STARS ARE DIFFERENT SIZES

BIG IDEA 5: EARTH IN SPACE AND TIME

BENCHMARKS AND TASK ANALYSES

SC.3.E.5.1 Explain that stars can be different; some are smaller, some are larger, and some appear brighter than others; all except the Sun are so far away that they look like points of light.
The student:

- understands that stars are different.
- observes that there are stars in the sky that are different sizes.
- identifies the Sun as a medium sized star when compared to other stars.
- recognizes that some stars appear brighter than others.
- understands that all stars are so far away that they look like points of light.

SC.3.N.1.3 Keep records as appropriate such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.6 Infer based on observations.
SC.3.N.3.2 Recognize that scientists use models to help understand and explain how things work.
The student:

- uses models to help understand and explain how things work.

SC.3.N.3.3 Recognize that all models are approximations of natural phenomena; as such, they do not perfectly account for all observations.

KEY QUESTION

How does distance relate to the size of stars?

TEACHER BACKGROUND INFORMATION

Stars vary in weight, temperature, color, brightness and size. The biggest stars are about 100,000 times bigger than the sun. Except for the sun, most stars are too far from the Earth for their distances to be measured. Of the billions of stars in the universe, only a small percentage can be seen even with the help of the most powerful telescope.

Stars appear to be different sizes as seen from Earth's surface because of distance. The farther a star is from Earth, the smaller it will appear. The closer a star is to Earth the larger it will appear. The Sun is the closest star to Earth. This is why it appears to be so large.

MATERIALS

Per pair
flashlight
meter stick
white poster board

Per student
science notebook

SAFETY

Remind students not to shine the flashlight directly into anyone's eyes.
Remind students only to go outside at night with adult supervision.

TEACHING TIPS

1. Have students observe the night sky several nights in a row prior to the start of this lesson.
2. Close all blinds and turn off the lights to aid in the activity.

ENGAGE

1. Prior to this lesson, ask students to observe the night sky several nights in a row.
2. Ask*: What did you observe in the night sky?*
3. Create a circle map about stars.
4. Ask*: Why do you think some stars look big and some look small?*

EXPLORE

1. One student stands two meters away from the wall and shines the flashlight towards the wall.
2. The other student draws a circle around the pattern of the light on poster board and label the pattern as 2 meters.
3. One student stands one meter away from the wall and shine the flashlight towards the wall.
4. The other student will draw a circle around the pattern of the light on poster board and label the pattern as 1 meter.
5. Direct students to draw a diagram of the patterns of light from the poster board in their science notebooks. Remind students to label the pattern with the distance (2 meters, 1 meter).

EXPLAIN

Host a discussion and ask:

1. *Did you observe any differences between the first meter and the second meter? What?*
2. *Did you observe any similarities between the first meter and the second meter? What?*
3. *Did you notice anything about the size of the patterns of light on your poster boards? What?*
4. *Why do you think one circle (*pattern of light*) was smaller than the other? (*distance from poster board)
5. *Why do you think some stars look big and some look small in the night sky?*
6. *The Sun is a star, why do you think it looks bigger to us than the nighttime stars? (*The Sun is closer to Earth than the other stars.*)*
7. *Why do you think the other stars in the sky look like points of light? (*They are much farther from Earth than the Sun is.*)*
8. *Are all stars the same? Why? Why not?*
9. *You created a model today. What do you think the flashlight represented in our model today? (*star*) Was it really a star? (*no*) Is it the size of a real star? (*no*) How do you know?*
10. *What do you think the poster board represented? (*surface of the Earth*) Was it really the surface of the Earth? (*no*) How do you know?*
11. *Why do you think scientists use models? (*to learn more about the real thing*)*

EXTEND AND APPLY

Challenge students to continue to create patterns of light (and trace the patterns) that are labeled with the amount of meters (distance) they are from Earth. Require larger and smaller stars (different meter lengths than one or two).

ASSESSMENT

In their science notebooks, have students answer the key question: How does distance relate to the size of stars? Require a diagram of two stars that are different distances from Earth.

STARS ARE DIFFERENT MAGNITUDES

BIG IDEA 5: EARTH IN SPACE AND TIME

BENCHMARKS AND TASK ANALYSES

SC.3.E.5.1 Explain that stars can be different; some are smaller, some are larger, and some appear brighter than others; all except the Sun are so far away that they look like points of light.
The student:

- understands that stars are different.
- observes that there are stars in the sky that are different sizes.
- identifies the Sun as a medium sized star when compared to other stars.
- recognizes that some stars appear brighter than others.
- understands that all stars are so far away that they look like points of light.

SC.3.N.1.3 Keep records as appropriate such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.6 Infer based on observations.
SC.3.N.3.2 Recognize that scientists use models to help understand and explain how things work.
The student:

- uses models to help understand and explain how things work.

SC.3.N.3.3 Recognize that all models are approximations of natural phenomena; as such, they do not perfectly account for all observations.

KEY QUESTION

What makes the brightness (magnitude) of stars differ?

TEACHER BACKGROUND INFORMATION

Stars vary in weight, temperature, color, brightness (magnitude) and size. The biggest stars are about 100,000 times bigger than the sun. Except for the sun, most stars are too far from the Earth for their distances to be measured. Of the billions of stars in the universe, only a small percentage can be seen even with the help of the most powerful telescope.

Stars appear to be different sizes as seen from Earth's surface because of distance. The farther a star is from Earth, the smaller it will appear. The closer a star is to Earth the larger it will appear. The Sun is the closest star to Earth. This is why it appears to be so large and bright.

The brightness of stars can be described in two ways: apparent and actual. Differences in actual brightness are caused by temperature differences between stars themselves. Apparent brightness involves how bright a star appears from Earth. A bright star that is very far away from Earth may seem to be just as bright as a weaker star that is closer to Earth.

MATERIALS

Per student
science notebook
15 clear cellophane squares 4 cm x 7 cm
scissors

Teacher
stapler
tape
cardstock copy of viewer for each student

ruler
pencil
cardstock copy of viewer

SAFETY
Remind students only to go outside at night with adult supervision.

TEACHING TIPS
1. Have students observe the night sky several nights in a row prior to the start of this lesson.
2. Close all blinds and turn off the lights to aid in the activity.
3. Copy viewer pattern on cardstock prior to this lesson.
4. The viewers could be used during a Family Science Night.
5. Send home a direction sheet for parents.

ENGAGE
- Prior to this lesson, ask students to observe the night sky several nights in a row.
- Ask*: What did you observe in the night sky?*
- Ask*: Why do you think some stars look brighter than others?*

EXPLORE Day 1
1. Give each student a cardstock copy of the viewer.
2. Have students cut around the viewer on the dotted line.
3. Tell students to cut out each circle.
4. Tell students to fold the viewer in half so that both sides have circles visible.
5. Cover the hole on the right with 1 square of clear cellophane. Tape the cellophane in place.
6. Tape 2 pieces of cellophane on the next hole (to the left of the one covered).
7. Tape 3 pieces of cellophane on the next hole.
8. Tape 4 pieces of cellophane on the next hole.
9. Tape 5 pieces of cellophane on the next hole.
10. Fold the viewer over and staple the edges of the cardstock.
11. Label the holes (from left to right) 1 through 5 on the outside of the cardstock. Hole 1 coincides with the hole that has 5 pieces of cellophane taped to it, hole 2 has 4 pieces, hole 3 has 3 pieces, hole 4 has 2 pieces and hole 5 has 1 piece of cellophane.
12. Direct students to start looking through hole 1 (which has the most layers of cellophane) while holding the viewer to their eye and pointed towards the ceiling light.
13. Direct students to look at the light using hole 2, hole 3, hole 4, and hole 5 and without any holes.

EXPLAIN Day 1
Hold a discussion and ask:
1. *When was it the easiest to see the light? (without any holes)*
2. *When looking at stars in the nighttime sky, scientists would call that a sixth-magnitude (brightness). It is not bright enough to be seen through many layers.*
3. *When was it the most difficult to see the light clearly? (hole 1) Why? (there are many layers to see through)*
4. *What can practicing the use of this viewer help us understand about the brightness (magnitude) of stars? (The more layers the star can be seen through, the brighter it is. The fewer layers it can be seen through, the less bright the star is, as seen from Earth.)*

EXPLORE Day 2

1. Have students create a data table in their science notebooks labeled Hole One, Hole Two, Hole Three, Hole Four, Hole Five, and Six (without the word hole).
2. Explain to students that they will observe stars at home using the viewer. Explain that they need to record tally marks under each label for the stars they could observe in their science notebooks. (If they were able to see five stars through hole number one, then they would have five tally marks under the label Hole One)
3. Tell students to also record a few observations (using words instead of tally marks) to describe how bright the stars under each label appeared.
4. Explain that the viewer is a scale that scientists use to measure how bright stars look from Earth. Students should start on hole one and try to observe a star. If it can be seen through hole one, it is considered a bright star. If it cannot be seen through hole one, try hole two (if the star can be seen, it is a second magnitude star). Whatever hole the star can be seen through determines the magnitude (brightness) rating. If it cannot be seen through hole 5 but can be seen with the naked eye, it is considered a sixth-magnitude star.

EXPLAIN Day 2

Hold a discussion by asking the following question:

- *Do all stars appear the same in the nighttime sky?*
- *What is different about them?* (brightness, size, etc*)*
- *The Sun is a star, why do you think it looks brighter to us than the nighttime stars? (*the Sun is closer to Earth than the other stars)
- *Why do you think the other stars in the sky look like points of light? (*they are much farther from Earth than the Sun is*)*
- *Are all stars the same? Why? Why not?*
- *The numbers on your viewer work like a scale that scientists use to measure how bright stars look from Earth. If a star can be seen through hole 1, it is considered a bright star. How many bright stars did you see last night?*
- *What magnitude were those stars? (*accept third, second, or first*)*
- *How many stars did you see that were not very bright?*
- *What magnitude were those stars? (*accept fourth, fifth, or sixth*)*
- *Why do you think scientists use models? (*to learn more about the real thing*)*
- *Do you think that it is the amount of layers that a star can be seen through that is the only reason why some stars appear brighter than others? (*distance and size as learned from prior lesson also plays a part)

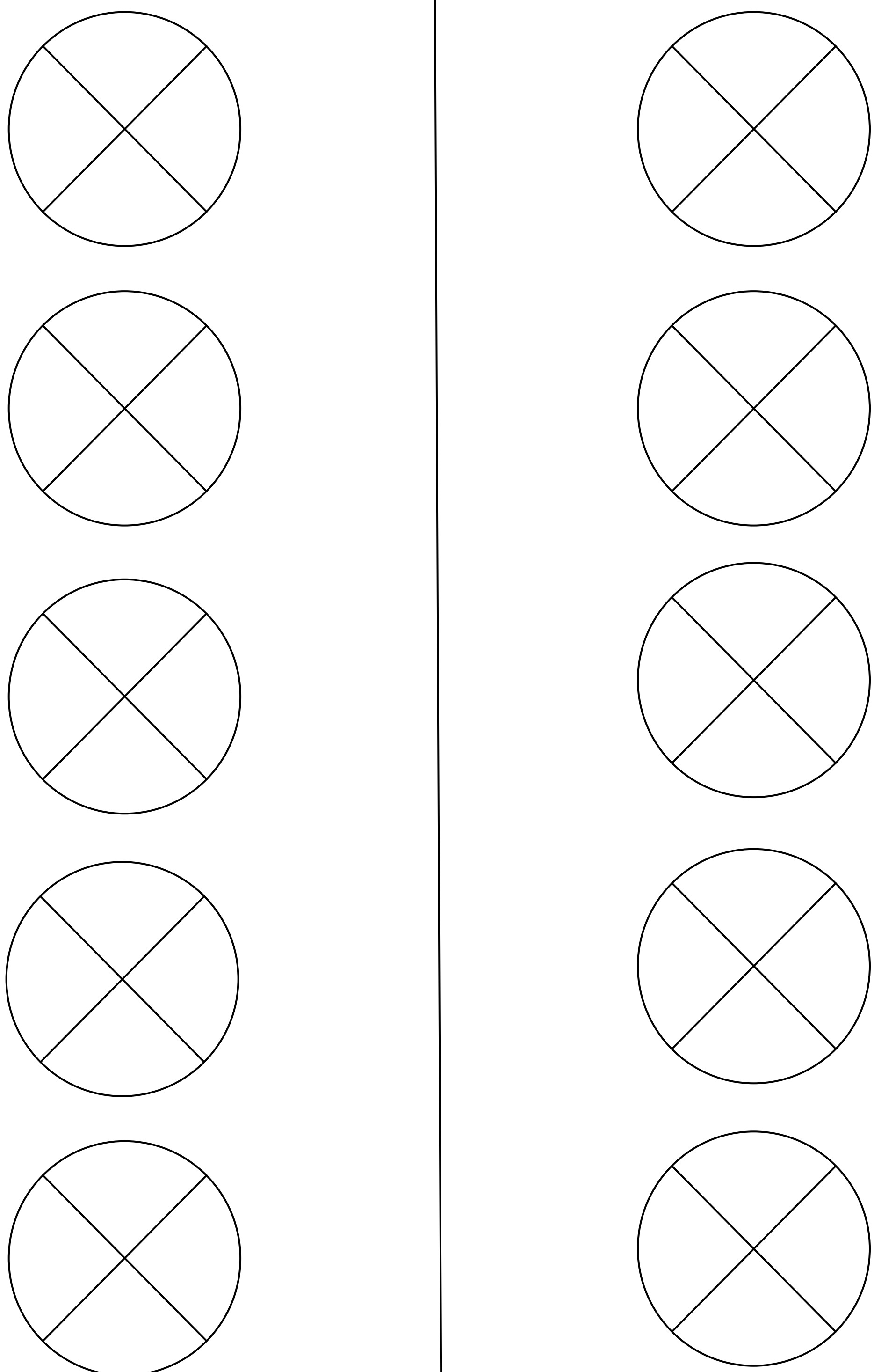
EXTEND AND APPLY

Allow students to create a 3D diagram of the nighttime sky, including stars of various sizes and magnitudes.

ASSESSMENT

In their science notebooks, have students answer the key question: What makes the brightness (magnitude) of stars differ?

Cut



NUMBER OF STARS SEEN THROUGH A TELESCOPE

BIG IDEA 5: EARTH IN SPACE AND TIME

BENCHMARKS AND TASK ANALYSES

SC.3.E.5.1 Explain that stars can be different; some are smaller, some are larger, and some appear brighter than others; all except the Sun are so far away that they look like points of light.
The student:

- understands that stars are different.
- observes that there are stars in the sky that are different sizes.
- identifies the Sun as a medium sized star when compared to other stars.
- recognizes that some stars appear brighter than others.
- understands that all stars are so far away that they look like points of light.

SC.3.E.5.5 Investigate that the number of stars that can be seen through telescopes is dramatically greater than those seen by the unaided eye.
SC.3.N.1.3 Keep records as appropriate such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.6 Infer based on observations.
SC.3.N.3.2 Recognize that scientists use models to help understand and explain how things work.
The student:

- uses models to help understand and explain how things work.

SC.3.N.3.3 Recognize that all models are approximations of natural phenomena; as such, they do not perfectly account for all observations.

KEY QUESTION

What is the difference between looking at stars with the naked eye and with a telescope?

TEACHER BACKGROUND INFORMATION

Telescopes are used to make objects appear closer so that scientists can study things that are too far away from Earth. The Hubble Telescope magnifies many things in space and then takes pictures that are transmitted to scientists at NASA.

MATERIALS

Per student
black construction paper
white crayon
magnifying glass

Teacher
several pocket telescopes

Per group
plate of sand

SAFETY

Remind students only to go outside at night with adult supervision.

TEACHING TIPS
Continue referring back to the size and distance of stars as students learn about telescopes.

ENGAGE
1. Share pictures of the nighttime sky from this website:
   http://www.shadowsandstone.com/gallery/2144813_iR63W#111146929_497eU-A-LB
2. Share pictures taken with the Hubble Telescope from these websites:
   http://spaceplace.nasa.gov/en/kids/wfpc_fact1.shtml\
   http://www.nasa.gov/mission_pages/hubble/story/index.html
3. Discuss differences between the photos focusing on the amount of stars seen in the nighttime sky without a telescope and the amount of stars seen with telescopes.

EXPLORE
1. Tell students to observe the plate of sand and to write observations in their science notebook.
2. Give students a magnifying glass.
3. Allow time to observe the sand with the magnifying glass. Remind students to write observations in their science notebook.
4. *Ask:*
   - *What was different when you observed the sand with your eyes and then with the magnifying glass?*
   - *Did the magnifying glass add sand to the plate? (*no*)*
   - *What did the magnifying glass do to the sand? (*made it look bigger and closer*)*
   - *Why would we want to see sand bigger and closer? (*to learn more about it, to make better observations*)*
5. Give students a piece of black construction paper.
6. Tell students to fold the paper in half lengthwise.
7. Label one half of the folded paper 'Stars Seen with Unaided Eye'.
8. Tell to use a white crayon to draw 10 dots (representing stars seen with the unaided eye).
9. Ask*: How many stars do you think a telescope would help us see?*
10. Label the other half 'Stars Seen with Use of a Telescope'.
11. Allow time to add many stars (representing the use of a telescope).
12. Ask: *What was the difference in stars from the unaided eye to the use of a telescope?*

EXPLAIN
Hold a discussion to explain concepts by asking the following questions:
- *What are telescopes used for? (*to magnify objects*)*
- *Why are telescopes useful? (*to help people on Earth learn about things and places that they cannot travel to)
- *Do telescopes that take pictures (*like the Hubble Telescope*) actually travel to the galaxies that they take picture of? (*no*)*
- *What is the difference in how many stars we can see with just our eyes and how many stars we can see with a telescope? (*see many more stars with a telescope, more than we can count, see stars that we do not even know exist because they are so far away*)*
- *When we look at the nighttime sky with a telescope, does the telescope actually add more stars to an area like we did with our crayons? (*no*)*
- *What is the telescope really doing then? (*making the stars appear closer so we can see how many more that there are that our eyes cannot see, magnifying*)*
- *What star are we closest to? (*the Sun*)*

- *What does the Sun provide Earth with? (*heat and light energy*)*
- *Today we made a model of the nighttime sky and how it looks with the use of a telescope. Do we really know, for sure, how many stars a telescope could help us see? (*no*)*
- *Why do scientists use models? (*to learn more about something*)*
- *Why don't we just visit the stars to see how many there are? (*too far away)

EXTEND AND APPLY

- Pocket telescopes are available for around $9.00. Allow students to take home a pocket telescope and draw diagrams in their science notebooks of the nighttime sky without a telescope and then with a telescope.
- Host a Science Family Night. Allow students to observe the nighttime sky using telescopes.

ASSESSMENT

In their science notebooks, have students answer the key question. Require a diagram of stars seen with the unaided eye and stars seen with the use of a telescope.

OVERCOMING GRAVITY

BIG IDEA 5: EARTH IN SPACE AND TIME

BENCHMARKS AND TASK ANALYSES

SC.3.E.5.4 Explore the Law of Gravity by demonstrating that gravity is a force that can be overcome.
The student:

- demonstrates that gravity is a force that can be overcome.

SC.3.N.1.3 Keep records as appropriate such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.6 Infer based on observations.
SC.3.N.1.2 Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
The student:

- works in a group using the same tools as other groups to gather common data.
- compares groups' data and explains differences.

SC.3.N.1.3 Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

1. records in science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.4 Recognize the importance of communication among scientists.
The student:

2. understands the importance of communicating results.

KEY QUESTION

What are some ways that the force of gravity can be overcome?

TEACHER BACKGROUND INFORMATION

Gravity is the force that pulls everything toward the Earth. To overcome the force or gravity, another force is needed. A Slinky and rubber bands are used like a spring scale to investigate weight and its relationship to gravity. These items work well to measure force as the class investigates overcoming gravity. This experiment will measure how much stretch from a Slinky (a spring scale) it takes to overcome the force of gravity. As students understand that the stretch in the Slinky or rubber band is a way to measure resistance to gravity, they will begin to understand that a force is in place. Students will discover that heavier objects require more stretch (force) than lighter ones. As students investigate, they will be asked questions about the invisible but fascinating force of gravity.

MATERIALS

Per pair
2 rulers
paperclips
books to stack
rubber bands (stretchy enough to hold several washers)

Per student
science notebook
pencil

variety of washers or items that will hang
from a hook

Teacher
Slinky
piece of yarn or string (about 30 cm)
strong tape to hold the Slinky
strip of paper (5cm x 2 m)
variety of coins, especially 10 pennies

SAFETY
Remind students not to pinch their fingers with the Slinky.

TEACHING TIPS
Prior to students arriving in class, tape one end of a large Slinky from the top of a door frame and near the vertical side. Beside the suspended Slinky, tape the vertical strip of paper. Punch two holes in the cup and thread the string (or yarn) through the holes to create a swinging basket. Hook the string to the bottom of the hanging Slinky so the cup is suspended.

ENGAGE
Day One:

1. Have students group around the doorway and ask: *What is gravity?* (it pulls objects to the earth; gravity is a force, etc.)
2. Drop a few pennies to the floor to demonstrate gravity. Ask: *If I put 5 pennies in this paper cup, what do you think will happen? Will the force of gravity pull the pennies toward the Earth until they are together?* Accept all predictions from the students.
3. As you drop each penny is put into the cup, have students notice the amount of “stretch” that occurs.
4. Mark the point where the cup stops after you add the 5 pennies. Ask: *Why don’t the coins get pulled all the way to the earth? Is the Slinky helping to overcome the force of gravity? Slow the force of gravity? Which of our predictions were correct? What observations could we record in our notebook about what has happened?*
5. Ask students what they think will happen if 10 pennies are put into the cup.
6. Make a mark where the cup stops. Ask: *Why did the Slinky stretch more with the 10 pennies? What forces were involved?*

EXPLORE
Day Two:

1. Student groups will construct their own “spring scale” using a rubber band. Have each group make two stacks of books. Each stack should be about 8 inches high and should be 9-10 inches apart. Place the rubber band around the ruler, and suspend the ruler between the stacks of books (like a bridge).
2. Bend the paperclip into a hook and attach it to the end of the rubber band.
3. Using their notebooks, have students construct a two-column data table. Label the columns *Our Predictions* and *Actual Amount of Stretch*.
4. Using the other ruler, students will measure the length of the rubber band after they place washers on the rubber band hook. Make sure students make a prediction before adding washers and record the measurement before they change the number of washers.

5. As students work together, encourage them to discuss their observations about gravity and force used in overcoming it. Ask: *Does weight change the length of the rubber band? What does that mean? Do heavier objects require more force than lighter ones to overcome gravity? What represents the force in our experiment?*

EXPLAIN

1. Discuss results as a whole group.
2. Have the class create two conclusions in sentence form that will explain their group results, e.g. a force is required to overcome gravity, heavier objects require more force than lighter ones to overcome gravity, the rubber band stretched more with heavier stuff, etc.
3. Help students use key words in their explanations to show understanding. Allow time for each group to write concluding statements on chart paper to be displayed.
4. Discuss the observations by different groups. Ask: *Do all groups have the same measurements? Why or why not? Why do you think scientists share their results with the scientific community?*

EXTEND AND APPLY

1. Leave the materials set up in the room to allow students to continue to explore the concept of weight and gravitational attraction.
2. Use a variety of coins to compare weights.
3. Repeat the experiment using a plastic Slinky.
4. Have students investigate the idea of gravity on other planets.
5. Have students investigate the amount of force required for the Space Shuttle to escape Earth's gravity to get into Space. They may use the following websites:
   - http://www.nasa.gov/audience/forkids/kidsclub/flash/visionfeature/Back_to_the_Moon.html
   - http://www.nasa.gov/returntoflight/system/system_STS.html
   - http://www.nasa.gov/returntoflight/launch/index.html
   - http://spaceplace.nasa.gov/en/kids/galex/pegasus.shtml
6. Ask*: How do shuttles overcome the pull of gravity?* (Needs to push harder than the shuttle is being pulled and it uses fuel to give the power needed to do that)

ASSESSMENT

Display charts from the different groups around the class. Check for understanding of concepts and accuracy of data in the sentences the class created.