Solar Scale

Summary

Explore the shear size of the solar system by making a scale model and walking a scaled distance.

Time Frame

2 class periods of 45 minutes each

Group Size

Pairs

Life Skills

Communication, Systems Thinking

Materials

- Planets:
    - Sun=8 in ball (bowling or soccer ball) and a smaller ball for the Walk (this will depend on your scale)
    - Mercury=pin
    - Venus=peppercorn
    - Earth=peppercorn
    - Mars=pin
    - Jupiter=0.9 in ball (large marble)
    - Saturn=0.75 in ball (regular marble)
    - Uranus=coffee bean
    - Neptune=coffee bean
    - Pluto=pin
- 10 Flags
- tape
- glue
- pencils
- markers
- tape measure (optional)

Background for Teachers

Scaled models are necessary to visualize both very small and very large objects. The solar system is one of these objects that needs to be scaled down. The scale is still difficult to represent as planets are very small compared to the vast space between them.
Planets are thousands of miles across and there are millions of miles between planets.
The planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Pluto was X'ed from the list but you can still included as a known space object.

Student Prior Knowledge

Know of planets and that there is a solar system. Know that the Sun is a the center of the solar system and planets orbit around it.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills
    c. Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
    d. Compare things, processes, and events.
    3. Understand Science Concepts and Principles
    a. Know and explain science information specified for the grade level.
    4. Communicate Effectively Using Science Language and Reasoning
    b. Describe or explain observations carefully and report with pictures, sentences, and models.
    d. Use reference sources to obtain information and cite the source.
    e. Use mathematical reasoning to communicate information.

Instructional Procedures

Ahead of time:
Using Google Earth (or pace it out), measure the longest strait section on school property that you could use to lay out the planets. This will be around 200 yards. Use the attached .xls file to determine how spaced your planets need to be for the walking exercise.

Part 1: Scaled Planets
Begin with a discussion to get students thinking of size. How big is this room? this school? this city? this state? this country? the Earth? Students should see that the Earth is very, very, very, big compared to their immediate surroundings. Of course we aren't stopping there: the solar system and the universe are so big that it is hard to comprehend. If we want to see the solar system all in one place, we need to scale it. Introduce what a scale is: a hot wheels car is a 1/64th scale version of real cars. Therefore if you made a hot wheels car 64x bigger, it would be the size of a real car. We need to scale the solar system down much farther than that. The Earth is 8000 miles in diameter and the sun is 800,000 miles in diameter. If we are to make a model, these objects need to be able to fit into a classroom. Let's set a scale of 100,000 miles = 1 inches. That is a scale of 1:6,336,000,000. At this scale the sun has an 8 in diameter. the Earth has a diameter of 0.08 in (peppercorn diameter). Show how the bowling ball compares to the peppercorn. List the other diameters on the board.

Activity:
Split the class into 8 or 9 groups (depending on Pluto's inclusion). Assign the planets to groups. Each group should research a few facts about their planet and write it on the card along with the real diameter, scaled diameter, and the distance from the Sun. Students should glue their scaled planet to the card. When students are done, present each planet in front of the class so everyone can see the relative size of each planet.

If there is time left, start the discussion in Part 2

Part 2: The Walk
Now that we have scaled planets, how far apart should the planets be at this scale. Will they fit on a desk? a table? in this room? in this school? The answer to all of these is no. We need approximately 1000 yards to accurately space these planets from the Sun to Pluto. That is about 4 SLC blocks. Maybe we need to adjust our scale. If we only have 200 yards available, our scale is 1/5th of what it was, therefore all the planet sizes need to be divided by 5. Sun=1.6 in diameter. 1/5 of a pin head is too small so we will just mark out the planets with flagged stakes and use a scaled Sun. A very large marble or golf ball may work at this scale.

Activity: Walk it out
Assign a planet or task to each student or group of students and give them the materials. Walk to your predetermined starting point and set down the Sun. At your feet it already looks pretty small. As a group measure or pace out all of the planets. Assume that one step is 1 yard. When you get to each planet location, plant the appropriate flag and tell the students how many miles we are from the Sun

(these distances are listed in the .xls sheet). When you get to the Earth, point out that at this distance, the sun looks about as big as it does in the sky. Therefore out scale is correct! When you get to Pluto (or Neptune), look back at the Sun. Can you see it? How much heat makes it to here? We are very very very far away from the Sun but on the edge of the solar system. Where is the next closest star? The closest star is Proxima Centari which is 4.2 light years from the Sun. No matter what your scale is, that is hundreds of miles away AT SCALE! AND THIS IS ONLY ONE OF ABOUT 10 23 STARS!!!!!! THE UNIVERSE IS ENORMOUS!!!!!!!! This should blow your mind.
Fun facts: at a 200 yard scale, the Sun is still 380,000 Watts, that's the power of over 6000 60 Watt lightbulbs! At 1000 yard scale the Sun is 9.6 million Watts (MW). That is a small power plant and would provide energy for approximately 10,000 homes!

Extensions

Make students more responsible for calculations. Scale other object up or down and make models from clay or found objects.

Bibliography

http://www.noao.edu/education/peppercorn/pcmain.html

Authors

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