Strange New Worlds Junior Adventure Day

Welcome to the Strange New Worlds Junior Adventure Day. At this Junior Adventure Day Girls will meet space travelers from a distant star system. The crew of the spaceship includes six different types of creatures who live on different planets in that star system. At home their star is expanding and getting very hot. Their home planets are heating up and soon they will need new places to live. It is our mission to find habitable planets for the six different types of creatures with different life requirements.

First note that the ice breaker activity "Search for a Habitable Planet" is concluded in the closing time. As the girls do the different activities they learn how scientists find out about our nearest neighbors. They will discover how the various planets are similar as well as different from the planet we call home.

In some of the activities you will find text in italics. This is for the station leader either to read to the girls directly or he/she may put in their own words. The text helps to set the stage for the activity and provide other valuable information needed for the activity.

All the activities are based on NASA education materials. The first activity in "Dance of the Solar System" was created by some of the participants at the "Exploring the solar System Workshop." Some of the activities have been modified to fit the Adventure Day time frame and to make them appropriate for Junior Girl Scouts.

Two activities "Edible Comets" and "Edible Rocks" could be used as a snack time activity. Have some juice or other beverage on hand as well as a snack that doesn't have chocolate for any girls who may not be able to have foods with chocolate, nuts or milk.

A Junior Adventure Day is set up to run for three hours. In that time there will be nine - twenty minute segments.

8:45	Registration
9:00	Opening - "Search for a Habitable Planet"
9:20	Activity -
9:40	Activity -
10:00	Activity -
10:20	Snack - Or use an edible activity here like "Edible Comets"
10:40	Activity -
11:00	Activity -
11:20	Activity -
11:40	Closing - "Search for a Habitable Planet" conclusion

The event director and event team will pick the six activities to fill in the twenty minute time slots. Put the girls in groups. If possible make the groups with 12, 18, or 24 girls. I would have no more than 24 in a group. This makes the maximum number of girls for this event 144.

Junior Adventure Days can be hosted by Cadet and Senior girls. In my council a Cadet girl is using a Junior Adventure day as a Silver Award project.

Marguerite Blodgett

List of Activities

Ice Breaker: Search for a habitable planet

1. AU this is cool
2. UV bracelet
3. Edible rocks
4. Creature feature
5. Comet Ice Cream
6. Dance of the Solar system
7. Mars Pathfinder
8. Rover races
9. Saturn model
10. Strange new world
11. Build a volcano

Search for a Habitable Planet

Supplies

Art supplies: an assortment of items that could be used to create a creature. This can include items like chenille stems, balloon, feathers, wiggle eyes, yarn, pompoms, plastic cups, beads, pieces of foam, plastic wrap, floral wire, milk carton caps, fabric scraps, and more. Your supplies are only limited by what you can find. This is a great way to recycle trash into art.
Tacky glue
Clear tape
Masking tape
Glue guns (a supervised glue gun station works well)
Creature cards (one per group)
Planetary lithographs (pictures)

Object: an ice breaker and to get the girls thinking about what is needed for a habitable planet and what planets are made of.

1. Set the stage by reading the following introduction.

We are space travelers from a distant star system. The crew of our spaceship includes six different types of creatures who live on different planets in that star system. Our star is expanding and getting very hot. Our home planets are heating up and soon we will need new places to live. it is our mission to find habitable planets for our six different types of creatures with different life requirements. In all we need to find new homes for five billion inhabitants.

First we need to know what makes a planet habitable so we can set up probes to measure the characteristics of various planets. The different requirements for life can be related to the characteristics of various planets. What do creatures require to live?

2. Brainstorm on requirements for life and characteristics of the planets. Encourage free thinking, there aren't any specific right answers, but lead girls to the following topics, among others.

Life requirements	Planet characteristics
food to eat	surface & atmosphere composition
gas to breath	atmosphere composition
comfortable temperature	temperature range
ability to move	surface type (solid, liquid, gas)
gravity	size

3. Ask the girls what kinds of probes might be used to measure these characteristics. Answers may range from general to specific and may be based on science fiction. This could be done while the girls are working on their creature.

4. Give each group a creature card (more than one group can design the same creature.) Tell the girls they are to create a creature that fits the characteristics on their creature card. Girls may select art supplies and should be able to finish their creature in 15 minutes. They should name their creature ambassador and be ready to introduce it to all the groups. This will be done during the closing time. Encourage teamwork and creativity!

6. Have a place to display the creature till the closing time. At this time the girls will have the opportunity to introduce their creature.

7. Post the planetary lithographs on a wall if possible. You will be starting with the outermost planet (Pluto). Tell the girls that you will be reading a description of various planets. After each description ask if any group has a creature that could make that planet it's home. The girls can then share their creatures requirements and tell about the creature. Be prepared, it may take the girls longer than you think to introduce their creatures, they get very involved with their creations.

Read the descriptions below to the girls one at a time.

Today we are traveling through an outer section of the Milky Way galaxy. There are many, many stars. We are approaching a medium-sized star, the type which often has habitable planets. As we draw closer we see that there are nine planets orbiting this star. We will tour this planetary system and use our probes to measure planet characteristics in our search for a habitable planet. Try to find a planet where your groups creature could live.

` *We will now tour this new planetary system, starting from the outside and going toward the star. We are approaching the first planet.*

The <u>first planet</u> is tiny (2350 km) and made of rock and methane ice. It has almost no atmosphere (just a trace of methane) and is very cold (-203 C),

The <u>second planet</u> is medium large (49,500 km) and made of liquid hydrogen and helium. It has a thick atmosphere of hydrogen, helium and methane and is very cold (-220 C).

The <u>third planet</u> is very similar to the 2nd except that it has a small ring system. It is medium large (51,000 km) and made of liquid hydrogen and helium. It also has a thick atmosphere of hydrogen, helium and methane and is very cold (-210 C).

The <u>fourth planet</u> is large (120,500 km) and has an extraordinary ring system. It has no solid surface, but is a giant mass of hydrogen and helium gas outside and liquid hydrogen inside. it is cold (-180 C).

The <u>fifth planet</u> is the largest (143,000 km) in this planetary system. Like the fourth, it is a gas giant made of hydrogen and helium with no solid surface. It is also cold (-150 C) in the upper atmosphere, but increases in temperature and pressure and becomes liquid in the interior.

The sixth planet is small (6786 km) and rocky. There is some water ice in polar regions and a thin atmosphere of carbon dioxide. The temperature is moderate (-23 C).

The seventh planet is medium small (12,750 km). The surface is made of liquid water and rock with some carbon compounds. The atmosphere is mostly nitrogen and oxygen with some carbon dioxide and water vapor. The temperature is moderate (21 C).

The eighth planet is also medium small (12,100 km.) The atmosphere of carbon dioxide is so thick that we can't see the rocky surface beneath it, but need our radar probes. The temperature is very hot (480 C).

The ninth planet is tiny (4880 km) and rocky. It has almost no atmosphere (just a hint of helium). Temperatures are generally hot, but extremely variable, ranging from -180 C on the space-facing side to 400 C in the star-facing side.

We have now finished our tour and (hopefully) have found possible homes for our creatures.

Creature	Planet(s)
A	4 & 5 (Saturn and Jupiter), but also 2 & 3 (Neptune and Uranus)
B	8 (Venus)
C & F	7 (Earth)
D	2 & 3 (Neptune and Uranus)
E	6 (Mars)

No creatures can live on planets 1 and 9 (Pluto and Mercury) because there is no gas to breathe.

8. Everyone will want to take the creatures home. I suggest that each troop get one creature for a mascot. Suggestion put the troop numbers in a hat and draw and then let the leaders pick a mascot.

Creature Cards

Creature A

Food - Helium
Breaths - Hydrogen
Motion - Flies
Temperature - Cold

Creature B

Food - Rock
Breaths - Carbon Dioxide
Motion - Flies
Temperature - Hot

Creature C

Food - Carbon
Breathes - Oxygen
Motion - Walks

Creature D

Food - Methane
Breathes - Hydrogen
Motion - Swims

Creature E

Food - Water
Breathes - Carbon Dioxide
Motion - Walks
Temperature - Moderate

Creature F

Food Carbon
Breathes - Oxygen
Motion - Swims
Temperature - Moderate

A U This is Cool

Supplies

metric rulers and or meter sticks tape scissors
heavy string (the heavy crochet thread from Wal-Mart works well)
pony beads: in the following colors - yellow, solid red, cream, clear blue, clear red, black, orange, clear gold, dark blue, light blue, brown.

Objective: To find out what an astronomical unit is and how it is used to measure distances in the solar system.

1. You will need a long distance area like a hallway (or go outside) to do the first part of the activity.
   An astronomical unit or AU is the distance between the sun and the earth, 93,003,000 miles. We will work together to make a model to show the relative distances between the planets.

2. Assign each girl one of the following planetary body: sun, Mercury, Venus, Earth, Mars, Asteroid belt, Jupiter, Saturn, Uranus Neptune, and Pluto. To measure distance 1 AU will equal 4 steps. Using the "planetary distance guide" help the girls figure out how many steps away from the sun each planet and the asteroid belt should be from the sun. Encourage the girls to try and figure out how many steps they will need to take from the sun. If you are inside you may run out of room before you get all nine planets in place.

   Planetary Distance Guide

Planet	AU	Steps
Sun	0.0	0
Mercury	0.4	2
Venus	0.7	3
Earth	1.0	4
Mars	1.5	6
Asteroid Belt	2.8	11
Jupiter	5.0	20
Saturn	10.0	40
Uranus	19.0	76
Neptune	30.0	120
Pluto	39.0	156

3. For part two give each girl a string that is 4 meters and 25 cm long, 11 pony beads, and a "Planet AU" sheet. Wrap a piece of tape around one end of the string to prevent raveling. For this model 1 AU = 10 cm. String on the first bead to represent the sun and tie it at the end that does not have tape on it. A simple over hand knot works well. Measure out 4 cm and tie on a bead for Mercury. Continue till all 9 planets and the asteroid belt are on the string. Point out that if you ignore the decimal point that you will have the correct number of cm from the sun for each planet. Make sure the girls measure from the sun each time and not from the last planet.

Planet	AU	Bead
Sun	0.0	yellow
Mercury	0.4	solid red
Venus	0.7	cream
Earth	1.0	clear blue
Mars	1.5	clear red
Asteroid Belt	2.8	black
Jupiter	5.0	orange
Saturn	10.0	clear gold
Uranus	19.0	dark blue
Neptune	30.0	light blue
Pluto	39.0	brown

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UV Bracelets

Supplies

UV beads (available online http://store.estreet.com/Spanglerscience/StoreFront.bok)
cording - lacing
scraps of cloth from shear to heavy
masking tape
scissors

Objective: To increase awareness of ultraviolet radiation and how we can protect ourselves from it.

1. Bracelet pattern - use one from a braiding or friendship bracelet book or let the girls make up their own. The cording or lacing could be (but is not limited to): embroidery floss, plastic lacing, leather lacing, yarn, heavy crochet thread, macramé cord, jute.

Ultraviolet radiation is a invisible to the human eye. UV is a natural product of our sun. The ozone layer in the earth's atmosphere helps to block out UV radiation but is not 100% effective. Our skin is sensitive to UV radiation. It is what causes us to tan and burn. Too much exposure to UV radiation over many years can lead to skin cancer. So it is important for us to protect our skin from UV radiation. Some of our alien visitors from that far away planet too are sensitive to UV radiation. These UV sensitive aliens wear a UV detector that tells them when they are exposed to UV radiation. Today we will be making our own UV detector, a bracelet with UV beads in it. UV beads are special beads that change color when exposed to UV radiation. The brighter the color the more UV radiation you are being exposed to.

2. Use scissors to cut the cording into the length needed for the bracelet pattern. Give each girl 6-10 UV beads to work into their bracelet. Use the masking tape to hold down one end of the bracelet for braiding.

3. If you are working in a room with no natural light the beads will remain white. Once the girls have finished their bracelets have them put them on and cover them with them with scraps of cloth. Make sure that a variety of types of scraps are used.

*Lead them to an area with some natural light.
*Ask the girls if they think there is UV radiation in the room.
*Have the girls uncover part of the bracelet and see the color change.
*Lead the girls outside with part of the bracelet still covered.
*Look at the color change outside.
*Carefully peek under the cloth covering to see if there is any change. You will have to do this quick since the beads react to UV fast. Then uncover the rest of the bracelet and watch the beads change.
*Have the girls share what they saw under their cloth.
*What type of cloth worked better at protecting the beads from UV radiation?
*Do you think there would be more UV radiation in sunny or cloudy weather?

Edible Rocks

Supplies

edible rock samples (see below)	knife
small plastic bags	paper
pencils	colored pencils or crayons
copies of field note sample descriptions	copies of glossary sheet

Objective: To observe and describe the physical characteristics of an edible sample. To provide an introduction to some of the terms used in describing meteorites.

1. Prepare the samples ahead of time. You will need one for each group of 2 girls. Recipes are included for some of the samples at the end. The first six listed on the answer key are especially important since they closely represent meteorite characteristics. The answer key contains the list of kinds of samples and the numbers match up with the "field note sample descriptions." If you choose not to use any of the suggested samples be sure to remove their matching field note description. Cut the field note sample descriptions into numbered segments.

2. Cut the samples so that a flat interior surface is exposed. Reserve part or most of the sample - to be eaten as a reward. (Or you may choose to make marshmallow cereal treats or brownies as a snack reward.)

3. Give each team of girls a sample, paper, pencil, and colored pencils or crayons. Give them the following instructions:

Does anyone know what rocks that come from space and land on the earth are called? (Meteorites) Scientists find out more about the rocks that land on earth by cutting them and looking inside. then they carefully describe and draw what they see. Today you are going be a scientist and look at your own special "rock" sample. Its is a sample of an edible rock. With your partner you are to carefully observe the sample. You may remove the sample from the bag but handle it carefully and do not eat it or taste it! Make a large, detailed sketch of the the sample. The sketch should show the interior cut surface that is flat and any important details of the exterior. Write 2-3 sentences describing the cut surface. Do not use any food terms. For example do not use chocolate.

When you have finished you description and sketch take it to the table with the field note descriptions are located. Try to find the description that fits your sample. Check with a leader to see if you are right. Place your description, sketch and sample beside the "field note" description for your sample. There is a glossary of geological terms available to help you with the field notes.

4. Once the girls have found the right field note reward them with the rest of the sample or other snack.

Recipes

Rocky Road (#2 Edible Rock)
6 oz. semi-sweet pieces melted
2 cups mini-marshmallows

Butter a loaf pan or folded foil. Pour about half of melted chocolate into pan. Add the marshmallows and mix so that they are covered with chocolate. Pour the remaining chocolate over the marshmallows and spread flat. Refrigerate until cold. Cut a cube so the vertical surface is exposed.

Solid Chocolate (#3 Edible rock)

Use any thick chunk of solid chocolate.

Chocolate Brownies (#6 Edible Rock)
brownie recipe or mix nuts
large chunks of semi-sweet baking chocolate or large chocolate candies

Use any recipe for dark chocolate brownies or a mix. Add large chunks of semi-sweet baking chocolate or solid chocolate candy and nuts (add enough so that the solid candy and nuts will be exposed on a cut surface). Bake and cool completely.

Cut a cube of brownie exposing some solid chocolate and nut chunks. Cut the cube into several pieces. Then reassemble the cube in a jumbled fashion and allow to dry. Cut into slices so that chunks of nuts and chocolate are exposed.

Regolith Breccia simulant (#5 Edible Rock)
One batch of marshmallow crispy rice cereal treats
6 oz. semi-sweet chocolate pieces melted
jelly beans, chocolate chunks, or other large edible lumps

Mix up the cereal treats and spread 1/2 of the mix into buttered pan. Spread the melted semi-sweet chocolate over the mixture in the pan. Top with the remaining cereal treat mix.

As soon as the mix is cool enough to handle, but not hard cut out one cube about an inch square. Then cut it into 2 or three slices. Embed one or two jelly beans in part of the cube and mold back together again to form a “breccia.” Allow to harden and then recut to expose the jelly bean.

Edible rock answer key

1. Peanut Brittle (chondrites)
2. Rocky road (chondrites)
3. Chocolate (iron with fusion crust)
4. 3 Musketeers (achondrite with fusion crust)
5. Rice Cereal Treats (meteorite regolith breccia)
6. Chocolate brownie (carbonaceous chondrites)
7. Snickers
8. Milky Way
9. Bar None
10. Hersey Bar
11. Twix
12. Butterfinger
13. Skor
14. Rolo
15. Kit Kat
16. Symphony
17. M & M
18. Nestle Crunch
19. Whatchamacallit
20. Mounds
21. P.B. Max
22. Mr. Goodbar
23. Hersey with Almonds

These food descriptions are in geologic “field note” style. Therefore, they may be short and sometimes cryptic.

1. Sample is a thin layer. There is a golden matrix surrounding tan rounded or broken inclusions. The inclusions have a reddish brown rim or crust.

2. Sample consists mainly of white, soft rounded to angular blebs completely surrounded by a uniform dark brown matrix.

3. Sample is a sold dark brown dense mass with no obvious fusion crust.

4. Sample has a homogeneous light brown interior with a few small vesicles. The exterior looks fairly regular, dark brown fusion curst with some patterning.

5. Sample appears to have been distorted. The dominate phase is made of rounded light tan fragments containing may void spaces. A dark brown layer fill spaces between some rounded fragments. There are some large foreign inclusions.

6. Sample is totally dark brown with two phases. The dominant phase is shiny and crumbly. The other phase is dense and slightly lighter in color. A light fusion curst appears on only one side.

7. Outside: Thin medium-brown layer with ripple-marks on bottom.
Inside: Bottom - (~1/3) flat dense buff layer.
Top - (~2/3) pebbles consolidated in a fine grained tan matrix.

8. Outside: Thin medium brown layer with wavy ripple marks on the bottom.
Inside: Bottom - dense dark buff layer
Top - shiny, smooth, medium tan layer

9. Outside: Medium brown layer, thin on the bottom, the thicker top contains angular inclusions
Inside: Thin alternating horizontal layers of smooth dark brown and fragmented dark brown.

10. Dense medium brown sample, flat on bottom with three parallel ridges on top.

11. Outside: Thin medium brown layer with wavy ripples on the bottom
Inside: Bottom - poorly consolidated light tan porous layer
Top - shiny smooth medium tan layer

12. Outside: thin medium brown layer
Inside: Poorly consolidate, friable, shiny to dull golden platy fragments.

13. Outside: Thin medium brown layer, very thin in bottom and side, thicker on top with large wavy ripples
Inside: Thin dense layer of shiny light-golden unfractured material

14. Outside: Thin, medium brown, edges higher on outside of top, sides slanted.
Inside: Smooth material that is yellowish brown and sticky

15. Four segments of layered material.
Outside: Thin, medium brown
Inside: Alternating light and medium

16. Dense layer, solid medium brown with a few light tan angular fragments.

17. Sample consists of unconsolidated pebbles with various colors and regular shape. Each individual pebble has a medium brown interior with a thin, hard colored shell.

18. Sample has a thin layer of dense brown material, containing very light inclusions at the bottom. The sample top has a depression in the middle with a ridge on each side.

19. Sample is a rectangular layer of rounded light pebbles surrounded by a thin coating of medium brown. Some yellowish brown sticky material is above the pebbles.

20. Sample interior consists of white, moist-looking fragments. These are surrounded by a dark brown exterior layer.

21. Irregular sample.
Outside: Bumpy medium brown
Inside: Yellow brown solid material resting on light tan fragments, some large tan fragments are found near the top.

22. Outside: Dense layer of medium brown with a dip in the top
Inside: Light tan pebbles that have settled to the bottom

23. Dense sample of medium brown material, rounded on the top and flat on the bottom, with a few light brown pebble inclusions.

Glossary

Achondrite: stoney meteorite without chondrules.

Bleb: a small, usually rounded fragment of another rock enclosed within a rock.

Breccia: rock consisting of angular, coarse fragments embedded in a fine-grained matrix.

Carbonaceous chordate: a primitive type of meteorite usually with chondrules; they contain water and carbon compounds, including organic molecules.

Chondrite: stone meteorite containing condrules embedded in a find grained matrix of pyroxene, olivine, and metallic nickel-iron.

Chondrule: a small rounded body of various materials, chiefly olivine or pyroxene, found embedded in a usually fragmental matrix in certain of the stoney meteorites.

Crust: the outermost layer.

Friable: easily crumbled rock fragments.

Fusion crust: dark glassy coating on the surface of a meteorite, caused by heating as the meteorite enters the atmosphere.

Inclusions: a fragment of another rock enclosed within a rock.

Homogeneous: composed of one type of material.

Matrix: the smaller sized grains in a rock, where the rock consists of large grains or fragments surrounded by smaller grains.

Platy: the texture of a rock that is composed of flat minerals or rock fragments.

Regolith: loose, unconsolidated rock, mineral, and glass fragments; on the Moon and some planetary bodies, this debris is produced by impacts and blankets the surface.

Unconsolidated: materials loosely packed, but no cemented to each other.

Unfractured: does not contain breaks or cracks.

Vesicle: bubble-shaped cavity in a volcanic rock formed by expanding gases.

Creature Feature

Supplies

pre-made creature in opaque box - one for every 2-4 girls plus one extra

paper	pencils
metric rulers	colored pencils, markers, or crayons

Objective: To practice observation and descriptive skills.

1. Make the creatures ahead of time. Use yarn, pompoms, eyes, chenille stems, fabric, feathers, whatever you can find to make fanciful creatures that are 3-4 inches in length. Place each creature in an opaque box with a lid.

While you are exploring some of the different planets you find a strange new creature. Your job is to describe the creature to the best of your ability. Do not draw your creature, use words and numbers only. Don't forget to use measurements. Try to use the metric side of the ruler - scientists use metric not feet and inches. Be as detailed as you can, someone else will be trying to draw your creature from your description. Remember you are a team of scientists so work together.

2. Divide the girls into teams of 2-4. Give each team paper and pencil and a creature in its box. Have the girls write their names on the paper. Give the girls about 8 minutes to describe their creatures. Then have the girls put their creatures back in the boxes.

3. Collect the creatures. Have the different groups trade descriptions of their creatures. Give each group another sheet of paper and the marker, crayons or colored pencils. This time each group is to try and draw a picture of the creature described on the first paper. Give them about 5 minutes to do this.

4. While the girls are drawing set out the creatures on a separate table including the extra creature. At the end of the 5 minutes. Allow each team to come up to the table one or two at a time and pick the creature they think is the one in the description they received. Have them read off the names on the paper and hold up the creature. Ask the girls who wrote the description if they have the correct creature.

If you have time ask the girls if there is anything they might have done differently in describing their creature.

Comet Ice Cream

Supplies

sandwich size re-closable plastic bags	gallon size re-closable plastic bags
small cups	plastic spoons
ice	can opener
whole milk	sugar
vanilla extract	evaporated milk
chunky cookies of any kind, crushed candies, coconut flakes, and peanuts	
mittens or gloves	old towels (for quick cleanups)
measuring cup	measuring spoons
salt	paper and pencil

Object: To make an edible model of a comet to examine and eat.

1. Have girls wash hands. Ask about any allergies to milk, chocolate, and or peanuts.
   *Comets have sometimes been described as dirty snowballs, snowy dirtballs or something in-between. Comets are believed to be a cold mixture of frozen water, dry ice, and other sandy/rocky materials left over from the early formation of our solar system.

1. Divide the girls into groups of 3-5. For each group you will need the following.

1/3 c. evaporated milk	2/3 c. whole milk
5 spoonfuls of crushed cookie	5 tsp. of sugar
2 spoonfuls of coconut flakes	2 spoonfuls of "rock material"
1/4 tsp. vanilla extract	ice-enough to fill a gallon bag 3/4 full
sandwich bag	gallon bag
cups-the number of girls plus 1	spoons-one for each
mittens or gloves	

Comet connection: Add ingredients to the ice cream to represent dust (crushed cookies -like Oreo- in fine and large chunks) rocks (peanuts, crushed candies like MM's, toffee, peppermints), Dry Ice/carbon dioxide (coconut flakes).

2. Measure the milk, evaporated milk, vanilla and sugar into a sandwich bag. Let the girls measure out the crushed cookie, coconut flakes, and rocks into their own cups. Remind them they are to add only one type of rock material. Add the ingredients to the sandwich bag. Squeeze any extra air out of the sandwich bag and close it. Be sure it cannot leak! Slowly tilt the bag to check the seal.

3. Place the sandwich bag into the bottom on the gallon bag. Fill gallon bag with ice, add 8-10 spoonfuls of salt. Close the large bag tightly, removing as much air as possible and check for

leaks. Shake and roll the bag for approximately 10 minutes to freeze the ice cream. Let the girls start shaking the bag with bare hands so they can feel the temperature change. Then if hands get too cold give the team a pair of mittens to share.

4. When the ice cream feels stiff to the touch take it out of the ice and rinse the inner bag briefly with fresh water to remove any salt.

5. Have the groups trade bags with another group. Then spoon the ice cream into cups, one for each group member and one extra. Don't eat the extra cup.

Different scientific instruments take different kinds of data. Pretend your eyes, hands and taste buds are scientific instruments taking data from your "comet." Take the following "data" and record it on your paper.

**Look at your comet and see what you can observe visually.*

**Take the extra cup and have your group feel the contents with your fingers.*

**Holding you nose, taste the comet and see what your can taste and feel in your mouth.*

**Release your nose and see what you able to taste with your sense of smell added.*

**Record what you discovered as you watched the elements in the bag become ice cream.*

**Share what you discovered with the other groups. Did you identify all in ingredients in the ice cream.*

Hints:

-In winter snow can be used instead of ice.
-Have a mop on hand for drips.
-Remind the girls not to toss the bags or bang them against a hard surface or the bag may break.
-You may want to pre measure the milk, evaporated milk, vanilla and sugar into a glass before the groups arrive to save time.
-If the weather is nice do the activity outside.

Dance of the Solar System

Supplies

String or yarn or light rope
Optional - Instrumental music CD or tape and player

Object: To learn about orbits and the objects found in our solar system.

1. You will need a large space to do this activity. Cut the string or yarn in the following lengths: 2 meters, 3.5 meters, 5 meters, 7.5 meters. This represents the distance from the sun for the first 4 planets in our solar system.

2. Part 1 orbits: 5 girls at a time will take part in this part of the activity. One will be the sun she will hold one end of all the strings in her hand above her head. The other 4 girls will each hold the end of one string standing away as far away from the sun as possible. Have the girls stand in a straight line.

3. The object of this part is to show why the planets don't travel around the sun all lined up. Have the girls walk around the sun at the end of their strings counter clockwise. After the inner most girl has made two revolutions around the sun stop the girls. Ask why the girls why even if they are walking at the same speed they don't end up in the same place. Now tell the girls that objects further from the sun move slower than those closer in. Try another couple of revolutions. Then change the girls around till everyone has had a chance to be a part on the mini solar system.

4. Ask the girls what different objects are found in our solar system: planets, sun, moons, asteroids, comets (remind the girls that these are occasional visitors). Avoid meteors, you don't want girls crashing into each other.

*planets spin while orbiting
*comets have a tail that always faces away from the sun and come from outside the solar system, go around the sun and leave the system again
*moons orbit planets
*there are many asteroids in the asteroid belt
*suns have solar flares
*our solar system from the center out - Sun, Mercury, Venus, Earth, Mars, Asteroid Belt, Jupiter, Saturn, Uranus, Neptune, Pluto

5. Have the girls work together to decide who will be each part of the solar system. Remember that you don't have to make it just like our solar system if there are not enough girls. Encourage expression by the girls. Arms straight out from the side may be rings when a girl spins while orbiting. Arms back might be the tail of a comet. The sun may stick an arm or leg out and pull it back in for a solar flair. Have the girls get into position and then turn on the music and let them dance around the sun "dance."

Mars Pathfinder Egg Drop and Landing

Supplies

cereal boxes	10" balloons
string	newspaper
eggs	masking tape
scissors	rulers and / or meter sticks
pencils	hole punch

Object: To build a model of the Mars Pathfinder lander and test it. Encourage team work and problem solving.

1. Divide girls into groups of 4-6. Each group will build a lander.
   After extensive testing NASA decided that the best shape for the Mars Pathfinder lander is a tetrahedron. No matter which side the lander falls on it will be level and the payload is secure.

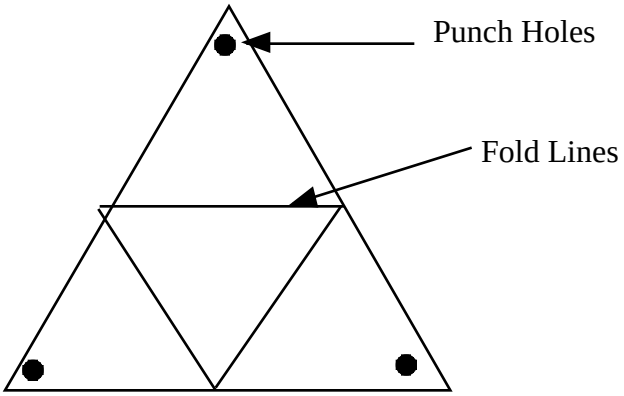
2. To build the lander:
   *Open the cereal box up. On one side of the box trace the triangle pattern and cut out. Punch a hole in each corner.
   *Fold the triangle into a tetrahedron to form a "lander."
   *Tape closed one side of the tetrahedron about half way up.
   *Place the egg in the lander and tape the other two side up halfway.
   *Tie a 1 meter piece of string through the holes. Finish taping up the three sides.

3. Parachute
   *Unfold a large piece of newspaper.
   *Cut off the edge of the newspaper sheet to form a square.
   *Cut off each corner of the square to form an octagon.
   *Using four 1 meter pieces of string, tape each end of each string to adjacent corners of the octagon parachute.

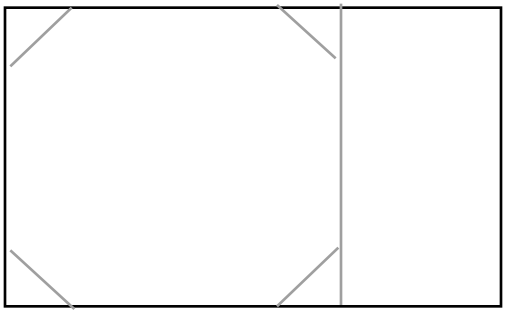
4. Air bags
   *Inflate four balloons and tie.
   *Using tape rolled back on itself, tape each balloon to each face of the lander.
   *Gather the four strings on the parachute and tie them to the string on the lander.

5. Entry, Descent and Landing
   *Drop you "Pathfinder" from a high place and see if your payload (egg) survives!

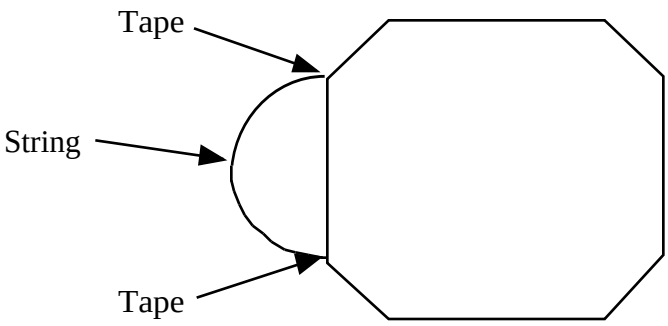
Lander



Parachute - cut on the dotted lines



Add strings with tape - Repeat for all four sides.



Rover Races

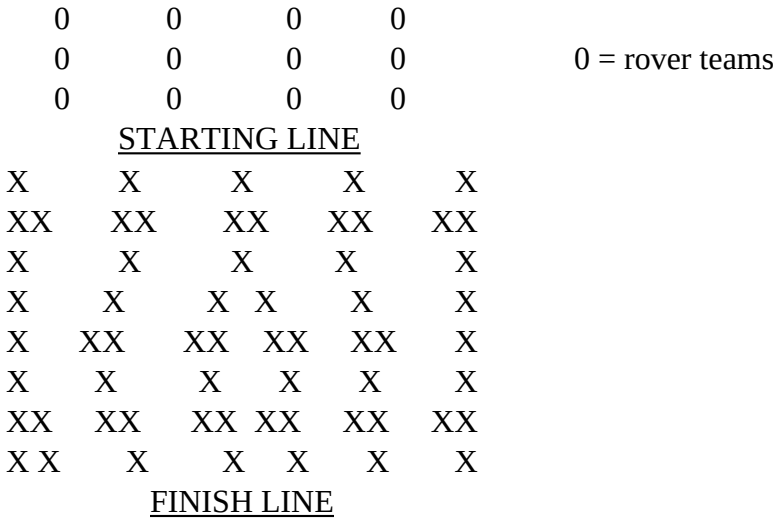
Objective: The girls will learn the challenges of operating a planetary rover and problem solve solutions by using a hands-on simulation.

Supplies:

large playing area (classroom, gym, or outside area)
red construction paper - laminated construction paper works well (**note:** do not use any materials that the blindfolded students will trip or fall over).
3 blindfolds per team
clipboard and pencil for each driver and judge
stopwatch for the timer of each team
masking tape
driver's sheet
judge's sheet
safety cones or empty gallon milk jugs (optional)

Preparation:

1.. Use construction paper tiles (red 9" x 12" work well) to create the obstacle course that the rovers will traverse. Laminated paper tiles work the best and last for many uses. Tape the tiles down or you will have to reset it for each run. Do not use desks or chairs, as girls may trip over them. Make any type of course by arranging the tiles symmetrically. An easy example of this might be:



Set the stage by reading the following introduction.

Many people think that robotic vehicles (like the Mars Pathfinder Sojourner Truth rover) can be driven much like they drive their toy radio controlled cars. They imagine a rover driver watching a computer screen showing the rover on Mars and moving a joystick to make it go. The reality is not so!

The time it takes for a command to reach the surface of another planet (such as Mars) varies with the distance between the planets involved. This prevents any "joy-stick" driving in real time. The commands travel via radio waves at the speed of light (186,000 miles / second) and can take many minutes to reach their destination. Much can happen to an interplanetary robotic vehicle during this time interval. If, for instance, a command were given from the Earth-base for it to go forward on Mars and the Earth-base got a reply (say 12 minutes later) saying that the rover was indeed traveling forward. It

would then take another 12 minutes to send a command from the earth-base to stop the rover. If the rover runs into trouble, crashes, or flips over, there is no one there to fix the situation. The rover mission is over!

Procedure:

1. Choose or draw names of girls to form teams of six. One girl will be designated as "the rover driver", one will be the "team timer", and another will be the "team judge". The remaining three students will become the rover by hooking together in a line (both hands to the shoulders in front of them (O=O=O). The rover will be guided by the driver through an obstacle course (simulated Martian surface)
2. The drivers will proceed through the course first, writing down the instructions that will guide the rover through the course (i.e. 3 steps forward, stop, 1 step left, stop, etc.)
3. Once the drivers have recorded their "upload sequences" on their driver sheets, the rover races can begin. The rover teams line up at the starling line. The three rover members are blindfolded, as to not aid the driver in executing their commands. The rover members link up (to form the 3 sets of wheels like the real rover designs) with their hands on the shoulders of the person in front of them (it is fun to choose different-sized girls to form a rover, as the different sizes of steps taken by each is more evident). The judges will keep a tally of the number of foot faults that their rover team makes by counting each time the front rover person's foot steps on a red tile (Mars rock). The timer of each team will record the time it takes for their rover team to make it through the course. (NOTE: remind the teams that accuracy, not speed is more important when driving a robotic vehicle on another planetary surface.)
4. The teams will all start at the same time, with the timers starting the team stopwatches when the leader indicates. The driver may stand near their team to give the command sequences, but may not physically touch their rover to help guide it (this is, after all, teleoperations!). They must guide their rover by voice only. The rover driver may not deviate from the commands that have been written in their previous trip through the course, even if the rover is going off course.
5. Allow time for all teams to complete the course. Talk about how the driving went - the challenges and what they might change to do a better job the next time.
6. The girls might observe that their steps and those of the rover people might need some type of calibration (i.e. "take baby steps" or "take giant steps"). Turns might be more accurate by saying, "turn 45 or 90 degrees". Running a rover with 3 axles is also different than walking a course singularly.
7. Repeat the activity as time permits, allowing the changes the girls brainstormed to be tested

Race Variations:

1. Safety cones or empty milk jugs can be added to the course as return sample rocks to be collected. Spread cones or milk jugs along the course for each team. When the rover is in the proper position for the last person on in the rover team to bend down (blindfolded) and pick up the "rock", the driver can command "retrieve rock sample". Once the "rock" has been retrieved, the cone can be passed to the middle rover person to be carried.
2. The tiles can be arranged in any design to make the course easier or more difficult.
3. Talk about the time differences the teams took to complete the course. Are there advantages to taking it slower (more careful moves, less crashes) or perhaps the power supply is getting low and more territory needs to be covered (faster).
4. Instead of taping the "tiles" down just mark their place on the floor with tape. Let the girls see how they have "messed up" the Martian landscape. Then the girls can reset the tiles for the next group.

Rover Races

Information Sheet and Course Directions for Driver

Commands:

← Left (L) Right (R) →

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. F 3 steps. S.
2. Turn L 1 step. S.)

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

Rover Races

Judges Sheet

Make a mark (example: IIII) every time the first person on the rover team steps on a tile (rock crashes!). Keep track through the whole course and make a total at the end.

TOTAL ROCK CRASHES =

TOTAL TIME TO COMPLETE THE COURSE =

TOTAL ROCK SAMPLES COLLECTED=

Make a Model Saturn

Supplies

unwanted CDs (Many people get these free in the mail)
2 inch styrofoam balls
wooden toothpicks
glitter - several different colors
small paper clips
scissors
markers
white glue
paint brushes
black yarn
heavy thread or light string
small wire cutters

Object: To find out about Saturn's rings. Use the the "Why does Saturn have rings?" sheet to stimulate discussion.

1. Each girls will need a styrofoam ball and a CD. Cut the styrofoam ball in half ahead of time.

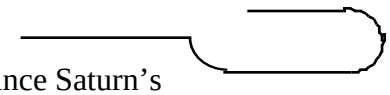
2. The CD will be Saturn's rings. usually one side of the CD has printing on it. This is the side you will decorate with glitter.

*Try not to get glitter in the center part of the CD, where you will be gluing the styrofoam ball.
*Rinse the paintbrush out between uses so it will stay soft and easy to use.
*Use the paintbrush to carefully spread glue on the CD in a ring. Sprinkle glitter on the ring. Add a ring of glue right next to the glitter and glue on yarn in a ring to show the gaps in the rings. Continue adding glitter and yarn to the outer edge.

3. Stick a toothpick into the center of the flat side of each half of the Styrofoam ball to give yourself a handle. Decorate each half of the styrofoam ball with glitter and markers.

4. Take the toothpick out of one of the styrofoam halves. On the other half, make sure the toothpick is stuck exactly into the center and push it in until it starts to poke out the top. Spread glue on the decorated side of the CD in the center. Pick ut the CD and place the styrofoam half with the toothpick exactly in the center of the CD, toothpick sticking through the hole. Now put some glue on the center of the other side of the CD. Push the other styrofoam half onto the toothpick sticking out the hole. When both halves are flat against the CD, a small part of the toothpick may be sticking out of one of Saturn's "poles." Break it off with the wire cutters.

5. Open a paper clip so you have a hook at one end.



Decide which half of Saturn you want to be the top. Since Saturn's axis is tilted 28 degrees, stick the paperclip into the top about 3/4 inch away from the center. Angle the paperclip so it passes through the hole in the CD and helps hold the two styrofoam halves together. Tie a length of thread to the paperclip for hanging.

**When you hang you Saturn up, and it turns in the breeze, you will see the "rings" from different angles - just as we see the real Saturn at different angles from the Earth.*

Helpful hints:

*Have old aluminum pie pans to put under the models while shaking the glitter. Dumping the glitter back into the container can be done with a paper cone.

*Have some containers of water for cleaning paintbrushes.

*A pan of water and old towel can come in handy for cleaning up sticky fingers.

Why does Saturn have rings?

Scientists have ideas about why Saturn has rings, but no one knows for sure.

What are Saturn's rings made of? Are they solid like the CD you used to make your model? Or are they made of many particles dancing in formation around the planet?

Three robotic spacecraft from Earth have already visited Saturn - Pioneer 11, Voyager 1, and Voyager 2. they revealed many surprising things about Saturn's rings.

The rings are about 40,000 kilometers (24,000 miles) wide. That's about three Earth's across. But the rings are only 100 meters (330 feet) thick. That's only a little thicker than a football field is long.

They range from particles too tiny to see to "particles" the size of a bus. Scientists think they are icy snowballs or ice covered rocks.

There are actually many rings - maybe 500 to 1000. There are also gaps in the rings. (That's way we put some black rings on our model Saturns.)

A new spacecraft is now on its way to study Saturn much more thoroughly than earlier spacecraft could. After a seven year journey, the Cassini (ka-SEE-nee) spacecraft will arrive at Saturn on July 1,2004. It will go into orbit around Saturn and study its rings, its many moons, and the planet itself.

Cassini also caries a probe, called Huygens (HOY-guns), that will parachute into the atmosphere of Saturn's giant moon Titan. Huygens will sent back information on this strange world whose surface we have never seen. What exciting new discoveries Cassini and Huygens will make!

Strange New Planet

Supplies

cardboard tube for each girl
blue plastic wrap or cellophane
black cloth
rubber bands
4 planet models

Object: Demonstrates how planetary features are discovered by using remote sensing devices.

1. To make planet models use playdough or small balls (about 4" across) in different colors. Decorate the planet with beads, artificial jewels, paint, foils, etc. Playdough can be molded into mountains, rivers, etc. The idea is to create features all around the planet.

2. You will need a large area to do this activity, the girls will need to stand at least 30 feet away from the table for the first step. A hallway works well. Set up a table with the four planets and cover with a black cloth.

3. Have each girl cover one end of a cardboard tube with 3-4 layers of blue plastic wrap or 2 layers of blue cellophane and rubber band in place. This will be their telescopes.

4. Divide the girls into groups of 4. Have the girls stand at 30-40 feet away from the table. Uncover the planets and let the girls look for 1 minute through their telescopes (blue plastic wrap towards the planets). Then cover the planets again. Let the girls talk about what they saw in their groups.

Ask the girls if they know why they put the blue plastic wrap on the ends of their telescopes. It is to represent looking through an atmosphere.

6. Have the girls move half way towards the table and take off the plastic wrap from the telescopes. Again uncover the planets for one minute. Then cover the planets again. Let the girls talk about what they saw in their groups.

The closer view without the plastic wrap is like viewing a planet from the Hubble Space Telescope. Note that you can see much more detail without the atmosphere in the way.

7. The next step will be a fly by. Have the girls walk past the uncovered planets. Make sure they move quickly and do not stop. Once they are past again cover up the planets. Note how much more detail you can get from a flyby in space. Let the girls talk about what they saw in their groups.

8. Ask the girls if there is any way we could get more information about the planets. They may suggest landing, using probes, and orbiting the planets. This time tell the girls they will be orbiting their planets. Tell them that each girl should look at one planet. Give each group time to orbit the planets. Then the girls can share what they saw within their groups.

9. Let the girls pick up and look at the planets more closely, gatheing more informaton like a lander.

Make and Map a Volcano

Object: to discover that many planets have things in common with each other.

Volcanoes and/or lava flows are prominent features on all large rocky planetary bodies. Even some asteroid fragments show evidence of lava flows. The largest volcano we know about is found on the planet Mars. Olympus Mons is over 20 km high and would cover the entire state of Arizona.

This activity comes in two parts, building a volcano and then mapping a volcano. Give the groups 10 minutes to build a volcano and then another 10 to map out another groups volcano. Split the group into two smaller groups and have each smaller group make a volcano. Then the two groups trade volcanos and map out each others volcano.

Part 1: Lava Layering - building a shield volcano

Supplies for each volcano:

1 screw on pop bottle cap
1 cardboard, approx. 45 cm. square
spoon
baking soda (approx. 1/4 cup)
paper towels
paper and pencil
2 paper cups 4-6 oz size
3-4 fist sized balls of playdough, each a different color
vinegar (1/2 c.)
marker
colored pencils, crayons, or markers

1. Glue the pop bottle cap onto the center of the cardboard with so it forms a small cup. Do this ahead of time for the girls.

2. Have the girls mark north, south, east, and west on the board. Tell the girls that the cap is the eruption source and the cardboard is the original land.

3. Place one heaping spoon of baking soda in the bottle cap. Slowly pour vinegar into the bottle cap and watch the eruption of simulated lava.

4. When the lava stops, quickly draw around the flow edge with a marker. Wipe up the fluid with paper towels.

5. As best you can, use a thin layer of playdough to cover the entire area where lava flowed.

6. On a separate sheet of paper record information about the flow. Indicate the color and shape. Use the colored pencils (etc.) to make a map of the flows.

7. Repeat steps 3-6 two or three more times. Record which flow is the largest and the smallest. Record the order of the colors of the flows (ie. red first, blue second, etc.). Be sure to mark

where the lava flows go over previous flows as well as on the cardboard. Cover the entire area of each succeeding flow. You may need to remove excess vinegar from the cup.

Part 2: Mapping the volcano

Supplies:

volcano from earlier	crayons, colored pencils, or markers
8 tooth picks	metric ruler
plastic knife	eight 5 cm pieces of clear straw
mapping worksheet	paper

1. Make sure the girls are mapping a volcano they did not make.

2. The girls can examine the volcano using the following.

I. Make one river bed by cutting a "V" shaped channel that is no more than 10 cm. long with the plastic knife.

II. Make one road cut by cutting a vertical channel that is no more than 10 cm. long with the plastic knife.

III. Make up to 8 core samples using the clear straw pieces. Use a tooth pick to stick the straw next to it's core hole.

3. Have the girls try to figure out the following questions.

I. The order of the flows.

II. Which flow is the smallest.

III. Which flow is the largest.

4. After the girls are finished working let them check with the volcano makers notes to see if they correct the information the gathered was.