Instructor's Notes

Lesson: Shoot for the Stars

Subjects: Reading, writing, science, math, social studies, and critical thinking

Procedure:

1. Read the *Stars* handout.
2. Discuss space travel and inventions that have make it possible. Read the article about Slinkys, ask critical thinking questions, and do the exercises. **Complete the reading, writing, math, social studies, and science extensions.**
3. Discuss measurements. Show students how to convert standard measurements in metric and change inches to feet or yards, or cups into pints, quarts, or gallons. Working in teams, have the students complete the *Frequency, Wavelength, and Energy* activity.

4. Working in teams, have the students rewrite the words to "Twinkle, Twinkle Little Star" to go along with the story. You can ask for volunteers to perform (sing) their version. If the students agree, you can video tape the performances and give them a copy to keep.
5. Discuss the "I have to twinkle" cartoon. Political cartoons can answer the same journalistic questions that news articles do. Visual stimuli play an important role on the GED Test. By using political cartoons you can help your students gain necessary skills to transition into a GED classroom. Give each student a political cartoon and the *Political Cartoon* worksheet.
6. Using paper stars and tape, have a relay race to see which team of students can put stars on their shirts and then remove them the quickest. (Do this outside or in a large area.) Have one student run 50 meters and hand off the star to the next student who sticks it to his shirt. Then that student would run back to the start to pass it to the next student. Keep going until all the team members have crossed the finish line. (*This activity targets kinesthetic learners.)* If space does not permit this activity, it can be modified in the following way: Instead of running, the students must answer questions. For example, the first

student has to answer a trivia type question correctly in order to pass his/her star on to the next student. The activity continues until one team has passed the star to every team member. Since you can use any topic for the questions, this would be a good activity to use for reviewing important concepts.

7. Have the students complete the *Solar System* handout and the *Planetary Years* worksheet.

Make a mini-workshop. Arrange stations around the room with each station containing one activity. The students will then move from station to station completing the given activity at their own speed. (*In order to target different learning styles, you can play music in the background while the students are working at the stations.)* The mini-workshop can be repeated with any subject or theme. The stations can contain the following activities or any other hands-on activities:

8. Popsicle stick shape
9. Starfish maze—be sure to think outside the box on this one (or the starfish as the case may be).
10. Star Light/Star Bright *(This activity is repeated in the Home Visit ideas.)*
11. The Star addition problem
12. Sunburst pattern
13. Alike and Different
14. We Lost our Marbles
15. Geographic *Superstars* (fractions)
16. Which numbers are Star-Ons
17. Quarter and dime activity
18. Hello Stargazer

Activity # 1 (Page 1 of 2)

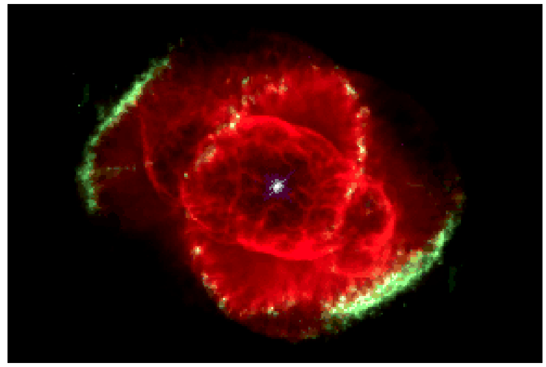
As you read through these next pages, remember - there is more to the Universe than meets the eye!

Stars

A star is a brilliantly glowing sphere of hot gas whose energy is produced by an internal nuclear fusion process. Stars are contained in galaxies. A galaxy contains not only stars, but clouds of gas and dust. These clouds are called nebulae, and it is in a nebula where stars are born. In the nebula is hydrogen gas which is pulled together by gravity and starts to spin faster. Over millions of years, more hydrogen gas is pulled into the spinning cloud. The collisions which occur between the hydrogen atoms start to heat the gas in the cloud. Once the temperature reaches 15,000,000 degrees Celsius, nuclear fusion takes place in the center, or core, of the cloud. The tremendous heat given off by the nuclear fusion process causes the gas to glow creating a protostar. This is the first step in the evolution of a star. The glowing protostar continues to accumulate mass. The amount of mass it can accumulate is determined by the amount of matter available in the nebula. Once its mass is stabilized, the star is known as a main sequence star. The new star will continue to glow for millions or even billions of years. As it glows, hydrogen is converted into helium in the core by nuclear fusion. The core starts to become unstable and it starts to contract. The outer shell of the star, which is still mostly hydrogen, starts to expand. As it expands, it cools and starts to glow red. The star has now reached the red giant phase. It is red because it is cooler than the protostar phase and it is a giant because the outer shell has expanded outward. All stars evolve the same way up to the red giant phase. The amount of mass a star has determines which of the following life cycle paths the star will take.

MEDIUM STARS

As a red giant, the hydrogen gas in the outer shell continues to burn as the temperature in the core continues to rise. At 200,000,000 degrees Celsius, the helium atoms fuse to form carbon atoms in the core. The last of the hydrogen gas in the outer shell is blown away to form a ring around the core. This ring is called a planetary nebula. When the last of the helium atoms in the core are fused into carbon atoms, the medium size star begins to die. Gravity causes the last of the star's matter to collapse inward and compact. This is the white dwarf stage which is extremely dense. White dwarfs shine with a white hot light but once all of their energy is gone, they die. The star has now reached the black dwarf phase.



MASSIVE STARS

Once massive stars reach the red giant phase, the core temperature continues to increase as carbon atoms are formed from the fusion of helium atoms. Gravity continues to pull together the carbon atoms in the core until the temperature reaches 600,000,000 degrees Celsius. At this temperature, carbon atoms form heavy elements such as oxygen and nitrogen. The fusion and production of heavy elements continues until iron starts to form. At this point, fusion stops and the iron atoms start to absorb energy. This energy is eventually released in a powerful explosion called a supernova. A supernova can light the sky up for weeks. The temperature in a supernova can reach 1,000,000,000 degrees Celsius. This high temperature can lead to the production of new elements that may appear in the new nebula that results after the supernova explosion. The core of a massive star that is 1.5 to 4 times as massive as our Sun ends up as a neutron star after the supernova. Neutron stars spin rapidly giving off radio waves. If the radio waves appear to be emitted in pulses (due to the star's spin), these neutron stars are called pulsars. The core of a massive star that has 10 or more times the mass of our Sun remains massive after the supernova. No nuclear fusion is taking place to support the core, so it is swallowed by its own gravity. It has now become a black hole which readily swallows any matter and energy that comes too near it. Some black holes have companion stars whose gases they pull off. As the gases are pulled down into the black hole, they heat up and give off energy in the form of X-rays. Black holes are detected by the X-rays that are given off as matter falls down into the hole.

Activity # 3 (Page 1 of 2)

STAR FACT: *Stars evolve, or change, over time. It may take millions of years or it may take billions of years for a star to complete its life cycle.*

Frequency, Wavelength, and Energy

Sometimes you want to express a measurement in different units. For example, when talking about how far away something is, sometimes it may be useful to say it is a certain DISTANCE (Chicago is 300 miles from here), and sometimes it is more useful to use TIME to express how far away it is (Chicago is a 6 hour drive from here). Of course **miles** are not equal to **hours**, so there must be some way to convert from one to the other. In this case, the conversion is **speed**: if a car drives an average of 50 miles/hour, then it can drive 300 miles in 6 hours. For this constant speed, 300 miles equals 6 hours.

$$300 \text{ miles} = 6 \text{ hours} \times 50 \frac{\text{miles}}{\text{hour}} = 6 \times 50 \frac{\text{hours}}{\text{hours}} \text{ miles} = 300 \text{ miles} \quad \left(\frac{\text{hours}}{\text{hours}} = 1\right)$$

<u>**Problem**</u>

1. If you walk at a speed of four miles an hour, and your friend lives two miles away, how far away is her house

a. in miles?

b. in minutes, if you are walking?

c. in minutes, if you are driving at an average speed of 25 miles an hour?

In much the same way, different **units** can be used to characterize light. We can refer to light by its **wavelength**, its **frequency**, or its **energy**. This is similar to talking about distance in units of miles or hours.

<u>I. Wavelength --> Frequency</u>

Light waves travel at a constant speed, so there is a one to one relationship between light's wavelength and its frequency. If waves are short, there must be more of them in a set amount of time to travel the same distance in that time (the same speed).

Activity # 3 (Page 2 of 2)

Problems

2. The speed of light is 186,000 miles per second. What is the frequency of light that has a wavelength of three feet? two inches? 1/1,000,000 inches? one mile?

3. What is the wavelength of the radio waves of your favorite radio station? (HINT: the frequency of radio stations is equal to the station number times 1,000,000 Hz. So WAMU - National Public Radio - at FM 88.5 - is 88,500,000 Hz. Now, use the fact that the wavelength is equal to the speed of light, a constant, divided by frequency.)

II. Frequency --> Energy

In 1900, Planck discovered that there was a direct relationship between a photon's frequency and its energy:

E = h nu

The higher the frequency of light, the higher its energy. We know from the problems above that higher frequencies mean shorter wavelengths. We can also say that E = h c / lambda. High frequency light has short wavelengths and high energy. X-rays or gamma-rays are examples of this. Radio waves are examples of light with a long wavelength, low frequency, and low energy.

In much the same way, the gallons of gas you put in your car and the cost of the gas are proportional: the same value multiplied by a constant (the price of a gallon of gas). If you know the constant (the price per gallon) and you know the number of gallons, you can calculate how much the gas costs. Or, if you know how much the gas cost, you can calculate how much gas was bought.

4. Planck's constant is 6.626×10^{-34} erg sec. What is the frequency of light that has an energy of 12.5 keV? (Hint: 1 keV = 1000 eV)

5. What is the energy corresponding to the frequency of your favorite radio station? (see problem 3 for the frequency of your favorite radio station). How does that compare to the energy given off by a 50 Watt light bulb in an hour?

The Slinky

It was a mistake. A goof-up. An invention that didn't work. A flop; that's what the Slinky was, at least in the beginning.

In 1945, an engineer by the name of Richard James was hard at work in a Philadelphia shipyard. The U.S. Navy had hired him to invent a stabilizing device for its ships. When a ship is plowing through the waves at sea, it pitches and plunges and rocks every which way. And its navigational instruments do, too. Richard's job was to come up with something that would counterbalance the instruments so that they would be level at all times. Springs. Richard believed that some sort of arrangement of springs would do the trick. He tried all different types and sizes, and put them together in every conceivable way. For weeks he toiled, making dozens of different devices. But none of them worked. In fact, he never did come up with the item the Navy had hired him to invent.

But one day Richard accidentally knocked a large experimental spring off a shelf. It should have just plopped to the floor. Instead, it walked down. Crawled, really. Coil by coil, end over end, it descended onto a stack of books…then down to a desktop…down to a chair…and from there to the floor, where it gathered itself back together.

He tried it again and again. Each time, the same thing happened.

As soon as the workday was over, Richard hurried home. Fascinated with the strange spring, he showed his wife, Betty, what it could do. Together, they tried it out in all sorts of ways and in all sorts of places. It was especially good at walking down stairs.

A toy?

Richard didn't think of it that way. Betty did. She was the one who realized that what her husband had invented was a terrific toy. Betty was also the one who named it.

At first, all sorts of names came to mind, but none seemed quite right. For the next two days she thumbed through a dictionary, keeping a list of some of the best possibilities. Finally, she came upon what she believed was the perfect word to describe the toy: slinky.

Activity # 2 (Page 2 of 6)

Slinky® Tidbits

- Betty James, CEO of James Industries and widow of Slinky inventor Richard James, named the famous toy. She scanned the dictionary for ideas and knew she'd found the perfect name with "Slinky," which is Swedish and means stealthy, sleek, sinuous.
- Some very innovative uses have been found for the Slinky. It has been used in pecan-picking devices in Texas and Alabama; on lighting fixtures in Harrah's Casino in Las Vegas because of the unusual shadows it casts; and as table decorations, drapery holders, bird repellers, mail holders, therapeutic devices, wave motion coils, gutter protectors, and in numerous other ways. Also, the Slinky sometimes is prescribed by physical therapists for coordination development.
- During the Vietnam War (early 1960s-1975) the Slinky reverted to its original role. First intended for the military, Slinky the toy ended up on the battlefield. Carried by radioman in the jungles of Vietnam, Slinkys were tossed over high tree branches as make-shift antennas.
- The amount of wire used since 1943 to make Slinkys could wrap around the Earth 126 times.
- Fifty years after its invention, the Slinky sells for only about twice the one dollar it originally cost.
- The Slinky has appeared in several movies, including *Ace Ventura: When Nature Calls*, *Demolition Man*, *Other People's Money*, and *Hairspray*, and the Slinky® Dog played in *Toy Story.*
- There are about eighty feet of wire in a standard-sized Slinky.
- It takes approximately ten seconds to manufacture one Slinky.
- Slinky's most recent accomplishment was in outer space. Bunches have gone aboard space shuttles. The purpose: to test the effects of zero gravity on springs.

From Toys! Amazing Stories Behind Some Great Inventions by Don Wulffson

Slinky Classroom Exercises

In addition to being a terrific toy, the Slinky is an excellent device for demonstrating various properties of physics.

The Slinky, like all objects, tends to resist change in its motion. Because of this *inertia*, if placed at the top of stairs it stays at rest. At this point it has *potential or stored energy*. But once it is started down the stairs and *gravity* affects it, the potential energy is converted to the *energy of motion or kinetic energy* and the Slinky gracefully tumbles coil by coil down the stairs.

Physical properties of the Slinky determine how quickly it moves under the influence of *gravity*. Although its movement may look simple, from a scientific point of view the motion is quite complex.

Exercise #1: Racing Slinkys

In this activity, inertia, gravity, potential energy, kinetic energy, and longitudinal waves are demonstrated when the Slinky "walks" down stairs or an incline.

Materials:

- A large slinky
- A small slinky
- Stairs or books stacked

Procedure:

1. Show the class two Slinkys of different sizes and ask which one they think will win a race down stairs or an incline. (Graduated stacks of books work well; also any board or table top with a non-slip surface will do. Slope surface so rise equals about 1 foot for every 4-foot length.)

2. Place both Slinkys on the top stair or top of a ramp. Ask why the Slinkys remain motionless. What will it take to get them in motion? (Newton's first law of motion: *A body at rest will remain at rest unless an external force acts upon it. A body in motion will remain in motion in a straight line at a steady speed unless an external force acts upon it.*)

3. Grip a coil of each Slinky at the top and flip it over toward the middle of the next lower step, releasing your hold (with this action, potential energy is converted to kinetic energy). The Slinkys race downward all by themselves.

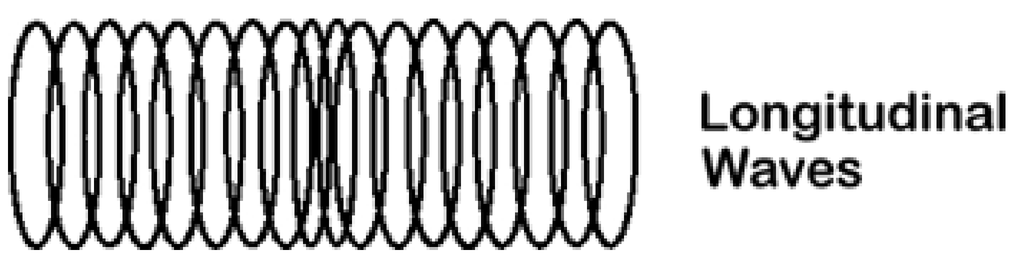
4. After the race, ask why the smaller Slinky won. (As the Slinky moves down the steps, energy is transferred along its length in a longitudinal or compressional wave which resembles a sound wave that travels through a substance by transferring a pulse of energy to the next molecule. How quickly the wave moves through the Slinky depends on the tension and mass of the coil. The smaller the mass, the tighter the tension; the tighter the tension, the faster the wave speed. So, the wave moves faster through the smaller Slinky.)

Exercise #2: Slinky Waves

A Slinky can easily demonstrate the two basic types of waves, *longitudinal* and *transverse*, as well as several others. A longitudinal wave vibrates parallel to (in the same direction of) wave travel (sound waves are a good example). A transverse wave vibrates perpendicular (at right angles) to the wave travel (water waves are a good example).

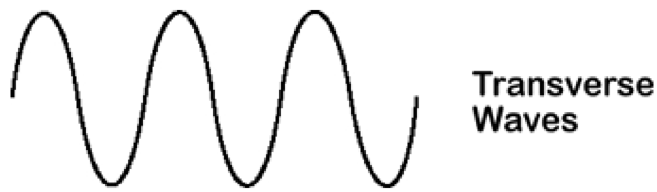
To demonstrate the types of waves:
Have two students each take one end of a Slinky and stretch it out along the floor (the waves will be more apparent this way).

Longitudinal Waves. Have one student grasp and draw toward himself or herself several coils of a stretched metal Slinky and then release the coils. The other student must hold his or her end of the Slinky still. A longitudinal wave pulse will be generated and travel down the length of the Slinky.

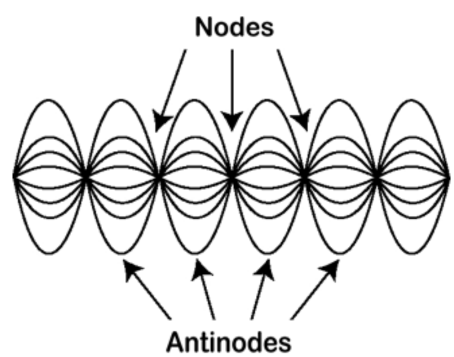


Activity # 2 (Page 5 of 6)

Transverse Waves. Have one student move his or her end of a plastic or metal Slinky back and forth (left and right, like a snake crawling), perpendicular to its stretched length. The other student must hold his or her end of the Slinky still. A series of transverse waves will be generated.



Standing Waves. When a series of wave pulses are sent through a medium and then reflected back upon themselves, *standing waves* can be generated, as demonstrated in the space shuttle footage in the video, *Slinky Scientific Shindig*. These distinctive waveforms have places where the medium does not vibrate at all, called *nodes*, and other places where the medium vibrates the most, called *antinodes*. When the students are demonstrating transverse waves, standing waves with varying numbers of nodes and antinodes can be generated by having the student moving the Slinky vary the rate at which he or she continually moves it back and forth.



Compressions and Rarefactions. Longitudinal waves can be composed of *compressions*, where the parts of the medium (coils of the Slinky) are closer together than normal, or *rarefactions*, where the parts of the medium are farther apart than normal. In the above demonstration, the students created compressional longitudinal waves. A rarefactional longitudinal wave can be produced by stretching a segment of the Slinky and then releasing it.

The stretched area (rarefaction) will then travel along the length of the Slinky.

Across the Curriculum Instruction Extensions

Science

- Discuss springs and where they are used and their purposes
- Find springs in items we use everyday
- Use simple machines to make daily tasks easier
- What else can Slinkys be made of?
- Radio waves – what are they, how do they work
- Space – discuss Slinkys used in space and why
    - zero gravity
    - space shuttle
    - the solar system

Social Studies

- Patents – what are they and how do you get one, why do we have them?
- Vietnam War – why was this war so controversial
  who was involved in it
  when was it fought and what was the outcome
  Vietnam Memorial – where is it and what does it look like?

Math

- Math problems using the length of manufacturing time – how many could you make in a minute, an hour?
    - how many feet of wire would you need to make 10 Slinkys, etc.?
    - production costs – you sell them for $2 a piece, it costs you $0.25 in materials, decide how much you think labor and marketing cost and how much money you make; how many do you have to manufacture and sell to make $1,000,000?

Reading

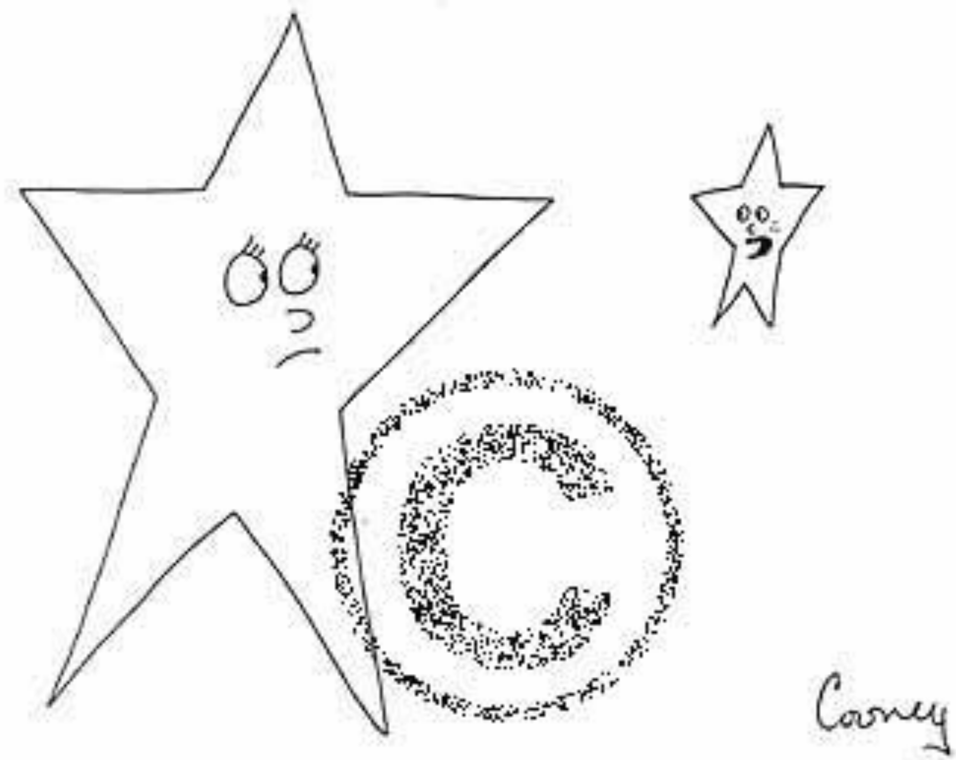
- Read the excerpt on Slinkys and ask critical thinking questions.
- Read about any of the above topics in an effort to research additional information on any of these areas.
- Read about inventors and their inventions and patents. Especially focus on inventors who failed many times but persevered such as Thomas Edison and the lightbulb.

Writing

- Write about a time a situation didn't go as planned but some surprise good came of it.
- Write about an inventor after researching his/her life & report to the class.

Activity # 5 (Page 1 of 2)

Using Political Cartoons in the Classroom



"I have to twinkle."

Activity # 5 (Page 2 of 2)

Political Cartoons

1. WHO?
   Who are the people represented in the cartoon?

2. WHAT?
   What issues and events are portrayed in the cartoon?

   What is the artist's opinion of the issue or event?

3. HOW?
   How do you know what the artist's opinion is? Identify the elements of the picture or written clues that tell you.

4. WHERE?
   Where does the cartoon take place?

   Would people who do not live the United States understand it?

5. WHEN?
   When is the situation happening? Past, present, or is it a future prediction?

   Does it compare past situations to the present?

6. WHY?
   Why are the topics in the cartoon important?

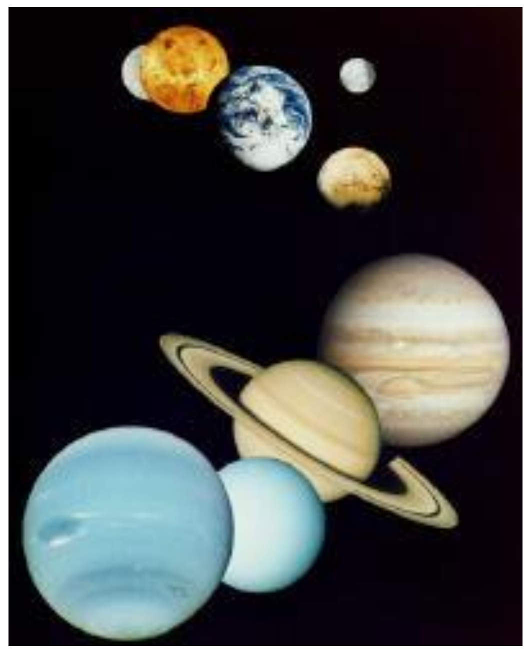
The Solar System

The following hands-on activity can be used with your class to help them visualize how big and how far away the other plants are from Earth.

Subjects: Science, reading, writing, math, and critical thinking

Materials:

- A tape measure
- Pumpkin or basketball
- Tomato see
- 2 peas
- A raisin
- An apple
- A peach
- 2 plums
- A strawberry seed
- 3" X 5" cards
- Markers
- *Planet Report* worksheet
- Computers with Internet access
- Chalkboard/markerboard
- Posterboard



Procedure:

1. Write the names of the planets and the sun on 3" X 5" cards. Use one card and a different color for each planet.
2. Pick 10 students to hold the items representing the sun and the planets. You will need to do this activity outside or in a very large room.
3. Give each student an item representing a planet and the corresponding name card.
4. Place the sun and measure out 50 feet to place Mercury. Continue with the other planets until it is not physically possible to do in the space provided. Of course, you will not be able to place one student nearly a mile away from the other students but they should get the idea after

looking at the first few examples.

5. Discuss the results and what the students could do to make the demonstration possible in the current space constraints.
6. Divide the class into 9 groups. Have each group research one planet on the Internet. *(If the Internet is not available, the instructor could bring in resource materials with the information.)*
7. Have each group complete the *Planet Rep*ort worksheet.
8. As a class, create a chart on the board compiling all the results from the reports.
9. Have each group make a poster of their planet and then hang all the posters in order around the room.

Math extensions:

- Have the students figure out a different scale to use so that they could fit all nine planets and the sun in the same room. For example, you could change the feet to inches (50 feet would be 50 inches) or divide the measurements by 10 or 100 or even 1000 and recalculate all of the measurements. (*Remember a mile equals 5280 feet.)*
- Convert all of the standard measurements to metric.
- Review the geometry of a circle (i.e. diameter, radius, circumference, area).

The Solar System

The sun, the largest star in our galaxy, is about one million times larger than our Earth and the Earth is in orbit about 93 million miles away from the sun. Using a BB or a pea to represent the Earth, you can use the following items to visualize the size and distance of the other planets.

If the sun were a pumpkin (or a basketball) about a foot in diameter:

- Mercury would be a tomato seed about 50 feet away.
- Venus would be a pea about 75 feet away.
- Earth would be a pea about 100 feet away.
- Mars would be a little raisin about 175 feet away.
- Jupiter would be an apple about 550 feet away.
- Saturn would be a peach about 1025 feet away.
- Uranus would be a plum about 2050 feet away.
- Neptune would be a plum about 3225 feet away.
- Pluto would be smaller than a strawberry seed nearly a mile away.

PLANET REPORT

Information to include:

1. What is the size of your planet?
2. How far is it from the sun?
3. Does it have any moons? If so, how many?
4. How long does it take for the planet to orbit the sun?
5. What is its distance from the Earth?
6. How long does it take to make one rotation? (How long is one day on this planet?)
7. What is the temperature like?
8. What is the planet made of?
9. Add anything else you want to tell about your planet.
10. Are there any conclusions you can make form this information? (Use your critical thinking skills!)

Planetary Years

A planetary year is the length of time it takes that planet to revolve around the sun. The planets revolve around the sun in different amounts of time, so a "year" on each planet is a different amount of time. The farther a planet is from the sun, the longer its year.

Planet	YEAR
Mercury	87.96 Earth days
Venus	224.68 Earth days
Earth	365.26 Earth days
Mars	686.98 Earth days
Jupiter	11.862 Earth years
Saturn	29.456 Earth years
Uranus	84.07 Earth years
Neptune	164.81 Earth years
Pluto	247.7 Earth years

1. Calculate how old you would be on the planet nearest the sun.

2. Calculate how old you would be on the largest planet.

3. Calculate how old you would be on the planet farthest from the sun.

4. How old would you be on the "red planet"?

Activity # 10 (Page 1 of 2)

Star Light/Star Bright

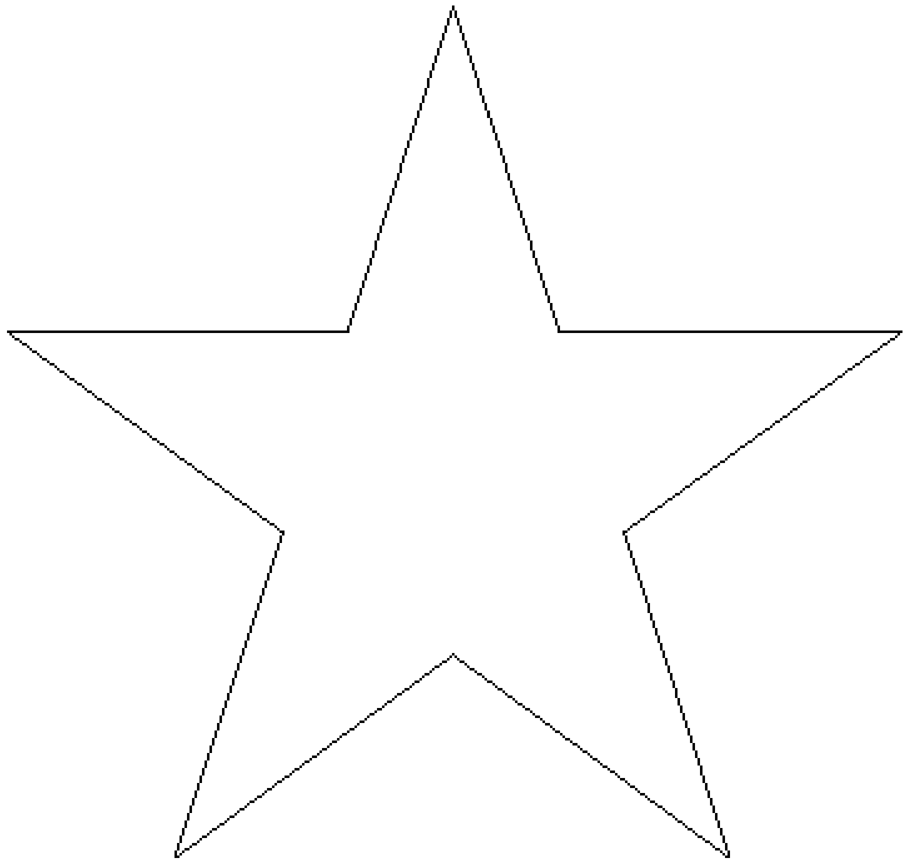
This quick and easy craft will help students visualize their fondest wish.

Supplies needed:

- White paper
- Dark blue and yellow construction paper
- Scissors
- Glue
- Pencil, crayons

1. Copy the star template and words to the poem "Star Light, Star Bright".
2. Trace a star on yellow construction paper. Cut the star out.
3. Glue the poem towards the bottom of the sheet of dark blue construction paper. Glue only the top ray of the yellow star towards the top of the blue sheet.

4. Write "I wish" on the front of the star. Write your wish on the back of the star.
5. Don't forget to look at the stars tonight.



Star Light, Star Bright,
First star I see tonight,
I wish I may,
I wish I might,
Get the wish
I wish tonight.

Activity # 14 (Page 1 of 2)

We've Lost Our Marbles

Oops! We've lost the marbles from the game. However, the weird thing is—if we had them, you couldn't do this puzzle!

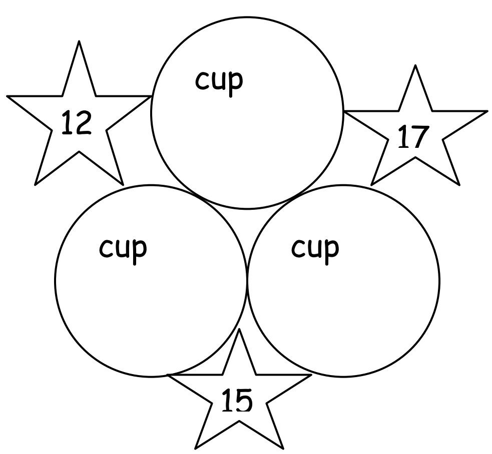
The object is to figure out how many marbles are missing from each cup. To do it, look at the number on the star between each pair. That's how many marbles are missing from those two cups combined.

Use the marbles to help you figure it out.

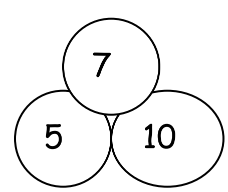
Instructor Notes

- Set up the game according to the figure on the left below. Place the "We've Lost Our Marbles" card and 22 marbles (or you can use coins) in a container next to the three cups.
- This is a hands-on activity. The students can move marbles back and forth until they figure out the answer.
- Don't stop there! Have the student make up a new game with a different number of marbles in each cup. Then have them challenge a classmate to figure out how many marbles he/she "lost" from each circle on the board he/she made up.

Set-up



Answer Key



These numbers are star-ons.

60 24

30 15 9

12 36

These numbers are not.

10 25

62 29 55

4 70

Which of these numbers are star-ons?

Activity # 17

I have $2.05 in quarters and dimes.
I have ten coins in all.
How many quarters do I have?

Note to Instructor: To set-up place 10 quarters and 10 dimes on the table with the instructions (above). Remember to cut off the answer!

Answer Key: 7 quarters

Activity # 13

Alike and Different

How are these objects alike? Write two ways. How are these objects different? Write two ways.

Instructor Notes:

This activity uses four objects. In this case a 3-D planet, sun, star, and moon were used. However, you can use pictures of the objects also. Place the *Alike and Different* card on the table with the objects. Have the students write their responses. You can then choose different objects on another day and do the same activity again. There are no right or wrong answers but the students must give reasons to substantiate their ideas. You will notice that the students' answers will improve over time.

Some possible answers for the objects given are: the same—they are all in space, they can all be seen with and without a telescope. Different—some are brighter than others, some are larger, some look bigger, some are visible during the day while others are visible at night.

Activity # 15 (Page 1 of 2)

Geographic *Superstars*

Half of the cards have a geography supertitle and a fraction on them. The other half of the cards have a fraction and a place on them. Reduce all of the fractions to the lowest terms. Then match the cards with equal fractions and you will know all the answers.

Instructor Notes

- Before beginning this activity, review reducing fractions.
- Copy the cards on colored paper and cut apart. Place the cards and directions on the table and let the students move them around until they find the matches.
- After completing the activity, you could ask the students to find all of the places on a world map.

Answers: World's tallest mountain—Everest, Largest cave system-Mammoth-Flint Ridge, Smallest continent-Australia, Largest desert-Sahara, Deepest spot in the ocean-Marianas Trench, Largest country by population—China, Largest country by land area—Soviet Union, Highest waterfall—Salto Angel

World's highest mountain 3/9	1/9 Soviet Union
Largest Cave system 12/18	1/4 Sahara
Smallest Continent 3/21	3/4 Salto Angel
Largest desert 7/28	1/ 3 Everest

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