Strange New Planet
Teacher Guide

Essential Question: Why is it important that scientists look at things they are studying in different ways? Why is this method important in space exploration?

Brief Lesson Overview:
For this activity, students will experience the processes involved in planetary explorations. This activity demonstrates how planetary features are discovered by the use of remote sensing techniques.

Key Words:
Model Observations Questions Planets Mission

Goal:
In this activity, students will use 21st Century Skills and remote sensing to identify the types of missions that can be used, the purpose for each type of mission, advantages and disadvantages, and later develop an understanding that science is a team effort.

Objectives – Students Will:
1. Make relevant observations
2. Write questions to be answered based on their observations
3. Revise questions based on new evidence that may arise from their observations
4. Design a simple mission plan
5. Explain how scientists investigate planets, moons, and other objects in the Solar System.
6. Describe the types of missions that can be used
7. Explain that science is a team effort
8. Explain that discoveries are made with a variety of technologies and people

Grade Level:
K-4

Additional Disciplines:
Reading

Estimated Time Required:
One 45-minute session

Linked Activities:

Mars Image Analysis Activity
Rover Races
Earth / Moon / Mars Balloons
Exploring Crustal Materials from a Mystery Planet

Relevant Standards and Skills:

1. **National Science Education Standards (NSES)**
    a. Content Standard A: Science as Inquiry
        i. Abilities Necessary to do Scientific Inquiry
        ii. Understandings about Scientific Inquiry
    b. Content Standard B: Physical Science
        i. Properties of Objects and Materials
        ii. Position and Motion of an Object
    c. Content Standard E: Science and Technology
        i. Understandings about Science and Technology
    d. Content Standard G: History and Nature of Science
        i. Science as a human endeavor.
2. **21st Century Skills**
    a. Critical Thinking and Problem Solving
    b. Communication
    c. Collaboration
    d. Information and Communications Technology (ICT) Literacy
    e. Flexibility and Adaptability
    f. Initiative and Self-Direction
    g. Productivity and Accountability

Materials/Equipment:

Planets: (Can be made from a combination of materials – 4 to 5)

Plastic Balls	Modeling Clay	Foam Balls	Play Dough	Sequins
Round fruit	Vinegar	Perfume	Essential Oils	Candy
Small Stickers	Marbles	Cotton Balls	Glue	Toothpicks
Marshmallows	Grapes			

Viewer: (1 per student – Choose from different types)

Sheet of Paper Paper Towel Roll Toilet Paper Roll Rubber bands
5”x5” Clear Blue Cellophane Squares Paint Roller Tubes (non-consumable for use each year)

Other materials:

Cloth or Towel Push-Pins Masking Tape Colored Pencils or Crayons

Teacher Tip: (Set-Up)

1. Place the object (planet) on a desk in the back of the room. Cover the object with a towel before students arrive.
2. Students will construct viewers out of loose-leaf paper by rolling the shorter side into a tube (can also substitute a toilet paper roll, a paper towel roll or paint roller tubes.) These viewers should be used whenever observing the planet.

Teacher Tip: (Constructing the Planet)

1. Choose an object such as a plastic ball or fruit that allows for multi-sensory observations. Decorate the object with stickers, scents, 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 inspections. Some suggested features are, but not limited to:
    a. Create clouds by using cotton
    b. Carve Channels
    c. Attach a grape or marshmallow using a toothpick
    d. Small beads make good craters
    e. Affix small stickers or embed other objects into the planet
    f. Apply scent sparingly to a small area

Teacher Tip: (For Older Students)

1. Teams can create their own planets for other teams to view. This allows the students to create their own set of planetary features and write up a key. These features may then be compared with the team that explores the planet.

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5E Application:

1. Engage:

First person story from Mars Scientist, Dr. Phil Christensen, Regents Professor, Arizona State University (Ask Dr. C. – http://marsdata1.jpl.nasa.gov/DrC). Dr. C remembers how people's ideas about Mars changed tremendously after the first fly-by of Mars. In the late 1950s, people thought Mars had plants, a thick atmosphere (air) and was a lot like Earth. Encyclopedias like The *World Book Encyclopedia* and publications like *National Geographic* had articles written about Mars describing Mars like Earth. After the Mariner 4 flyby – collecting the first close-up photographs of another planet on July 14, 1965, our ideas of Mars changed forever. Mars was not a lush green planet, but a barren, desert-like planet (http://photojournal.jpl.nasa.gov/catalog/PIA02980). This important flyby helped NASA plan for the missions that followed, as each mission gives NASA new information to plan their exploration interesting places in the solar system and leads to many of the new discoveries that have been made and will be made in the future.

In 1997, NASA landed the first small robotic rover on Mars – the Sojourner Rover. This rover gave humans the capability to move around and explore on another planet. In 2004, the Mars Exploration Rovers Spirit and Opportunity landed. In 2012, the Curiosity Rover will begin a new era of exploration and helping scientists on Earth make new discoveries about Mars!

2. Explore:

a. Pre-Launch Reconnaissance (Earth-bound observations).

i. Arrange Mission Teams (4-5 students) against a side of the room. These areas will be referred to as Mission Control.
ii. To simulate Earth's atmosphere, a blue cellophane sheet could be placed on the end of the viewers, held in place by a rubber band. This helps to simulate the variation that occurs when viewing objects through the Earth's atmosphere.
iii. Lift the towel. Teams observe the planet(s) with viewers for 30 seconds.
iv. Replace the towel. Teams can discuss and record their observations of the planet on the **Student Sheet #1.**
v. Most of the observations will be visual such as color, shape, and texture.
vi. Teams will write questions to be explored in the future missions to the planet on their **Student Sheet #1**.
vii. Explain that there are 3 types of missions scientists and engineers will plan. The Fly-by, the Orbiter, and the Lander/Rover. Each of these will progressively give a closer view and more detail of the planet, but they also begin to answer more detailed questions.

b. Mission 1: The Fly-by

i. Ask students to remove the blue cellophane from their viewers.
ii. All Teams will be at Mission Control with backs turned toward the planet.
iii. Each Mission Team will simulate a Fly-by mission. Each team will have a turn at walking quickly past one side of the planet. Keep the backside

of the planets covered with the towel. Students will need to maintain a distance of 5 feet from the planet (placing some masking tape on the floor to show the boundary helps.

iv. Teams will return the Mission Control and again turn their backs to the planet while other teams complete their Fly-by.

v. Replace the towel and give students the opportunity to record their observations and discuss what they will be looking for on their orbit mission.

c. Mission 2: The Orbiter

i. Each Mission Team will take one minute to orbit (circle) the planet at a distance of no nearer than two feet.

ii. Using their viewer, students will observe distinguishing features and record their data once they have returned to Mission Control.

iii. Mission Teams will develop a Mission Plan for their landing expedition onto the planet's surface. Mission Plans should include the landing spot and features to be examined.

d. Mission 3: The Lander / Rover

i. Using their viewers, each Mission Team will approach their landing site and mark it with a pushpin (use masking tape or sticker if the pin will destroy the planet).

ii. Each member of the Mission Team will take turns observing the landing site with the viewers.

iii. The field of view can be kept consistent by aligning the pushpin inside the viewer toward the top.

iv. Mission Teams will be given 5 minutes to complete their Mission Plan then return to Mission Control.

v. Students will record final observations in the **Student Sheet #1**.

3. Explain:

a. Students will complete the **Student Sheet #2**. Here they will need to explain their discovery about the purpose of each type of mission and the types of data you can collect.

b. You will find links on the **Resource Page** regarding each Mars mission categorized by mission type. These can be used to help students understand the history and nature of scientific discovery.

4. Elaborate:

a. Explain to students about the most recent mission to Mars. Access http://mars.jpl.nasa.gov/programmissions/missions for the most information on the most current and future missions. Explain the type of mission and the mission goals. Ask the students what types of missions must have come before this one and ask them to explain what information scientists must have needed before they could prepare this mission.

5. Evaluate:

a. Students will complete a presentation of their discoveries for the class and finalize **Student Sheet #2** with their understanding of the History and Nature of Science.

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Resource Guide

Fly-bys:

Mariner 4, 6, and 7
http://mars.jpl.nasa.gov/missions/past/mariner3-4.html
http://mars.jpl.nasa.gov/missions/past/mariner6-7.html

Orbiters:

Mariner 9
http://mars.jpl.nasa.gov/missions/past/mariner8-9.html

Viking 1 and 2
http://mars.jpl.nasa.gov/missions/past/viking.html

Mars Global Surveyor
http://mars.jpl.nasa.gov/missions/past/globalsurveyor.html

Mars Odyssey Orbiter
http://mars.jpl.nasa.gov/missions/present/odyssey.html

Mars Reconnaissance Orbiter
http://mars.jpl.nasa.gov/programmissions/missions/present/2005/

Landers / Rovers:

Viking 1 and 2
http://mars.jpl.nasa.gov/missions/past/viking.html

Mars Pathfinder and Sojourner Rover
http://mars.jpl.nasa.gov/missions/past/pathfinder.html

Mars Exploration Rovers (Spirit and Opportunity)
http://mars.jpl.nasa.gov/missions/present/2003.html

Phoenix
http://mars.jpl.nasa.gov/missions/past/phoenix.html

Mars Science Laboratory Curiosity Rover
http://mars.jpl.nasa.gov/missions/present/msl.html

Student Sheet #1

Explain how you think we know about the planets & moons in our solar system?

_____

_____

_____

_____

_____

Earth-based Observation: Record your observations here

Draw	Describe

Questions for future exploration:

_____

_____

_____

_____

Mission 1: The Fly-by – Record your observations here

Draw	Describe

Which of your questions did this mission answer? Record your answers?

_____

_____

_____

_____

_____

_____

What will you be looking for on your orbiter mission?

_____

_____

_____

_____

Mission 2: The Orbiter – Record your observations here

Draw	Describe

Which of your questions did this mission answer? Record your answers.

_____

_____

_____

_____

_____

_____

Mission 3: Lander / Rover Mission Plan - Plan your observations here

Draw Landing Site	Describe Features to Observe

Mission 3: The Lander / Rover – Record your observations here

Draw	Describe

Which of your questions did this mission answer? What is the answer?

_____

_____

_____

_____

_____

How did your team decide on a landing site?

_____

_____

_____

_____

_____

_____

Strange New Planet
Student Sheet #2

In the tables below:

1. Assign a sequence you think scientists will use to explore planets with these types of missions.
2. List the kinds of information you can collect from each type of mission.
3. List the advantages and disadvantages of using each type of mission.

Mission Type	Sequence (1-4)	Type of Information	Advantages	Disadvantages
Earth-Based Observations				
Fly-by				

Mission Type	Sequence (1-4)	Type of Information	Advantages	Disadvantages
Orbiter				
Lander/ Rover				

Why do you think the missions will go in this order? What is the advantage or purpose?

Do scientists work alone or in teams? Give examples from this activity to support your answer.

Prepare a presentation for the class that includes:

1. *Drawings of your observations*
2. *A list of all your discoveries*
3. *Identify your most important discovery and explain why it is so important*.

What did you learn new about the Strange New Planet during class presentations?

What is the advantage of a variety of missions and having multiple scientists investigating other planets?

Why is it important that scientists look at things they are studying in different ways?

