



EXPLORE! Beyond Earth

Strange New Planet

Adapted from *Mars Activities: Teacher Resources and Classroom Activities*, a Mars Education Program product from the Jet Propulsion Laboratory and Arizona State University.

Overview

Children ages 10 to 13 work in teams to collect data and plan missions to explore unknown worlds! The facilitator creates three "planets" out of clay decorated with craft items ahead of time. In this 45-minute activity, the planets are unveiled and teams send observers armed with "viewers" (paper towel tubes) to study them. The observers first view the planets from a distance to simulate observations by groundbased telescopes, then have opportunities to study them from increasingly closer distances during flybys and orbits. The teams use their collected information to plan lander and sample return missions.

What's the Point?

- Space missions are scientific investigations that involve observing and describing planets and moons. Sample return missions allow scientists to collect and analyze specimens.
- Space scientists use technology, such as telescopes and robotic spacecraft, to help them make better observations. Robotic spacecraft may fly by or orbit a planet, or they may investigate the surface (landers and sample return missions).
- Scientists plan exploration missions based on previous scientific knowledge and investigations. Different kinds of investigations answer different kinds of questions.
- Scientists and engineers often work in teams with different individuals doing different things that contribute to the results. The team members work together to gather and analyze data, and they use that data to plan future investigations.

Materials

For the group:

- Modeling clay, Play-Doh®, Styrofoam™ balls, plastic balls, balloons, or rounded fruit (pumpkins, oranges, grapes, etc.) (enough to make 3 "planets" with additional for "moons," if desired)
- Craft and food materials:
 - Planet surface features: small stickers, sequins, candy, marbles, cotton balls, felt, toothpicks, pasta, beads (use your imagination!)
 - "Life": butterfly stickers or cloves
 - Scents (optional): scent stickers, spices such as cloves, vinegar, perfume, or other scents
 - 1 (2' x 3') dark-colored cloth
 - Glue or tape
 - Toothpicks
- 1 pedestal or stool
- A space large enough for the children to observe the "planets" from varying distances of 30 feet to less; children should be able to circle the "planets" from a distance of 2 to 5 feet
- 5 sheets of poster paper
- 2–4 markers of different colors
- Optional: a computer, projector, and access to the following websites:
 - [NASA's Solar System Exploration Timeline](#) allows site visitors to scroll along an interactive display of "robotic firsts," beginning with Sputnik 1 in 1957 and extending into the future. Appropriate for ages 8 and up.
 - NASA's [Eyes on the Solar System](#) combines video game technology and NASA data to create an environment for users to ride along with NASA spacecraft and explore the cosmos. Appropriate for ages 8 and up.

For each team of three to four children:

- 2 cardboard or rolled paper tubes
- 2 (5" × 5") blue cellophane squares
- 2 rubber bands
- Masking tape
- 1 set of [Our Solar System](#) (NASA educational product number LS-2001-08-002-HQ) lithographs, preferably in color
- Books about the exploration of the bodies in the solar system (optional)
- Paper
- Pencils or pens

For the facilitator:

- **Background information**
- **Shopping list**

Activity

- Create three "planets" using the craft and food materials. Decorate the planets with beads, stickers, sequins, candy, marbles, scents (optional), etc., to make the object interesting to observe. Some of these materials should be placed discreetly so that they are not obvious upon brief or distant inspection. Some suggestions for features are to create cotton-ball "clouds," carve channels, add moons by attaching grapes with toothpicks, affix small stickers or embed other objects into the planet, and apply scent sparingly to a small area. To one planet, attach something that depicts life or is alive, e.g., butterfly stickers or cloves.
- Prepare a large, open area with the planets elevated at the center on a pedestal or stool. Drape the dark-colored cloth over the planets. Allow enough room for the children to observe the planets from an initial distance of about 30 feet. Leave a clear path around the planets for the children to walk in a complete circle ("orbit") around them from a distance of about 2 feet.
- If desired, make two viewer tubes for each team ahead of time. Attach the blue cellophane squares to one of the ends with a rubber band (this will be removed by the children after their initial observations).
- Gather information sources about the exploration of our solar system. You may wish to include books about the planets, dwarf planets, moons, asteroids, and comets that discuss the history of their exploration. NASA's *Our Solar System* lithograph set and NASA websites are sources of information about the various missions.
- Hang the sheets of poster paper around the room. Draw a line down (or across) each piece, so that it is divided in half. Label one section Mercury, one Venus, and continue for the rest of the planets on the remaining four sheets. Include one section for Earth's Moon. The moons of other planets can be grouped with that planet.

Activity

1. Brief participants on their mission: **to explore strange new planets.**

- How do scientists explore planets? *Astronomers look at planets through telescopes on the ground (like in observatories) or in orbit around Earth (like the Hubble Space Telescope). NASA and other agencies send robotic spacecraft to fly by, orbit, or land on other planets and moons. Only one other body in our solar system has been visited by humans — the Moon!*

Explain that in this activity, the children will work in teams to remotely explore strange, *new* planets, report the data they gathered, and then form questions they can help answer with the next exploration step. Each stage of the exploration provides progressively more detailed information. Team members will either serve as observers who study the planets and collect information or as mission control scientists on Earth. The roles will switch at each stage of exploration so that all team members have the opportunity to serve in both roles.

2. Divide the children into teams of three to four and allow each member to select a role to play (or assign one) for the initial step. Arrange the teams at one end or side of the room—this is mission control. Provide two viewer tubes to each team for the two observers. If the tubes were not assembled beforehand, instruct the children on how to assemble them. Provide paper and pens or pencils to the mission control scientists.

Provide the mission control scientists of each team with the books, lithographs, and posters to discover examples of historic telescopic observations and flyby, orbiter, lander, rover, and sample return missions. Prompt them to note which planets and moons have been visited by these different types of missions; at the close of the activity, they will have the opportunity to share what they learned about the exploration of our solar system.

3. Pre-Launch Reconnaissance: Invite the observers to study the planets from Earth-based telescopes. Have the observers stand 30 feet away from the covered planets while the mission control scientists remain seated. Instruct the observers to place their tubes at one of their eyes and the scientists to turn away from the covered planets. Emphasize that the planets may only be viewed through the viewers.

- What does the blue cellophane represent? *Earth's atmosphere.*
- How does Earth's atmosphere affect your ability to see detail? *Makes it harder.*

Remove the cloth covering the planets. Teams observe the planets using their viewers for one minute. Replace the cloth. Invite the observers to report back to Mission Control their observations of color, shape, texture, and position. Invite the children to make drawings of their discoveries and note questions they would like to pursue. Allow time for the teams to discuss the observations and plan a closer inspection of the planets.

Have the teams repeat their observations from the distance of 30 feet for one minute with the cellophane removed from their "telescopes." Allow the observers to update Mission Control and have the teams record any new observations.

- Were their observations different? In what way? *Without the cellophane — "Earth's atmosphere" — details could be seen more clearly.*
- How might scientists minimize — or remove — the affect of Earth's atmosphere? *They could put telescopes on high mountains or completely above the atmosphere.*
- Do we have any telescopes that are above Earth's atmosphere? *Yes, the Hubble Space Telescope!*

4. Mission 1 — The Flyby: Invite two new observers from each team to walk quickly past the "front" side (the side they just viewed from a distance) of the planets at a distance of 5 feet. Ask them to place the tubes at their eyes.

Uncover the planets but leave one side draped under the cloth. Invite the observers to file past. Teams then reconvene at the side of the room (Mission Control) with their backs to the planet while the other teams conduct their flyby. Replace the cloth over the planets once all the flybys have taken place. Allow the teams time to discuss what data they gathered and what they will look for on the next orbit mission.

5. Mission 2 — The Orbiter: Invite the observers to walk around the planets in a circle (orbit) at a distance of 2 feet. (The children should rotate roles so that other team members again have a chance to observe.) They observe

distinguishing features through their viewers and record their data back at Mission Control. Invite the teams to use the information to plan the next mission.

- Where would your team like to send a lander? What one location out of the three planets would you choose? What features will you examine?

6. Mission 3 — The Lander: Invite one member of each team to approach their landing site and mark it with masking tape. Emphasize that only one planet may be visited — missions of exploration are expensive! Invite the new observers to observe the landing site with the viewers. Instruct them to keep the field of view constant by aligning their viewers with the tape located inside and at the top of their viewers. After observing for five minutes, the observers return to Mission Control to record their findings and plan a sample return mission.

- Based on what you learned from your explorations, what one sample will your team collect?

Sample return missions are very expensive and must be carefully informed by all the previous mission data.

- What questions will you be able to answer based on that sample?

7. Mission 4 — Sample Return: Invite the observers (again, rotate roles) to collect *one* sample (a tiny pinch) from *one* planet. Have the observers bring the samples to their Earth laboratories for examination.

Invite the teams to share their interpretations of the characteristics of each planet, based on their observations.

Invite the children to share what they learned about the missions across our solar system. Record their findings for each planet and its moons on the appropriate sheet of poster paper. Note that they will not necessarily know about all the missions in the short amount of time available, but they will have a sense of past and present exploration.

- Are there any missions happening around or on other planets or moons right now? Which planets or moons? What kinds of missions? *Lots of satellites are orbiting Earth, and Earth's Moon. Mars currently has orbiters and rovers, and recently a lander has been active. A mission is on the way to Pluto (New Horizons). Another is orbiting Saturn (Cassini). One is orbiting Mercury (MESSENGER).*
- Which planets and moons have been visited by flybys?
- By orbiters?
- By landers?
- By human missions?
- Which planets have been studied by the most missions — and why? *Earth, Earth's Moon, Mars*
- The least — and why? *Uranus, Neptune, and Pluto*
- Where would they like to see a mission travel? What kind of mission? Why to that planet and why that kind of mission?

Conclusion

Unveil the planets and invite the children to look at them (without their viewers).

- What did you first observe through the viewers? How did the blue cellophane affect what you saw?
- What surprised you when you were able to remove the cellophane and take a closer look (fly by)?
- Did the orbiting mission reveal anything surprising on the "back sides" of the planets?
- Were there any indications of life on the planets? What were the clues?
- What was the role of Mission Control scientists?
- How did your drawings — your scientific understanding — change as you learned more?
- How did you decide what to observe next?
- Would you like to be a scientist or engineer sending missions to other planets?

Last updated
October 3, 2012

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