



Temperature of Inner Planets

Adapted from MiniLab from McGraw-Hill Science Textbook

Focus on Inquiry

The student will conduct an investigation in which they will infer what affects the temperature on the inner planets using a student made model.

Lesson Content Overview

Students will understand that the atmosphere or lack of atmosphere affects the temperature of inner planets.

Duration	Setting	Grouping	PTI Inquiry Subskills
50 minutes	Classroom & Outside	Groups of 3-5 students	2.2, 3.1, 3.2, 3.3, 3.7, 5.3. 5.8. 7.3

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5	3.3	Computer w speakers, internet access, Promethean or Smart board	3	Students watch two small entertaining video clips about the inner planets. Students will make inferences about the difference in temperature with the four inner planets.
Explore	20	3.1, 3.2, 3.7, 5.8	Timer	3	Students will work in groups of 3-5 students to create a model to investigate what can affect temperature, simulating the greenhouse effect.
Explain	15	2.2		2	Through a series of guided questions the students will describe how the temperature of the two thermometers differs and possible causes for this change in temperature. Students will explain how situations with our inner planets might explain why temperature differs between the inner planets.
Expand	5	5.3	Individual computers	3	Students will read a brief article about the milky way galaxy and choose from a choice board a variety of writing activities to infer about what might possibly be at the center of the milky way galaxy.
Evaluate	5	7.3		3	Students will take an assessment in which they will infer what might affect the temperature of the inner planets.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 2:Developing and Using Models

NGSS Practice 3: Planning and Carrying Out Investigations

NGSS Practice 4: Analyzing and Interpreting Data

NGSS Practice 6: Constructing explanations

NGSS Practice 7: Engaging in arguments from evidence

NGSS Practice 8: Obtaining, Evaluating and Communicating Information



Next Generation Science Standards – Earth Science

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Florida Science Standards - Inquiry

SC.8.N.3.1 Select models useful in the investigations

Florida Science Standards – Earth Science

SC.8.E.5.7 Compare and contrast the properties of objects in the Solar System including the Sun, planets, and moons to those of Earth, such as gravitational force, distance from the Sun, speed, movement, temperature, and atmospheric conditions.

Materials and Advance Preparation**Materials List**

Class set (per group):

- 2 long thermometers
- One clear 2-liter plastic bottle
- Golf ball size ball of modeling clay
- Shoe box or similar size plastic storage tub
- Tape
- Timer

Blackline Masters

1. Blackline Master #1 – Post video discussion Round Robin Write Questions.
2. Blackline Master #2 – Lab procedures and inquiry questions.
3. Blackline Master #3 – Extend Center of the Milky Way Writing Directions and Rubric
4. Blackline Master #4 – Post lab assessment

Advance Preparation

1. Prepare materials for each group in the small tubs or shoe boxes.
2. Set up computer with video clips ready to show.
3. Copy blackline masters.

Lesson Information**Learning Objectives**

1. The student will be able to use the data collected in this lab to correctly infer what might be the cause of the temperature differences between the inner planets.
2. The student will be able to correctly state, based on their data, the bottle let the sun's energy in and that the energy became trapped in the bottle because of air could not circulate in and out of the bottle (simulating an atmosphere).
3. The student will be able to compare and contrast some of the properties of the inner planets including the temperature, and atmospheric conditions.

Prior Knowledge Needed by the Students

- Students need to know the names and positions of the inner planets.
- Students will need to know that in general scientific investigations at this level that temperatures should be recorded in Celsius.

Background Information

The four inner planets have many similarities such as they all share surface characteristics similar to Earth. Hence, they are called the terrestrial planets. They have similar compositions and densities. These planets are closer to the sun and relatively small. The atmospheres have changed due to

sunlight which produces chemical reactions that can break apart water molecules. Some other changes have occurred.

Lesson Procedure

Engage

1. Show the first video using the following clip (:58) <http://www.tubechop.com/watch/6203488>
2. Show the second video using the following clip (1:54): <http://www.tubechop.com/watch/6203507>
3. Students use the Round Robin write to complete the two Round Robin Write compare and contrast questions. (Directions are on Blackline Master #1)

Explore

1. Students insert one thermometer into a clear 2-liter plastic bottle.
2. Students wrap modeling clay around the opening to hold the thermometer in the center of the bottle. Be sure to form an airtight seal with the clay.
3. Students rest the bottle against the side of the shoe box or plastic tub in an area that receives direct sunlight.
4. Students lay the second thermometer on the top of the box with the tip extending off the side of the box. The tip should be at the same height as the tip of the thermometer that is inside the bottle.
5. Students tape the second thermometer to the top of the box.
6. Students read the two thermometers and record the temperature in Celsius on the data collection sheet (Blackline Master #2).
7. Students set the timer for fifteen minutes.
8. At five minute intervals, students record the temperatures on each of the thermometers on the data collection sheet.
9. After fifteen minutes and four temperatures (including starting temperature) have been recorded, students disassemble the model and return materials to the tub as they were when you received the tub.
10. Once students have returned to the classroom, they discuss their findings with another group to compare results.

Explain

Discuss the following questions with the class following the explore activity.

1. *What were the independent variables in this lab?*
2. *What were the dependent variables in this lab?*
3. *How did the two temperatures compare on the initial reading?*
4. *What was the difference (in degrees) after five minutes?*
5. *What was the difference (in degrees) after ten minutes?*
6. *What was the difference (in degrees) after fifteen minutes?*
7. *What do you think caused this difference in temperatures?*
8. *Why do you think it was important that we had the end of the thermometers at the same height?*
9. *Why might it have been important that we take an initial reading?*
10. *Why might it have been important that we take three additional readings?*
11. *What is the purpose of you sharing and comparing your findings with other groups?*
12. *How might we relate this model to inner planets and their temperatures?*
13. *What did the bottle represent in regard to Earth?*
14. *Using this information, what can we infer might be the cause of global warming on Earth?*

Expand

1. Students read the article *Eureka! Astronomers figure out distance to the earliest galaxy yet online* using the following link: <https://www.newsela.com/articles/galaxy-distance/id/9320/> (Students and teacher must sign up for a free account.)
2. Students read the following prompt and choose one writing choice options below:

You know that our galaxy is composed of many, many objects such as suns, planets, asteroids, comets, gas and dust. These objects all orbit around the center of the Milky Way Galaxy. What can you infer is at the center of the Milky Way Galaxy?

- a. Imagine that you were able to travel to the center of the Milky Way Galaxy. Write a newspaper article about your findings there.
 - b. Write a diary entry describing the day you finally arrived at the center of the Milky Way Galaxy.
 - c. Draw and label a detailed diagram of what you might find at the center of the Milky Way Galaxy.
3. Students use the attached rubric to guide their work. This is used by the teacher for grading.

Evaluate**FORMAL EVALUTION**

1. Three question summative evaluation (Blackline Master #4)

INFORMAL or OPTIONAL EVALUTIONS***Informal:***

1. Discussion during Engage (Blackline Master #1)
2. Observation during Explore (Blackline Master #2)
3. Creation of chart and graph during explore. (Blackline Master #2)
4. Oral discussion and questions during Explain.

Optional:

1. Extend Writing Activity (Blackline Master #3)

WRAP UP.

Bring the lesson to a conclusion by allowing students to pose one question they have regarding the content from the lesson on a post-it note to place on the “Parking Lot” poster by the door.

Supplementary Resources***Teachers***

RubriStar Home. (n.d) Retrieved June 11, 2015, from <http://rubistar.4teachers.org/index.php>
Website used to create the rubric for the writing activity.

Inner Planets. (n.d). Retrieved June 11, 2015, from <http://www.ronyerby.com/ss/inner.html>
Website used to gather additional information for background knowledge.

OuterSpace: "We are the Planets," The Solar System Song by StoryBots. (n.d.). Retrieved June 11, 2015 from <https://www.youtube.com/watch?v=ZHAqT4hXnMw>
Website containing first video for Engage

Interplanet Jane School House Rock. (n.d.). Retrieved June 11, 2015, from <https://youtube.com/watch?v=vmYVWJ82dQQ>
Website containing second video for Engage

TubeChop – Chop YouTube Videos. (n.d.). Retrieved June 11, 2015, from <http://www.tubechop.com>
Website used to chop only wanted sections of the youtube videos.

Michelle, A. (2012). Chapter 2 Lesson 2 Inner Planets. In *Florida Interactive Student Textbook Course 3 Science Glencoe* (p. 58). Columbus, OH: McGraw-Hill Companies

Students

McGraw-Hill/Glencoe, What's Science Got to Do With It? Middle School Science Earth Science 42 "Home Sweet Home: Video

A video discussing the former hypotheses regarding the inner planets and how scientific discoveries have proven these to not be supported. (accessible to those who use this textbook only)

Eureka! Astronomers figure out distance to the earliest galaxy yet. (n.d.). Retrieved from <https://www.newsela.com/articles/galaxy-distance/id/9320/>

Website containing article for the Expand activity. (Students and teacher must create a free account.)

CITATION OF SOURCES.

Where did you get the idea/materials for this lesson?(Put the author/date/book name or the Name of the website and the complete URL). I/We used the following resources to build our lesson:

Based on Michelle, A. (2012). Chapter 2 Lesson 2 Inner Planets. In *Florida Interactive Student Textbook Course 3 Science Glencoe* (p. 58). Columbus, OH: McGraw-Hill Companies

Yes, I cited all materials and resources used in this lesson.

Marcie A. Farrell

Lesson author signature

Blackline Master #1

Student Name: _____
Period #: _____

Date: _____

Post Video Round Robin Write Activity**Directions:**

1. On your paper, write one similarity of and one difference between the inner or terrestrial planets.
2. Then switch papers with your shoulder partner. Shoulder partners add one similarity and one difference to their partner's paper that is different than the previous answers.
3. Then switch with your face partner and add one more similarity and difference.
4. Be prepared for your group to share at least one similarity and one difference with the class.

Similarities:

1. _____
2. _____
3. _____

Differences:

1. _____
2. _____
3. _____

Blackline Master #2Student Name: _____
Period #: _____

Date: _____

Inner Planet Inquiry Lab

1. Insert one thermometer into a clear 2-liter plastic bottle.
2. Wrap modeling clay around the opening to hold the thermometer in the center of the bottle. Be sure to form an airtight seal with the clay.
3. Rest the bottle against the side of the shoe box or plastic tub in an area that receives direct sunlight.
4. Lay the second thermometer on the top of the box with the tip extending off the side of the box. The tip should be at the same height as the tip of the thermometer that is inside the bottle.
5. Tape the second thermometer to the top of the box.
6. Read the two thermometers and record the temperature in celcuis on the data collection sheet.
7. Set the timer for fifteen minutes.
8. At five minute intervals, record the temperatures on each of the thermometers on the data collection sheet.
9. After fifteen minutes and four temperatures (including starting temperature) have been recorded, disassemble the model and return materials to the tub as they were when you received the tub.
10. Once you have returned to the classroom, discuss your findings with another group to compare results..
11. On the back, create a line graph showing your data in one color and another groups in another color.

<u>Inner Planet Lab Data</u>				
	Initial Temp	Five min.	Ten min.	Fifteen min.
Degrees in Celsius				

Blackline Master #3Student Name: _____
Period #: _____

Date: _____

Extend Writing Activity**Directions:**

1. Read the article *Eureka! Astronomers figure out distance to the earliest galaxy yet* online using the following link: <https://www.newsela.com/articles/galaxy-distance/id/9320/>
2. Read the following prompt and choose one writing choice options below:

You know that our galaxy is composed of many, many objects such as suns, planets, asteroids, comets, gas and dust. These objects all orbit around the center of the Milky Way Galaxy. What can you infer is at the center of the Milky Way Galaxy?

- a. Imagine that you were able to travel to the center of the Milky Way Galaxy. Write a newspaper article about your findings there.
 - b. Write a diary entry describing the day you finally arrived at the center of the Milky Way Galaxy.
 - c. Draw and label a detailed diagram of what you might find at the center of the Milky Way Galaxy.
3. Use the rubric on the back to guide your writing. This will be used to grade your writing as well.

The Center of the Milky Way Galaxy Rubric

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Focus on Topic (Content)	There is one clear, well-focused topic. Main idea stands out and is supported by detailed information.	Main idea is clear but the supporting information is general.	Main idea is somewhat clear but there is a need for more supporting information.	The main idea is not clear. There is a seemingly random collection of information.
Word Choice	Writer uses vivid words and phrases that linger or draw pictures in the reader's mind, and the choice and placement of the words seems accurate, natural and not forced.	Writer uses vivid words and phrases that linger or draw pictures in the reader's mind, but occasionally the words are used inaccurately or seem overdone.	Writer uses words that communicate clearly, but the writing lacks variety, punch or flair.	Writer uses a limited vocabulary that does not communicate strongly or capture the reader's interest. Jargon or cliches may be present and detract from the meaning.
Sentence Length (Sentence Fluency)	Every paragraph has sentences that vary in length.	Almost all paragraphs have sentences that vary in length.	Some sentences vary in length.	Sentences rarely vary in length.
Flow & Rhythm (Sentence Fluency)	All sentences sound natural and are easy-on-the-ear when read aloud. Each sentence is clear and has an obvious emphasis.	Almost all sentences sound natural and are easy-on-the-ear when read aloud, but 1 or 2 are stiff and awkward or difficult to understand.	Most sentences sound natural and are easy-on-the-ear when read aloud, but several are stiff and awkward or are difficult to understand.	The sentences are difficult to read aloud because they sound awkward, are distractingly repetitive, or difficult to understand.
Grammar & Spelling (Conventions)	Writer makes no errors in grammar or spelling that distract the reader from the content.	Writer makes 1-2 errors in grammar or spelling that distract the reader from the content.	Writer makes 3-4 errors in grammar or spelling that distract the reader from the content.	Writer makes more than 4 errors in grammar or spelling that distract the reader from the content.

Blackline Master #4

Name _____ Date _____ Period # _____

Checking for Understanding: Inner Planets Model Lab

- ___ 1. Which of the following **DID OUR LAB** illustrate as a factor in the temperature of the inner planets? (LO#1)
- A. Planets that are closer to the sun will have a warmer temperature than those that are farther away.
 - B. The composition of each of the inner planets is a factor in determining the temperature of each of those planets.
 - C. The rate of a planet's rotation is a factor in determining the temperature of each of the inner planets.
 - D. Planets that have an atmosphere experience warming affect due to the Sun's energy becoming trapped in the atmosphere.
- ___ 2. Why did the temperature rise in the model with the bottle? (LO#2)
- A. The bottle magnified the sun's energy and warmed the air in the bottle.
 - B. The sun's energy became trapped in the bottle and warmed the air in the bottle.
 - C. The air in the bottle became compressed and got warmer.
 - D. The clay that was surrounding the thermometer warmed the thermometer.
3. On the back, briefly explain in your own words how atmospheres and atmospheric conditions affect the temperature of the inner planets. (SC.8.E.5.7) (LO#3)

Name _____ Date _____ Period # _____

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Answer Keys for Blackline Masters

Blackline Master #1

Student answers will vary.

Blackline Master #2

The chart should show a gradual increase in temperature for the thermometer inside the bottle.

The graph should be properly titled, labeled and drawn. It should show a gradual increase in temperature over time.

Blackline Master #3

The rubric should be used in the scoring of student writings.

Blackline Master #4

1. D
2. B
3. Answers will vary but should state that planets that contain an atmosphere experience the global warming affect which affects a planet's temperature.