adventurer collect treasure!
12	Ocean Scene with Loops	Here, students use loops to create patterns. At the end of this stage, students will be given the opportunity to create their own images using loops.
13	The Big Event	This shows that events are a great way to add variety to a sequential algorithm.
14	On the Move with Events	Students will have the opportunity to learn how to use events in Play Lab and apply their coding skills to create an animated game.

Course B: Overview

Course B was developed with first-graders in mind. Tailored to a novice reading level, this course also assumes limited knowledge of shapes and numbers.

While the concepts in Course B parallel those in Course A, students will be exposed to more sophisticated unplugged activities and greater variety in puzzles. Students will learn the basics of programming, collaboration techniques, investigation and critical thinking skills, persistence in the face of difficulty, and internet safety. At the end of this course students will create their very own custom game in Play Lab.

Core concepts:

- Sequencing
- Loops
- Events
- Copyright and Creativity
- Digital Citizenship

Attitudinal goals:

- Programming is fun
- It's okay not to get it right the first time
- I can solve problems if I keep trying

Key teaching tips:

- Read through the Course A stories with your students beforehand (if possible) and talk about the situations
- Work through sample problems with students as a class
- Connect unplugged lessons to the online lessons using “bridging activities”
- Remind students that they can go back and fix mistakes
- Celebrate persistence

Course B: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	Move It, Move It	This lesson will work to prepare students mentally for the coding exercises that they will encounter over the length of this course.
2	Sequencing with Scrat	This begins with a brief discussion on computer lab manners, then will progress into using a computer to complete online puzzles.
3	Your Digital Footprint	Students will learn that the information they put online leaves a digital footprint or “trail.” [Common Sense Education]
4	My Robotic Friends Jr.	This teaches students the connection between algorithms and programming, as well as the valuable skill of debugging.
5	Programming with Scrat	Students will use the concepts of programming to get Scrat to the acorn.
6	It's Great to Create and Play Fair	This lesson exists to help students understand the creative process of sharing and inspiration. Along with that comes the promotion of creative expression and the need to be fair with creative work.
7	Programming with Rey and BB-8	In this lesson, students will use their newfound programming skills in more complicated ways to navigate a tricky course with BB-8.
8	My Loopy Robotic Friends Jr.	Using the language from ‘My Robotic Friends’. Students find that they can build big structures faster using loops.
9	Loops with Scrat	This lesson builds on the idea of using loops in a program.
10	Loops with Laurel (or Collecting Treasure with Loops)	Students use loops to collect treasure more efficiently.
11	Drawing Gardens with Loops	Here, students use loops to create patterns. At the end of this stage, students will be given the opportunity to create their own images using loops.
12	The Big Event	This lesson shows that events are a great way to add variety to a pre-written algorithm.
13	A Royal Battle with Events	In this online activity, students will have the opportunity to learn how to use events in Play Lab and apply all of the coding skills that they've learned to create an animated game.

Course C: Overview

Course C was developed for students in and around the second grade. Lessons in this course may assume a limited understanding of shapes and elementary math concepts.

Students will create programs with sequencing, loops, and events. They will translate their initials into binary, investigate problem-solving techniques, and develop strategies for building positive communities both online and off. By the end of the course, students will create interactive games that they can share. Each concept in Course C is taught from the beginning, graduating toward experiences that allow for growth and creativity to provide all students a rich and novel programming experience.

Core concepts:

- Sequencing
- Loops
- Events
- Digital Citizenship
- Binary

Attitudinal goals:

- I can read code and predict the outcome
- Programming can make repetitive tasks easy

Key teaching tips:

- Talk with students before you begin about how frustration will be present
- Use pair programming and encourage students to help each other
- Provide lesson examples to set students off on the right foot
- Connect unplugged lessons to the online lessons using “bridging activities”

Course C: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	Building a Foundation	Students will build a structure with common materials. Most students will not get this right the first time, but it's important they push through and keep trying.
2	Coding with Angry Birds	Students will develop sequential algorithms to move a bird from one side of the maze to a pig at the other side.
3	Debugging with Angry Birds	Students will step through the existing code to identify errors, including incorrect loops, missing blocks, extra blocks, and blocks that are out of order.
4	Paper Planes	Students will relate the concept of algorithms back to everyday activities.
5	Collecting Treasure with Laurel	Students will continue to develop their understanding of algorithms and debugging by creating sequential algorithms to pick up treasure with a Laurel the Adventurer.
6	Creating Art with Code	This Artist stage will allow students to create images of increasing complexity using new blocks like `move forward by 100 pixels` and `turn right by 90 degrees.`
7	Getting Loopy	Students will dance their way to a better understanding of how to use repeat loops.
8	Loops with Rey and BB-8	Students will use loops to traverse mazes more efficiently than before.
9	Sticker Art with Loops	This lesson builds on the understanding of loops from previous lessons and gives students a chance to be truly creative.
10	Harvesting Crops with Loops	Students will loop new actions to help the harvester collect multiple veggies growing in large bunches.
11	The Big Event	Students will learn that events are a great way to make their program interactive.
12	Build a Flappy Game	In this special stage, students get to build their own Flappy Bird game by using event handlers to detect mouse clicks and object collisions.
13	Screen Out the Mean	This helps children recognize that it is essential to tell a trusted adult if something online makes them feel angry, sad, or scared. [Common Sense Education]
14	Chase Game with Events	It's time to get creative and make a game in Play Lab!
15	Looking Ahead with Minecraft	Students will get the chance to practice ideas that they have learned up to this point, as well as getting a sneak peek at conditionals!
16	Binary Bracelets	This lesson helps demonstrate how it is possible to take something from real life and translate it into a series of ons and offs.

Course D: Overview

Course D was created for students who read at roughly a third grade level. Angles and mathematical concepts are introduced with helpful videos and hints.

The course begins with a review of the concepts found in Courses A, B, and C. This review can be used to introduce or refresh basic ideas such as loops and events. Afterward, students will develop their understanding of algorithms, nested loops, while loops, conditionals, and events. Lessons on digital citizenship are also included. This course is crafted to build a strong foundation of basic concepts before opening up to a wide range of new and exciting topics.

Core concepts:

- Events
- Nested Loops
- While/Until Loops
- If/Else Conditionals
- Digital Citizenship

Attitudinal goals:

- Struggle is good, and a sign that I'm growing
- I can read programs and predict their outcomes
- Programs can be written to make simple choices

Key teaching tips:

- Talk to students about the frustration/learning connection before you begin
- Use pair programming and encourage students to help each other
- Begin to teach students the importance of solving their own issues
- Encourage students to use a journal during and after activities
- Give students the opportunity to share successes

Course D: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	Graph Paper Programming	By "programming" one another to draw, students will develop an understanding of the connection between code and what it produces.
2	Introduction to Coding	Students will practice sequencing and debugging before adding new skills.
3	Relay Programming	Students will race against the clock as they break into teams and work together to write a program one instruction at a time.
4	Debugging with Laurel	Students will practice debugging in the Collector environment.
5	Bounce	Students will work through puzzles making the program react to events.
6	Loops in Ice Age	This stage will have students using the repeat block to get Scrat to the acorn.
7	Drawing Shapes with Loops	This gets students thinking about why loops are better than longhand.
8	Nested Loops in Maze	Using Bee and Plants vs Zombies, students will learn to nest loops.
9	Fancy Shapes using Nested Loops	In this online activity, students will create designs in Artist using nested loops.
10	Snowflakes with Anna and Elsa	Students will get practice nesting loops while creating images that they will be excited to share.
11	While Loops with the Farmer	Students will develop a beginner's understanding of condition-based loops.
12	Until Loops in Maze	Students will build programs that have the main character repeat actions until they reach their desired stopping point.
13	Conditionals with Cards	This lesson demonstrates how conditionals can be used to tailor a program to specific information.
14	If/Else with Bee	The if / else blocks will allow for a more flexible program.
15	Harvesting with Conditionals	It's time to get creative and make a game in Play Lab!
16	Digital Citizenship	Students learn the difference between what is and is not safe to share online. [Common Sense Education]
17	Ninjas vs. Pirates Game	It's time to get creative and make a game in Play Lab!
18	Binary Images	This lesson illustrates how a computer can store complex information (such as photos and colors) in binary.
19	Binary Images with Artist	In this lesson, students will build binary images in Artist by translating 0s and 1s to offs and ons (or black and white).

Course E (Ramp-Up): Overview

Course E begins with a set of optional ramp-up lessons which will be presented again at the beginning of Course F. These condensed lessons exist to help make sure that students are confident with basic concepts before they begin learning more complex combinations later in the series.

The approach to the ramp-up section depends on your classroom. If your students have no prior experience, then it's essential that you use the ramp-up to provide your students with a solid introduction to the core concepts that will be built upon later in the course. Pay particular attention to the unplugged lessons, as they give students the real-life foundations that they will need to connect these concepts together later.

If students are already familiar with the concepts presented in the ramp-ups, you can pick and choose from the lessons to keep the ramp-up experience slim. As long as students are confident using the various programming environments present to program sequences, loops, and nested loops, they will have what they need to be successful in later lessons.

Core concepts:

- Sequencing
- Debugging
- Loops
- Nested Loops
- Conditionals

Attitudinal goals:

- I'm comfortable with basic programming concepts

Key teaching tips:

- Remind students that this series is to help them learn, not to see how quickly they can solve puzzles
- Require students to make a first attempt at problem-solving before asking for help
- Remind students of the importance of persistence
- Encourage students to check themselves (and each other) for understanding during and after each lesson

Course E (Ramp-Up): Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	My Robotic Friends	This lesson teaches students the connection between symbols and actions, as well as the difference between an algorithm and a program.
2	Coding with Comments	Students will be guided through an introduction (or review depending on the experience of your class) of Code.org's online workspace.
3	Building a Foundation	Students will build a structure with common materials. Most students will not get it right the first time, and should be encouraged to keep trying.
4	Debugging with Scrat	In this lesson, students will encounter puzzles that have been solved incorrectly. They will then work to identify and fix errors.
5	Creating Art with Code	This Artist stage will allow students to create images of increasing complexity using new blocks.
6	My Loopy Robotic Friends	Students learn the simplicity and utility of loops by “programming” their friends using the language from ‘My Robotic Friends’.
7	Drawing Shapes with Loops	This lesson builds on the understanding of loops from previous lessons and gives students a chance to be truly creative.
8	Nested Loops in Maze	In this online activity, students will have the opportunity to push their understanding of loops to a whole new level. Playing with Bee and Plants vs Zombies, students will learn how to nest loops.
9	Nested Loops with Frozen	Now that students know how to layer their loops, they can create many beautiful things. This lesson will take students through a series of exercises to help them create their own portfolio-ready images.
10	Conditionals with Cards	This lesson demonstrates how conditionals can be used to tailor a program to specific information.
11	Conditionals with the Farmer	This lesson briefly covers the conditional concepts, including `while` loops, `until` loops, and `if/else` statements.

Course E: Overview

Course E in CS Fundamentals was tailored to the needs of students in the fourth grade.

At this point students should be growing in their confidence using basic programming concepts, and are ready to start using them to solve more novel problems. Throughout this course students will learn to identify when to apply and combine the many concepts they've learned in previous courses. Students will begin with some light review, followed by a deep dive into the idea of functions. For many, the lessons in Course E will provide the first puzzles where difficult concepts are mixed together, making it one of the most challenging courses in the series.

Because of the complexity of Course E, it is important to be consistent with expectations from the very beginning. With fourth graders, it is advised that students be encouraged to work together to find solutions, rather than relying on help from the teacher or other experienced supervisor. Students should be empowered to try multiple techniques and should be given praise for persistence and for helping others.

Ultimately, Course E will be setting the foundation for Course F in the fifth grade. This means that it is as critical for students to understand the ideas behind each puzzles as it is for them to successfully solve the puzzle. For this reason, you might want to show students how to use peer interaction or journaling to help with difficult puzzles. Mainly, they should mention four things:

- What does the puzzle want me to do?
- What did I try to make that happen?
- Where did it go wrong?
- What might be the next thing I could try?

Core concepts:

- Events
- Conditionals
- Functions
- Digital Citizenship
- Copyright and Creativity

Attitudinal goals:

- There are often many ways to solve a problem
- Reflecting on past problems helps me solve new ones
- Programming is creative

Key teaching tips:

- Promote an environment of cross-team collaboration for group activities and projects
- Help students understand that the content is supposed to be difficult and it will start to feel easier with practice
- Encourage students to go back and replay puzzles if they are having trouble moving forward

Course E: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
12	Private and Personal Information	[Common Sense Education] Developed by Common Sense Education, this lesson is about the difference between information that is safe to share online and info that is not.
13	Build a Star Wars Game	Students will learn events before creating their own event-driven games.
14	Songwriting	This lesson will help students intuitively understand why combining chunks of code into functions can be such a helpful practice.
15	Functions with Minecraft	Students will be taught that functions are helpful in this interactive Minecraft adventure!
16	Functions with the Harvester	This lesson will push students to use functions in the new ways by combining them with while loops and if / else statements.
17	Digital Sharing	Students will learn the proper way to handle the use of content that is not their own.
18	Functions with Artist	For more complicated patterns, students will learn about nesting functions by calling one function from inside another.
19	Determine the Concept	This lesson gives students a chance to think critically about how they would solve each problem, but without telling them which concept to apply.
20	Learning Sprite Lab	This lesson is designed to introduce students to the core vocabulary of Sprite Lab and allow them to apply concepts they learned in other environments to this tool.
21	Alien Dance Party	This lesson features Sprite Lab, a platform where students can create their own alien dance party with interactions between characters and user input.
22	Pet Giraffe	Students will use events, behaviors, and custom code to create their very own pet giraffe that gets hungry, playful, and even filthy!
23	Explore Project Ideas	Students will play with examples of projects in both Artist and Sprite Lab for inspiration.
24	The Design Process	Students will learn about the design process and how to implement it in their projects.
25	Build Your Project	Students will be given their own space to create their project with either Artist or Sprite Lab. This will be the longest portion of the project.
26	Present Your Project	Finally, students will be able to present their finished work to their peers or share with their loved ones with a special link.
27	Internet	In this lesson, students will pretend to flow through the internet, all the while learning about connections, URLs, IP Addresses, and the DNS.
28	Crowdsourcing	This lesson will show students how helpful teamwork can be in the industry of CS.

Course F (Ramp-Up): Overview

Course F begins with the same set of optional ramp-up lessons presented in Course E, as well as an additional review of functions. These condensed lessons are here to help make sure that students are confident with basic concepts before they begin learning more complex combinations later in the series.

The approach to the ramp-up section depends on your classroom. If your students have no prior experience, then it's essential that you use the ramp-up to provide your students with a solid introduction to the core concepts that will be built upon later in the course. Pay particular attention to the unplugged lessons, as they give students the real-life foundations that they will need to connect these concepts together later.

If students are already familiar with the concepts presented in the ramp-ups, you can pick and choose from the lessons to keep the ramp-up experience slim. As long as students are confident using the various programming environments present to program sequences, loops, and nested loops, they will have what they need to be successful in later lessons.

Core concepts:

- Sequencing
- Debugging
- Loops
- Nested Loops
- Conditionals
- Functions

Attitudinal goals:

- I'm comfortable with basic programming concepts

It is recommended that you:

- Remind students that this series is to help them learn, not to see how quickly they can solve puzzles
- Require students to make a first attempt at problem-solving before asking for help
- Remind students of the importance of persistence
- Encourage students to check themselves (and each other) for understanding during and after each lesson

Course F (Ramp-Up): Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
1	My Robotic Friends	This lesson teaches students the connection between symbols and actions, as well as the difference between an algorithm and a program.
2	Coding with Comments	Students will be guided through an introduction (or review depending on the experience of your class) of Code.org's online workspace.
3	Building a Foundation	Students will build a structure with common materials. Most students will not get it right the first time, and should be encouraged to keep trying.
4	Debugging with Scrat	In this lesson, students will encounter puzzles that have been solved incorrectly. They will then work to identify and fix errors.
5	Creating Art with Code	This Artist stage will allow students to create images of increasing complexity using new blocks.
6	My Loopy Robotic Friends	Students learn the simplicity and utility of loops by “programming” their friends using the language from ‘My Robotic Friends’.
7	Drawing Shapes with Loops	This lesson builds on the understanding of loops from previous lessons and gives students a chance to be truly creative.
8	Nested Loops in Maze	In this online activity, students will have the opportunity to push their understanding of loops to a whole new level. Playing with Bee and Plants vs Zombies, students will learn how to nest loops.
9	Nested Loops with Frozen	Now that students know how to layer their loops, they can create many beautiful things. This lesson will take students through a series of exercises to help them create their own portfolio-ready images.
10	Conditionals with Cards	This lesson demonstrates how conditionals can be used to tailor a program to specific information.
11	Conditionals with the Farmer	This lesson briefly covers the conditional concepts, including `while` loops, `until` loops, and `if/else` statements.
12	Functions with Minecraft	Students will begin to understand how functions can be helpful in this fun and interactive Minecraft adventure!

Course F: Overview

The final course in CS Fundamentals is tailored to the needs of students in the fifth grade.

In this course, students will investigate problem-solving techniques and discuss societal impacts of computing and the internet. By the end of the course, students will have created interactive stories and games that they can share with their friends and family.

In Course F students are begin to understand how the concepts that they have learned impact the world around them, and how they can be applied to solve interesting and personally relevant problems. By this point students should be cognitively mature enough to think about plans that they want to bring to life, and have the skills to start down that path.

Starting with the first few lessons students are given greater autonomy and creative freedom in programming, which also necessitates an increased emphasis on debugging and problem solving. Students in the fifth grade should be expected to take the first steps in solving all of their own coding problems as they arise, and when solving problems they should be encouraged to work with peers to overcome obstacles rather than relying on the teacher to do so.

Remember, *solving* a puzzle is not as important as *understanding* a puzzle, so when students are stuck, encourage them to look at several angles until a solution begins to appear.

Core concepts:

- Variables
- For-loops
- Functions
- Digital Citizenship

Attitudinal goals:

- I can use computer science to solve real and meaningful problems
- Programming is creative

Key teaching tips:

- Promote an environment of cross-team collaboration for group activities and projects
- Help students understand that the content is supposed to be difficult and it will start to feel easier with practice
- Encourage students to go back and replay puzzles if they are having trouble moving forward
- Provide students with autonomy, allowing them to make decisions, edits, and fixes for themselves

Course F: Lesson Outlines

Online lessons are in regular text and unplugged lessons are in **bolded** text.

#	Lesson Name	Description
13	The Power of Words	[Common Sense Education] Students explore ways to handle cyberbullying and how to respond in the face of upsetting language online.
14	Envelope Variables	This lesson explains what variables are and how to use them in different ways.
15	Variables with Artist	Students explore the creation of repetitive designs using variables in Artist.
16	Changing Variables with Bee	Students will get further practice with variables by gathering honey and nectar.
17	Changing Variables with Artist	This artist level takes variables to new heights.
18	For Loop Fun	`For` loops have extra structures built-in to create more powerful & dynamic code.
19	For Loops with Bee	This focuses on `for` loops and using the increment to solve more complicated puzzles.
20	For Loops with Artist	Students continue to practice `for` loops, this time with Artist.
21	Learning Sprite Lab	This lesson is designed to introduce students to the core vocabulary of Sprite Lab and allow them to apply concepts they learned in other environments to this tool.
22	Alien Dance Party	This lesson features Sprite Lab, a platform where students can create their own alien dance party with interactions between characters and user input.
23	Pet Giraffe	Students will use events, behaviors, and custom code to create their very own pet giraffe that gets hungry, playful, and even filthy!
24	Explore Project Ideas	Students will play with pre-built examples to prepare for the creation of their own projects.
25	The Design Process	Students will learn about the design process and how to use it for their own projects.
26	Build Your Project	Students will be given their own space to create a project of their own design.
27	Revise Your Project	Students are given the opportunity to get feedback from peers and revise their projects.
28	Present Your Project	Students will present their finished work to their peers and/or share with their loved ones.

Courses A-F Additional Supplies List

Most of the unplugged lessons in Courses A-F require only paper, scissors, and writing instruments. We have included here a list of activities where lessons can benefit from more.

Course A

- Marble Run** [Lessons 1 & 2] - Tape, cardboard, other misc. supplies for building, kid friendly marbles (or round cereal)
- Real-Life Algorithms: Plant a Seed** [Lesson 3] - Dirt, seeds, paper cups
- Big Event (K-1 Version)** [Lesson 13] - Printouts

Course B

- Move It, Move It** [Lessons 1] - Printouts, blank paper
- My Robotic Friends** [Lesson 4] - Plastic cups, index cards
- My (Loopy) Robotic Friends** [Lesson 8] - Plastic cups, index cards
- Big Event (K-1 Version)** [Lesson 12] - Printouts

Course C

- Building a Foundation** [Lesson 1] - Gumdrops and toothpicks or marshmallows and popsicle sticks
- Real-Life Algorithms: Paper Airplanes** [Lesson 4] - Paper for airplane construction
- Binary Bracelets** [Lesson 15] - Markers (Optional: beads and pipe cleaners)

Course D

- Graph Paper / Relay Programming** [Lessons 1 / 3] - Printouts, Markers
- Conditionals with Cards** [Lesson 11] - Deck of cards, or something similar
- Digital Citizenship** [Lesson 16] - Cubecraft superheros (see resources for more details)
- Binary Images** [Lesson 18] - Printouts, markers, optional: coin (with heads and tails)

Course E

- My Robotic Friends** [Lesson 1] - Plastic cups, index cards
- Building a Foundation** [Lesson 3] - Gumdrops and toothpicks or marshmallows and popsicle sticks
- My (Loopy) Robotic Friends** [Lesson 6] - Plastic cups, index cards
- Conditionals with Cards** [Lesson 10] - Deck of cards, or something similar
- Functions: Songwriting** [Lesson 14] - Paper, written song lyrics
- Internet** [Lesson 27] - Blank paper, lesson printouts
- Crowdsourcing** [Lesson 26] - Deck of cards, jar full of small items (buttons, beads, beans, etc)

Course F

- My Robotic Friends** [Lesson 1] - Plastic cups, index cards
- Building a Foundation** [Lesson 3] - Gumdrops and toothpicks or marshmallows and popsicle sticks
- My (Loopy) Robotic Friends** [Lesson 6] - Plastic cups, index cards
- Conditionals with Cards** [Lesson 10] - Deck of cards, or something similar
- Envelope Variables** [Lesson 14] - Envelopes
- For Loop Fun** [Lesson 18] - Dice

Technology Requirements

A computing device and an Internet connection.

We work hard to build an environment that supports all modern web browsers on desktops and mobile devices. This includes Internet Explorer 11+ and the latest versions of Firefox, Chrome, Safari.

Our instructional videos may be affected depending on your school's internet filters. If YouTube is blocked at your school, our video player will attempt to use our non-YouTube player instead. For more details about the IT requirements for accessing and playing our embedded videos, see our IT requirements page at <https://code.org/educate/it>. We've made all of our videos available for download using a link located in the bottom corner. If all fails, some videos have a "Show Notes" tab that provide a storyboard equivalent of the video.

Implementation Tips and Considerations

This document offers suggestions for implementing an individual CS Fundamentals course in an elementary school classroom, as well as planning the rollout of all Courses A-F as a pathway across elementary school grade levels.

Scheduling The Lessons

The CS Fundamentals courses have been designed for flexibility in implementation, and have been successfully used in a variety of formats, including in the classroom alongside other subjects, as a rotating special, in computer lab time, or as stations. While each course is intended to run as one lesson per week for a semester, they can alternatively be run two or three times a week for about two months, or one lesson every two weeks for a year. Regardless of how you chose to pace the courses, it's important to remember that lessons are meant to be completed in order and can range from as little as 20 minutes to more than 45 minutes if extension activities are included.

Teaching in the Classroom

Here are implementation tips for four common situations in elementary school:

- **Grade Specific Classroom**
 - Even if you have 1:1 computers, consider grouping students up for pair programming. This setup allows students to gain insight into the problem solving processes of their peers while helping them to develop collaboration and communication skills.
 - You do not need computers for unplugged days, unless you plan to double up and work on an online lesson immediately after the offline one. Consider giving time for the concept to sink in after an unplugged lesson before moving to online programming.
 - Keeping the class together on the same lesson helps to build a sense of community and prevents struggling students from feeling left behind by their peers. Make sure students feel empowered to travel at their own pace within a lesson and consider what you want to do with students who finish early. Extension challenges or peer support can both be effective.

- End of Lesson puzzles should be seen as a great opportunity to showcase the things students have learned during the day, not as a required assessment for the segment.
- **Mixed Grade Classroom**
 - When selecting groups for pair programming, make sure that students are paired either with students of a similar age or a similar experience level. Having pairs that are too far separated in skills is not fair to either member of the team.
 - If your class is regularly held in the lab, look for rooms to “visit” for unplugged activities (like the library or the gym.) This will give students room to spread out and feel like they are learning authentically, rather than trying to “make do” in the available space.
 - It’s expected that students from different grades could be on different lessons or even in different courses. Decide on what rules you want to foster surrounding these differences and get buy-in from students before each lesson to prevent things from getting unruly.
- **Using “Centers” or “Stations”**
 - Some classrooms have a small number of computers set up in one area and teachers use these as activity centers. This can be very effective once the class has already gone through the unplugged activities for a concept together.
 - Continue to encourage pair programming, even if students are only able to get through 2 to 4 puzzles at a time. The realizations that they have while learning to talk through problems will far outweigh any reduction in speed that they experience while trading off.
 - If you have empty stations open, offer unplugged activities that relate back to the online lessons. Providing extra opportunities for context switching will help to solidify ideas that might otherwise cause them to struggle.
- **Sporadic Lessons**
 - If you are a teacher that struggles to find a time and place to integrate computer science into your annual curriculum, you are in good company. Remember, when taught well, a little computer science is better than no computer science.
 - Choose a concept and teach it thoroughly.
 - In elementary school, the main goal is to teach students that they are capable of learning computer science. If you ditch a deep dive on concepts in favor of a shallow introduction, students might be left feeling as if they don’t understand any of it.
 - Start with the unplugged lesson for the concept that you are choosing. Use the word (such as “loops”) often in class for days after the unplugged lesson has been completed.
 - On your next trip to the computer lab, start by completing a bridging activity that ties your concept to the online lessons that students are about to do. Spend that day in the lab doing the straightforward, educational puzzles that come in the lesson directly following the unplugged activity in the course.
 - If you have another chance to get to the lab, explore other online puzzles with that same concept. This can be either a second concept lesson on Code.org, or a supporting lesson from another tool or curriculum (such as Scratch or the Foos.)

Standards Mapping

CS Fundamentals was written using both the K–12 Computer Science Framework [<https://k12cs.org>] and the draft CSTA standards as guidance. Courses are also mapped to CC and NGSS standards. Details can be found at curriculum.code.org/csf/standards.



Assessments

At Code.org, we believe that you know your students best, which is why we do not attempt to automatically determine what “grade” students should receive for any given lesson. Instead, we try to build tools that allow you to easily see student progress and to identify evidence of learning. The ability to see where a student is succeeding and where they need help is fundamental to providing the opportunity to tailor their learning experience. To that purpose, our teacher dashboard is continually evolving to better highlight the work done by your class sections. Keep an eye on the Code.org blog [<http://blog.code.org>] for more information on changes and improvements.

Please note, we have provided assessment worksheets with most unplugged activities, and “assessment” puzzles for many online lessons. For more information on assessing student work using those items, see the thread on our teacher forum at <http://forum.code.org/t/assessment-in-csf>.

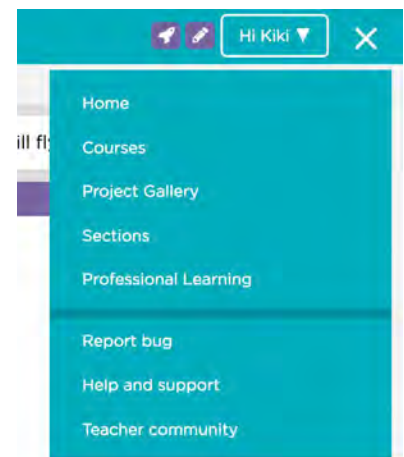
Getting Help

The curriculum is completely free for anyone to teach anywhere. For support, click on the menu in the upper right-hand corner of the website.

Here, you’ll find our “Help and support” forum where you can email us or find how-to articles. You’ll also see a link to our “Teacher community” forums where you can connect to other teachers for support, teaching tips, or best practices.

When you’re in a puzzle, you’ll see an additional “Report bug” link for that puzzle. Thank you for helping us find and fix any issues!

If you are a teacher and you’d like to attend a free training on our K-5 Computer Science curriculum, you can find links to local workshops by visiting <https://code.org/professional-development-workshops>.



Appendix A: Unplugged Lesson Plans

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Lesson 11: The Big Event

Unplugged | Events

Overview

Students will soon learn that events are a great way to add flexibility to a pre-written algorithm. Sometimes you want your program to be able to respond to the user exactly when the user wants it to. Events can make your program more interesting and interactive.

Purpose

Today, students will learn to distinguish events and actions. The students will see activities interrupted by having a "button" pressed on a paper remote. When seeing this *event*, the class will react with a unique action. Events are widely used in programming and should be easily recognizable after this lesson.

Agenda

Warm Up (15 min)

Vocabulary

A Series of Events

Main Activity (15 min)

The Big Event (Courses C-F) - Worksheet

Wrap Up (10 min)

Flash Chat: What did we learn?

Assessment (10 min)

The Big Event - Assessment

Extended Learning

Objectives

Students will be able to:

- Repeat commands given by an instructor.
- Recognize movements of the teacher as signals to initiate commands.
- Practice differentiating pre-defined actions and event-driven ones.

Preparation

- Watch the **The Big Event - Teacher Video**.
- Print one **The Big Event (Courses C-F) - Worksheet** and Event Controller.
- Print one **The Big Event - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **The Big Event** - Unplugged Video (**download**)
- **The Big Event** - Teacher Video
- **The Big Event (Courses C-F)** - Worksheet
- **The Big Event** - Assessment
- **The Big Event** - Assessment Answer Key

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Event** - An action that causes something to happen.

Teaching Guide

Warm Up (15 min)

Vocabulary

This lesson has one new and important vocabulary word:

Event - Say it with me: E-vent

An event is an action that causes something to happen.

A Series of Events

- Prep your class to answer a question:
 - "I'm going to ask you a question. I want you to raise your hand if you want me to call on you for the answer."
 - Ask a simple question that most of your students should be able to answer, such as:
 - How many thumbs do I have?
 - What is bigger, a bird or a horse?
 - Call on a student who has their hand raised and let them give their answer.
 - Upon finishing that display, ask the class how you knew that the student wanted you to call on them.
 - Your class will likely mention the raising of the hand.
 - Explain to everyone that when students raise their hand, it is an "event" that causes you to know that they want to be called on.
- Ask the class if they can think of any other events that give signals.
 - You may need to remind them that you're not talking about an event like a birthday party or a field trip.
 - If they have trouble, you can remind them that an event is an action that causes something to happen.
 - What about an alarm clock going off? What does that make happen?
 - What about pressing "Start" on the microwave? What does that do?
 - What about pressing the power button on your tv remote?
- Today, we're going to practice changing programs by introducing events.

Main Activity (15 min)

The Big Event (Courses C-F) - Worksheet

- Do you remember guiding Red from Angry Birds to the pig in the Maze puzzles?
 - In that exercise, you knew in advance exactly where you wanted Red to go, so you could make a program that took Red from start to finish without any interruptions.
 - In most real programs, we can't do that because we want to have options, depending on what the user needs.
 - Say that I only want my character to move when my finger is on the screen of my phone. I would need to program the character to only move when I put my finger on the screen of my phone.
 - Putting my finger on the screen would then become an "event" that tells my character to move.

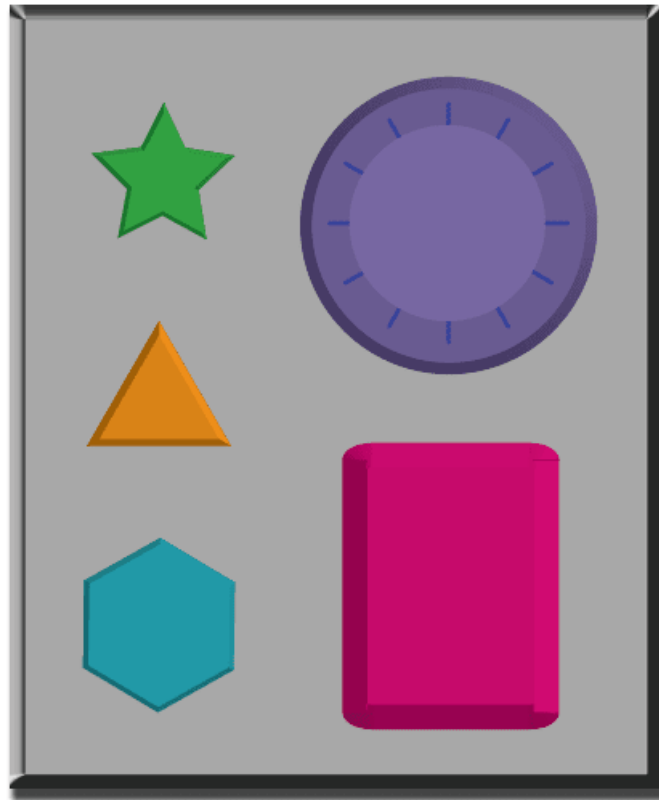
💡 Lesson Tip

If your students seem confused, talk about their favorite games and all of the ways that they let the characters know what they're supposed to do. Point out how the game would be really boring if it ran from start to finish without any events required.

In earlier lessons, we created algorithms that allowed us to control a friend or other character for several steps at a time. It was fun and useful, but what happens when you don't know everything that you want your friend to do in advance? This is where events come in!

Directions:

- Project the Event Controller onto your classroom screen.



- Decide with your class what each button does. We suggest:
 - Pink Button -> Say "Wooooo!"
 - Teal Button -> "Yeah!"
 - Purple Dial -> "Boom!"
 - Green Button -> Clap
 - Orange Dial -> Stomp
- Practice tapping the buttons on the overhead and having your class react.
- Add some button sequences into the mix and have the students try to keep up with their sounds.
- Let your class know that every time you push a button, it is an "event" that lets them know what they are expected to do next.
- Get the class started on a planned task before interrupting them again with the buttons. We suggest:
 - Counting to 10
 - Singing "Old MacDonald"
- Once their plan is underway, interject button presses sporadically.
- Continue the blend until they understand the difference between actions that are guided by a plan and those that are event driven.

Wrap Up (10 min)

Flash Chat: What did we learn?

- Why do we need to be able to handle events in a program?
- What are some other kinds of events that you can think of?

Assessment (10 min)

The Big Event - Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

One Person's Event is Another One's Reaction

- Assign each student an event to watch out for, and an appropriate reaction to that event. Chain the actions so that each child's reaction becomes an event that triggers the reaction of another student. Keep assigning until everyone has something to do and everyone makes someone react.

Eventtopia

- Break the class up into groups. Using the Events Controller, assign each group a different reaction to the same button. Do this for all three buttons, then watch the chaos!

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ MP - Math Practices

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming

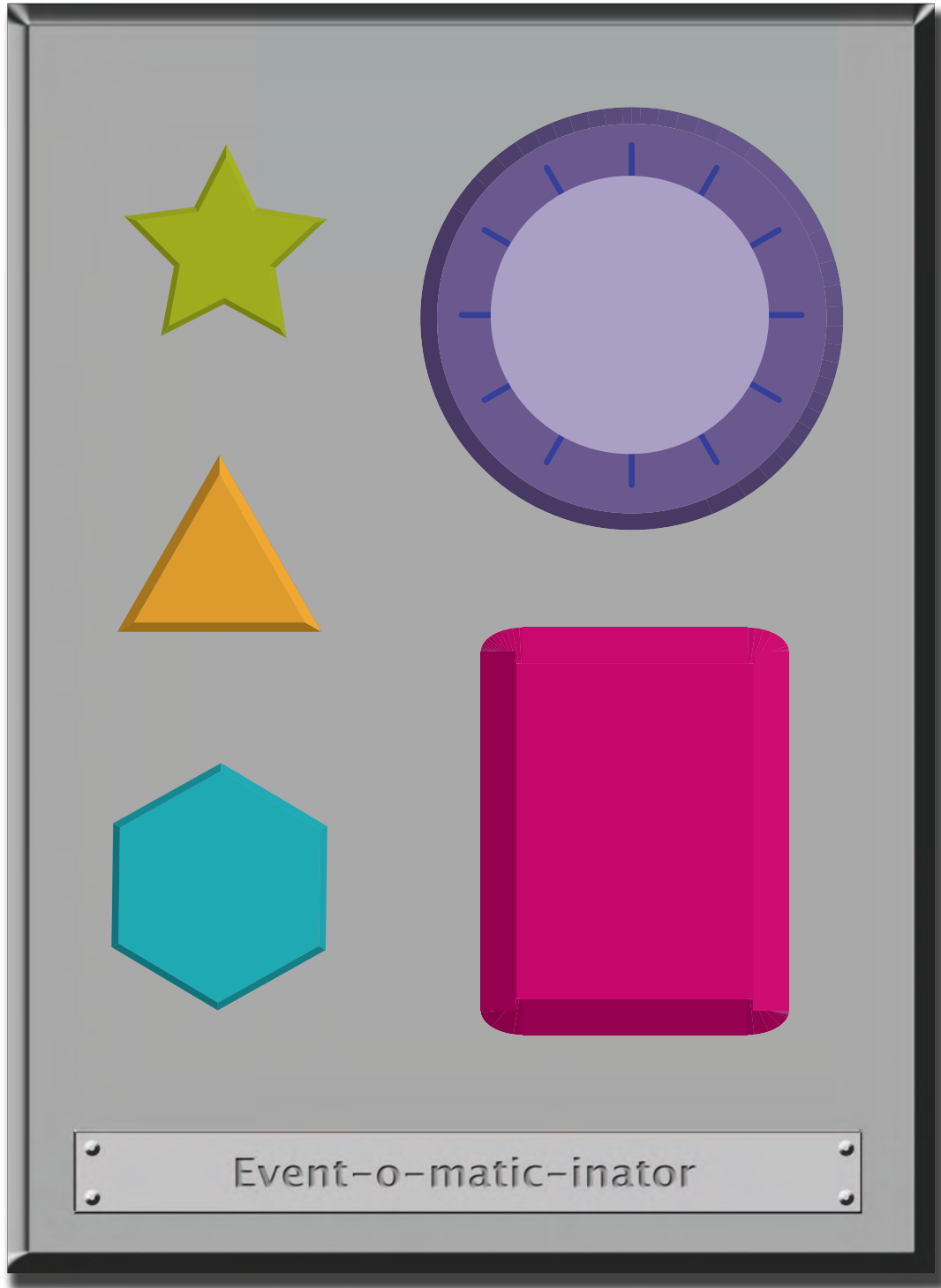
Next Generation Science Standards

- ▶ ETS - Engineering in the Sciences



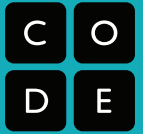
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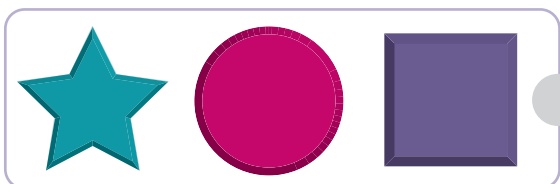
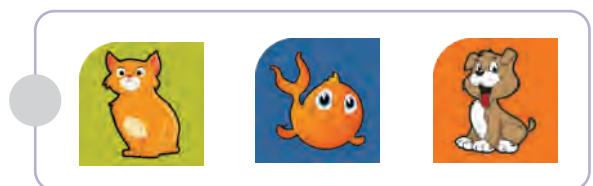
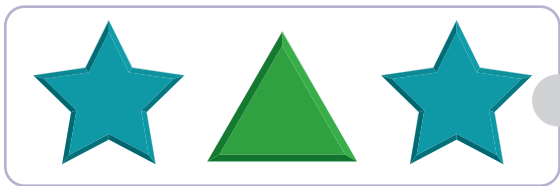
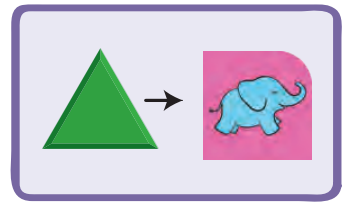
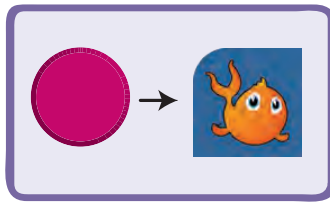
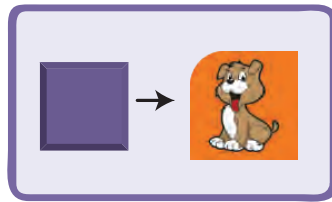
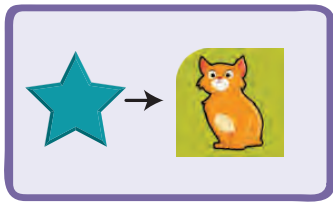
The Big Event

Controlling by Events Assessment



You've been given a magical controller that changes the picture on the frame on your desk.

Take a look below to see what each button does. Can you figure out which series of button events will cause your frame to show the pictures on the right? Draw a line from each set of pictures to the button combination that causes it. The first one has been done for you.



Lesson A.13/B.12: The Big Event Jr.

Unplugged | Event

Overview

Events are a great way to add variety to a pre-written algorithm. Sometimes you want your program to be able to respond to the user exactly when the user wants it to. That is what events are for.

Purpose

Today, students will learn to distinguish events from actions. The students will see activities interrupted by having a "button" pressed on a paper remote. When seeing this *event*, the class will react with a unique action. Events are widely used in programming and should be easily recognizable after this lesson.

Agenda

Warm Up (15 min)

Vocabulary

A Series of Events

Main Activity (15 min)

The Big Event

Wrap Up (15 min)

Flash Chat: What did we learn?

Journaling

Assessment (10 min)

The Big Event - Assessment

Extended Learning

Objectives

Students will be able to:

- Recognize actions of the teacher as signals to initiate commands.
- Practice differentiating pre-defined actions and event-driven ones.

Preparation

- Watch the **The Big Event - Teacher Video**.
- Print one **The Big Event (Courses A, B) - Worksheet**.
- Print **The Big Event - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **The Big Event** - Unplugged Video (**download**)
- **The Big Event** - Teacher Video
- **The Big Event (Courses A, B)** - Worksheet
- **The Big Event** - Assessment
- **The Big Event** - Assessment Answer Key

For the Students

- **Feeling Faces** - Emotion Images
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Event** - An action that causes something to happen.

Teaching Guide

Warm Up (15 min)

Vocabulary

This lesson has one new and important vocabulary word:

- **Event** - Say it with me: E-vent

An action that causes something to happen.

A Series of Events

- Prep your class to answer a question:
 - "I'm going to ask you a question. I want you to raise your hand if you want me to call on you for the answer."
 - Ask a simple question that most of your students should be able to answer, such as:
 - How many thumbs do I have?
 - What is bigger, a bird or a horse?
 - Call on a student who has their hand raised and let them give their answer.
 - Upon finishing that display, ask the class how you knew that the student wanted you to call on them.
 - Your class will likely mention the raising of the hand.
 - Explain to everyone that when students raise their hand, it is an "event" that causes you to know that they want to be called on.
- Ask the class if they can think of any other events that give signals.
 - You may need to remind them that you're not talking about an event like a birthday party or a field trip.
 - If they have trouble, you can remind them that an event is an action that causes something to happen.
 - What about an alarm clock going off? What does that make happen?
 - What about pressing "Start" on the microwave? What does that do?
 - What about pressing the power button on your tv remote?
- Today, we're going to create programs with events.

Main Activity (15 min)

The Big Event

- Do you remember helping the Flurbs find fruit?
 - In that exercise, you knew in advance exactly where you wanted your Flurb to end up, so you could make a program that took them from start to finish without any interruptions.
 - In most real programs, we can't do that because we want to have options, depending on what the user needs.
 - Say that I only want my character to move when my finger is on the screen of my phone. I would need to program the character to only move when I put my finger on the screen of my phone.
 - Putting my finger on the screen would then become an "event" that tells my character to move.

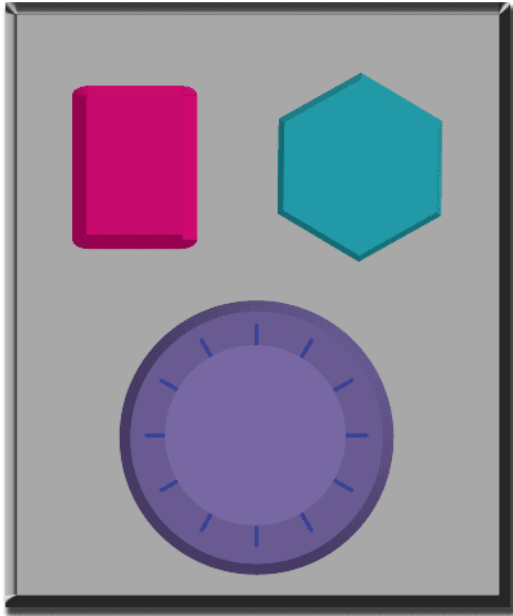
💡 Lesson Tip

If your students seem confused, talk about their favorite games and all of the ways that they let the characters know what they're supposed to do. Point out how the game would be really boring if it ran from start to finish without any events required.

In earlier lessons, we created algorithms that allowed us to control a friend or Flurb for several steps at a time. It was fun and useful, but what happens when you don't know everything that you want your friend to do in advance? This is where events come in!

Directions:

- Project the Event Controller onto your classroom screen.



- Decide with your class what each button does. We suggest:
 - Pink Button -> Say "Wooooo!"
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- Once their plan is underway, interject button presses sporadically.
- Continue the blend until they understand the difference between actions that are guided by a plan and those that are event driven.

Wrap Up (15 min)

Flash Chat: What did we learn?

- Why do we need to be able to handle events in a program?
- What are some other kinds of events that you can think of?

Journaling

Journal Prompts:

- What was today's lesson about?
- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Draw an event that caused an action today.
- Draw an action that was caused by an event that happened today.

Assessment (10 min)

The Big Event - Assessment

- Hand out the assessment activity and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

One Person's Event is Another One's Reaction

Assign each student an event to watch out for, and an appropriate reaction to that event. Chain the actions so that each child's reaction becomes an event that triggers the reaction of another student. Keep assigning until everyone has something to do and everyone makes someone react.

Eventopalooza

Break the class up into groups. Using the Events Controller, assign each group a different reaction to the same button. Do this for all three buttons, then watch the chaos!

Standards Alignment

View full course alignment

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- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **CC** - Counting And Cardinality
- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

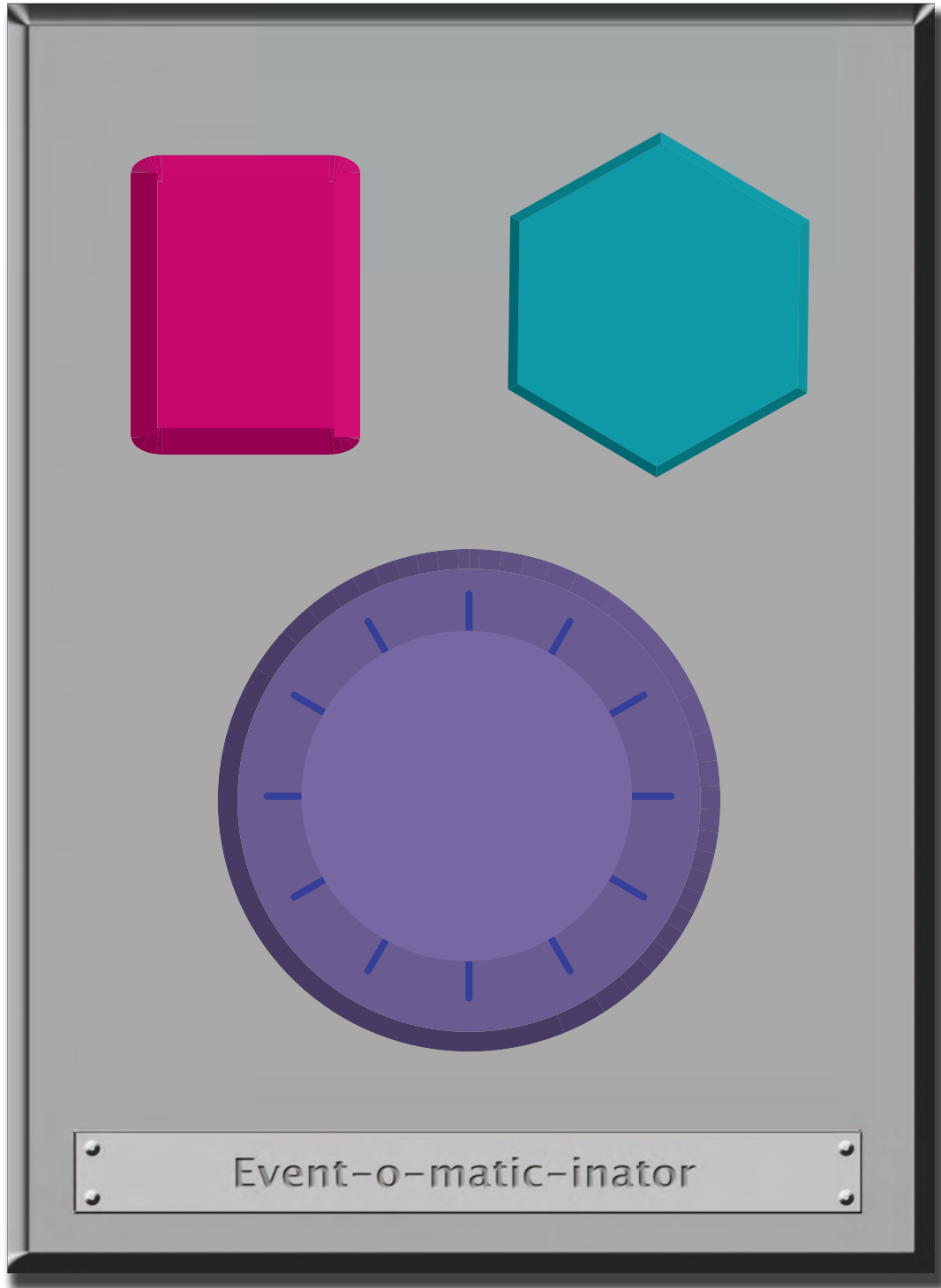
Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



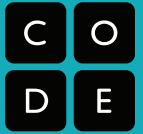
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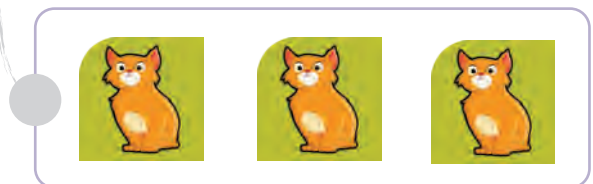
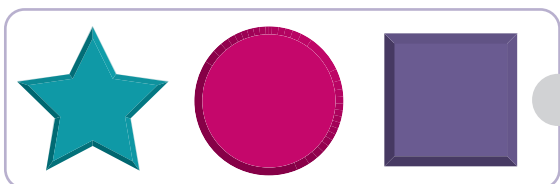
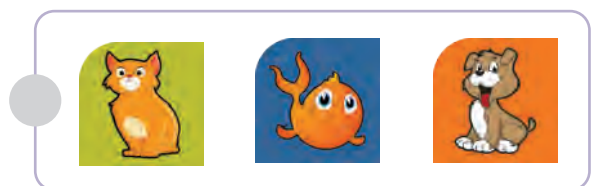
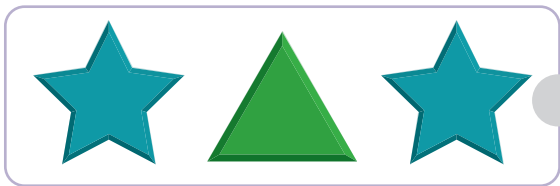
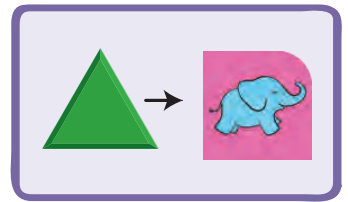
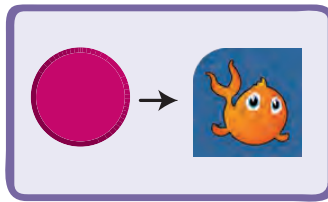
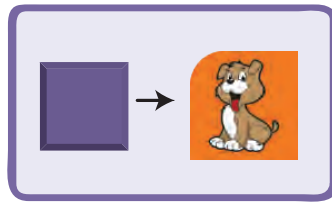
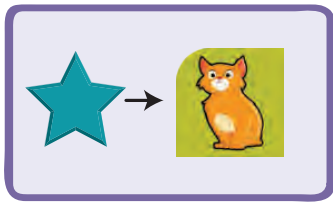
The Big Event

Controlling by Events Assessment



You've been given a magical controller that changes the picture on the frame on your desk.

Take a look below to see what each button does. Can you figure out which series of button events will cause your frame to show the pictures on the right? Draw a line from each set of pictures to the button combination that causes it. The first one has been done for you.



Lesson 16: Binary Bracelets

Unplugged | Binary

Overview

Binary is extremely important in the world of computers. The majority of computers today store all sorts of information in binary form. This lesson helps demonstrate how it is possible to take something from real life and translate it into a series of ons and offs.

Purpose

In this lesson students will learn how information is represented in a way such that a computer can interpret and store it. When learning *binary*, students will have the opportunity to write codes and share them with peers as secret messages. This can then be related back to how computers read a program, translate it to binary, use the information in some way, then reply back in a way humans can understand. For example, when we type a sentence into a document then press save, a computer translates the sentence into binary, stores the information, then posts a message indicating the document has been saved.

Agenda

Warm Up (15 min)

Vocabulary
Off and On

Main Activity (20 min)

Binary Bracelets - Worksheet

Wrap Up (5 min)

Flash Chat: What did we learn?
Journaling

Assessment (15 min)

Binary Bracelets - Assessment

Extended Learning

Objectives

Students will be able to:

- Encode letters into binary.
- Decode binary back to letters.
- Relate the idea of storing letters on paper to the idea of storing information in a computer.

Preparation

- Watch the **Binary Bracelets - Teacher Video**.
- Watch the **Binary Bracelets - Lesson in Action Video**.
- Gather markers for the bracelets. Other decorations like beads and pipecleaners are optional.
- Print one **Binary Bracelets - Worksheet** per student.
- Print one **Binary Bracelets - Assessment** per student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.
- (Optional) Write a short message on the board in binary.
- Prepare to show the **Bits Versus Bytes - Student Video**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Binary Bracelets** - Unplugged Video ([download](#))
- **Binary Bracelets** - Teacher Video
- **Binary Bracelets** - Lesson in Action Video
- **Binary Bracelets** - Worksheet
- **Binary Bracelets** - Assessment
- **Binary Bracelets** - Assessment Answer Key

For the Students

- **Bits Versus Bytes** - Student Video
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Binary** - A way of representing information using only two options.

Teaching Guide

Warm Up (15 min)

Vocabulary

This lesson has one new and important word:

Binary - Say it with me: Bye-nair-ee

A way of representing information using only two options

Off and On

- If you've written a short message on the board in binary, call the students' attention to it and ask if anyone knows what it is or what it means.
 - Put the message aside and move on to prepping for the activity.
- You can start by asking the class if they have ever seen inside a computer.
 - What's in there?
 - This is a good place to actually show them the inside of a computer (or pictures of the inside of a computer).



- Wires carry information through the machine in the form of electricity.
 - The two options that a computer uses with respect to this electrical information are "off" and "on." Just like the lights in this room!
 - When computers represent information using only two options, it's called "Binary."
 - That theme of two options doesn't stop when the information gets to its destination.
- Computers also *store* information using binary.
 - Binary isn't always off and on.

- Hard Disk Drives store information using magnetic positive and magnetic negative.
- DVDs store information as either reflective or non-reflective.
- How do you suppose we can convert real-life things that we want to store in a computer into binary?
 - Let's start with letters.
 - Use the **Binary Bracelets - Worksheet** to show how a computer might represent capital letters.
 - This is a good time to mention that each spot where you have a binary option is called a "binary digit" or "bit" for short.
 - Ask if anyone knows what a grouping of eight bits is called (it's a byte.)
 - Fun fact: A grouping of four bits is called a nibble.
 - Watch the **Bits Versus Bytes - Student Video** (~1 minute)
 - Go over a few examples of converting letters into binary, then back.
 - Afterward, write an encoded letter and give the class a few seconds to figure out what it is.
 - When the class can figure out that encoded letter on their own, you can move on to the activity.

Main Activity (20 min)

Binary Bracelets - Worksheet

You do not need to cover the whole of binary, like counting and converting numbers back and forth from decimal. This lesson is intended to be a fun introduction to how computers store information, not a frustrating lesson in bases.

Directions:

- Find the first letter of your first name on the activity sheet.
- Fill in the squares of a bracelet to match the pattern of the squares next to the letter that you selected.
- Cut the bracelet out.
- Tape the bracelet around your wrist to wear it!
- Share your bracelet with your classmates to see if they can figure out your letter.

A ■■■■ ■■■■	N ■■■■ □□■
B ■■■■ ■■■■	O ■■■■ □□□
C ■■■■ ■■■■	P ■■■■ ■■■■
D ■■■■ ■■■■	Q ■■■■ ■■■■
E ■■■■ ■■■■	R ■■■■ ■■■■
F ■■■■ ■■■■	S ■■■■ ■■■■
G ■■■■ ■■■■	T ■■■■ ■■■■
H ■■■■ □■■■	U ■■■■ ■■■■
I ■■■■ □■■■	V ■■■■ ■■■■
J ■■■■ □■■■	W ■■■■ ■■■■
K ■■■■ □■■■	X ■■■■ □■■■
L ■■■■ □■■■	Y ■■■■ □■■■
M ■■■■ □■■■	Z ■■■■ □■■■

After the activity, revisit the message that was on the board and see if your class can decypher it using what they've learned.

Wrap Up (5 min)

Flash Chat: What did we learn?

- What else do you think is represented as binary inside of a computer?
- How else might you represent binary instead of boxes that are filled or not filled?
- What was your favorite part about that activity?

💡 Lesson Tip

You know your classroom best. As the teacher, decide if students should do this individually or if students should work in pairs or small groups.

💡 Lesson Tip

If your class has extra budget for materials, try doing this exercise using thread (or pipe cleaners) and beads to create the binary bracelets instead of pen and paper. You can provide any combination of two colors in beads to the students, but black and white tend to be easiest, given the way that the key is done.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Use the activity worksheet to write out the rest of your name or your favorite word in binary.
- Imagine a world where we spoke in binary, saying "on" or "off", but nothing else. Draw two characters trying to talk to each other in binary.

Assessment (15 min)

Binary Bracelets - Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Binary Images

- There are several great resources on the web for taking this activity to the next level.
- If your students are interested in how images (or even music) can be represented as binary, you can find more details in Thinkersmith's **Binary Baubles**.

Standards Alignment

View full course alignment

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- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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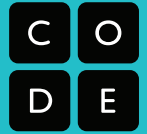
Unplugged

Name: _____

Date: _____

Binary Bracelets

Binary Decoder Key



A	■ □ ■ ■ ■	■ ■ ■ ■ □
B	■ □ ■ ■ ■	■ ■ ■ □ ■
C	■ □ ■ ■ ■	■ ■ ■ □ □
D	■ □ ■ ■ ■	■ □ ■ ■ ■
E	■ □ ■ ■ ■	■ □ ■ ■ □
F	■ □ ■ ■ ■	■ □ □ ■ ■
G	■ □ ■ ■ ■	■ □ □ □ □
H	■ □ ■ ■ ■	□ ■ ■ ■ ■
I	■ □ ■ ■ ■	□ ■ ■ ■ □
J	■ □ ■ ■ ■	□ ■ □ ■ ■
K	■ □ ■ ■ ■	□ ■ □ □ □
L	■ □ ■ ■ ■	□ □ ■ ■ ■
M	■ □ ■ ■ ■	□ □ ■ ■ □

N	■ □ ■ ■ ■	□ □ □ ■ ■
O	■ □ ■ ■ ■	□ □ □ □ □
P	■ □ ■ □ □	■ ■ ■ ■ ■
Q	■ □ ■ □ □	■ ■ ■ ■ □
R	■ □ ■ □ □	■ ■ □ ■ ■
S	■ □ ■ □ □	■ ■ □ □ □
T	■ □ ■ □ □	■ □ ■ ■ ■
U	■ □ ■ □ □	■ □ ■ ■ □
V	■ □ ■ □ □	■ □ □ ■ ■
W	■ □ ■ □ □	■ □ □ □ □
X	■ □ ■ □ □	□ ■ ■ ■ ■
Y	■ □ ■ □ □	□ ■ ■ ■ □
Z	■ □ ■ □ □	□ ■ □ ■ ■

Find the first letter of your first name.

Fill in the squares of the bracelet below to match the pattern of the squares next to the letter that you found.

Cut the bracelet out and tape it around your wrist to wear it!

□	□	□	□	□	□	□	□
---	---	---	---	---	---	---	---



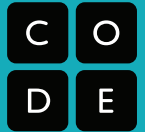
Unplugged

Name: _____

Date: _____

Binary Bracelets

Assessment for Binary Bracelets Lesson

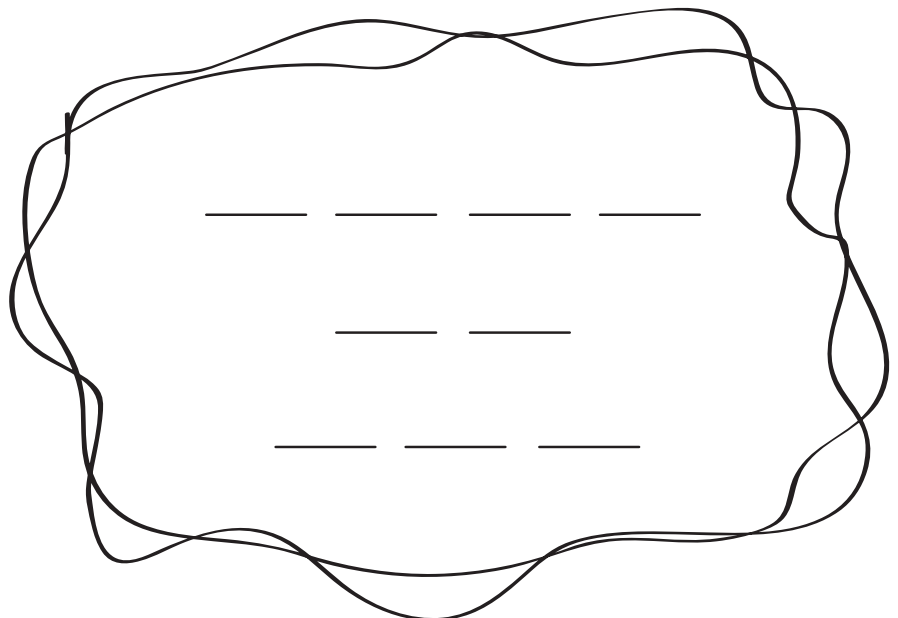


Use the Binary Decoder Key below to decode the message at the bottom of the sheet.

A	■□■ ■■■□	N	■□■ ■■■■
B	■□■ ■■■■	O	■□■ ■■■■
C	■□■ ■■■■	P	■□■ ■■■■
D	■□■ ■■■■	Q	■□■ ■■■■
E	■□■ ■■■■	R	■□■ ■■■■
F	■□■ ■■■■	S	■□■ ■■■■
G	■□■ ■■■■	T	■□■ ■■■■
H	■□■ ■■■■	U	■□■ ■■■■
I	■□■ ■■■■	V	■□■ ■■■■
J	■□■ ■■■■	W	■□■ ■■■■
K	■□■ ■■■■	X	■□■ ■■■■
L	■□■ ■■■■	Y	■□■ ■■■■
M	■□■ ■■■■	Z	■□■ ■■■■

Can you figure out what the message says?

■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____
■□■ ■■■■	■■■ ■■■■	_____



Lesson 18: Binary Images

Binary | Unplugged

Overview

Though many people think of binary as strictly zeros and ones, students will be introduced to the idea that information can be represented in a variety of binary options. This lesson takes that concept one step further as it illustrates how a computer can store even more complex information (such as images and colors) in binary, as well.

Purpose

In this lesson students will learn how information is represented in a way such that a computer can interpret and store it. When learning *binary*, students will have the opportunity to write code and share it with peers to view as images. This can then be related back to how computers read a program, translate it to binary, use the information in some way, then reply back in a way humans can understand. For example, when we type a sentence into a document then press "save", a computer translates the sentence into binary, stores the information, then posts a message indicating the document has been stored.

Agenda

Warm Up (10 min)

Vocabulary

Introduction to Binary

Main Activity (20 min)

Binary Images - Worksheet

Wrap Up (10 min)

Flash Chat: What did we learn?

Journaling

Assessment (10 min)

Binary Image - Assessment

Extended Learning

Objectives

Students will be able to:

- Identify methods for encoding images into binary.
- Relate images to a peer using binary encoding.
- Reproduce an image, based on binary code.

Preparation

- Watch the **Binary Images - Teacher Video**.
- Print one **Binary Images - Worksheet** per pair.
- Print one **Binary Image - Assessment** per student.
- Gather groupings of items that can show opposites for students to use when coming up with their own binary encodings (Optional).
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Binary Images** - Unplugged Video (**download**)
- **Binary Images** - Teacher Video
- **Binary Images** - Worksheet
- **Binary Image** - Assessment
- **Binary Images** - Assessment Answer Key
- **Binary Baubles** - Thinkersmith Lesson

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Binary** - A way of representing information using only two options.
- **Binary Alphabet** - The two options used in your binary code.

Teaching Guide

Warm Up (10 min)

Vocabulary

This lesson has two new terms:

- **Binary** - Say it with me: Bi-nare-ee

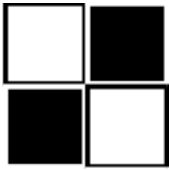
A way of representing information using only two options.

- **Binary Alphabet** - Say it with me: Bi-nare-ee Al-fa-bet

The two options used in your binary code.

Introduction to Binary

What if we had a picture like this, where there's only two color options for each square, black or white.



How might we encode this so that someone else could recreate the picture without seeing it?

- Some students might think back to the Graph Paper Programming lesson. While there could be a lot of similarities, let them know that this is different enough that they should not use that lesson to guide this one

You may hear suggestions like: "Say 'white, black, white, black'."

- "That's a great suggestion! Now I'm going to break you up into pairs. Work with your teammate to decide on a binary alphabet."

Decide whether you want your pairs to share their encodings with the other groups ahead of time, and tell them if they will be creating a key, or keeping their methods secret.

- "Now, let's encode some images, just like a computer would!"

Main Activity (20 min)

Binary Images - Worksheet

Now it's the students' turn!

Activity Directions:

1. Divide students into pairs.
2. Have them choose an image with their partner.
3. Encourage them to figure out what their binary alphabet is going to be.
4. Have them encode their image using their new binary alphabet.
5. Instruct students to trade encodings with another team and see if they can figure out which picture the other worked on.
6. Choose a Level
 - Easy: Let the other team know what your encoding method was
 - Tough: Have the other team guess your encoding method.

Wrap Up (10 min)

Flash Chat: What did we learn?

- What did we learn today?
- What kind of binary alphabet did you create?
- Can you think of how you could encode an image using only your fingers?
- Do you think you could create a binary alphabet out of sounds?

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a binary alphabet?
- What kind of information can you share using binary?

Assessment (10 min)

Binary Image - Assessment

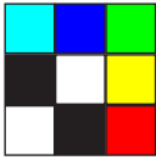
Pass out this assessment for students to do individually. Try to save time at the end to go over answers.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Storing Color Images

- If your class really gets the idea behind storing binary images, they may want to know how to do color images.
 - First, you'll need to discuss how color works using binary (as in **Binary Baubles - Thinkersmith Lesson**, page 21).
 - Then, introduce some images that use combinations of those colors
- Encourage your students to come up with ways to code these color images.



Hexadecimal

- Take the idea of color one step further to introduce **hexadecimal color codes**.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ G - Geometry
- ▶ MP - Math Practices

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming

Next Generation Science Standards

- ▶ ETS - Engineering in the Sciences



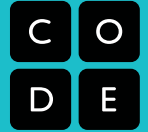
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Binary Images

Binary Representation Activity



Here are six images. Work with a partner to figure out how you can encode them into binary in such a way that another team can use the code to figure out what image you selected.

DIRECTIONS

1. Choose an image with your partner.
2. Figure out what your binary alphabet is going to be.
3. Encode your image using your new binary alphabet.
4. Trade your encoding with another team and see if you can figure out which picture they worked on.
5. Choose a Level
 - * Easy: Let the other team know what your encoding method was
 - * Tough: Have the other team guess your encoding method.

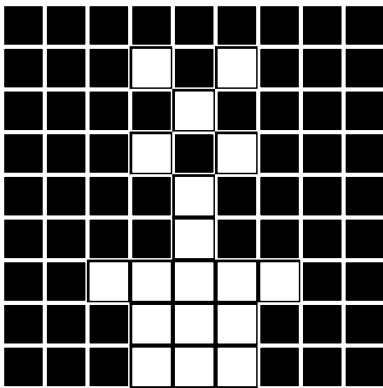


Image 1

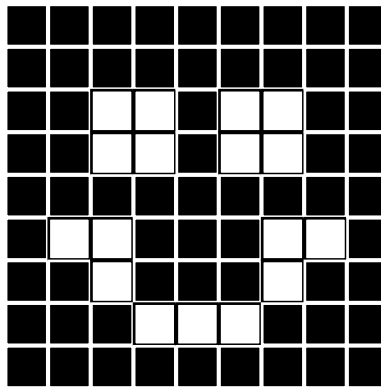


Image 2

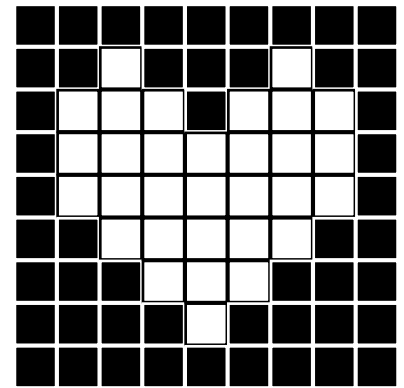


Image 3

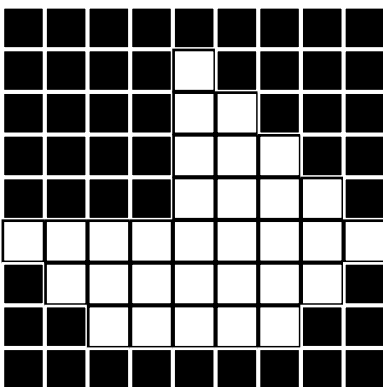


Image 4

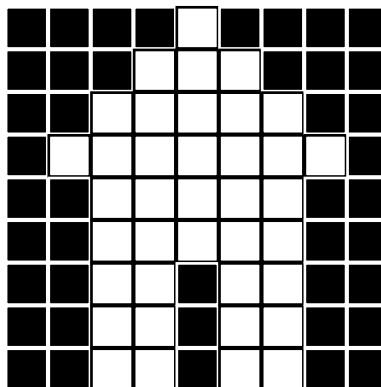


Image 5

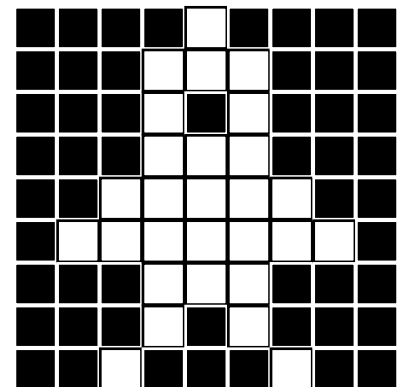


Image 6

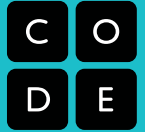


Name: _____

Date: _____

Binary Images

Binary Representation Activity



Match the image to the binary code that describes it. In order to get the images correct, you will need to figure out the binary alphabet for each encoding.

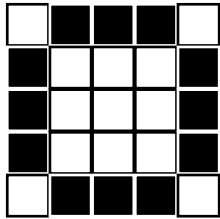


image #1

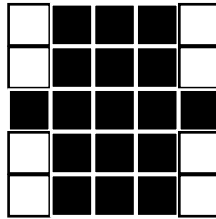


image #2

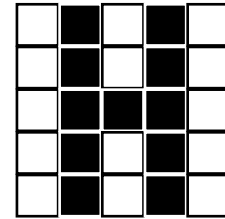


image #3

A) ★ × × × ★ ★ × × × ★ × × × × × ★ × × × ★ ★ × × × ★

× = _____ ★ = _____ This encodes image # _____

B) ○ ● ● ● ○ ● ○ ○ ○ ● ● ○ ○ ○ ● ● ○ ○ ○ ● ○ ● ● ● ○

○ = _____ ● = _____ This encodes image # _____

C) ♀

♀ = _____ ♀ = _____ This encodes image # _____

How do you know that your answers are correct?

Lesson C.1/E.3/F.3

Unplugged

Overview

In this lesson, students are asked to build a load-bearing structure using common materials. The structure will be tested on its ability to hold a textbook for more than ten seconds. The goal of this activity is to engage students in a difficult challenge to highlight strategies for showing persistence in the face of frustration. Most students will not get this right the first time, but if they continue trying and iterating, you can help them identify techniques to make struggle productive.

Purpose

While this lesson may not at first seem connected to Computer Science, it plays an essential role in preparing students to tackle some of the more difficult challenges that will come their way when approaching new CS content. This lesson teaches that failure is not the end of a journey, but rather a step towards success. The majority of students should feel frustrated at some point in this lesson, but it's important to emphasize that failure and frustration are common steps that lead to creativity and success.

Agenda

Warm Up (15 min)

Try, Try Again

Activity (20 min)

**Building a Foundation
Testing and Iteration**

Wrap Up (10 min)

Vocabulary

Flash Chat: What did we learn?

Objectives

Students will be able to:

- Identify the feeling of frustration when felt or described
- List strategies for overcoming frustration during a difficult task
- Model persistence while working on a difficult task

Preparation

- Watch **Practicing Persistence - Teacher Video**.
- Watch the **Building a Foundation - Lesson in Action Video**.
- Print **Building a Foundation - Teacher Prep Guide**.
- Gather enough building elements (marshmallows or gumdrops with toothpicks or popsicle sticks) for each group. You don't have to give any certain amount; just make sure you put some limit on materials.
- Give a **Think Spot Journal - Reflection Journal** to each student.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Building a Foundation** - Lesson in Action Video
- **Building a Foundation** - Teacher Video
- **Building a Foundation** - Teacher Prep Guide

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Frustrated** - Feeling annoyed or angry because something is not the way you want it.
- **Persistence** - Trying again and again, even when something is very hard.

Teaching Guide

Warm Up (15 min)

Try, Try Again

Think: Ask students to close their eyes and think of a time where they tried to do something and didn't succeed. Maybe it was attempting a new sport, playing a tough video game, or learning a new skill. As they are thinking silently, ask that they focus specifically on:

- What were you feeling?
- What were you thinking?
- What were you saying?
- What were you doing?

Pair: Without discussing *what* the actual situation was, have students share with a neighbor about what it looked to try something and not succeed. Encourage them to talk about the things they were feeling, thinking, saying, and doing.

Share: Once all of the students have had a chance to share thoughts with their neighbors, ask a few to share what they were talking about with the whole class. Keep track of common answers somewhere that students can refer to later in the lesson (and possibly during future lessons as well).

Discuss: Using the list that the class generated, discuss which responses to failure were productive (potentially led towards later success) and which were not. Highlight the constructive responses so that students can refer to them later.

Share: Share out a personal experience where you (the teacher) initially failed at something, but persisted through to success. Let students know that today we are all going to work on a challenge that is meant to be hard and even frustrating. Let them know that it was chosen because it's likely to create several failed attempts before it works but we can rely on some of the constructive responses we talked about earlier to move towards success.

Lesson Tip

As you work to embed persistence into your classroom culture, consider using some of these images as occasional reminders.

- **Mouse Wants a Cracker**
- **Fall 7 Times, Stand Up 8**
- **Never Ever Give Up**
- **If You Quit Too Soon**

Discussion Goal

Focus on the experience: The goal of this discussion is to remind students what it feels like to fail, because we want to be able to identify those feelings when they occur so that we know when to rely on persistence strategies. Students may be tempted to share information about the specific memories they thought of, but redirect students to focus on their experience. Some expected answers include:

- Felt sad / mad
- Cried
- Yelled (or even cursed)
- Threw or broke things
- Asked for help
- Quit

Activity (20 min)

Building a Foundation

The goal of this lesson is not just building a structure, like the activity makes it appear. Instead, it's to prepare students to face failure and frustration with persistence. In order for that to happen, students need to know that they are not alone in feeling bad when things go wrong. They also need to be prepared to struggle. The outcome of this activity is much stronger when students know what they are about to experience.

Remarks

We are going to work in groups today to solve a challenge. It is going to be a very hard challenge, and they made it this way on purpose! Part of completing this challenge is knowing that we will struggle and we will probably even feel frustrated. Just know that if you hang in there through the failure, you will eventually succeed!

Set Up: You'll need to have a collection of supplies for each group ready for this activity. It's important that the available supplies are limited in number and structurally unsound. Potential supply kits include:

- 20 gumdrops and 50 toothpicks
- 20 drinking straws and 6" of tape
- 20 marshmallows and 20 craft sticks
- 10 playing cards and 4" of tape

Transition: Introduce the challenge, which is to build a structure that can hold a textbook for at least 10 seconds, using provided materials.

📍 **Group:** Divide students into groups of three or four.

Distribute: Pass out the building supplies, letting students know that they are limited to only the supplies you provide.

Display: Show rules that are similar to the ones itemized below in a place where students can easily see and refer back to as they work.

- Use only the supplies provided to build a structure.
- The structure can be any shape, but it has to be at least 2.5" tall. (Example)
- The structure must support the weight of a book for a full 10 seconds. (Example)

Prompt: Ask groups to spend at least 5 minutes planning a method for building their first tower. Each group should draw or write down the steps in their plan.

Circulate: Encourage students to begin building, and observe as they work. Keep your eyes open for signs of frustration and repeated failure. Make sure to acknowledge frustration and praise their persistence. Refer to the methods of dealing with frustration and the methods for productive persistence that are written on the board. Keep reminding individuals that the goal of this lesson is to experience frustration and persistence, so if they are failing, they're really succeeding!

When groups have reached a design they believe will meet conditions, move them to the "Testing and Iteration" phase.

Testing and Iteration

Model: The first time a group tests their structure, model for them how you intend to test in line with the rules. Specifically you'll want to:

- Check that it's at least 2.5" tall
- Ensure that they are using only provided materials
- Gently place a text book on top and time how long it holds out.

Prompt: If the group's structure failed, ask them to discuss:

- Why it failed
- Whether their plan needs revision, or just another try
- How they're going to improve the next iteration

If the structure succeeded, push them to support more weight until it breaks, and then follow the same reflection and iteration process.

Circulate: Allow as much time as you can for groups to continue iterating on their plans. Make sure to be excited not only for the successes, but also the failures. Model for students how much you can learn from your failed attempts.

Wrap Up (10 min)

Vocabulary

Display: Present the vocab for this lesson, persistence, frustrated. Let the class know that they were showing persistence when they worked through failures in their structures.

Flash Chat: What did we learn?

🗨️ **Discuss:** Reflect on the activity as a class, using the following prompts as a start.

- Did anyone feel frustrated during this lesson?
 - Can you share what that felt like?
- (Alternatively, you can ask "Who felt frustrated at some point during this lesson?" and cheer for the students who raise their hand.)

💡 Teaching Tip

Providing Examples: The planning stage can be difficult for young students. It may be helpful for you to place some idea "examples" at the front of the room. Do not announce that they are there. Simply encourage students to take a walk if they get frustrated. Try to encourage students to locate the tips on their own if at all possible. This helps students feel like they "discovered" something that helped them, rather than being rescued. Make sure you also have "tips" for being persistent and for dealing with frustration written in a clear location.

Tips for Overcoming Frustration

- Count to 10
- Take deep breaths
- Journal about them
- Talk to a partner about them
- Ask for help

Tips for Being Persistent

- Keep track of what you have already tried
- What is happening?
- What is supposed to happen?
- What does that tell you?
- Make a change and try again

💬 Discussion Goal

This Flash Chat is meant to help the students come to terms with the negative emotions that they felt during the project, and help them see that they were not alone in their struggle. It should also prepare them to recall the tools that they used to help themselves overcome frustration and be persistent so that they can access those tools again when solving online puzzles.

- Then YOU won this lesson, and YOU won this lesson, and YOU won, too!
- Was there a time that you thought about giving up?
 - What were you feeling, saying, doing, or thinking at that time?
 - How did you get past that feeling?
- Do you think that you would be more proud of yourself for solving something that was easy, or something that was very, very hard?

End the discussion by bringing the context back to the warm-up.

Think: Where would you be now if you had not been persistent when you were learning to walk as a baby? Or if you had been too frustrated to keep going when you were learning to talk? What other things did you learn to do, even though they were very, very hard?

Pair: Have students discuss this thought exercise with an elbow partner to come up with 1-3 things that fit that description.

Share: Have students write the answers in their journals to remind themselves how strong they can be when faced with a challenge.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences

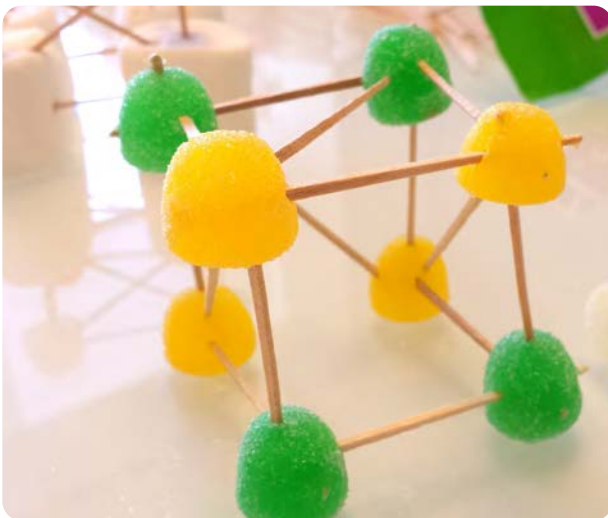


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Directions:

- 1) Divide students into groups of 3 or 4.
- 2) Explain the rules of the challenge, provided on the other page.
- 3) Provide each group with limited supplies and make it known that they will get no more.
- 4) Challenge the class to think ahead to the problem and plan out their method of building their first tower.
- 5) Encourage students to begin building, then have them alert you when they think they've met the challenge described by the rules.
- 6) Test each structure. Is it taller than the cup? Does it hold a book?
- 7) If not, have students enter a cycle of planning, fixing, testing, and planning again until the challenge has been met.
- 8) Congratulate the students as they succeed and take pictures of the successful towers (if possible) to upload to the Code.org site!



Lesson D.13/E.11/F.11: Conditionals with Cards

Conditionals | Unplugged

Overview

This lesson demonstrates how conditionals can be used to tailor a program to specific information. We don't always have all of the information we need when writing a program. Sometimes you will want to do something different in one situation than in another, even if you don't know what situation will be true when your code runs. That is where conditionals come in. Conditionals allow a computer to make a decision, based on the information that is true any time your code is run.

Purpose

One of the best parts of teaching *conditionals* is that students already understand the concept from their everyday lives.

This lesson merges computer science into the real world by building off of their ability to tell if a condition is true or false. Students will learn to use `if` statements to declare when a certain command should be run, as well as `if / else` statements to declare when a command should be run and what do run otherwise. Students may not recognize the word *conditionals*, but most students will understand the idea of using "if" to make sure that some action only occurs when it is supposed to.

Agenda

Warm Up (20 min)

Vocabulary
Introduction

Main Activity (20 min)

Conditionals with Cards Sample Program - Teacher Prep Guide

Wrap Up (15 min)

Flash Chat: What did we learn?
Journaling

Assessment (5 min)

Conditionals with Cards - Assessment

Extended Learning

Objectives

Students will be able to:

- Define circumstances when certain parts of a program should run and when they shouldn't.
- Determine whether a conditional is met based on criteria.
- Traverse a program and predict the outcome, given a set of input.

Preparation

- Watch the **Conditionals with Cards - Teacher Video**.
- Watch the **Conditionals with Cards - Lesson in Action Video**.
- Gather decks of cards or something similar.
- One **Conditionals with Cards Sample Program - Teacher Prep Guide** for the class to look at.
- Print one **Conditionals with Cards - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Conditionals with Cards** - Unplugged Video ([download](#))
- **Conditionals with Cards** - Teacher Video
- **Conditionals with Cards** - Lesson in Action Video
- **Conditionals with Cards Sample Program** - Teacher Prep Guide
- **Conditionals with Cards** - Assessment
- **Conditionals with Cards** - Assessment Video
- **Conditionals with Cards** - Assessment Answer Key

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Conditionals** - Statements that only run under certain conditions.

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important word:

Conditionals - Say it with me: Con-di-shun-uls

Statements that only run under certain conditions.

Introduction

- We can start this lesson off right away
 - Let the class know that if they can be completely quiet for thirty seconds, you will do something like:
 - Sing an opera song
 - Give five more minutes of recess
 - Do a handstand
 - Start counting right away.
 - If the students succeed, point out that they succeeded, so they get the reward.
 - Otherwise, point out that they were not completely quiet for a full thirty seconds, so they do not get the reward.
- Ask the class "What was the condition of the reward?"
 - The condition was IF you were quiet for 30 seconds
 - If you were, the condition would be true, and you would get the reward.
 - If you weren't, the condition would be false, so the reward would not apply.
 - Can we come up with another conditional?
 - If you can guess my age correctly, the class can give you applause.
 - If I know an answer, I can raise my hand.
 - What examples can you come up with?
- Sometimes, we want to have an extra condition, in case the "IF" statement is not true.
 - This extra condition is called an "ELSE" statement
 - When the "IF" condition isn't met, we can look at the "ELSE" for what to do
 - Example: IF I draw a king from this deck of cards, everybody claps. Or ELSE, everyone says "Awwwwwwwwe."
 - Let's try it. (Draw a card and see if your class reacts appropriately.)
 - Ask the class to analyze what just happened.
 - What was the IF?
 - What was the ELSE?
 - Which condition was met?
 - Believe it or not, we have even one more option.
 - What if I wanted you to clap if I draw a 7, or else if I draw something less than seven you say "YAY," or else you say "Awwwwwwwwe"?"
 - This is why we have the terms If, Else-If, and Else.
 - If is the first condition
 - Else-If gets looked at only if the "If" isn't true.
 - Else gets looked at only if nothing before it is true.

Now let's play a game.

Main Activity (20 min)

Conditionals with Cards Sample Program - Teacher Prep Guide

Directions:

- Create a few programs with your class that depend on things like a card's suit, color, or value to award or subtract points. You can write the program as an algorithm, pseudocode, or actual code.

Here is a sample algorithm:

```
if (CARD is RED)
  Award YOUR team 1 point

Else
  Award OTHER team 1 point
```

Here is a sample of the same program in pseudocode:

```
If (card.color == RED){
  points.yours = points.yours + 1;
}

Else {
  points.other = points.other + 1;
}
```

- Decide how you want to split your class into teams.
- Each team should have a pile of cards (at least as many cards as team members) nearby.
- Put one of your “Programs” up on the board for all to see.
- Have the teams take turns drawing cards and following the program to see how many points they score in each round.
- Play several times with several different programs to help the students really understand conditionals.

Once the class has had some practice, you can encourage students to nest conditionals inside one another. Make sure they understand that if the card is red, YOUR team is awarded 1 point, and then *nothing else happens*, since the condition was met:

```
If (CARD is RED){
  Award YOUR team 1 point

Else
  If (CARD is higher than 9)
    Award OTHER team 1 point
  Else
    Award YOUR team the same number of points on the card
```

Here is the same program in pseudocode:

```
If (card.color == RED ){
  points.yours = points.yours + 1;
}
Else {
  if (card.value > 9){
    points.other = points.other + 1;
  }
  Else {
    points.yours = points.yours + card.value;
  }
}
```

Wrap Up (15 min)

Flash Chat: What did we learn?

- If you were going to code this up in Blockly, what would you need to add around your conditionals to let the code run more than one time? (A loop)
- What other things do you do during the day under certain conditions?
- If you are supposed to do something when the value of a card is more than 5, and you draw a 5, do you meet that condition?
- Notice that conditions are either "True" or "False." There is no assessment of a condition that evaluates to "Banana."
- When you need to meet several combinations of conditions, we can use something called "nested conditionals."
 - What do you think that means?
 - Can you give an example of where we saw that during the game?
- What part of that game did you like the best?

💡 Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a conditional? How did you use a conditional today?
- What are some of the conditionals you used today? Can you come up with some more that you would use with a deck of cards?

Assessment (5 min)

Conditionals with Cards - Assessment

Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities. Here's a **Conditionals with Cards - Assessment Video** to watch as a guide.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

True/False Tag

- Line students up as if to play **Red Light / Green Light**.
- Select one person to stand in front as the Caller.
- The Caller chooses a condition and asks everyone who meets that condition to take a step forward.
 - If you have a red belt, step forward.
 - If you are wearing sandals, take a step forward.
- Try switching it up by saying things like "If you are *not* blonde, step forward."

Nesting

- Break students up into pairs or small groups.
- Have them write if statements for playing cards on strips of paper, such as:
 - the suit is clubs
 - the color is red
- Have students create similar strips for outcomes.
 - Add one point
 - Subtract one point
- Once that's done, have students choose three of each type of strip and three playing cards, paying attention to the order selected.
- Using three pieces of paper, have students write three different programs using only the sets of strips that they selected, in any order.
 - Encourage students to put some if statements inside other if statements.
- Now, students should run through all three programs using the cards that they drew, in the same order for each program.
 - Did any two programs return the same answer?
 - Did any return something different?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Sample program as algorithm

```
If (CARD is RED)
    Award YOUR team 1 point
Else
    Award OTHER team 1 point
```

This program has you choose a card. If the card is red, your team gets a point. Else, the other team gets a point.

Sample program from above as pseudocode (like code, but in no particular language)

```
If (card.color == RED) {
    points.yours = points.yours + 1;
}

Else {
    points.other = points.other + 1;
}
```

Sample program as algorithm

```
If (CARD is RED)
    Award YOUR team 1 point
Else
    If ( CARD is higher than 9)
        Award OTHER team 1 point
    Else
        Award YOUR team the same
        number of points on the card
```

This program has you choose a card. If the card is red, your team gets a point. Else, the card must be black. If your black card is higher than 9, then the other team gets a point, else your card must be black and lower than or equal to 9, and you get as many points as are on your card.

Sample program from above as pseudocode (like code, but in no particular language)

```
If (card.color == RED) {
    points.yours = points.yours + 1;
}

Else {
    If ( card.value > 9) {
        points.other = points.other + 1;
    }

    Else {
        points.yours = points.yours + card.value;
    }
}
```



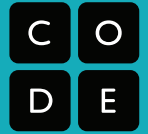
Unplugged

Name: _____

Date: _____

Conditionals with Cards

Assessment Activity



Look at the program below.

The steps below show each team taking turns to play the Conditionals Game. See if you can figure out what happens for each draw. Write down the score during each round along the way. After three rounds, circle the winner.







```

If (CARD is lower than 5)
  If ( CARD is BLACK)
    Award YOUR team the same
    number of points on the card.

  Else
    Award OTHER team 1 point.

Else
  If ( CARD is HEARTS)
    Award YOUR team 1 point
  
```

Here's how the game went:

	TEAM #1	END OF ROUND SCORE	TEAM #2	END OF ROUND SCORE
ROUND #1		<u>0</u>		<u>0</u>
ROUND #2		_____		_____
ROUND #3		_____		_____

Lesson 28: Crowdsourcing

Unplugged | Crowdsourcing

Overview

In computer science, we face some big, daunting problems. Challenges such as finding large prime numbers or sequencing DNA are almost impossible to do as an individual. Adding the power of others makes these tasks manageable. This lesson will show your students how helpful teamwork can be in the industry of computer science.

Purpose

It's very rare that one computer scientist works completely alone on a project. Even when that does happen, there is always benefit in numbers. Today, students will learn what it means to crowdsource a project. This activity builds teamwork and creates an efficient environment for students to solve problems.

Agenda

Warm Up (20 min)

Vocabulary
Introduction

Main Activity (20 min)

Crowdsourcing - Worksheet

Wrap Up (15 min)

Flash Chat: What did we learn?
Journaling

Extended Learning

Objectives

Students will be able to:

- Identify a large task that needs to be done.
- Rearrange a large task into several smaller tasks.
- Build a complete solution from several smaller solutions.

Preparation

- ☐ Watch the **Crowdsourcing - Teacher Video**.
- ☐ Review **Crowdsourcing - Worksheet**.
- ☐ Obtain a jar of lots of something (pennies, buttons, slips of paper, etc) and a deck of cards.
- ☐ Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Crowdsourcing** - Unplugged Video ([download](#))
- **Crowdsourcing** - Teacher Video
- **Crowdsourcing** - Worksheet

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Crowdsourcing** - Getting help from a large group of people to finish something faster.

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important word:

Crowdsourcing - Say it with me: Crowd-sore-sing

Getting help from a large group of people to finish something faster.

Introduction

- Show your students your jar full of something.
 - "Look at this jar. I have a lot of buttons in here, and I need to tell the principal how many there are before the end of class."
 - "Can you think of a way I could get these counted quickly?"
- Your students may guide you toward seeking help, but if they don't, you can suggest it, too.
 - Pour all of the buttons (or pennies, etc.) into a pile on the floor.
 - Invite all of the students to come up and grab a small number (ten is good, but you can do more if your students can handle it).
 - Once they've counted out their ten, have them report to you, drop their buttons back in the jar, and go again until the pile is gone.
- Comment on how fast the task went.
 - Have the class reflect on how long it might have taken or how hard it may have felt to do alone.

💡 Lesson Tip

Jars of buttons and pennies work nicely, but if you find yourself with little time to prepare, you can cut slips of paper and put them in a ziplock bag or even a pencil box.

Main Activity (20 min)

Crowdsourcing - Worksheet

Sometimes you have a big job that needs to get done, but it feels like it will take forever. Crowdsourcing is a way of using teamwork to make the job go much faster! In this game, we'll use crowdsourcing to sort decks of playing cards.

Directions:

1. Divide into groups of 4, 5, or 6.
2. Grab your deck of playing cards and dump it into a bag, bucket, or even a loose pocket that you can make with the bottom of your shirt.
3. Shake the cards until they're all mixed up.
4. Dump the cards out onto a table or desk where the whole group can see them.
5. Decide how to break up the task of sorting the deck so that every person has something to do and no one is doing too much.
6. Time yourself sorting the cards. Can you figure out a way to do it faster?
7. Repeat the game over and over until you think you have found the fastest way of crowdsourcing the card sorting activity.

💡 Lesson Tip

It can be challenging for students to figure out how to break apart large tasks at first. Students might find it helpful to have some ideas handed to them after working for a while. One great division for sorting cards is as follows:

- One person picks up the cards and determines the suit of each one.
- One person manages Hearts.
- One person manages Diamonds.
- One person manages Clubs.
- One person manages Spades.
- (If there's another, they can put all sorted suits back together again.)

Wrap Up (15 min)

Flash Chat: What did we learn?

- Have you ever tried to sort a pile of cards by yourself?
- Do you think it was easier or harder to have help?
- What other things do you have to do in life that could be easier with help?

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What are the benefits of crowdsourcing?
- What kind of things do you want to make with computer science? How do you see crowdsourcing being beneficial in those projects?

Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Reverse Crowdsourcing

Often we think of crowdsourcing as pulling things apart to make them more simple. You can also make big, beautiful things with the same technique.

Have your students each grab three cards and build one segment of a **card house**. Each student can go one after another to build a grand card tower.

Try with two, or even three students adding their chunk at a time.

- Does crowdsourcing always make a task easier?

Crowdsourcing in the Round

- You can crowdsource all at the same time or you can do it one person at a time. Try having the whole class sort the same deck of cards, one student at a time.
 - Shuffle the cards and place them in a pile in the center of the room.
 - Have each student approach the pile and choose four cards.
 - Have four piles for the students to sort their cards into
 - Spades
 - Clubs
 - Hearts
 - Diamonds
 - Once all cards have been put in their four piles, have the following four students sort the individual piles.
 - The last person will put all four piles together.
- This version may not save a lot of time, but it still divides the work and lets each individual have more free time!

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ MP - Math Practices

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming

Next Generation Science Standards

- ▶ ETS - Engineering in the Sciences



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Lesson 16: Digital Citizenship

Common Sense Education | Unplugged

Overview

In collaboration with Common Sense Education, this lesson helps students learn to think critically about the user information that some websites request or require. Students learn the difference between private information and personal information, distinguishing what is safe and unsafe to share online.

Students will also explore what it means to be responsible and respectful to their offline and online communities as a step toward learning how to be good digital citizens.

Purpose

As students spend more time on computers, they should be aware that the internet is not always a safe space. In this lesson, students are taught what information is safe to share and what information should remain private. Students will create "superheros" and learn what it means to be a Digital Citizen on the internet.

Agenda

Warm Up (15 min)

Vocabulary

Personal vs. Private Online

Main Activity (35 - 40 min)

Cubecraft Superhero Templates - Manipulatives

Wrap Up (15 min)

Flash Chat: What did we learn?

Journaling

Assessment (5 min)

Digital Citizenship - Assessment

Extended Learning

Objectives

Students will be able to:

- Compare and contrast their responsibilities to their online and offline communities.
- Understand what type of information can put them at risk for identity theft and other scams.
- Reflect on the characteristics that make someone an upstanding citizen.
- Devise resolutions to digital dilemmas.

Preparation

- Watch the **Digital Citizenship - Teacher Video**.
- Print out a good selection of male and female **Cubecraft Superhero Templates - Manipulatives** sheets for the whole class.
- Print one **Digital Citizenship - Assessment** for each student.
- Review **CSF Digital Citizenship - Resource List** for more online safety content.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Digital Citizenship** - Teacher Video
- **Cubecraft Superhero Templates** - Manipulatives
- **Digital Citizenship** - Assessment
- **Digital Citizenship** - Assessment Answer Key
- **Common Sense Education** - Website
- **CSF Digital Citizenship** - Resource List

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Digital Citizen** - Someone who acts safely, responsibly, and respectfully online.

Teaching Guide

Warm Up (15 min)

Vocabulary

This lesson has one new and important phrase:

Digital Citizen - Say it with me: Dih-jih-tal Sit-i-zen

Someone who acts safely, responsibly, and respectfully online

Personal vs. Private Online

- Ask "What types of information do you think are okay to share publicly online or on a profile that others will see?"
- What are some examples of websites where you must register in order to participate?
 - Write the names of the websites on the board.
- What information is required and why do you think it is required?
 - Information may be required to help distinguish one person from another.
 - The website may keep a record of who uses it.
- Explain that it's important to know that sharing some kinds of user information can put you and your family's privacy at risk.
- Point out that you do not have to fill out fields on websites if they are not required.
 - Required fields are usually marked by an asterisk (*) or are highlighted in red.
- Elementary school students should never register for sites that require private information without the approval and guidance of a parent or guardian.
- Here is an example of public versus private information:

💡 Lesson Tip

If you have access to a computer, feel free to navigate to a site that might require this type of information, such as Gmail or Facebook.

SAFE - Personal Information	UNSAFE - Private Information
Your favorite food Your opinion (though it should be done respectfully) First name (with permission)	Mother's maiden name Social Security number Your date of birth Parents' credit card information Phone number

- Explain that some people will actively try to get you to share this kind of information so that they can use it to take over your identity. Once a thief has taken someone's identity, he or she can use that person's name to get a driver's license or buy things, even if the person whose identity they stole isn't old enough to do these things!
 - It's often not until much later that people realize that their identity has been stolen. Identity thieves may also apply for credit cards in other people's names and run up big bills that they don't pay off. Let students know that identity thieves often target children and teens because they have a clean credit history and their parents are unlikely to be aware that someone is taking on their child's identity.

Now, let's see what we can do to keep ourselves safe.

Main Activity (35 - 40 min)



Cubecraft Superhero Templates - Manipulatives

- Spiderman says "With great power comes great responsibility." This is also true when working or playing on the Internet.
- The things we read, see, and hear online can lead people to have all sorts of feelings (e.g., happy, hurt, excited, angry, curious).
 - What we do and say online can be powerful.
- The Internet allows us to learn about anything, talk to people at any time (no matter where they are in the world), and share our knowledge and creative projects with other people.

- This also means that negative comments can spread very quickly to friends of all ages.
- CREATE a three-column chart with the terms “Safe,” “Responsible,” and “Respectful” written at the top of each column. Invite students to shout out words or phrases that describe how people can act safely, responsibly, and respectfully online, and then write them in the appropriate column.

Safe	Responsible	Respectful

Now, let's really make sure we understand how to be a Super Digital Citizen!

Directions:

- Have each student grab a small selection of papercraft sheets and encourage them to blend the pieces to make their very own superhero.
- Allow plenty of time for students to cut, glue, and color.
- Give students a 5 minute warning to wrap up.
- Separate students into groups of 2-4 and tell them to use their superheroes and leftover supplies to stage a scene in which one superhero sees an act of poor digital citizenship. Then have the superhero fix the problem ... and save the day!
- Go around the room, having each student explain their scene to the class.

Lesson Tip

For more in-depth modules, you can find additions to this curriculum at the **Common Sense Education - Website** page on Scope and Sequence.

Wrap Up (15 min)

Flash Chat: What did we learn?

- What is a good way to act responsibly online?
- What kinds of personal information could you share about yourself without showing your identity?
- What kinds of superpowers or qualities did your digital superheroes have in common?
- What does Spider-Man’s motto “With great power comes great responsibility” mean to you, as someone who uses the internet?

Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Journaling

Having students write about what they learned, why it’s useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a Digital Citizen?
- What do you need to do to be a Digital Citizen?

Assessment (5 min)

Digital Citizenship - Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Common Sense Education

- Visit **Common Sense Education - Website** to learn more about how you can keep your students safe in this digital age.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **NI** - Networks & the Internet



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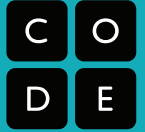
Unplugged

Name: _____

Date: _____

Digital Citizenship

Assessment Worksheet



Just because you **can** do something online doesn't mean that you **should!**

Cross out the information that you should not share online. Use the words that are leftover as the key to what you should find in the word search.

WORDS

- 1) Your Credit Card Info (CARD)
- 2) Your Online Name (NICKNAME)
- 3) What You Ate Today (FOOD)
- 4) Your Email (EMAIL)
- 5) Your Favorite Color (COLOR)
- 6) The Last Book you Read (BOOK)
- 7) The School You Attend (SCHOOL)
- 8) Your Favorite Band (BAND)
- 9) Your Phone Number (PHONE)
- 10) Your Address (ADDRESS)
- 11) Your Birthday (BIRTHDAY)



Write a paragraph in the area below, telling about what you will do when you're on the Internet to make sure that you practice kind and respectful behavior.

Lesson 17: Digital Sharing

Overview

Loaned to Computer Science Fundamentals by the team over at Copyright and Creativity, this lesson exists to help students understand the challenges and benefits of respecting ownership and copyright, particularly in digital environments. Students should be encouraged to respect artists' rights as an important part of being an ethical digital citizen.

Purpose

Students will soon be creating projects to share and most of these projects will contain either code or imagery that students did not create themselves. This lesson is here to show students the proper way to handle the use of content that is not their own.

Agenda

Warm-Up (Optional) (15 min)

Write a Character Sketch

Ethical Sharing (30 min)

To Share or Not to Share?

Okay to Share

Not Okay to Share

Wrap-Up (10 min)

Journaling / Flash Chat

Extended Learning

Objectives

Students will be able to:

- Interpret ethical sharing of copyrighted material vs. sharing that is not ethical.
- Understand their own rights regarding materials that they have created

Preparation

- ▣ Locate the copyright sharing video at **Digital Sharing Ethics (Video) - Video**
- ▣ Download and review the complete **Digital Sharing Lesson Plan** from Copyright and Creativity
- ▣ As the teacher, create a piece of art for the lesson (picture, song, slideshow, etc.)
- ▣ You will need a tablet or smart phone to replicate the sharing of that item

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Digital Sharing Lesson Plan**

For the Students

- **Digital Sharing Ethics (Video) - Video**

Vocabulary

- **Copyright** - the exclusive legal right to print, publish, perform, film, or record literary, artistic, or musical material, and to authorize others to do the same

Teaching Guide

Warm-Up (Optional) (15 min)

The following writing exercises are designed to create context, help students engage with the topic, and prepare them for the lesson discussion.

Watch: Have students watch the one-minute **Digital Sharing Ethics (Video) - Video**. *You may need to play it two or three times.*

Write a Character Sketch

Ask students to write a character sketch about one or both of the characters in the video. Be as creative as you can. There are no wrong answers. Give these characters a life of their own, whatever you want it to be.

Prompt with questions:

- Who is your character?
- What is his/her name?
- Who are his/her friends?
- How long have they known each other?
- Who are the people in his/her family? What are they like?
- What's his/her backstory?
- Where does he/she live?
- Where did he/she used to live?
- What exciting thing might have happened to them back in kindergarten, first grade, etc.?
- What is he/she looking forward to?
- What is he/she afraid of?

NOTE: These exercises may also be done orally as a class discussion before the copyright lesson. Write the story or character sketch on the board as students contribute ideas.

Ethical Sharing (30 min)

Activity: Have all of your students stand up. Begin reading the list of ways to create content below. Instruct students to sit down as soon as they can answer “Yes” to one of the prompts.

- Have you ever made a video (on a camera, phone, iPad, or computer) and sent it to a family member or posted it online?
- Have you taken a photo and sent to a family member or posted it online?
- Have you created a piece of art to share with your family and friends?
- Have you made up a song to make your friends laugh? Or a sad song to make them cry?
- Have you written a poem for your mom or dad on their birthday?

Keep asking similar questions until the entire class is seated.

Discuss:

- How did it feel to produce something creative?
- How did you feel when you were able to share your creation with others?
- How do you feel when you view or listen to other people's creations?

Encourage all responses.

Help students feel the joy of creating something. Creating can be a lot of hard work, but it is one of the most rewarding things we do. Sharing what we create is fun, and it can encourage more creativity and art. As we get older, we have more and more opportunities to share our work and explore media and art that other people have created. We want to make sure we are always fair when using others' art and creative work.

Say: Remember, copyright protects all kinds of creative work so that artists/creators can get paid for their effort. This includes, original writing (stories), art, photographs, audio, images, music, song lyrics, even the doodle you drew on your napkin at lunch. It doesn't matter if it was created by a famous artist or by you. When you make an original work, you get to decide who can:

- make copies
- distribute copies
- display or perform the work in public
- make spin-offs; we call these derivatives (for example, like a book being made into a movie)

These rights are given to artists and creators to encourage them to make even more creative work.

Think: Have students think back to the art creation prompt where they first sat down. Inform them that they created an original work with legal protection. Congratulations!

Pair:

- How might you know if something is copyrighted?
- *[The circle © indicates copyright, but copyright protection exists even without the symbol. Creators have ownership over their work, unless they sell it to someone else.]*
- Where have you seen the copyright symbol?
- *[At the front of books, in movies, on images, posters, etc.]*

Share: Encourage students to share their answers with the class.

Demonstrate: Show students how to draw a copyright symbol and write the year next to it. When you make something creative like this, it's automatically protected by copyright, even without the copyright symbol.

Discuss:

- How does it feel when you share your things with someone else?
- What does it feel like when someone takes your things and shares them without your permission?

The same principles of respect and fairness apply when we share our work or someone else's work online.

To Share or Not to Share?

Demonstrate: Pull out the instructor's creative work: picture, song, story, video, recipe.

Watch: Have students watch the one-minute **Digital Sharing**

Ethics (Video) - Video. *You may need to play it two or three times.*

As we watch the video, decide if the music is OK to share or not.

Discuss: What did you think of that? How do you think you would feel if you wrote a song and people shared it without asking for your permission? When we share digital files by:

- sending pictures or songs through email
- copying songs from our MP3 player to our friend's computer
- copying a movie from a DVD to all our friends' computers

That's not just sharing, it's making new copies!

Discuss: If you were one of these characters in the video, what could you do to share fairly? What about other sharing situations? What other ethical considerations are there?

(Some acceptable responses:) - Send your friend a link to the artist's YouTube channel where she can listen to the song. - Help your friend buy the song from an online store that you can trust because it's used by a large online community, like iTunes or Amazon.

Ask yourself: Who owns this? Do I have permission to share? Do I have a right to make a copy? Am I being fair to everyone involved?]

Discussion Goal

Okay to Share

- I made this. That means I own it. I think I'm going to share it. I'm going to take out my phone (iPad, camera, etc.) to get a picture. I think I want to share it on my blog where I might make some money advertising on [Use the site of your choice.] Is this fair?
 - [Yes, this is OK to share because I made it — I own the copyright.]
- What about a song I wrote? Can I share that? . . . Who gets to decide?
 - ["That's right, I do."]
- What will happen when I share it?
 - [Take responses: "It's fun, . . . I'll get a bunch of 'likes' . . . People will want to use it for mashups."]
- Let's say you draw a picture to sell at a school art show. The money from the art sale will go to buy new library books. Is this a good share . . . is it ethical?
 - [Yes.]
 - Why is this share OK?
 - [Take responses: "It's yours!", "You made it. You own it. You can choose to share it."]

Wrap-Up (10 min)

Remember, copyright is a protection given to writers and artists for a limited time to let them receive payment for their work. It's intended to foster more creativity. As we share and use, we need to respect each other's work and the laws of copyright. Just because we own a copy of something does not mean we have the right to make more copies to give or sell to other people. Copyright gives us some protection over how our art will be used and shared by others.

Journaling / Flash Chat

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Give an example of a way that you have seen other creators share or remix someone's work. Do you believe that was fair? Why or why not?

Extended Learning

Please be sure to visit **Copyright & Creativity** to find more lessons on digital sharing and creative rights.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ RI - Reading Informational
- ▶ SL - Speaking & Listening

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming



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Discussion Goal

Not Okay to Share

- Have you ever transferred songs to your friend's MP3 player? Is that OK?
 - [If it's a song you hear on the radio, it's most likely protected by copyright and NOT OK to share, copy, and give away.]
- What if your friend invites you to his house to watch a movie that just came out on DVD? This is one of your favorite movies. You want it on your phone, so you can watch it whenever you want. So, you take out your phone and record the movie. Is this a fair way to get a copy of the movie?
 - [No. This is not OK to share/copy. Why? Because you don't own the right to make a copy and give it away.]
 - How else could you get an authorized (legal) copy of the movie for your phone?
 - [iTunes or Amazon sell movies legally.]

Teaching Tip

Demonstrate the following by handing a book to a student:

Sharing a digital file is different from face-to-face sharing. If I hand you my book to share it with you, you have the book and I don't—that's sharing. If I hand you my iPod, so you can listen to my music, that is sharing. If I share a digital file with you—like a song or a movie or computer game—we both end up with the file. In that case, we made a copy. If I copy my songs for you to put on your iPod, that is not sharing—it's copying. Making copies of copyrighted work hurts the artist/creators. In addition, P2P sharing and torrent sites can put your computer at risk for bad stuff: malware, ads, and worse.

Lesson 14: Envelope Variables

Unplugged | Variable

Overview

Variables are used as placeholders for values such as numbers or words. Variables allow for a lot of freedom in programming. Instead of having to type out a phrase many times or remember an obscure number, computer scientists can use variables to reference them. This lesson helps to explain what variables are and how we can use them in many different ways. The idea of variables isn't an easy concept to grasp, so we recommend allowing plenty of time for discussion at the end of the lesson.

Purpose

Variables are very helpful in programming. Students will be introduced to this topic using envelopes to represent variables that have been given names. The value of the variable will be written on a card inside of an envelope. This lesson helps students understand how names can be a placeholder for values in the physical world, so that programming with variables will seem less confusing in the virtual world.

Agenda

Warm Up (10 min)

Vocabulary
Introduction

Main Activity (20 min)

Envelope Variables - Worksheet

Wrap Up (10 min)

Flash Chat: What did we learn?
Journaling

Assessment (10 min)

Envelope Variables - Assessment

Extended Learning

Objectives

Students will be able to:

- Identify variables and determine their values.
- Define and call variables in the context of real-life activities.
- Create situations which require the use of variables.

Preparation

- Watch the **Envelope Variables - Teacher Video**.
- Obtain 6 or more blank envelopes for warm up plus some for the main activity.
- Print one **Envelope Variables - Worksheet** per student.
- Print one **Envelope Variables - Assessment** for each student.
- Provide students with envelopes, paper, pens & pencils.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Variables in Envelopes** - Unplugged Video ([download](#))
- **Envelope Variables** - Teacher Video
- **Envelope Variables** - Worksheet
- **Envelope Variables** - Worksheet Answer Key
- **Envelope Variables** - Assessment
- **Envelope Variables** - Assessment Answer Key

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Variable** - A placeholder for a piece of information that can change.

Teaching Guide

Warm Up (10 min)

Vocabulary

This lesson has one important word:

- **Variable** - Say it with me: Vayr-ee-ah-buhl

A placeholder for a piece of information that can change.

Introduction

Call four volunteers to the front of the room and line them up. Let the students know that you are going to write a poem for each of them.

On the board (or under your document camera) write the sentence for your first student (suppose it's Bill):

"My student Bill, standing proud
is a fine example for the crowd"

Encourage the students to clap at your abilities and thank Bill for volunteering. Allow Bill to sit down (or go to the back of the line) as you erase the board, then call the next volunteer (we'll say that she's called Annie).

"My student Annie, standing proud
is a fine example for the crowd"

Again, accepting applause, erase the board and invite the next volunteer.

"My student Jenny, standing proud
is a fine example for the crowd"

As you call the final volunteer, inquire as to whether everyone in the class would like a poem written about each of them. Maybe the everyone in the whole school? Goodness, that's going to take a while! Pose the question to your students:

"How could I do this more quickly?"

Your students will likely pick up on the fact that only one word is changing, and that word is simply a person's name. Help them see the location by circling Jenny's name on the board and writing "firstName" next to it.

"It would take a long time to write a poem for everyone in the school if I couldn't start until I knew who I was writing it about, wouldn't it?"

- How long do you think it would take to make a video game if they couldn't start until they knew your username?
- How expensive would video games be if they had to be created separately for each person?
- How do you think we can get around that?

By this time, it's quite likely that your class will come up with the idea of having a placeholder. With that, they're most of the way into understanding where this lesson goes.

- What would we call that placeholder?
 - We need to call it something that makes sense. We wouldn't want to call it "age" if it was a placeholder for their name, right?

Now, let's add some more volunteers. Give them each a piece of paper to write their name on, and have them tuck it inside individual envelopes labeled firstName.

This time, put the poem on the board with a blank space labeled "firstName" where the student's name will go.

- Have the first student in line (likely the last student from the previous example) pull their name from the envelope and that's what you'll write in the space.
- When you erase the board, only erase the portion with the last student's name in it.
- Call the next student to show their variable.
- Repeat as many times as is entertaining

Now it's time for the main activity.

Main Activity (20 min)

Envelope Variables - Worksheet

Once the students understand how the envelopes relate to the sentences, pass out the activity worksheet and let them prepare some variables of their own.

Directions:

- Divide students into groups of 2-4.
- Have students design (draw) a robot.
- After 10-15 minutes, request that the students fill their envelopes with important details about their robot such as its name, height, and purpose.
- Collect each group's envelopes, then bring them to the front of the room to share.
- Write on the board, "My robot's name is robotName, it is numUnitsTall tall, and it's purpose is purpose."
- Use the envelopes to fill the appropriate variable in the sentence, then ask each group to stand when they hear the sentence that describes their creation.

Wrap Up (10 min)

Flash Chat: What did we learn?

- What did we learn today?
- Can you think of anywhere that you have seen variables before?
- There is at least one variable at the top of most homework hand outs? Can you think of what it could be?
- Why do you think that professionals do not put spaces in variable names?
 - What would happen if there was a variable "eye" a variable "color" and a variable "eye color"?
- Variables can be used to store numbers, too.
 - Suppose I have envelopes labeled num1 and num2, then I write num1+num2?
 - What happens if the "num1" envelope contains the number 4 and "num2" contains the number 5?

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a variable?
- Why do you think variables are important in programming?

Assessment (10 min)

Envelope Variables - Assessment

Allow students enough time to finish this assessment. If you are willing to spare more time, go over the answers as a class.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

What's in the box?

- Draw boxes on a piece of paper with simple mathematical operators between them.
 - For instance $\square + \square = \square$
- Have similar size squares with numbers between 1 & 20.
- Ask one student to come create a true equation, using the numbers provided.
- Once the student has finished (and the class verifies the equation) exchange one of the numbers with another one, then remove a second number entirely.
 - Tell the students that there is a hidden number in the empty box that makes that equation true again.
 - What number is in the box?
- Play this game over and over again until you can remove the number from any location and the students can figure out what it is supposed to be.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ MP - Math Practices

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming

Next Generation Science Standards

- ▶ ETS - Engineering in the Sciences



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Unplugged

Name: _____

Date: _____

Variables in Envelopes

Robot Variables Worksheet



Think about a robot. What is it supposed to do? What does it look like?

Draw your robot on paper. When you're done, answer the three questions below on separate pieces of paper, then put them in the correct envelopes.

robotName

numUnitsTall

purpose

1. My robot's name is robotName.

2. My robot's height is numUnitsTall. (don't forget units!)

3. My robot's primary purpose is purpose.



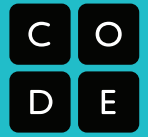
Unplugged

Name: _____

Date: _____

Variables in Envelopes

Variables Assessment Worksheet



Given the value of each variable envelope, fill-in the blanks to finish the sentence.

$$\boxed{\text{color}} = \text{pink}$$

$$\boxed{\text{petalNumber}} = 22$$

$$\boxed{\text{animal}} = \text{monkey}$$

$$\boxed{\text{bestSport}} = \text{golf}$$

$$\boxed{\text{hobby}} = \text{coding}$$

When I grow up, I want to own a guard _____
animal

I found a flower with _____ petals, so I
petalNumber
picked it.

My dad just painted his house _____ to
color
match his car.

I love _____. I do it every evening.
hobby

There is no such thing as _____ rivers, so if you find
color
one, don't swim in it!

The best sport in the world is _____, do
bestSport
you agree?

Variable envelopes can also contain number values. Use these envelopes and the provided equations to figure out the magic numbers below.

$$\boxed{\text{numOne}} = 2$$

$$\boxed{\text{numTwo}} = 5$$

$$\boxed{\text{numThree}} = 7$$

$$\boxed{\text{magicNumberA}} = \frac{\quad}{\text{numThree}} - \frac{\quad}{\text{numOne}}$$

$$\boxed{\text{magicNumberB}} = \frac{\quad}{\text{numTwo}} * \frac{\quad}{\text{numOne}}$$

$$\boxed{\text{magicNumberC}} = \frac{\quad}{\text{numOne}} + \frac{\quad}{\text{numTwo}} * \frac{\quad}{\text{magicNumberB}}$$

Lesson 18: For Loop Fun

Unplugged | For Loops

Overview

We know that loops allow us to do things over and over again, but now we're going to learn how to use loops that have extra structures built right in. These new structures will allow students to create code that is more powerful and dynamic.

Purpose

At this point, students have become masters of loops. Today, they will learn about another loop commonly used in programming. The `for` loop repeats commands a certain number of times, but also keeps track of the values it is iterating over. For example, a `for` loop that begins at 4, ends with 8, and has a step value of 1 will repeat 4 times, but the values 4, 5, 6, and 7 will also be captured for use elsewhere. Using this structure with variables can create some pretty fantastic programs. Today, students will simply be learning the basics of a `for` loop before diving into programming with them next time!

Agenda

Warm Up (20 min)

Vocabulary

For One and All

Main Activity (20 min)

For Loop Fun - Worksheet

Wrap Up (15 min)

Flash Chat: What did we learn?

Journaling

Assessment (5 min)

For Loop Fun - Assessment

Extended Learning

Objectives

Students will be able to:

- Determine starting value, stopping value, and stepping value for a `for` loop.
- Illustrate the counter values hit each time through a `for` loop during runtime.

Preparation

- Watch the **For Loop Fun - Teacher Video**.
- Watch the **For Loop Fun - Lesson in Action Video**.
- Print one **For Loop Fun - Worksheet** per group.
- Print one **For Loop Fun - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **For Loop Fun - Unplugged Video** ([download](#))
- **For Loop Fun - Assessment Key** - Teacher Key ([download](#))
- **For Loop Fun** - Teacher Video
- **For Loop Fun** - Lesson in Action Video
- **For Loop Fun** - Worksheet
- **For Loop Fun** - Worksheet Answer Key
- **For Loop Fun** - Assessment

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **For Loop** - Loops that have a predetermined beginning, end, and increment (step interval).

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important word:

- **For Loop** - Say it with me: For-Loop

Loops that have a predetermined beginning, end, and step value.

For One and All

- Point out that there are certain loops that happen very frequently, for example, loops where you need to keep track of how many times you have been through
 - Sometimes, you don't want to start with one
 - Sometimes, you don't want to count by ones
 - for loops give you a powerful way to keep a counter that starts when you want, ends when you want, and increases by whatever size step that you want

Here, you can jump right into a sample of the game (example in English)

ROUND 1

Player 1 For values of X from 3 to 12 incrementing by 4
starting value stopping value interval

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2 For values of X from 2 to 14 incrementing by 2
starting value stopping value interval

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE
21
56

ROUND 2

Player 1 For values of X from 1 to 18 incrementing by 3
starting value stopping value interval

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2 For values of X from 5 to 12 incrementing by 5
starting value stopping value interval

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE
51
15

ROUND 3

Player 1 For values of X from 2 to 10 incrementing by 4
starting value stopping value interval

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Player 2 For values of X from 3 to 16 incrementing by 4
starting value stopping value interval

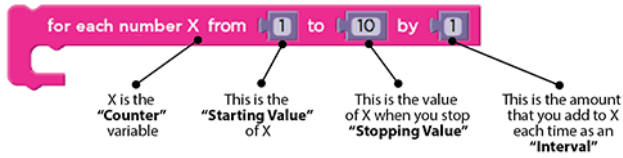
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE
18
36

Main Activity (20 min)

For Loop Fun - Worksheet

Sometimes we want to repeat things a certain number of times, but we want to keep track of values as we do. This is where a `for` loop comes in handy. When you use a `for` loop, you know right from the start what your beginning value is, what your ending value is, and how much the value changes each time through the loop.



`for` Loop block (in English)

Directions:

It may be difficult for young students to understand this written in pseudocode, but it may be helpful to have you explain out loud (and perhaps with a diagram) what they will be using as the content of a `for` loop.

- Divide students into pairs
- To start the round, each student rolls three times:
 - One die to determine the starting value of X
 - Three dice to determine the stopping value for X
 - One die to determine the stepping value of X each time through
- Use one of the provided number lines to trace the `for` loop that they've made
 - Start at the starting value of X
 - Count down the number line, circling the numbers at the rolled interval
 - Stop when you get to the predetermined stopping value
- Add all of the circled values to your score, then let the other player take a turn
- Best 2 out of 3 wins

💡 Lesson Tip

When you play this game, it's as if you're running through a loop like this

```
for (x=startValue; x <= stopValue; x = x + step){  
  circle currentXvalue;  
  add currentXvalue to roundScore;  
}
```

💡 Lesson Tip

If any of the values rolled are outside the bounds of the game (like rolling a start value of 6 but then rolling 2, 1, 2 for the end value), have the student re-roll everything.

Wrap Up (15 min)

Flash Chat: What did we learn?

- What would your interval need to be if you wanted to count from 4 to 13 by threes?
- What kinds of things do you think you could do with a `for` loop?
- Can you reproduce a normal loop using a `for` loop?
- What would you need to do?

💡 Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow-partner.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a `for` loop?
- Why would you use a `for` loop instead of a `repeat` loop or a `while` loop?

Assessment (5 min)

For Loop Fun - Assessment

Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Run it Backward

- Try this activity again, but this time have the start number be selected using three dice, and the stop number with only one. Make sure to have a negative increment!

Hop Scotch

- Using chalk, draw a hop scotch diagram outside on the blacktop
 - Number the squares from bottom to top
 - Have students give each other a start square, stop square, and how many at a time they need to jump
 - When the jumper is done, have them write down the loop they just performed
 - Start adding additional activities to be done at each square, this will add complexity to the written portion, as well

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices
- ▶ **OA** - Operations And Algebraic Thinking

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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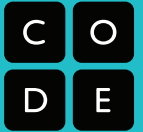
Unplugged

Name: _____

Date: _____

For Loop Fun

Sample Game Sheet



Directions:

- * Use the number lines to trace the "for loop" for each turn
 - * Start at the starting value of X
 - * Count down the number line, circling the numbers at the correct interval
 - * Stop when you get to the stopping value
- * Add all of the circled values to get the score for your round
- * Best 2 out of 3 Wins

SAMPLE

ROUND 1

For values of X from 3 to 12 incrementing by 4
starting value stopping value interval

Player 1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 21

For values of X from 2 to 14 incrementing by 2
starting value stopping value interval

Player 2

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 56

ROUND 2

For values of X from 1 to 18 incrementing by 3
starting value stopping value interval

Player 1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 51

For values of X from 5 to 12 incrementing by 5
starting value stopping value interval

Player 2

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 15

ROUND 3

For values of X from 2 to 10 incrementing by 4
starting value stopping value interval

Player 1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 18

For values of X from 3 to 16 incrementing by 4
starting value stopping value interval

Player 2

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

SCORE 36



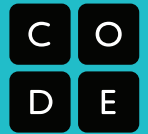
Unplugged

Name: _____

Date: _____

For Loop Fun

Number Lines and Score Sheet



Directions:

- * Use the number lines to trace the “for loop” for each turn
 - * Start at the starting value of X
 - * Count down the number line, circling the numbers at the correct interval
 - * Stop when you get to the stopping value
- * Add all of the circled values to get the score for your round
- * Best 2 out of 3 Wins

ROUND 1

	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	SCORE
Player 1		_____
Player 2	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	

ROUND 2

	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	SCORE
Player 1		_____
Player 2	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	

ROUND 3

	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	SCORE
Player 1		_____
Player 2	For values of X from _____ to _____ incrementing by _____ <small style="display: inline-block; width: 100px; text-align: center;"><i>starting value</i> <i>stopping value</i> <i>interval</i></small>	



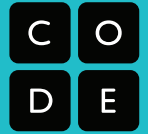
Unplugged

Name: _____

Date: _____

For Loop Fun

Assessment Worksheet

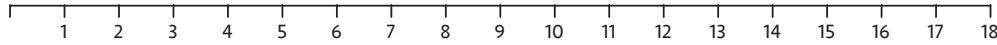


Below, you will find three rounds of the For Loop Game, along with what each player rolled during their turn. Fill out the number lines and tally the scores for each round. Who won the game?

ROUND 1

Player 1

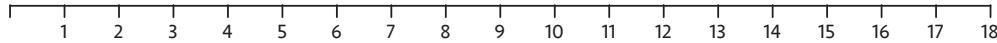
For values of X from 1 to 18 incrementing by 4
starting value stopping value interval



SCORE

Player 2

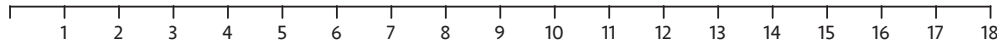
For values of X from 3 to 11 incrementing by 2
starting value stopping value interval



ROUND 2

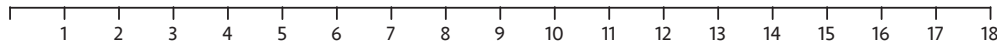
Player 1

For values of X from 3 to 17 incrementing by 5
starting value stopping value interval



Player 2

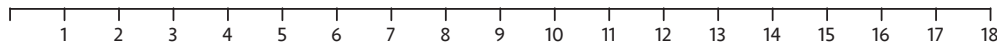
For values of X from 5 to 17 incrementing by 3
starting value stopping value interval



ROUND 3

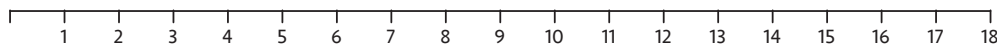
Player 1

For values of X from 6 to 11 incrementing by 1
starting value stopping value interval



Player 2

For values of X from 2 to 15 incrementing by 6
starting value stopping value interval



Directions:

- * Use the number lines to trace the “for loop” for each turn
 - * Start by circling the number at the starting value of X
 - * Count down the number line, circling the numbers at the correct interval
 - * Stop when you get to the stopping value
- * Add all of the circled values to get the score for your round
- * Best 2 out of 3 Wins

WHO WON?
PLAYER # _____

Lesson 7: Getting Loopy

Unplugged | Loops

Overview

As we start to write longer and more interesting programs, our code often contains a lot of repetition. In this lesson, students will learn about how loops can be used to more easily communicate instructions that have a lot of repetition by looking at the repeated patterns of movement in a dance.

Purpose

At this point in the course, students should have developed comfort with programming a set of linear instructions. Frequently the linear set of instructions includes patterns that are repeated multiple times and as students want to write more complex and interesting programs, manually duplicating that code becomes cumbersome and inefficient. To enable students to write more powerful programs, we'll need to rely on structures that break out of the that single linear list. *Loops* allow for students to structure their code in a way that repeats. In this lesson, we will focus on identifying patterns in physical movement before moving back onto the computer to look for patterns in our code.

Agenda

Warm Up (5 min)

Repeat After Me

Main Activity (15 min)

Assessment (10 min)

Wrap-Up (15 min)

Vocabulary

Flash Chat: What did we learn?

Journaling

Extended Learning

So Moving

Connect It Back

Objectives

Students will be able to:

- Repeat actions initiated by the instructor.
- Translate a picture program into a real-world dance.
- Convert a series of multiple actions into a single loop.

Preparation

- Watch the **Getting Loopy - Teacher Video**.
- Print one **Getting Loopy - Worksheet** for the class.
- Print one **Getting Loopy - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Getting Loopy** - Unplugged Video (**download**)
- **Getting Loopy** - Teacher Video
- **Getting Loopy** - Assessment Answer Key

For the Students

- **Getting Loopy** - Worksheet
- **Getting Loopy** - Assessment
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Loop** - The action of doing something over and over again.
- **Repeat** - Do something again

Teaching Guide

Warm Up (5 min)

Repeat After Me

Model: Ask for a volunteer and have them stand.

- Instruct your volunteer to walk around the table (or their chair, or a friend).
- When they finish, instruct them to do it again, using the exact same words you did before.
- When they finish, instruct again.
- Then again.

Prompt: Would it have been easier for me to just ask you to go around the table four times?

Think: What if I wanted you to do it ten times? How would you reword my instructions so that they were more efficient and I didn't have to repeat myself so much? Feel free to write your instructions down on a piece of scrap paper.

Share: Ask a few students to share their instructions with the class, pointing out how each approach has simplified the overall approach to giving instructions.

Remarks

Today we're going to work on finding ways to make giving lots of instructions easier, especially when those instructions repeat themselves a lot. This will be really useful when we go back to the computers and have to write lots of instructions in our programs.

Main Activity (15 min)



Say: Introduce the main activity by letting the class know that we will be having a dance party. In order to have that party, we'll need to know what all of the steps in the dance are, and how many times we should do them.

Display: Show the **Getting Loopy - Worksheet** so that all students can see it. Talk through the different sections of the dance as a class. Point out the section that repeats, in particular.

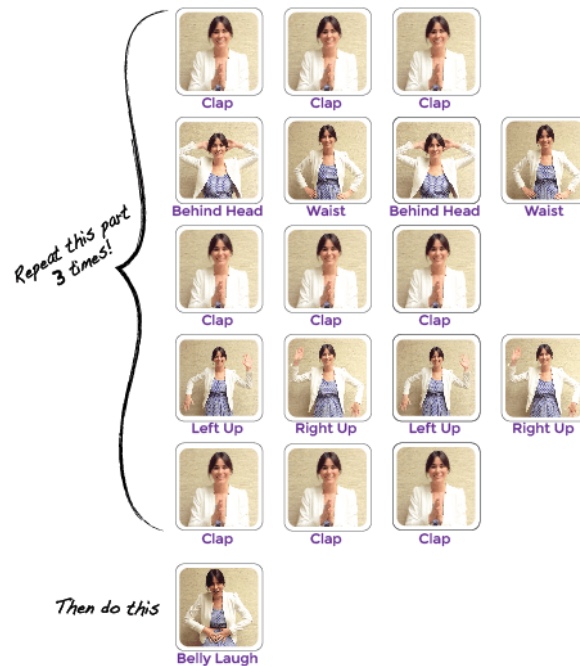
Lesson Tip:

Looking for some good music? Here are some great places to find some:

- **Radio Disney**
- **Nick Radio**
- **Kidz Bop Radio**

Please be advised that some of these stations may display ads with third-party content. If you find that displayed ads are inappropriate, you may want to direct students to a different site, or research ad-blockers that can prevent this content.

The Iteration



Model: Show the class what the entire dance looks like done at full-speed. Then run through the dance slowly, asking a different student to call out each line of instructions. Next, have the students perform the dance along with you, saying the instructions aloud as they get to each move.

Prompt: Ask students to work with a neighbor to find all of the sections of the dance that repeat.

Share: Ask a few students to share the repeating patterns that they found. As a class, talk through how you might rework the instructions to be even shorter by repeating those patterns.

Finally, help them understand a symbology for capturing these loops on their picture program, since the assessment will utilize this same method. Here is an example:



Assessment (10 min)

Ending with an assessment sheet will help solidify this lesson for your students.

Distribute: Hand out the **Getting Loopy - Assessment** to each student. Allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities.

Wrap-Up (15 min)

Vocabulary

Display: Present the vocab for this lesson, loop. Ask the class to point out the main loop that was in the dance. Why do you think we call it a loop?

Flash Chat: What did we learn?

- Do you think it is easier to add more pictures to the screen or change the number of times we loop?
 - Would your answer be the same if we wanted to loop 100 times?
- Could we use these same loops with different dance moves?
- Do you know any dances that are done inside a loop?
- What was your favorite part about that activity?

Journaling

Having students write or draw about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Draw a picture of you dancing today. Draw the loops that you did, like clapping three times.
- What else can you use a loop for?

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

So Moving

- Give the students pictures of actions or dance moves that they can do.
- Have students arrange moves and add loops to choreograph their own dance.
- Share the dances with the rest of the class.

Connect It Back

- Find some YouTube videos of popular dances that repeat themselves.
- Can your class find the loops?
- Try the same thing with songs!

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices
- ▶ **OA** - Operations And Algebraic Thinking

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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The Iteration

*Repeat this part
3 times!*



Clap



Clap



Clap



Behind Head



Waist



Behind Head



Waist



Clap



Clap



Clap



Left Up



Right Up



Left Up



Right Up



Clap



Clap



Clap



Belly Laugh

Then do this



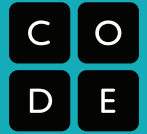
Unplugged

Name: _____

Date: _____

Getting Loopy

Unplugged Loops Activity




















Looping can save space!

What if we wanted to take The Iteration dance below and make more loops inside? Can you circle the actions that we can group into a loop and cross out the ones that we don't need anymore? Write a number next to each circle to let us know how many times to repeat the action.

The first line has been done for you.

*Repeat this part
3 times!*

3				
	Clap	Clap	Clap	
				
	Behind Head	Waist	Behind Head	Waist
				
	Clap	Clap	Clap	
				
	Left Up	Right Up	Left Up	Right Up
				
	Clap	Clap	Clap	

Then do this



The Iteration

Lesson 8: Going Places Safely

Common Sense Education | Unplugged

Overview

In collaboration with **Common Sense Education - Website**, this lesson helps students learn that many websites ask for information that is private and discusses how to responsibly handle such requests. Students also find out that they can go to exciting places online, but they need to follow certain rules to remain safe.

Purpose

Common Sense Education has created this lesson to teach kids the importance of being safe online. By relating places in the real world to websites on the internet, students will make important connections between safe websites and safe places in their own neighborhood.

Agenda

Warm Up (20 min)

Vocabulary
Where We Go

Main Activity (20 min)

Keep It Private

Wrap Up (15 min)

Flash Chat: What did we learn?
Journaling

Assessment (5 min)

Going Places Safely - Assessment

Extended Learning

Objectives

Students will be able to:

- Understand that being safe when they visit websites is similar to staying safe in real life
- Learn to recognize websites that are safe for them to visit.
- Recognize the kind of information that is private and understand that it should never be shared online.

Preparation

- ▢ Watch the **Going Places Safely - Teacher Video**.
- ▢ Prepare to show the **Going Places Safely - Lesson Video**.
- ▢ Live access or print-off of **SecretBuilders** sign-up page (Click "New Player," select an age, and then select "I'm a Girl" or "I'm a Boy.>").
- ▢ Print one **Going Places Safely - Assessment** for each student.
- ▢ Make sure each student has a **Think Spot Journal - Reflection Journal**.
- ▢ Review **CSF Digital Citizenship - Resource List** for more online safety content.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Going Places Safely - Teacher Video**
- **Going Places Safely - Lesson Video**
- **Going Places Safely - Assessment**
- **Going Places Safely - Assessment Answer Key**
- **Common Sense Education - Website**
- **CSF Digital Citizenship - Resource List**

For the Students

- **Feeling Faces - Emotion Images**
- **Think Spot Journal - Reflection Journal**

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important word:

Username - Say it with me: Yews-er-naym

A name you make up so that you can see or do things on a website, sometimes called a "screen name"

Where We Go

- Invite students to talk about places they have visited on a class field trip.
 - If students have limited experience with field trips, provide some examples of the types of places they could visit as a class, such as museums, science centers, or zoos.
 - Have students choose a place they would like to go on a class field trip.
- Have students take an imaginary field trip to their chosen place.
 - Narrate the preparations while having students pantomime what's happening – For example: put on your jacket; climb on/off the bus; get your ticket checked; go inside.
 - Have students describe what they think they might see and do once they arrive.
- Let the students sit back down, then ask: "What do you need to do to stay safe when you visit new places?"

Play **Going Places Safely - Lesson Video**.

What three rules does Jeremiah follow when he goes places online?

- 1) Always ask your parent (or teacher) first
- 2) Only talk to people you know
- 3) Stick to places that are just right for you

Now, let's see what more we can do to keep ourselves safe.

Main Activity (20 min)



Keep It Private

Access **SecretBuilders** sign-up page live, or project a print-out on the board for the class to see.

- Invite students to give examples of information that they should keep private.
 - Write down their responses on the board or chart paper so that you can return to them later in the lesson.
- Make sure they understand that private information includes the following:
 - full name
 - age
 - address
 - telephone number
 - email address (or parents' email addresses)
 - where they go to school or after school
 - where their parents work
- Encourage students to discuss why it is important to keep this information private.
 - Stress that it is never safe to give out private information to people they don't know.
 - Students should always ask a parent or caregiver before they give out private information to anyone.
- Refer back to the sign-up page.
 - Ask "Do you think you should use your real name, or something that includes your real name, when you make up a username?"

Guide students through the following rules and tips for creating usernames:

Rules:

- Ask a parent or other trusted adult before you create a username.
- Never include any private information in your username, such as your real name, age, birthday, the name of your school or hometown, parts of your address or phone number, or email address.
- Avoid using symbols or spaces, as they are usually not allowed in usernames.

Tips

- Include the name of something that will help you remember your username, like your favorite animal, character, or toy. You might have to combine this with other words or numbers.
- If the username you create is already taken, you will have to come up with another one.
- Write down your username and password and, with the help of a parent, find a safe place to keep it in case you forget them.

Distribute paper and place students in pairs.

Directions:

1. Have students interview their partner using the following questions, and write down their responses:
2. What is your favorite pet or animal?
3. What is your favorite TV show, book, or movie character?
4. What are your favorite numbers?
5. Instruct students to make up three safe usernames for their partner using information from their interview responses.
6. They should not include their partner’s name, age, school, email address, birthday, or any other private information.
7. Invite students to share one or more of their usernames with the class.
8. Encourage students to respond to one another’s usernames, confirming that each name follows the rules they have learned.

Lesson Tip

For more in-depth modules, you can find additions to this curriculum at the **Common Sense Education - Website** page on Scope and Sequence.

Wrap Up (15 min)

Flash Chat: What did we learn?

- What information should you always keep private when you are using the computer?
- What rules should you follow when you make up a username?
- What can the Internet be used for?
- What rules do we have for visiting places online?

Take the time to discuss again what is appropriate information to share on the Internet, and what is not:

Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students’ greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Appropriate	Not Appropriate
Interests	Address
Hobbies	Full Name
First Name	Information that would hurt others

Journaling

Having students write about what they learned, why it’s useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today’s lesson about?
- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today’s lesson in the corner of your journal page.
- Draw some things that you should never talk to a stranger about on the internet. For example, draw your house to represent your address, draw your school, or draw your family.

Assessment (5 min)

Going Places Safely - Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Common Sense Education

- Visit **Common Sense Education - Website** to learn more about how you can keep your students safe in this digital age.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Keep It Private

Just because you can share something online doesn't mean that you should!

1) Circle the place you would most like to visit online



THE JUNGLE



OUTER SPACE



THE OCEAN

2) Can you spot the private information? Mark "X" through the information that you should not share with people you do not know well.



My address is
2524 Sycamore Lane.

My birth date
is February 5th,
2006



I like watermelon.



I like swimming.

3) On the back of this paper, draw something that you enjoy and want to share on the Internet.

Lesson 1: Graph Paper Programming

Overview

By "programming" one another to draw pictures, students get an opportunity to experience some of the core concepts of programming in a fun and accessible way. The class will start by having students use symbols to instruct each other to color squares on graph paper in an effort to reproduce an existing picture. If there's time, the lesson can conclude with images that the students create themselves.

Purpose

The goal of this activity is to build critical thinking skills and excitement for the course, while introducing some of the fundamental programming concepts that will be used throughout the course. By introducing basic concepts like sequencing and algorithms to the class in an unplugged activity, students who are intimidated by computers can still build a foundation of understanding on these topics. In this lesson, students will learn how to develop an algorithm and encode it into a program.

Agenda

Warm Up (10 min)

Introduction to Graph Paper Programming

Main Activity (30 min)

Practice Together The Students' Turn

Wrap Up (15 min)

Journaling / Flash Chat

Optional Assessment (10 min)

Graph Paper Programming - Assessment

Extended Learning

Objectives

Students will be able to:

- Reframe a sequence of steps as an encoded program
- Explain constraints of translating problems from human language to machine language

Preparation

- ▢ Watch the **Graph Paper Programming - Teacher Video**.
- ▢ Watch the **Graph Paper Programming - Lesson in Action Video**.
- ▢ Print out one **Graph Paper Programming - Worksheet** for each group.
- ▢ Print one **Graph Paper Programming - Assessment** for each student.
- ▢ Supply each group with several drawing grids, paper, and pens/pencils.
- ▢ Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Graph Paper Programming** - Teacher Video
- **Graph Paper Programming** - Lesson in Action Video
- **Graph Paper Programming** - Worksheet Answer Key
- **Graph Paper Programming** - Assessment Answer Key

For the Students

- **Graph Paper Programming** - Unplugged Video ([download](#))
- **Graph Paper Programming** - Worksheet
- **Graph Paper Programming** - Assessment
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Algorithm** - A list of steps to finish a task.
- **Program** - An algorithm that has been coded into something that can be run by a machine.

Teaching Guide

Warm Up (10 min)

Introduction to Graph Paper Programming

In this activity, students will encode instructions to guide each other toward making drawings without letting the rest of their group see the original image. This warm-up frames the activity for the class.

Display: Watch one of the videos below to give students context for the types of things that robots can do:

- **Asimo by Honda** (3:58)
- **Egg drawing robot** (3:15)
- **Dancing Lego Robot** (1:35)

• **Discuss:** How do you suppose that robots know how to do the things that they do? Do they have brains that work the same way that ours do?

Work this into a discussion on how people have to program robots to do specific things, using specific commands.

Discussion Goal

The goal of this quick discussion is to call out that while robots may seem to behave like people, they're actually responding only to their programming. Students will likely refer to robots from movies and TV that behave more like humans. Push them to consider robots that they've seen or heard of in real life, like Roombas, or even digital assistants like Amazon Alexa.

Main Activity (30 min)

Practice Together

In this activity, students will act as both programmers and robots, coloring in squares according to programs that they have written for one another.

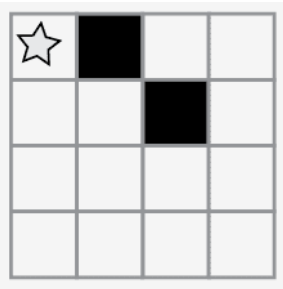
Distribute: Students will use 4x4 grids (or sheets of graph paper with 4x4 boxes sectioned off). They will also need the image worksheet.

Display: Project these commands, or write them on the board. They won't persist long, but they will help students make the transition from Algorithm to Program.

```
Move one square right
Move one square left
Move one square up
Move one square down
Fill in square with color
```

Say: Today, we all get to program robots...and they're already here in the room! It's you! We're going to write programs using symbols with special meanings to help each other recreate a picture. First, we'll practice together as if I am the robot and you are the programmers, then we can break up into groups so that everyone can get a turn.

Display: Display both the image that you are going to have the students walk you through, and a blank grid that you will fill-in with your ARM. Make sure that the instructions, grid, and image remain visible at the same time.



Remarks

Here is an image. Pretend that I am the robot with an Automatic Realization Machine (ARM). These are the only instructions that I understand.

Starting at the upper left-hand corner, guide my ARM out loud with your words.

Model: The class might give you instructions like these below. As you hear an instruction that you intend to follow, make sure to repeat it out loud so that the students can keep track of what you are doing.

```
Move One Square Right
Fill In Square with Color
Move One Square Right
Move One Square Down
Fill In Square with Color
```

Continue with the activity until you have completed your sample square.

Capture: Write each of the commands down so that students can see all of the steps that went into the one image.

```
Move One Square Right
Fill In Square with Color
Move One Square Right
Move One Square Down
Fill In Square with Color
```

Say: You just gave me a list of steps to finish a task. In programming, they call that an algorithm. Algorithms are great, because they are easy for you to understand as the programmer. BUT, what happens when we want to write down the algorithm for a drawing like this?

Display: Show the students a more complicated image, like the one below.



Next, begin writing down some of the instructions that it would take to replicate that image. Hopefully, students will see that writing everything out longhand would quickly become a bit of a nightmare.

```
Move One Square Right
Fill In Square with Color
Move One Square Right
Move One Square Right
Fill In Square with Color
Move One Square Down
Move One Square Left
Fill In Square with Color
Move One Square Left
Move One Square Left
Fill In Square with Color
PLUS 12 MORE INSTRUCTIONS!
```

Display: Show the students this list of symbols.



Discussion: How could we use these symbols to make our instructions easier?

Draw out ideas that relate to transitioning from the verbal instructions to the symbols. Once the students get to that place, point out that this text:

- “Move one square right, Move one square right, Fill-in square with color”

would now correspond to the program:



Discussion Goal

The goal for this discussion is to get at the idea that students can use symbols to stand for entire phrases. Once they understand that, share with them that making the switch from listing steps in detail to encoding them is called “programming.”

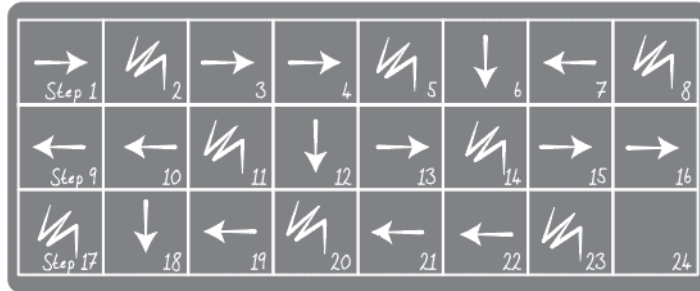
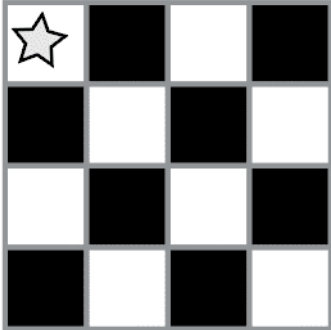
🔗 **Model:** Now, have the class help you draw the larger image using only symbols. Do not worry about unnecessary steps for now. If their final program works to create the image, consider it a win.

The classroom may be buzzing with suggestions by this point. If the class gets the gist of the exercise, this is a good place to discuss alternate ways of filling out the same grid. If there is still confusion, save that piece for another day and work with another example.

See a sample solution below:

🔗 **Teaching Tip**

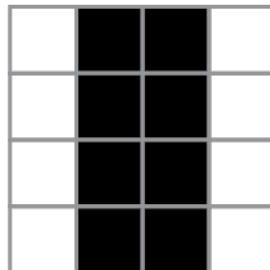
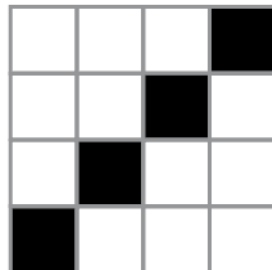
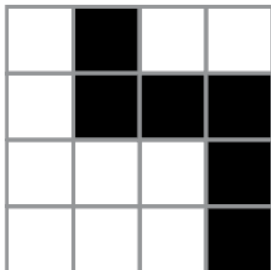
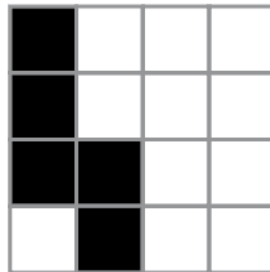
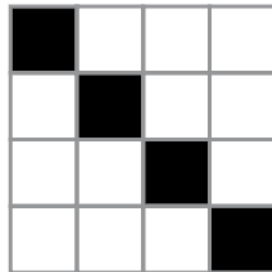
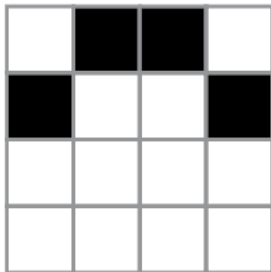
Notice that we have written our program from left to right like you would read a book in English. Some students prefer this method. Others like to start each line of the grid on a new line of paper. The way they write their program doesn't matter as much as whether the other people in their groups can follow along!



The Students' Turn

Group: Divide students into pairs or small groups.

- Have each pair/group choose an image from the worksheet.
- Discuss the algorithm to draw chosen image with partner(s).
- Convert algorithm into a program using symbols.
- Trade programs with another pair/group and draw one another's image.
- Choose another image and go again!



Wrap Up (15 min)

Journaling / Flash Chat

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Draw another image that you could code. Can you write the program that goes with this drawing?
- What other types of robots could we program if we changed what the arrows meant?

Optional Assessment (10 min)

Graph Paper Programming - Assessment

- Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Better and Better

- Have your class try making up their own images.
- Can they figure out how to program the images that they create?

Class Challenge

- As the teacher, draw an image on a 5x5 grid.
- Can the class code that up along with you?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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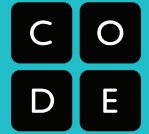
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Name: _____

Date: _____

Graph Paper Programming



Unplugged

Four-by-Fours Activity Worksheet

Choose one of the drawings below to program for a friend. Don't let them see which one you choose!

Write the program on a piece of paper using symbols. Can they recreate your picture?

Use these symbols to write a program that would draw each image.

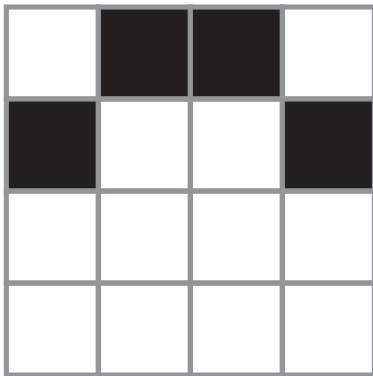
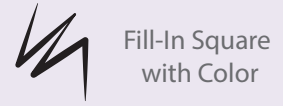
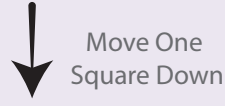
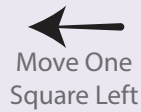


Image 1

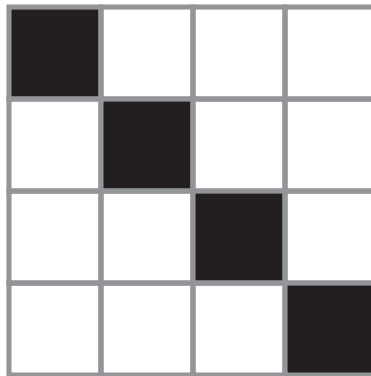


Image 2

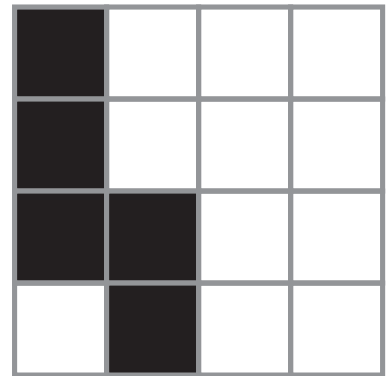


Image 3

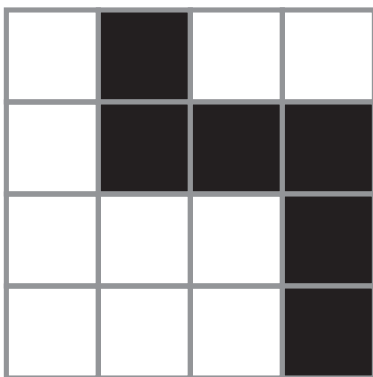


Image 4

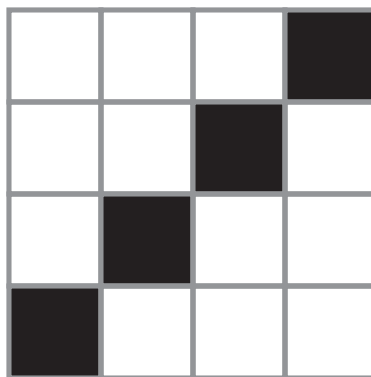


Image 5

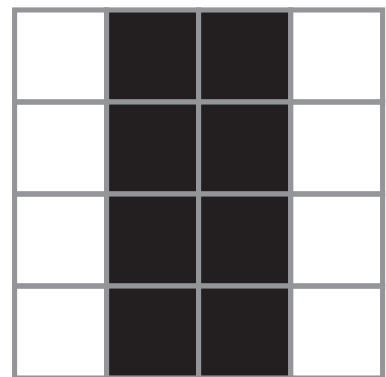


Image 6

Game #1

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #2

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #3

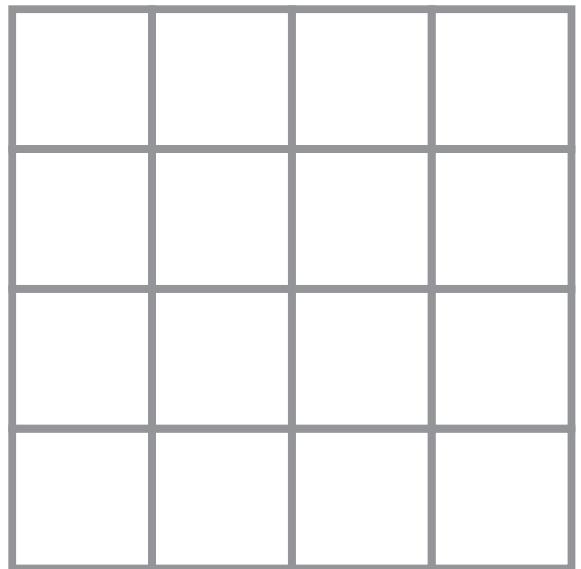
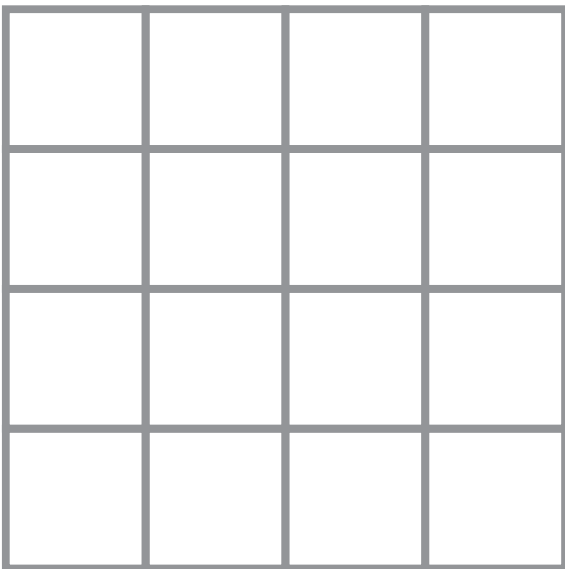
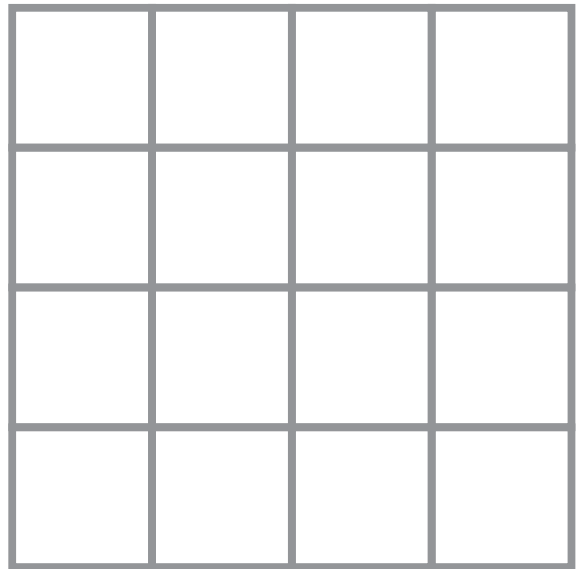
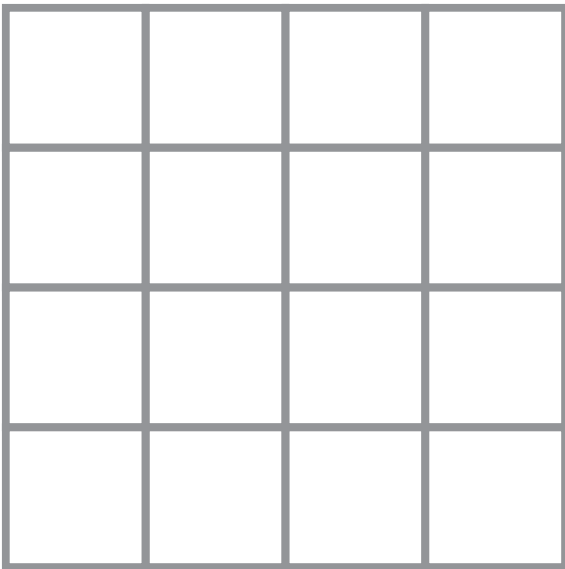
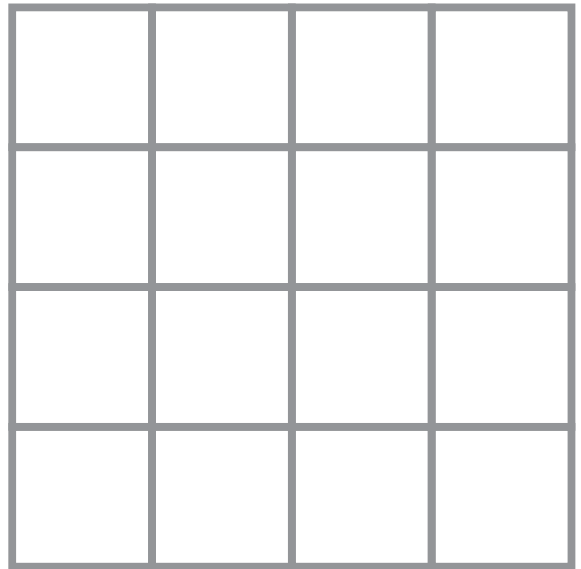
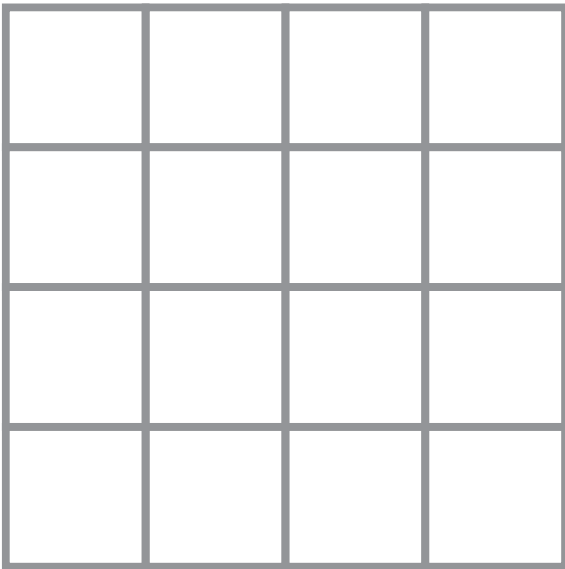
Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #4

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #5

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45





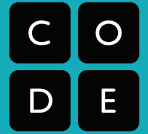
Unplugged

Name: _____

Date: _____

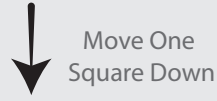
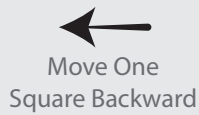
Graph Paper Programming

Assessment Worksheet

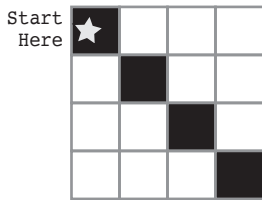


You have just learned how to create algorithms and programs from drawings, and how to draw an image from a program that someone gives to you. During the lesson, you worked with other people to complete your activities. Now you can use the drawings and programs below to practice by yourself.

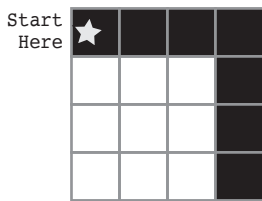
Use the symbols below to write a program that would draw each image.



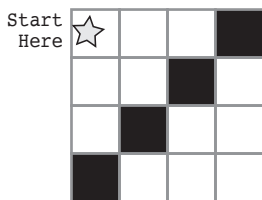
Fill-In Square with Color



Step 1	2	3	4	5	6	7	8	9	10
Step 11	12	13	14	15	16	17	18	19	20

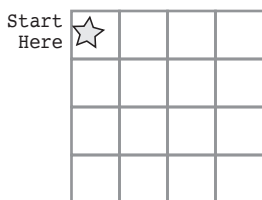


Step 1	2	3	4	5	6	7	8	9	10
Step 11	12	13	14	15	16	17	18	19	20



Step 1	2	3	4	5	6	7	8	9	10
Step 11	12	13	14	15	16	17	18	19	20

Now, read the program below and draw the image that it describes.



Step 1		2		3		4		5		6		7		8		9		10
Step 11																		

Lesson 9: Happy Loops

Unplugged | Loop | Repeat

Overview

This activity revisits Happy Maps. This time, student will be solving bigger, longer puzzles with their code, leading them to see utility in structures that let them write longer code in an easier way.

Purpose

This lesson serves as an introduction to loops. Loops allow for students to simplify their code by grouping commands that need to be repeated. Students will develop critical thinking skills by noticing repetition in movements of their classmates and determining how many times to repeat commands. By seeing "Happy Maps" again, students will get the chance to relate old concepts such as sequencing to the new concept of repeat loops.

Agenda

Warm-Up (5 min)

Happy Maps Review

Main Activity (20 min)

Happy Loops

Wrap Up (8 min)

Journaling

Extension Activities

Objectives

Students will be able to:

- Identify repeating code and shorten multiple actions into a single loop.
- Interpret a program with loops as a series of multiple actions.

Preparation

- Watch the **Happy Loops - Teacher Video**
- Print out a **Happy Map Cards - Worksheet** to display for the class
- Print out **Happy Map Game Pieces - Manipulatives** for each group
- Print out **Happy Map Cards XL - Worksheet** for each group
- Print out **Happy Map Game Pieces Bonus Pack - Manipulatives** for each group
- Make sure each student has a **Think Spot Journal - Reflection Journal**

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Happy Loops - Teacher Video**

For the Students

- **Feeling Faces - Emotion Images**
- **Happy Map Cards - Worksheet**
- **Happy Map Cards XL - Worksheet**
- **Happy Map Game Pieces - Manipulatives**
- **Happy Map Game Pieces Bonus Pack - Manipulatives**
- **Think Spot Journal - Reflection Journal**

Vocabulary

- **Loop** - The action of doing something over and over again.
- **Repeat** - Do something again

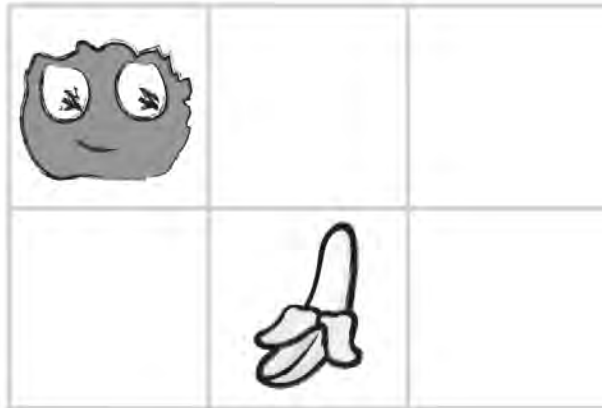
Teaching Guide

Warm-Up (5 min)

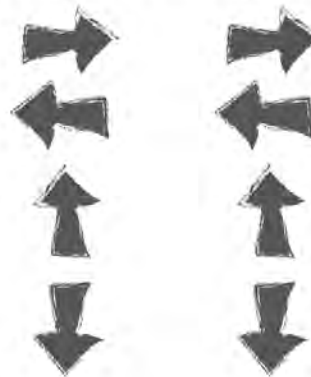
Happy Maps Review

This lesson builds off of the Happy Maps activity from earlier in the year. Students might benefit from a quick refresher before you hop into the difficult stuff.

Display:



Which two ways should the Flurb step to get to the supplies?



Model: Select one of the maps that your class covered together in the last lesson.

Have students look at the puzzle, then think-pair-share their solution for how they would get the Flurb to the fruit (using the symbols from last time).

Think: Do you remember writing programs to get the Flurbs to the fruit? What would this program look like coded with arrows?

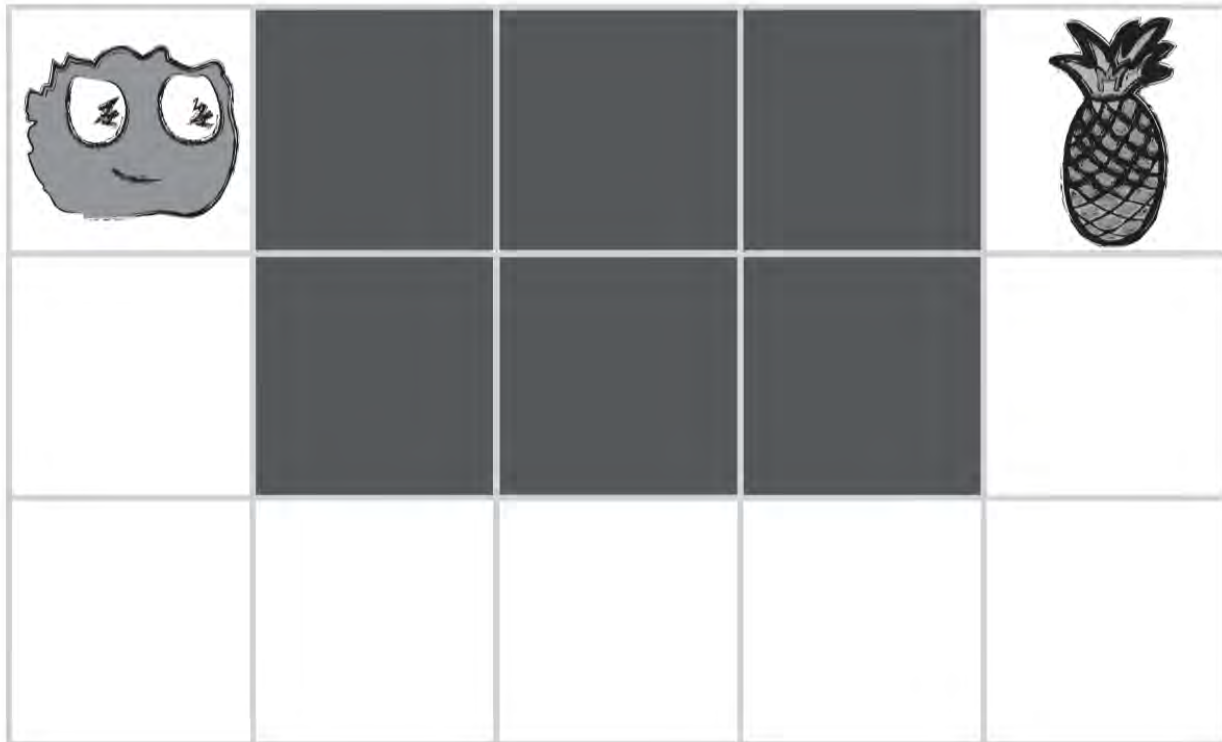
Pair: Have students discuss for about 90 seconds.

Share: Ask a student to use their fingers to point in the direction of the arrows that they chose to solve this puzzle.

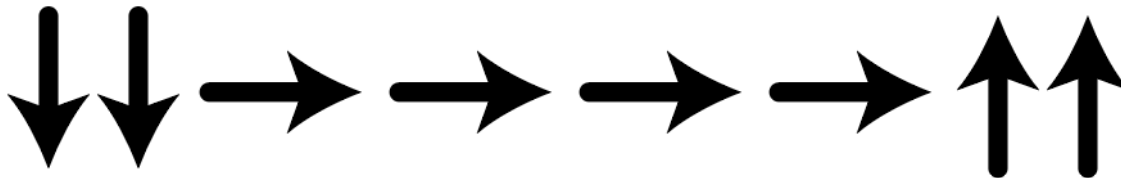
Main Activity (20 min)

This portion of the lesson should help students see that there is an easier way to handle repetitive code than to brute force a solution with dozens of the same symbols.

Display:



Model: Once you are confident that your students remember Happy Maps, pull up one of the new -- and much longer -- *Happy Maps XL*. Can your students help you program these maps? The resulting code might look something like this:



It's a bit longer, isn't it?

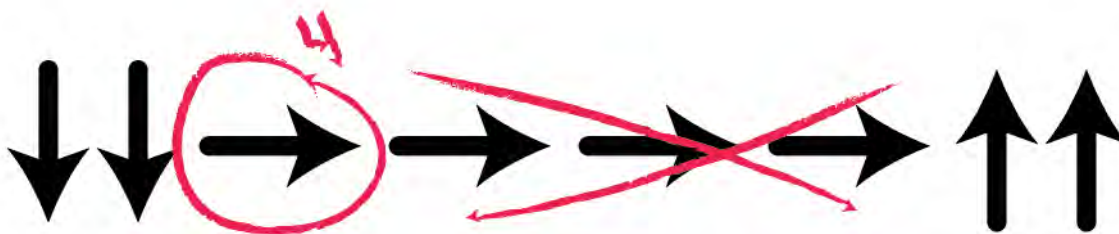
Discuss:

Give students the opportunity to brainstorm shorter ways to relay the code that they're creating. (This bit can be skipped over if your students start saying things like: "Move forward 6 times." Since that will open the discussion about how to show "six times" with symbols.)

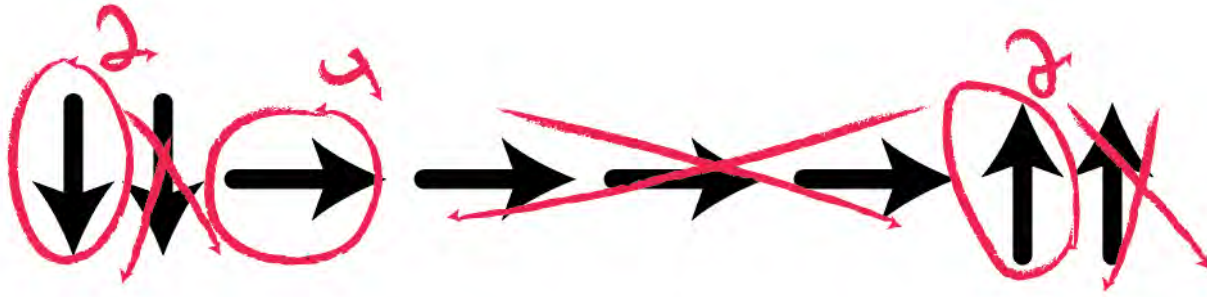
Discussion Goal

The point of this discussion is to get students to see that, sometimes, many symbols are repeated and they can lump all of those movements into a single icon.

Ideally, students will land on a method that looks like this one:



Which can be reduced even further to this:



Eventually, students can write programs like this on the fly:



Define: Once students have put together the idea of “repeating” code, give them the vocabulary around it. Make sure to share with them that often the terms “repeat something” and “loop something” will be used interchangeably in Code Studio.

Happy Loops

Now that students are familiar with the ability to repeat lots of code using a single loop, select an XL map and let them help you write code for the situation. Do this as many times together as a class as you need, then set students off in groups to solve some problems on their own. You may also need to add the **Happy Map Game Pieces Bonus Pack - Manipulatives** to adapt this activity for loops.

Circulate: Make sure to walk around and have students run through their code with you watching. Are there any bugs? Use the debugging questions to help them find a solution.

- What does it do?
- What is it supposed to do?
- What does that tell you?
- Does it work at the first step?
- Does it work at the second step?
- Where does it stop working

Wrap Up (8 min)

Journaling

Having students write about what they learned, why it’s useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today’s lesson in the corner of your journal page.
- Have the students write or draw something in their journal that will remind them later what loops are. Prompts include:
 - What does “repeat” mean to you?
 - Draw a picture of you repeating something.

Extension Activities

- Create a life-size grid on the rug with tape and have student bring stuffies to school. Now students can program friends to move their actual stuffies as directed in the programs.
- Have students create their own maps for other students to solve using loops.
- Draw a program on the board that uses several sets of repeated commands and have students take turns coming to the front to swap symbols for repeat loops.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



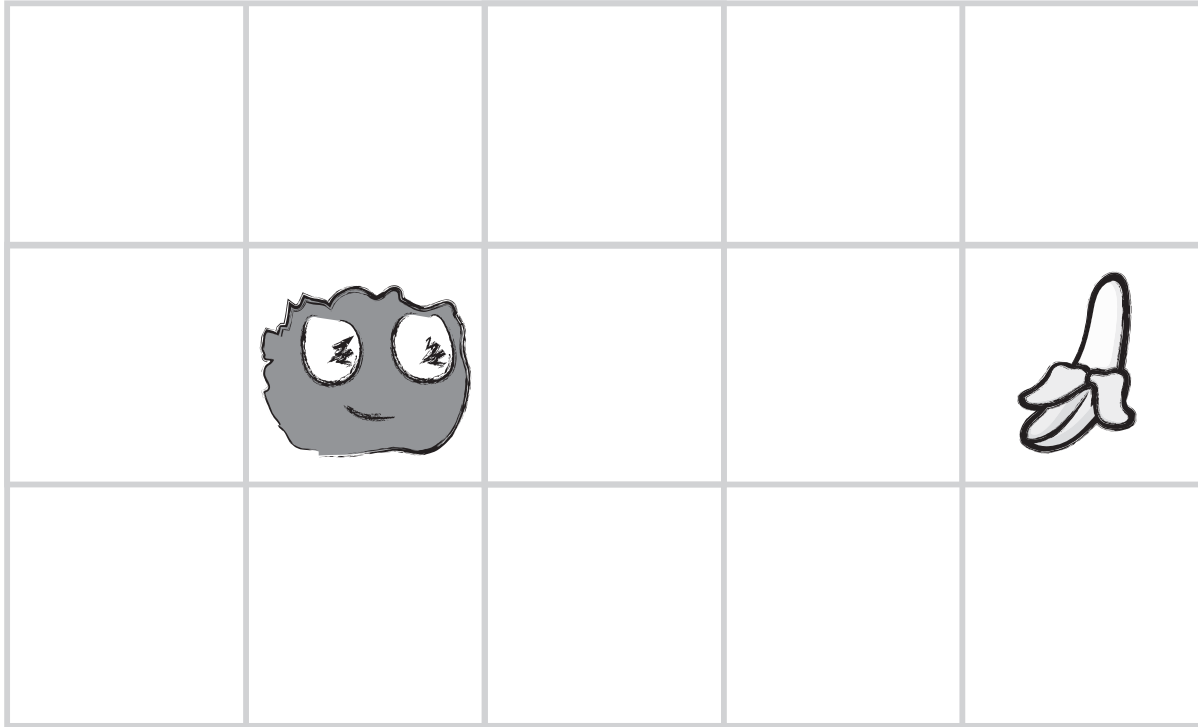
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1

Happy Map XL 1

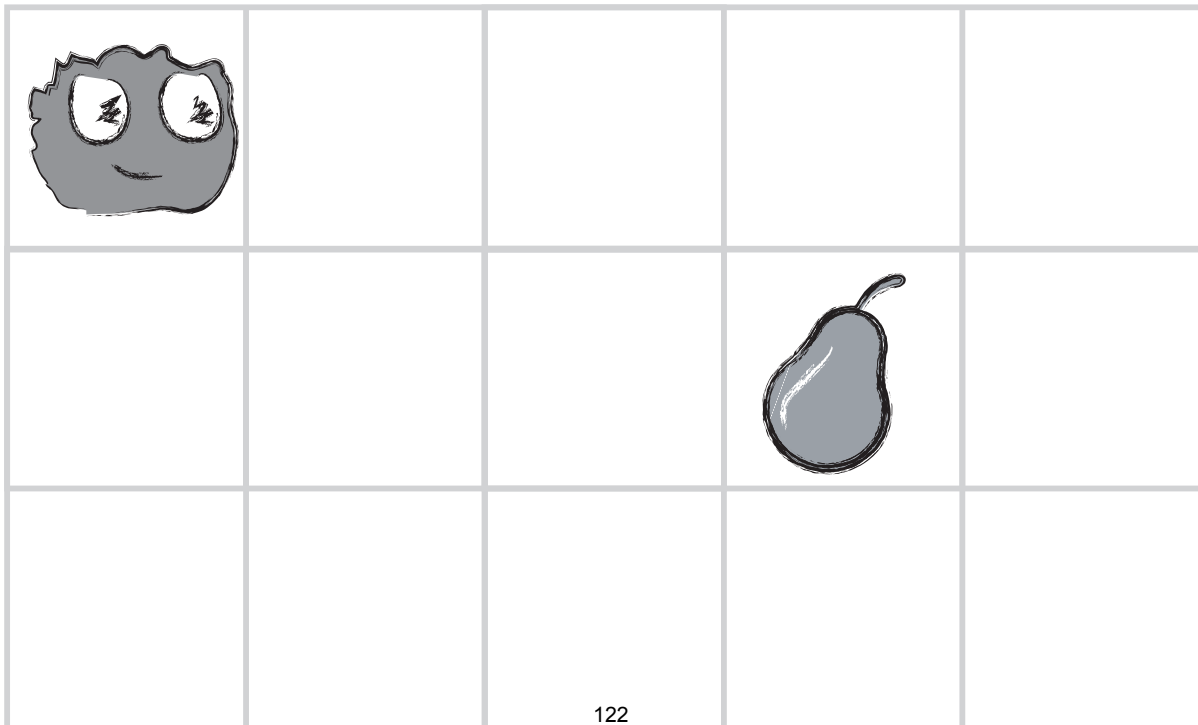
C O
D E



2

Happy Map XL 2


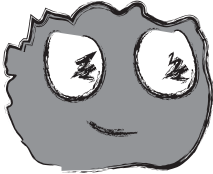
C O
D E



3

Happy Map XL 3

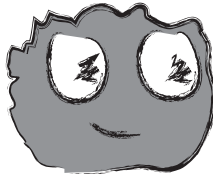

C O
D E

4

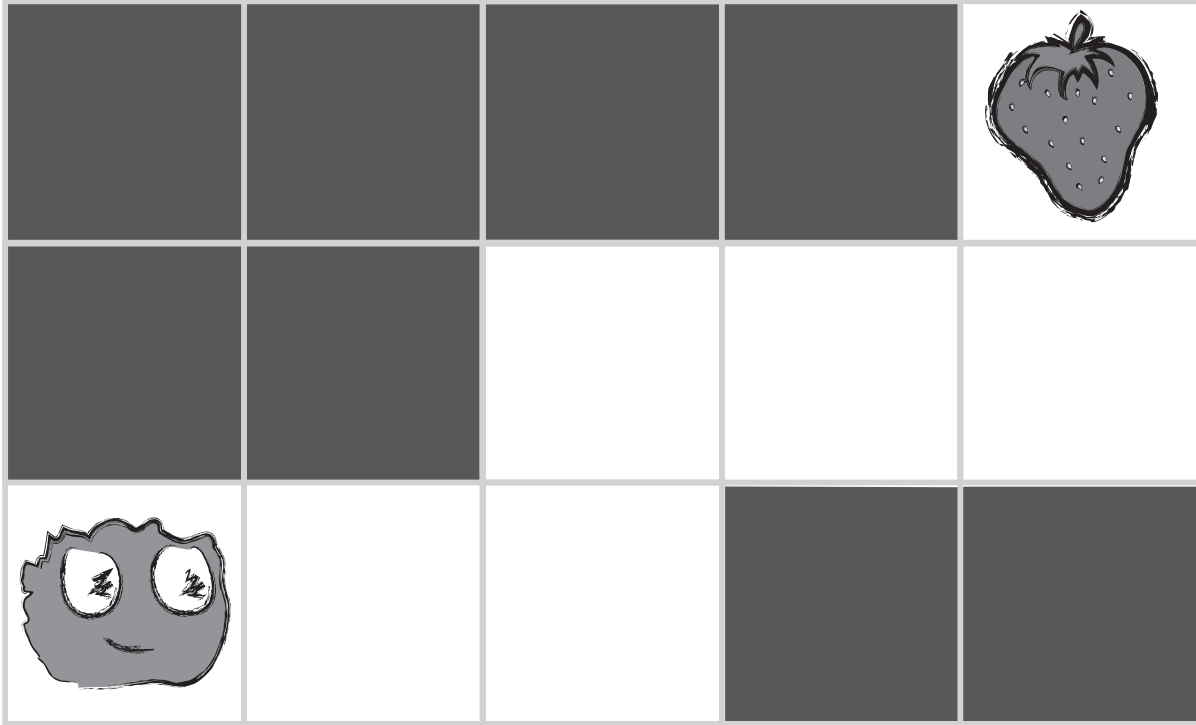
Happy Map XL 4

C O
D E

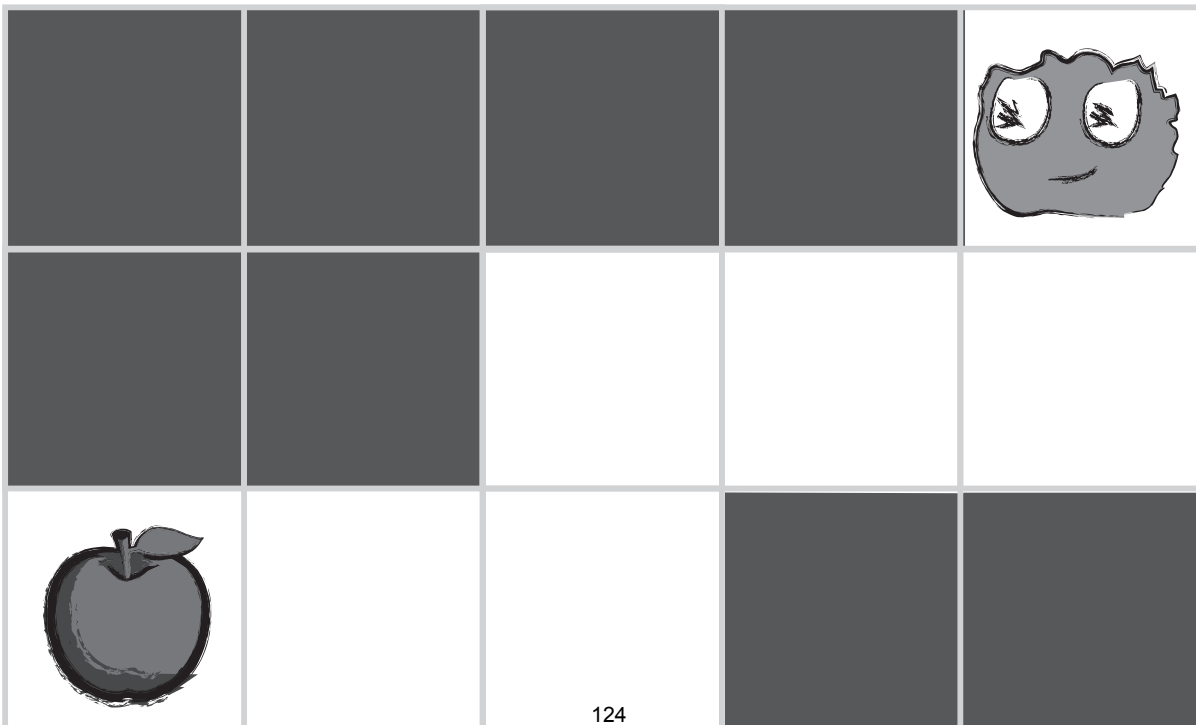
5

Happy Map XL 5



6

Happy Map XL 6





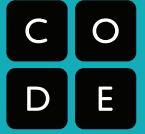
Unplugged

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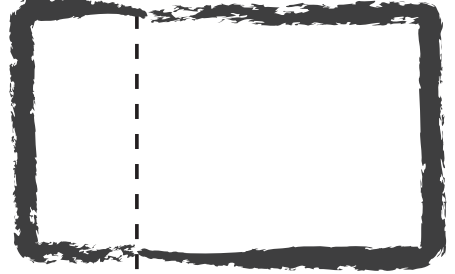
Date: _____

Happy Maps

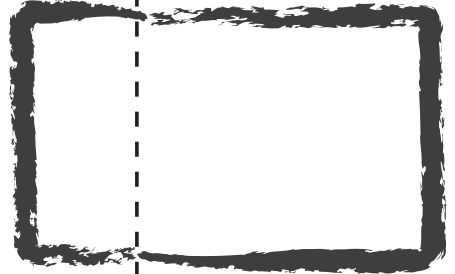
Game Pieces Bonus Pack



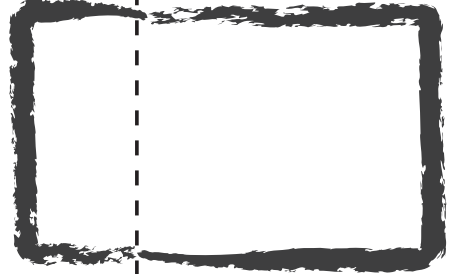
repeat



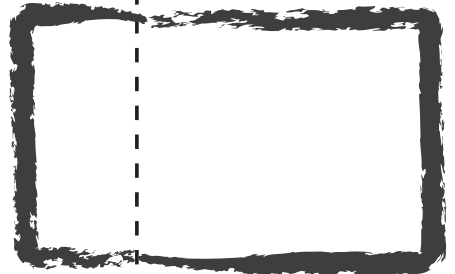
repeat



repeat



repeat



U

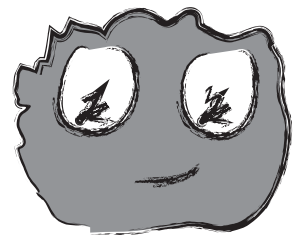
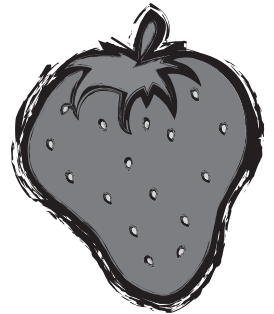
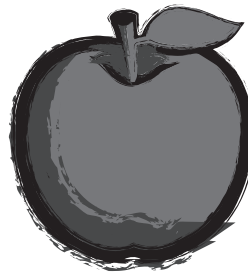
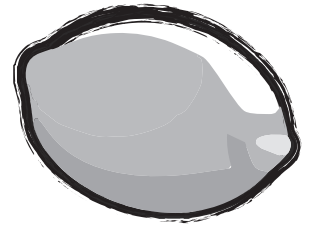
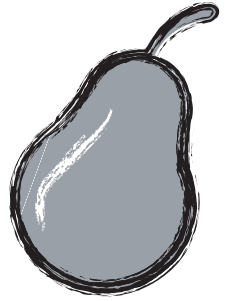
Unplugged

Name: _____

Date: _____

Happy Maps Game Pieces

C O
D E



Happy Map XL Blank (right)



Lesson 5: Happy Maps

Algorithms | Sequencing | Unplugged

Overview

This unplugged lesson brings together teams with a simple task: get the "flurb" to the fruit. Students will practice writing precise instructions as they work to translate instructions into the symbols provided. If problems arise in the code, students should also work together to recognize bugs and build solutions.

Purpose

The bridge from algorithms to programming can be a short one if students understand the difference between planning out a sequence and encoding that sequence into the appropriate language. This activity will help students gain experience reading and writing in shorthand code.

Agenda

Warm Up (5 min)

Step-by-Step

Activity (40 min)

Happy Maps Programming

Students' Turn

Wrap Up (8 min)

Flash Chat

Journaling

Extended Learning

Objectives

Students will be able to:

- Translate an algorithm into a program
- Decode and run a program created by someone else
- Identify and address bugs or errors in sequenced instructions

Preparation

- Watch the **Happy Maps - Teacher Video**.
- Print out **Happy Map Cards - Worksheet** for each group.
- Print out **Happy Map Game Pieces - Manipulatives** for each group.
- Make sure each student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Happy Maps - Teacher Video**
- **Happy Map Cards - Worksheet Answer Key**

For the Students

- **Feeling Faces - Emotion Images**
- **Happy Map Cards - Worksheet**
- **Happy Map Game Pieces - Manipulatives**
- **Think Spot Journal - Reflection Journal**

Vocabulary

- **Algorithm** - A list of steps to finish a task.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Program** - An algorithm that has been coded into something that can be run by a machine.

Teaching Guide

Warm Up (5 min)

Step-by-Step

This warm-up is meant to get the class thinking about how to break a big problem down into a list of individual steps.

Model: Start by asking the class for step-by-step directions on how to get to the chalkboard. Make sure that you ask students to break apart any large instructions, like "Walk to the chalkboard," into smaller instructions like "Step forward."

When you reach the board, ask for instructions to draw a smiley face and try to get them to keep their instructions equally small.

🗣️ **Say:** Well done! You just gave me a list of steps to finish a task. In computer science, that's called an Algorithm! [Follow up with your typical method of introducing vocabulary: word wall, repeat-after-me, etc.]

💡 Teaching Tip

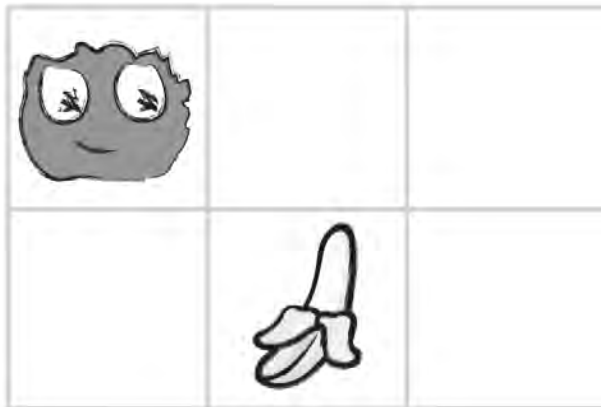
If the class starts shouting simultaneously, explain that you can only hear one instruction at a time. Call on students individually if that helps.

Activity (40 min)

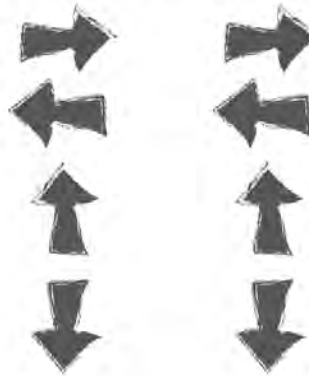
Happy Maps Programming

In this exercise, the class will get map cards that have a pre-defined start space (Flurb) and end space (fruit). Students will need to get the Flurbs to the fruit on each card, using the arrows provided.

Display:



Which two ways should the Flurb step to get to the supplies?



Model: Select one of the intermediate maps, like the one shown above. Display it for the class and work through the puzzle together.

Have students look at the puzzle, then think-pair-share their solution for how they would get the Flurb to the fruit.

Think: This Flurb needs to take two steps to get to the fruit. Work with your elbow partner to decide what you think those two steps are.

Pair: Have students discuss with neighbors for about 90 seconds.

Share: Ask a few students to describe their algorithm to the class. Move your finger along the displayed map as the students read their steps. Once you have a solution, ask if anyone else came up with a different idea that also works.

Now, share with the students that the magic step of changing an algorithm into a "program" happens when the code is written down using symbols. Do the students see any symbols on the display?

Think: Challenge students to encode the algorithm that they came up with before into symbols, and to write those symbols down in their journals (or on a piece of paper.)

Pair: Once students have written down their symbols, ask them to swap with a partner to see if they can follow each others' instructions.

Share: Ask for volunteers to come draw their arrows on the board. If the original code doesn't work, spend some time debugging as a class. Students should be familiar with the idea of "debugging" from previous lessons, so be sure to use the vocabulary to get them comfortable with it.

Once the code has been successfully written on the board, congratulate the class on writing their first program together!

Students' Turn

Group: If your class is comfortable, place students into small groups of 2-3. Otherwise, you can continue solving these problems as a class and having them think-pair-share to write programs.

Distribute: Pass out one of the images from the **Happy Map Cards - Worksheet** to each group as needed. *(Optional)* If you start noticing that students are ready for more, use the provided **Happy Map Game Pieces - Manipulatives** and let students choose their own start and finish destinations on the blank map.

Encourage the students to follow these steps:

- Discuss an algorithm to get the Flurb to the fruit.
- Encode the algorithm into arrows in their journals.
- Try their code to see if everything works as expected.
- Debug any issues and fix their code until it works correctly.

Share: When the lesson is done, offer to let groups share out the most difficult maps that they solved. If you had time, ask them to share their solutions as well.

Wrap Up (8 min)

Flash Chat

Discuss: When it's time to wind down, ask students if they can tell the difference between an algorithm and a program. Both are a list of steps, but a program (code) has been encoded in a way that can be run by a machine (or a kindergartener!)

- Do you think that someone who speaks another language would be able to run your program?
- Why or why not?

Journaling

Students should be encouraged to capture their thoughts in their journal after each activity (with text or images.) Choose a journal prompt that will help students remember the purpose of this exercise.

Journal Prompts:

- What was today's lesson about?
- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Can you draw your own Flurb map?
- What would the code be to solve your map?

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Stuffie Maps

- Create a life-size grid on the rug with tape and have student bring stuffed animals to school.
- Now students can program friends to move their actual stuffies as directed in the programs.

Create Your Own

- Have students create their own maps.
- Have other students solve them using programs.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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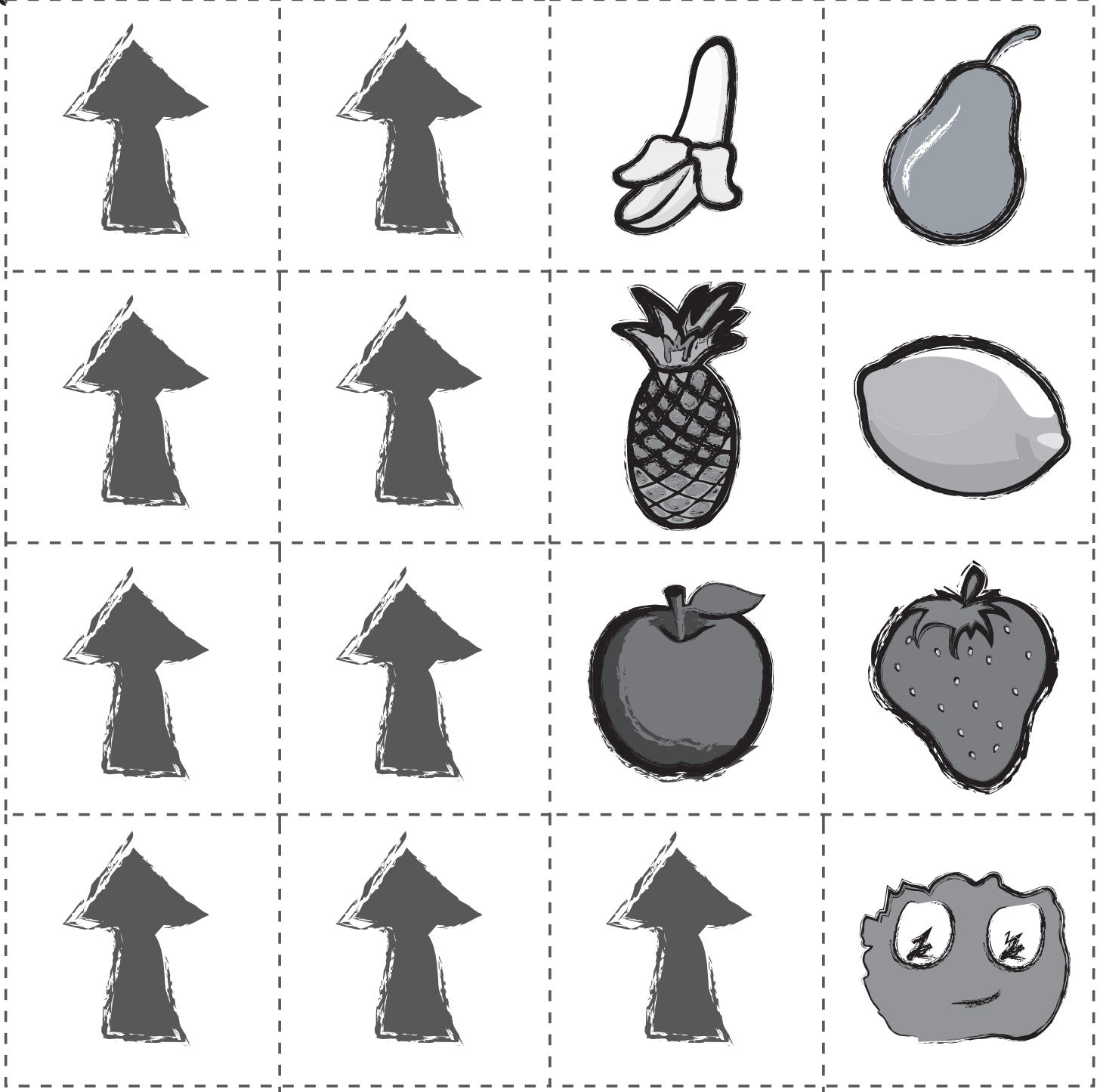
Unplugged

Name: _____

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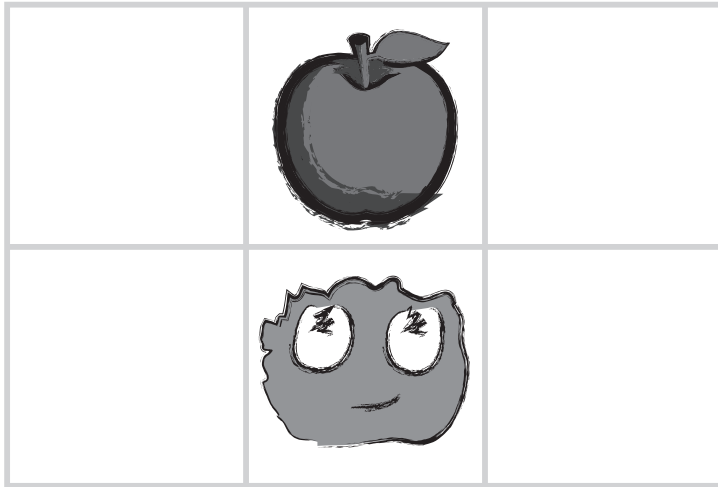
Happy Maps Game Pieces

C O
D E



1

Happy Map 1



Which way should the Flurb step to get to the supplies?



Revision 161003.1a

2

Happy Map 2

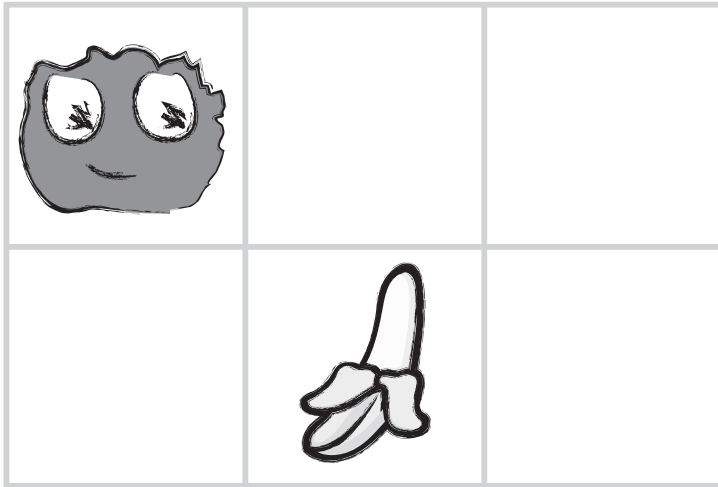


Which way should the Flurb step to get to the supplies?

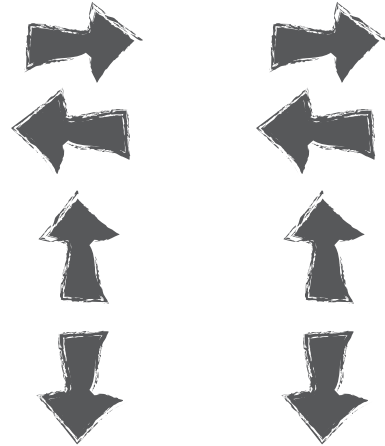


Revision 161003.1a

Happy Map 3

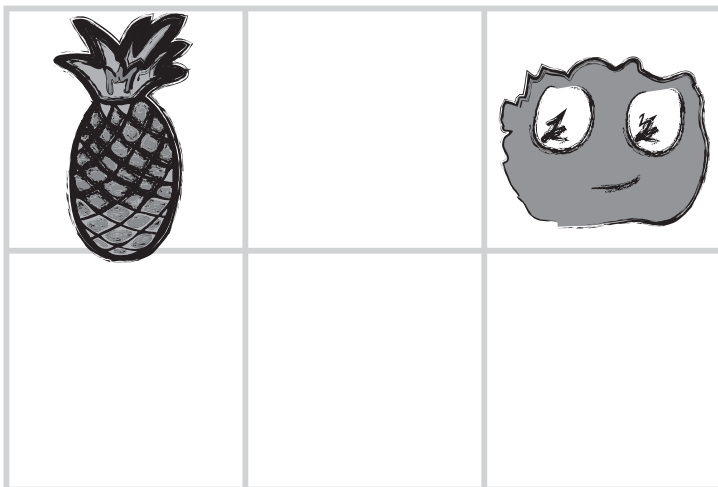


Which two ways should the Flurb step to get to the supplies?

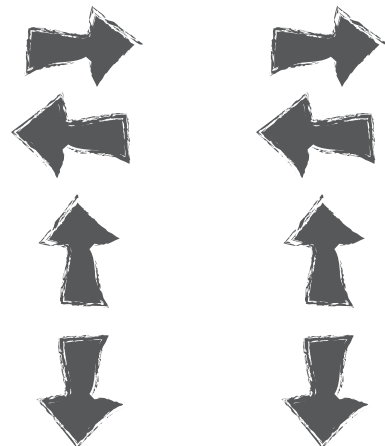


Revision 161003.1a

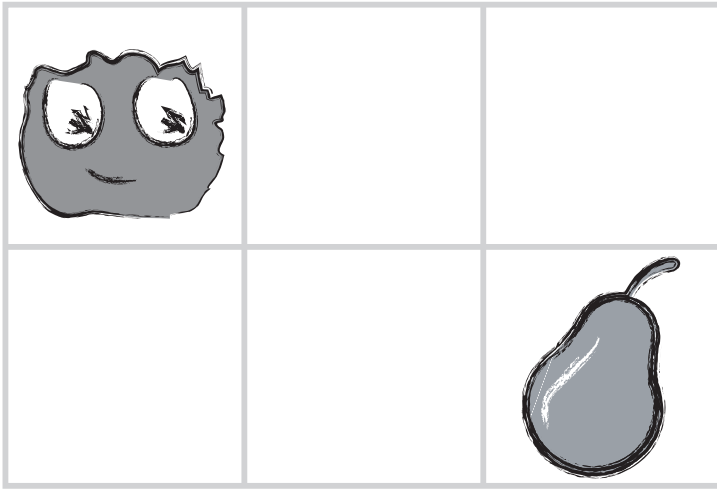
Happy Map 4



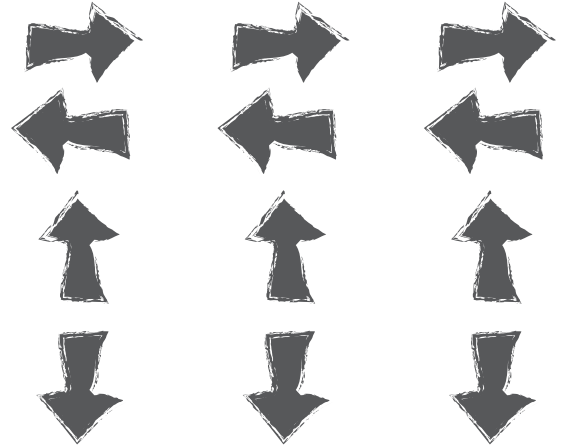
Which two ways should the Flurb step to get to the supplies?



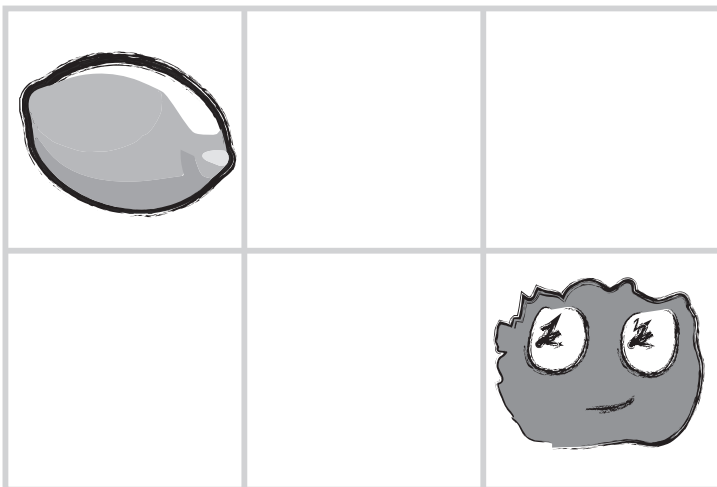
Revision 161003.1a



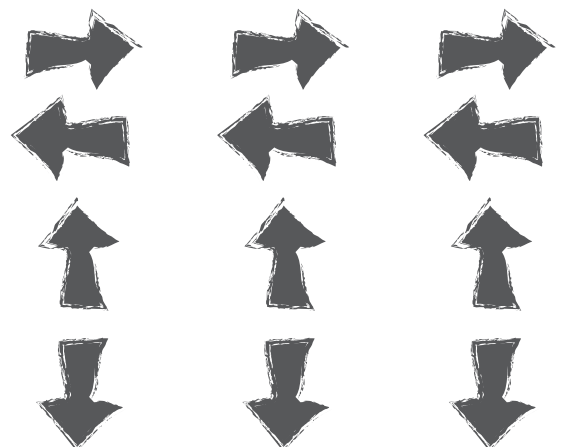
What should the Flurb do to get to the supplies?



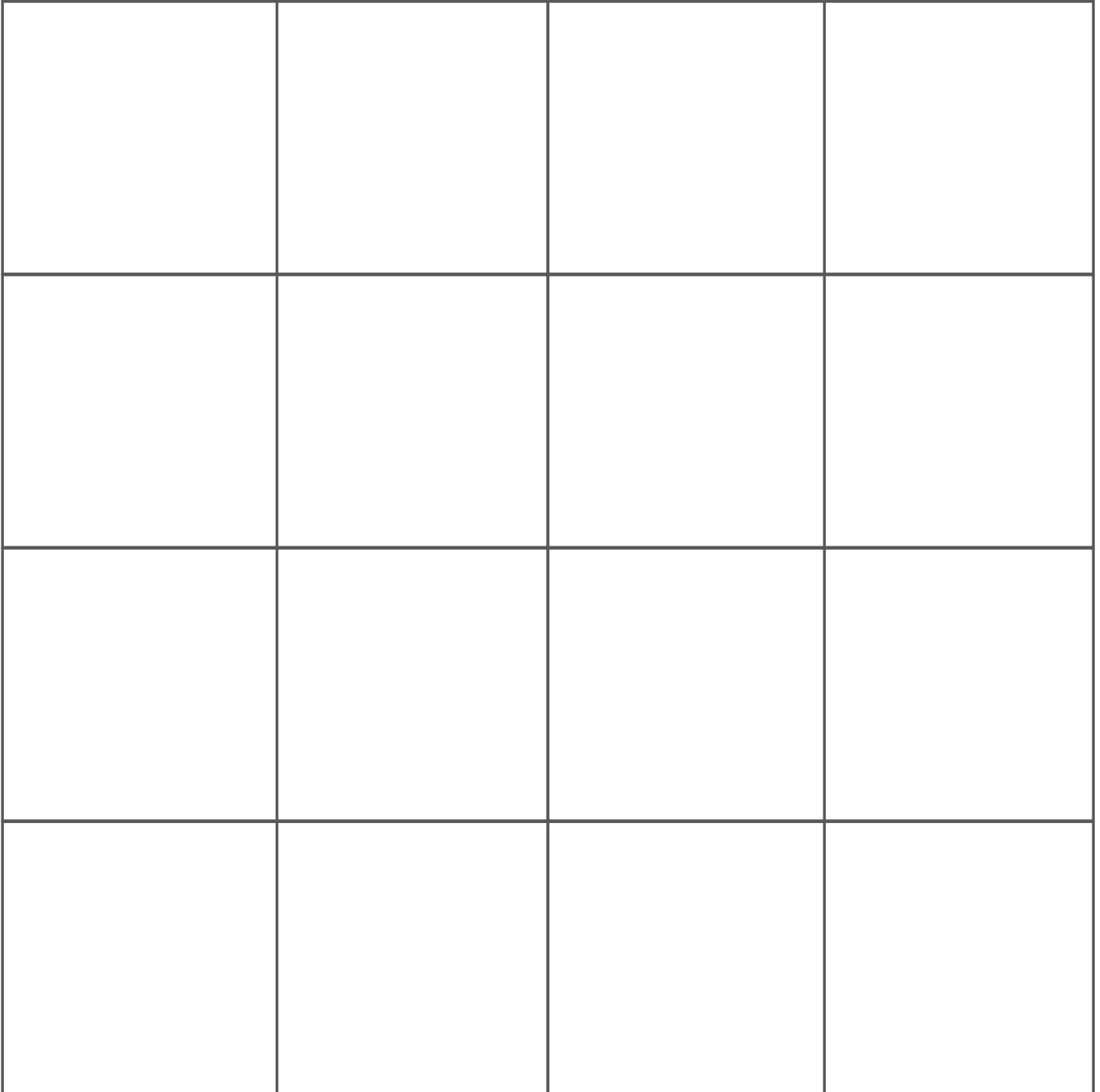
Revision 161003.1a



What should the Flurb do to get to the supplies?



Revision 161003.1a



Lesson 27: The Internet

Unplugged | Internet

Overview

Even though many people use the internet daily, not very many know how it works. In this lesson, students will pretend to flow through the internet, all the while learning about connections, URLs, IP Addresses, and the DNS.

Purpose

If you have been doing every lesson in this course, then each student in your classroom has used the internet...but how many know how it works? Learning more about the internet will help students develop a better understanding of its endless possibilities.

Agenda

Warm Up (20 min)

Vocabulary

Getting the Message

Main Activity (20 min)

The Internet

Wrap Up (15 min)

Flash Chat: What did we learn?
Journaling

Assessment (5 min)

Internet - Assessment

Objectives

Students will be able to:

- Learn about the complexity of sending messages over the internet.
- Translate URLs into IP Addresses.

Preparation

- Watch the **Internet - Teacher Video**.
- Print enough **IP Address Cards and Delivery Type Cards - Manipulatives** for each group.
- Print one **Internet - Assessment** for each student.
- Access to the internet (such as **get-site-ip.com**).
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

For the Teacher

- **The Internet** - Unplugged Video ([download](#))
- **Internet** - Teacher Video
- **IP Address Cards and Delivery Type Cards - Manipulatives**
- **Internet** - Assessment
- **Internet** - Assessment Answer Key

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **DNS** - The service that translates URLs to IP addresses.
- **DSL/Cable** - A method of sending information using telephone or television cables.
- **Fiber Optic Cable** - A connection that uses light to transmit information
- **Internet** - A group of computers and servers that are connected to each other.
- **IP Address** - A number assigned to any item that is connected to the Internet.
- **Packets** - Small chunks of information that have been carefully formed from larger chunks of information.
- **Servers** - Computers that exist only to provide things to others.
- **URL** - An easy-to-remember address for calling a web page (like www.code.org).
- **Wi-Fi** - A wireless method of sending information using radio waves.

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has several new and important words:

- **IP Address** - Say it with me: I-P Add-ress

A number assigned to any item that is connected to the Internet

- **DNS (Domain Name Service)** - Say it with me: D-N-S

The service that translates URLs to IP addresses

- **URL (Universal Resource Locator)** - Say it with me: U-R-L

An easy-to-remember address for calling a web page (like www.code.org)

- **Internet** - Say it with me: In-ter-net

A group of computers and servers that are connected to each other

- **Servers** - Say it with me: Ser-vers

Computers that exist only to provide things to others

- **Fiber Optic Cable** - Say it with me: Fye-ber Op-tic Cay-bl

A connection that uses light to transmit information

- **Wi-Fi** - Say it with me: Wye-Fye

A wireless method of sending information using radio waves

- **DSL/Cable** - Say it with me: D-S-L / Cay-bl

A method of sending information using telephone or television cables

- **Packets** - Say it with me: Pack-ets

Small chunks of information that have been carefully formed from larger chunks of information

💡 Lesson Tip

A quick preview is all you need here. These words will all be explained as part of the lesson, so it would be far less confusing to do a brief intro to the words as a "see if you can spot these during the day" type of heads-up.

Getting the Message

- It's quite likely that your students are aware of what the internet is, but they may not really understand what the internet does.

- Ask "What is the internet?"
- Is the internet a public place or a private place?
- (Truthfully, many people think it can be both, but it should be viewed as a public space no matter what settings you think you've mastered.)
- How does information get from place to place?

- Let's say that I want to look at the webpage for Code.org. What do you suppose the process would be like for me to send a message to request that page?
 - What do I do as a user?
 - What do you think happens inside the internet?

💡 Lesson Tip

There are some great YouTube videos on this subject that can make this lesson a little easier to understand. You can show them to the class in advance, or just watch them yourself. **Here is one of the videos in the Code.org video series on "How the Internet Works"**. (We recommend watching from 1:44 - 5:13, if possible.) The rest of the playlist is available [here](#).

Sending a message over the internet is a lot like sending a message through the mail...if every letter we sent required thousands of envelopes!

Every message we send through the internet gets chopped up and each piece is wrapped in its own version of an envelope. We call those "packets." Packets are specially formed chunks of information that are able to easily flow through any of the internet's channels.

Sometimes, a few of those packets will get lost, because the internet is a crazy place. In that case, the packets need to be resent, and the whole message has to get put on hold until they arrive.

Where do you think those packets are headed?

- Even if you're sending messages to another person, they first have to go to at least one "server."
 - A server is a special computer that is supposed to be always on and ready to send and receive information.
 - Every website has a server.
 - Even email goes through servers.

Servers don't have names like you and I do. They're actually addressed using numbers. These numbers are called IP addresses, and they look a little strange.

- For example: One of Code.org's IP addresses used to be 54.243.71.82
 - (Please be sure to check this out in advance. Most IP addresses change from time to time and they are then reused for other sites.)

There are many ways to reach the internet from your house, school, or place of business.

- You can connect directly using a cable (that might be DSL, Cable, or Fiber Optic)
- Or you can connect using radio waves over the air through Wi-Fi

Direct connections are most reliable, but they can be inconvenient.

- Can you figure out why?
 - (You have to be attached to a cable!)

Wi-Fi connections are super convenient, but they aren't always reliable.

- Can you figure out why not?
 - (Radio waves bounce all over the place and can get lost.)

So, if you're used to sending information to URLs (like **www.code.org**) and the servers actually have IP addresses for names (like 54.243.71.82) how does the Internet change from one to the other? That's what the DNS is for. The DNS (Domain Name Server) has tables that allow the system to go back and forth between URLs and IP addresses. If the Domain Name Servers ever stopped working, it would shut down the internet as we know it!

Lesson Tip

If you're thinking that this is a lot of text and it would be extremely boring to try to lecture this to a class full of elementary school kids, you're absolutely right! If you're unable to show a YouTube video in class to help explain it all, I highly recommend drawing pictures to explain each idea above, or choosing students as volunteers to act out what you describe while you're explaining. They're not expected to get every detail and definition at this point, only to gain exposure.

With that said, let's try to understand what the DNS does by making a little DNS table ourselves.

Pull out a piece of paper and draw a grid similar to that in the internet activity:

Sample of DNS Table:

#	URL	IP Address
1	code.org	54.243.71.82
2		
3		
4		
5		

First, we need to fill in this table.

- Survey the class for their favorite websites and write the URLs in the left column
- Use a site like **get-site-ip.com** to find the IP addresses for those sites and write them in the corresponding rows of the right column.

Now let's take this DNS Table and pretend to send messages through the internet!

Main Activity (20 min)

The Internet

Directions:

- Create your own DNS table, similar to what is shown above.
- Have the class help you fill in the blank spots in the table. Pick your favorite URLs and find their IP addresses using a site like **www.get-site-ip.com**.
- Divide into groups of 3 to 5.
- Assign each group an IP address from the newly created table, and assign each person in the group a position:
 - The Message Writer
 - The Internet
 - The Server (carries the IP address)
 - The Return Internet (optional)
 - The Message Receiver (optional)
- Each group will draw an **IP Address Cards and Delivery Type Cards - Manipulatives** to find out where their message is going and what their method of message delivery (Wi-Fi, Cable/DSL, or Fiber Optic Cable) will be.
- The Message Writer will craft a note to send to the server.
- The Internet will rip the message up into 4 small pieces called packets, then deliver each packet one at a time to the Server with the IP address that was drawn from the IP Address Card stack.
- The Server will make sure that the message arrives in order, then will send each packet off one at a time with the Return Internet (can be the same person or different person than the original Internet).
- The Return Internet will deliver each piece back to the Message Receiver (can be the same person or different person than the Message Writer) and put it back together.
- The Message Receiver will wait for all of the pieces to arrive, then read the message to be sure it arrived correctly!

Rules:

- The Internet must rip the message into exactly four packets.
- If the Internet drops a packet, they have to pick it up and go back to the start to deliver it again.
- The server has to wait for all of the message pieces to arrive before it can begin to send the message along.

Info:

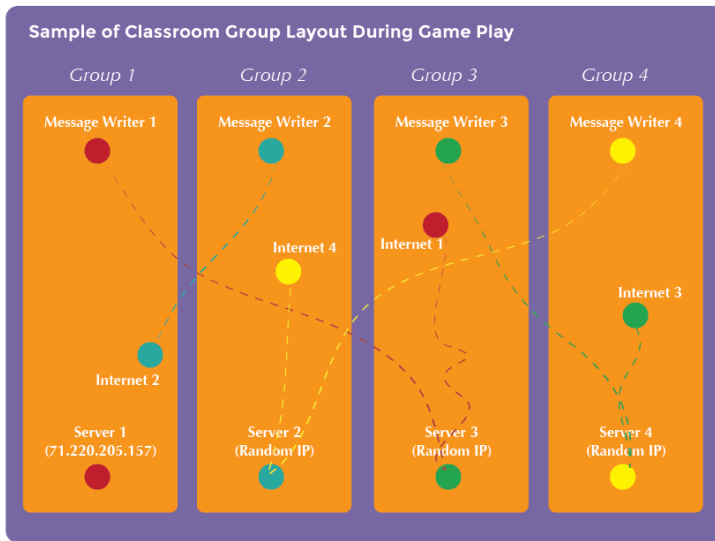
- Wi-Fi: Convenient, but spotty. Wi-Fi doesn't require cables, but since the signal bounces all over the place, packets can get lost pretty easily.
 - Simulation: Internet must carry each packet on their shoulder (no hands).
- Cable/DSL: Fairly good at delivering messages, but you must be connected to a wire.
 - Simulation: Internet must carry each packet on the back of one hand and must keep the other hand touching a wall, desk, chair or the floor at all times.
- Fiber Optic Cable: The best at delivering messages, but you must be connected to a wire.
 - Simulation: Internet can carry packets in hand, but must keep the other hand touching a wall, desk, chair or the floor at all times.

To play this game, you can have your groups cluster anywhere, but for the first time it can be less confusing to have groups play in a line.

- Line up the "Servers" on one end of the room (holding their IP addresses). The Return Internet players can be over there as well (if you have that many people in each group).
- Have the everyone else line up across from their server at the other side of the room.
- The Message Senders will likely be sending their messages to a server other than their own, so the Internet players will likely cross over from group to group. It may look something like the diagram below (in English):

💡 Lesson Tip

If it feels like there are too many rules to explain outright, feel free to post them on the board and just explain the game as you go. You can play multiple rounds until the class really understands.



Wrap Up (15 min)

Flash Chat: What did we learn?

- What kind of connection would you rather have (Wi-Fi, DSL/Cable, or Fiber Optic)? Why?
- Why might it take your message a long time to get somewhere?

💡 Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What's something you learned about the internet today?
- Why is learning about the internet important?

Assessment (5 min)

Internet - Assessment

Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

CSTA K-12 Computer Science Standards

- ▶ NI - Networks & the Internet



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Directions:

- 1) Create your own DNS table, similar to what is shown here.
- 2) Have the class help you fill in the blank spots in the table.
Pick your favorite URLs and find their IP addresses using a site like www.getip.com.
- 3) Divide into groups of 3 to 5.
- 4) Assign each group an IP address from the table, and each person in the group a position:
 - * The Message Writer
 - * The Internet
 - * The Server (carries the IP Address)
 - * The Return Internet (Optional)
 - * The Message Receiver (Optional)
- 5) Each group will draw an IP address Card and a Delivery Card to find out where their message is going and what their method of message delivery (Wi-Fi, Cable/DSL, or Fiber Optic Cable) will be.
- 6) The Message Writer will craft a note to send to the server.
- 7) The Internet will rip the message up into small pieces called packets, then deliver each packet one at a time to the Server with the IP address that was drawn from the IP address Card stack.
- 8) The Server will make sure that the message arrives in order, then will send each packet off one at a time with the Return Internet (can be the same person or different person than the original Internet).
- 9) The Return Internet will deliver each piece back to the Message Receiver (can be the same person or different person than the Message Writer) and put it back together.
- 10) The Message Receiver will wait for all of the pieces to arrive, then read the message to be sure it arrived correctly!

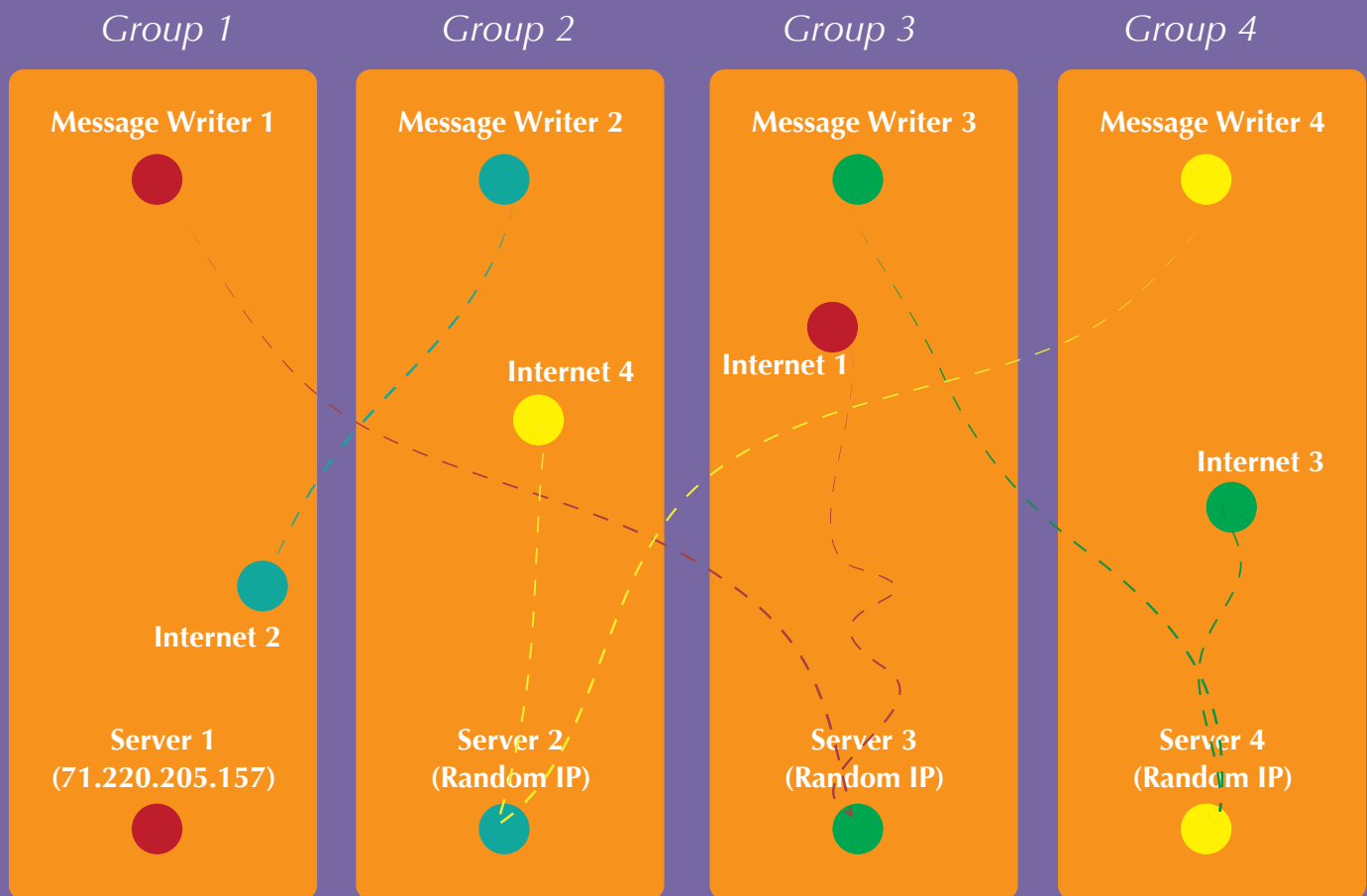
Rules:

- 1) The Internet must rip the message into exactly four packets.
- 2) If the Internet drops a packet, they have to pick it up and go back to the start to deliver it again.
- 3) The server has to wait for all of the message pieces to arrive before it can begin to send the message along.

Sample of DNS Table

#	URL	IP ADDRESS
1	www.code.org	
2		
3		
4		
5		

Sample of Classroom Group Layout During Game Play



**These cards correlate with numbered entries in the DNS Table.
(You should make one distinct row for each group.)**

1

2

3

4

5

6

These cards correlate with different methods of delivering messages over the Internet.
(Print enough to have one card for each group.)

Wi-Fi

Fiber Optic

DSL

Cable

Types:

- 1) **Wi-Fi:** Convenient, but spotty. Wi-Fi doesn't require cables, but since the signal bounces all over the place, packets can get lost pretty easily.
Simulation: *Internet must carry each packet on their shoulder (no hands).*
- 2) **Cable/DSL:** Fairly good at delivering messages, but you must be connected to a wire.
Simulation: *Internet must carry each packet on the back of one hand and must keep the other hand touching a wall, desk, chair or the floor at all times.*
- 3) **Fiber Optic Cable:** The best at delivering messages, but you must be connected to a wire.
Simulation: *Internet can carry packets in hand, but must keep the other hand touching a wall, desk, chair or the floor at all times.*

The Internet

How the Internet Does What it Does



The DNS has gone out, and now you're in charge of delivering information all over the Internet! Use the DNS Look-Up Table to figure out where each packet is supposed to go.

DNS Look-Up Table

#	URL	IP ADDRESS
1	code.org	54.243.71.82
2	csisfun.com	100.42.50.110
3	thinkersmith.org	64.14.68.10
4	light-bot.com	54.209.61.132
5	khanAcademy.org	23.23.224.106

Draw a line from each packet to the server where it is supposed to be delivered. The first one has been done for you.

This message is being delivered from someone at code.org to someone at thinkersmith.org. Draw the path that the message is likely to take.

Lesson 6: It's Great to Create and Play Fair

Overview

Loaned to Computer Science Fundamentals by the team over at Copyright and Creativity, this lesson exists to help students understand the creative process of sharing and inspiration. Along with that comes the promotion of creative expression and the need to be fair with creative work.

Purpose

Students will soon be creating projects to share and most of these projects will contain either code or imagery that students did not create themselves. This lesson is here to show students the proper way to handle the use of content that is not their own.

Agenda

Warm-Up (Optional) (15 min)

Create Your Own Superhero! (15 min)

Wrap-Up

Journaling

Extended Learning

Objectives

Students will be able to:

- Explain why it is not okay to claim that someone else's work is your own.
- Create original art for the purpose of empathizing with other creators.

Preparation

- Review the original **It's Great to Create and Play Fair - Lesson Plan** lesson plan
- Watch the **It's Great to Create and Play Fair (Video) - Video**
- Prepare drawing/painting materials for main activity

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **It's Great to Create and Play Fair - Lesson Plan**

For the Students

- **It's Great to Create and Play Fair (Video) - Video**

Teaching Guide

Warm-Up (Optional) (15 min)

Watch: Play the **It's Great to Create and Play Fair (Video) - Video** with your students. You can play it several times throughout this lesson.

The following discussions are designed to create context, help students engage with the topic, and prepare them for the lesson discussion.

Character Sketch

Ask students to help you create a character sketch about one of the characters in the video.

Say: We're going to do a character sketch where we decide who this person is.

Discuss: Which one of the characters should we use? Let's vote. [Take a quick vote.]

Write the character sketch on the board as students contribute ideas. Prompt with questions:

- Who is this character?
- What is his/her name?
- Who are his/her friends? How long have they known each other?
- Who are the people in his/her family? What are they like?
- What is his/her backstory?
- Where does he/she live?
- Has he/she lived there all his/her life or has he/she moved from somewhere else?
- What exciting thing might have happened to him/her back in kindergarten, first grade?
- What does he/she look forward to?
- What is he/she afraid of?

Teaching Tip

Encourage students to be as creative as they can. There are no wrong answers. Give this character a life of his/her own.

Create Your Own Superhero! (15 min)

Display: If possible, show images of two or three superheroes on the board.

Discuss: Discuss the stories of these characters. What are their super powers? What do they use their powers for?

(Other ways to tie the activity into the lesson: Have students classify superpowers into like groups, list similarities and differences between superheroes, or discuss the character traits and back stories of the superheroes.)

Activity: After discussion, ask your students to draw their own superhero character.

Discuss: When they are finished, discuss what they created:

- What did you create?
- What inspired your character?
- What makes your superhero different from or better than any other?
- How is yours similar to other superheroes?
- Have you ever seen a movie or played a video game that made you want to make something?

Say: I'm going to play a short video. As you watch the video, think about how you would feel if this situation happened to you. What would you do? **Watch:** Play the **It's Great to Create and Play Fair (Video) - Video** with your students.

Discuss: It's great to create. And, it's great to recognize how others' creations inspire our new creations. We want to be fair when we're using each other's creative work.

- What did you think about that situation? What was going on?
- These students combined their work to make something new — the t-shirt.
- What would you do in that situation?
- Did these friends treat each other fairly?
- What if she had wanted to add a ballerina tutu or big boots or glasses to the dragon?
- Do you think the boy would have liked that?
- Do you think that would be fair?
- How would you have felt?

Wrap-Up

Creating new things is fun — art, music, movies, paper creations, structures, even buildings! It's great to create and share and be inspired — as long as we respect each other as artists and play fair.

Journaling

Give the students a journal prompt to help them process some of the things that they encountered during the day. You can choose one of the prompts below, or make up your own.

Journal Prompts:

- Draw a feeling face in the corner of your journal page
- Think of a superhero that one of your classmates made. Can you draw your own picture of that superhero? Give proper credit to your classmate as the creator of the original version.

Extended Learning

Please be sure to visit [Copyright & Creativity](#) to find more lessons on digital sharing and creative rights.

Standards Alignment

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- ▶ **SL** - Speaking & Listening

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming



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Lesson 1: Move It, Move It

Overview

This lesson will work to prepare students mentally for the coding exercises that they will encounter over the length of this course. In small teams, students will use physical activity to program their classmates to step carefully from place to place until a goal is achieved.

Purpose

By using physical movement to program their classmates, students will run into issues and emotions similar to what they will feel when they begin coding on a computer. Encountering those stresses in a playful and open environment will help to alleviate intensity and allow students to practice necessary skills before they run into problems on their own.

Agenda

Warm Up (20 min)

Where did I go wrong?

Activity: Move It, Move It (20 minutes)

Wrap-up (10 min)

Journaling

Extended Learning

Objectives

Students will be able to:

- Define a list of steps (algorithm) to get a friend from their starting position to their goal
- Translate a list of steps into a series of physical actions
- Identify and fix errors in the execution of an algorithm

Preparation

- Watch the **Teacher Video - Move it, Move it**
- Print (or otherwise prepare) one **Move It, Move It Teacher Debugging Puzzle - PDF** for displaying to the class
- Print one **Move It, Move It: Debugging - PDF** for each group of 2-3 students
- Print one **Move It, Move It: Activity - pdf** for each group of 2-3 students
- Prepare blank papers to fill out the rest of the walking grid (4-7 needed per group)

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Move It, Move It Teacher Debugging Puzzle - PDF**
- **Teacher Video - Move it, Move it**

For the Students

- **Move It, Move It: Activity - pdf**
- **Move It, Move It: Debugging - PDF**

Vocabulary

- **Algorithm** - A precise sequence of instructions for processes that can be executed by a computer
- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Frustrated** - Feeling annoyed or angry because something is not the way you want it.
- **Persistence** - Trying again and again, even when something is very hard.

Teaching Guide

Warm Up (20 min)

Where did I go wrong?

Goal: In this lesson, we want to help students learn to identify and fix bugs in their own programs. The easiest way to do that is to first present students with a program that contains bugs that are not their fault. Once they've helped you fix "your" program, share with them how frustrating it can be to make mistakes, and help them see that those feelings are completely normal and they shouldn't feel embarrassed by them.

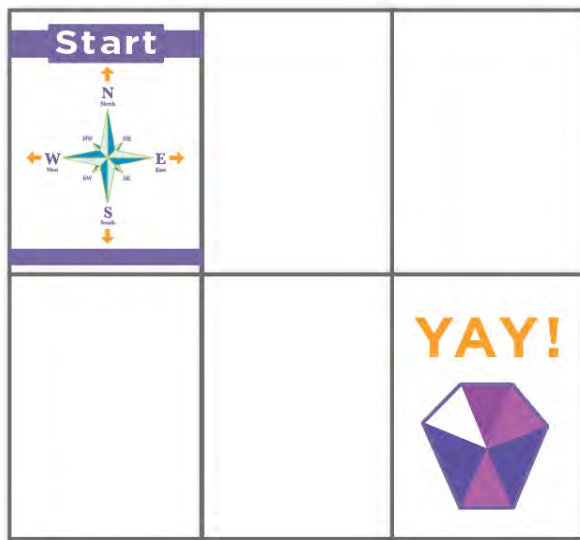
Display: Put an image of **Move It, Move It Teacher**

Debugging Puzzle - PDF up on the screen where everyone can see it.

Teaching Tip

If your class has not already learned cardinal directions, it will be worth covering them before they begin Course B. This conversion will come in handy for nearly all of the online puzzles aimed at first grade, as well as several of the unplugged activities.

Let students know that they will continue to see those directions in the online programs next to the direction arrows.



Move East →

Move East →

Move North ↑

Discuss: Get the attention of the class and let them know that you are stuck! You have this challenge, and you thought you had solved it, but it doesn't seem to be working. Your program has a bug, can they help you fix it?

Take a moment to walk them through the rules: - Start at the compass rose - Follow the instructions step-by-step - End at the happy face

Optional: Walk through your program using your fingers on top of the map, under the document camera. Express frustration when your fingers end up off the map, instead of at the treasure.

Think: My program says "East, East, North". Can you figure out why my program doesn't work?

Pair: Let students work together to see if they can figure out what the program is supposed to say.

Share: Ask students if anyone was able to figure out a way to solve the problem. When you get a correct answer, let the students know that they are great at "debugging"!

Discuss: Ask the students if they could tell how you were feeling when you couldn't figure out the answer. They might suggest that you were "mad" or "sad". Instead of telling them "no", describe that you were feeling a little bit mad, a little bit sad, and a little bit confused. When you put all of those emotions together, it makes a feeling called "frustration". When you are "frustrated" you might think you are mad, sad, or confused -- and you might be tempted to give up -- but frustration is a natural feeling and it's a big hint that you are about to learn something! Instead of quitting, practice persistence. Keep trying over and over again. After a few times, you will start to understand how to debug your problems!

Distribute: To make sure that students understand the idea of finding and fixing errors (debugging) pass out the **Move It, Move It: Debugging - PDF** and have students complete the task in pairs.

Optional: If you want to move the activity along more quickly, feel free to complete these as a class, instead.

Transition: Now it's time to play the game!

Activity: Move It, Move It (20 minutes)

Distribute: Hand each group of 2-3 students a packet of Move It, Move It maps, as well as the blank papers for the grid on the ground. Allow students to either cut the halves of each map apart, or fold the sheets in half so that each map is clearly visible (without distraction.)

Set-Up: In each group, each player will get a task.

- Player 1: Choose/set-up the map to play
- Player 2: Programmer
- Player 3: Walking Machine

Directions for Class:

- 1) Decide who will take each job.
- 2) Have player 1 set a grid on the floor made up of pieces of paper (as shown on one of the Move It Maps) except with the gem
- 3) Player 3 will start by standing on the page with the compass rose.
- 4) Player 2 will then guide player 3 step-by-step through the paper maze using the provided arm signals.
- 5) When player 2 gives the signal to "STOP", player 3 will flip over the page that they are on. If that page is a gem, then the
- 6) If there is time, let everyone rotate positions and go again!

Note that the rules are not the most important thing here. Feel free to clarify if the students have questions, but if the students are playing a bit differently than described, you don't need to hold them to the letter of the game. The crucial bit is that they are moving from immediate instructions to giving two or three instructions before the Walking Machine moves.

Wrap-up (10 min)

Journaling

Give the students a journal prompt to help them process some of the things that they encountered during the day. You can choose one of the prompts below, or make up your own.

Journal Prompts:

- Draw a feeling face in the corner of your journal page
- What were the four directions on the compass rose?
 - What tricks can we use to remember North, South, East and West?
- Draw another way we could we have given instructions without using our arms
- Draw your favorite part about that game

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

X's and O's

- Draw a tic-tac-toe board for the class.
- Place a single X and a single O somewhere on the board.
- Ask the class if they can get the X to the O using arm gestures as a class.

Content Corner

For more on persistence and frustration, try reading **Stevie and the Big Project** to your students. It will help them spot moments of frustration. It will also help give them the tools to deal with it.

If you do not read the book, take a moment to cover tips on frustration and persistence as a class:

Tips to Help With Frustration

- Count to 10
- Take deep breaths
- Journal about them
- Talk to a partner about them
- Ask for help

Tips for Being Persistent

- Keep track of what you have already tried
- Describe what is happening
- Describe what is supposed to happen
- What does that tell you?
- Make a change and try again

Teaching Tip

Here are some useful links in case your class hasn't yet talked about the compass rose and cardinal directions:

- **The Cardinal Directions Geography Song**
- **Cardinal Direction Mnemonics Lesson**

X's, O's, and Arrows

- Similar to the activity above, but have the students write their programs in advance using arrows instead of hand gestures.
 - This can be done in groups.
 - Groups can share their solutions for the class.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ CC - Counting And Cardinality
- ▶ G - Geometry
- ▶ MP - Math Practices

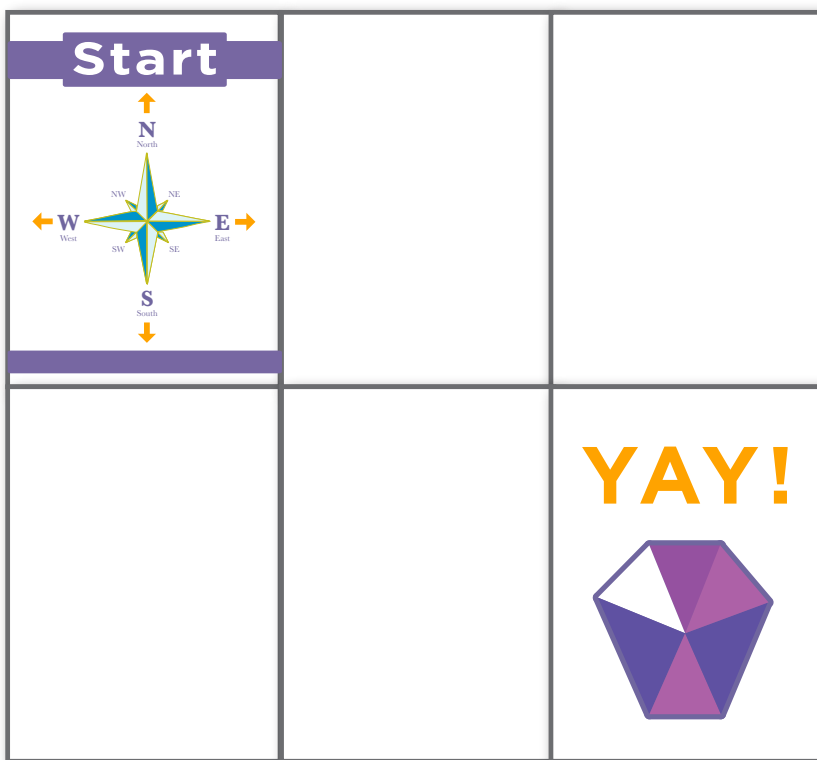
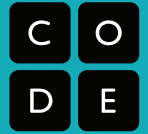


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Move It Move It

Debugging



Move East



Move East



Move North





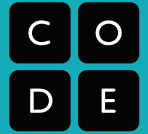
Unplugged

Name: _____

Date: _____

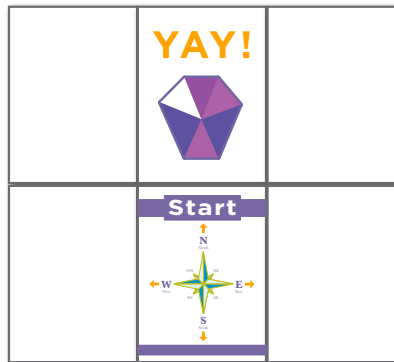
Move It Move It

Debugging



Each of these algorithms has a mistake. Can you find the mistake and cross it out?

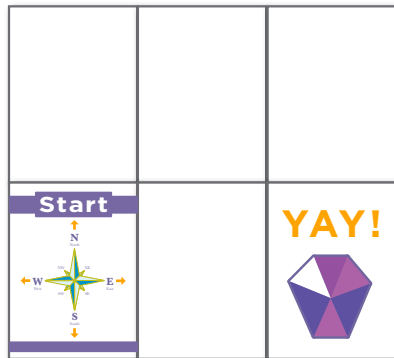
1)



Move North 

Move North 

2)

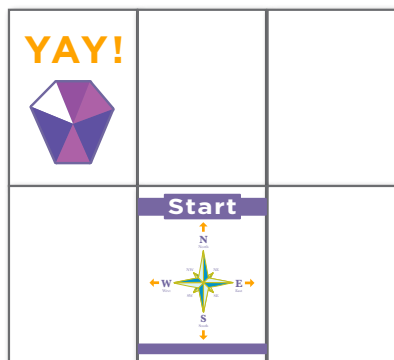


Move East 

Move North 

Move East 

3)



Move South 

Move East 

Move South 



Unplugged

Name: _____

Date: _____

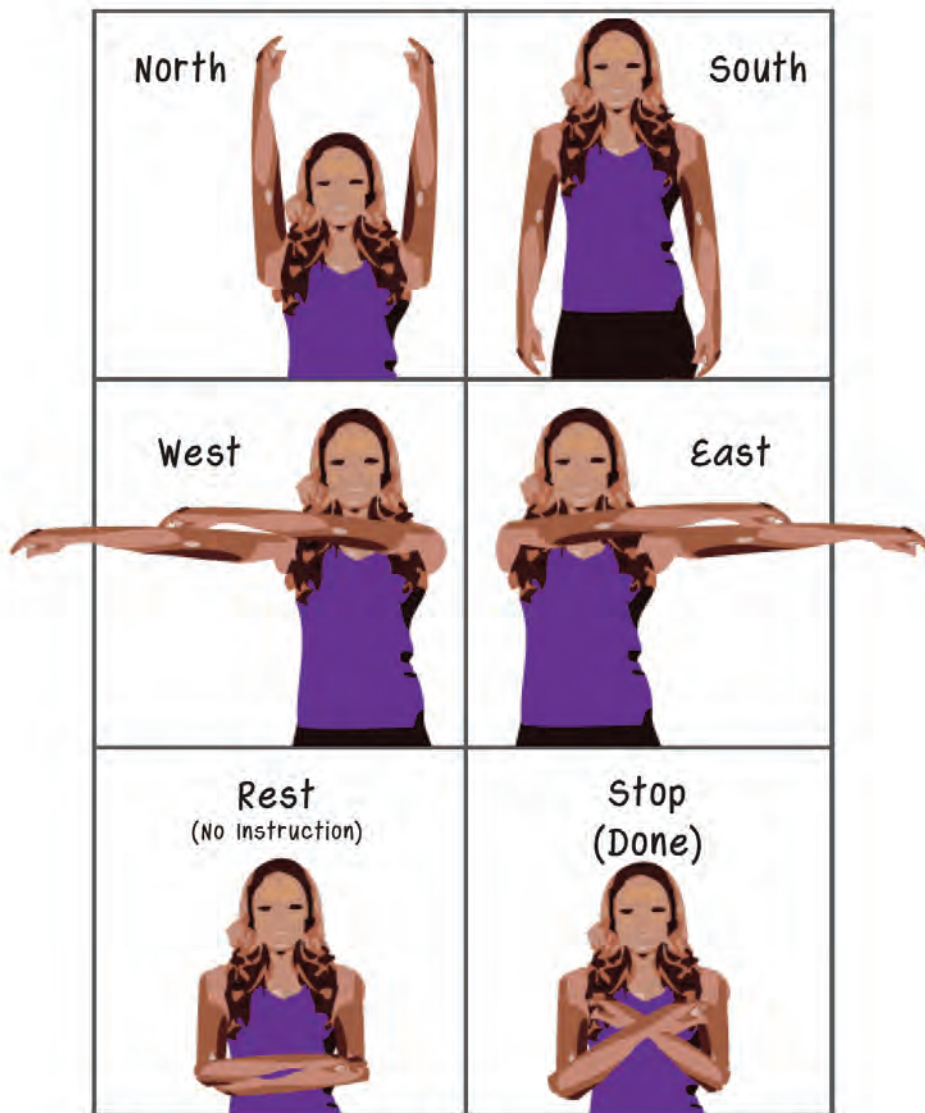
Move It, Move It

Multi-Step Adventure Activity Key

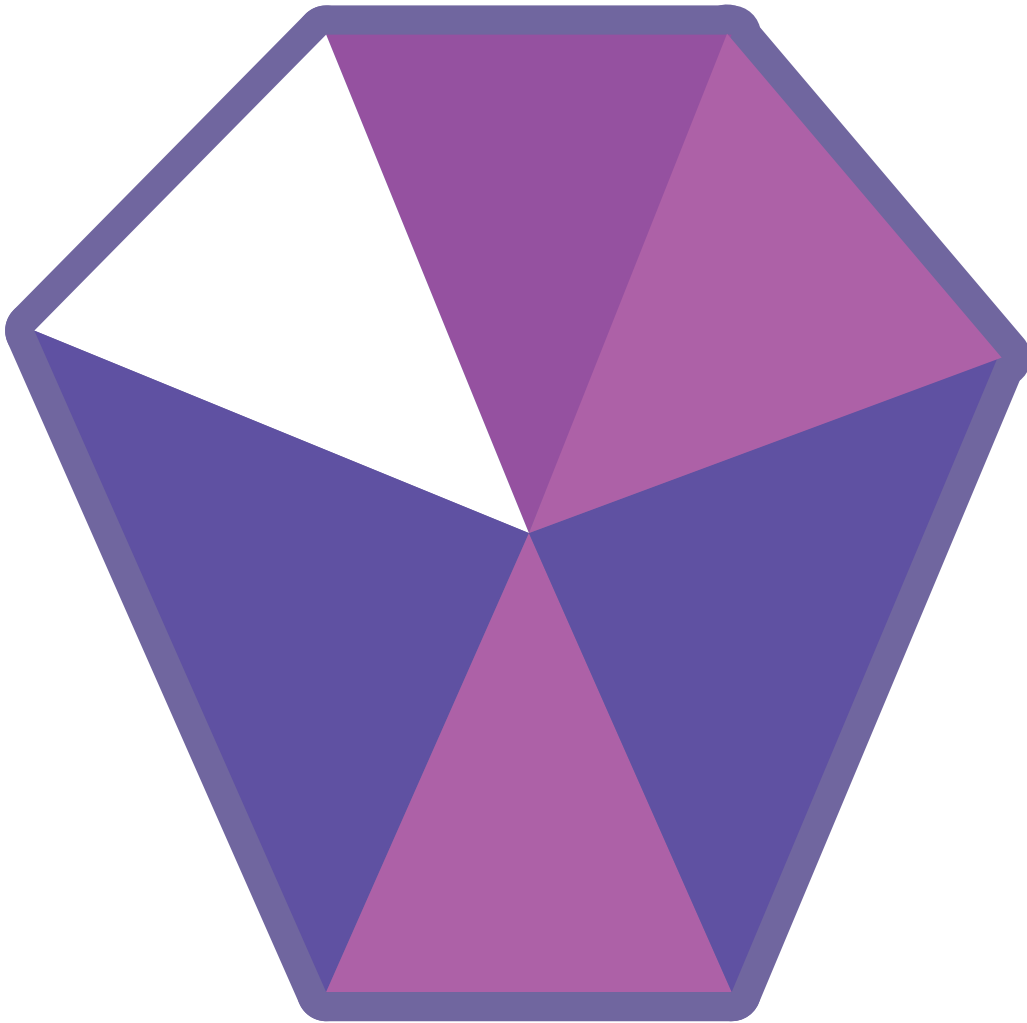


These are the moves that you can do to help guide your friend.

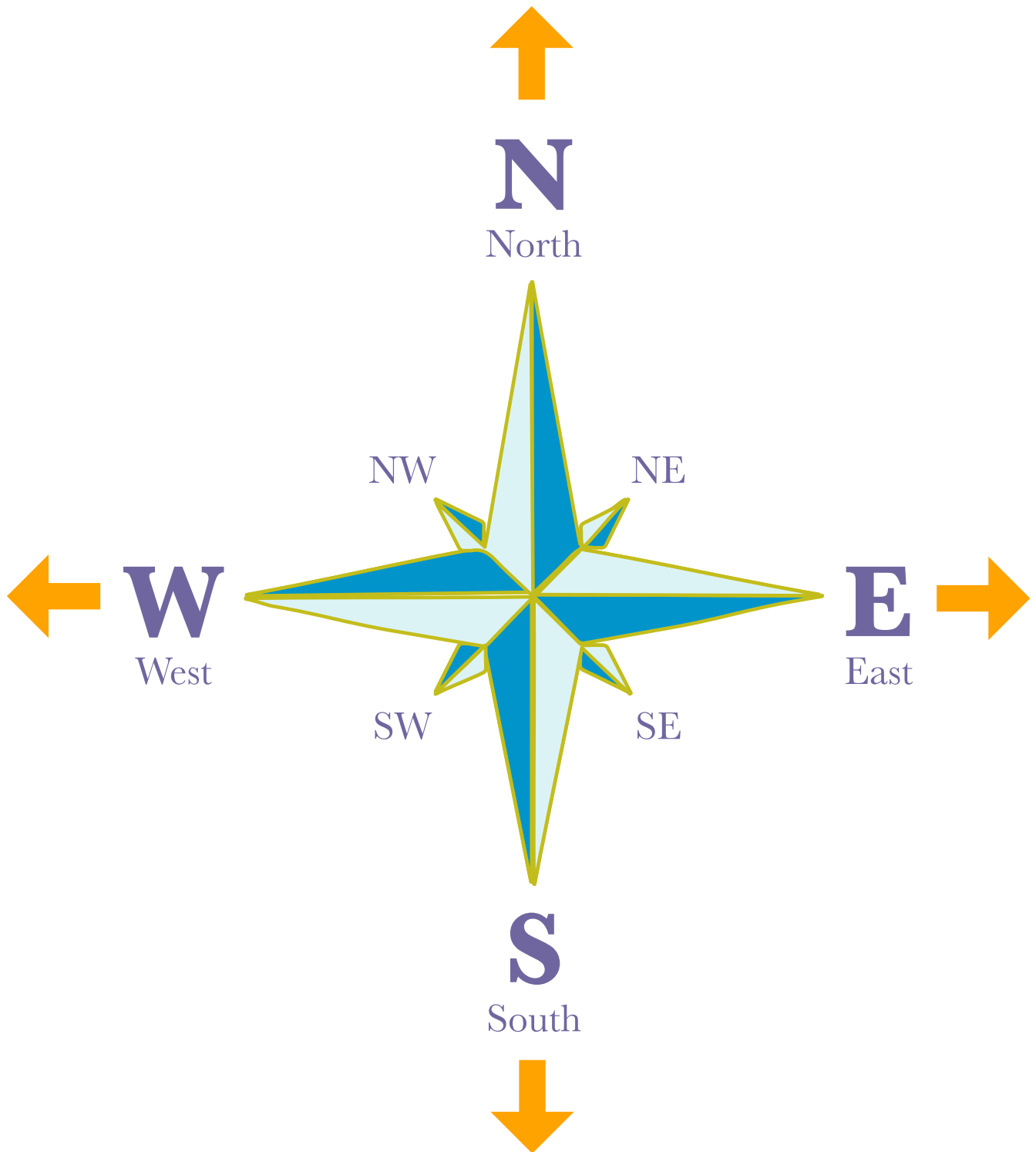
Practice a few times to be sure that you both understand what each move does.



YAY! !

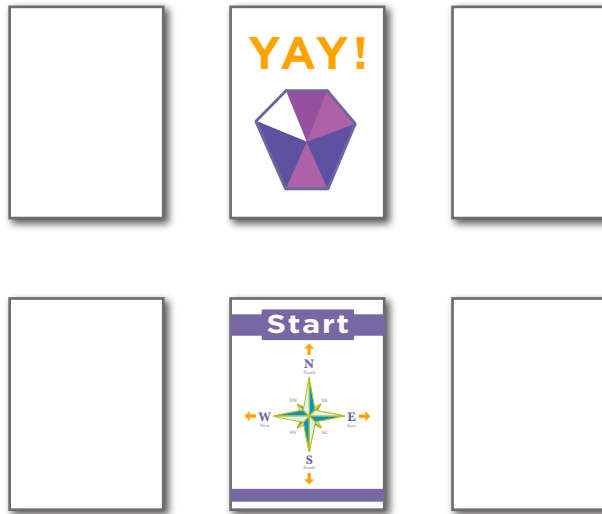
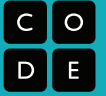


Start



1

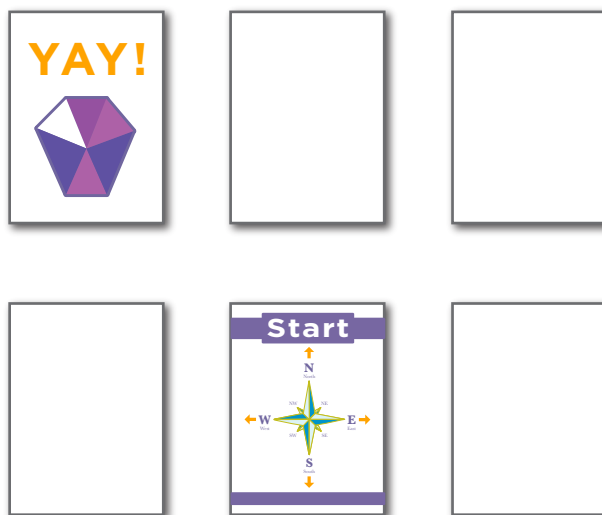
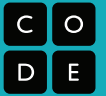
Move It Map 1



Revision 180417.1a

2

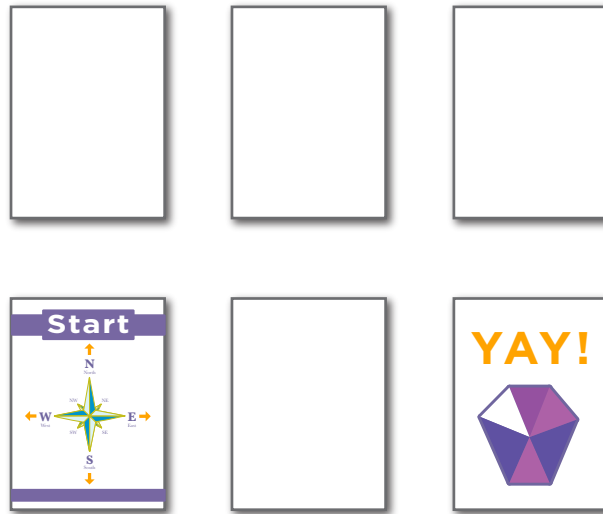
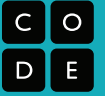
Move It Map 2



Revision 180417.1a

3

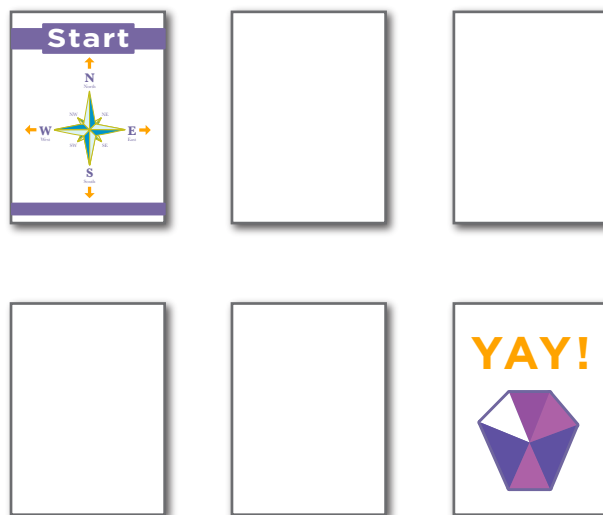
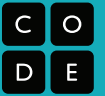
Move It Map 3



Revision 180417.1a

4

Move It Map 4



Revision 180417.1a

Lesson E.6/F.6: My Loopy Robotic Friends

Unplugged | Loop | Repeat

Overview

Building on the initial "My Robotic Friends" activity, students learn to use loops when programming their robots in order to build bigger structures more efficiently.

Purpose

This lesson serves as a reintroduction to loops, using the now familiar set of "robot" programming instructions. Students will develop critical thinking skills by looking for patterns of repetition in the movements of classmates and determining how to simplify those repeated patterns using loops.

Agenda

Warm Up (10 min)

My Robotic Friends Review

Activity (30 min)

Introduction and Modeling

Looping Your Robots

Wrap Up (5 min)

Flash Chat / Journaling

Extension Activities

Objectives

Students will be able to:

- Identify repeated patterns in code that could be replaced with a loop
- Write instructions that use loops to repeat patterns

Preparation

- Make sure each student has a **Think Spot Journal - Reflection Journal**
- Watch the **My Loopy Robotic Friends - Teacher Video**
- Prepare a stack of 20 paper cups for each group of 4 students
- (Optional) Print out one **My Loopy Robotic Friends Packet - PDF** per group of 4 students

OR

- Display the **My Robotic Friends - Symbol Key** where students can reference throughout the lesson.
- Print and cut out **Paper Trapezoid Template - Manipulatives** for each group if your class is not going to use cups.
- Print out one set of **Stacking Cup Ideas - Manipulatives** per group.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **My Loopy Robotic Friends - Teacher Video**

For the Students

- **My Loopy Robotic Friends Packet - PDF**

Vocabulary

- **Loop** - The action of doing something over and over again.
- **Program** - An algorithm that has been coded into something that can be run by a machine.
- **Programming** - The art of creating a program.
- **Repeat** - Do something again

Teaching Guide

Warm Up (10 min)

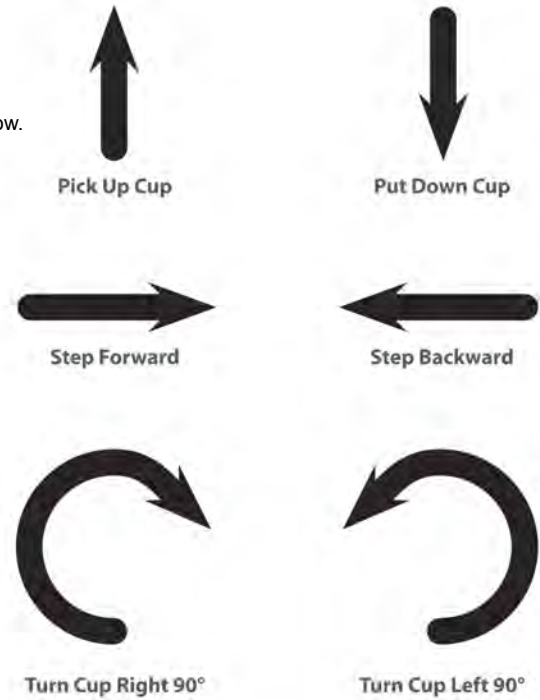
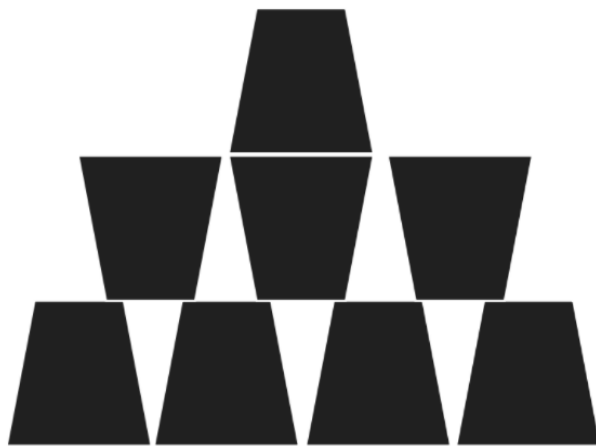
My Robotic Friends Review

Goal: This review will refresh the students' minds about how quickly programs for the "My Robotic Friends" activity can get intense.

Display: Show the **My Robotic Friends - Symbol Key** that we used in My Robotic Friends. For each of the six symbols, ask students to show you what it looks like for a robot to follow that instruction.

Model: With the class together as a group, pull an easy puzzle from the "My Robotic Friends" Cup Stack Pack and program together as a reminder of rules and terminology.

Next, pull a puzzle that's slightly harder, but also requires a lot of steps like the one below.



Volunteer: Ask a volunteer (or a group of volunteers) to come forward to help program this one on the board. If you make them stick strictly to the "no symbols other than those on the key" rule, it will probably take a while!

Display: Now, bring up this image:



What is the reaction of the class?

Prompt Give students the opportunity to brainstorm shorter ways to relay the code that they're about to create. (This bit can be skipped over if your students start saying things like: "Move forward 6 times." Since that will open the discussion about how to show "six times" with symbols.)

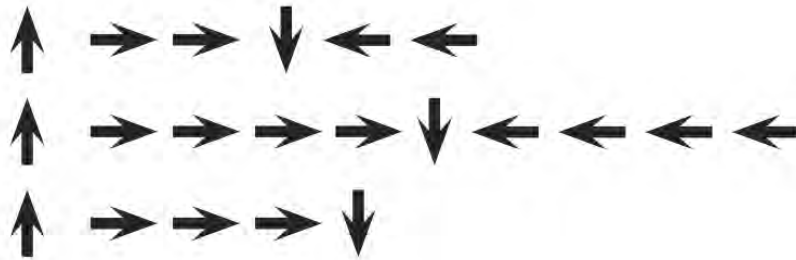
Once students have put together the idea of "repeating" code, give them the vocabulary around it. Make sure to share with them that the terms "repeat something" and "loop something" are often used interchangeably.

Activity (30 min)

Introduction and Modeling

Set Up: Have stacks of cups or cut paper trapezoids available for groups.

Display: Take the program from one of your previous cup stacks and display it for the class, or use the one below.

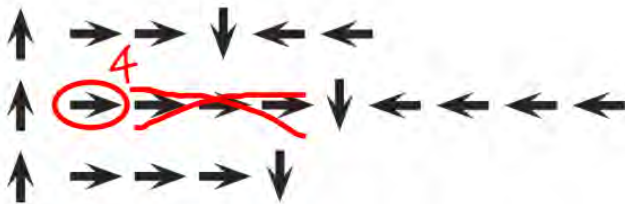


Think: Ask students to think quietly about where in this program they can find a pattern of instructions that repeat uninterrupted (one repetition after another).

Pair: Turn to a neighbor and share one of the repeating patterns you found.

Share: Ask a few students to share out the patterns they identified. Try to pull out different approaches to grouping patterns. For each pattern, ask students to identify how many times the pattern repeats.

Model: Using one of the repeating patterns that the class identified, model how to circle the instruction or pattern that repeats, write the number of loops near that circle, then cross out the rest of the arrows.



Repeat this until the entire program has been shortened, then re-write the program in a way where students can see how much more simple the resulting instructions are.

Looping Your Robots

Group: Place students into groups of 4. Each group should then further break down into two pairs - each pair will develop their own program for the other pair to "run".

Distribute: Give each group one stack of cups or paper cutouts.

Display: Show **Stacking Cup Ideas - Manipulatives** to the class or hand out individual copies for groups to use. Have each pair (not group) choose which idea they would like their robot to do. Encourage pairs to select a more complicated pattern this time around.

🔗 **Discuss:** Let each group discuss how the stack should be built, then instruct each group to translate the algorithm into the symbols. Make sure each group writes down the program somewhere for the "robot" to read later. As students are working on their programs, remind them to be on the lookout for opportunities to replace a repeating pattern with a loop.

Do: When groups have finished their instructions, have each pair take turns "running" their code with another pair. Remind students to be on the lookout for bugs in their code, but not to interrupt a robot until it's finished running the program.

Discuss: When all of the pairs have had a chance to run their programs, ask a few to share their solutions with the class. Use this opportunity to discuss how groups came up with different solutions to the same puzzle. In particular, you might ask of each program:

- How did they identify the loops?
- Are there other ways those loops could have been written?
- How much shorter is the program with loops than it would be without?
- Is the program easier to understand with loops or written out longhand? Why?

Wrap Up (5 min)

Flash Chat / Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and help to build a review sheet for them to look at in the future.

Flash Chat:

Here are some possible topics:

- Do you feel like loops make programming easier or harder?
- What other kinds of things in life do we repeat?
 - Eating - put food in mouth, chew 20 times
 - Brushing hair - brush through hair 35 times
 - Routines - Wake up, go to school, come home, go to bed
- Write or draw something in your journal that will remind you later what loops are.
 - What does "repeat" mean to you?
 - Draw a picture of you repeating something.

Extension Activities

- Have students draw their own cup stacking creations for someone else to code.
- Provide students with algorithms that utilize repeats, then have them expand the program back out to a full step-by-step version.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ MP - Math Practices
- ▶ OA - Operations And Algebraic Thinking

CSTA K-12 Computer Science Standards

- ▶ AP - Algorithms & Programming

Next Generation Science Standards

- ▶ ETS - Engineering in the Sciences

Teaching Tip

Looking for Loops: Be sure to keep your eyes open for students using loops. Try to avoid correcting their overall algorithms or prescribing a solution, but feel free to direct students towards patterns that could be shortened using a repeat circle.

Watch students as they run through the code. Are there any bugs? Use the debugging questions to help them find a solution.

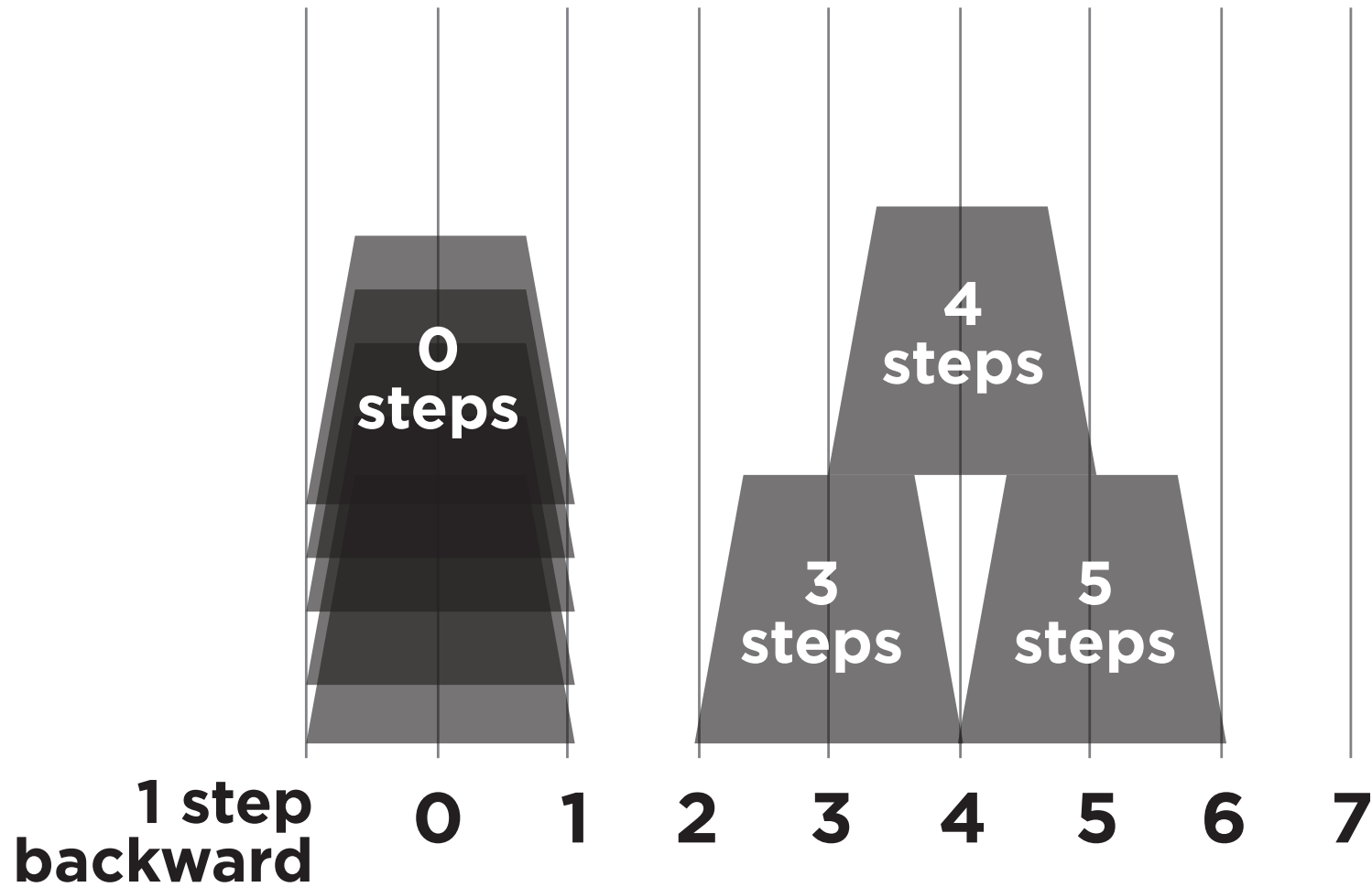
- What does it do?
- What is it supposed to do?
- What does that tell you?
- Does it work at the first step?
- Does it work at the second step?
- Where does it stop working?



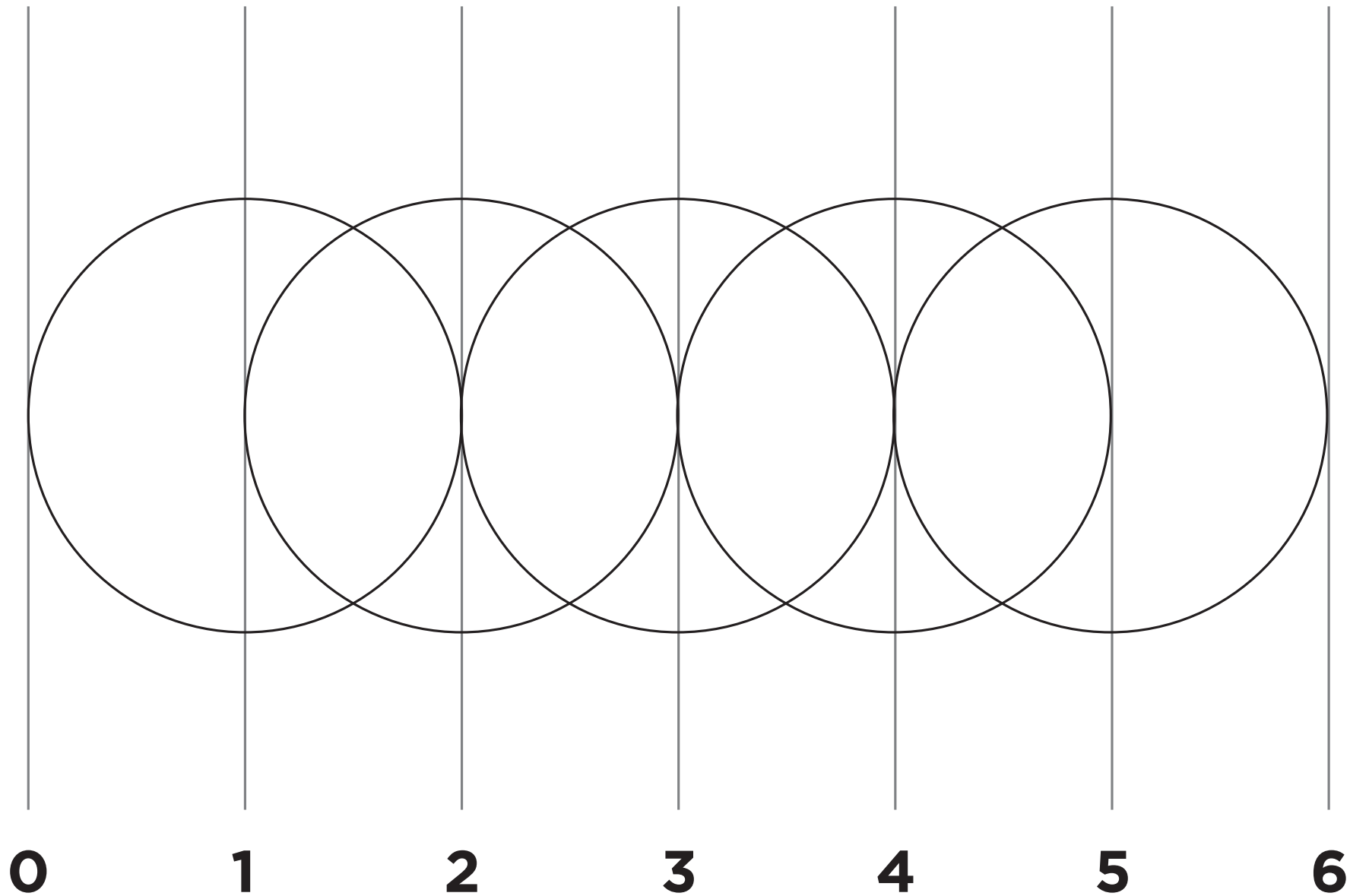
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Sample Table Arrangement for Cups



Sample Template for Moving Cups





Pick Up Cup



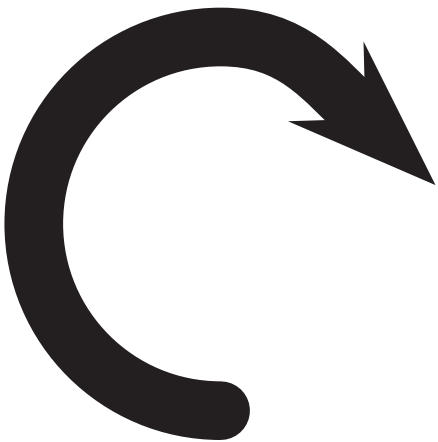
Put Down Cup



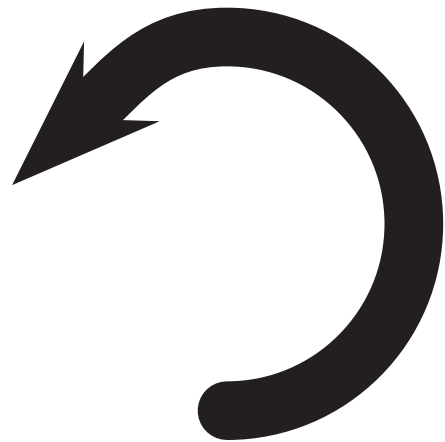
Step Forward



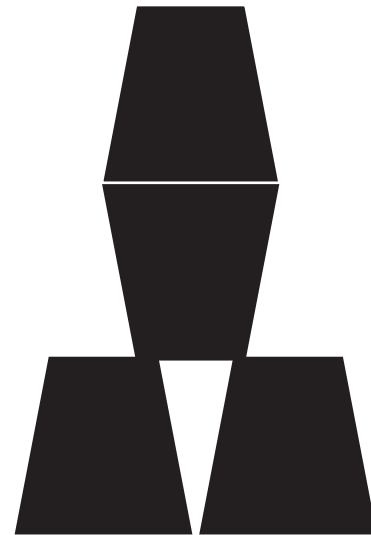
Step Backward

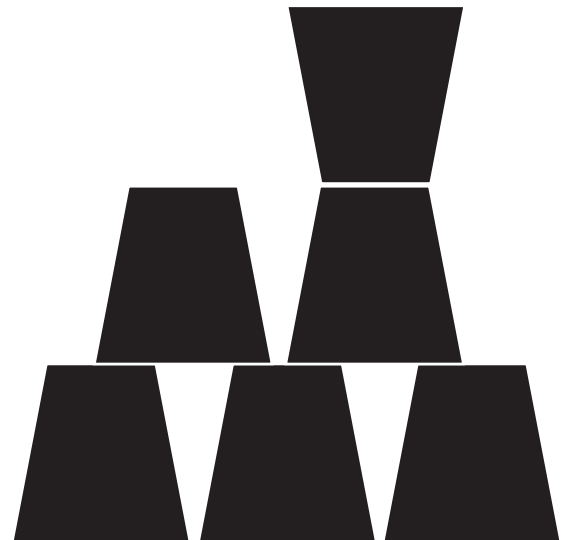
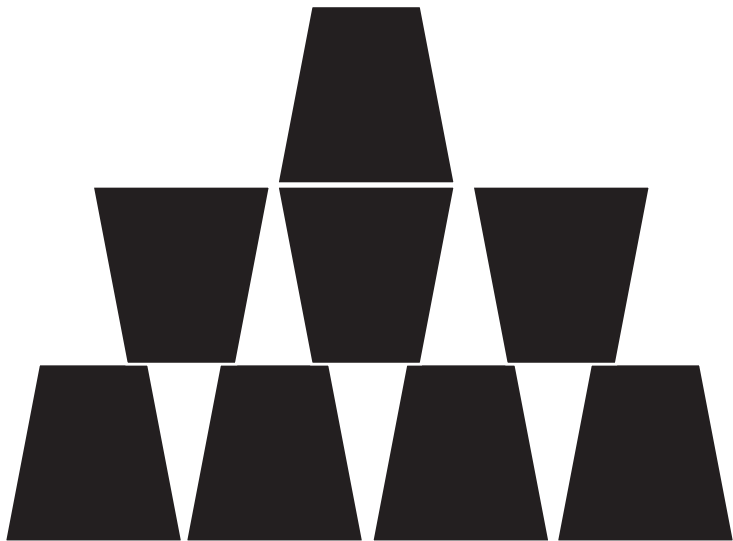
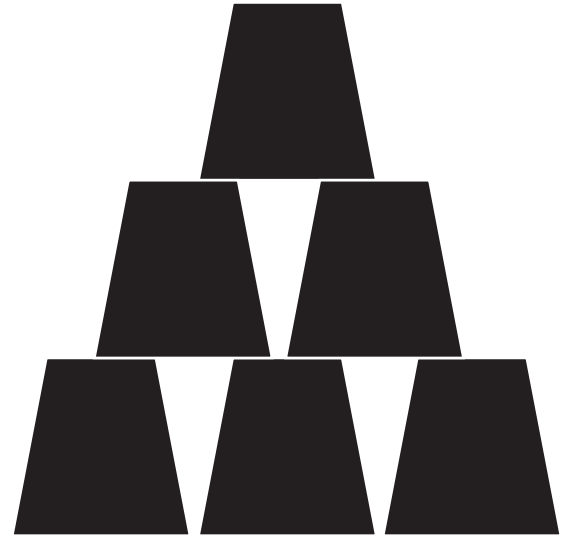


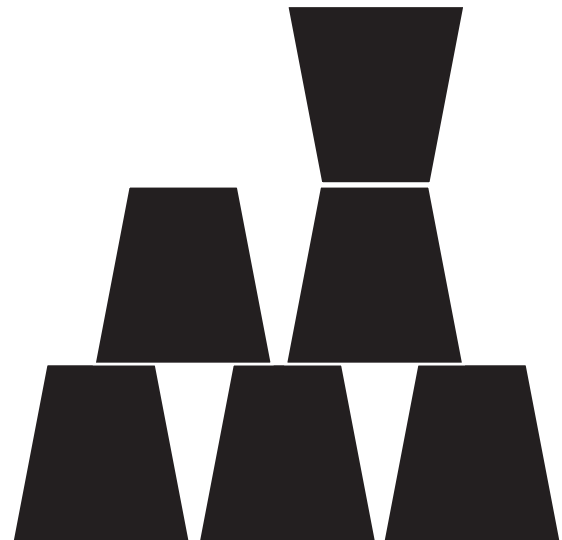
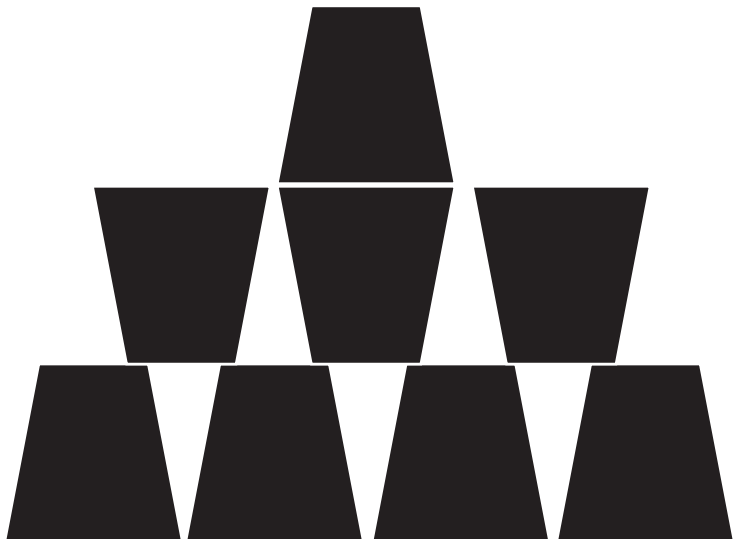
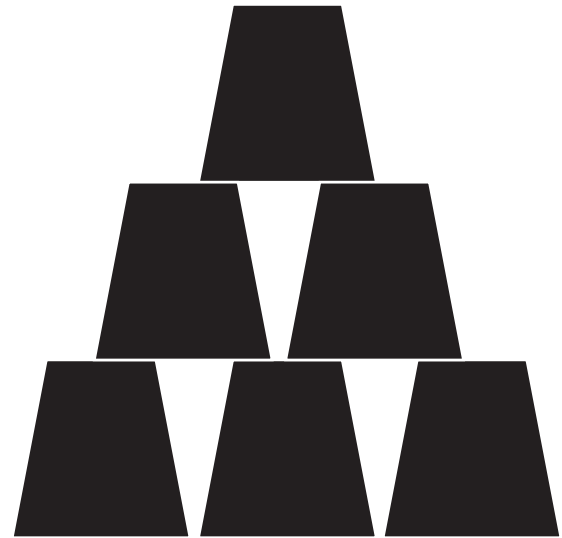
Turn Cup Right 90°

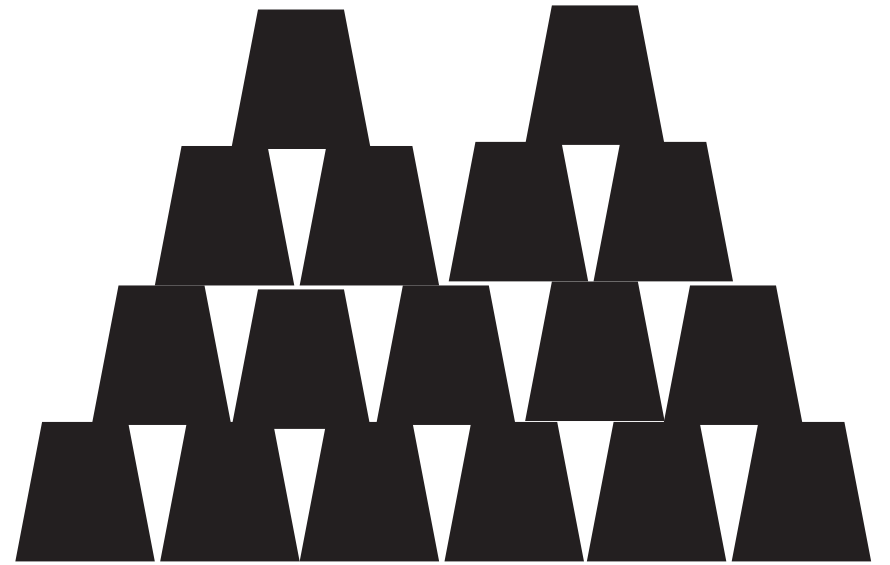
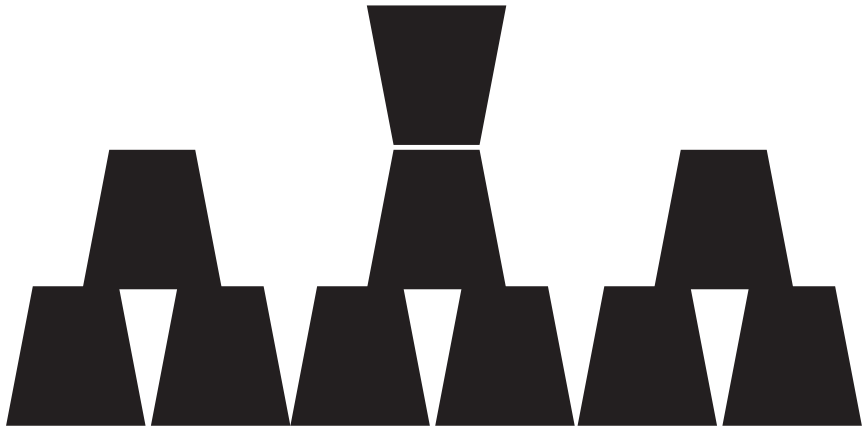


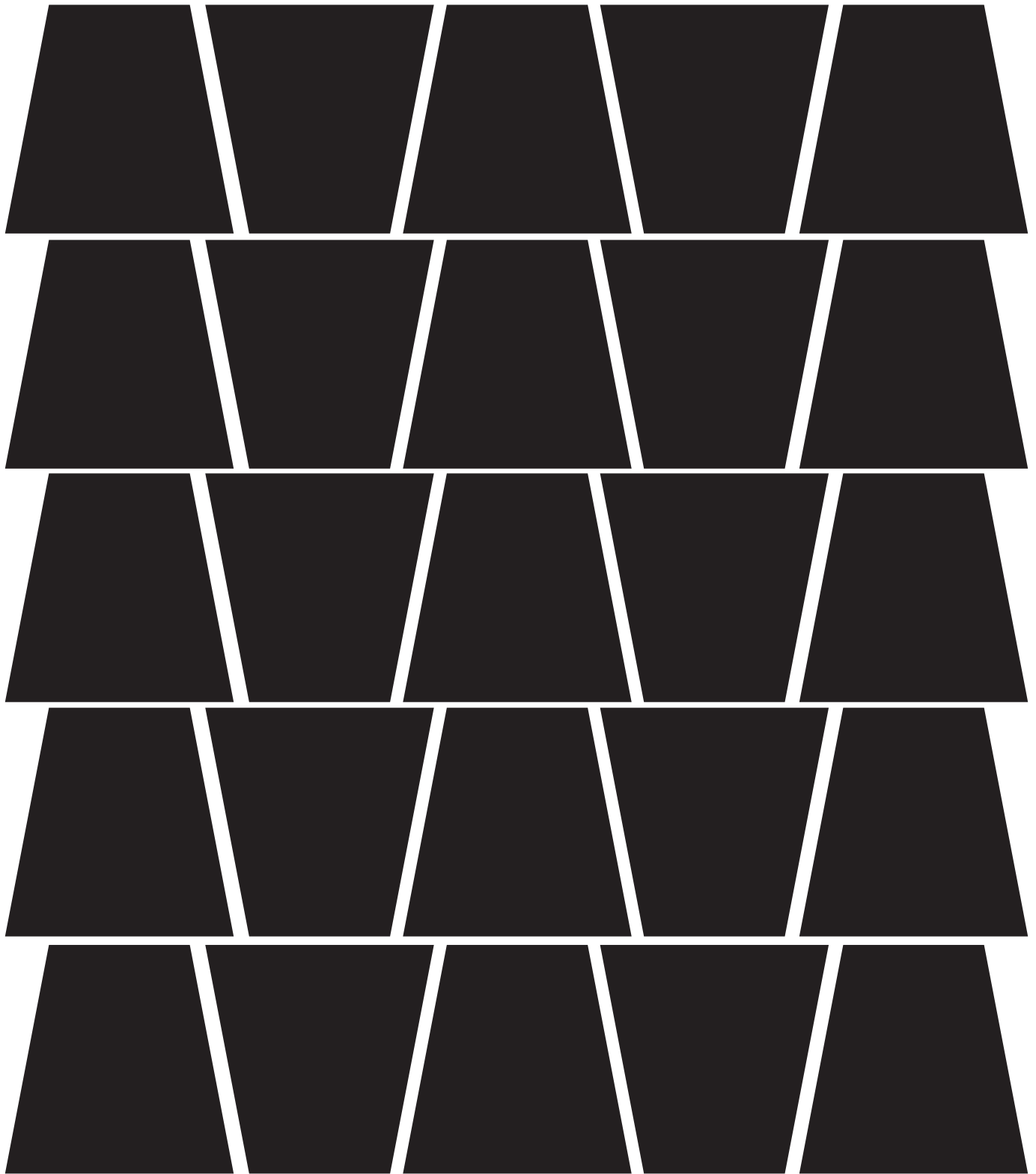
Turn Cup Left 90°











To cut quickly:

First cut in horizontal strips, then snip along lines to make trapezoids.

Lesson 8: My Loopy Robotic Friends Jr.

Unplugged | Loop | Repeat

Overview

Building on the initial "My Robotic Friends" activity, students tackle larger and more complicated designs. In order to program their "robots" to complete these bigger designs, students will need to identify repeated patterns in their instructions that could be replaced with a loop.

Purpose

This lesson serves as a reintroduction to loops, using the now familiar set of "robot" programming instructions. Students will develop critical thinking skills by looking for patterns of repetition in the movements of classmates and determining how to simplify those repeated patterns using loops.

Agenda

Warm Up (10 min)

My Robotic Friends Review

Activity (30 min)

Introduction and Modeling Looping Your Robots

Wrap Up (5 min)

Extension Activities

Objectives

Students will be able to:

- Identify repeated patterns in code that could be replaced with a loop
- Write instructions that use loops to repeat patterns

Preparation

- ☐ Make sure each student has a **Think Spot Journal - Reflection Journal**
- ☐ Watch the **My Loopy Robotic Friends - Teacher Video**
- ☐ Prepare a stack of 20 paper cups for each group of 4 students
- ☐ (Optional) Print out one **My Loopy Robotic Friends Cup Stack (Course B) - Image Pack** per group of 4 students

OR

- ☐ Display the **My Robotic Friends Symbol Key (Course B) - Key** where students can reference throughout the lesson.
- ☐ Print and cut out **Paper Trapezoid Template - Manipulatives** for each group if your class is not going to use cups.
- ☐ Print out one set of **My Loopy Robotic Friends Cup Stack (Course B) - Image Pack** per group.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **My Loopy Robotic Friends - Teacher Video**

For the Students

- **My Robotic Friends Symbol Key (Course B) - Key**
- **Feeling Faces - Emotion Images**
- **Paper Trapezoid Template - Manipulatives**
- **My Loopy Robotic Friends Cup Stack (Course B) - Image Pack**

Vocabulary

- **Loop** - The action of doing something over and over again.
- **Repeat** - Do something again

Teaching Guide

Warm Up (10 min)

My Robotic Friends Review



Pick Up Cup



Put Down Cup



Step Forward



Step Backward

Goal: This review will refresh the students' minds about how quickly programs for the "My Robotic Friends" activity can get intense.

Display: Show the **My Robotic Friends Symbol Key (Course B) - Key** that we used in My Robotic Friends. For each of the four symbols, ask students to show you what it looks like for a robot to follow that instruction.

Model: With the class together as a group, pull an easy puzzle from the "My Robotic Friends" Cup Stack Pack and program with each other as a reminder of rules and terminology.

Next, pull a puzzle that's slightly harder, but also requires a lot of steps like the one below.



Volunteer: Ask a volunteer (or a group of volunteers) to come forward to help program this one on the board. If you make them stick strictly to the “no symbols other than those on the key” rule, it will probably take a while!

Display: Now, bring up this image:



What is the reaction of the class?

Prompt: Give students the opportunity to brainstorm shorter ways to relay the code that they’re about to create. (This bit can be skipped over if your students start saying things like: “Move forward 6 times.” Since that will open the discussion about how to show “six times” with symbols.)

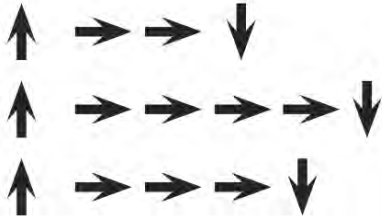
Once students have put together the idea of “repeating” code, give them the vocabulary around it. Make sure to share with them that often the terms “repeat something” and “loop something” are often used interchangeably.

Activity (30 min)

Introduction and Modeling

Set Up: Have stacks of cups or cut paper trapezoids available for groups.

Display: Take the program from one of your previous cup stacks and display it for the class, or use the one below.

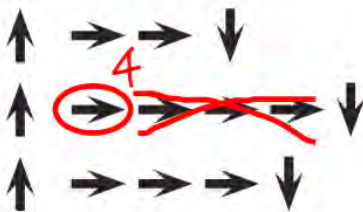


Think: Ask students to think quietly about where in this program they can find a pattern of instructions that repeat uninterrupted (one repetition after another).

Pair: Turn to a neighbor and share one of the repeating patterns you found.

Share: Ask a few students to share out the patterns they identified. Try to pull out different approaches to grouping patterns. For each pattern, ask students to identify how many times the pattern repeats.

Model: Using one of the repeating patterns that the class identified, model how to circle the instruction or pattern that repeats, write the number of loops near that circle, then cross out the rest of the arrows.



Repeat this until the entire program has been shortened, then re-write the program in a way where students can see how much more simple the resulting instructions are.

Looping Your Robots

Group: Place students into groups of 4. Each group should then further break down into two pairs - each pair will develop their own program "run" on the other pair.

Distribute: Give each group one stack of cups or paper cutouts.

Display: Show **My Loopy Robotic Friends Cup Stack (Course B) - Image Pack** to the class or hand out individual copies for groups to use. Have each pair (not group) choose which stack they would like their robot to do. Encourage pairs to select a more complicated pattern this time around.

🗣️ **Discuss:** Let each group discuss how the stack should be built, then instruct each group to translate the algorithm into symbols. Make sure each group writes down the symbol algorithm somewhere for the "robot" to read later. As students are working on their programs, remind them to be on the lookout for opportunities to replace a repeating pattern with a loop.

Do: When groups have finished their instructions, have each pair trade with another pair to run one another's code. Remind students to be on the lookout for bugs, but not to interrupt a robot until it's finished running the program.

Discuss: When all of the pairs have had a chance to run their programs, ask a few to share their solutions with the class. Use this opportunity to discuss how groups came up with different solutions to the same puzzle. In particular, you might ask of each program:

- How did they identify the loops?
- Are there other ways those loops could have been written?
- How much shorter is the program with loops than it would be without?
- Is the program easier to understand with loops, or written out longhand? Why?

💡 Teaching Tip

Looking for Loops: Be sure to keep your eyes open for students using loops. Try to avoid correcting their overall algorithms or prescribing a solution, but feel free to direct students towards patterns that could be shortened by using a repeat circle.

Watch students as they run through the code. Are there any bugs? Use the debugging questions to help them find a solution.

- What does it do?
- What is it supposed to do?
- What does that tell you?
- Does it work at the first step?
- Does it work at the second step?
- Where does it stop working?

Wrap Up (5 min)

Journal Prompts:

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Have the students write or draw something in their journal that will remind them later what loops are. This can come from a prompt like:
 - What does "repeat" mean to you?
 - Draw a picture of you repeating something.

Extension Activities

- Have students draw their own cup stacking creations for someone else to code.
- Provide students with algorithms that utilize repeats, then have them expand the program back out to a full step-by-step version.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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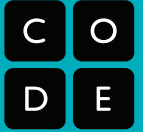
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U

Unplugged

My Robotic Friends

Symbol Key (Course B)



Pick Up Cup



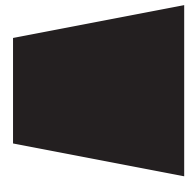
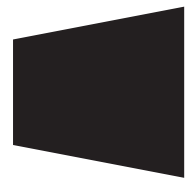
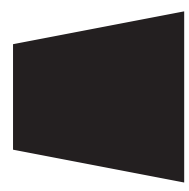
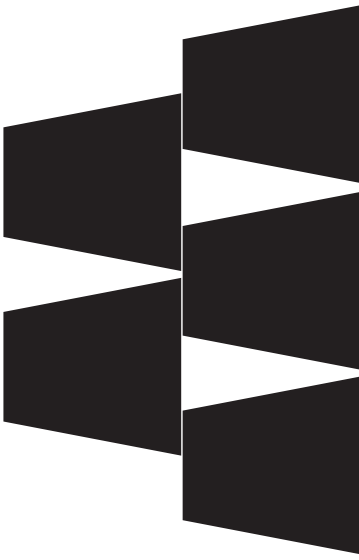
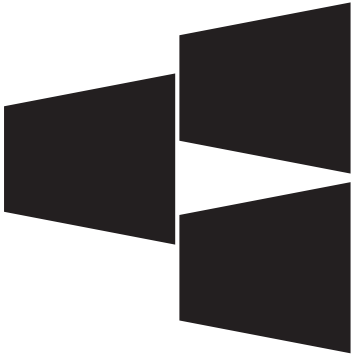
Put Down Cup

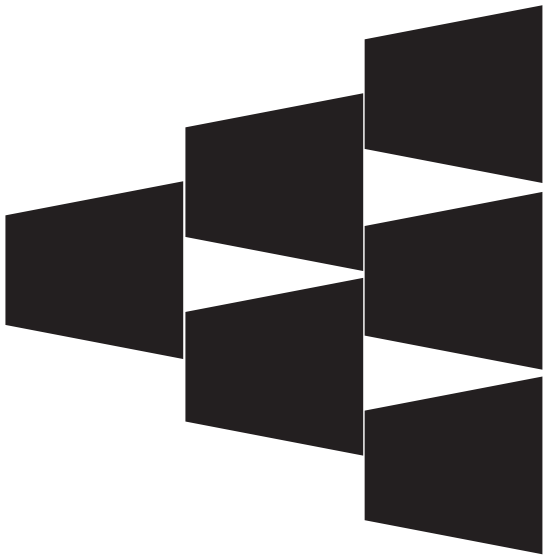
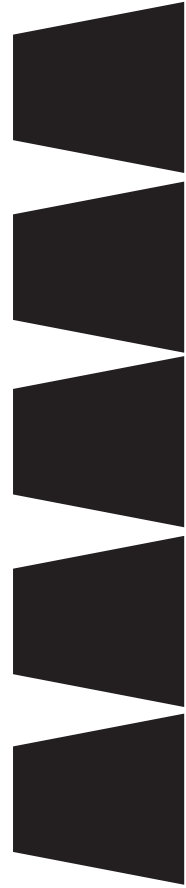
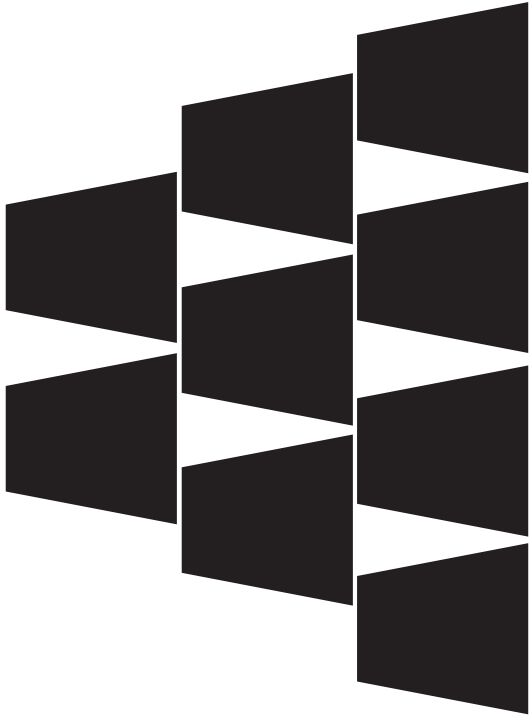


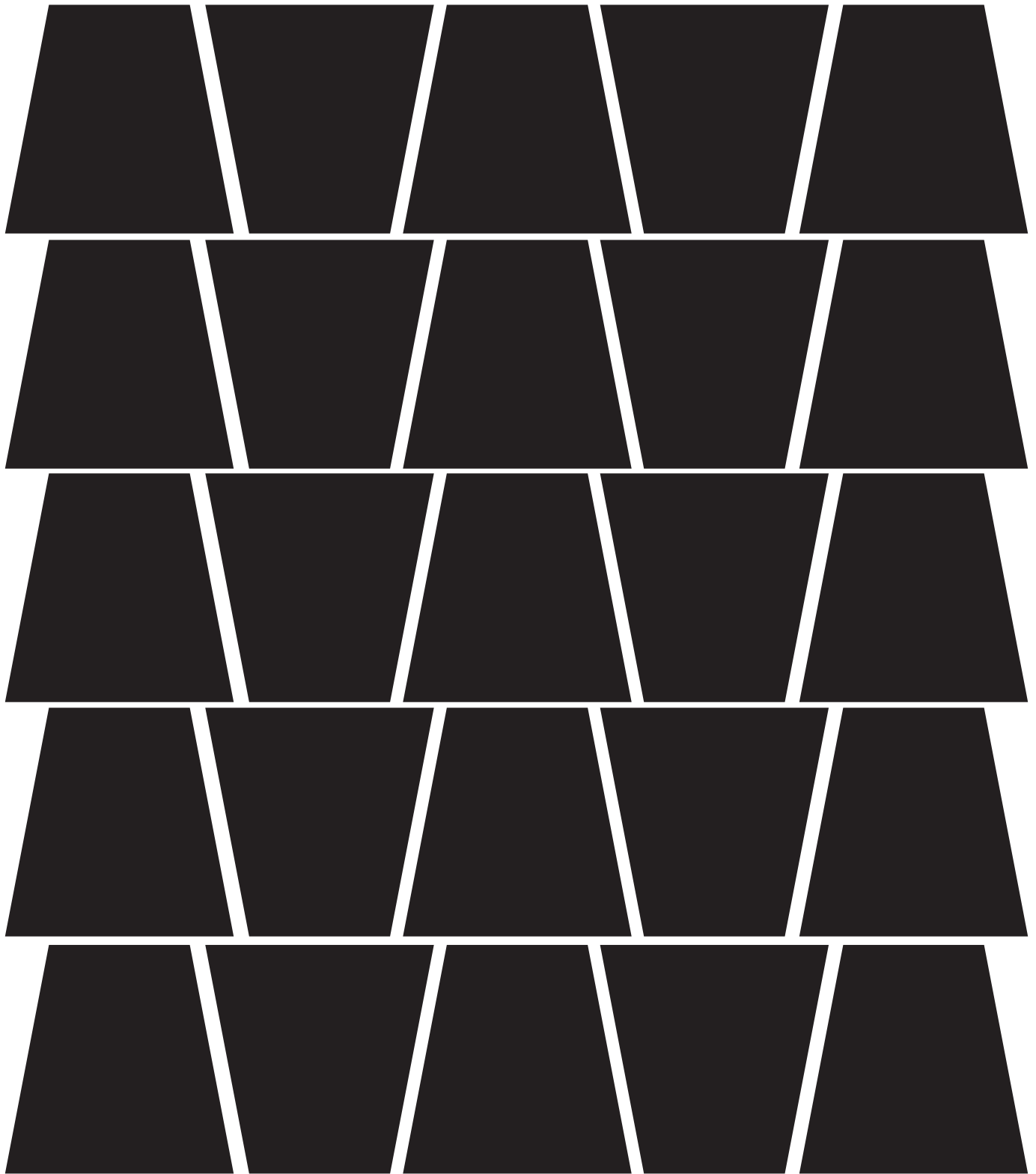
Step Forward



Step Backward







To cut quickly:

First cut in horizontal strips, then snip along lines to make trapezoids.

Lesson E.1/F.1: My Robotic Friends

Algorithms | Debugging | Unplugged

Overview

Using a special set of offline commands, students will design algorithms to instruct a "robot" to stack cups in different patterns. Students will take turns participating as the robot, responding only to the algorithm defined by their peers. This segment teaches students the connection between symbols and actions, the difference between an algorithm and a program, and the valuable skill of debugging.

Purpose

This unplugged lesson brings the class together as a team with a simple task to complete: get a "robot" to stack cups in a specific design. Students will work to recognize real world actions as potential instructions in code. The art of following precise instructions will also be practiced, as students work to translate algorithms into code, using the symbols provided. If problems arise in the code, students should work together to recognize bugs and build solutions. This activity lays the groundwork for the programming that students will do throughout the course as they learn the importance of defining a clearly communicated algorithm.

Agenda

Warm Up (5 min)

Talking to Robots

Activity (45 min)

Introduction and Modeling

Differentiation Options:

Programming Your Robots

Wrap Up (10 min)

Journaling

Objectives

Students will be able to:

- Reframe a sequence of steps as an encoded program
- Identify and address bugs or errors in sequenced instructions

Preparation

- Watch the **My Robotic Friends - Teacher Video**.
- (Optional) Print out one **My Robotic Friends - Symbol Key** per group or 4 students. Alternatively, find a place to display this information where students can reference throughout the lesson.
- Prepare a stack of 10 disposable cups per group of 4 students, OR
- (Optional) print and cut out **Paper Trapezoid Template - Manipulatives** for each group if your class is not going to use cups.
- Print out one set of **Stacking Cup Ideas - Manipulatives** per group.
- Make sure each student has a **Think Spot Journal - Reflection Journal**.

Links

For the Teacher

- **My Robotic Friends - Teacher Video**

For the Students

- **Stacking Cup Ideas** - Manipulatives
- **Paper Trapezoid Template** - Manipulatives
- **My Robotic Friends** - Unplugged Video ([download](#))
- **My Robotic Friends** - Symbol Key

Vocabulary

- **Algorithm** - A list of steps to finish a task.
- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Loop** - The action of doing something over and over again.
- **Program** - An algorithm that has been coded into something that can be run by a machine.
- **Repeat** - Do something again

Teaching Guide

Warm Up (5 min)

Talking to Robots

- **Discuss:** Start by asking the class if anyone has heard of robotics. Has anyone seen a robot or touched one? Does a robot really “hear” you speak? Does it really “understand” what you say?

Say: Robots can only do what they've been instructed or programmed to do. In order to accomplish a task, a robot needs to have a list of instructions (sometimes called an algorithm) that it can read. Today, we are going to learn what it takes to make that happen.

Discussion Goal

The goal of this quick discussion is to call out that while robots may seem to behave like people, they're actually responding only to their programming. Students will likely refer to robots from movies and TV that behave more like humans. Push them to consider robots that they've seen or heard of in real life, like Roombas, or even digital assistants like Amazon Alexa.

Activity (45 min)

Introduction and Modeling

Display: Display the **My Robotic Friends - Symbol Key** or write the allowed actions on the board - make sure these are in a place where they can be seen for the whole activity. Explain to the class that these will be the only six actions that they will be using for this exercise. For this task, they will instruct their “robot” friend to build a specific cup stack using only the commands listed on the key.

Model: In order to explain how the instructions are intended to work, model for the class how to create and follow an algorithm for replicating a simple pattern. Place a single stack of cups in front of you to start.

Display: Hold up the pattern you plan to model. A simple three cup pattern is a great place to start.



Prompt: Ask the class what the first instruction should be, using *only the six instructions allowed*. The first move should be to “pick up cup.” If students suggest something else from the list, perform that action and allow them to see their error. If they suggest something not from the list, make a clear malfunction reaction and let them know that the command is not understood.

With cup in hand, ask the class to continue giving you instructions until the first cup is placed. This is a great place to clarify that a “step forward” and “step backward” each imply moving half a cup width. See the image below for reference.

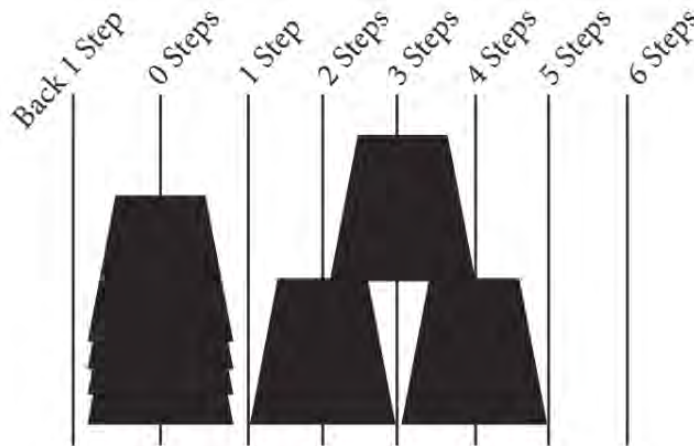
Differentiation Options:

Simplify: Does this all feel a little complicated for your classroom? Here are a couple of tips to simplify the process:

- Load lots of steps into the ups and downs
 - Up means that the cup automatically goes up as high as it needs to
 - Down means that it automatically goes down until it lands on something
 - Hand automatically returns to cup stack after setting down a cup

Intensify: Are your students more advanced? Do you want this lesson to relate more closely to the online puzzles? Here are some modifications that you can make:

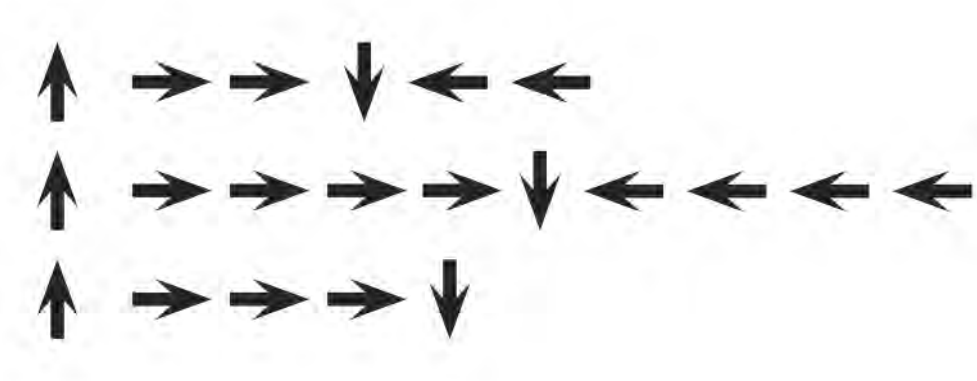
- One arrow corresponds to one movement
 - When a cup is removed from the stack, it returns to table-level before moving
 - Students need to use multiple "up" arrows to lift the cup multiple levels
 - Students need to use multiple "down" arrows to lower the cups multiple levels
 - Students need to use the "back" arrows to get back to the cup stack
 - **Set Up:** Have stacks of cups or cut paper trapezoids available for groups.



Continue asking for instructions from the classroom until you have completed the entire design.

Once your stack is complete, point out that they just gave you a list of instructions for completing a task. That's an algorithm. Algorithms are great for sharing ideas, but spelling them out word by word can take a long time. That's what the symbols are for! When you encode an algorithm into symbols that a robot (or computer) understands, that's called programming.

Ask the class to help you write the "program" for that first move, and then the rest of the moves necessary to complete the pattern. Depending on the confidence of your students, you might switch back and forth frequently between acting as the "robot" and writing down the code, or you might push them to write the whole program before you will implement it. One possible solution looks like this:



Volunteer: Once the class has completed the model program, ask one of the students to come up and act as the "robot" to ensure that the program really works. Encourage them to say the instructions out loud as they "run" the code.

Programming Your Robots

Group: Place students into groups of 4. Each group should then further break down into two pairs - each pair will develop their own program to be "run" by the other pair.

Distribute: Give each group one stack of cups or paper cutouts.

Display: Show **Stacking Cup Ideas - Manipulatives** to the class or hand out individual copies for groups to use. Have each pair (not group) choose which idea they would like their robots to do. Try to push for an easier idea for the first time, then have them choose a more complex design later on. Encourage pairs to keep their choice secret from the other half of their group.

Discuss: Give each pair time to discuss how the stack should be built, using only the provided symbols. Make sure each group writes down the "program" somewhere for the "robot" to read later.

Do: Once both of the group's pairs have decided on their algorithms, they can take turns being "robots" for each other by following the instructions each pair wrote. Encourage students to watch their "robot" closely to ensure that they are following instructions. If a student sees a bug and raises their hand, have the robot finish the instructions to the best of their ability. Afterward, have the students discuss the potential bug and come up with a solution. Continue repeating until the stack is built properly.

Circulate: Look for groups who are trying to take shortcuts by adding things (like numbers) to their code. Praise them for their ingenuity, but remind them that for this exercise, the robots do not understand *anything* but the provided symbols. If you like, you can hint that they should save their brilliant solution for the next time they play this game, since they might get the chance to use it soon!

Iterate: Depending on your time available, mix up the pairs and give them a chance to do a different pattern. Each time groups repeat the process, encourage them to choose a more challenging pattern.

Discuss: After everyone has had a chance to be the robot, bring the class back together to discuss their experience. In particular, discuss as a class:

- What was the most difficult part of coming up with the instructions?
- Did anyone find a bug in your instructions once your robot was following them?
 - What was the bug?
 - Why do you think you didn't notice it when writing the program?
- When you were the robot, what was the hardest part of following the instructions you were given?

Teaching Tip

Enforcing the rules: While the robot is working on the stack make sure that the class knows:

- Programmers are not allowed to talk when the robot is working. This includes blurting out answers or pointing out when the robot has done something wrong.
- Programmers should raise their hand if they see a bug.

Discussion Goal

Sense making: The goal of this discussion is to give students space to make sense of their experience both as robot and programmer. The questions are intentionally broad, but designed to get students thinking about the challenges of writing a clear program and the constraints of a robot or computer in interpreting your instructions.

Wrap Up (10 min)

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Draw a stack of cups that the robot made today.
- Draw a stack of cups that you would like a robot to make someday!

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

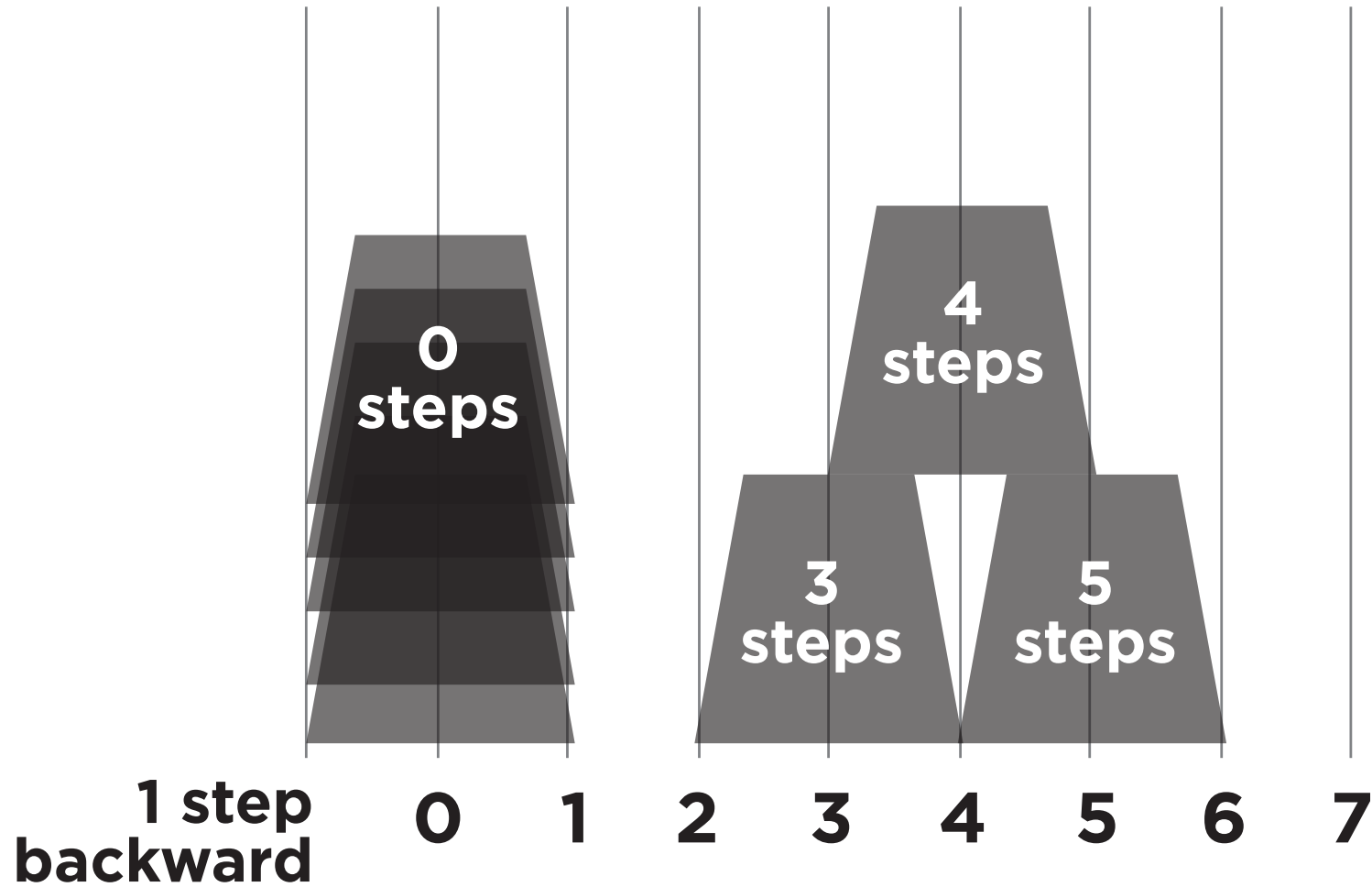
- ▶ **ETS** - Engineering in the Sciences



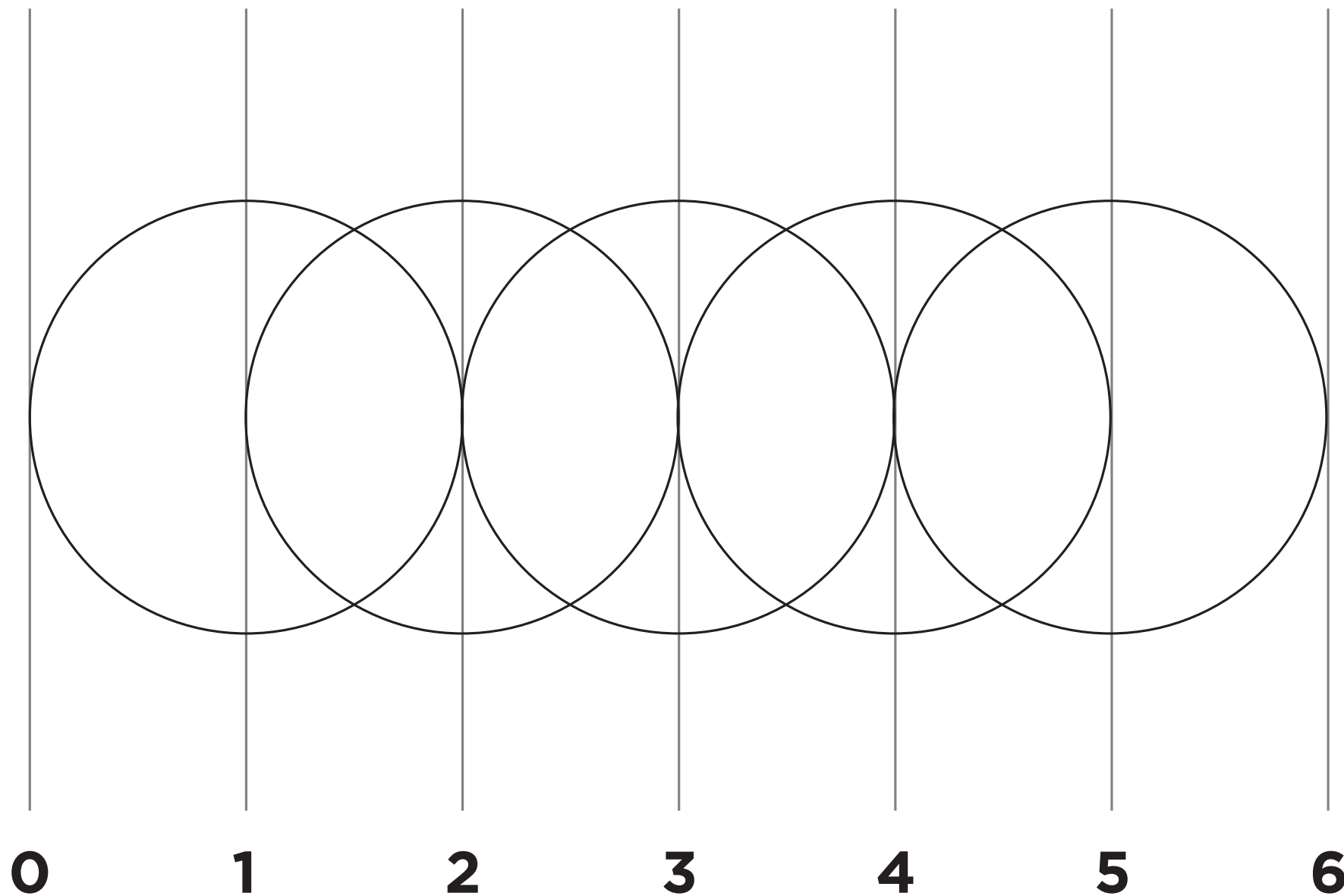
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Sample Table Arrangement for Cups



Sample Template for Moving Cups





Pick Up Cup



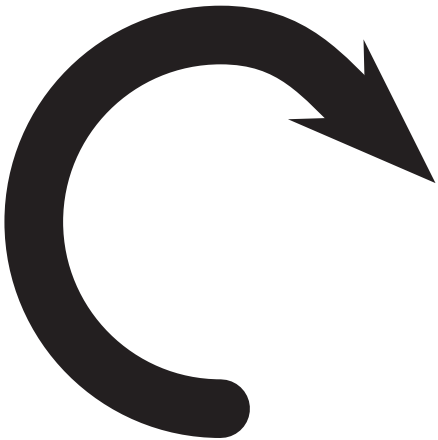
Put Down Cup



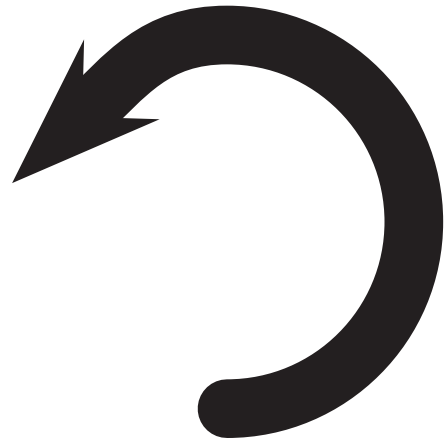
Step Forward



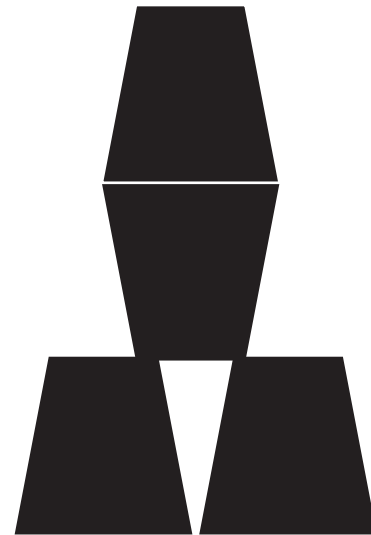
Step Backward

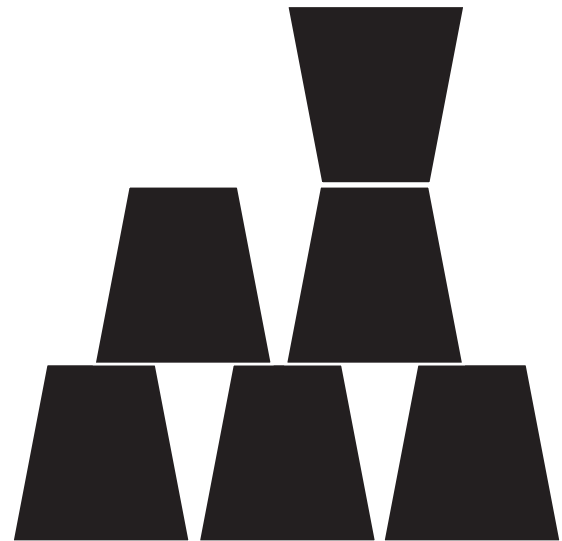
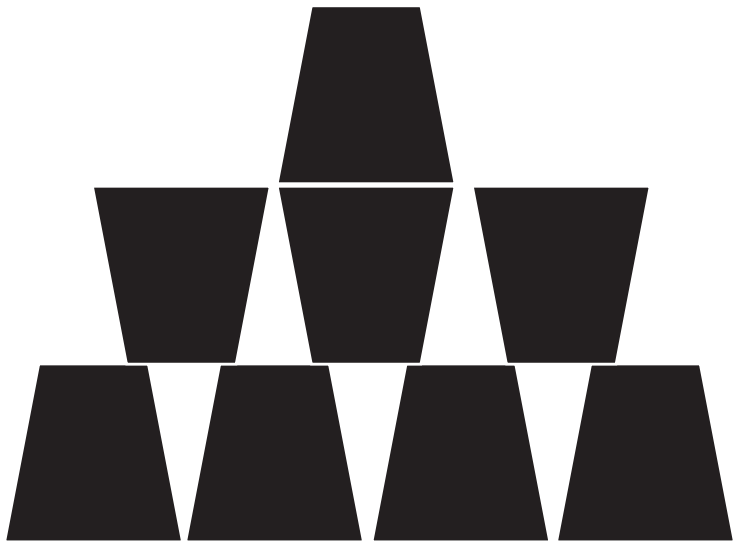
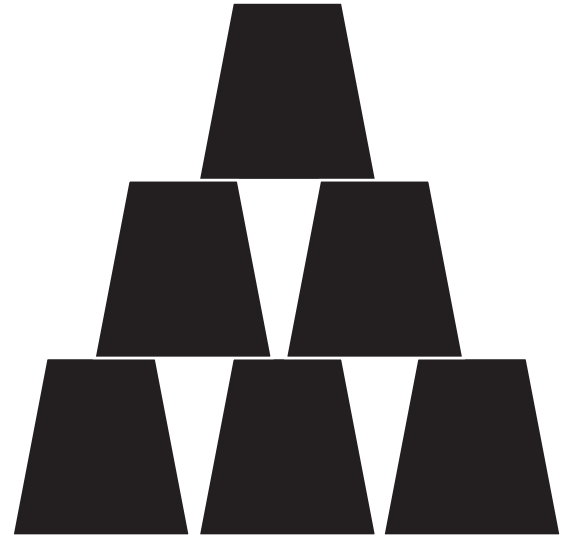


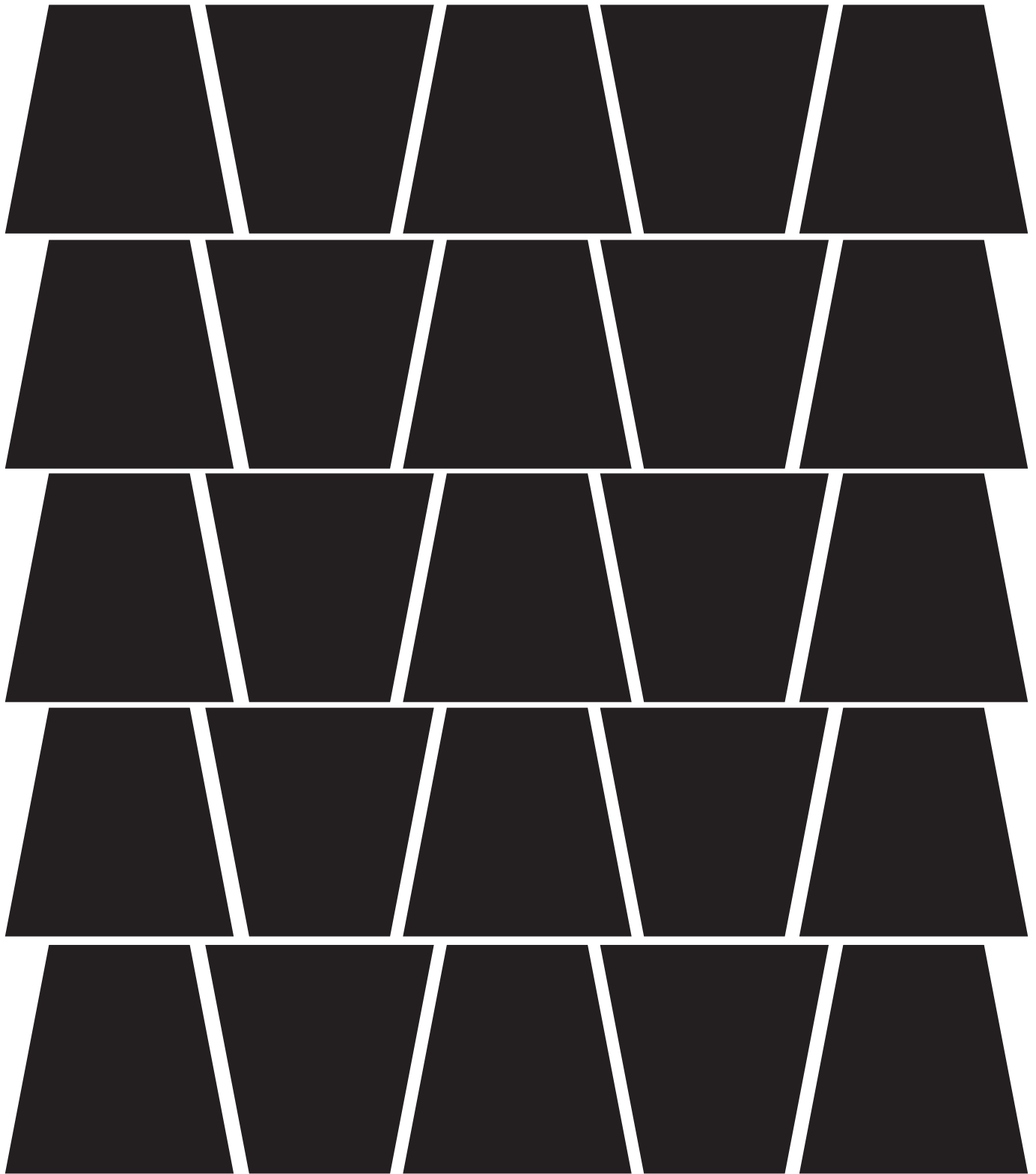
Turn Cup Right 90°



Turn Cup Left 90°







To cut quickly:

First cut in horizontal strips, then snip along lines to make trapezoids.

Lesson 4: My Robotic Friends Jr.

Algorithms | Debugging | Unplugged

Overview

Using a set of symbols in place of code, students will design algorithms to instruct a "robot" to stack cups in different patterns. Students will take turns participating as the robot, responding only to the algorithm defined by their peers. This segment teaches students the connection between symbols and actions, the difference between an algorithm and a program, and the valuable skill of debugging.

Purpose

This unplugged lesson brings the class together as a team with a simple task to complete: get a "robot" to stack cups in a specific design. This activity lays the groundwork for the programming that students will do throughout the course as they learn the importance of defining a clearly communicated algorithm.

Agenda

Warm Up (5 min)

Talking to Robots

Activity (30 min)

Introduction and Modeling

Handy Rules:

Differentiation Options:

Programming Your Robots

Wrap Up (10 min)

Journaling

Objectives

Students will be able to:

- Attend to precision when creating instructions
- Identify and address bugs or errors in sequenced instructions

Preparation

- ☐ Watch the **My Robotic Friends - Teacher Video**.
- ☐ (Optional) Print out one **My Robotic Friends Symbol Key (Course B) - Key** per group or 2-3. Alternatively, find a place to display this information where students can reference throughout the lesson.
- ☐ Prepare a stack of 10 disposable cups per group of 2-3 students, OR
- ☐ (Optional) print and cut out **Paper Trapezoid Template - Manipulatives** for each group if your class is not going to use cups.
- ☐ Print out one set of **My Robotic Friends Cup Stack Pack (Course B) - Image Pack** per group.
- ☐ Make sure each student has a **Think Spot Journal - Reflection Journal**.

Links

For the Teacher

- **My Robotic Friends - Teacher Video**

For the Students

- **Feeling Faces** - Emotion Images
- **My Robotic Friends Symbol Key (Course B) - Key**
- **My Robotic Friends** - Unplugged Video (download)
- **My Robotic Friends Cup Stack Pack (Course B) - Image Pack**
- **Paper Trapezoid Template** - Manipulatives
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Algorithm** - A precise sequence of instructions for processes that can be executed by a computer
- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Program** - An algorithm that has been coded into something that can be run by a machine.

Teaching Guide

Warm Up (5 min)

Talking to Robots

Display: Watch one of the videos below to give students context for the types of things that robots can do:

- **Asimo by Honda** (3:58)
- **Egg drawing robot** (3:15)
- **Dancing Lego Robot** (1:35)

• **Discuss:** Refer to the video that you chose and ask students how they think that the robot knew what to do. Does a robot really “understand” what you say? Is it worried about getting in trouble if it doesn't do what it's told?

Say: Robots can only do what they've been told to do, but we don't just tell them using words. In order to do something, a robot needs to have a list of steps that it can read. Today, we are going to learn what it takes to make that happen.

Discussion Goal

The goal of this quick discussion is to call out that while robots may seem to behave like people, they're actually responding only to their programming. Students will likely refer to robots from movies and TV that behave more like humans. Push them to consider robots that they've seen or heard of in real life, like Roombas, or even digital assistants like Amazon Alexa.

Activity (30 min)

Introduction and Modeling

Set Up: Have stacks of cups or cut paper trapezoids available for groups.

Display: Display the **My Robotic Friends Symbol Key (Course B) - Key** or write the allowed actions on the board - make sure these are in a place where they can be seen for the whole activity. Explain to the class that these will be the only four actions that they can use for this exercise. For this task, they will instruct their “robot” friend to build a specific cup stack using only the commands listed on the key.

Model: In order to explain how the instructions are intended to work, model for the class how to create and follow an algorithm for replicating a simple pattern. Place a single stack of cups in front of you to start.

Display: Hold up the pattern you plan to model. A simple three cup pattern is a great place to start.



Prompt: Ask the class what the first instruction should be, using *only the four instructions allowed*. The first move should be to “pick up cup.” If students suggest something else from the list, perform that action and allow them to see their error. If they suggest something not from the list, make a clear malfunction reaction and let them know that the command is not understood.

With cup in hand, ask the class to continue giving you instructions until the first cup is placed. This is a great place to clarify that “step forward” and “step backward” each imply moving half a cup width. See the image below for reference.



Pick Up Cup



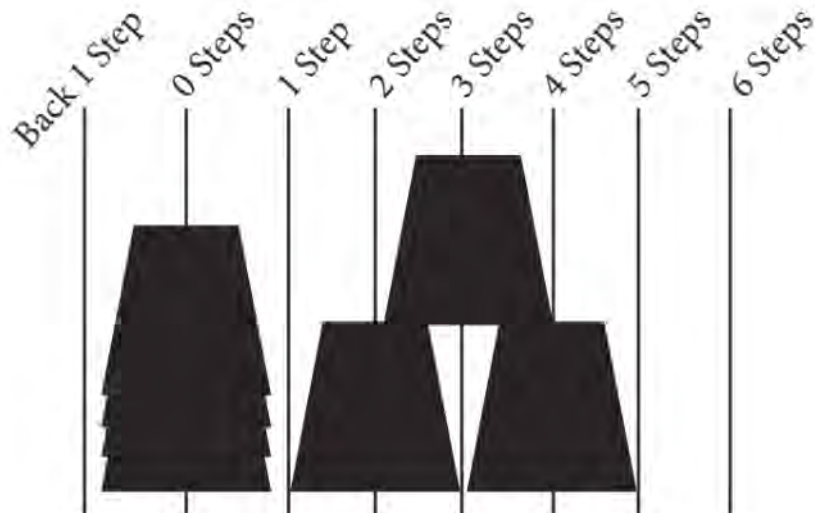
Put Down Cup



Step Forward



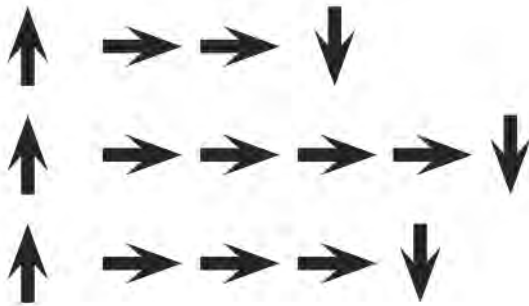
Step Backward



Continue asking for instructions from the classroom until you have completed the entire design.

Once your stack is complete, point out that they just gave you a list of steps for completing a task. That's an algorithm. Algorithms are great for sharing ideas, but spelling them out word by word can take a long time. That's what the symbols are for! When you change an algorithm into symbols that a robot (or computer) understands, that's called programming.

Ask the class to help you write the "program" for that first move by changing the text into an arrow. Then work with them to write down the rest of the moves necessary to complete the pattern. Depending on the confidence of your students, you might switch back and forth frequently between acting as the "robot" and writing down the code, or you might push them to write the whole program before you will implement it. One possible solution looks like this:



Volunteer: Once the class has completed the model program, ask one of the students to come up and act as the "robot" to ensure that the program really works. Encourage them to say the instructions out loud as they "run" the code.

Programming Your Robots

Group: Place students into groups of 4. Each group should then further break down into two pairs - each pair will develop their own program to be "run" by the other pair.

Distribute: Give each group one stack of cups or paper cutouts.

Display: Show **My Robotic Friends Cup Stack Pack**

(Course B) - Image Pack to the class or hand out individual copies for groups to use. Have each pair (not group) choose

which idea they would like their robots to do. Try to push for an easier idea for the first time, then have them choose a more complex design later on. Encourage pairs to keep their choice secret from the other half of their group.

Discuss: Give each pair time to discuss how the stack should be built, using only the provided symbols. Make sure each group writes down the "program" somewhere for the "robot" to read later.

Do: Once both of the group's pairs have completed their programs, they can take turns being "robots" for each other by following the instructions the other pair wrote. Encourage students to watch their "robot" closely to ensure that they are following instructions. If a student sees a bug and raises their hand, have the robot finish the instructions to the best of their ability. Afterward, have the students discuss the potential bug and come up with solutions. Continue repeating until the stack is built properly.

Circulate: Look for groups who are trying to take shortcuts by adding extra things (like numbers) to their code. Praise them for their ingenuity, but remind them that for this exercise, the robots do not understand *anything* but the provided symbols. If you like, you can hint that they should save their brilliant solution for the next time they play this game, since they might get the chance to use their invention soon!

Iterate: Depending on the time available, mix up the pairs and give them a chance to do a different pattern. Each time groups repeat the process, encourage them to choose a more challenging pattern.

Teaching Tip

Handy Rules:

- **Up** means that the cup automatically goes up as high as it needs to
- **Down** means that it automatically goes down until it lands on something
 - The hand automatically returns to cup stack after setting down a cup
- **Forward** means the robot moves one step (1/2 cup width) forward
- **Backward** means the robot moves one step (1/2 cup width) Backward
 - Note: Students may not use backward at this age unless they want to build the cup stacks in reverse (which is also okay)
- Programmers are not allowed to talk when the robot is working. This includes blurting out answers or pointing out when the robot has done something wrong
- Programmers should raise their hand if they see a bug

Differentiation Options:

Simplify: Does this all feel a little complicated for your students?

Don't forget to model this in front of the class until students understand all of the rules. If it's still confusing, try running this whole activity together as a classroom using volunteers as robots, instead of breaking up into groups!

Intensify: Are your students more advanced? Do you want this lesson to relate more closely to the online puzzles? Here are some modifications that you can make:

- One arrow corresponds to one movement
 - When a cup is removed from the stack, it returns to table-level before moving
 - Students need to use multiple "up" arrows to lift the cup multiple levels
 - Students need to use multiple "down" arrows to lower the cups multiple levels
 - Students need to use the "back" arrows to get back to the cup stack

🗣️ **Discuss:** After everyone has had a chance to be the robot, bring the class back together to discuss their experience. In particular, discuss as a class:

- What was the most difficult part of coming up with the instructions?
- Did anyone find a bug in your instructions once your robot started following them?
 - What was the bug?
 - Why do you think you didn't notice it when writing the program?
- When you were the robot, what was the hardest part of following the instructions you were given?

Discussion Goal

Sense making: The goal of this discussion is to give students space to make sense of their experience both as robot and programmer. The questions are intentionally broad, but designed to get students thinking about the challenges of writing a clear program and the constraints of a robot or computer in interpreting your instructions.

Wrap Up (10 min)

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Draw your own stack of cups that you would like to see a robot build.
- Can you create a program for that cup stack?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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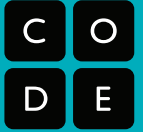
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U

Unplugged

My Robotic Friends

Symbol Key (Course B)



Pick Up Cup



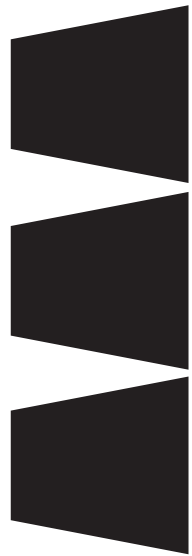
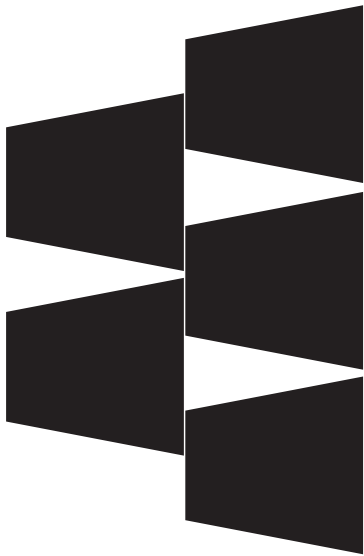
Put Down Cup

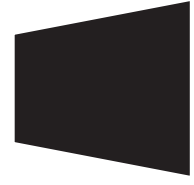
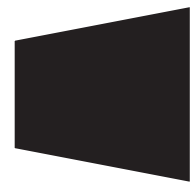
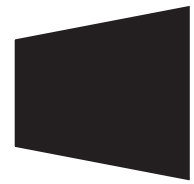
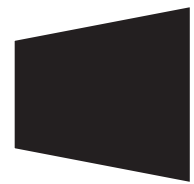
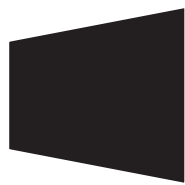
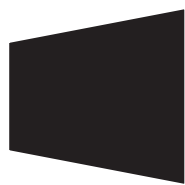
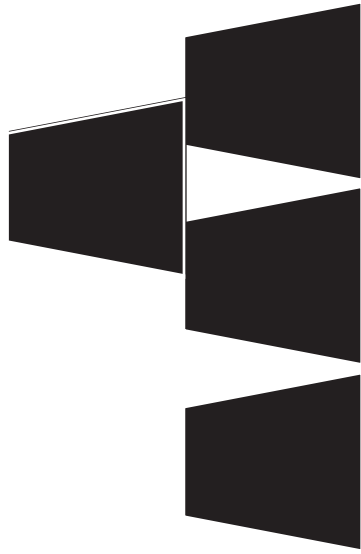


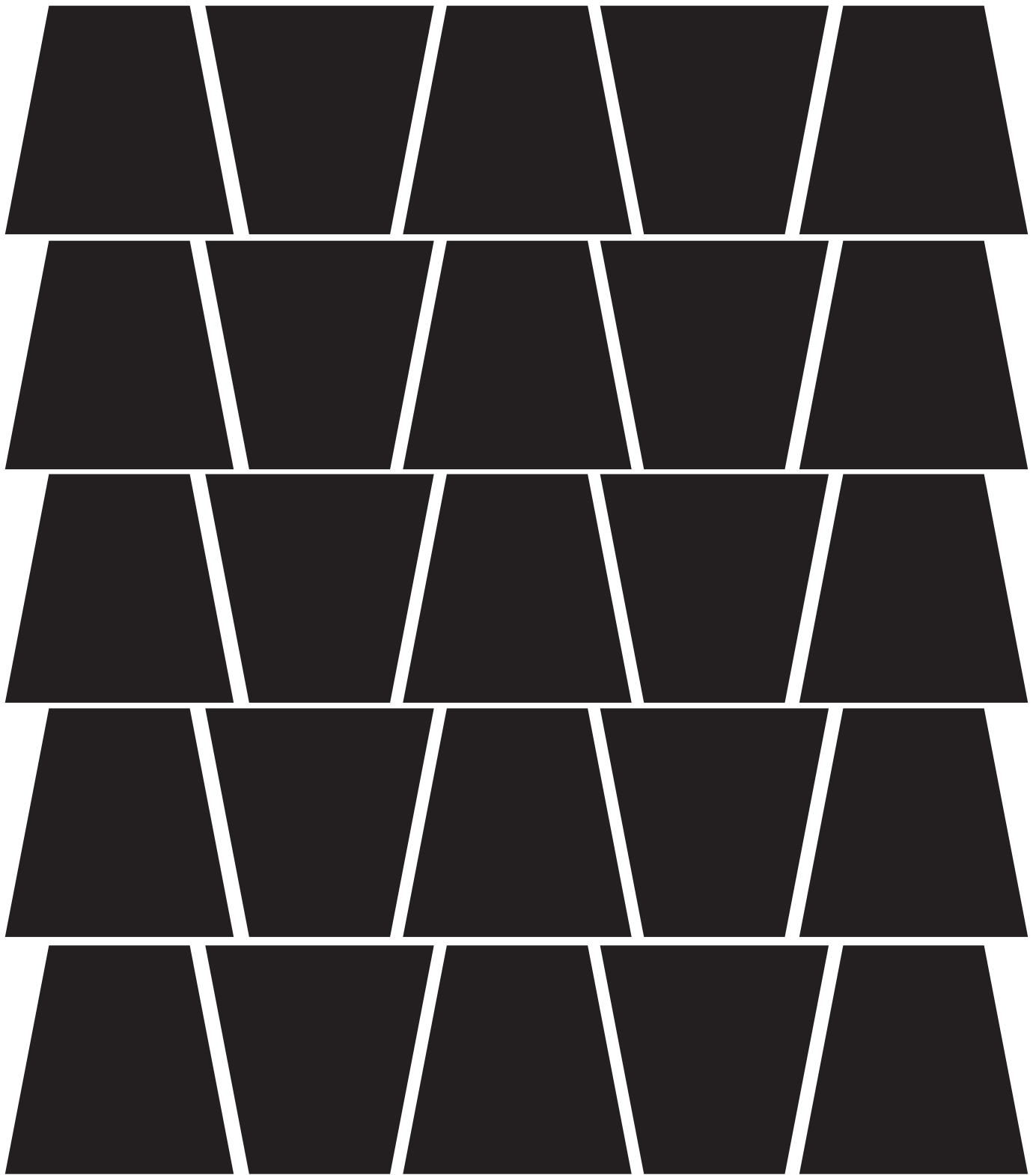
Step Forward



Step Backward







To cut quickly:

First cut in horizontal strips, then snip along lines to make trapezoids.

Lesson 4: Paper Planes

Unplugged | Algorithms | facilitating discussion

Overview

In this lesson, students will relate the concept of algorithms back to everyday activities. After discussing their steps, students will make paper planes using an algorithm. The goal here is to start building the skills to translate real world situations to online scenarios and vice versa.

Purpose

This lesson exists to help students see that an "algorithm" is just a list of steps that someone can take to finish a task. Students will also learn that the order of the individual steps can make a difference in the final product. This should help lay a foundation of understanding for arranging blocks into programs.

Agenda

Warm Up (15 min)

Main Activity (20 min)

Wrap Up (15 min)

Journaling

Assessment (15 min)

Extended Learning

Objectives

Students will be able to:

- Decompose large activities into a series of smaller events.
- Organize sequential events into their logical order.

Preparation

- Watch the **Real-Life Algorithms: Paper Planes - Teacher Video**.
- Watch the **Real-Life Algorithms: Paper Planes - Lesson in Action Video**.
- Gather paper for students to construct paper airplanes from.
- Print out **Real-Life Algorithms: Paper Planes - Worksheet** for each student.
- Print **Daily Algorithms - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Real-Life Algorithms: Paper Planes** - Unplugged Video ([download](#))
- **Real-Life Algorithms: Paper Planes** - Teacher Video
- **Real-Life Algorithms: Paper Planes** - Lesson in Action Video
- **Real-Life Algorithms: Paper Planes** - Worksheet Answer Key

For the Students

- **Real-Life Algorithms: Paper Planes** - Worksheet
- **Daily Algorithms** - Assessment
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Algorithm** - A list of steps to finish a task.

Teaching Guide

Warm Up (15 min)

This warm-up will help your students get perspective on what it means to create a list of steps to finish a task.

Prompt: Ask your students what they did to get ready for school this morning.

Discuss: Write their answers on the board. If possible, put numbers next to their responses to indicate the order that they happen. If students give responses out of order, have them help you put them in some kind of logical order, pointing out places where order matters and places where it doesn't.

Say: Introduce students to the idea that it is possible to create algorithms for the things that we do everyday. Give them a couple of examples, such as making breakfast, brushing teeth, and planting a flower.

Main Activity (20 min)

Real-Life Algorithms: Paper Planes - Worksheet

You can use algorithms to help describe things that people do every day. In this activity, we will create an algorithm to help students fold a paper plane.

Pair: Have students pair up with an elbow partner to cut the individual steps apart. They should discuss among themselves which six are needed and which three can be recycled.

Distribute: Hand out some blank paper (or the back of other papers) for students to glue/tape their instructions to once they've decided on the order. Make sure they have a second piece that they can actually fold into the final plane.

Share: Finally, have students trade their finished algorithms with another pair and have them use one another's algorithms to make a paper plane.

Circulate: Walk around during the activity and check that students are trying to debug mistakes. If they get stuck, have them check-in with the group who originally coded their algorithm and see if they can work together to fix it.

Discuss: What did we learn?

- How many of you were able to follow your classmates' algorithms to make your planes?
- Did we leave anything out when making the plane?
 - What would you have added to make the algorithm even better?
 - What if the algorithm had been only one step: "Fold a Paper Plane"?
 - Would it have been easier or harder?
 - What if it were forty steps?
- What was your favorite part about this activity?

💡 Lesson Tip

If you think it will be too difficult for your students to decide which steps are correct, do that piece together as a class before you break up into pairs.

💡 Lesson Tip

If you are concerned about injury when your students begin flying their paper planes, we recommend having them blunt the tip of the plane by either folding it inward or ripping it off and covering the ripped edges with tape.

Wrap Up (15 min)

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Can you imagine an algorithm for building a real plane? What do you think that would look like?
- Write out an algorithm that would take you from your desk to the front of the class.

Assessment (15 min)

Daily Algorithms - Assessment

- Hand out the **Daily Algorithms - Assessment** and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Go Figure

- Break the class up into teams.
- Have each team come up with several steps that they can think of to complete a task.
- Gather teams back together into one big group and have one team share their steps, without letting anyone know what the activity was that they had chosen.
- Allow the rest of the class to try to guess what activity the algorithm is for.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

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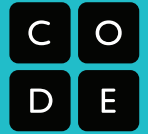
Unplugged

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Date: _____

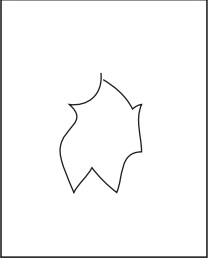
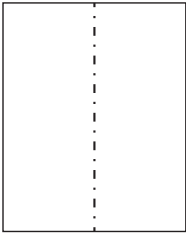

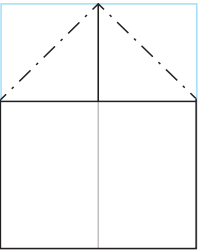
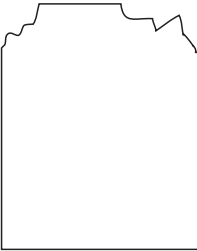
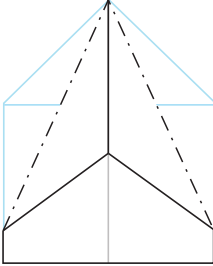
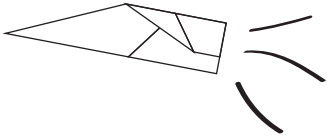
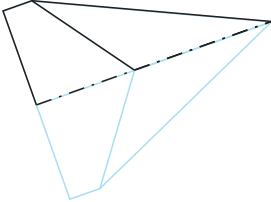
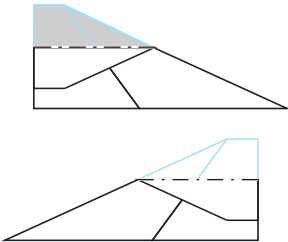
Real-Life Algorithms

Paper Airplane Worksheet



You can use algorithms to help describe things that people do every day. In this activity, we will create an algorithm to help each other make paper airplanes.

Cut out the steps of making an airplane below. Glue the six the correct steps, in order, onto a separate piece of paper. Trade your finished algorithm with another person or group and let them use it to make an actual flying model paper plane!

 <p>CUT CENTER OUT OF PAPER</p>	 <p>CREASE PAPER DOWN THE CENTER</p>	 <p>CRUMBLE PAPER</p>
 <p>FOLD TOP CORNERS TO CENTER</p>	 <p>RIP CORNER OFF PAPER</p>	 <p>FOLD CORNER SIDES TO CENTER</p>
 <p>TOSS FINISHED PLANE</p>	 <p>FOLD PAPER IN HALF AGAIN</p>	 <p>PULL SIDES DOWN</p>



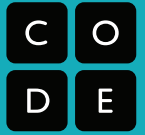
Unplugged

Name: _____

Date: _____

Daily Algorithms

Assessment Worksheet

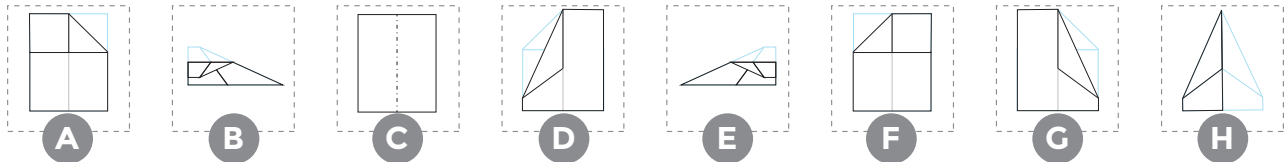


An algorithm is a list of instructions for accomplishing a task. We follow algorithms everyday when it comes to activities like making the bed, making breakfast, or even getting dressed in the morning.

These images are not in order. First, describe what is happening in each picture on the line to its left, then match the action to its order in the algorithm. The first one has been done for you as an example.

<i>Teeth are clean!</i>		○	○	Step 1
_____		○	○	Step 2
_____		○	○	Step 3
_____		○	○	Step 4

Sometimes you can have more than one algorithm for the same activity. The order of some of these steps can be changed without changing the final product. Use the letters on the images below to create two algorithms for making a paper airplane.



ALGORITHM 1: _____

ALGORITHM 2: _____

Lesson 3: Plant a Seed

Unplugged | Algorithms

Overview

In this lesson, students will relate the concept of algorithms back to everyday, real-life activities by planting an actual seed. The goal here is to start building the skills to translate real-world situations to online scenarios and vice versa.

Purpose

In this lesson, students will learn that algorithms are everywhere in our daily lives. For example, it is possible to write an algorithm to plant a seed. Instead of giving vague or over-generalized instructions, students will break down a large activity into smaller and more specific commands. From these commands, students must determine a special sequence of instructions that will allow their classmate to plant a seed.

Agenda

Warm Up (10 min)

Vocabulary
What We Do Daily

Main Activity (20 min)

Real-Life Algorithms: Plant a Seed - Worksheet

Wrap Up (10 - 20 min)

Flash Chat: What did we learn?
Journaling

Assessment (15 min)

Real-Life Algorithms: Plant a Seed - Assessment

Extended Learning

Go Figure

Objectives

Students will be able to:

- Decompose large activities into a series of smaller events.
- Arrange sequential events into their logical order.

Preparation

- Watch the **Plant a Seed - Teacher Video**.
- Prepare supplies for planting seeds. You'll need seeds, dirt, and paper cups for each student or group.
- Print one **Real-Life Algorithms: Plant a Seed - Worksheet** for each student.
- Print one **Real-Life Algorithms: Plant a Seed - Assessment** for each student.
- Make sure each student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Real-Life Algorithms: Planting a Seed - Unplugged Video (download)**
- **Plant a Seed - Teacher Video**
- **Real-Life Algorithms: Plant a Seed - Worksheet**
- **Real-Life Algorithms: Plant a Seed - Worksheet Answer Key**
- **Real-Life Algorithms: Plant a Seed - Assessment**
- **Real-Life Algorithms: Plant a Seed - Assessment Answer Key**

For the Students

- **Feeling Faces - Emotion Images**
- **Think Spot Journal - Reflection Journal**

Vocabulary

- **Algorithm** - A precise sequence of instructions for processes that can be executed by a computer

Teaching Guide

Warm Up (10 min)

Vocabulary

This lesson has one vocabulary word that is important to review:

Algorithm - Say it with me: Al-go-ri-thm

A list of steps that you can follow to finish a task

What We Do Daily

- Ask your students what they did to get ready for school this morning.
 - Write their answers on the board
 - If possible, put numbers next to their responses to indicate the order that they happen
 - If students give responses out of order, have them help you put them in some kind of logical order
 - Point out places where order matters and places where it doesn't
- Introduce students to the idea that it is possible to create algorithms for the things that we do everyday.
 - Give them a couple of examples, such as making breakfast, tying shoes, and brushing teeth.
- Let's try doing this with a new and fun activity, like planting a seed!

Main Activity (20 min)

Real-Life Algorithms: Plant a Seed - Worksheet

You can use algorithms to help describe things that people do every day. In this activity, we will create an algorithm to help each other plant a seed. Directions:

💡 Lesson Tip

You know your classroom best. As the teacher, decide if you should all do this together, or if students should work in pairs or small groups.

- Cut out the steps for planting a seed from **Real-Life Algorithms: Plant a Seed - Worksheet**.
- Work together to choose the six correct steps from the nine total options.
- Glue the six correct steps, in order, onto a separate piece of paper.
- Trade the finished algorithm with another person or group and let them use it to plant their seed!

Wrap Up (10 - 20 min)

💡 Lesson Tip

If deciding on the correct steps seems too difficult for your students, do that piece together as a class before you break up into teams.

Flash Chat: What did we learn?

- How many of you were able to follow your classmates' algorithms to plant your seeds?
- Did the exercise leave anything out?
 - What would you have added to make the algorithm even better?
 - What if the algorithm had been only one step: "Plant the seed"?
 - Would it have been easier or harder?
 - What if it were forty steps?
- What was your favorite part about that activity?

Journaling

Ask the students to go back to their desks to reflect individually on what they learned. Write a couple of the questions up above on a whiteboard. Ask the students to discuss these in their journal. Sample prompts include:

Journal Prompts:

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Draw the seed you planted today.
- Write the algorithm you used to plant the seed.

Assessment (15 min)

Real-Life Algorithms: Plant a Seed - Assessment

- Hand out the **Real-Life Algorithms: Plant a Seed - Assessment** and allow students to complete the activity independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Go Figure

- Break the class up into teams.
- Have each team come up with several steps that they can think of to complete a task.
- Gather teams back together into one big group and have one team share their steps, without letting anyone know what the activity was that they had chosen.
- Allow the rest of the class to try to guess what activity the algorithm is for.

Standards Alignment

View full course alignment

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- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **LS** - Life Science

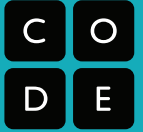


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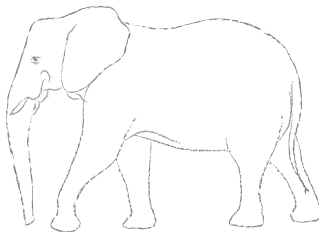






Real-Life Algorithms

Plant a Seed Worksheet



You can use algorithms to help describe things that people do every day. In this activity, we will create an algorithm to help each other plant a seed.

Cut out the steps of planting a seed below, then work together to glue the six correct steps, in order, onto a separate piece of paper. Trade your finished algorithm with another person or group and let them use it to plant their seed!

 <p>PUT POT IN SUNLIGHT</p>	 <p>PUT SEED IN HOLE</p>	 <p>HUG AN ELEPHANT</p>
 <p>PUT GLUE ON SEED</p>	 <p>FILL POT WITH SOIL</p>	 <p>POKE HOLE IN SOIL</p>
 <p>WATER POT</p>	 <p>COVER SEED WITH SOIL</p>	 <p>POUR SODA POP IN POT</p>



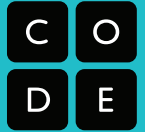
Unplugged

Name: _____

Date: _____

Real-Life Algorithms

Assessment Worksheet



An algorithm is a list of steps that you can follow to finish a task. We follow algorithms every day when it comes to activities like making the bed, making breakfast, or even getting dressed in the morning.

Pria the Programmer just woke up and is still feeling very sleepy. Can you put together some algorithms to help Pria get ready for the day?

Help Connie Put on Shoes:

1	2	3
---	---	---



Help Connie Brush her Teeth:

1	2	3	4
---	---	---	---



Help Connie Plant a Seed:

1	2	3	4	5	6
---	---	---	---	---	---





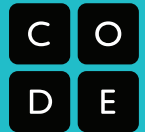
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Name: _____

Date: _____

Real-Life Algorithms

Assessment Worksheet

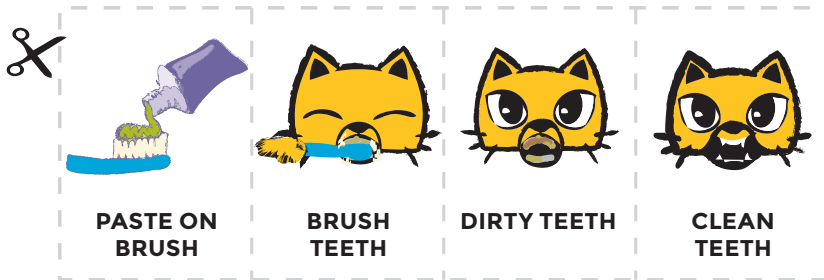


These items are out of order. To help Princess Pria, cut out each picture and rearrange them into the right sequence.

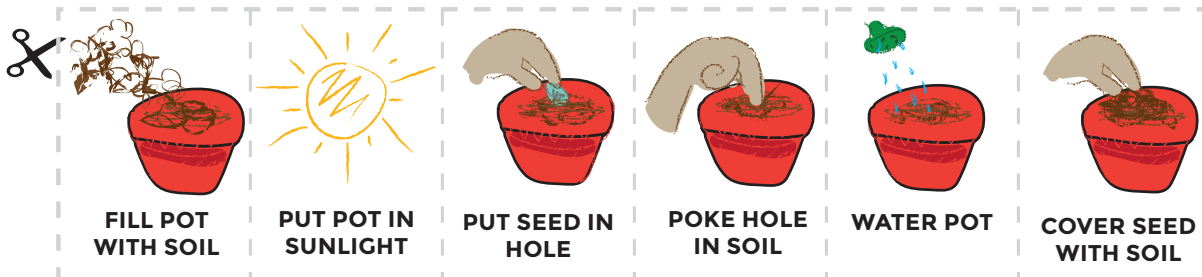
Put on Shoes



Brush Teeth



Plant a Seed



Lesson 13: The Power of Words

Common Sense Education | Cyberbullying

Overview

Students consider that while they are enjoying their favorite websites they may encounter messages from other kids that can make them feel angry, hurt, sad, or fearful. They explore ways to handle cyberbullying and how to respond in the face of upsetting language online.

Students discuss all the ways they use technology for communication and explore the similarities and differences between in-person and online communication. Students then brainstorm ways to respond to cyberbullying.

Purpose

This lesson will provide students with the tools that they need to handle cyberbullying if they are ever in the situation of having someone negatively respond to their online postings.

Students may not ever have the misfortune of experiencing cyberbullying, but they should understand what it is so that they can spot it online. Students will learn how to identify cyberbullying and what steps they should take to make it stop. This may become helpful in later puzzles when students have the opportunity to share their work.

Agenda

Warm Up (5 min)

Introduction

Main Activity (35 min)

What's the Problem?

Crossing the Line

Talk and Take Action

Wrap Up (15 min)

Flash Chat: What did we learn today?

Journaling

Assessment (10 min)

Objectives

Students will be able to:

- Empathize with those who have received mean and hurtful messages.
- Judge what it means to cross the line from harmless to harmful communication online.
- Generate solutions for dealing with cyberbullying.

Preparation

- ▢ Preview the **Common Sense Education - Power of Words - Teacher Prep Guide** and prepare to show it to your class.
- ▢ Print out the **Words Can Hurt Handout** from **Common Sense Education - Power of Words - Teacher Prep Guide** (page 7) for each group of four.
- ▢ Print out the **Talk and Take Action Handout** from **Common Sense Education - Power of Words - Teacher Prep Guide** (page 6) for each student.
- ▢ Print out the assessment on page 8-9 of **Common Sense Education - Power of Words - Teacher Prep Guide**.
- ▢ Obtain colored pencils and a string the length of the classroom.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Common Sense Education - Power of Words - Teacher Prep Guide**
- **The Power of Words - Lesson Video**
- **Common Sense Education - Website**
- **CSF Digital Citizenship - Resource List**

For the Students

- **Feeling Faces - Emotion Images**
- **Think Spot Journal - Reflection Journal**

Vocabulary

- **Cyberbully** - Using technology tools to deliberately upset someone else.

Teaching Guide

Warm Up (5 min)

Introduction

Draw a series of expressive faces on the board. View **Feeling Faces - Emotion Images** for examples.

Invite the students to suggest emotions that match each face's expression. With every suggestion, write the emotion next to the feeling face. Answers will vary.

Tell students that not everyone will react to a particular situation in the same way, but just because a reaction is different from our own, doesn't mean we should discount others' feelings.

Explain to students they are going to watch a video about how words, whether typed or spoken, can impact how someone else feels.

Show students **The Power of Words - Lesson Video**.

Ask:

- Who has heard of the saying, "Sticks and stones may break my bones, but words will never hurt me"?
- What did Guts mean in his text that sometimes words can hurt?
 - Words are powerful. Sometimes it is hard to ignore what someone is saying when it's a mean name. Names *can* make you feel sad or hurt.

Remind students to keep Leg's question in the back of their mind during this lesson: *How do you treat others online?*

Main Activity (35 min)



What's the Problem?

Organize students into groups of four and have each group pick a person to record their ideas.

Distribute the **Words Can Hurt Student Handout**. Have the groups of students read the scenario about Rani and Aruna receiving mean messages through a children's game website.

Have each group answer the questions, then have them share their responses with the class. Look for responses that show empathy for Rani and Aruna and acknowledge that the messages sent to them were mean and hurtful. Ask the students to read the 'Use Common Sense!' section on the **Words Can Hurt Student Handout**.

Invite students to share their own stories.

Ask:

- Have you seen mean messages sent to you or others online? Tell us about it, but do not use real names.

Divide students into pairs.

Invite one partner to write the phrase "You're weird" on a piece of paper, then hand it to their partner. Tell them that they just received this text.

Ask:

- What are the reasons the person might have texted "You're weird"?
 - They're continuing an inside joke; the first person did something silly at an earlier time; a group of kids is teasing the kid; the person who sent the text really does think the person is weird but is afraid to say it to his or her face.
- How did the partner feel about being called weird?
 - Possibly like the other person was kidding around, but maybe that the person was teasing or being hurtful.

Tell one person from each pair to say to the other person, "You're weird," with a smile on their face.

Ask:

- Why might you feel differently if you could see the person?
 - People give non-verbal cues through facial expressions and body language.

Crossing the Line

Place the piece of string across the length of the classroom. Ask students to stand on one side of the line. Then ask them to imagine that they are online and somebody has sent them a message, which you will read to them. Tell the students to stay where they are if they think the message is okay; to cross over the line if they think the message is not okay; or to stand on the line if they think the message is in between.

Read:

- You are my friend.
- You are an idiot.
- I'm having a party and you're not invited.
- I like your new haircut.
- You are ugly.
- Thanks for the advice. Next time, will you tell me in person rather than through text?
- Did you finish your homework?
- Why is it taking you so long to finish it?
- You are such a freak.

Review with the students that kids like to go online and use cell phones to email, chat, watch videos, send messages, play games, and do homework. But sometimes the language can get mean or scary. Messages that make people feel bad cross the line. Sometimes that meanness is unintentional, but when people use tools such as the internet and cell phones to deliberately upset someone else over and over, that's cyberbullying.

Talk and Take Action

Have students return to their seats.

Discuss how easy is it to feel angry or upset when somebody sends you a mean or scary message online.

Define:

- **Cyberbullying:** Using technology tools such as the internet and cell phones to deliberately upset someone else.

Explain that cyberbullies deliberately try to make you feel that way, just like real-life bullies.

Discuss:

- Cooling down can be a good first step when you receive a mean message online. Taking a deep breath, counting backwards from 10, or pausing to think about what you will do next can give you time to think of the BEST way to handle the situation.
- Finding help or telling a trusted adult or friend can be a good way to take action. You shouldn't deal with the cyberbullying situation alone. The person you tell should be someone who wants to hear what you have to say and will help you work on a solution. Adults can be especially good because they often have the power to influence the situation or they can give you advice about what to do.
- Ignoring the person who is cyberbullying you can be very effective. Those who bully often like attention.
- Whatever you do, remember to keep a copy of your communication with the individual who is cyberbullying you. If you delete the communication, there is no proof of how the bully treated you if you need to show a trusted adult.

Distribute the **Talk and Take Action Student Handout** to each student. Encourage them to depict a cyberbullying scenario and possible solution. They can use pencils and paper to make the comics.

Wrap Up (15 min)

Flash Chat: What did we learn today?

You can use these questions to assess your students' understanding of the lesson objectives. You may want to ask students to reflect in writing on these questions in their **Think Spot Journal - Reflection Journal**.

Ask:

- Why is it a bad idea to send mean or scary messages online?
 - Because they can make the person who gets the message upset, angry, or scared.
- Why might there be more misunderstandings between people when they send online messages as opposed to a face-to-face discussion?
 - Online messages can be more confusing or scarier than face-to-face messages because there are no face-to-face cues to help you understand people's intentions.
- What can kids do when they get cyberbullying messages?
 1. Stay calm and take a deep breath
 2. Tell a friend or trusted adult who can help develop a plan to handle the situation
 3. Ignore the bully
 4. Keep a copy of the communication with the bully.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is cyberbullying?
- Who are some people you can go to if you are ever bullied online or in person?

Assessment (10 min)

Print out the assessment from **Common Sense Education - Power of Words - Teacher Prep Guide** (page 8-9) and distribute it to the class. Give students enough time to complete the assessment, but make sure there is enough time to go over answers.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **NI** - Networks & the Internet

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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The Power of Words

Directions

Create a cartoon about a cyberbullying situation. Each frame should show a different part of the situation:

FRAME 1: Make a cartoon about something that a cyberbully might do or write online. Remember to use language appropriate for school.

FRAME 2: Show what you might do if you saw what the cyberbully has done or written.

FRAME 3: What might be a positive outcome, or result, of the situation?

What might a cyberbully say or do?

What would you do in response?

What would a positive outcome be?

Use Common Sense!

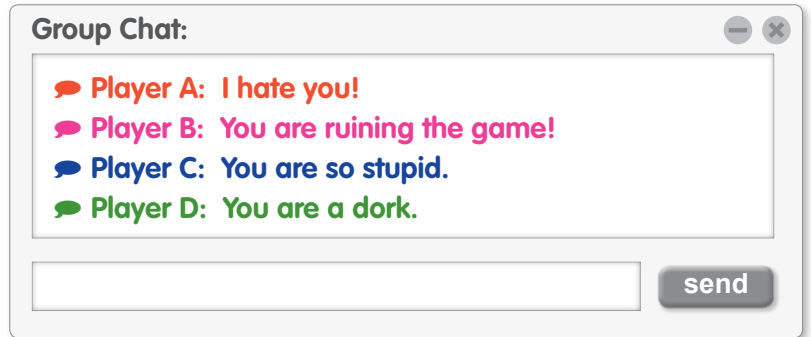
- If someone is mean to you online, take a breather and ignore them. Save a copy of your conversation between you and the bully.
- If you, or someone you know, is cyberbullied, talk to a trusted adult – like a parent, family member, or teacher. Together, you can think of a plan for how to respond.

The Power of Words

Directions

Read the story below and then answer the questions that follow.

Rani and Aruna love a website that has games and chatting for kids. Their parents let them play on the site. Lately, though, Rani and Aruna have been receiving mean messages on the site, including:



1. How do you think Rani and Aruna feel when they read those messages?

Rani and Aruna feel _____

2. How would you feel if you received messages like these?

I would feel _____

3. Why do you think people send these kinds of message to people they don't know?

People send these kinds of messages because _____

Use Common Sense!

There's an old saying: "Sticks and stones may break my bones, but words will never hurt me."

I think that this saying is TRUE/NOT TRUE (circle one) because _____


The Power of Words

1. Alicia receives a text message from her friend Ronald. The message says, “I am having a party. You are not invited.” Circle the word that shows how Alicia might feel after she receives the message.


- a) hurt
- b) excited
- c) popular

2. Theo is having fun playing Dragons and Knights online. Then he sees a message from another player. It says, “You’re ruining the game, stupid!” What should Theo do about the message? What shouldn’t he do? Use the chart below to fill in the letters that go with each answer.

- a) Ignore the player who sent the mean message
- b) Write a message back that says, “You’re so stupid, you’re the one ruining the game”
- c) Pretend that he doesn’t feel hurt by the message
- d) Save the message in case the other player sends Theo another mean message
- e) Tell an adult about the message
- f) Never play Dragons and Knights online again



Things Theo should do	Things Theo should not do



The Power of Words

3. The following acronym, **STOP**, gives advice on what to do when something goes wrong online. Explain what each letter means.

STOP	What is the meaning of each phrase? Explain in your own words.
S tep away	
T ell a trusted adult	
O kay sites first	
P ause and think online	

Lesson 12: Private and Personal Information

Common Sense Education | Personal Information | Private Information | Identity Theft

Overview

Developed by Common Sense Education, this lesson is about the difference between information that is safe to share online and information that is not.

As students visit sites that request information about their identities, they learn to adopt a critical inquiry process that empowers them to protect themselves and their families from identity theft. In this lesson, students learn to think critically about the user information that some websites request or require. They learn the difference between private information and personal information, as well as how to distinguish what is safe or unsafe to share online.

Purpose

Common Sense Education has created this lesson to teach kids the importance of security on the internet. By discussing the difference between personal and private information, students will be able to recognize what information should and shouldn't be shared. Students will also learn what signs you should look for to determine if a website is safe or not.

Agenda

Warm Up (5 min)

Introduction

Main Activity (35 min)

Log In

Private and Personal

What's Safe to Share Online?

Wrap Up (15 min)

Flash Chat: What did we learn about today?

Journaling

Assessment (10 min)

Private and Personal Information

Objectives

Students will be able to:

- Learn about the benefits and risks of sharing information online.
- Understand what type of information can put them at risk for identity theft and other scams.

Preparation

- ▢ Copy the *Protect Yourself Student Handout* (7th page of the teacher prep guide), one for each student.
- ▢ Copy the *All About Me Student Handout* (6th page of the teacher prep guide), one for each student.
- ▢ Print out an assessment (8th page of the teacher prep guide) for each student. Teacher version is the page after the student assessment.
- ▢ Preview websites like **Neopets**, **Nickelodeon**, and **BookAdventure** and prepare to show them to the class.
- ▢ Review **CSF Digital Citizenship - Resource List** for more online safety content.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Common Sense Education - Private and Personal Information** - Teacher Prep Guide
- **Common Sense Education** - Website
- **CSF Digital Citizenship** - Resource List

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Identity Theft** - When a thief steals someone's private information in order to pretend to be that person.
- **Personal Information** - Information that can't be used to identify you.
- **Private Information** - Information that can be used to identify you.
- **Register (Online)** - To enter your information in order to sign up and get access to a website.

Teaching Guide

Warm Up (5 min)

Introduction

Ask:

- What types of information do you think are okay to share publicly online such as on an online profile that others will see?
 - Interests and favorite activities
 - Opinions about a movie
 - First name
- What are some examples of websites where you must register in order to participate?
 - Social networking sites
 - Video-sharing sites
 - Youth discussion sites
 - Ask-an-expert sites
 - Game sites

Write the names of the websites on the board. Explain that it's important to know that sharing some kinds of user information can put you and your family's privacy at risk.

Main Activity (35 min)



Log In

Project for the class, or have students go online to **Neopets**, **Nickelodeon**, or **BookAdventure**. *Do not ask the students to sign up for these sites!*

Discuss with the students the kinds of information that each website requires or requests before the users can participate.

Ask:

- What information is required? Why do you think it is required?
 - First name, username, password, password hint, gender, the state you live in, parent's permission, etc. This information is required because it helps distinguish one person from another. Or perhaps the website is keeping a record of who uses it.
- What information is optional? Why do you think it is optional?
 - Parent's email, birthday, state, country, gender, etc. This information is likely optional because the website does not require it for payment or to distinguish people. Or perhaps the website wants to keep track of this kind of information.
- Why do you think websites ask for this kind of information?
 - They want to get people to pay in order to use the site, they want to send messages to people who are signing up, or they want to try to sell things to those people.

Point Out that you do not have to fill out fields on websites if they are not required. Required fields are usually marked by an asterisk (*) or are highlighted in red.

Private and Personal

Explain to the students that some kinds of information are generally safe to share on the internet and some are not. However, the information that's considered safe should not be shared one-on-one with people the students don't already know offline.

Define:

- **Personal Information:** Information that can't be used to identify you.
- **Private Information:** Information that is about you and can be used to identify you.

Teacher Tip

As an offline alternative, print out and copy the website pages that ask for registration and log-in information. Distribute these to the students.

Teacher Tip

If you'd like a more clear distinction between "personal" and "private" information in these definitions, you can use other phrases like "friendly information" or "sharable information" to better define the line that the students should recognize. We chose to keep "personal" and "private" to stay true to Common Sense Education's lesson plan.

Emphasize that personal information is usually safe to share online. Private information is usually unsafe to share online, meaning students should get permission from a parent or guardian before sharing this kind of information.

Share the following examples of information that is safe or unsafe to share:

SAFE - Personal Information	UNSAFE - Private Information
<ul style="list-style-type: none"> - Your favorite food - Your opinion (though it should be done respectfully) - First name (with permission) 	<ul style="list-style-type: none"> - Mother's maiden name - Social Security number - Your date of birth - Parents' credit card information - Phone number

Ask:

- Why would someone want to steal someone else's identity on the internet?
 - To steal money
 - To do something bad or mean
 - To hide their real identity

Define:

- **Identity Theft:** When a thief steals someone's private information in order to pretend to be that person.

Explain that an identity thief uses private information to pretend to be the person whose identity he or she has stolen. Once the thief has taken someone's identity, he or she can use that person's name to get a driver's license or buy things, even if the person whose identity they stole isn't old enough to do these things! It's often not until much later that people realize their identity has been stolen. Identity thieves may also apply for credit cards in other people's names and run up big bills that they don't pay off. Let students know that identity thieves often target children and teens because they have a clean credit history and their parents are unlikely to be aware that someone is taking on their child's identity.

Emphasize the difference between private information (which can be used to steal your identity) and personal information (which cannot be used to steal your identity). Invite students to answer the following questions (write their answers on the board):

Ask:

- What kinds of private information could an identity thief use to find out and steal your identity?
 - First and last name, postal address, email address, phone numbers, passwords, credit card numbers, Social Security number, mother's maiden name.
- What kinds of personal information could you share about yourself without showing your identity?
 - Your age, gender, how many siblings you have, your favorite music, your favorite food, what pets you have, the name of your pet, your opinion about something.

Explain to students that on the internet, people you interact with could be your friends next door or strangers who live on the other side of the world. Because it's hard to know the intentions of people who you've never met before, it is best to remain cautious when sharing your information. You wouldn't give strangers your private information in the real world, and you need to be just as careful when you're online.

Remind students how important it is each time they share information online to stop and think: "Am I giving out information that I should keep private?" Point out that it can sometimes be safe to give out some private information. For example, a website might ask for your birth date or email address. But students should always ask their parent or guardian before giving out private information.

Distribute the *Protect Yourself Student Handout* and have students complete the activity. Review the answers as a class.

What's Safe to Share Online?

Distribute the *All About Me Handout*. Have students write down all the personal information they would like to share on a public profile in an online community. Emphasize that even though personal information is safe to share online, it is okay to choose not to share it. Remind students that everything on the list should be safe to share; none of it should be private information that can put their identity at risk.

Encourage students to share their lists with the class.

Ask:

- Is there anything on the lists that could be used by an identity thief? Why?
 - Guide students to explain their answers and encourage them to use the vocabulary terms.

Wrap Up (15 min)

Flash Chat: What did we learn about today?

You can use these questions to assess your students' understanding of the lesson objectives. You may want to ask students to reflect in writing on one of the questions, using a journal or an online blog/wiki.

Ask:

- What is identity theft?
 - Using someone else's private information to pretend to be that person.
- How do personal information and private information differ?
 - Private information, such as a Social Security number, is unsafe to share. It should be kept private so that identity thieves cannot use it. Personal information, such as your favorite food, cannot be used by identity thieves and is safe to share. Even though personal information is usually safe to share online, you might choose not to share this information, and that's fine.
- What would be a good rule for kids about giving out private information?
 - They should not share it online without the permission of a teacher, parent, or guardian.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What did you learn in today's lesson?
- How do you feel about today's lesson?
- Give an example of personal information and private information.
- What's a website that you use often? How do you know it is a safe website to use?

Assessment (10 min)

Private and Personal Information

Hand out the assessment to students. Allow students time to complete the assessment. If there is time left over, go over the answers with the students.

Standards Alignment

View full course alignment

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- ▶ **L** - Language
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Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **NI** - Networks & the Internet

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Private and Personal Information

Directions

Pretend you have a public profile in an online community. There are people you know, and people you don't know, who can view your profile.

Write down personal information that you would want to share about yourself. Make sure that everything on your list is safe to share and that it is not private information that could reveal your identity.

Use Common Sense!

Each time you share information about yourself online, stop and think: "Am I giving out information that I should keep private?"

Personal information often is safe to share. But you should never share private information without the permission of a parent, guardian, or teacher.

Private and Personal Information

Directions

Decide if each piece of information below is an example of personal information or private information. Then check the box to show your answer.

Information	Personal	Private
Full name (first and last)		
Age		
Street address		
Email address		
Date of birth		
Gender		
How many brothers and sisters you have		
Favorite band		
Phone numbers		
Credit card information		
Favorite food		
The name of your pet		
Mother's maiden name		
Name of your school		

Private and Personal Information

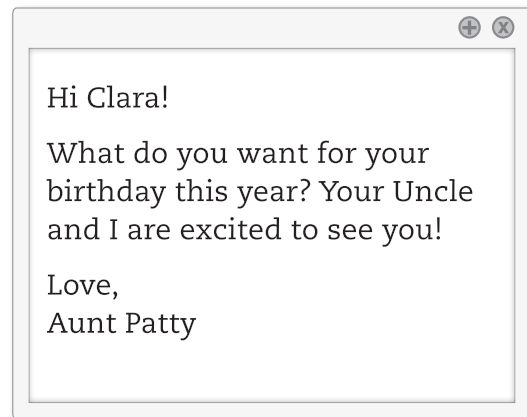
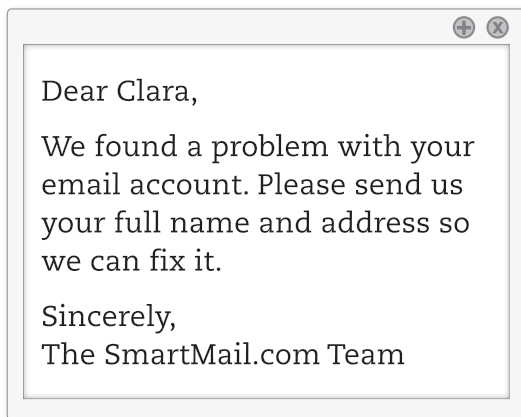
1. If a website asks you for your _____ online, you should talk to a parent or family member.

- a) favorite color
- b) date of birth
- c) screen name

2. An identity thief probably would not be interested in your personal information, such as _____.

- a) our full name
- b) your street address
- c) your favorite movie

3. Clara received two emails. Which email should she NOT respond to?
Circle your answer.



Private and Personal Information

1. If a website asks you for your _____ online, you should talk to a parent or family member.

- a) favorite color
- b) date of birth**
- c) screen name

Answer feedback

The correct answer is **b**. Your date of birth is an example of private information. If a website asks for private information, you should ask a trusted adult before doing anything.

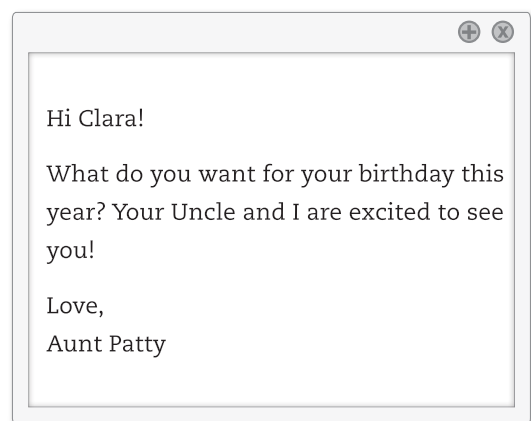
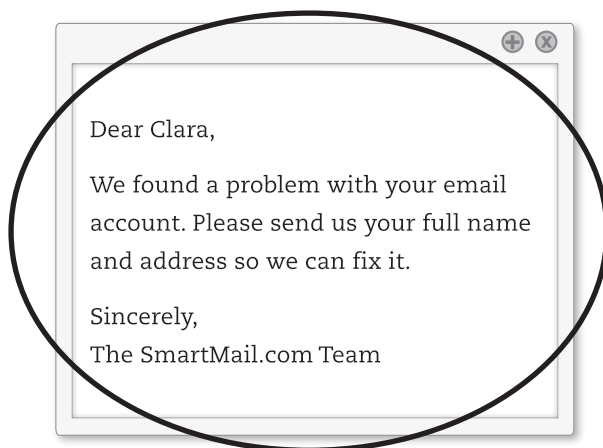
2. An identity thief probably would not be interested in your personal information, such as _____.

- a) your full name
- b) your street address
- c) your favorite movie**

Answer feedback

The correct answer is **c**. Both your full name and your street address are examples of private information. Personal information, like your favorite movie, would probably not be useful for an identity thief.

3. Clara received two emails. Which email should she NOT respond to? Circle your answer.



Answer feedback

If an email asks you for private information, such as your full name or address, you should not respond—especially if you do not know the person who sent the message.

Lesson 3: Relay Programming

Unplugged | Relay Programming | Algorithms

Overview

This activity will begin with a short lesson on debugging and persistence, then will quickly move to a race against the clock as students break into teams and work together to write a program one instruction at a time.

Purpose

Teamwork is very important in computer science. Teams write and debug code with each other, instead of working as individuals. In this lesson, students will learn to work together while being as efficient as possible.

This activity also provides a sense of urgency that will teach students to balance their time carefully and avoid mistakes without falling too far behind. This experience can be stressful (which is expected!) Make sure you provide students with the tools to deal with potential frustration.

Agenda

Warm Up (15 min)

Where did I go wrong?

Main Activity (20 min)

Relay Programming

Wrap Up (15 min)

Journaling

Extended Learning

Objectives

Students will be able to:

- Define ideas using code and symbols.
- Verify work done by teammates.
- Identify signs of frustration

Preparation

- Watch the **Relay Programming - Teacher Video**.
- Locate a wide open space for this activity, such as the gym or outdoor field.
- Print out one **Relay Programming Activity Packet - Activity Packet** for each group.
- Supply each group with plenty of paper and pens/pencils.
- Print one **Relay Programming - Assessment** for each student.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

For the Teacher

- **Relay Programming - Teacher Debugging - Image**
- **Relay Programming - Unplugged Video (download)**
- **Relay Programming - Teacher Video**

For the Students

- **Relay Programming Debugging Packet**
- **Relay Programming Activity Packet - Activity Packet**
- **Think Spot Journal - Reflection Journal**

Vocabulary

- **Algorithm** - A list of steps to finish a task.
- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Frustrated** - Feeling annoyed or angry because something is not the way you want it.
- **Persistence** - Trying again and again, even when something is very hard.
- **Program** - An algorithm that has been coded into something that can be run by a machine.

Teaching Guide

Warm Up (15 min)

Recall that in "Graph Paper Programming" we guided our teammate's Automatic Realization Machine (ARM) using arrows. This warm up will bring back these ideas, which will be needed in the main activity.

Where did I go wrong?

Goal: In this lesson, we want to help students learn to identify and fix bugs in their own programs. The easiest way to do that is to first present students with a program that contains bugs that are not their fault. Once they've helped you fix "your" program, share with them how frustrating it can be to make mistakes, and help them see that those feelings are completely normal and they shouldn't feel embarrassed by them.

Display: Show your students the provided **Relay Programming - Teacher Debugging - Image**.



Discuss: Get the attention of the class and let them know that you are stuck! You have this challenge, and you thought you had solved it, but it doesn't seem to be working. Your program has a bug, can they help you fix it?

Take a moment to walk them through the rules: - Start at the star - Follow the instructions step-by-step - End when all of the right squares are filled in

Optional: Follow along by filling in a blank grid. Express frustration when the picture doesn't turn out the way that you wanted it to.

Think: Can you figure out why my program doesn't work?

Pair: Let students work together to see if they can figure out what the program is supposed to say.

Share: Ask students if anyone was able to figure out a way to solve the problem. When you get a correct answer, let the students know that they are great at "debugging"!

Discuss: Ask the students if they could tell how you were feeling when you couldn't figure out the answer. They might suggest that you were "mad" or "sad". Instead of telling them "no", describe that you were feeling a little bit mad, a little bit sad, and a little bit confused. When you put all of those emotions together, it makes a feeling called "frustration". When you are "frustrated" you might think you are mad, sad, or confused -- and you might be tempted to give up -- but frustration is a natural feeling and it's a big hint that you are about to learn something! Instead of quitting, practice persistence. Keep trying over and over again. After a few times, you will start to understand how to debug your problems!

Distribute: To make sure that students understand the idea of finding and fixing errors (debugging) pass out the **Relay Programming Debugging Packet** and have students complete the task in pairs.

Optional: If you want to move the activity along more quickly, feel free to complete these as a class, instead.

Transition: Now it's time to play the game!

Content Corner

For more on persistence and frustration, try reading **Stevie and the Big Project** to your students. It will help them spot moments of frustration. It will also help give them the tools to deal with it.

If you do not read the book, take a moment to cover tips on frustration and persistence as a class:

Tips to Help With Frustration

- Count to 10
- Take deep breaths
- Journal about them
- Talk to a partner about them
- Ask for help

Tips for Being Persistent

- Keep track of what you have already tried
- Describe what is happening
- Describe what is supposed to happen
- What does that tell you?
- Make a change and try again

Main Activity (20 min)

Relay Programming

With Graph Paper Programming in mind, it's time to split up into teams and prepare to run the activity as a relay!

Set-Up: Prepare the **Relay Programming Activity Packet - Activity Packet** by printing out one copy for each team of 4-5 students. Cut or fold each page along the center dotted line.

Go over the rules of the game with your class:

- Divide students into groups of 3-5.
- Have each group queue up relay-style.
- Place an identical image at the other side of the room/gym/field from each team.
- Have the first student in line dash over to the image, review it, and write down the first symbol in the program to reproduce that image.
- The first student then runs back and tags the next person in line, then goes to the back of the queue.
- The next person in line dashes to the image, reviews the image, reviews the program that has already been written, then either debugs the program by crossing out an incorrect symbol, or adds a new one. That student then dashes back to tag the next person, and the process continues until one group has finished their program.

Clarifications

Here are some clarifications that need to be shared from time to time:

- Only one person from each group can be at the image at one time.
- It is okay to discuss algorithms with the rest of the group in line, even up to the point of planning who is going to write what when they get to the image.
- When a student debugs a program by crossing out an incorrect instruction (or a grouping of incorrect instructions) this counts as their entire turn. The next player will need to figure out how to correct the removed item.

First group to finish with a program that matches the image is the winner! Play through this several times, with images of increasing difficulty.

Go through the game as many times as you can before time runs out or your students begin feeling exhausted.

Transition: Once the game is over, circle everyone up to share lessons learned.

Discuss: What did we learn today?

- What if each person on a team were allowed to do five arrows at a time?
 - How important would it be to debug our own work and the work of the programmer before us?
 - How about with 10 arrows?
 - 10,000? Would it be more or less important?
- Do you think a program is better or worse when more than one person has worked on it?
- Do you think people make more or fewer mistakes when they're in a hurry?
- If you find a mistake, do you have to throw out the entire program and start over?

Wrap Up (15 min)

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- How did teamwork play a role in the success of writing today's program?
- Did you start to get frustrated at any point? What did you do about it?

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Pass the paper

- If you don't have the time or room for a relay, you can have students pass the paper around their desk grouping, each writing one arrow before they move the paper along.

Fill It, Move It

- As the teacher, draw an image with as many filled squares as children in each group.
- Have the students write as many arrows in the program as it takes to get to a filled-in square (including actually filling that square in) before passing to the next person.

Debugging Together

Draw an image on the board. Have each student create a program for the image. Ask students to trade with their elbow partner and debug each other's code.

- Circle the first incorrect step, then pass it back.
- Give the students another chance to review and debug their own work.
- Ask for a volunteer to share their program.

Ask the class:

- How many students had the same program?
- Anyone have something different?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Game #1

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #2

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #3

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #4

Step 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Game #5

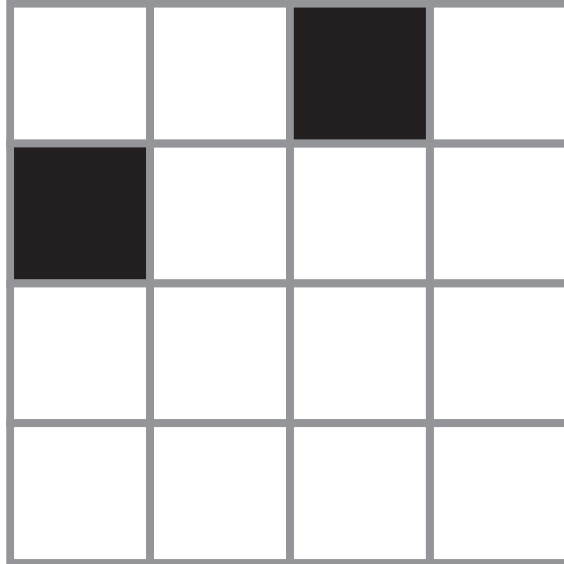
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Step 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Step 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

1

Relay Programming

Relay Image 1

C O
D E



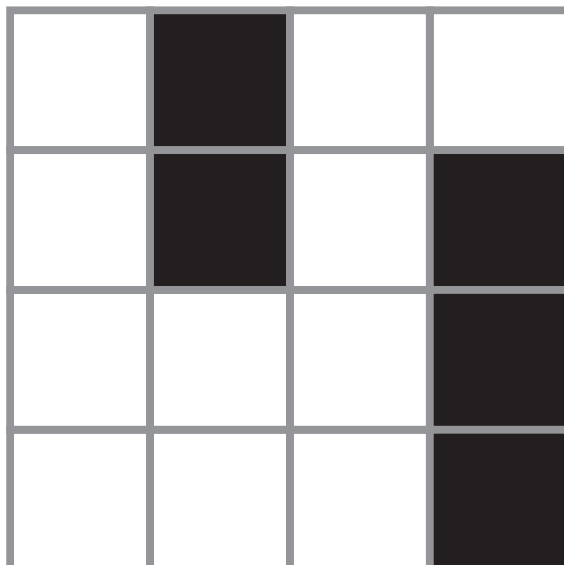
Revision 140710.1a

2

Relay Programming

Relay Image 2

C O
D E



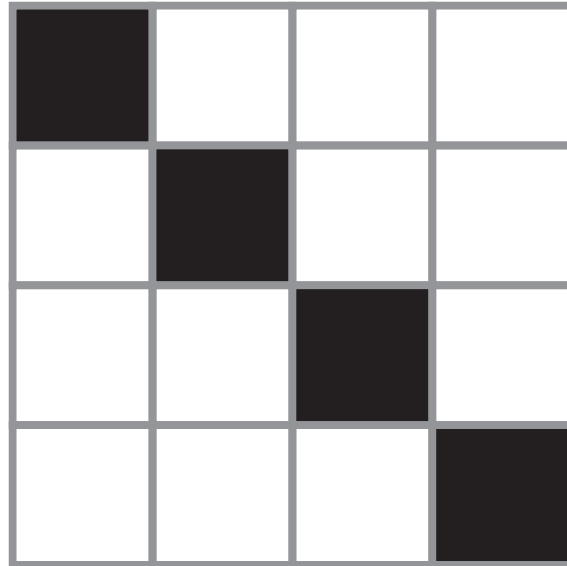
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3

Relay Programming

Relay Image 3

C O
D E



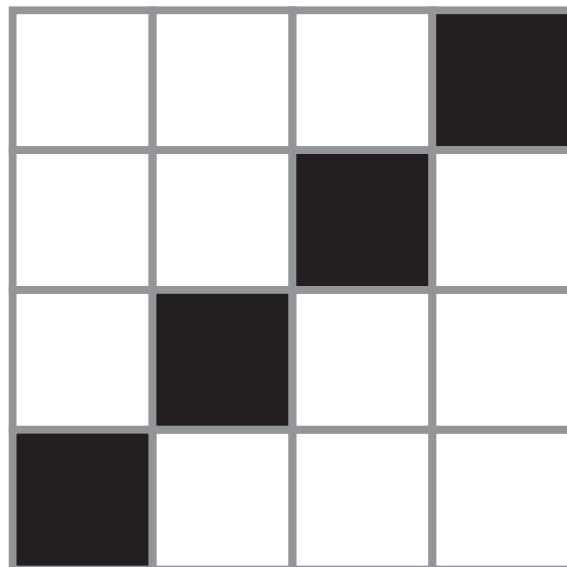
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4

Relay Programming

Relay Image 4

C O
D E



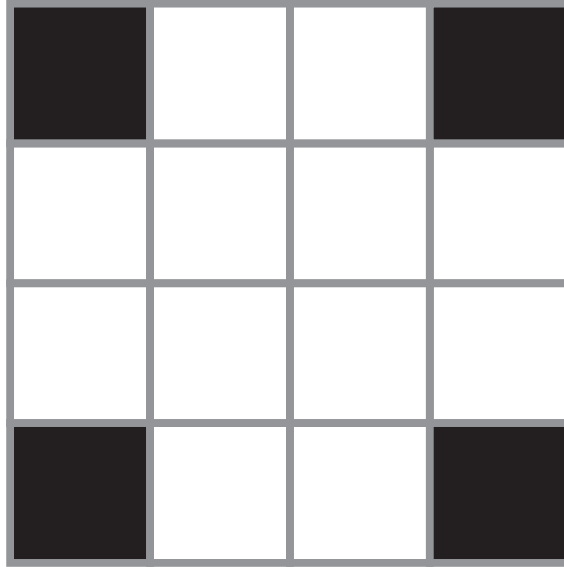
Revision 140710.1a

5

Relay Programming

Relay Image 5

C O
D E



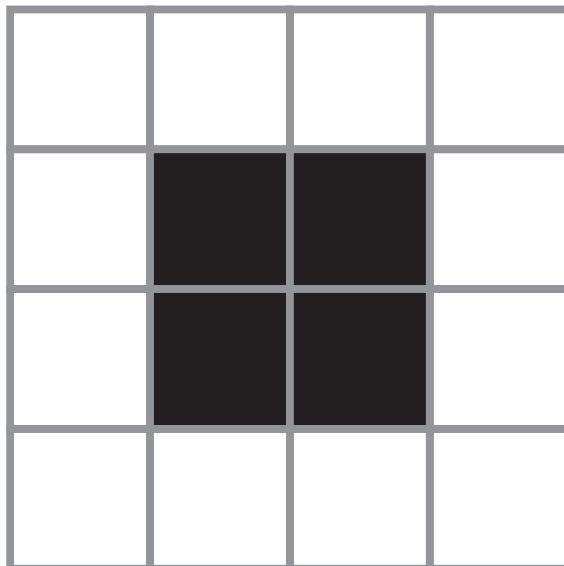
Revision 140710.1a

6

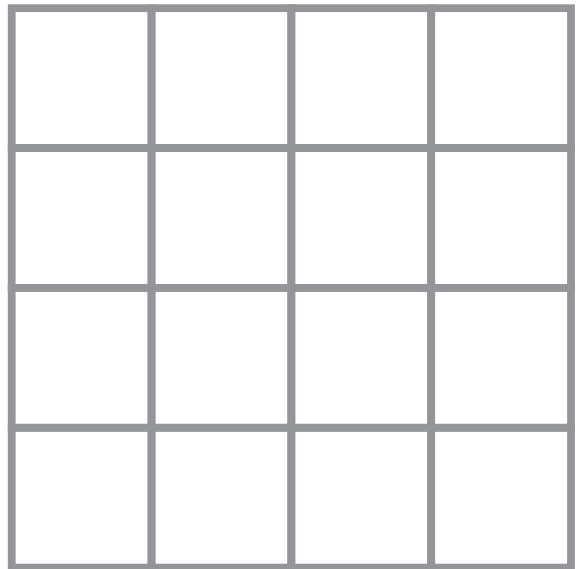
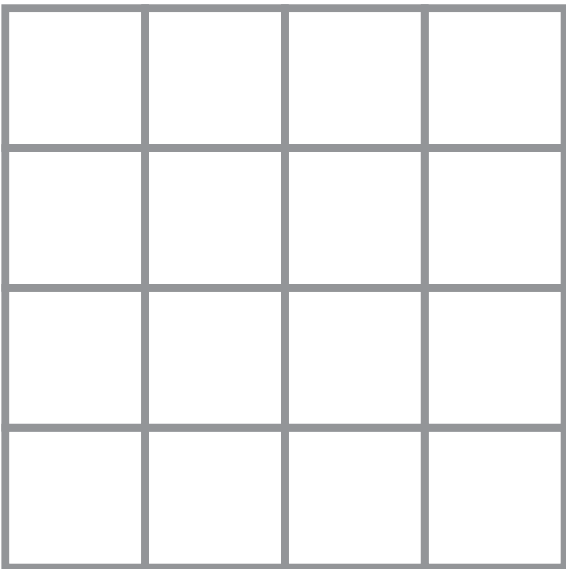
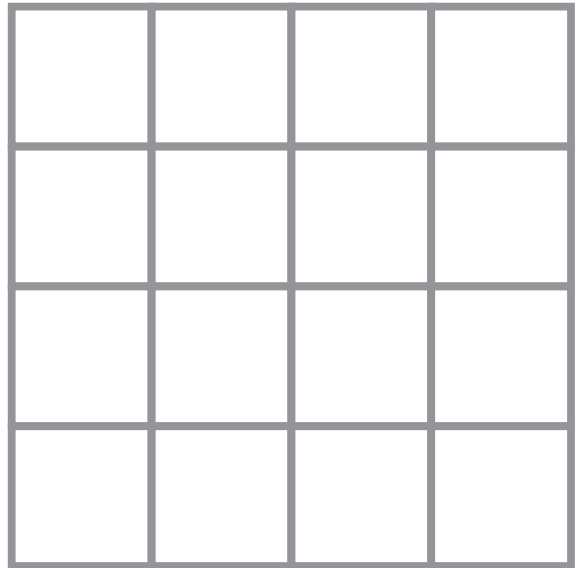
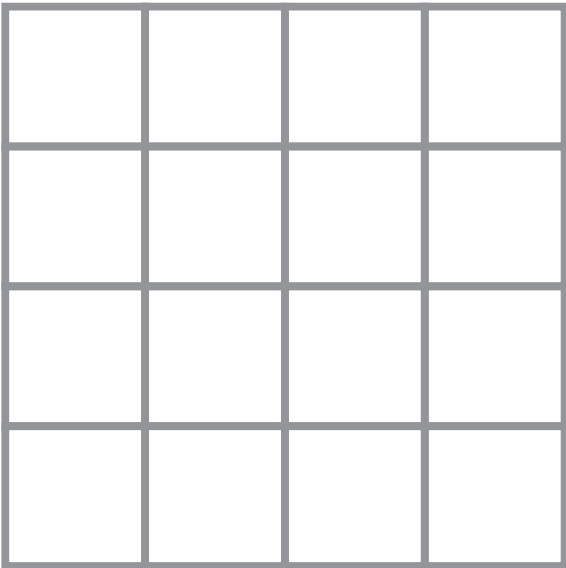
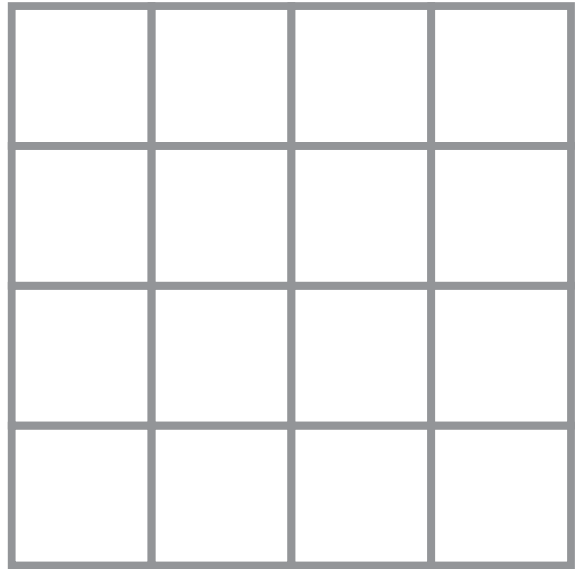
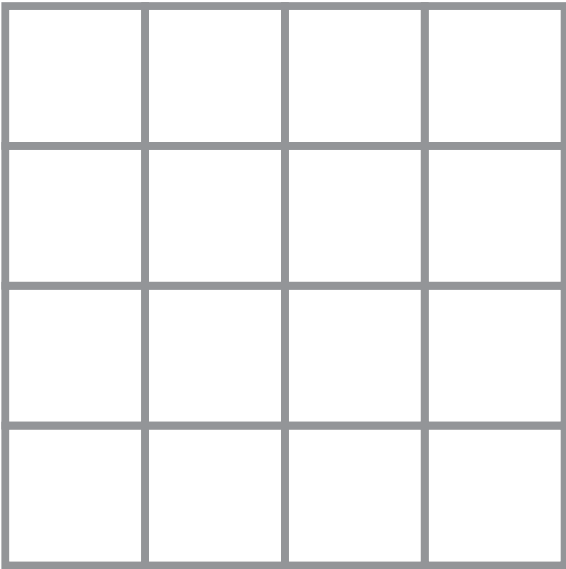
Relay Programming

Relay Image 6

C O
D E



Revision 140710.1a





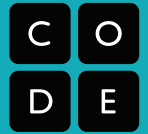
Unplugged

Name: _____

Date: _____

Debugging

Assessment Worksheet




Sometimes when you are coding in groups, someone will make an error that will affect everyone.


Somebody has already written programs for the images below, but each one has a mistake! Figure out what the programs are *supposed* to look like, and circle the error in each one. Then, draw the correct symbol in the box beneath.


Each program should use the symbols below to draw the image to its left.

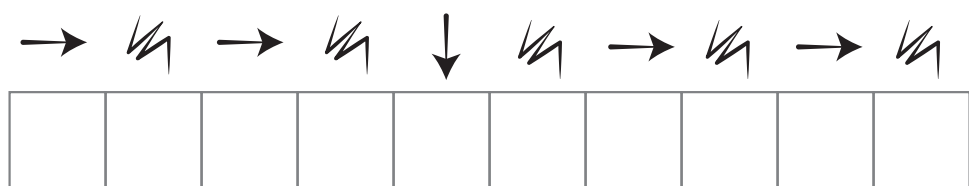
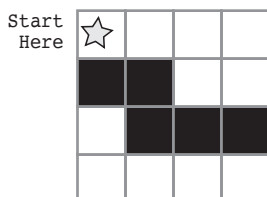
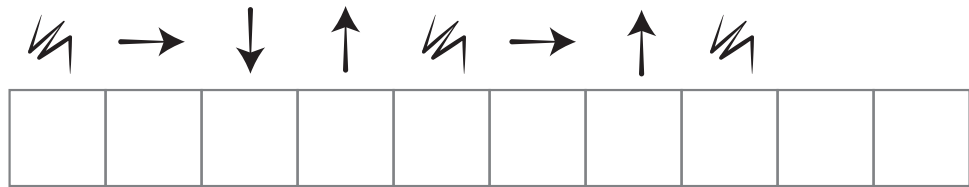
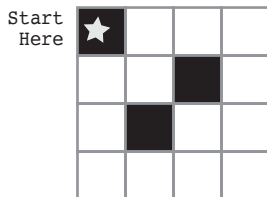
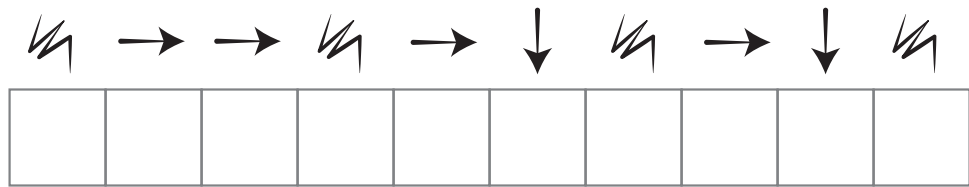
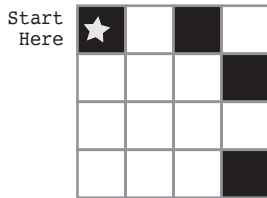
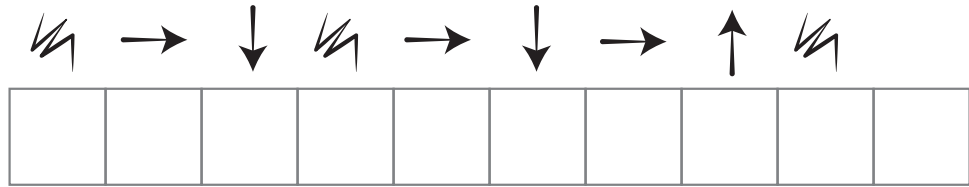
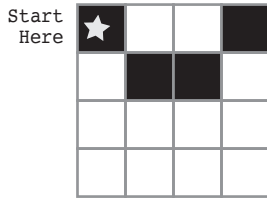

Move One
Square Right


Move One
Square Left


Move One
Square Up


Move One
Square Down

 Fill-In Square
with Color



Lesson 13: Screen Out the Mean

Common Sense Education | Cyberbullying | Unplugged

Overview

This lesson helps children to recognize that it is essential to tell a trusted adult if something online makes them feel angry, sad, or scared.

Students learn that other people can sometimes act like bullies when they are online. They will explore what cyberbullying means and what they can do when they encounter it. After reading a scenario about mean online behavior, students discuss what cyberbullying is, how it can make people feel, and how to respond. Finally, they use their knowledge to create a simple tip sheet on cyberbullying in their journal.

Purpose

Students may not ever have the misfortune of experiencing cyberbullying, but we want to make sure that the students are prepared for and knowledgeable about it, in case they ever witness it during an online situation. Students will learn how to identify cyberbullying and what steps they should take to make it stop. This may become helpful in later puzzles when students have the opportunity to share their work. If someone negatively responds to a student's work, this lesson will provide them with the tools that they need to handle the situation.

Agenda

Warm Up (5 min)

Introduction

Main Activity (35 min)

What Is Cyberbullying?

What to Do About Cyberbullying

Wrap Up (15 min)

Flash Chat: What did we learn?

Journaling

Assessment (5 - 10 min)

Screen Out the Mean - Teacher Prep Guide

Objectives

Students will be able to:

- Analyze online behaviors that could be considered cyberbullying.
- Explain how to deal with a cyberbullying situation.
- Recognize the importance of engaging a trusted adult if the student experienced cyberbullying.

Preparation

- ☐ Review **Screen Out the Mean - Teacher Prep Guide** from Common Sense Education's website.
- ☐ Print out a worksheet from the link above (page 6) for each student.
- ☐ Print out an assessment from the link at the top (page 7) for each student.
- ☐ Make sure every student has a **Think Spot Journal - Reflection Journal**.
- ☐ Print or display the **Online Safety Poster - Student Handout** for the class to see.
- ☐ Review **CSF Digital Citizenship - Resource List** for more online safety content.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Screen Out the Mean** - Teacher Prep Guide
- **Common Sense Education** - Website
- **CSF Digital Citizenship** - Resource List

For the Students

- **Online Safety Poster** - Student Handout
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Cyberbullying** - Doing something on the internet, usually again and again, to make another person feel angry, sad, or scared.
- **Online** - Connected to the internet.

Teaching Guide

Warm Up (5 min)

Introduction

Encourage:

Encourage students to share what they know about bullying.

Ask:

- What kinds of things count as bullying?
 - Students should understand that bullying is behavior that is purposefully mean or scary to someone else. For example, making fun of how someone looks, telling lies about them, or threatening to do something bad to them.
- How does bullying make other people feel?
 - Hurt, angry, upset, scared
- What is the best thing to do when you feel bullied, or when you see someone else being bullied?
 - Students should know to always tell a trusted adult when they experience or witness bullying.

Explain:

Students will be learning about a kind of bullying that can take place when they use the internet.

Main Activity (35 min)



What Is Cyberbullying?

Define:

- *Online*: Connected to the internet
- *Cyberbullying*: Doing something on the internet, usually again and again, to make another person feel angry, sad, or scared

Discuss:

Some kids do not go online very much at all, either because of their family's rules or because they do not like it very much. Other kids do go online to do different things.

Ask:

- What do you do online, or what do you think you might like to do?
 - Students may mention activities like sending messages to friends and playing games.

Share:

Most of the time when students go online it is to do fun or interesting things. But sometimes people can be mean to each other online and this is called cyberbullying.

Ask:

- Did you ever see someone make someone else feel bad online?
 - Answers will vary. Remind students to tell what happened, but not to use real names.

Explain:

Tell students that they will be learning more about how cyberbullying occurs, and what to do when it happens to them or to someone they know.

What to Do About Cyberbullying

Discuss:

Read aloud these two scenarios and discuss them briefly with the class.

- Kyle keeps getting instant messages from someone saying mean things about him. The person who is sending the messages doesn't use a real name, but Kyle can tell the messages are coming from someone who also makes fun of him at school in gym class.
- Sasha is a new girl at school, and she's making a lot of friends. Then Sasha finds out that another girl sent around an email that had a picture of a cow with Sasha's name on it.

Next, pass out the **Screen Out the Mean - Teacher Prep Guide** worksheet from page 6. Read aloud the story at the top and ask students to work in pairs or groups to finish the worksheet.

Ask the class to discuss Jada's story. Tell the class there are specific steps to handling a cyberbully.

- Jada should STOP using the computer.
- Jada should TELL an adult she trusts what happened.
- Jada should not go back online or return to the pony website until an adult says it is OK.
- If Jada and Michael are good friends, Jada may want to tell Michael how his actions made her feel after she gets help from an adult.
- If Michael continues cyberbullying her, she should play with other kids who don't cyberbully others.

In general, there are four steps students should take if they or someone they know are experiencing cyberbullying.

1. Stop using the computer until it is safe.
2. Tell an adult you trust.
3. Go online only when a trusted adult says it is okay.
4. Play online only with kids who you know and are nice.

Discussion Goal

Questions to stimulate discussion include:

- What do you think happened to Jada's game?
- How do you think Jada, Kyle, or Sasha felt when these things happened to them?
- How do you know if someone is cyberbullying you?
- Why do you think it is important to stop using the computer when someone starts cyberbullying you?
 - It's possible that if students stay online, the cyberbullying may continue or get worse.

Teacher Tip:

These scenarios can be read all at once and discussed as a whole, or be read and discussed individually.

Wrap Up (15 min)

Flash Chat: What did we learn?

Ask:

- What is cyberbullying. How does it make people feel?
 - Students should recognize that cyberbullying is any kind of online behavior that makes people feel sad, scared, angry or upset.
- What four things can you do to help stop cyberbullying?

S. *Stop* using the computer until it is safe.

T. *Tell* an adult you trust.

O. Go *Online* only when a trusted adult says it is okay.

P. *Play* online only with kids who are nice.

- What is the most important thing to do if someone starts cyberbullying you?
 - Telling a trusted adult is the most important response whenever someone makes them feel sad, scared, or angry online.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How did you feel during today's lesson?
- Write down the names of some trusted adults you can go to if you ever feel bullied.
- What are the four steps you should take if you or someone you know is being cyberbullied.

Assessment (5 - 10 min)

Screen Out the Mean - Teacher Prep Guide

Pass out an assessment to each student. Allow students a few minutes to complete it then review the answers (page 9 of the link above) with the class. If there's time, allow for a discussion about the questions.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MP** - Math Practices

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Screen Out the Mean

Directions

Jada's parents let her play on a website where she can take care of a pet pony and decorate its stall. Her friend Michael has played with her in the past and knows her user name and password.

One day Jada goes to the site to care for her pony. She finds that her pony's stall is a mess and that there are some things missing.



What do you think happened?

How do you think Jada feels?

What should you do if someone starts cyberbullying you?



STOP using the computer until it is safe.

TELL an adult you trust.

Go **ONLINE** only when a trusted adult says it's **OK**.

PLAY online only with kids who are nice.

Screen Out the Mean

1. Draw lines to show which things a cyberbully would do most and which things an in-person bully would do most.

**IN-PERSON
BULLY**



CYBERBULLY



Threatens to
pull your hair

Takes your stuff
in an online game

Sends mean
emails

Hits you

2. A cyberbully might:

- Write an email to make someone feel scared
- Say mean things at recess
- Share a knock-knock joke online




3. What should you do if you are cyberbullied?


- Stop using the computer until it is safe
- Tell an adult you trust
- Both a and b



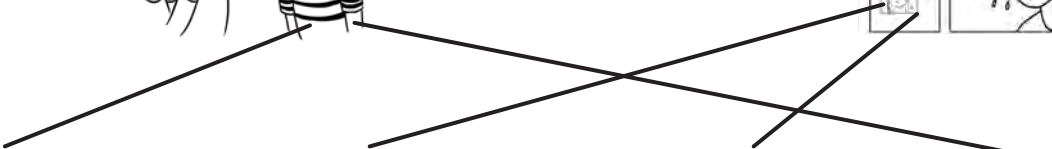
Screen Out the Mean

1. Draw lines to show which things a cyberbully would do most and which things an in-person bully would do most.

IN-PERSON BULLY 

CYBERBULLY 

Threatens to pull your hair Takes your stuff in an online game Sends mean emails Hits you



Answer feedback

A cyberbully does and says mean things online. An in-person bully is mean in person.

2. A cyberbully might:

- a) Write an email to make someone feel scared
- b) Say mean things at recess
- c) Share a knock-knock joke online

Answer feedback

The correct answer is **a**. Cyberbullies are mean online.



3. What should you do if you are cyberbullied?

- a) Stop using the computer until it is safe
- b) Tell an adult you trust
- c) Both a and b

Answer feedback

The correct answer is **c**. If someone is mean to you online, get off the computer and tell an adult. Saying mean things to a cyberbully won't help.



Lesson 14: Songwriting

Unplugged | Function

Overview

One of the most magnificent structures in the computer science world is the function. Functions (sometimes called procedures) are mini programs that you can use over and over inside of your bigger program. This lesson will help students intuitively understand why combining chunks of code into functions can be such a helpful practice.

Purpose

The use of functions helps simplify code and develop the student's ability to organize their program. Students will quickly recognize that writing functions can make their long programs easier to read and easier to debug if something goes wrong.

Agenda

Warm Up (20 min)

Vocabulary
Sing a Song

Main Activity (20 min)

Functions Unplugged: Songwriting - Worksheet

Wrap Up (5 min)

Flash Chat: What did we learn?
Journaling

Assessment (5 min)

Functions Unplugged: Songwriting - Assessment

Extended Learning

Objectives

Students will be able to:

- Locate repeating phrases inside song lyrics.
- Identify sections of a song to pull into a function.
- Describe how functions can make programs easier to write.

Preparation

- Watch the **Songwriting and Songwriting with Parameters (Functions) - Teacher Video**.
- Watch the **Functions Unplugged: Songwriting - Lesson in Action Video**.
- Print several **Functions Unplugged: Songwriting - Worksheet** for each group.
- Print one **Functions Unplugged: Songwriting - Assessment** for each student.
- Access to the internet, or pre-downloaded songs and lyrics for activity.
- Make sure every student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Songwriting with Functions** - Unplugged Video (download)
- **Songwriting and Songwriting with Parameters (Functions)** - Teacher Video
- **Functions Unplugged: Songwriting** - Lesson in Action Video
- **Functions Unplugged: Songwriting** - Worksheet
- **Functions Unplugged: Songwriting** - Assessment
- **Functions Unplugged: Songwriting** - Assessment Answer Key

For the Students

- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Function** - A named group of programming instructions. Functions are reusable abstractions that reduce the complexity of writing and maintaining programs.

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important word:

- **Function** - Say it with me: Func-shun

A piece of code that you can call over and over again.

Sing a Song

- Let the class know that today is song day!
- We're going to learn a song together.
 - Start with a simple song, either written out or projected on the screen.
 - Point to the chorus and be sure that the class knows how it goes before you begin on the song.
 - Blast through the song, singing it with them in the beginning, then see what happens when you get to the part where it calls the chorus.

📍 **Chorus:**

Little bunny Foo Foo
Hopping through the forest
Scooping up the field mice
And bopping 'em on the head
Down came the Fairy
And she said
"Little bunny Foo Foo
I don't wanna see you
Scooping up the field mice
And bopping 'em on the head"*

💡 Teaching Tip

Little Bunny Foo Foo is being used here as an example only. If your students know this song, feel free to use it. Otherwise, choose an appropriate song that they might be more familiar with (either from music class or the radio.)

Song:

Chorus

*I'll give you 3 chances.
Then I'll turn you into a goon!
The next day. . .*

Chorus

*I'll give you 2 chances.
Then I'll turn you into a goon!
The next day. . .*

Chorus

*I'll give you 1 chance.
Then I'll turn you into a goon!
The next day. . .*

Chorus

*"I gave you two chances.
Now I'll turn you into a goon!"
(POOF!)*

*And the moral of the story is:
Hare today, goon tomorrow!*

- It's quite likely that the majority of the class will sing the lyrics for the chorus when you point to that bit.
 - Stop the song once that happens, and explicitly highlight what just happened.
 - You defined the chorus.
 - You called the chorus.
 - They sang the chorus.

- Ask the class why they suppose you only wrote the chorus once at the top of the paper instead of writing it over and over in each place where it is supposed to be sung.
 - What are other benefits of only writing the chorus once when you sing it many times?

Now, imagine that this song is a computer program. Defining a title (like "chorus") for a little piece of code that you use over and over again is called creating a function.

This is helpful to computer scientists for some of the same reasons that it is helpful to songwriters.

- It saves time not having to write all the code over and over in the program.
- If you make a mistake, you only have to change it one place.
- The program feels less complicated with the repeating pieces defined just once at the top.

We are going to play with songs a little more, to try to really understand how often this technique is used!

💡 Lesson Tip

To hit this point home, you can look up the lyrics for some popular songs on the Internet. Show the students that the standard for repeating lyrics is to define the chorus at the top and call it from within the body of the song.

Main Activity (20 min)

Functions Unplugged: Songwriting - Worksheet

A fantastic way to compare functions to something we see in our everyday lives is to look at songs. Songs often have certain groups of lyrics that repeat over and over. We call such a group a "chorus."

Directions:

- Divide into groups of 4, 5, or 6.
- Give each group several copies of the Songwriting Worksheet.
- Play a short song for the class that contains a clear chorus that does not change from verse to verse.
- Challenge the class to identify (and write down) the chorus.
- Compare results from each group.

Did everyone get the same thing? Sing your choruses together to find out! Play this game over and over until the class has little trouble identifying the choruses.

- It is often easier just to have the class listen to (or watch) the song, then vote on what the chorus is by singing it together, rather than writing the whole thing down. If you choose this method, consider having the class do a written chorus for the final song selection to be sure that the visual learners get proper reinforcement.

💡 Lesson Tip

It's most exciting for students to do this lesson with popular music from the radio, but if you're having a hard time finding appropriate songs where the lyrics repeat exactly, here are a few timeless options:

- **You Are My Sunshine**
- **Boom, Boom, Ain't it Great**
- **How Much Is That Doggie in the Window**
- **I Love Trash**

Wrap Up (5 min)

Flash Chat: What did we learn?

- Would you rather write lyrics over and over again or define a chorus?
- Do you think it's possible to make multiple choruses for the same song?
- Does it make sense to make a new chorus for every time it's needed in a song?

💡 Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow partner.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- How do you feel about today's lesson?
- What is a function and how do you use it?
- Can you think of another activity where you might want to call a special group of instructions several times?

Assessment (5 min)

Functions Unplugged: Songwriting - Assessment

Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Functional Suncatchers Visit the **CS Fundamentals Unplugged Table** or click on the link for **Functional Suncatchers**. This activity does take a few supplies from the craft store, but it helps students to see the value of calling multiple functions.

Create Your Song

- Start by creating a chorus together, then repeat it between verses of a song that you develop around it.
- Make a change to the chorus, and ponder how much easier it is to change in just one place.
- Change the chorus again, making it much longer than it was originally.
- Add a second chorus and alternate between them in your verses.

Songwriting a Program

- What if we acted out songs instead of singing them? All of a sudden, our chorus would be a function of repeated actions, rather than words.
- Use the concepts of the arrows from the Graph Paper Programming lesson and create a program with lots of repeating instructions.
 - Circle those repeating actions so that the class can see where they are.
 - Define a function called "Chorus" above the program.
 - Cross out everywhere the repeating actions appear in the program and write "Chorus" instead.
- Repeat until the class can go through this process with little direction.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ L - Language
- ▶ SL - Speaking & Listening

Common Core Math Standards

- ▶ MP - Math Practices

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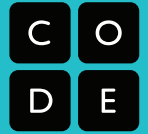
Unplugged

Name: _____

Date: _____

Songwriting

Using Lyrics to Explain Functions and Procedures



One of the most magnificent structures in the computer science world is the function. Functions (sometimes called procedures) are mini programs that you can use over and over inside of your bigger program.

A fantastic way to compare functions to something we see in our everyday lives is to look at songs. Songs often have certain groups of lyrics that repeat over and over. We call such a group a “chorus.”

Directions:

- 1) Divide into groups of 4, 5, or 6.
- 2) Give each group several copies of the Songwriting Worksheet.
- 3) Play a short song for the class that contains a clear chorus that does not change from verse to verse.
- 4) Challenge the class to identify (and write down) the chorus.
- 5) Compare results from each group. Did everyone get the same thing?

New Word!

Function

Say it with me: **Func-shun**

A piece of code that you can call over and over again.

Let's make a **function** for the bits that we use most often so that we don't need to write so much as we go.



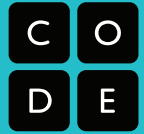
Unplugged

Group Name: _____

Date: _____

Songwriting Worksheet Example

Using Lyrics to Explain Functions and Procedures



Song Name:

Chorus:

Song Name:

Chorus:



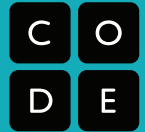
Unplugged

Name: _____

Date: _____

Songwriting

Using Lyrics to Explain Functions - Assessment



Look at the lyrics for the two songs below.

If it were your job to write these songs as computer programs, what chunk of code from each would you turn into a function so that you could use it over and over again with just one word?

Circle the segments of each program that repeat most often. Is everything that you circled exactly the same? If so, that can be your chorus!

Finish by writing the chorus for each song on the Songwriting Worksheet and give it a name. Those are your functions!

Song 1: I'm a Nut

I'm a little acorn brown
sitting on the cold, cold ground.
Everybody steps on me
that is why I'm cracked, you see.

I'm a nut
I'm a nut
I'm a nut, I'm a nut, I'm a nut

Called myself on the telephone
just to see if I was home.
Asked myself out on a date.
Picked me up at half-past eight.

I'm a nut
I'm a nut
I'm a nut, I'm a nut, I'm a nut

Took myself to the picture show.
Sat myself in the very first row.
Wrapped my arms around my waist.
Got so fresh, I slapped my face!

I'm a nut
I'm a nut
I'm a nut, I'm a nut, I'm a nut

Song 2: Skip to my Lou

Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Skip to my Lou, my darlin'.

Fly's in the buttermilk,
Shoo, fly, shoo,
Fly's in the buttermilk,
Shoo, fly, shoo,
Fly's in the buttermilk,
Shoo, fly, shoo,
Skip to my Lou, my darlin'.

Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Skip to my Lou, my darlin'.

Cows in the cornfield,
What'll I do?
Cows in the cornfield,
What'll I do?
Cows in the cornfield,
What'll I do?
Skip to my Lou, my darlin'.

Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Lou, Lou, skip to my Lou,
Skip to my Lou, my darlin'.



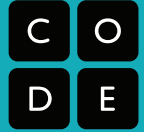
Unplugged

Group Name: _____

Date: _____

Songwriting Worksheet

Using Lyrics to Explain Functions - Assessment



Song 1 Name:

Chorus:

Song 2 Name:

Chorus:

Lesson 2: Stevie and the Big Project

Fail | Frustrated | Persistence | Unplugged

Overview

When students run into a barrier while answering a question or working on a project, it's so easy for them to get frustrated and give up. This lesson will introduce students to the idea that frustration can be an important part of learning. Here, frustration is presented as a step in the creative process, rather than a sign of failure.

This lesson can be done over one or two class sessions. If you have more time, feel free to draw out the building and revising phase of the Marble Run activity.

Purpose

The goal of this lesson is to help students realize that failure and frustration are common when working on projects, but that doesn't mean that they should give up.

In this lesson, students will develop an understanding of what it means to be frustrated while working on a large project. It's possible that not every student will experience frustration with this activity, but there are many opportunities to open a discussion about moments in the past where students have felt frustrated but nevertheless persisted.

Agenda

Warm Up (15 min)

Stevie and the Big Project Vocabulary

Marble Run (20 - 45 min)

**Before the Project
Building the Marble Run
After the Marble Run**

Wrap Up (5 min)

Journaling

Extended Learning

Vocabulary

- **F.A.I.L.** - First Attempt In Learning
- **Frustrated** - Feeling annoyed or angry because something is not the way you want it.
- **Persistence** - Trying again and again, even when something is very hard.

Objectives

Students will be able to:

- Identify and point out symptoms of frustration.
- Illustrate at least one reason why they will choose to be persistent in the face of frustration, rather than giving up.

Preparation

- ☐ Watch the **Stevie and the Big Project - Teacher Video**.
- ☐ Pre-read "Stevie and the Big Project" to identify appropriate questions for your class.
- ☐ Follow instructions in the **Marble Run - Teacher Prep Guide** to make a Marble Run.
- ☐ Print copies of the **Marble Run Ruler** (page 2 of teacher guide) for each student or pair of students.
- ☐ Prepare a resource station with cardstock, safety scissors, tape, and anything else you think might be fun for students to build with. Include a stack of the "**Marble Run Hints**" pages from the Teacher Prep Guide, but do not advertise their existence.
- ☐ (Optional) Allow students to bring cardboard, popsicle sticks, string, or other tidbits from home to add to the resource station.
- ☐ Make sure each student has a **Think Spot Journal - Reflection Journal**.

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Stevie and the Big Project** - Teacher Video
- **Marble Run** - Teacher Prep Guide
- **Stevie and the Big Project** - Storybook (PDF) ([download](#))

For the Students

- **Feeling Faces** - Emotion Images
- **Stevie and the Big Project** - Online Story
- **Think Spot Journal** - Reflection Journal

Teaching Guide

Warm Up (15 min)

Stevie and the Big Project

This lesson is meant to introduce students to the idea that they should not give up just because they are frustrated.

Read: Begin by reading **Stevie and the Big Project - Storybook (PDF)**. Students will be introduced to the ideas of persistence and frustration through the relatable challenges of Stevie the Squirrel and her crew. Chief among these are the concept that struggle leads to learning and that persistence can lead to success.

This book should be read as a classroom story, any other format exists only for students without access to a teacher.

Discuss: When sharing this story with your class, feel free to use the reading techniques that work in your classroom. If your students like to discuss things that happen as they appear in the book, be sure to stop your class after large plot areas like when Stevie breaks her structure, or when Laurel explains frustration.

If your students like to sit through a whole story and discuss at the end, read through the book, then prompt their memory with some “Remember when...” type questions.

Vocabulary

Review: The vocabulary in this lesson is among the most important of the year. You may need to do a little extra work with your students at the end of the story to make sure that they understand that frustration is the feeling of being annoyed or angry at something and that persistence is choosing not to give up, and attempting something over and over again.

- *Persistence* - Say it with me: Purr-siss-tense. Not giving up. Persistence works best when you try things many different ways, many different times.
- *Frustrated* - Say it with me: Frus - straight - ted. Feeling annoyed or angry because something is not the way you want it.
- *F.A.I.L.* - First Attempt in learning. When you try to do something, but you don't do it quite right.

Marble Run (20 - 45 min)

This activity is meant to highlight and normalize the feeling of frustration, while giving students a chance to be persistent.

Set-Up: How you conduct this lesson depends heavily on your confidence in your own classroom. If you don't feel that your students are ready to be taping rolled paper into tubes, then you might want to modify the lesson and its materials to be something that students can be more successful with. Some alternatives are:

- Newspapers taped to the wall/chair/floor
- Cardboard tubes and paper cups
- Wooden building blocks with train/car tracks

The options are really endless. Just make sure that the point of the activity remains the same. Students need to struggle with a hard task long enough to be able to identify the feeling of frustration in themselves, then they must be intentionally persistent.

Lesson Tip

Sample Questions:

- How would you feel if you were given a project that feels much harder than what you are used to?
- Do you think it's okay to try something new, even if it doesn't work out the first time?
- Why do you think Stevie smashed her project?
 - Do you think that helped her or hurt her when it comes to reaching her goal?
 - What do you think Stevie should have done instead of breaking her project?
- Can somebody explain what frustration is?
- How do you think you can know when you are frustrated?
 - What face do you make when you are frustrated?
 - How can you make yourself feel better when you start to get frustrated?
 - We all get frustrated sometimes. Does that mean that we should give up?
- Can someone tell me what persistence is?
 - Why is it hard to learn if you're not persistent?
 - Can you tell me why you might be tempted not to be persistent?
 - What happened when Stevie decided to be persistent?
 - Do you think you can be persistent?

Building the Marble Run

Remarks

Now, we're going to do something very fun, and very challenging! I am going to let you all try to make a Marble Run of your own!

This is **supposed** to be challenging. That's part of the fun! Your Marble Run probably won't work right the first time, and that's alright. The goal for this game is to practice being persistent.

Remember, Stevie showed us that this might be difficult, and sometimes difficult things are frustrating. It is okay if you get frustrated during this activity. Most of us probably will at some point. How should we handle those feelings?

- Count to 10
- Take deep breaths
- Journal about them
- Talk to a partner about them
- Ask for help

Time to be an engineer!

Group: Break students up into pairs and have them quickly come up with a team name. This should help to unify them in their work.

Next, point out the resource station that you have set up with all of the supplies and goodies that students will have access to. Make sure you are very clear about whether they are limited only to the items in the resource station or whether they are allowed to ask for other items for their creation.

It can be a good idea to give students checkpoints for this activity. Make sure that they know that there is no penalty for not finishing on time.

Preplanning is optional, since prediction is not often a kindergartener's strong suit.

Circulate: The first attempt at building will likely be hectic and a bit sloppy, but it should give students access to the feelings and opportunities for persistence that are being studied in this lesson.

Try to end the Marble Run build with an opportunity for groups to collaborate. This will improve the chances of success for students who have been struggling, without the need for teacher intervention.

After the Marble Run

Discuss: Time to do some damage control if any is needed.

Remind students that this activity was planned to teach students how to identify feelings of frustration and work past them to be persistent.

Discuss the difference between being successful at building their contraption and being successful for the purpose of this activity. Allow students the opportunity to celebrate their hard work and persevering through frustration.

Wrap Up (5 min)

Journaling

Goal: Allow students to reflect on the emotions and processes experienced during the lesson.

Journal Prompts:

Finish out this lesson by asking students to spend some time in their Think Spot Journal.

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Draw a picture of what you look like when you're frustrated.
- Draw a picture that shows things you can do to feel better when you're frustrated.
- What does persistence look like?

Teaching Tip

Before the Project

It is vitally important that students understand that this activity is meant to help them learn about frustration and persistence. This is not one of those times when we allow students to experience something, then give it a name afterward. Students need to know that they will be feeling some emotions, and that those emotions are okay.

Take a moment to relate the next activity back to the book that you just read. The class might be excited that they get to try the same project that Stevie did, but they might also be apprehensive at the thought of tackling something difficult.

Encourage your students to have their Think Spot Journals around during the activity so they can use them to plan, solve, and voice concerns.

Teaching Tip

Checkpoint Suggestions:

- Pre-planning time (3-5 minutes)
- First attempt at building (10-15 minutes) -- For a longer (or two day) time period --
- Discuss with another group (3-5 minutes)
- Revision of structure (10-15 minutes) -- Wrap Up Work --
- Collaborative work time (5-15 minutes)

Teacher Tip

As you know, tears are a very common byproduct when kindergarteners attempt difficult lessons. You will likely want to have a pre-packaged prescription for students who become emotionally raw.

- Can you put into words what you are feeling right now?
- Stevie would be so proud of you. What do you think Laurel and Jorge would say if you told them how you feel?
- What would it be called if you said out loud that you are frustrated, but decided to keep working anyway?
 - Do you feel like you can be persistent with me today?

Extended Learning

- Add a third piece to the beginning of the Marble Run. Can students start a marble up even higher and get it to flow through the rest of their contraption?
- Talking through frustration. Can students think of things that they can say to classmates to help them be persistent when they are frustrated?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **RL** - Reading Literature
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

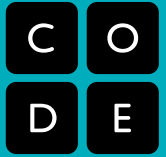
Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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This guide will provide assistance through a set of two lessons using a Marble Run contraption.

The first portion of this kindergarten series is the debugging lesson, where students will help you debug your Marble Run. In order to do this, you need to have a broken prototype that can be fixed in a predictable way. This guide will suggest an easy step-by-step solution, and give you tips for making a creation using your own design.

For the second half, we are going to ask students to do something incredibly challenging in order to stretch their understanding and aptitude for persistence. This guide will provide additional suggestions and resources to keep the project grade appropriate.

Stage 1: Debugging

The Rules:

The rules of the student version of the Marble Run activity are pretty simple:

- 1) Build two Marble Runs.
- 2) Each Marble Run should have at least 3 pieces.
- 3) Marble Run 1 should take a marble at **Start** height and finish at **Middle** height.
- 4) Marble Run 2 should take a marble at **Middle** height and finish at **End** height.
- 5) Put the two Marble Runs together and watch the marble go from **Start to End**.

There are a couple of additional rules to adapt this to be effective for the lesson on debugging:

- 1) The teacher's contraption must not work to begin with.
- 2) The fix for the issue should be detectable by following the marble's path and determining where the change from "expected" to "unexpected" occurs.

The Set-Up:

Use the Marble Run Ruler (provided on page 2) to determine the starting and ending height for each of the two components, we will call those Component A and Component B.

Component A needs to take in a marble (Input A) at a height that falls somewhere within the highlighted "Start" region. It should then return the marble (Output A) at a height somewhere within the highlighted "Middle" region.

Component B should take a marble (input B) at a height that falls somewhere within the highlighted "Middle" region. It should then return the marble (Output B) at a height somewhere within the highlighted "End" region.

Two simple ways for a teacher to initiate an easy-to-fix failure would be:

- A) Have two working components, but connect them in an incorrect way
- B) Have Component A release the marble lower than Component B can receive it

Proceed to the teacher guide for Stage 2 for more information on building a Marble Run that falls into either of those categories.

Start



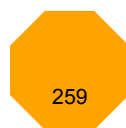
Start

Middle

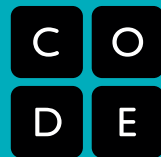


Middle

End



End



Stage 2: Building a Marble Run

The Rules:

These are the rules for the student version of the Marble Run activity:

- 1) Build two Marble Runs.
- 2) Each Marble Run should have at least 3 pieces.
- 3) Marble Run 1 should take a marble at **Start** height and finish at **Middle** height.
- 4) Marble Run 2 should take a marble at **Middle** height and finish at **End** height.
- 5) Put the two Marble Runs together and watch the marble go from **Start** to **End**.

Feel free to change the parameters of these heights as you see fit.

The Set-Up:

Set-up of the student resource area is crucial. Supplies should be plentiful and easy to locate. In addition to the classroom norms (cardstock, tape, safety scissors) volunteers can also donate extra items if given enough notice (paper cups, cereal boxes, and the like).

For further support, place a stack of copies of “Marble Run Hints” (pages 7 & 8) for students to find. You do not need to let the class know that those are available. Students will feel more like they have “discovered” something if the teacher is not involved in the process.

The Build:

We have provided tutorials on four relatively simple pieces that are quite helpful for this project. These pieces are:

- **Tube (fig. 1)** - A piece of paper that has been rolled into a cylinder
- **Ramp (fig. 2)** - Paper folded in a zig-zag fashion to provide a ramp with attaching flaps
- **Bridge (fig. 3)** - Paper where two sides have been folded into the center to create a bridge
- **Cone (fig. 4)** - Paper rolled first into a cylinder, then tightened at the bottom and loosened at the top. Once the basic cone has been created, secure with tape, then cut the top and bottom to customize.

A low-frills example contraption can be created using the steps that follow.

Component A:

- 1) Cut an 8.5”x11” sheet of cardstock in half lengthwise, then cut one of those halves lengthwise again. Fold both of the quarter strips bridge style.
- 2) Lay the bridges on their sides and tape free edges together to form a square or rectangle.
- 3) Cut an 8.5”x11” sheet of cardstock in quarters (length, then width). Roll two of the pieces along the long edge and two along the short edge, then secure with tape, to make a total of 4 tubes.
- 4) Tape the long tubes to the back of the square case from step 2, and the short tubes should be taped in front.

Component A (continued):

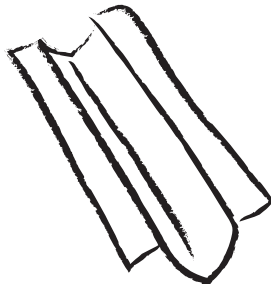
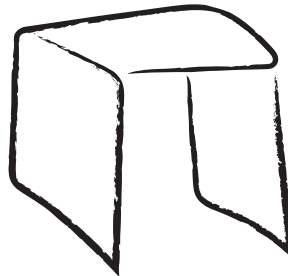
- 5) Cut an 8.5"x11" sheet of cardstock in half widthwise. Fold one piece in half lengthwise, then fold the long edges back out toward the crease to make a ramp.
- 6) Tape the edges of the ramp to the tops of the posts. This gives your main marble path, but it's not quite tall enough.
- 7) Add a cone at the intake point, and you'll be set!

Component B:

- 8) Cut an 8.5"x11" sheet of cardstock in half widthwise and roll one of the pieces along the short side, to make an 8.5" tube. Secure with tape.
- 9) Cut the tube at a point anywhere from 2" - 4" at about a 45 degree angle.
- 10) Rotate one of the pieces to form an elbow, and tape back together.
- 11) Cut a 1" strip from the remaining 8.5" x 5.5" cardstock half (lengthwise) and make a bridge to use as a triangular base for the tube to sit in.
- 12) Use the remaining cardstock to make an input cone for the top of Component B. Trim tube and cone to get appropriate height.

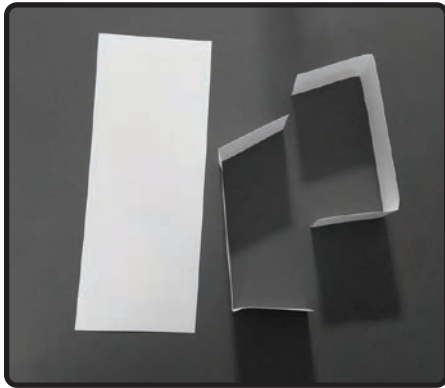
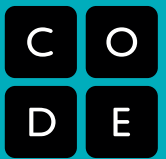
Voila! Your very own Marble Run!

Note: It is highly unlikely that your students will come up with anything this clean and stable. That is OKAY! The version here is meant to be messed with and reused.

Tube*Figure 1***Ramp***Figure 2***Bridge***Figure 3***Cone***Figure 4*



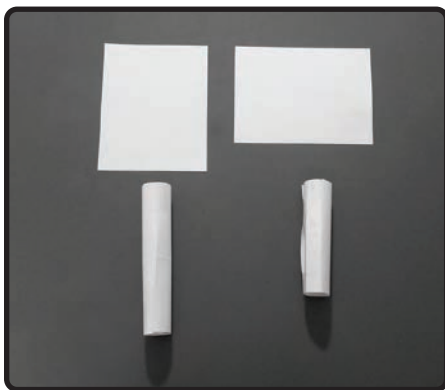
Marble Run



Step 1: Fold strips "bridge style"



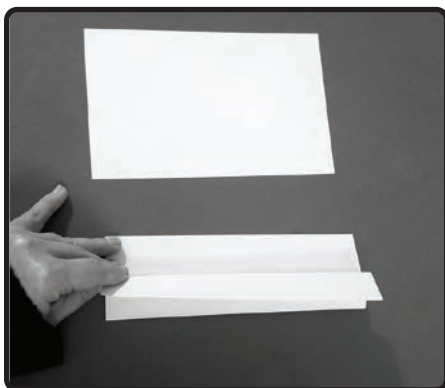
Step 2: Tape ends of folded strips together to make a base.



Step 3: Roll quartered paper into tubes and secure with tape.



Step 4: Tape tubes inside case. Make sure to tape them near the top for height.

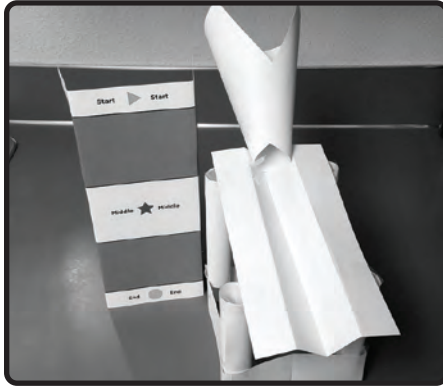


Step 5: Make a ramp from a half sheet of cardstock.



Step 6: Tape ramp to base and check height.

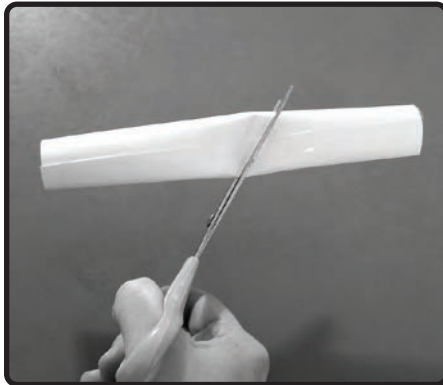
Marble Run



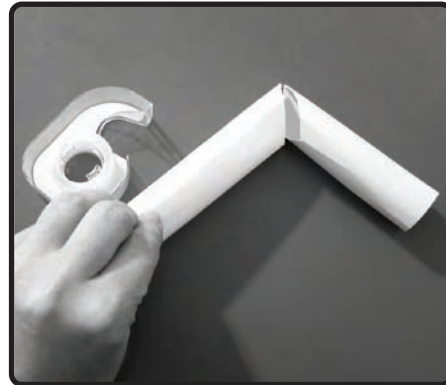
Step 7: Add cone to finish Component A.



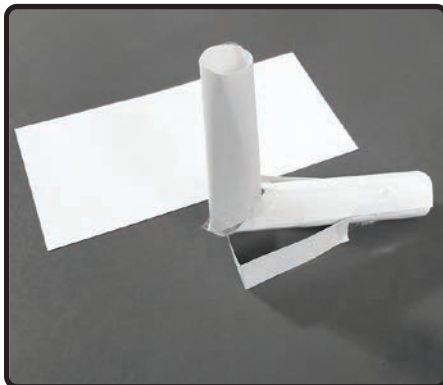
Step 8: Roll 1/2 sheet into tube to start on Component B.



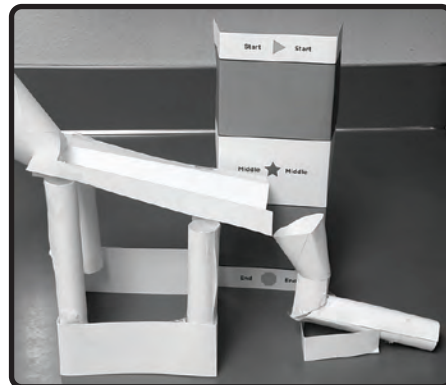
Step 9: Cut tube at an angle.



Step 10: Tape tubes back together to make an elbow.



Step 11: Make a base from a thin strip of cardstock.



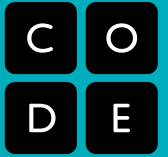
Step 12: Add a cone to the top and trim pieces to size.



Handout

Marble Run Hints

Student Handout

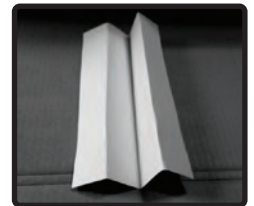
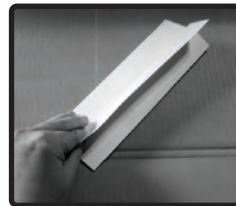


Try using some of these:

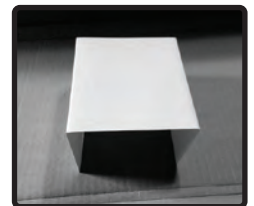
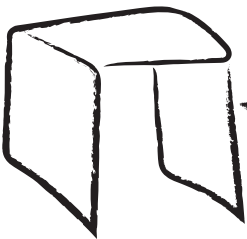
Tube



Ramp



Bridge



Cone



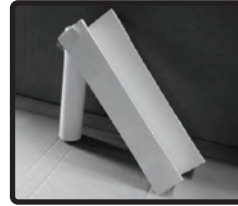
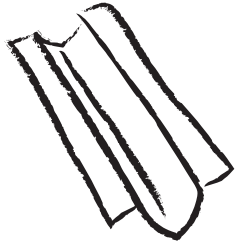
Now try putting them together!

Tube

Ramp



+

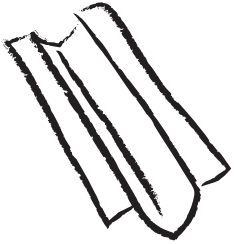


or

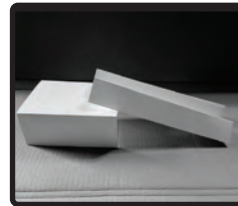
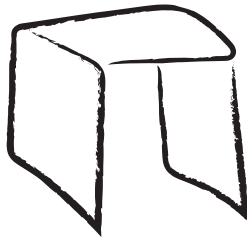


Ramp

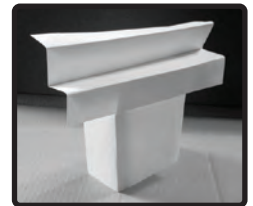
Bridge



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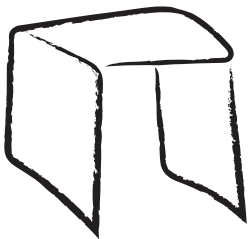


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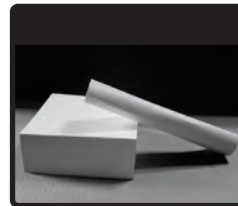


Bridge

Tube



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or

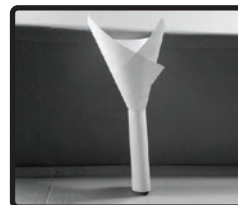


Cone

Tube



+



or



Lesson 1: Unspotted Bugs

Bug | Debugging | Persistence | Unplugged

Overview

This lesson will guide students through the steps of debugging. Students will learn the mantra: "What happened? What was supposed to happen? What does that tell you?"

Purpose

Research shows that some students have less trouble debugging a program than writing one when they first learn to code. In this lesson, we introduce the idea of debugging in a real world sense.

The goal in this lesson is to teach students steps to spot a bug and to increase persistence by showing them that it's normal to find mistakes. In later lessons, students will debug actual programs on Code.org.

Agenda

Warm Up (12 min)

Unspotted Bugs
Vocabulary

Marble Run Breakdown (10 - 20 min)

Debug the Run

Wrap Up (10 - 20 min)

Journaling

Extended Learning

Real Life Bug Hunting

Objectives

Students will be able to:

- Express that they have noticed when something goes differently than what is expected.
- Identify what the expected result was before an error occurs.
- Determine and describe the difference between what was expected and what actually happened in the event of an error.

Preparation

- Watch the **Unspotted Bugs - Teacher Video**.
- Review the Unspotted Bugs Story (**Unspotted Bugs - Online Story**)
- Pre-read Unspotted Bugs to identify appropriate questions for your classroom
- Follow instructions in the **Marble Run - Teacher Prep Guide** to make a Marble Run (which will be arranged incorrectly at the start)
- Give a **Think Spot Journal - Reflection Journal** to each student

Links

Heads Up! Please make a copy of any documents you plan to share with students.

For the Teacher

- **Unspotted Bugs** - Teacher Video
- **Marble Run** - Teacher Prep Guide
- **Unspotted Bugs** - Storybook (PDF)

For the Students

- **Feeling Faces** - Emotion Images
- **Unspotted Bugs** - Online Story
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Bug** - Part of a program that does not work correctly.
- **Debugging** - Finding and fixing problems in an algorithm or program.
- **Persistence** - Trying again and again, even when something is very hard.

Teaching Guide

Warm Up (12 min)

Goal: Help students understand the steps involved in debugging.

Unspotted Bugs

This story can be presented in several ways, including:

- Circled up story time
- Projected with document camera / smartboard
- Pair shared with students at their computers

The story of Unspotted Bugs presents many of the ideas that students will need to understand the debugging process of coding. This warm-up is meant to tie a memorable story together with a concept that young kids often find to be difficult.

Read the book and discuss the techniques that JD used to discover and take care of bugs. Make sure those questions and tactics get repeated often enough that students can recall (if not recite) them without the story in hand.

Potential Questions for Storytime:

- Page 3: What do you notice in the picture? What's wrong with the flower? (It's upside down!) What's wrong with the clock? (The hands aren't in the center) Why do you think there is something wrong with these items?(Because there are bugs on them!)
- Page 7: What's wrong with the picture? (The lamp is upside down) Why is that? (There's a bug)
- Page 11: What's wrong in this scene? (The car doesn't have wheels!) Why? (Because there are bugs on it!)
- What did JD find when he went looking for the bug? What was wrong? What does this mean? (JD found an upside down tree. This is wrong because the tree trunk should be touching the ground! This means there is a bug on the tree!)

💡 Lesson Tip

Important ideas from the story:

- What happened?
- What was supposed to happen?
- What does that tell you?
- Did it work at the first step?
- Did it work at the second step?
- Where did it go wrong?

Vocabulary

This lesson has three new and important vocabulary words:

- *Bug* - Say it with me: Buhh-g. Something that is going wrong. An error.
- *Debugging* - Say it with me: Dee-bug-ing. To find and fix errors.
- *Persistence* - Say it with me: Purr-siss-tense. Not giving up. Persistence works best when you try things many different ways, many different times.

Marble Run Breakdown (10 - 20 min)

Goal: Help students think critically about the difference between what is happening and what is expected.

Debug the Run

Now that students have been introduced to the idea of looking for problems, they can try to apply it to more places in the real world. This next activity gives them practice looking for bugs in Marble Runs (a project that they will be working with next week.)

Grab your sample marble run (built from our plans, or something similar.) Show the students how each piece works, then demonstrate putting them together (but put them together incorrectly, to prevent the ball from flowing properly from A to B.

The goal of this exercise is to help the students identify when something goes wrong, so if they don't catch it the first time, run it again, and again. It can help to make exaggerated frustration faces when the ball doesn't do what you would like it to do.

Let the students share hypotheses about what is going wrong, and how to fix it. Students should feel free to try things that you know will be incorrect. If students misidentify solutions, use the bug finding formula on their configurations. Repeat until you get a working run.

Encouragement is key here. If things don't work right away, praise the class for being so persistent and choosing not to give up. If they start to get frustrated, encourage them to persist a bit longer, promising them that they will get it soon if they just hang in there.

Wrap Up (10 - 20 min)

Journaling

Goal: Students will start to understand the importance of the activity they just completed by reflecting on it verbally, then through drawing in their journals.

Clear your mind:

It can be distracting to a learner when they have unanswered questions or doubts. To end this lesson, we'll give everyone the chance to get those out so that they can reflect on what they've been taught.

Encourage students to share their thoughts and questions either with the whole class or with an elbow partner.

Reflect:

Once they've had time to ponder their own thoughts, get the students thinking about the purpose of the lesson that they just learned. Why did you do this activity? How will it help them later? Can they think of buggy things that they've seen in the real world?

Students should finish by drawing or writing in their journal.

Possible topics include:

- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- How do you feel when something that you are working on acts buggy?
- How many times do you think you should try to fix a bug before you give up?
- What would you do if you notice that something is buggy, but you don't know how to fix it?

Extended Learning

Real Life Bug Hunting

Take your students outside. Do you see any signs of bugs? What are they? Now look closer... can you find the actual bug?

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **RL** - Reading Literature
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **G** - Geometry
- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **AP** - Algorithms & Programming

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences

💡 Lesson Tip

Say:

Great! You all are so good at this, maybe you can help me with my own problem!

See, I have this marble run that I made. It comes in two pieces. When I put the ball in here (input A) it's supposed to come out here (output A). When I put the ball in here (input B) it's supposed to come out here (output B). Now, when I slide them together, I should be able to put the ball in here (input A) and have it come out here (output B). But it doesn't work, watch.

[Slide the pieces together with output B facing output A.]

Watch what happens. [Drop ball at input A and notice that it does not come out output B.]

- **BUG!**

What happened?

- The ball fell on the table.

What was supposed to happen?

- The ball was supposed to drop from A into B.

What does that tell you?

- You should turn B around so that the ball goes into the right place!

💡 Lesson Tip

Say:

What do you think we learned in this lesson?

- Debugging
- How to solve a problem
- How to make a marble go
- How do you think that can help us in other places?

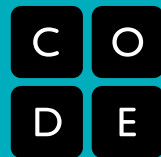
💡 Lesson Tip:

The signs of real-live bugs won't be as dramatic as upside down trees, but it might be dead leaves, spots on flowers, or slime on the sidewalk. Have the students brainstorm these before going outside to look for them.



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This guide will provide assistance through a set of two lessons using a Marble Run contraption.

The first portion of this kindergarten series is the debugging lesson, where students will help you debug your Marble Run. In order to do this, you need to have a broken prototype that can be fixed in a predictable way. This guide will suggest an easy step-by-step solution, and give you tips for making a creation using your own design.

For the second half, we are going to ask students to do something incredibly challenging in order to stretch their understanding and aptitude for persistence. This guide will provide additional suggestions and resources to keep the project grade appropriate.

Stage 1: Debugging

The Rules:

The rules of the student version of the Marble Run activity are pretty simple:

- 1) Build two Marble Runs.
- 2) Each Marble Run should have at least 3 pieces.
- 3) Marble Run 1 should take a marble at **Start** height and finish at **Middle** height.
- 4) Marble Run 2 should take a marble at **Middle** height and finish at **End** height.
- 5) Put the two Marble Runs together and watch the marble go from **Start to End**.

There are a couple of additional rules to adapt this to be effective for the lesson on debugging:

- 1) The teacher's contraption must not work to begin with.
- 2) The fix for the issue should be detectable by following the marble's path and determining where the change from "expected" to "unexpected" occurs.

The Set-Up:

Use the Marble Run Ruler (provided on page 2) to determine the starting and ending height for each of the two components, we will call those Component A and Component B.

Component A needs to take in a marble (Input A) at a height that falls somewhere within the highlighted "Start" region. It should then return the marble (Output A) at a height somewhere within the highlighted "Middle" region.

Component B should take a marble (input B) at a height that falls somewhere within the highlighted "Middle" region. It should then return the marble (Output B) at a height somewhere within the highlighted "End" region.

Two simple ways for a teacher to initiate an easy-to-fix failure would be:

- A) Have two working components, but connect them in an incorrect way
- B) Have Component A release the marble lower than Component B can receive it

Proceed to the teacher guide for Stage 2 for more information on building a Marble Run that falls into either of those categories.

Start



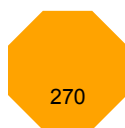
Start

Middle

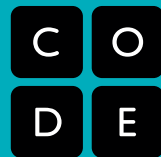


Middle

End



End



Stage 2: Building a Marble Run

The Rules:

These are the rules for the student version of the Marble Run activity:

- 1) Build two Marble Runs.
- 2) Each Marble Run should have at least 3 pieces.
- 3) Marble Run 1 should take a marble at **Start** height and finish at **Middle** height.
- 4) Marble Run 2 should take a marble at **Middle** height and finish at **End** height.
- 5) Put the two Marble Runs together and watch the marble go from **Start** to **End**.

Feel free to change the parameters of these heights as you see fit.

The Set-Up:

Set-up of the student resource area is crucial. Supplies should be plentiful and easy to locate. In addition to the classroom norms (cardstock, tape, safety scissors) volunteers can also donate extra items if given enough notice (paper cups, cereal boxes, and the like).

For further support, place a stack of copies of “Marble Run Hints” (pages 7 & 8) for students to find. You do not need to let the class know that those are available. Students will feel more like they have “discovered” something if the teacher is not involved in the process.

The Build:

We have provided tutorials on four relatively simple pieces that are quite helpful for this project. These pieces are:

- **Tube (fig. 1)** - A piece of paper that has been rolled into a cylinder
- **Ramp (fig. 2)** - Paper folded in a zig-zag fashion to provide a ramp with attaching flaps
- **Bridge (fig. 3)** - Paper where two sides have been folded into the center to create a bridge
- **Cone (fig. 4)** - Paper rolled first into a cylinder, then tightened at the bottom and loosened at the top. Once the basic cone has been created, secure with tape, then cut the top and bottom to customize.

A low-frills example contraption can be created using the steps that follow.

Component A:

- 1) Cut an 8.5”x11” sheet of cardstock in half lengthwise, then cut one of those halves lengthwise again. Fold both of the quarter strips bridge style.
- 2) Lay the bridges on their sides and tape free edges together to form a square or rectangle.
- 3) Cut an 8.5”x11” sheet of cardstock in quarters (length, then width). Roll two of the pieces along the long edge and two along the short edge, then secure with tape, to make a total of 4 tubes.
- 4) Tape the long tubes to the back of the square case from step 2, and the short tubes should be taped in front.

Component A (continued):

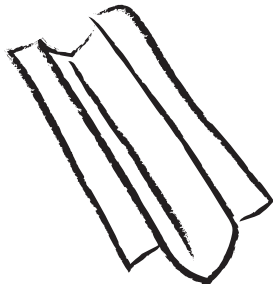
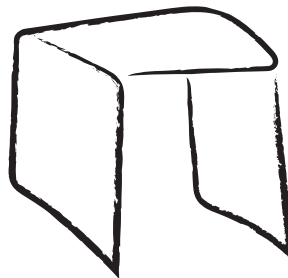
- 5) Cut an 8.5"x11" sheet of cardstock in half widthwise. Fold one piece in half lengthwise, then fold the long edges back out toward the crease to make a ramp.
- 6) Tape the edges of the ramp to the tops of the posts. This gives your main marble path, but it's not quite tall enough.
- 7) Add a cone at the intake point, and you'll be set!

Component B:

- 8) Cut an 8.5"x11" sheet of cardstock in half widthwise and roll one of the pieces along the short side, to make an 8.5" tube. Secure with tape.
- 9) Cut the tube at a point anywhere from 2" - 4" at about a 45 degree angle.
- 10) Rotate one of the pieces to form an elbow, and tape back together.
- 11) Cut a 1" strip from the remaining 8.5" x 5.5" cardstock half (lengthwise) and make a bridge to use as a triangular base for the tube to sit in.
- 12) Use the remaining cardstock to make an input cone for the top of Component B. Trim tube and cone to get appropriate height.

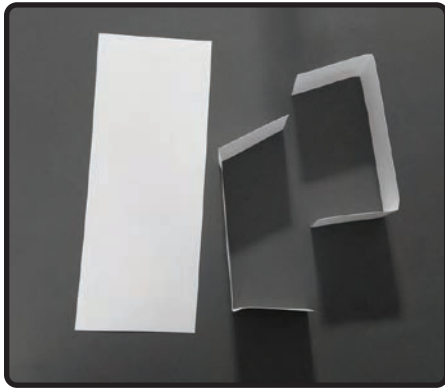
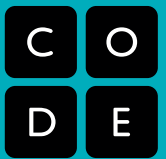
Voila! Your very own Marble Run!

Note: It is highly unlikely that your students will come up with anything this clean and stable. That is OKAY! The version here is meant to be messed with and reused.

Tube*Figure 1***Ramp***Figure 2***Bridge***Figure 3***Cone***Figure 4*



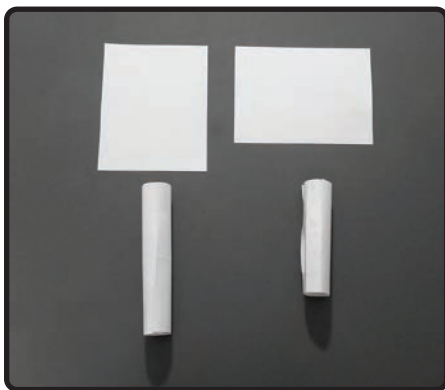
Marble Run



Step 1: Fold strips "bridge style"



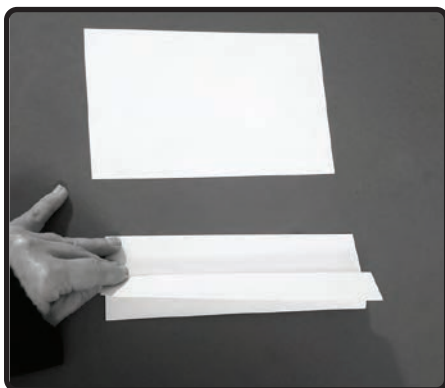
Step 2: Tape ends of folded strips together to make a base.



Step 3: Roll quartered paper into tubes and secure with tape.



Step 4: Tape tubes inside case. Make sure to tape them near the top for height.

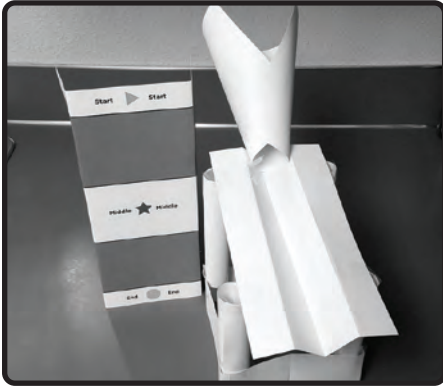


Step 5: Make a ramp from a half sheet of cardstock.



Step 6: Tape ramp to base and check height.

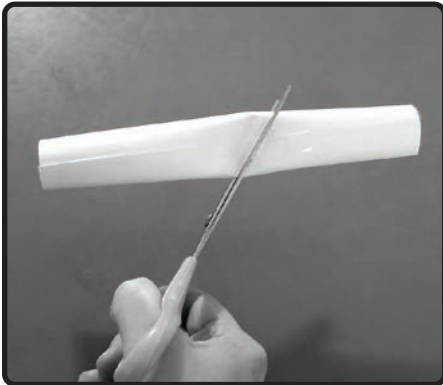
Marble Run



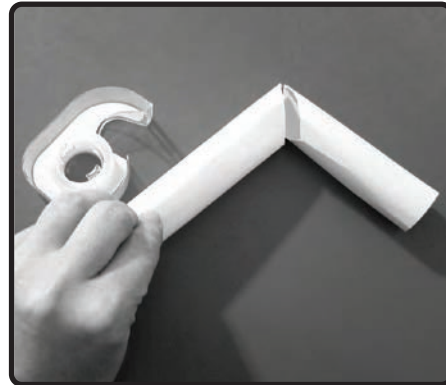
Step 7: Add cone to finish Component A.



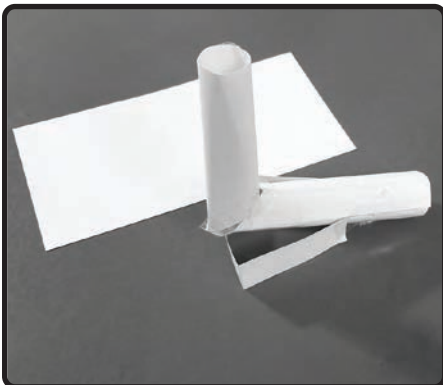
Step 8: Roll 1/2 sheet into tube to start on Component B.



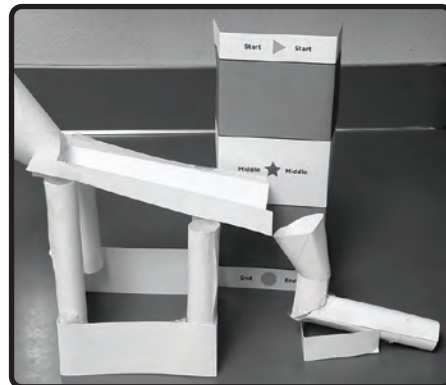
Step 9: Cut tube at an angle.



Step 10: Tape tubes back together to make an elbow.



Step 11: Make a base from a thin strip of cardstock.



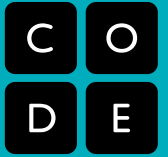
Step 12: Add a cone to the top and trim pieces to size.



Handout

Marble Run Hints

Student Handout

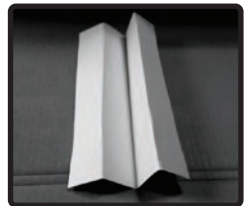
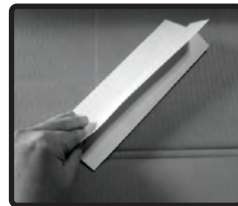


Try using some of these:

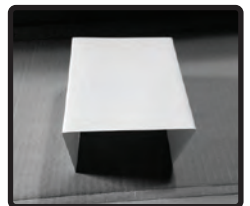
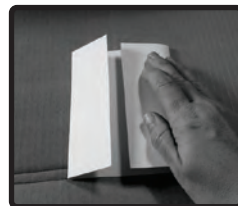
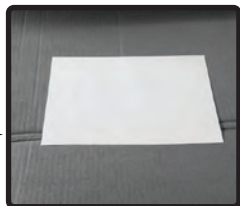
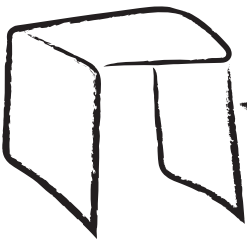
Tube



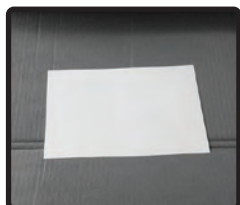
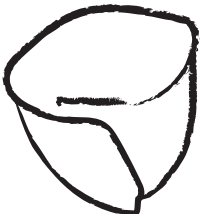
Ramp



Bridge



Cone



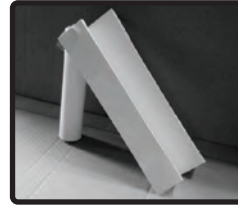
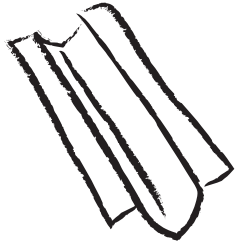
Now try putting them together!

Tube



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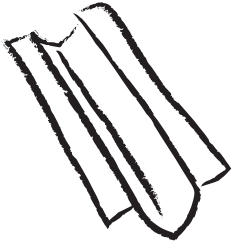
Ramp



or

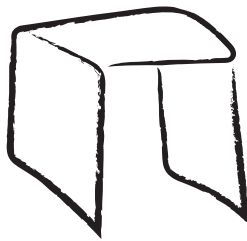


Ramp

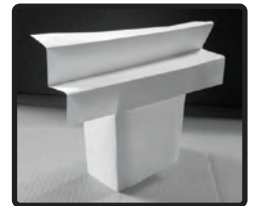


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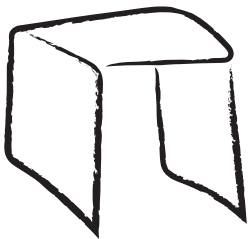
Bridge



or



Bridge



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Tube



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Cone



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Tube



or



Lesson 3: Your Digital Footprint

Common Sense Education | Unplugged

Overview

In collaboration with **Common Sense Education - Website**, this lesson helps students learn about the similarities of staying safe in the real world and when visiting websites. Students will also learn that the information they put online leaves a digital footprint or “trail.” This trail can be big or small, helpful or hurtful, depending on how they manage it.

Purpose

Common Sense Education has created this lesson to teach kids the importance of understanding the permanence of something posted on the internet. By relating footprints on a map to what a student might post online, students will make important connections between being tracked by a physical footprint on a path and being tracked based on information posted online.

Agenda

Warm Up (20 min)

Vocabulary
Pause and Think

Main Activity (20 min)

Follow the Digital Trail - Worksheet

Wrap Up (15 min)

Flash Chat: What did we learn?
Journaling

Assessment (5 min)

Digital Footprint - Assessment

Extended Learning

Objectives

Students will be able to:

- Understand that being safe when they visit websites is similar to staying safe in real life.
- Learn to recognize websites that are safe for them to visit.
- Recognize if they should ask an adult they trust before they visit a particular website.
- Explore what information is appropriate to be put online.

Preparation

- Watch this **Your Digital Footprint - Teacher Video**.
- Prepare to show **Your Digital Footprint - Lesson Video**.
- (Optional) Prepare to show **Pause and Think Online - Video**.
- Common Sense Education's **Follow the Digital Trail - Worksheet** game.
- Print one **Animal Tracks** chart (page 7) for each student.
- Print one **Digital Footprint - Assessment** for each student.
- Review **CSF Digital Citizenship - Resource List** for more online safety content.

Links

For the Teacher

- **Your Digital Footprint** - Teacher Video
- **Your Digital Footprint** - Lesson Video
- **Follow the Digital Trail** - Worksheet
- **Digital Footprint** - Assessment
- **Digital Footprint** - Assessment Answer Key
- **Common Sense Education** - Website
- **CSF Digital Citizenship** - Resource List

For the Students

- **Feeling Faces** - Emotion Images
- **Think Spot Journal** - Reflection Journal

Vocabulary

- **Digital Footprint** - The collected information about an individual across multiple websites on the Internet.

Teaching Guide

Warm Up (20 min)

Vocabulary

This lesson has one new and important phrase:

- **Digital Footprint** - Say it with me: Dih-jih-tal Foot-print

The information about someone on the internet.

Pause and Think

- Ask What does it mean to be safe?
- When you walk down the street or play in your neighborhood without a trusted adult there, how do you stay safe?
- Tell students that just as they should stay safe in the real world, they should stay safe when they go into the online world (visiting websites). Make parallels between the answers students gave you about their neighborhood and the online world.

Play the **Your Digital Footprint - Lesson Video**.

- Introduce the idea that there are three different kinds of websites that students may have the opportunity to visit.
 - Green: A “green” website is:
 - A good site for kids your age to visit
 - Fun, with things for you to do and see
 - Has appropriate words
 - Doesn’t let you talk to people you don’t know
 - Yellow: A “yellow” website is:
 - A site you are not sure is right for you
 - One that asks for information such as who you are, where you live, your phone number or email address, etc.
 - A place where you are allowed to communicate freely with others
 - Red: A “red” website is:
 - A site that is not right for you
 - A place you might have gone to by accident
 - Filled with things that are for older kids or adults
 - Discuss examples of each of these kinds of sites.

💡 Lesson Tip

If you have access to a computer, feel free to navigate to sites that might showcase each of these types (using extreme caution with your RED selection).

Now, let's see what we can do to keep ourselves safe.

Main Activity (20 min)



Follow the Digital Trail - Worksheet

- Peruse the **Follow the Digital Trail - Worksheet** lesson on the Common Sense Education webpage.
- Give each student an **Animal Tracks Chart** (page 7).

	Mizzle the Mouse	Electra the Elephant
Whose full name do you know?		
Whose house could you find?		
Whose birth date do you know?		
Whose user name and password do you know?		
Who let out a secret on the internet?		
Which animal can you describe better from his or her photo?		

Directions:

- Place the *Digital Trail Squares* on the ground, face down, in two different trails, keeping Mizzle the Mouse and Electra the Elephant's trails separate from one another.
- Share the stories of Mizzle and Electra. These animals decided it would be fun to put some information about themselves online. They went onto www.wildkingdom.com and posted information. The only problem is that they forgot to ask their parents if it was okay first.
- Explain to students that they are from the "Things Big and Small" Detective Agency. A hunter has hired them to find out as much as possible about Mizzle the Mouse and Electra the Elephant. The more the detectives learn, the better for their plan to take over the animal kingdom.
- Divide students into groups of four. Tell them that each group should have a detective that will keep detailed notes.
- Invite students to go on a hunt for information. Let them know that the information that Mizzle and Electra post can be seen by anyone, including the detectives. Each group should follow the digital trail of both animals, starting with the mouse and then the elephant. Stagger the groups so they are on the trail at slightly different times. Students should fill out their handout as they go.

Lesson Tip

If your students have trouble writing, feel free to do this activity as a group and have students raise their hand when they find clues. This will allow you (or a teacher aide) to help communicate and record the information being shared.

For more in-depth modules, you can find additions to this curriculum at the **Common Sense Education - Website** page on Scope and Sequence.

Wrap Up (15 min)

Flash Chat: What did we learn?

- Who can the detectives find out more about, and why?
- Which animal has a bigger digital footprint?
- Mizzle says some interesting things about himself on the Internet. What are they?
- Is there anything that Electra posted on the Internet that could become a problem for her? If so, what and why?

Take the time to discuss what is appropriate information to share on the Internet, and what is not:

Appropriate	Not Appropriate
Interests	Address
Hobbies	Full Name
First Name	Information that would hurt others

Lesson Tip

Flash Chat questions are intended to spark big-picture thinking about how the lesson relates to the greater world and the students' greater future. Use your knowledge of your classroom to decide if you want to discuss these as a class, in groups, or with an elbow-partner.

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future.

Journal Prompts:

- What was today's lesson about?
- Draw one of the **Feeling Faces - Emotion Images** that shows how you felt about today's lesson in the corner of your journal page.
- Draw some things that you should never talk to a stranger about on the internet. For example, draw your house to represent your address, draw your school, or draw your family.

Assessment (5 min)

Digital Footprint - Assessment

Hand out the assessment worksheet and allow students to complete the activity independently after the instructions have been well explained. This should feel familiar, thanks to the previous activities.

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Common Sense Education

- Visit **Common Sense Education - Website** to learn more about how you can keep your students safe in this digital age.

Standards Alignment

View full course alignment

Common Core English Language Arts Standards

- ▶ **L** - Language
- ▶ **SL** - Speaking & Listening

Common Core Math Standards

- ▶ **MD** - Measurement And Data
- ▶ **MP** - Math Practices

CSTA K-12 Computer Science Standards

- ▶ **IC** - Impacts of Computing

Next Generation Science Standards

- ▶ **ETS** - Engineering in the Sciences



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Follow the Digital Trail

Essential Question

What information is appropriate in a digital footprint?

Lesson Overview

Students learn that the information they put online leaves a digital footprint or “trail.” This trail can be big or small, helpful or hurtful, depending on how they manage it.

Students follow the digital information trails of two fictional animals. They make observations about the size and content of each trail, and connect these observations by thinking critically about what kinds of information they want to leave behind.

Learning Objectives

Students will be able to ...

- learn that the information they put online leaves a digital footprint or “trail.”
- explore what information is appropriate to be put online.
- judge the nature of different types of digital footprints by following the information trails of two fictional animals.

Materials and Preparation

- Cut apart the Digital Trail Squares (found at the end of the lesson plan), keeping the elephant and mouse squares separate. Be prepared to lay out each animal’s “tracks” in different locations in the classroom after the lesson introduction.
- Copy the **Animal Tracks Student Handout**, one for each group of four.

Family Resources

- Send home the **Privacy and Digital Footprints Family Tip Sheet (Elementary School)**.

Estimated time: 45 minutes

Standards Alignment –

Common Core:

grade K: RL.1, RL.3, RL.4, RL.10, RI.1, RI.4, RI.10, RF.4, W.2, W.5, W.7, W.8, W.10, SL.1a, SL.1b, SL.2, SL.3, SL.4, SL.6, L.6

grade 1: RL.1, RL.3, RL.4, RI.1, RI.4, RI.10, RF.4a, W.5, W.7, W.8, L.6

grade 2: RL.1, RL.3, RI.4, RI.10, RF.4a, W.2, W.5, W.7, W.8, SL.1a, SL.1b, SL.1c, SL.3, SL.6, L.6

NETS•S: 1a, 1d, 2d, 3d, 4a-c

Key Vocabulary –

trail: a path or track



digital footprint: the information about you on the Internet

permanent: there forever

introduction

Warm-up (5 minutes)

SHARE with students that you can place information online much like you pin something to a bulletin board.

ASK:

What kinds of things are on the bulletin board or walls in our classroom?

Sample responses:

- Student work
- Photos of students
- Birthday chart

INVITE students to imagine that all of the information on the walls of their classroom was pinned up on a bulletin board at a local grocery store.

ASK:

Would you be comfortable with this information being up for everyone to see?

Guide students to think about how some information is better kept for only their eyes or the eyes of people close to them.

EXPLAIN that there is certain information that might be fine to show anyone. But there is also personal and private information – such as their addresses, birth dates, and photos of their family vacations – which is not meant for most people’s eyes.

teach 1

Follow the Digital Trail (15 minutes)

DEFINE the Key Vocabulary term **trail**.

PLACE the Digital Trail Squares on the ground, face down, in two different trails, keeping Mizzle the Mouse’s and Electra the Elephant’s trails separate from each another.

SHARE the stories of Mizzle and Electra. These animals decided it would be fun to put some information about themselves online. They went onto www.wildkingdom.com and posted information. The only problem is that they forgot to ask their mamas if it was okay first.

EXPLAIN to students that they are from the Things Big and Small Detective Agency. An evil human has hired them to find out as much as possible about Mizzle the Mouse and Electra the Elephant. The more the detectives learn, the better for their plan to take over the animal kingdom.

DIVIDE students into groups of four. Tell them that each group should have a detective that will keep detailed notes.

DISTRIBUTE the **Animal Tracks Student Handout** to each group.

INVITE students to go on a hunt for information. Let them know that the information that Mizzle and Electra post can be seen by anyone, including the detectives. Each group should follow the digital trail of both animals, starting with the mouse and then the elephant. Stagger the groups so they follow the trails at slightly different times. Students should fill out their handout as they go.



teach 2



Digital Footprints (20 minutes)

INVITE each group to report to the rest of the class what they learned about each of the animals, using the **Animal Tracks Student Handout**.

	Mizzle the Mouse	Electra the Elephant
1. Whose full name do you know?		x
2. Whose house could you find		x
3. Whose birth date do you know?		x
4. Whose username and password do you know?		x
5. Who let out a secret on the Internet?		x
6. Which animal can you describe better from his or her photo?		x

DEFINE the Key Vocabulary terms **digital footprint** and **permanent**.

ASK:

Who can the detectives find out more about, and why?

Electra, because we now know where Electra lives, what she looks like, and private and personal information about her life. Point out to students that having a bigger digital footprint means the detectives can learn more about them too.

Which animal has a bigger digital footprint?

Electra, because she put more private and personal information online than Mizzle.

Mizzle says some funny things about himself on the Internet. What are they?

He says he likes Swiss cheese, his photo is of cheese, and he has a pet flea.

Is there anything that Electra posted on the Internet that could become a problem for her? If so, what and why?

Private and personal information (e.g., address, full name) allows others to learn more about her. This could be unsafe. Saying that she fights with her brother could hurt her brother's feelings because it is public.)

CREATE a chart with students that summarizes which information is okay to share online and what is not okay.

Okay to Share	NOT Okay to Share
Interests	Address
Hobbies	Full name
First name	Information that would hurt others

DISCUSS how Mizzle and Electra both had very interesting information online, but Mizzle used better judgment about what was most appropriate to post. Mizzle had a smaller digital footprint. Electra put some information online that might make her unsafe or might upset her brother.

REMINDE students that the Internet is a public space where people they do not know will likely see their information. And this information is very hard to remove. It is basically permanent.

EMPHASIZE that it's important for students to ask their parents or caregivers for permission before sharing information about themselves online.

closing

Wrap-up (5 minutes)

You can use these questions to assess your students' understanding of the lesson objectives.

ASK:

What is a digital footprint, and what did Mizzle's and Electra's footprints look like?

A digital footprint is the information about you on the Internet. Mizzle's footprint is pretty small and does not reveal private or personal information. Electra's is large and contains information that could make her unsafe or upset others.

What kind of information is okay to share on the Internet? What kind of information is NOT okay to share on the Internet?

Appropriate: interests, hobbies, first name.
Inappropriate: full name, address, hurtful information about others.

Can you put interesting and funny information online and still be appropriate?

Absolutely. Just look at the information that Mizzle posted.

Mizzle the Mouse

Name:
Mizzle



Where you live:
Mouse hole



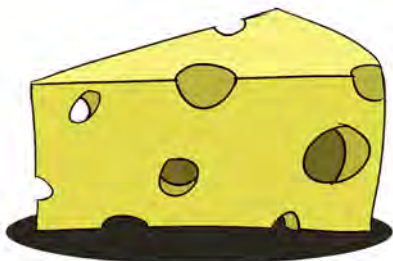
Pet's name:
Frank the Flea



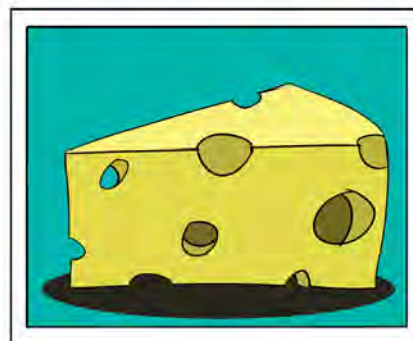
Favorite hobby:
Ice skating



Favorite food:
Cheese



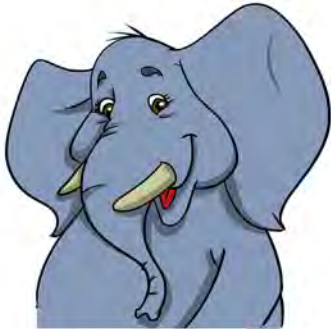
My favorite photo:



Electra the Elephant

Name:

My full name is:
Electra Ella Elephant



Where you live:

123 Water Hole Lane,
Peanuts, Ohio



Birth date:

February 21, 2010



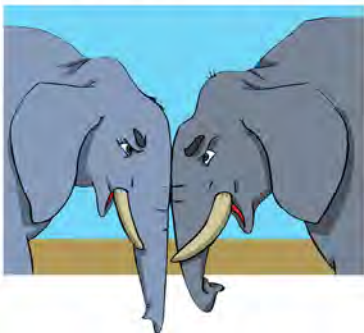
User name: gray_toes

Password: bamboo



Secret:

My brother and I
fight all the time



My favorite photo:



Follow The Digital Trail

Directions

Follow the trails of Mizzle the Mouse and Electra the Elephant. Fill in the chart below. Then answer the questions.

	Mizzle the Mouse	Electra the Elephant
1. Whose full name do you know?		
2. Whose house could you find?		
3. Whose birth date do you know?		
4. Whose username and password do you know?		
5. Who let out a secret on the Internet?		
6. Which animal can you describe better from his or her photo?		

Question

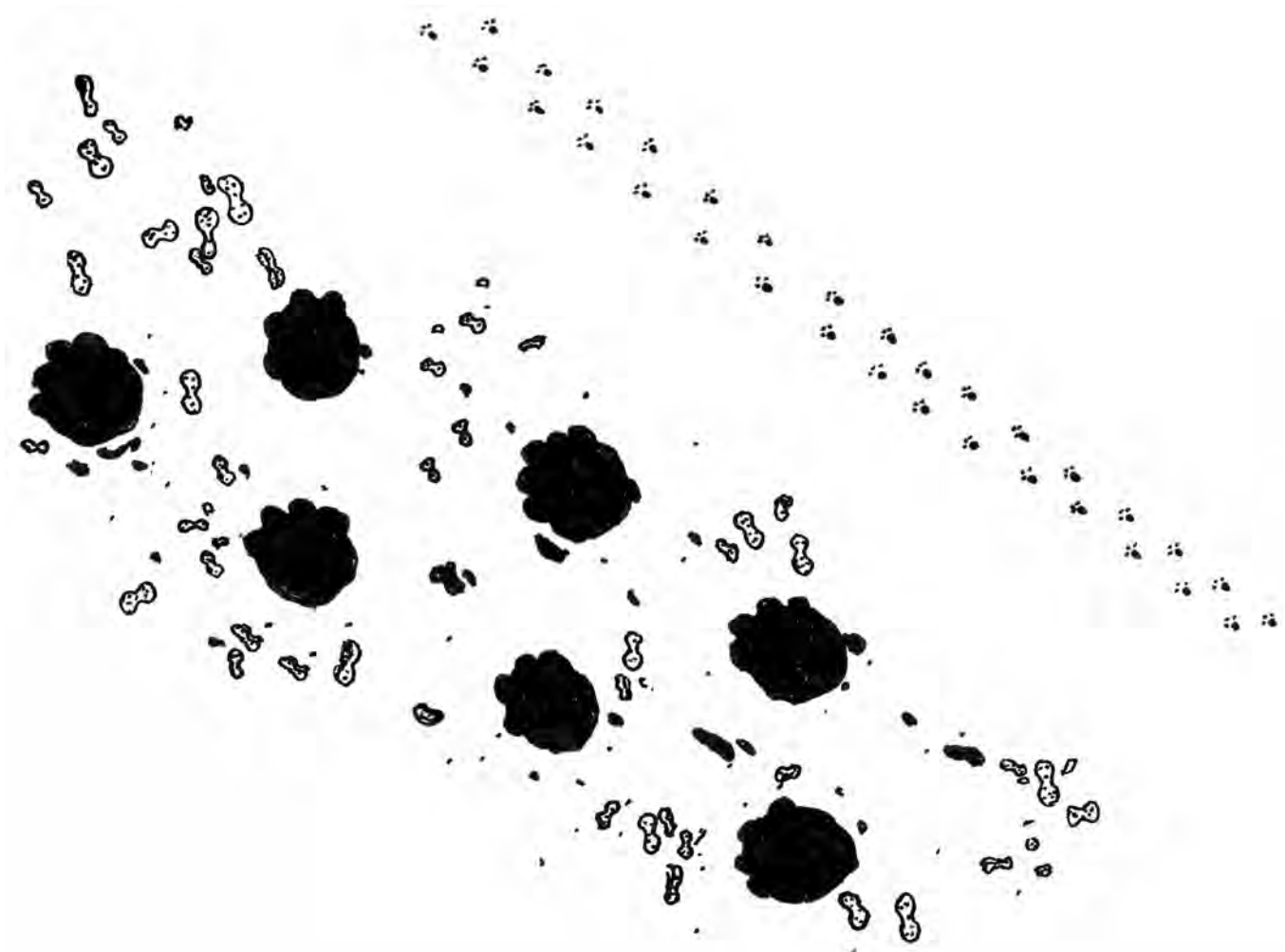
1. Who can the detectives find out more about, and why?

2. Which animal has a bigger digital footprint?



3. Mizzle says some funny things about himself on the Internet. What are they?

4. Is there anything that Electra posted on the Internet that could become a problem for her? If so, what and why?



Follow the Digital Trail

1. What is a digital footprint?

- a) A track that animals leave behind
- b) Shoes that you buy on the Internet
- c) The information about you on the Internet















2. What kind of information is safe to share online?

- a) Your birth date
- b) Your first name or computer username
- c) Your address



3. Which animal below has the digital footprint that leaves him or her most unsafe?

HINT: Think about which animal shares the most private information online.

	A) Fran the Fish 	B) Betty the Bird 	C) Tony the Tiger 
Hobbies	Swimming 	flying 	going to the 3rd Street gym 
Address	the sea 	a nest 	523 Green Street 
Other	pet's name is Frank 	I love seeds! 	My real name is Thomas 

- a) Fran the Fish
- b) Betty the Bird
- c) Tony the Tiger

Follow the Digital Trail

1. What is a digital footprint?

- a) A track that animals leave behind
- b) Shoes that you buy on the Internet
- c) The information about you on the Internet**



Answer feedback

The correct answer is **c**. Your digital footprint is the information about you online, such as a news story with your name in it or something that you write online.

2. What kind of information is safe to share online?

- a) Your birth date
- b) Your first name or computer username**
- c) Your address



Answer feedback

The correct answer is **b**. It is okay to share your first name or your username online. But sharing your address or birth date could make your information unsafe because other people might use your information to pretend to be you!

3. Which animal below has the digital footprint that leaves him or her most unsafe?

HINT: Think about which animal shares the most private information online.

	A) Fran the Fish	B) Betty the Bird	C) Tony the Tiger
Hobbies	Swimming	flying	going to the 3rd Street gym
Address	the sea	a nest	523 Green Street
Other	pet's name is Frank	I love seeds!	My real name is Thomas

- a) Fran the Fish
- b) Betty the Bird
- c) Tony the Tiger**

Answer feedback

The correct answer is **c**. Tony the Tiger put private information online, like his address, which is not safe. Fran and Betty shared information, but they did not share anything private about themselves.



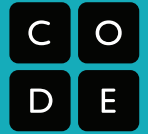
Unplugged

Name: _____

Date: _____

Your Digital Footprint

Staying Safe and Responsible Assessment



Just because you can share something online doesn't mean that you should!




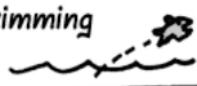
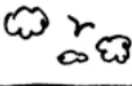







Cross out the information that you should not share online. Use the words that are leftover as the key to what you should find in the word search.

WORDS

- 1) Your Real Name (NAME)
- 2) Your Online Name (NICKNAME)
- 3) Your Address (ADDRESS)
- 4) Your Email (EMAIL)
- 5) Your Favorite Color (COLOR)
- 6) The Last Book you Read (BOOK)
- 7) Your Credit Card Info (CARD)
- 8) Your Favorite Band (BAND)
- 9) Your Phone Number (PHONE)
- 10) What You Ate Today (FOOD)
- 11) Your Birthday (BIRTHDAY)



Which animal below has the digital footprint that leaves him or her most unsafe?
HINT: Think about which animal shares the most private information online.

	A) Fran the Fish 	B) Betty the Bird 	C) Tony the Tiger 
Hobbies	swimming 	flying 	going to the 3rd Street gym 
Address	the sea 	a nest 	523 Green Street 
Other	pet's name is Frank 	I love seeds! 	My real name is Thomas 

Circle One:

- A) Fran the Fish
- B) Betty the Bird
- C) Tony the Tiger

Appendix B: Glossary of Vocabulary

Vocabulary

Encouraging students to learn and use official computer science terms will enable them to communicate correctly and efficiently with others and builds their knowledge such that it can be further developed without having to relearn terms and concepts at a later time. The terms and concepts used in the unplugged lessons are defined using words that young students can understand.

abstraction

Pulling out specific differences to make one solution work for multiple problems.

accessibility

The design of products, devices, services, or environments taking into consideration the ability for all users to access, including people who experience disabilities or those who are limited by older or slower technology.

algorithm

A list of steps to finish a task. A set of instructions that can be performed with or without a computer. For example, the collection of steps to make a peanut butter and jelly sandwich is an algorithm.

binary

A way of representing information using only two options.

binary alphabet

The two options used in your binary code.

bit

A contraction of "Binary Digit". A bit is the single unit of information in a computer, typically represented as a 0 or 1.

block-based programming language

Any programming language that lets users create programs by manipulating "blocks" or graphical programming elements, rather than writing code using text. Examples include Code Studio, Scratch, Blockly, and Swift. (Sometimes called visual coding, drag and drop programming, or graphical programming blocks)

Blockly

The visual programming language used in Code.org's online learning system for K-5 students.

bug

An error in a program that prevents the program from running as expected.

byte

the most common fundamental unit of digital data eg. Kilobyte, Megabyte, etc. A single byte is 8 bits-worth of data.

call (a variable)

Use a variable in a program.

call (a function)

This is the piece of code that you add to a program to indicate that the program should run the code inside a function at a certain time.

click

Press the mouse button.

code

One or more commands or algorithm(s) designed to be carried out by a computer. See also: program

command

An instruction for the computer. Many commands put together make up algorithms and computer programs.

computational thinking

Mental processes and strategies that include: decomposition, pattern matching, abstraction, algorithms (decomposing problems into smaller, more manageable problems, finding repeating patterns, abstracting specific differences to make one solution work for multiple problems, and creating step-by-step algorithms).

computer science

Using the power of computers to solve problems.

conditionals

Statements that only run under certain conditions or situations.

crowdsourcing

Getting help from a large group of people to finish something faster.

cyberbullying

Doing something on the internet, usually again and again, to make another person feel angry, sad, or scared.

data

Information. Often, quantities, characters, or symbols that are the inputs and outputs of computer programs.

debugging

Finding and fixing errors in programs.

decompose

Break a problem down into smaller pieces.

define (a function)

To add code inside a function so that the program knows what it is supposed to do when the function is called.

digital citizen

Someone who acts safely, responsibly, and respectfully online.

digital footprint

The information about someone on the Internet.

DNS (domain name service)

The service that translates URLs to IP addresses.

double-click

Press the mouse button twice very quickly

drag

Click your mouse button and hold as you move the mouse pointer to a new location

drop

Release your mouse button to "let go" of an item that you are dragging

DSL/cable

A method of sending information using telephone or television cables.

event

An action that causes something to happen.

event-handler

A monitor for a specific event or action on a computer. When you write code for an event handler, it will be executed every time that event or action occurs. Many event-handlers respond to human actions such as mouse clicks.

F.A.I.L

First Attempt In Learning

fiber optic cable

A connection that uses light to transmit information.

for loop

A loop with a predetermined beginning, end, and increment (step interval).

frustrated

Feeling annoyed or angry because something is not the way you want it.

function

A piece of code that you can easily call over and over again. Functions are sometimes called 'procedures.' A function definition is a segment of code that includes the steps performed in the function. A function call is the code segment, typically within the main logic of the program, which invokes the function.

function call

The piece of code that you add to a program to indicate that the program should run the code inside a function at a certain time.

function definition

The code inside a function that instructs the program on what to do when the function is called.

if-statement

The common programming structure that implements "conditional statements".

input

A way to give information to a computer.

Internet

A group of computers and servers that are connected to each other.

IP address

A number assigned to any item that is connected to the Internet.

iteration

A repetitive action or command typically created with programming loops.

loop

The action of doing something over and over again.

online

Connected to the internet.

output

A way to get information out of a computer.

packets

Small chunks of information that have been carefully formed from larger chunks of information.

pattern matching

Finding similarities between things.

parameter

An extra piece of information that you pass to the function to customize it for a specific need.

persistence

Trying again and again, even when something is very hard.

pixel

Short for "picture element" it is the fundamental unit of a digital image, typically a tiny square or dot which contains a single point of color of a larger image.

program

An algorithm that has been coded into something that can be run by a machine.

programming

The art of creating a program.

repeat

To do something again.

run program

Cause the computer to execute the commands you've written in your program.

search engine

A program that searches for and identifies items in a database that correspond to keywords or characters specified by the user, used especially for finding particular sites on the World Wide Web.

servers

Computers that exist only to provide things to others.

toolbox

The tall grey bar in the middle section of Code.org's online learning system that contains all of the commands you can use to write your program.

trustworthy

Able to be relied on as honest or truthful.

try

Attempt to do something

URL (universal resource locator)

A relatively easy-to-remember address for calling a web page (like www.code.org).

username

A name you make up so that you can see or do things on a website, sometimes called a “screen name.”

variable

A placeholder for a piece of information that can change.

website

A location connected to the Internet that maintains one or more pages on the World Wide Web.

while loop

A loop that continues to repeat while a condition is true.

Wi-Fi

A wireless method of sending information using radio waves.

workspace

The white area on the right side of Code.org's online learning system where you drag and drop commands to build your program.

Appendix C: Student Skills and Strategies for Tackling Difficult Challenges

This appendix outlines specific strategies that you can encourage students to take in tackling challenges in CS Fundamentals.

Approaching Lesson Progressions

Growth Mindset

Throughout these lessons, it is critical that students understand that nobody is born knowing computer science. Everyone starts at the beginning, experiences failure, learns from mistakes, then experiences success. Students should not view frequent programming failures as a sign that they lack talent, but should instead be proud of their own persistence as they make changes and try again. All computer scientists fail. The best programmers are the ones who keep trying long enough to learn from the problems that they encounter.

Here are some tips to help your students stay persistent:

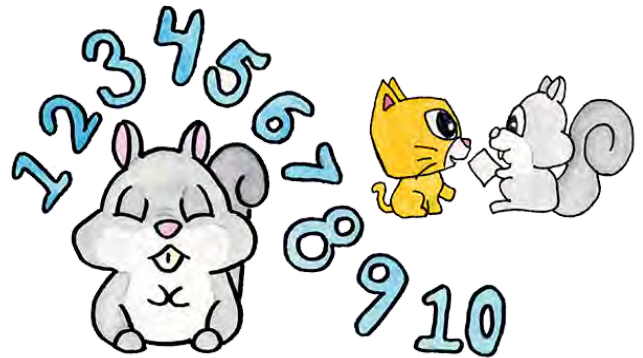
- Keep track of what you have already tried
- Figure out what is happening
- Understand what is supposed to happen
- Look at what that tells you
- Make a change and try again

Frustration

Frustration is a natural part of learning. Instead of trying to avoid frustration at Code.org, we embrace it. The key to persistence is in learning that frustration is a positive sign, not a negative one. When a student gets frustrated, it means that they are about to learn something new. It can be compared to the pain you feel in your mouth before you get a new tooth, or the soreness in your muscles before you get stronger. Congratulate students on recognizing and persevering through frustration.

Here are some tips to help your students deal with frustration:

- Count slowly to 10
- Take some deep breaths
- Write your worries in a journal
- Talk to a partner about your feelings
- Ask for help



Paper and Pencil

It is common for a teacher to expect students to work out code in their head. This puts unfair stress on students, as programs can get complicated and confusing. Encourage students to code with a piece of paper and pencil nearby so that they can scribble down predictions and trace out paths for solving puzzles. Paper can be helpful to record the ideas that have already been tried, as well as thoughts about what can be tried next. It might even help students to write a little about what they did to pass a level so that they can share with classmates who are in need of a little help.

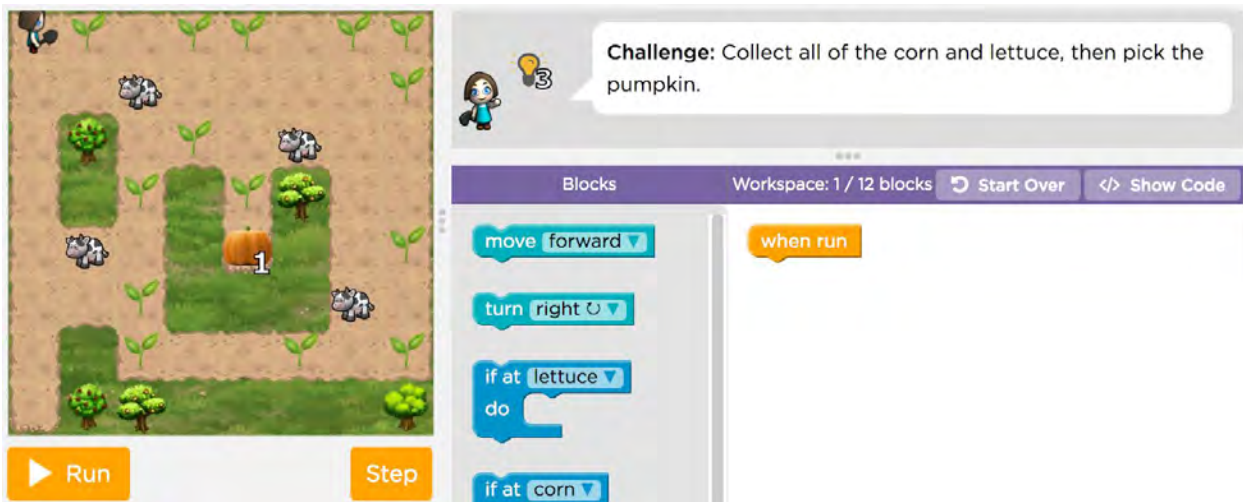
Trying (Then Skipping) Challenges

When Code.org places so much value on persistence, it is hard to justify skipping puzzles because they feel too difficult or confusing. It is, however, how our challenge puzzles were designed.

Most of our online lessons contain one “challenge” puzzle near the end of the series. This puzzle was carefully placed to inspire students to practice new concepts in a different way. It will test their persistence, highlight misconceptions, and hopefully lead them to the “ah-ha” moment that educators love! Additionally, spending a fair amount of time with the challenge puzzle will help the following levels feel simple in comparison, even though the levels that follow demonstrate the exact target of understanding expected from a student by the time they finish each lesson.

In order to provoke those strong accomplishments, challenge levels must all but guarantee that they cannot be solved quickly. Because of this, they will be far too hard for many students, which means that the messaging of these challenges is extremely important. Keep these things in mind, and make sure that you review them with your students before each visit to the computer lab.

- When you get to the challenge puzzle, give it your best try!
- Keep notes as you try to solve the puzzle so that you don’t lose your place or try the same thing over and over again.
- These puzzles are supposed to be hard. You don’t have to solve it in order to learn from it, but you do have to try your best!
- Remember that you can come back to the challenge puzzle later. If you start to get frustrated, go ahead and skip the challenge until you complete the rest of the lesson. You can come back to it when you’ve finished everything else!



Lesson Extras

Many teachers like to keep their entire class on the same lesson instead of letting students skip ahead to new concepts. For that reason, we have provided an area at the end of each lesson series where students can use the concepts that they’ve learned in new and interesting ways. These puzzles are considered “optional.” They are a sandbox to keep the quickest students challenged and entertained until the end of class. In addition, the Lesson Extras can be used to add an additional day onto concept lessons, offering the opportunity for students to come back and create personal and authentic projects with their newest concepts.

Copy/Paste

Though we do not make it obvious, most individual blocks in CS Fundamentals are able to be copied/pasted within the same level. If you feel that the ability to copy and paste blocks will enhance your student's learning experience, then you can share the copy/paste method with them:

1. Highlight the block that you want to copy
2. Press ctrl+c to copy
3. Press ctrl+v to paste
4. Move your pasted block to where you would like it

While this “hack” generally only allows you to copy one block at a time, there is a work around for duplicating larger chunks of code. All you need to do is pull a statement block (like a loop, conditional, or simple function) from the toolbox and place all of the code to be copied inside. Now, select the statement block and copy/paste. All of the code inside will be duplicated. You can now pull the extra code out of the statement block and use it as desired.

Puzzle/Problem Solving Recipe

Start a Puzzle with Understanding

Often, the quickest way to pass a level is to know where you're headed from the start. Help students understand that being successful means taking a look at what is required before dragging anything out to the workspace. Here are some important questions that students should ask:

- What do the instructions say?
- What am I supposed to do?
- What has already been done?
- Are there any questions that I need answers to?
- Have I solved another problem like this one?
- Can I put the puzzle's goal into my own words?

Debugging

Small misunderstandings can lead to big problems! Help keep students moving by showing them some basic debugging skills.

Step Button

Most puzzles in CS Fundamentals have a “Step” button (excluding Artist, Play Lab, and BB-8 levels.) With the “Step” button, it is possible to go through a program block by block to see what happens each step of the way. This is a helpful tool when your code moves too quickly to understand where things get off course.

To use the “Step” button, simply click on “Step” instead of “Run”. Your code will run exactly one block before coming to a rest again. To continue through the code, keep pressing “Step” until you have completed your program, or found your bug!

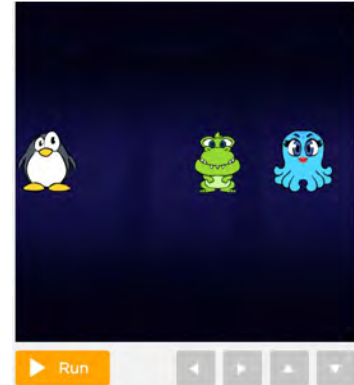
In Artist puzzles, the “Step” button is replaced by a speed slider. For a similar effect, try moving the slider to the far left and watching the artist go through each step very slowly.



Example of level with "Step" button.



Example of level with speed slider..



Example level with no "Step" button.

Finger/Paper Tracing

For puzzles that don't have a "Step" button, students can find a great amount of help looking through their program on their own.

The ability to predict what a program will do is an amazing skill, but it takes a lot of practice. Students can find opportunities to grow in this area by using finger tracing and/or paper tracing as they code in CS Fundamentals.

- Finger Tracing
 - Use your finger to point to the first block on the screen. What does everything look like? What values do the variables hold (if there are any)? What happens to that landscape after the current block is executed?
 - Drop your finger to the next block and ask the same questions.
 - Can you run through the whole program and predict the outcome?
- Paper Tracing
 - Draw a line down the center of your paper
 - On one side, write the code for your program
 - On the other side, write notes on the starting state of the program: Where are the characters? What are the values of the variables? Anything else to note?
 - Now look at the first line of your program. What changes when it is executed? Write the new details in your notes area.
 - Continue to run through the written code until you reach the end. Is everything as you expected?

Critical Questions

If looking through your code does not provide the answers you need, you will have to dig a little more deeply. These questions will help students to highlight the clues provided by their program when things are not working:

- What does it do?
- What is it supposed to do?
- What does that tell me?
- Is it right at the first step?
- Is it still right at the second step?
- Where is the first place that it goes wrong?

Asking for Help

In computer science, there's a fine line between the benefit that you get from figuring out something on your own, and the benefit of learning from the experience of a peer. For this reason, CS Fundamentals encourages a "Try three / Try three / Ask me" system.

With this system (3/3/Me) students are asked to tackle a problem with three different solutions before asking peers for help. Once their classmates get involved, they should try three more solutions together before involving a teacher. At that point, as an educator, you should ask them to put in words what they tried and what that told them. Also ask them if they have narrowed down any places where the problem is **not**. If they have not yet solved their problem, guide them in trying a few additional options.

In all cases, make sure that you and your class are familiar with the right way to help a student:

- Don't sit in the classmate's chair
- Don't use the classmate's keyboard or tablet
- Don't touch the classmate's mouse
- Make sure the classmate can describe the solution to you out loud before you walk away

If, after all of this, issues still persist, you might consider [filing a bug report](#) with Code.org through the website or by emailing support@code.org.