

Activity #1

The Goldilocks Question: Just Right, Too Cold, or Too Hot?

Scale Model of the Inner Solar System [Adult]



Adapted from *The Earth As A Peppercorn*: <http://tinyurl.com/2ooch5> Guy Ottewell, NOAO.
Unless otherwise noted, all images are courtesy of SETI Institute.

1. Introduction

In this activity, you will “Think like a scientist!”

Scientists construct models to test ideas about objects or processes that cannot be directly studied. A model is not the real thing, but a substitute that can be tested and used to make predictions.

2. Science Objectives

Cadettes will learn how a planetary feature such as surface temperature can be determined by size and location in space by comparing Venus, Earth, and Mars.

In this activity, Cadettes are also introduced to a recurring theme that scientists investigate processes that cannot be directly observed though the use of models. Models can be built to scale out of common materials, with evidence gathered from spacecraft images, and tested to see how well that model explains a phenomenon. This process leads to discussions about the limitations of models, their usefulness when dealing with objects very far away, and at the same time, reflects one aspect of how science goes forward.

3. Materials

- [2] dolls or action figures of different sizes (i.e., different scales)
- Sun: any ball, diameter 20 cm (about 8 in), for instance, a soccer ball
- Index cards
- Mercury: a pin point
- Venus: a peppercorn, diameter 0.20 cm (0.08 in)
- Earth: a second peppercorn
- Mars: a pinhead, diameter 0.08 cm (0.03 in)

Outer planets are optional, but recommended:

- Jupiter: a chestnut or a puff ball, diameter 2.3 cm (0.90 in)
- Saturn: a hazelnut, acorn, or a puff ball, diameter 1.8 cm (0.70 in)
- Uranus: a wooden or plastic bead, diameter 0.76 cm (0.30 in)
- Neptune: a second wooden or plastic bead, diameter 0.76 cm (0.30 in)
- Pluto: a third pin point (or smaller, as Pluto is the smallest on the list)
- [2] balls: a large ball and a ball approximately half the diameter of the large ball

Advance Preparation

- a. Glue planets to index cards and label. Alternate set-up: for planets other than Mercury, Mars, and Pluto, use a marker to draw a spot on a card for each planet in the size specified.
 - b. Place the planets in a small box or bag.
 - c. Refer to [The Earth as a Peppercorn Activity Instructions: http://tinyurl.com/2ooch5](http://tinyurl.com/2ooch5)
 - d. Experiencing the entire solar system model is an eye- and mind-opening experience. At a minimum, the Sun and inner planets must be modeled to set the stage for the Girls Go To Mars Activities #2–5. The inner planets can be modeled in a large room or in a hallway, with reference made to the location of the outer planets (e.g., across the parking lot, in the next building, at the stoplight). The activity was written before Pluto was determined to be a dwarf planet. Pluto remains a favorite planet of many people.
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4. Leader Will Lead Large Group

- 4.1. Using the dolls/action figures, explain that each doll is a “model” human, to scale. The parts of a model are to the same scale. In this case, the model is smaller than actual, all parts and lengths are in proportion.
- 4.2. Ask the following questions:
 - 4.2.1. Why would scientists use smaller models?
To examine very large systems like the solar system.
 - 4.2.2. Why would scientists use models that are larger than actual?
To investigate or explain miniscule objects like molecules or DNA.
 - 4.2.3. Would the shoes (pants, shirt, etc.) of model A fit model B?
No, they would not be to the same scale.
- 4.3. Explain that the solar system model will have the objects and distances to the same scale.
- 4.4. The soccer ball is the Sun. Ask all in the group to show using their hands and fingers, the size of the Earth compared to the ball. After checking with everyone, take out model Earth. Explain the size difference between Earth and the Sun.
- 4.5. Ask everyone to use their hands to show how far the Earth is from the Sun in the model. After checking everyone, tell them they will explore that by walking.
- 4.6. Line up the group and take 10 giant steps from the Sun (at a wall, or the starting point outside). This is Mercury’s location! Proceed through all of the planets through Mars at a minimum.

Scale Model Steps Between Objects

Sun/Planet	Giant Steps to Next Object	Total Distance
Sun	0	—
Mercury	10	—
Venus	18	—
Earth	25	—
Mars	38	—
Subtotal: Inner Solar System	91	91 m (.05 mi)
Jupiter	130	—
Saturn	238	—
Uranus	478	—
Neptune	749	—
Pluto	983	—
Total Steps	2,669	1 km (0.6 mi)

4.7. Ask the following questions:

4.7.1. What was surprising?

Answers vary.

4.7.2. What did you learn?

Answers vary.

4.7.3. What aspects of this model are accurate?

The distances in between the planets are proportional to the planet sizes; the planets and distances are the correct size.

4.7.4. What aspects of this model are inaccurate?

The planets are always moving in their orbits around the Sun. The planets are not in a straight line.

4.7.5. Why are models important to scientists?

They aid in understanding relationships and concepts.

4.8. Conclude by showing the Earth and Mars models (two balls).

4.9. Ask “If the large ball is Earth, which planet is the smaller ball?”

Mars.

5. Connection to the Leadership Journey *Breathe. It's Your Planet — Love It!*

Inform the Cadettes that the temperatures of the atmosphere on Earth and Mars are related to the planets' sizes and distances from the Sun. The difference in size is important to recall in later activities. Have Earth and Mars on display during the later activities.