Name: _____

mystery science

Fourth Grade

Student Booklet
With Anchor Layer

mystery science

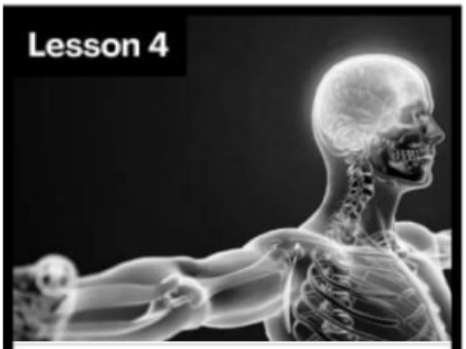
Human Body, Vision, & The Brain

4th Grade • NGSS • Unit Worksheets

Why do your biceps bulge?

What do people who are blind see?

How can some animals see in the dark?



How does your brain control your body?

I am also curious about...

Owl System Model

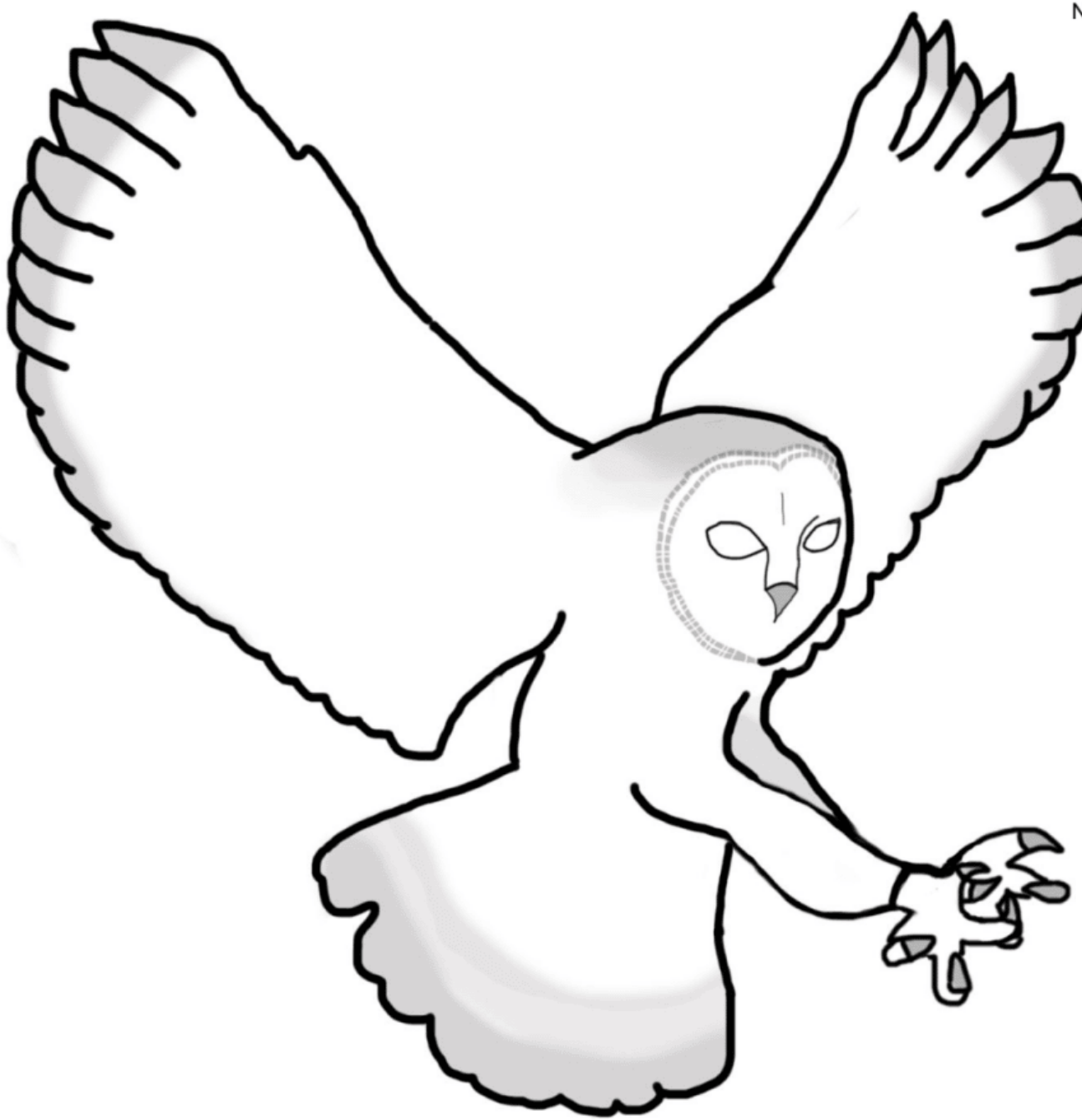
Name: _____

Directions:

1) Label the owl's external body parts that work together to hunt.

2) Draw in any internal body parts that you think help the owl hunt.

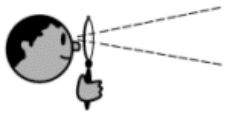
3) Use symbols and captions to explain how you think the body parts work together.



See-Think-Wonder Chart

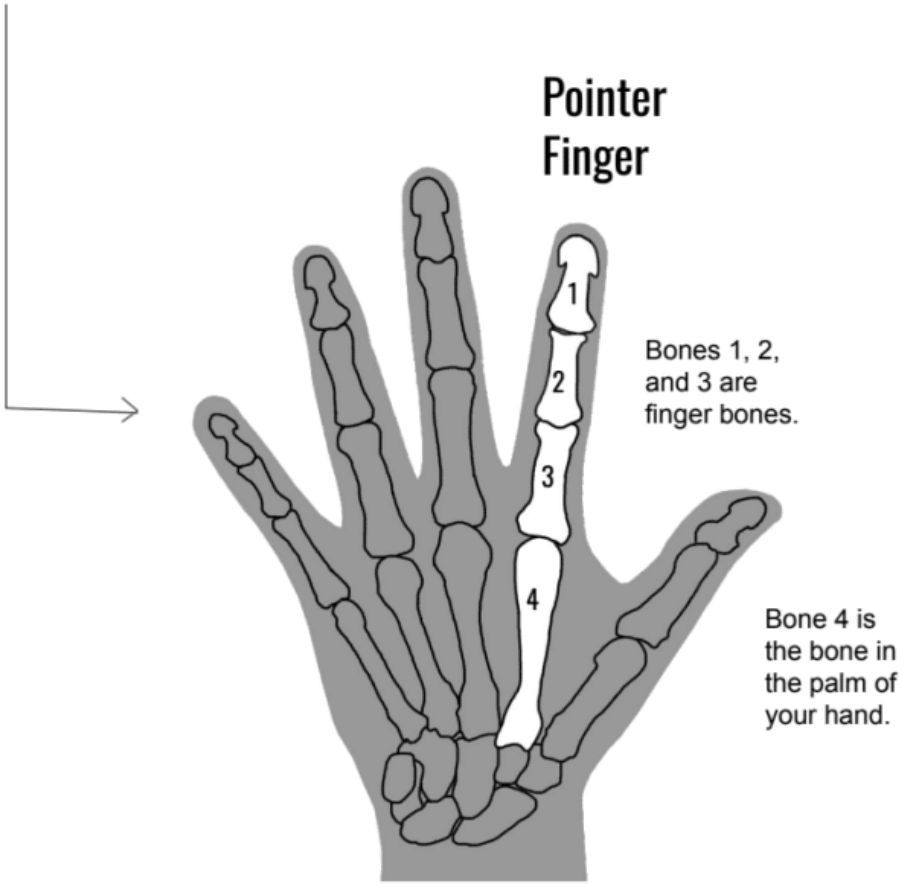
Name: _____

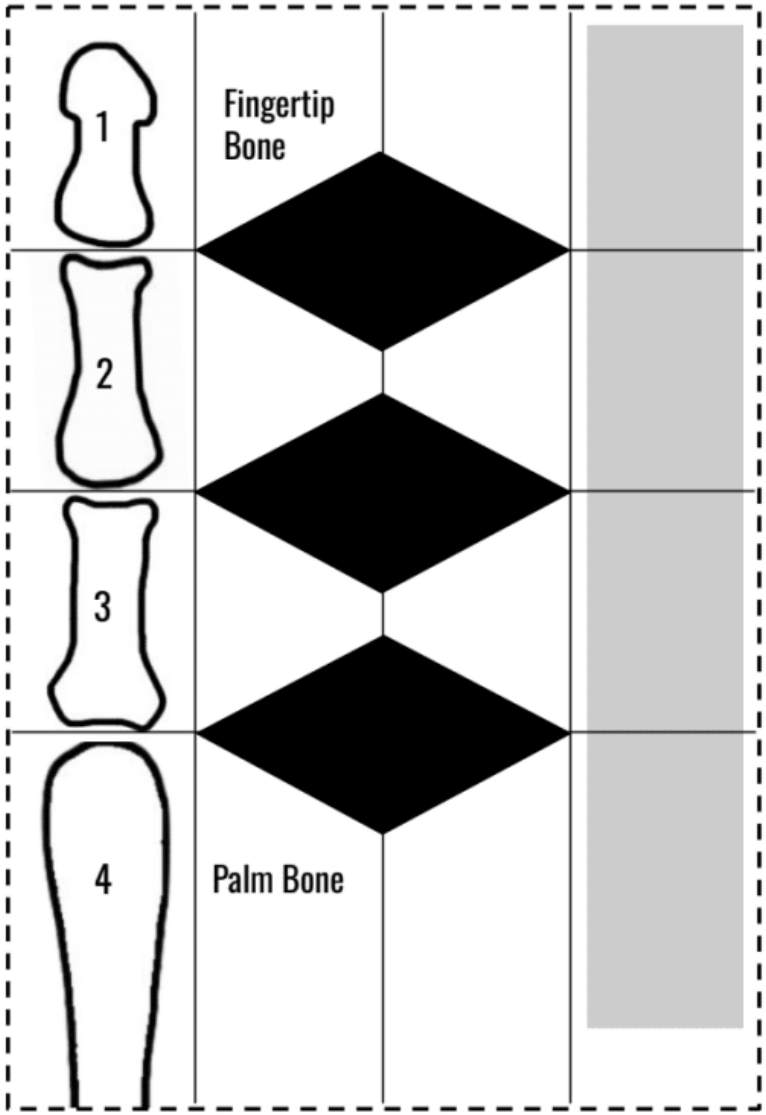
mystery science

See	Think	Wonder
What did you observe? 	How can you explain what is happening? 	What questions do you have? 

Robot Finger Template

Look at the drawing of the bones in your hand (below). You're going to be making a "robot" version of your pointer finger.



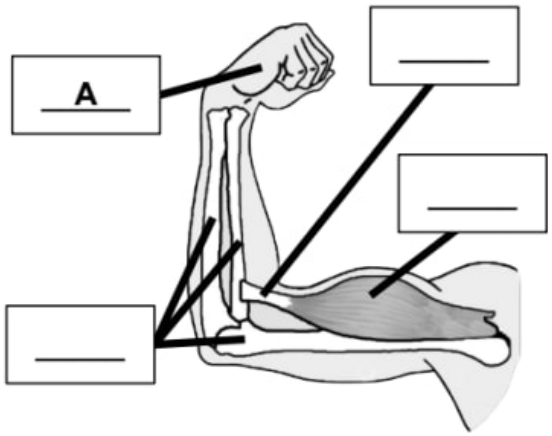


Name: _____

Date: _____

Lesson Assessment

1. The drawing to the right shows a person's arm and hand. The drawing shows **bones**, a **tendon**, and a **muscle** inside the arm. Each part of the arm and hand has a specific function.



Look at the list of functions below. Then, match each function with the part that does that function. The first one, A, is done for you.

A: Grabs hold of things

B: Provides shape and structure to the arm

C: Moves bones

D: Attaches muscles to bones

2. Each part of the arm has a function, and all of the parts work together as a system. If any part of the system is missing, then the system won't work the same way anymore. Read the following statements about what might happen when a part of the system is removed. Circle all that are correct. There may be more than one correct answer.

a. If the muscle is missing, the arm won't have any structure at all anymore because muscles are what give arms their structure.
b. If the tendon is removed, the arm will still have its shape. But the muscle won't be able to move the arm anymore because the muscle won't be attached to the bone.
c. If the bones are removed, the arm won't have any structure at all anymore because bones are what give arms their structure.
d. If the muscle and tendon are removed, the arm will still have *most* of its shape. But it won't be able to move at all, because muscles make arms move.

3. Arms and hands can help people pick up and eat food. That means that arms and hands can help people survive. On the lines below, explain how the **muscles**, **bones**, **and tendons** inside of an arm work together as a system to help people eat, which helps them to survive.

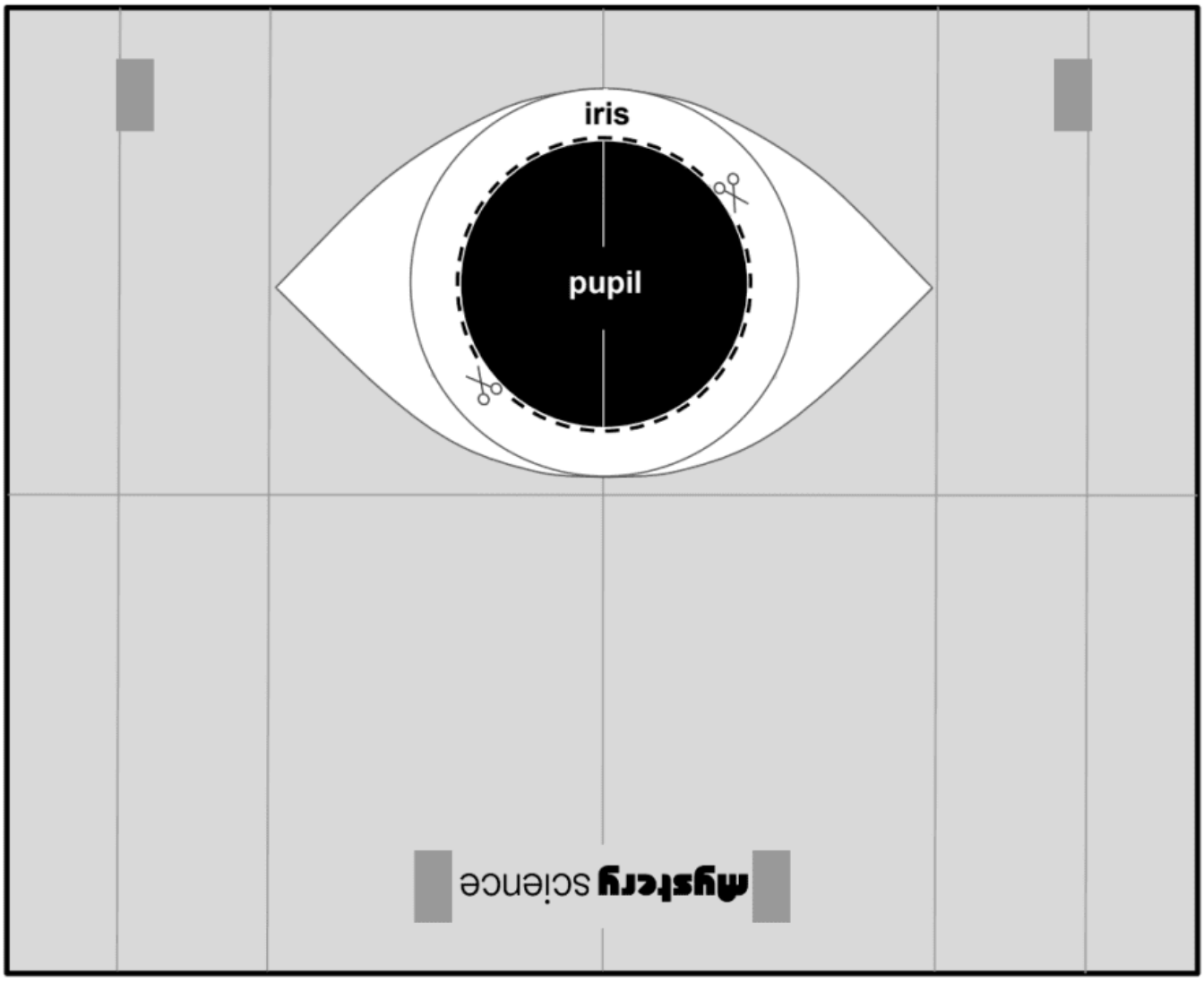
_____

_____

_____

_____

Front of the Eye

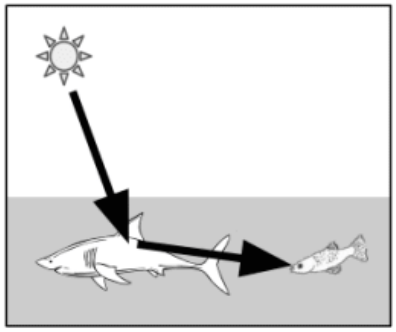


Name: _____

Date: _____

Lesson Assessment

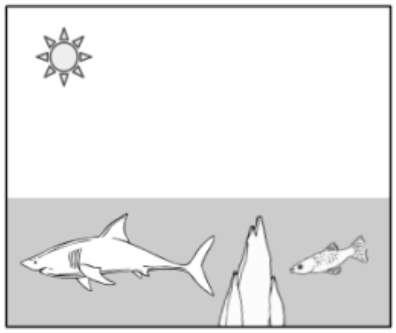
1. Fish eyes work like human eyes do: light has to go into a fish's eyes for it to be able to see. In the drawing to the right, a fish is looking at a shark. The arrows show the path that the light follows. Study this drawing. Then, answer the following question.



Which of the following models best describes the path of the light?

a. fish's eye → shark → Sun
b. shark → fish's eye → Sun
c. Sun → shark → fish's eye
d. Sun → fish's eye → shark

2. In the drawing to the right, the fish is now hiding behind a few rocks. The fish can't see the shark anymore.



Add arrows to the drawing to show why the fish <u>can't</u> see the shark anymore. The arrows will show the path of the light. The drawing in question 1 might help you figure out how to draw the arrows of light.

3. Look back at your drawing in question 2. You drew the path of the light. On the lines below, explain how that drawing shows why the fish can't see the shark.

_____

_____

_____

4. Light has to go into a fish's eyes for it to see a shark. When light goes into the fish's eyes, the eyes send a signal to the fish's brain. The fish's brain can then control its fins so it can choose where to swim. On the lines below, explain how the fish needs its eyes, brain, and fins to work together to help the fish survive when it sees a shark.

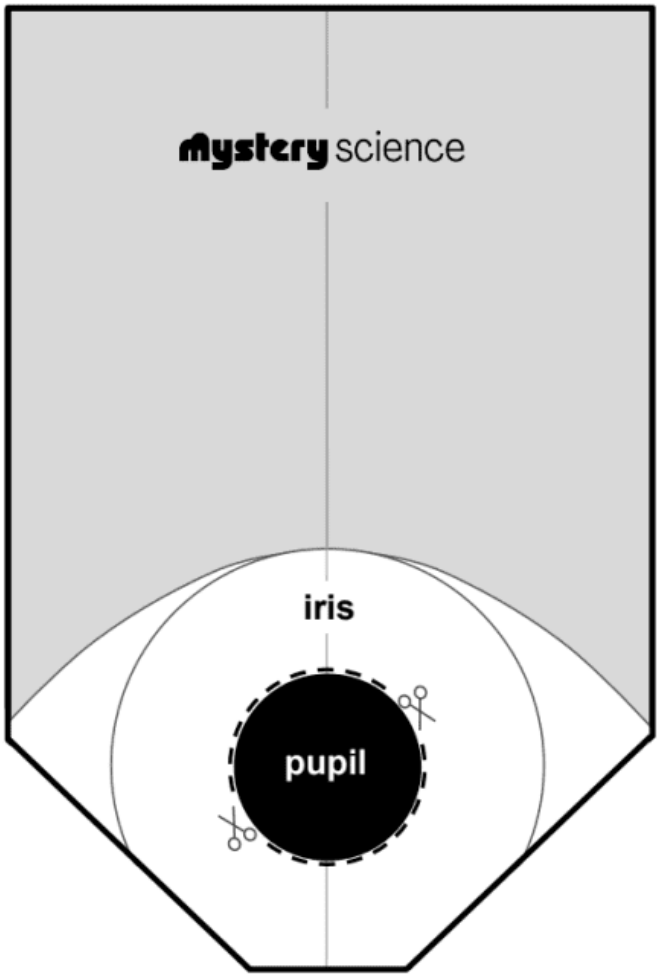
_____

_____

_____

_____

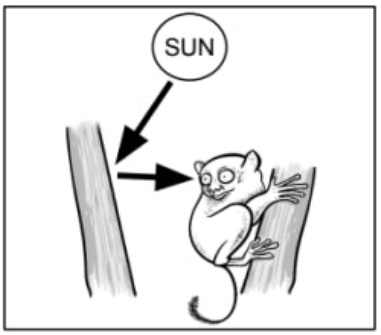
Pupil card



Name: _____

Date: _____

Lesson Assessment



1. The drawing to the right shows a small animal called a tarsier. Tarsiers are similar to monkeys. This tarsier is looking at another branch. The arrows show the path of light that allows the tarsier to see that branch.

Which of the following models best describes the path of the light?

a. tarsier's eye sends out light → light reflects off branch → light goes to Sun
b. light reflects off branch → light goes into tarsier's eye → light goes to Sun
c. light travels from Sun → light reflects off branch → light goes into tarsier's eye
d. light travels from Sun → light goes into tarsier's eye → light reflects off branch

2. The following drawings show a tarsier. One drawing is from the day, and one is from the night. Compare each drawing. Then, circle the drawing that you think is of the tarsier at **night**.

3. Tarsiers are most active at night. That's when they move around and hunt for insects to eat. Look back at the drawing you chose in question 2. Explain **two** things: why the tarsier's eyes look the way that they do, **and** how that might help the tarsier find insects to eat at night.

_____

_____

_____

4. Tarsiers climb around at night, looking and listening for insects to eat. To do those things, they need **hands**, **feet, eyes, and ears**. On the lines below, explain how those four body parts work together as a system to help the tarsier climb **and** find food when it is completely dark out.

_____

_____

_____

_____

_____

_____

Name: _____

THINK FAST!

Record your results

Trial	Number on ruler
Trial #1	_____ cm
Trial #2	_____ cm
Trial #3	_____ cm

RULE #1

Droppers must hold the ruler so the 1 cm mark is between the Catchers' fingers.

RULE #2

Catchers can't move until they *see* the ruler drop.

Circle the picture by your fastest reaction time

Picture	Distance on ruler	Time it takes for the ruler to fall this far	That's the same time it takes...
	0 - 5 cm	less than 100 milliseconds	...for a ROCKET SHIP to travel a ½ mile
	6 - 10 cm	100 to 140 milliseconds	...for a BLINK of an eye
	11 - 15 cm	140 to 180 milliseconds	...for a LIGHTNING BOLT to travel 10 miles
	16 - 20 cm	180 to 200 milliseconds	...for a CHEETAH to run 20 feet
	21 - 25 cm	200 to 230 milliseconds	...for a SNAP of the fingers
	26 -30 cm	230 to 250 milliseconds	...for a RACE CAR to drive 85 feet

1000 milliseconds = 1 second

Name: _____

Date: _____

Lesson Assessment

1. The drawing below shows a fox hunting a squirrel. The drawing also shows each animal's brain. Each animal has other body parts that help that animal see, smell, and hear.

On the drawing below, draw lines that connect the brain of each animal to **each** body part that **sees**, **smells**, and **hears**. The lines represent nerves that connect the brain with those body parts. The line that connects the brain to the body part that sees is already drawn for you.

2. Each animal also has nerves that connect the **brain** to front and back **limbs**. In the drawings above, add lines that represent the nerves that connect the brain to the limbs.

3. Imagine that the fox **sees** the squirrel and **chases** after it. Which of the following models best describes how the fox's body parts do that?

a. eyes see squirrel → legs run after squirrel
b. nose sees squirrel → nose sends a message along the nerves to the brain → brain sends messages down the nerves to make the legs run
c. brain sees squirrel → brain sends a message along the nerves to the eyes → eyes send a message along the nerves to make the legs run
d. eyes see squirrel → eyes send a message along nerves to the brain → the brain decides to chase → brain sends a message along the nerves to make the legs run

4. Imagine that the squirrel **smells** the fox behind it and decides to run away. How does it do this? Write out how the squirrel's body parts work together as a system to smell the fox and then run away. You can use arrows in your answer, like the choices back in question 3.

_____

_____

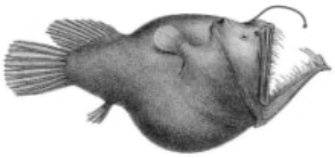
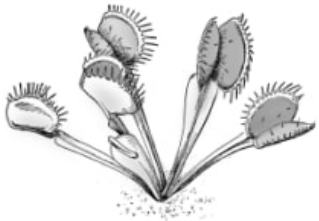
_____

_____

Final Project — System Model

Choose One

Name: _____

Animal or Plant		How do the parts of the animal or plant work together as a system when...
Anglerfish		...the anglerfish finds and catches fish in the deep, dark ocean?
Bat		...the bat hunts for insects while flying at top speed in total darkness?
Great White Shark		...the shark searches the ocean waters for seals to eat?
Venus Flytrap		...the Venus flytrap captures a fly and sucks up its nutrients?
Rattlesnake		...the rattlesnake stalks a mouse in the darkness by sensing its heat?

Final Project — System Model

Research Notes

Name: _____

Directions: Take notes from your reading in the spaces below. List each body part you read about, and then write any information you gather about that body part. If there are any other body parts that you already know the animal or plant uses, or there are any other body parts that you learn about while researching somewhere else, add them.

You don't need to fill in every row. The spaces are there if you need them.

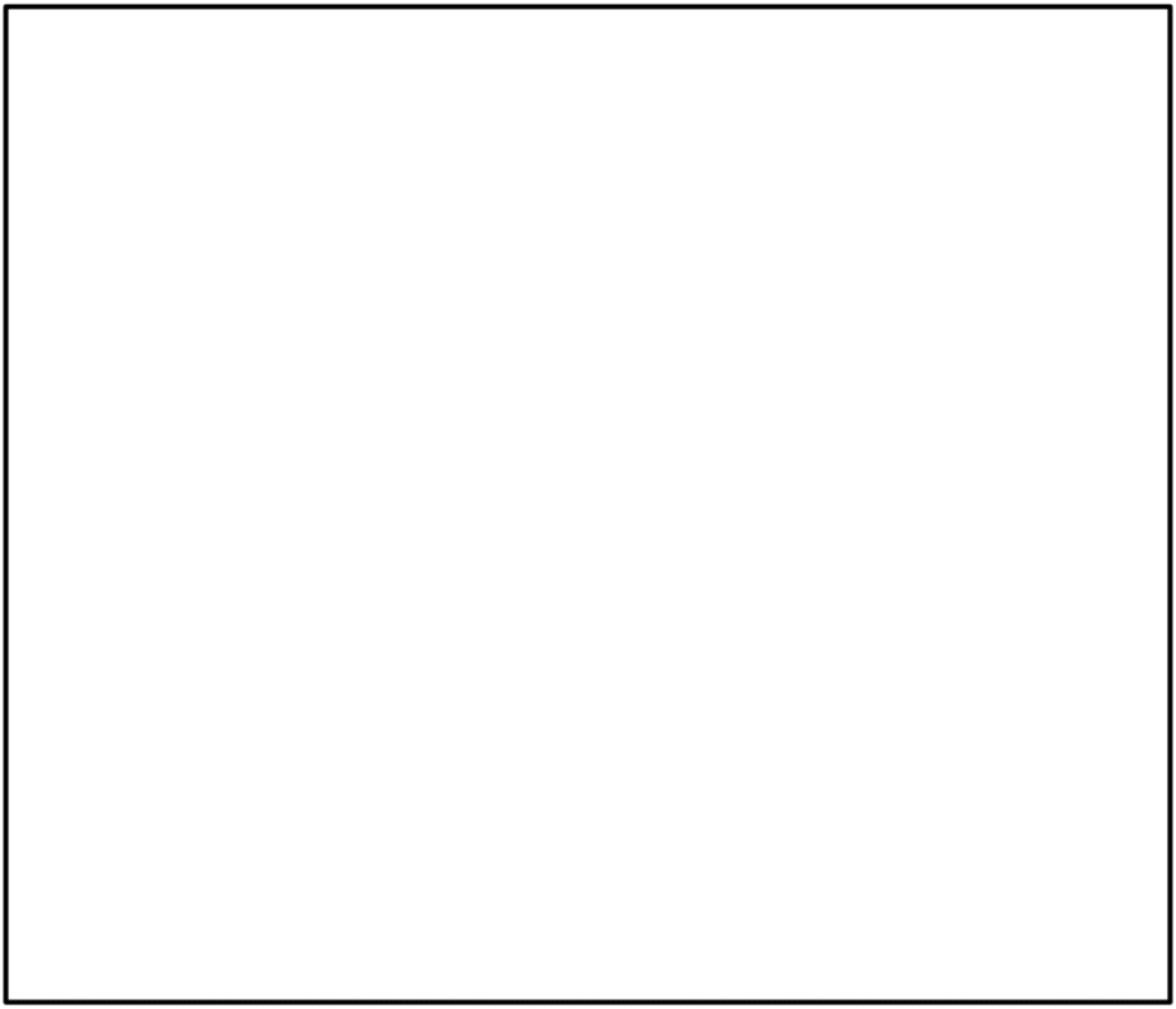
The animal or plant I am researching is: _____

Body Part	Write what you learn about this body part. Some possible things to write down are: What does it do? Where is it located on the plant or animal? What other body parts does it work with? What other interesting things did you learn?

Final Project — System Model

Name: _____

Directions: Draw a model of your animal or plant that shows how it uses its parts as a system to sense and respond to something in its environment. Add symbols and captions to explain your model, just as you did with the owl model.



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_____

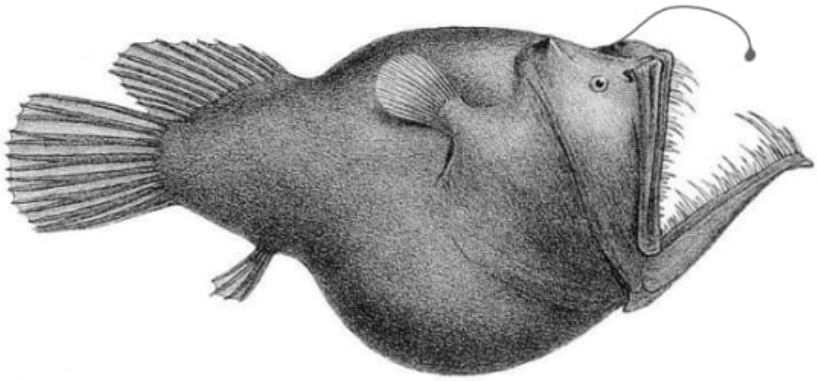
_____

_____

Name _____

Angler Fish

The angler fish lives more than a mile below the ocean's surface. It's dark down there, even in the middle of the day.



Length: 5 inches (13 cm)

The angler fish has a long spine sticking out of the top of its head. This spine acts like a fishing pole. The end of the spine glows in the dark. The light attracts hungry fish, just like the bait at the end of a fishing line.

The angler fish's eyes aren't much use in the darkness. But this fish can always sense when other fish are swimming nearby. Fibers that grow from the angler fish's skin move when the water moves. When other fish swim nearby, they send ripples through the water. Those ripples make the fibers move. The fibers send signals to the angler fish's brain. Those signals let the angler fish know that another fish is near.

The angler fish waits until a hungry fish touches its glowing bait. That touch sends a signal to the muscles that control the angler fish's mouth. The enormous mouth snaps shut with the hungry fish inside. Instead of getting a snack, that hungry fish becomes a snack.

Name _____

Great White Shark

The great white shark lives in cool ocean waters close to the land all over the world. Young sharks eat fish. Older sharks prefer seals, sea lions, and even small whales.

Length: 15 feet (4.5 m)

The great white shark's amazing sense of smell helps it find its prey. If cookies are baking, you can smell them from the other end of the house. The shark doesn't care about cookies. But it can smell other animals from far away, because a great white shark can smell one drop of blood in ten billion drops of water!

The great white shark also has great eyesight. It can see well in daytime and in darkness.

The shark's ears are small holes right near the shark's eyes. They may not look like much. But those ears can detect tiny vibrations in the water. A swimming seal makes ripples that the shark can hear and feel from 800 feet away. That's twice the length of a football field!

When the shark is hunting, all its senses work together. The brain gets messages from the nose ("Hey, smells like seals are nearby!"), the ears ("Those vibrations sound like a swimming seal!"), and the eyes ("That dark shape at the water's surface looks like a seal!")

The brain tells the shark's muscles to sweep its tail from side to side. The tail pushes the shark through the water. The eyes tell the brain when to signal the jaw muscles. The jaws bite, and 300 sharp teeth grab that seal. Before the brain tells the shark to swallow, the shark's taste sensors signal the brain. Does that bite taste like a seal? If it tastes right, the shark swallows. Dinner time!

Name _____

Bat

This insect-eating bat sleeps during the day, hanging upside down in a cave or a tree. At night, the bat hunts for flying insects, snatching them out of the air.

The bat uses sound to find the insects it eats. As the bat flies, it makes loud clicking sounds through its open mouth.

The clicking sounds bounce off everything around the bat. Some bounce back to the bat's ears. Those are called echoes.

When you shout in a tunnel, you hear echoes. That's because your voice bounces off the tunnel walls into your ears.

Echoes of the bat's clicks enter the animal's ears. The ears send signals to the brain. Using those signals, the brain makes a picture of the world. The bat "sees" using echoes. This way of "seeing" with sound is called "echolocation."

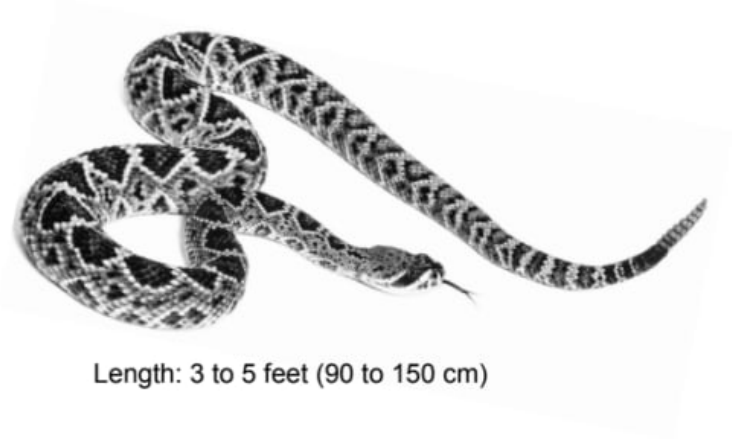
When the brain detects echoes from flying insects like moths and mosquitoes, that's good news! The bat's brain sends signals to the animal's wing muscles. The wing muscles make the wings flap. The bat flies to catch the insect. At just the right moment, the brain signals the bat's mouth to snatch the insect from the air.

The bat's brain not only has to listen for the echoes of the sounds the bat makes. It also has to know the difference between echoes of the bat's clicks — and the sounds of other bats hunting nearby. It's not easy being a bat!

Name _____

Rattlesnake

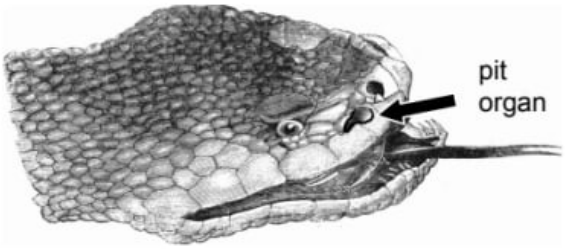
This rattlesnake lives in deserts, forests, and meadows. It eats mice, rats, and other small animals.



Length: 3 to 5 feet (90 to 150 cm)

Like all snakes, the rattlesnake uses its sense of smell to find food. It does not smell with a nose like you do. Snakes smell with their tongues. When a snake flicks out its tongue, it is smelling the air.

During the day, the rattlesnake can see its prey. In the dark, it uses a special sense to find its prey. In front of each eye, the snake has a small hole called a “pit organ.” The pit organs sense heat. You can see a pit organ marked with an arrow in the picture to the right.



Close up

If you held a mouse in your hand, you could feel that the mouse is warm. The rattlesnake does not have to touch the mouse to sense its warmth. With its pit organs, the snake can sense the mouse’s heat from three feet (one meter) away!

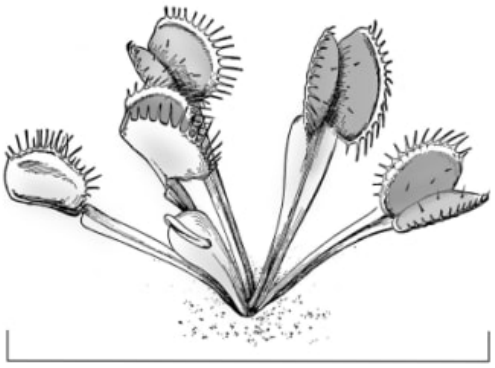
When the rattlesnake spots a mouse in the dark, the pit organs send signals to the brain. Using those signals, the brain makes a picture of the world. That picture shows where the mouse is.

The brain sends signals to the snake’s muscles. In the time it takes you to blink, the snake’s muscles propel its body forward. The jaws close on the mouse. Goodbye, mouse! Hello, lunch!

Name _____

Venus Flytrap

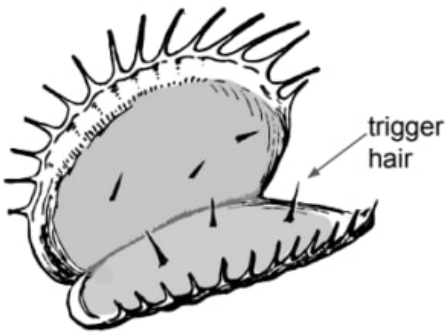
The Venus Flytrap is a strange plant that catches flies to eat.



Length: 6 inches (15 cm)

The trap of the flytrap is made of two special leaves. These leaves look like a pair of jaws. These leaves ooze sweet juice called nectar. When a fly lands in the trap to sip the nectar, the trap slams shut, catching the fly. Juices from the plant turn the fly's body into a liquid. The plant soaks up that liquid, then opens the trap again, ready for its next victim.

The Venus flytrap is a plant, not an animal. It doesn't have nerves to carry signals. It doesn't have a brain. It doesn't have muscles. So how can it catch flies?



Close-up

To answer that question, scientists studied the leaves that form the trap. Each leaf has tiny hairs, called trigger hairs. When a fly bumps two trigger hairs, an electrical signal travels through the leaf. That springs the trap!

Maybe you're wondering how this plant can move without muscles. Plants droop when they are low on water and then straighten up when you water them. Something like that is going on inside the flytrap. The electrical signal in the leaf causes water to shift around. Some parts of the leaf droop and others stiffen. That springs the trap, and it's flies for lunch!

Why does the flytrap catch flies? Like other plants, the flytrap makes the food it needs using carbon dioxide from the air and energy from sunlight, plus water and nutrients. The nutrients are like vitamins for the plant. Most plants get their nutrients from the soil. Where the flytrap plant grows, the soil is low on nutrients. Luckily, flies are packed with nutrients. And so tasty, too! Yum!

Human Body, Vision, & The Brain

Name: _____

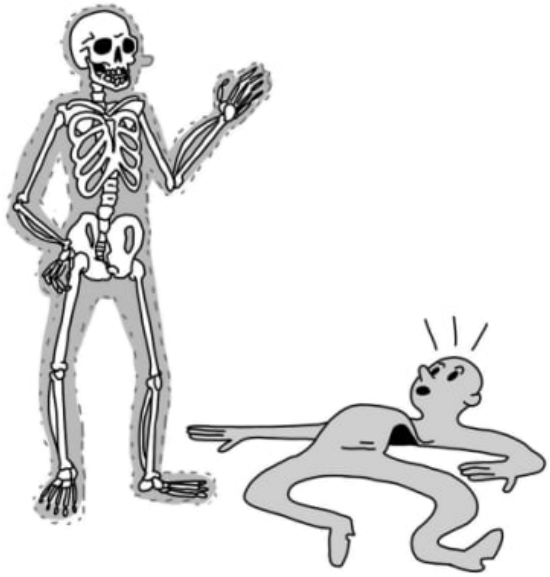
Date: _____

Unit Assessment

1. Shelly has an idea for a new superhero that she's calling "The Muscle." Shelly tells you:

"The Muscle doesn't have a skeletal system - they have no bones! Because they don't have any bones to get in the way, The Muscle is super strong. When The Muscle meets supervillains, they always win the battle and survive."

Do you agree with Shelly that The Muscle would be a strong superhero? Do you think they would survive a battle with a villain? Why or why not? Support your argument with reasoning.



_____

_____

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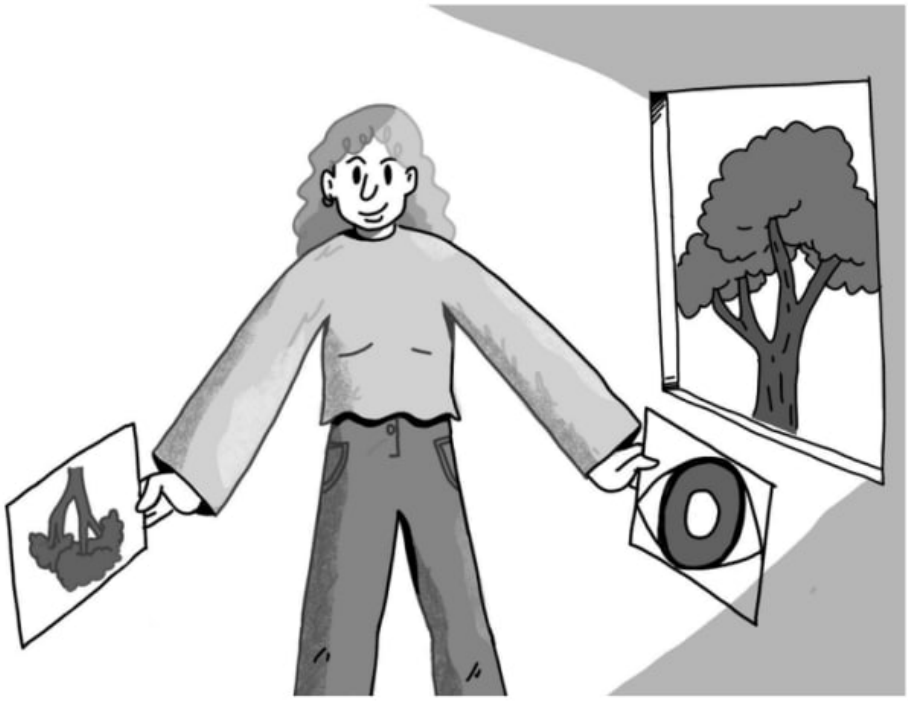
_____

2. Jacob wants to make an eye model. He has a magnifying lens, a flashlight, a piece of paper, and a donut.

How should Jacob arrange these objects to make an eye model? In a real eye, light travels through the corneal lens, goes through the pupil, and reaches the retina at the back of the eye.

a. Flashlight, Donut, Paper, Magnifying Lens
b. Flashlight, Magnifying Lens, Donut, Paper
c. Flashlight, Paper, Donut, Magnifying Lens
d. Flashlight, Paper, Magnifying Lens, Donut

3. In the picture below, Shira is using a model of an eye to get an image of a tree on the model retina. Draw arrows that show the path that light takes to get the image onto the model retina.



4. In the above picture, if the tree image on the model retina is blurry and fuzzy, what is something that Shira could do to make the image crisp and clear?

a. Shira can remove the cornea lens from the eye model.
b. Shira can darken the room to let less light through.
c. Shira can change the distance between the retina and the cornea lens.
d. Shira can change the color of the iris.

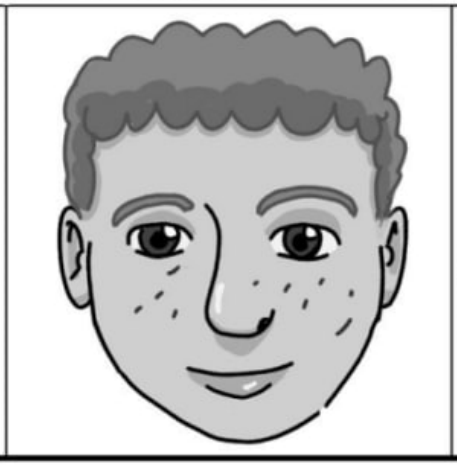
5. If Shira tries to use her eye model at 10:00 pm at night, what do you think will happen?

a. The eye model will work just as well as it did during the day.
b. The eye model won't work as well because there won't be as much light to illuminate objects.
c. The eye model won't work as well because the pupil is too big and lets too much light through.

CAT

OWL

RACCOON

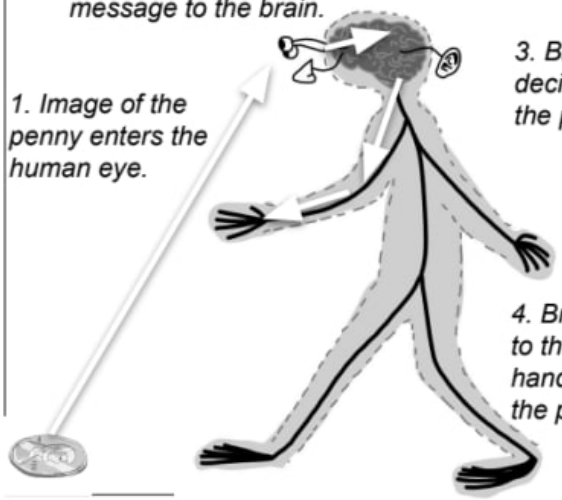


BLUE JAY

HUMAN

COYOTE

6. Darius closely examines the eyes of different animals. He notices that cats, owls, and raccoons have much larger pupils than blue jays, humans, and coyotes. Darius makes the claim that the reason cats, owls, and raccoons have larger pupils is because they are predators. He says that predators have large pupils because the main function of pupils is to help animals search for prey and survive. Do you agree with Darius? Why or why not? Support your answer with evidence.



The image on the left shows a model of a human. The arrows and words show each step of what happens when a human sees a penny on the ground. Use this example to help you answer Question #7 and #8.

7. In the picture above, there is a sleeping cat and a model of a human that shows the brain and connected nerves (the nervous system). Add arrows and words to the model to describe each step of what happens to the human when the cat starts purring.

8. In the picture above, there is a sleeping cat and a model of a mouse that shows the brain and connected nerves (the nervous system). Add arrows and words to the model to describe each step of what happens to the mouse when the cat starts purring.

9. Circle TRUE or FALSE for each of the three sentences below.

TRUE FALSE Humans and mice both receive the information “purring cat” through their senses.

TRUE FALSE Humans and mice both process the information of “purring cat” in their brain.

TRUE FALSE Humans and mice both respond to the information of “purring cat” in the same way.

mystery science

Animal & Plant Adaptations

4th Grade • NGSS • Unit Worksheets

Lesson 1

Why do some sea creatures look so strange?

Lesson 2

Why would a sea turtle eat a plastic bag?

Lesson 3

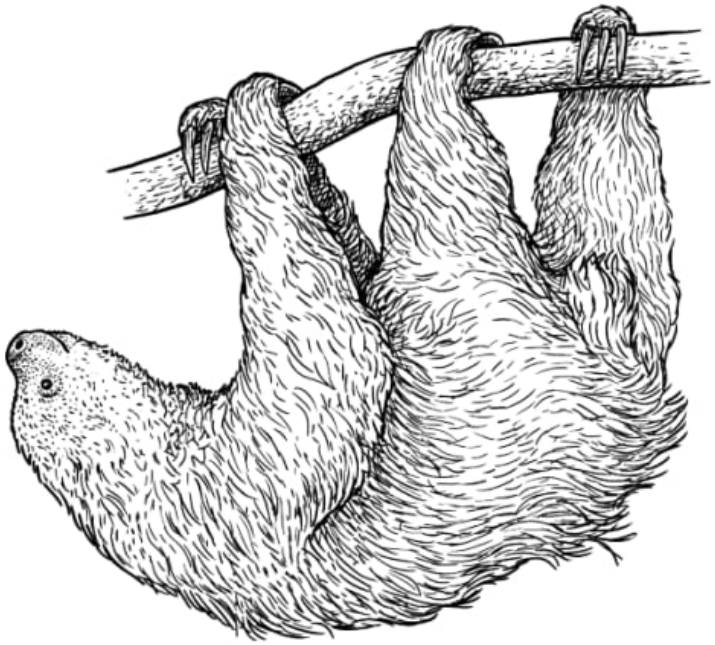
Why don't the same trees grow everywhere?

I am also curious about...

Survival of the Slowest

Name: _____

Add labels or drawings to show ways that sloths are able to survive.



Write your ideas for ways that sloths are able to survive.

_____

_____

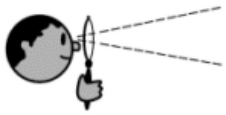
_____

_____

See-Think-Wonder Chart

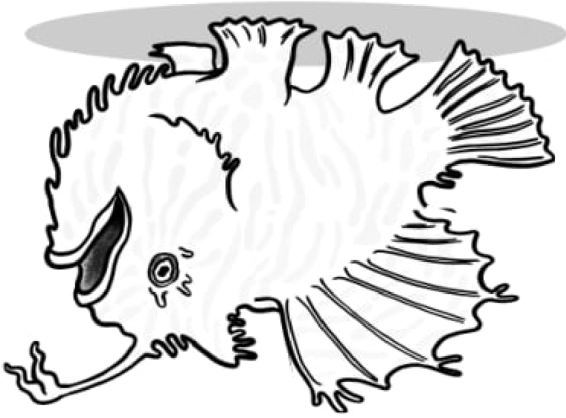
Name: _____

mystery science

See	Think	Wonder
What did you observe? 	How can you explain what is happening? 	What questions do you have? 

Name: ____________________

Survival of the Frogfish



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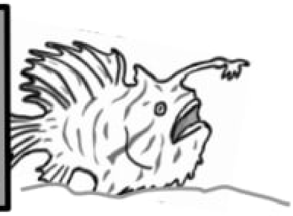
Why do some sea creatures look so strange?

6. **"Frogfish have structures that work together to help them survive."**

Do you agree or disagree with this? Why? Provide evidence to support your reasoning.

Getting close to prey

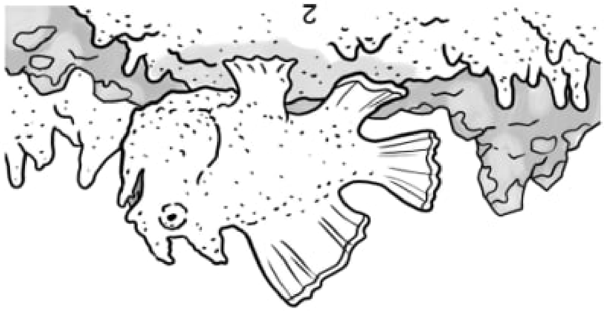


1. How does the frogfish get close to its prey?

1A. What did it do (behaviors)?

1B. What parts of its body (structures) helped it?

B

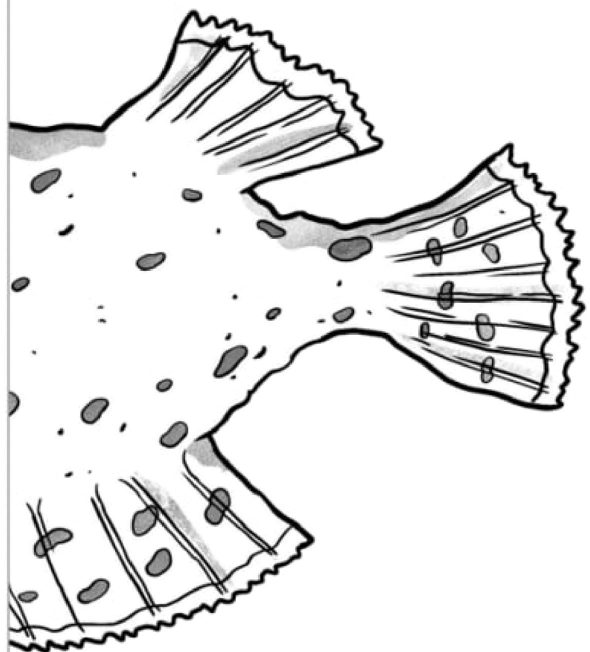


2. How does it get close to its prey?

2A. What did it do (behaviors)?

2B. What parts of its body (structures) helped it?

5. Circle and label all the structures (at least 3) that work together to help a frogfish catch and eat food.



A

Eating Prey

3. How does the frogfish eat its prey?

3A. What did it do (behaviors)?

3B. What parts of its body (structures) helped it?

4. How can the frogfish eat such large prey?

Name: _____

Date: _____

Lesson Assessment

A stingray is a kind of animal that lives in the sea. A stingray has a very flat body. Its eyes are on the top of its body while its mouth is on the bottom. It also has a long tail with a spine on it. It uses gills to breathe underwater.

Hammerhead sharks are predators of stingrays. Stingrays protect themselves from predators by hiding in the sand. Examine the image on the left carefully and answer the questions based on evidence that you see in this image.

1. Circle **True** or **False** for each statement.

True False The structure of the stingray's eyes on the top of its body help it to see predators even when it is buried in the sand.

True False The structure of the stingray's mouth on the bottom of its body helps it to scare away predators.

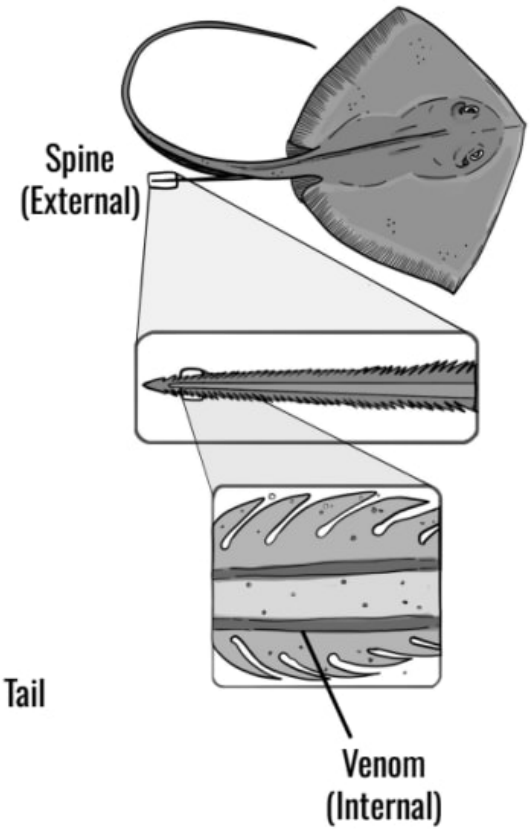
True False The structure of the stingray's flattened body helps it bury in the sand and camouflage so it can hide from predators.

2. Using the image above as evidence, which of the following **structures** work together as a **system** to help the stingray hide from predators? Circle all that apply.

Eyes Mouth Gills Flat Body Long Tail Sharp Spine

Stingrays don't spend all their time buried in the sand. They also need to swim around so they can find food, which helps them grow and survive. Scientists have observed that when a stingray sees a shark, it will whip its long tail around and hit a shark with its sharp spine.

The long tail and sharp spine of the stingray are *external* structures. Scientists have also found structures inside the stingray spine that produce venom. These are *internal* structures. When a stingray hits a shark with its spine, they also inject venom into the shark, which is painful for the shark. Both the spine and the venom help the stingray escape from hammerhead sharks.



3. Using information from the text above as evidence, which of the following work together as a **system** to help the stingray escape from predators? Circle all that apply.

Eyes	Mouth	Gills	Flat Body	Long Tail
Sharp Spine	Broad Fins	Venom	Stomach	

4. Stingrays don't use their venom to capture the small fish they eat. But the venom **DOES** actually help stingrays get the food they need in another way.

Claim: Stingray venom works together as a system with other structures and behaviors of the stingray to help them get the food they need to survive.

Support this claim with evidence and reasoning from the text and images you've seen.

Raccoon Memory Cards

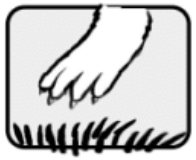
Page 1

mystery science

Why would a sea turtle eat a plastic bag?

Touch Memory

I remember touching things that felt **fuzzy.** They were food!



mystery science

Touch Memory

I remember touching things that felt **crinkly**. They had food on the inside!

mystery science

Touch Memory

I remember touching some **round** things that felt **hard.** They were food!

mystery science

Touch Memory

I remember touching some **round** things that felt **hard.** They were not food.

mystery science

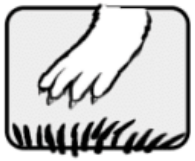
Touch Memory

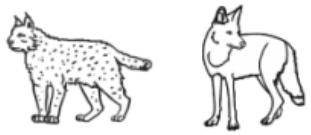
I remember touching things that felt **crinkly**. They were not food.

mystery science

Touch Memory

I remember touching things that felt **fuzzy.** They tried to eat me. Stay away!

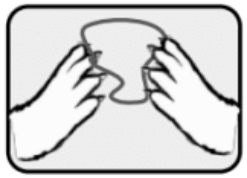


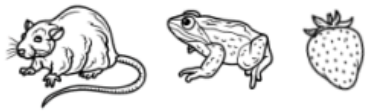


mystery science

Touch Memory

I remember touching things that felt **squishy**. They were food!

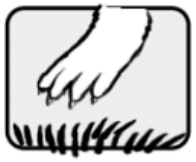




mystery science

Touch Memory

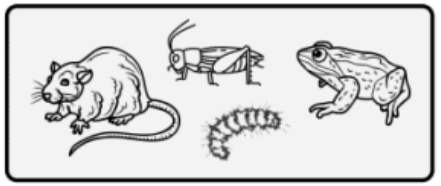
I remember touching things that felt **fuzzy**. They were not food.



mystery science

Sight Memory

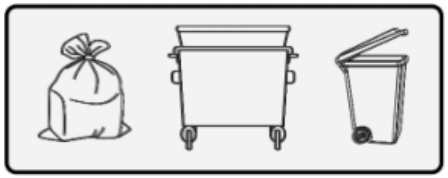
I remember seeing things that were **smaller** than me and **moved**. They were food!



mystery science

Sight Memory

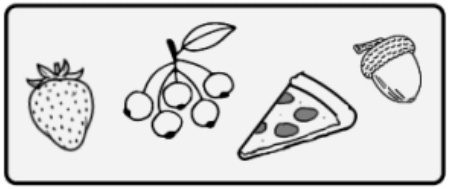
I remember seeing things that were **bigger** than me and **did not move**. They were not food. BUT, they had food inside of them!



mystery science

Sight Memory

I remember seeing things that were **smaller** than me and **did not move**. They were food!



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Raccoon Memory Cards

Page 2

mystery science

Why would a sea turtle eat a plastic bag?

Sight Memory

I remember seeing things that were **bigger** than me and **moved**. They chased me. Stay away from them!

mystery science

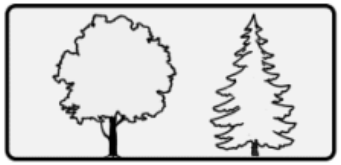
Sight Memory

I remember seeing things that were **smaller** than me and **did not move**. They were not food.

mystery science

Sight Memory

I remember seeing things that were **bigger** than me and **did not move.** They were not food but had food on the ground nearby.



mystery science

Smell Memory

I remember sniffing things that smelled **sweet** *(like the smell of fruit or corn)*. They were food!

smell lines

mystery science

Smell Memory

I remember sniffing things that smelled **nutty** *(like the smell of peanuts or acorns)*. They were food!

smell lines

mystery science

Smell Memory

I remember sniffing things that smelled **meaty** *(like the smell of burgers or cooked chicken)*. They were food!

smell lines

mystery science

Smell Memory

I remember sniffing **large** things that smelled **musky** *(like a bobcat or coyote)*. They tried to eat me. Stay away!

smell lines

mystery science

Smell Memory

I remember sniffing things that smelled **rotten** *(like the smell of trash or rotting meat)*. I learned from watching mom to not eat things that smell like that.

smell lines

mystery science

Smell Memory

I remember sniffing **small** things that smelled **musky** *(like a rabbit or a mouse)*. They were food!

smell lines

mystery science

Smell Memory

I remember sniffing things that smelled **spicy** *(like the smell of pepper or onions)*. I don't like that smell. Do not eat!

smell lines

mystery science

Smell Memory

I remember sniffing things that smelled **earthy** *(like a caterpillar or grasshopper)*. They were food!

smell lines

mystery science

Raccoon Brain

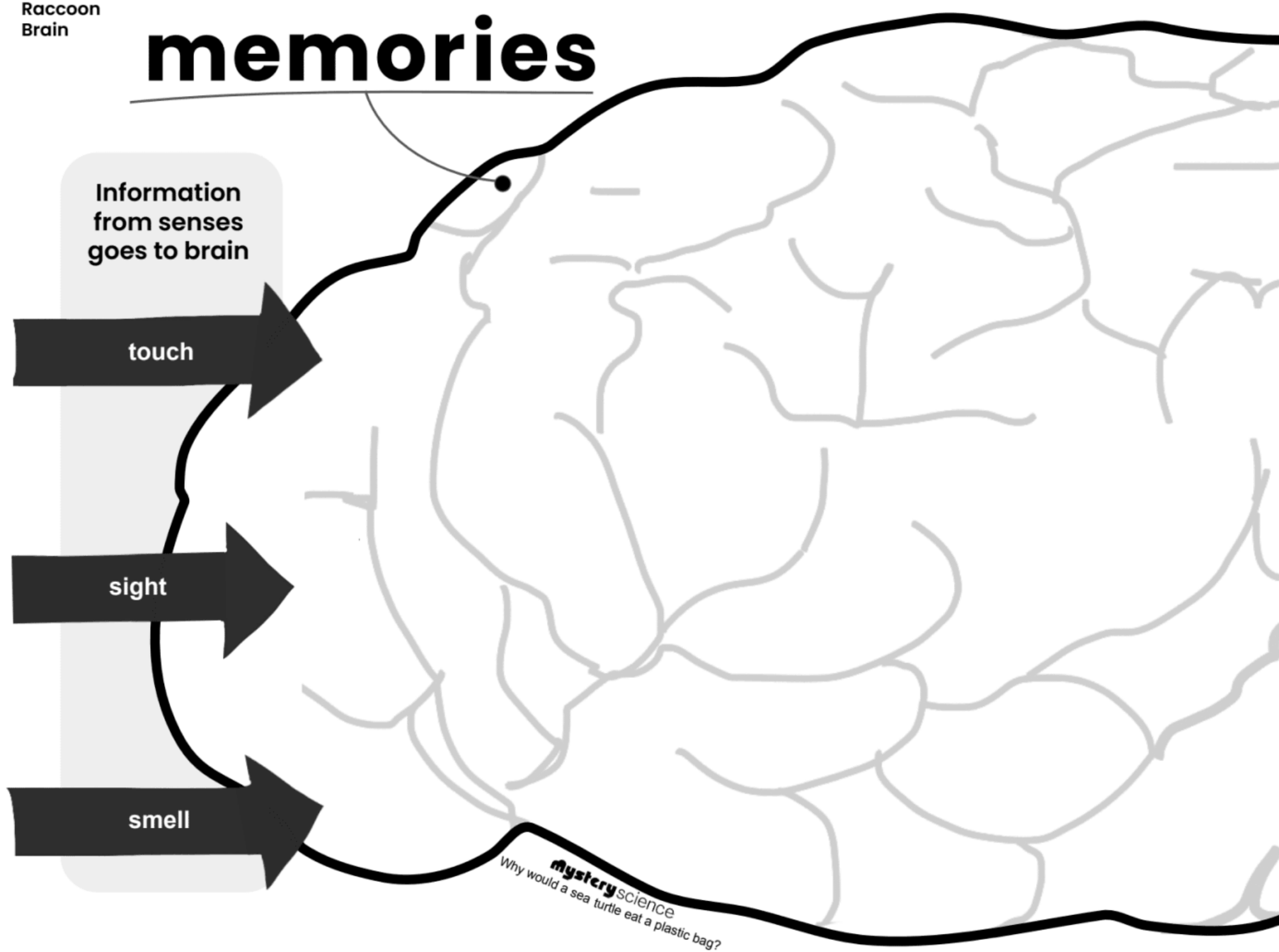
memories

Information from senses goes to brain

touch

sight

smell



Your senses + your memories help you make decisions

Touch Memories

Smell Memories

Sight Memories

Raccoon Behavior

Mystery Item 1

What will you do?

1. Based on the information you gathered with your racoon senses and your raccoon memories, what do you think Mystery Item 1 is?

_____

2. As a raccoon, what do you think you should do? Why?

_____

_____

_____

Name: _____

Raccoon Behavior

Mystery Item 2

What will you do?

3. Based on the information you gathered with your racoon senses and your raccoon memories, what do you think Mystery Item 2 is?

_____

4. As a raccoon, what do you think you should do? Why?

_____

_____

_____

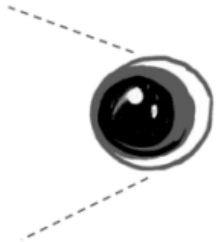
Raccoon Senses

Mystery Item **1**

touch

information goes to the brain

sight



information goes to the brain

smell

information goes to the brain

Name: _____

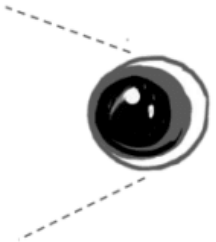
Raccoon Senses

Mystery Item **2**

touch

information goes to the brain

sight



information goes to the brain

smell

information goes to the brain

Why would a sea turtle eat a plastic bag?

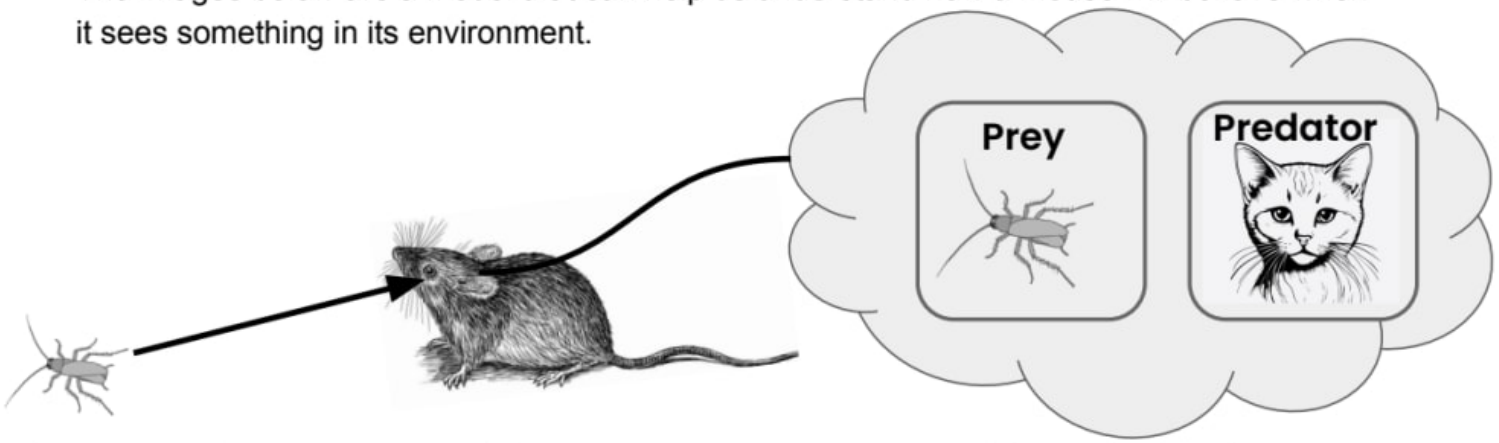
mystery science

Name: _____

Date: _____

Lesson Assessment

The images below are a model that can help us understand how a mouse will behave when it sees something in its environment.



Cockroach Mouse Mouse's Brain

1. What do the images of the prey and predator represent in this model?
   a. The inside of the mouse's stomach
   b. The mouse's sight memories
   c. The mouse's imagination

2. The model shows the mouse seeing a cockroach in its environment. Using information from the model, what do you predict the mouse's behavior will be? Why?
   a. The mouse will move away from the cockroach because the mouse has memories that this is a predator.
   b. The mouse will move away from the cockroach because the mouse has memories that this is prey.
   c. The mouse will move toward the cockroach because the mouse has memories that this is a predator.
   d. The mouse will move toward the cockroach because the mouse has memories that this is prey.

3. Different animals, including humans, have different instincts and memories. What would YOU do if you saw the same cockroach that the mouse sees? What memories do you have that might cause YOUR behavior?

_____

_____

_____

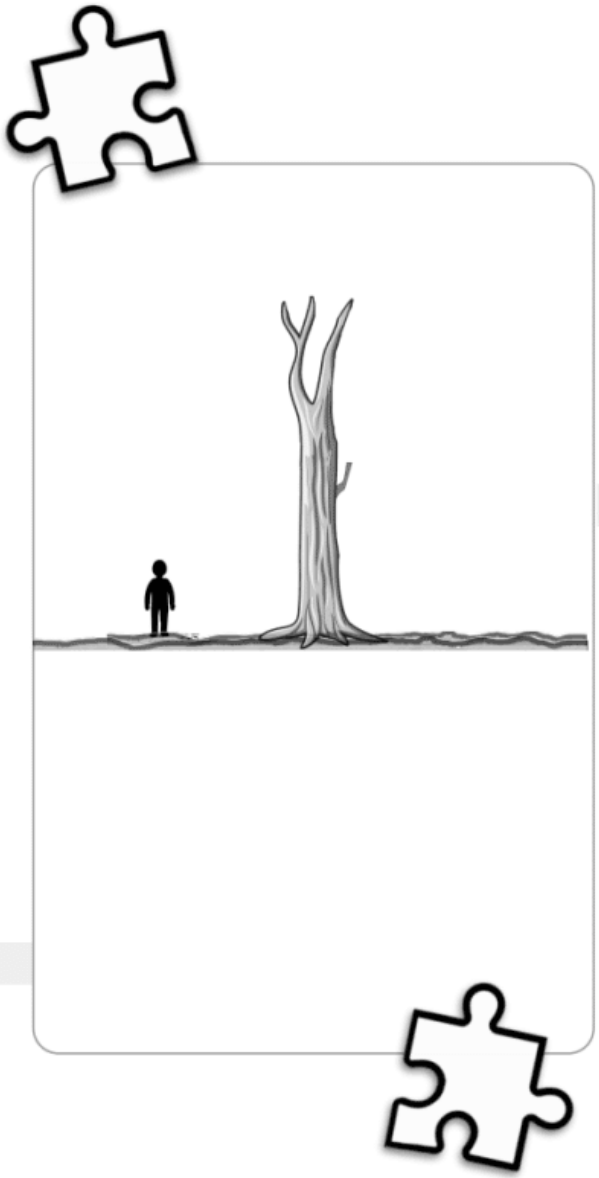
_____

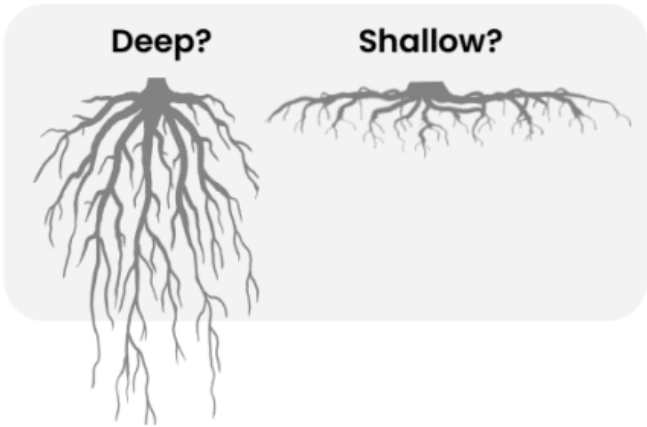
Solve the Puzzle

Name: _____

Roots Puzzle

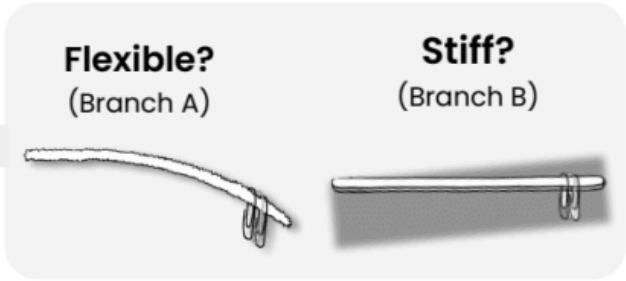
1. Which type of roots would help a tree survive in Anchortown Forest? Deep or shallow? Use evidence to support your claim below. Then, draw those kind of roots under the tree.



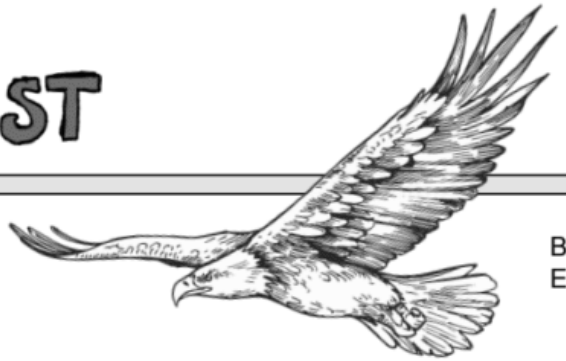


Branches Puzzle

2. Which type of branches would help a tree survive in Anchortown Forest? Flexible or stiff? Use evidence to support your claim below. Then, draw those kinds of branches on the tree trunk.



ANCHORTOWN FOREST



Bald Eagle

What's the weather like?

The table below shows the months of the year that it snows vs. rains in the forest:

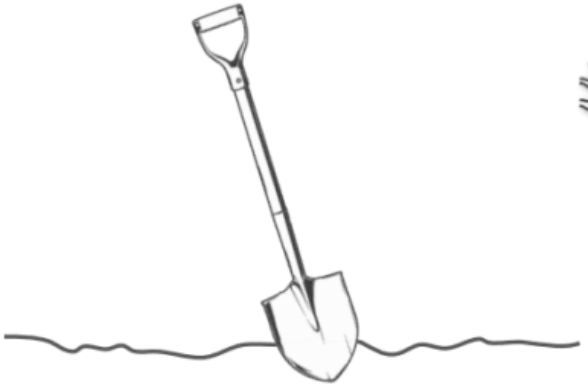
Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.
❄ Heavy Snow	❄ Heavy Snow	❄ Heavy Snow	❄ Snow	❄ Snow	💧 Rain	💧 Rain	💧 Rain	❄ Snow	❄ Heavy Snow	❄ Heavy Snow	❄ Heavy Snow

Keep an eye out for these Anchortown animals!

The forest is home to more than just trees! Here are a few of the animals that play an important role in the forest's health.

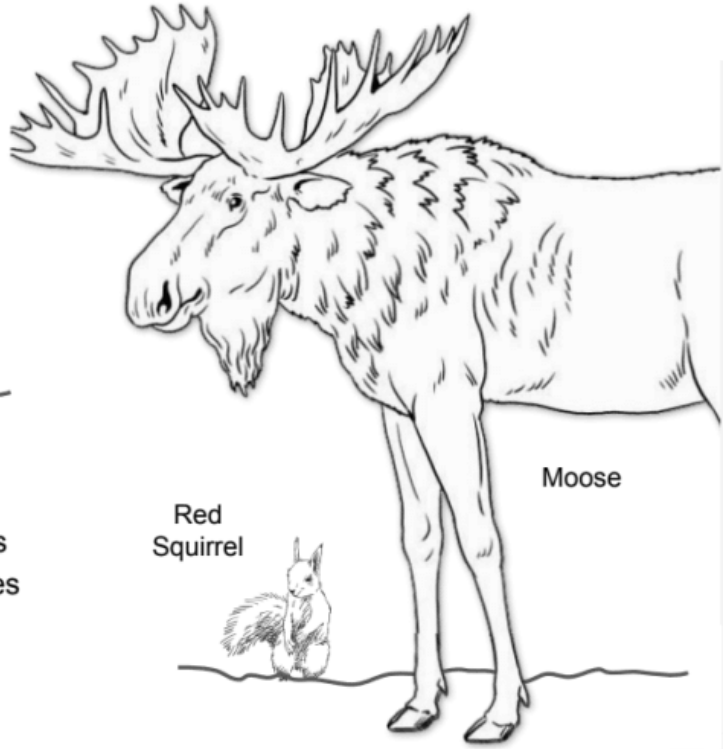
Local Scientist Interview

"When there is a heavy snowstorm in Anchortown Forest, it's not exactly a fun snow day. Instead of sledding and building snowmen, locals must stay inside. These blizzards bring lots of heavy, icy snow that can cause damage. Thankfully, The tree branches here bend a lot. The snow slides right off if they get too heavy! But I can't say the same for the power lines. Since they don't bend much, they often break under the weight of all the snow. This means no power for the nearby towns until they get fixed. It's a real problem!"



What's underground?

It's so cold in Anchortown Forest that there's only about a meter of soil for plants and trees to sink their roots into. Underneath that is a thick layer of frozen ground. The soil also doesn't have many nutrients. It's a harsh environment for trees to grow in!



Moose

Red Squirrel

Evidence

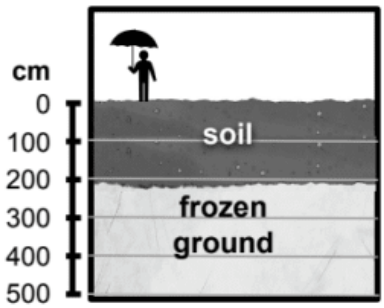
Name: _____

mystery science

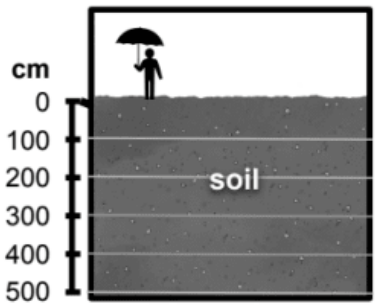
Why don't the same trees grow everywhere?

Underground: Roots

Environment A



Environment B



1a. What do you notice happens when it rains here?

_____

_____

1b. What do you notice happens when it rains here?

_____

_____

2a. Which roots are most likely to help a tree survive in Environment A? (Circle all that apply:)

A B C D E F

Why? _____

_____

_____

_____

2b. Which roots are most likely to help a tree survive in Environment B? (Circle all that apply:)

A B C D E F

Why? _____

_____

_____

_____

Branch Experiments

3. What happened to each branch after you added 1 paper clip to them?

Branch A (pipe cleaner): _____

Branch B (wooden stick): _____

4. What happened to each branch after you added more paper clips to them?

Branch A: _____

_____

Branch B: _____

_____

5. What happened to each branch when even more weight was added to them?

Branch A: _____

Branch B: _____

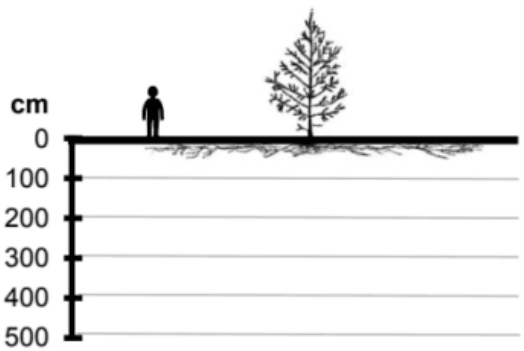
Roots

Name: _____

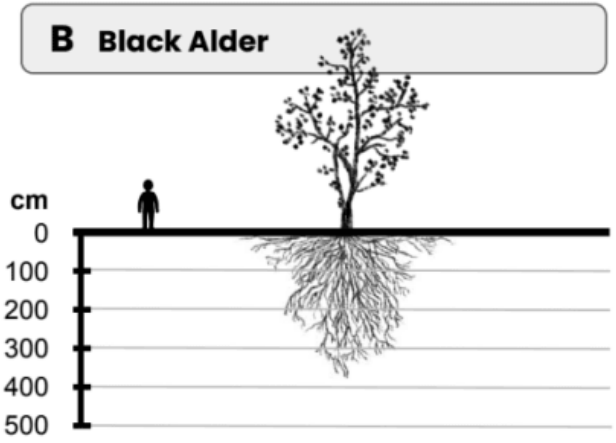
Find similarities and differences between these roots.
Write and draw your observations on the pictures.

cm = centimeters

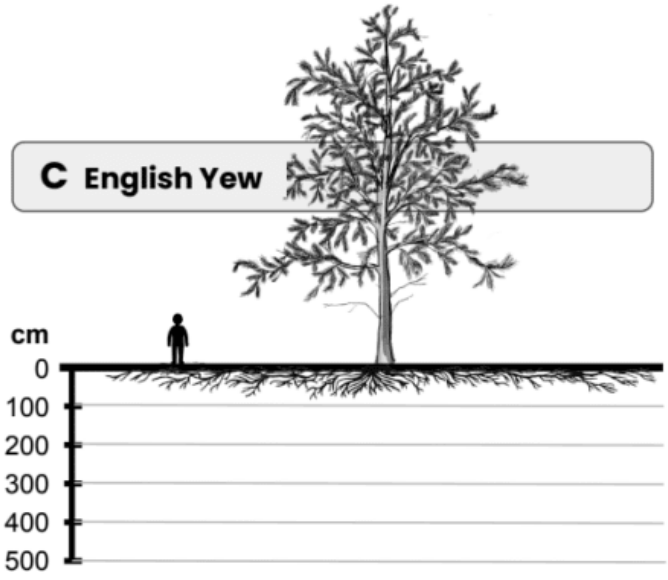
A Scots Pine



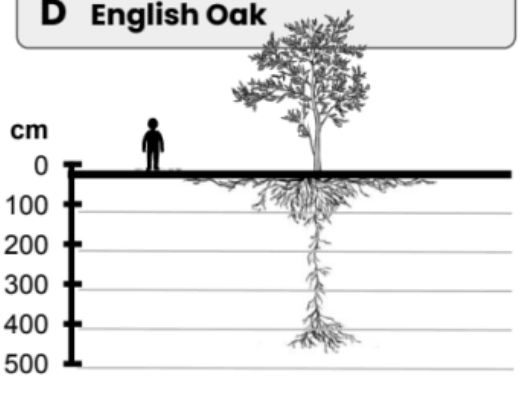
B Black Alder



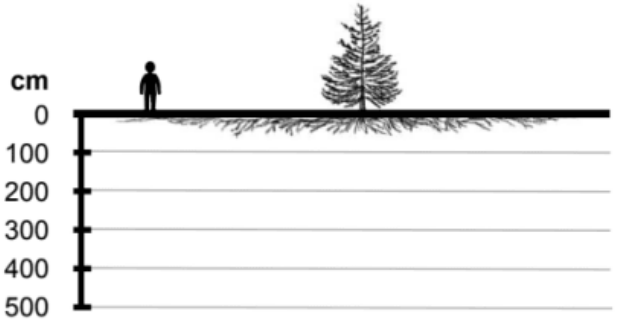
C English Yew



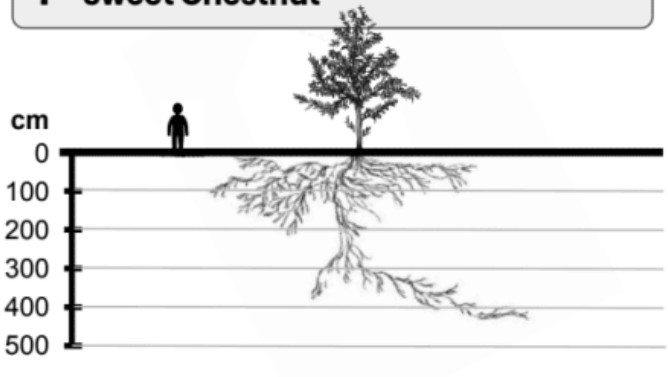
D English Oak



E Norway Spruce



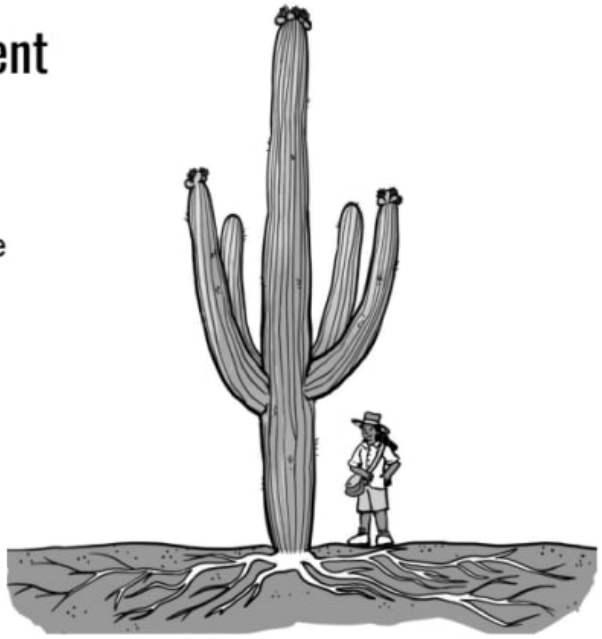
F Sweet Chestnut



Name: _____

Date: _____

Lesson Assessment



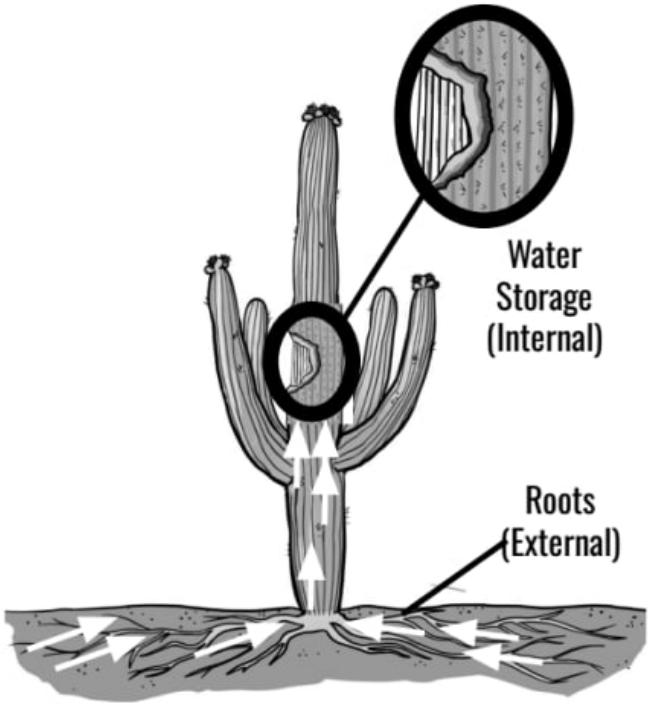
A saguaro is a large, tree-like cactus that can grow to be 40 feet (12 meters) tall. These giant cacti only grow in the environment of the very hot Sonoran Desert.

A saguaro cactus, just like any plant, needs water to grow and survive. The table below shows how many inches of rain falls in the Sonoran Desert each month.

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Rain (inches)	0.86	0.63	0.71	0.31	0.15	0.24	2.54	2.03	1.32	0.79	0.59	0.94

1. Which statement is correct about the environment of the Sonoran Desert?
   a. There is always over 1 inch of rain every month of the year.
   b. There are some months where it rains a few inches, but there are other months where it rains less than 1 inch.
   c. There is always less than 1 inch of rain every month of the year.

2. Many environments get 10 inches, 20 inches, or even 30 inches of rain EACH month of the year! Which of the following statements is correct?
   a. Much more rain falls in the Sonoran Desert compared to many other environments.
   b. About the same amount of rain falls in the Sonoran Desert compared to many other environments.
   c. Much less rain falls in the Sonoran Desert compared to many other environments.



Most of the saguaro's roots are shallow and spread out far from the plant. These *external* parts absorb the rain that falls in the Sonoran Desert. The cactus also has *internal* stem structures. These *internal* parts can store large amounts of water.

The white arrows in the image to the left show the path that water takes from the soil to the roots to the stem.

3. Which of the following claims do you agree with? Circle one.

a. The structures of the roots and stem **do** work together to help saguaros get the water they need to survive in the Sonoran Desert.

b. The structures of the roots and stem **do not** work together to help saguaros get the water they need to survive in the Sonoran Desert.

4. Support the claim you circled above using evidence and reasoning from the text, table, and images.

Name: _____

Survival in the Slow Lane

Sloths are amazing creatures. They are small, quiet, and spend most of their time either being perfectly still or moving very, very slowly.

How can an animal like this survive? The answer involves many things, including sloth behaviors and different parts of sloth bodies. On this worksheet, you will put all of the things that you have learned about sloths together to explain how sloths survive!

1. Draft a brief introduction. Your goal is to state a general **claim** about why sloths are good at survival. Try to write this in a way that will get people excited to learn about sloths! You don't need to go into each detail–this is just an introduction. You will write detailed **evidence** and **reasoning** in steps 2-4.

_____

_____

_____

2. **Sloths stay up in trees for most of their lives.**

- How does this help sloths survive? _____

_____

- Which body parts help sloths stay up in trees? _____

_____

- Other: _____

Survival in the Slow Lane

Name: _____

3. **Sloths keep themselves warm.**

- How does this help sloths survive? _____

_____

- Which body parts help sloths stay warm? _____

_____

- Other: _____

4. **Mother sloths take care of their babies, and baby sloths learn from their mothers.**

- How does this help sloths survive? _____

_____

- Which body parts help baby sloths and mother sloths do this? _____

_____

- Other: _____

5. Draft a final paragraph. Summarize what you explained and why sloths are amazing creatures! _____

_____

_____

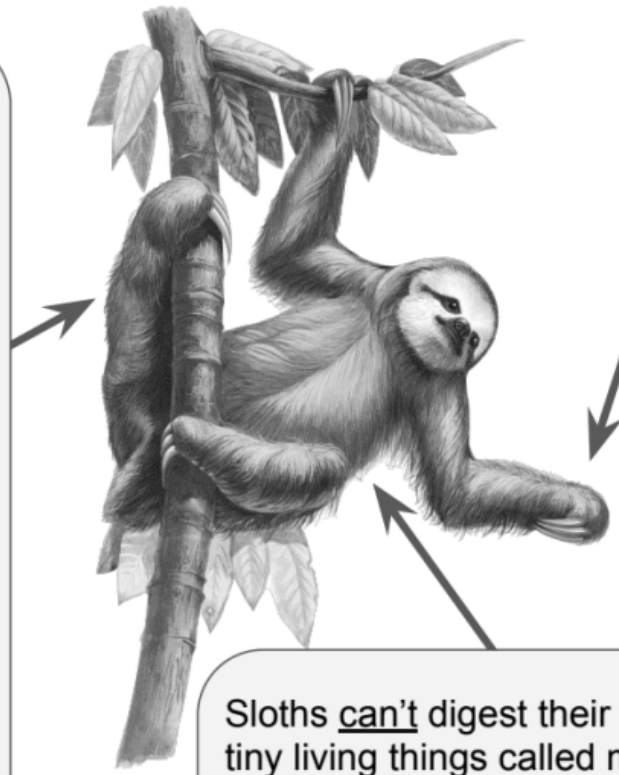
Life in the Trees

Name: _____

A sloth has to spend almost all of its life up in the trees. This is where sloths find food and where they hide from predators. Read about how the different parts of a sloth's body work together as a system to help them survive in the trees.

The outside of a sloth's body is completely covered in fur. Fur helps the sloth to stay warm.

Fur does more than just keep sloths warm, though. Baby sloths hold onto their mother's fur while their mother is taking care of them. Fur also helps sloths blend in with the trees. That helps them hide from predators.



A sloth's hands and feet have large claws. These claws help sloths climb so that they can find food and hide from predators.

Inside of their hands and feet, sloths have very strong muscles. These strong muscles help sloths hang from branches day after day without getting tired.

Sloths climb every day of their lives. Baby sloths have to hold onto their mother's fur starting on the very day that they are born!

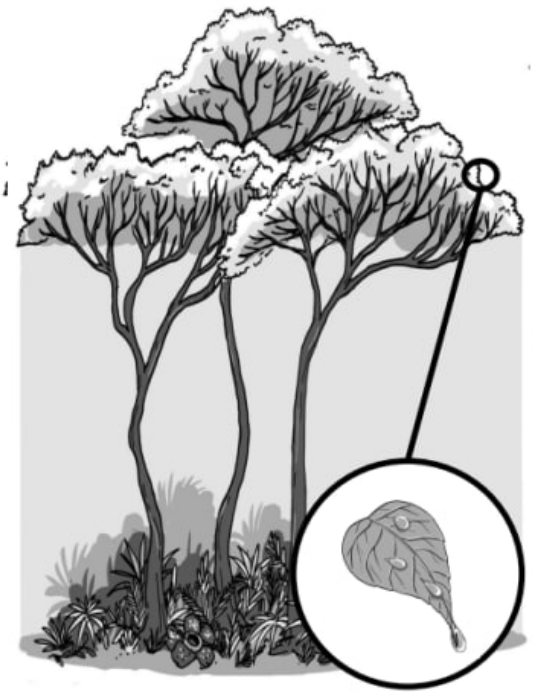
Sloths <u>can't</u> digest their food on their own! They need help. There are tiny living things called microbes inside of sloths' stomachs. The microbes help sloths digest their food.

If a sloth gets too cold, then the microbes can't survive. If the microbes can't survive, then the sloth can't survive either because it can't digest its food. This is why it is so important for a sloth to stay warm.

Animal & Plant Adaptations

Name: _____

Date: _____



Unit Assessment

Tropical rainforests are environments that get lots of rain. The island of Borneo is one example of a rainforest environment.

Borneo is filled with many tall trees that grow to over 100 feet (30 meters) tall. The leaves of these trees are all clustered near the top. They look like a dense, green umbrella, where everything below is shaded. The plants living below the trees can survive in the shade, but the trees need lots of sunlight.

The leaves of these trees have very pointy tips called “drip tips”. They help all the rain wash off the leaf so that the weight of all that water doesn’t break them.

1. Based on the information above, circle **True** or **False** for each statement.

True False The structure of the tall trunk helps these trees get the sunlight that they need to grow and survive.

True False Trees absorb all of the water that they need to grow and survive through the pointed tips of their leaves.

True False The structure of having branches only at the top helps these trees get the sunlight that they need to grow and survive.

2. Circle one of the options below to make a claim.
Claim: The structures of the trunks, branches, and leaves (do / do not) work together to help trees of the Borneo rainforest grow and survive.

Support this claim with evidence and reasoning from the text and images above.

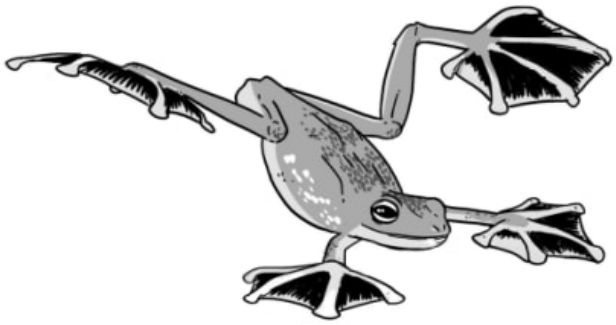
_____

_____

_____

_____

Living up in these very tall trees is a species of frog called the flying frog. These frogs use their eyes to help them see where they're going through the trees and search for insects to eat. They have large toe pads that help them grip onto the tree branches as they search for food.



When they see predators, these frogs use the strong muscles in their hind legs to help them leap off tree branches. The flying frog doesn't actually fly, but they do have webbed hands and feet that spread out. These webbed hands and feet help them glide through the air away from predators.

The only other reason the flying frog comes down from the tree tops is to lay their eggs. Just like other frogs, they need to lay their eggs near water so that the tadpoles can survive once they hatch.

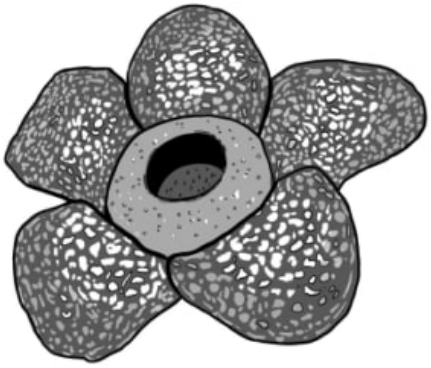
3. Using the text and images above as evidence, which of the following external and internal **structures** work together as a **system** to help the flying frog escape from predators? Circle all that apply.

Eyes	Mouth	Leg Muscles	Skin	Long Tail
Tongue	Webbed Hands	Webbed Feet	Eggs	Stomach

4. Flying frogs don't use their webbed feet to lay eggs. But the webbed feet **DO** actually help these frogs successfully lay their eggs and reproduce.

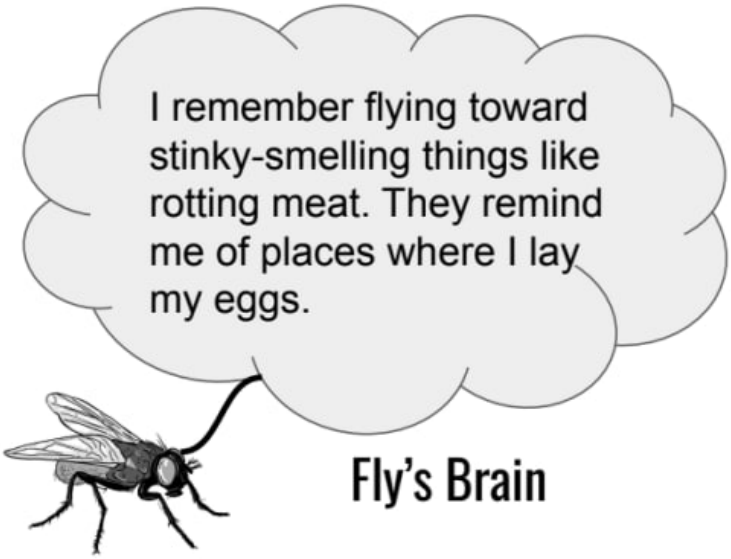
Claim: Webbed feet work together as a system with other structures and behaviors of the flying frog to help them lay eggs and reproduce.

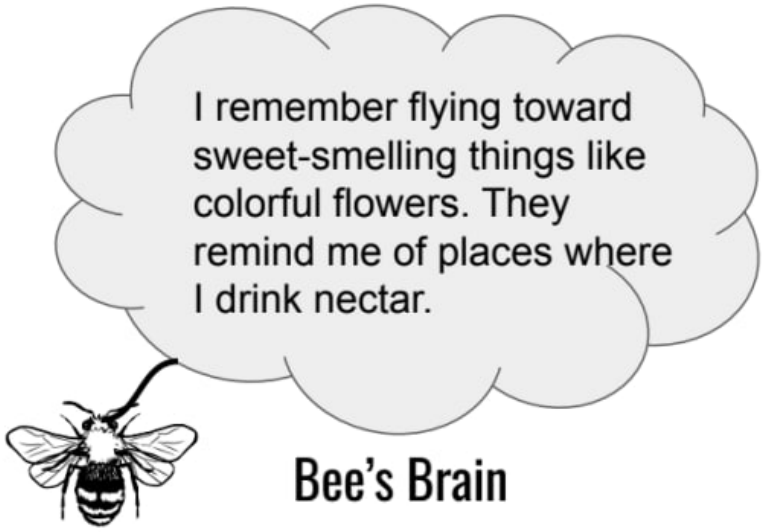
Support this claim with evidence and reasoning from the text and images above.



Another amazing plant in the rainforest of Borneo is called *Rafflesia*. This plant has the largest flowers in the world. Not only are these flowers special because they're gigantic, but they also have a unique scent. They smell like rotting meat!

Below are models of smell memories of a fly and a bee.





5. Using information from the model, what do you predict the fly's behavior will be if it smells a *Rafflesia* flower? Why?

a. The fly will move away from the flower because the fly has memories of being attracted to stinky smells.
b. The fly will move away from the flower because the fly has memories of being attracted to sweet smells.
c. The fly will move toward the flower because the fly has memories of being attracted to stinky smells.
d. The fly will move toward the flower because the fly has memories of being attracted to sweet smells.

6. Bees like the one shown above visit flowers to gather nectar. *Rafflesia* is a type of flower. If the bee smells a *Rafflesia* flower, will it behave in the same way as the fly? Why or why not? Use evidence from the model to support your answer.

_____

_____

_____

_____

mystery science

Earth's Features & Processes

4th Grade • NGSS • Unit Worksheets

Lesson 1

Could a volcano pop up where you live?

Lesson 2

Why do some volcanoes explode?

Lesson 3

Will an mountain last forever?

Lesson 4

What did your town look like 100 million years ago?

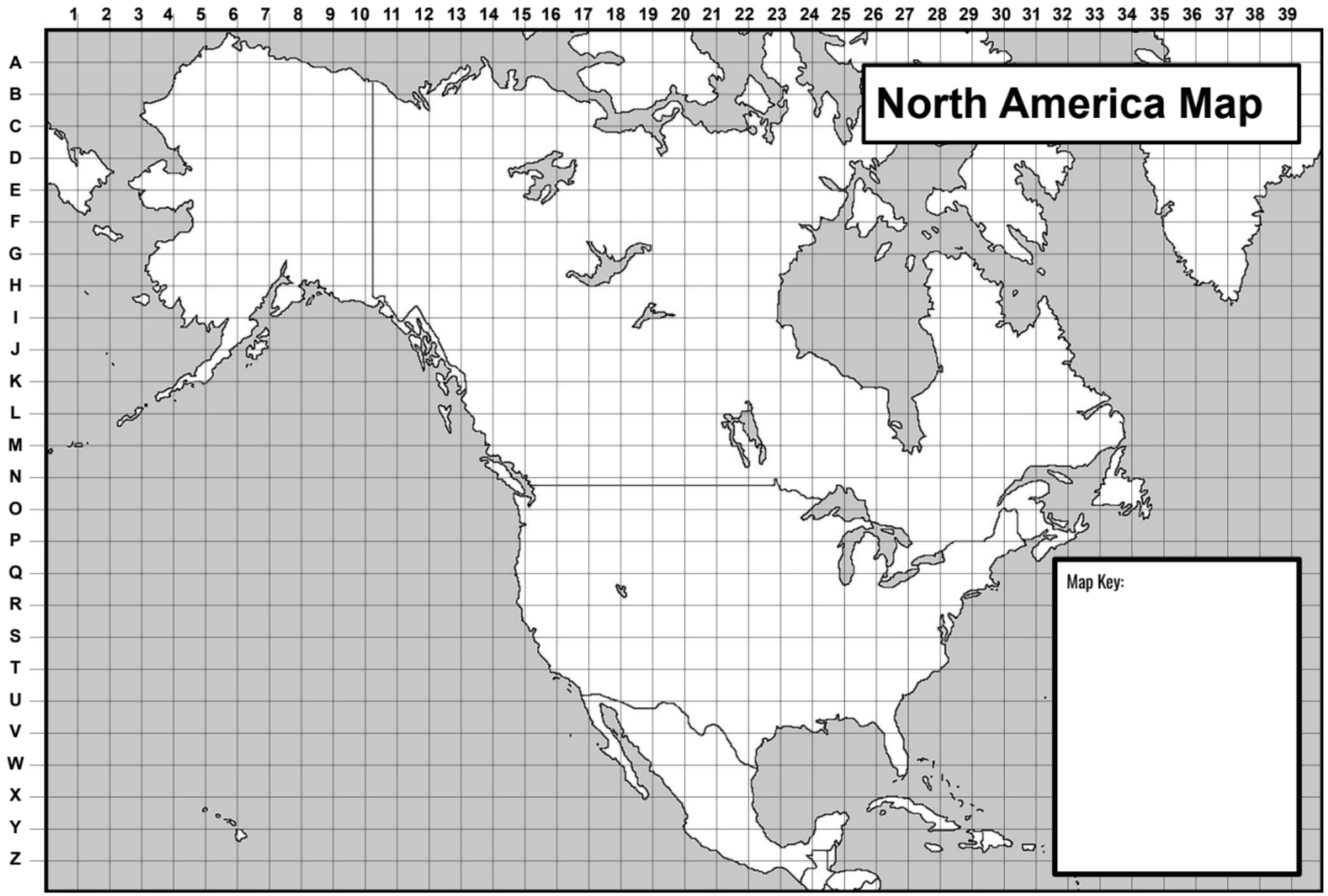
Lesson 5

How could you survive a landslide?

I am also curious about...

Ashfall Fossil Beds Evidence Chart

Name: _____



Directions: After each lesson, add any new evidence that helps you answer each question about the rhinoceros fossils.

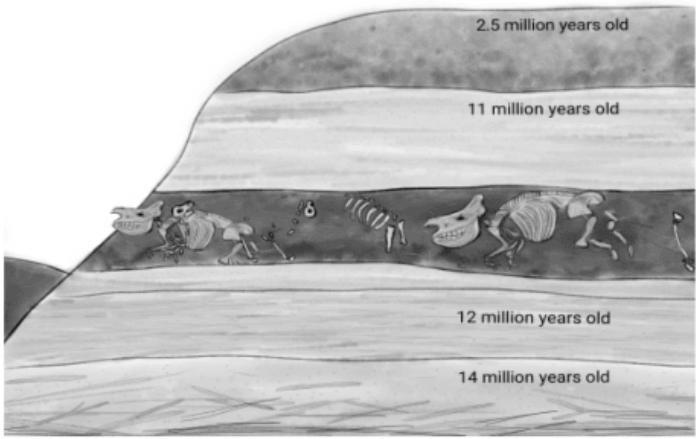
	Question 1: How did the prehistoric rhinos and other animals die?	**Question 2:** Why did it take 11 million years to find the fossils of the animals?	**Question 3:** How were the fossils eventually found?
Lesson 1: Could a volcano pop up where you live?			
Lesson 2: Why do some volcanoes explode?			
Lesson 3: Will a mountain last forever?			
Lesson 4: What did your town look like 100 million years ago?			
Lesson 5: How could you survive a landslide?			

Ashfall Fossil Beds Explanation

Name: _____

?

11 million years



What Happened Here?

1. What killed the prehistoric rhinos and other animals?

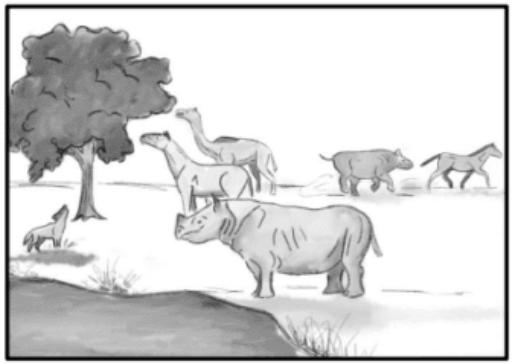
2. How did the bones end up underground?

3. What changes in the land uncovered the rhinoceros fossil?

Ashfall Fossil Beds Explanation

Name: _____

Directions: Fill in each step to create a sequence of events that happened between the prehistoric animals being alive 11 million years ago and their fossils being found.



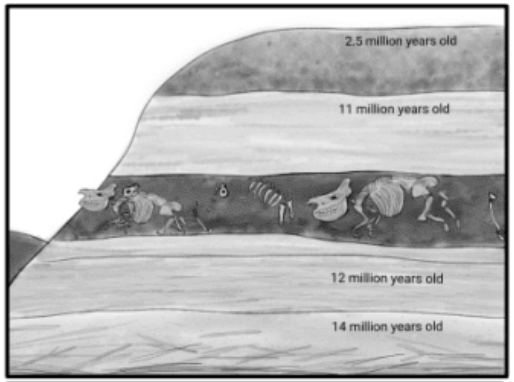
Step 1: Prehistoric animals lived 11 million years ago on the land that is now Nebraska.

Step 2:

Step 3:

Step 4:

Step 5:

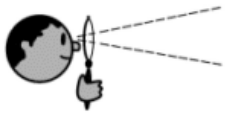


Step 6: The jawbone of a baby rhinoceros was discovered in a ridge on a farm in Nebraska.

See-Think-Wonder Chart

Name: _____

mystery science

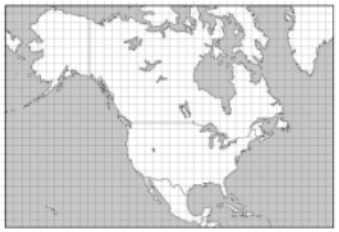
See	Think	Wonder
What did you observe? 	How can you explain what is happening? 	What questions do you have? 

North America Map: Volcano List

Name: _____

Name: _____

1). Make sure you have the map that goes with this page. It should look like this:



2). Read the location of each volcano out loud so your partner can draw them on the map. *After* each is done, put a checkmark in the box.

Added to map?	Location	Name of Volcano	Country	Year Last Erupted
▢	**6, Y**	Kilauea	Hawaii, USA	2021
▢	**16, R**	Lassen Peak	California, USA	1915
▢	**17, S**	Mammoth Mountain	California, USA	1400
▢	**5, K**	Mount Aniakchak	Alaska, USA	1931
▢	**1, M**	Mount Cleveland	Alaska, USA	2014
▢	**7, H**	Mount Redoubt	Alaska, USA	2009

Switch jobs with your partner now so you get a chance to map and they get a chance to announce.

▢	**15, O**	Mount St. Helens	Washington, USA	2008
▢	**9, G**	Mount Wrangell	Alaska, USA	1999
▢	**24, Z**	Pacaya	Guatemala	2013
▢	**21, Y**	Parícutin	Mexico	1952
▢	**22, Y**	Popocatepetl	Mexico	2015
▢	**18, W**	Tres Virgenes	Mexico	1857

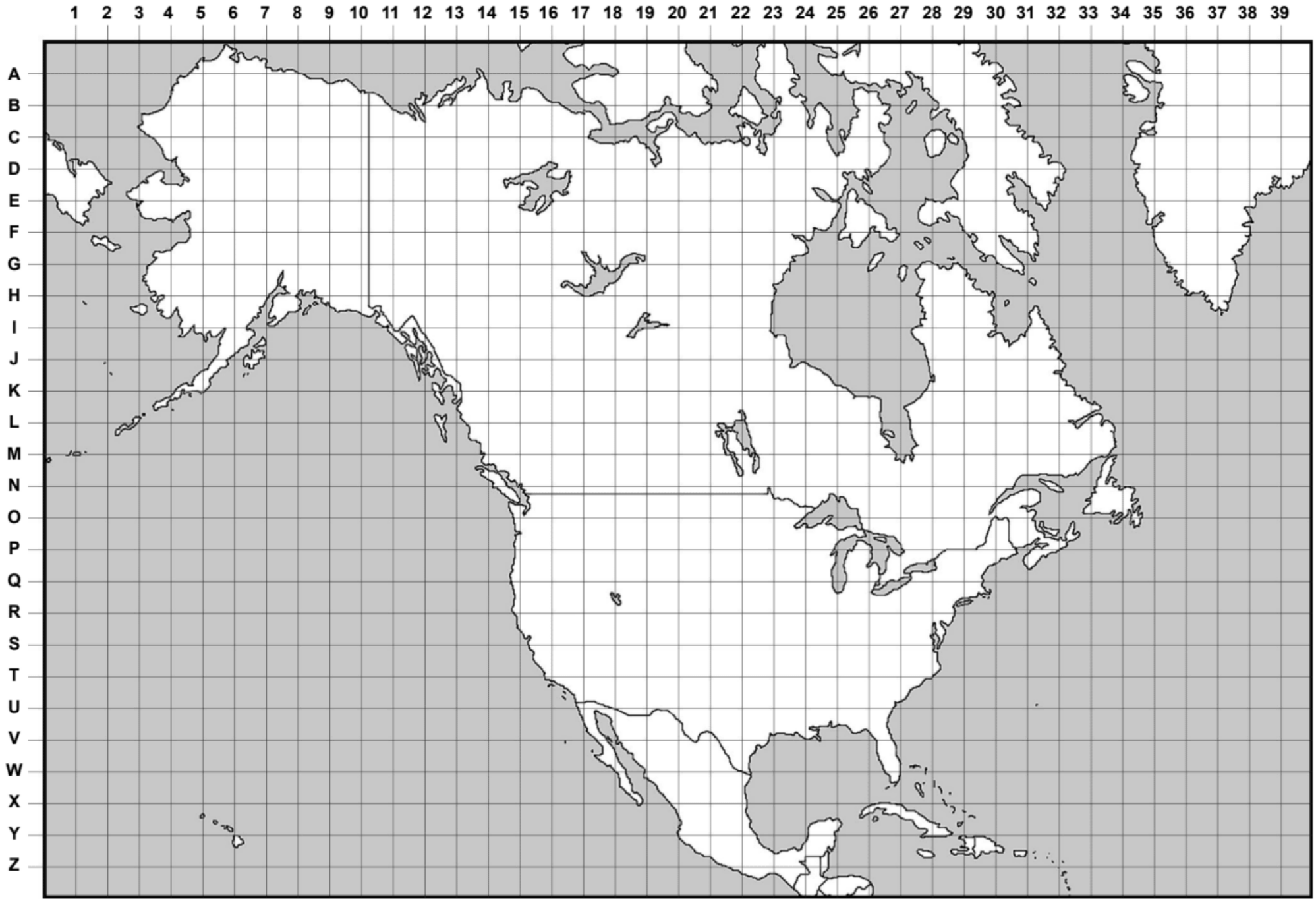
North America Map

Name: _____

Name: _____

mystery science

Could a volcano pop up where you live?

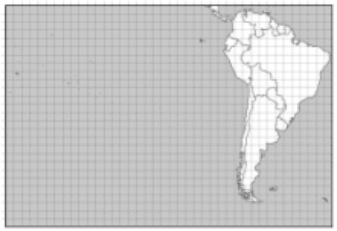


South America Map: Volcano List

Name: _____

Name: _____

1). Make sure you have the map that goes with this page.
It should look like this:



2). Read the location of each volcano out loud so your partner can draw them on the map. *After* each is done, put a checkmark in the box.

Added to map?	Location	Name of Volcano	Country	Year Last Erupted
▢	**29, V**	Burney	Chile	1910
▢	**29, Q**	Copahue	Chile	2012
▢	**29, T**	Mount Hudson	Chile	1991
▢	**28, C**	Nevado del Ruiz	Colombia	2012
▢	**29, P**	Planchón-Peteroa	Chile	2010
▢	**30, L**	Pular	Chile	1990

Switch jobs with your partner now so you get a chance to map and they get a chance to announce.

▢	**28, D**	Reventador	Ecuador	2014
▢	**29, I**	Sabancaya	Peru	2013
▢	**30, K**	San Pedro	Chile	1960
▢	**26, A**	Turrialba	Costa Rica	2015
▢	**30, J**	Wallatiri	Chile	1985
▢	**24, D**	Wolf	Galápagos, Ecuador	2015

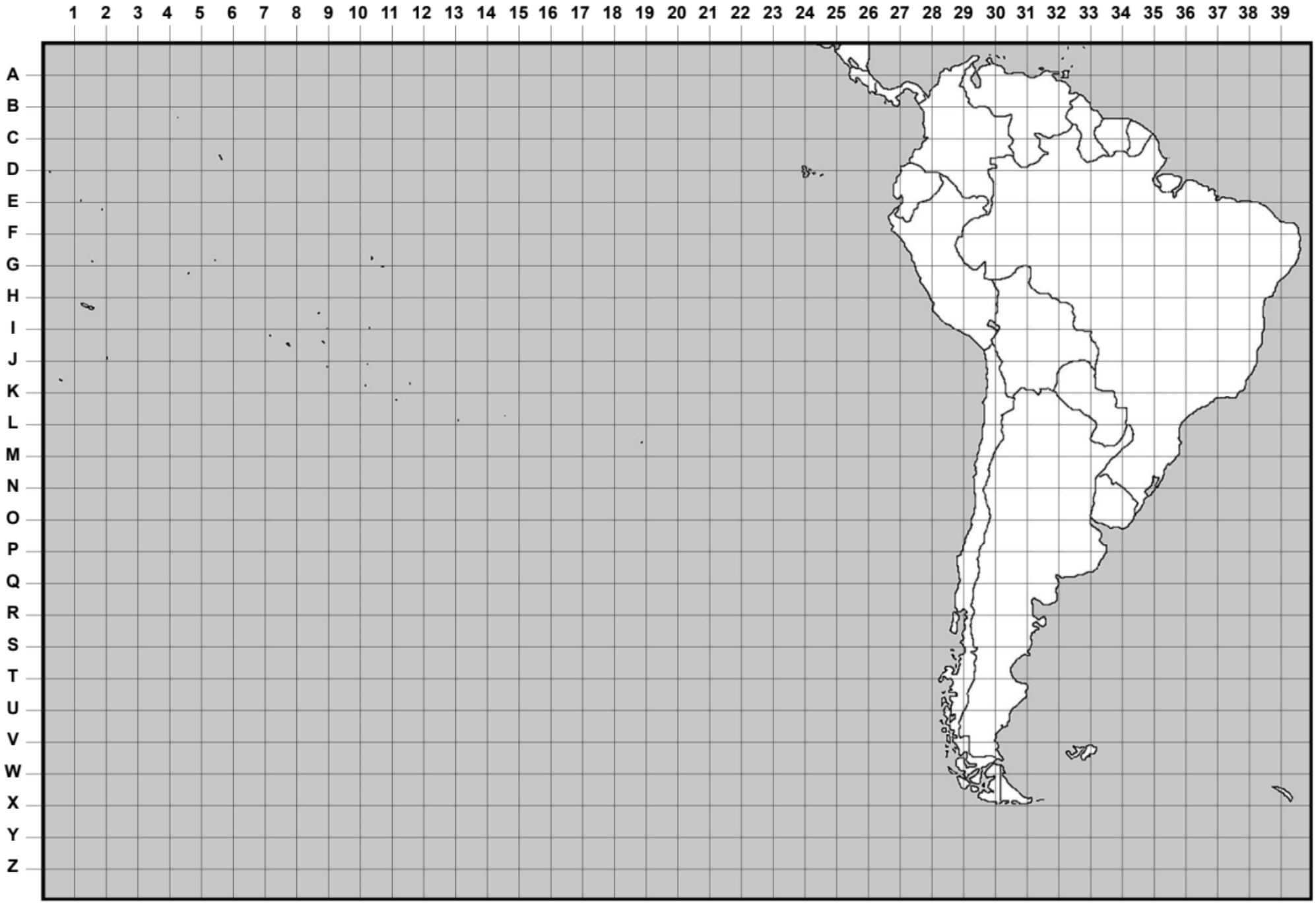
South America Map

Name: _____

Name: _____

mystery science

Could a volcano pop up where you live?

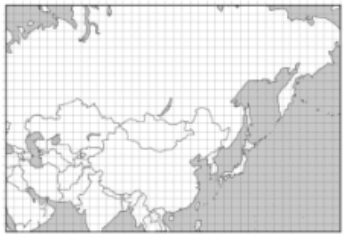


Asia Map: Volcano List

Name: _____

Name: _____

1). Make sure you have the map that goes with this page.
It should look like this:



2). Read the location of each volcano out loud so your partner can draw them on the map. *After* each is done, put a checkmark in the box.

Added to map?	Location	Name of Volcano	Country	Year Last Erupted
▢	**32, N**	Chirinkotan	Russia	2013
▢	**31, P**	Chirpoi	Russia	2013
▢	**39, M**	Gareloi Volcano	Alaska, USA	1989
▢	**23, X**	Guishan Island	Taiwan	1795
▢	**34, J**	Klyuchevskaya Sopka	Russia	2015
▢	**33, L**	Koryaksky	Russia	2008

Switch jobs with your partner now so you get a chance to map and they get a chance to announce.

▢	**34, K**	Kronotsky	Russia	1923
▢	**26, T**	Mount Aso	Japan	2004
▢	**28, T**	Mount Fuji	Japan	1707
▢	**29, Q**	Mount Meakan	Japan	2008
▢	**26, U**	Sakura-jima	Japan	2013
▢	**34, L**	Zhupanovsky	Russia	2015

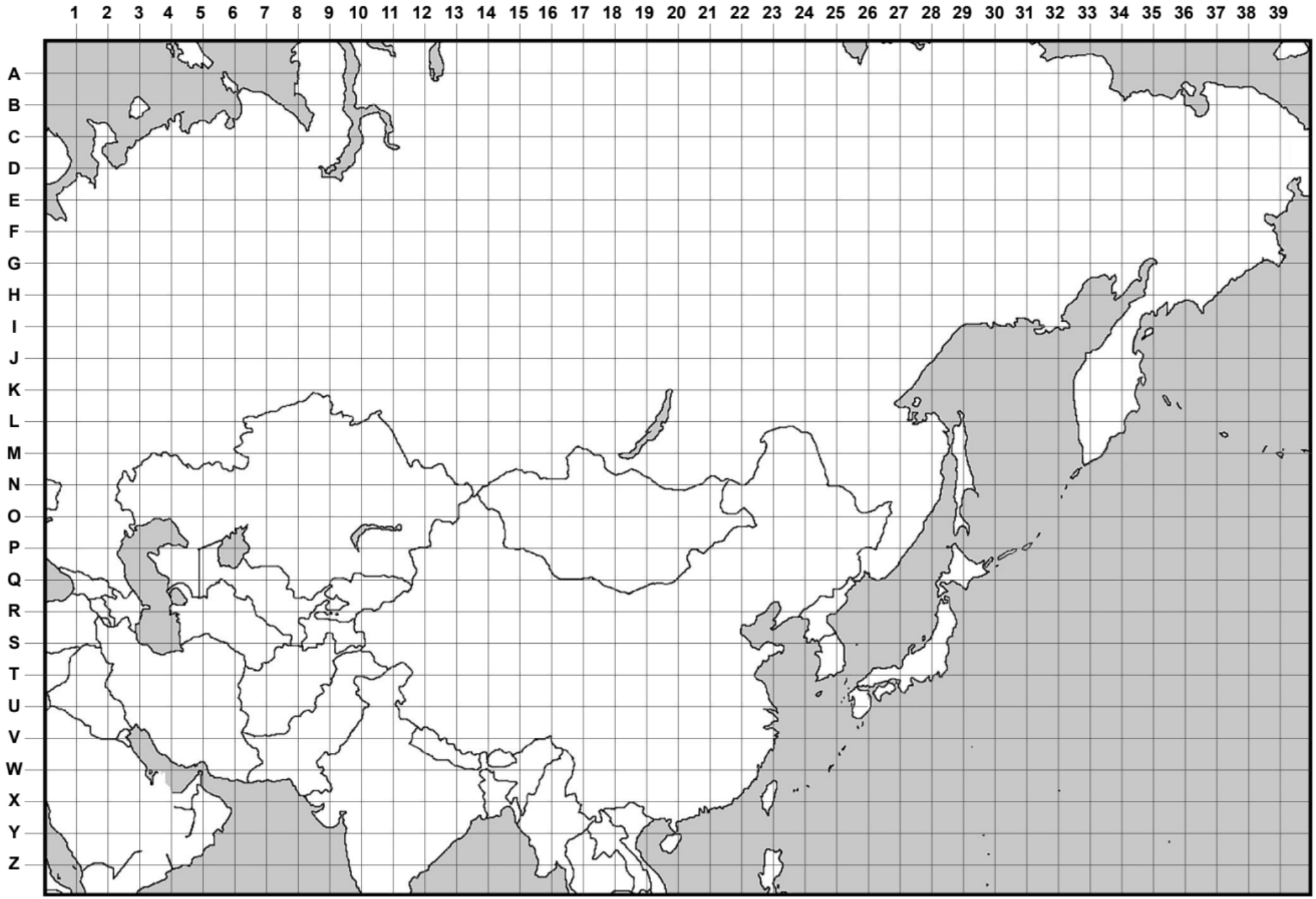
Asia Map

Name: _____

Name: _____

Mystery science

Could a volcano pop up where you live?

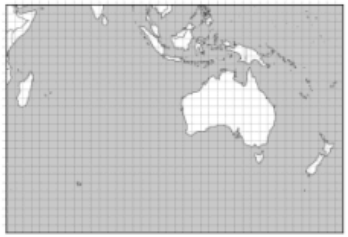


Australia & Nearby Islands Map: Volcano List

Name: _____

Name: _____

1). Make sure you have the map that goes with this page.
It should look like this:



2). Read the location of each volcano out loud so your partner can draw them on the map. *After* each is done, put a checkmark in the box.

Added to map?	Location	Name of Volcano	Country	Year Last Erupted
▢	**32, F**	Bagana	Papua New Guinea	2006
▢	**23, G**	Egon	Indonesia (Java)	2005
▢	**31, F**	Garbuna Group	Papua New Guinea	2005
▢	**18, E**	Kaba	Indonesia (Sumatra)	2000
▢	**24, A**	Kanlaon	Philippines	2006
▢	**30, F**	Manam	Papua New Guinea	2006

Switch jobs with your partner now so you get a chance to map and they get a chance to announce.

▢	**21, G**	Merapi	Indonesia (Java)	2010
▢	**38, Q**	Mount Tongariro	New Zealand	2012
▢	**19, F**	Papandayan	Indonesia (Java)	2002
▢	**22, G**	Rinjani	Indonesia (Java)	2004
▢	**17, D**	Sinabung	Indonesia (Sumatra)	2014
▢	**24, D**	Soputan	Indonesia (Java)	2007

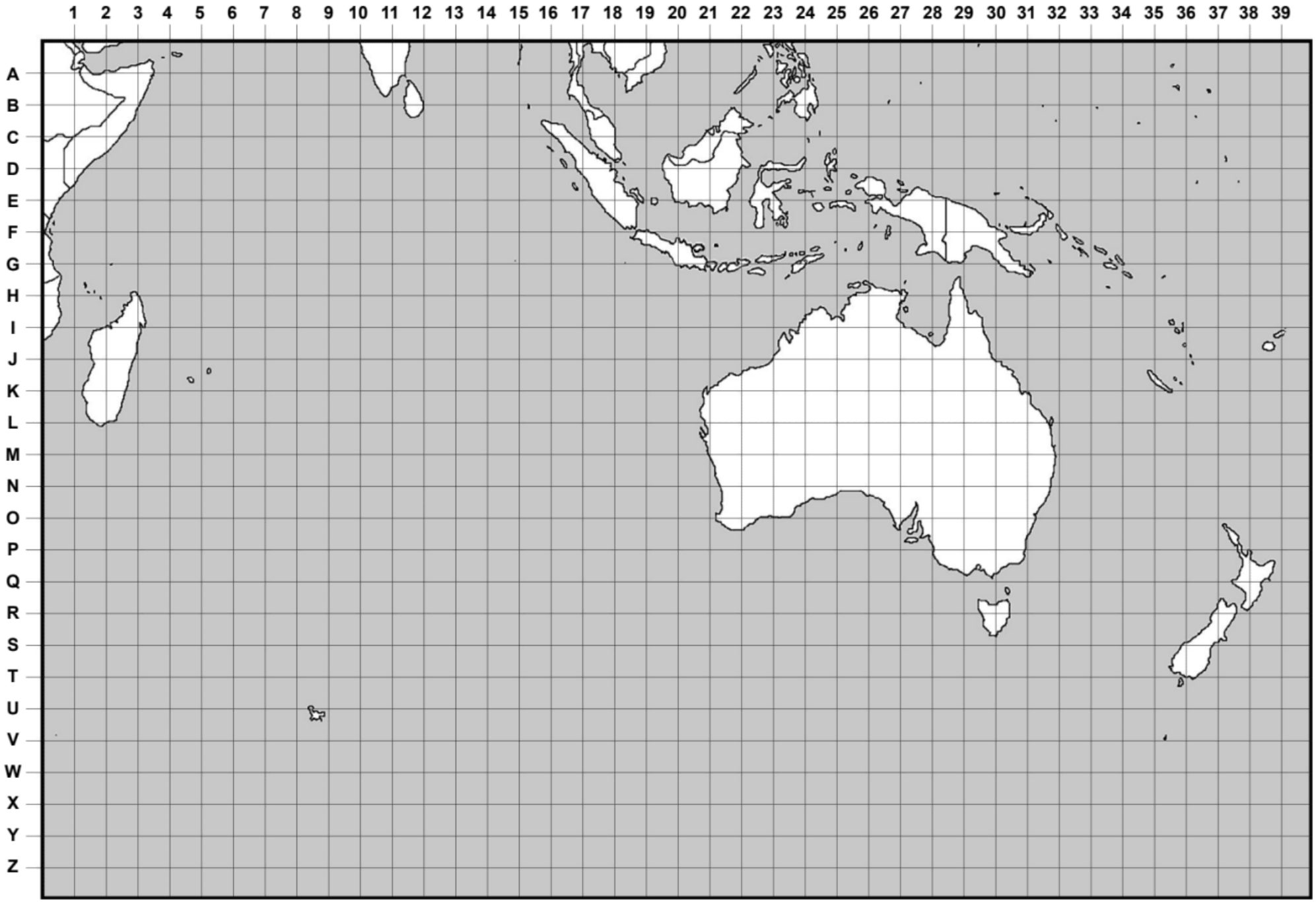
Australia & Nearby Islands Map

Name: _____

Name: _____

mystery science

Could a volcano pop up where you live?



Name: _____

Volcano Discoveries

1. Suppose you wanted to tell an explorer where to look for volcanoes. Check the box of the sentence you would choose.

   - ▢ You can find just as many volcanoes in the middle of a continent as you can near the coast.
   - ▢ You can find more volcanoes near the ocean than you can in the middle of the continent.

2. If you had to describe how the volcanoes on your map are arranged, what sentence would you choose?

   - ▢ The volcanoes are scattered evenly across the map.
   - ▢ The volcanoes are in groups near the coast.

3. What if you **wanted** a volcano to pop up in your backyard? Where would you choose to live and why? Use information from your map to explain.

_____

_____

_____

mystery science

Could a volcano pop up where you live?

Name: _____

Volcano Discoveries

1. Suppose you wanted to tell an explorer where to look for volcanoes. Check the box of the sentence you would choose.

   - ▢ You can find just as many volcanoes in the middle of a continent as you can near the coast.
   - ▢ You can find more volcanoes near the ocean than you can in the middle of the continent.

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3. What if you **wanted** a volcano to pop up in your backyard? Where would you choose to live and why? Use information from your map to explain.

_____

_____

_____

mystery science

Could a volcano pop up where you live?

Name: _____

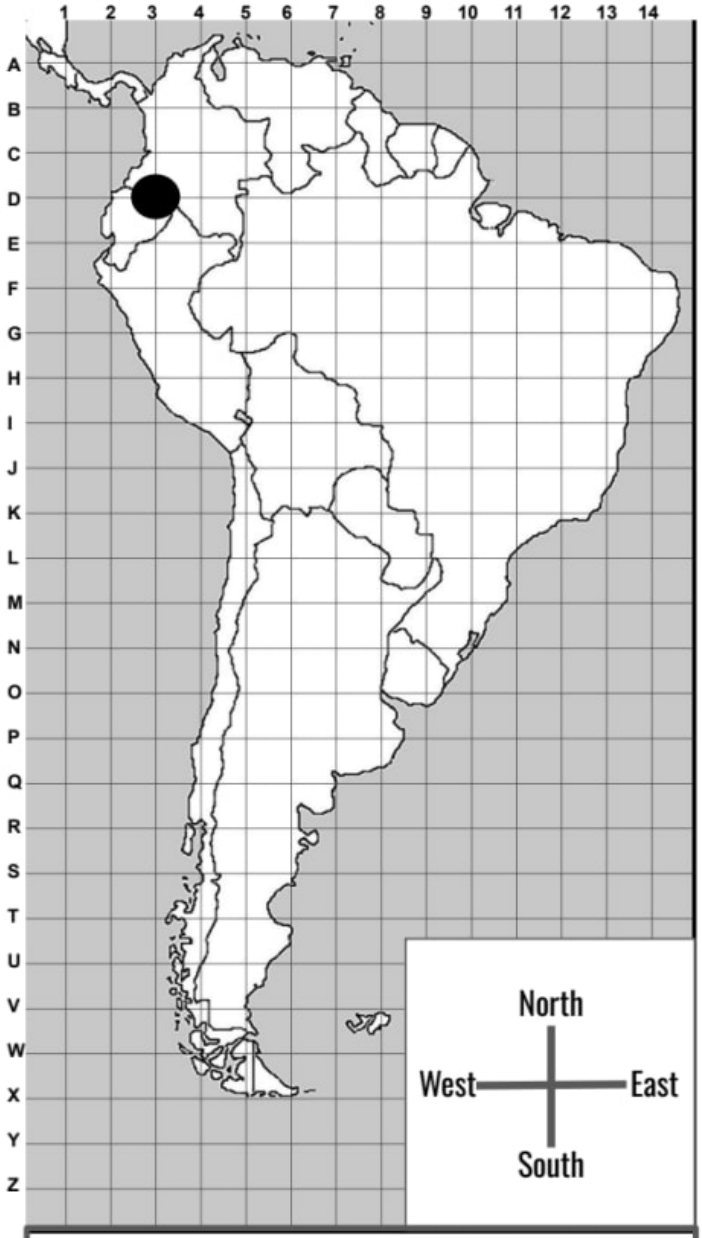
Date: _____

Lesson Assessment

1. Juan lives in South America. He's curious where the volcanoes in South America are located. Juan finds some information from his local library that gives the coordinates of volcano locations. Using these coordinates, first find the location of each volcano on the map. Then, draw a dot on the map to show where each volcano is located. The first location is done for you.

Key: ● = Volcano

Name of Volcano	Location
Reventador	**3, D**
Nevado del Ruiz	**4, C**
Burney	**4, V**
Copahue	**4, Q**
Sabancaya	**4, H**
Pular	**5, L**
Wallatiri	**5, J**



Map of South America

2. What **pattern** do you notice about the volcano locations in South America?

a. Volcanoes are found near the east coast of South America.
b. Volcanoes are found near the west coast of South America.
c. Volcanoes are found near the middle of South America.
d. Volcanoes are found near the north and south coasts of South America.
e. There is no pattern to where volcanoes are located in South America.

3. Juan also wants to learn about the tallest mountains in South America. He finds another map at his local library. This map is shown to the right. The triangles on this map represent some of the tallest mountains in South America.

Key: ▲ = Tall Mountain

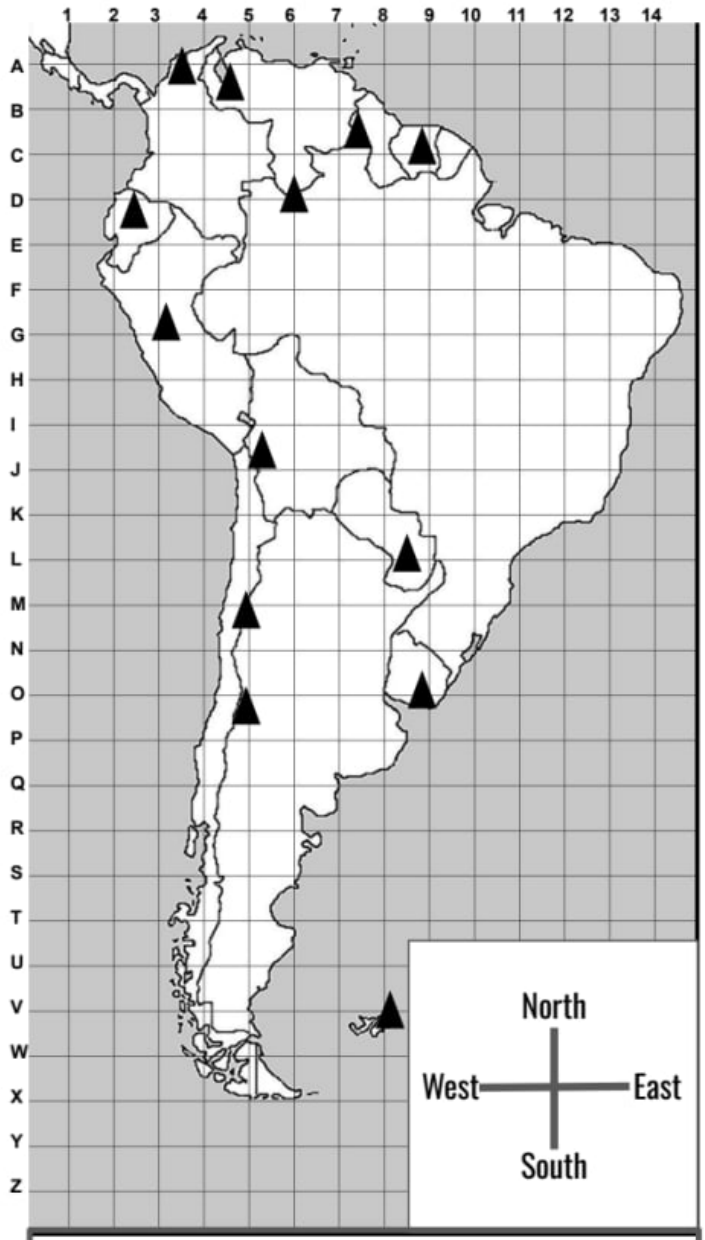
Circle **True** or **False** for each statement.

True False — All the tallest mountains in South America follow the same pattern of volcano locations.

True False — Some of the tallest mountains in South America follow the same pattern of volcano locations.

True False — The tallest mountains are mostly found along the west coast and the north coast.

True False — The tallest mountains are mostly found along the east coast and the south coast.



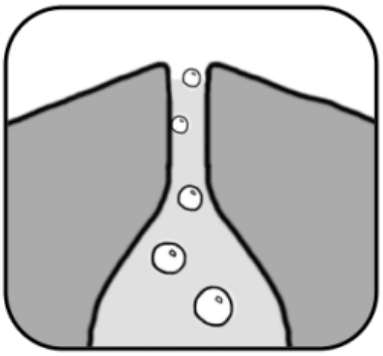
Map of South America

4. Juan lives in the country of Uruguay. His home is near the coordinates **9, N** on the map. First, add a star to the map to show where Juan lives. Then, make a claim about the landforms near Juan. The maps don't show all the volcanoes and tall mountains in South America. Do you think a volcano or a tall mountain is more likely to be found close to where Juan lives? Use evidence from the maps to support your reasoning.

Name:_____

Lava Experiment #1

Bubbles form in lava as it rises up from deep underground. With a straw, you can add bubbles to your lava, too.



1. Stir each sample with your straw, then blow bubbles in each cup. Note: bubbles in the thick lava may not look like the bubbles you're used to. Watch for craters when they burst through the surface.

2. Which lava is it **easiest** to blow bubbles in? **the thin lava** **the thick lava**

3. See if you can blow **just 1 bubble** in each cup.

Can you do it in the thin lava? Explain: _____

_____

_____

Can you do it in the thick lava? Explain: _____

_____

_____

4. How are the bubbles different in the different lavas?

_____

_____

_____

Name:_____

Lava Experiment #2

5. With your partner, put 1 spoonful of the **THIN** lava on the plate. Try to make it into a mountain-shape. Draw a picture in the box showing how tall it turned out:

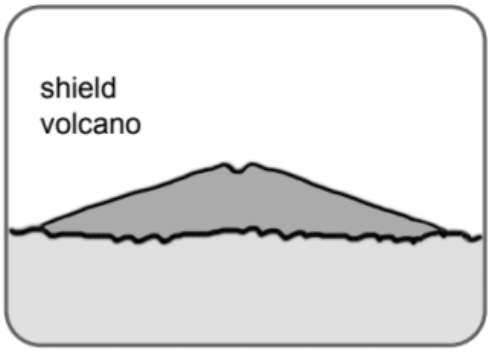
6. Repeat step 1 with the **THICK** lava.

7. What kind of lava do you think **shield volcanoes** have? Why?

_____

_____

_____

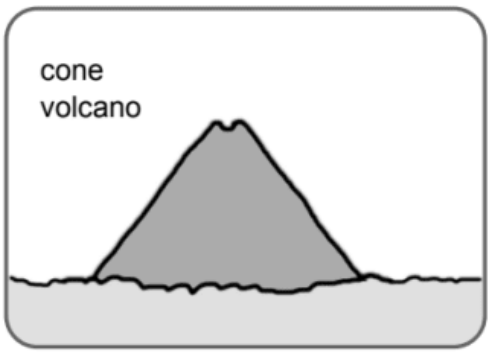


8. What kind of lava do you think **cone volcanoes** have? Why?

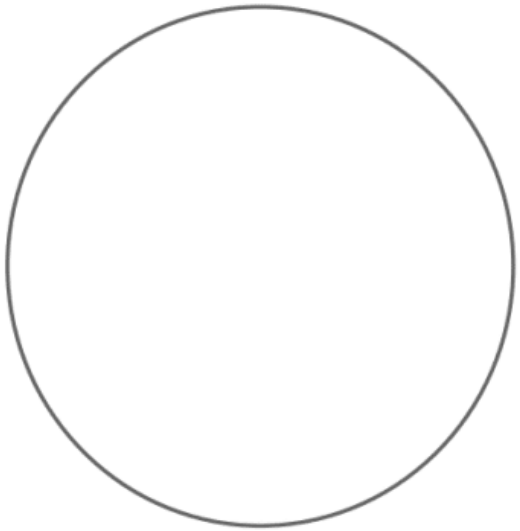
_____

_____

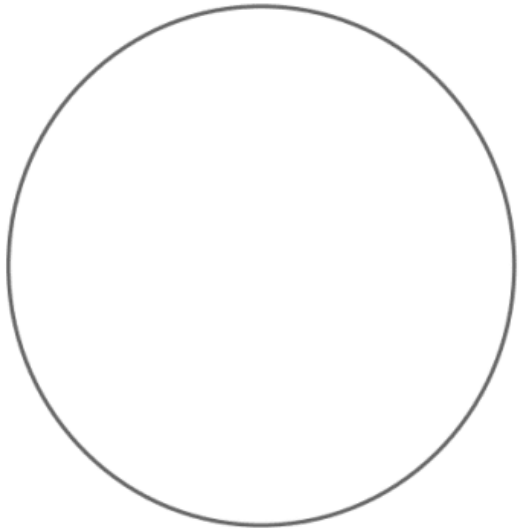
_____



Watch the next video to see which type of bubbles makes volcanoes explode!



thin



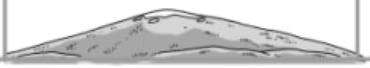
thick

Name: _____

Date: _____

Lesson Assessment

Makenna lives in a town where there's a volcano nearby. Makenna recently learned that some volcanoes are more likely to erupt quickly with an explosion, but some volcanoes erupt gently without an explosion. Makenna wants to figure out if the volcano located near her town is the kind that explodes. To help her figure it out, Makenna gathers information about other volcanoes. The images below show the shape of volcanoes that explode and the shape of volcanoes that do not explode.

Volcano Explodes			
Volcano Does NOT Explode			

1. What **pattern** do you notice?
   a. All volcanoes are tall and pointed at the top.
   b. All volcanoes are short and rounded at the top.
   c. Volcanoes that explode are tall and pointed at the top. Volcanoes that don't explode are short and rounded at the top.
   d. Volcanoes that explode are short and rounded at the top. Volcanoes that don't explode are tall and pointed at the top.
   e. There is no pattern between volcanoes that explode and those that don't explode.

2. The table below shows some rocks found near volcanoes that explode and rocks found near volcanoes that do not explode. What **pattern** do you notice?
   a. Volcanoes that explode have rocks that are larger than volcanoes that don't explode.
   b. Volcanoes that explode have rocks that are wider than volcanoes that don't explode.
   c. Volcanoes that explode have darker-colored rocks than volcanoes that don't explode.
   d. Volcanoes that explode have lighter-colored rocks than volcanoes that don't explode.
   e. There is no pattern of rocks found near volcanoes that explode.

Volcano Explodes					
Volcano Does NOT Explode					

3. Makenna takes a walk around the volcano in her town and finds a rock, as shown in the image to the left. Using the rock that Makenna found as evidence, along with the information she's found about other volcanoes, do you think that the volcano in Makenna's town is the kind that explodes or the kind that doesn't explode? Why do you think that? Use evidence to support your idea.

4. Makenna talks with a scientist who tells her that the volcanoes that explode usually have thick lava, while the volcanoes that don't explode usually have thin lava. If Makenna could look at the lava that comes from the volcano in her town, what do you think it would look like–thick or thin? Why do you think that? Use evidence to support your idea.

mystery science

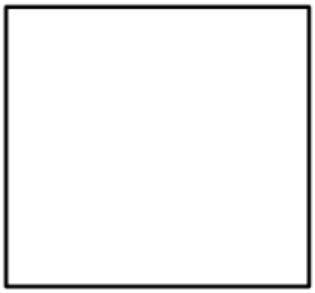
Will a mountain last forever?

Name: _____

Sugar Shake Data Sheet

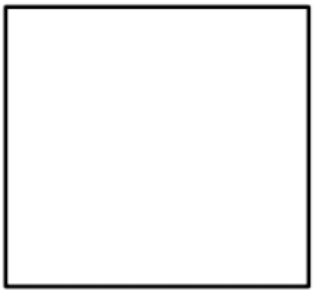
1

Draw what your sugar cube looks like here:



2

What will it look like after 200 shakes? Draw your best guess here:

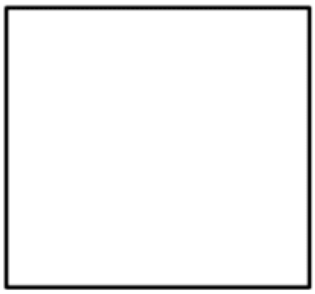


3 How many edges does a sugar cube have? _____

4

Trial #	Shake this many times:	Describe the shape of the sugar cubes you shook. How did they change?	How many edges still have some color?
#1	**40**		
#2 switch jobs	**40**		
#3 switch jobs	**40**		
#4 switch jobs	**40**		
#5 switch jobs	**40**		

5 You've done 5 trials of 40 shakes each. That's 200 shakes! What do the sugar cubes look like now? Draw one in the box:



6 Does your drawing match your guess in question 2? Yes No

7 What happened to the sugar cubes when they bashed together in the container? How are they different from the one you didn't shake?

_____

_____

8 When you take the sugar cubes out of the container, what's left in the container? Where did that come from?

_____

_____

9 What do you think would happen if you shook rocks instead of sugar cubes?

_____

_____

_____

10 How many more shakes do you think it would take to make the sugar cubes **really** round (like a marble)? _____ If you have time, try it out!

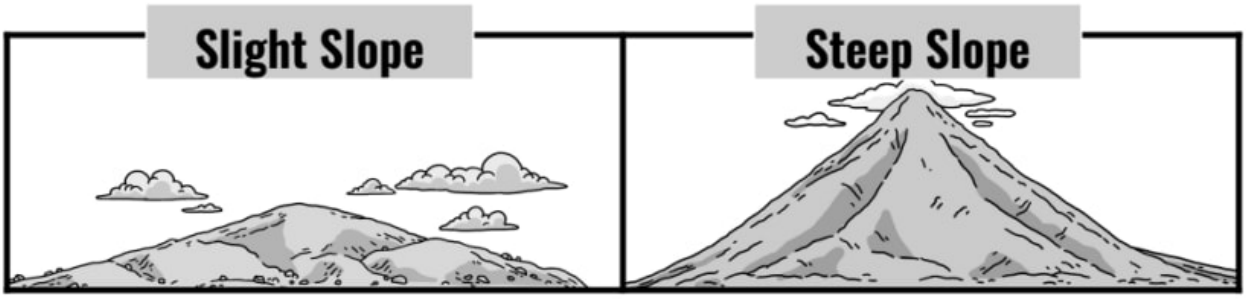
Name: _____

Date: _____

Lesson Assessment

James recently learned that mountain rocks break into smaller pieces (weathering). Those rocks often move from the top to the bottom of the mountain because of gravity (erosion). James wants to investigate if the slope of a mountain affects the number of rocks that move from the top to the bottom in a year. James wants to know:

Does the slope of a mountain affect the rate of erosion?



1. What could James do to figure out the answer to his question?
   a. Compare rocks at the top and bottom of two mountains that have a slight slope.
   b. Compare rocks at the top and bottom of two mountains that have a steep slope.
   c. Compare rocks at the top and bottom of a mountain that has a slight slope with the rocks of a mountain that has a steep slope.

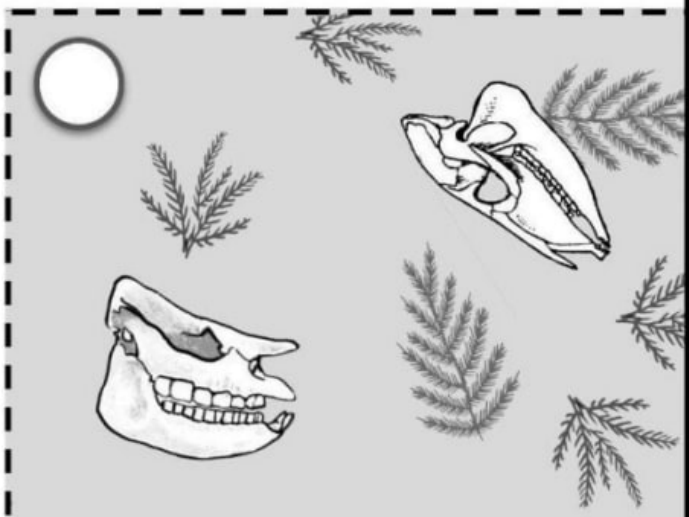
2. What observations or measurements could James make to help him figure out the answer to his question? There may be more than one correct answer.
   a. Count the number of rocks at the bottom of each mountain after 1 year.
   b. Count the number of plants at the bottom of each mountain after 1 year.
   c. Weigh all of the rocks that fell to the bottom of each mountain after 1 year.
   d. Observe the color of the rocks at the bottom of each mountain after 1 year.

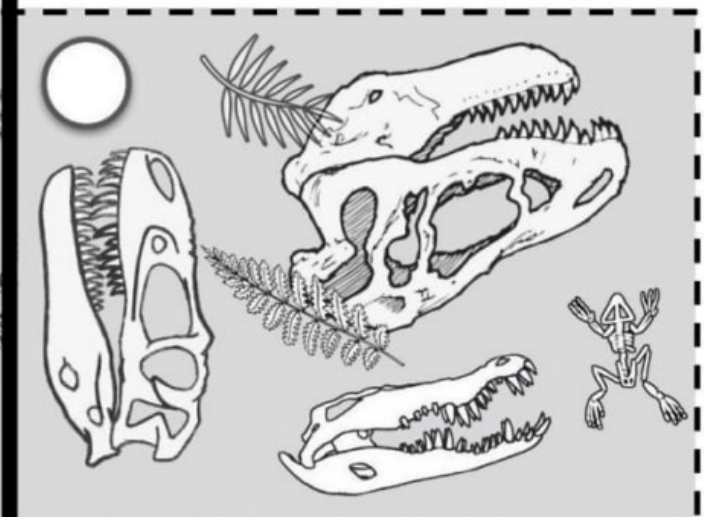
3. James observes 32 small rocks at the bottom of one mountain and 6 small rocks at the bottom of another mountain. What else could James do to figure out the answer to his question? There may be more than one correct answer.
   a. Count the number of rocks at the bottom of more mountains.
   b. Count the number of rocks at the bottom of the same mountains over many years.
   c. Break the rocks into smaller pieces.
   d. There is nothing else James can do.

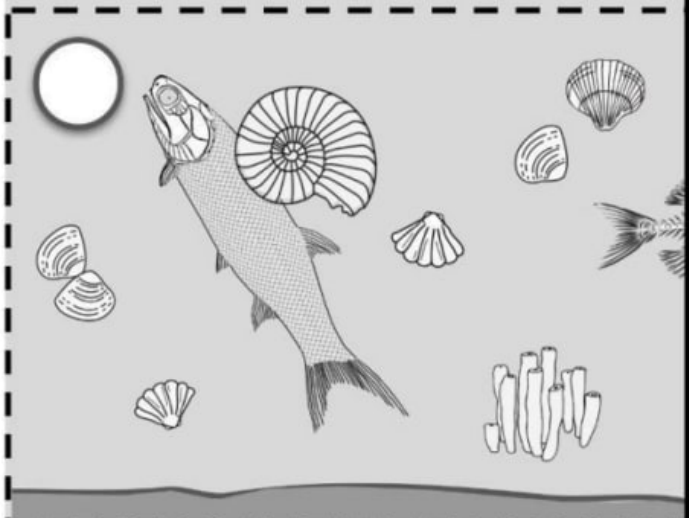
Fossil Cards

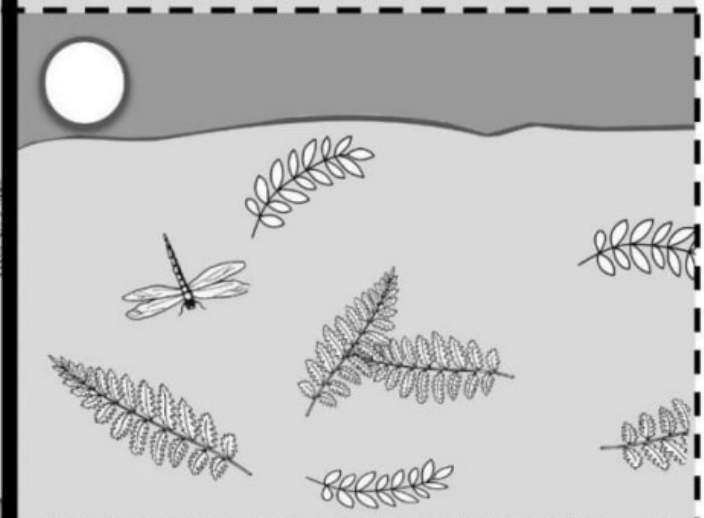
mystery science

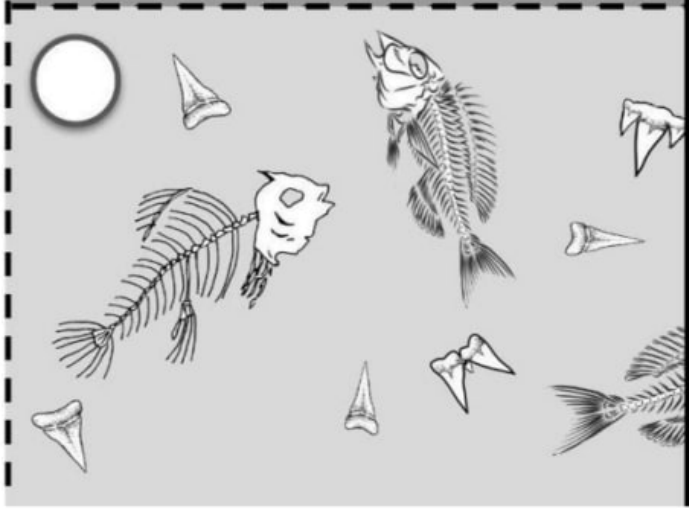
What did your town look like 100 million years ago?

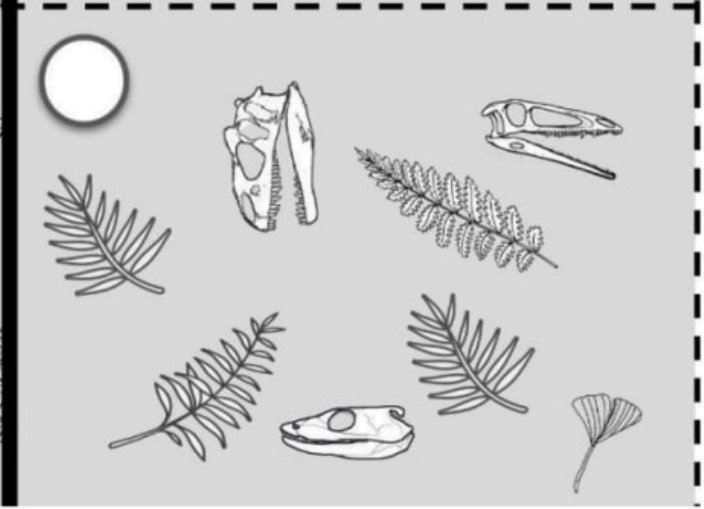










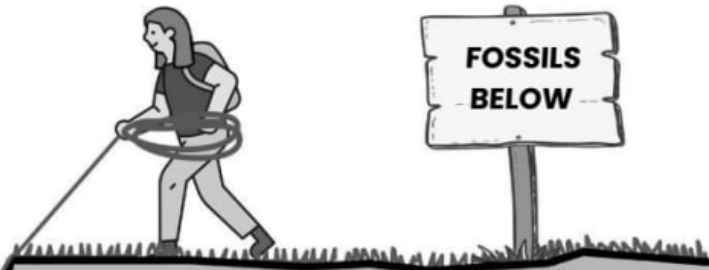


Colossal Canyon

Names: _____ & _____

Mystery science

What did your town look like 100 million years ago?



6 You've reached the top rock layer of the canyon! The fossil plants that you see along this final part of your journey look very different. The branches have many tiny, needle-like leaves. They remind you of pine trees you might find in the forest. You notice large fossil skulls in this rock layer too. The teeth found within these skulls are different—instead of sharp, pointed teeth, now they're mostly flat.

5 As you continue climbing up to the top of the canyon, the fossils you find change slightly again. Now the fossil skulls are getting bigger—much, much bigger! The largest skulls contain many sharp, curved, pointed teeth. Luckily, these don't remind you of animals alive today. There is one skull, though, that looks very similar to an alligator you might find hiding in a swamp.

4 You continue your journey and notice big changes. You no longer see shell fossils. You notice fossil plants that are similar to the ones you've seen lower in the canyon. There are also several fossil skulls here that look like tiny lizard skulls. Maybe they're the remains of ancient animals that once walked on land.

Mystery science

What did your town look like 100 million years ago?

3 As you continue your climb up the canyon, you start to notice a few fish fossils again. But now there's something different. In this rock layer, you also see lots and lots of fossil shells! Some of these fossil shells look quite similar to shells that you may have seen wash up on the beach.

2 As you climb up, you no longer see fish fossils. Instead, the rock becomes stuffed with plant fossils. Each branch looks like it has many tiny little leaves. You also notice the fossil of an insect with four wings. Part of the rock is darker here and doesn't seem to have any fossils.

1 The first things you notice are several fossils that look like the bones of fish! You also notice a few sharp, pointy fossils. Maybe they're teeth? Perhaps they once belonged in the mouth of a large sea creature.

3

2

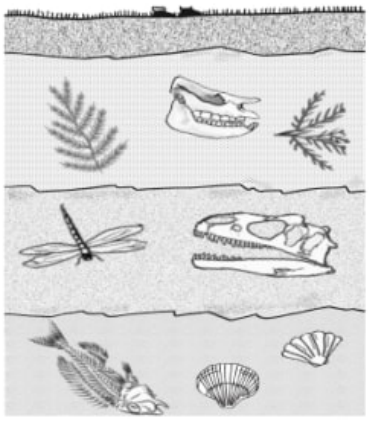
1

Name: _____

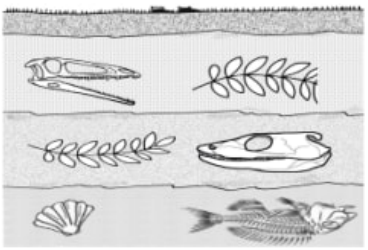
Date: _____

Lesson Assessment

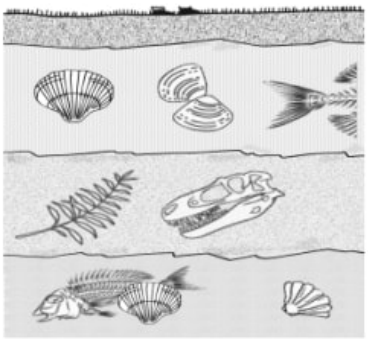
California



Texas



New York



1. Elena looks at the fossils in the rock layers from three different places in the United States. These three places are all very far apart from one another. California is on one side of the country, and New York is on the complete opposite side. Texas is about in the middle. Elena thinks that millions of years ago, all of these places must have been covered under ocean water. What evidence do you see to support Elena's explanation for the fossil pattern that she observes? Circle **Evidence** or **Not Evidence** for each sentence.

Evidence	Not Evidence	Some of the fossils found in each location look like organisms that would have lived in an ocean environment.
Evidence	Not Evidence	Some of the fossils found in each location are organisms that look different from organisms that are alive today.
Evidence	Not Evidence	The fossils found in the lowest layer of rock are similar, even though they are from different locations.
Evidence	Not Evidence	Some layers of rock are thicker than others in different locations.

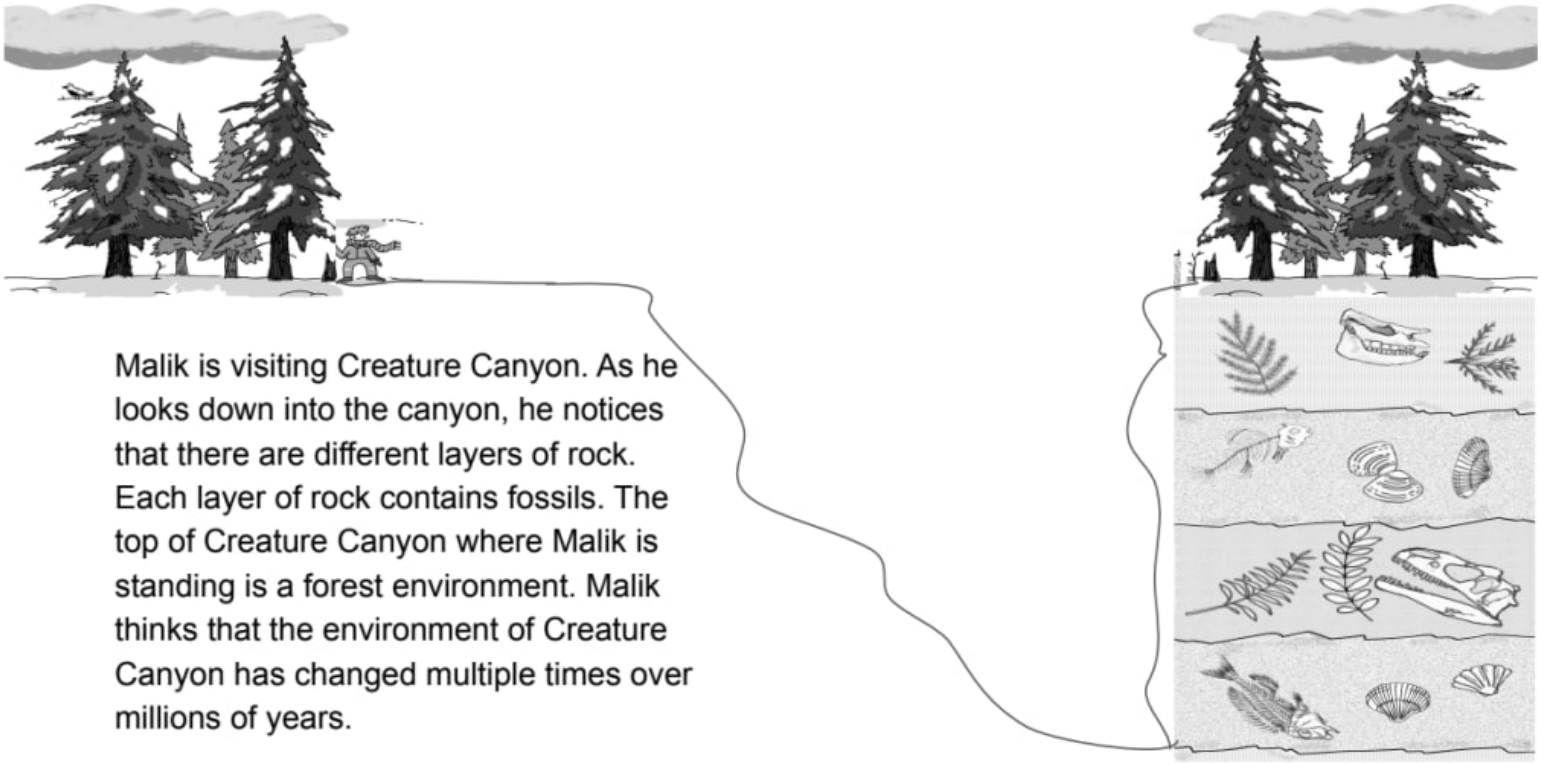
2. If you looked at the layers of rock from another location in the United States, what kinds of fossils do you think you would most likely find in the very bottom layer? Use evidence from the fossils that you see in Question 1 to support your claim.

_____

_____

_____

_____



Malik is visiting Creature Canyon. As he looks down into the canyon, he notices that there are different layers of rock. Each layer of rock contains fossils. The top of Creature Canyon where Malik is standing is a forest environment. Malik thinks that the environment of Creature Canyon has changed multiple times over millions of years.

3. Looking at the fossil layers of Creature Canyon, which of the following statements describe the correct **complete** history of its landscape.

a. The fossil layers of Creature Canyon show that the landscape changed from water (aquatic) to land.
b. The fossil layers of Creature Canyon show that the landscape changed from land to water (aquatic).
c. The fossil layers of Creature Canyon show that the landscape changed from water (aquatic) to land, back to water (aquatic), and then to land again.
d. The fossil layers of Creature Canyon show that the landscape changed from land to water (aquatic), back to land, and then to water (aquatic) again.

4. Which piece of evidence is the **strongest** one that supports Malik's claim that the environment has changed not just once but many times? Circle the best answer.

a. Some of the fossils look similar to organisms that would be found in a water (aquatic) environment.
b. Some of the fossils look similar to the pine trees that are in the current environment at the top of the canyon.
c. Some of the fossils look like plants and animals that aren't found in the current environment at the top of the canyon where Malik is standing.
d. The fossils that look similar to organisms found in the water (aquatic) are separated by a layer of rock that has fossils that look like plants and animals you would find in an environment on land.

Name:_____

Saving My Slide-City Home

What's the name of your plan? _____

Explain how your plan will protect your house or prevent a landslide:

_____

_____

_____

_____

Draw your plan in this box.

Name: _____

Date: _____

Lesson Assessment

Slide City is located at the bottom of a mountain, and the citizens are concerned about landslides. A landslide occurs when loose rocks and soil quickly fall down a steep slope. One of the main things that causes landslides is water. Landslides often happen after big rain storms or after snow melts into the soil. The city is deciding between two solutions.

Solution #1: Ground Netting
Cost: $50,000
Time to Build: 10 months
The city will build a giant net that will be placed on top of the sloping ground to hold the rocks, boulders, and soil in place.

Solution #2: Pipe System
Cost: $100,000
Time to Build: 3 months
The city will build a system of pipes along the steep slope. The pipes will move the rainwater that falls on the slope to a different area.

1. A local geologist studying landslides predicts that a landslide will very likely happen in Slide City in 6 months. Given this information, what is a major consideration, or ***constraint,*** of the solution?

a. The amount of money needed to build the solution.
b. The materials needed to build the solution.
c. The amount of time it will take to build the solution.
d. The amount of trees that need to be removed to build the solution.

2. Carefully read the information about each solution and think about the major consideration (***constraint)*** from Question 1. Which solution is the better choice for Slide City? Why?

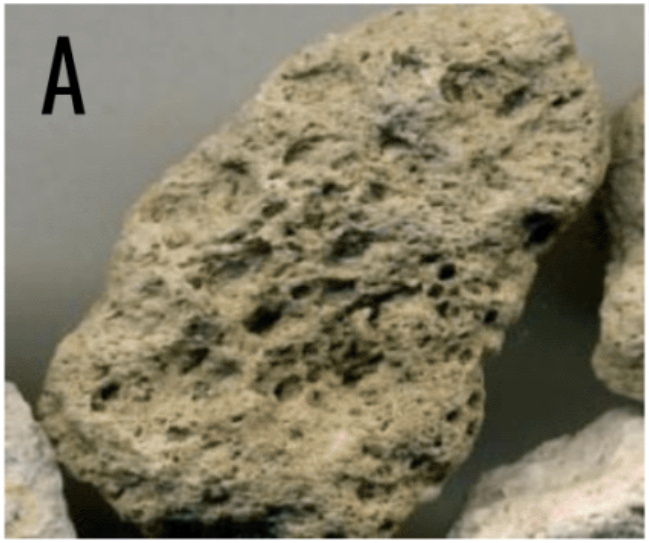
a. Ground Netting because it costs less.
b. Ground Netting because it takes less time to build.
c. Pipe System because it costs less.
d. Pipe System because it takes less time to build.

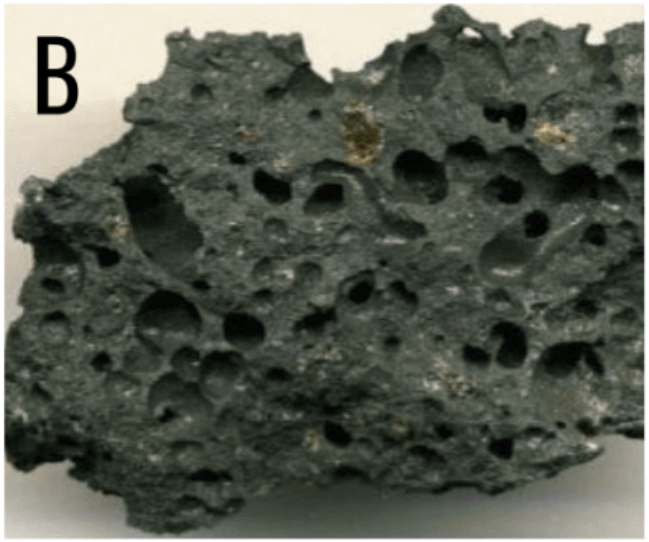
3. How will the engineers know if the solution they choose is actually working to solve the problem of landslides? Given what you know about landslides, what would you use as the ***criteria*** for success?

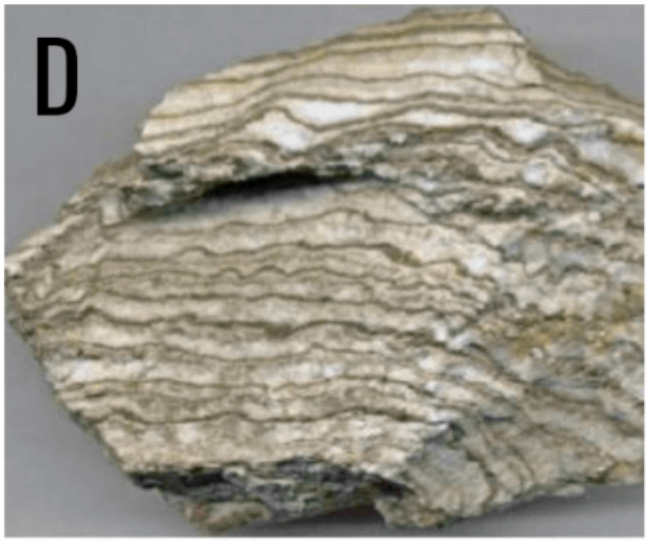
a. There are fewer rainstorms that occur in the city each year.
b. There are fewer rocks that fall into the city each year.
c. There are fewer people who live in Slide City each year.
d. There is no way to know if this solution is successful.

Story of a Rock Part 1

Name _____







Task: A group of geologists spent the summer collecting samples of the rocks found in many locations. They took photos of each place that they collected rocks and marked that place on a map. They carefully labeled where each rock came from. Unfortunately, on the trip back home, a box of rocks fell over. Every rock was separated from the label that identified where it had been found. It's a disaster for the research project!

Working with a partner, you will look for clues about where these rocks came from. Then you'll match the rocks to the locations where the geologists found them.

Story of a Rock Part 1

Name _____

Step 1: **Look for clues.**

Write down what you notice about each rock. What could that tell you about its history?

	What do you notice about this rock?	**What clues does this give you about where the rock may have come from?**
Rock A		
Rock B		
Rock C		
Rock D		

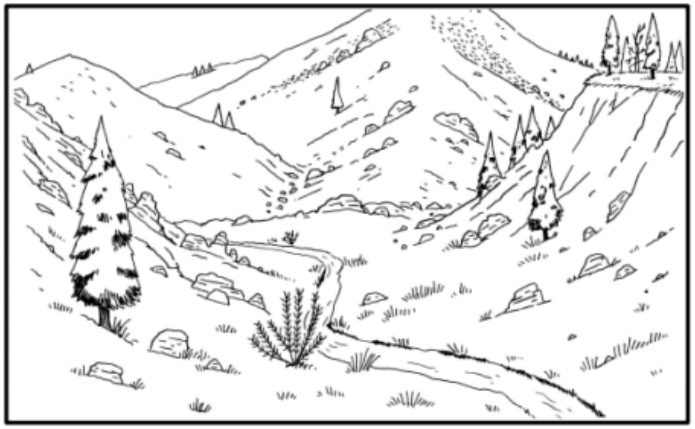
Story of a Rock Part 2

Name _____

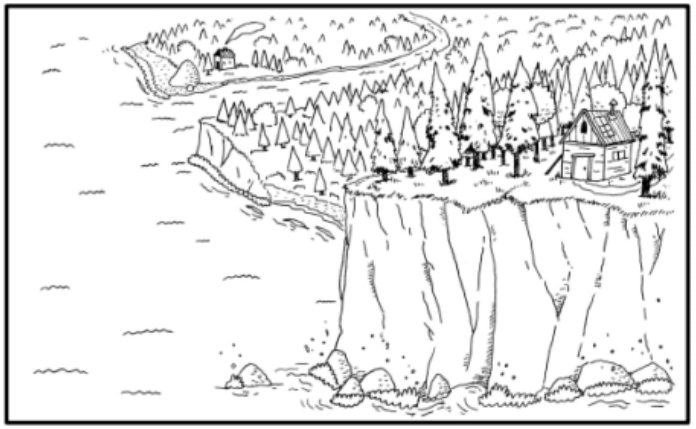
Step 2: **Consider the possibilities.**

Each time the geologists collected a rock, they drew a sketch of the location and took a photo.

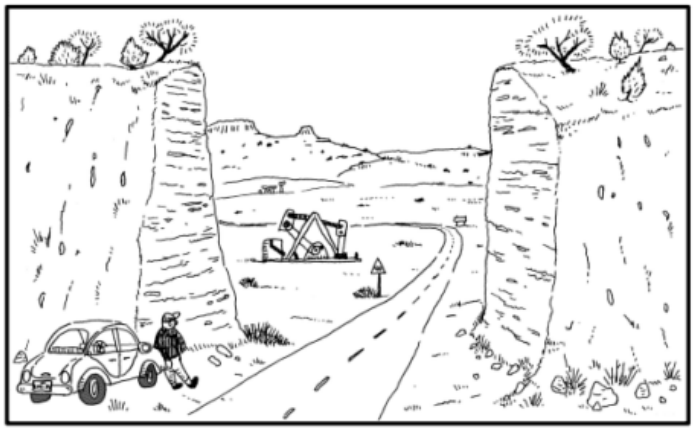
Cut out each sketch. Then, use the clues in the location sketch and photo to help you figure out the location each rock came from.



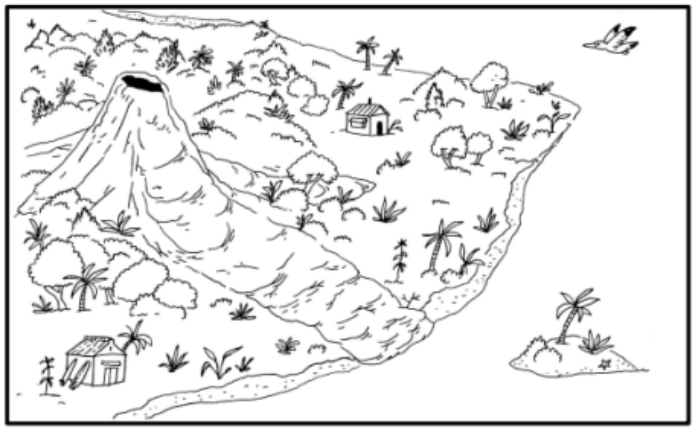
Location 1: Valles Caldera
(New Mexico, USA)



Location 2: Iona's Beach, Lake Superior
(Minnesota, USA)



Location 3: Permian Basin, Eddy County
(New Mexico, USA)



Location 4: Kilauea Volcano, Kapoho
(Hawaii, USA)

Story of a Rock Part 2

Name _____

Step 3: **Refine your choices.**

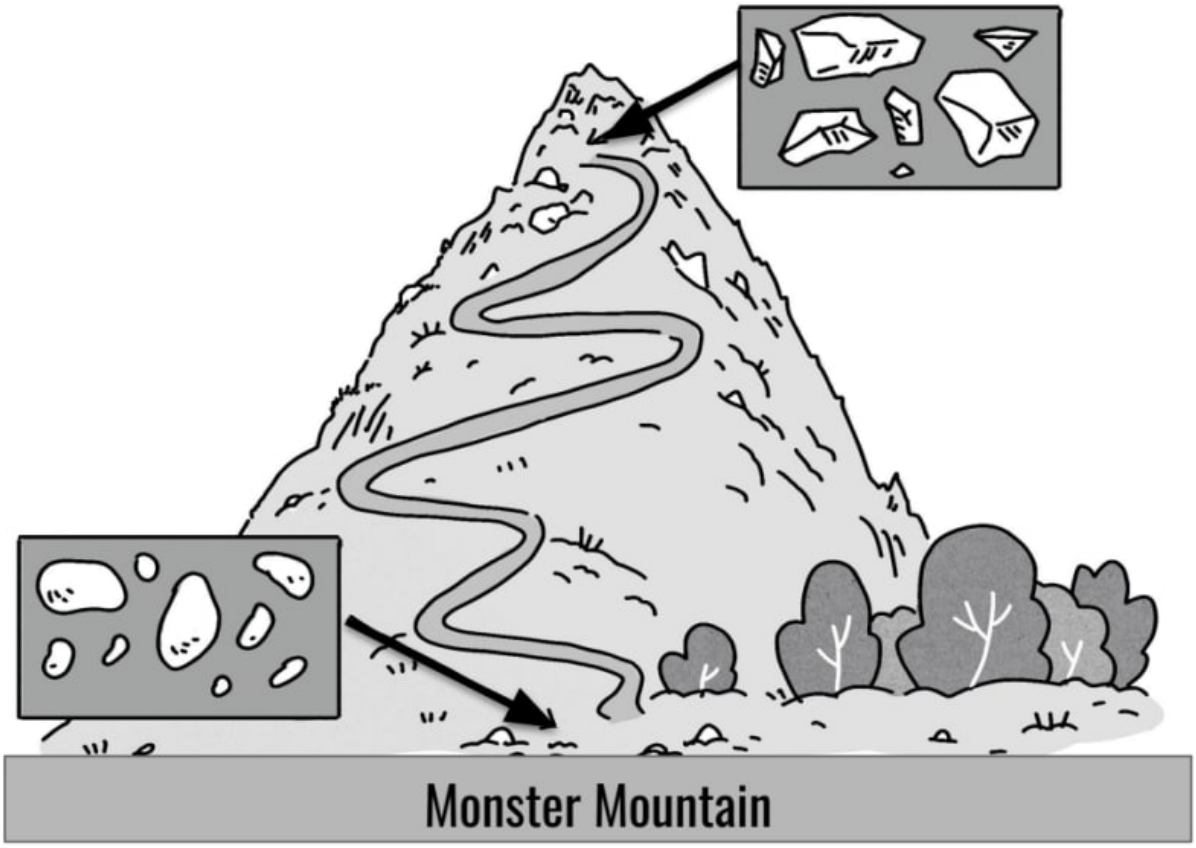
Write down which rock came from each location. Support your choice with evidence from the rocks, location sketches, and photos.

	Which rock came from here?	**What evidence do you have for this claim?**
Location 1		
Location 2		
Location 3		
Location 4		

Name: _____

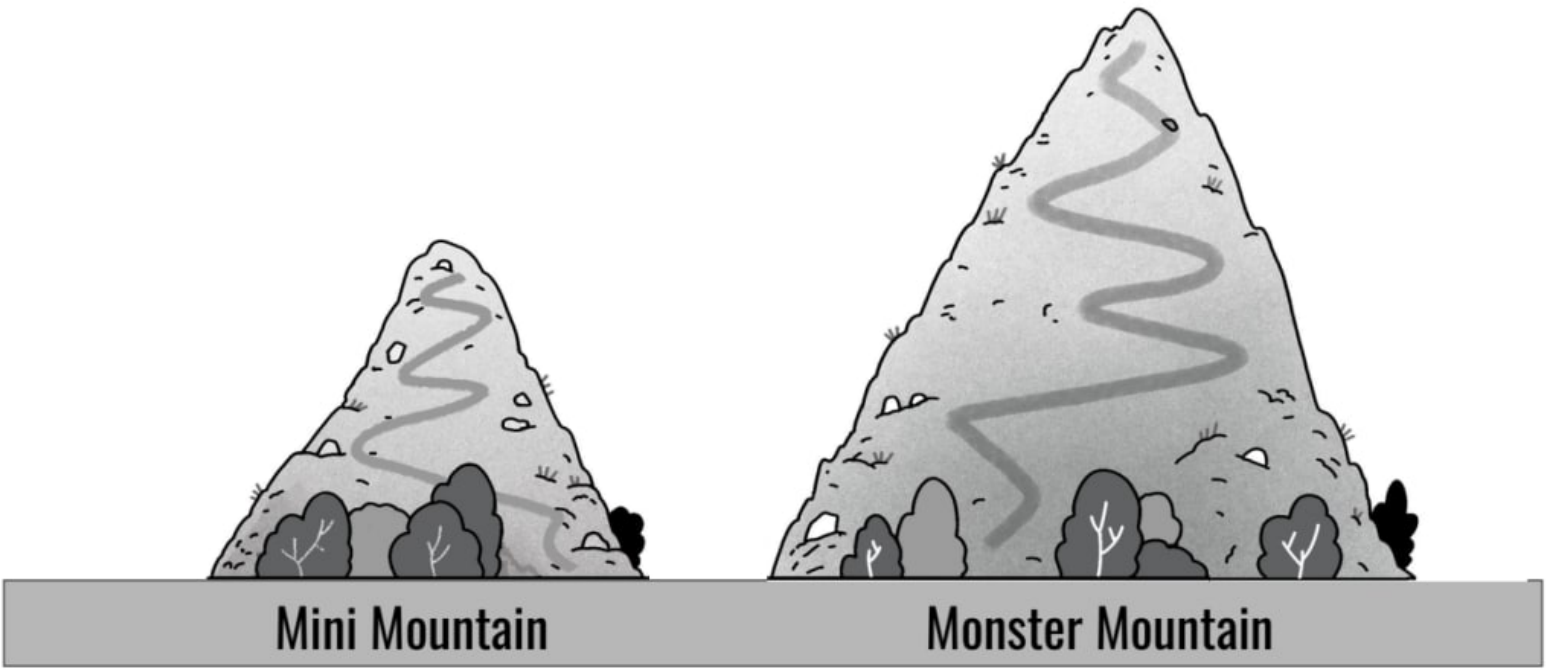
Date: _____

Unit Assessment



1. Alessandra recently learned that mountain rocks can break into smaller pieces (weathering) and can then be moved from one location to another by water, wind, or gravity (erosion). But she is curious if rocks continue to break down as they move from the top of mountains to the bottom. Alessandra takes photos of rocks at the top and at the bottom of Monster Mountain. Some of her photos are shown above. What evidence do you see in Alessandra's photographs that the rocks have continued to break down as they moved from the top of Monster Mountain to the bottom of Monster Mountain? There may be more than 1 correct answer. Circle all the correct answers.

a. The rocks at the bottom of the mountain have smoother edges compared to the rocks at the top of the mountain.
b. There are more trees at the bottom of the mountain compared to the top of the mountain.
c. There are more small rocks at the bottom of the mountain compared to the rocks at the top of the mountain.
d. The rocks at the bottom of the mountain are darker in color compared to the rocks at the top of the mountain.

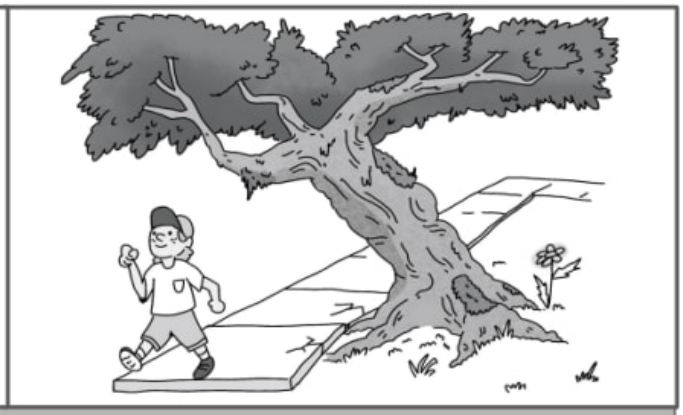


2. In Alessandra's town there is another mountain called Mini Mountain. Mini Mountain is right next to Monster Mountain. What would **most likely** cause the rocks at the bottom of Mini Mountain to be less eroded than rocks at the bottom of Monster Mountain? Pick the best answer.

a. There are more rivers flowing down Monster Mountain compared to Mini Mountain.
b. There is more distance for rocks to fall down Monster Mountain compared to Mini Mountain.
c. There is more wind blowing across Monster Mountain compared to Mini Mountain.
d. There are more trees on Monster Mountain compared to Mini Mountain.

3. Monster Mountain is twice as tall as Mini Mountain. Alessandra wonders: **"Would rocks halfway down Monster Mountain look the same as rocks at the bottom of Mini Mountain?"**

Describe what observations or measurements Alessandra could make to answer her question.

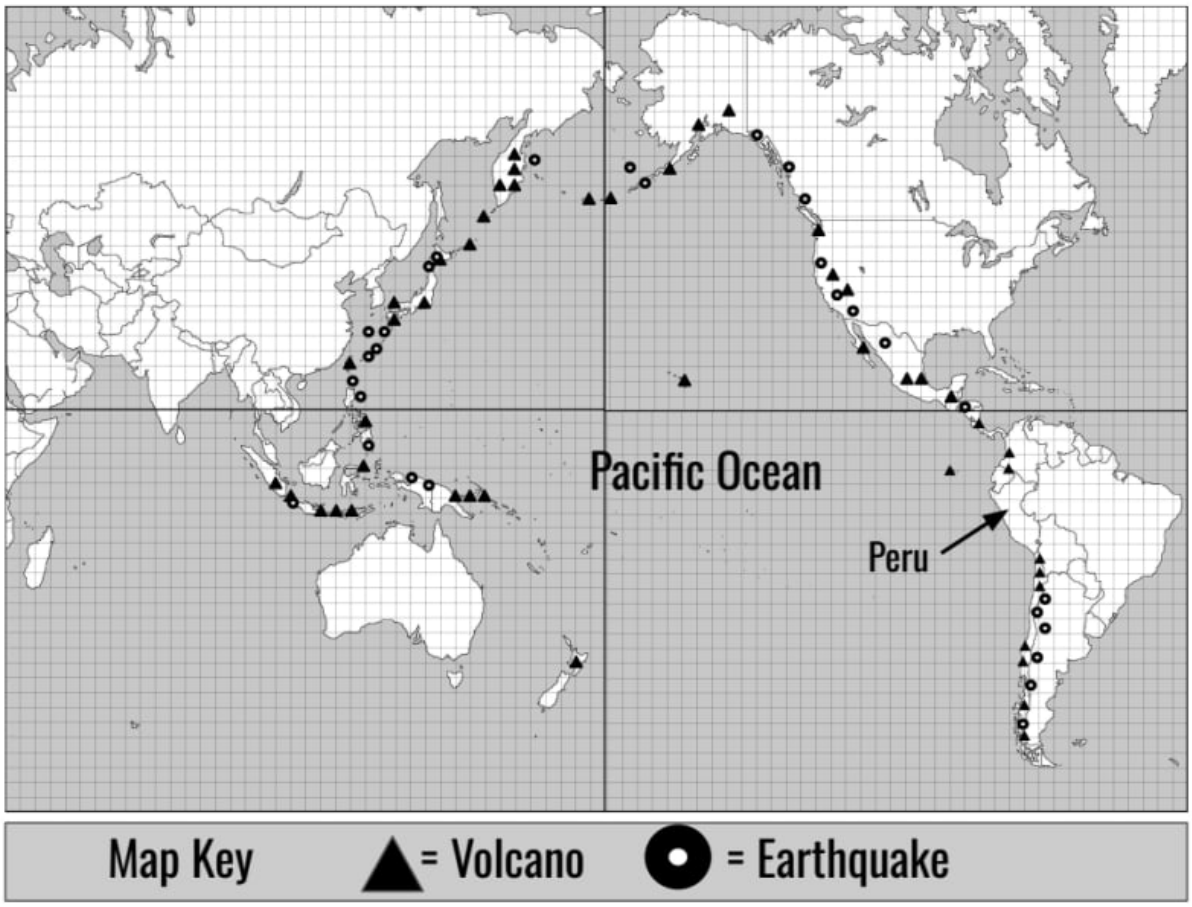
	
New Jersey	**Florida**
Jayla lives in New Jersey. During the winter, snow and ice cover the ground. The sidewalks in Jayla's neighborhood have lots and lots of cracks.	Aiden lives in Florida. During the winter, it never snows. The sidewalks in Aiden's neighborhood have a few little cracks.

4. Aiden and Jayla recently learned that weathering (root wedging and ice wedging) breaks down rocks. They think that root wedging and ice wedging have caused the cracks in the sidewalks where they live. Why do sidewalks in New Jersey have so many more cracks than the sidewalks in Florida?

a. Only ice wedging is causing the sidewalk cracks in New Jersey. Both root wedging and ice wedging are causing the sidewalk cracks in Florida.
b. Only ice wedging is causing the sidewalk cracks in Florida. Both root wedging and ice wedging are causing the sidewalk cracks in New Jersey.
c. Only root wedging is causing the sidewalk cracks in New Jersey. Both root wedging and ice wedging are causing the sidewalk cracks in Florida.
d. Only root wedging is causing the sidewalk cracks in Florida. Both root wedging and ice wedging are causing the sidewalk cracks in New Jersey.

5. Jayla and Aiden wonder: ***"Do the cold New Jersey winters affect how many cracks appear in the sidewalk?"*** To answer their question, Jayla and Aiden decide to carry out a science investigation. They first need to find evidence that there are more sidewalk cracks in New Jersey compared to sidewalks in Florida. Which of the following could be used as evidence to answer their question? There may be more than 1 correct answer. Circle all the correct answers.

a. They can make observations and count how many sidewalk cracks they notice along 3 streets in their neighborhoods. Then they can compare their observations.
b. They can make observations and count the number of houses they notice along 3 streets in their neighborhoods. Then they can compare their observations.
c. They can take measurements of the cracks that they notice along 3 streets in their neighborhoods. Then they can compare their measurements.
d. They can use rulers to take measurements of the mushrooms that they notice along 3 streets in their neighborhoods. Then they can compare their measurements.



The map above shows the locations of active volcanoes and recent earthquakes. Use the information from this map to answer Questions 6 and 7.

6. Isabella lives in Peru. The arrow on the map shows where Peru is located. Do you think a volcano could pop up where Isabella lives?

a. No, I do not think a volcano could pop up where Isabella lives. The pattern of volcanoes on the map shows that it's not possible for a volcano to pop up in this location.
b. No, I do not think a volcano could pop up where Isabella lives. The map shows that there isn't a volcano where she lives so it could never happen.
c. Yes, I think a volcano could pop up where Isabella lives. The pattern of volcanoes shows that it's possible for a volcano to pop up in this location.
d. Yes, I think a volcano could pop up where Isabella lives. The map shows that there is already a volcano where she lives.

7. What observations can you make from the map of volcanoes and earthquakes?

Circle **True** or **False** for each sentence.

True	False	Volcanoes form a pattern around the Pacific Ocean. The pattern is in the shape of a ring or horseshoe.
True	False	Earthquakes do not form any kind of pattern.
True	False	Volcanoes and earthquakes have similar patterns of where they are located.

8. Kenji finds some interesting black rocks next to a hill. The hill is very close to where Kenji lives. Kenji shows the rocks to a scientist, who tells him that the rocks are basalt. Basalt is a type of rock that is formed after lava erupts from volcanoes, but there currently aren't any volcanoes where Kenji lives.

Do you think that there used to be a volcano where Kenji lives? Why or why not? Support your answer with evidence.

_____

_____

_____

_____

_____

9. What would be additional evidence that Kenji could use to support a claim that there used to be a volcano where he lives? There may be more than 1 correct answer. Circle all the correct answers.

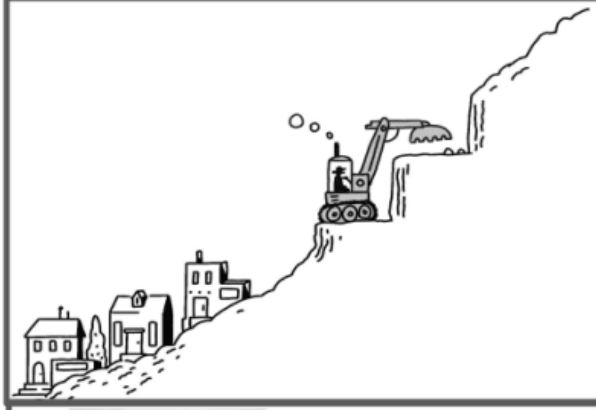
a. If Kenji finds more basalt rocks where he lives, this is more evidence to support his claim.
b. If Kenji finds other types of rock where he lives, this is more evidence to support his claim.
c. If Kenji finds more hills with basalt rocks near them in his neighborhood, this is more evidence to support his claim.
d. If Kenji finds more hills, but without basalt rocks near them in his neighborhood, this is more evidence to support his claim.

Landslides can occur when there is a hill with a very steep slope that has lots of loose rocks that can slide down after it rains. Slide City experienced a landslide last year that destroyed several houses. The city wants to prevent future landslides from happening. The following three solutions were presented to the mayor of Slide City.

Solution #1: Build a Giant Umbrella.

A giant umbrella will prevent rain from falling on the hill. This will reduce the amount of water that washes rocks down the hill.

Cost: $500,000



Solution #2: Dig Steps Into the Hill.

A construction company will use machines to carve large steps into the side of the hill. The steps will reduce the slope and catch falling rocks.

Cost: $9,000

Solution #3: Pick Up Loose Rocks.

People from the town can help pick up loose rocks on the hill. This will reduce the number of rocks that can slide down the hill.

Cost: $700

10. Slide City has a budget of $10,000 to fix their landslide problem. Which solution would you choose? Why? Explain why your solution is the best option for Slide City.

mystery science

Sound, Waves, & Communication

4th Grade • NGSS • Unit Worksheets

Lesson 1

How do you send a secret code?

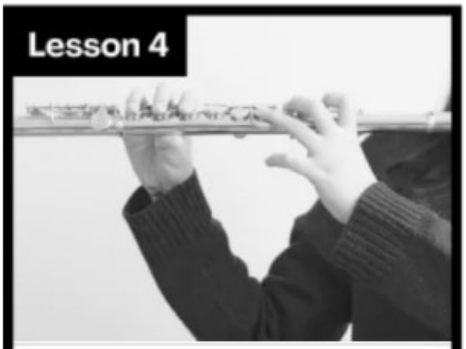
Lesson 2

How far can a whisper travel?

Lesson 3

What would happen if you screamed in outer space?

Lesson 4



Why are some sounds high and some sounds low?

I am also curious about...

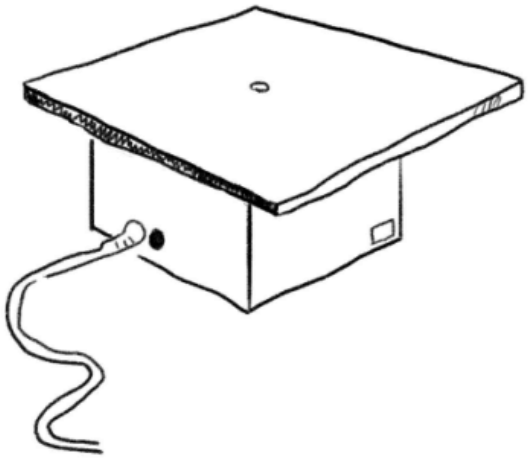
Seeing Sound

Metal Plate

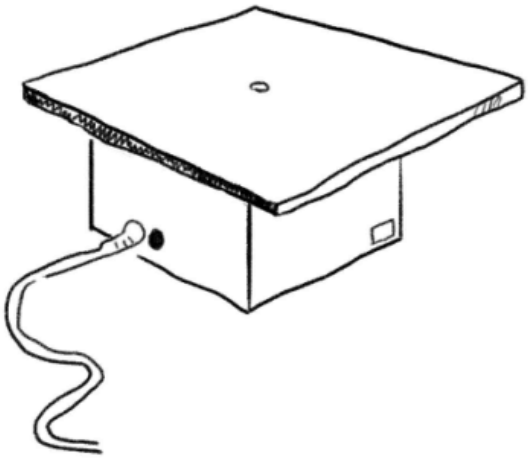
Name: _____

Directions: Use labels and symbols to show how the pattern on the Metal Plate changes and how the device makes sound waves visible. Use the lines below to help you explain the device.

No Sound



Sound



Explanation: _____

_____

_____

_____

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_____

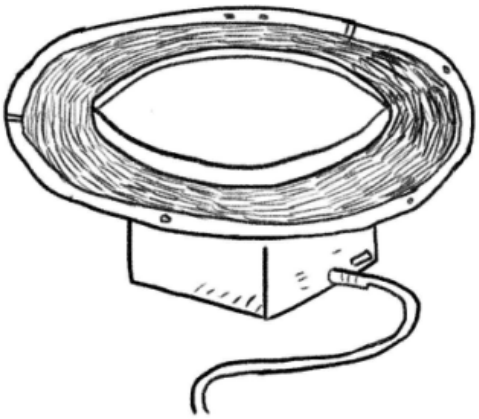
Seeing Sound

Name: _____

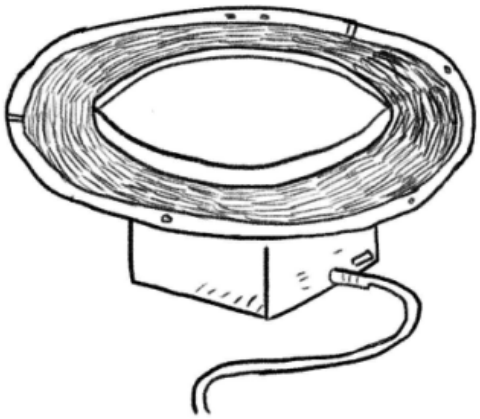
Speaker Dish

Directions: Use labels and symbols to show how the pattern in the Speaker Dish changes and how the device makes sound waves visible. Use the lines below to help you explain the device.

No Sound



Sound



Explanation: _____

_____

_____

_____

_____

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_____

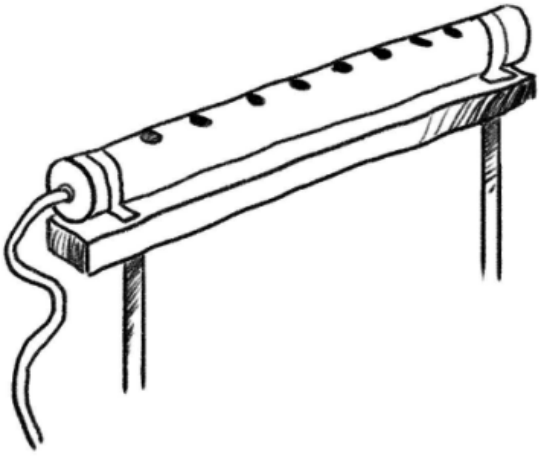
Seeing Sound

Ruben's Tube

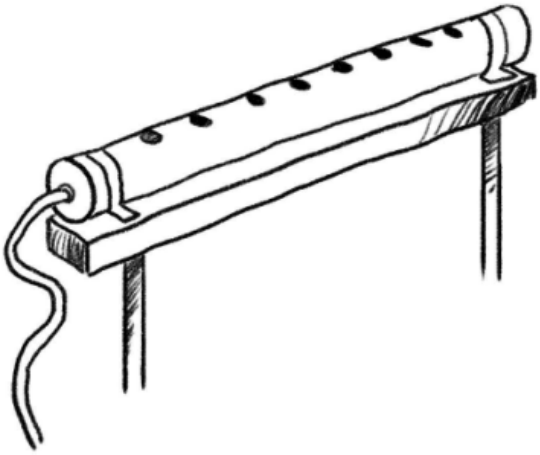
Name: _____

Directions: Use labels and symbols to show how the pattern on Ruben's Tube changes and how the device makes sound waves visible. Use the lines below to help you explain the device.

No Sound



Sound



Explanation: _____

_____

_____

_____

_____

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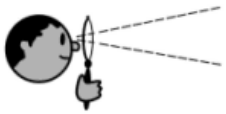
_____

See-Think-Wonder Chart

Name: _____

mystery science

	See What did you observe? 	Think How can you explain what is happening? 	Wonder What questions do you have? 
Metal Plate			
Speaker Dish			
Ruben's Tube			

Sound Code

Name: _____

1. Our favorite Sound Code idea:

This will mean a **black box:**

This will mean a **white box:**

---

2. **Your secret snack:** Write what you will do.

Say "**START**"

Say "**STOP**"

---

3. **Your partner's code:** Write down what your partner does. Double-check what you write down!

Reminder: only listen!

4. What is your partner's secret snack? _____

5. Where and when might a sound code work better than a visual code? Why?

_____

_____

Visual Code

Name: _____

1. Our favorite Visual Code idea:

This will mean a **black box:**

This will mean a **white box:**

---

2. **Your secret snack:** Write what you will do.

---

3. **Your partner's code:** Write down what your partner does. Double-check what you write down!

4. What is your partner's secret snack? _____

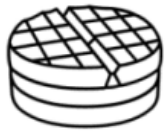
5. Where and when might a visual code work better than a sound code? Why?

_____

_____

Snack Decoder

mystery science
How do you send a secret code?



Name: _____

Date: _____

Lesson Assessment

Jen and Max live across the street from each other. They learned how to send secret codes at school. They wanted to try it at home, so they came up with their own code to send messages. The code has two parts: black and white boxes. Here are their codes:

 = Let's play frisbee	 = Let's play tag

Max and Jen needed to figure out how to send their codes across the street. Jen decided to shine a flashlight across the street to send the code. She made a pattern with two parts: one part for the white boxes, and one part for the black boxes. Here was her pattern:

 = turn the flashlight on	 = turn the flashlight off

1. Help Max come up with a <u>different</u> way to send the codes back to Jen. You can use your imagination for how to do this. There are only three requirements. First, you must have a two-part pattern to send the code. Second, the code must be able to be seen across a street. And third, you must come up with a way that does <u>not</u> use a flashlight.

 = _____ _____ _____	 = _____ _____ _____

2. Imagine that Jen tried to send a code to Max ten times. Five of those times, Max couldn't understand the code. He said, "I couldn't tell when she was starting and stopping." On the lines below, come up with a way to improve how Jen sends her code with a flashlight.

_____

_____

_____

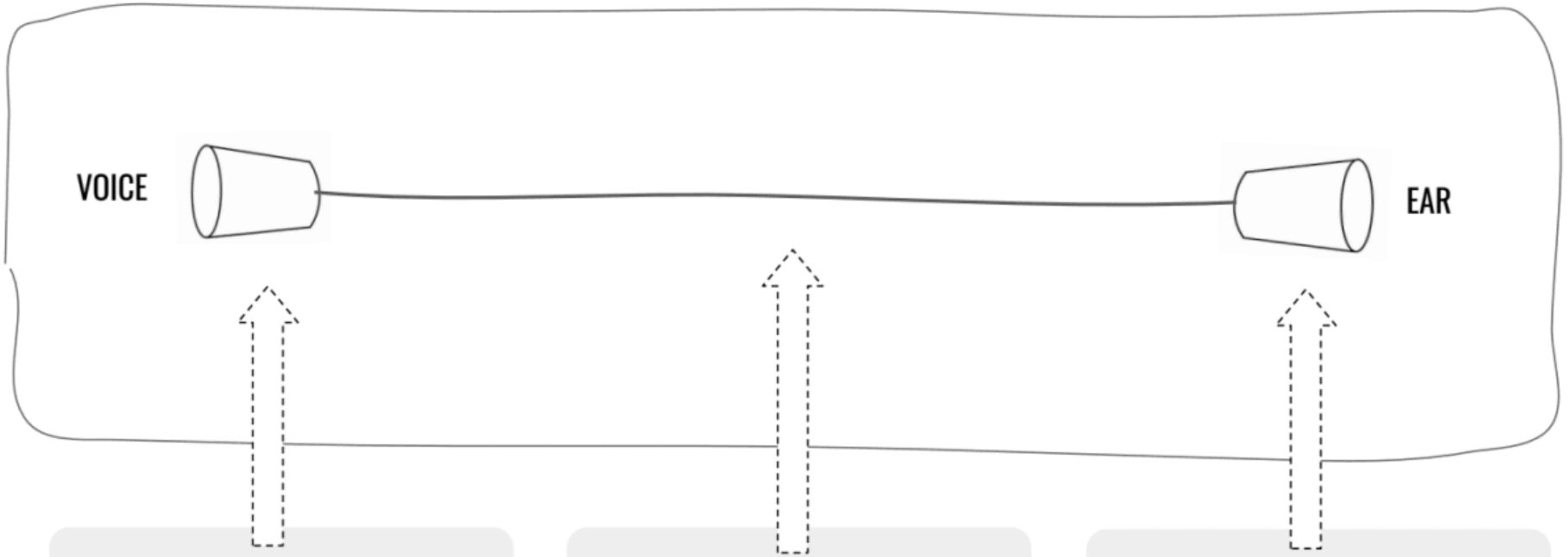
_____

Name: _____

Paper Cup Telephone

1. EXPLAIN HOW IT WORKS

How do you think the paper cup telephone works? Draw and describe what happens to the sound as it goes from cup to cup.



mystery science

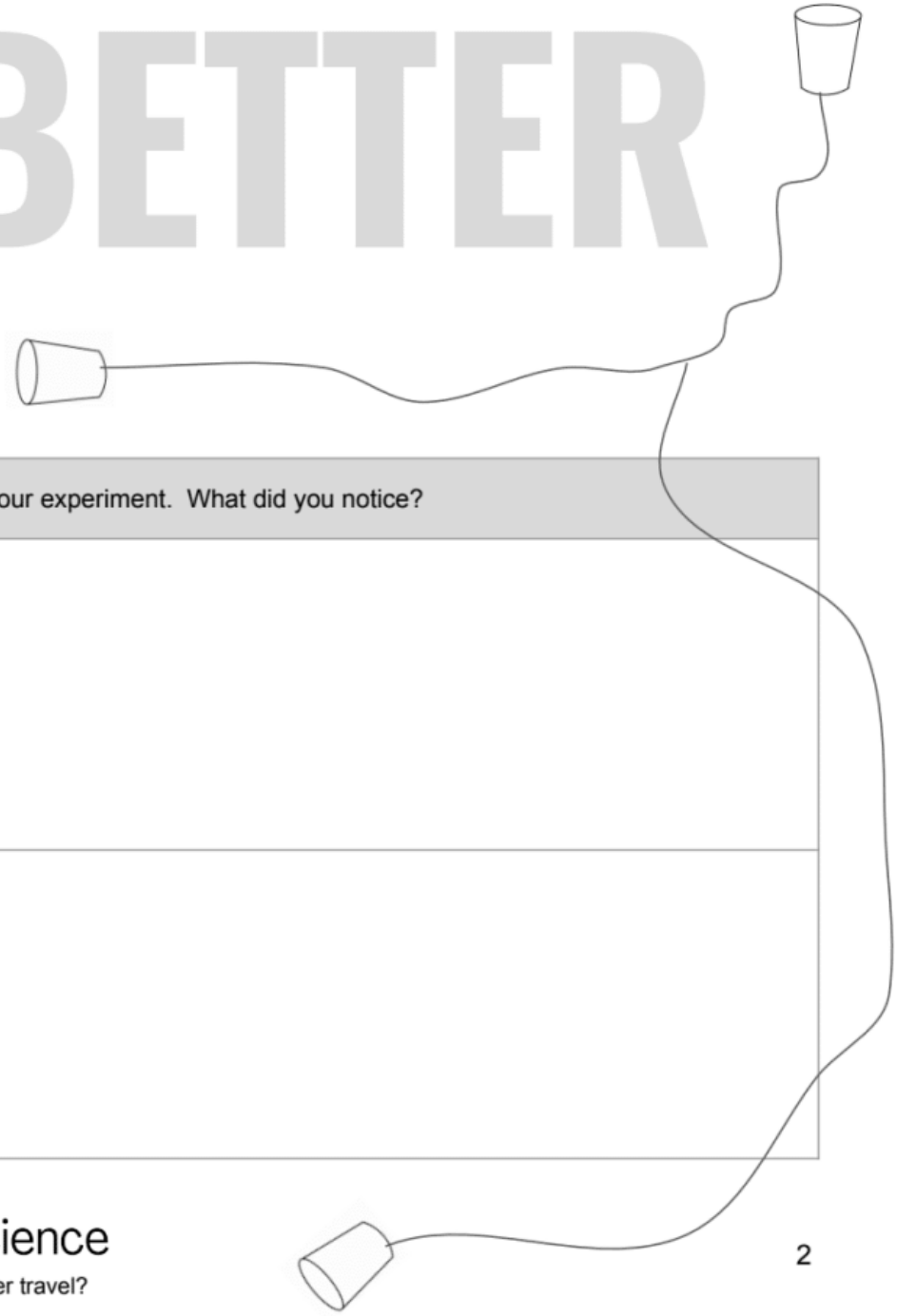
How far can a whisper travel?

Name: _____

2. DISCUSS:

HOW COULD YOU CHANGE YOUR PAPER CUP TELEPHONE TO MAKE IT BETTER?

BETTER



Write 2 ideas to test down here

3. EXPERIMENT!

The 2 experiments you decided on:	Try your experiment. What did you notice?
Here's what we'll do: _____ _____ Here's what we think will happen: _____ _____	
Here's what we'll do: _____ _____ Here's what we think will happen: _____ _____	

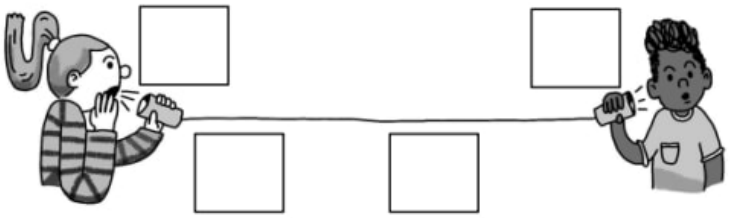
If you need more space, use the back of the page.

Name: _____

Date: _____

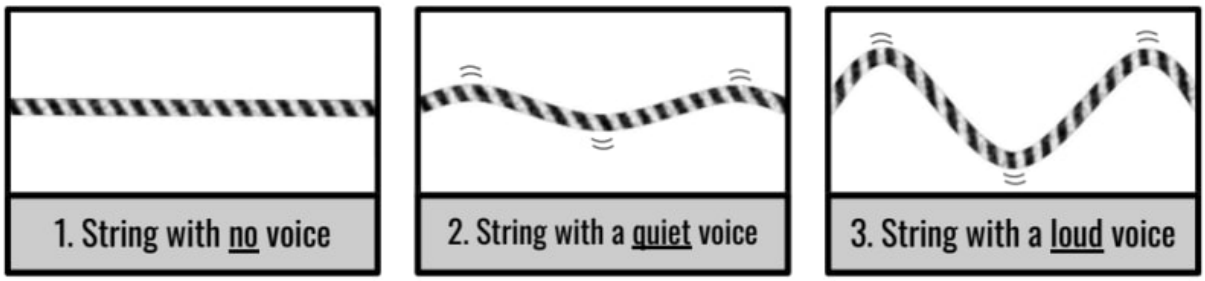
Lesson Assessment

1. Ava and Mateo made a paper cup telephone in school. Each statement below describes how part of the paper cup telephone works. Read each statement. Then, write the matching letter into the correct empty box in the drawing. This will create a model of how the whole paper cup telephone works.



a. The string makes Mateo's cup vibrate.
b. Vibrations travel along the string.
c. Ava's voice makes one cup vibrate.
d. Ava's cup makes the string vibrate.

2. Mateo and Ava could ***hear*** the vibrations in the cups and string. But they wanted to ***see*** the vibrations, so their teacher set up a special camera that could take close-up pictures of the string. They took pictures of the string when they talked quietly and loudly. Study each picture of the string below, and look for a pattern, then answer the following questions.



Circle **True** or **False** for each of the statements below. Use the pictures above to help you decide.

True	False	When there is no voice, there are no vibrations. There are only vibrations when there is a voice making sound.
True	False	When the voice is loud, the vibrations are the same as when the voice is quiet.
True	False	If someone talked with an even louder voice, the vibrations would be even bigger than they are in picture 3.
True	False	If someone talked with a voice between quiet and loud, the vibrations would be bigger than picture 2, but smaller than picture 3.

3. Ava and Mateo wanted to try to improve their paper cup telephone. They found a stretchy rubber string and wanted to see if it worked better than a regular string.

How should they build a new paper cup telephone if they want to figure out which string works best?

a. Put **both** the regular string **and** the stretchy rubber string between two cups.
b. Take the regular string off of the cups and replace it with the stretchy rubber string.
c. Attach one end of the stretchy rubber string to one cup and just hold the other end of the stretchy rubber string between their fingers.
d. Try to use the stretchy rubber string with no cups at all.

Ava and Mateo tested their paper cup telephones with a regular string and a stretchy rubber string. They tested it with quiet voices and loud voices. The results of their test are in the table below. Study their results in the table, then answer the question.

	Regular string	**Stretchy rubber string**
Quiet voice	Could hear	Could NOT hear
Loud voice	Could hear	Could only hear a little

4. Does the paper cup telephone work better with a regular string or a stretchy rubber string? Use the table above to help you answer this question.

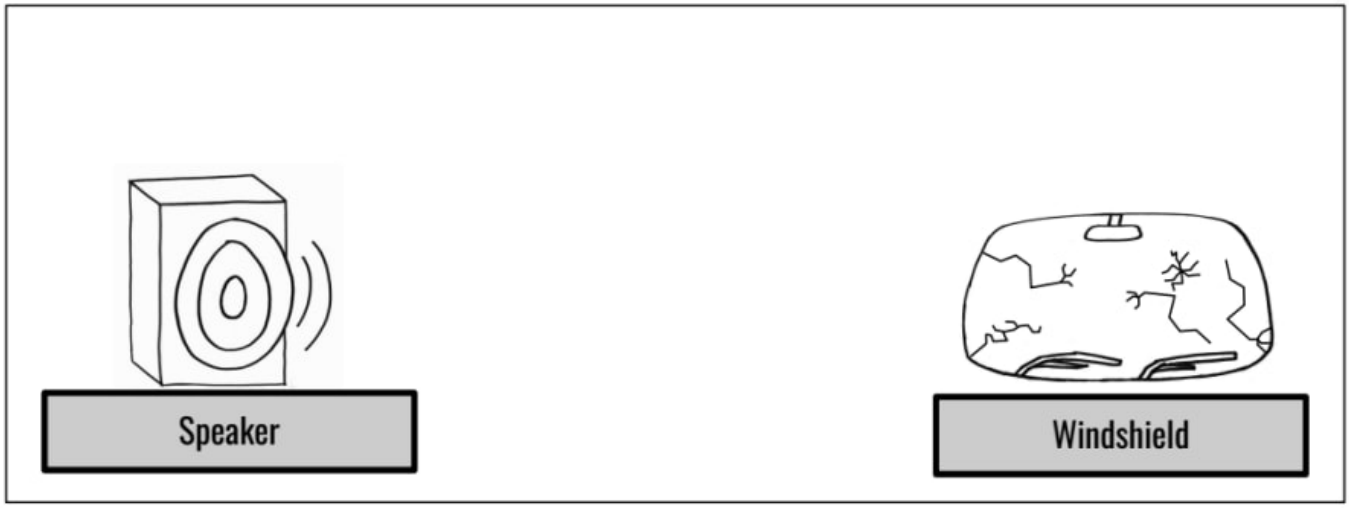
Name: _____

Date: _____

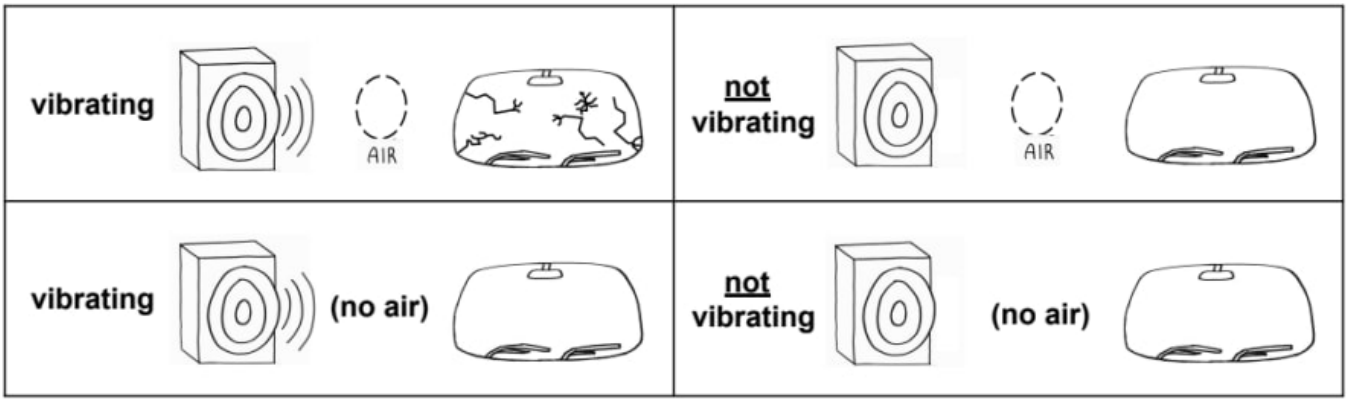
Lesson Assessment

1. The drawing below shows a windshield and a vibrating speaker. Somehow, the vibrating speaker cracked the windshield, even though the speaker isn't touching the windshield.

Add drawings and words in the box below to make a model that shows how the speaker made the windshield move and crack. Hint: You can draw "air blobs" in your model if that helps.



The drawings below show what happens when the speaker is vibrating or not, and when there is air or not. Look at each picture for the **vibrations** and for the **air**. Look for patterns of when the windshield cracks and when it doesn't. Then, answer the question.



3. Circle **True** or **False** for each statement below. Use the drawings above to help you decide.

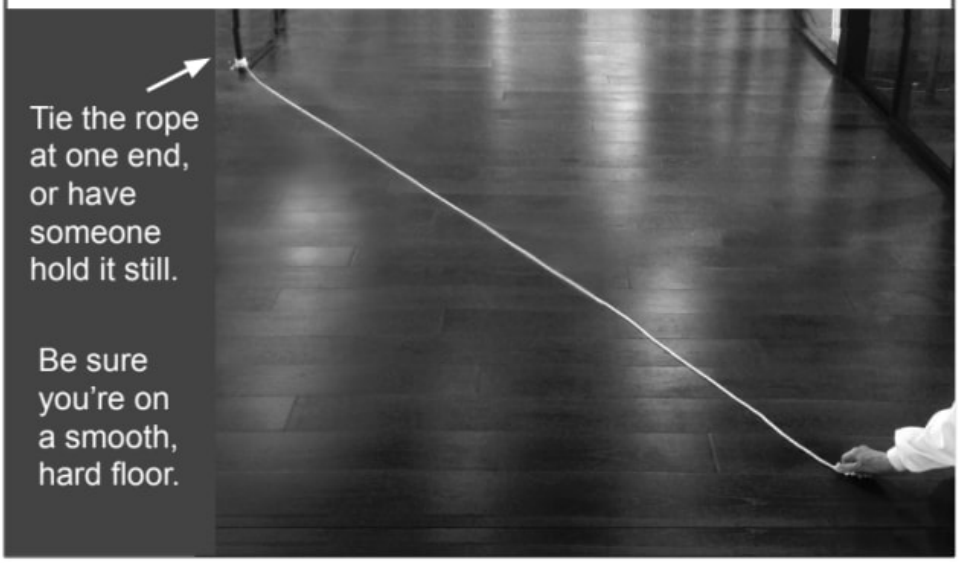
True	False	Sometimes, the speaker cracked the windshield when there was no air.
True	False	Whenever the speaker was vibrating, it always cracked the windshield.
True	False	The windshield cracked only when the speaker was vibrating and there was air.
True	False	Sometimes, the speaker cracked the windshield even when it wasn't vibrating.

Be the Vibration!

Name: _____

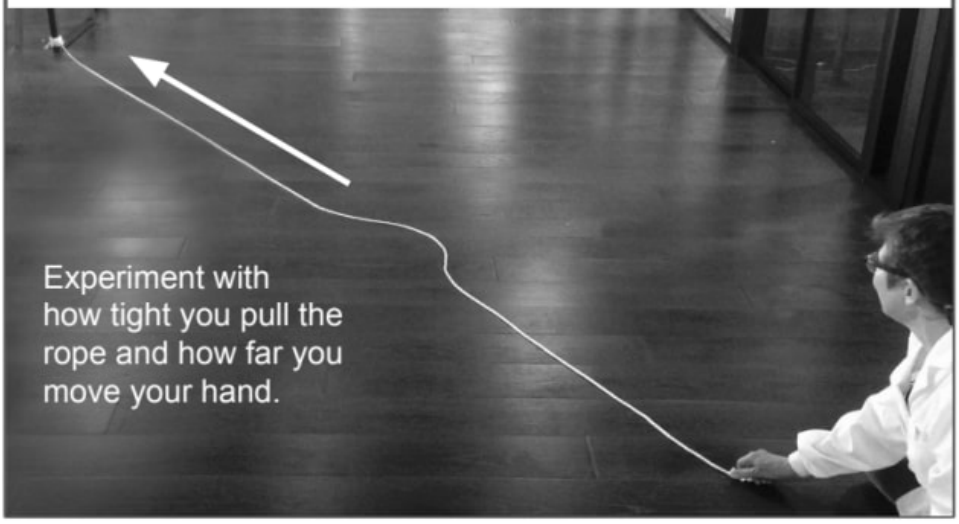
1

Step 1 Make sure you have all your supplies. Your experiment set-up should look like this:



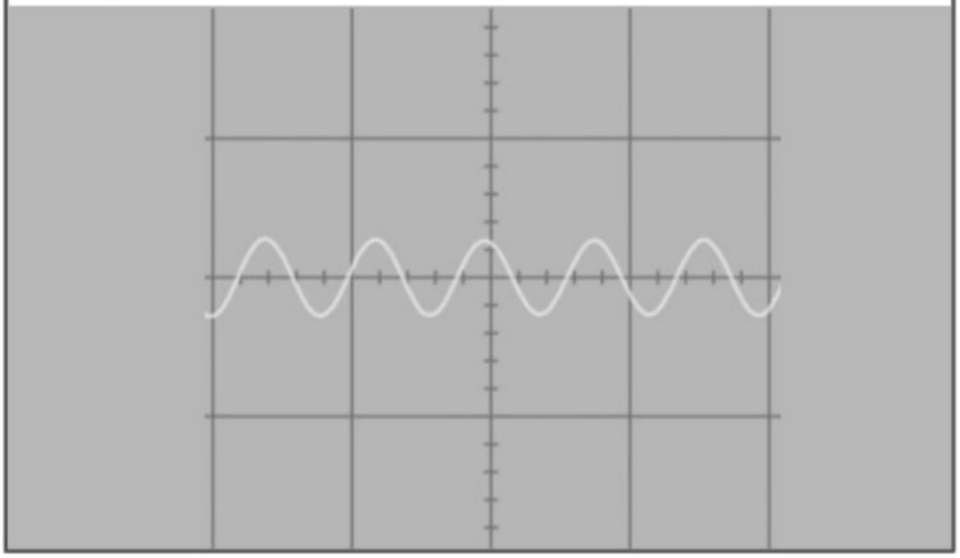
2

Step 2 Make a vibration by jerking your hand to the side and back. Try to make a wave that travels to the end of the rope.



3

Step 3 Challenge! Make waves that look like this oscilloscope picture of a **high**-pitched sound:

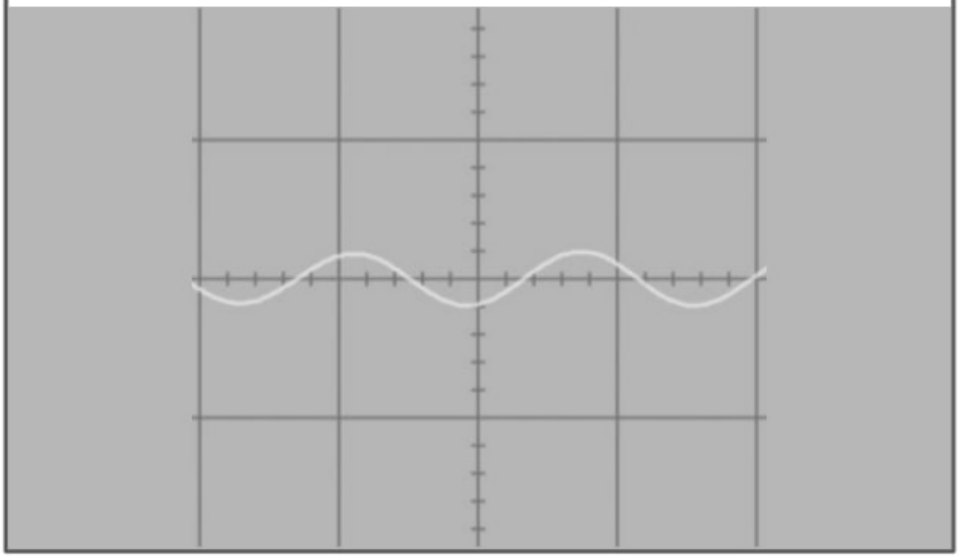


How do you have to vibrate your hand to make waves that are squished together like this?

_____

4

Step 4 Challenge! Make waves that look like this oscilloscope picture of a **low**-pitched sound:



How do you have to vibrate your hand to make waves that are spread out like this?

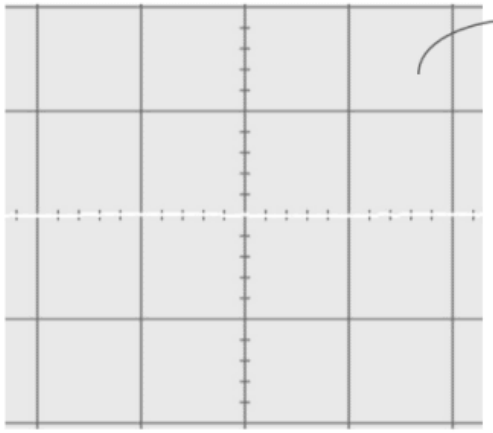
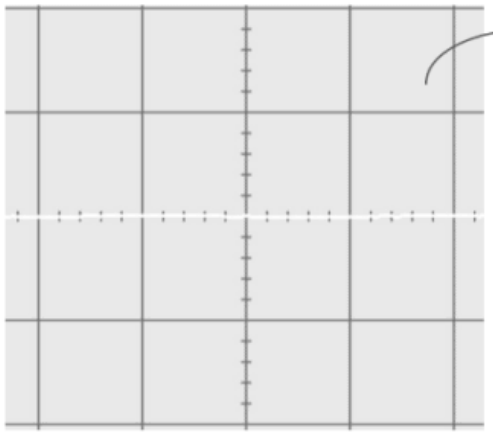
_____

Sound vibrations

Name: _____

mystery science

Why are some sounds high and some sounds low?

PITCH	VIBRATION	HOW THE SOUND WAVE LOOKS	WAVELENGTH
High pitch  *Imagine the sound of a **flute***	The vibration is: _____	 High-pitched sound waves look: spread out squished together	The wavelength is: short long
Low pitch  *Imagine the sound of a **tuba***	The vibration is: _____	 Low-pitched sound waves look: spread out squished together	The wavelength is: short long

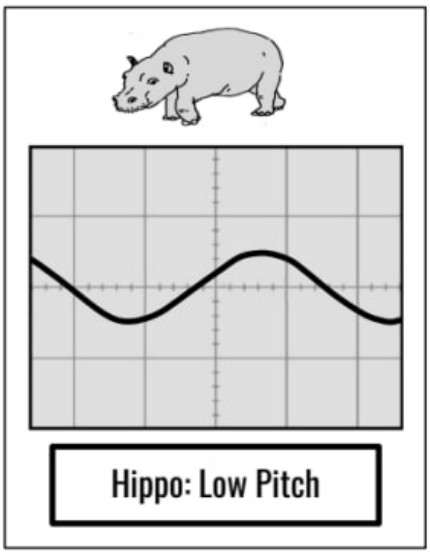
Name: _____

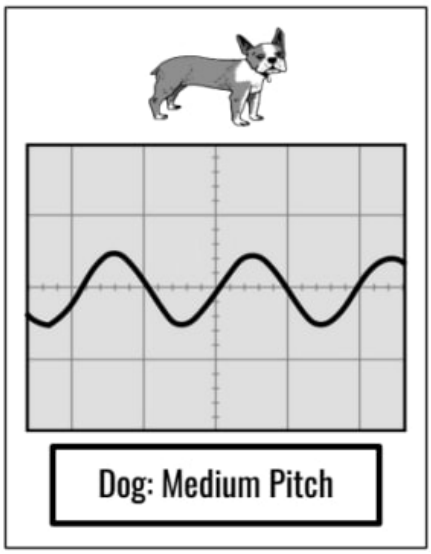
Date: _____

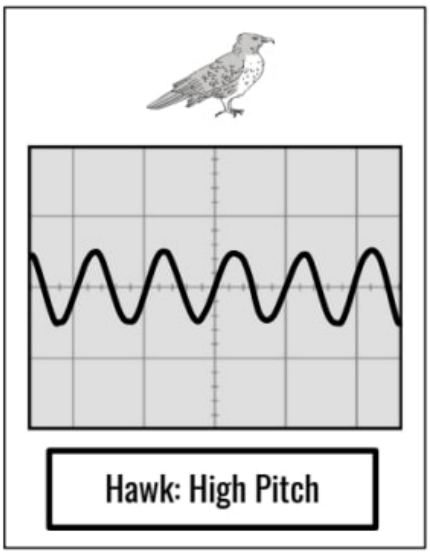
Lesson Assessment

Different kinds of animals can make very different sounds. Some animals can make low-pitched sound waves, while others can make high-pitched sound waves. We can use our ears to hear sound waves, but we can also use special tools to be able to see what sound waves look like.

The pictures below show the sound waves from three different animals: the low pitch of a hippo's grunt, the medium pitch of a dog's bark, and the high pitch of a hawk's screech. Study each sound wave, and then answer the question below.





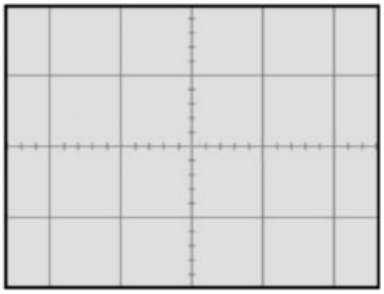


1. Look at the sound waves above and compare the wavelength and pitch of each one. What is the **pattern** when you compare the wavelength and pitch of the sounds? Circle the correct answers below. There may be more than one correct answer.

a. There is no pattern between wavelength and pitch.
b. The longer the wavelength, the lower the pitch of the sound.
c. Higher and higher pitched sounds have shorter and shorter wavelengths.
d. All sound waves have the same wavelength.

2. Bats can make even higher pitched sounds than hawks. (Look above to see the pattern of how sound waves change as pitch gets higher. Bats make even higher pitched sound waves than hawks!)

In the gray box below, draw what a very high-pitched sound wave from a bat might look like. Then, on the empty lines, explain why a high-pitched sound wave might look the way that you drew it.



_____

_____

_____

_____

Name: _____

My Sound Wave Watcher

Part 1: You've been invited to make an exhibit for the International Museum of Interesting Sounds. The museum wants to fill a room with devices that make sound waves visible.

1. **Brainstorm** Write or draw at least 3 ideas for a Sound Wave Watcher in the boxes.

   For each idea, include a sound source (something that makes sound) and a sound detector (something that shows the vibrations of sound waves).

Idea #1

Idea #2

Idea #3

Name: _____

2. Design & Test

Choose your best idea (or two ideas) and build your device. Test your device with your partner by asking them to use and explain your device.

a. What is the sound source for your device?

b. How does your device make sound waves visible?

3. Reflect & Improve

Think about what you can improve on your device. You can use our ideas or come up with your own.

Things I can improve on my device	Ways to improve

Suggested improvements to try:

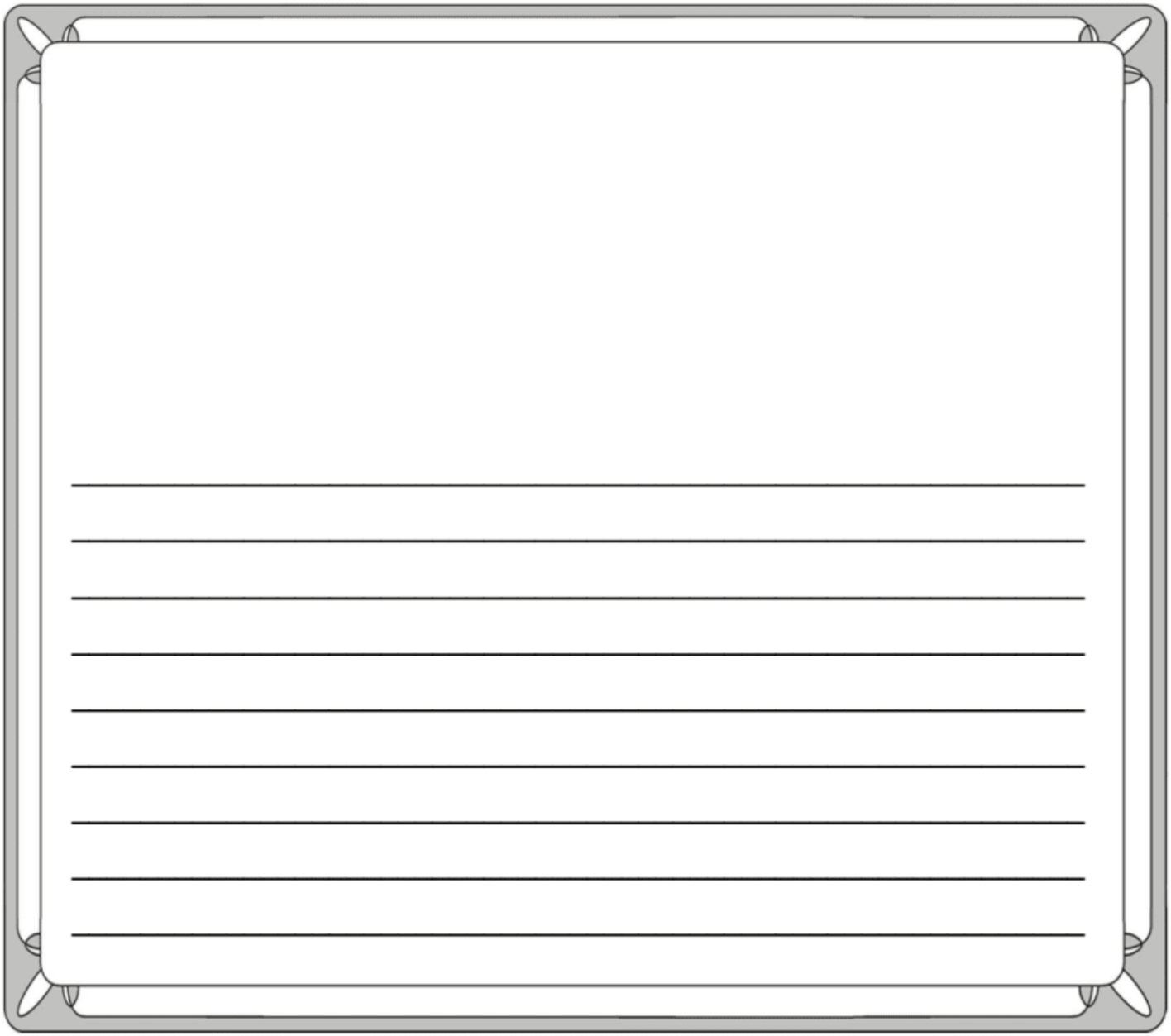
- ❑ Use a sound that has a higher or lower pitch.
- ❑ Turn up the volume—make a louder sound.
- ❑ Find a sound detector that vibrates more easily.
- ❑ Add a sound box (like the body of a guitar). *Sound waves bounce around inside the box, adding up to a bigger vibration.*

Waves of Sound
Final Project

Name: _____

Part 2: You'll need to tell museum visitors how to use your device and how it works. You can write and draw to explain your device. Your sign must include:

- ❏ How to use the device
- ❏ What sound works best
- ❏ How to see the sound waves
- ❏ How the sound travels from the sound source to the Sound Wave Watcher



Sound, Waves, & Communication

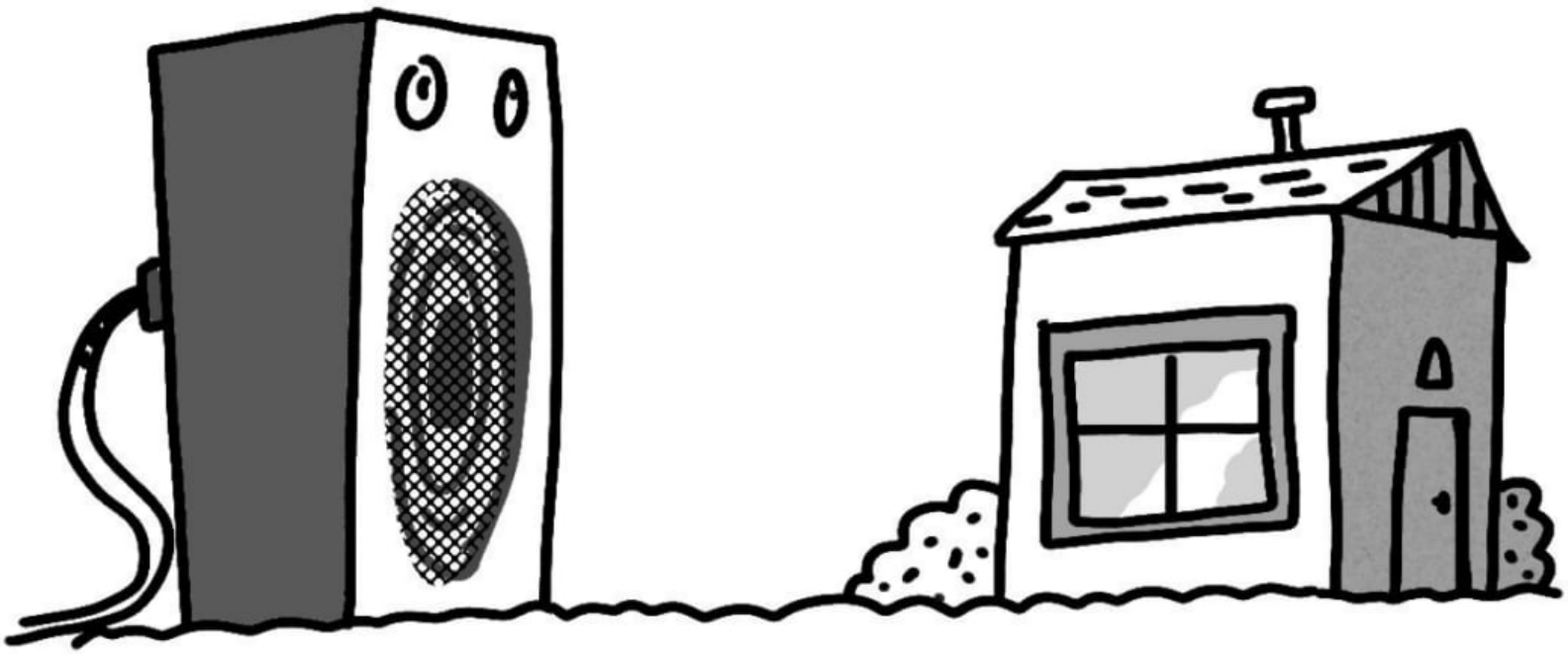
Name: _____

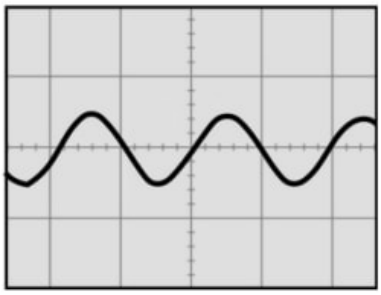
Date: _____

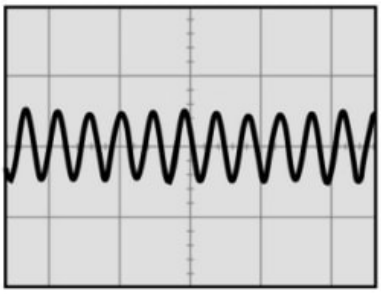
Unit Assessment

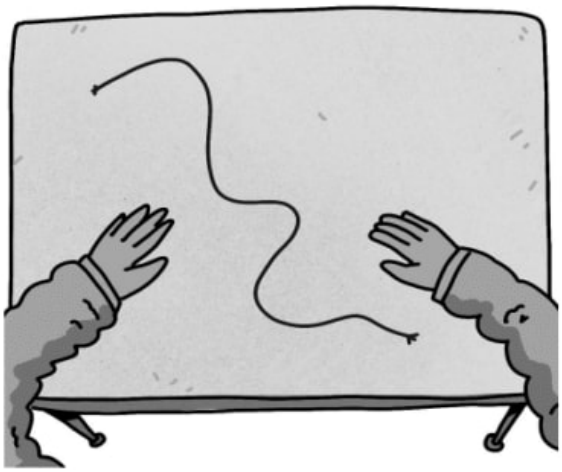
1. Isaiah has built a giant speaker so that he can play music really loudly. He has set the speaker right outside his neighbor's house. Draw arrows and add words to the image below to show a model of what will happen to the glass window of the house when Isaiah starts playing music using the large speaker.

Hint: You can add "air blobs" to your model if that helps.









You recently learned about the wavelengths of sound waves. You've learned that different sounds have different wavelengths. For example, a tuba makes a low sound that has a long wavelength, but a flute makes a high sound that has a short wavelength. Pretend your teacher has given you a long piece of string and asked you to use it to model what sound waves look like. You can lay the string on your desk and bend it to make different wave shapes.

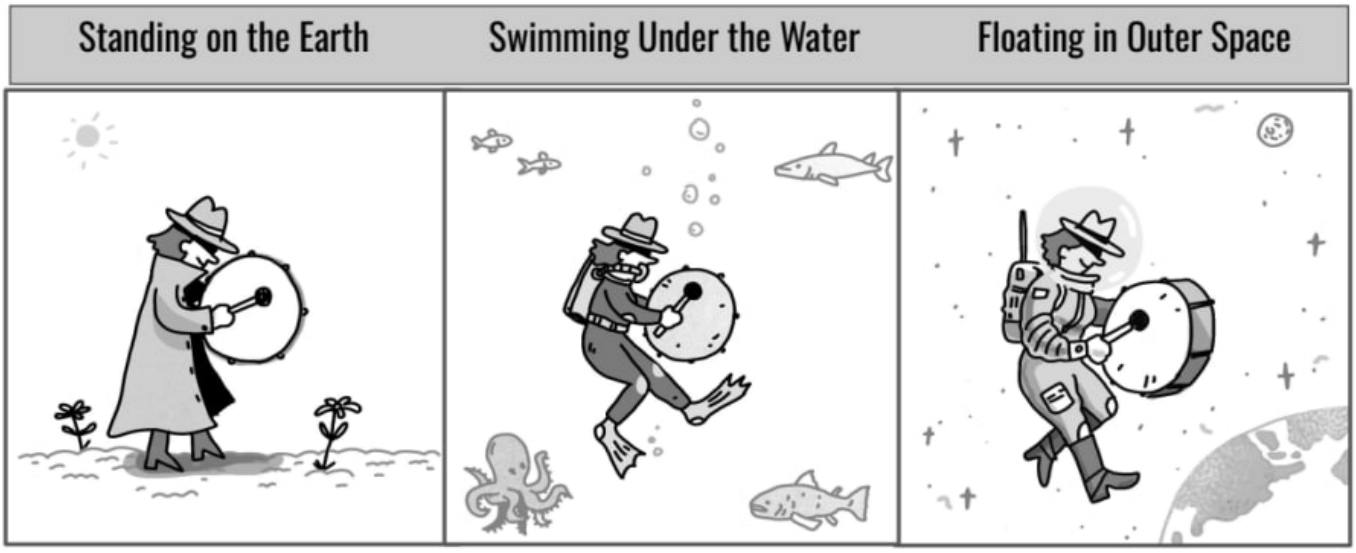
2. Imagine your teacher plays the high-pitched sound of a bird singing. Draw what the string on your desk should look like when you use it to create a model for the sound waves of the bird song.

3. Imagine your teacher plays the low-pitched sound of a whale singing. Draw what the string on your desk should look like when you use it to create a model for the sound waves of the whale song.

4. Leketa is a secret agent. She needs to send secret messages to her partner, Daniel. Leketa uses the sound waves from the beat of a drum to send her messages. Leketa and Daniel create a secret code using a pattern of drum beats to communicate with one another.
Here's their secret code:

BAM-BAM-BAM	means "Danger!"
BAM-BAM	means "Mission Accomplished!"
BAM	means "Send Help!"

Leketa bangs on her drum from three different locations: standing on the Earth, swimming under the water, and floating in outer space.



In which of the following places would using a drum work to send her secret messages?

a. The drum will work on Earth, under the water, and in outer space.
b. The drum will work on Earth and under the water. The drum will not work in outer space.
c. The drum will work on Earth and in outer space. The drum will not work under the water.
d. The drum will work under the water and in outer space. The drum will not work on Earth.

5. Why did you choose your answer to Question 4? Explain in terms of sound waves.

6. Mateo and Ava made a paper cup telephone that they use to communicate with one another. But there is a problem: The string is too long, so there is a lot of distance between the two paper cups. Mateo can hear sounds when Ava speaks, but he cannot hear the exact words. Mateo thinks that they can solve the problem if they develop a code **using a pattern of sounds**. Generate at least two different ideas that Ava and Mateo could use to communicate with a sound pattern when they use the cups and string. Be sure to explain how each solution would work.

Solution 1:

_____

_____

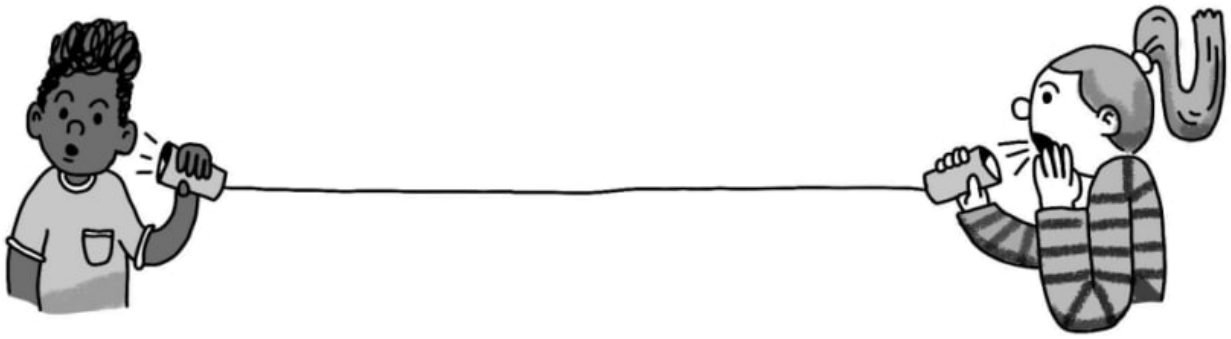
_____

Solution 2:

_____

_____

_____



7. Mateo and Ava want to compare the solutions that you came up with to see which one will work better. Using the two solutions that you generated above, how could Ava and Mateo test these solutions to compare them and see which one works the best? Choose the best answer.

a. Ava sends a message using Solution 1 that instructs Mateo to sit down. Mateo hears the sound pattern and sits down. This is evidence that Solution 1 is better than Solution 2.
b. Ava sends a message using Solution 2 that instructs Mateo to stand on one foot. Mateo hears the sound pattern and stands on one foot. This is evidence that Solution 2 is better than Solution 1.
c. Ava sends a message using Solution 1 that instructs Mateo to sit down. Mateo hears the sound and sits down. Ava then sends a message using Solution 2 that instructs Mateo to stand on one foot. Mateo doesn't stand on one foot. This is evidence that Solution 1 is better than Solution 2.
d. Ava sends a message using Solution 1 that instructs Mateo to sit down. Mateo hears the sound and sits down. Ava then sends a message using Solution 2 that instructs Mateo to stand on one foot. Mateo doesn't stand on one foot. This is evidence that Solution 2 is better than Solution 1.

mystery science

Energy & Energy Transfer

4th Grade • NGSS • Unit Worksheets

Lesson 1

How is your body similar to a car?

Lesson 2

What makes roller coasters go so fast?

Lesson 3

How can marbles save the world?

Lesson 4

Could you knock down a building using only dominoes?

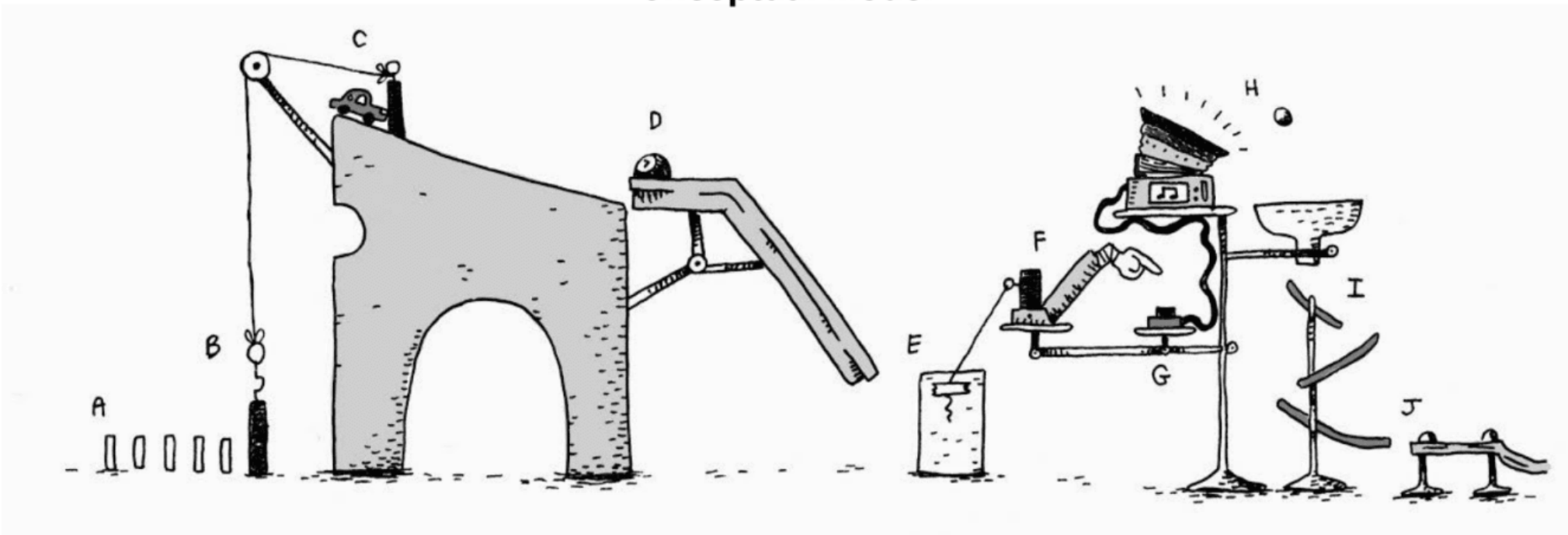
Lesson 5

Can you build a chain reaction machine?

I am also curious about...

Conceptual Model # _____ Name: _____

Rube Goldberg Machine
Conceptual Model



Symbol Key:

Explain how this machine works. You can refer to each part by its letter.

_____

_____

_____

_____

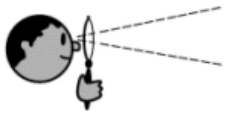
_____

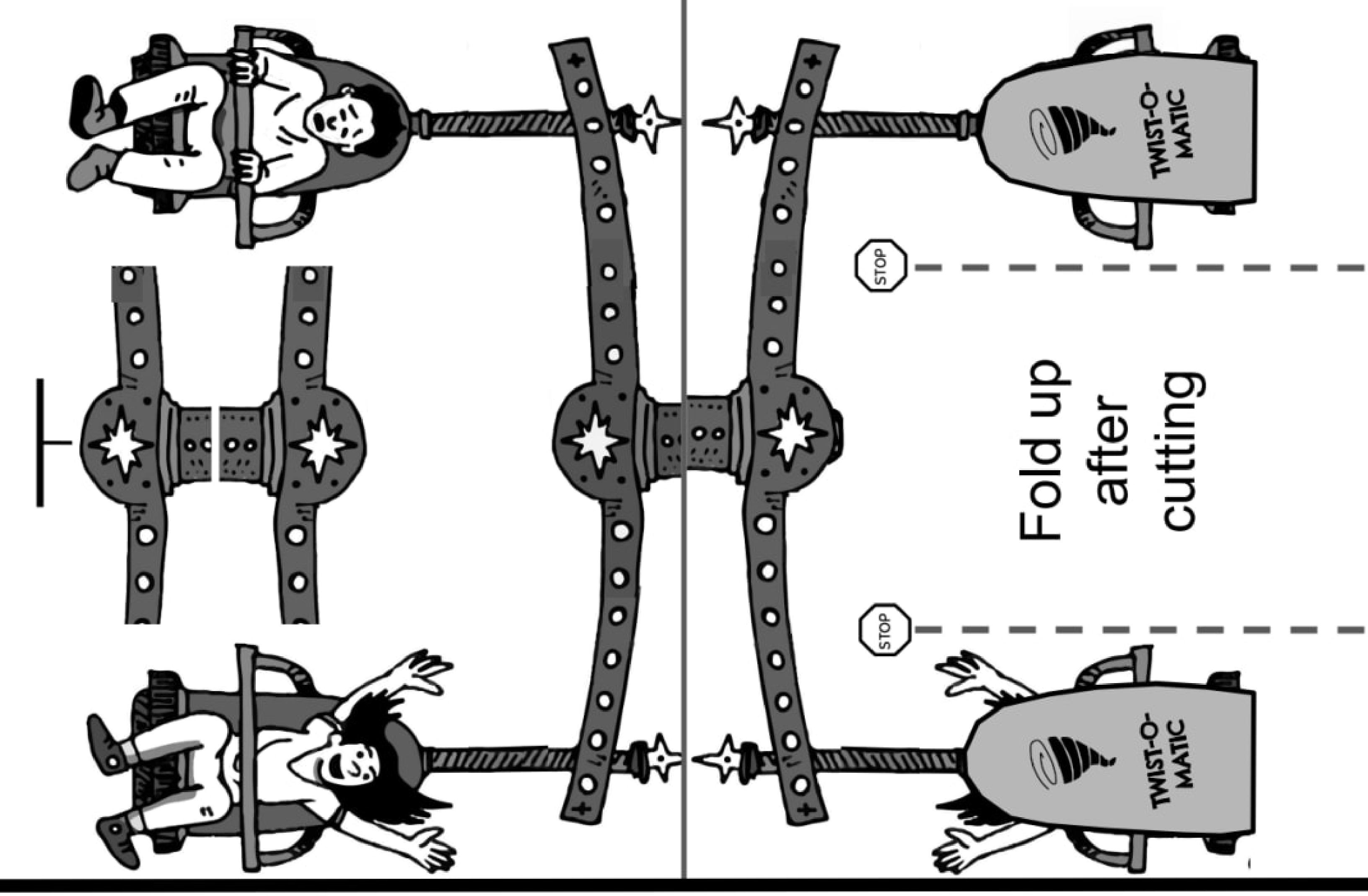
_____

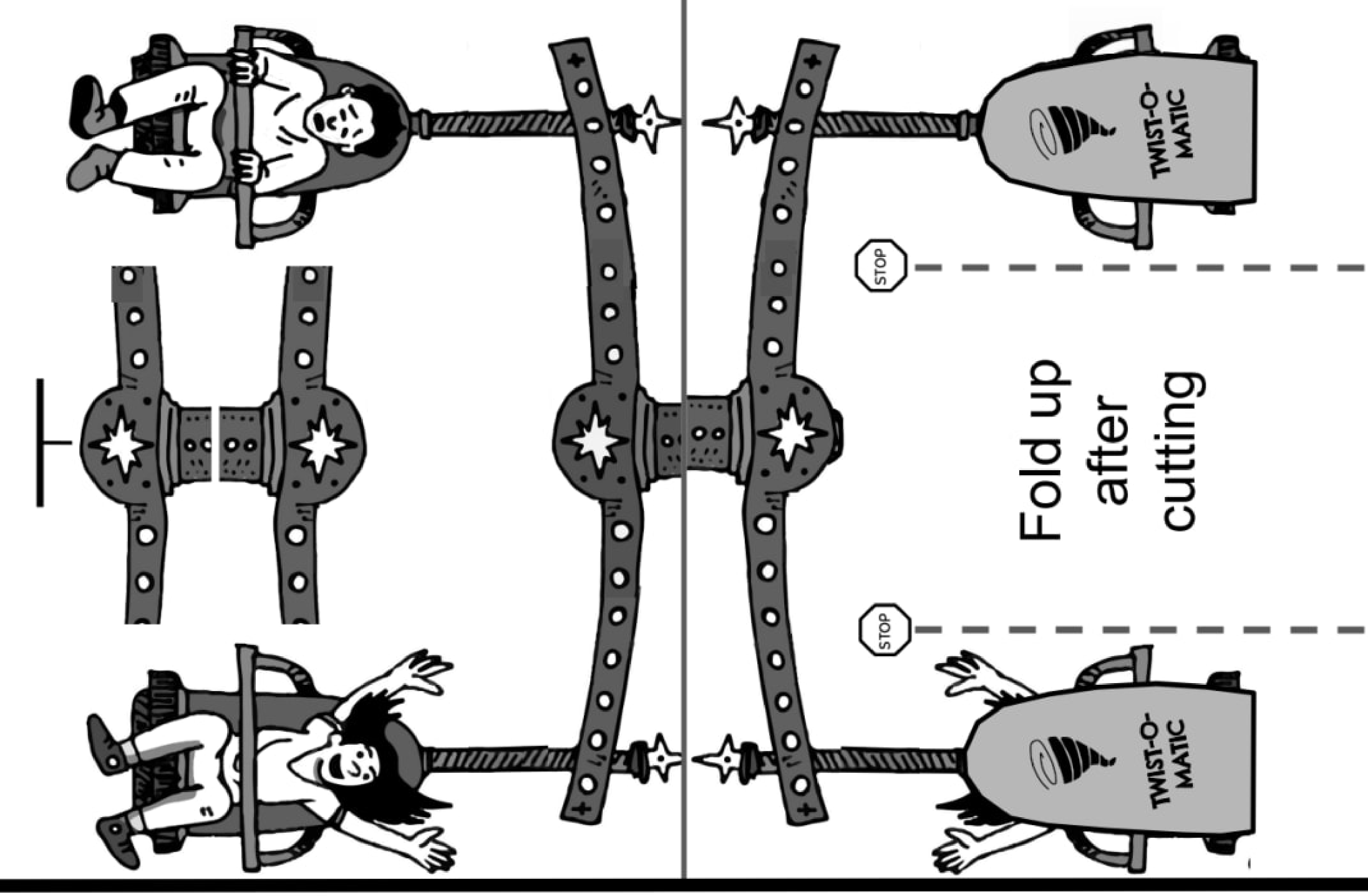
See-Think-Wonder Chart

Name: _____

mystery science

See	Think	Wonder
What did you observe? 	How can you explain what is happening? 	What questions do you have? 


STOP
STOP
Fold up after cutting
TWIST-O-MATIC
TWIST-O-MATIC


STOP
STOP
Fold up after cutting
TWIST-O-MATIC
TWIST-O-MATIC

Twist-O-Matic Challenges

Name:_____

mystery science
How is your body similar to a car?

CHALLENGE #1

The Twist-O-Matic needs to spin exactly **5 times** on its own. So...

- How many times do you need to turn the Twist-O-Matic with the **THIN** rubber band? _____
- How many times do you need to turn the Twist-O-Matic with the **THICK** rubber band? _____

Would you use **THIN** or **THICK** rubber bands to make the most exciting ride? Why?

_____

_____

CHALLENGE #2

Sadly, you can't use **THICK** rubber bands. Do some experiments and describe what you did to make a fun, fast Twist-O-Matic ride using the **THIN** rubber band. (It's okay if the ride spins around more than 5 times.)

_____

_____

Why do you think your experiment was successful in terms of **energy**? _____

_____

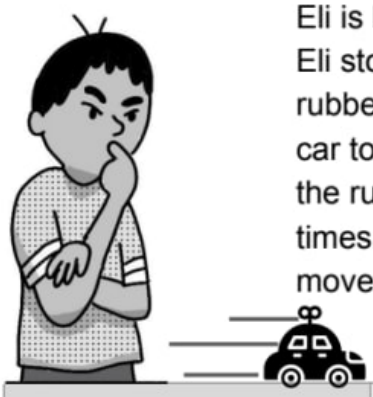
CHALLENGE #3

How will you make your real ride go—where will the stored energy come from? Draw your ideas in the box. (If you need more room, use the back of the page.)

Name: _____

Date: _____

Lesson Assessment



Eli is building a new toy car that uses rubber bands to store energy. Eli stores energy in the rubber bands by twisting them. When the rubber bands untwist, they release the energy, which causes the toy car to move. Eli experiments to see what happens when he twists the rubber band different amounts. Eli twists a thin rubber band 5 times, 10 times, and 15 times. Then he watches how fast the toy car moves. His observations are in the table below.

Rubber Band	Thin 	Thin 	Thin 
Number of Twists	5	10	15
Speed of Toy Car	Slow	Fast	Very Fast

1. What **pattern** do you notice?
   a. The more Eli twists the rubber bands, the more energy they store, so the toy car moves faster.
   b. The less Eli twists the rubber bands, the less energy they store, so the toy car moves faster.
   c. The number of twists of the rubber band doesn't change how fast the car moves.

Eli is curious what would happen if he uses rubber bands of different thickness. He uses three different types of rubber bands (thin, thick, and very thick). He twists each 10 times and then watches how fast the toy car moves. His observations are in the table below.

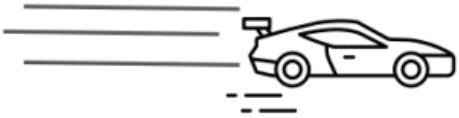
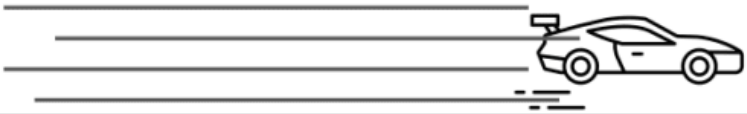
Rubber Band	Thin 	Thick 	Very Thick 
Number of Twists	10	10	10
Speed of Toy Car	Slow	Fast	Very Fast

2. What **pattern** do you notice about the rubber bands and the speed of the toy car?
   a. The thinner rubber bands store more energy, so the toy car moved faster.
   b. The thicker rubber bands store more energy, so the toy car moved faster.
   c. The thickness of the rubber band doesn't change how fast the car moves.

3. Looking at Eli's experiments, which of the following rubber bands will store the MOST energy?

a. A thin rubber band that is twisted 10 times.
b. A thin rubber band that is twisted 15 times.
c. A thick rubber band that is twisted 10 times.
d. A thick rubber band that is twisted 15 times.
e. A very thick rubber band that is twisted 10 times.
f. A very thick rubber band that is twisted 15 times.

4. After testing his toy cars, Eli makes some observations of real cars on a racetrack. The image below shows three different race cars and how fast they were going around the track.

Car	**Car Speed**
A 	50 miles per hour *(80 km per hour)*
B 	65 miles per hour *(105 km per hour)*
C 	75 miles per hour *(121 km per hour)*

Which race car (A, B, or C) is using the most energy? How do you know? Support your answer with evidence gathered from Eli's experiments on the previous page.

_____

_____

_____

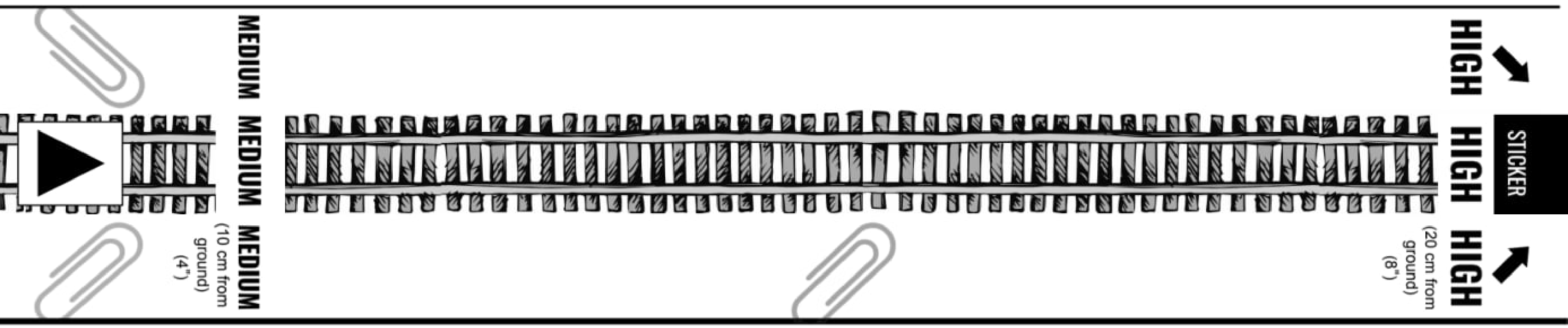
_____

_____

Klunk's Track

Name: ____________

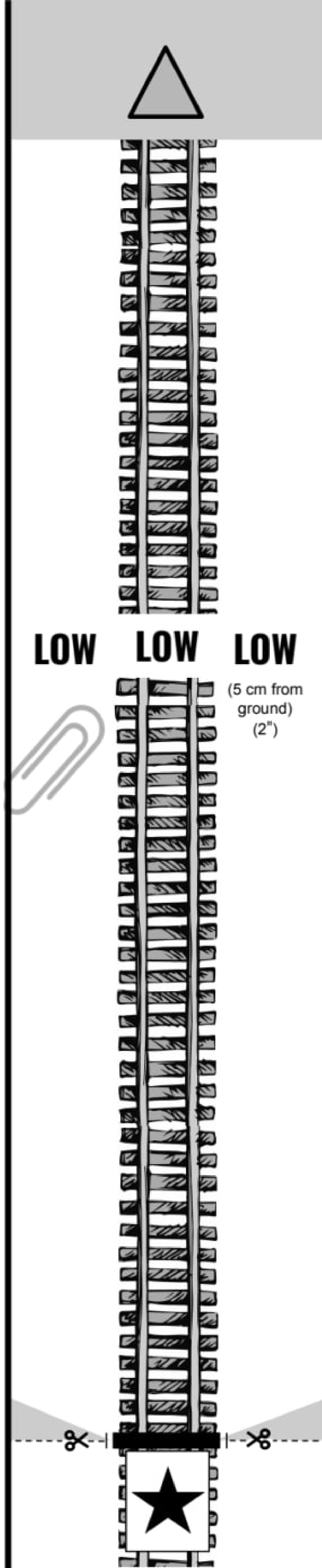
mystery science
What makes roller coasters go so fast?



Track 1
(Klunk)

Track 2

(Boom)



Boom's Track

Name: ______________

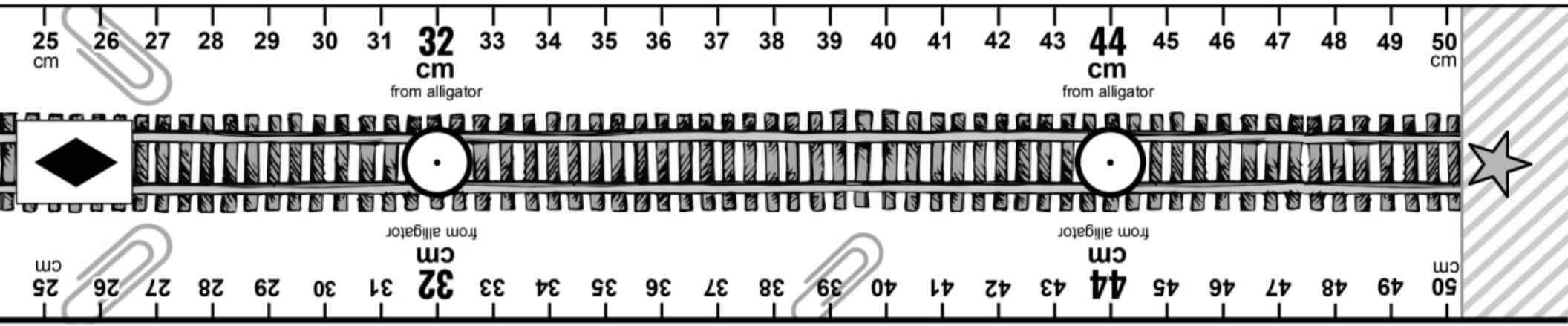
mystery science
What makes roller coasters go so fast?

Crash's Track

Name: _____

mystery science

What makes roller coasters go so fast?



Track 3

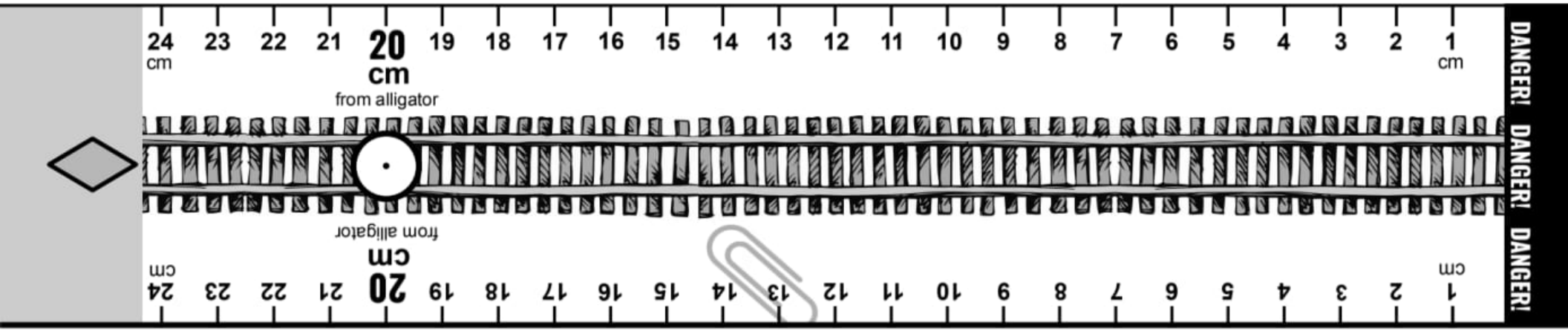
(Crash)

Pow's Track

Name: _____

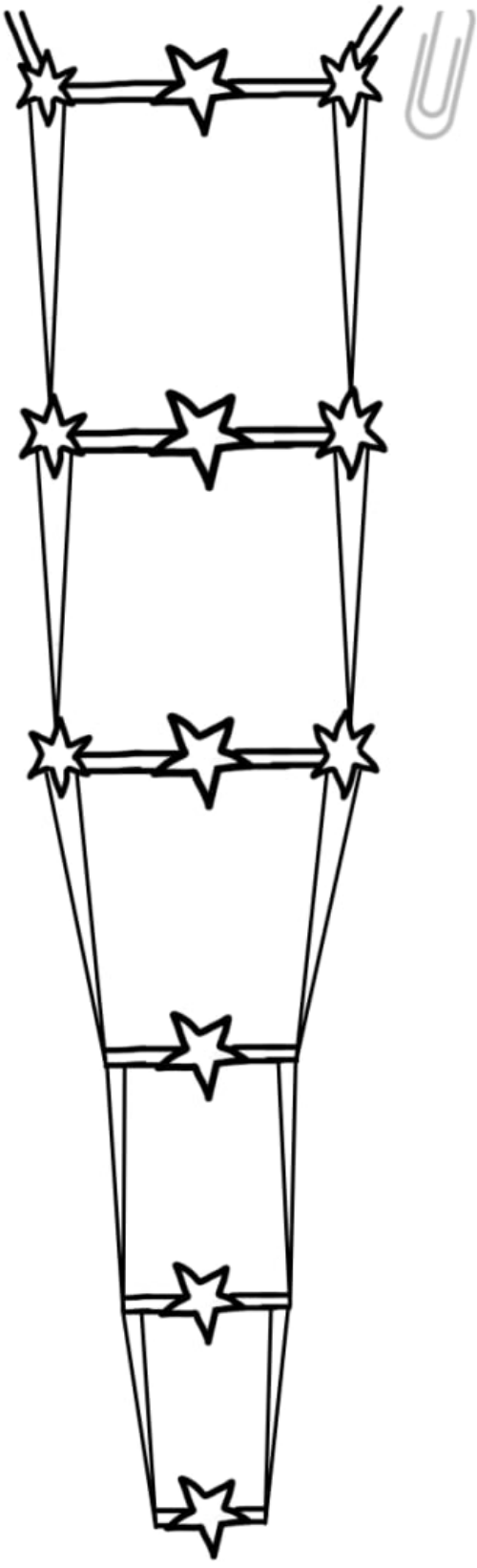
mystery science

What makes roller coasters go so fast?



Track 4

(Pow)



Mystery science

What makes roller coasters go so fast?

HOLD HERE

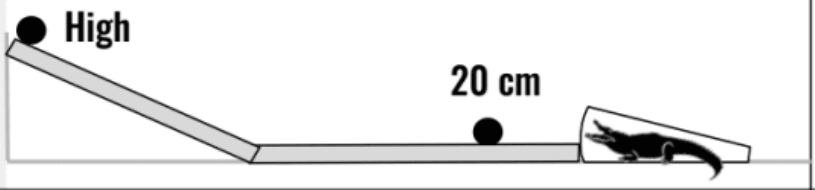
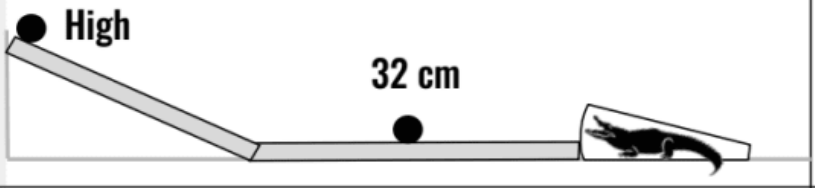
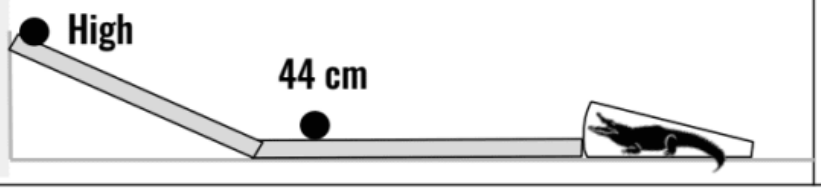
HOLD HERE

mystery science

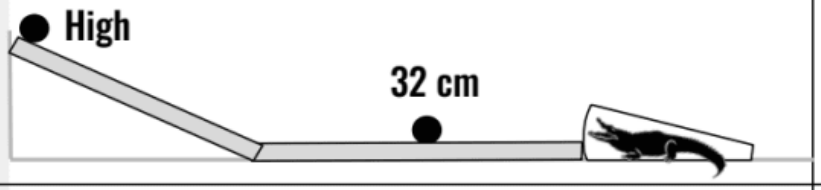
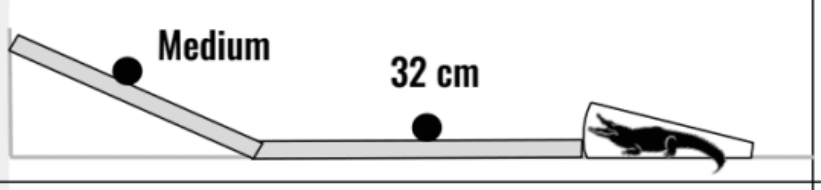
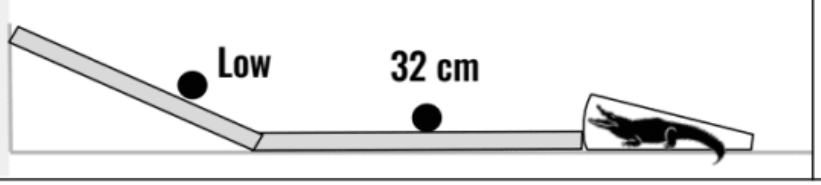
What makes roller coasters go so fast?

Name:_____

Distance and Height Experiments!

Always release the Hill Marble at the "High" mark:	Change the distance of the Bumper Marble from the alligator:	Did the Hill Marble get eaten? (It's ok if the Bumper Marble got eaten.)			
		Trial 1	Trial 2	Trial 3	Trial 4
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe

DISTANCE RESULTS: Moving the Bumper Marble farther away from the alligator **(always / sometimes / never)** kept the Hill Marble from getting eaten. Currently, the Bumper Coaster ride has **(too much / just enough / too little)** energy.

Change the height where you release the Hill Marble:	Always place the Bumper Marble 32 cm from the alligator:	Did the Hill Marble get eaten? (It's ok if the Bumper Marble got eaten.)			
		Trial 1	Trial 2	Trial 3	Trial 4
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe

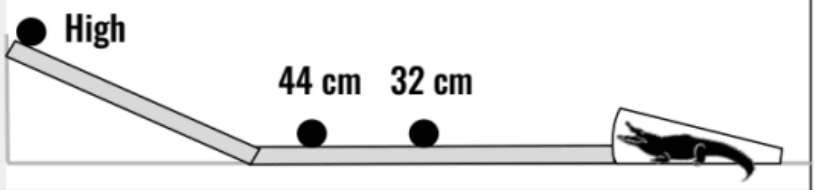
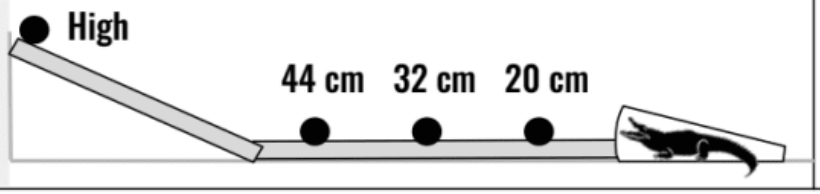
HEIGHT RESULTS: Moving the Hill Marble lower on the hill **(always / sometimes / never)** kept it from getting eaten. Currently, the Bumper Coaster ride has **(too much / just enough / too little)** energy.

mystery science

What makes roller coasters go so fast?

Name:_____

Collisions Experiments!

Always release the Hill Marble at the "High" mark:	Change the number of Bumper Marbles on the track:	Did the Hill Marble get eaten? (It's ok if the Bumper Marbles got eaten.)			
		Trial 1	Trial 2	Trial 3	Trial 4
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe

COLLISIONS RESULTS: Adding more Bumper Marbles **(always / sometimes / never)** kept the Hill Marble from getting eaten. Why do you think this happens? Explain your results in terms of energy:

_____

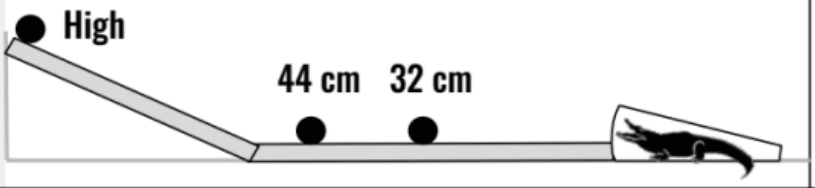
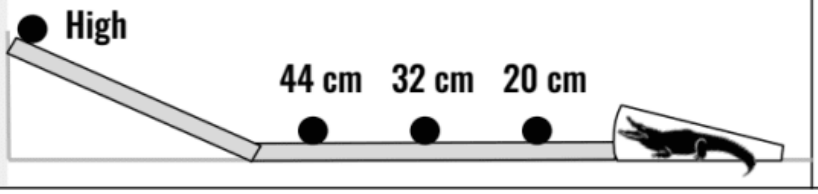
_____

mystery science

What makes roller coasters go so fast?

Name:_____

Collisions Experiments!

Always release the Hill Marble at the "High" mark:	Change the number of Bumper Marbles on the track:	Did the Hill Marble get eaten? (It's ok if the Bumper Marbles got eaten.)			
		Trial 1	Trial 2	Trial 3	Trial 4
		eaten safe	eaten safe	eaten safe	eaten safe
		eaten safe	eaten safe	eaten safe	eaten safe

COLLISIONS RESULTS: Adding more Bumper Marbles **(always / sometimes / never)** kept the Hill Marble from getting eaten. Why do you think this happens? Explain your results in terms of energy:

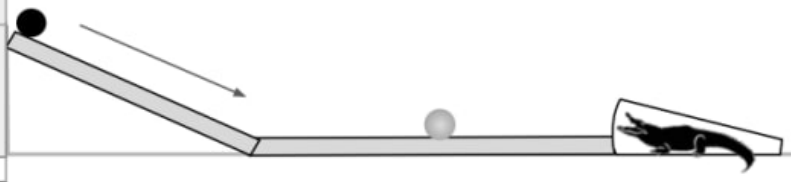
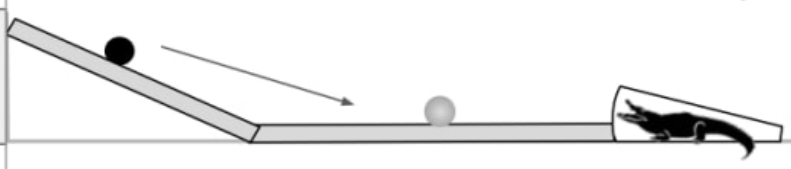
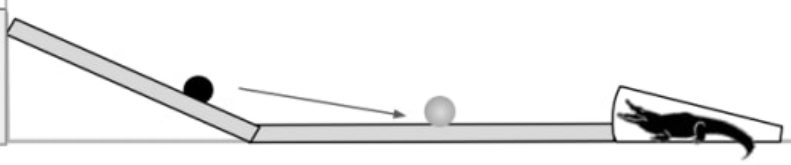
_____

_____

Name: _____

Date: _____

Lesson Assessment

Height		Speed	Sound
High		Very Fast	Very Loud
Medium		Fast	Loud
Low		Slow	Quiet

Rafael released a black marble from three different heights (high, medium, low). The black marble rolled down the ramp and collided with the gray marble. When they collided, they made a “click” sound. The table above shows the speed of the black marble as it rolled down the ramp and how loud the sound was when it collided with the gray marble.

1. What **pattern** do you notice about the height of where the black marble is released?
   a. When the black marble is released from a higher point, it moves faster.
   b. When the black marble is released from a lower point, it moves faster.
   c. The height of the black marble has no effect on how fast it moves.

2. What **pattern** do you notice about the sound the two marbles make?
   a. The faster the black marble was moving, the quieter the sound it made when it collided.
   b. The faster the black marble was moving, the louder the sound it made when it collided.
   c. The speed of the black marble has no effect on the sound of the collision.

3. Rafael notices that the gray marble ***only*** rolls into the mouth of the alligator when the black marble is released from the High height. When the black marble is released from a Medium or Low height, the gray marble stops rolling before reaching the alligator. Why did that happen? Explain in terms of energy. Use evidence to support your claim.

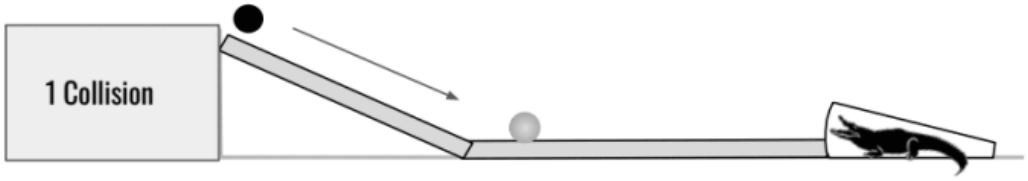
_____

_____

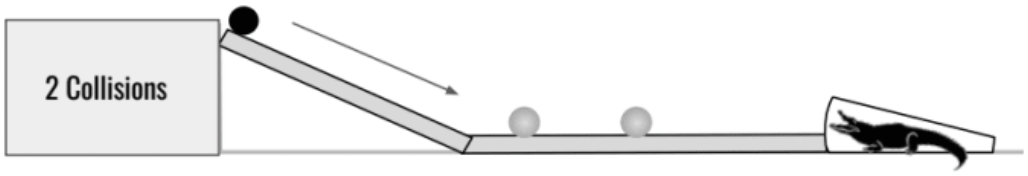
_____

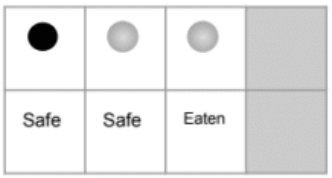
_____

Rafael released a black marble from the top of a ramp. It rolled down the ramp and collided with a gray marble. When they collided, they made a “click” sound. Both marbles rolled into the alligator’s mouth and were “eaten.”

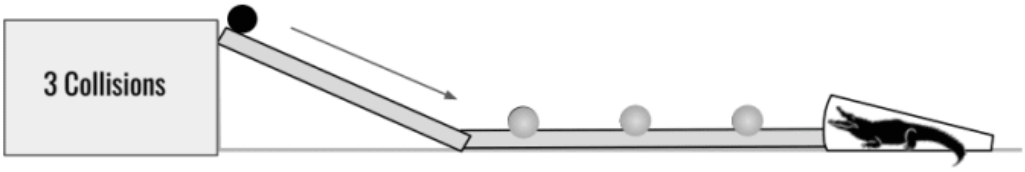


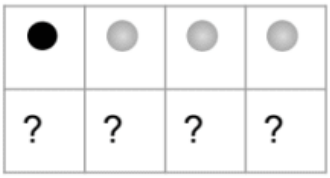
Rafael did the same experiment, but this time added another gray marble so that there would be two collisions. Both collisions made a “click” sound. This time one of the gray marbles was “eaten,” but the other two marbles were safe.





4. What do you **predict** will happen if Rafael releases the black marble from the top of the ramp, but adds another gray marble so that there are three collisions?





a. I think all the marbles will be “eaten.”
b. I think the black marble will be “safe” and all three gray marbles will be “eaten.”
c. I think the black marble and one gray marble will be “safe” and two gray marbles will be “eaten.”
d. I think all the marbles will be “safe.”
e. There is no way to predict what will happen with the current information.

5. Why did you choose your answer to Question 4? Explain in terms of energy.

_____

_____

_____

_____

_____

Tube

Collision Track

Collision Track

Jump

mystery science

How can marbles
save the world?

Zone

3

Zone

2

Zone

1

End of Jump Ramp

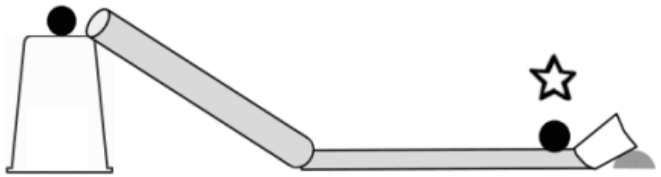
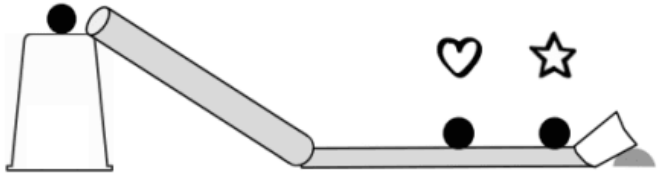
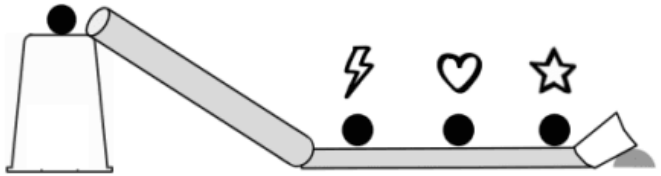
Bumper Jumper
Landing Zones

mystery science
How can marbles save the world?

Bumper Jumper Game

Names:_____

_____

	Game Setup Set up marbles in these locations:	Predict	Trial 1: Landing Zone	Trial 2: Landing Zone	Trial 3: Landing Zone	Score
Round 1			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	
Round 2			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	
Round 3			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	

Add up your score here:

mystery science

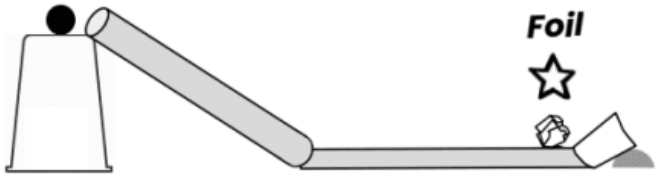
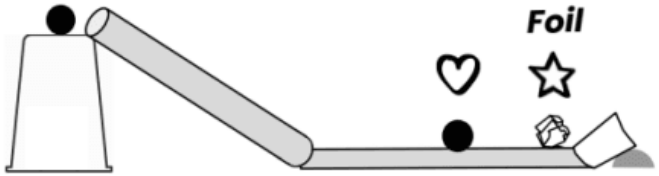
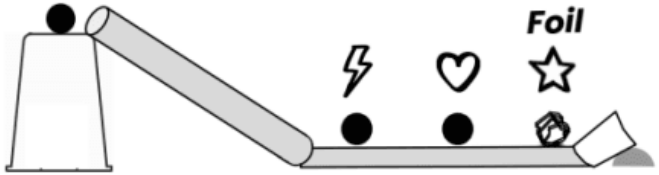
How can marbles save the world?

Bumper Jumper Game

with Foil

Names:_____

_____

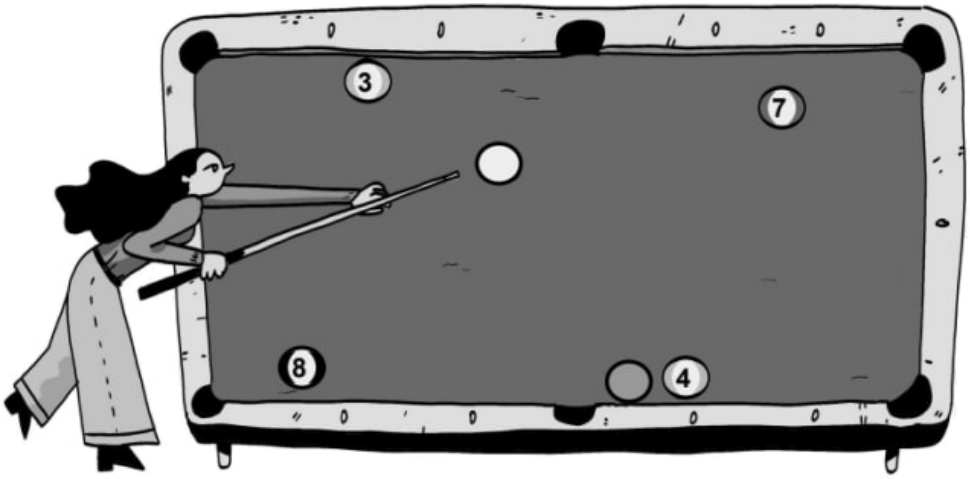
	Game Setup Set up marbles in these locations:	Predict	Trial 1: Landing Zone	Trial 2: Landing Zone	Trial 3: Landing Zone	Score
Round 1			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	
Round 2			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	
Round 3			No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	No Jump Zone 1 Zone 2 Zone 3	

Add up your score here:

Name: _____

Date: _____

Lesson Assessment



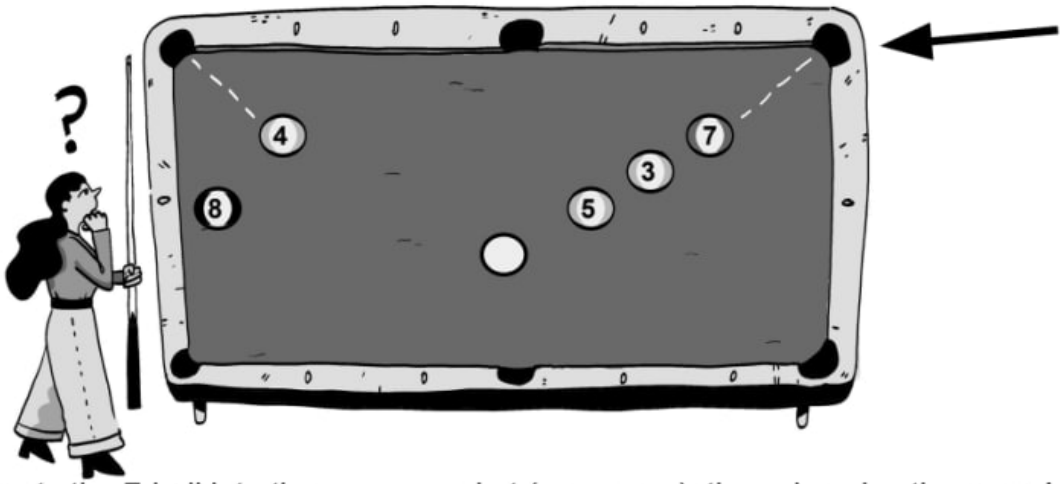
Camila is playing a game of pool. The game works by having players hit a white ball with a stick. The white ball then rolls across the table and collides with another pool ball.

1. In the picture above, Camila is about to use her energy to hit the white ball with the stick. What do you predict will **most likely** happen to the energy Camila puts into the stick?

a. The energy will transfer back to the 3-ball.
b. The energy will transfer to the 7-ball. Then the 7-ball will start to move.
c. The energy will transfer to the white ball. Then the white ball will start to move. It will hit the 7-ball and make a sound. Then the 7-ball will start to move.
d. All the energy will stay in the stick. It will not transfer to the pool balls.

2. Camila has lots of questions she's curious about as she plays her game of pool. Which of the following are questions that Camila can answer with a scientific investigation? There may be more than one correct answer.

a. I wonder how far the white ball will travel if I hit the white ball with a small amount of energy compared to a large amount of energy.
b. I wonder why the white ball doesn't have a number, but some of the other pool balls do have numbers.
c. I wonder who invented the game of pool.
d. I wonder if the sound from the collision will change if I change the amount of energy I use to hit the white ball.



If Camila gets the 7-ball into the corner pocket (see arrow), then she wins the game!

3. What do you **predict** will **most likely** happen if Camila lightly taps the white ball, giving it just a small amount of energy?

a. The white ball will transfer energy to the 5-ball. The 5-ball will move a little and then stop.
b. The white ball will transfer energy to the 5-ball. Then the 5-ball will transfer energy to the 4-ball. The 4-ball will move a little and then stop.
c. The white ball will transfer energy to the 5-ball. Then the 5-ball will transfer energy to the 3-ball. Then the 3-ball will transfer energy to the 7-ball. The 7-ball will move and may go into the right corner pocket.

4. What do you **predict** will **most likely** happen if Camila hits the white ball really hard, giving it a large amount of energy?

a. The white ball will transfer energy to the 5-ball. The 5-ball will move a little and then stop.
b. The white ball will transfer energy to the 5-ball. Then the 5-ball will transfer energy to the 4-ball. The 4-ball will move a little and then stop.
c. The white ball will transfer energy to the 5-ball. Then the 5-ball will transfer energy to the 3-ball. Then the 3-ball will transfer energy to the 7-ball. The 7-ball will move and may go into the right corner pocket.

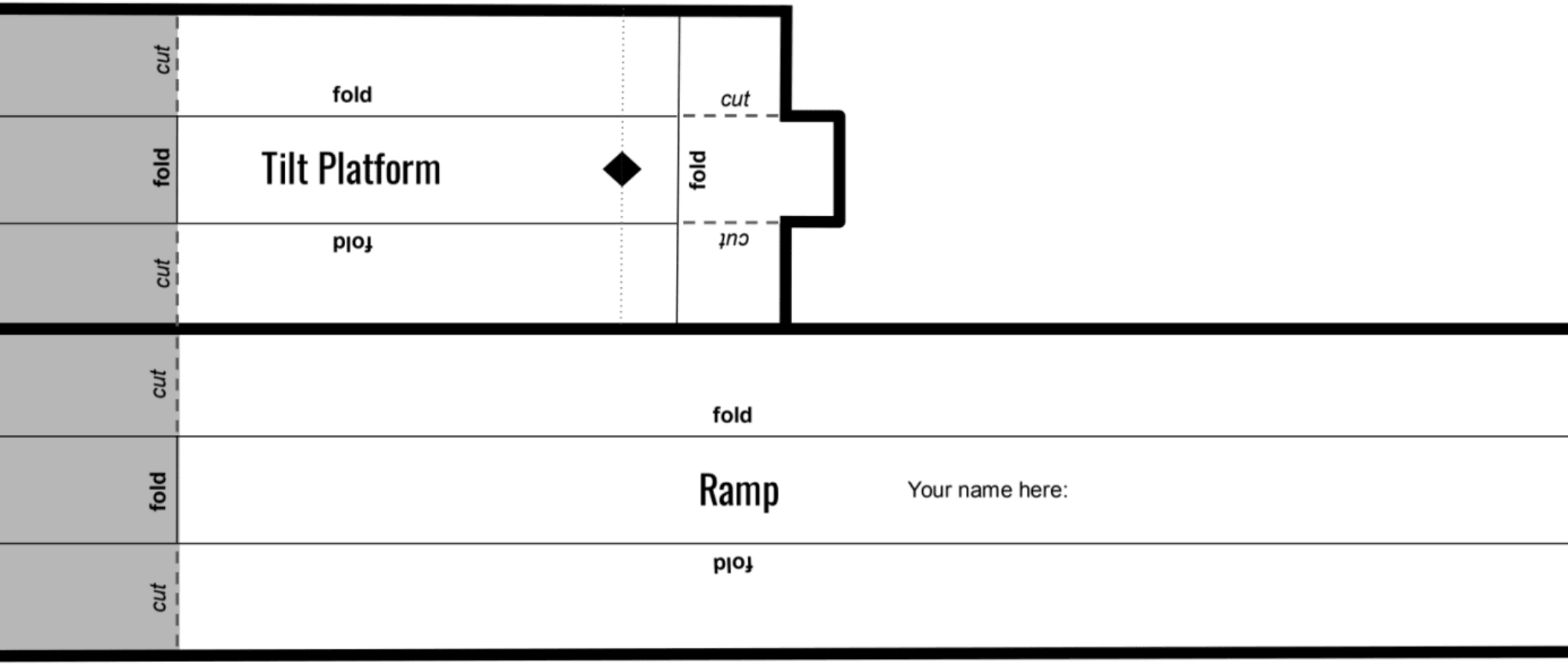
5. Camila wants to try playing the game using marbles instead of pool balls. Marbles are MUCH smaller and don't weigh as much as pool balls. Come up with one question about this scenario. It can be ANY question related to the amount of energy Camila uses, or the energy transfer, or how loud the sounds are, or the distance the marbles travel, or the number of collisions that will occur! The **only rule** is that a science experiment should help you figure out the answer to your question. (Hint: Think about things you could measure in the experiment to help you answer the question.)

I wonder _____

_____

_____

Chain-Reaction Starter Kit



mystery science

Could you knock down a building using only dominoes?

fold up

fold up

fold up

Marble Corral

Put cup here

Put the end of the ramp in the cup

Name: _____

Date: _____

Lesson Assessment

1. Armando has an idea for a new game called Ramp Bowling. The game will be small enough to play on a table. To play the game, people will roll a marble down a ramp so that the height energy of the marble will transfer to a bowling pin. The criteria for the design is that the marble needs to have enough energy to hit a tiny bowling pin and knock it down. Armando isn't sure how to build the ramp, but he has the following materials that he can use:

BOOKS

MARBLE

METER STICK

TAPE

PAPER

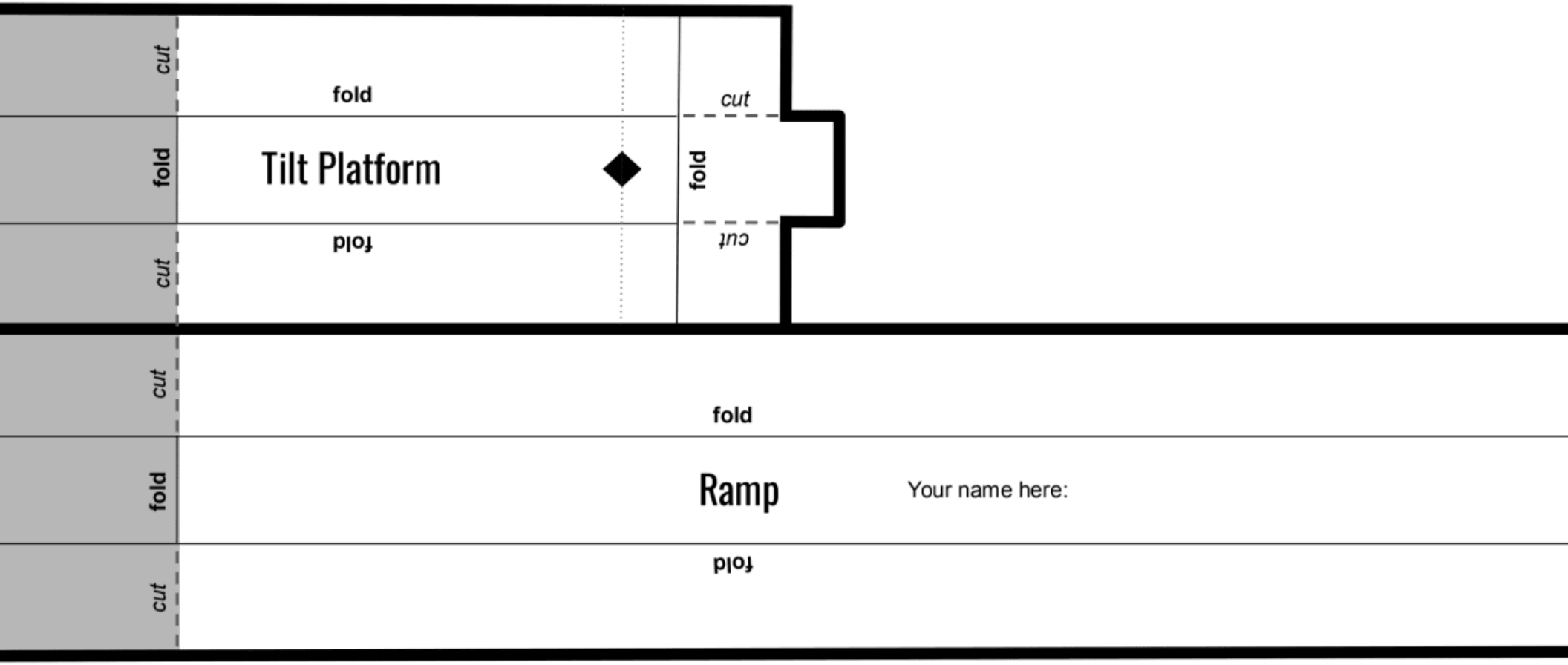
In the space below, you can see a table with a tiny bowling pin on it. Using the above materials, draw one way to build a ramp for Ramp Bowling. You might not need all of the materials.

2. On your drawing, add two labels. First, label where the marble will have the most energy from being up high. Then, label where the energy from the marble will transfer to the bowling pin.

3. Imagine if the goal of the game changed. Instead of trying to knock the pin down, the new goal is to try to get the marble as close to the pin as possible *without* knocking it over. To do this, players would have to change how much energy the marble has. How might they do this? Choose the best answer.

a. Change the design so that the marble starts higher. That way, the marble will have more energy when it hits the pin.
b. There is no way to change how much energy the marble has. Gravity is always the same, so that means the marble always has the same energy no matter what.
c. Change the design so that the marble starts lower. That way, the marble will have less energy when it hits the pin.

Chain-Reaction Starter Kit



TABLE

TABLE

TABLE

mystery science

Can you build a chain reaction machine?

Name: _____

Date: _____

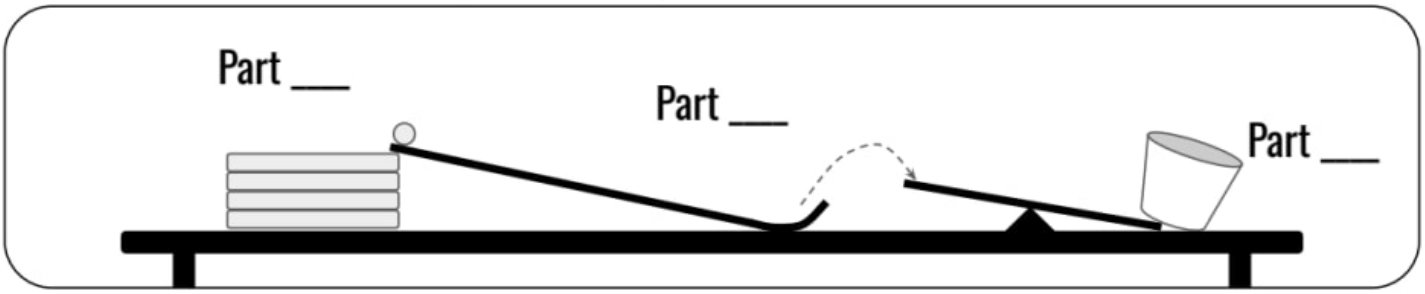
Lesson Assessment

1. Jacob is building a chain reaction machine in school that converts height energy into motion energy. He has a plan for what he wants it to do.

His plan is for the chain reaction machine to have three parts:

- Part A. A lever with a cup on one end that can be knocked over when the lever moves
- Part B. A stack of books to give the marble height energy
- Part C. A ramp that the marble can roll down and then launch/fly into the air

The drawing below shows Jacob's chain reaction machine. On the blank lines, label Part A, Part B, and Part C. Then study the drawing.



2. This chain reaction machine converts energy from one form to another. Which of the following statements are correct? Circle all that apply. There may be more than one correct answer.

a. When the marble is at the top of the ramp, it has height energy. The height energy is converted to energy of motion as it rolls down.

b. No matter what, the marble always has energy of motion.

c. The marble has less height energy at the bottom of the ramp compared to the top.

d. The marble transfers energy to the lever if the marble hits the lever.

3. Jacob tested his machine, and it wasn't working. The marble did not have enough energy to fly all the way to the lever. What should he do to try and make the machine work?

a. The marble always has the same energy, so it can't fly any farther.

b. Jacob should try moving the lever farther away.

c. Jacob should start the marble lower. That will give it more energy so it can fly farther.

d. Jacob should make the ramp taller. That will make the marble start with more height energy, which will be converted to more motion energy, so that it can fly farther.

Name: _____

Performance Task: Rube Goldberg Machine
Conceptual Model and Summary

Key:

Explain how your Rube Goldberg machine works. You can use letters and symbols to help you.

_____

_____

_____

_____

_____

_____

Name: _____

Brainstorm and Blueprint:
Rube Goldberg Machine

The goal our Rube Goldberg Machine will complete is _____

_____

Energy & Energy Transfer
Final Project

Name: _____

Rube Goldberg Machine

Task: Rube Goldberg machines use A LOT of steps to accomplish a small task, like ringing a doorbell or putting toothpaste on your toothbrush. They are pretty funny and really interesting to watch.

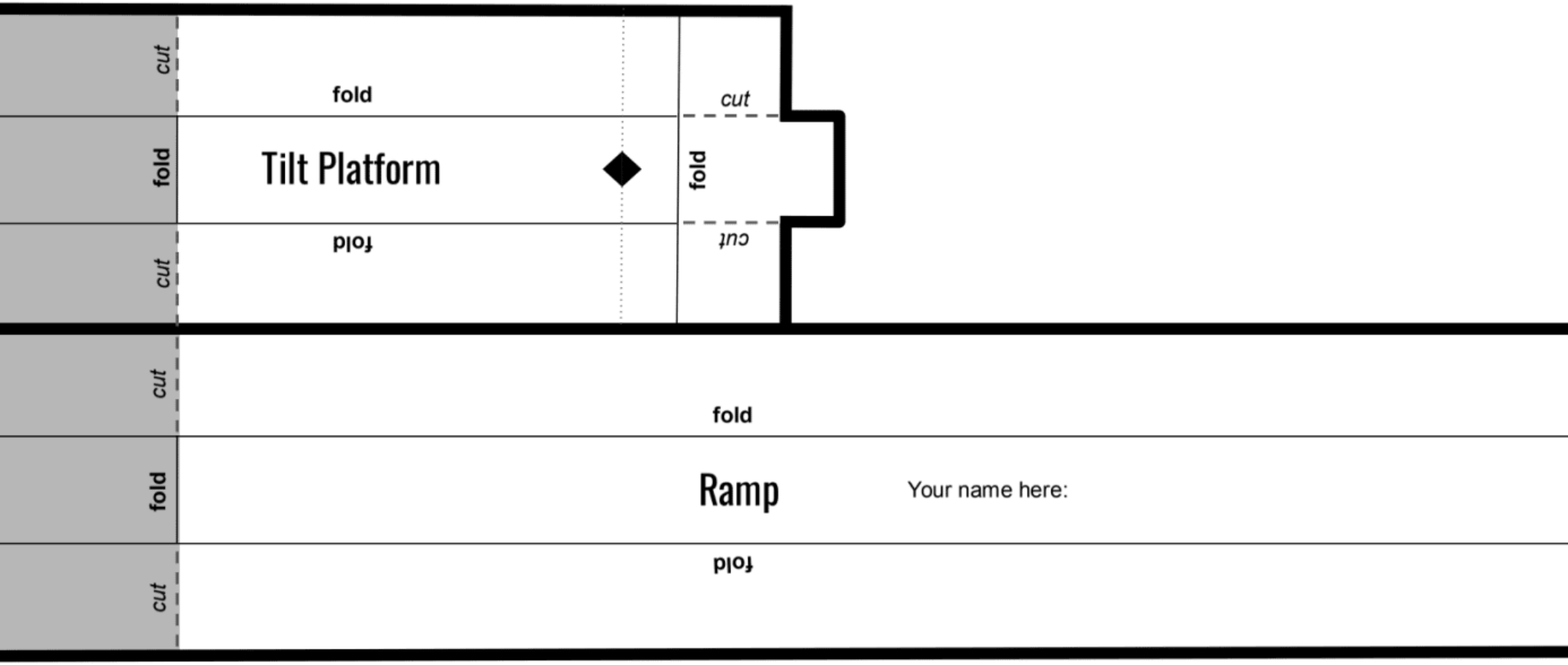
Energy makes things move, it can be transferred, and it comes in different forms. Energy is what makes the Rube Goldberg machine work.

You are going to be an engineer and create a Rube Goldberg machine that completes a simple goal that you will get to choose.

My project should include, but is not limited to:

- ❑ At least 4 total steps
- ❑ A labeled and detailed **blueprint**
- ❑ At least 2 of each of the following:
  - ❑ **Energy transfers**
  - ❑ Places with **stored energy**
  - ❑ Places with **released energy**
  - ❑ **Collisions**
- ❑ At least 1 place with **height energy**
- ❑ A **written explanation** that details where all required energy transfers, collisions, stored energy, released energy, and objects moving at different speeds occur.

Chain-Reaction Starter Kit



Energy & Energy Transfer

Name: _____

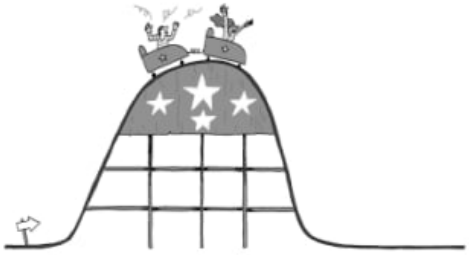
Date: _____

Unit Assessment

You have been hired to design a new roller coaster for Acme Amusements. You find information about three different roller coasters that have already been built. Pictures of the first hill of each roller coaster are shown below. The height of the first hill, the top speed, and the number of hills of each roller coaster are also shown below.

Dragon Fyre
Height of First Hill: 78 feet
Top Speed: 50 miles per hour
Number of Hills: 2

Aftershock
Height of First Hill: 192 feet
Top Speed: 66 miles per hour
Number of Hills: 3



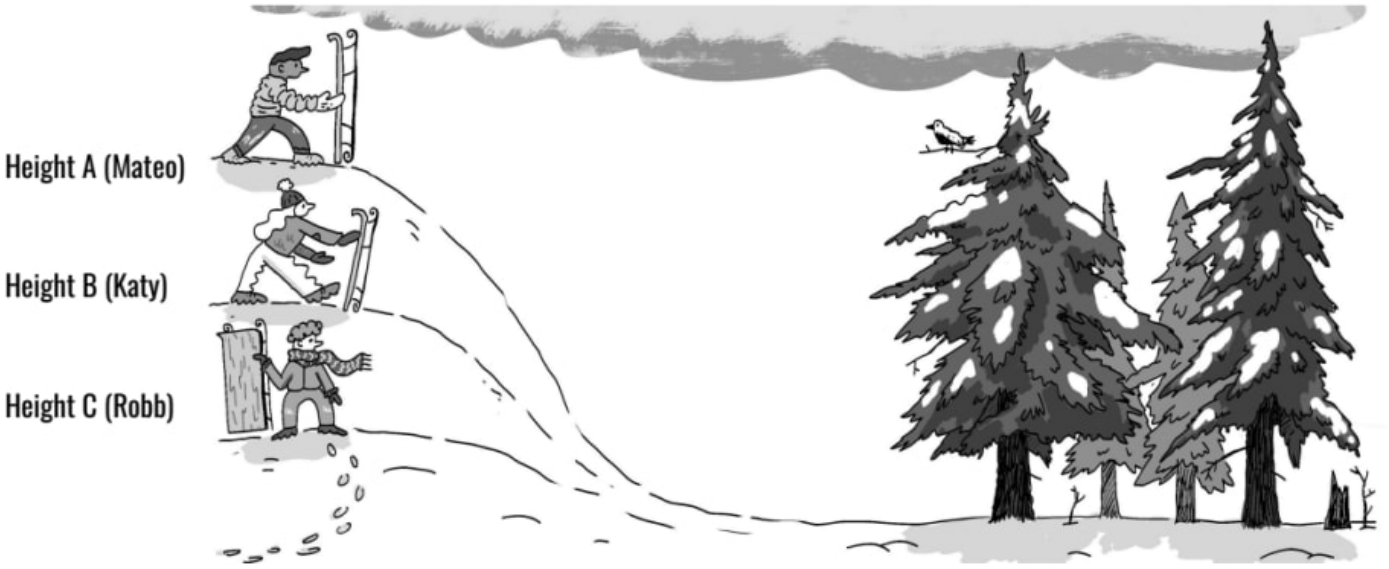
Millennium Force
Height of First Hill: 300 feet
Top Speed: 93 miles per hour
Number of Hills: 1

1. What **pattern** do you notice about the top speed of the roller coasters?

a. The more riders on the roller coaster, the faster the roller coaster goes.
b. The taller the first hill of the roller coaster, the faster the speed of the roller coaster.
c. The more hills it has, the faster the speed of the roller coaster.
d. There is no pattern that can help you predict the speed of a roller coaster.

2. If you decide to build a roller coaster with the first hill at a height of 100 feet, what do you think its top speed will most likely be? Use the pattern above to help you figure it out.

a. 30 miles per hour
b. 50 miles per hour
c. 60 miles per hour
d. 100 miles per hour



Mateo, Katy, and Robb are all competing in a sled race. They raced each other three times. Mateo always started from Height A, Katy always started from Height B, and Robb always started from Height C. The table shows how fast each person was going when they reached the forest at the bottom of the hill each time. The winner is the person that goes the fastest.

Sledder	Trial #1	Trial #2	Trial #3
Mateo	24 miles per hour	21 miles per hour	22 miles per hour
Katy	17 miles per hour	16 miles per hour	18 miles per hour
Robb	10 miles per hour	9 miles per hour	8 miles per hour

3. What kind of pattern do you notice? Choose all correct answers.

a. Mateo always went faster than Katy but slower than Robb.
b. Mateo always went faster than Katy.
c. Katy always went slower than Robb but faster than Mateo.
d. Katy always went faster than Mateo.
e. Katy always went faster than Robb.

4. Robb wants to win the next sled race. He asks for your advice. What would you tell him he should change in order to win? Explain why your solution would work in terms of energy.

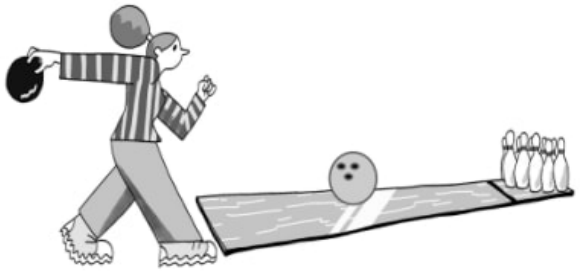
_____

_____

_____

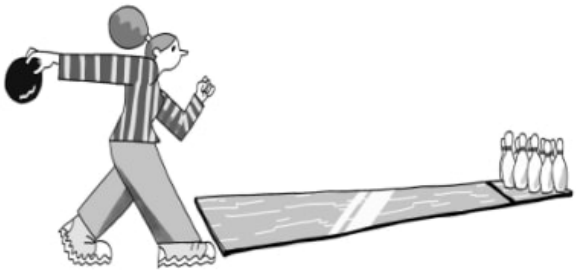
_____

5. Abigail is bowling and a gray bowling ball gets stuck in the middle of the lane. She wonders what will happen if she hits the gray ball with another bowling ball. Abigail throws a black bowling ball at the gray bowling ball. What do you predict will **most likely** happen?

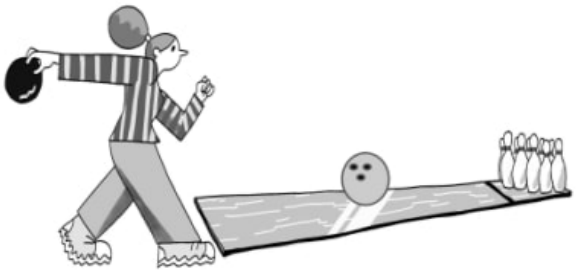


a. The black ball will hit the gray ball but will not make a sound. The black ball will transfer all of its energy to the gray ball. The gray ball will start to move.
b. The black ball will hit the gray ball and make a sound. The black ball will transfer some of its energy to the gray ball. The gray ball will start to move.
c. The black ball will hit the gray ball and make a sound. The black ball won't transfer energy to the gray ball, so the gray ball will not move.

6. Abigail throws the black bowling ball at 20 miles per hour and knocks down 9 pins. She wonders if putting the gray bowling ball in the middle of the lane will help her knock down more pins. If Abigail throws the black ball at 20 miles per hour again, but this time it hits the gray ball first, what do you predict will **most likely** happen?



Black Bowling Ball Speed	Number of Pins Knocked Down
20 miles per hour	9 pins



Black Bowling Ball Speed	Number of Pins Knocked Down
20 miles per hour	????

a. When the black ball collides with the gray ball, all the energy from the black ball will transfer to the gray ball. The gray ball will move toward the pins and have enough energy to knock down 9 or more pins.
b. When the black ball collides with the gray ball, some of the energy from the black ball will transfer to the gray ball. The gray ball will move toward the pins, but it will have less energy, so it won't knock down as many pins.
c. When the black ball collides with the gray ball, none of the energy from the black ball will transfer to the gray ball. The gray ball will not move toward the pins and it will not knock down any pins.

mystery science

Electricity, Light, & Heat

4th Grade • NGSS • Unit Worksheets

Lesson 1

What's the best way to light up a city?

Lesson 2

What if there were no electricity?

Lesson 3

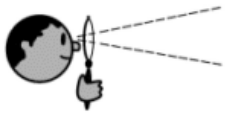
How long did it take to travel across the country before cars and planes?

I am also curious about...

See-Think-Wonder Chart

Name: _____

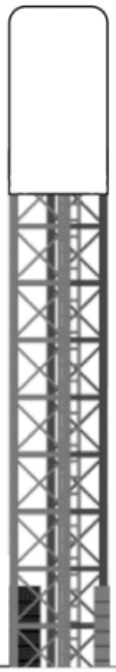
mystery science

See	Think	Wonder
What did you observe? 	How can you explain what is happening? 	What questions do you have? 

Mystery Tower

Name: _____

Add labels or drawings to show what the tower is, what it is for, and how it works.



Write your ideas for what the tower is, what it is for, and how it works.

_____

_____

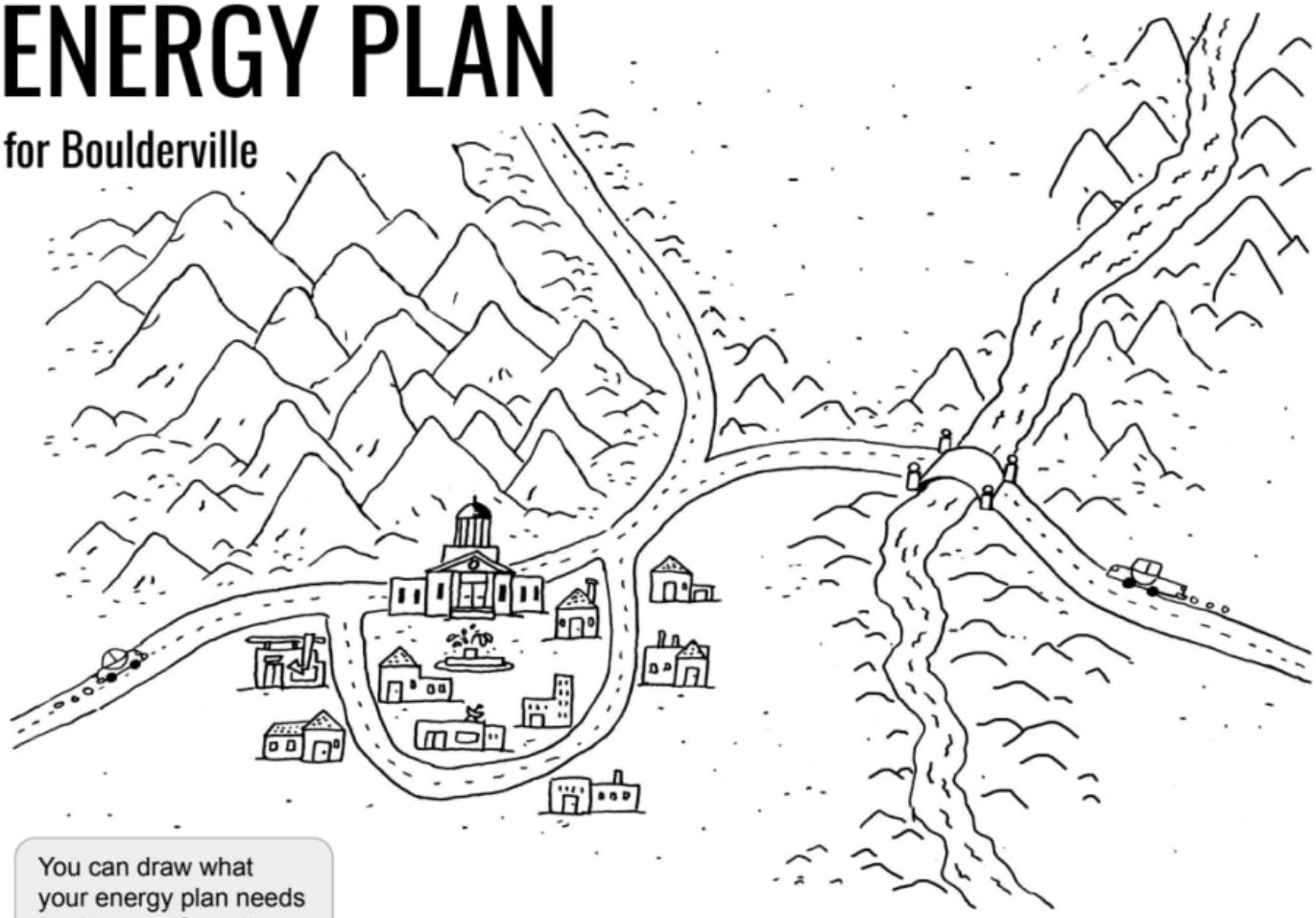
_____

_____

Name: _____

ENERGY PLAN

for Boulderville



You can draw what your energy plan needs on the map if you like.

What's the Plan?

Dear Boulderville Town Council,

We have figured out an excellent plan to provide your town with electricity.

You can get the energy you need using (circle your choice):

Wind **Sun** **Water** **A combination of:** _____

Our plan will work because (come up with at least three reasons):

_____

_____

_____

_____

_____

Sincerely, _____

If you need more space, write on the back.

Name: _____

WIND ENERGY

in Greensburg, Kansas

mystery science

What's the best way to light up a city?

Report from Greensburg, Kansas

From the Mayor

On May 4th, 2007, a tornado knocked down all the buildings in our town. We needed to rebuild the town. We wanted our new town to get its electricity from the wind. Then we would have less air pollution.

There was plenty of room for windmills around the town. So we built ten big windmills. When the wind blows, the windmills turn. The turning windmills change wind energy into electrical energy.

The wind blows almost every day in our town. It blows hard and fast. That's a good thing. The wind has to blow at least 15 miles per hour to make the windmills turn. (That's at least 6 meters per second.) When the wind doesn't blow fast enough, the windmills don't turn. Our ten windmills make enough electricity for four towns the size of Greensburg. We sell our extra electricity to other towns.

1. What are the benefits or advantages of using energy from wind?

_____

_____

2. What are possible problems or disadvantages of using energy from wind?

_____

_____

3. What does Greensburg have that makes energy from wind a good choice for this town?

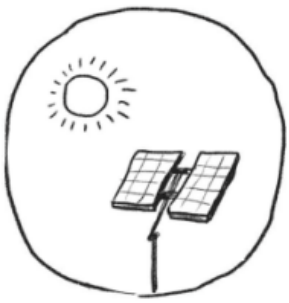
_____

_____

4. Does Boulderville have what it needs to use energy from wind? Explain.

_____

_____



Name: _____

SUN ENERGY

in Ranchtown, Florida

mystery science

What's the best way to light up a city?

Report on Ranchtown, Florida *From the town engineer*

We wanted to use solar panels to power our town. These panels take energy from sunlight and change it into electricity. They don't make any smoke or air pollution!

Our town's solar panels take up a lot of space–about 440 acres, the size of 333 football fields. But we get enough energy from those panels to power more than 10,000 homes! During the day, our town doesn't use all the electricity that comes from our solar panels. We have extra left over.

But there's a problem. Solar panels only work when the Sun is shining. You can't get electricity from a solar panel at night.

Right now, we have no way to store the extra energy. At night and on cloudy days, we have to get our electricity from other towns, which make it by burning coal and other fuels.

1. What are the benefits or advantages of using energy from sunlight?

_____

_____

2. What are possible problems or disadvantages of using energy from sunlight?

_____

_____

3. What does Ranchtown have that makes energy from sunlight a good choice for this town?

_____

_____

4. Does Boulderville have what it needs to use energy from sunshine? Explain.

_____

_____

Name: _____

WATER ENERGY

in Aspen, Colorado

mystery science

What's the best way to light up a city?

Report on Aspen, Colorado *From the town historian*

Our town is high in the Rocky Mountains. Every spring, snow from the mountains melts. Water flows downhill into streams and rivers.

Over 100 years ago, an engineer figured out how to transform energy from the flowing water into electricity. People built a dam, a thick wall to control the flow of the river. Then they built giant wheels called turbines. The dam releases water to turn the turbines. The turbines spin, and the machine turns that energy into electricity.

It takes a lot of flowing water to get enough electricity for our town. It takes a flow of about one million gallons a minute!

Today, our town needs more energy than the dam and turbines can supply. People don't want to build another dam. They want to be sure the rivers have enough water for fish and other wild animals. So our town buys some electricity from nearby towns that have energy to spare from windmills powered by the wind.

1. What are the benefits or advantages of using energy from flowing water?

_____

_____

2. What are possible problems or disadvantages of using energy from flowing water?

_____

_____

3. What does Aspen have that makes energy from flowing water a good choice for this town?

_____

_____

4. Does Boulderville have what it needs to get its energy from flowing water? Explain.

_____

_____

Name: _____

Date: _____

Lesson Assessment

Maya lives in TinyTown, which gets its electricity from burning coal. Maya recently learned about renewable energy sources such as wind, flowing water, and sunlight. She's curious if TinyTown could use renewable energy for its electricity. Maya obtains information from three different people in the town to help her make a decision.

Weather Reporter

It's very windy in TinyTown! Most days, the winds are strong enough to spin a wind turbine. Those winds move air pollution away, but they also bring in clouds and rain. It's always a good idea to have an umbrella with you when you're walking around the town.

City Planner

Our power plant is just outside of town and uses coal. We built TinyTown next to a beautiful river that flows quickly most of the year. There's also lots of space to build a dam. Or, we could also use that space for wind turbines or solar panels.

Biologist

TinyTown is famous for the salmon that swim upstream every year. A dam would get in the way of their migration. Pollution from the coal plant is getting into the river and causing some fish to get sick. Many birds also live nearby, but they stay local and don't migrate.

1. Which natural resources does TinyTown have available to possibly use for electricity? Choose all that apply. There may be more than one correct answer.

a. Coal.
b. Wind.
c. Flowing Water.
d. Sunlight.

2. If you could ONLY choose **one** energy source for TinyTown, which would it be?

a. Coal.
b. Wind.
c. Flowing Water.
d. Sunlight.

3. List at least 3 reasons why you chose the energy source in Question 2. Include the positive or negative effects that using other energy sources may have on the environment.

_____

_____

_____

_____

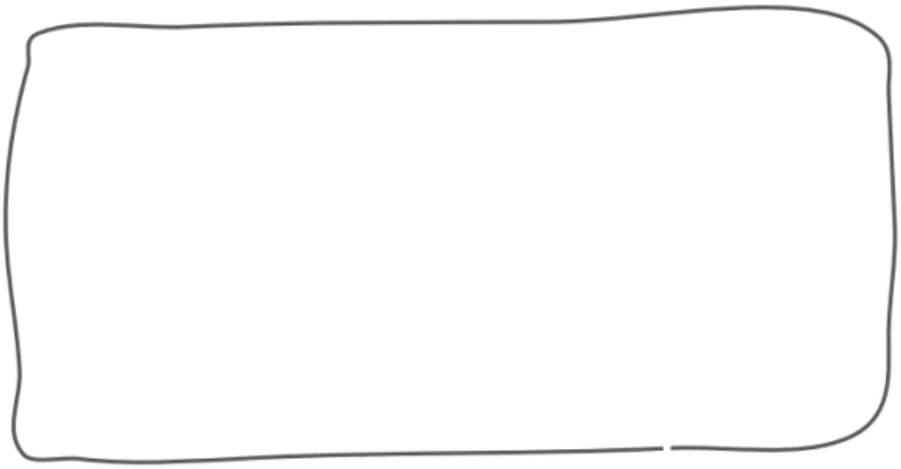
_____

Flashlight Maker!

Name: _____

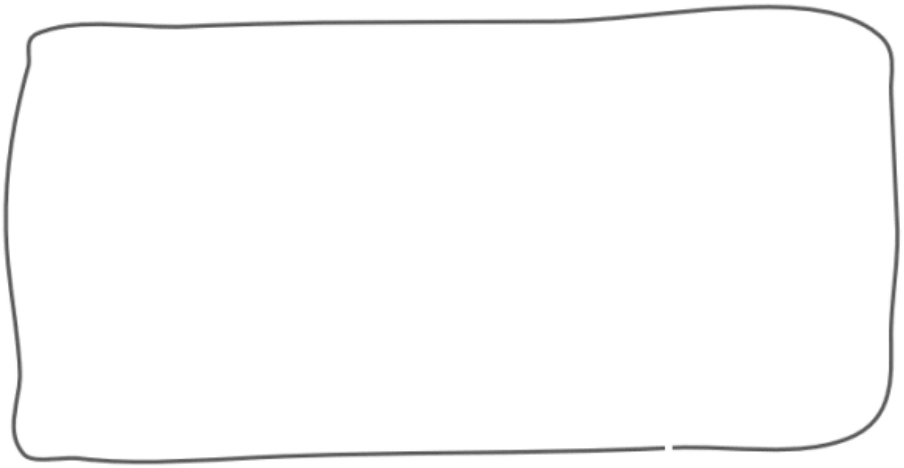
1. Draw a picture of your battery in the box. →

Make it big.
Label the positive side (+), the negative side (-), and anything else you think might be important.



2. Draw a picture that shows what you did to make the LED light up. →

Add arrows and labels to explain how the battery is making the LED light up.



3. Fill in the blanks below. You'll need this information later.

To make the LED light up, I connect:

- the long wire to the _____side of the battery
  and
- the short wire to the _____ side of the battery

4. What additional features would you like your flashlight to have?

_____

_____

_____

Name: _____

Date: _____

Lesson Assessment

1. Paula was experimenting at school with small electric fans. She wanted to see if the energy stored in a battery can be used to make the blades of a fan spin and make sound. Each fan had two wires sticking out. Paula noticed that when she connected the wires to a battery, the fan *started* spinning. When she took one of the wires away from the battery, the fan *stopped* spinning.

In this experiment, where are all the places energy is being transferred? Circle all correct answers.

a. Energy flows from the battery through the wires.
b. Energy is stored in the battery.
c. Electric energy is causing the fan blades to spin and to move.
d. Energy from the spinning fan blade becomes sound energy.

Paula wanted to try and make a fan spin faster. She got another battery, and another fan. She tried connecting two batteries to one fan. She also tried connecting one battery to two fans. Paula recorded her observations, and they are shown in the boxes below. Look at each of her experiments and read the results.

Fan spins very quickly

Both fans spin very slowly

2. What do Paula's observations provide evidence of? Circle all that apply.

a. The stored energy from one battery is transferred to both fans. Each fan gets less energy. That's why both fans spin very slowly.

b. Two fans make twice as much energy. That's why two fans spin quickly.

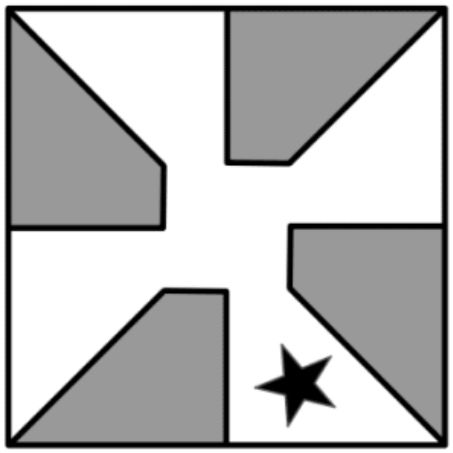
c. One fan spins quickly with two batteries because two batteries can send more energy.

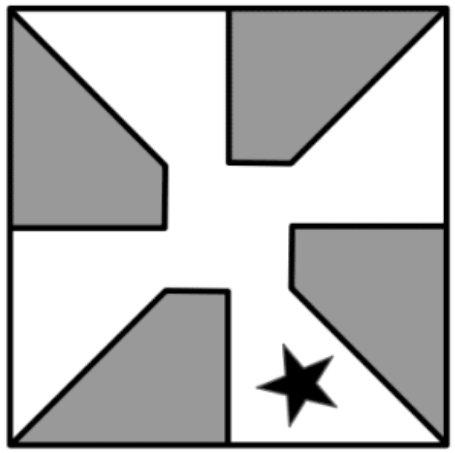
d. All of the fans will stop if all of the batteries are removed. The fans only spin when they get energy from the batteries

mystery science

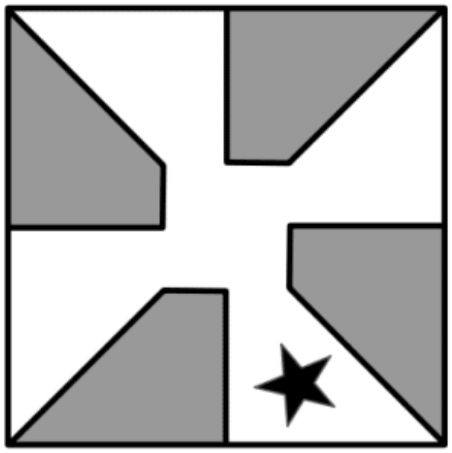
How long did it take to travel across the country before cars and planes?

Heat Spinners





Extra:



mystery science

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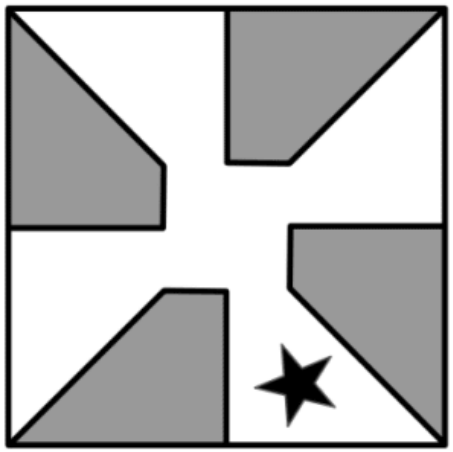
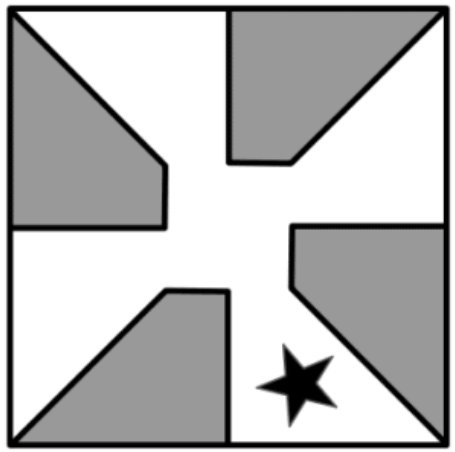
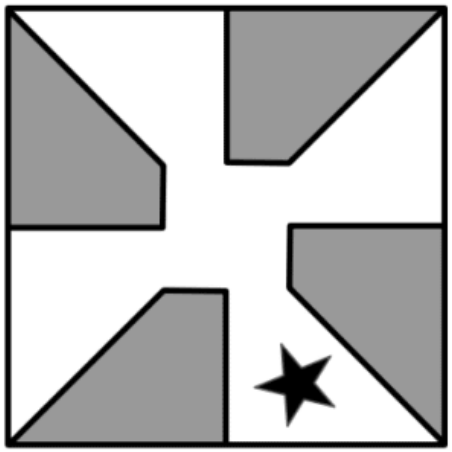




Extra:



Get to Know Your Spinner

Name:_____

1. Working with your partner, set the cup on the desk. Try these experiments and write down what happens. Does the spinner wobble? Spin? Do nothing at all?

   1a. Breathe gently on your spinner from one side. What happens? _____

   1b. Blow gently down on your spinner from straight above. What happens? _____

   (If the spinner falls off the pin, don't blow as hard.)

   1c. Talk to your spinner. What happens? _____

   1d. Fan the spinner with your hand. What happens? _____

2. Now you are going to pick up the cup VERY carefully. It takes skill to pick up the cup without knocking off the spinner. Once you can do that, try these experiments.

   2a. Lift the cup straight up. What happens? _____

   2b. Lower the cup straight down. What happens? _____

   2c. Have your partner hold the cup while you blow upwards into the cup. (This is tricky!) What happens?

   _____

mystery science

How long did it take to travel across the country before cars and planes?

Get to Know Your Spinner

Name:_____

1. Working with your partner, set the cup on the desk. Try these experiments and write down what happens. Does the spinner wobble? Spin? Do nothing at all?

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   _____

mystery science

How long did it take to travel across the country before cars and planes?

Inventing a Heat Engine

Name:_____

Discuss & Invent

Discuss these questions and write your answers on a separate piece of paper.

1. Watch the video on the screen of the spinner and the candles. (The video is on Step 6.) Discuss what could be making that spinner move. Draw a picture to show what you think is going on.
2. Discuss: How could you use a paper heat spinner in a Chain Reaction machine? Draw a picture or describe what you could do.
3. Talk to your spinner. Figure out what sentence makes it spin the most. Why does that sentence work so well?
4. Discuss: The spinner spins in one direction when you lift the tower and the other direction when you lower it. Explain why that might be. Draw a picture to support your explanation.

Experimental Station

5a. Find the heat source at this station. Describe it: _____

5b.

Put the spinner here:	Let about 20 seconds pass, then notice what the spinner is doing. Write down your observations. Draw a picture if you want.
Next to the hot thing	After 20 seconds, I notice...
Above the hot thing	After 20 seconds, I notice...
Below the hot thing	After 20 seconds, I notice...

5c. Did you find any spots where the spinner doesn't turn—or turns just a little? Where?

_____

5d. Did you find a spot where the spinner turns steadily? Where? Does it turn at least 30 times?

_____

Name: _____

Date: _____

Lesson Assessment

1. Imagine you are making a cup of hot chocolate on a cold day. It takes several steps to do it. Some of those steps are shown below. If you make careful observations of each step, you might notice transfers of energy.

Which of the following observations provides evidence that energy has transferred from one place to another? Circle **True** or **False** for each.

True False First, you put a pot of water on a stove. The flames from the stove are very hot. The heat from the flames makes the pot of water warmer. This is evidence of a transfer of heat energy from the flames to the pot of water.

True False After a while, steam starts to come out of the pot. The pot also starts to rattle and shake and the steam coming out makes a sound. This is because the water is very, very hot. This is evidence of a transfer of heat energy from the flames to the pot of water.

True False Once the water is hot, you can pour it into a cup and sprinkle in the hot chocolate powder. This turns the water into hot chocolate. This is evidence of a transfer of heat energy from the hot chocolate powder to the water.

True False Finally, you stir the hot chocolate with a metal spoon. You can feel the handle of the spoon get hotter and hotter from being in the hot chocolate. This is evidence of a transfer of heat energy from the hot chocolate to the spoon.

Names: _____

1. WIND TURBINES

Wind turbines look like giant fans. When wind blows, it makes wind turbines spin. The spinning turbine is connected to a generator. The generator transforms the energy from spinning into electric energy.

So, the electric energy came from the energy of the spinning turbine, and the energy in the spinning turbine came from energy in the wind. But where does the energy in the wind originally come from?

Almost all wind on Earth is caused by heat energy. Heat causes air to move around, and we feel that moving air as wind. (This is a lot like how heat made your heat spinner move.)

So where does almost all of the heat on Earth come from? The Sun! Energy in wind comes from energy in sunlight. That's right: almost all wind energy comes from solar energy. And the wind can keep blowing, even after the Sun sets at night. So if a wind turbine is running at night, this means something amazing. This means the turbine is getting energy that originally came from the Sun—even at night!

1. In your own words, describe how the parts of a wind turbine work together to make electricity.

_____

_____

2. A wind turbine makes electric energy. But the electric energy doesn't come out of nowhere. It comes from other forms of energy. List where the energy in the electricity came from. Include each step.

_____

_____

3. Are wind turbines able to use energy from the Sun at night? Explain.

_____

_____

_____

_____

Names: _____

2. WATER TURBINES

When water flows downhill, it carries energy. Dams hold back water flowing downhill.

Some dams have an opening that lets some water through. Inside that opening, there is a turbine. The turbine spins when water flows past it. The spinning turbine is connected to a generator that transforms the energy from spinning into electric energy.

So, the electric energy came from the energy of the spinning turbine. And the energy in the spinning turbine came from energy in the water flowing downhill. But *before* the water could go downhill, it had to get *uphill* first. Energy has to go *into* the water to make it go uphill. So where did that energy come from?

When water gets hot, it can turn from a liquid into a gas and float high into the air. Almost all of the energy for this comes from sunlight! Once water is high in the air, it can rain down onto mountains and flow downhill. Then, we can get electric energy from that flowing water. And the water can keep flowing, even after the Sun sets at night. So if a water turbine is running at night, this means something amazing. This means the turbine is getting energy that originally came from the Sun—even at night!

1. In your own words, describe how the parts of a water turbine work together to make electricity.

_____

_____

2. A water turbine makes electric energy. But the electric energy doesn't come out of nowhere. It comes from other forms of energy. List where the energy in the electricity came from. Include each step.

_____

_____

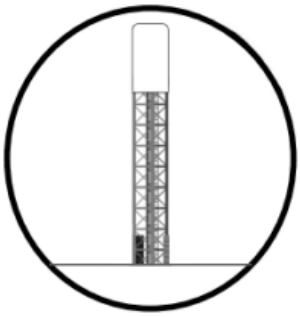
3. Are water turbines able to use energy from the Sun at night? Explain.

_____

_____

_____

_____



Names: _____

3. SOLAR THERMAL TOWERS

Sunlight makes things warm. Imagine if you could take a whole bunch of sunlight that's spread out over a big area and put it all into one small area. All of that warm sunlight would add up and the small area would get very, very hot!

That's how a solar thermal tower works. Mirrors are spread out on the ground over a big area. Sunlight shines down on the mirrors. The sunlight bounces off of all of the mirrors, and the sunlight goes up to one single tower. That makes the tower very hot.

Inside the tower, there are pipes filled with water that turn into steam. That steam makes a steam turbine spin. The spinning turbine is connected to a generator that transforms the energy from spinning into electric energy.

All of these parts can stay super hot for hours and hours after the Sun sets. Some are even designed to stay as hot as possible, for as long as possible, on purpose! This extra heat can be used to keep making steam and electricity at night. That means we can keep using energy from the Sun <u>after</u> the Sun has set!

1. In your own words, describe how the parts of a solar thermal tower work together to make electricity.

_____

_____

2. A solar thermal tower makes electric energy. But the electric energy doesn't come out of nowhere. It comes from other forms of energy. List where the energy in the electricity came from. Include each step.

_____

_____

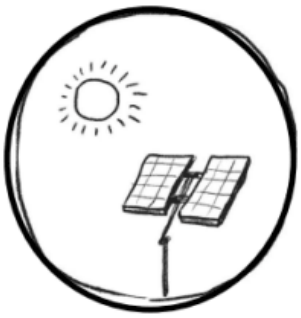
3. Are solar thermal towers able to use energy from the Sun at night? Explain.

_____

_____

_____

_____



Names: _____

4. SOLAR PANELS

Imagine if you could make electricity, and you didn't need any special turbines or any special generators. Imagine if you didn't need any giant towers in the desert surrounded by thousands of mirrors. Imagine if all you needed was a special material that would directly transform light into electric energy.

That's exactly what solar panels are! Solar panels are made of a very special material that can change light energy directly into electric energy. There are no spinning turbines attached to spinning generators. They don't have any big moving parts at all.

This means that solar panels can be so quiet and so small that they can even go onto the roofs of houses and other buildings. Solar panels are one of the very best ways to generate electricity right on top of small homes and other buildings.

Solar panels are very simple in a lot of ways, but that comes with at least one disadvantage. The moment that sunlight stops shining, they stop making electricity.

1. In your own words, describe why a solar panel doesn't need big moving parts to make electricity.

_____

_____

2. Solar panels make electric energy. But the electric energy doesn't come out of nowhere. It comes from another form of energy. Write where the energy in the electricity came from.

_____

_____

3. Are solar panels able to use energy from the Sun at night? Explain.

_____

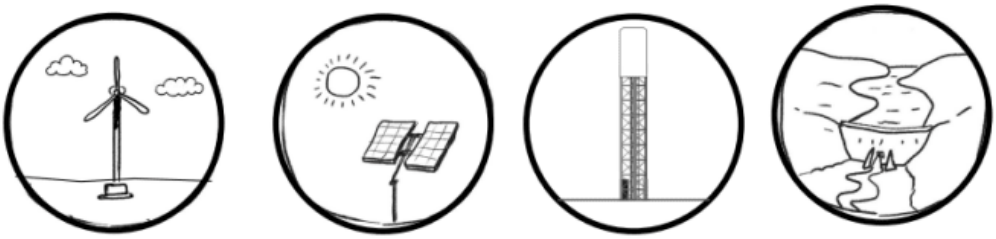
_____

_____

_____

Names: _____

5. ALL TYPES



1. Look back at all that you have learned. On the lines below, write at least two **similarities** between some of the types of electricity generation that you studied.

   - _____

     _____

   - _____

     _____

2. Look back at all that you have learned. On the lines below, write at least two **differences** between some of the types of electricity generation that you studied.

   - _____

     _____

   - _____

     _____

3. We can also burn things like coal or natural gas to make electricity. The heat from burning these things can make turbines spin. If the turbines are connected to a generator, the generator will make electric energy. This is very similar to some of the other ways you learned to make electric energy.

   In what ways is it **different** when we make electricity from burning coal or natural gas, as opposed to using energy from the Sun? Be sure to think about what is left behind in the environment.

   _____

   _____

   _____

   _____

   _____

Electricity, Light, & Heat

Name: _____

Date: _____

Unit Assessment

1. Padma makes toast for breakfast. She puts bread into the toaster, plugs the toaster into the electrical outlet, and pushes the button to start the machine. As the toaster works, Padma makes several observations. Which of Padma's observations provides evidence that energy has been transferred from the electrical outlet to another place?

Circle **True** or **False** for each sentence.

True False

Padma looks down and observes that the coils inside the toaster are glowing red. Light is a form of energy. This is evidence that electrical energy from the outlet has been transferred to the toaster.

True False

Padma feels that the air above the toaster is warm. Heat is a form of energy. This is evidence that electrical energy from the outlet has been transferred to the toaster.

True False

Padma eats the toast and it tastes delicious. Taste is a form of energy. This is evidence that electrical energy from the outlet has been transferred to the toaster.

True False

Padma listens closely and hears that the toaster is making a soft buzzing sound. Sound is a form of energy. This is evidence that electrical energy from the outlet has been transferred to the toaster.

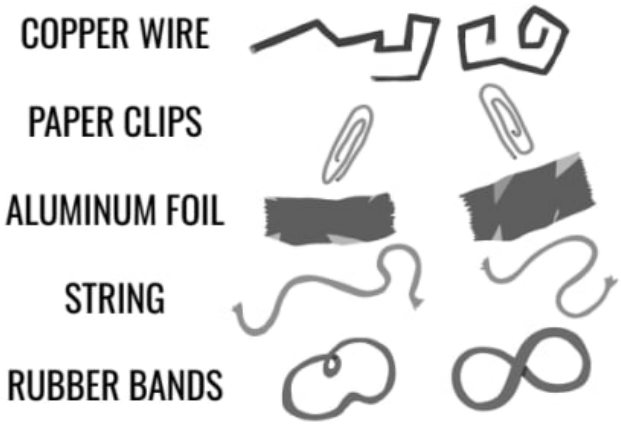
2. Maya wants to build a tiny flashlight by connecting a battery to an LED bulb. There are three rules that Maya needs to follow to get her flashlight to work:

1. The electrical energy must follow a path.
2. The path must be made using a conducting material.
3. Energy can only flow along the path in the direction of negative (-) to positive (+).

Maya has the following materials available:

LED

BATTERY

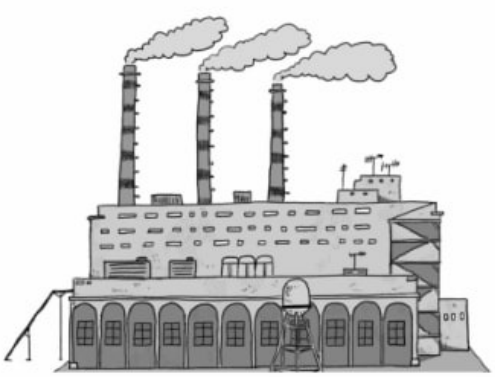


Using the materials above, make a drawing of how Maya could connect them so that the LED bulb will light up. Make sure to add labels to your drawing.

3. Maya wants to figure out if paper clips or copper wire work better for her flashlight. What could Maya do to test which of these two materials works better?

a. Maya can use paper clips to connect the battery to the LED bulb. If it lights up, this is evidence that paper clips are a better material than copper wire.
b. Maya can use copper wire to connect the battery to the LED bulb. If it lights up, this is evidence that copper wire is a better material than paper clips.
c. Maya can first test the flashlight using paper clips. Then, she can test the flashlight using copper wire. If the LED bulb glows brighter with the copper wire compared to the paper clips, this is evidence that copper wire is a better material to use.

The people who live in the town of Smogville have noticed that the air is smoky throughout the year. Many people in the town have trouble breathing during the smoky days. Some think the smoky air is caused by the town's power plant, which is shown to the right. The power plant burns fossil fuels to provide the town with energy. But when the fossil fuels are burned, smoke goes into the air.

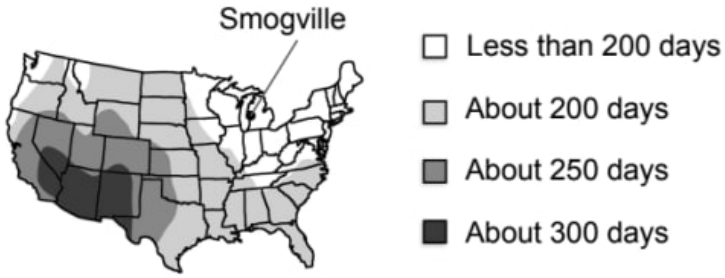


The people of Smogville think that using renewable energy to power the town could solve the town's air problem. Smogville isn't near a river, so they cannot use water energy. The renewable energy sources the town can choose from are solar energy and wind energy.

4. In order for Smogville to use solar energy, there must be at least 250 sunny days each year. Look at the map shown to the right. Can Smogville use solar energy?

a. Yes, Smogville can use solar energy.
b. No, Smogville can't use solar energy.
c. There is no way to tell if Smogville can use solar energy or not.

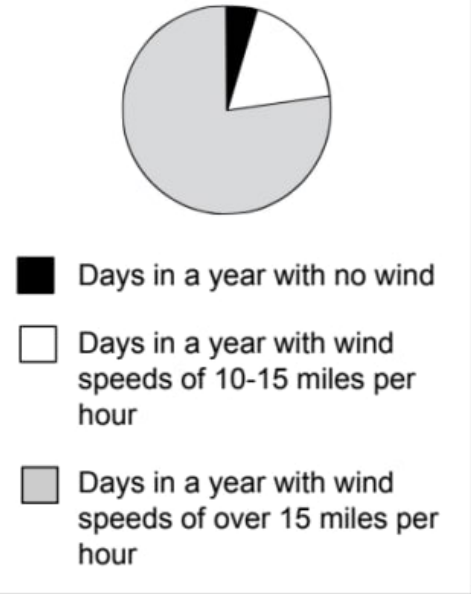
Number of Sunny Days in a Year in Different Areas



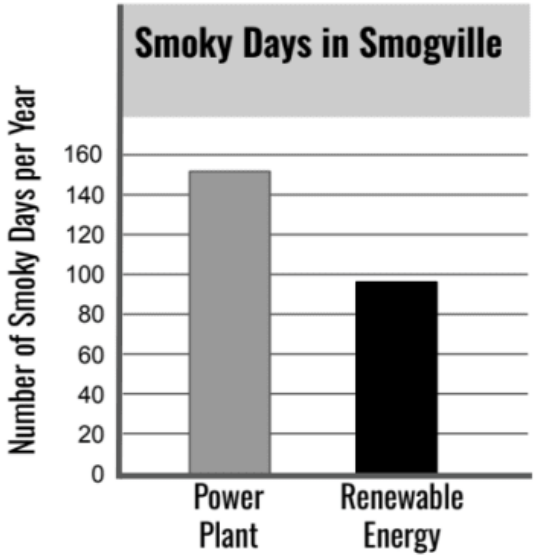
5. In order for Smogville to use wind energy, the wind needs to blow at a speed of over 15 miles per hour. Look at the chart to the right. Can Smogville use wind energy? Why or why not?

a. Yes, Smogville can use wind energy because the wind blows over 15 miles per hour most days.
b. Yes, Smogville can use wind energy because the wind blows less than 15 miles per hour most days.
c. No, Smogville can't use wind energy because the wind blows over 15 miles per hour most days.
d. No, Smogville can't use wind energy because the wind blows less than 15 miles per hour most days.

Average Wind Speed in Smogville Every Year



6. Smogville tried using renewable energy to power the town. The town stopped running the power plant for a year. The graph below shows how many smoky air days the town had during a year when they used the fossil fuel power plant. It also shows the number of smoky days the town had during the year when they used renewable energy. What does the graph show you about the cause of the smoky air problem in Smogville?



a. The power plant was the only cause of the smoky air problem. Using renewable energy has completely solved the problem of smoky days in Smogville.
b. The power plant was not the cause of the smoky air problem. Using renewable energy has not helped to solve the problem of smoky days in Smogville.
c. The power plant was one cause of the smoky air problem. Using renewable energy has partially solved the problem of smoky days in Smogville. There are fewer smoky days than when the town used the power plant.

7. Why did you choose your answer to Question 6? Explain what you notice from the graph to provide evidence about the cause of the smoky air in Smogville.

_____

_____

_____

_____

_____

_____