Our Solar System Gallery

Adler Planetarium & Astronomy Museum

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Our Solar System Gallery

Let's explore the Solar System to find out about the worlds revolving around our Sun!

- Go to the "Exploration" exhibit under the planet models. There are spacecraft going to **planets**, **moons**, and even **asteroids**! Pick one spacecraft shown in the exhibit. What does it study? If you planned a space mission, what world would you visit, and what would you like to find out about it?

- Go to the "Surfaces" exhibit next to the "Exploration" exhibit. Look at the pictures. Pick one and describe the surface. Does it have craters? Are there signs of lava flows? What can surfaces tell you about a world? What are some surfaces you would find on our planet?

- Go to the "Hot Stuff" exhibit on the back of "Surfaces." Read about the heat inside planets. Now, go to the round table display and experiment with turning the handle. Could this surface be Earth? Io? How about Pluto? Why or why not?

- Look at the Moon rock, **meteorite** and Mars rocks in the back of the gallery along the windows. What are the similarities and differences between these? What are some similarities and differences to other rocks you've seen here on Earth?

- Look at the "Size and Scale" exhibit, to the right of the Mars Rover. These are the **rocky planets**. Now look up to see the **gas giants**! All these planets are to size scale in relation to the giant yellow sun in the center of the floor. Which are bigger, which are smaller, rocky planets or gas planets?

- Go to the "Atmospheres in Motion" exhibit, and turn the globe to make patterns as the directions say. Compare this to the planet models – which planets does this exhibit look most like?

- Choose one planet and draw a picture of it. What have you learned about this world?

Use the clues below and explore the planet panels and the Surfaces, Size and Scale and Atmospheres exhibits in the “Our Solar System” gallery to determine **WHO AM I?**

I am close to the Sun. I have clouds. I am almost the same size as Earth. Who am I? ________________	I have storms. I have rings. Earth can fit in my red spot. Who am I? ________________	I am very cold. I have rings. Triton is one of my moons. Who am I? ________________

I have craters. I am smaller than Earth. I am really hot in the day and really cold at night. Who am I? ________________	I am smaller than Earth. I am far from the Sun. My orbit is 249 years. Who am I? ________________	I have rings. I am far from the Sun. I am tilted on my side. Who am I? ________________

I have moons. I have storms. I have the biggest volcano in the Solar System. Who am I? ________________	I have storms. I have craters. I have oxygen in my atmosphere. Who am I? ________________	I am a gas giant. I have rings. I have at least 20 moons, 18 with names. Who am I? ________________

The Thousand Yard Model

PURPOSE:
This activity is designed as a teacher led tour of the solar system.

OBJECTIVE:
Students will create a distance and scale model of the solar system.

INTENDED AUDIENCE:
K – 12th grade

TIME REQUIRED:
30 – 40 minutes

MATERIALS:
The following are suggested items intended to represent objects in our Solar System.

Sun: a ball, diameter 8.00 inches
Mercury: a pinhead, diameter 0.03 inch
Venus: a peppercorn, diameter 0.08 inch
Earth: a second peppercorn
Mars: a second pinhead
Jupiter: a chestnut or a pecan, diameter 0.90 inch
Saturn: a hazelnut or an acorn, diameter 0.70 inch
Uranus: a peanut or coffee bean, diameter 0.30 inch
Neptune: a second peanut or coffee bean
Pluto: a third pinhead (or smaller, since Pluto is the smallest planet)

PREPARATION:
1. The three pins should be stuck through index cards in order to ensure the heads are visible. You may wish to attach each object to a labeled index card for easy identification.
2. An advantage of distinct objects such as peanuts is that their rough sizes are remembered along with them. It does not matter if the peanut is not exactly .3 inches long, nor that it is not spherical.
3. The actual distances used are not precise, since the length of students' and teachers' paces will vary.
4. Identify your outdoor location and secure necessary permissions to leave school grounds.

PROCEDURE:

Part I: Introducing the Concepts in the Classroom

4. Begin by spilling the objects out on a table and setting them in a row. Here is the moment to remind everyone of the number of planets (9) and their order (MVEMJSUNP).
5. Show the contrast between the great round looming Sun and the tiny planets. (And note a proof of the difference between reading and seeing: if it were not for the picture, the figures such as "8 inches" and ".08 inch" would create little impression.) Look at the second peppercorn--our "huge" Earth--up beside the truly huge curve of the Sun.
6. Having set out the objects with which the model is to be made, the next thing is to ask: "How much space do we need to make it?" Children may think that the tabletop will suffice, or a fraction of it, or merely moving the objects apart a little. Adults think in terms of the room or a fraction of the room, or perhaps the corridor outside. To arrive at the answer, we have to introduce scale.
7. The Earth is eight thousand miles wide! The peppercorn is eight hundredths of an inch wide. What about the Sun? It is eight hundred thousand miles wide. The ball representing it is eight inches wide. So, one inch in the model represents a hundred thousand miles in reality.
8. This means that one yard (36 inches) represents 3,600,000 miles. Take a pace: this distance across the floor is an enormous space-journey called "three million six hundred thousand miles."
9. Now, what is the distance between the Earth and the Sun? It is 93 million miles. In the model, this will be 26 yards. While you are talking and introducing the idea of the model, it may be helpful (depending on the age of the audience) to build up the scale as follows:

	Actual	Scale
Earth's width	8,000 miles	8/100 inch
Sun's width	800,000 miles	8 inches
therefore the scale is	100,000 miles	1 inch
therefore	3,600,000 miles	36 inches or 1 yard
and Sun-Earth distance	93,000,000 miles	26 yards

10. This still may not mean much until you get one of the students to start at the side of the room and take 26 paces. The student will come up against the opposite wall at about 15!
11. Clearly, it will be necessary to go outside.

Part II: Taking the Tour Outside

1. Hand the Sun and the planets to members of the class, making sure that each knows the name of the object he or she is carrying, so as to be able to produce it when called upon.
2. You will have found in advance a spot from which you can walk a thousand yards in something like a straight line. This may not be easy. Straightness of the course is not essential; nor do you have to be able to see one end of it from the other. You may have to "fold" it back on itself. It should be a unit that will make a good story afterwards like "All the way from the flagpole to the Japanese garden!"
3. Put the Sun ball down, and march away as follows. **10 paces to Mercury**. Ask the student with Mercury to put the card and pinhead down, weighting it with a pebble if necessary.

(After the first few planets, you will want to appoint someone else to do the actual pacing so that you are free to lead the tour.)

4. Another **9 paces to Venus**. Put down the peppercorn. Then another **7 paces on to Earth**.
5. Already the thing seems beyond belief. Mercury is supposed to be so close to the Sun that it is merely a scorched rock, and we never see it except in the Sun's glare at dawn or dusk-yet here it is, utterly lost in space! As for the Earth, who can believe that the Sun could warm us if we are that far from it?
6. The correctness of the scale can be proved to skeptics (for older students) on the spot. The apparent size of the Sun ball, 26 paces away, is now the same as that of the real Sun-half a degree or arc, or half the width of your little finger held at arm's length. (If the size of an object and the distance have both been scaled down by the same factor, then the angle it subtends must remain the same.)
7. Continue the tour. Another **14 paces to Mars**.
8. Now come the gasps, at the first substantially larger leap: another **95 paces to Jupiter**! Here is the "giant planet"-but it is a chestnut, more than a city block from its nearest neighbor in space! From now on, amazement itself cannot keep pace, as the intervals grow extravagantly.
9. Another **112 paces to Saturn**. Another **249 paces to Uranus**. Another **281 paces to Neptune**. Another **242 paces to Pluto**.
10. You have marched more than half a mile! (The distance in the model adds up to 1,019 paces. A mile is 1,760 yards.) Look back toward the Sun ball, which is no longer visible even with binoculars. Look down at the pinhead Pluto. You have traveled a distance that it is representative of the vastness of space.

EVALUATION:

Discuss the concepts of scale, distance and size as a class.

1. How do the distances **between planets** in the real solar system change as they orbit the Sun? (The distances between the planets in the scale model solar system are the minimum distances between the planets, since they are all neatly in a line.)
2. Where would you put the Moon in this model? (The Moon is about 30 Earth diameters away from the Earth, and it is about 1/4 the diameter of the Earth.)
3. Where would you put the nearest star to the Sun on this model? (Alpha Centauri, the nearest star to our Sun, is about 4.3 light years away. If you wanted to put it on your scale model of the solar system, you would need to walk about 8,000,000 paces! You would have to walk about the distance between San Francisco and New York! Some students may be confused about the size of the stars, even if they know the Sun is a star. The Sun is a relatively small star. A few stars have diameters larger than the distance between the Sun and Jupiter. Alpha Centauri is actually a system of 3 stars, one of which is just like the Sun, and the other two are smaller than the Sun. One of the stars would be the size of an orange on this scale. The 3rd star, Proxima Centauri, is the closest of the 3 and a very small star. It would be the size of a cherry on the model.)

CLOSURE:

At the end of the walking tour, you may want to turn your class around and retrace your steps. Re-counting the numbers and looking for the little objects re-emphasizes how lost they are in space. The journey back to the Sun will prepare them for further in depth exploration of the Solar System.

ACKNOWLEDGEMENTS:

This activity has been adapted from *The Thousand Yard Model (Or The Earth As A Peppercorn)* by Guy Ottewell, as presented in *The Universe At Your Fingertips: An Astronomy Activity and Resource Book*, edited by Andrew Fraknoi, Astronomical Society of the Pacific, San Francisco, CA, 1995.

Invent An Alien

PURPOSE:
This activity encourages students to creatively apply their knowledge of planetary characteristics to a design project.

OBJECTIVE:
Students will construct a model of an alien being suited the environmental conditions of a known or unknown world.

INTENDED AUDIENCE:
3rd – 12th grade

TIME REQUIRED:
1 week

MATERIALS:
Common items found around the house (paper towel tubes, yarn, pipe cleaners, aluminum foil, etc.)
Paper and pencil
Small box or bag
Slips of paper
Access to research materials: library, Internet, etc.

PREPARATION:
1. Place the name of each planet or satellite the class will be studying (except the Earth) on separate slips of paper. Make enough slips so there is one for each student in the class. Note: It is desirable to have more than one slip for each planet so students can see that there may be different solutions to the same problem.
2. The scientific accuracy of their alien beings is not as important as the reasoning processes they go through to create them.

PROCEDURE:
1. Place the slips of paper in a hat or box and have each student pick a world. The students should not reveal their world to other members of the class.
2. Inform the students that their goal is to construct the model of an alien creature that could live on the world they selected. These should be three-dimensional models made from any material they can find around the house.
3. Ask the students to research their world to identify the environmental characteristics their alien would encounter. Students should focus on features such as temperature, gravity,

terrain, radiation exposure, composition, and atmosphere.

4. Discuss what some of the requirements for a being to exist in a given world. Help the students brainstorm a list of needs that creatures need for survival. These might include:
   - a means to get food or nutrients
   - a way to move around the planet
   - a way to breathe
   - a means to reproduce
   - a mechanism to maintain proper body temperature
   - other means to sense the environment (equivalent to our five senses)
   - other suggestions they may have, such as the effects of a gravitational pull that is much larger or smaller than we experience
5. Before the students begin construction of their aliens, ask them to prepare a plan for their creature. This plan should outline the characteristics of the planets they have researched and the features allowing their alien to be suited for that world.
6. Students will build a representation of their creature that is suited to the environmental conditions of their world and meets the needs for survival. The outline should guide the development of their model and serve as the basis for a written description of their alien (without revealing the name of their planet).

EVALUATION:

1. On the day that the aliens are due, students display their models and descriptions around the room.
2. The students should then have the opportunity to examine each other's projects to try to determine their planet of origin. This part of the activity can also be done as an oral presentation. (If the written descriptions are used during this part of the activity, students must be instructed to write them without naming their worlds.)

CLOSURE:

1. After the aliens are reviewed, ask the students to discuss the difficulties they ran into designing life on other worlds.
2. What is it about Earth that makes it uniquely suited to sustain the diversity of life?

RESOURCES:

The following websites may be good starting points for your students research:
Windows to the Universe
http://windows.arc.nasa.gov

The Nine Planets
http://www.ece.nwu.edu/~pred/TNP/nineplanets

Welcome to the Planets: Jet Propulsion Laboratory
http://pds.jpl.nasa.gov/planets/

Views of the Solar System
http://www.hawastsoc.org/solar/eng/homepage.htm

ACKNOWLEDGEMENTS:
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