Strange New Planet

Grades: Middle School   Prep Time: ~45 Minutes   Lesson Time: 2.5 Hours

WHAT STUDENTS DO: Explore a Model Planet to Discover New Features

Students find out how human curiosity in planetary exploration results in science questions, engineering solutions, and teamwork. This activity demonstrates how planetary features are discovered by the use of remote-sensing techniques. Students will experience the different phases in planetary exploration, including telescope observations, fly by missions, orbiters, landers, rovers…and their own ideas about human exploration. In this collection, this lesson provides one of the building blocks for understanding the relationship among science, engineering, technology, and teamwork, necessary to discovery and innovation.

NRC FRAMEWORK / NGSS CORE QUESTION

HOW DO ENGINEERS SOLVE PROBLEMS?

NRC Core Question: ETS1: Engineering Design

What is a design for? What are the criteria and constraints of a successful solution?

NRC ETS1.A: Defining and Delimiting an Engineering Problem

INSTRUCTIONAL OBJECTIVES (IO)

Students will be able to

IO1: use a physical model to investigate and describe how scientists and engineers understand the limitations presented through certain technologies and use a variety of increasingly complex tools to explore our solar system

See Section 4.0 and Teacher Guide at the end of this lesson for details on Instructional Objective(s), Learning Outcomes, Standards, & and Rubrics.

1.0 Materials

Required Materials

Please supply:

For making "strange new planets"
- Modeling clay or play-dough
- Choose among: plastic balls, foam balls, sequins, round fruit, perfume, essential oils, candy, small stickers, marbles, cotton balls, glue, toothpicks, marshmallows, beads

For viewing "strange new planets"
- Sheets of paper, paper towel rolls, toilet paper rolls, or paint roller tubes
- Rubber bands
- 5"X5" clear, blue cellophane squares

Facility
- A room where students can easily move around. If it is too difficult to change the arrangement of a classroom or small space, consider doing the activity outside or in a more open room, such as a cafeteria or a gym.

Other:
- cloth or towel
- push pins
- masking tape
- colored pencils or crayons

Please Print:

From Student Guide:

(A)	Earth-Based Observations	
(B)	Telescope Observations	– 1 per student
(C)	Fly-by Mission Observations	– 1 per student
(D)	Orbiter Mission Observations	– 1 per student
(E)	Lander Mission Plan	– 1 per student
(F)	Comparison of Mission Types	– 1 per student
(G)	Humans to Mars Concept	– 1 per student
(H)	Reflections	– 1 per student

 NGSS Teacher Tip: Print the *(H) Reflection of Science and Engineering Practices* on blue paper and *(H) Reflection Crosscutting Concepts* on green paper to match the color-coded posters and standards.

Optional Materials

From Teacher Guide:

(I) Mars Mission Facts
(J) "Strange New Planet" Assessment Rubrics

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NGSS Materials:
"A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas" (NRC, 2012), also known as the Framework, articulates a vision of exemplary science instruction based upon current research. This vision centers on 3-dimensional learning in which Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts in science and engineering are coherently integrated in instructional design. It isn't enough, however, that students engage in the Practices as they develop a deep understanding of the Core Ideas. Students must also be cognitively aware of what they are doing and what the Practices are. The reflection assignment will engage students in thinking about the Practices, about what those Practices are, and how the Practices relate to doing science.

This lesson will assist you in integrating this activity and will suggest resources.

Please Print:

NGSS Practices Poster
NGSS Crosscutting Concepts Poster
NGSS Understanding about the Nature of Science Poster

Please Read:

Appendix F – Science and Engineering Practices in NGSS
Appendix G – Crosscutting Concepts
Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards

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3.0 Vocabulary

Ask questions	scientists asks questions that can be answered using **empirical evidence**
Fly by	a spacecraft designed to go by a planet and study it on its way past
Empirical Evidence	knowledge gained through direct or indirect observation
Lander	a spacecraft designed to explore on the surface of a planet from a stationary position
Limitation	something that controls how much of something is possible or allowed
Mission	a spacecraft designed to explore space, seeking to answer scientific questions
Models	a simulation that helps explain natural and human-made systems and shows possible flaws
Observations	specific details recorded to describe an object
Orbiter	a spacecraft designed to explore space, seeking to answer scientific questions
Rover	a robot designed to travel on the surface of a planet
Planet	a sphere moving in orbit around a star (e.g., Earth moving around the sun)

3.0 Procedures

PREPARATION (~45 minutes)

Constructing the "Strange New Planet"

A. Take play dough or modeling clay and form a ball (the planet). You can use multiple colors if you would like. Decorate the planet with stickers, objects, scents etc. to make the planet interesting to observe. Some of these materials should be placed discreetly so that they are not obvious upon brief or distant observations. Some suggested features include:

a. creating clouds by adding cotton

b. carving channels in the play dough or clay

c. attaching a grape or marshmallow using a toothpick representing a moon

d. using small beads to make craters in the play dough or clay

e. affixing small stickers (perhaps with a picture of a bug to signify life)

f. embedding beads or other small objects in the play dough or clay

g. applying scent sparingly to a small area.

h. Have fun with it!!

Teacher Tip: Make one planet blue. This planet will be difficult to see with the blue cellophane covering the viewer. If making multiple planets, place this blue planet to the outside of the others. Students will tend to focus on the planets in the middle of your display first. This gives the students an opportunity to discover "something new" when the blue cellophane is removed.

B. Place the object (planet) on a desk or table in a space clear enough to allow students to walk past the table and eventually fully orbit around the table. Make sure the "back side" of the planet has something interesting that can't be seen from its front side. Cover the object with a towel before students arrive.

C. Use masking tape on the floor to create a 2-foot distance and a 5-foot distance around the desk or table.

Constructing the Planet Viewers

D. Construct viewers (or have students construct viewers) out of an empty toilet paper, paper towel roll, or paint roller tubes.

E. Place one translucent, blue cellophane square over one end of the tube and attach with a rubber band.

Printing:

F. Please print handouts (A) – (H) in the Student Guide

STEP 1: ENGAGE (~15 minutes)

How Science & Engineering Come Together in Planetary Exploration

A At the beginning of the lesson very briefly tell students that scientists and engineers engage in certain practices when they are doing science or engineering and certain fundamental ideas are applicable to all science and engineering, called crosscutting concepts.

B Provide either wall posters (11 x 17 format) or individual handouts (8.5 by 11 format) briefly describing the Practices and Crosscutting Concepts (be sure to include the Nature of Science also).

C Tell students that they will be asked to identify if they do any of these practices at the end of the activities.

NGSS Teacher Tip: The descriptions of the Practices and Crosscutting Concepts on the poster or handout are brief; therefore, you may wish to become more familiar with the Crosscutting Concepts and the Understandings about the Nature of Science. You can get very good information from the Next Generation Science Standards (NGSS) web site. Recommended are *Appendix F – Science and Engineering Practices in NGSS, Appendix G – Crosscutting Concepts*, and *Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards*. These resources will help you to assist your students if they say that they don't understand the Practices, Crosscutting Concepts, or the Nature of Science. Also, in the Alignment document provided for this lesson the instructional designers have indicated the Crosscutting Concepts they have determined to be most appropriate.

D. Tell students they have a mission. They are scientists who have just discovered a strange new planet, and their job is to find out all about it. They will be exploring this new world in the same way that NASA explores the solar system. Ask them what questions about the new planet they may have. Ask them how they might go about answering the questions. Discuss the idea that people have questions about the natural world and observations and measurements using technology tools helps us find answers (see standards, Section 4.0).

E. If desired, provide a first-person account through storytelling.

"Let me tell you a story about Dr. Christensen, a scientist who studies Mars today. He was interested in space since he was a kid. "Dr. C" remembers how people's ideas about Mars changed tremendously after the first spacecraft went to 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 describing Mars like Earth. Our first spacecraft to Mars sent back the first photographs of another planet ever—in 1965.

When we got those pictures, our ideas of Mars changed forever. Mars was not a lush green planet, but a barren, desert-like planet. That information helped NASA plan missions that followed, including orbiters, landers, and rovers. Each mission brought new information that led to new questions. New questions lead to new discoveries. You're going to find that out in exploring your own "strange new planet." (See also Extensions.)

STEP 2: EXPLORE (~45 minutes)

How Engineering & Technology Support Science Questions

Telescope Observations from the Earth's Surface

A. Arrange Mission Teams (4-5 students) against the front of the room, or opposite the wall with the table and the cloth-covered "strange new planet." Tell students that they are standing in "Mission Control."

B. Hand out *(A) Earth-based Observation Worksheet* to each team.

C. To simulate Earth's atmosphere, place a blue cellophane sheet on the end of the viewers, held in place by a rubber band. Tell the students that the tube represents a telescope located on the surface of the Earth and that the blue cellophane represents Earth's atmosphere.

D. Tell students they will have the first look at the "strange new planet" with their telescopes. Lift the towel. Allow the team to observe the planet(s) with viewers for 30 seconds.

E. Replace the towel. Tell teams to discuss and record their observations on *(B) Telescope Observation Worksheet*.

Teacher Tip: Most of the observations at this point will likely be general in nature, such as color, shape, texture, or a large, obvious feature such as the presence of a moon.

Telescope Observations from above the Earth's Atmosphere

A. Ask students to remove the blue cellophane and take one-step forward. Tell them that their viewer is now a space telescope (like the Hubble) and that the atmosphere no longer obscures their view.

B. Tell students that a space telescope is expensive, and many scientists want time to use it to answer their questions. So, they have short scheduled times to use it.

C. Lift the towel again and allow students to observe the planet(s) with viewers for 30 seconds. Cover the planet(s).

D. Allow students to record any additional observations on the *(A) Telescope Observation Worksheet*.

E. Ask students to create questions they have about the planet, based on their observations.

Fly By of the Planets

A. Ask students at their mission control stations to turn their backs to the planets until it is time to do their mission.

B. Uncover the front part of the planet(s), but keep the backside covered by the cloth.

C. Ask students in the first team to raise their viewer to their eyes. Tell them that they will have a chance to pretend to be a spacecraft that will quickly fly by the planet, but cannot cross the masking-tape line that is 5-feet from the table. Have the first team turn around and make a pass by (fly by) the planet(s), and return to Mission Control, keeping their backs turned once there. Repeat with remaining teams.

D. Once all teams have conducted their fly by mission, replace the towel.

E. Hand out a *(C) Fly-by Observation Worksheet* to each student. Give students an opportunity to record their observations and discuss what questions they have for an orbital mission.

Teacher Tip: It's okay for students to discuss their finding in earshot of other students. Scientists work in much the same way, learning from their peers and building on top of previously done science.

Orbiting the Planets

A. Ask students at their mission control stations to turn their backs to the planets until it is time to do their mission.

B. Uncover all sides of the planet(s).

C. Tell each mission team they have one minute to orbit (circle) the planet at a distance of no more than 2 feet, looking through their viewer. Allow each team to conduct their mission and return to mission control.

D. Hand out a *(D) Orbiter Observation Worksheet* to each student. Give students an opportunity to record their observations and discuss what questions they have for an orbital mission.

Landing on the Planets

A. Hand out a *(E) Lander/Rover Mission Plan* to each student. Tell students they will develop a mission plan for their landing expedition onto the planet's surface. Mission plans should include the landing spot and feature to be examined based on their interests and science questions from prior observations. Teams will have to agree on one place to examine.

B. Using a pushpin, have a mission team member approach the selected landing site and mark it. (Use masking tape or a sticker if the pin would damage the planet.)

Last edited: March 31, 2016

C. Tell each mission team that they have one minute to look at their landing site through their viewers. So that they all see the same things through their viewers, instruct students to line up the location of the pushpin in their “field of view” in the viewer in a common place (inside the viewer, at the top of their view, in the center.

Teacher Tip: To illustrate, draw a simple circle on the board and mark the position of the pushpin at top center of the circle.

D. When team members have observed the landing site to record their observations and then discuss answers to their science questions.

Technology Option: Take a photo of the area the students want to explore, just like taking an image with an orbiting satellite. Provide the image to students digitally to make their observations.

STEP 3: EXPLAIN (~10 – 30 minutes)

How Engineering and Technology Support Answering Scientific Questions.

A. Hand out *(F) Comparisons of Mission Ty*pes.

B. Share information about the history of Mars Exploration or have them research online about Mars missions so far (see Teacher Guide.) Ask students to compare mission types based on their own observations of the strange new planet and the history of mission types in Mars Exploration.

C. Organize students into groups of size and composition you know to be most effective.

D. Hand out *(F) Reflections*.

E. Allow discussion for 10 – 15 minutes.

F. Ask each group to share its best thinking about which Practices and Understanding of Nature of Science were done, when it was done, and what the group’s reasoning was for this. Record the results from each group in columns on the board.

Teacher Tip: The most important part of these activities is to engage students’ thinking about the Practices, Crosscutting Concepts and the Nature of Science. The emphasis is on the rationale the students provide rather than what Practices or Crosscutting Concepts were identified in the Alignment document. Be prepared to ask questions to elicit more complete reasoning for the group’s decision. Allow discussion if groups do not initially agree. The discussions will help to develop deeper understandings.

STEP 4: ELABORATE (~10 minutes)

Planning a New Mission.

A. Tell students they are going to plan the first human mission to Mars, which will involve the ideas of teams from many nations and people from many cultures. Explain that this mission may be the first step in many before we can establish a community there.

Last edited: March 31, 2016

B. Hand out *(G) Mission Concept for the First Human Mission to Mars* and allow each team to complete the first section, with each team member contributing at least one idea for inclusion. Tell each team that all team members should pick at least one science question they would want astronauts to answer and their ideas about what kind of engineering and technological solutions would be needed.

STEP 5: EVALUATE (~60 minutes)

Assessing Strengths and Weaknesses of Proposed Missions.

A. Ask each team to present the ideas for their mission to other teams, with each team member explaining at least one science question related engineering and technological solutions that would be needed.

B. As each team presents, have other teams complete the second section of *(F) Mission Concept for the First Human Mission to Mars*.

C. Collect student work and use rubrics to evaluate their current level of proficiency.

4.0 Extensions

- Use Marsbound! Mission to the Red Planet to plan a mission to Mars using their newfound knowledge regarding how we explore the solar system. For more information on this fun and exciting Engineering Design Mission Simulation, visit: https://marsed.mars.asu.edu/lesson_plans/marsbound
- As a homework activity, ask students to follow their curiosity about Mars. Ask them to go online (with parents or guardians, if their age suggests it), and ask "Dr. C" at least 3 questions about Mars. Have them write down the following url: http://mars.nasa.gov/drc/

7.0 Evaluation/Assessment

Use the *(L) Strange New Planet Rubric* as a formative and summative assessment, allowing students to improve their work and learn from mistakes during class. The rubric evaluates the activities using the Next Generation Science Standards.

(A) Student Handout. Earth-Based Observations

NAME:______________________________

1. **Explain how you think we know about the planets and moons in our solar system.**

2. **Record Your Observations.**

Draw	Describe

3. **Based on your observations, record your questions for future exploration.**

(B) Student Handout. Telescope Observations

NAME:________________________________

1. Record Your Observations.

Draw	Describe

2. Which of your questions (based on your "telescope" observations) did the fly-by mission answer? What are the answers?

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3. What new or remaining questions do you have for a future spacecraft that can orbit the planet?

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(C) Student Worksheet. Fly By Mission Observations

NAME:________________________________

1. Record Your Observations.

Draw	Describe

2. Which of your questions (based on your "telescope" observations) did the fly-by mission answer? What are the answers?

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3. What new or remaining questions do you have for a future spacecraft that can orbit the planet?

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(D) Student Worksheet. Orbiter Mission Observations

1. Record Your Observations. **NAME:**________________________________

Draw	**Describe**

2. Which of your questions (based on your "telescope" and fly-by observations) did the orbiter answer? What are the answers?

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3. What new or remaining questions do you have for a future spacecraft that can land on the planet?

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Last edited: March 31, 2016

(E) Student Worksheet. Lander/Rover Mission Plan (1 of 2)

1. Plan Your Observations. **NAME:**______________________________

Draw the Landing Site	Describe Features to Observe

2. How did your team decide on a landing site?

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____

(E) Student Worksheet. Lander/Rover Mission Plan (2 of 2)

NAME:_______________________________

3. Record Your Observations.

Draw	Describe

4. Which of your questions did this mission answer? What are the answers?

Last edited: March 31, 2016

(F) Student Worksheet. Mission Type Comparisons (1 of 3)

NAME:_______________________________

In the tables below, list the kinds of information you can collect from each type of mission, as well as the advantages and limitations of using each type.

Mission Type	Type of Information	Advantages	Limitations
Telescope Observations			
Fly By Missions			

(F) Student Worksheet. Mission Type Comparisons (2 of 3)

NAME:______________________________

In the tables below, list the kinds of information you can collect from each type of mission, as well as the advantages and limitations of using each type.

Mission Type	Type of Information	Advantages	Limitations
Orbiter Missions			
Lander/Rover Missions			

(F) Student Worksheet. Mission Type Comparisons (3 of 3)

NAME:_______________________________

In addition to engineering and technology, teamwork among people with different perspectives is important in answering science questions. Reflect on the following:

Question	My Thoughts
1. What were the advantages of working on a team to study the "strange new planet"?	
2. What were the limitations of working on a team to study the "strange new planet"?	
3. What could you do to encourage good teamwork in the future?	
4. Why is it important for many people with different perspectives and backgrounds to work together?	
5. How do you think scientists and engineers benefit from working together?	

(G) Student Worksheet. Humans to Mars Mission Concept (1 of 3)

NAME:_______________________________

Humans to Mars is the next logical step in exploration after rovers. Scientists can get even more detailed observations about a planet as humans explore and the Martian surface is a perfect example! Congratulations. You've just been selected to be part of a team that designs the first human mission to Mars! This mission is daring, and will require the skills and talents of many people.

Human Goals: **Our human mission to Mars will seek answers to the following science questions:**	**Human Innovations:** **Engineering and Technology Tools we imagine will be needed to answer these questions:**
1.	
2.	
3.	
4.	
5.	

(G) Student Worksheet. Humans to Mars Mission Concept (2 of 3)

Use the chart below to record science questions and mission plans for each group that presents their ideas.

Team	Science Question	Engineering and Technology Solutions

(G) Student Worksheet. Humans to Mars Mission Concept (3 of 3)

Compare your ideas to those of other teams. What ideas were similar? Which ideas did you like from the other teams that your team didn't think of?

(I) Teacher Resource. Mars Mission Facts

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

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

(H) Reflection – Science and Engineering Practices (1 of 6)

When scientists study phenomena to better understand how the natural world works or when engineers design solutions to a problem, they engage in certain processes called practices. These practices are, essentially, how science or engineering is done.

These Practices are:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Furthermore, there are 4 understandings about the Nature of Science that scientists have that are a foundation for the practices.

These Understandings about the Nature of Science are:

1. Scientific investigations use a variety of methods.
2. Scientific knowledge is based on empirical evidence (knowledge obtained by observation and experimentation).
3. Scientific knowledge is open to revision in light of new evidence.
4. Science models, laws, mechanisms, and theories explain natural phenomena.

Last edited: March 31, 2016

(H) Reflection – Crosscutting Concepts (2 of 6)

Some concepts are important to all studies in science and engineering. Seven of these ***Crosscutting Concepts*** – ideas that are important to any science (biology, physics, chemistry, ecology, astronomy, geology, etc.) and to all engineering – have been identified.

i. ***Patterns.*** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

ii. ***Cause and effect:*** *Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

iii. ***Scale, proportion, and quantity.*** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

iv. ***Systems and system models.*** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

v. ***Energy and matter: Flows, cycles, and conservation.*** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

vi. ***Structure and function.*** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

vii. ***Stability and change.*** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Furthermore, there are 4 understandings about the Nature of Science that are closely related to the Crosscutting Concepts.

These Understandings about the Nature of Science are:

1. Science is a way of knowing.
2. Scientific knowledge assumes an order and consistency in natural systems.
3. Science is a human endeavor.
4. Science addresses questions about the natural and material world.

(H) Reflection – Science and Engineering Practices (3 of 6)

Name: ____________________________

In your group, reflect carefully on the activities you have just completed and answer the following questions using the table on the next page.

a. What Science and/or Engineering Practices did you do and which of the understandings about the Nature of Science were important to what you did? (There is probably more than one.)
b. When? During which activities?
c. Explain your reasoning.
d. Be prepared to explain your best thinking about what Practices you used and when you were doing them in a full class discussion.

Nature of Science	When?	What is your reasoning?
Scientific investigations use a variety of methods.		
Scientific knowledge is based on empirical evidence (knowledge obtained by observation and experimentation).		
Scientific knowledge is open to revision in light of new evidence.		
Science models, laws, mechanisms, and theories explain natural phenomena.		

(H) Reflection – Science and Engineering Practices (4 of 6)

Practice	When?	What is your reasoning?
Asking questions (for science) and defining problems (for engineering)		
Developing and using models		
Planning and carrying out investigations		
Analyzing and interpreting data		
Using mathematics and computational thinking		
Constructing explanations (for science) and designing solutions (for engineering)		
Engaging in argument from evidence		
Obtaining, evaluating, and communicating information		

(H) Reflection – Crosscutting Concepts (5 of 6)

Name: ______________________________

In your group, reflect carefully on the activities you have just completed and answer the following questions using the table on the next page.

a. What Crosscutting Concepts did you do and which of the understandings about the Nature of Science were important to what you did? (There is probably more than one.)
b. When? During which activities?
c. Explain your reasoning.
d. Be prepared to explain your best thinking about what Crosscutting Concepts you used and when you were doing them in a full class discussion.

Nature of Science	When?	What is your reasoning?
Science is a way of knowing.		
Scientific knowledge assumes an order and consistency in natural systems.		
Science is a human endeavor.		
Science addresses questions about the natural and material world.		

(H) Reflection – Crosscutting Concepts (6 of 6)

Crosscutting Concepts	When?	What is your reasoning?
Patterns		
Cause and effect: Mechanism and explanation		
Scale, proportion, and quantity		
Systems and system models		
Energy and matter: Flows, cycles, and conservation		
Structure and function		
Stability and change		