STAR_net Hands-on

Tested & Approved STEM Activities

Strange New Planet

Activity Guide

STAR_net
Science-Technology Activities & Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (STAR_Net) program.
Visit our website at www.starnetlibraries.org for more information on our educational programs.
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Strange New Planet

Credit: Lunar and Planetary Institute

Activity Time

45 minutes

Intended Audience

Families or other mixed-age groups, including children as young as 5 years old *with assistance from an older child, teen, or adult*
School-aged children ages 7 and up
Tweens up to age 13

Type of Program

☑ **Facilitated hands-on experience**

☑ **Station, presented in combination with related activities**

☑ Passive program (if instructions are provided at the start of the course)

☐ Demonstration by facilitator

Overview

In this simulation of space exploration, participants plan and carry out five missions to a "planet" and communicate their discoveries to their family or a friend.

What's The Point?

- **Scientists plan space exploration missions based on previous scientific knowledge and investigations. Different kinds of investigations answer different kinds of questions.**
- **Space missions are scientific investigations that involve observing and describing planets, asteroids, 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 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

Facility needs:

- ☐ A (30′ x 6′ or larger) hallway or open space
- ☐ Optional: 5-7 chairs or cushions
- ☐ 1 pedestal or stool

For each facilitator:

- ☐ Craft and food items for constructing one or more "planets," each constructed from:
  - ☐ 1 (3-6″) Styrofoam© ball, plastic ball, balloon, or large, round fruit (pumpkin, grapefruit, etc.)
  - ☐ 1 (1-lb.) container of modeling clay or case of Play-Doh© in a variety of colors
  - ☐ A selection of "planet" surface features: small stickers, sequins, candy, marbles, cotton balls, felt, toothpicks, pasta, beads (use your imagination!)
  - ☐ "Life": butterfly stickers, whole cloves, or small green leaves from a plant such as thyme
  - ☐ Scents (optional): scent stickers, spices such as cloves, vinegar, perfume, or other scents
  - ☐ Glue or tape
  - ☐ 2–4 markers of different colors
- ☐ Optional: one or more pieces of dark, opaque cloth to cover the "planets"
- ☐ 1 measuring tape
- ☐ Optional: 1 roll of masking tape **AND** 1 permanent marker

For each audience of 10-15 participants:

- ☐ 1 or more "telescopes on Earth," each constructed from
  - ☐ 1 cardboard or rolled paper tube
  - ☐ 1 (5″ × 5″) blue cellophane square
  - ☐ 1 rubber band
- ☐ 1 or more additional cardboard or rolled paper tubes to serve as the "telescope in space"
- ☐ Optional: 1 set of walkie-talkies for the group to share
- ☐ 5-7 observation sheets, printed on cardstock
- ☐ 5-7 pencils and/or colored pencils
- ☐ 5-7 flag stickers
- ☐ 5-7 toothpicks for "planting" the flag

Supporting Resources

Consider setting up a digital device (such as a computer or tablet), speakers, and access to the Internet to display websites or multimedia before or after the activity.

Books:

Brake, Mark. *How to Be a Space Explorer: Your Out-of-This-World Adventure.* Oakland, CA: Lonely Planet Publications, 2014. (ISBN-13: 978-1743604342)

Portman, M. (2013). *Are there other Earths?* New York, NY: Gareth Stevens Publishing. (Hardcover ISBN 978-1-4339-8257-6) Grade 2 – 3

Interactive Websites:

NASA's Eyes on the Solar System: Learn about our home planet, our solar system, the universe beyond, and the spacecraft exploring them with this downloadable application: http://eyes.jpl.nasa.gov

Planet Hunters Exoplanets Citizen Science project: Search for extra solar planets: http://www.planethunters.org

Video:

Finding Life beyond Earth
PBS, 2012, ASIN: B005KLOPGY
Powerful telescopes and unmanned space missions have revealed a wide range of dynamic environments – atmospheres thick with organic molecules, active volcanoes, and vast saltwater oceans. This ongoing revolution is forcing scientist to expand their ideas about what kids of worlds could support life. If we do find primitive life-forms elsewhere in the solar system, it may well be that life is common in the universe – the rule, and not the exception.

Handouts:

Our Solar System lithographs (NASA educational product number LS-2013-07-003-HQ)
http://solarsystem.nasa.gov/planets/solarsystem/resources

Images:

NASA Solar System Exploration
http://solarsystem.nasa.gov

Planetary PhotoJournal (NASA/JPL)
http://photojournal.jpl.nasa.gov

Preparation

Advanced Planning Tips:

- **If possible, incorporate additional science, technology, engineering, art, and mathematics (STEAM) activities into the event. See the STAR_Net resources listed at www.starnetlibraries.org for ideas.**
- **Prepare and distribute publicity materials for programs based on this event.**
- **Pull supporting resources out of circulation to feature during the program.**

- Create a "planet" using the craft and/or food materials. Decorate the planet 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. Features might include:
  – Cotton-ball "clouds"
  – "Stream beds" or "rifts" cut into the surface
  – "Volcanos" or "mountains"
  – A "moon" grape attached with toothpicks
  – Scent applied sparingly to a small area
  – Butterfly stickers, cloves, small green leaves, or other signs of "life."

- Prepare a hallway or large, open area with the "planet" elevated at one end on a pedestal or stool. Leave a clear path around the "planet" for the participants to walk in a complete circle ("orbit") around them from a distance of about 2 feet.

This activity can be set up as a self-guided exploration for individual families or small groups to do with minimal facilitation: Using tape and a marker, provide labels on the floor for where observers should stand at each stage of exploration. Space the labels out so over a distance of about 20 feet (measurements are approximate):

- First marker: Telescope on Earth (20 feet from the "planet")
- Second marker: Telescope in Space (18 feet from the "planet")
- Third marker: Space Probe (10 feet from the "planet")
- Fourth marker: Orbiter (2 feet from the "planet")
- Fifth marker: Lander (next to the "planet")

Preparation (continued)

- Create a "mission control" area at the farthest point from the "planet" (with seating, if desired).
- Make at least one "telescope on Earth" by attaching a blue cellophane square to one end of a paper towel tube of rolled piece of paper using a rubber band. If multiple teams will view the "planet" at the same time, make one "telescope on Earth" and one "telescope in space" for each team. (Alternatively, provide time during the activity for the participants to make their own "telescopes.")
- Optional: If the walkie-talkies will be used, test them beforehand for battery strength and to set them to the clearest channel.

Activity

1. Share ideas and knowledge.

- Introduce yourself. Help the participants learn each other's names (if they don't already know each other).
- Frame the activity with the main message: Exploration allows us to build new knowledge on the discoveries of others.
- Brief participants on their mission: to plan and carry out the exploration of a new "planet" as if they are looking through a telescope from Earth or traveling to the planet as a space probe, orbiter, lander, or sample return mission.

How do scientists explore planets? Telescopes on Earth and in orbit around Earth provide scientists with information about our solar system. That information is used to plan where spacecraft fly and where they "point their cameras." NASA and other agencies send robotic spacecraft to fly by, orbit, or land on other planets and moons. With each mission, scientists added new knowledge to our understanding of the solar system.

Only one other body in our solar system has been visited by humans — the Moon! The Apollo astronauts brought back nearly 850 pounds of lunar samples, which scientists continue to study today. Chunks of planets and asteroids sometimes land on Earth as meteorites, giving scientists the chance to study pieces of other worlds.

- Invite one person from each team to serve as an "observer."
- Have the remaining team members remain at "mission control" and encourage them to use the observation sheets and pencils to record what they learn from the observers at each stage of exploration.
- Optional: Have the group take turns using the walkie-talkies to report back observations to "mission control." Begin with a demonstration on how the walkie-talkies work.

2. Guide the participants as they plan, then carry out, the following five stages of exploration.

Invite observers to look at the "planet" and report the "planet's" colors, shapes, and textures to mission control. Have the teams use this information to decide together on how best to proceed at the next stage of exploration, when they are able to move closer to the "planet." (Optional: cover the "planet" after each exploration stage.) (Optional: use walkie-talkies to incorporate technology into this process).

Optional: Ensure that each team member has the chance to serve both as an observer and as a mission control scientist. Repeat the exploration process with another "planet," or have a different team member make the observations at each stage of exploration.

A. Telescope observations:
- i. Observers look through cellophane-covered tubes to study the "planet" as it would appear from Earth-based telescopes.
- iI. Observers look through tubes (without cellophane) to study the planet as it would appear from Earth orbit.
- iii. Ask the participants to consider how the blue cellophane represents the Earth's atmosphere and discuss what affect the Earth's atmosphere would have on our ability to see details on the planet's surface.

Telescopes are located on high mountains in order to get above as much of the interfering atmosphere as possible. The Hubble Space Telescope orbits Earth above the distortion of the atmosphere and provides much more detailed images.

B. Space probe: Observers view the "front" side (the side they just viewed from a distance) of the "planet."

Some spacecraft — probes — travel very fast and don't slow down to stay long at a planet. Orbiters circle around a planet or moon for an extended period of time. Landers land on a planet or moon to study a particular place (rovers are able to move and visit more than one place in the area).

C. Orbiter: Observers walk around the "planet" in a circle (orbit) at a distance of 2 feet.

D. Lander:
- i. Each team uses their prior observations to decide where they would like to send a lander and what feature(s) they would like to examine.
- iI. Observers mark their "landing site" by planting a toothpick, with a flag sticker attached, onto their chosen site. Observers then study only that spot for up to about five minutes.

E. Optional – Sample return mission:
  i. Each team uses their prior observations to decide what sample they would like to collect.
  ii. Observers return to the "landing site" to collect one sample (a tiny pinch) from the "planet." They bring the sample back to mission control for examination in a scientific laboratory.

Sample return missions are extremely expensive. Samples from the Moon collected during the Apollo missions cost $28,500 per pound! (Their value to science and society, however, could be considered much greater than their cost!) Spacecraft have also brought samples back from a comet, an asteroid, solar wind, and low-Earth orbit.

3. Have the participants describe what they discovered by exploring the model planet, based on their observations.

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4. Conclude.

Draw on the participants' discoveries to summarize the experience, and encourage teams to talk with each other. Prompt conversation with questions such as:

- What did you first observe through the "telescopes"? How did the blue cellophane affect what you saw?
- How did your understanding of the "planet" and its features change with each stage of exploration?
- What evidence can each team provide to argue that there is — or is not — life on the "planet"?
- How did talking to your teammates help you decide what you were seeing and what to look for during the next stage of exploration?
- How did your drawings — your scientific understanding — change as you learned more?
- What questions will you be able to answer based on your sample?
- To what real planet would you like to send spacecraft to explore?

References

Adapted from *Mars Activities: Teacher Resources and Classroom Activities* (http://mars.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf), a Mars Education Program product from the Jet Propulsion Laboratory and Arizona State University.

Taylor, Stuart Ross. 1975. *Lunar science: a post-Apollo view; scientific results and insights from the lunar samples.* New York: Pergamon Press, p. 8.

Ralph L McNutt. *"Space Exploration."* In Handbook of space engineering, archaeology, and heritage, Darrin, Ann GaErrison, and Beth Laura O'Leary, eds. 2009. Boca Raton: Taylor & Francis, p. 842.

Correlations to the Next Generation Science Standards

Science and Engineering Practices

Asking Questions and Defining Problems
- Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships

Developing and Using Models
- Distinguish between a model and the actual object, process, and/or events the model represents.
- Identify limitations of models.

Planning and Carrying Out Investigations
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Analyzing and Interpreting Data
- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.

Constructing Explanations and Designing Solutions
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Engaging in Argument from Evidence
- Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.

Correlations to the Next Generation Science Standards (continued)

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Structure and Function

- Students observe how the shape and stability of structures of natural and designed objects are related to their function(s).

The Nature of Science

Scientific Investigations Use a Variety of Methods

- Science methods are determined by questions.

Scientific Knowledge is Open to Revision in Light of New Evidence

- Scientific explanations are subject to revision and improvement in light of new evidence.
- Science findings are frequently revised and/or reinterpreted based on new evidence.

Science is a Human Endeavor

- Most scientists and engineers work in teams.
- Creativity and imagination are important to science.
- Advances in technology influence the progress of science and science has influenced advances in technology.

Science Addresses Questions About the Natural and Material World

- Scientific knowledge is constrained by human capacity, technology, and materials.

Brief Facilitation Guide

Download the full activity guide at www.starnetlibraries.org

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Brief Facilitation Guide (continued)

B. Space probe: Observers view the "front" side (the side they just viewed from a distance) of the "planet."

C. Orbiter: Observers walk around the "planet" in a circle (orbit) at a distance of 2 feet.

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- How did your drawings — your scientific understanding — change as you learned more?
- What questions will you be able to answer based on your sample?
- To what real planet would you like to send spacecraft to explore?

Strange New Planet

Observation Card

Draw the features you see on the planet at each stage of exploration.

Telescope on Earth

Telescope in Space

Space Probe

Orbiter

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Observation Card (continued)

Draw the features you see on the planet at each stage of exploration.

Lander

Sample Return Mission

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