Unit Leader's Guide

STEM in a BOX
Cub Scout
NOVA Award Program

Michigan Crossroads Council, BSA
STEM Programs
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Table of Contents

STEM Program Guide

Introduction

The Boy Scouts of America launched the Nova awards program in an effort to incorporate learning about Science, Technology, Engineering and Math (STEM). The national BSA website details the goals and aims of the program and a link is provided at the end of the document.

The program is open to Cub Scouts, Boy Scouts and Venturing and the activities and requirements are age appropriate and designed to stimulate interest in STEM.

Why STEM

In today's world, the ability to understand the concepts around STEM has proven essential to developing strong career paths. The Boy Scouts of America is in the business of developing youth and STEM provides a supplement to the traditional Scouting program and complements the outdoor activities and a Scout's journey to Eagle.

Secondly, many aspects of our lives involve STEM whether we know it or not. From simple calculations about how early we should leave for an appointment to calculating the amount of paint we need to buy to cover a child's bedroom are all STEM-related activities. By bringing STEM activities into the Scouting program we can enhance the Scouting experience and cultivate the natural curiosity of youth.

Finally, various Scout Activities from building a Pinewood Derby car to archery to cooking to fire building involves a STEM concept. STEM is literally all around us and we make use of it every day. What better way to complement the traditional Scouting program than to add an element that explains the physics behind archery in addition to teaching the skill.

What Is a STEM Award

There are two types of STEM awards: Nova and Supernova awards. The Nova awards incorporate various STEM-related activities, e.g., reading, viewing, experimenting, and outings along with earning STEM related adventure loops, pins or merit badges. The Supernova awards are more rigorous and build upon the Nova awards.

STEM Program Guide

Nova Awards

To earn a Nova award a Cub Scout, Boy Scout or Venturer can earn traditional belt loop/pin or merit badge in conjunction with satisfying other specific requirements for the individual Nova award.

Nova awards are guided by a Nova awards counselor. The counselors need to have an interest in helping with the STEM program and a general familiarity with STEM, but in no way needs to be a scientist, technologist, engineer or mathematician. A counselor is any registered adult age 21 or older (unless he/she is working with his/her own child).

The STEM initiative is meant to be "fun" and cultivate a desire to explore additional STEM concepts and ideas much like the traditional Scouting program asks youth to seek a broader outdoor experience.

Nova awards are work done at a unit level and the barrier to entry for each unit is low. A willingness to try is all that is required of the adult leader to help a Scout move forward with an award.

Since STEM stands for science, technology, engineering and mathematics, there is a Nova award for each category at each level of Scouting. They are listed as follows:

CUB SCOUT NOVA

- 1-2-3 Go! Tracking Form
- Science Everywhere Tracking Form
- Swing! Tracking Form
- Tech Talk – Tracking Form

BOY SCOUT NOVA

- Designed to Crunch Tracking Form
- Shoot! Tracking Form
- Start Your Engines Tracking Form
- Whoosh! Tracking Form

VENTURING NOVA

- Hang On! Tracking Form
- Launch! Tracking Form
- Numbers Don't Lie Tracking Form
- Power Up Tracking Form

Supernova Awards

These awards are a higher level award requiring more rigor to complete. They are built, however, on the foundation of the Nova awards. Thus the youth would complete a number of Nova awards as pre-work to beginning the Supernova project.

Supernova awards mentors must be 21 or older, be subject matter experts in a STEM (science, technology, engineering, mathematics) field and be a registered and approved member of Michigan Crossroads Council.

For the Supernova awards, the youth will work with a Supernova mentor who is a registered member and approved by the Michigan Crossroad Council's Advancement Committee.

Keys to a Successful STEM Program

The STEM program complements the traditional Scout program and provides another avenue for exploration, leadership development and fun. For many youth, the allure of science and technology is overwhelming and used properly the STEM program can be a powerful recruiting tool.

First, make it fun. The STEM program is not designed to supplement traditional schooling, but rather to spark the imagination and natural curiosity of youth.

Second, incorporate it into your traditional program. It is simple to add a STEM element to Scouting activities which complements the "what" of the activity with the "how and why" it works. For example, the Pinewood Derby event at the Cub Scout level is all about science and engineering.

Start with a group session to introduce the topic to your pack, troop or crew. The project should have a physical element.

Most important is to review the information in websites of both the BSA and the Michigan Crossroads Council. Everything a unit needs to start a STEM initiative is located on the website including the Nova awards guidebooks or you can purchase the guidebooks at your local Scout shop.

Please note: Nova Award Books for Cub Scouts are available, as of June 2015, for the NEW Cub Scout Program. Check the printing date on your books and ONLY use the June 2015 books if you are starting your Nova Awards after 6/1/2015. Your local Scout Shop will have only these books on hand now.

How to Start

Up until now, we've talked about what the program is about. Now, we discuss how to practically launch the program in your unit. The following is a practical step-by-step guide to getting the program up and running.

Step 1: Contact your District STEM Chair and include STEM in your program planning.

This individual is charged by his/her district with helping to roll the STEM program out to each unit. They will be active at roundtable around STEM topics and will be willing to discuss with your unit leadership about the STEM program.

The District STEM Chair can make a presentation to your unit leadership and/or unit membership. Leverage this resource.

Part of the discussion will center on how to incorporate STEM into your program planning and recruiting efforts.

Step 2: Recruit Nova awards counselors.

The Nova awards counselor is a unit appointed position, and can be any registered adult age 21 or older (unless he/she is working with his/her own child). To be effective the single most important aspect for the counselor is a willingness to help. While an interest in and a familiarity with STEM concepts is helpful, it is not in the least bit required. In fact, any adult leader can administer the Nova awards program.

The above notwithstanding, each and every unit probably has a number of individuals who have STEM careers and would be more than willing to be subject matter experts (SME's) for your unit. Use the resource survey (see Resources section) to identify the candidates.

Additional resources can be found at roundtable and on the Michigan Crossroads Council website.

Step 3: Schedule a group STEM activity.

In your unit, designate a pack meeting, troop meeting or crew meeting to launch and explain the STEM program to the youth. This is not just a lecture, but a practical and hands on approach where you will get started on a Nova award as a group.

Select a single Nova award for your unit and work with your District STEM Chair to help launch. Have a Nova awards counselor introduce the award at a group meeting and be available to guide participants through the award. Start by doing part of the award during a unit function. The activities should include a practical exercise—watching a video or conducting individual experiments.

Sample activities include:

- Show a video that applies to an award.
- Do a STEM-related demonstration.
- Go on a STEM-related field trip.

Examples can be found at: http://mindtrekkers.mtu.edu

Step 4: Call for Supernova awards mentors (optional).

This step is needed if a member in your unit wants to pursue the Supernova award. The Supernova awards mentor is similar to a merit badge counselor, in that they must be a registered leader and have domain expertise. In simple terms, they must have STEM credentials. They will need to fill out an application and be approved by the Michigan Crossroad Council's Advancement Committee as a Supernova mentor.

Resources

The following are links to assets and websites that can aid in your STEM journey:

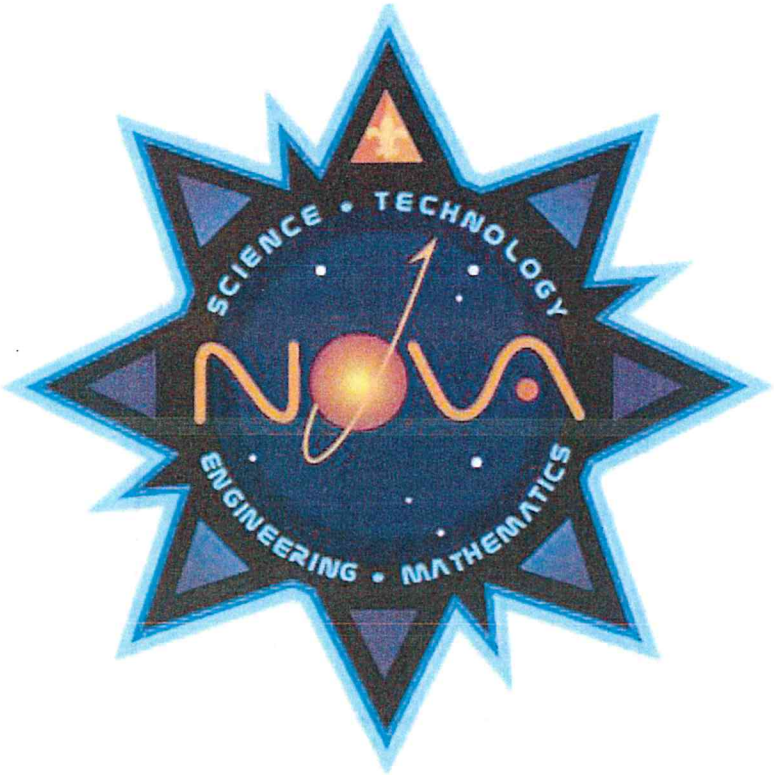
The national BSA website (http://www.scouting.org/stem/Awards/AboutNova.aspx) begins detailing the goals and aims of the program.

Check out the Michigan Crossroads Council calendar, and search on STEM to find events, activities, camps, and Nova Award specific events in our Council: http://www.michiganscouting.org/Calendar

CUB SCOUT NOVA

STEM in a Box

SWING! Kit

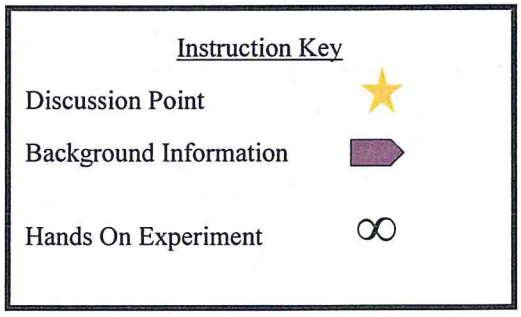


BOY SCOUTS OF AMERICA®
MICHIGAN CROSSROADS COUNCIL

How to use this guide

The STEM in a Box program is designed to give Scout leaders an easy, user-friendly way to present concepts to their Scouts. Each kit contains everything you need to complete the requirements for that module. Where possible, we have provided you with background information to help with the idea. Experiments were designed to make the learning fun and interactive for your Scouts.

This instruction key provides visuals to help you know what each lesson entails. For example, when you see the yellow star, you know that this information will be a discussion point you can use with your Scouts to explore a topic further.



Be sure to look through the STEM in a Box kit before you use it for the first time. There may be some information that will be helpful to read before you have a room full of Scouts ready to start their STEM adventures.

Please be sure to note any supplies that need to be replenished on the supply list enclosed, before you return the STEM kit to the Field Service Center. If an item breaks, please let us know right away.

Most importantly, have FUN with your Scouts! You are doing important work, inspiring and engaging future engineers, doctors, chemists, rocket scientists, electricians and more. Thank you for what you do!

Stem-in-a-Box

Swing NOVA Box Content List

- Bound Manual
- Bound book of playground equipment

Lever Experiment (5 sets of each for 4 groups/20 Scouts

- 5 Pencil Boxes (plastic) Items below will fill 5 total boxes:
- 2" Wooden Spool (5 each)
- Roll Masking Tape (5 each)
- 3 Dixie Cups (15 each)
- Permanent Marker (5 each)
- Marbles or weights (25 Total for 5 each box)
- Rulers (5 each)

- Load/Effort Data Charts (10 copies, 3 to a sheet)
- 20 Pencils / 3 Sharpeners
- 25 Sheets of blank paper

NOTE: Items in RED will need to be resupplied after each use. Box should be stocked for 20 Scouts.

Pack #47

Stem-on-the-Go

Swing!

Introduction

The Swing! module is designed to help Cub Scouts explore how engineering and simple machines called levers affect their life each day. The materials in this box provide the resources to complete the award.

- Lever demonstration kit
- Sheet referencing online resources about anything related to motion or machines.
- Common household items that are levers
- Pictures of activities of the pins and loops required for the Swing Award
- Award Tracking Forms
- Cub Scout Nova Awards Guidebook

Directions

Review the Swing! requirements (Page 23) and the counselor instruction (Page 70) in the Cub Scout Nova Awards Guidebook. The following notes instruct how to use the materials provided with this box.

Requirement (1.A)

Watch an episode or episodes (about one hour total) of a show about anything related to science. Then do the following:

1. *Make a list of at least two questions or ideas from what you have watched.*
2. *Discuss two of the questions or ideas with your counselor.*

Suggested videos:

National Geographic for Kids
http://video.nationalgeographic.com/video/kids/

Mythbusters clips and short episodes
http://www.discovery.com/tv-shows/mythbusters

Requirement (3.A.1)

Make a list or drawing of the three types of levers. (A lever is one kind of simple machine.)

Types of Levers

Beforehand, refer to the background info provided to learn about the three types of levers.

- Discuss the three different types of levers. Show the pictures of each type of lever, the example and the collage.
- Pass around the household items: baseball bat, tongs and the seafood and nut cracker. Ask the Scouts to identify the class of lever for each item and how it works.

Note: You can add additional tools and household items to these demonstration props. Some suggestions are:
Class 1 - Scissors, Pliers, Claw hammer (removing nails)
Class 2 - Nail clippers (folding type), Stapler, Crowbar
Class 3 - Fishing rod, Tweezers, Broom

Learning Concepts

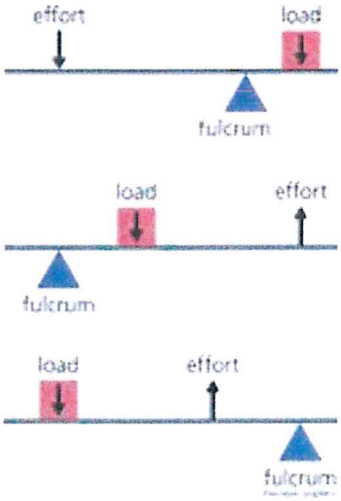
Levers can be used to:

- Make things easier to move—A small force applied over a large distance results in a large force moving a small distance (class 1 levers where the applied force is farther away from the fulcrum than the load, and class 2 levers).
- Change the direction of the applied force (class 1 levers).
- Increase the distance an object moves—A large force applied over a small distance moves the load a large distance. (This happens with class 3 levers and class 1 levers where the fulcrum is closer to the applied force than the load.)

BACKGROUND INFORMATION

Simple Machines: Levers

In our day-to-day life we use many devices to make our work easy and simple. At school when we introduce the concept of lever to children we need to take examples from surroundings of children and make them encourage to ask questions relating to it. This is quite essential to develop their motivation and relate the new content to be taught with their experiences. Even in teaching science the same strategies can also be applied citing examples like knives, pliers, scissors, etc. These are simple machine/devices used to make our work easier.



Lever is a term used to denote a simple machine comprised of three components. Three different possible combinations are there to represent different classes of lever to perform different tasks.

3 classes of levers and how they work

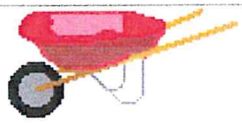
In a Type 1 Lever, the pivot (fulcrum) is between the effort and the load. In an off-center type one lever (like a pliers), the load is larger than the effort, but is moved through a smaller distance.

Examples of common tools (and other items) that use a type 1 lever include:

Item		Number of Class 1 Levers Used
see-saw		a single class 1 lever
hammer's claws		a single class 1 lever
scissors		2 class 1 levers
pliers		2 class 1 levers

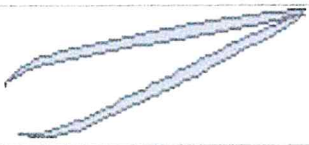
In a Type 2 Lever, the load is between the pivot (fulcrum) and the effort.

Examples of common tools that use a type 2 lever include:

Item		Number of Class 2 Levers Used
stapler		a single class 2 lever
bottle opener		a single class 2 lever
wheelbarrow		a single class 2 lever
nail clippers		Two class 2 levers
nut cracker		Two class 2 levers

In a Type 3 Lever, the effort is between the pivot (fulcrum) and the load.

Examples of common tools that use a type 3 lever include:

Item		Number of Class 3 Levers Used
fishing rod		a single class 3 lever
tweezers		Two class 3 levers
tongs		Two class 3 levers

There are three components in each lever. They are

1. Load
2. Effort
3. Fulcrum

- Fulcrum-where movement is possible
- Load-where work has to be done
- Effort-where force is applied

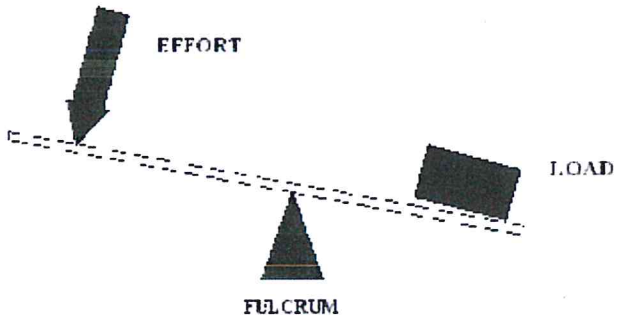
Different positions of this components form different classes of levers.

There are 3 types (classes) of lever. The type of lever depends upon the position of the basic components (load, effort, fulcrum).

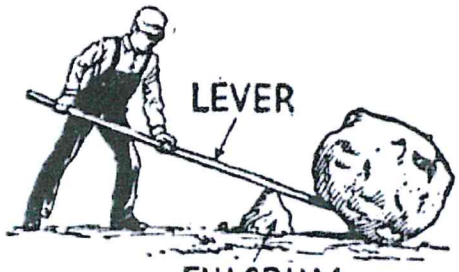
First class lever

In this lever, the position of the fulcrum is between the load and the effort.

FIRST CLASS LEVER



Example

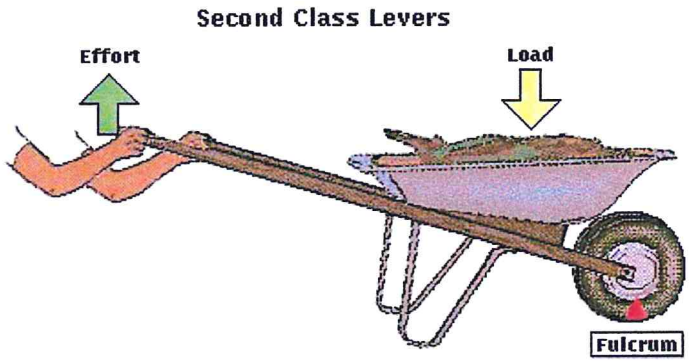


Man lifting a stone with a lever

Second class lever

In this lever, the position of the Load is inbetween Fulcrum and the Effort.

Example



A wheelbarrow is a second-class lever.

Experiment: Types of Levers

Refer to the experiment that follows for a hands-on way to teach Scouts about the three types of levers with weights, spools, rulers and cups.

STEM-in-a-Box Experiment

Types of Levers Experiment

Lever Terms

The *load* is the object you are trying to lift. It sits on the resistance arm of the lever. The *effort* is the force you use to push down on the lever to lift the load. It's applied to the effort arm of the lever. The resistance arm and the effort arm are separated by the *fulcrum*, the point where the lever pivots.

Experiment

Materials:

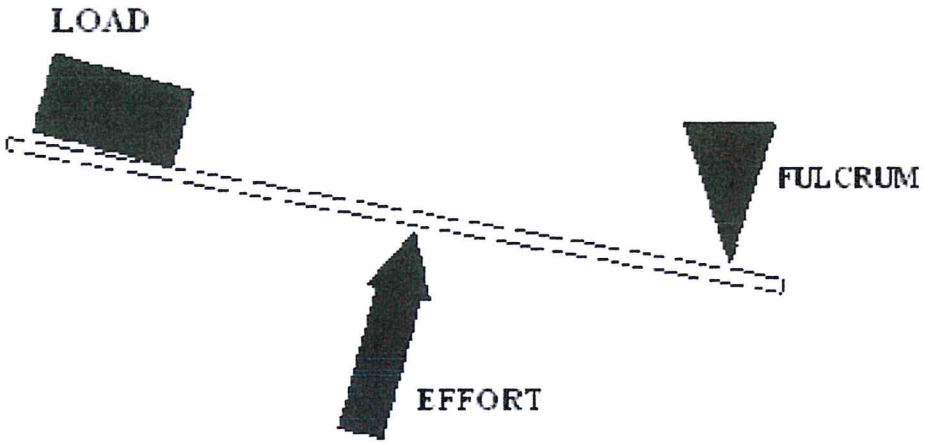
- Ruler (30 cm)
- Large spool
- Masking tape
- Marker
- 2 paper Dixie cups
- Poster tack to stabilize the spool
- A small rock or other weight
- Handful of pennies, marbles, etc.

1. Use a marker to label one cup "Load" and the other cup "Effort." Use tape to attach the cups to opposite ends of the ruler.

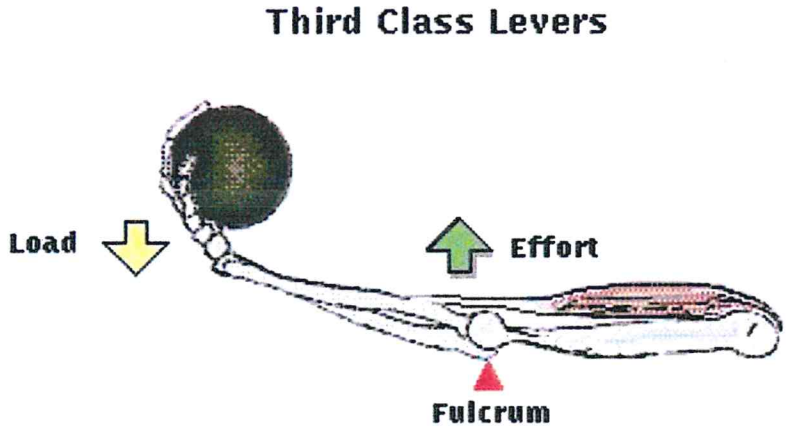
Third class lever

In this lever, the position of the Effort is in-between the Fulcrum and the Load.

THIRD CLASS LEVER



Example



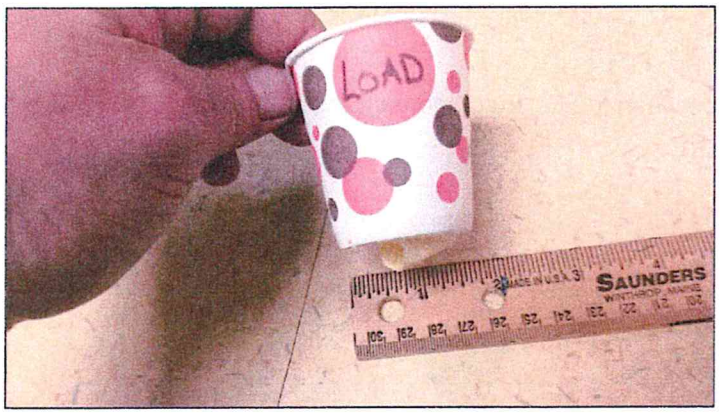
Human hand carrying a ball

By interchanging the position of the three components (i.e. fulcrum load and effort), the class, uses and applications of the lever changes.

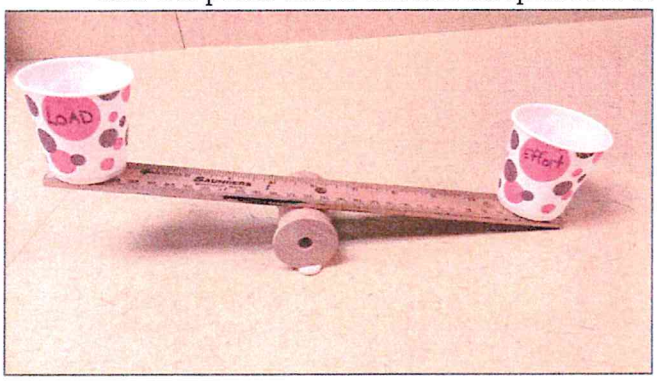
1. Which class of lever is generally used to lift heavy load?

2. Which class of lever is used in moving load?

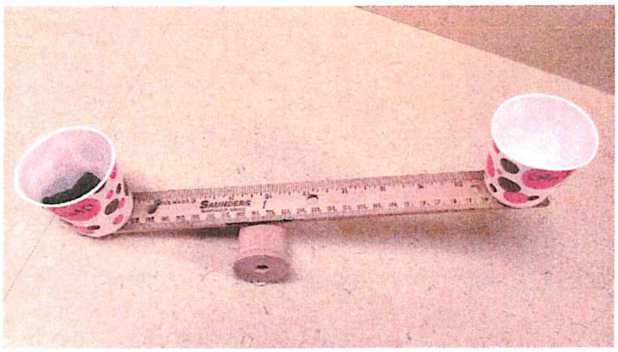
3. In which class of lever is the effort applied generally more than load lifted?



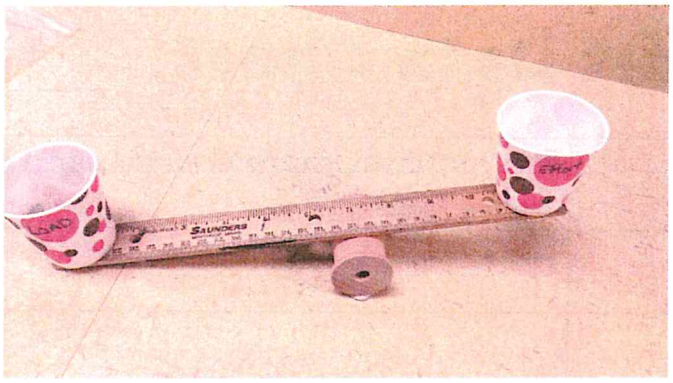
2. Position the spool underneath and perpendicular to the ruler, so the pencil crosses below the 5 cm line. Use poster tack to stabilize the spool so it doesn't roll around!



3. Place the rock or weight in the "Load" cup. One by one, place pennies in the "Effort" cup until the load lifts into the air. Record the number of pennies it took using the data table supplied.



4. Repeat Steps 5 through 7 with the spool placed at 15 cm and 25 cm.



5. Ask the following questions:
    - How did the position of the fulcrum affect the number of pennies needed to lift the load?
    - How could you modify the lever to make it even easier to lift the load?
    - What are some similarities between a lever and an inclined plane? Differences?
    - What real-life situations would be ideal for using a lever?

Conclusion

Levers assist in doing work by increasing the effort you use to move something. The closer the fulcrum is to the resistance force, the easier it is to lift the object. At the same time, the distance over which you must apply the effort increases. Levers do not increase the amount of work done; instead, they make work easier by distributing the effort over a longer distance.

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
15 cm	
25 cm	

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
15 cm	
25 cm	

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
15 cm	
25 cm	x

REFERENCE #2

Requirement (3C)

With your counselor, discuss: (1) The type of lever that is involved with the motion for chose for requirement 2.

Photos of Sporting Action

Note: All the Cub Scout activities for this award use class 3 levers except BB-gun Shooting. BB guns use a class 1 lever for the trigger. The lever for Mathematics depends upon which activity or requirement the Scout completed. It is possible that a lever was not used and no picture is provided for Mathematics.

REFERENCE #2

Requirement (5.A.1)

On your own, design, including a drawing, sketch or model, ONE of the following:
(1) A playground fixture that uses a lever.

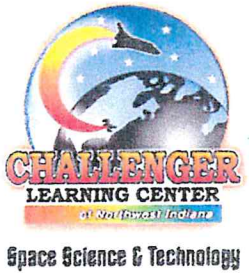
Photos of Playground Equipment

Use the pictures of playground equipment for this requirement.

Other Requirements

Complete the remaining requirements per the instructions in the guidebook.

PHOTOS OF SPORTING ACTION/DESIGN A PLAYGROUND FIXTURE



Swing Requirement 2 Photos

Badminton

Baseball

BB Gun Shooting

Fishing

Golf

Hockey

Mathematics

Softball

Table Tennis

Tennis

Ultimate Frisbee

CHALLENGER LEARNING CENTER

Space Science & Technology

How to use this book:

Requirement 2 asks Scouts to discuss what type of lever is involved in the motion for the belt loop or pin you chose for Requirement 2:

- Badminton
- Baseball
- BB Gun Shooting
- Fishing
- Golf
- Hockey
- Mathematics
- Softball
- Table Tennis
- Tennis
- Ultimate Frisbee

These photos represent someone performing each of these areas.

Use these photos to discuss what type of lever or levers might be used for people to do the actions of each sport or pursuit.

Req. 2 Badminton

Req. 2 Baseball

Req. 2 BB Gun Shooting

Req. 2 Fishing


CHALLENGER
LEARNING CENTER
Space Science & Technology
NOVA
photo by Tour Pro Golf Clubs, stockphotofo.com

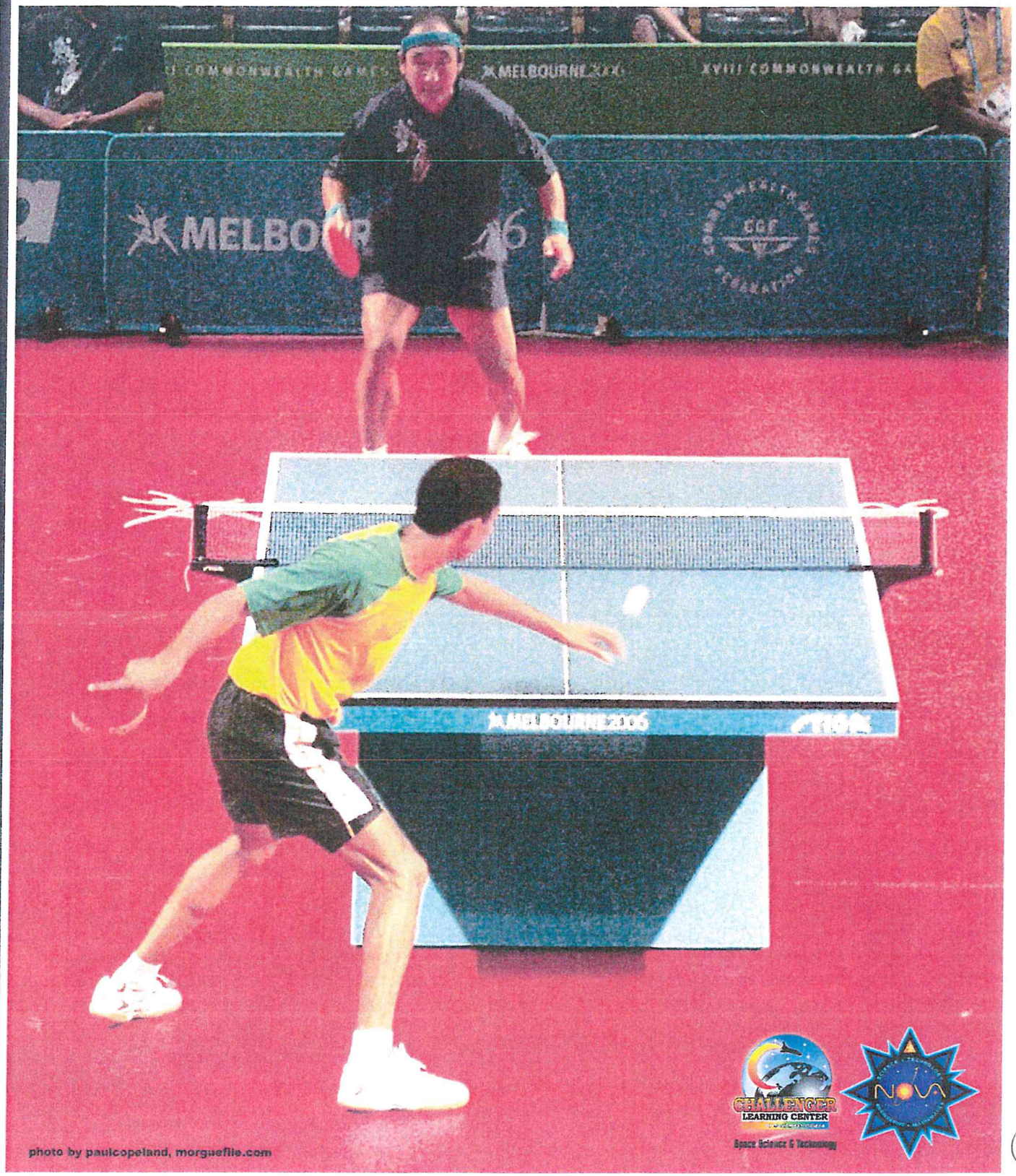
Req. 2 Golf

photo by Battle Creek CVB, stockpholio.com

Req. 2 Hockey

Req. 2 Mathematics

Req. 2 Softball



Req. 2 Table Tennis

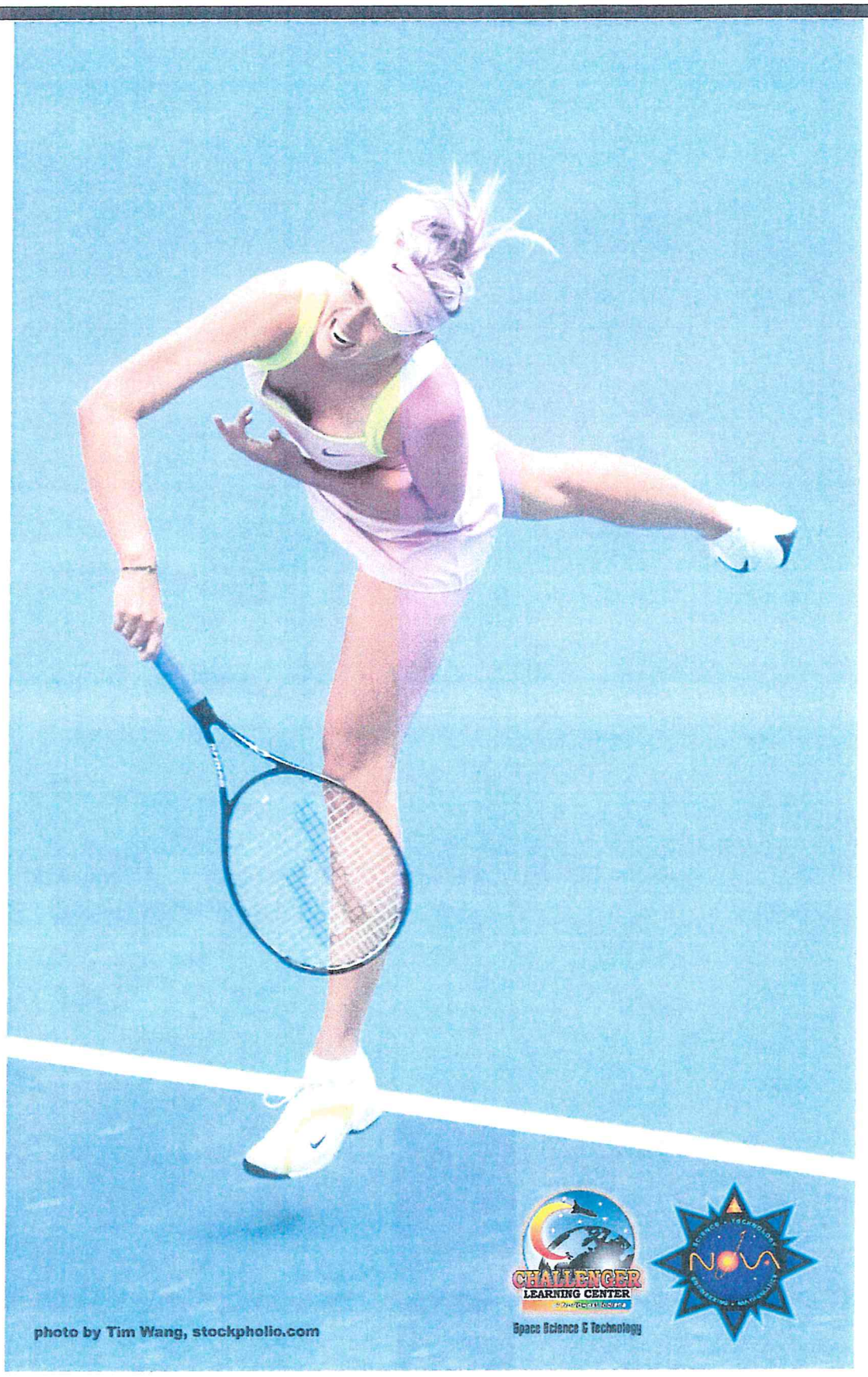


photo by Tim Wang, stockpholio.com
CHALLENGER
LEARNING CENTER
Space Science & Technology
NOVA

Req. 2 Tennis

Req. 2 Ultimate Frisbee

Stem-in-a-Box

Swing NOVA Box Content List

- Bound Manual
- Book of playground equipment

Lever Experiment (5 sets of each for 4 groups/20 Scouts

- 5 Pencil Boxes (plastic) Items below will fill 5 total boxes:
- 2" Wooden Spool (5 each)
- Roll Masking Tape (5 each)
- **3 Dixie Cups (15 each)**
- Permanent Marker (5 each)
- Marbles or weights (25 Total for 5 each box)
- Rulers (5 each)

- **Load/Effort Data Charts (10 copies, 3 to a sheet)**
- 20 Pencils / 3 Sharpeners
- **25 Sheets of blank paper**

NOTE: Items in **BOLD** will need to be resupplied after each use. Box should be stocked for 20 Scouts.

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
15 cm	
25 cm	

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
15 cm	
25 cm	

Load/Effort Data Chart

Position of fulcrum	# of pennies/marbles/etc. used to move load
5 cm	
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