

**Girl Scouts of the Jersey Shore  
Council's Own Junior Badge**

# **Planetary Mysteries Badge**



## **PLANETARY MYSTERIES BADGE**

These fun and unusual activities will help you unravel some of the mysteries concerning planets, space exploration and even our own earth.

### Activity #1 – Play Dough Volcanoes

Volcanoes played an important part in forming the planets. Many eruptions, over a very long time, form layers that scientists can study. This helps them understand the history of some of the planets, the moon and even our own earth. Pretend you're a scientist and build this simple volcano. Watch the "lava" form layers. Make observations. Take a core sample. Record your observations on the results sheet.

### Activity #2 – Rover Races

A rover is a robotic vehicle that explores a planet where humans cannot safely travel. It has six wheels and can move about the planet while collecting rock and soil samples. Have some fun pretending you are a rover. Follow the instructions from "radio control". What are some of the problems the rover encountered? What changes might be made to help the mission be more successful in the future?

### Activity #3 – Solar Bead Bracelets

UV (ultraviolet) is one of the types of energy that comes from the sun. Unlike sunlight, which we can see, UV is invisible. It helps our bodies in making and using Vitamin D, but it also can cause many health problems. Make your own personal UV detector in the form of a solar bead bracelet. Do the suggested experiments, observe the results, and then answer the questions.

### Activity #4 – Mars Lander

A bouncing spacecraft? The Mars Lander, Pathfinder, actually bounced across the surface of Mars for over a minute before coming to rest, right side up. Read about how the Pathfinder worked and why it was developed. Build and test your own Mars Lander.

### Activity #5 – Planetary Discoveries

Make observations while viewing a planet from earth, while doing a flyby, while in orbit, and after landing. Use a tube, colored cellophane, Play Dough, pebbles and beads to act as a telescope and planets. After each activity, write down your observations and share them with the others in your troop.

## Activity #6 – Pocket Solar System

You probably have seen drawings of the solar system. To make the drawing fit on a piece of paper, the artist had to draw the planets closer together than they really are. Using string and beads, make a model of the solar system that REALLY gives you an idea how far apart the planets are. Make some observations. Which planet would be the coldest? The hottest? Which planet would take the longest to orbit around the sun? Notice the placement of the planets in relations to each other and to the sun.

## Activity #7 – Searching for Meteorites

Meteorites fall all over the world, but they usually just sink to the bottom of an ocean, are buried by shifting earth, or are easily confused with ordinary rock. So where is the best place on Earth to find a meteorite? Put on your scientist's hat, follow the instructions for this activity and find out where the meteorites are hiding.

## Activity #8 – Impact Craters

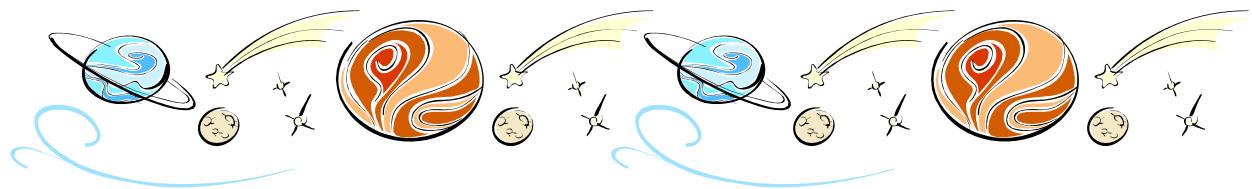
How are craters formed? Simulate the cratering of the Moon, Earth, and other planets. Make observations about your craters. Compare your observations to an actual photograph of the Moon.

## Activity #9 – Edible Tectonics

The surface of the Earth is actually “broken” into large plates. The plates are constantly moving, reshaping the face of the Earth as they move. This theory is called plate tectonic. Use a Milky Way candy bar to demonstrate the theory of plate tectonic.

## Activity #10 – Dancing with the Planets

Incorporate music, costumes and props in a demonstration of the movements of Earth and Mars around the Sun.



The girls must complete 6 of the activities to receive the Planetary Mysteries Badge.

Directions for each activity are attached. A list of supplies is included in the directions. Some items, like scissors, tape, crayons, etc., are items that you probably have on hand. You will need to purchase other items, like Play Dough, colored cellophane, etc.

## ACTIVITY #1

### PLAY DOUGH VOLCANOES

Supplies:      1 – 4 oz. paper cup  
                    1 piece of cardboard or poster board  
                    4 different colors of Play Dough  
                    Tape  
                    Spoon  
                    ¼ cup baking soda  
                    ½ cup vinegar  
                    Pencil or marker  
                    Paper towels  
                    Clear plastic straws

Cut the 4 oz. cup to a height of about 1 inch. Secure it onto the cardboard using a small loop of tape on the outside bottom of the cup. This short cup is your eruption source and the cardboard is the original land surface.

Place about one tablespoon of baking soda in the cup.

You are now ready to make an eruption. Slowly pour a very small amount of vinegar into your source cup and watch the eruption of “lava”.

When the lava stops, quickly draw around the flow edge with a pencil or marker.

Wipe up the fluid with paper towels

As best you can, use a thin layer of play dough to cover the areas where the “lava” flowed.

Exact placement is not necessary.

Repeat steps 3 through 6 for each color of play dough.

NOTE: You may add fresh baking soda to the source cup or spoon out excess vinegar from the source cup as needed. Be sure you mark where the lava flows go over the previous flows, as well as on the cardboard.

Take a core sample. Have each girl push her straw into the clay at a point where there is obvious overlapping of “lava”. The straw should be held straight and should be pushed slowly and firmly down through the clay until the end of the straw touches the cardboard. Slowly pull the straw straight up out of the clay.

Looking at the straw, you can see the different colored layers of “lava”. Record your observations by answering the questions on the following page.

## PLAY DOUGH VOLCANOES – RESULTS SHEET

1. After your four eruptions, can you still see the original land surface (posterboard)?  
Where?
2. Describe what you see and include observations of flows covering or overlapping other flows.
3. Where is the oldest flow?
4. Where is the youngest flow?
5. Did the flows always follow the same path?
6. What do you think influenced the path direction of the lava?

## ACTIVITY #2

### ROVER RACES

Supplies:      construction paper  
                    Object to act as a rock sample  
                    3 blindfolds  
                    Command log  
                    Pencil

1. Leader should set up a course in an area which is about 20' x 20', using construction paper to mark the course. At some point within the course, you should place the object to be used as a rock sample.
2. Using only the commands list below, fill out the command log. Walk the course and write down the exact course directions for the rover to follow. See example.

Right	(R)
Left	(L)
Backward	(B)
Forward	(F)
Stop	(S)
Rock Sample Retrieval	(RSR)

3. When the rover is in the correct position for the last person of the rover to collect the rock sample, insert the Rock Sample Retrieval (RSR) command. (NOTE: The rover will only be able to follow your set of written commands. The commands to the rover cannot be any different than the ones you have written down.)
4. Select three girls for the rover. Blindfold them. Have them hold onto each other by the shoulders. Designate someone to be "radio control" and have them read the instructions as they are stated on the command log.
5. Once the rover has completed the course, discuss the questions listed under Activity #2.

## ROVER RACES

### Information Sheet and Course Directions

#### Commands:

Right	(R)
Left	(L)
Backward	(B)
Forward	(F)
Stop	(S)
Rock Sample Retrieval	(RSR)

1. Write down the course directions for the rover to follow, counting your steps as you walk through the Mars course.
2. When the rover is in the correct position for the last person of the rover to collect a rock sample, use the Rock Sample Retrieval command.
3. The rover will only be able to follow your set of written commands. The commands to the rover cannot be any different than the ones you have written down.

#### Commands:

(Example – 1. Forward 3 steps. Stop. 2. Turn left 1 step. Stop.)

- |     |     |
|-----|-----|
| 1.  | 11. |
| 2.  | 12. |
| 3.  | 13. |
| 4.  | 14. |
| 5.  | 15. |
| 6.  | 16. |
| 7.  | 17. |
| 8.  | 18. |
| 9.  | 19. |
| 10. | 20. |

## ACTIVITY #3

### SOLAR BEAD BRACELETS

Supplies:           1 – 12” pipe cleaner per girl  
                  Solar beads

Thread solar beads onto the pipe cleaner. Twist closed to form a bracelet. (You may also use cord or wire for the bracelet).

ORDINARY BEADS OF A VERY BORING COLOR? I THINK NOT!!! These are special beads which change color when exposed to ultraviolet (UV) radiation from the sun. They are not affected by visible light and so will remain white indoors.

WHAT DOES UV LIGHT DO? Ultraviolet light is needed by the human body to synthesize Vitamin D.

SO WHAT’S THE PROBLEM WITH UV LIGHT? Ultraviolet light is a major cause of sunburn, skin cancer, eye problems, aging of the skin, and other medical complications.

HOW CAN WE PREVENT UV DAMAGE? You should protect your skin whenever you are outside – on sunny days as well as cloudy days. Use a sunscreen on all exposed parts of your body, including your face. Sunglasses will protect your eyes from the UV rays, as well as help you see better – THEY LOOK COOL TOO! A hat or cap with a brim will also help protect your face.

1. Hold the beads near a window. What happens to the beads?
2. Take the girls outside and have them notice the changes in their beads.
3. Use a pair of sunglasses to block the UV light. What happens to the beads now?
4. Try to block the light with a regular pair of eyeglasses. Discuss the results.
5. Coat the beads with sunscreen lotion. Expose them to direct sunlight. How well does your sunscreen protect you from the UV light?

What the girls have created is their own personal UV detector. Perhaps when they wear the bracelet it will serve as a reminder to always use sunscreen to protect their skin and sunglasses to protect their eyes.

## ACTIVITY #4

### MARS LANDER

Imagine a bouncing spacecraft coming to rest on an alien planet. Giant balloons that surround the rocket deflate and out rolls a robotic vehicle. This may sound like science fiction, but it's actually science fact.

The landing plan for Pathfinder was new and revolutionary. NASA had devised a landing that would cut down costs and set a precedent for missions to come. Until July 4, 1997, all spacecraft had landed with dignity. NASA scientists were now proposing a landing that resembled something like a giant beach ball rolling around on a beach. Not too many people believed that it was going to work.

The plan...A special shell would slow the craft as it entered the Martian atmosphere. A parachute would then open to further slow down the spacecraft. The onboard computer would be preprogrammed to inflate the giant airbags. Once the lander hit the planet, it would bounce away until it came to rest. Depending on which way it landed, Pathfinder's computer could fire small rockets so that the lander could right itself up.

The Mars Lander, Pathfinder, was launched in December 1996 and entered the Martian atmosphere in July 1997. The lander deployed the parachute to slow it down, and inflated airbags protected the lander as it bounced more than 15 times. SUCCESS! NASA's radical "faster, cheaper, better" design launched a new era of space exploration.

Use the following instructions to build a bouncing lander.

Supplies (per Mars Lander):

- 1 piece of thin cardboard or posterboard
- 1 egg
- 5 pieces of string, 40 inches each
- 1 large piece of newspaper
- 4 balloons (10-inch)
- Masking tape / scissors / ruler / pencil / hole punch

Lander:

1. Measure a triangle onto the cardboard, 8.5 inches on each side.
2. Cut out the triangle and punch a single hole near each point.
3. Fold the triangle as shown in Diagram (A).
4. Place the egg inside the triangle shape and tape closed along each seam.
5. Tie one piece of string (40 inches) through the holes at the points.

Parachute:

6. Unfold a large piece of newspaper.
7. Cut off the edge of the newspaper sheet to form a perfect square.
8. Cut off each corner of the square to form an octagon – see Diagram (B).
9. Tape string to corners of octagon as instructed in Diagram (C).

Air Bags:

10. Inflate the balloons.
11. Gather the four string of the parachute and tie them to the string on the lander.
12. Using rolled tape, attaché one balloon to each side of the lander.

Drop your Mars Lander from a high place. See if your payload (egg) survives.

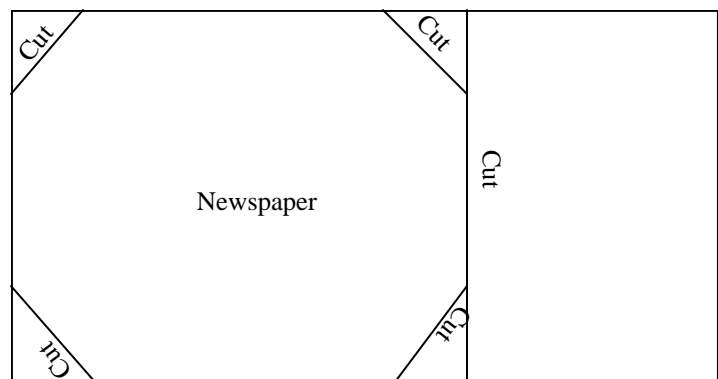
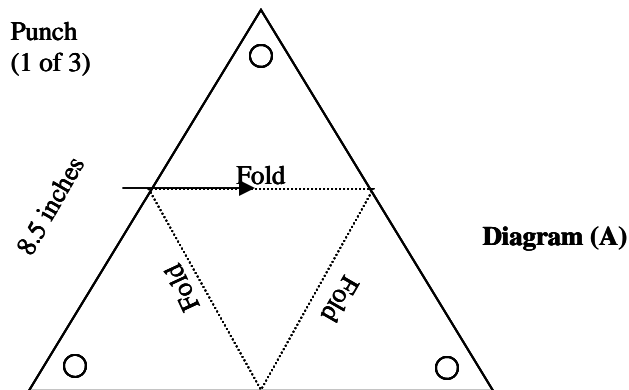
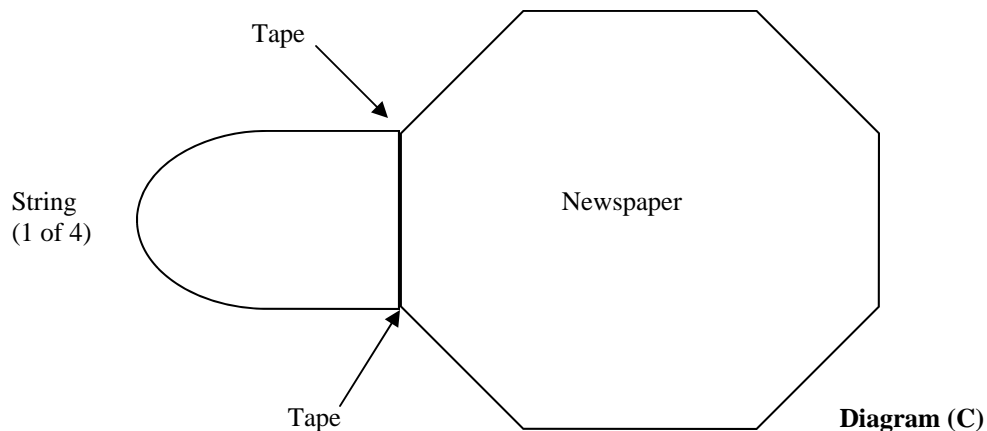


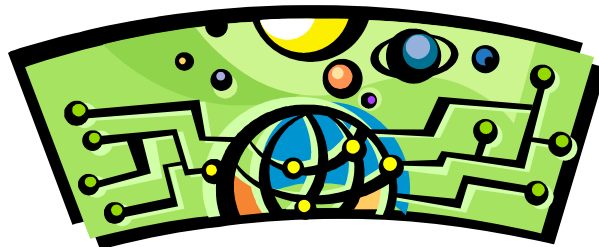
Diagram (B)



ACTIVITY #5  
PLANETARY DISCOVERIES

Supplies: 12” paint rollers — cardboard tubes will work but are not as sturdy  
Colored cellophane  
Rubber bands  
Play dough  
Small beads or pebbles  
Piece of cloth (to hide the “planets”)

1. Prepare four play dough planets with beads, pebbles, or other small objects embedded in the play dough.
2. Prepare the telescopes. Cover one end of the tube opening with a piece of colored cellophane. Attach the cellophane with a rubber band.
3. Place the objects on a table and cover them with the cloth. Have the girls walk a good distance from the objects. Uncover the planets. Tell the girls to look at the planets through their telescopes. After a few minutes, cover the planets. Have the girls write down what they saw.
4. Have the girls come closer to the planets and remove the cellophane from their telescopes. Tell them what they saw before was what you would see with a telescope from earth. Tell them that what they see now would be what they would see with the very powerful Hubble Telescope. Again, have them write down their observations.
5. Telling the girls to be careful, have them pass the planets. (They should walk past the table, without stopping, while looking through their telescopes.) Explain that this is a **fly by** simulation. Record their observations.
6. Have the girls circle the planets once. (Slowly walk around the table while looking at the planets through their telescopes.) This is an **orbit**. Record their observations.
7. Finally, have the girls sit in groups and give each group a planet to investigate. This is a **landing**. Record their observations.
8. Have each girl share her observations with the troop.



ACTIVITY #6  
POCKET SOLAR SYSTEM

Supplies:      string — 14 feet long  
                  11 beads  
                  Tape measure

1. There are nine planets, the sun, and an asteroid belt in this activity.
2. Tie a bead at one end of the string to represent the sun.
3. Tie the next bead (Mercury) approximately 1 1/2 inches from the first.
4. Continue tying the “planets” to the string, using the chart below as a guide. NOTE: ALL MEASUREMENTS ARE FROM THE FIRST BEAD (THE SUN).

<u>PLANET</u>	<u>DISTANCE FROM SUN</u>
Sun	0
Mercury	1 1/2 inches
Venus	2 3/4 inches
Earth	4 inches
Mars	6 inches
Asteroid Belt	11 inches
Jupiter	20 inches
Saturn	39 inches
Uranus	75 inches
Neptune	118 inches
Pluto	154 inches

ACTIVITY #7  
SEARCHING FOR METEORITES

Supplies (per launch):      balloon  
   1/2 cup flour  
   15 small pebbles (5 each red, blue, green)  
   Water  
   Measuring cup / funnel  
   Data table

1. Designate target areas — Find a minimum of two locations of various surfaces where balloons filled with water and pebbles can be exploded. For example: concrete or asphalt pavement, sand, grass, gravel, pebbles, shells, snow, ice.
2. Prepare balloon — place a funnel in the neck of a balloon. Fill the balloon with approximately 1/2 cup of flour.
3. Add pebbles one at a time. Note the number and color of the pebbles on the data table.
4. Fill the balloon 3/4 full with water. **Do not shake the balloon.** Be sure to tie the balloon securely. This step must be done JUST before going outside to launch the balloon.
5. Launch the balloon in the designated area. You may throw the balloon at an angle, lob it, or throw it straight up so that it impacts vertically.
6. Study the impact site. Record your observations on the data table. Make a sketch of the scatter pattern.
7. Repeat steps 2– 5, launching a balloon on at least one other type of surface.
8. Compare launches. On which surface were the pebbles easier to find?
9. Clean up all balloon fragments and leave impact areas as clean as possible.

The balloon represents a meteor striking the earth. The flour represents the ejected crater materials and the pebbles represent the meteorite fragments as they scatter across the landscape. You can see how scientists would know where to search for meteorites once they know the impact point.

So, where is the best place on Earth to find meteorites?

At the bottom of the Earth, in Antarctica, huge sheets of blue ice remain pure and barren. When searching such an ice sheet, a dark rock will stick out. These rocks have a high probability of being true meteorites—pieces of another world. An explosion or impact might have catapulted these meteorites from the Moon, Mars, or even an asteroid, yielding valuable information about distant worlds and our early Solar System.

What other area of the world would be good places to retrieve meteorites?

LAUNCH INFORMATION DATA TABLE

LAUNCH SITE: \_\_\_\_\_

BALLOON FILLING:

PEBBLES (number) \_\_\_\_\_ (color) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

WATER VOLUME: FILL BALLOON 3/4 FULL

FLOUR VOLUME: 1/2 CUP

LAUNCH SITE DESCRIPTION:

TERRAIN: \_\_\_\_\_

WIND DIRECTION: (estimated) \_\_\_\_\_

WIND SPEED: (none/mild/windy) \_\_\_\_\_

LAUNCH SPECIFICS:

IMPACT: (angled / straight) \_\_\_\_\_

IMPACT VELOCITY: (fast / slow) \_\_\_\_\_

SKETCH IMPACT SITE: (use separate sheet of paper if necessary)

NUMBER AND COLORS OF PEBBLES RECOVERED:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## ACTIITY #8 IMPACT CRATERS

### Supplies:

Flour  
Cocoa Powder  
Marbles or small rocks  
Large aluminum pan (Lasagna size)  
Flour sifter or screen type strainer  
Newspaper or plastic—to protect the floor

1. Begin by looking at craters in photographs of the Moon and asking the girls their ideas of how craters were formed.
2. Spread the newspaper or plastic to catch spills or do the activity outside.
3. Spread flour in the pan, thick enough so the marble or rock stops before hitting the bottom of the pan.
4. Sift a thin layer of cocoa powder over the top.
5. Drop small rocks or marbles from a variety of heights. Begin close to the surface and go upwards to a safe height. After each drop observe the crater. Make measurements of diameter and depth and record the data. Look for rays, lines of ejected material that go out in all directions from the crater.
6. Resurface the flour by gently shaking the container, or by smoothing the surface with the ruler. Try not to pack it down. (Whichever method you choose, be consistent.) Cratering results may vary if the flour is packed down for some drops and not for others.

Compare the results of different drops. Note that the crater size is affected by the size of the rock or marble, and it is also affected by the height from which it is dropped.



## ACTIVITY #9 EDIBLE TECTONICS

Supplies (per girl):

1 Milky Way Bar  
Napkin

1. It is suggested that you go over the entire procedure before handing out the candy bars. This is done so the girls don't play with the candy or worse yet, eat the candy, before the demonstration begins. Instruct the girls that they will be allowed to eat the candy when they're done so they should be as "sanitary" as possible.
2. Carefully unwrap the candy bar and use your fingernail to make a few cracks across the middle portion of its top. The cracked chocolate models the plates of the Earth's outer shell (the lithosphere).
3. Hold the candy bar with the top facing up. Gently and slowly stretch the candy bar, pulling it apart about 1/2 of an inch. The chocolate should separate, exposing the caramel. The exposed caramel represents new material that can rise to the Earth's surface.
4. Slowly push the stretched candy bar back together again. The brittle chocolate may crumble. On the other hand, "mountain ranges" may form when the pieces of chocolate "plates" collide. The other alternative is that one chocolate "plate" may slide beneath another.
5. Continue to slowly pull the candy bar apart and push it back together again. Do this until you understand the movement of the plates by the motion of the caramel underneath.
6. Now pull the candy completely apart. Look at its exposed interior and think of the candy bar as a model of the Earth's layers. The top layer of chocolate is the Earth's brittle lithosphere, broken into plates. The caramel and nougat represent the zone of the Earth known as the asthenosphere, where the material is solid yet still able to flow.
7. Enjoy the Milky Way! Discuss: What might you expect to see at that point on Earth where two plates are moving apart? What might you expect to see at a point on Earth where two plates collide?



ACTIVITY #10  
DANCING WITH THE PLANETS

As scientists and engineers plan for travel to other planets, they have to deal with some basic planetary science.

Earth and Mars move at different speeds around the Sun.

Earth's orbit is about 150 million kilometers (km) from the Sun.

Mars' orbit is about 200 million kilometers from the Sun.

Earth completes a solar orbit every 365 days.

Mars completes a solar orbit every 687 days. (The difference in orbit times is about a 2 to 1 ratio, Mars / Earth.)

Earth completes its orbit in shorter time because it is closer to the Sun and has less distance to travel.

Earth travels faster in its orbit. Planets closer to the Sun travel faster.

Using these facts, demonstrate dramatically the movement of the Earth and Mars around the Sun. Incorporate music, costumes and props in your demonstration for added effects. You may gather additional information about Earth and Mars and use it in your demonstration, but make sure your presentation is scientifically accurate.

