Space Day:
Prospecting for Knowledge

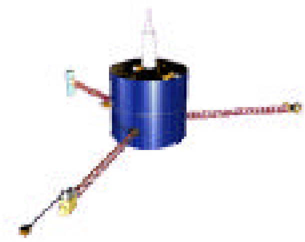
1-Lunar Prospector model-building instructions

REQUIRED INGREDIENTS: both large (4 per model) and small marshmallows (3 per model); heavy (white) coverstock paper; scissors; hole punch; soda straws; two highlighter markers (one yellow and one blue); scotch tape, aluminum foil, 15-30 min of time.

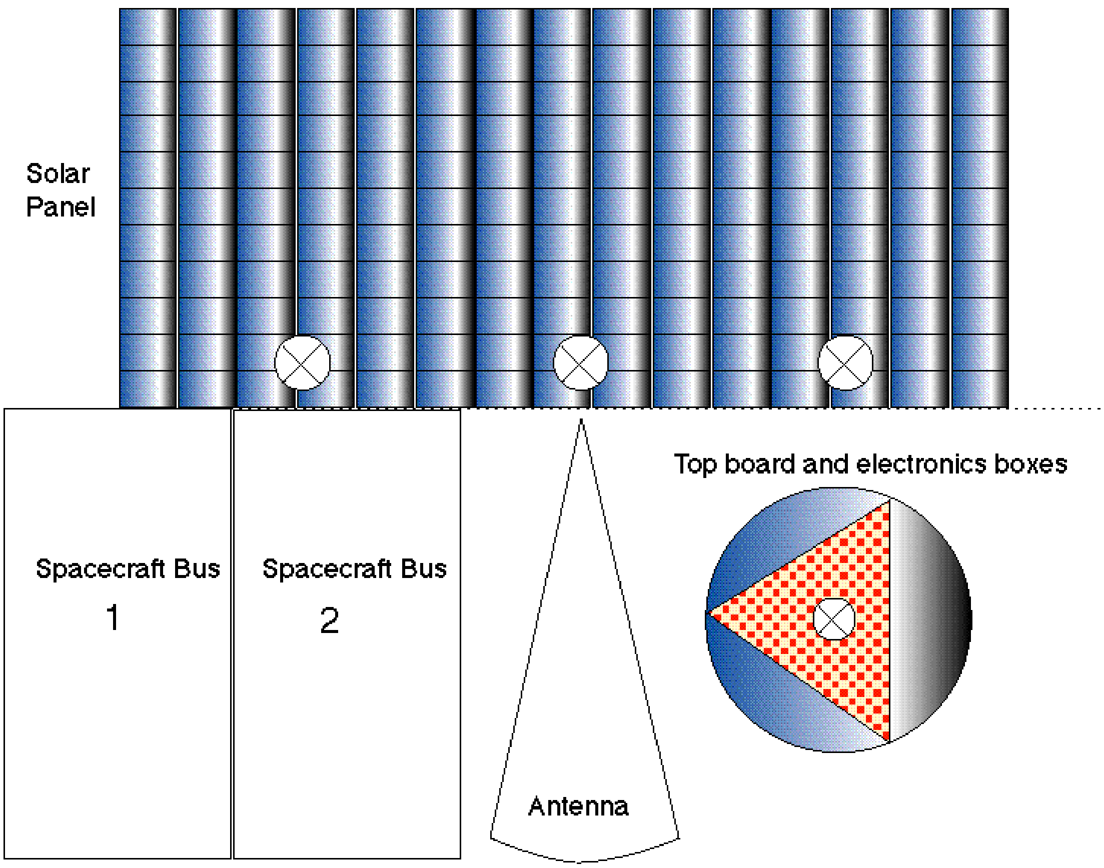
NOTE: Large marshmallows = hydrazine fuel tanks, small marshmallows = science instruments, straws = spacecraft booms (masts), foil = thermal protective coating, triangle (cone) = antenna(e)

- Cut out all pieces (“1” and “2” rectangles, “tiled” larger rectangle, triangle and circle) with scissors
- Color large rectangle **blue** (with marker) and inside triangle of circle **yellow** (with marker). Note: Students can use their imaginations, if they want. Colors are suggestions only.
- Punch holes at indicated small circles (three in large rectangle and one inside circle (fold in half and punch in middle)
- Slightly overlapping, tape together two small rectangles, end-to end. Tape again to make a cylinder (slightly overlapping, approx. 1/2 inch)
- Wedge three **large** marshmallows, side-by-side and flat sides up, into cylinder
- Wrap entire cylinder, with marshmallows inside, in foil. Top and bottom should be also covered. Note: This does not have to be done precisely. Students, especially younger students, can just scrunch the foil around the cylinder, making sure that the marshmallows are held in place.
- Wrap large blue rectangle around foil cylinder and tape together, forming an outer cylindrical wrapping.
- Push straws into three holes in bottom of blue outside cylinder. (This is now the **bottom** of the spacecraft) Wedge one **large** marshmallow in between the three straw ends, inserting straw ends into middle marshmallow.
- Fold triangle into a cone, and push through hole in circle.
- Attach rolled over tape (one to two pieces) to underneath side of circle-cone and attach inside top of blue cylinder (opposite side of where the straws (booms) are) -- this is now the **top** of the spacecraft
- Attach **small** marshmallows (one each) to straws.
- Send to the Moon! (or eat the marshmallows)

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge



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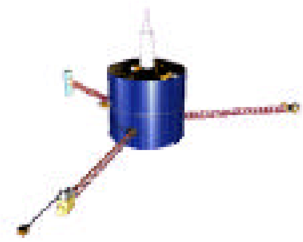


Space Day:
Prospecting for Knowledge

2-Construct a Lunar Habitat – Teacher Page

Purpose: To examine an aspect of future space exploration.

Materials needed:

- cardboard, styrofoam, or heavy tagboard for the base
- markers
- scissors
- glue (glue guns work best)
- construction materials of your choice (plastic containers, paper rolls,
- foil, construction paper, 2-liter pop bottles, string, yarn, etc.
- Raft junk makes a great alternative

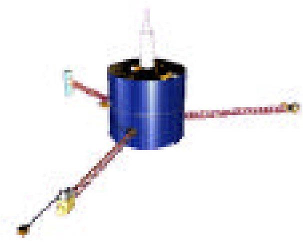
Background: With the discovery of ice on the moon, future habitation of its surface is now a possibility. Wherever habitation occurs, the following necessities of life must be considered: food source, recycling water and wastes, mining raw materials for building, solar power stations, underground/above ground living and working areas, recreation, launch and landing pads, etc.

This activity: Using the materials gathered, the students will construct a lunar habitat that addresses the issues for survival.

Preparation: Materials will need to be gathered. Students should be encouraged to gather and bring in materials from home. A discussion of the basic needs for survival should preclude the activity.

In class: Teams of 4 students work best in an activity of this type. Gathered materials should be displayed in a pick-up area. A "glue gun station" works well.

Reference: Young Astronaut Council, The Adventure Series, "Returning to the Moon", 1990.



Space Day:
Prospecting for Knowledge

2-Construct a Lunar Habitat - Student Page

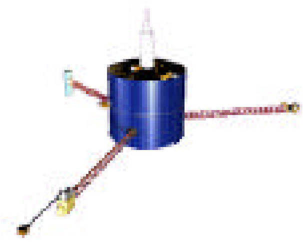
Purpose: To examine an aspect of future space exploration.

Materials needed:

- cardboard, styrofoam, or heavy tagboard for the base
- markers
- scissors
- glue (glue guns work best)
- construction materials of your choice (plastic containers, paper rolls,
- foil, construction paper, 2-liter pop bottles, string, yarn, etc.

Procedure:

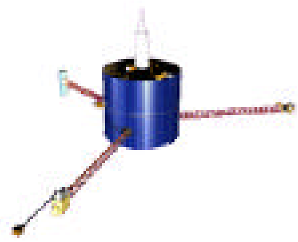
Using the materials provided, construct a lunar habitat that takes into consideration the basic needs of survival you discussed with your teacher: food, water source, shelter, etc.



Space Day: Prospecting for Knowledge

3-Lunar Prospector Simulation-
http://www.exploringspace.arc.nasa.gov/lp.htm

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

4-Edible Rocks - Teacher Page

Purpose: To observe and describe physical characteristics of edible samples chosen as models of real rocks or meteorites.

Background: Meteorites are mostly pieces of rock, though a few are metal, that fall to Earth from space. Most meteorites come from the break-up of small asteroids that never accreted to form a planet. Meteorites give us clues to the origin and history of the solar system.

Meteorites come in a variety of types and a wide range of sizes and shapes, but most meteorites have two things in common: they have dark brown or black glassy crusts on the outside and contain enough iron metal to attract a magnet. The outside crust of the meteorite is produced as the rock is heated by friction when it comes through the atmosphere. The outer part melts and forms dark fusion crust that often has flow marks or indentations like thumbprints. The inside stays cool and is usually light gray to black in color, but some may be tan or, if weathered and rusted, brown.

This Activity: This activity has been designed as a comfortable introduction to describing meteorites. It helps students become better observers by making a connection between the familiar (candy bars) and the unfamiliar (meteorites).

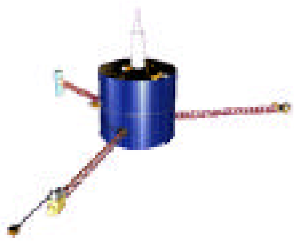
Edible "rocks" are used in a scientific context, showing students the importance of observation, teamwork, and communication skills. Using everyday terms, students draw and describe the food.. They attempt to match their observations with short descriptions written in geologic "Field Note" style.

These six candies most closely represent meteorite characteristics:
1. Peanut Brittle (chondrites)
2. Rocky Road (chondrites)
3. Thick Bar, Solid Chocolate (iron without fusion crust)
4. 3 Musketeers TM (achondrite with fusion crust)
5. Rice Cereal Treats (meteorite regolith breccia)
6. Chocolate brownie (carbonaceous chondirtes)

Preparation:
1. Obtain the samples.
2. Cut the samples so that a flat, cut face exposes the interior. Reserve part or most of each sample to be eaten by the students afterwards.
3. Place each sample in a small plastic bag. Each team of two students will have one bag containing one sample.
4. Give one student sheet to each team.
5. Cut apart the "Field Note" sample descriptions. These descriptions are written the way a scientist might take notes in a field record book.
6.Arrange the "Field Note" sample descriptions on a table so that students may attempt to match their own descriptions with these "key" descriptions.

Recipes:

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
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Rocky Road — 170 g (6 oz.) semi-sweet chocolate pieces; melted
120 g (2 cups) mini-marshmallows

Butter a samll pan (8 cm x 15 cm x 5 cm deep) and pour in about half of the melted chocolate. Add marshmallows and mix until coated. Pour remaining chocolate over the marshmallows and spread flat. Refrigerate until cold. Cut into small squares, so that vertical surrfaces are exposed.

Rice Cereal Treats — 240 g (1/2 cup) buttor or margarine; melted
300 g (10-11 oz.) mini-marshmallows
200 g (8 cups) crispy rice cereal
170 g (6 oz.) semi-sweet chocolate pieces; melted several
jelly beans, chocolate chunks, or other large edible lumps

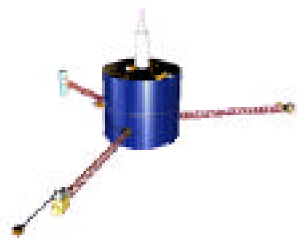
Melt butter and marshmallows together; stir until smooth. Pour over cereal in large bowl, and stir until coated. Press half of mixture into buttered baking pan (20 cm x 25 cm x 5 cm deep) and top with layer of melted chocolate. Press remaining cereal mixture on top of the chocolate layer. When cooled but still moldable, cut one cube about 5 cm square. Cut this square again once or twice. Embed one or two jelly beans and other lumps into the cut cube. Mold these cut pieces together again to form a "breccia". Allow to harden. Recut to expose interior and jelly bean and other lumps.

Chocolate Brownies

Use any recipe for dark chocolate brownies or box mix. Add large chunks of chocolate pieces; enough so that the pieces will be exposed on a cut surface. Bake according to directions and cool completely. Cut into small squares.

In Class: Distribute a sample and student sheet to each team. Note: Content vocabulary should not be expected initially. The processes of observing and recording should be kept simple. Explain that each team is responsible for describing and sketching its sample. Encourage teams to describe their observations using familiar vocabulary; however, use no food terms. Emphasize that working together is important. When finished, students should go to the "Field Note" sample descriptions which you have arranged on the "key" table. Emphasixe that their observations will not be exactly like the "Field Notes". They will likely try several matches before they have the accurate paring. Reward the students with pieces of the reserved candies.

Have each team share their descriptions and sketches with the class. Conduct a discussion that includes the following points which emphasize basic skills needed to be good scientists: (1) The students made detailed observations of a sample, (2) The task was accomplished by using teamwork, (3) Although the student's descriptions differed from those provided and each team has a different style, the skills and processes used to observe and record the data were the same for each group. The students communicated and shared their observations and sketches. During the discussion, you may expand and help define the meteorite and geologic vocabulary in context and encourage students to apply it to their own samples.



Space Day:
Prospecting for Knowledge

4-Edible Rocks – Student Page

Purpose: To observe and describe physical characteristics of edible samples chosen as models of real rocks or meteorites.

Background: Good observations set the foundation for good interpretations. The ability to carefully observe and describe things improves with practice. Here is a chance to practice your observation skills on something you are already familiar with: candy! Can you describe the physical characteristics of these edible samples without using food terms? Could you or someone else identify the sample after reading your description? Try it!

Materials: Prepared edible samples in transparent bags; Sketch paper

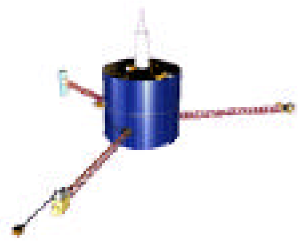
Procedure:

1. Choose a sample to observe and describe. You may remove the sample from the bag, but handle it carefully and do not taste.

2. Make a detailed sketch of the sample. Show the interior and exterior details. You may lable parts of the sketch, but do not use any food terms.

3. Write 2 to 3 sentences descibing the physical characteristics of the interior and exterior of the sample. Do not use any food terms. For example, do not use the word chocolate. Make your description as clear and complete as you possibly can.

4. How descriptive were you? If all the samples were placed in a row, could a classmate match your description to the correct sample? Try it. Can you match your description to the "Field Note" Sample Descriptions on the "key" table? Try it.



Space Day:
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5-Alka Rockets – Teacher Page

Purpose: To design a paper rocket propelled by alka seltzer and water to demonstrate Newton's third law of motion.

Background: The paper rocket in this activity is propelled according to the principle stated in Isaac Newton's third law of motion: "For every action there is an opposite and equal reaction." Gas pressure builds inside the film canister due to the mixing of alka seltzer and water. This action continues until enough pressure builds to blow apart the canister from its lid. The reaction is the launch of the rocket.

Materials: index card (5 x 8 in.); empty film canister with lid that snaps inside; markers, crayons, or colored pencils; tape; scissors; Alka Seltzer tablets; water; metric tape measure or meter sticks

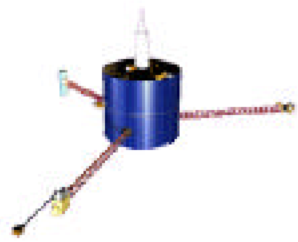
Preparation: Review and prepare materials. It is most important to use film canisters with lids that snap inside. Do not use lids that close around the outside of the canister.

In Class: This is an outdoor activity. If gusty winds are a problem, then place a quarter in the canister to keep the rocket from falling over. Launching near a wall where a metric tape has been hung or where meter sticks have been stacked may make it easier to judge how high the rocket goes. You may want to require students to wear safety glasses during this experiment as a general safety precaution. Everyone should stand away from loaded rockets when they are on the launch pad. It may take 15 to 20 seconds to build up enought pressure to launch, so a loaded rocket should not be approached prematurely. These rockets can shoot 5 meters or more into the air. No sharp objects should be placed on top of the nose cone or elsewhere on the rocket.

Wrap-up: One way to record the results of different "fuel" mixtures is to make a simple graph of height vs. amount of water. Such a graph gives a clear, visual record of the observations and can be used as evidence to support interpretations.

Extensions: Design and launch a rocket powered by two, three or more film canisters. Design a two-stage rocket. In each case, the students will need to work cooperatively to use the knowledge they've gained to solve problems of fuel mixtures and timing.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

5-Alka Rockets – Student Page

Purpose: To design a paper rocket propelled by alka seltzer and water to demonstrate Newton's third law of motion.

Procedure:

1. Decorate the index card. This will form the body of your rocket.

2. Roll the index card into an 8-inch-tall tube. Slide an empty, film canister into the tube so that the canister opens at one end of the tube. Securely tape the paper tube to the canister. You do not want these two parts to separate.

3. Now tape the 8-inch-long seam of the paper tube.

4. Cut two triangular, paper fins and tape them onto the rocket.

5. What is the function of the rocket fins?

6. Make a small paper cone and tape it to the top ofthe rocket if you would like a nose cone.

7. What is the function of the nose cone?

8. Hold the rocket upside down and add water to the canister to one-quarter full.

9. Add half a tablet of alka seltzer to the film canister and quickly snap on the lid.

10. Place the rocket on the ground, lid down. Stand back and count down while you are waiting for launch!

Observations:

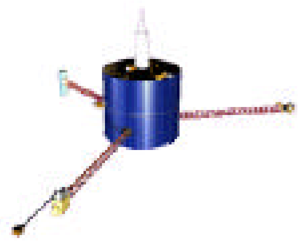
1. How high did the rocket go?

2. What happened when the alka seltzer was added to the water?

3. What action happened inside the film canister?

4. What was the reaction of the rocket?

5. Experiment using different amounts of water or alka seltzer to see how it affects the height of the rocket.



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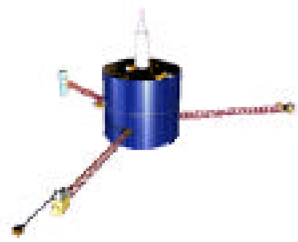
6. Experiment to see how the weight of the rocket affects the height it travels keeping the amount of water and Alka Seltzer constant each time.

Interpretations: What is the best combination of alka seltzer and water to produce the maximum launch height? What is your evidence?



Space Day:
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6-Moon Archeology-Chip Mines – Teacher Page

Materials:

- Chocolate Chip Cookie
- Toothpick (round ones are stronger, but flat ones scoop better)
- Straw (cut into pieces 1 inch long)
- Paper towel

Think: What's the best way to mine (remove) the chocolate from a cookie?

The rules:

- Your mine will earn $1,000 for every 1-inch straw you fill with chocolate pieces.
- You will be charged $100 for every minute it takes to process your chocolate (get out all the crumbs).
- The value of your Chip Mine (your cookie) goes down $100 just for mining it. The more damage, the more you lose. The fine: $100 for each cookie piece that breaks off.

Activity:

1. Place your Chip Mine on a paper towel and examine it. How many chips can you see on the surface? Make a drawing of your Chip Mine.

2. Use a toothpick to carefully dig out chocolate chips. You may "look underground" by peeking at the bottom of your cookie. But you *must* mine it from the top.

3. Done? Draw your Chip Mine again.

4. Compute your Land Damage: Count the cookie pieces. (If your cookie is whole, that's 1 piece.) Record the total under Land Damage on your chart.

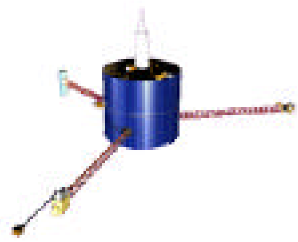
5. Process your chocolate: Separate the crumbs from the chocolate. Have a friend time your work. Round off the time to the nearest minute. Record it under Processing Time.

6. Measure your chocolate: Pick up the pieces with a 1-inch straw. Repeat with as many straws as you need. Record the number of straws under Chocolate Mined.

7. Follow the steps in "How to Figure Your Earnings" to find out how successful your Chip Mine is.

Wrap-up: Whose mine made the most money? Why? (Lots of chocolate in the mine? Careful digging? What else?) Did anyone go bankrupt (broke)? How would your mining plan change if there were no fines for breaking apart your Chip Mine? What if you used a different brand of cookie – a softer one, for instance?

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



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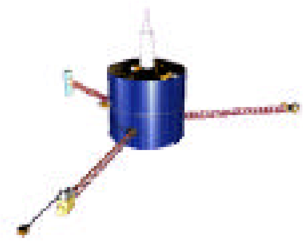
Bonus: Suppose your Chip Mine is an oatmeal raisin and chocolate chip cookie. Would you dig for chocolate, oatmeal, or raisins? Why?



Space Day: Prospecting for Knowledge

6-Moon Archeology-Chip Mines – Student Page

How to Figure Your Earnings:

How much "dough" did your Chip Mine make? Follow these steps:

1. Fill in your scores and multiply to get the total dollar values.

    Land Damage (Step 4): ________ pieces x $100 = $________

    Processing Time (Step 5): ________ minutes x $100 = $________

    Chocolate Mined (Step 6): ________ straws x $1,000 = $________

2. Add the dollar values for Processing Time and Land Damage. Write the answer here:

    Total Costs: $________

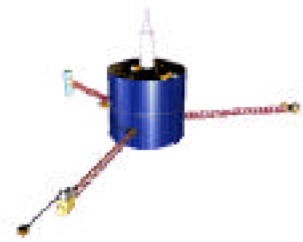
3. Are the Total Costs (Step 2) more than the dollar value of your Chocolate Mined (Step 1)?

    If Yes: Your mine has lost money. Write Bankrupt in the blank.

    If No: Subtract the Total Costs from the Chocolate Mined. Write the answer here:

    Total Earnings: $________

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
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7-Gelatin Volcanoes – Teacher Page

Purpose: To understand how and why magma moves inside volcanoes.

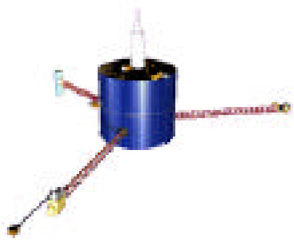
Background: Magma is molten rock, including crystals and dissolved gases, found at depth in a planetary interior. When magma erupts onto the surface, the volcanic products make distinctive landforms including lava plains and volcanoes, depending on the details of the eruption. One of the most interesting things to consider about magma is how it moves up from underground reservoirs, called magma chambers, to erupt as lava on planetary surfaces. Does it travel in natural tubes or pipes? Or along fractures? This experiment strikingly reveals the answer.

Magma leaves underground reservoirs through fractures in the surrounding rock. The fractures are either pre-existing or are created by the erupting magma. An active dike is a body of magma moving through a sheet-like, vertical or nearly vertical fracture. An important aspect of magma flow not dealt with in the gelatin activity is the heat lost during eruption. Magma, ascending as a dike begins to cool and solidify and the flow may become localized in the dike. Such localized eruption of magma over a long period of time produces a volcano. Stresses in the planet affect the orientation of dikes. Dikes open (widen) in the direction of least resistance. They propagate (grow longer and taller) perpendicular to the direction of opening. Hawaiian shield volcanoes are characterized by concentrated regions of dike injections, called rift zones. A series of experiments using gelatin models was conducted by researchers in 1972 to explain the growth and orientation of Hawaiian rift zones. The "Gelatin Volcanoes" classroom activity was inspired by this work.

This Activity: Gelatin, molded in bowls or bread pans, is used as transparent models of volcanic land-forms. Colored water is used as the dike-forming magma. In this activity, dikes tend to propagate radially from the center of bowl-shaped casts of gelatin because the resistance to opening is the same in every direction. Dikes tend to parallel the long-axis of ridge-shaped (bread pan) casts of gelatin because the narrow dimension provides less resistance to opening than the long dimension. The dike opens in the narrow dimension and we see propagation in the long dimemsion. With a slow, steady injection rate, the colored water creates a dike and generally erupts from the flanks or ends of the gelatin casts. Edge-on, a dike appears as a line. When the gelatin cast is sliced through with a knife, dikes appear as red lines in the vertical, cut edges.

Materials: Unflavored gelatin, 28 gm (one-ounce) box containing four packages; Spoon; Bowls or bread pans, either one 2-liter (or 2-quart) capacity, or smaller sizes; Red food coloring, to mix with water in a glass to make "magma" ; Syringe for injecting magma, best to use a plastic variety found at pet stores for feeding birds; Peg board, 40 x 60 cm, with 5-mm-diameter holes spaced 2.5 cm apart; Two bricks, 30 cm high; Large knife to cut through the gelatin model; Tray, for collecting drips; Rubber gloves (optional) for protecting hands from food coloring.

Preparation: Prepare magma by mixing water in a glass with enough red food coloring to make a very dark liquid. Gelatin requires at least three hours of refrigeration to set. Use a warm water bath to free the gelatin from the bowl without getting water on the gelatin itself. Unflavored gelatin is ideal for this experiment because of its transparency. Sweetened gelatin desserts also work. If you prefer the dessert variety, then use a flavor that is easy to see through, such as lemon. Another alternative is agar. Agar



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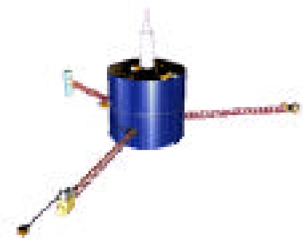
hardens at room temperature, eliminating the need for refrigeration, but it must be made so it is easy to see through. Two-liter (or two-quart) capacity bowls work very well because the diameter allows enough space for multiple dike injections. This size is large enough for demonstration purposes. Smaller bowls, down to the size of margarine containers, have also been used successfully.



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7-Gelatin Volcanoes – Student Page

Purpose: To understand how and why magma moves inside volcanoes.

Procedure:

1. Prepare "magma" by mixing water in a glass with enough red food coloring to make a very dark liquid.

2. Fill a syringe with red water. Remove air bubbles from the syringe by holding it upright and squirting out a small amount of water. Air tends to fracture the gelatin.

3. Predict what will happen when red water is injected into the gelatin cast. What direction will it go? What shape will it take? Will it erupt through the surface of the gelatin? If so, where?

4. Insert the syringe through a hole in the peg board into the center of the gelatin cast. (See photo below.) Inject the red water slowly, at a rate of about 20 cc/minute, and watch carefully. Describe how the experimental results compare with your predictions.

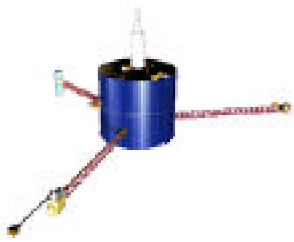
5. Looking directly down on the gelatin cast, sketch the positions and shapes of the magma bodies. Label your drawing "Map View."

6. Use a sharp knife to cut through the gelatin cast. Separate the pieces and examine the cut surfaces. Note the traces made by the magma bodies; these are similar to what we see in highway road cuts or cliff faces.

7. Sketch the positions and shapes of the magma bodies on a cut face. Lable your drawing "Cross-sectional View." Compare what you see in two dimensions on the cut face with what you see in three dimensions looking into the gelatin cast. Which view gives you more information. Why?

8. How and why does magma move through volcanoes?

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



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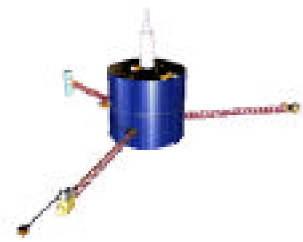


Space Day: Prospecting for Knowledge

8-Lava Layering – Teacher Page

Purpose: To learn about the stratigraphy of lava flows produced by multiple eruptions.

Background: Dark, flat maria (layers of basaltic lava flows) cover about 16 percent of the Moon's total surface. They are easily seen on a full Moon with the naked eye on clear nights from most backyards. The maria, quite similar to Earth's basalts, generally flowed long distances utlimately flooding low-lying areas such as impact basins. Yet, the eruption sources for most of the lunar lava flows are difficult to identify. The difficulty in finding source areas results from burial by younger flows and/or erosion from meteoritic bombardment.

Generally, the overall slope of the surface, local topographic relief (small cliffs and depressions), and eruption direction influence the path of lava flows. Detailed maps of the geology of the Moon from photographs reveal areas of complicated lava layering. The study of rock layering is called stratigraphy. On the Moon, older flows become covered by younger flows and/or become more pocked with impact craters.

On Earth, older lava flows tend to be more weathered (broken) and may have more vegetation than younger flows. Field geologists use differences in roughness, color, and chemistry to further differentiate between lava flows. They also follow the flow margins, channels, and levees to try to trace lava flows back to the source area.

This Activity: The focus of this activity is on the patterns of lava flows produced by multiple eruptions. We use a short cup to hold the baking soda because we are looking at the flows and not at constructing a volcano model. Volcanoes, like those so familiar to us on Earth and Mars, are not present on the Moon. Three well-known areas on the Moon interpreted as important volcanic complexes are: Aristarchus plateau, and the Marius Hills and Rumker Hills (both located in Oceanus Procellarum). These areas are characterized by sinuous rilles (interpreted as former lava channels and/or collapsed lava tubes) and numerous domes.

Materials: Paper cups, 4 oz. size, some cut down to a height of 2.5 cm; Cafeteria tray or cookie sheet, 1 for each; Eruption source; Tape; Tablespoon; Baking soda; Measuring cup; Vinegar; Food coloring, 4 colors; for example, red, yellow, blue, green; Playdough or clay in the same 4 colors as the food coloring.

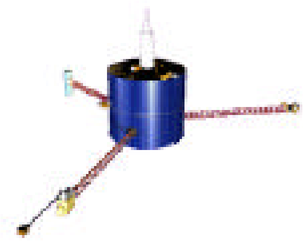
Preparation:

Baking soda-vinegar solutions and playdough are used to model the basaltic lavas. Different colors identify different eruption events; this activity calls for 4 colors. Students will be asked to observe where the flows traveled and to interpret the stratigraphy. Cover the work area and be prepared for spills.

Recipes:

Play Dough (stove-top recipe)-best texture and lasts for months when refrigerated in an air tight container.

2 cups flour



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1/3 cup oil, scant
1 cup salt
2 cups cold water
4 teaspoons cream of tarter
food colorings (20 drops more or less)

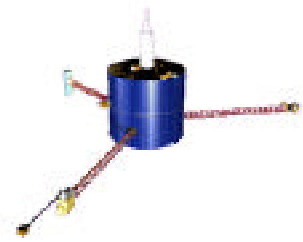
Make this large batch one color or divide ingredients in half to make 2 colors. You will need 4 colors total. Combine ingredients and cook mixture in a large sauce pan, stirring constantly, until the dough forms a ball. Turn dough out onto a floured surface to cool. Then kneed until smooth and elastic. Cool completely; refrigerate in air tight containers.

Play Dough (no-cooking recipe)

2 cups flour
2 Tablespoons oil
1 cup salt
1 cup cold water
6 teaspoons alum or cream of tartar
food colorings (as above)

Make this large batch one color or divide ingredients in half to make 2 colors. You will need 4 colors total. Mix ingredients and kneed until smooth and elastic. Store in air tight containers.

Wrap-Up: Have students compare their layered lava patterns with their classmates' patterns. Did they recognize individual flows by color and outline? Point out how the oldest flow is on the bottom of the stack. Each succeeding flow covers older flows. The youngest flow is on top.



Space Day: Prospecting for Knowledge

8-Lava Layering – Student Page

Purpose: To learn about the stratigraphy of lava flows produced by multiple eruptions.

Procedure:

1. Take one paper cup that has been cut to a height of 2.5 cm and secure it onto the tray. (You may use a small loop of tape on the outside bottom of the cup.) This short cup is your eruption source and the tray is the original land surface.

2. Place one Tablespoon of baking soda in this cup.

3. Fill 4 tall paper cups each with 1/8 cup of vinegar.

4. To each paper cup of vinegar add 3 drops of food coloring; make each cup a different color. Set them aside.

5. Set aside small balls of playdough, one of each color.

6. You are now ready to create an eruption. Pour red-colored vinegar into your source cup and watch the eruption of "lava."

7. As best you can, use red playdough to cover the areas where red "lava" flowed.

8. Repeat steps 6 and 7 for each color of vinegar and playdough. You may add fresh baking soda to the source cup or spoon out excess vinegar from the source cup as needed.

Results:

1. After your four eruptions, can you still see the original land surface (tray)? Where?

2. Describe what you see and include observations of flows covering or overlapping other flows. Make a sketch.

3. Where is the oldest flow? Where is the youngest flow? Did the flows always follow the same path? (be specific) What do you think influences the path direction of lava flows? If you had not watched the eruptions, how would you know that there are many different layers of lava? Give at least 2 reasons.

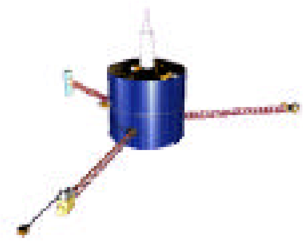
4. Which of the reasons listed in answer 6 could be used to identify real lava layers on Earth?

5. What are other ways to distinguish between older and younger layered lava flows on Earth?

6. Which of the reasons listed in answer 5 could be used to identify lava layers on the Moon?

7. What are other ways to distinguish between older and younger layered lava flows on the Moon?

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
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8. Make a vertical cut through an area of overlapping playdough "lava" layers. Draw what you see in the vertical section. Color your sketch and add these labels: oldest flow, youngest flow.

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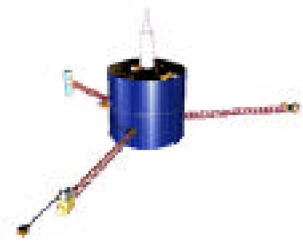
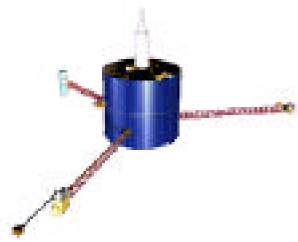


Space Day: Prospecting for Knowledge

9-Phases of the Moon – Teacher Page

Order pictures of the phases of the Moon to understand the relationships between the Sun, the Earth and the Moon. (more to follow)



Space Day:
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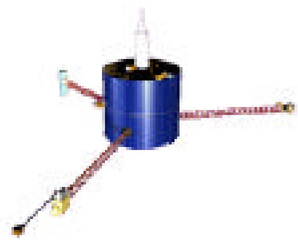
9-Phases of the Moon - Student Page

Order these pictures of the phases of the Moon (more to follow)

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

10-Reaping Rocks – Teacher Page

Purpose: To make predictions about the origin of lunar rocks by first collecting, describing, and classifying neighborhood rocks.

Background: Geologists are scientists who study the formation, structure, history, and processes (internal and on the surface) that change Earth and other planetary bodies.

Rocks and the minerals in them give geologists key information about the events in a planet's history. By collecting, describing and classifying rocks, we can learn how the rocks were formed and what processes have changed them. Geologists classify rocks into three types:

Igneous - rock formed when magma cools and hardens either below the surface (for example, granite) or on the surface during volcanic events (for example, basalt).

Sedimentary - rock formed by the collection, compaction, and cementation of mineral grains, rock fragments, and sand that are moved by wind, water, or ice to the site of deposition.

Metamorphic - rock formed when heat and/or pressure deep within the planet changes the mineral composition and
grain size of existing rocks. For example, metamorphism changes limestone into marble.

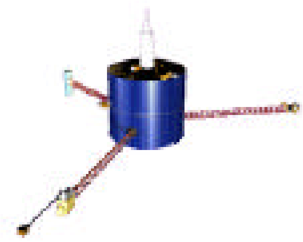
We find all three rock types on Earth's surface and the rocks are constantly changing (recycling), very slowly because of heat, pressure, and exposure to weather and erosion.

The Moon's surface is dominated by igneous rocks. The lunar highlands are formed of anorthosite, an igneous rock predominantly of calcium-rich plagioclase feldspar. The lunar maria are made of layers of basaltic lava, not unlike the basaltic flows of the Columbia River Plateau or of Iceland. The orange glass found on the Moon's surface is another product of volcanic activity. Moon rocks are not exposed to weather nor are they eroded by wind, water, or ice. The Apollo astronaut's footprints are as fresh as the day they were made.

Materials: Rocks; Empty egg carton, box, or other collection tray; Labels; Magnifying lens or stereo microscope; "My Own Rock Chart"; "Moon ABCs Fact Sheet"

Preparation: Review and prepare materials listed on the student sheet. Spend time familiarizing the students with rock and mineral identification.

Students may need more than one copy of "My Own Rock Chart" because it has spaces for only three samples. You may want to collect empty egg cartons, small boxes, or trays that the students could decorate themselves to display their rocks. Use of magnifying lenses or a stereo microscope would greatly enhance observations.



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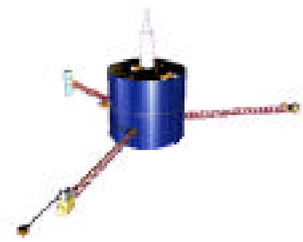
"Moon ABCs Fact Sheet" may come in handy during the wrap-up when students try to make predictions about the Moon rocks.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day: Prospecting for Knowledge

10-Reaping Rocks – Student Page

Purpose: To make predictions about the origin of lunar rocks by first collecting, describing, and classifying neighborhood rocks.

Procedure:

1. Display your rocks on a tray or egg carton, and label each one with the location of where you found it.

2. Look carefully at each rock with and without a magnifying lens or stereo microscope. What details can you see under magnification?

3. Describe what you see by filling out "My Own Rock Chart." Use as many adjectives or descriptive phrases as you can.

4. Classify your rocks as igneous, sedimentary or metamorphic. Try to interpret how your rocks were formed; that is, try to determine the origins. Add this information to your chart.

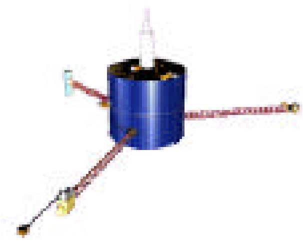
5. Now, based on your chart and the "Moon ABCs Fact Sheet," predict what the Moon rocks will look like.

6. How do you think the different Moon rocks might have formed?

My Own Rock Chart

Observations	Sample ___________	Sample ___________	Sample ___________
Sketch of Sample			
Shape			
Size			
Color			
Texture			
Apollo Mission/Collection Site			
Interpretations	Sample ___________	Sample ___________	Sample ___________

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



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Classification			
Origin			

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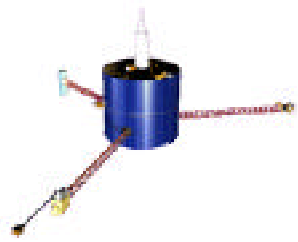

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Moon ABCs Fact Sheet

Property	Earth	Moon	Brain Busters
Equatorial diameter	12,756 km	3,476 km	How long would it take to drive around the Moon's equator at 80 km per hour?
Surface area	510 million square km	37.8 million square km	The Moon's surface area is similar to that of one of Earth's continents. Which one?
Mass	5.98 x 10E24 kg	7.35 x 10E22 kg	What percentage of Earth's mass is the Moon's mass?
Volume	??	??	Can you calculate the volumes of Earth and the Moon?
Density	5.52 grams per cubic cm	3.34 grams per cubic cm	Check this by calculating the density from the mass and volume.
Surface gravity	9.8 m/sec/sec	1.63 m/sec/sec	What fraction of Earth's gravity is the Moon's gravity?
Crust	Silicate rocks. Continents dominated by granites. Ocean crust dominated by basalt.	Silicate rocks. Highlands dominated by feldspar-rich rocks and maria by basalt.	What portion of each body is crust?
Mantle	Silicate rocks dominated by minerals containing iron and magnesium.	Similar to Earth.	Collect some silicate rocks and determine the density. Is the density greater or lesser than the Earth/Moon's density? Why?
Core	Iron, nickel metal	Same, but core is much	What portion of each

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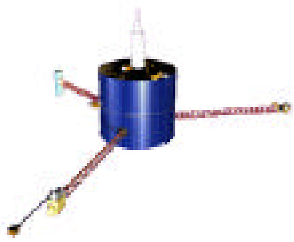
		smaller.	body is core?



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Moon ABCs Fact Sheet (Contd)

Property	Earth	Moon	Brain Busters
Sediment or Regolith	Silicon and oxygen bound in minerals that contain water, plus organic materials.	Silicon and oxygen bound in minerals, glass produced by meteorite impacts, small amounts of gases (e.g., hydrogen) implanted by the solar wind. No water or organic materials.	Do you think life ever existed on the Moon? Why or why not?
Atmospheric (main constituents)	78% nitrogen, 21% oxygen	Basically none. Some carbon gases, but very little of them. Pressure is about one-trillionth of Earth's atmospheric pressure.	Could you breathe the lunar atmosphere?
Length of day (sidereal rotation period)	23.93 hours	27.3 Earth days	How long does daylight last on the Moon?
Temperature	Air temperature ranges from -88C (winter in polar regions) to 58C (summer in tropical regions).	Surface temperature ranges from -193C (night in polar regions) to 111C (day in equatorial regions).	Why are the temperatures of Earth and the Moon so different?
Surface features	25 percent land (seven continents) with varied terrain of mountains, plains, river valleys. Ocean floor characterized by mountains, plains, and trenches.	84 percent heavily-cratered highlands. 16 percent basalt-covered maria. Numerous impact craters - some with bright rays, crater chains, and rilles.	Compare maps of Earth and the Moon. Is there any evidence that plate tectonics operated on the Moon?

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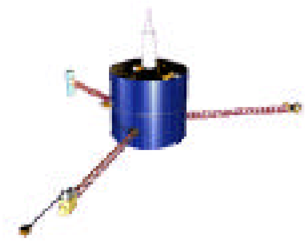


Space Day:
Prospecting for Knowledge

11-Sticky Electrostatics-Teacher's Page

Electrical experiments using plastic adhesive tape.

Contrary to popular belief, static electricity is not generated from fricton. Static electrification is more properly called CHARGE SEPARATION.

Atoms are composed of positive and negative particles (protons and electrons). Static electricity is a separating, un-cancelling, of positive and negative particles which are already present in the materials involved.

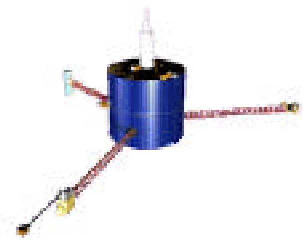
All matter is composed of this *cancelled* or *neutralized* electricity.

If you grab an atom by its protons and electrons and separate them far apart from each other, then you create "static electricity" or "charge separation." Our bodies are held together by static electricity!

This is an experiment using Scotch Magic™ tape that demonstrates charge separation (or static electricity):

- **Pull a couple of 6" strips from the roll of tape.**
- **Hold them by their ends so they hang downwards, then slowly bring them side by side. Notice that they repel each other without any friction?**
- **Next, pass the entire length of each hanging strip of tape lightly between two fingers several times, then hang them next to each other again. This time they won't repel each other. You have neutralized them by touching them.**
- **Next, fold over 1/2 inch on the top of both strips. Stick the sticky side of 1 strip to the "dry" side of the other, and rapidly pull apart. Avoid rubbing tape. Hold them far apart and slowly bring together. You'll find that they now attract each other quite strongly! Before they repelled, now they attract.**

What's going on? Obviously, static electricity is not caused by friction. It is caused by contact between dissimilar insulating materials, and is amplified when these materials are forcibly separated. When the tape is stuck together, it causes a separation of charges. When you peeled them apart, you pulled the opposite charged areas away from each other, causing "un-cancelling" of charges. Another name for this is "contact electrification."



Space Day:
Prospecting for Knowledge

11-Sticky Electrostatics -Student Page

Electrical experiments using plastic adhesive tape.

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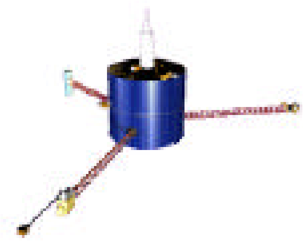


Space Day: Prospecting for Knowledge

12-Wright Flyer – Teacher Page

Purpose: To investigate the engineering issues involved when constructing a "flying machine".

Materials needed:

- 8 inch paper plate
- cement frosting
- popsicle stick
- 3 graham crackers
- about a dozen pretzel sticks

Cement icing: (Enough for 6-8 models.) With an electric mixer, beat together until foamy 2 egg whites, 2 teaspoons water, and 1/8 teaspoon cream of tartar. Gradually add 3 cups sifted powdered sugar, beating constantly until stiff. Store in airtight container until used.

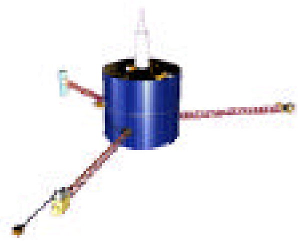
Background: There are many famous firsts in aviation history. One of these was the work of Orville and Wilbur Wright. They built the Wright Flyer. Orville was the first to fly the plane at Kill Devil Hill in North Carolina on December 17, 1903. This was the very first flight of a powered airplane. The flight lasted twelve seconds and the plane flew 120 feet.

This activity: Using graham crackers, pretzels, and cement frosting, students will construct a model of the 1903 Wright Flyer.

Preparation: Cement frosting will need to be prepared in advance and stored in an airtight container. Very "thick" frosting works best. Inexpensive paper plates are appropriate for this activity. A sample should be prepared in advance for students to view.

In class: Each child will need: a paper plate, container of frosting, popsicle stick for spreading the frosting, graham crackers, and pretzels.

Reference: Young Astronaut Council, The Adventure Series, 1990.



Space Day:
Prospecting for Knowledge

12-Wright Flyer - Student Page

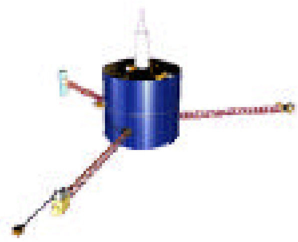
Materials needed:

- 8 inch paper plate
- cement frosting
- popsicle stick
- 3 graham crackers
- about a dozen pretzel sticks

Procedure:

1. Collect all needed materials.

2. Looking at a completed model of the Wright Flyer, use the materials to build a model of your own.

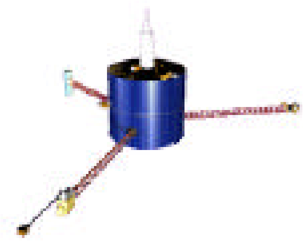


Space Day:
Prospecting for Knowledge

13-Lunar Ice Cream-Teacher page

The purpose of this activity is to give students a demonsrtation of freezing at different temperatures, to show how different compounds freeze at different temperatures (salt lowers the freezing temperature of the ice making it act “colder”) and to introduce them to 3 common temperature scales -Farenheit, Celsius and Kelvin.

Students will place 1/4 C of ice cream mixture into a small baggie
Seal the baggie completely.
Place the sealed baggie into a large baggie
Add 1/4 C rock salt and ~2Cs crushed ice.
Seat the large baggie.
Agitate (shake) bag for ~ 10 minutes. When the mixture sealed in the inner small baggie is thickened, remove it from the large baggie, open and dig in!



Space Day:
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13-Lunar Ice Cream-Student Page

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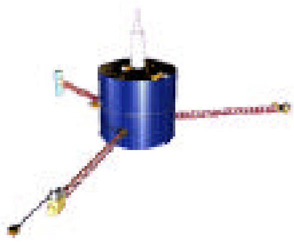

Space Day:
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14-Lunar Landform Identification – Teacher Page

Purpose: To identify landforms on the surface of the Moon using orbital, Apollo spacecraft photographs.

Background: Taking a good, close look at the Moon with the naked eye, through binoculars or a telescope can set the stage for a fascinating exploration of our nearest neighbor in space. Bright areas and streaks, dark areas, and circular features can be discerned easily. Photographs taken from lunar orbit give us even closer looks at the Moon's surface. The fun part is knowing what you're looking at and that's what this activity is all about.

Students will need to know the following vocabulary of landforms on the Moon:

Highlands - bright, extensively cratered areas of igneous rocks rich in the mineral plagioclase and breccias (rocks actually made of broken pieces of many rocks smashed back together again).
Maria - dark areas covered by lavas of the volcanic rock type called basalt.
Impact crater - roughly circular hole created when something struck the surface.
Terraced crater walls - steep walls of an impact crater with stair steps created by slumping due to gravity and landslides.
Central crater uplift - mountain in the center of large (>40 kilometer diameter) impact craters.
Crater ejecta - material thrown out from and deposited around an impact crater.
Ray - bright streak of material blasted out from an impact crater.
Multi-ringed basin - huge impact crater surrounded by circular mountain chains.
Lava flow - a break out of magma from underground onto the surface.
Rille - channel in lunar maria formed as an open lava channel aor a collapsed lava tube.
Wrinkle ridge - long, narrow, wrinkly, hilly section in maria.
Cinder Cone - low, broad, dark, cone-shaped hill formed by explosive volcanic eruption.
Dome - low, circular, rounded hill suspected to be a volcanic landform.

An easy-to-understand background article "The Moon: Gateway to the Solar System," written by Dr. G. Jeffrey Taylor, is available in NASA publication EG-1997-10-116-HQ. Find it on-line at the Lunar Prospector mission education homepage or in the curriculum materials section of NASA Spacelink. An accompanying slide set (Publication ES-1997-12-002-HQ) is also available on-line from Spacelink. Use these resources and other books and pictures to show your students what's on the Moon.

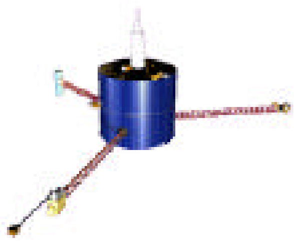
Additional on-line resources for lunar images and Moon mission information:

Moon missions and photos (including 3-D images) from the Lunar and Planetary Institute, Houston, Texas.

Apollo manned space program information from the National Air and Space Museum.

Futuristic moon mission artwork and real Apollo photos from Johnson Space Center.

This Activity:



Space Day:
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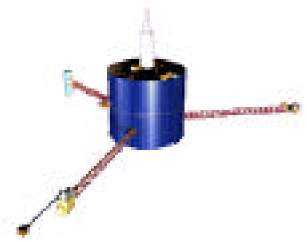
This activity uses eight photographs taken by Apollo mission orbital cameras to show thirteen major landforms on the surface of the Moon (defined above.) Students match the numbers on the photographs (1 through 20) with the name of the landform. A "Lunar Landform Identification" student chart is provided to record answers.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day: Prospecting for Knowledge

Preparation: Print out copies of the lunar photographs for this activity. Make copies of the blank "Lunar Landform Identification" student chart. Print out copies of the answer chart.

In Class: This activity can be used as a group or individual culminating experience for students who have been studying the Moon. The vocabulary words can be given as a separate assignment before the landform identification.

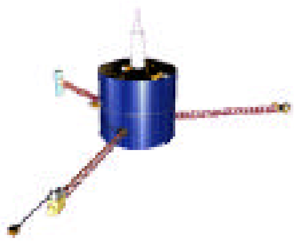
Wrap-Up: Compare student charts with the answer chart and discuss any discrepancies. Were some landforms easier to identify than others? Did shadows (sun angle) help make some features easier to see? Which landforms would you like to stand on?

Extensions: Using the label on each photograph, locate the areas on a globe or map of the Moon. Determine the latitude and longitude of the area in each photograph. Use maps of the Moon to determine the size of the landforms. Find the same landforms in photographs from the Apollo landing sites. Research and discuss Moon missions past, present, and future. Use the knowledge gained from this activity in the Lunar Life Support activity.

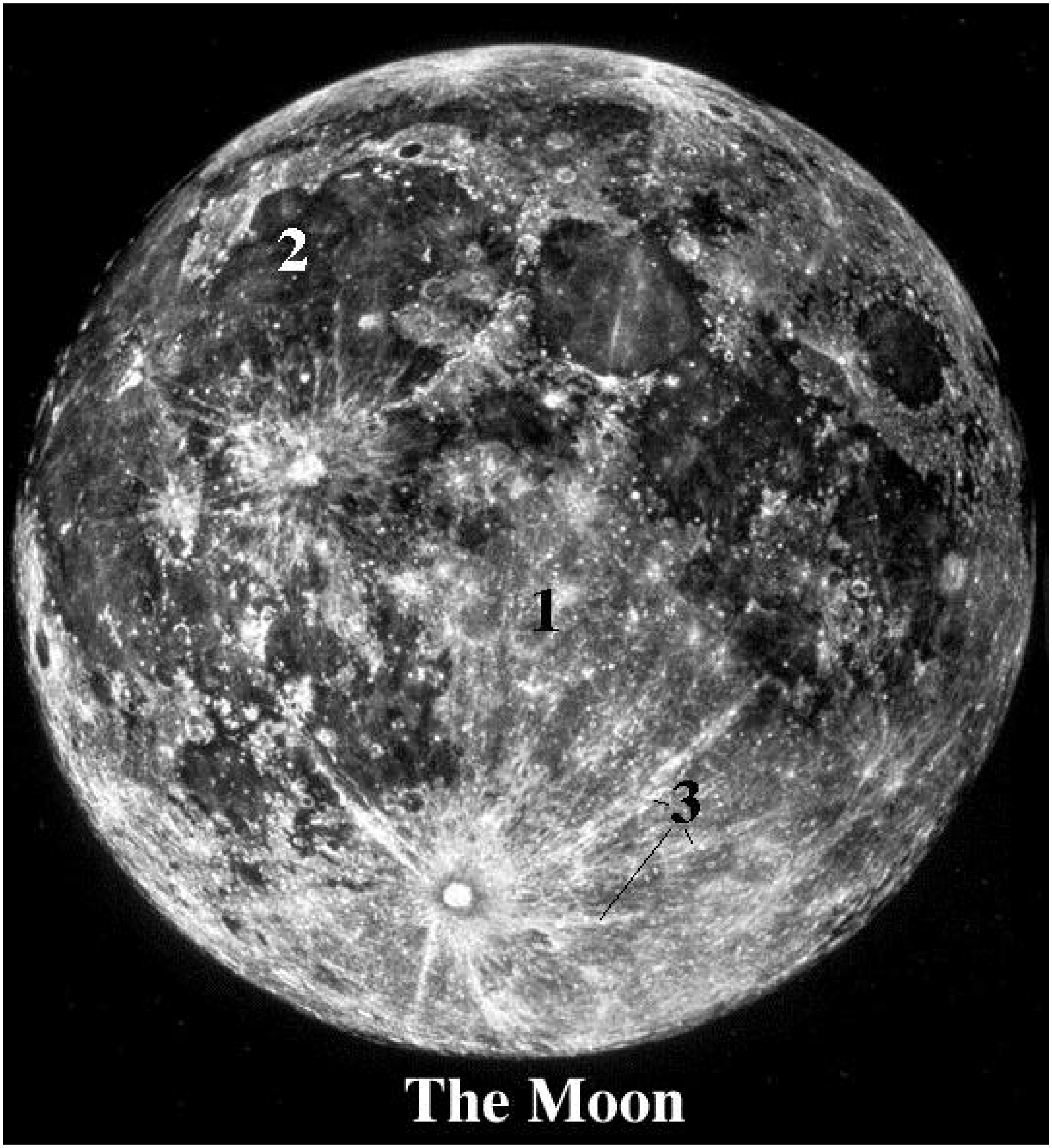
Lunar Landform Identification Answers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Highlands	X				X															
Maria		X				X														
Impact Crater								X	X											
Terraced Crater Walls												X							X	
Central Crater Uplift													X							X
Crater Ejecta											X									
Ray			X																	
Multi-ringed Basin				X														X		
Lava Flow														X						
Rille							X										X			
Wrinkle Ridge															X					
Cinder Cone										X										
Dome																X				

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge



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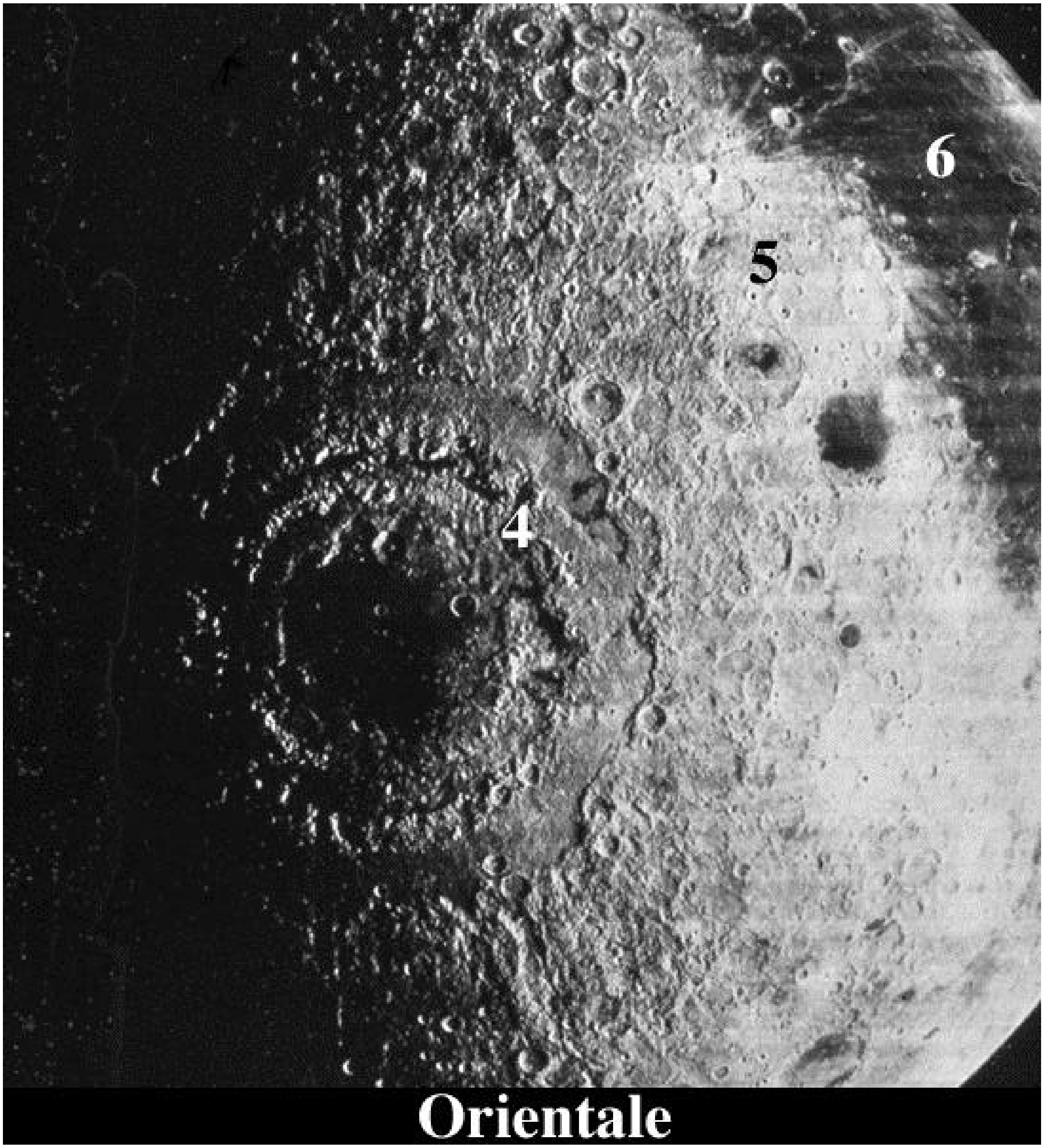

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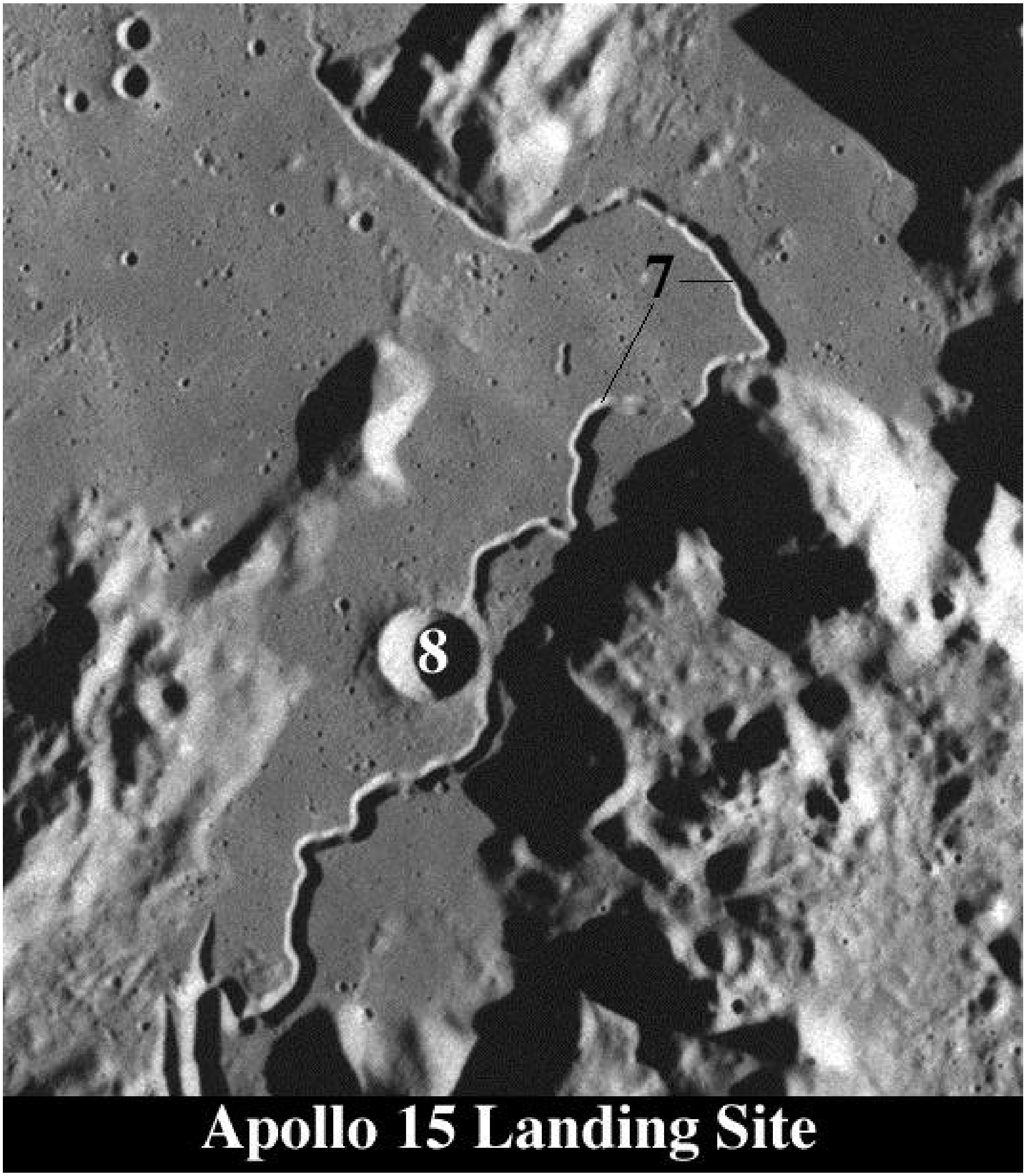

Apollo 15 Landing Site

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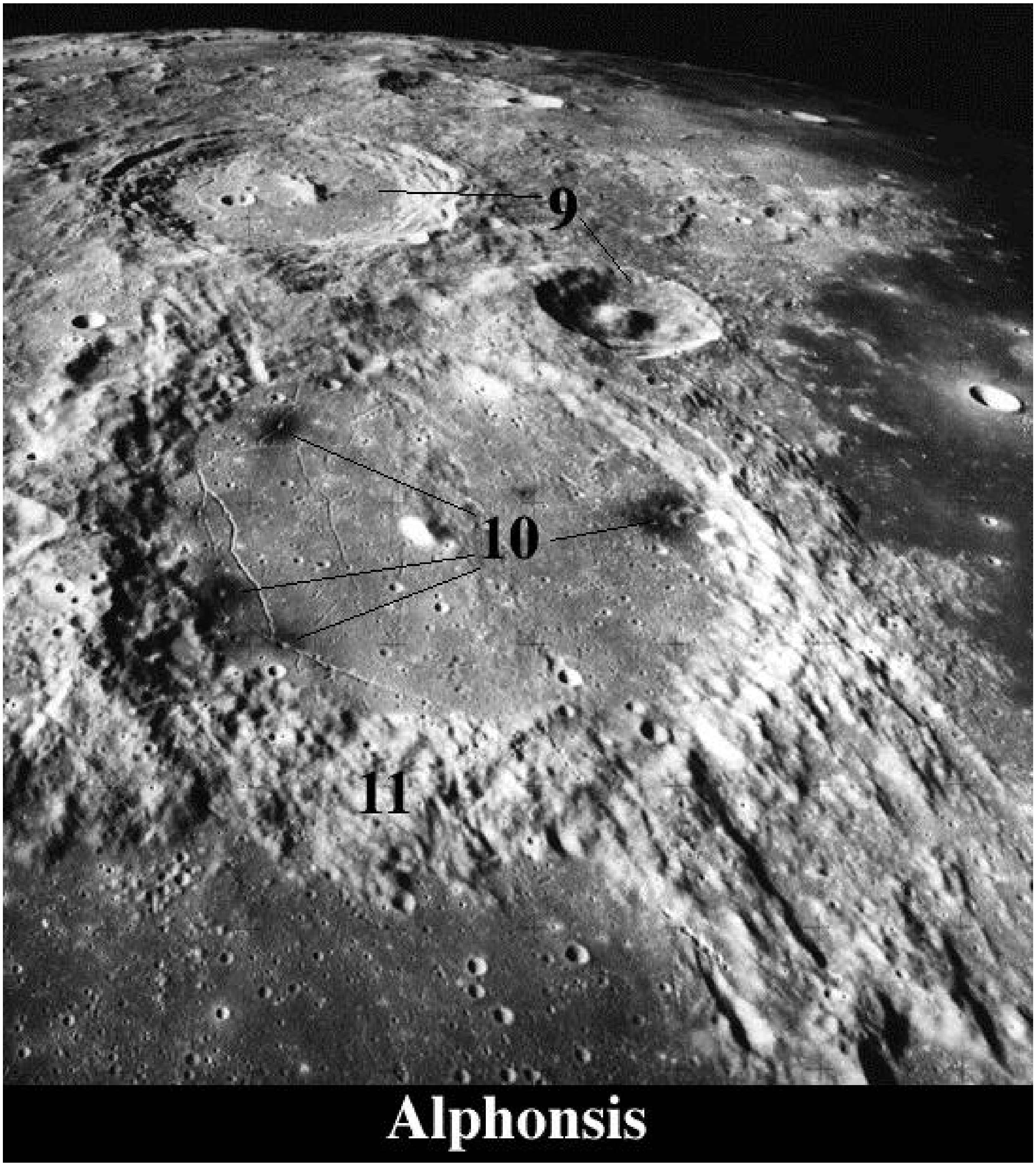

Alphonsis

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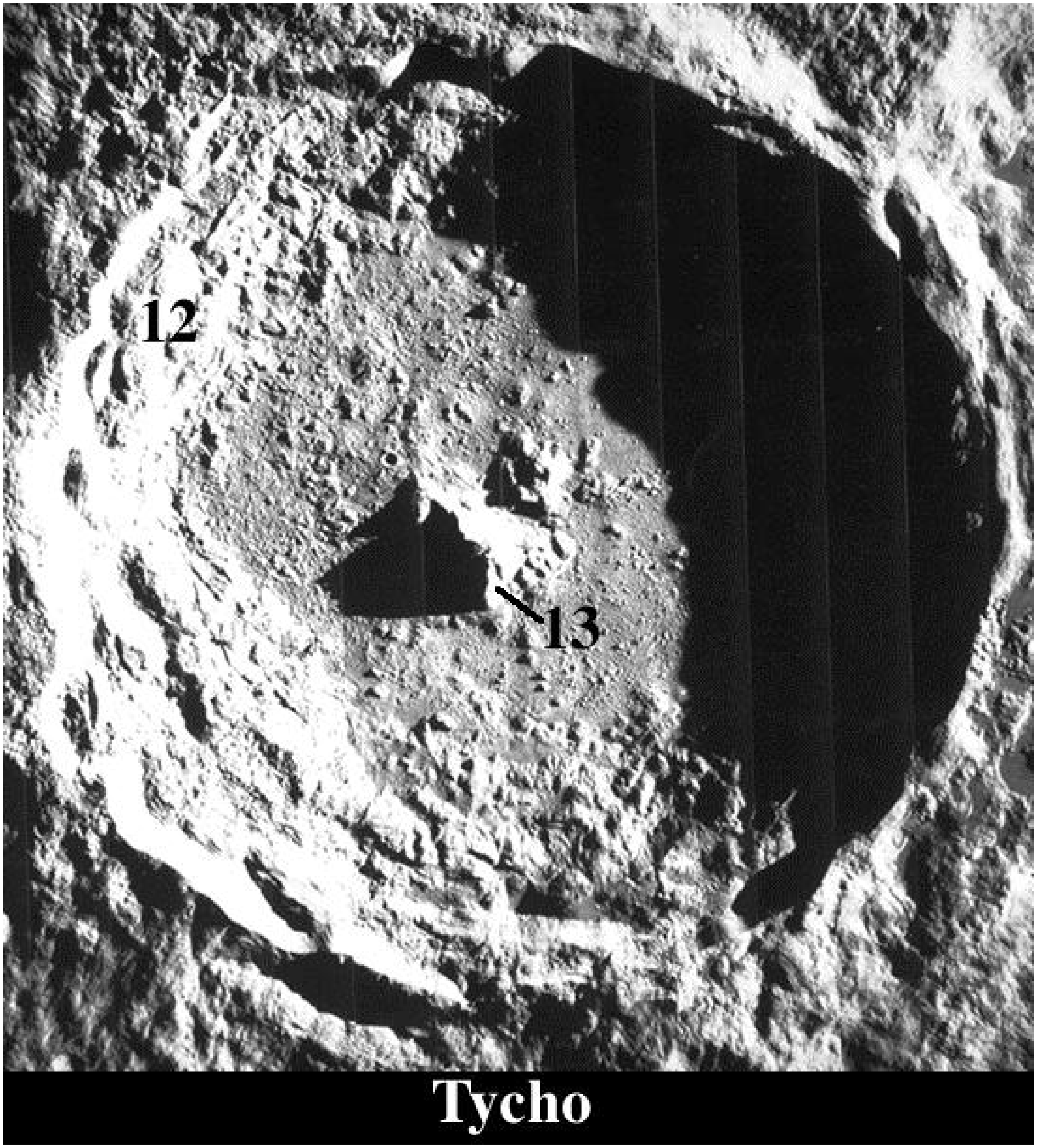

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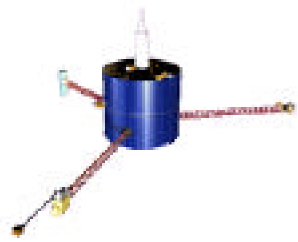

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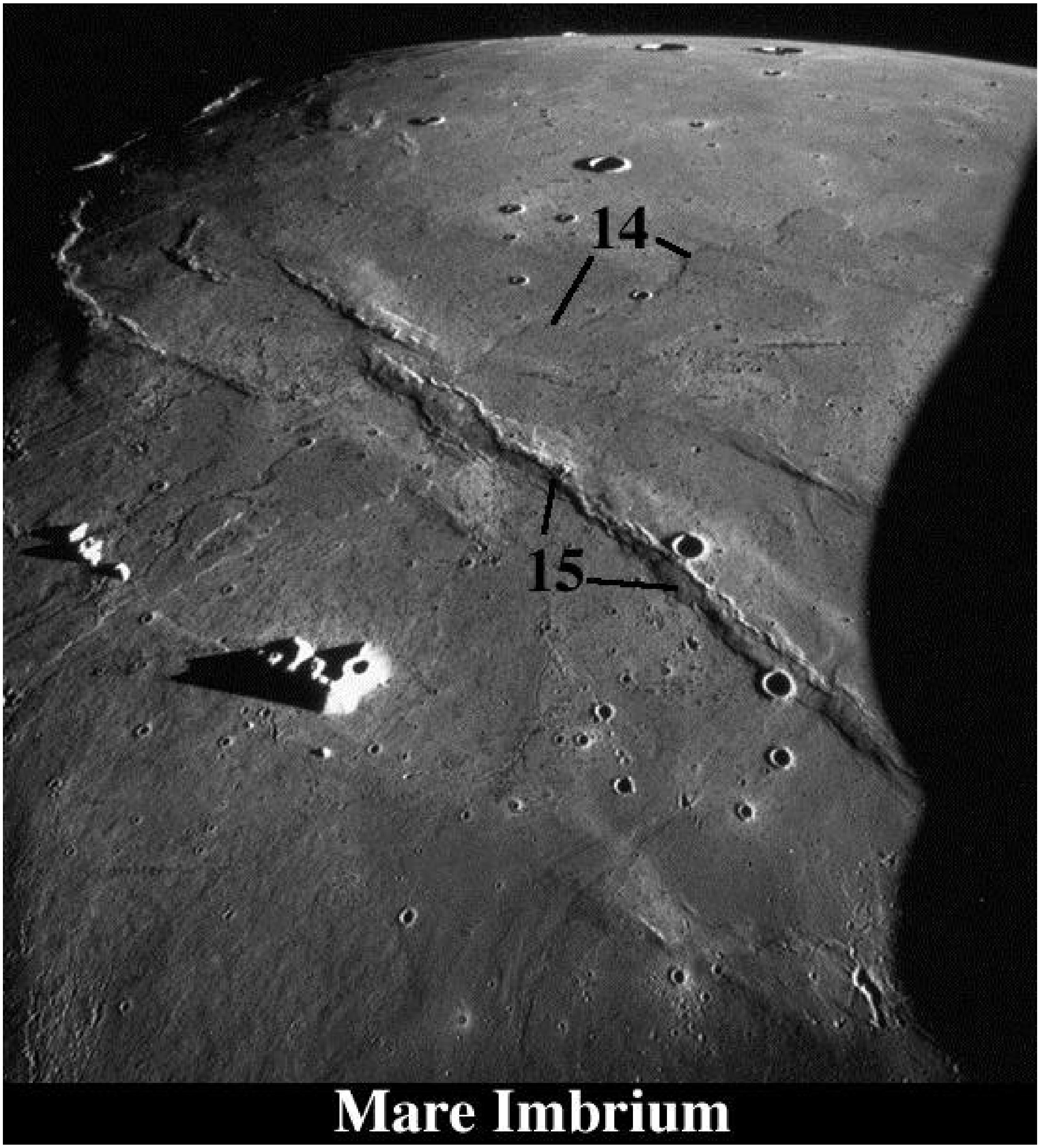

Mare Imbrium

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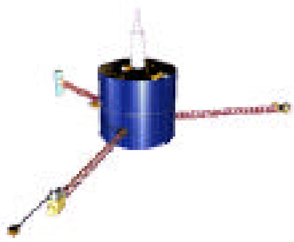

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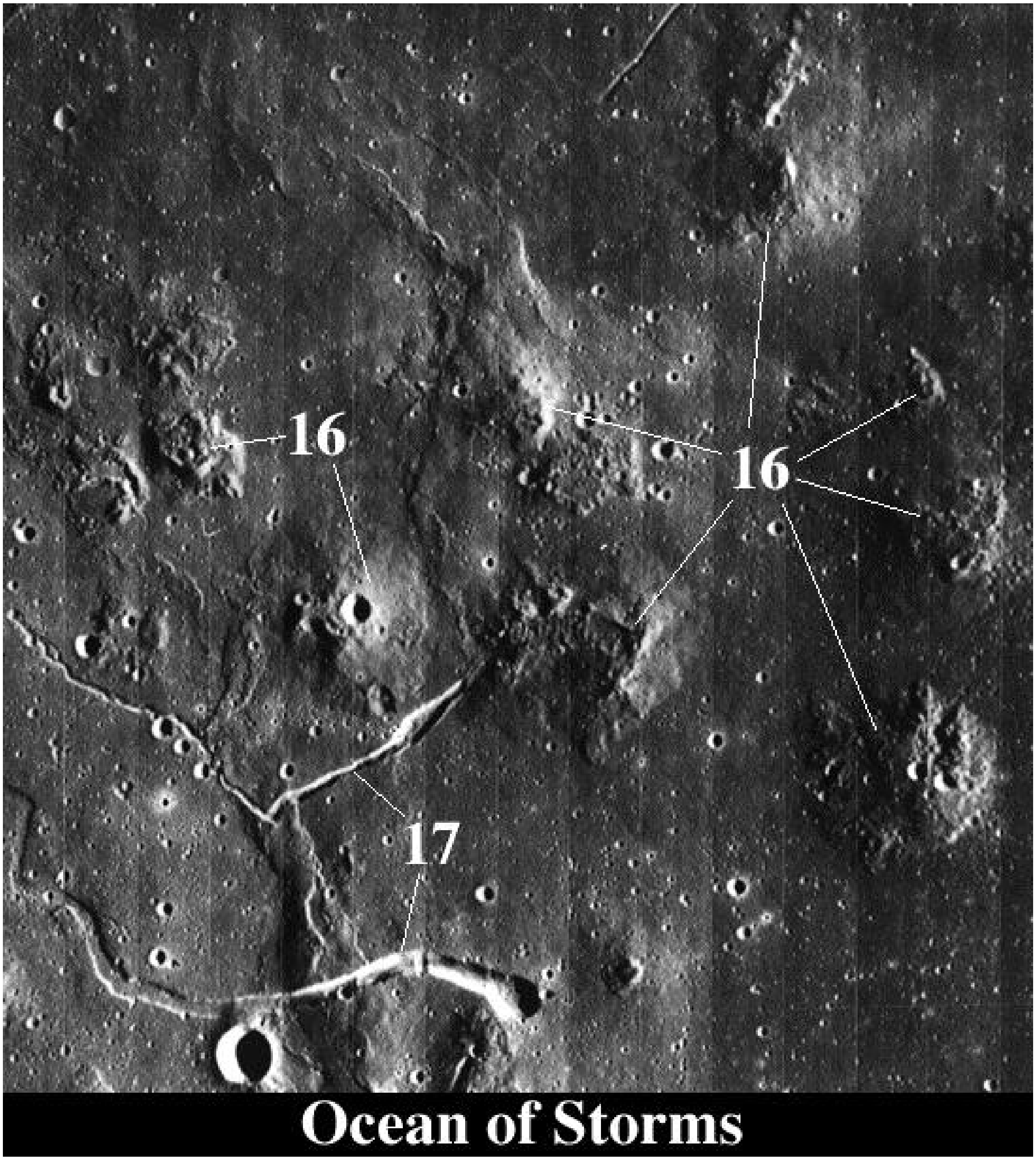

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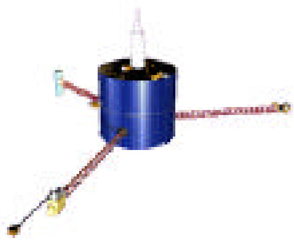

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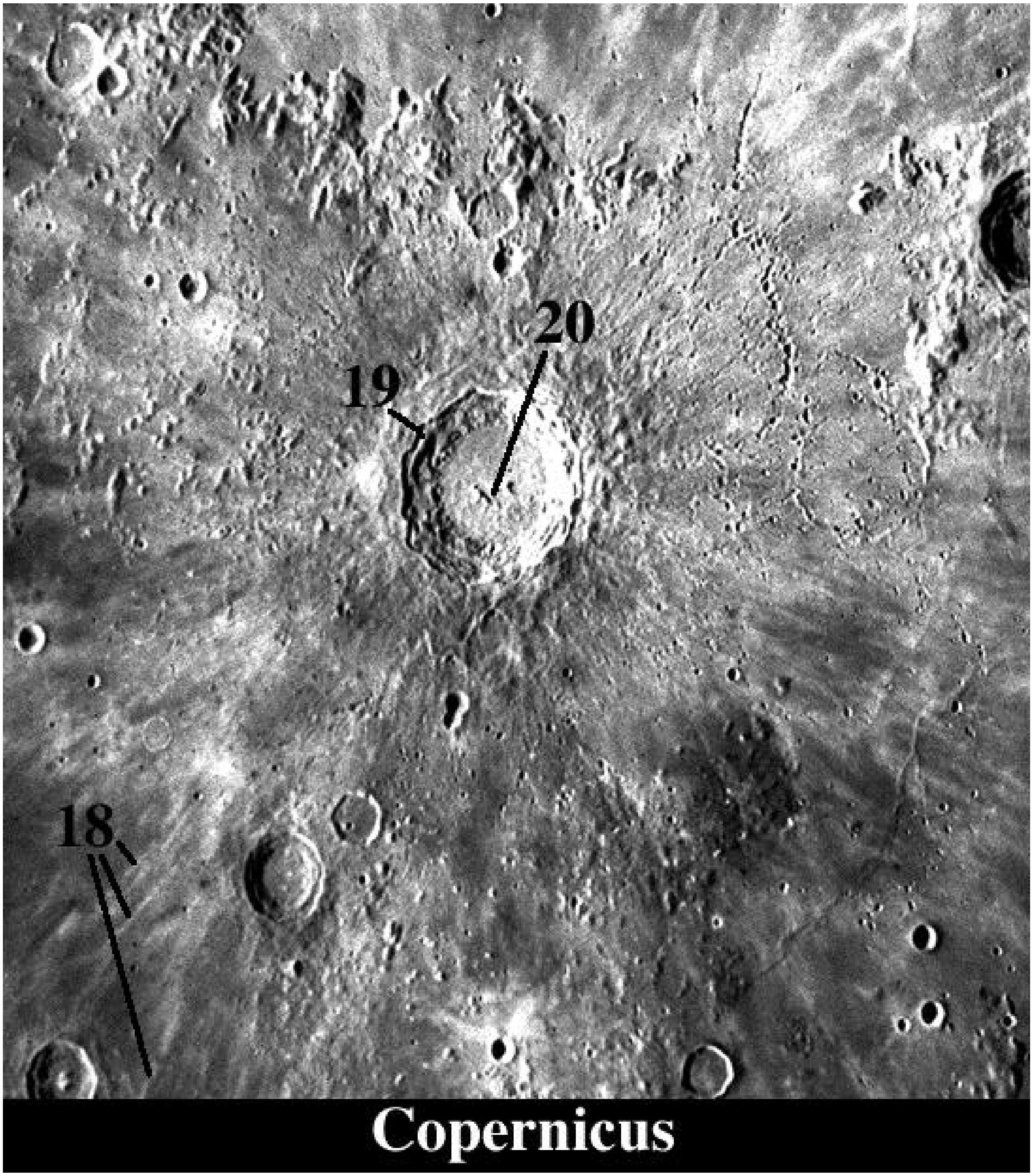

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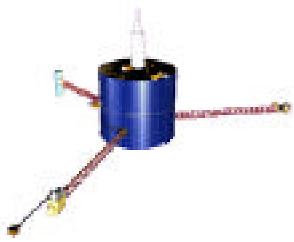

Space Day:
Prospecting for Knowledge

14-Lunar Landform Identification – Student Page

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Highlands																				
Maria																				
Impact Crater																				
Terraced Crater Walls																				
Central Crater Uplift																				
Crater Ejecta																				
Ray																				
Multi-ringed Basin																				
Lava Flow																				
Rille																				
Wrinkle Ridge																				
Cinder Cone																				
Dome																				

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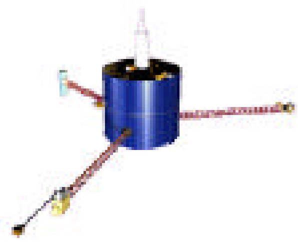


Space Day:
Prospecting for Knowledge

15-Regolith Formation – Teacher Page

Purpose: To compare the process of regolith formation on Earth and on the Moon.

Background: The loose, fragmental material on the Moon's surface is called regolith. This regolith, a product of meteoritic bombardment, is the debris thrown out of the impact craters. The composition and texture of the lunar regolith varies from place to place depending on the rock types impacted.

Generally, the older the surface, the thicker the regolith. Regolith on young maria may be only 2 meters thick; whereas, it is perhaps 20 meters thick in the older lunar highlands.

By contrast, regolith on Earth is a product of weathering. Weathering encompasses all the processes that cause rocks to fragment, crack, crumble, or decay. These processes can be physical (such as freezing water causing rocks to crack), chemical (such as decaying of minerals in water or acids), and biological (such as plant roots widening cracks in rocks).

The rock debris caused by weathering can then be loosened and carried away by erosional agents -- running water (fast-flowing rivers, rain, ocean waves), high-speed wind (by itself or sandblasting), and ice (glaciers).

In this activity, procedures A and B challenge the students to determine the effects of wind, sandblasting, and water on regolith formation and deposition on Earth. This is followed by prodedure C in which the students simulate regolith formation on the Moon by meteoritic bombardment.

Preparation: Review and prepare materials listed on the student sheet.

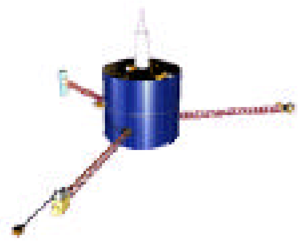
Toast, crackers, or brittle cookies can be used in this activity. Toast is the least expensive but most time consuming choice. In any case, students will need two different colors of materials for procedure C; for example, vanilla and chocolate graham crackers. Invariably, students get hungry at the sight of food, so you may want to reserve some clean materials for consumption or use something other than a rock for the projectile.

To prepare bread: use a conventional oven, toaster, or sun-dry method to produce the most crisp and brittle toast. Toast one loaf of white bread and one loaf of golden wheat or rye bread. Note that whole wheat bread does not get brittle enough.

For procedure B, fill margarine containers (one for each group) with water and sand, then freeze. The more sand, the better the illusion to a real rock.

For procedure C, do not use glass pans. Large plastic tubs are preferred for this procedure, but recyclable aluminum roasting pans or shallow cardboard boxes work as well.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

15-Regolith Formation – Student Page

Purpose: To compare and contrast the process of regolith formation on Earth and on the Moon.

Materials: Toasted white bread; Toasted golden wheat bread; Small pan; Sand paper, nail file, or edge of ruler; Ice cube with sand inside; Tray; Fist-size rock.

Regolith Formation on Earth - Procedure A: What effect does wind have on regolith formation?

1. Imagine that the piece of toasted bread is a rock on Earth. Your hand is the wind. The sand paper is wind carrying particles of sand.

2. Predict the effects of rubbing just your hand and then the sand paper across the taosted bread. Now try it. Rub your hand across the toasted bread and observe the bread the the pieces which fall from it onto the pan. Observations.

3. This time, rub the sand paper across the toasted bread and observe the bread and the pieces which fall from it onto the pan. Observations. How was the effect different? How is this activity related to processes on Earth?

Regolith Formation on Earth - Procedure B: What effect does falling or fast flowing water have on regolith formation?

1. Imagine that the ice cube with sand is a rock. Place this ice cube on a collection tray beneath the water faucet.

2. Adjust the water flow from the faucet so a medium stream hits the ice cube. Observe what happens to the ice cube and the remaining particles. What hapened to the rock (ice cube)? Describe the particles which remain.

3. How does water contribute to regolith formation on Earth?

Regolith Formation on the Moon - Procedure C:

1. Do you think regolith on the Moon is formed in the same manner as on Earth? Why or why not?

2. Now we will investigate the effects of meteoritic bombardment on regolith formation. In a small pan, place 2 slices of toasted white bread onto 3 slices of toasted golden wheat bread. This represents the Moon's crust.

3. Drop a rock onto the layers of toasted bread twice. Describe the bread slices and the crumbs.

4. Drop the rock 20 times onto the layers of toasted bread. Describe the bread slices and the crumbs.

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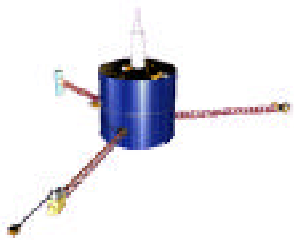
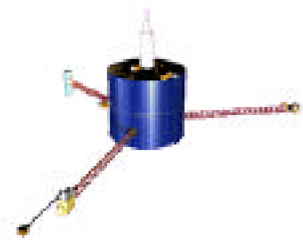


Space Day:
Prospecting for Knowledge

5. Which crumbs can be seen at the surface? Why? How does the thickness of the crumb layers compare after 2 hits and after 20 more hits?

7. How does meteoritic bombardment make regolith on the Moon?



Space Day:
Prospecting for Knowledge

16-Make a Crater – Teacher Page

Purpose: To determine the factors affecting the appearance of impact craters and ejecta.

Background: The circular features so obvious on the Moon's surface are impact craters formed when impactors smashed into the surface. The explosion and excavation of materials at the impacted site created piles of rock (called ejecta) around the circular hole as well as bright streaks of target material (called rays) thrown for great distances.

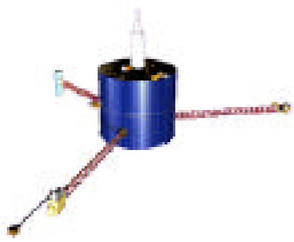
Two basic methods that form craters in nature are: 1) impact of a projectile on the surface and 2) collapse of the top of a volcano creating a crater termed caldera. By studying all types of craters on Earth and by creating impact craters in experimental laboratories, geologists concluded that the Moon's craters are impact in origin. The factors affecting the appearance of impact craters and ejecta are the size and velocity of the impactor, and the geology of the target surface.

By recording the number, size, and extent of erosion of craters, lunar geologists can determine the ages of different surface units on the Moon and can piece together the geologic history. This technique works because older surfaces are exposed to impacting meteorites for a longer period of time than are younger surfaces. Impact craters are not unique to the Moon. They are found on all the terrestrial planets and on many moons of the outer planets.

On Earth, impact craters are not as easily recognized because of weathering and erosion. Famous impact craters on Earth are Meteor Crater in Arizona, U.S.A.; Manicouagan in Quebec, Canada; Sudbury in Ontario, Canada; Ries Crater in Germany, and Chicxulub on the Yucatan coast in Mexico. Chicxulub is considered by most scientists as the source crater of the catastrophe that led to the extinction of the dinosaurs at the end of the Cretaceous period. An interesting fact about the Chicxulub crater is that you cannot see it. Its circular structure is nearly a kilometer below the surface and was originally identified from magnetic and gravity data.

This Activity: In this activity, marbles or other spheres such as steel shot, ball bearings, or golf balls are used as impactors that students drop from a series of heights onto a prepared "lunar surface." Using impactors of different mass dropped from the same height will allow students to study the relationship of mass of the impactor to crater size. Dropping impactors from different heights will allow students to study the relationship of velocity of the impactor to crater size.

Preparation: Review and prepare materials listed on the student sheet. The following materials work well as a base for the "lunar surface." Dust with a topping of dry tempera paint, powdered drink mixes glitter or other dry material in a contrasting color. Use a sieve, screen , or flour sifter. Choose a color that contrasts with the base materials for most striking results. All purpose flour (reusable in this activity and keeps well in a covered container); Baking soda (it can be recycled for use in the lava layering activity or for many other science activities). Reusable in this activity, even if colored, by adding a clean layer of new white baking soda on top. Keeps indefinitely in a covered container. Baking soda mixed (1:1) with table salt also works. Corn meal (reusable in this activity but probably not recyclable. Keeps only in freezer in airtight container.). Sand and corn starch mixed (1:1), sand must be very dry. Keeps only in freezer in airtight container. Pans should be plastic, aluminum, or cardboard. Do not use glass. They



Space Day:
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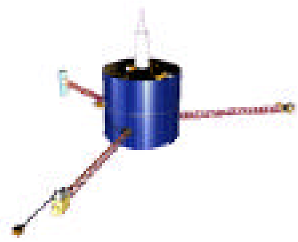
should be at least 7.5 cm deep. Basic 10"x12" aluminum pans or plastic tubs work fine, but the larger the better to avoid misses. Also, a larger pan may allow students to drop more marbles before having to resurface and smooth the target materials. A reproducible student "Data Chart" is included; students will need a separate chart for each impactor used in the activity.



Space Day:
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16-Make a Crater – Student Page

Purpose: To determine the factors affecting the appearance of impact craters and ejecta.

Materials: 1 pan; "lunar" surface material; tempera paint, dry sieve or sifter, balance, 3 impactors (marbles or other spheres); meter stick, ruler, plastic with middle depression; protractor; "Data Chart" for each impactor; graph paper.

1. Making an hypothesis:. After looking at photographs of the Moon, how do you think the craters were formed? What do you think are factors that affect the appearance of craters and ejecta?

2. Preparing a "lunar" test surface: Fill a pan with surface material to a depth of about 2.5 cm. Smooth the surface, then tap the pan to make the materials settle evenly. Sprinkle a fine layer of dry tempera paint evenly and completely over the surface. Use a sieve or sifter for more uniform layering. What does this "lunar" surface look like before testing?

3. Use the balance to measure the mass of each impactor. Record the mass on the "Data Chart" for this impactor. Drop impactor #1 from a height of 30 cm onto the prepared surface. Measure the diameter and depth of the resulting crater. Note the presence of ejecta (rays). Count the rays, measure, and determine the average length of all the rays. Record measurements and any other observations you have about the appearance of the crater on the Data Chart. Make three trials and compute the average values.

4. Repeat steps 2 through 5 for impactor #1, increasing the drop heights to 60 cm, 90 cm, and 2 meters. Complete the Data Chart for this impactor. Note that the higher the drop height, the faster the impactor hits the surface. Next, repeat steps 1 through 6 for two more impactors. Use a separateData Chart for each impactor. Graph your results. Graph #1 is Average crater diameter vs. impactor height or velocity. Graph #2 is Average ejecta (ray) length vs. impactor height or velocity. Note: on the graphs, use different symbols (e.g., dot, triangle, plus, etc.) for different impactors.

Results:

1. Is your hypothesis about what affects the appearance and size of craters supported by test data? Explain why or why not. What do the data reveal about the relationship between crater size and velocity of impactor. What do the data reveal about the relationship between ejecta (ray) length and velocity of impactor.

2. If the impactor were dropped from 6 meters, would the crater be larger or smaller? How much larger or smaller? Explain your answer. (Note: the velocity of the impactor would be 1,084 centimeters per second.) Based on the experimental data, describe the appearance of an impact crater.

3. The size of a crater made during an impact depends not only on the mass and velocity of the impactor, but also on the amount of kinetic energy possessed by the impacting object. Kinetic energy, energy in mostion, is described as: where, m = mass and v = velocity. During impact, the kinetic energy of an

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asteroid is transferred to the target surface, breaking up rock and moving the particles around. How does the kinetic energy of an impacting object relate to crater diameter?

4. Looking at the results in your Data Tables, which is the most important factor controlling the kinetic energy of a projectile, its diameter, its mass, or its velocity? Does this make sense? How do your results compare to the kinetic energy equation? Try plotting crater diameter vs. kinetic energy as Graph #3. The product of mass (in grams) and velocity (in centimeters per second) squared is a new unit called "erg."

Data Chart

Drop Height = 30 cm (Velocity = 242 cm/s)					
	Trial 1	Trial 2	Trial 3	Total	Average
Crater Diameter					
Crater Depth					
Average Length of all Rays					
Drop Height = 60 cm (Velocity = 343 cm/s)					
	Trial 1	Trial 2	Trial 3	Total	Average
Crater Diameter					
Crater Depth					
Average Length of all Rays					
Drop Height =90 cm (Velocity = 420 cm/s)					
	Trial 1	Trial 2	Trial 3	Total	Average
Crater Diameter					
Crater Depth					
Average Length of all Rays					
Drop Height = 2 meters (Velocity = 626 cm/s)					

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	Trial 1	Trial 2	Trial 3	Total	Average
Crater Diameter					
Crater Depth					
Average Length of all Rays					

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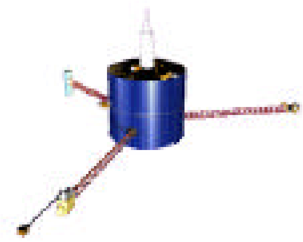

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17-How Much Do You Weigh – Teacher Page

Purpose: To understand that weight is a measure of gravitational attraction and that this force is not the same on each planet.

Materials: "New" Weight Chart; Calculator; Bathroom scale

Background: Gravity is a universal, natural force that attracts objects to each other. Gravity is the pull toward the center of an object; let's say, of a planet or a moon. When you weigh yourself, you are measuring the amount of gravitational attraction exerted on you by Earth. The Moon has a weaker gravitational attraction than Earth. In fact, the Moon's gravity is only 1/6 of Earth's gravity. So, you would weigh less on the Moon. How much would you weigh on the Moon and on the other planets?

Procedure:

1. Write your weight (or an estimate) here:

2. For a different planet, multiply your weight by the number given in the "New" Weight Chart.

    Example for the Moon - for a person weighing 60 pounds on Earth:

    $$60 \times 1/6 = 10$$

    A 60 pound person would weight 10 pounds on the Moon!

3. Follow the example and fill in the blanks in the "New" Weight Chart. Show your work.

Note for Space Day:

Encourage students to calculate 2-3 weights. Encourage them to work in groups to complete an entire chart.
the goal is simply to get the concept.

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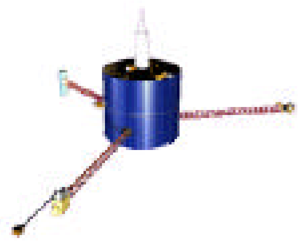

Space Day:
Prospecting for Knowledge

17-How Much Do You Weigh – Student Page

Purpose: To understand that weight is a measure of gravitational attraction and that this force is not the same on each planet.

Procedure:

1. Write your weight (or an estimate) here:

2. For a different planet, multiply your weight by the number given in the "New" Weight Chart.

   Example for the Moon - for a person weighing 60 pounds on Earth:

   60 x 1/6 = 10

   A 60 pound person would weight 10 pounds on the Moon!

3. Follow the example and fill in the blanks in the "New" Weight Chart. Show your work.

"New" Weight Chart

Planet	Multiply Your Earth Weight By:	Your "New" Weight
Mercury	0.4	
Venus	0.9	
Earth	1	
Moon	0.17	
Mars	0.4	
Jupiter	2.5	
Saturn	1.1	
Uranus	0.8	
Neptune	1.2	
Pluto	0.01	

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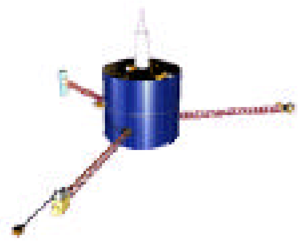

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Sun	28	

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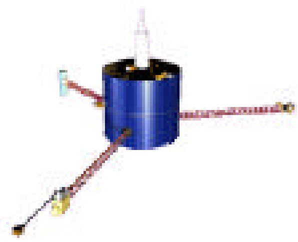

Space Day:
Prospecting for Knowledge

18-Teaching with Stories and Symbols

(Activity L-5, Grade Level: K-6)

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What's This Activity About? These three related activities show students that astronomy was important to ancient cultures and other present day cultures. Appropriate for early grades, the activities give students opportunities to decorate Sun symbols from various cultures, and to retell astronomical myths using felt puppets.

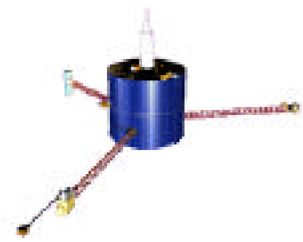
What Will Students Do? Students learn about Sun symbols from different cultures and decorate or create their own to hang in the classroom or bring home. In the third activity, students retell an astronomical myth or legend to themselves, peers, or parents.

Tips and Suggestions:

- See the "Skylore Bibliography" at the end of this section for an excellent listing of books containing myths and legends about astronomy.

- Have students create and decorate their own Sun symbols, or make up their own myths.

- The Sun signs, developed by cultures centuries old, like the other designs from Indian Designs, are excellent for mulitcultural and bilingual workshops, scouting and classroom projects. These designs can be used in many ways to illustrate skylore or for other crafts projects.



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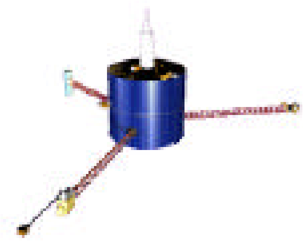

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19-Making a Comet in the Classroom

(Activity E-3, Grade Level: 4-9+)
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What's This Activity About? Comets are wonderfully mysterious things for our students. Since Halley's return in 1985, the only widespread images of comets have been artistic pictures prompted by the Shoemaker-Levy 9 impact at Jupiter in 1994. This activity give students a chance to observe the uneven surface, dark composition, delicate character, and even venting of trapped gas of a "mock" comet. All of these traits are based on the information scientists have gathered from watching comets over the years, and especially from the fly-by of Halley. "Making a Comet in the Classroom" can be done as a teacher demonstration or a student activity and is one of the most fun and accurate activities about comets.

What Will Students Do? Students will observe as a comet is created from common ingredients (dry ice, dirt, water). For later grades, with appropriate facilities and enough dry ice, students can make their own comets.

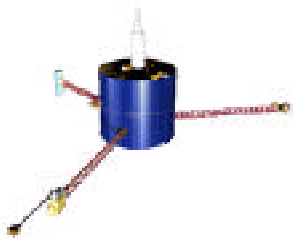
Tips and Suggestions:

- Be careful with the dry ice. Always use gloves, or oven mitts! If students handle the dry ice, review proper safety procedures and what to do if the ice contacts skin.

- For lower grades, use this activity as a demonstration. Ask students to note the proportions of ingredients, the color and surface characteristics, the jets, and the slow disintegration.

- For later grades, have the students create their own comets by mixing all of the ingredients in a plastic bag. If you're brave, allow the students to let their comets "fly" by throwing them outside in an open area.

- To simulate movement of the comet through the solar system, carry the comet as you walk around a bright bulb (the Sun) in a darkened room. Far from the bulb, walk very slowly, and comment on the low temperature and feeble light. Closer to the bulb, describe passing Saturn and Jupiter, and near Mars warming up so much that the tail begins to form. Walk more quickly toward the bulb (the increasing gravitational pull between the Sun and the comet causes the comet to travel faster), swing around it, and head away, tumbling the comet as you go. Follow up this activity with pictures of Halley's comet, taken by the Giotto spacecraft as it flew by.

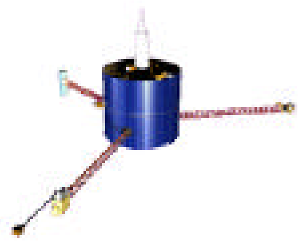


Space Day: Prospecting for Knowledge

- Places to get dry ice: ice cream stores, grocery stores, butcher shops.

The "ingredients" for a six-inch comet are:

2 cups of water
2 cups of dry ice (frozen carbon dioxide)
2 spoonfuls of sand or dirt
A dash of ammonia
A dash of organic material (dark corn syrup works well)



Space Day:
Prospecting for Knowledge

Other materials you should have on hand include:

An ice chest
A large mixing bowl (plastic if possible)
4 medium-sized plastic garbage bags
Work gloves
A hammer, meat pounder, or rubber mallet
A large mixing spoon
Paper towels

Dry ice is available from ice companies in most cities (look under “ice” in the Yellow Pages for a local source). Day-old dry ice works best, so you might want to buy it the afternoon before the day you do the activity. Keep the dry ice in an ice chest packed with newspaper and tightly closed. Most ice companies have a minimum on the amount of ice they will sell (usually 5 pounds). But having extra dry ice on hand will be useful because some will evaporate and also because it is advisable to practice this activity at least once before doing it with the class.

The Activity: Here are the steps for making a 6-inch comet (students make good baker’s assistants for this exercise!):

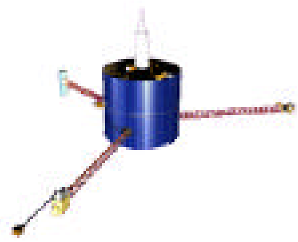
1) Cut open one garbage bag and use it to line your mixing bowl.
2) Have all ingredients and utensils arranged in front of you.
3) Place water in mixing bowl.
4) Add sand or dirt, stirring well.
5) Add dash of ammonia.
6) Add dash of organic material (e.g. corn syrup), stirring until well mixed.
7) Place dry ice in 3 garbage bags that have been placed inside each other. (Be sure to wear gloves while handling dry ice to keep from being burned.)
8) Crush dry ice by pounding it with a hammer.
9) Add the dry ice to the rest of the ingredients in the mixing bowl while stirring vigorously
10) Continue stirring until mixture is almost totally frozen.
11) Lift the comet out of the bowl using the plastic liner and shape it as you would a snowball.
12) Unwrap the comet as soon as it is frozen sufficiently to hold its shape.

Now you can place the comet on display for the students to watch during the day as it begins to melt and sublimate (turn directly from a solid to a gas—which is what carbon dioxide does at room temperature and comets do under the conditions of interplanetary space when they are heated by the Sun).

The comet is reasonably safe to touch without getting burned by the dry ice, but it is still best to have a spoon or a stick for the students to use while examining it. As the comet begins to melt, the class may notice small jets of gas coming from it. These are locations where the gaseous

carbon dioxide is escaping through small holes in the still-frozen water. This type of activity is also detected on real comets, where the jets can sometimes expel sufficient quantities of gas to make small changes in the orbit of the comet.

After several hours, the comet will become a crater-filled ice ball as the more volatile carbon dioxide sublimates before the water ice melts. Real comets are also depleted by sublimation each time they come near the Sun. Ultimately, old comets may break into several pieces or even completely disintegrate. In some cases, the comet may have a solid, rocky core that is then left to travel around the comet's orbit as a dark barren asteroid.



Space Day:
Prospecting for Knowledge

20-Orbital Forces – Teacher Page

Purpose: To demonstrate orbital motions and forces using a tennis ball swung by a ribbon.

Background: A center-directed force that causes an object to follow a circular path is called a centripetal force. When you swing a tennis ball from the end of a ribbon, you must pull on the ribbon - exerting a centripetal force. When you let go of the ribbon, the ball travels in a straight path but at a right angle to the ribbon at the moment of release. In other words, the ball follows a tangential path to the circle it was orignially traveling in.

Part of Newton's first law of motion states that an object in motion will move in a straight line unless acted on by an unbalance force. In the case of the tennis ball, your inward pull on the ribbon is the unbalance force that keeps the ball traveling in a circle instead of a straight line. Upon release, the ball travels away in a straight line in the exact direction it was traveling at that very moment.

In the case of a satellite in space, the launch vehicle that carried it up to orbit aimed it in a direction parallel to the Earth's surface. According to Newton's first law, the satellite will travel in a straight line. So, why doesn't it keep traveling straight away from us? Earth's gravity acts as an unbalance force, pulling on the satellite and causing the satellite to follow a circular path.

This Activity: The tennis ball and ribbon demonstration is a good analogy of a satellite in orbit. The pull of your hand through the ribbon represents gravity.

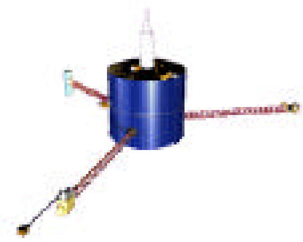
Preparation: Collect the following: one old tennis ball, one yard of one-inch-wide cloth ribbon, one dowel rod which is two inches long by 3/16 inches in diameter, sharp knife, needle and thread, stapler, and white glue.

To construct: loop one end of the ribbon over the dowel rod and glue or staple together. Hem or tie the other end of the ribbon to prevent raveling. Cut a one-ich-wide slit in the tennis ball. Then slip the dowel and ribbon at an angle through the slit in the tennis ball. The rod will prevent the ribbon from being pulled out.

Alternative: Instead of using a tennis ball and ribbon, you could simply tie a string around an eraser.

In Class: Conduct this activity outside where flying tennis balls or erasers will not harm people or property.

Wrap-Up:



Space Day:
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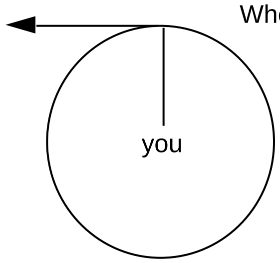
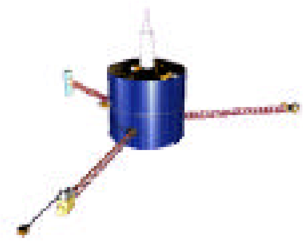
When released, the ball will fly off on a tangent to the circle



Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

20-Orbital Forces – Student Page

Purpose: To demonstrate orbital motions and forces using a tennis ball swung by a ribbon.

Materials: Tennis ball on ribbon; Pencil and paper

Background: A center-directed force that causes an object to follow a circular path is called a centripetal force. When you swing a tennis ball from the end of a ribbon, you must pull on the ribbon - exerting a centripetal force. What happens when you let go?

Procedure:

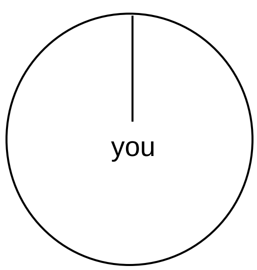
1. Hold the free end of the ribbon and swing the ball in a circle.

2. In this activity, the centripetal force on the ball is produced by ribbon tension. That is, the ribbon ransmits the centripetal force which pulls the ball nto a circular path. For a satellite orbiting Earth, here is no ribbon connection! What produces the centripetal "towards the center of the Earth" force?

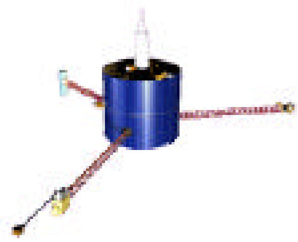
3. Let go of the ribbon and watch which direction the ball travels. The ribbon makes it easier to follow the direction of the ball.

4. Where did the ball go?

5. The circle shown on the left represents the path of the ball while you were swinging it with the ribbon. Draw an arrow from the circle to represent the path of the ball when you released it. Explain your answer.



Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day: Prospecting for Knowledge

21-Sun/Earth/Moon Role Play-Teacher Page

Explain that the goal of this unit will be to get a clear picture of how the Earth rotates around the sun, and how the Moon travels around the Earth.
Use a group of 3, 6 or 9 students. Suns earths and Moons can take turns and alll the kids can try to figure out the movements.

Use chalk to sketch an arc representing the path of the Earth around the Sun. Have a student represent the Sun by holding a light source (lamp). Have a student represent the Earth and take a position on the path. Have the student representing the Earth move slowly along that path. Explain that the Earth takes 365 days to make a complete orbit around the Sun. Ask your students to estimate how fast the Earth would have to move to complete that orbit. Have them decide how big each of the Earth's steps should be and how many steps represent one 24-hour day.

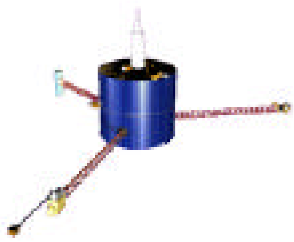
Add the Moon by having a third student, representing the Moon, hold one end of a 5 to 7 foot string or jump rope and the student representing the Earth hold the other end. The Moon orbits the Earth by keeping the rope taunt as it moves around the Earth at the same time as the Earth moves along its orbit. Halt the demonstration and explain that the Moon takes about 27 days to go around the Earth. Ask your students to choose appropriate speed of travel for the Moon and how many steps represent on Earth day. (For instance the Earth might take heel-to-toe steps while the Moon takes longer steps. Now add that the Earth rotaes on its axis one every 24 hours and tell the Earth student to spin as required. Next add that the Moon rotates on its axis at the same rate that it revolves around the Earth. Try to get the kids to figure out that this results in the "face" of the Moon always being directed toward the Earth. The Moon does rotate and the "dark side" of the Moon is only dark to us from earth's perspective. The sun sees it regularly.

Finally, continue the demonsrtation having the "Earth" student "tilt" on his/her axis about 23 degrees. See if thestudents can guess how much tilt this should be. Note that different parts of the earth face toward the Sun at different times of the year (Arctic/Antarctic 6 month summer and winter). Now say that the Moon is only tilted .5°. Have the "Moon" hold cupped hans on his/her head to represent a deep crater. Try to demonsrtate that the "crater " will be in permanent shadow because it does not tilt toward the Sun and the crater walls (fingers) keep out the light (and heat) of the Sun.

If students suggest things that are inaccurate try them out and see how the universe changes.! Encourage kids to try out ideas (such as how would earth weather change with a different tilt, or how much would the Moon have to tilt to melt the ploar ice?).

Finally, help the students connect that this is why the ice at the lunar poles hasn't ever melted and evaporated.

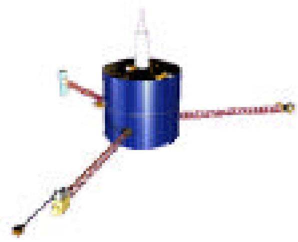
Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

21-Sun/Earth/Moon Role Play-Student Page

Volunteer to be the Sun , the Earth or the Moon!
This is your chance to be better than a mere astronaut, travelling in space-Be a planetary body!
Ask lots of questions and try to understand how the solar system really works.
Be sure to listen carefully to instructions. You can test out ideas, but be sure to get you mentor to help.



Space Day:
Prospecting for Knowledge

22-Edible Solar System – Teacher Page

Purpose: To learn the order of the planets in the solar system.

Materials:

- 8 inch paper plates (inexpensive ones)
- Compass
- Different sized hard candies to represent the planets
  (butterscotch for the sun; red hots, Skittles, mints, etc.)
- Colored, large crystal, sugar (for the asteroid belt)
- Canned frosting

Background: When the ancients studied the night sky, they noticed that five "stars" moved with respect to the others. They called them "planets," from the Greek word for "wanderer," and kept careful records of their motions. These records eventually enabled astronomers to figure out why they moved as they did: the planets, including our Earth, orbit around the Sun in nearly circular orbits. Over the years, telescopes have enabled us to discover three other planets, bringing the total number to nine (including Earth).

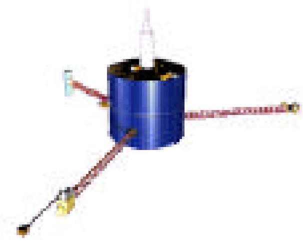
This activity: Using different sized candies, this activity will allow students to model the order of the planets in the solar system.

Preparation: Following the directions listed on the student sheet, the orbital paths of each planet must first be drawn on the paper plate. A compass works well. Older students can accomplish this task on their own. Younger students may need to have them drawn in. (This activity models only the order of the planets from the sun and not size or distance.)

In class: Each student receives a paper plate, different sized candies, and a small amount of cement frosting. "Features" on each planet may be added to larger planets using frosting and smaller sized candies.

Reference: Project ASTRO Resource Notebook, Astronomical Society of the Pacific.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

22-Edible Solar System – Student Page

Materials:

- 8 inch paper plates (inexpensive ones)
- Compass
- Different sized hard candies to represent the planets
  (butterscotch for the sun; red hots, Skittles, mints, etc.)
- Colored, large crystal, sugar (for the asteroid belt)
- Canned frosting

Procedure:

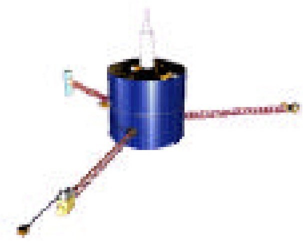
1. Using the compass, draw 9 concentric circles on the paper plate to represent the orbital paths of each planet.

2. Using canned frosting, attach a "candy planet" on each path around a "candy" sun. *A butterscotch candy be used for the sun. The smaller planets: Mercury, Venus, Earth, Mars, and Pluto should be represented with smaller candies, while the larger planets should be represented with larger candies. *Red spot on Jupiter, dark spot on Neptune, etc. can be shown by attaching smaller candies onto a larger candy. *String licorice can be used to depict the rings on the larger planets of Jupiter, Saturn, Uranus, and Neptune. *Colored sugar crystals should be sprinkled on between "Mars" and "Jupiter" to depict the asteroid belt.

Order of planets from the sun:

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto (At this time, Neptune is actually farthest, but normally Pluto has this distinction.)

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

23 - Paperbag Space Helmets - Teacher Page

Purpose: To discover the effects of a light filter and its application to the study of astronomy.

Materials:

- large grocery bag (large enough to fit over a student's head)
- 4"x 5" piece of red filter ("see-through", red report covers work well)
- 1" duct tape
- scissors
- colored markers
- "secret message" coloring page

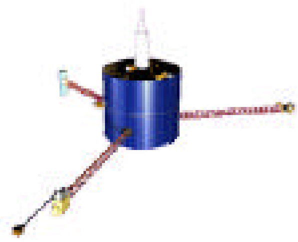
Background: It is possible to see a range of phenomena in the night sky using only the naked eye. Stars, planets, moons, meteors, and satellites are all visible from earth. Astronomers use various sky watching tools to see these things more clearly. Light filters can be used to "block out" some phenomena in order to view another particular phenomena more clearly. For example, astronomers often use filters to view pictures of stars and planets so they can see details not possible with the eye alone.

This activity: Using a red filter and grocery bag, students will construct a paperbag space helmet that will enable them to "read" secret messages. In this activity the students will learn that the color filter will allow them to see certain colors, but not others. Because of this, the filter will enable them to see a "secret message" that our eyes alone do not allow us to see.

Preparation: Materials must be gathered. Red, see-through report covers purchased at a stationery store work well and are the most inexpensive "filters" to use in this activity. (Arvey's sells these in quantity as "slide lock report covers".) Four filters can be obtained from one cover. A tagboard pattern can be created so that the students will only need to trace the areas to cut out on their grocery bags.

In class: Students will first construct a paperbag helmet using the materials listed. They will also need to color a "secret message". The message can then be read through the filter on the helmet.

Reference: Adapted from: LHS Gems, "Color Analyzers", 1989.



Space Day:
Prospecting for Knowledge

24-Saturn V Rocket – Teacher Page

Purpose: To learn about aspects of the Apollo program and lunar exploration.

Materials:
- Saturn V pattern
- Black construction paper strip, 15in. x 4 in.
- Scissors
- Glue

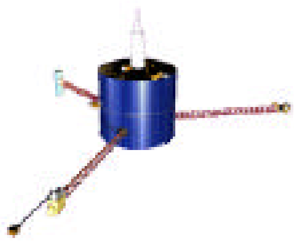
Background: The Saturn V launch vehicle was used for Apollo flights to the moon. The rocket was 364 feet tall and included the space-craft and three rocket stages. Each rocket stage pushed the space-craft farther and farther from Earth. The Saturn V flew ten missions to the moon, three unpiloted and seven piloted. (Apollo XIII was an unsuccessful mission that returned safely to Earth.)

This activity: By constructing a paper model of the Saturn V, this activity will allow students to identify the stages of the rocket and order these parts in proper sequence.

Preparation: Follow the directions to prepare the materials for this activity. Glue sticks work best for this activity. Younger children may have difficulty differentiating among the three stages of the rocket. They will need to carefully study the sample provided on the student sheet.

In class: Each student receives a pattern and black construction paper strip. Coloring the rocket is optional.

Reference: Young Astronaut Council, The Adventure Series, "Returning to the Moon", 1988.



Space Day: Prospecting for Knowledge

24-Saturn V Rocket - Student Page

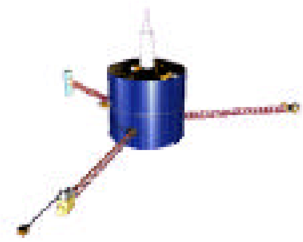
Materials:

- Saturn V pattern
- Black construction paper strip, 15in. x 4 in.
- Scissors
- Glue

Procedure:

1. Cut out the stages of the Saturn V rocket.
2. Use the pattern to assemble the pieces in the correct order.
3. Glue the stages to a the strip of black construction paper.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day:
Prospecting for Knowledge

25-Apollo Spacecraft – Teacher Page

Purpose: To learn about aspects of the Apollo program and lunar exploration.

Materials:

- Apollo spacecraft pattern
- Cardboard paper tube
- Scissors
- Crayons or markers
- Glue

Background: There were ten Apollo flights to the moon with six lunar landings. On July 20, 1969, Apollo 11 landed on the moon and Neil Armstrong became the first of twelve Americans to walk on the moon. Each three-man Apollo crew occupied a conical command module about 11.5 feet tall and 13 feet in diameter at the base, where the heat shield would be located. For most of the mission it was docked with a 14 foot long service module, carrying a propulsion motor, fuel cells and other equipment. Together they formed the CSM (Command and service Module), the Apollo
mother ship.

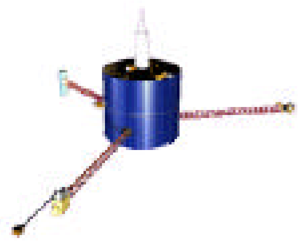
This activity: Students will construct a simple model of the Apollo spacecraft to learn about one aspect of early lunar exploration. This activity is simple enough that even very young students will not have difficulty.

Preparation: Supplies will need to be collected. Bathroom tissue rolls work well for this activity.

In class: Each student receives an Apollo pattern and cardboard paper roll to assemble the spacecraft. Glue sticks work best when attaching the pattern to the cardboard roll.

Extension: Students can be encouraged to write a story about a lunar adventure.

Reference: Young Astronaut Council, The Adventure Series, "Returning to the Moon", 1988.



Space Day: Prospecting for Knowledge

25-Apollo Spacecraft - Student Page

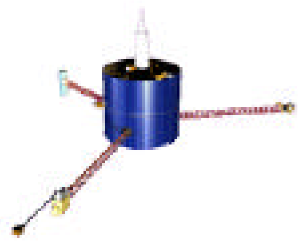
Materials:

- Apollo spacecraft pattern
- Cardboard paper tube
- Scissors
- Crayons or markers
- Glue

Procedure:

1. Write your name on the spacecraft.
2. Use crayons or markers to color the spacecraft.
3. Cut out the spacecraft.
4. Wrap the spacecraft around the cardboard tube. Glue the ends together.

What do know about the Apollo Program?
How many Apollo missions landed on the Moon?
What are some of the things we learned from the Apollo Days?
How long did the Apollo mission take to get to the Moon?
How long did Prospector take to get to the Moon?
Why do you suppose there is a difference?



Space Day: Prospecting for Knowledge

26 -Hubble Space Telescope – Teacher Page

Purpose: To learn about one aspect of exploring space.

Materials:

- Bathroom tissue roll
- Sheet of foil, 6" x 8"
- 6" skewer
- 2 black construction paper strips, 1 1/2" x 6"
- 1 black construction paper circle, approx. 2" in diameter
- 1 black construction paper square, 2" x 2"
- Tape
- Scissors (optional)

Background: The Hubble space telescope revolutionized optical astronomy when it became fully operational. It looks into the depths of space with a 7.8 foot diameter reflecting telescope. Because of its location above the atmosphere, it can see farther into space than we can from the ground. It transmits its data to the Science Institute in Baltimore via a tracking and data relay satellite (TDRS), a ground station at White Sands, and NASA's Goddard Space Center.

This activity: Students will construct a simple model of the Hubble space telescope to learn about one aspect of exploring space.

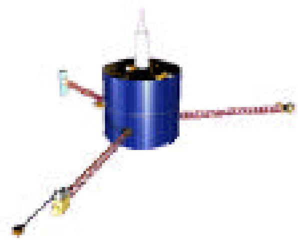
Preparation: Supplies will need to be collected. Older students can cut the black construction pieces on their own. Younger students will need the pieces precut. (Note: Use an end of the bathroom tissue roll as a "stencil" to trace a black circle onto black paper with a pencil, chalk, or white crayon.) A nail or screw works best to puncture the hole on both sides of the bathroom tissue roll. An adult should puncture the holes. The skewer can then be easily inserted by the student.

In class: Each student receives a bathroom tissue roll, piece of foil, a skewer, black construction paper (or precut pieces), and tape.

Extension: Students can be encouraged to write a story or draw a picture depicting a new discovery in space.

Reference: The Illustrated History of NASA by Robin Kerrod.

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology



Space Day: Prospecting for Knowledge

26 - Hubble Space Telescope - Student Page

Materials:

- Bathroom tissue roll
- Sheet of foil, 6" x 8"
- 6" skewer
- 2 black construction paper strips, 1 1/2" x 6"
- 1 black construction paper circle, approx. 2" in diameter
- 1 black construction paper square, 2" x 2"
- Tape
- Scissors (optional)

Procedure:

1. Roll the sheet of foil around the bathroom tissue roll, shiny side out. Secure the foil by tucking it into the roll at each end. (This is the main body of the telescope.)

2. Have an adult puncture two holes in the middle of the roll, one on each side.

3. Insert the skewer through both holes.

4. Attach a l 1/2" x 6" strip of black paper to each skewer. (These are the "solar arrays".)

5. Close one end of the "telescope" using a construction paper circle and tape.

6. Use a piece of tape to attach a black construction paper "flap" over the other end. (This flap opens and closes over the telescope's lens.)

Activity courtesy of University of Hawaii Institute of Geophysics and Planetology