

REMOTE-CONTROL MACHINES ANiMALS



THAMES & KOSMOS



Safety Information

WARNING. Only for use by children aged 6 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep packaging and instructions as they contain important information.

WARNING. Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Strangulation hazard — long cords may become wrapped around the neck. Store the experiment material and assembled models out of the reach of small children.

Safety for Experiments with Batteries

>>> The wires are not to be inserted into socket-outlets. Never perform experiments using household current! The high voltage can be extremely dangerous or fatal!

>>> To operate the models, you will need six AAA batteries (1.5-volt, type AAA/LR03) or six AAA rechargeable batteries (1.2-volt, min. 1100 mAh), which could not be included in the kit due to their limited shelf life.

>>> The supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.

>>> Different types of batteries or new and used batteries are not to be mixed.

>>> Do not mix old and new batteries.

>>> Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.

>>> Batteries are to be inserted with the correct polarity. Press them gently into the battery compartment. See page 2.

>>> Always close battery compartments with the lid.

>>> Non-rechargeable batteries are not to be recharged. They could explode!

>>> Rechargeable batteries are only to be charged under adult supervision.

>>> Rechargeable batteries are to be removed from the toy before being charged.

>>> Exhausted batteries are to be removed from the toy.

>>> Dispose of used batteries in accordance with environmental provisions, not in the household trash.

>>> Be sure not to bring batteries into contact with coins, keys, or other metal objects.

>>> Avoid deforming the batteries.

As all of the experiments use batteries, have an adult check the experiments or models before use to make sure they are assembled properly. Always operate the motorized models under adult supervision.

The models are to be used indoors only. Never use the animal models in water or on sand, grass, snow, ice, or other such surfaces.

After you are done experimenting, remove the batteries from the battery compartments. Note the safety information accompanying the individual experiments or models!

Notes on Disposal of Electrical and Electronic Components

The electronic components of this product are recyclable. For the sake of the environment, do not throw them into the household trash at the end of their lifespan. They must be delivered to a collection location for electronic waste, as indicated by the following symbol:



Please contact your local authorities for the appropriate disposal location.

Dear Parents,

Before starting the experiments, read through the instruction manual together with your child and discuss the safety information. Check to make sure the models have been assembled correctly, and assist your child with the experiments. **We hope you and your child have a lot of fun with the experiments!**

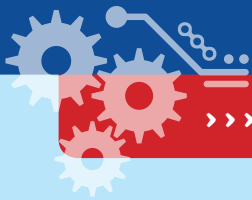
FCC Part 15 Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

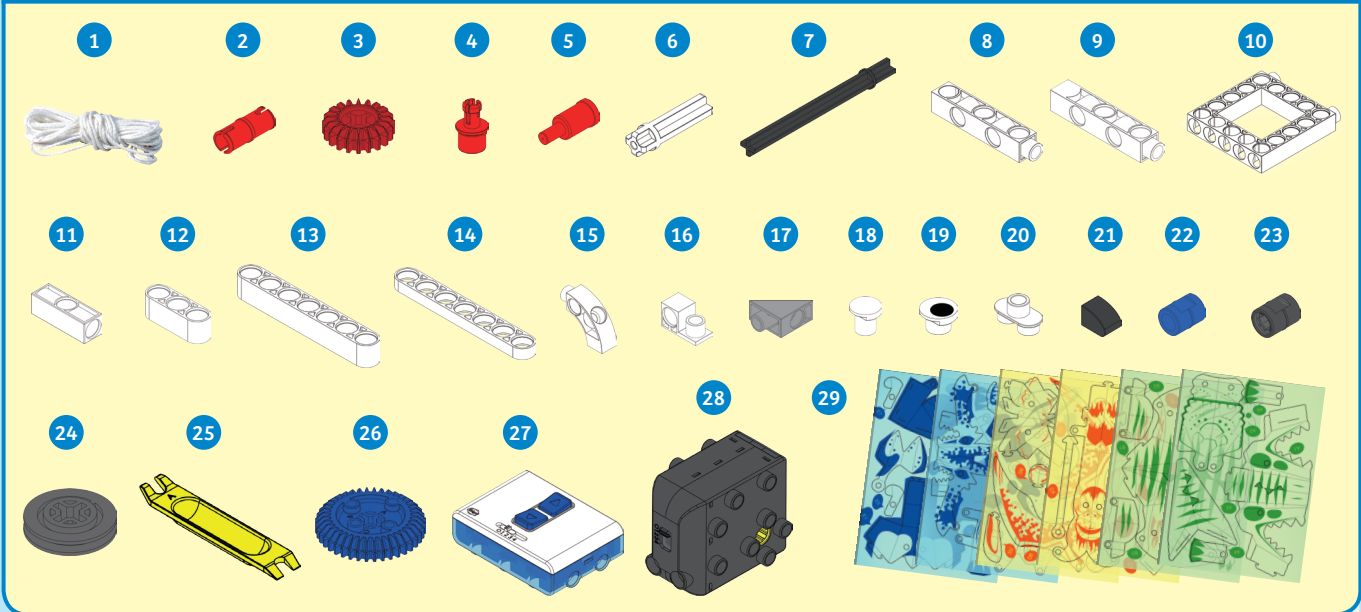


>>> KIT CONTENTS

GOOD TO KNOW!

If you are missing any parts, please contact Thames & Kosmos customer service.

What's inside your experiment kit:



Checklist: Find – Inspect – Check off

✓	No.	Description	Qty.	Item No.
<input type="radio"/>	1	String, cotton (200 cm)	1	R39-W85-200
<input type="radio"/>	2	Joint pin	8	1156-W10-A1R
<input type="radio"/>	3	Small gear	2	7026-W10-D2R
<input type="radio"/>	4	Shaft plug	4	7026-W10-H1R
<input type="radio"/>	5	Shaft pin	4	7026-W10-J3R
<input type="radio"/>	6	Motor axle	2	7026-W10-L1W
<input type="radio"/>	7	Axle, 7 cm	1	7061-W10-Q1D
<input type="radio"/>	8	5-hole dual rod B	2	7026-W10-S2W
<input type="radio"/>	9	5-hole dual rod C	2	7026-W10-S3W
<input type="radio"/>	10	Square frame	2	7026-W10-V1W
<input type="radio"/>	11	3-hole cross rod	3	7026-W10-X1W
<input type="radio"/>	12	3-hole wide rounded rod	4	7404-W10-C1W
<input type="radio"/>	13	7-hole wide rounded rod	4	7404-W10-C2W
<input type="radio"/>	14	7-hole flat rounded rod	4	7404-W10-C3W
<input type="radio"/>	15	Curved rod	4	7061-W10-V1W
<input type="radio"/>	16	90-degree converter - X	4	7061-W10-J1W
<input type="radio"/>	17	Flat triangle	4	7128-W10-A2S
<input type="radio"/>	18	Button pin	6	7061-W10-E2W
<input type="radio"/>	19	Eye pin	4	7128-W22-2
<input type="radio"/>	20	Two-to-one converter	4	7061-W10-G1W
<input type="radio"/>	21	Nose piece	2	7402-W10-C2D
<input type="radio"/>	22	Short anchor pin	1	880-W10-M1B
<input type="radio"/>	23	Anchor pin	8	7402-W10-C1D
<input type="radio"/>	24	Small pulley	1	7344-W10-N3S
<input type="radio"/>	25	Anchor pin lever	1	7061-W10-B1Y
<input type="radio"/>	26	Medium gear with 4 holes	4	7346-W10-C1B
<input type="radio"/>	27	IR remote control unit	1	7336-W85-A1
<input type="radio"/>	28	IR motor unit	1	7336-W85-B1
<input type="radio"/>	29	Plastic die-cut sheets (6)	1	7336-PP

>>> TABLE OF CONTENTS

Safety Information Inside front cover

Kit Contents..... 1
Table of Contents..... 1
Tips and Tricks 2

MODELS
 Crab 3
 Orangutan 7
 Tyrannosaurus Rex 12
 Penguin..... 17
 Pterosaur..... 21
 Rabbit..... 25
 Elephant 29
 Scorpion 33

Publisher's InformationInside back cover
Additional Experiments Back cover

TIP!

You will find additional information in the "Check it out" sections on pages 6, 11, 16, 20, 24, 28, 32, and 36.

You will also need:
 6 x AAA batteries (1.5-volt, type AAA/LR03)

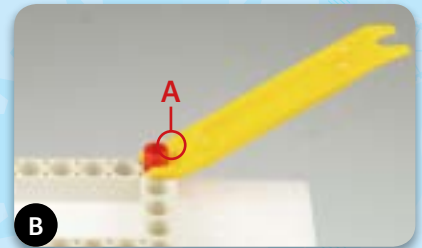
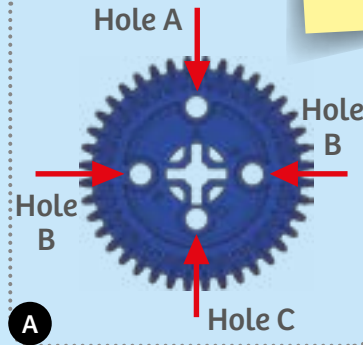


>>> TIPS AND TRICKS

Here are a few tips for assembling and using the models. Read them carefully before starting.

A. Pay attention to the hole alignment!

It is very important that you pay close attention to the alignment of the holes in the gear wheels. Make sure that you insert the shaft pins into the correct holes and that the gears are oriented exactly as shown in relation to each other and to the model. Otherwise, the animals will not move properly.

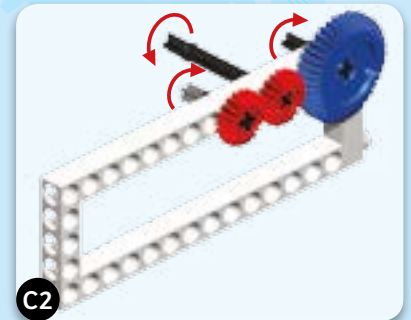
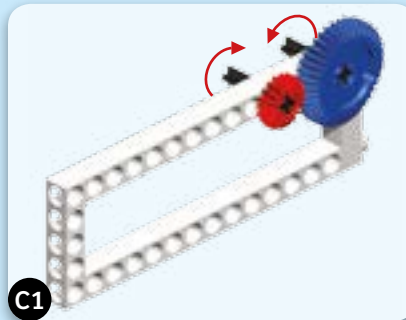


B. The part separator tool

In the box, you will find a little yellow tool called the anchor pin lever. End A of the part separator tool makes it easy to remove anchor pins from the frames.

C. Gear wheels

1. The models will often have several gear wheels installed in a row. In order for the models to work well, these gears will have to mesh well. Otherwise, the force from one gear wheel won't be properly transferred to the next.



2. You can transfer force without changing direction. Just insert a third gear wheel between the other two. Try it yourself.

D. Batteries in motor unit

Insert the batteries according to their indicated plus-minus polarity and close the compartment with the transparent cover.



E. Batteries in remote control unit

Open the battery compartment by unscrewing the screw and removing the cover. Insert two batteries, paying attention to the polarity indicated in the compartment and on the batteries. Close the compartment again and reinsert the screw to secure it.



F. Using the IR remote control

To control a model, turn on both the motor unit and the remote control unit by moving their switches from the "off" position (0) to any of the four channels (1-4). The motor unit and the remote control must be set to the same channel to communicate. The channels enable you to use up to four models (sold separately) at the same time in the same space.

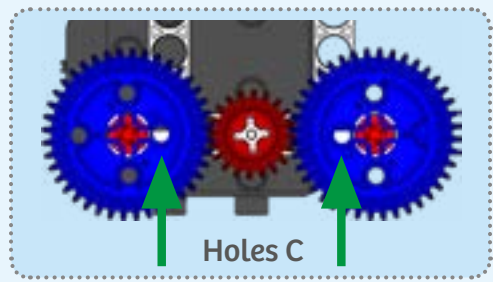
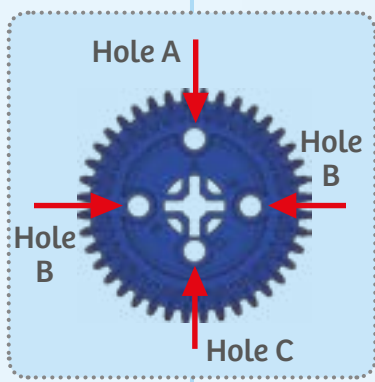
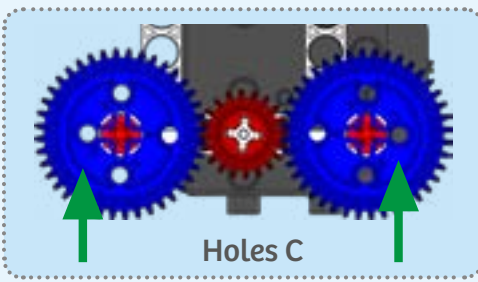
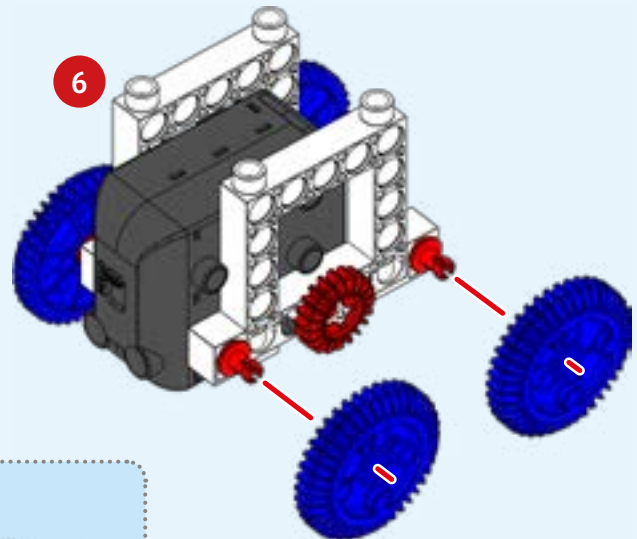
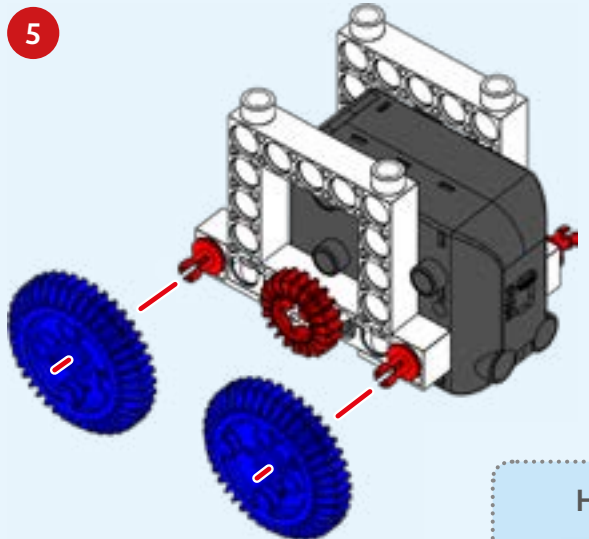
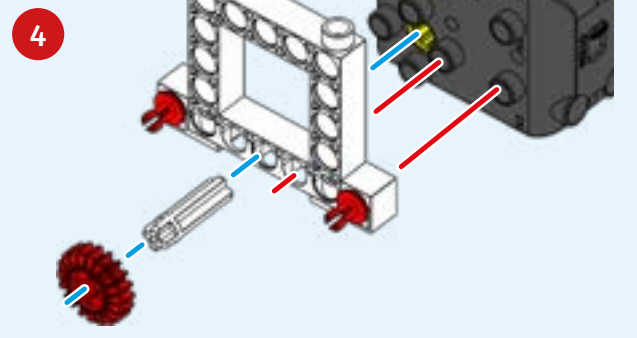
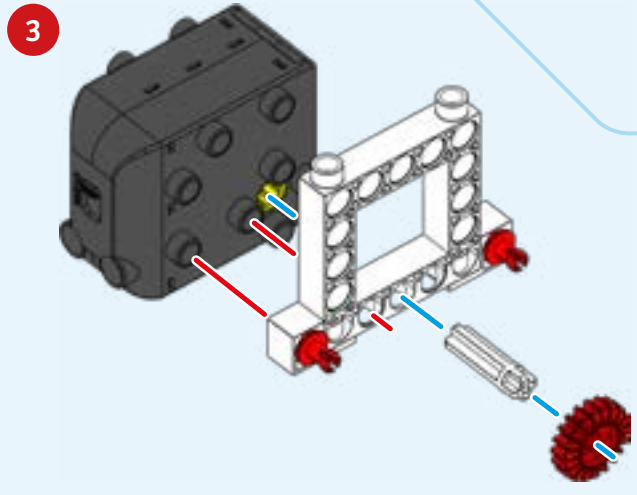
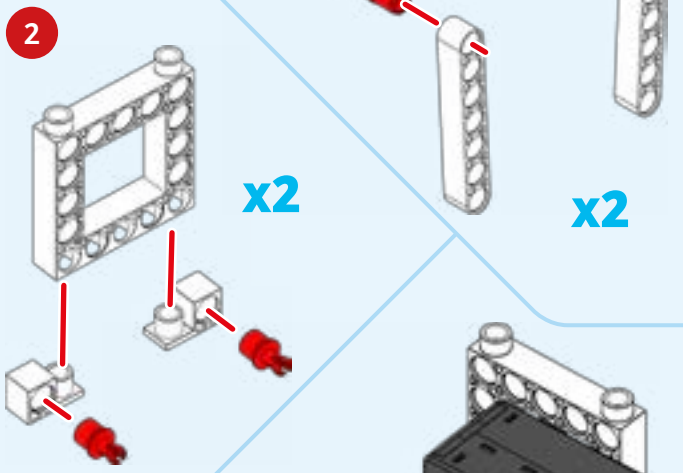
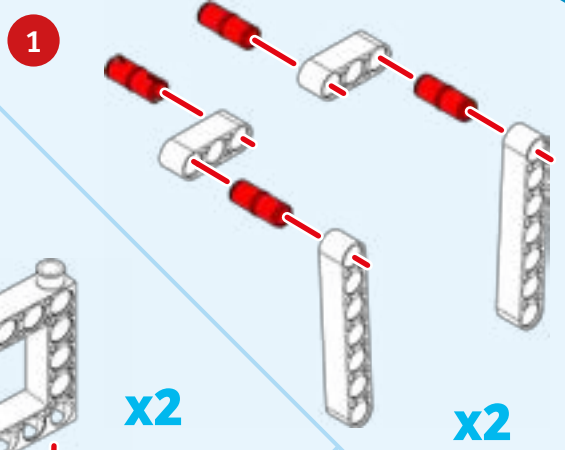
IMPORTANT!

Make sure your remote control unit and your motor unit are both set to the same channel (1-4) or else they will not work. When the remote control and motor are not in use, turn them off by setting their switches to "0" so as to not drain the batteries.



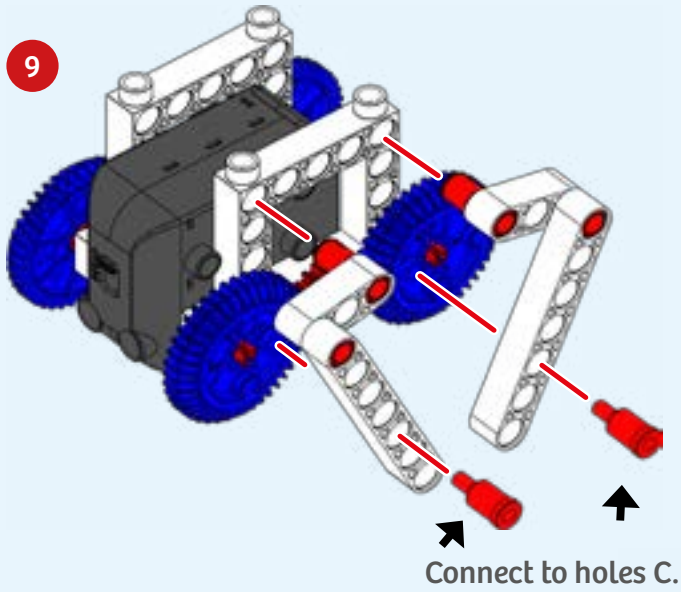
CRAB

2	3	4	5	6	10	11	12
8x	2x	4x	4x	2x	2x	2x	4x
13	14	16	18	19	23	26	
4x	1x	4x	5x	2x	4x	4x	
27	28					29	
1x	1x						

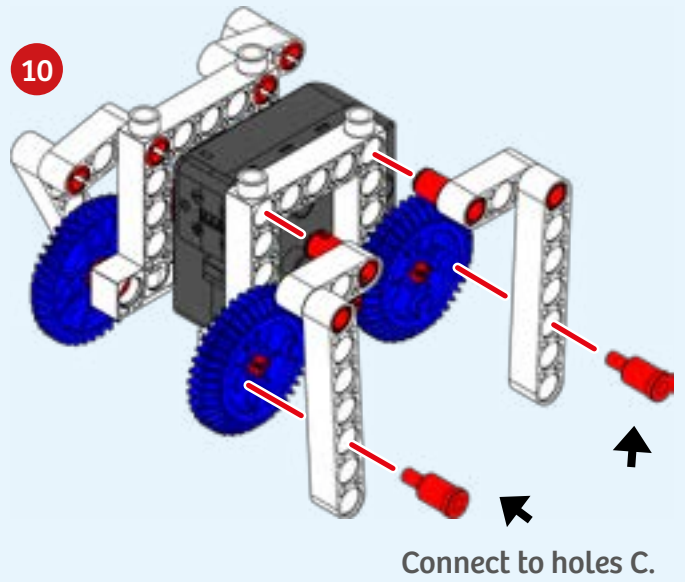




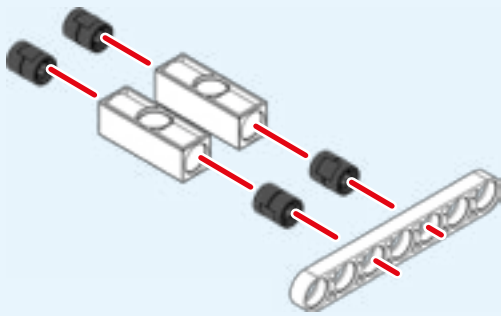
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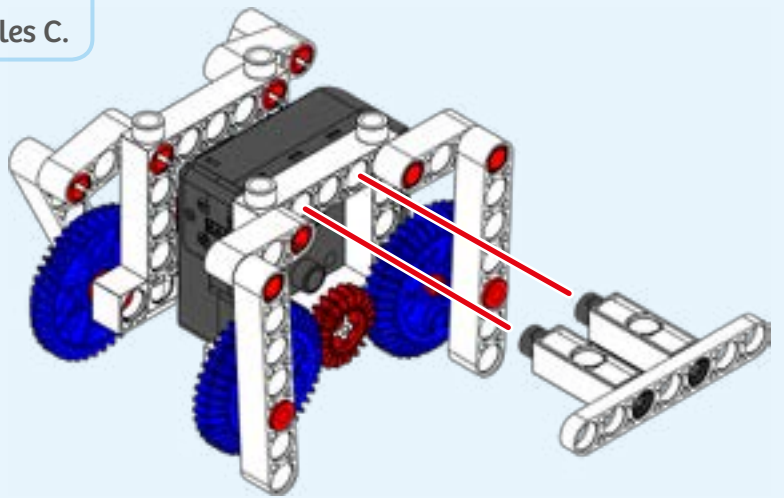
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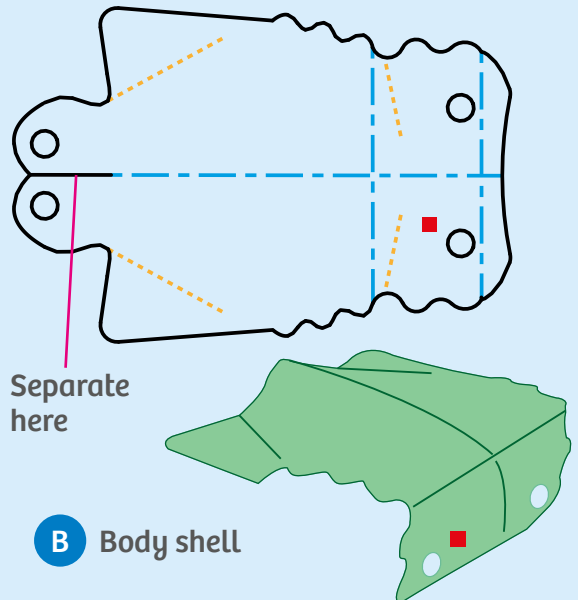
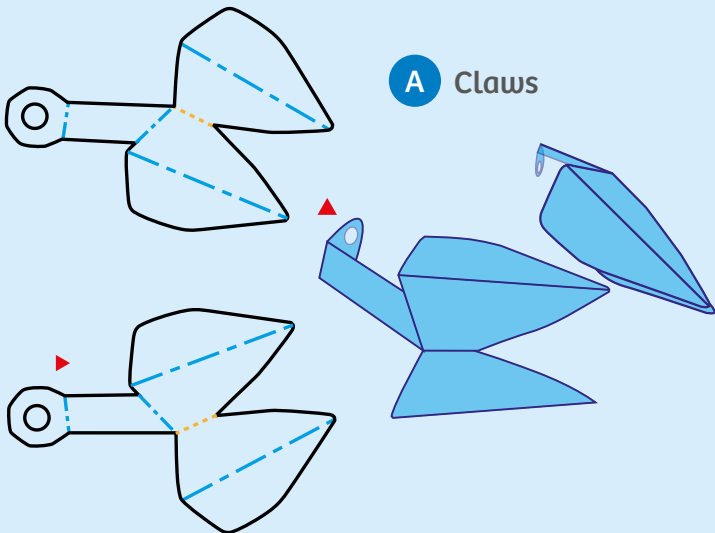
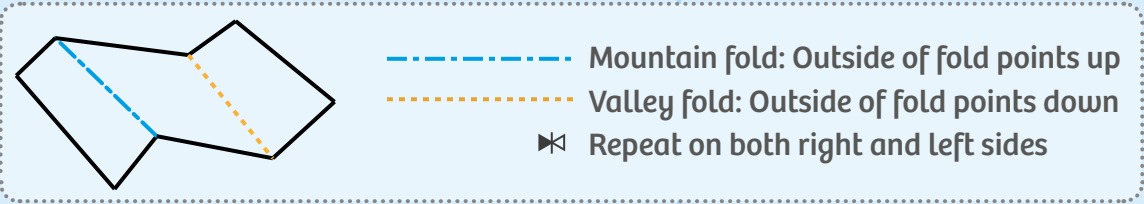
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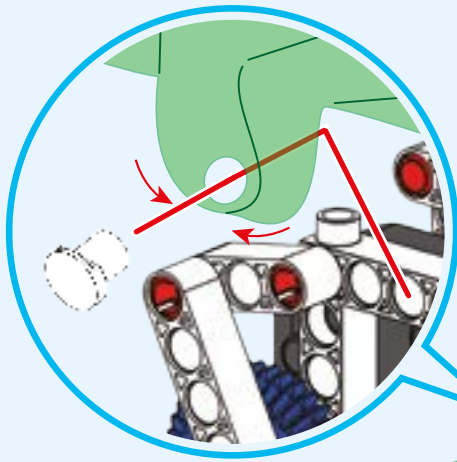
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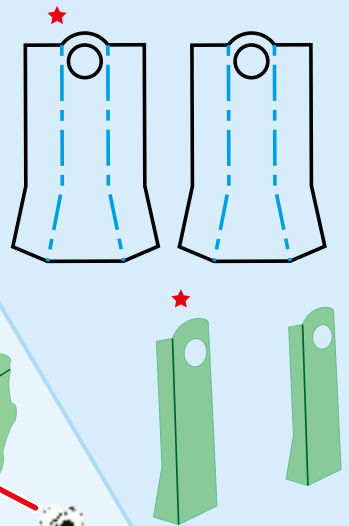
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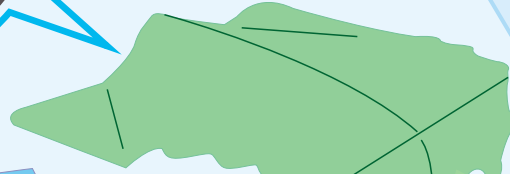
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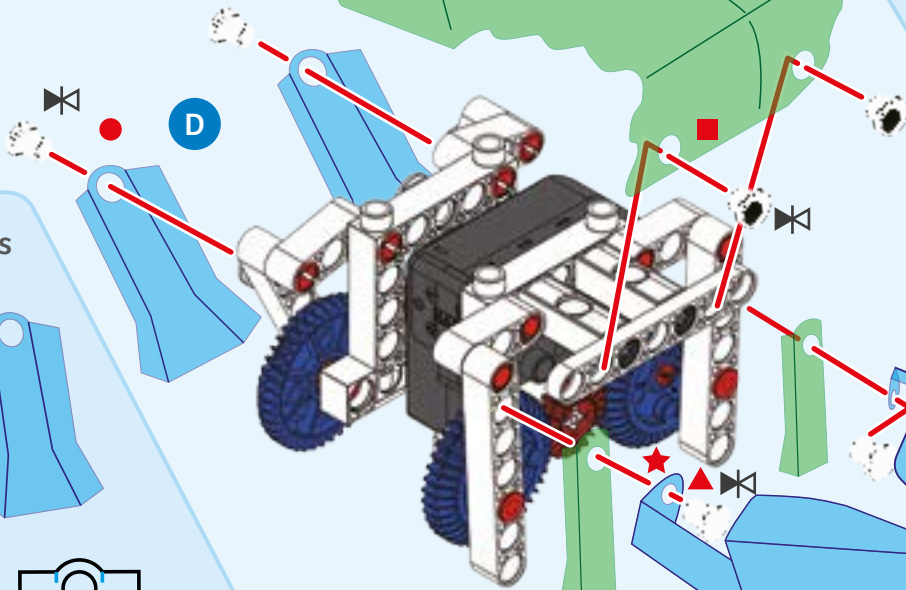
C Front legs



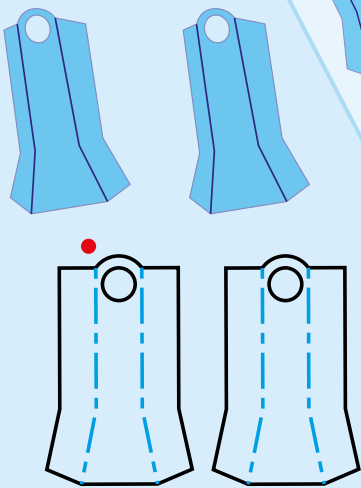
B



D



D Back legs



A

C

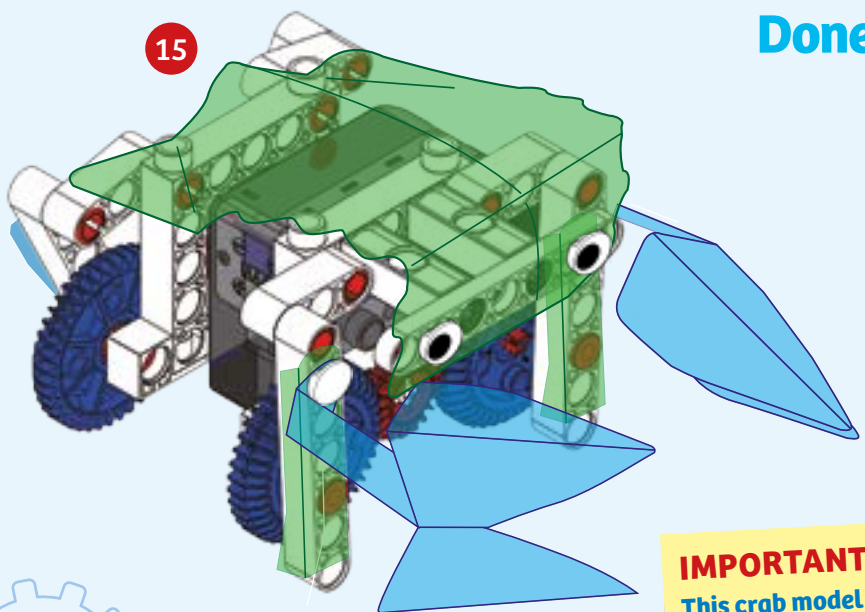
Done!

15



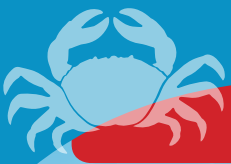
WHAT'S HAPPENING?

The crab model moves from side to side on four legs. The legs are jointed sideways to allow this type of motion. The legs are connected to the gears so that when one leg is up, another is down.



Now try the experiments on the back cover!

IMPORTANT!
This crab model cannot go in the water or move on sand!

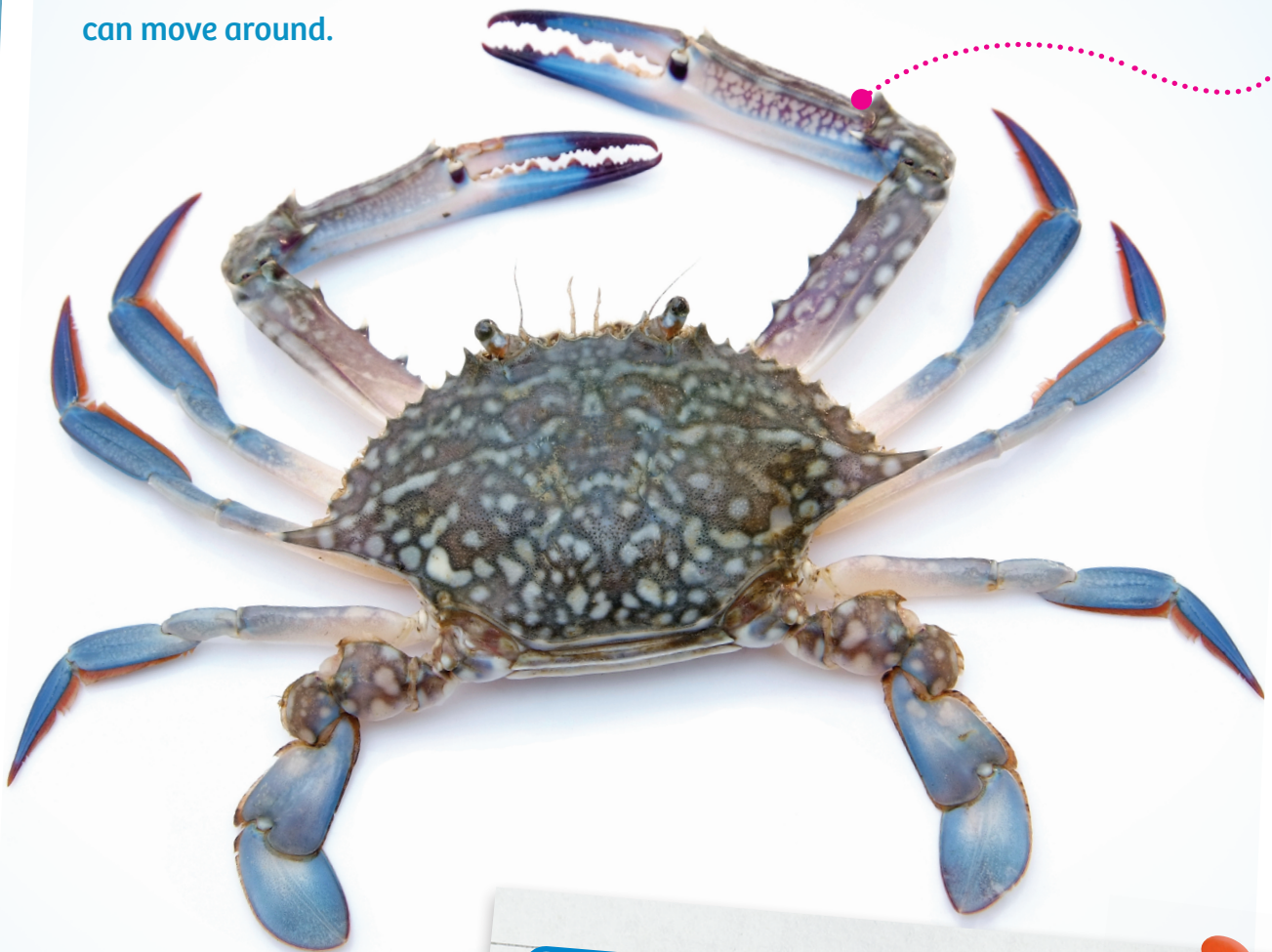


CHECK IT OUT



Crabby Bots

Instead of the gears, axles, rods, and motor that are in your crab machine, real crabs have an exoskeleton, a segmented body, and **jointed appendages (e.g., legs and claws)**. They have soft tissue consisting of muscles and nerves inside the hard exoskeleton. The appendages must have joints, like armor, so the hard exoskeleton can move around.



WHY DO CRABS WALK SIDeways?

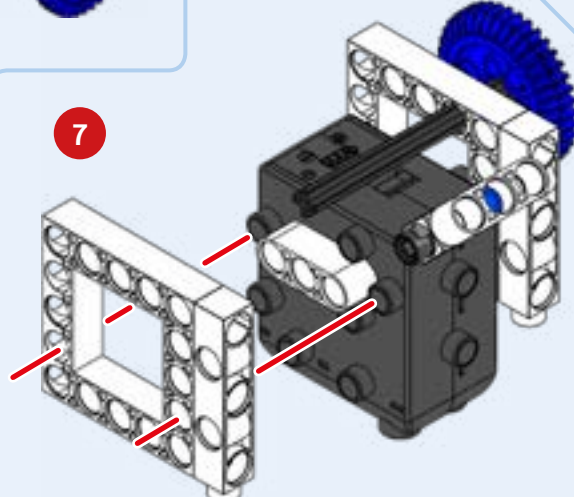
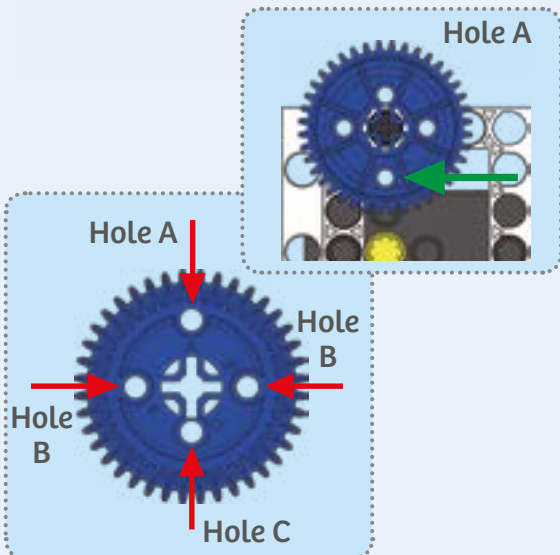
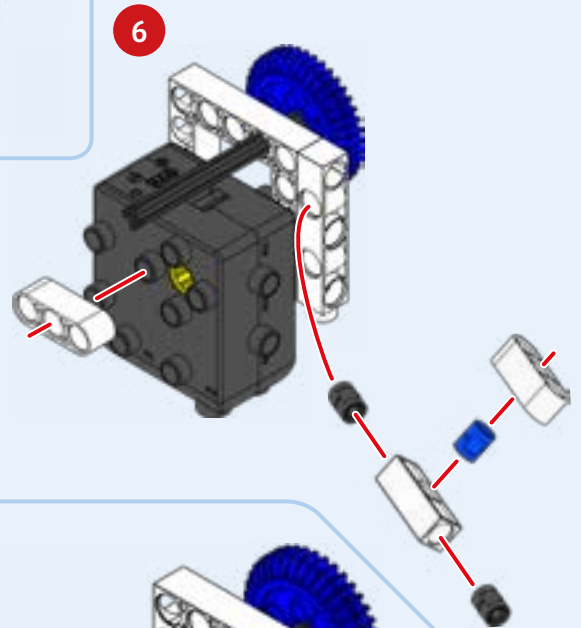
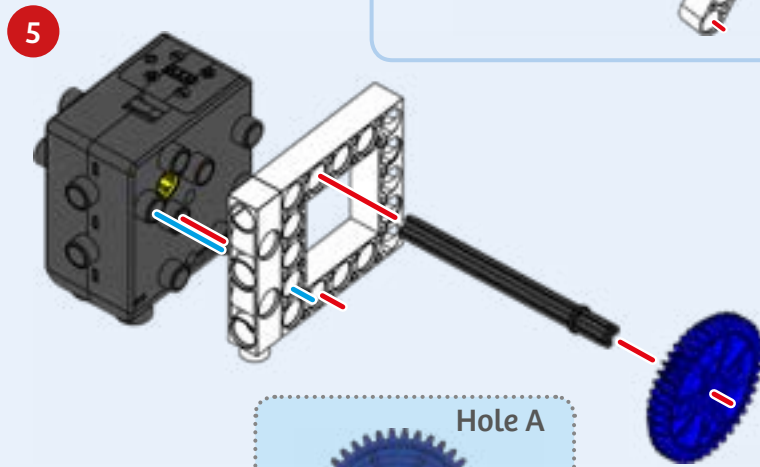
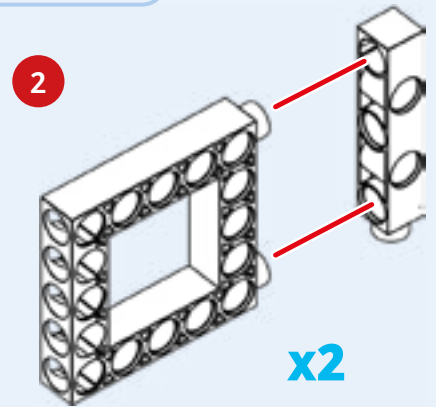
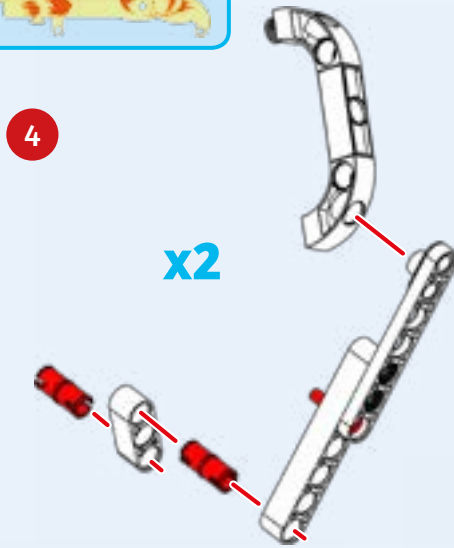
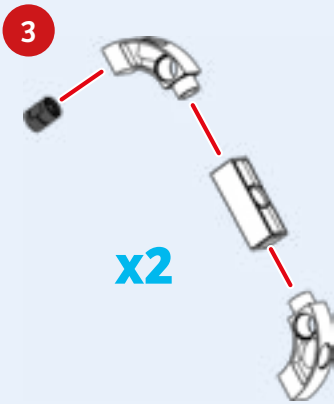
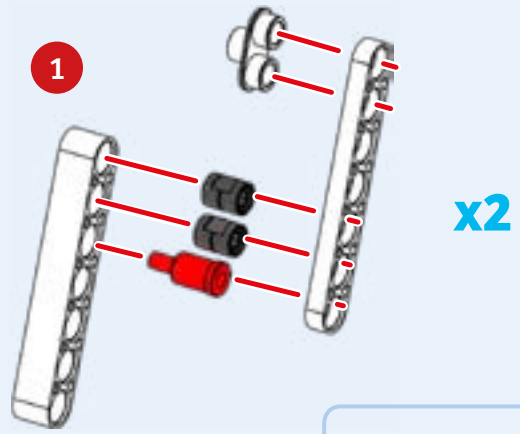
Humans can easily walk forward and backward because our knee joints bend forward and backward. We can shuffle from side to side because of the ball and socket joints in the hips. In contrast, crab's legs are attached to the sides of their bodies, and the joints bend toward the sides. This is why it's easier for crabs to walk sideways.

CRABS HAVE TEN LEGS

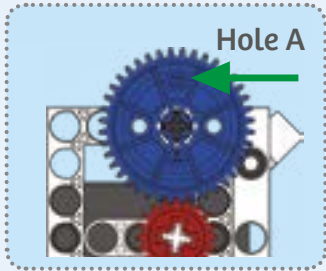
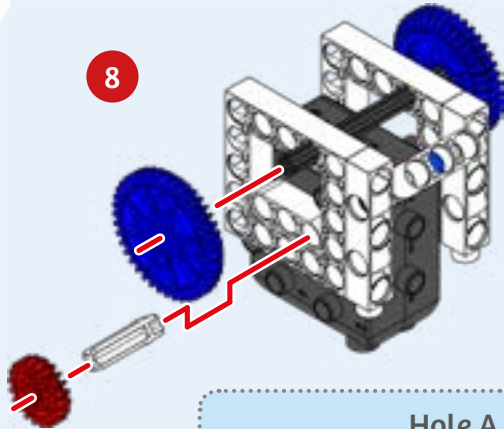
Crabs, crayfish, lobsters, prawns, and shrimp are decapods. The name decapod comes from the Greek words *deca* for ten and *pod* for foot. **All decapods have ten legs** organized symmetrically in pairs. Most of the legs are called **pereiopods**, which are used for walking and gathering food. Usually the two front pereiopods have **chelae, or claws**, on them. The back legs often have **flippers** on them for swimming.

ORANGUTAN

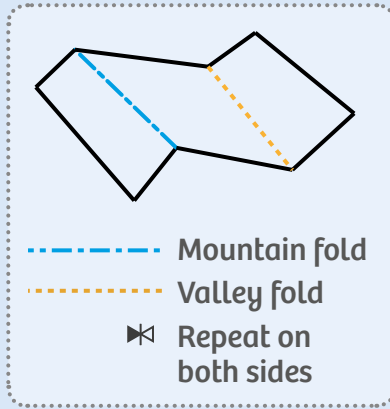
1	2	3	5	6	7	8	10	11		
1x	4x	1x	2x	1x	1x	2x	2x	3x		
12	13	14	15	16	18	19	20	21	22	23
4x	2x	2x	4x	2x	6x	2x	2x	2x	1x	8x
26	27	28			29					
2x	1x	1x								



8

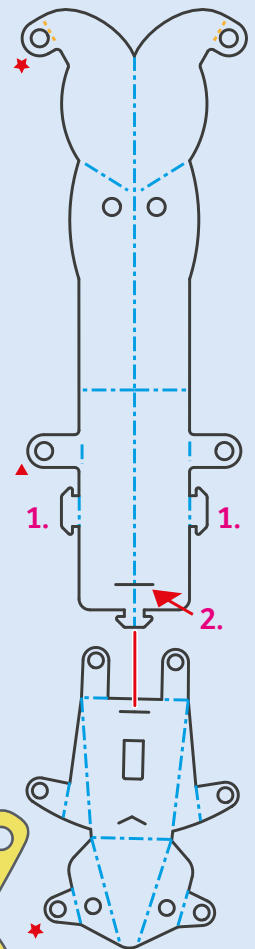


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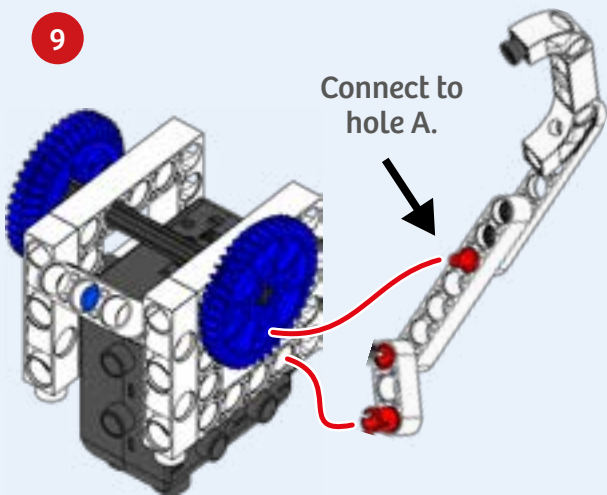


A Head and body

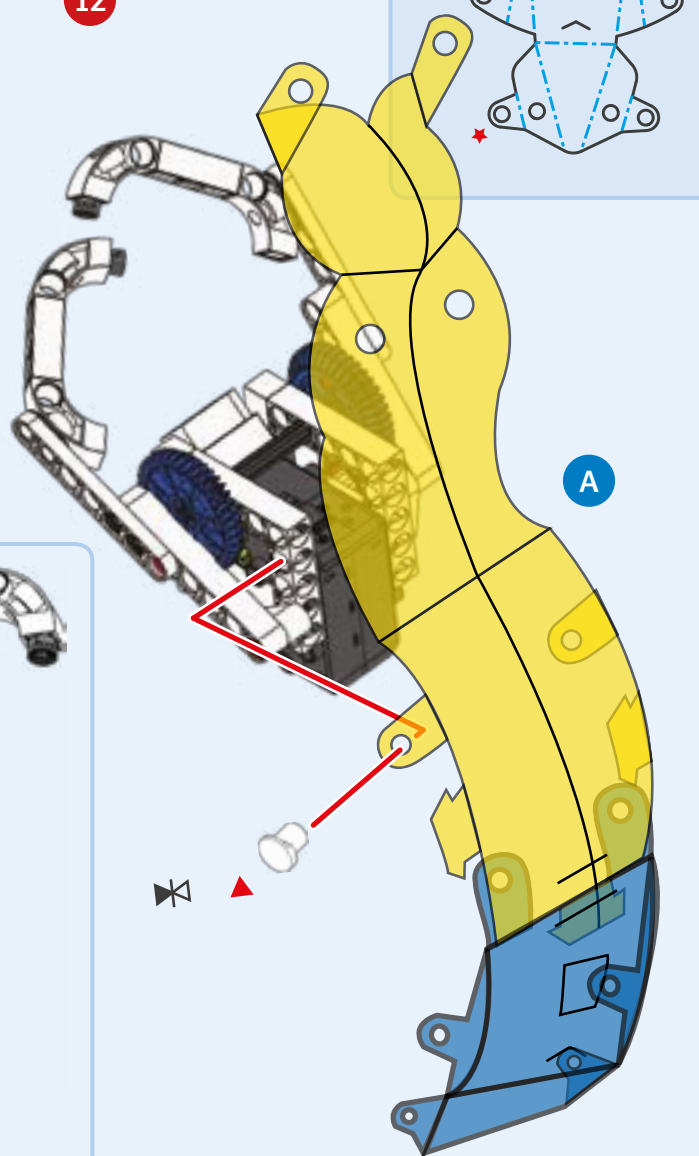
- 1. Connects to arms
- 2. Connects to tail



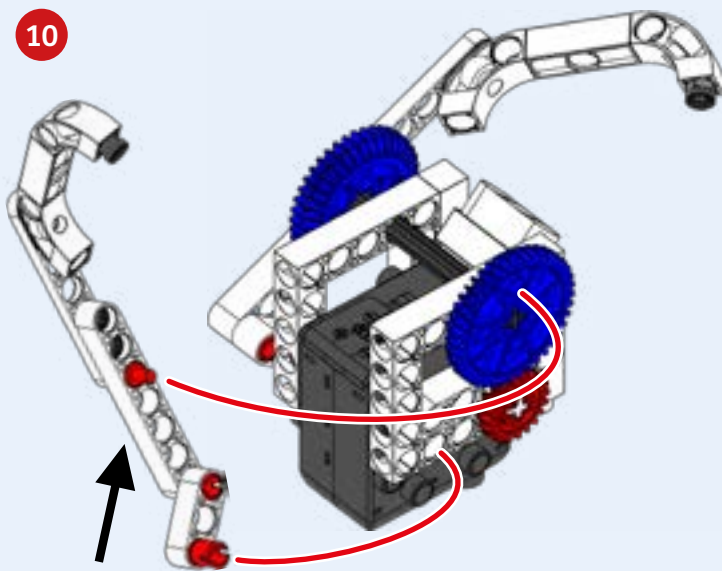
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12

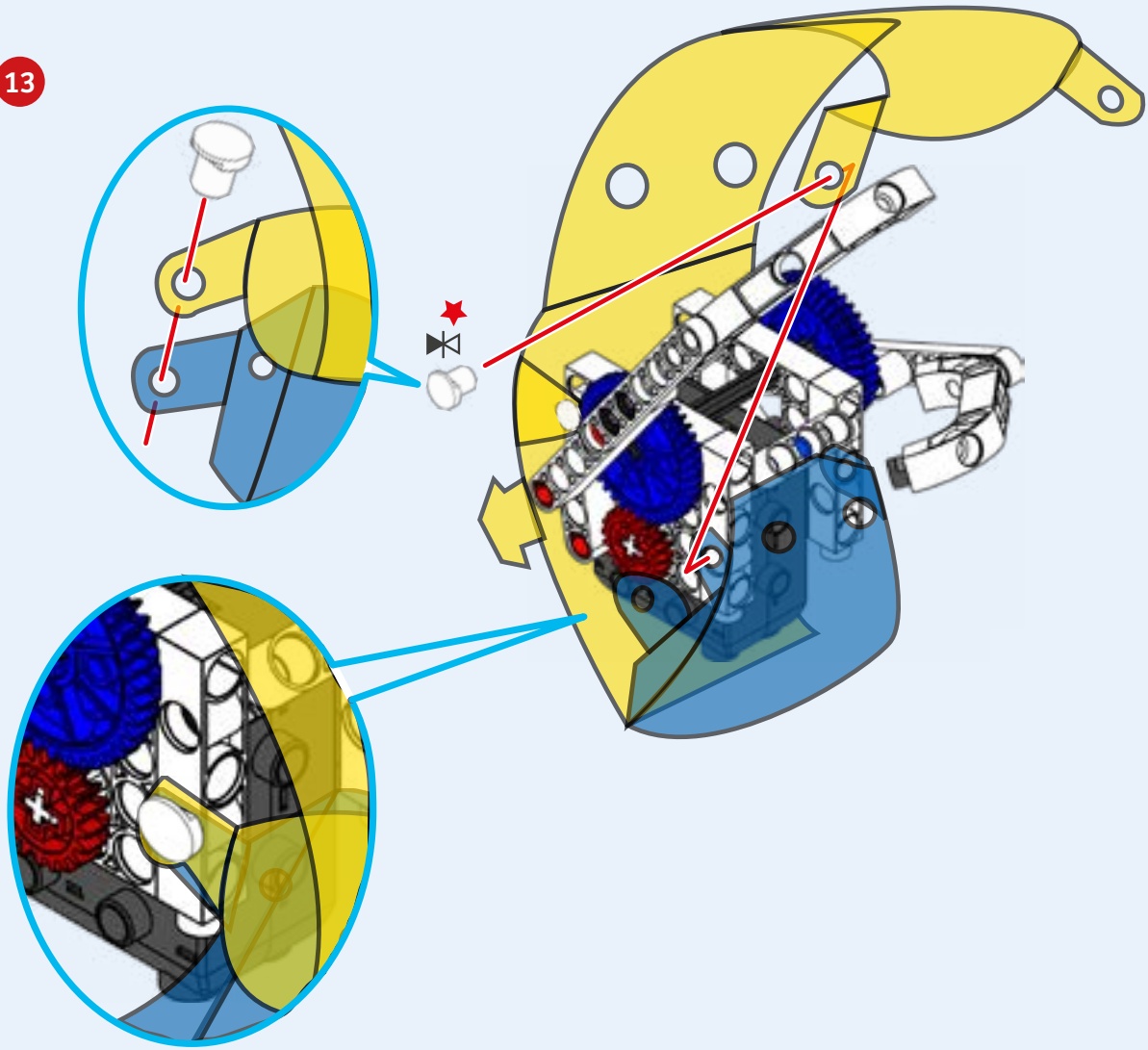


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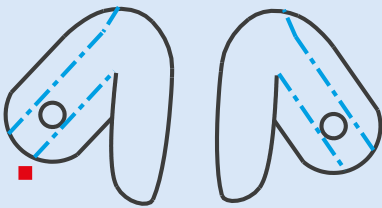


Connect to hole A.

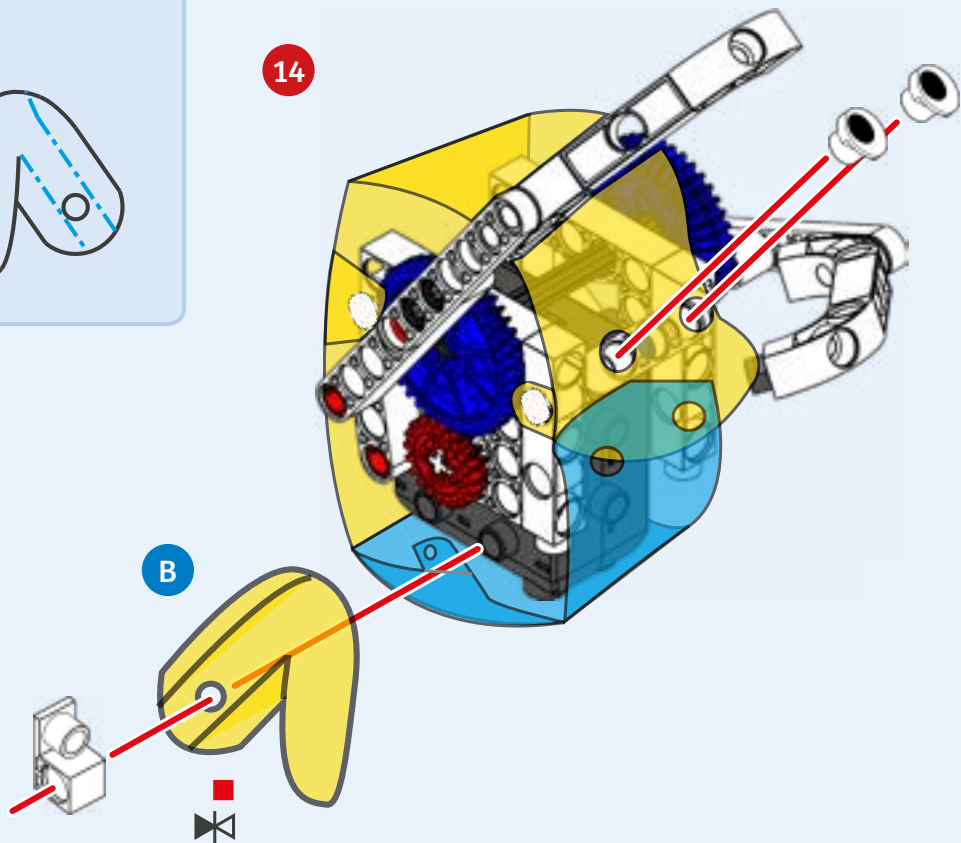
13



B Feet

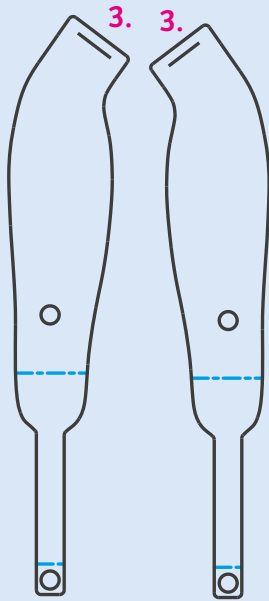


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15

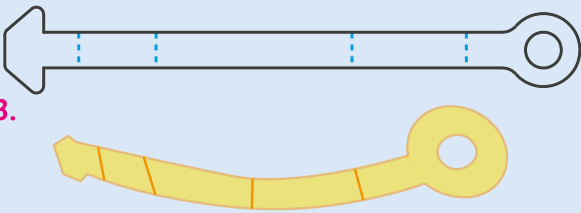
C Arms



3. Connects to body

16

D Tail

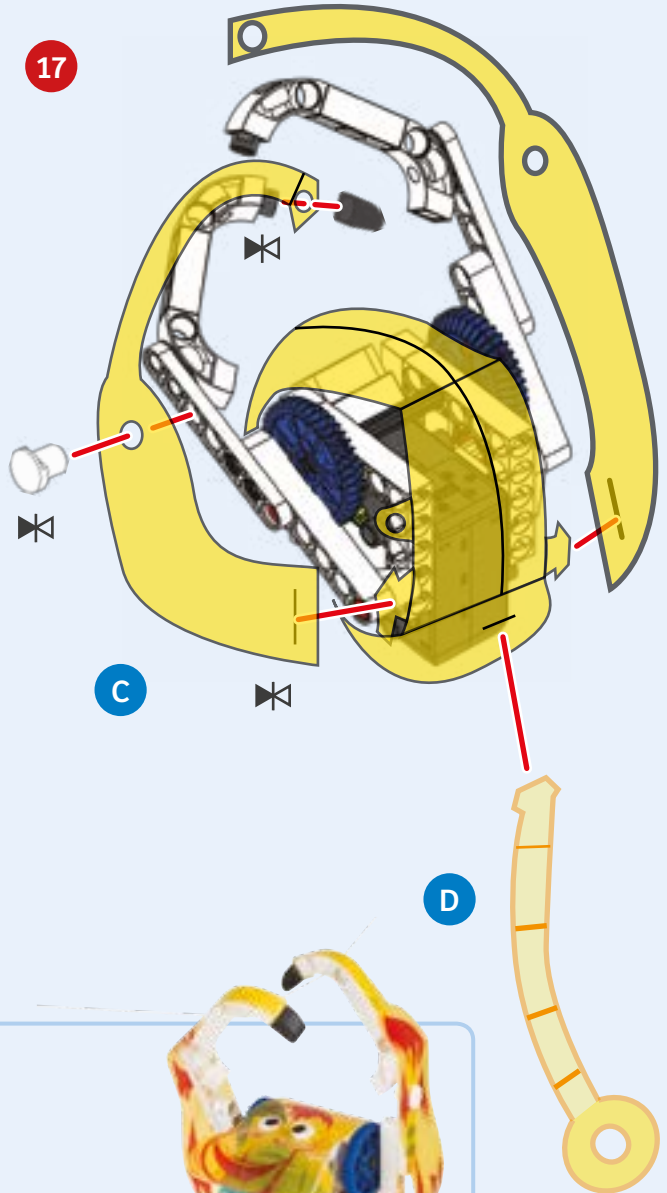


3.

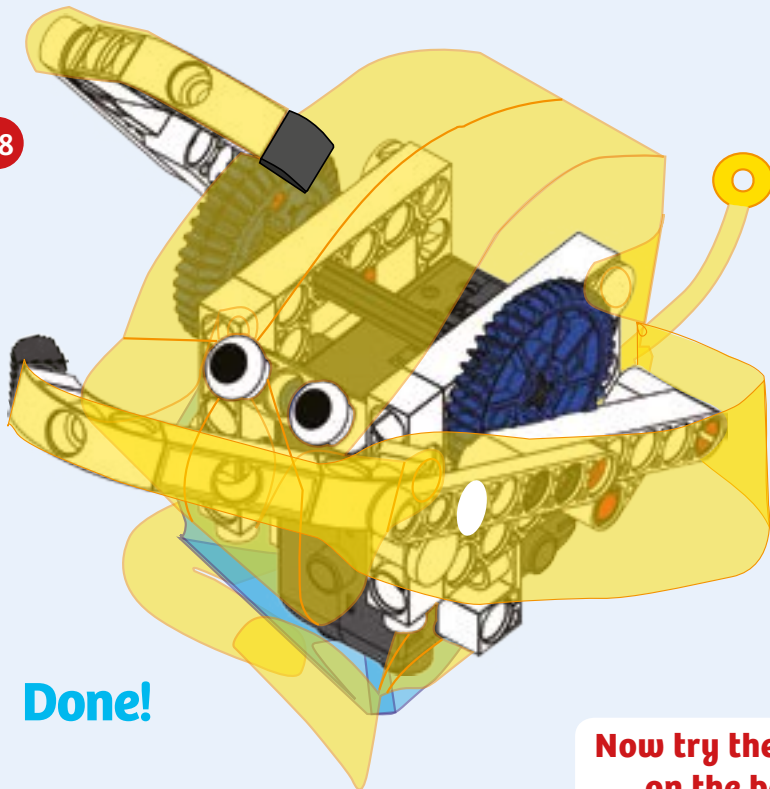
17

C

D



18



Done!

WHAT'S HAPPENING?

Run the string from one fixed point to another. Place the orangutan's arms on the string. When you control the model forward or backward, the orangutan crawls arm-over-arm along the rope. Go slowly and carefully so that an arm doesn't fall off the string.

Now try the experiments on the back cover!



CHECK IT OUT



Tree Living

Orangutans are great apes that live in rainforests in Borneo and Sumatra. They spend most of their time in trees. They eat mostly fruit, leaves, and bark from trees.

Orangutans' bodies have evolved features specifically adapted to a life swinging from tree branches. Their hands have four long fingers and an opposable thumb, like humans. Even at rest, the fingers form a curved hook shape which helps them hang onto branches. Their hands have a very tight grip both with and without the aid of the thumb.

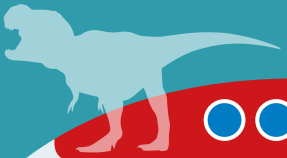
Orangutans' feet also have long toes and opposable big toes, allowing them to grip things with their feet as well as their hands!

BABY'S FIRM HANDSHAKE

Orangutans are usually born high up in the treetops. Right from birth, baby orangutans must have very strong grips to hang onto their mothers so they don't fall to the ground. Mothers carry their babies for years as the babies develop their other abilities.

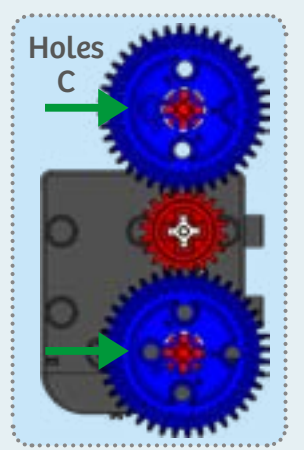
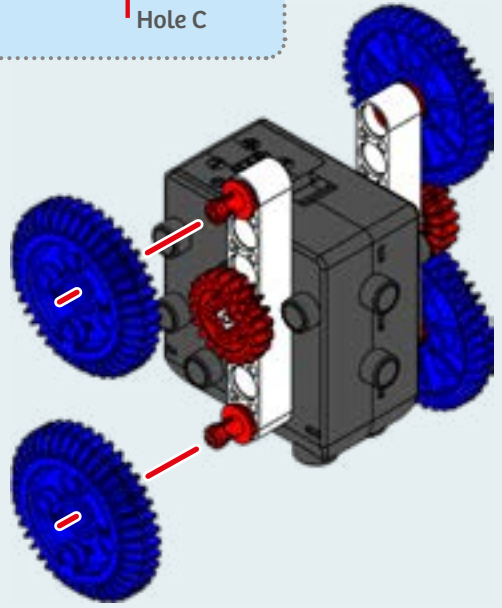
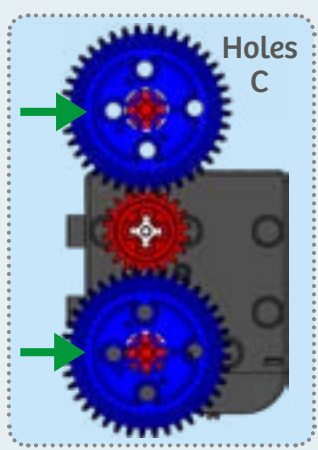
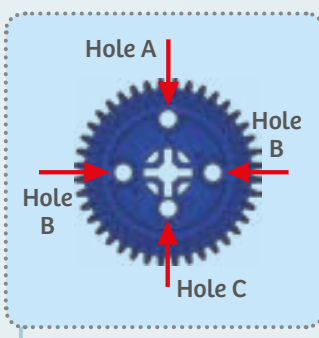
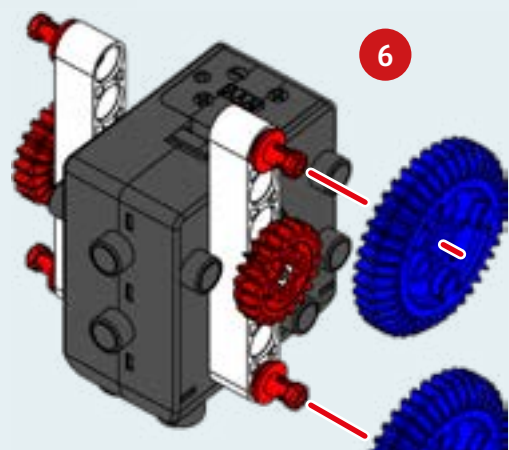
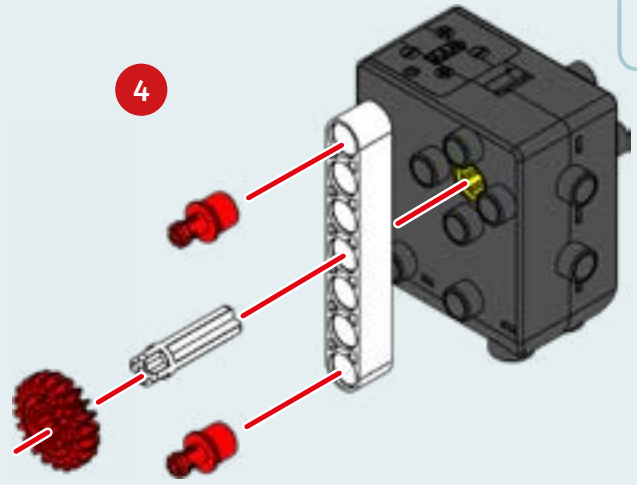
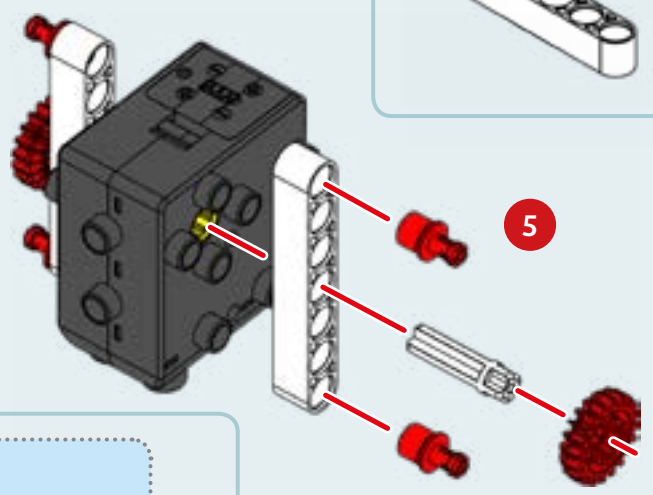
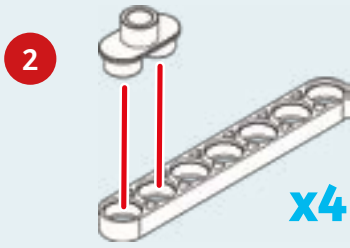
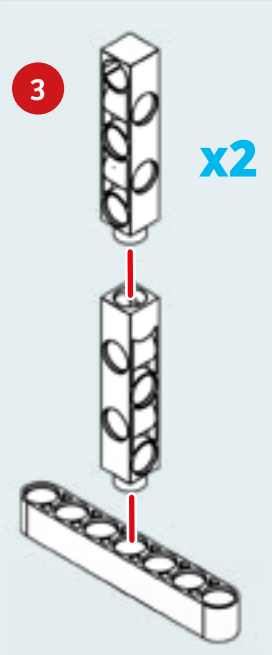
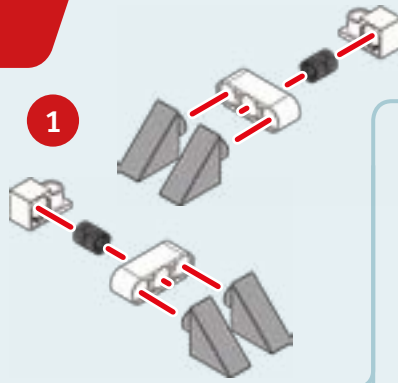
ORANGUTAN FACTS

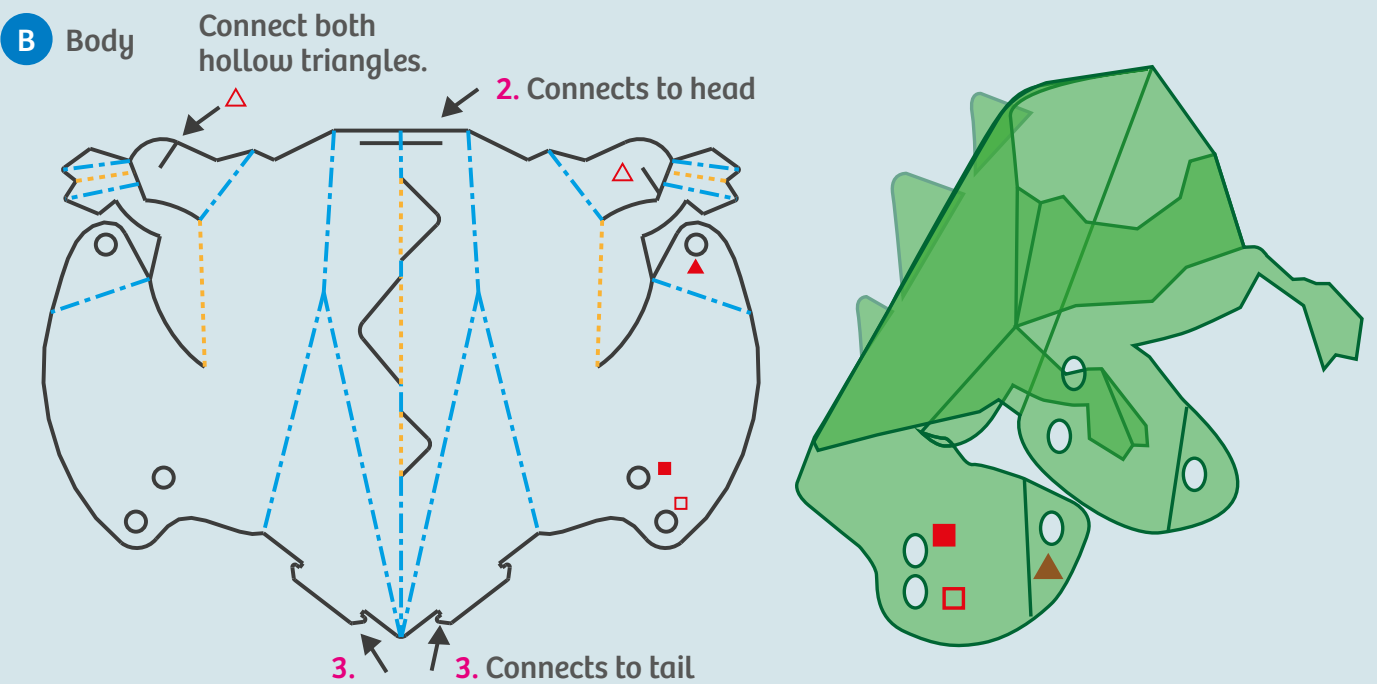
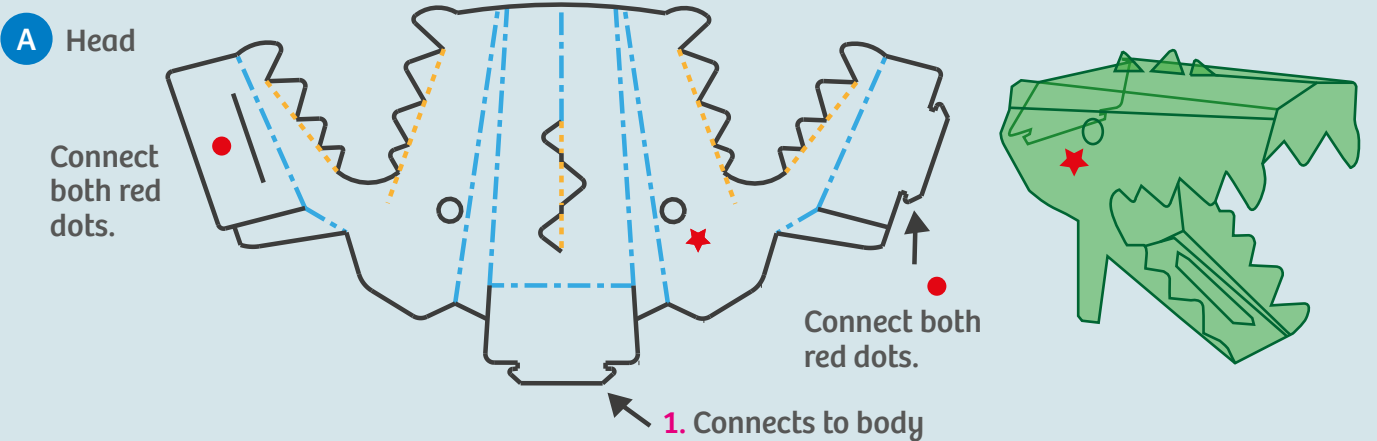
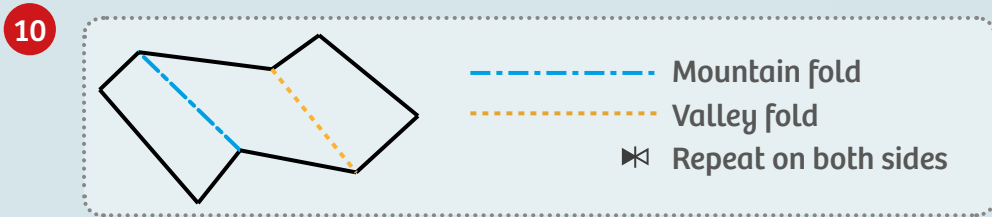
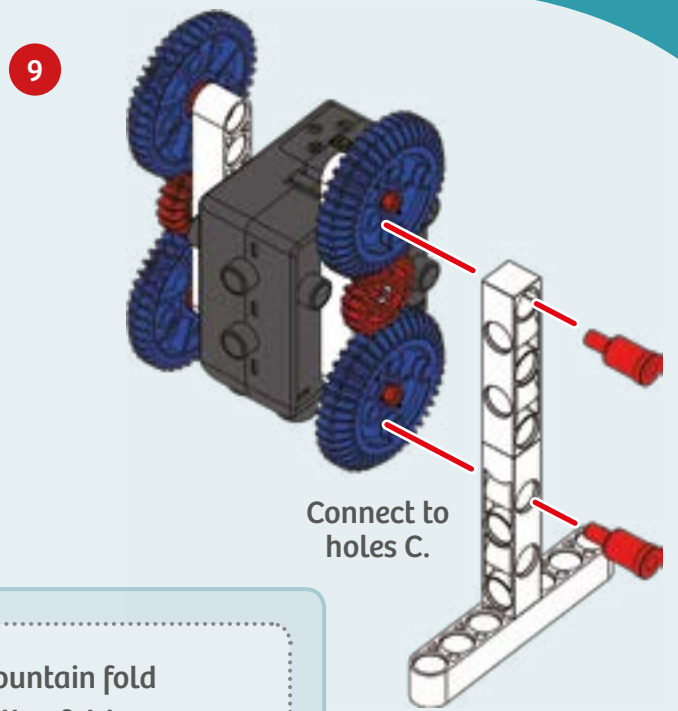
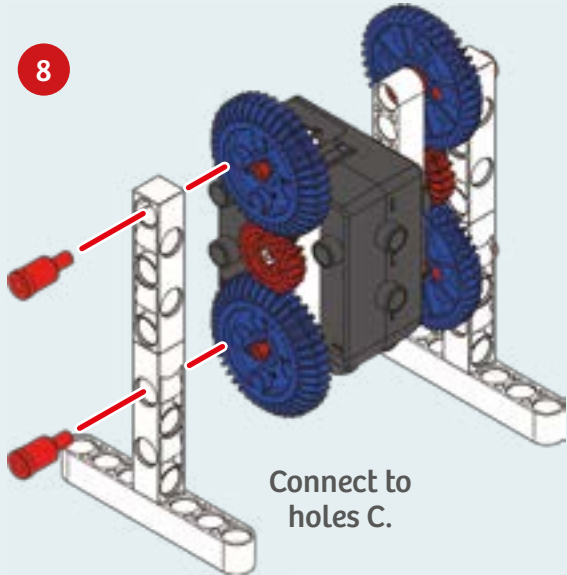
- >>> Orangutans' arms are almost twice as long as their legs.
- >>> Their arm muscles are seven times stronger than those of a human.
- >>> Their hands and feet are oriented inward.
- >>> They walk on their palms instead of their knuckles like most apes.
- >>> Their hip joints can move at almost any angle.
- >>> Their arm span can be almost seven feet from fingertip to fingertip.

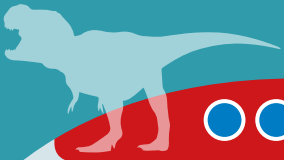


TYRANNOSAURUS REX

- | | | | | | | | |
|----|----|----|----|----|----|----|----|
| 3 | 4 | 5 | 6 | 8 | 9 | 12 | 13 |
| | | | | | | | |
| 2x | 4x | 4x | 2x | 2x | 2x | 2x | 4x |
| 14 | 16 | 17 | 18 | 19 | 20 | 23 | 26 |
| | | | | | | | |
| 4x | 2x | 4x | 6x | 2x | 4x | 2x | 4x |
| 27 | 28 | 29 | | | | | |
| | | | | | | | |
| 1x | 1x | | | | | | |

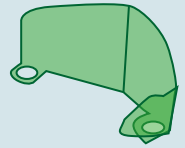
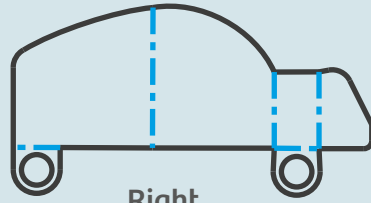
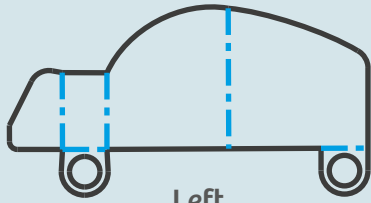
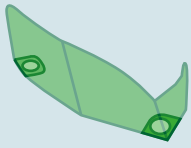




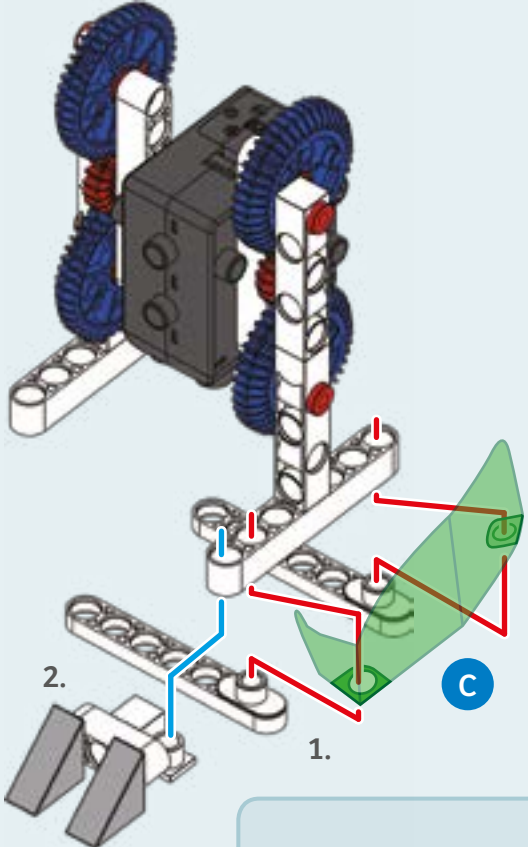


TYRANNOSAURUS REX

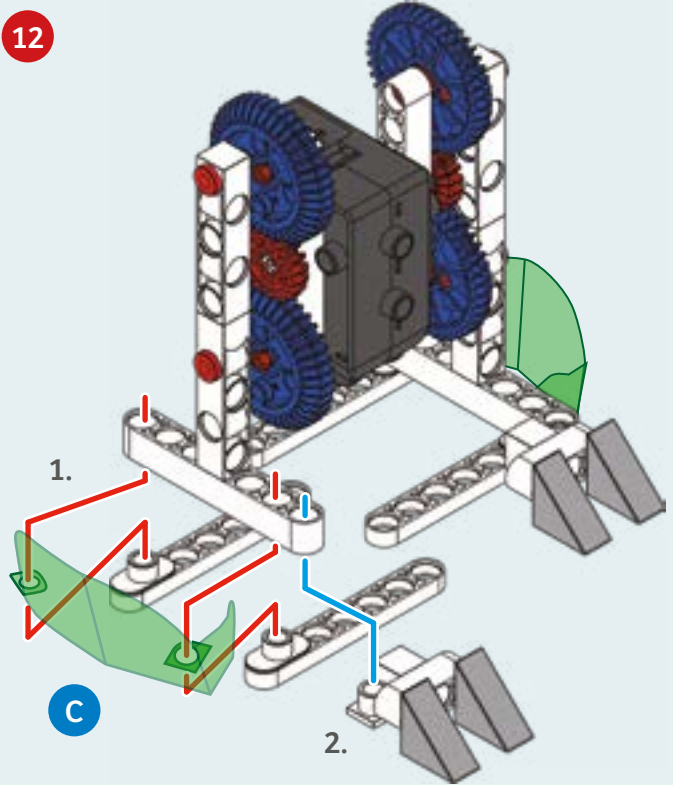
C Feet



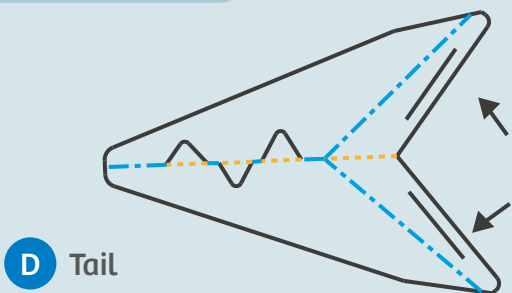
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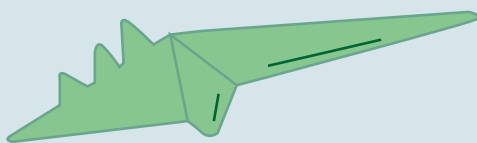
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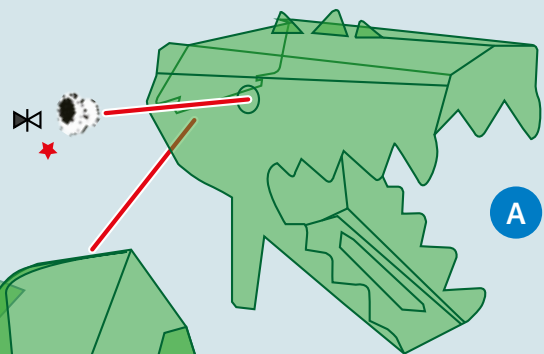
13



D Tail

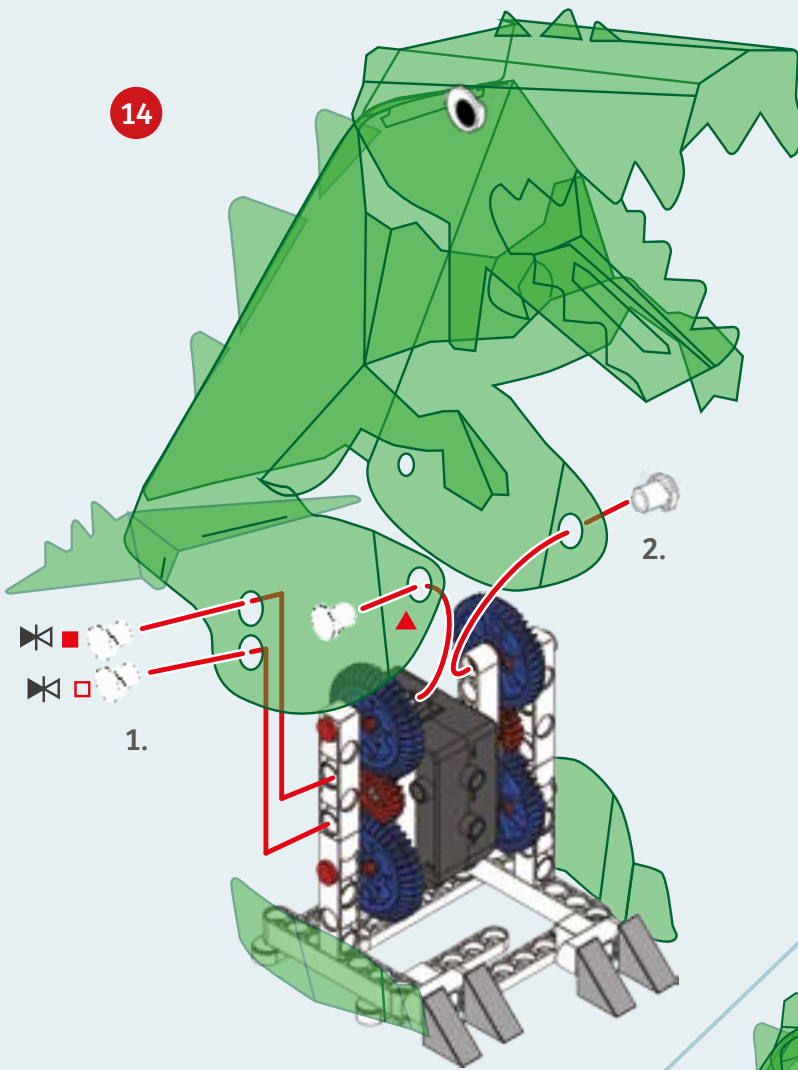


D



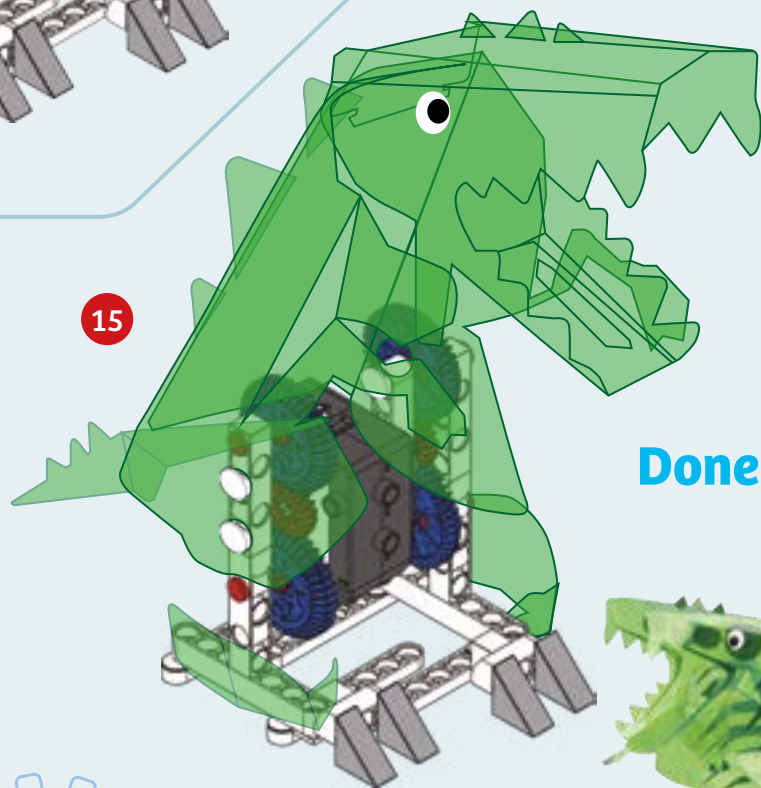
A

B



**KEYWORD:
BIOMECHANICS**

Biomechanics is the study of living things and biological systems according to the methods of mechanics, which is the area of physics concerned with objects, forces, and movement. The models in this kit are mechanical. They certainly do not function exactly the same way as the bones and muscles of the animals they represent. Rather, they are designed to use mechanical elements to mimic signature movements of the animals.



WHAT'S HAPPENING?

The T. rex walks forward or backward on two legs, balancing on one foot at a time. Notice how it shifts its weight from foot to foot. The large foot pads give it enough surface area to balance on, so it does not topple over.

The leg rods are mounted to the gears via holes that are off-center on the gears. When the gears rotate, their rotary motion is transformed into a linear, up-and-down motion of the legs.



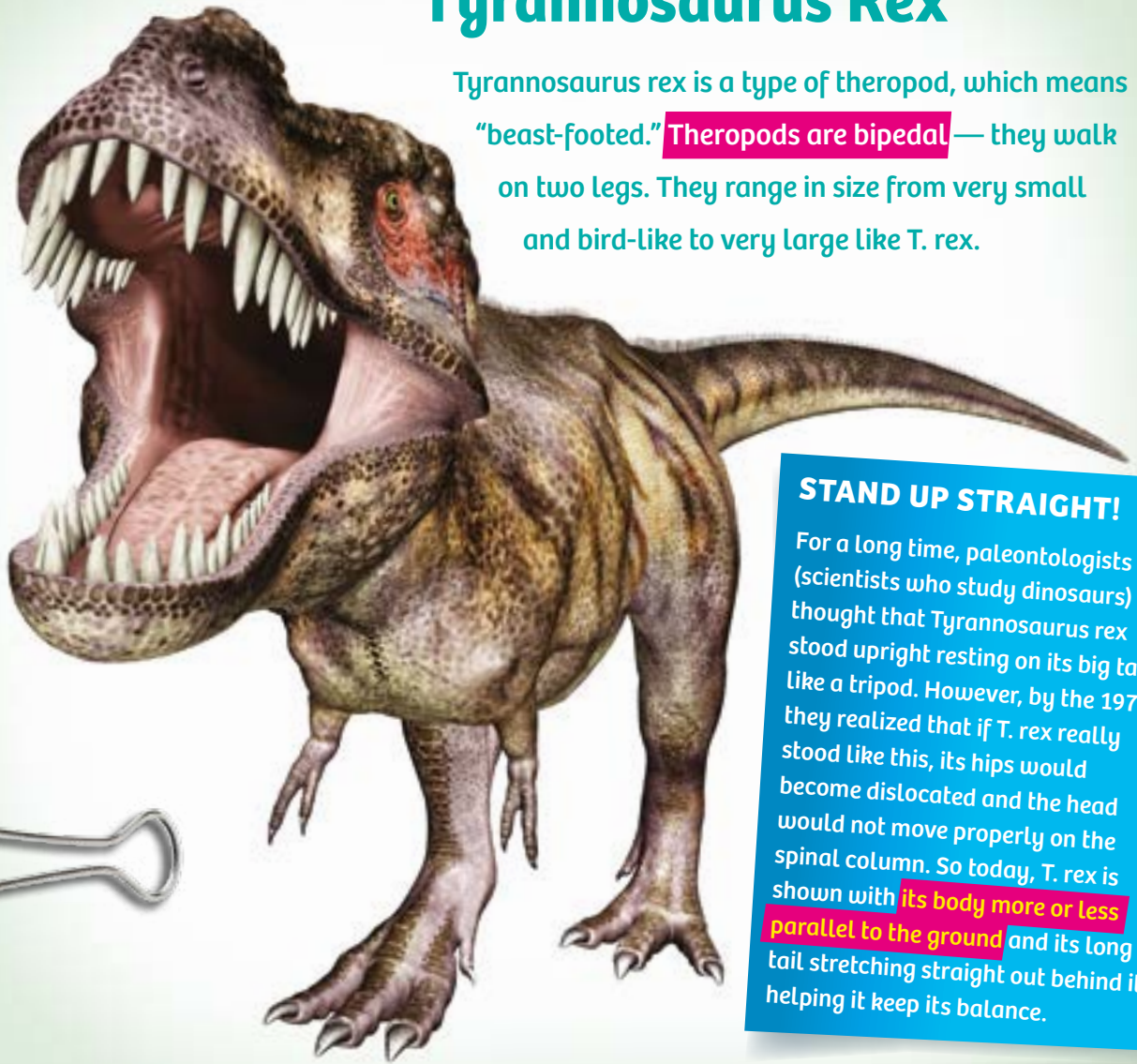
**Now try the experiments
on the back cover!**





Tyrannosaurus Rex

Tyrannosaurus rex is a type of theropod, which means “beast-footed.” **Theropods are bipedal** — they walk on two legs. They range in size from very small and bird-like to very large like T. rex.

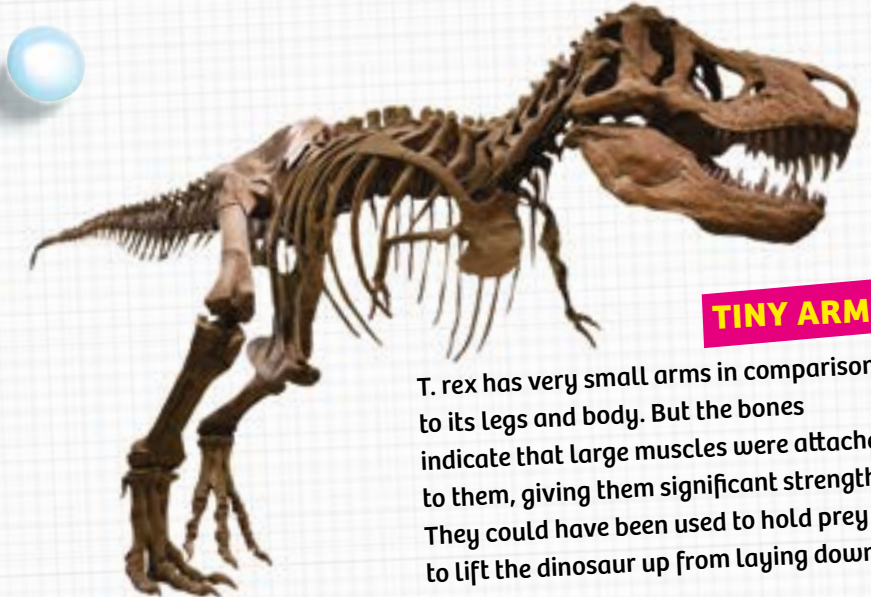


STAND UP STRAIGHT!

For a long time, paleontologists (scientists who study dinosaurs) thought that Tyrannosaurus rex stood upright resting on its big tail like a tripod. However, by the 1970s, they realized that if T. rex really stood like this, its hips would become dislocated and the head would not move properly on the spinal column. So today, T. rex is shown with **its body more or less parallel to the ground** and its long tail stretching straight out behind it, helping it keep its balance.

FOSSILS

Everything we know about dinosaurs comes from what we can infer from studying their fossilized remains and applying what we know about the analogous features of animals that are alive today. Dinosaur skeletons are like huge puzzles with which we are trying to unlock the secrets of these ancient creatures.

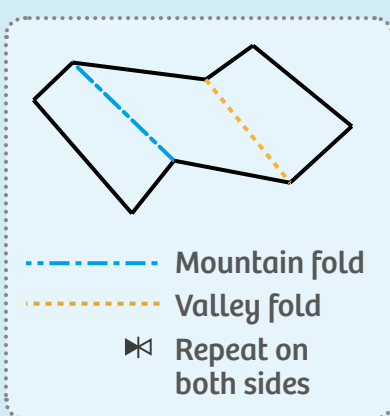
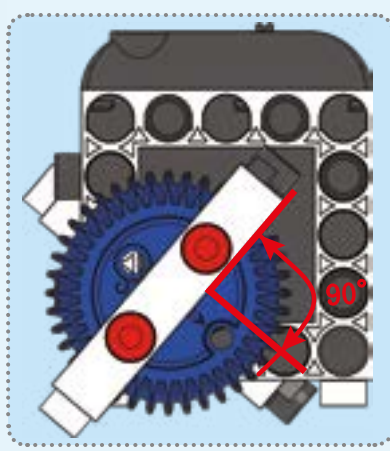
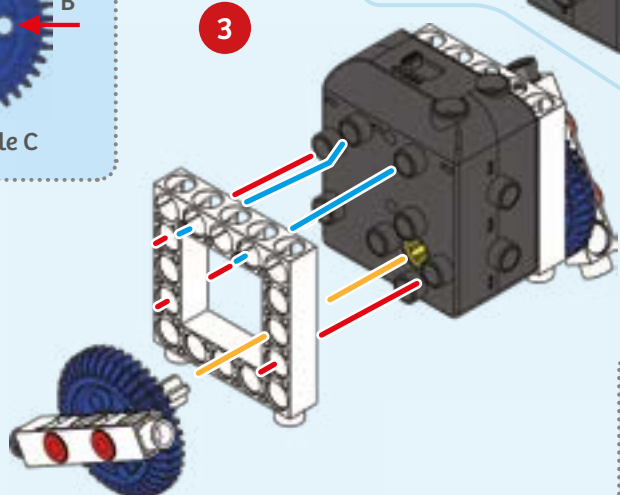
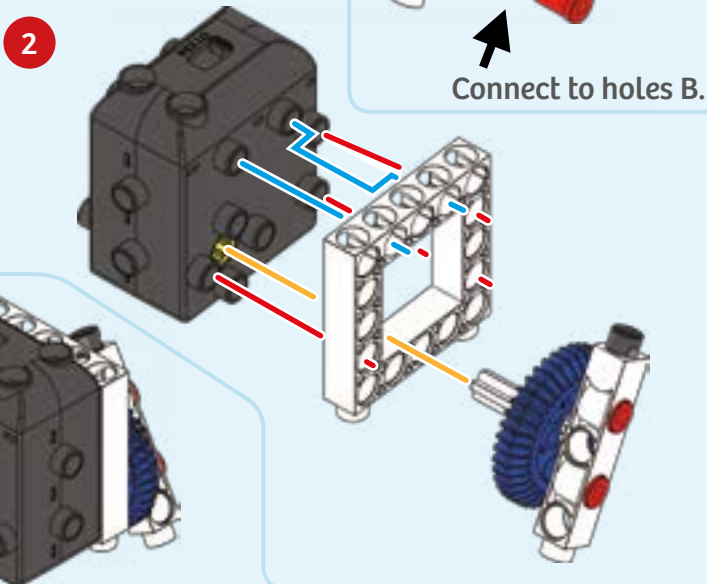
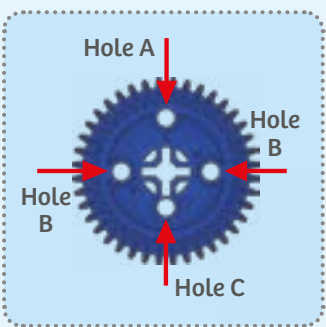
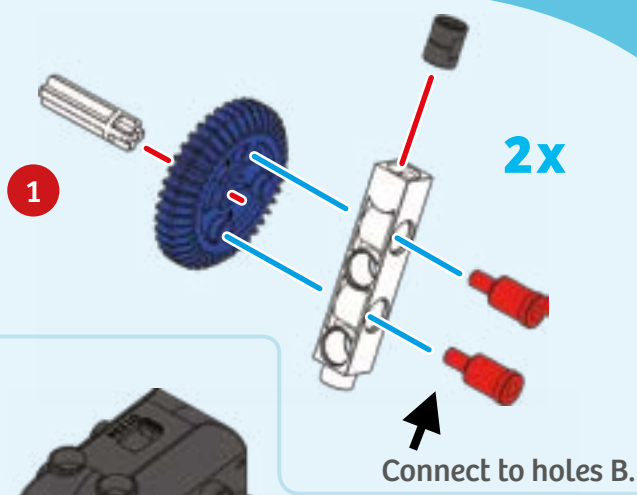


TINY ARMS

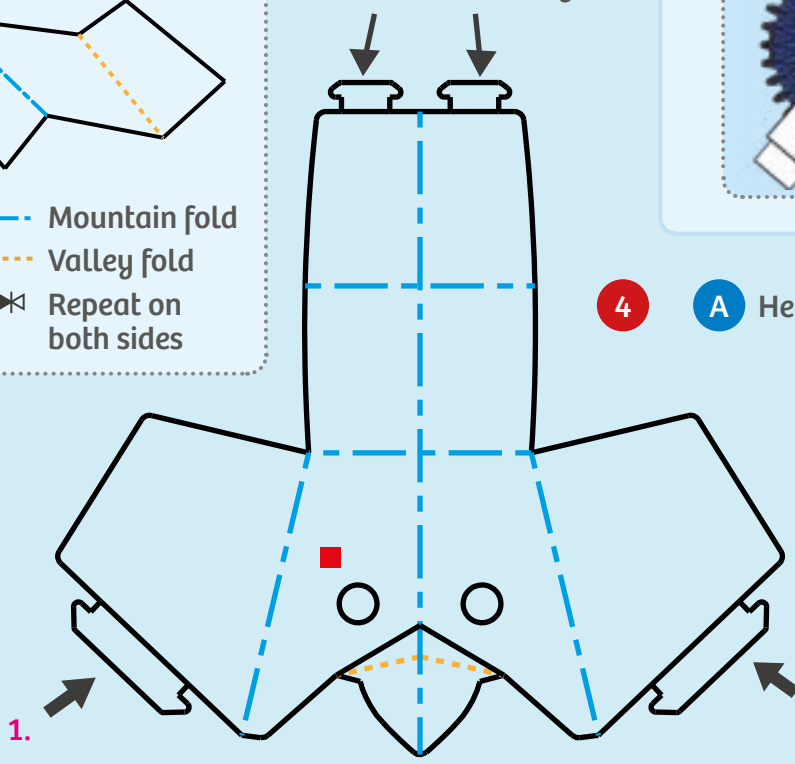
T. rex has very small arms in comparison to its legs and body. But the bones indicate that large muscles were attached to them, giving them significant strength. They could have been used to hold prey or to lift the dinosaur up from laying down.

PENGUIN

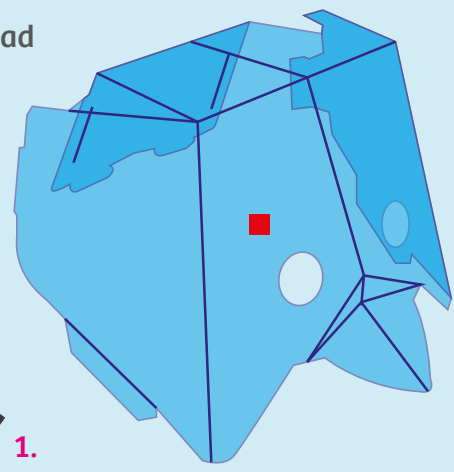
- | | | | | | | |
|----|----|----|----|----|----|----|
| 5 | 6 | 9 | 10 | 14 | 19 | 23 |
| 4x | 2x | 2x | 2x | 2x | 2x | 2x |
| 26 | 27 | 28 | 29 | | | |
| 2x | 1x | 1x | | | | |



1. Connect to body



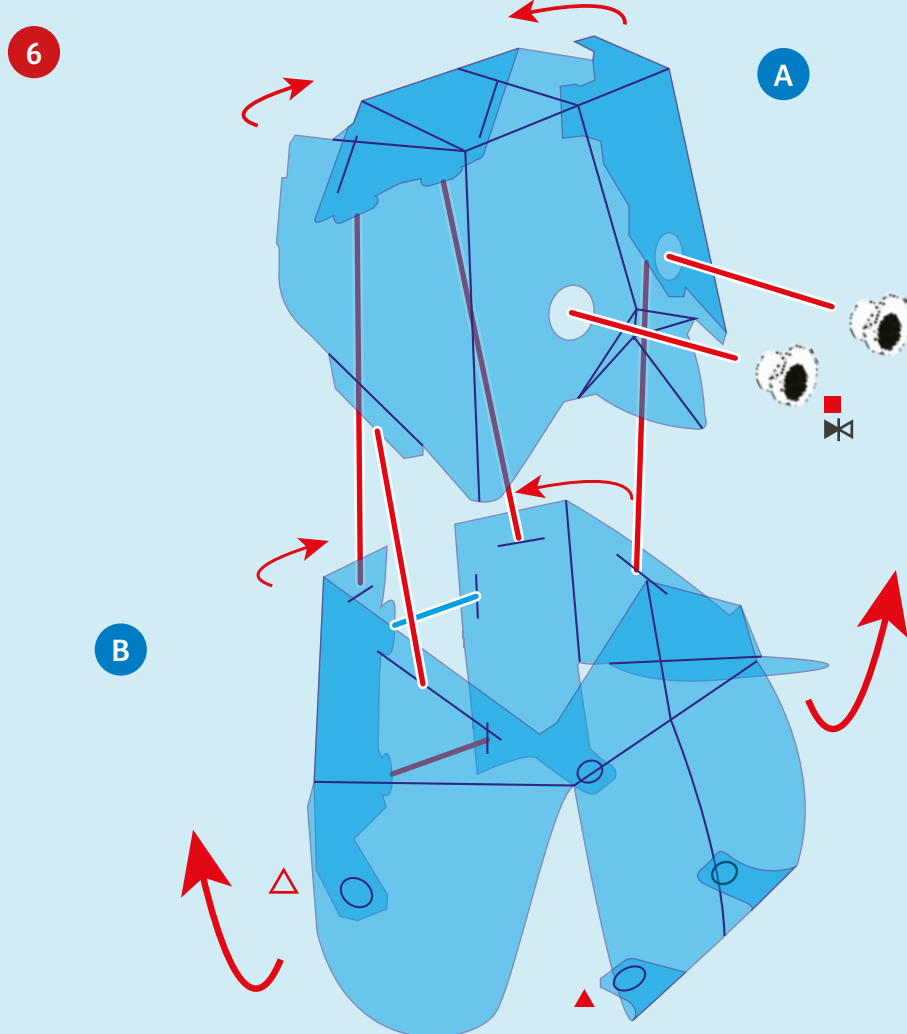
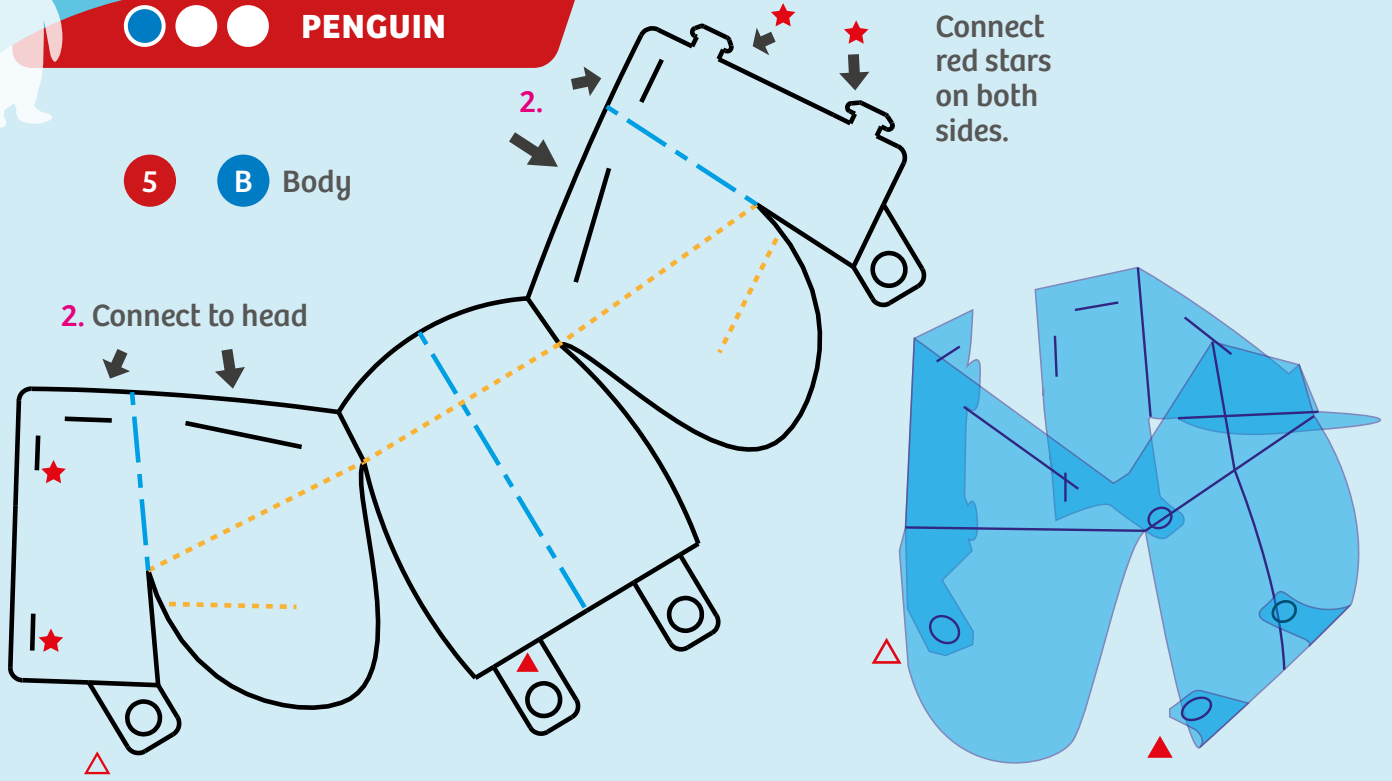
4 **A** Head



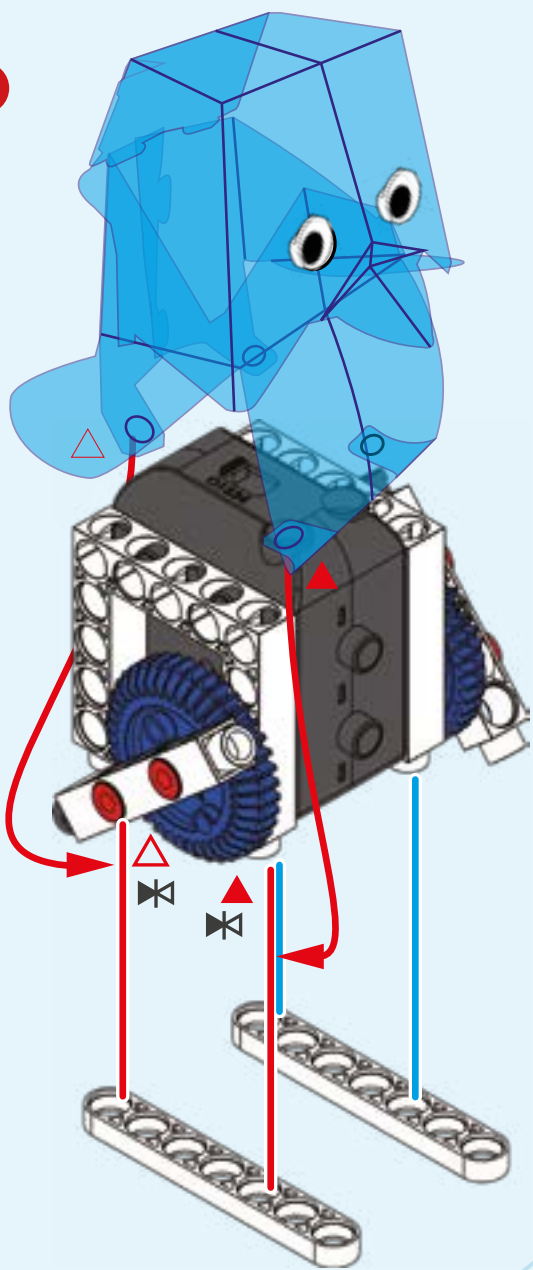


PENGUIN

5 **B** Body



7

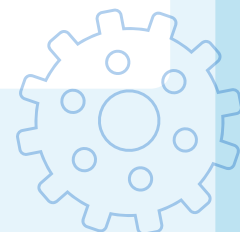


KEYWORD: BIOMIMETICS

Biomimetics is a term used to describe the imitation of things from the natural world for the purposes of performing tasks or solving problems. Humans find inspiration in the structures and materials of the natural world, and find ways to artificially mimic them. Examples include airplane wings that mimic bird wings, sticky materials that mimic the sticky footpads of a gecko, and strong ceramics that mimic the strong composition of seashells.

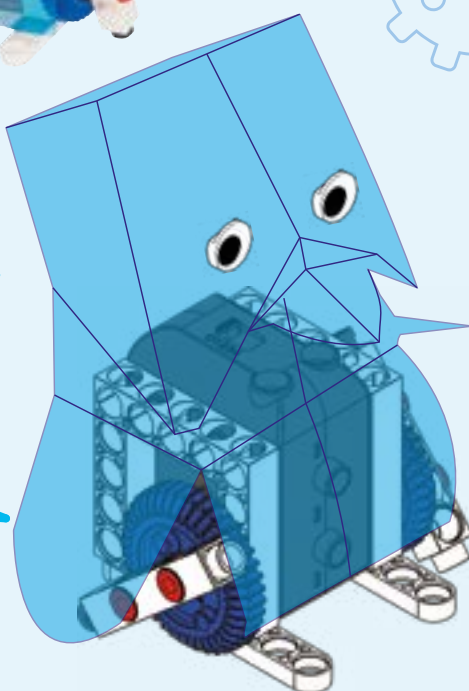
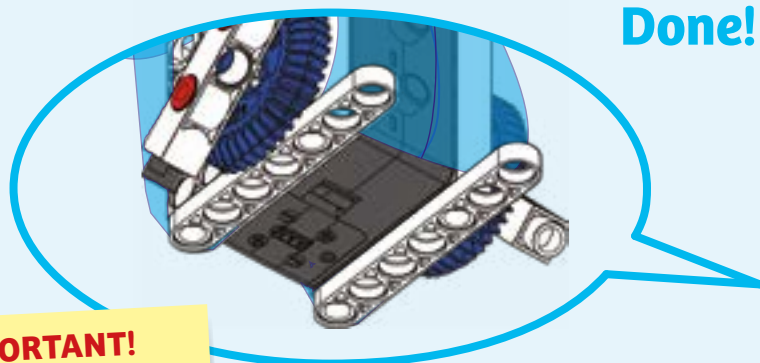
WHAT'S HAPPENING?

The model mimics the waddling behavior of a penguin with rods fixed to the gears at right angles from one another. When one rod is pushing its side upward, the other rod is not touching the surface.



8

Done!



IMPORTANT!
This penguin model cannot go in the water or move on ice!

Now try the experiments on the back cover!



CHECK IT OUT



Penguins

Penguins are birds that have evolved to swim very well, but they cannot fly at all. Their

wings have evolved into flippers and their sleek, streamlined bodies help them glide through the water.

On land, they are slow and seemingly awkward. They waddle around on two legs.

Their feet are better adapted for use as flippers in the water and their short legs cannot move very far in a single step. Often, a penguin will fall over on its belly to glide around on the ice, which is faster than walking!



SOLID BONES

While most birds have hollow bones to keep them light so they can fly, penguins have solid bones which make it easier for them to dive deep underwater in search of their food: fish, squid, and krill. If their bones were hollow, they would be too buoyant.



PTEROSAUR

1	2	3	5	6	7	8	9	10	
1x	4x	2x	2x	2x	1x	2x	2x	2x	
11	12	13	14	16	17	18	19	20	23
1x	3x	2x	2x	4x	4x	2x	2x	4x	6x
24	26	27	28						29
									1x
1x	2x	1x	1x						

1

2x

2

3

4

5

Hole A

Hole B

Hole B

Hole C

Connect to hole C.

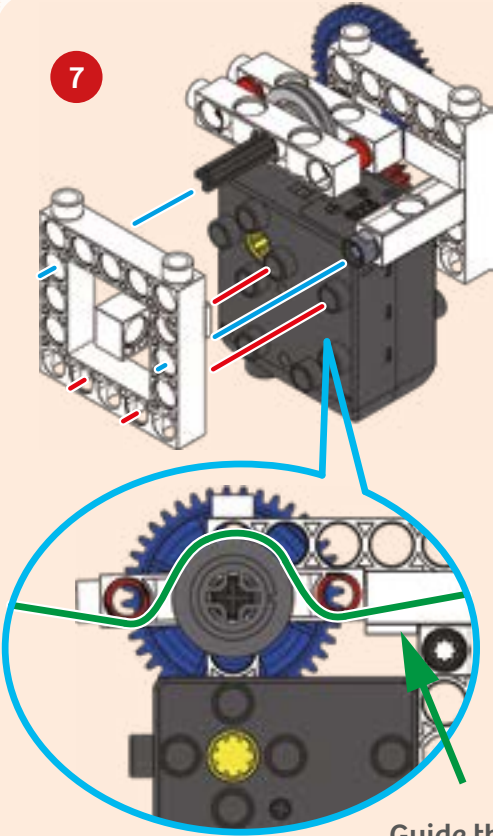
Hole C

6



PTEROSAUR

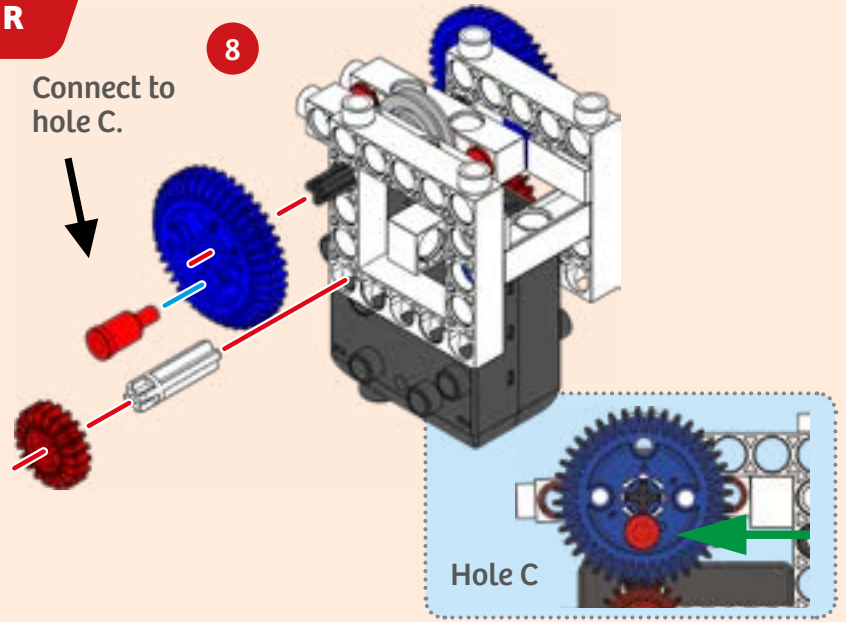
7



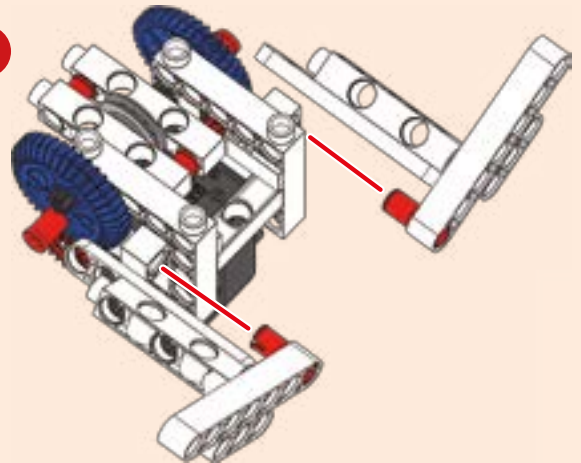
Guide the string under the red joint pins and over the gray pulley wheel.

8

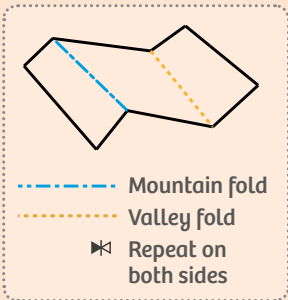
Connect to hole C.



9

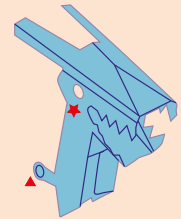
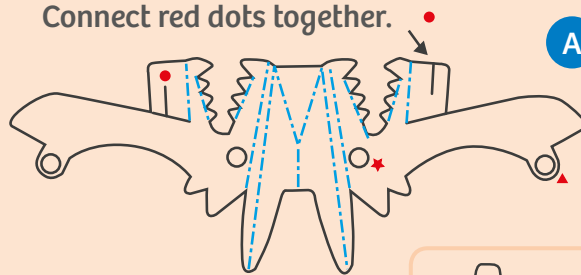


10

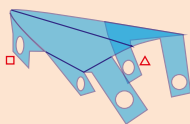
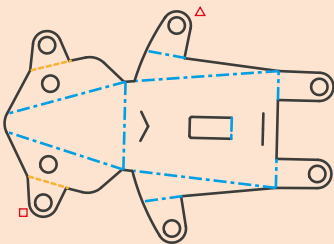


Connect red dots together.

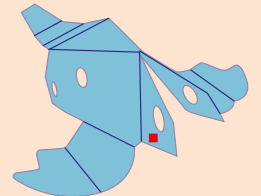
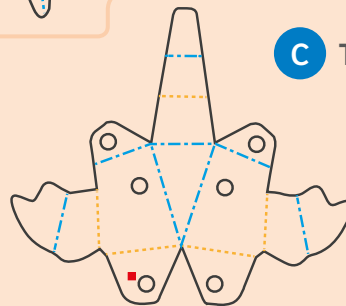
A Head



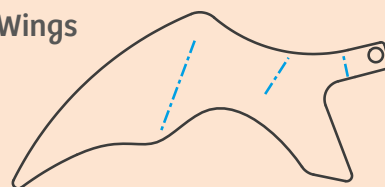
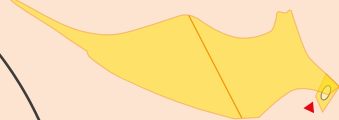
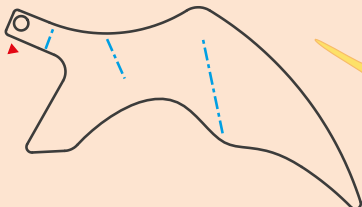
B Body

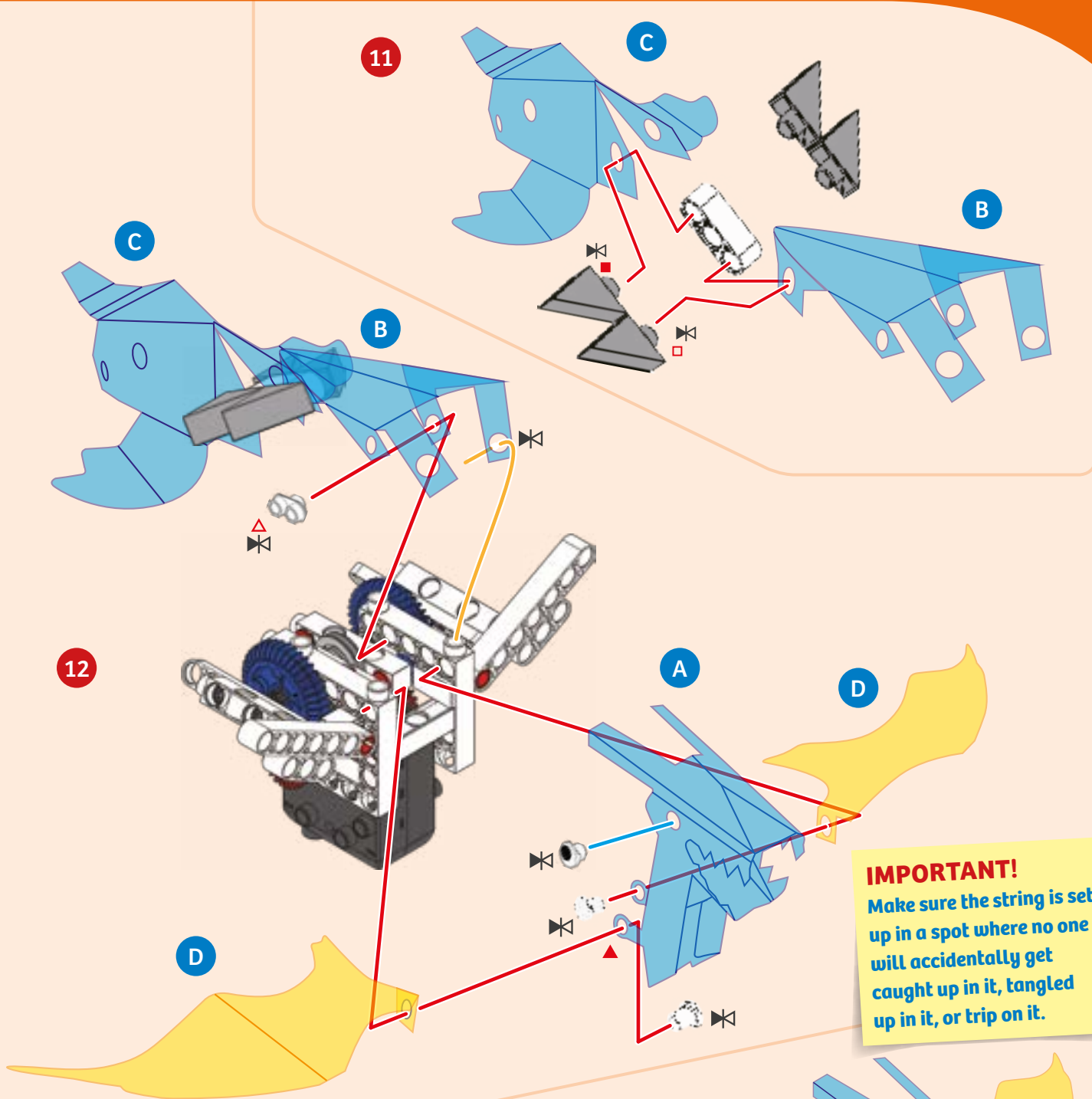


C Tail



D Wings

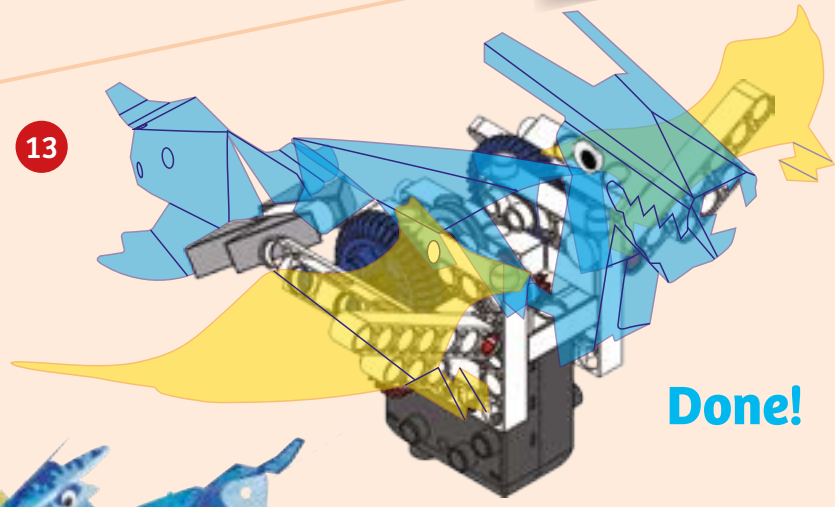




IMPORTANT!
 Make sure the string is set up in a spot where no one will accidentally get caught up in it, tangled up in it, or trip on it.

WHAT'S HAPPENING?

Fix the ends of the string to two points secure enough to hold the pterosaur up. When the model is activated, the pulley wheel inside it moves the model forward and backward along the string. The gears on the sides have an off-center pin on them that functions as a cam to push the wings upward once during each revolution.



Done!

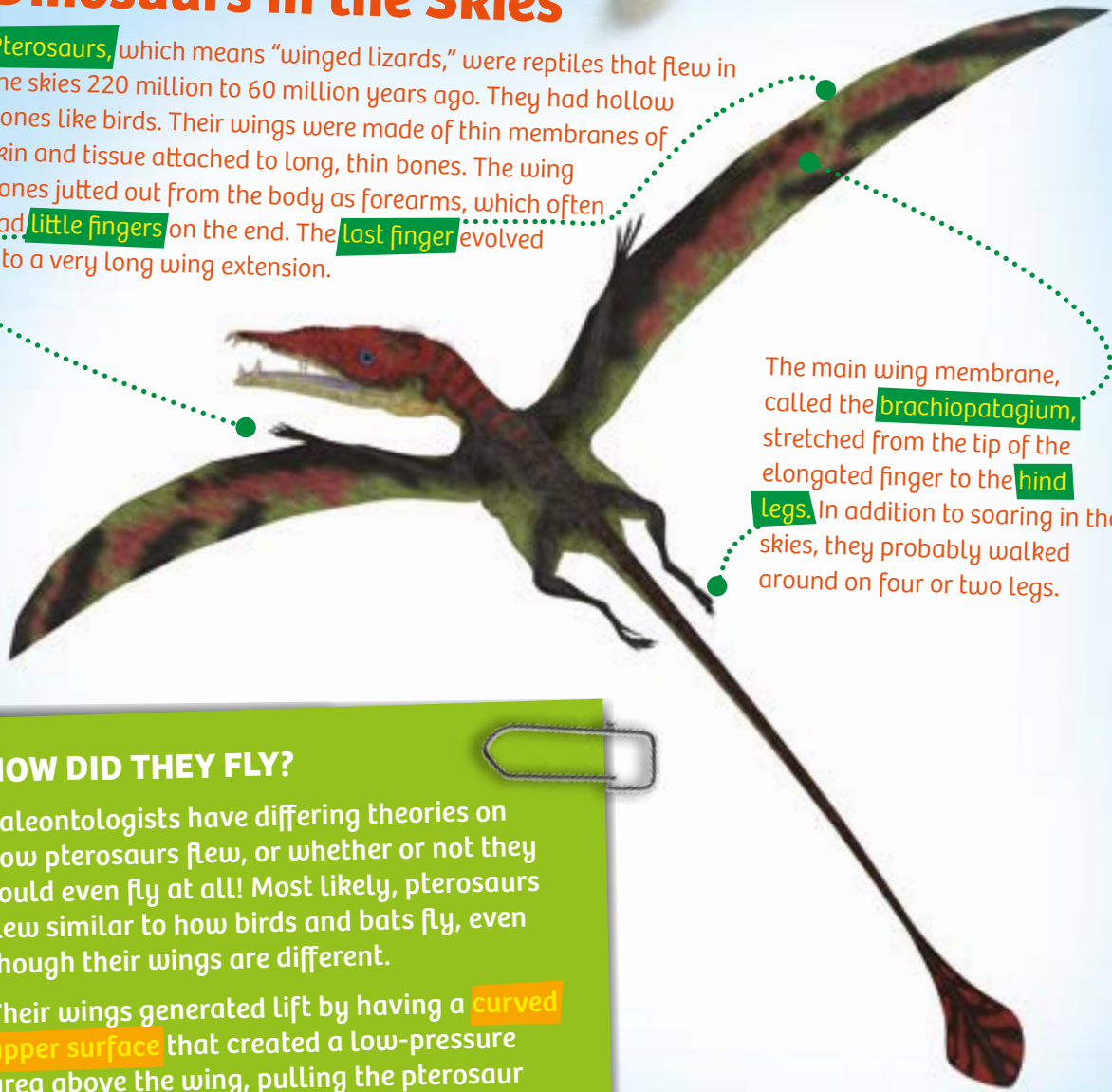
Now try the experiments on the back cover!





Dinosaurs in the Skies

Pterosaurs, which means “winged lizards,” were reptiles that flew in the skies 220 million to 60 million years ago. They had hollow bones like birds. Their wings were made of thin membranes of skin and tissue attached to long, thin bones. The wing bones jutted out from the body as forearms, which often had **little fingers** on the end. The **last finger** evolved into a very long wing extension.



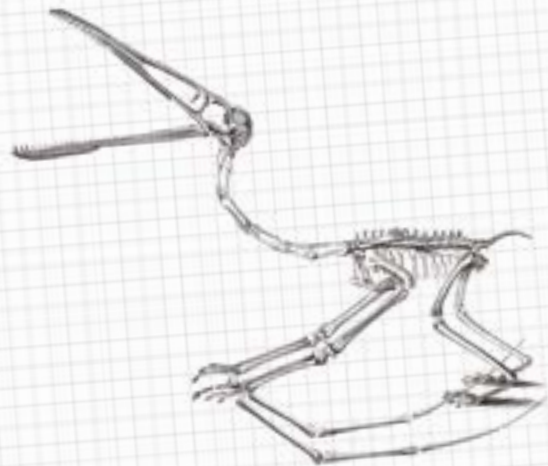
The main wing membrane, called the **brachioptagium**, stretched from the tip of the elongated finger to the **hind legs**. In addition to soaring in the skies, they probably walked around on four or two legs.

HOW DID THEY FLY?

Paleontologists have differing theories on how pterosaurs flew, or whether or not they could even fly at all! Most likely, pterosaurs flew similar to how birds and bats fly, even though their wings are different.

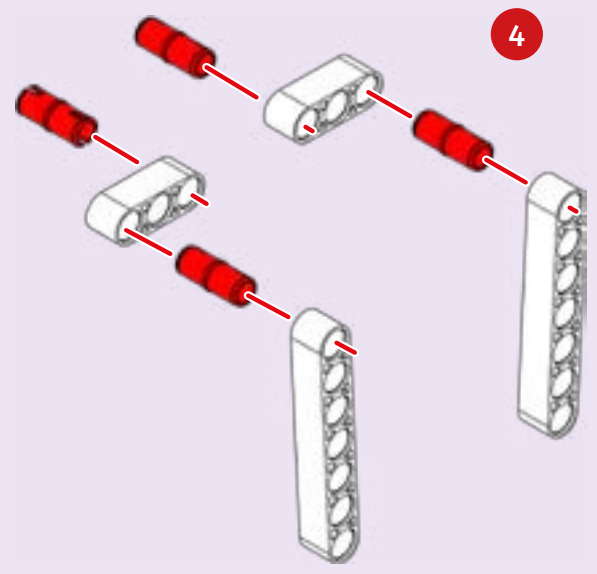
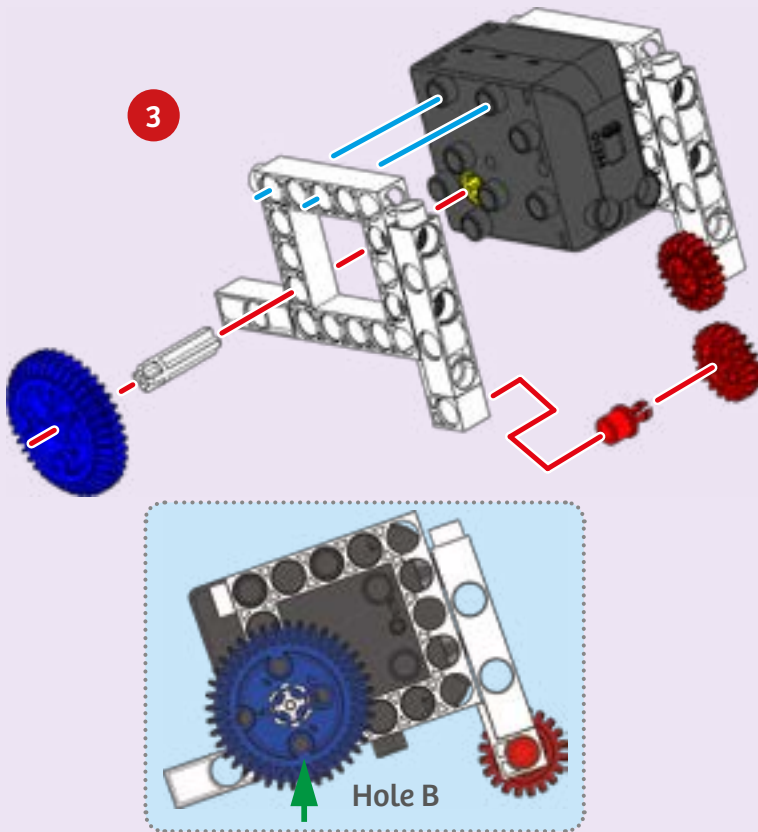
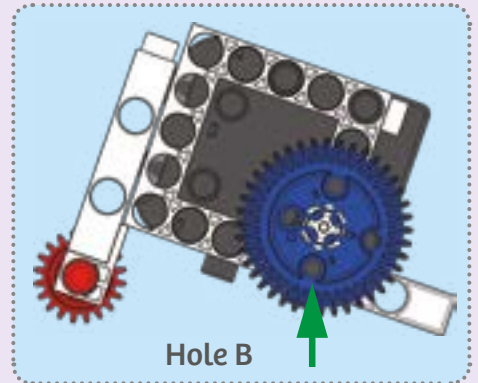
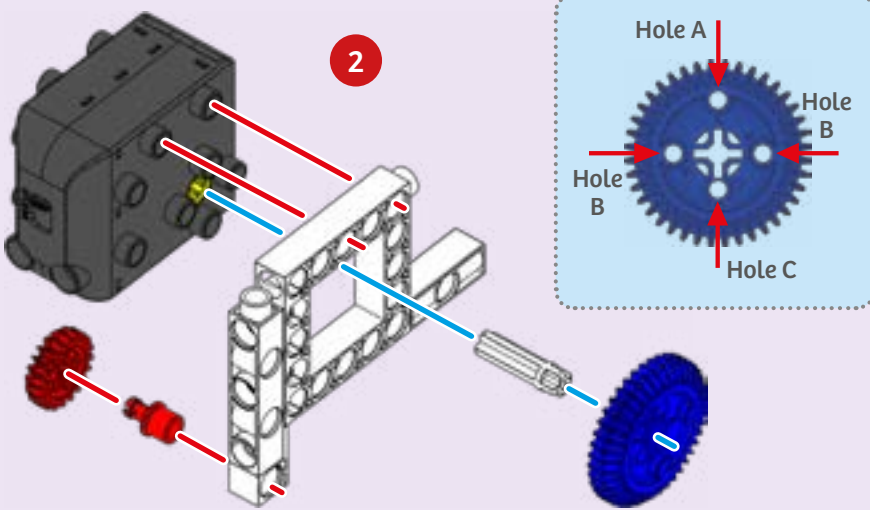
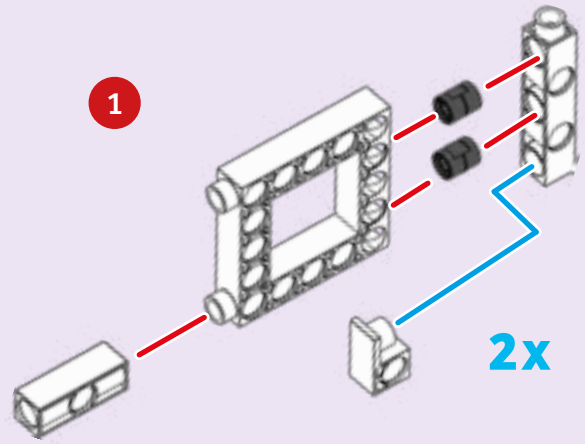
Their wings generated lift by having a **curved upper surface** that created a low-pressure area above the wing, pulling the pterosaur upward. Their small but strong forearm muscles allowed them to **flap their wings** to push them upward. Their powerful hind legs probably allowed them to jump up off the ground to take off.

The huge expanse of the brachioptagium probably created sufficient air resistance to allow the pterosaur to stay aloft for a good deal of time, **soaring through the air like a glider**. Although we will probably never see a pterosaur flying, we can infer a lot from its fossilized remains and their similarities to modern day birds and mammals that can fly.



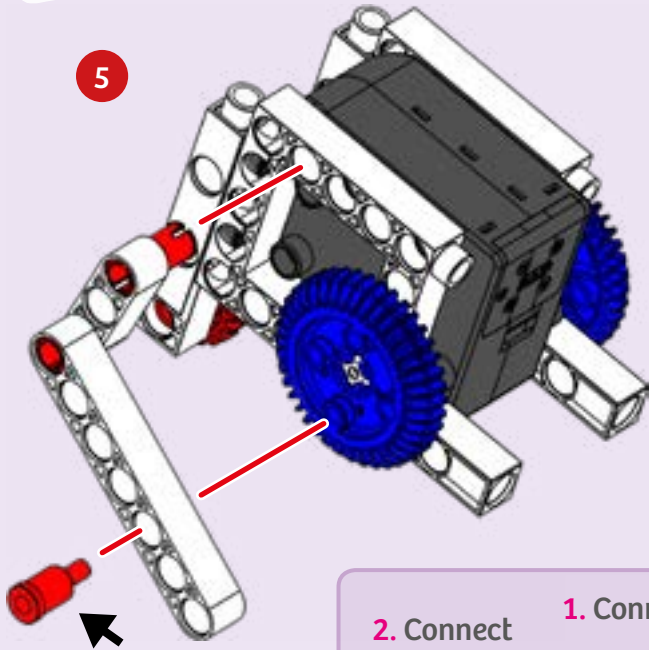
RABBIT

2	3	4	5	6	8	10	11
4x	2x	2x	2x	2x	2x	2x	2x
12	13	16	18	19	20	23	26
2x	2x	2x	6x	2x	2x	4x	2x
27	28	29					
1x	1x	1x					



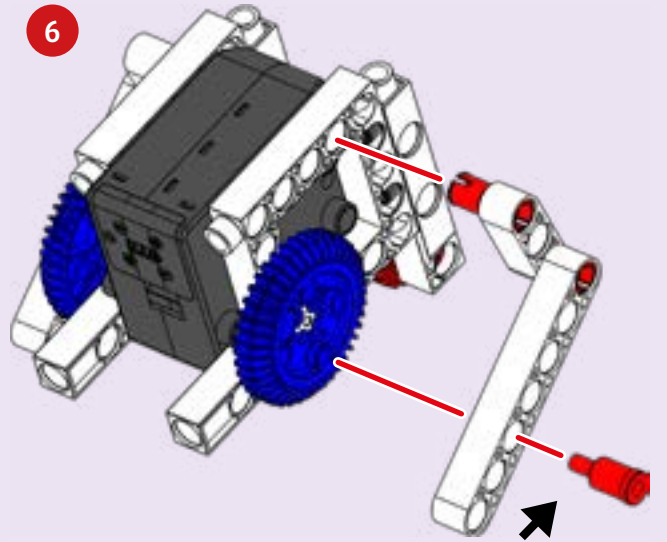


5



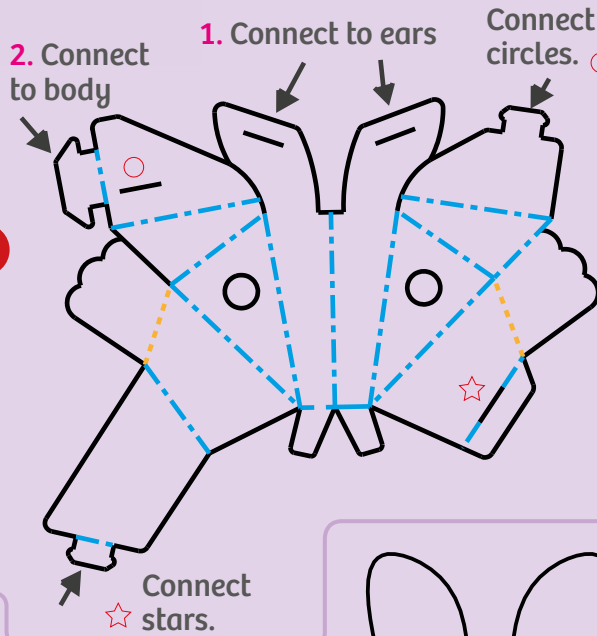
Connect to hole B (bottom).

6

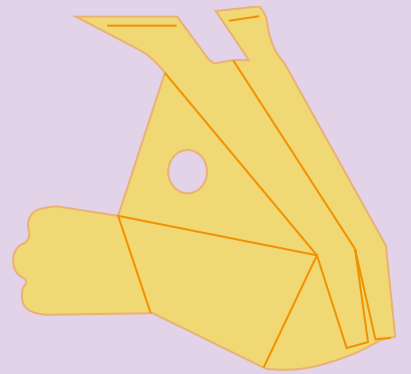


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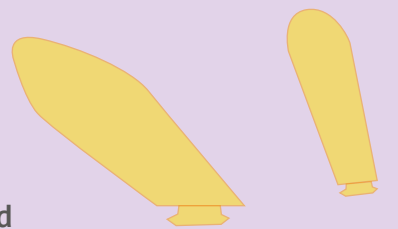
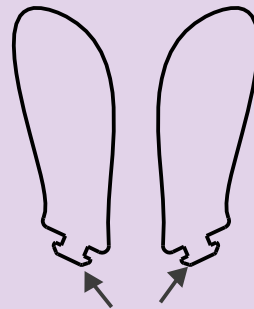
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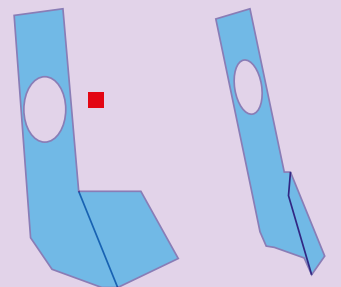
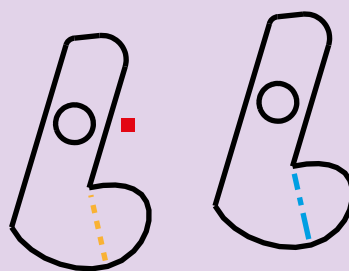
A Head



C Ears

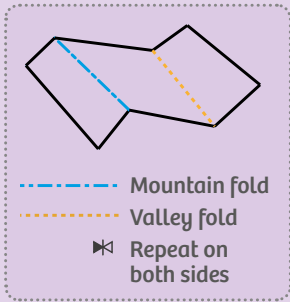
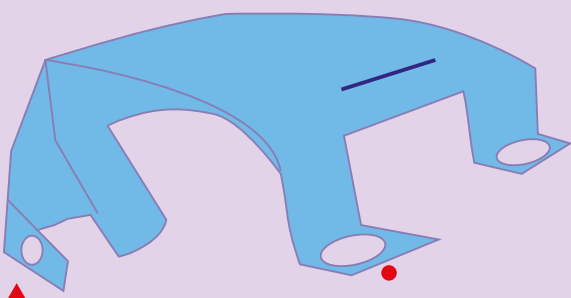
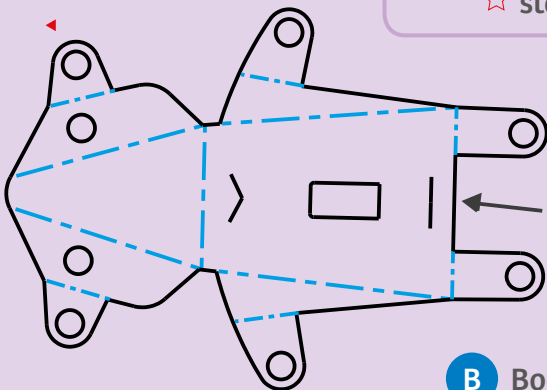


D Front legs

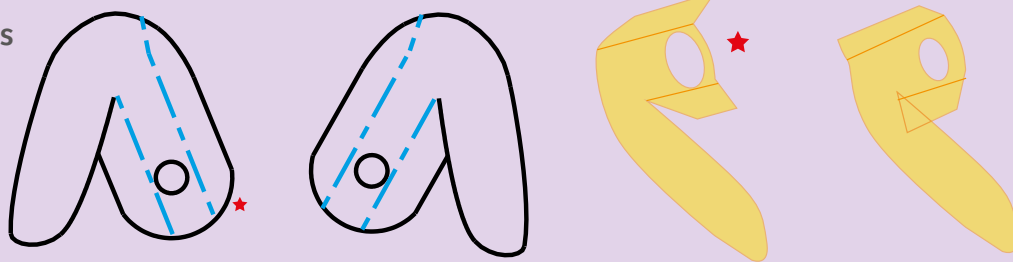


3. Connect to head

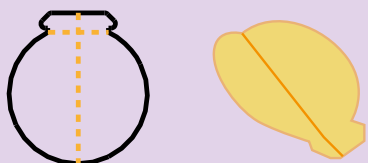
B Body



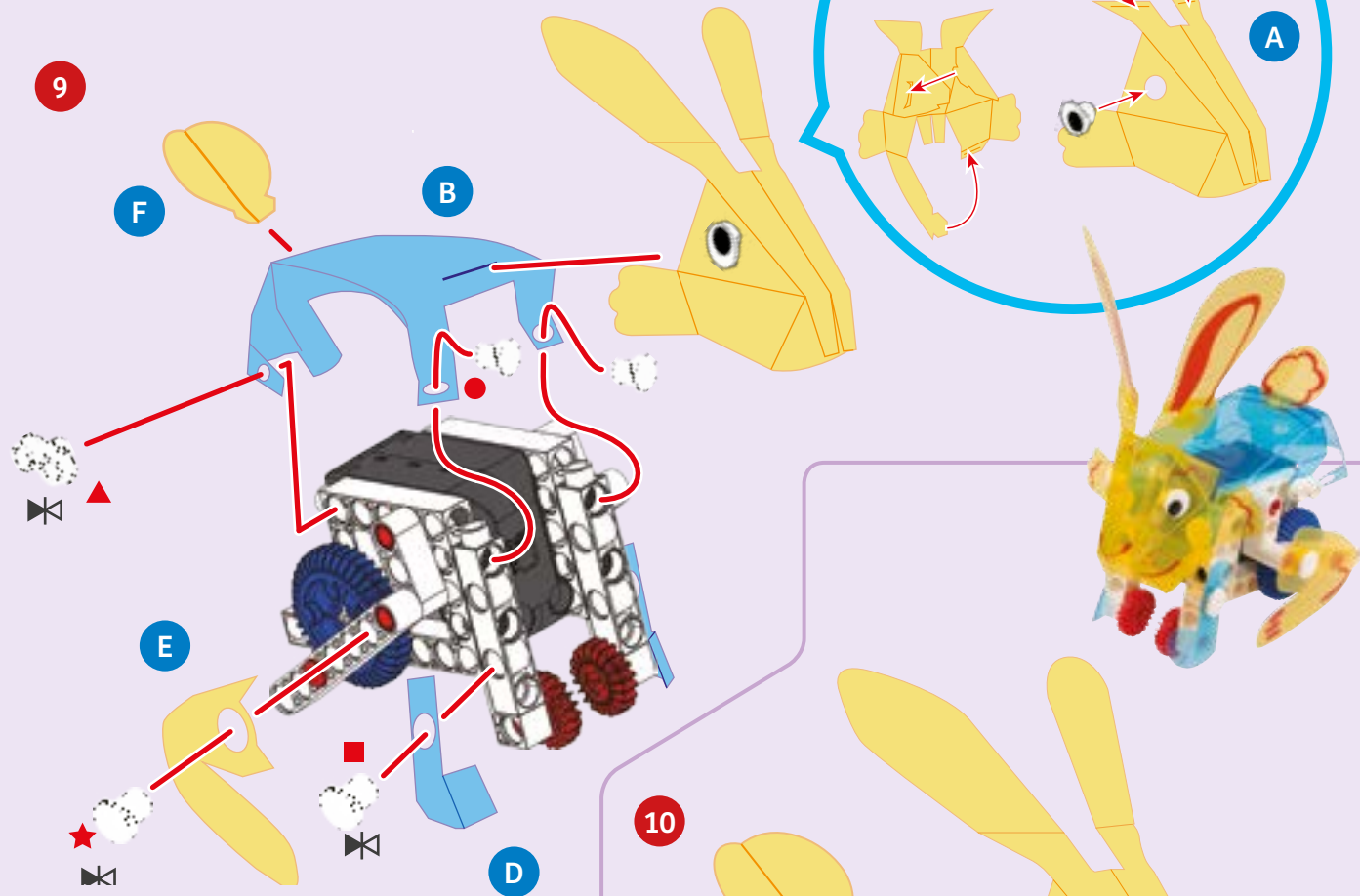
8 E Back legs



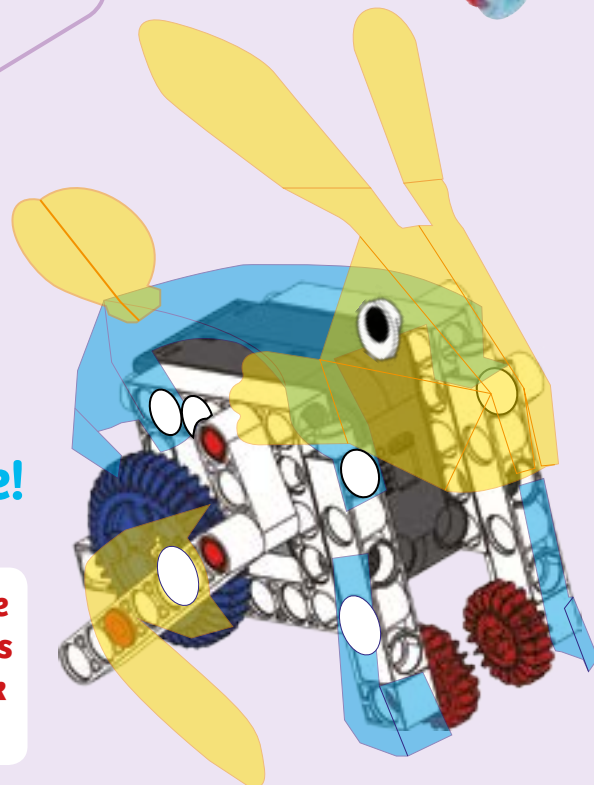
F Tail



9



10



WHAT'S HAPPENING?

The rabbit model hops forward or backward on its two hind legs. The off-center pin and the hinged rods transform the rotating motion of the gear into a more complex motion of the leg rods, which push the rabbit up and either forward or backward.

Done!

Now try the experiments on the back cover!



CHECK IT OUT



Hippity Hop

Rabbits are small, furry mammals that are best known for their big ears and their ability to jump. They can hop away from predators very quickly. If they are caught, their **powerful hind legs** can kick their predator, helping the rabbit escape.

Rabbits have light bones and powerful muscles, helping them jump high and far. Their back legs are longer than their **front legs**, which allows them to hop. Their hind legs have large footpads that give them a large surface area with which to push off.

When a rabbit jumps, its hind legs start in a folded-up position, like an accordion, and then spring out quickly and forcefully. The feet propel the rest of the leg off the ground, pushing the rabbit into the air.

RABBIT FACTS

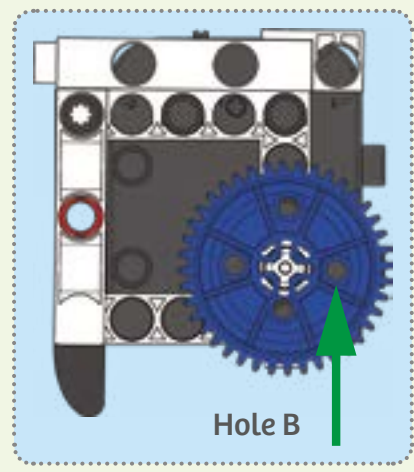
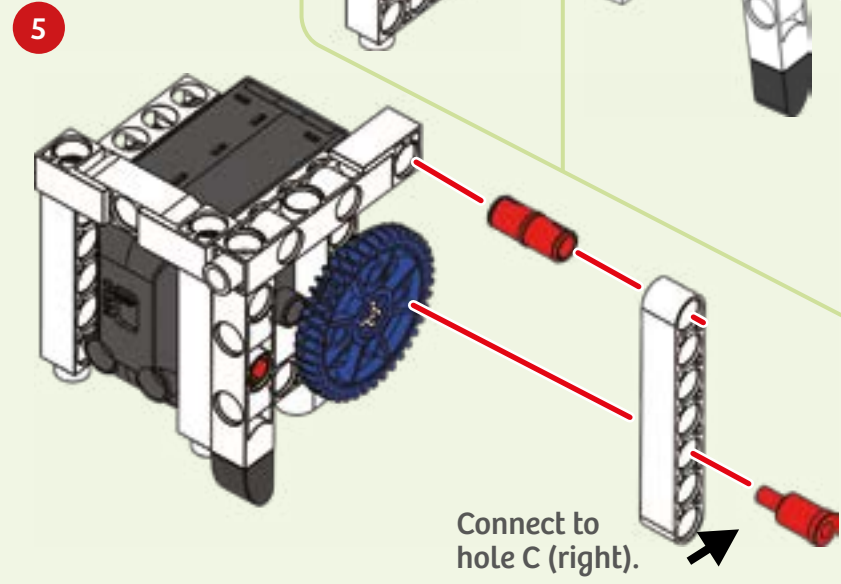
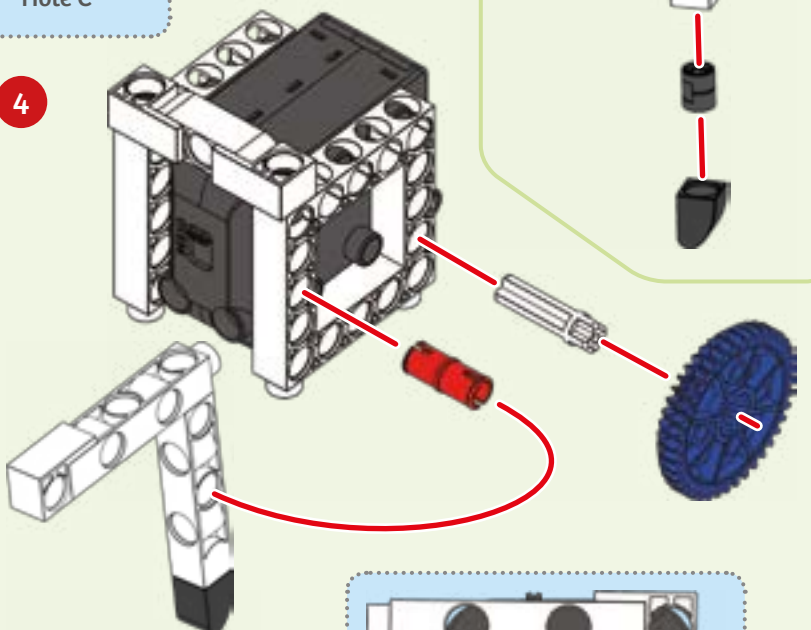
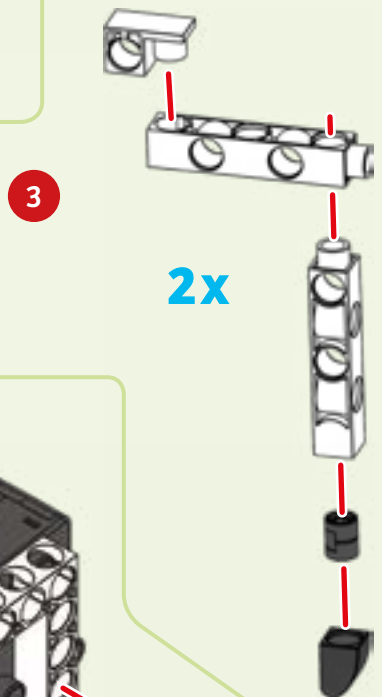
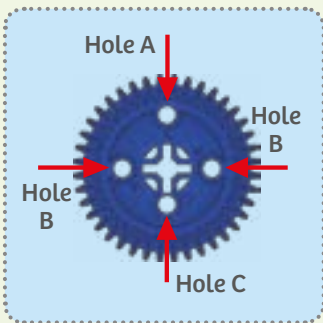
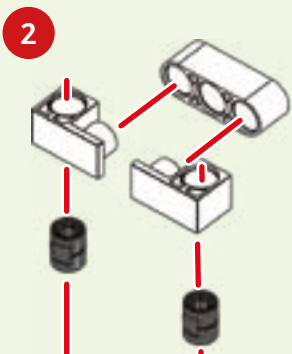
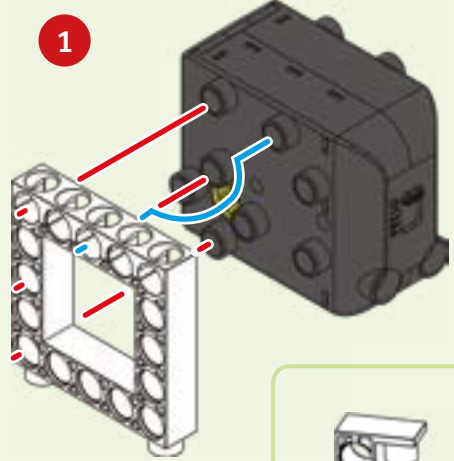
- »» Rabbits can jump more than three feet high and ten feet long.
- »» To show they are happy, rabbits will run, hop into the air, twist their bodies, and kick their feet.
- »» Rabbits will stand up on their hind legs to look around for food or predators.
- »» Rabbits have very fragile skeletons and their bones are easily prone to breaking.

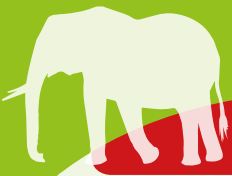
THUMPER

Rabbits also use their feet to communicate with each other. If danger is present, a rabbit will thump its back feet on the ground to communicate the danger to other rabbits nearby.

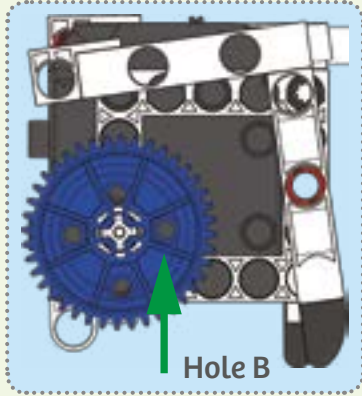
ELEPHANT

- | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|
| 2 | 5 | 6 | 8 | 9 | 10 | 11 | 12 | |
| 5x | 2x | 2x | 2x | 2x | 2x | 1x | 4x | |
| 13 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 23 |
| 3x | 4x | 4x | 1x | 6x | 2x | 2x | 2x | 5x |
| 26 | 27 | 28 | 29 | | | | | |
| 2x | 1x | 1x | | | | | | |

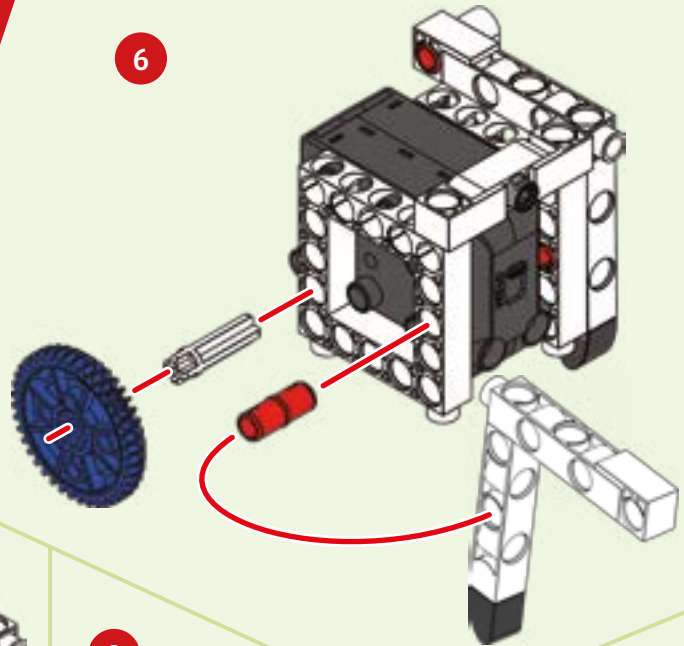




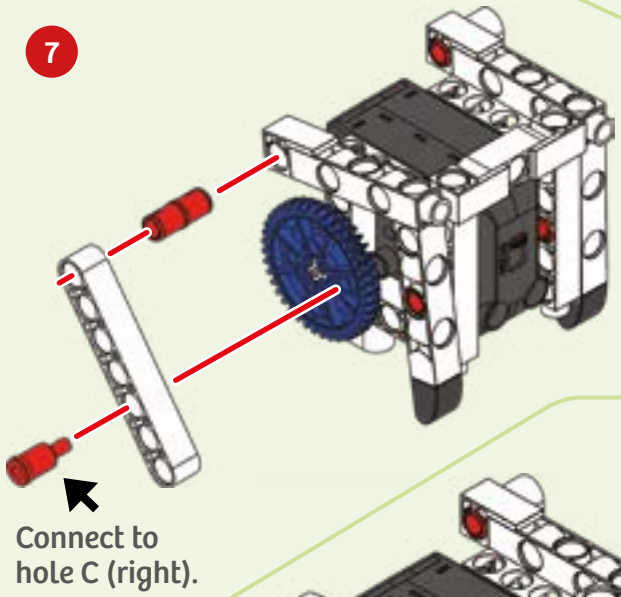
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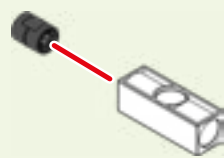
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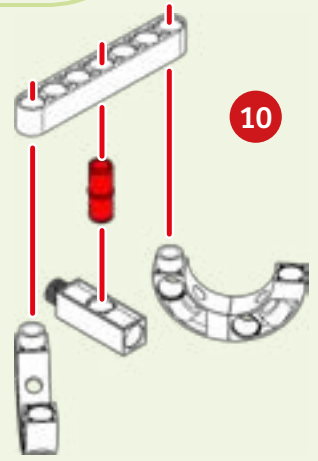
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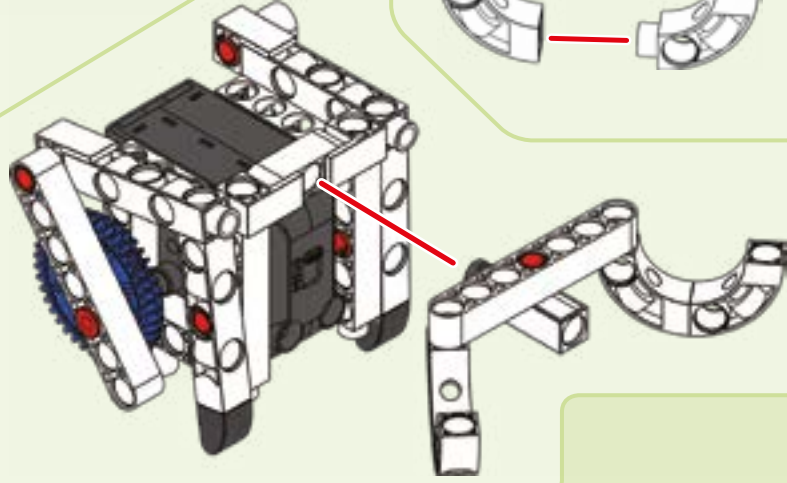
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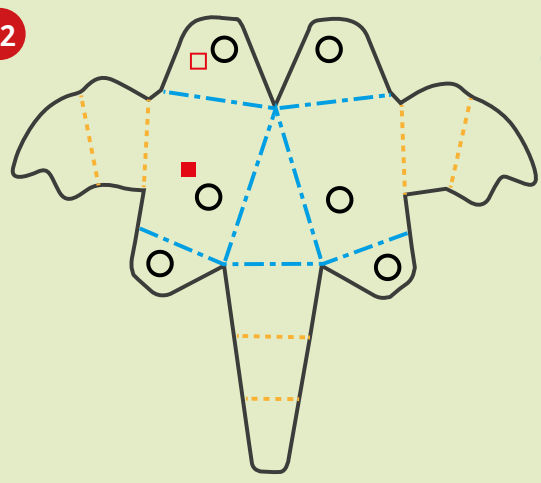
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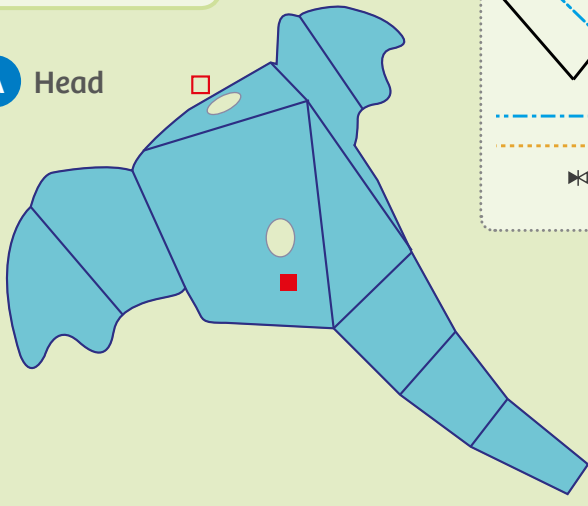
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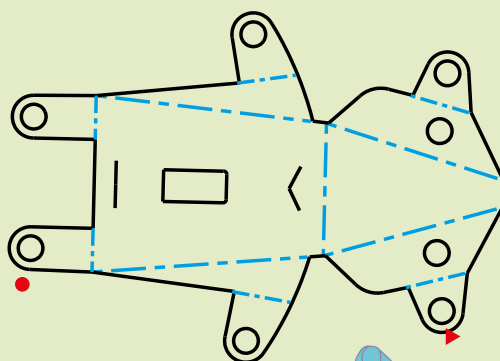
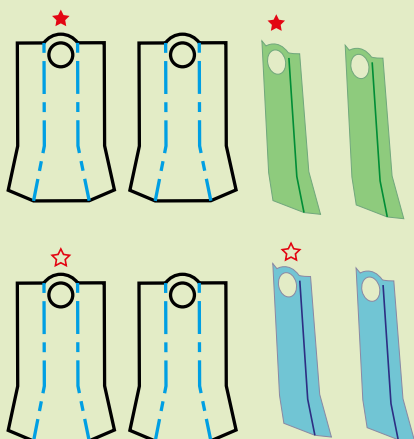
A Head



- - - Mountain fold
 - - - Valley fold
 ⇄ Repeat on both sides

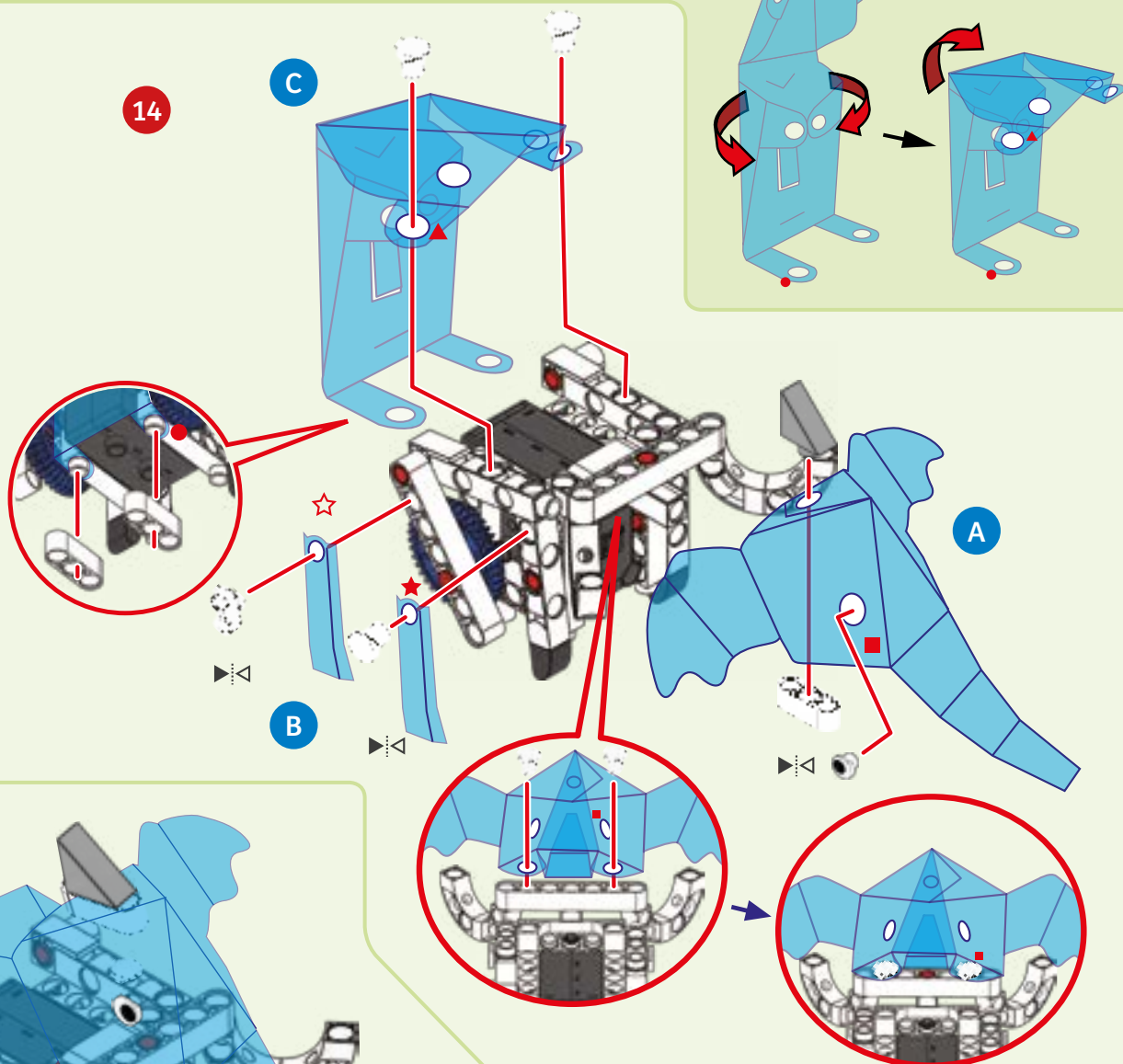
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B Legs

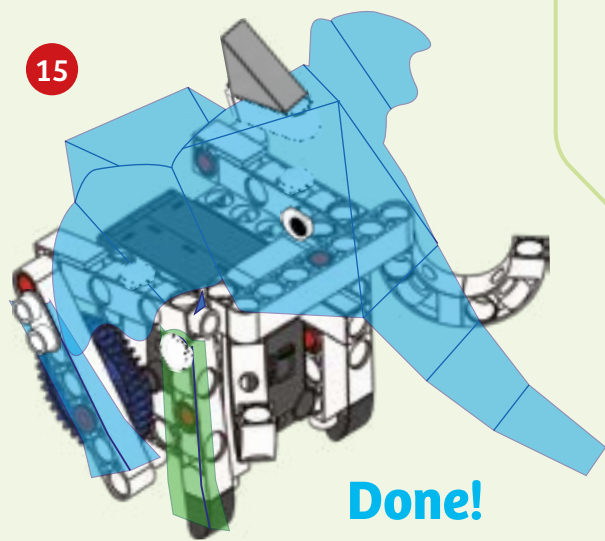


C Body

14



15



Done!

Now try the experiments on the back cover!

WHAT'S HAPPENING?

The elephant model has a clever mechanism that causes the back leg to move more than the front leg, even though they are both powered by the same gear wheel.





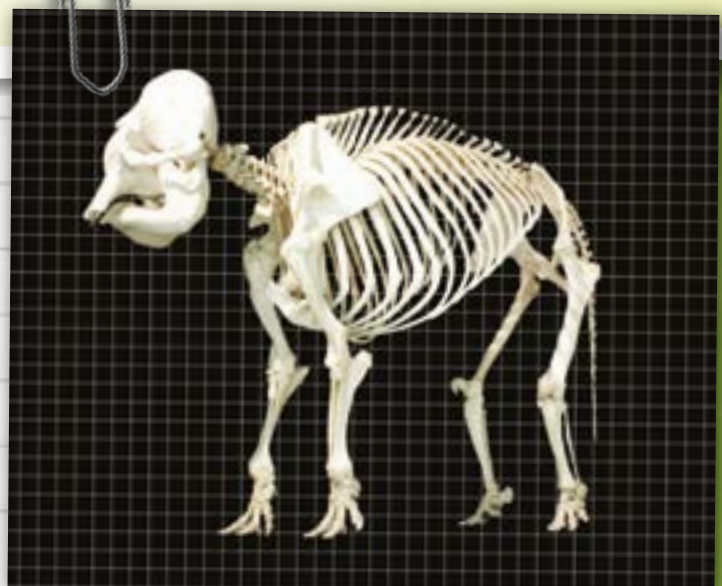
Mighty Elephants

Elephants are the largest land mammals alive today. They can be up to 13 feet tall and weigh up to 15,400 pounds. They are known for their large trunks, large ears, and tusks. The muscular trunk performs many functions: It is used for grasping objects, touching things, smelling, breathing, making noises for communication, sucking up water to spray it, and even as a snorkel when underwater.

Elephants stand and move on **four pillar-like legs** that are oriented directly under their bodies to support their heavy weight. Elephants cannot run, gallop, or jump, but they can stand on two legs and they can move very fast — their front legs run while their back legs walk. They have big, flat feet to cushion their weight, and thick skin all over.

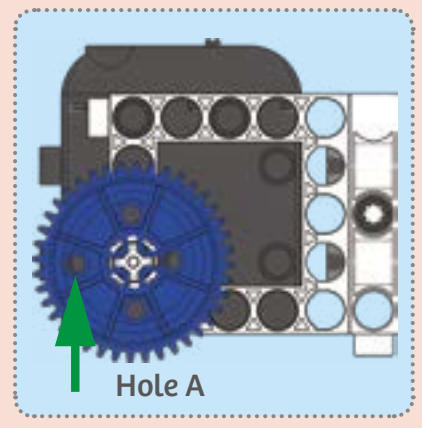
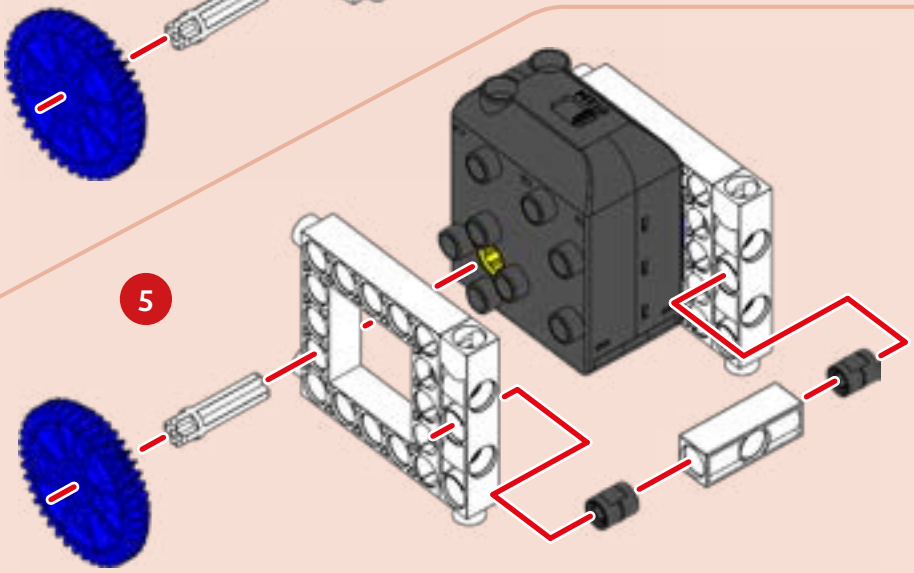
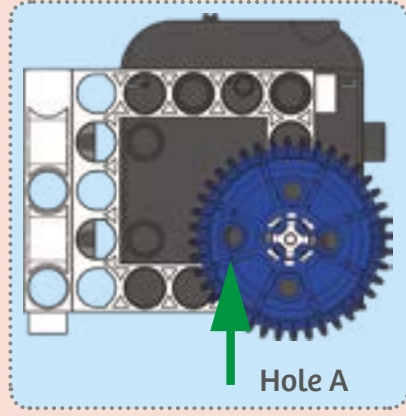
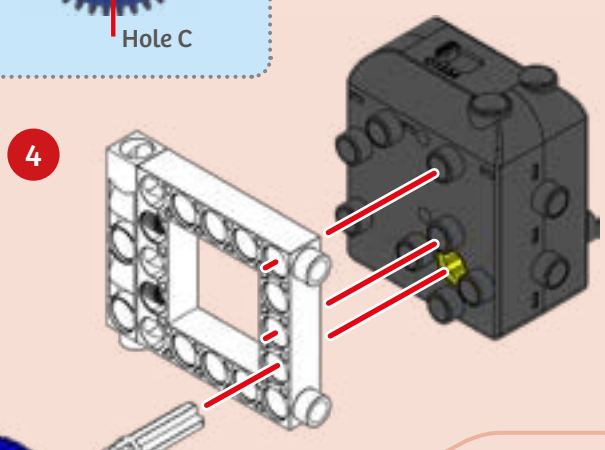
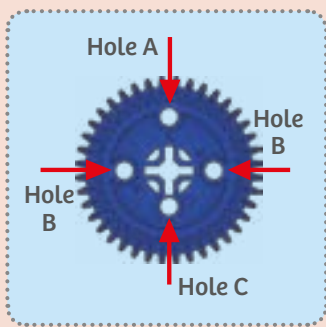
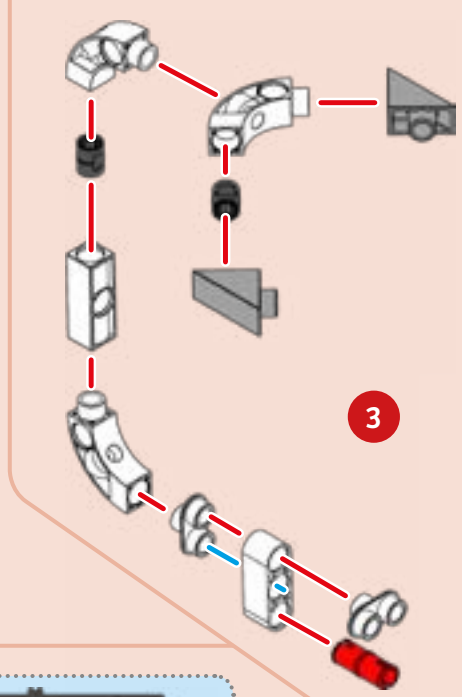
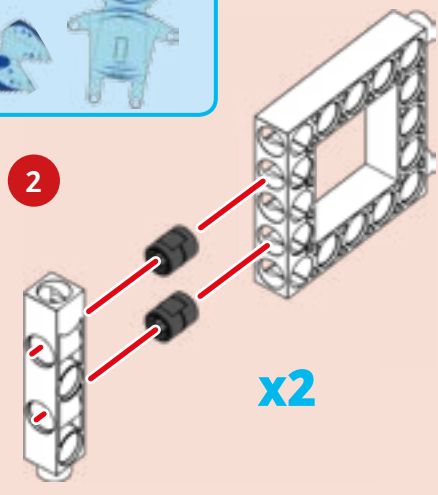
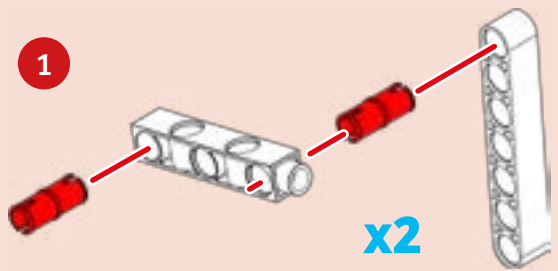
MASSIVE SKELETONS

Elephants have **huge skeletons** with giant bones and strong skulls to hold their heavy tusks and to withstand the heavy forces of head-on collisions with other elephants. The skeleton consists of up to 351 bones! There are no bones in the trunk or ears, so their skeletal heads look quite different from their living heads.



SCORPION

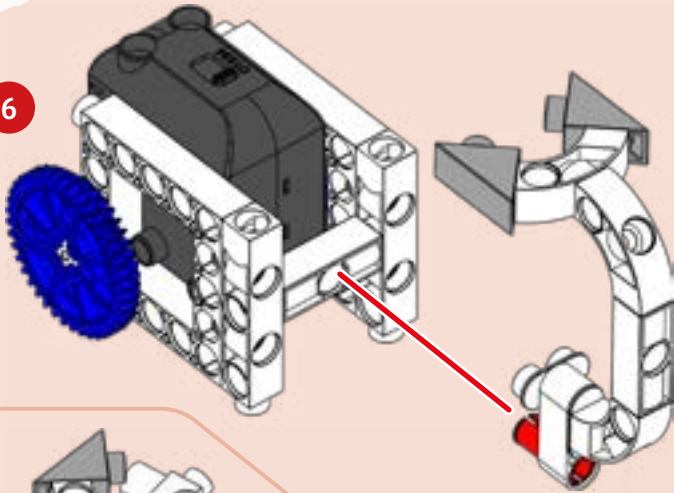
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12	13	15	17	18	19	20	23
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26	27	28	29		30		
2x	1x	1x	2x		1x		



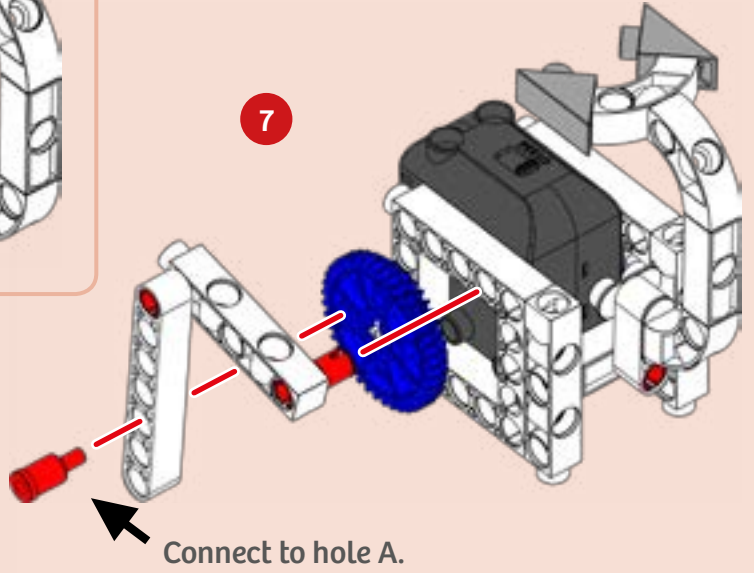


SCORPION

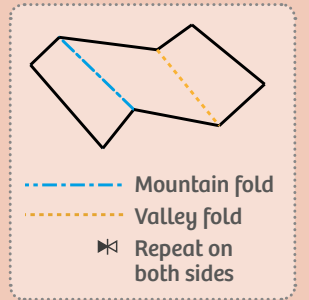
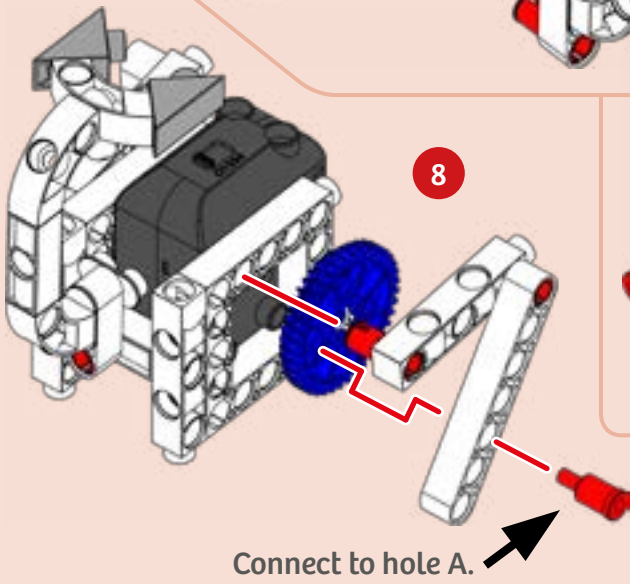
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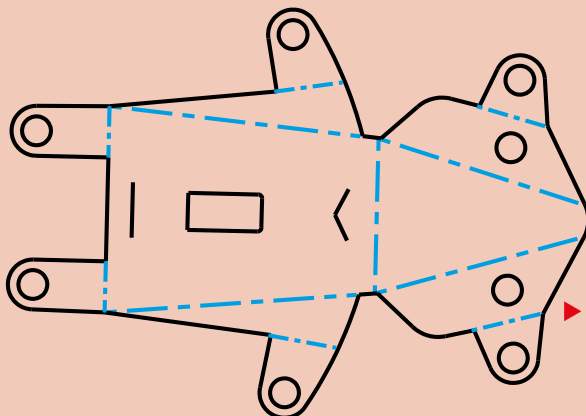
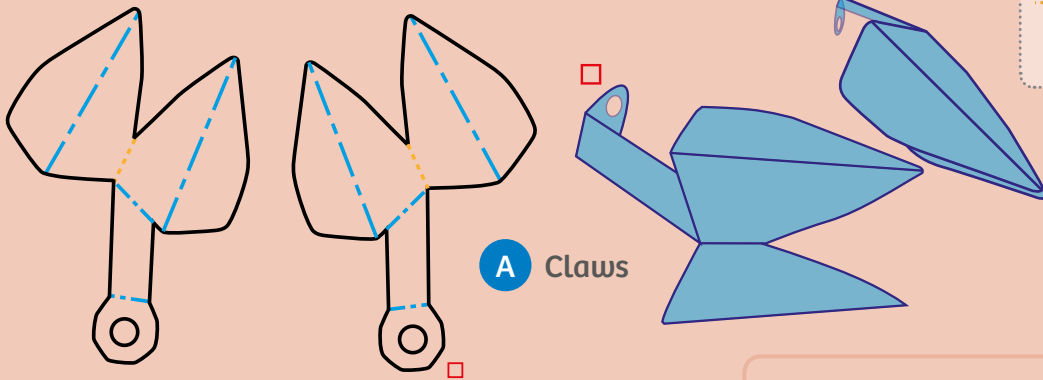
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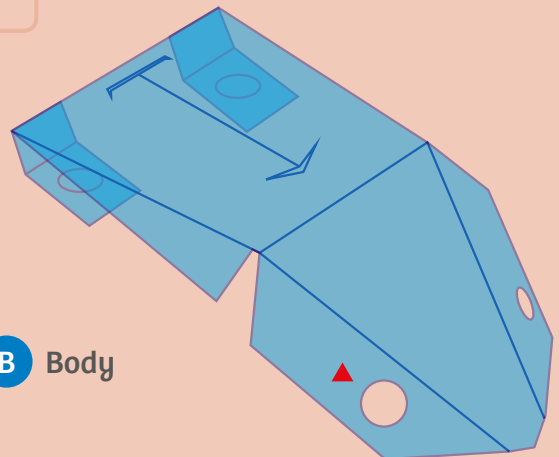
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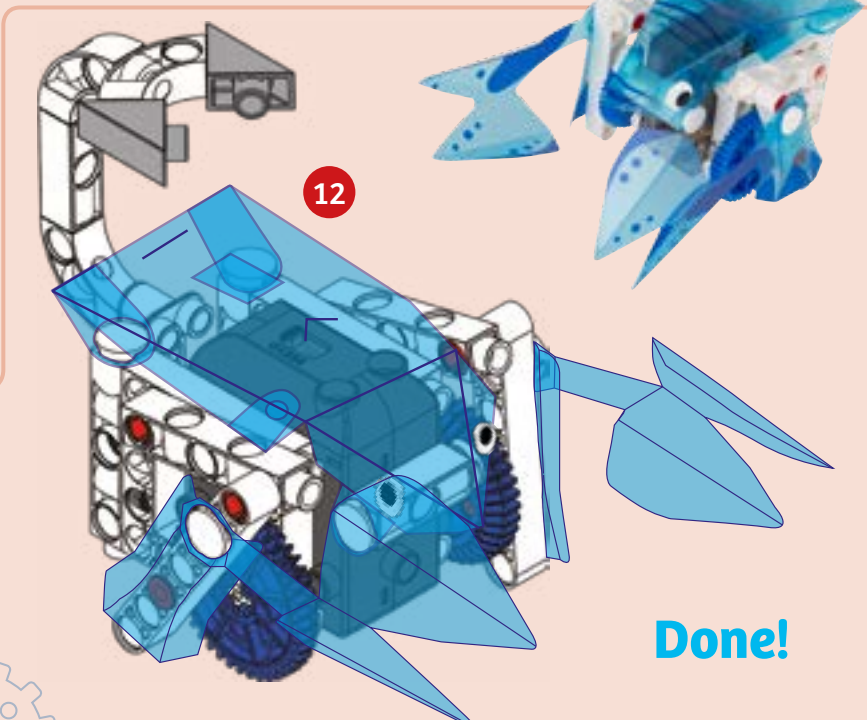
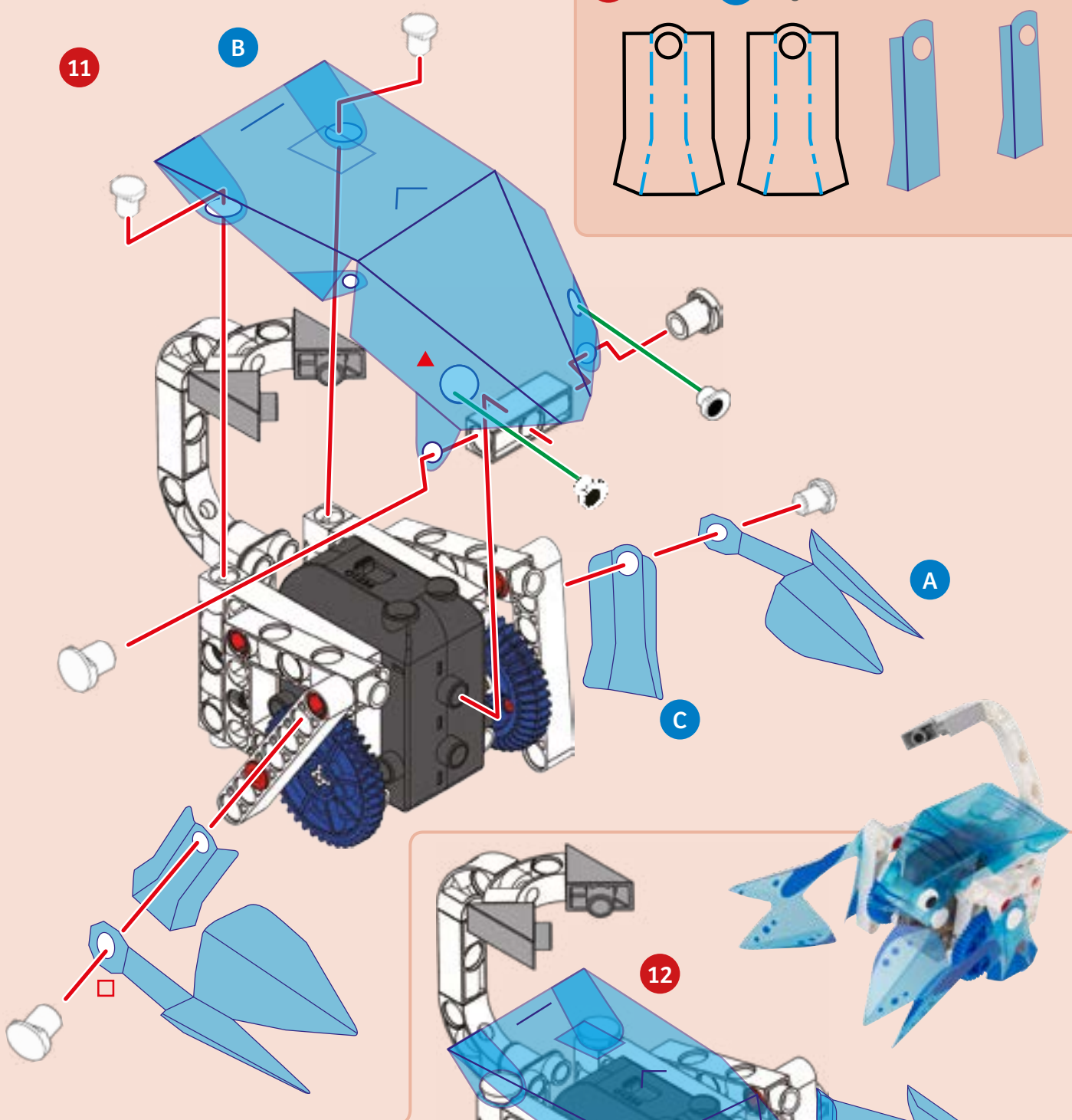
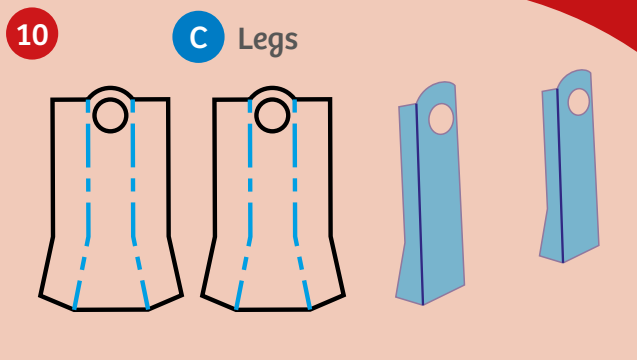


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B Body

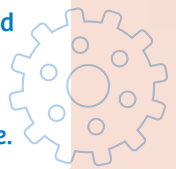




Done!

WHAT'S HAPPENING?

The scorpion model crawls on two legs — instead of eight like a real scorpion. As it shifts its weight from side to side, the claws and tail wiggle around giving the model the appearance of being alive, even though it is a machine.



Now try the experiments on the back cover!

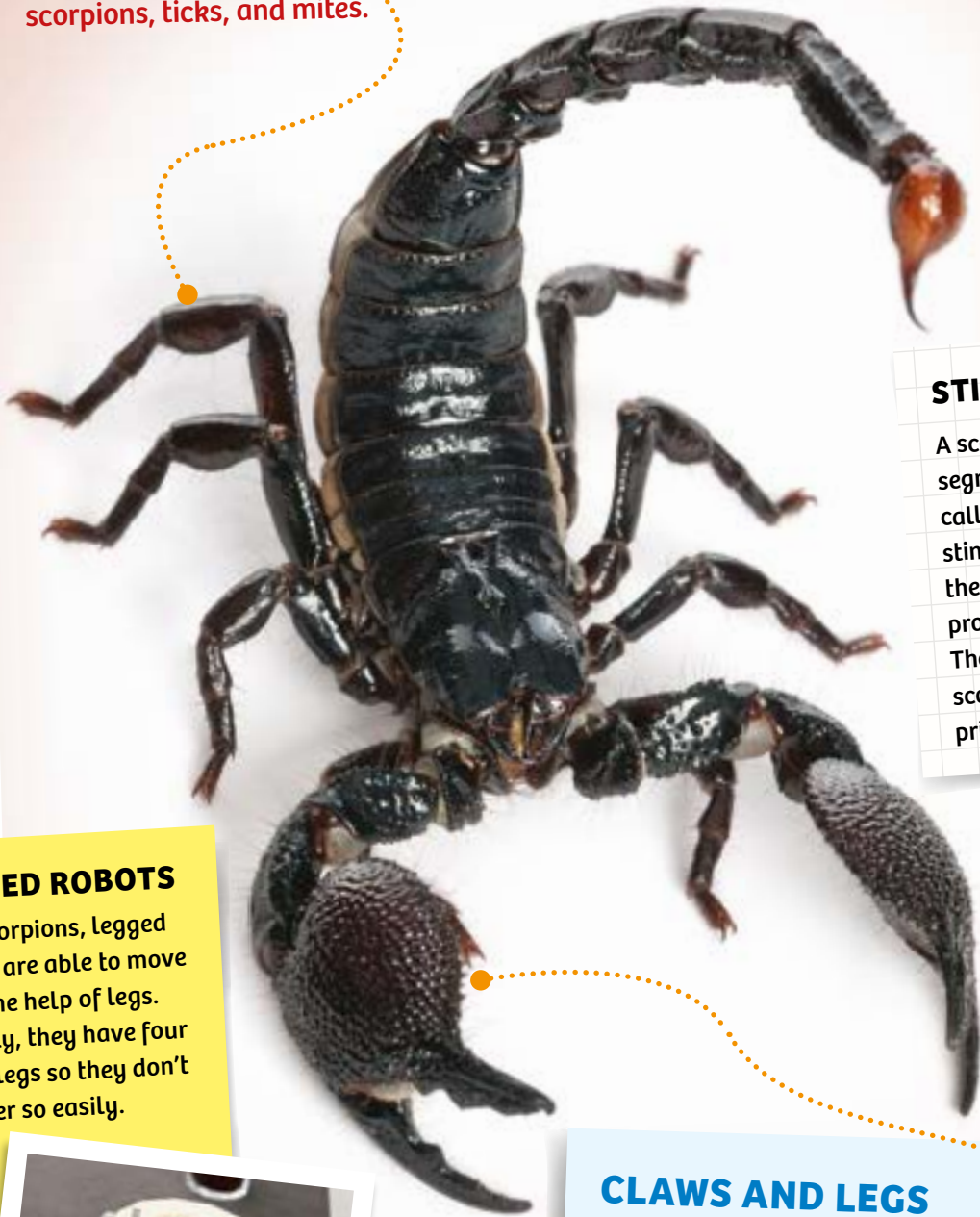


CHECK IT OUT



Deadly Arachnids

Scorpions are **arachnids**, a huge class of joint-legged invertebrates called arthropods. All arachnids have **eight legs**. There are over 100,000 species of arachnids including spiders, scorpions, ticks, and mites.



STINGER

A scorpion's tail has six segments. The last segment, called the **telson**, has a stinging barb on it. Inside, there are glands that produce poisonous venom. The venom paralyzes the scorpion's prey which primarily consists of insects.

LEGGED ROBOTS

Like scorpions, legged robots are able to move with the help of legs. Usually, they have four or six legs so they don't tip over so easily.



CLAWS AND LEGS

Like crabs, scorpions have **chelae, or claws**, on their foremost appendages. They have four pairs of symmetrical legs and a **carapace**— a large upper exoskeletal shell. Like crabs, they have an exoskeleton on the outside and muscles, nerves and tissue on the inside. Scorpions can move very quickly to surprise, attack, and paralyze their prey.



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Experiments for Your Remote-Control Animal Models

After building each model, set up your own experiments to answer the following questions below. Or come up with your own questions to answer!

- »» How long does it take for the animal model to move a distance of one meter? Which animal model is the fastest and which is the slowest?
- »» How far can the animal model move in 20 seconds?
- »» Can the animal model walk uphill? Set up an inclined board and see if the animal model can walk up the board. Try the board at different degrees of steepness. Likewise, can the animal model walk downhill?
- »» How does the incline affect the speed of the animal?
- »» What happens when you play with the orientation of the shaft pins in the medium gear wheels? Instead of putting the shaft pins in the correct holes as indicated in the instructions, try putting them in the other holes. How does it affect the animal model's movement? Do the models still work?
- »» How much weight can your animal model pull? Tie a string to the animal model that can drag along the surface behind the model. Tie various weights, such as metal hardware (nuts, bolts, etc) to the string. Is the model powerful enough to pull the weights forward?
- »» How does the material of the surface on which the animal model is moving affect its movement? For example, for the walking animals, do they walk better on carpeting, hardwood floor, asphalt, or a lawn?
- »» For the models that travel along a string: How does the degree to which the string is taut affect the animal model's movement? Can it move along a loose string as well as it can move along a taut string?
- »» Does the IR remote control work the same in a very dark room as in a normally lit room? What about in a very bright room?
- »» Can you control the model from another room, through walls, with the IR remote control? How about through a window?
- »» Can you imagine completely different types of bizarre mechanical animals that you could make out of the building pieces in this kit? Can you combine the models and plastic animal skins in new and funny ways to make creative hybrid animals? How about a flying rabbit, a penguin with the head of a T. rex, or an elephant with claws?

After you are finished with your experiments, draw conclusions from the observed results of your experiments.