Human Machine Mysteries:

Mystery 1: Why do your biceps bulge?

Mystery 2: What do people who are blind see?

Mystery 3: How can some animals see in the dark?

Mystery 4: How does your brain control your body?
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>What did you observe?</td>
<td>How can you explain what is happening?</td>
<td>What questions do you have?</td>
</tr>
</tbody>
</table>
Owl System Model

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.
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.

Bone 4 is the bone in the palm of your hand.

Point Finger

Bones 1, 2, and 3 are finger bones.
Human Machine
Mystery 1: Why do your biceps bulge?

End of Mystery Assessment

1. In the video, Doug claims that the human body “works a lot like a robot.” What are some ways that our bodies are similar to robots?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

2. Why do you think that scientists find dissection useful for learning how the body works?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
3. Make a drawing that explains how biceps move your lower arm. (Use words and arrows to help you explain it.)

4. Would you be able to move if you didn’t have bones? Why or why not?
Front of the Eye
1. Why do some people have blurry vision?

2. How does light enter the eye? On this drawing of the eye, label the *retina*, *cornea-lens*, *iris*, and *pupil*. Then use a big *arrow* to show where light enters the eye.

3. What would happen if your cornea-lens were cloudy instead of clear? What would you see?
Pupil card
Human Machine
Mystery 3: How can some animals see in the dark?

End of Mystery Assessment

1. Why does your pupil get larger when the room is dark?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

2. How do nocturnal animals see better in the dark than we can?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

3. Why does it sometimes look like people have red eyes when their picture is taken using a camera’s flash?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
**THINK FAST!**

**Record your results**

<table>
<thead>
<tr>
<th>Trial</th>
<th>Number on ruler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial #1</td>
<td>__________ cm</td>
</tr>
<tr>
<td>Trial #2</td>
<td>__________ cm</td>
</tr>
<tr>
<td>Trial #3</td>
<td>__________ cm</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Picture</th>
<th>Distance on ruler</th>
<th>Time it takes for the ruler to fall this far</th>
<th>That’s the same time it takes...</th>
</tr>
</thead>
<tbody>
<tr>
<td>🚀</td>
<td>0 - 5 cm</td>
<td>less than 100 milliseconds</td>
<td>...for a ROCKET SHIP to travel a ½ mile</td>
</tr>
<tr>
<td>👀</td>
<td>6 - 10 cm</td>
<td>100 to 140 milliseconds</td>
<td>...for a BLINK of an eye</td>
</tr>
<tr>
<td>⚡️</td>
<td>11 - 15 cm</td>
<td>140 to 180 milliseconds</td>
<td>...for a LIGHTNING BOLT to travel 10 miles</td>
</tr>
<tr>
<td>🦌</td>
<td>16 - 20 cm</td>
<td>180 to 200 milliseconds</td>
<td>...for a CHEETAH to run 20 feet</td>
</tr>
<tr>
<td>🖍️</td>
<td>21 - 25 cm</td>
<td>200 to 230 milliseconds</td>
<td>...for a SNAP of the fingers</td>
</tr>
<tr>
<td>🏎️</td>
<td>26 -30 cm</td>
<td>230 to 250 milliseconds</td>
<td>...for a RACE CAR to drive 85 feet</td>
</tr>
</tbody>
</table>

1000 milliseconds = 1 second
Human Machine

Mystery 4: How does your brain control your body?

End of Mystery Assessment

1. Why does it look like you have a hole in your hand when you try the hole-in-hand illusion?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. What is the difference between your movement nerves and your sensory nerves? What do they do?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
3. On the drawing below, add arrows and words to explain what happened as you did the “Reaction Time” activity.
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.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

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
The Birth of Rocks Mysteries:

Mystery 1: Could a volcano pop up where you live?

Mystery 2: Why do some volcanoes explode?

Mystery 3: Will a mountain last forever?

Mystery 4: How could you survive a landslide?
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</tbody>
</table>
Ashfall Fossil Beds Explanation

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

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

<table>
<thead>
<tr>
<th>Mystery 1: Could a volcano pop up where you live?</th>
<th>Question 1: How did the prehistoric rhinos and other animals die?</th>
<th>Question 2: Why did it take 11 million years to find the fossils of the animals?</th>
<th>Question 3: How were the fossils eventually found?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mystery 2: Why do some volcanoes explode?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery 3: Will a mountain last forever?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery 4: How could you survive a landslide?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

Volcano Discoveries

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   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

Name: __________________________

Mystery Science
The Birth of Rocks | Mystery 1
North America Map: Volcano List

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.

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<thead>
<tr>
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<th>Country</th>
<th>Year Last Erupted</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>6, Y</td>
<td>Kilauea</td>
<td>Hawaii, USA</td>
<td>2015</td>
</tr>
<tr>
<td>○</td>
<td>16, R</td>
<td>Lassen Peak</td>
<td>California, USA</td>
<td>1915</td>
</tr>
<tr>
<td>○</td>
<td>17, S</td>
<td>Mammoth Mountain</td>
<td>California, USA</td>
<td>1400</td>
</tr>
<tr>
<td>○</td>
<td>5, K</td>
<td>Mount Aniakchak</td>
<td>Alaska, USA</td>
<td>1931</td>
</tr>
<tr>
<td>○</td>
<td>1, M</td>
<td>Mount Cleveland</td>
<td>Alaska, USA</td>
<td>2014</td>
</tr>
<tr>
<td>○</td>
<td>7, H</td>
<td>Mount Redoubt</td>
<td>Alaska, USA</td>
<td>2009</td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>○</td>
<td>15, O</td>
<td>Mount St. Helens</td>
<td>Washington, USA</td>
<td>2008</td>
</tr>
<tr>
<td>○</td>
<td>9, G</td>
<td>Mount Wrangell</td>
<td>Alaska, USA</td>
<td>1999</td>
</tr>
<tr>
<td>○</td>
<td>24, Z</td>
<td>Pacaya</td>
<td>Guatemala</td>
<td>2013</td>
</tr>
<tr>
<td>○</td>
<td>21, Y</td>
<td>Paricutin</td>
<td>Mexico</td>
<td>1952</td>
</tr>
<tr>
<td>○</td>
<td>22, Y</td>
<td>Popocatepetl</td>
<td>Mexico</td>
<td>2015</td>
</tr>
<tr>
<td>○</td>
<td>18, W</td>
<td>Tres Virgenes</td>
<td>Mexico</td>
<td>1857</td>
</tr>
</tbody>
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<tbody>
<tr>
<td>○</td>
<td>29, V</td>
<td>Burney</td>
<td>Chile</td>
<td>1910</td>
</tr>
<tr>
<td>○</td>
<td>29, Q</td>
<td>Copahue</td>
<td>Chile</td>
<td>2012</td>
</tr>
<tr>
<td>○</td>
<td>29, T</td>
<td>Mount Hudson</td>
<td>Chile</td>
<td>1991</td>
</tr>
<tr>
<td>○</td>
<td>28, C</td>
<td>Nevado del Ruiz</td>
<td>Colombia</td>
<td>2012</td>
</tr>
<tr>
<td>○</td>
<td>29, P</td>
<td>Planchón-Peteroa</td>
<td>Chile</td>
<td>2010</td>
</tr>
<tr>
<td>○</td>
<td>30, L</td>
<td>Pular</td>
<td>Chile</td>
<td>1990</td>
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<th>Country</th>
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<tbody>
<tr>
<td>○</td>
<td>28, D</td>
<td>Reventador</td>
<td>Ecuador</td>
<td>2014</td>
</tr>
<tr>
<td>○</td>
<td>29, I</td>
<td>Sabancaya</td>
<td>Peru</td>
<td>2013</td>
</tr>
<tr>
<td>○</td>
<td>30, K</td>
<td>San Pedro</td>
<td>Chile</td>
<td>1960</td>
</tr>
<tr>
<td>○</td>
<td>26, A</td>
<td>Turrialba</td>
<td>Costa Rica</td>
<td>2015</td>
</tr>
<tr>
<td>○</td>
<td>30, J</td>
<td>Wallatiri</td>
<td>Chile</td>
<td>1985</td>
</tr>
<tr>
<td>○</td>
<td>24, D</td>
<td>Wolf</td>
<td>Galápagos, Ecuador</td>
<td>2015</td>
</tr>
</tbody>
</table>
Asia Map: Volcano List

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.

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</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>32, N</td>
<td>Chirinkotan</td>
<td>Russia</td>
<td>2013</td>
</tr>
<tr>
<td>○</td>
<td>31, P</td>
<td>Chirpoi</td>
<td>Russia</td>
<td>2013</td>
</tr>
<tr>
<td>○</td>
<td>39, M</td>
<td>Gareloi Volcano</td>
<td>Alaska, USA</td>
<td>1989</td>
</tr>
<tr>
<td>○</td>
<td>23, X</td>
<td>Guishan Island</td>
<td>Taiwan</td>
<td>1795</td>
</tr>
<tr>
<td>○</td>
<td>34, J</td>
<td>Klyuchevskaya Sopka</td>
<td>Russia</td>
<td>2015</td>
</tr>
<tr>
<td>○</td>
<td>33, L</td>
<td>Koryaksky</td>
<td>Russia</td>
<td>2008</td>
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<tr>
<td>○</td>
<td>34, K</td>
<td>Kronotsky</td>
<td>Russia</td>
<td>1923</td>
</tr>
<tr>
<td>○</td>
<td>26, T</td>
<td>Mount Aso</td>
<td>Japan</td>
<td>2004</td>
</tr>
<tr>
<td>○</td>
<td>28, T</td>
<td>Mount Fuji</td>
<td>Japan</td>
<td>1707</td>
</tr>
<tr>
<td>○</td>
<td>29, Q</td>
<td>Mount Meakan</td>
<td>Japan</td>
<td>2008</td>
</tr>
<tr>
<td>○</td>
<td>26, U</td>
<td>Sakura-jima</td>
<td>Japan</td>
<td>2013</td>
</tr>
<tr>
<td>○</td>
<td>34, L</td>
<td>Zhupanovsky</td>
<td>Russia</td>
<td>2015</td>
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Australia & Nearby Islands Map: Volcano List

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</tr>
</thead>
<tbody>
<tr>
<td>□</td>
<td>32, F</td>
<td>Bagana</td>
<td>Papua New Guinea</td>
<td>2006</td>
</tr>
<tr>
<td>□</td>
<td>23, G</td>
<td>Egon</td>
<td>Indonesia (Java)</td>
<td>2005</td>
</tr>
<tr>
<td>□</td>
<td>31, F</td>
<td>Garbuna Group</td>
<td>Papua New Guinea</td>
<td>2005</td>
</tr>
<tr>
<td>□</td>
<td>18, E</td>
<td>Kaba</td>
<td>Indonesia (Sumatra)</td>
<td>2000</td>
</tr>
<tr>
<td>□</td>
<td>24, A</td>
<td>Kanlaon</td>
<td>Philippines</td>
<td>2006</td>
</tr>
<tr>
<td>□</td>
<td>30, F</td>
<td>Manam</td>
<td>Papua New Guinea</td>
<td>2006</td>
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<tr>
<td>□</td>
<td>21, G</td>
<td>Merapi</td>
<td>Indonesia (Java)</td>
<td>2010</td>
</tr>
<tr>
<td>□</td>
<td>38, Q</td>
<td>Mount Tongariro</td>
<td>New Zealand</td>
<td>2012</td>
</tr>
<tr>
<td>□</td>
<td>19, F</td>
<td>Papandayan</td>
<td>Indonesia (Java)</td>
<td>2002</td>
</tr>
<tr>
<td>□</td>
<td>22, G</td>
<td>Rinjani</td>
<td>Indonesia (Java)</td>
<td>2004</td>
</tr>
<tr>
<td>□</td>
<td>17, D</td>
<td>Sinabung</td>
<td>Indonesia (Sumatra)</td>
<td>2014</td>
</tr>
<tr>
<td>□</td>
<td>24, D</td>
<td>Soputan</td>
<td>Indonesia (Java)</td>
<td>2007</td>
</tr>
</tbody>
</table>
The Birth of Rocks
Mystery 1: Could a volcano pop up where you live?

End of Mystery Assessment

1. When you look at a world map, where are most of the volcanoes located? What pattern do they form?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

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____________________________________________________________________________________

2. Why might you find lava rocks so far away from the Ring of Fire?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

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____________________________________________________________________________________

3. Is it possible for a volcano to erupt where you live? Why or why not?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
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?

   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

MYSTERY SCIENCE
The Birth of Rocks | Mystery 2
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!
The Birth of Rocks
Mystery 2: Why do some volcanoes explode?

End of Mystery Assessment

1. Why are some volcanoes cone-shaped and some shield-shaped?

2. If you were traveling and found a volcano, how could you figure out if the volcano makes felsite or basalt lava?

3. Which volcanoes are more likely to explode—the ones with thick lava or thin lava? Why? What evidence do you have?
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? |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 switch jobs</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#3 switch jobs</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4 switch jobs</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#5 switch jobs</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Name: ______________________
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!
1. Do mountains last forever? Why or why not?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

2. How does solid rock break into smaller pieces?

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____________________________________________________________________
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____________________________________________________________________

3. How are rocks at the top of a mountain different than the ones at the bottom?

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____________________________________________________________________
Saving My Slide-City Home

What's the name of your plan? _______________________

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

________________________________________________________________________

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Draw your plan in this box.
The Birth of Rocks
Mystery 4: How could you survive a landslide?

End of Mystery Assessment

1. What are landslides?

2. What causes landslides?

3. Imagine that you are camping in a hilly area. How can you figure out if it's a safe place to camp?
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

### Step 1: Look for clues.
Write down what you notice about each rock. What could that tell you about its history?

<table>
<thead>
<tr>
<th></th>
<th>Rock A</th>
<th>Rock B</th>
<th>Rock C</th>
<th>Rock D</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you notice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>about this rock?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What clues does this</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>give you about where</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the rock may have</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>come from?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mystery Science**

The Birth of Rocks | Performance Task
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.
**Story of a Rock Part 2**

**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.

<table>
<thead>
<tr>
<th></th>
<th>Which rock came from here?</th>
<th>What evidence do you have for this claim?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
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.
Waves of Sound Mysteries:

Mystery 1: How far can a whisper travel?

Mystery 2: What would happen if you screamed in outer space?

Mystery 3: Why are some sounds high and some sounds low?
### See-Think-Wonder Chart

#### Wonder
- What questions do you have?

#### Think
- How can you explain what is happening?

#### See
- What did you observe?

<table>
<thead>
<tr>
<th>See</th>
<th>Think</th>
<th>Wonder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Metal</td>
<td>Dish Speaker</td>
<td>Metal Speaker</td>
</tr>
<tr>
<td>Speaker</td>
<td>Tube Speaker</td>
<td>Speaker Tube</td>
</tr>
<tr>
<td>Rubber</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Seeing Sound**

**Metal Plate**

**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:**

---

Mystery Science
Wave of Sound | Unit Starter
Seeing Sound
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: ____________________________

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Seeing Sound
Ruben's Tube

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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______________________________________________________________________
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.
2. **DISCUSS:**

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

Write 2 ideas to test down here

3. **EXPERIMENT!**

<table>
<thead>
<tr>
<th>The 2 experiments you decided on:</th>
<th>Try your experiment. What did you notice?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Here’s what we’ll do:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Here’s what we think will happen:</td>
<td></td>
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<tr>
<td></td>
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<tr>
<td>Here’s what we’ll do:</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Here’s what we think will happen:</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you need more space, use the back of the page.
1. When you talk into your paper cup telephone, the person on the other end can feel the bottom of their telephone vibrate. **Why do you think this happens? Show your idea by drawing and using words:**
2. How could you find out if sound vibrations travel through other materials?


3. Think about all the sounds and noises around you each day. Besides human voices, what are some other examples of things that create sound vibrations? Make a list below:

• 
• 
• 
• 
• 
• 
• 
•
Waves of Sound
Mystery 2: What would happen if you screamed in outer space?

End of Mystery Assessment

1. Why can’t sound vibrations travel in outer space?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

2. Jayden and his little brother are on a boat trip looking for dolphins. Jayden’s little brother keeps banging his hand on the side of the boat. Jayden says to his little brother, “Shhh! Be quiet, I don’t want you to scare the dolphins away!” Jayden’s little brother says, “Don’t be ridiculous, the dolphins can’t hear us through the water!”

How could Jayden convince his little brother that sound can be heard through water?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
3. You've seen that it's possible for sound to break a car's windshield. Why do you think this happens? Show your ideas by drawing a picture below, and using words:
**Be the Vibration!**

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

- Tie the rope at one end, or have someone hold it still.
- Be sure you're on a smooth, hard floor.

**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.

Experiment with how tight you pull the rope and how far you move your hand.
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?

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?
Waves of Sound
Mystery 3: Why are some sounds high and some sounds low?

End of Mystery Assessment

1. What does sound have in common with ripples in a pond?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. If a vibration goes back and forth rapidly (fast), what kind of sound waves does it make in the air: short waves or long waves?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
3. The person in the drawing is at the bottom of the Grand Canyon. They yell, "HEY!!!" and then hear their echo a couple of seconds later.

Given what you know about sound, what do you think is happening when a person hears their echo? Show your ideas by drawing on the picture below, and using words:
4. The pictures below show two different sounds, seen through an oscilloscope. One of them is the sound of a flute (a high-pitched sound), and the other is the sound of a tuba (a low-pitched sound). Which is the tuba? Which is the flute? How do you know?

Sound A

Sound B
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
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.

<table>
<thead>
<tr>
<th>Things I can improve on my device</th>
<th>Ways to improve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.**
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
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.

<table>
<thead>
<tr>
<th>Standing on the Earth</th>
<th>Swimming Under the Water</th>
<th>Floating in Outer Space</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Standing on the Earth" /></td>
<td><img src="image2" alt="Swimming Under the Water" /></td>
<td><img src="image3" alt="Floating in Outer Space" /></td>
</tr>
</tbody>
</table>

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.
Energizing Everything Mysteries:

Mystery 1: How is your body similar to a car?
Mystery 2: What makes roller coasters go so fast?
Mystery 3: Why is the first hill of a roller coaster always the highest?
Mystery 4: Could you knock down a building using only dominoes?

Mystery 5: Can you build a chain reaction machine?
Mystery 6: What if there were no electricity?
Mystery 7: How long did it take to travel across the country before cars and planes?
Mystery 8: Where does energy come from?
<table>
<thead>
<tr>
<th>See</th>
<th>Think</th>
<th>Wonder</th>
</tr>
</thead>
<tbody>
<tr>
<td>What did you observe?</td>
<td>How can you explain what is happening?</td>
<td>What questions do you have?</td>
</tr>
</tbody>
</table>
Explain how this machine works. You can refer to each part by its letter.

Symbol Key:
**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.)

__________________________
Fold up after cutting.
Fold up after cutting.
End of Mystery Assessment

1. Why do Olympic athletes usually eat a lot of food for breakfast?
   a. Food provides energy and they need a lot of energy so they can move quickly.
   b. Olympic athletes are not allowed to eat dinner, so they only eat breakfast.
   c. The food always has lots of sugar that is used as energy.

2. Circle each of the objects below that has stored energy. Then draw an arrow to the image showing where that energy is released.
3. Amy, Claire, and Pat are in a slingshot competition to see who can make a marble travel the fastest. Below are pictures of what their slingshots looked like right before they release their rubber bands. Whose marble do you think will travel the fastest? Why? Explain in terms of energy.

![Images of slingshots held by Amy, Claire, and Pat]

4. You are building a model of the Twist-o-Matic ride. You run experiments to test Rubber Band “A,” Rubber Band “B,” and Rubber Band “C.” You watch how fast the ride spins around after you twist each rubber band five times. You record your observations in this table:

<table>
<thead>
<tr>
<th>Rubber Band</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twist-o-Matic Speed</td>
<td>Slow</td>
<td>Fast</td>
<td>Very Fast</td>
</tr>
</tbody>
</table>

Why do you observe this pattern? Explain in terms of energy.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
5. Acme Amusements is developing a new ride called the Spring-o-matic. It stores energy in very large springs. When energy is released, the springs move the riders up and down. There are two versions of the ride. Ride A uses a small, thin spring and Ride B uses a big, thick spring to store energy. You try both rides and you record how many times the ride moves up and down. You also record how quickly the ride moves. Why do you think Ride A takes so much longer than Ride B? Explain your answer in terms of energy.

<table>
<thead>
<tr>
<th></th>
<th>Ride A</th>
<th>Ride B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Times the Ride Moves</td>
<td>5 times</td>
<td>5 times</td>
</tr>
<tr>
<td>How Long The Ride Takes</td>
<td>40 seconds</td>
<td>10 seconds</td>
</tr>
</tbody>
</table>
Crash’s Track

Name: ____________________________

Track 3 (Crash)

Mystery Science
Energizing Everything | Mystery 2
Track 4
(Pow)
# Distance and Height Experiments!

<table>
<thead>
<tr>
<th>Always release the Hill Marble at the “High” mark:</th>
<th>Change the distance of the Bumper Marble from the alligator:</th>
<th>Did the Hill Marble get eaten? (It’s ok if the Bumper Marble got eaten.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="High" /> 20 cm</td>
<td><img src="image2" alt="High 20 cm" /></td>
<td>Trial 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eaten</td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
<tr>
<td><img src="image3" alt="High" /> 32 cm</td>
<td><img src="image4" alt="High 32 cm" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
<tr>
<td><img src="image5" alt="High" /> 44 cm</td>
<td><img src="image6" alt="High 44 cm" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Change the height where you release the Hill Marble:</th>
<th>Always place the Bumper Marble 32 cm from the alligator:</th>
<th>Did the Hill Marble get eaten? (It’s ok if the Bumper Marble got eaten.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="High" /> 32 cm</td>
<td><img src="image8" alt="High 32 cm" /></td>
<td>Trial 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eaten</td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
<tr>
<td><img src="image9" alt="Medium" /> 32 cm</td>
<td><img src="image10" alt="Medium 32 cm" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
<tr>
<td><img src="image11" alt="Low" /> 32 cm</td>
<td><img src="image12" alt="Low 32 cm" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>safe</td>
</tr>
</tbody>
</table>

**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.
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.)
---|---|---
[Diagram: High 44 cm 32 cm] | eaten | eaten | eaten | eaten
| safe | safe | safe | 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 2: What makes roller coasters go so fast?

End of Mystery Assessment

1. 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.

<table>
<thead>
<tr>
<th>Sledder</th>
<th>Trial #1</th>
<th>Trial #2</th>
<th>Trial #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mateo</td>
<td>24 miles per hour</td>
<td>21 miles per hour</td>
<td>22 miles per hour</td>
</tr>
<tr>
<td>Katy</td>
<td>17 miles per hour</td>
<td>16 miles per hour</td>
<td>18 miles per hour</td>
</tr>
<tr>
<td>Robb</td>
<td>10 miles per hour</td>
<td>9 miles per hour</td>
<td>8 miles per hour</td>
</tr>
</tbody>
</table>

What kind of pattern do you notice?

a. Mateo always went faster than Katy and Robb.
b. Katy always went faster than Mateo and Robb.
c. Robb always went faster than Mateo and Katy.

2. Why does the same person always win the sled races? Explain in terms of energy.
3. 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.

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.

4. In the picture above, Camila hits the white ball from her current position. What do you predict will most likely happen?
   a. The white ball will hit the 3-ball and make a sound. Then the 3-ball will start to move.
   b. The white ball will hit the 3-ball, but will not make a sound. Then the 3-ball will start to move.
   c. The white ball will hit the 7-ball and make a sound. Then the 7-ball will start to move.
   d. The white ball will hit the 7-ball, but will not make a sound. Then the 7-ball will start to move.

5. Why did you choose your answer to Question 4? Explain in terms of energy.
6. If Camila gets the 11-ball into the corner pocket (see arrow), then she wins the game! What is the biggest problem that might prevent Camila from winning the game?
   a. The 4-ball is in the left corner. There may not be enough energy transferred to the 4-ball to get it to move.
   b. The 5-ball and 3-ball are in front of the 11-ball. There may not be enough energy transferred to the 11-ball to get it to move.
   c. The 5-ball and 3-ball are in front of the 11-ball. There is no way to get energy to the 11-ball or get it to move.
   d. The 5-ball and 3-ball are in front of the 11-ball. There may be too much energy transferred to the 11-ball to get it to move.

7. 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 11-ball. The 11-ball will move and may go into the right corner pocket.

8. 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 11-ball. The 11-ball will move and may go into the right corner pocket.
Klunk's Track

Track A
(Klunk)

Valley

MYSTERY science
Energizing Everything | Mystery 3
Track D

(Pow)
Set up your experiments like this. (Each experiment uses 2 marbles. The Hill Marble always starts at the top. The Bumper Marble is in a different place each time.)

1. High Hill
2. High Hill
3. High Hill
4. High Hill

What pattern do you notice about the experiments where BOTH marbles made it to the goal?

How could you explain this pattern in terms of energy?
Low Hill
(Crash or Pow)
Low Hill
(Crash or Pow)
Medium Hill
(Klunk or Boom)
Energizing Everything
Mystery 3: Why is the first hill of a roller coaster always the highest?

End of Mystery Assessment

**Whirlwind**
- Height: 51 feet
- Top Speed: 37 miles per hour
- Number of Hills: 4 hills

**Freestyle**
- Height: 88 feet
- Top Speed: 50 miles per hour
- Number of Hills: 4 hills

**Xcelerator**
- Height: 200 feet
- Top Speed: 80 miles per hour
- Number of Hills: 4 hills

The picture above shows the first hill of three different roller coasters. It also shows the height of that first hill, the top speed, and the total number of hills for each roller coaster.

1. What is the **best explanation** for the pattern that you observe?
   a. The more riders a roller coaster has, the more energy the roller coaster will have and the faster it will go.
   b. The more popular a roller coaster is, the more energy it will have and the faster it will go.
   c. The higher the first hill of a roller coaster is, the more energy the roller coaster will have and the faster it will go.
   d. The more hills a roller coaster has, the more energy the roller coaster will have and the faster it will go.

2. If the Xcelerator coaster has a second hill, what is the **maximum height** that the second hill can be?
   a. 50 ft
   b. 100 ft
   c. 200 ft
   d. 300 ft

3. Why did you choose your answer to Question 2? Explain in terms of energy.

   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
Rafael released a black marble from the highest hill (Image A). When the black marble reached the goal, it was going at a speed of 8 meters per second. Then he tried releasing the black marble from the medium hill (Image B). This time the black marble was going at a speed of 4 meters per second when it reached the goal.

4. What do you predict will happen if Rafael releases the black marble from the highest hill, but also puts a gray marble in the first valley at the same time (Image C)?
   a. I think the black marble will reach the goal. It will be going faster than 8 meters per second when it reaches the goal.
   b. I think the black marble will reach the goal. It will be going 8 meters per second when it reaches the goal.
   c. I think the black marble will reach the goal. It will be going slower than 8 meters per second when it reaches the goal.
   d. I do not think the black marble will reach the goal.

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

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

6. What do you predict will happen if Rafael releases the black marble from the highest hill, but also puts a gray marble on the medium hill at the same time (Image D)?
   a. I think the black marble will reach the goal. It will be going faster than 8 meters per second when it reaches the goal.
   b. I think the black marble will reach the goal. It will be going 8 meters per second when it reaches the goal.
   c. I think the black marble will reach the goal. It will be going slower than 8 meters per second when it reaches the goal.
   d. I do not think the black marble will reach the goal.

7. Why did you choose your answer to Question 6? Explain in terms of energy.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
Chain Reaction Starter Kit
Energizing Everything
Mystery 4: Could you knock down a building using only dominos?
Mystery 5: Can you build a chain reaction machine?

End of Mystery Assessment

1. Here is a picture of a chain reaction machine created using gardening tools, including hammers, balls, and ramps.

Describe two places where energy has been stored and how it is stored. How will the stored energy be released?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
2. Circle the domino you think has the most stored energy.

Why did you choose that domino? Explain your reasoning below.

3. Could you create a domino chain reaction if your dominoes were set up like this and you gave the smallest one a push? Why or why not?
End of Mystery Assessment

1. Here is a picture of a chain reaction machine created using gardening tools, including hammers, balls, and ramps.

Describe two places where energy has been stored and how it is stored. How will the stored energy be released?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
2. Circle the domino you think has the most stored energy.

```
[Image: Three dominoes in a row, with the middle one taller than the other two.]
```

Why did you choose that domino? Explain your reasoning below.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Could you create a domino chain reaction if your dominoes were set up like this and you gave the smallest one a push? Why or why not?

```
[Image: Three dominoes in a row, with the middle one taller than the other two. A push is indicated on the right side of the middle domino.]
```

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

MYSTERY science
Energizing Everything | Mystery 4 & 5
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?
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
End of Mystery Assessment

1. Put an ‘x’ next to the things that would stop working during a power outage (when the electricity goes out in your neighborhood or city):

   ___ bus
   ___ microwave
   ___ ceiling fan
   ___ TV
   ___ car
   ___ cash register
   ___ cell phone
   ___ lamp
   ___ faucet
   ___ air conditioning

   Explain how you decided which items would stop working. How are they different from the items that kept working?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. Can you think of examples of how electrical energy is used to create different kinds of energy? Try to come up with at least one additional example for each one.

   A. Light? (ex: flashlight) __________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

   B. Heat? (ex: oven) _______________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

   C. Sound? (ex: radio) _____________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

   Name: ______________________
   Date: _______________
D. Movement? (ex: metro) ____________________________________________

3. Draw the wire connections between a battery and bulb so that the bulb will light up.

- +

You created a flashlight using aluminum to connect a battery and lightbulb. Why was aluminum a good material to use?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

LED picture CREDIT: http://www.microminiatures.co.uk/acatalog/Flashing_5mm_LED_s_Light_Emitting_Diodes.html
Get to Know Your Spinner

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
Energizing Everything | Mystery 7
Inventing a Heat Engine

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. 

<table>
<thead>
<tr>
<th>Put the spinner here:</th>
<th>Let about 20 seconds pass, then notice what the spinner is doing. Write down your observations. Draw a picture if you want.</th>
</tr>
</thead>
</table>
| **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?
Energizing Everything

Mystery 7: How long did it take to travel across the country before cars and planes?

End of Mystery Assessment

1. A fuel is something that...
   a. contains stored energy
   b. can burn
   c. releases heat
   d. all of the above

2. Steam locomotives (trains) move by burning fuel that...
   a. releases energy from height
   b. releases electrical energy
   c. releases heat energy
   d. stores energy in batteries

3. TRUE or FALSE? (circle one) Energy comes in many forms.

4. How can you tell that stored energy is being released? Describe two pieces of evidence that you could see, hear, or feel.

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________
5. How did transportation change because of the invention of the engine? In your answer, describe transportation before and after there were engines.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

6. In the space below, draw a diagram that shows energy being transferred from one place to another. Then, label the parts of the diagram. Include at least two types of energy.

You can use the heat spinners from the activity, or come up with your own example. You can get creative!
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.

MYSTERY SCIENCE
Energizing Everything | Mystery 8
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.
Report on Ranchtown, Florida  From the town engineer

We wanted our town to run on electricity made from sunlight. To do that, we use solar panels. 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 those panels make enough energy for more than 10,000 homes! During the day, we make more electricity than our town needs.

But there’s a problem. Solar panels only make electricity when the sun is shining. They don’t make electricity 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.

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________
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 make electricity using energy from the flowing water. 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 make electricity.

It takes a lot of flowing water to make enough electricity for our town. Making enough electricity for our town 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.
End of Mystery Assessment

1. Which is the most common source of energy used by towns and cities today?
   a. Water behind dams
   b. Sunlight
   c. Wind
   d. Burnable fuels

2. Air pollution...
   a. is a problem that no one will be able to solve
   b. can be seen in cities as “smog”
   c. is created mostly by solar panels
   d. is a natural part of the environment

3. Which energy source has to be burned to release its energy?
   a. Sunlight
   b. Wind
   c. Coal
   d. Water

4. Match each choice with the natural resource being used to produce energy.
   
   ___ Set up solar panels          A. Wood
   ___ Build a dam on a river       B. Coal
   ___ Dig it out of the ground      C. Wind
   ___ Build tall turbines (windmills) D. Sunlight
   ___ Cut down trees               E. Water

5. TRUE or FALSE? (circle one) Some energy sources are more packed with energy than others.
6. The town of Coalville wants to use more alternative energy sources, and the townspeople have gathered information to figure out which kind of alternative energy will work best.

<table>
<thead>
<tr>
<th>Number of clear, sunny days</th>
<th>70 sunny days (out of 365 days in a year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of rivers nearby</td>
<td>1 small stream</td>
</tr>
<tr>
<td>Average wind speed</td>
<td>20 mph (30 km/h), or very windy</td>
</tr>
</tbody>
</table>

Based on this information, which kind of alternative energy would you recommend for Coalville? Provide reasoning to support your answer.

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

7. Energy sources have changed a lot over time! What is one way that scientists and engineers have improved how we get energy?

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________
Fold
Your name here:

Ramp

Fold

Fold

Cut

Fold

Tilt Platform

Cut

Fold

Fold

Cut

Chain-Reaction Starter Kit
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—it makes things move, it can be transferred, and it comes in different forms—makes the Rube Goldberg machine work.

You are going to be an engineer and create a Rube Goldberg machine that turns on the flashlight you made in the last Mystery.

My project should include, but is not limited to:

- At least 6 total steps
- A labeled and detailed blueprint
- At least 3 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.
Brainstorm and Blueprint:
Rube Goldberg Machine
Performance Task: Rube Goldberg Machine
Conceptual Model and Summary

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

1. 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

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. Abigail is bowling. At the start of each turn, there are 10 bowling pins standing. Each time Abigail throws the ball, it rolls down the lane, collides with the pins, and knocks some of them down. The number of pins that fell down after three different tries are shown to the right.

What pattern do you notice about how many pins fall down? There may be more than one correct answer. **Circle all correct answers.**

- a. The faster the bowling ball speed, the more pins are knocked down.
- b. The lower the bowling ball is held, the more pins are knocked down.
- c. The more energy the bowling ball has, the more pins are knocked down.
- d. There is no pattern to predict how many pins will fall down.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Bowling Ball Speed</th>
<th>Number of Pins Knocked Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 miles per hour</td>
<td>4 Pins</td>
</tr>
<tr>
<td>2</td>
<td>20 miles per hour</td>
<td>9 Pins</td>
</tr>
<tr>
<td>3</td>
<td>18 miles per hour</td>
<td>6 Pins</td>
</tr>
</tbody>
</table>
3. Abigail wonders what will happen if she puts a second bowling ball in the middle of the lane. Abigail releases the black bowling ball and aims for the gray bowling ball that is sitting in the middle of the bowling lane. What do you predict will most likely happen?

![Image of Abigail bowling](image)

- 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.
- 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.
- 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.

4. Abigail throws the black bowling ball at 20 miles per hour and knocks down 9 pins. She wonders if putting the grey 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?

![Image of Abigail bowling](image)

<table>
<thead>
<tr>
<th>Black Bowling Ball Speed</th>
<th>Number of Pins Knocked Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 miles per hour</td>
<td>9 Pins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Black Bowling Ball Speed</th>
<th>Number of Pins Knocked Down</th>
</tr>
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<tr>
<td>20 miles per hour</td>
<td>????</td>
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</table>

- 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.
- 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 towards the pins, but will only have enough energy to knock down fewer than 9 pins.
- 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.
5. Padma wants to make toast for breakfast. She puts bread into the toaster and presses the button down to start the machine. Nothing happens. Padma realizes she needs to plug the toaster into the electrical outlet on the wall. She plugs the toaster into the outlet and presses the button down to start the machine. This time, as the toaster works, Padma makes several observations. Which of Padma’s observations provide 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.
6. 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:

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.

7. 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.

8. 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.

9. 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 most days the wind blows over 15 miles per hour.
   b. Yes, Smogville can use wind energy because most days the wind blows less than 15 miles per hour.
   c. No, Smogville can’t use wind energy because most days the wind blows over 15 miles per hour.
   d. No, Smogville can’t use wind energy because most days the wind blows less than 15 miles per hour.
10. 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?

![Graph showing number of smoky days per year for Power Plant and Renewable Energy]

- 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.

11. Why did you choose your answer to Question 10? Explain what you notice from the graph to provide evidence about the cause of the smoky air in Smogville.

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