Young Astronomers

Solar system in my scale

Classroom Activity – After visiting the Observatory

Overview

Age Range: 7-10 years

Lesson Time: 75 min

Cost per activity: Relatively low

Includes the use of:
Computer and Excel

IF YOU MAKE THE MODEL OUTSIDE:
yard/sports field, tape measurer, small ball, a few grains of spices
IF YOU DRAW THE SCALE IN THE PAPER: ruler, pen and map of home town
IF YOU DRAW THE SCALE IN TOILET PAPER: toilet paper roll, pen

Fruits/berries of different sizes

Outline

Welcome on a trip to our neighbourhood, the Solar System! How far away are the other planets from Earth? And how small is our home planet compared to the other objects that orbit our Sun?

This assignment provides instructions on creating a model Solar System with correct relative distances in your schoolyard, for example. The other assignment uses fruit to compare the sizes of the planets.

Pupils will Learn:

- The small rocky planets that orbit closest to the Sun are relatively close to one another. The larger gas planets orbit further away from the Sun. The Sun is clearly the largest object in the Solar System.
- The sizes of the planets are very small when compared to the distances between them.

The online observatory collaboration consists of the following partners:
Baldone Observatory, Brorfelde Observatory, Cardiff University, Harestua Solar Observatory, Helsinki Observatory

Lesson Plan:

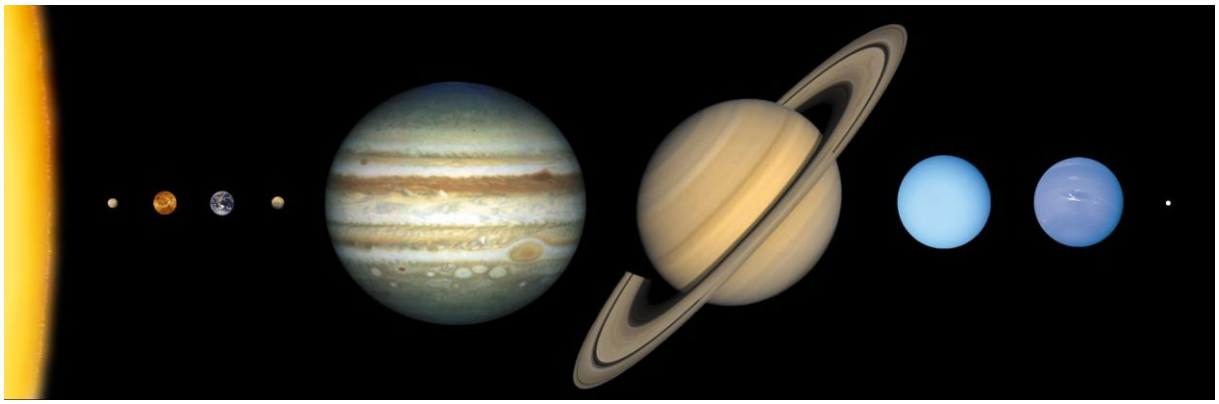
Description	Time	Notes
Introduction to the subject	5 min	
Activity 1: Solar system in my backyard	45 min	Learn the distances between the planets. This assignment can be done outside, or in class using a map or a roll of toilet paper. Use the calculator file provided (SolarSystemInMyScale Calculator.xlsx).
Assessment	5 min	
Activity 2: Fruit Solar system	15 min	Learn the relative sizes of the planets.
Assessment	5 min	

Introduction to the subject:

In many images of the Solar System, it is practically impossible to draw both the sizes of the objects and their distances from one another using the same scale. How large are the planets really, and how far away are they from one another? How big is our star, the Sun, compared to the planets?

Activate the pupils' existing knowledge and determine their knowledge level by discussing the following questions:

- What objects are there in our Solar System?
  [The Sun, stone and gas planets, and their moons. In addition, there are many smaller objects, such as asteroids, meteoroids, comets and dwarf planets (e.g., Pluto).]
- Which planets can you name? Which ones are closest to the Sun?
  [The rocky planets Mercury, Venus, Earth and Mars are in the inner areas of the Solar System. The planets consisting largely of gas, Jupiter, Saturn, Uranus and Neptune, are further on the outskirts. The small, icy Pluto is no longer considered a planet since many similar smaller objects were discovered around it. We would have had to add too many planets to our textbooks! Pluto is currently considered one of the dwarf planets and plutoids of the Solar System.]
- What is a scale model? Can you think of examples?
  [For example, a model airplane can come to mind. But consider that a doll is also a model of a human!]



The Solar system: Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Credit: Nasa.

Activity 1: Solar system in my backyard

1. Choose the area of your scale. The size of the area determines the scale of your project. Enter the size of the area as the longest distance in the calculator file SolarSystemInMyScale Calculator.xlsx (i.e., the distance between Neptune and the Sun). The calculator will display the average distances of the planets from the Sun as well as the diameters of the Sun and the planets in this scale. Please note that the sizes of the planets are extremely small when compared to the distances!
2. Build your scale model in the yard or a sports field. Bring a measuring tape and the results from the calculator file. First mark the position of the Sun on one edge of the area and calculate the locations of the planets. The calculator will also display how far our closest other star Alpha Centauri would be in the chosen scale.
3. For example, if the scale model is built on a football field which is 100 meters across, you will really only be able to include the Sun (a ball 3 cm in diameter), Jupiter and Saturn (e.g., small peppercorns 3 mm in diameter) as well as Uranus and Neptune (e.g., grains of salt 1 mm in diameter). Store the peppercorns and grains in small containers so they don't get lost on the ground!
4. If you do not have a large outdoor field at your disposal, you can also demonstrate the scale in class with a roll of toilet paper. The calculator will display the locations of the planets based on a roll of 200 squares of toilet paper, but it is also possible to change the total number of squares.
5. Alternatively, if the town or country is very familiar to the group, it may be helpful to understand the scale by drawing the planets on an actual map of the area. Check the calculator to see how large the objects would be if placed on the scale of the map. If you use the town as the scale, you could take a walk to the locations of the planets in your scale model so that you walk through the entire Solar system!

Assessment:

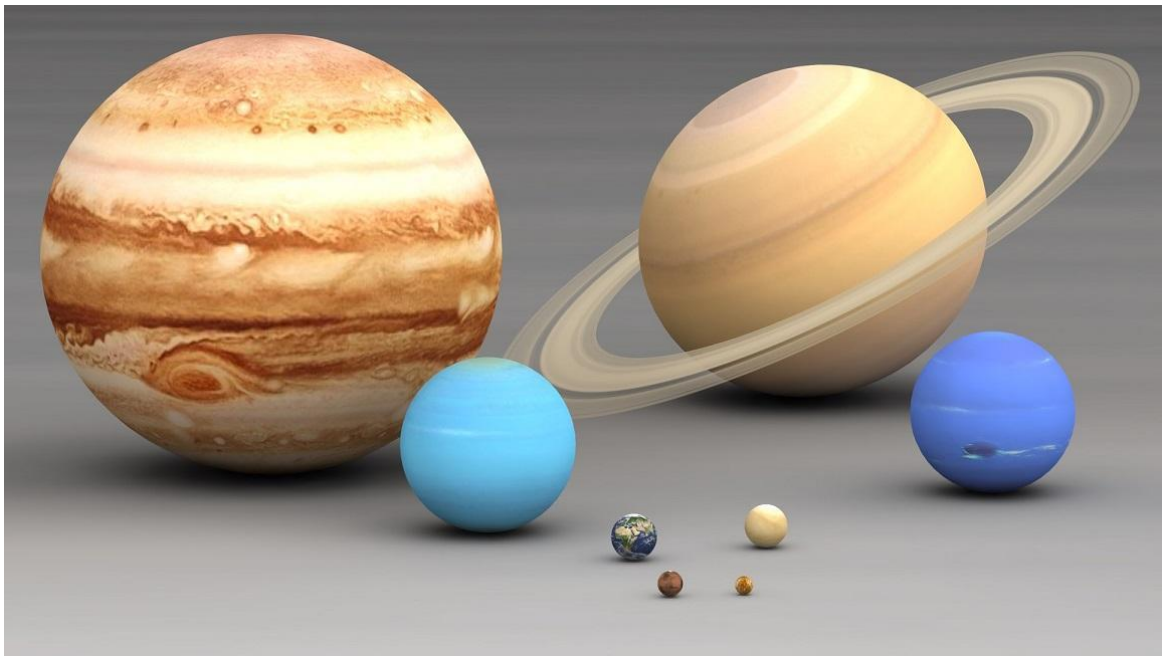
- How do the distances between the planets vary?

  [The orbits of the planets closest to the Sun are close together, while the planets further away move on orbits that are spaced further apart from one another.]
- Astronomers often measure distances in astronomical units (AU, the distance from the Earth to the Sun) or light years (the distance light travels in a year). Why are they more convenient than kilometres?
  [The distances are so huge that the measurements between the planets and the Sun would go up to giant figures if we used kilometres. It's easier, shorter and clearer to show the distances using the astronomical unit, for example, where 1 AU is approximately 150,000,000,000 metres.]
- When are scale models useful? Why is it sometimes difficult to make them fully correspond to reality?
  [A scale model is a good way to depict things that are very large or very small. However, it is often impossible to show all of the characteristics of the real objects in the right scale. For example, it is very difficult to show both the relative sizes and distances of the planets in the same scale model.]

Activity 2: Fruit Solar system

1. This assignment focuses on the relative sizes of the planets. You can find the necessary items in your local grocery store as follows (in this scale, the distance between Neptune and the Sun is 8,000 metres):
   - JUPITER: **1 large watermelon** (about 25 cm)
   - SATURN: **1 large grapefruit or small melon** (about 20 cm)
   - URANUS: **1 apple** (about 9 cm)
   - NEPTUNE: **1 orange, slightly smaller than the apple** (about 8,5 cm)
   - EARTH AND VENUS: **2 cherry tomatoes** (about 2 cm)
   - MARS: **1 large blueberry** (about 1 cm)
   - MERCURY: **1 pea** (about 8 mm)
2. Place the planets in the right order from the Sun (the rocky planets Mercury, Venus, Earth and Mars followed by the gas planets Jupiter, Saturn, Uranus and Neptune). See how large the objects seem next to each other.
3. It is impossible to find a fruit large enough to serve as the Sun, which is ten times the size of Jupiter. If our Jupiter watermelon is approximately 25 cm in diameter, the Sun would have to be 2.5 meters! You can use a metre ruler to illustrate this. The pupils can also form a circle the size of the Sun in this scale so that the fingertips of each child touch those of their neighbour. A circle with a 2,5-metre diameter will take

between five and seven pupils. You can now place the fruit-planets inside the Sun circle: they will all fit easily!



Jupiter, Saturn, bluish Neptune and Uranus, Earth, Venus, Mars and Mercury. Credit: User: Lsmpascal/Own work/Wikimedia Commons/CC BY-SA 3.0

Assessment:

- Which planets are the largest? Which ones are smallest? [The planets closest to the Sun are smaller than the considerably larger planets orbiting further away from the Sun.]
- What is the largest object in the Solar System? [The Sun!]

Background Material/Knowledge:

- numbers, counting
- measuring, using a ruler