Classroom Activity: How are Planets Classified?

By Cris L. DeWolf

Back in 2011 I attended a workshop at the Space Telescope Science Institute at Johns Hopkins University in Baltimore. The workshop – "The Solar System: Inside and Out" – was part of a NASA Explorer School teacher recognition program.

One of the activities we field- tested involved using physical data about solar system objects to arrange them into similar groups. This was, in part, meant to help teachers explain why Pluto is now considered a dwarf planet, rather than the 9th planet.

The lesson I am sharing here is patterned on what I learned that summer. I've used it with my 9th grade Earth & Space Science students, and with students in Astronomy 111 at Delta College this past winter.

Classifying the Solar System

Our solar system consists of the sun, 8 planets, 5 dwarf planets, and numerous moons, comets, and asteroids. The dwarf planets were first recognized as a separate category of solar system object in 2006 after the discovery of other objects similar in size to Pluto beyond the orbit of Neptune. They include Pluto, Eris, Makemake, Haumea, and Ceres. Other trans-Neptunian objects have not been formally classified as dwarf planets – yet. These include Sedna, Quaoar, Salacia, and Orcus.

The 8 planets can be subdivided into 3 groups – terrestrial planets, gas giants, and ice giants. The terrestrial planets, like Earth, have rocky crusts and mantles, with metallic cores. They also have relatively thin atmospheres. Gas giants and ice giants together are commonly referred to as Jovian planets after Jupiter, the largest of these planets. Gas giants and ice giants differ in their composition. Gas giants are much richer in hydrogen and helium (90%) than are the ice giants (20%).

Image Credit: NASA

If we consider the ratio between diameter and average density of objects in the solar system, we can quickly see by making a plot of this data the compositional differences among the objects, and a basis for their classification. This may also help us understand why Pluto lost its planetary status and became a dwarf planet.

Plotting Density versus Diameter for Solar System Objects

Materials

Solar System Object Cards

Density versus Diameter grid paper

- You will use the information for diameter and density provided on 13 cards to create a scatter-plot. As you plot the position of these objects on the grid provided, be sure to label each point with the object number.
- Make an attempt to sort the objects into 4 groups, based on their positions on the grid. Circle each set of objects that you consider part of the same group.

Questions

1. Which objects do you feel are the terrestrial planets? Why?
   Objects 1, 2, 3, 4, & 5. These are in the terrestrial group because they have the highest densities, and are smaller in diameter than the giants.

2. Which objects do you feel are the gas giants? Why?
   The gas giants are those objects with the largest diameters and the lowest densities. (6 & 7)

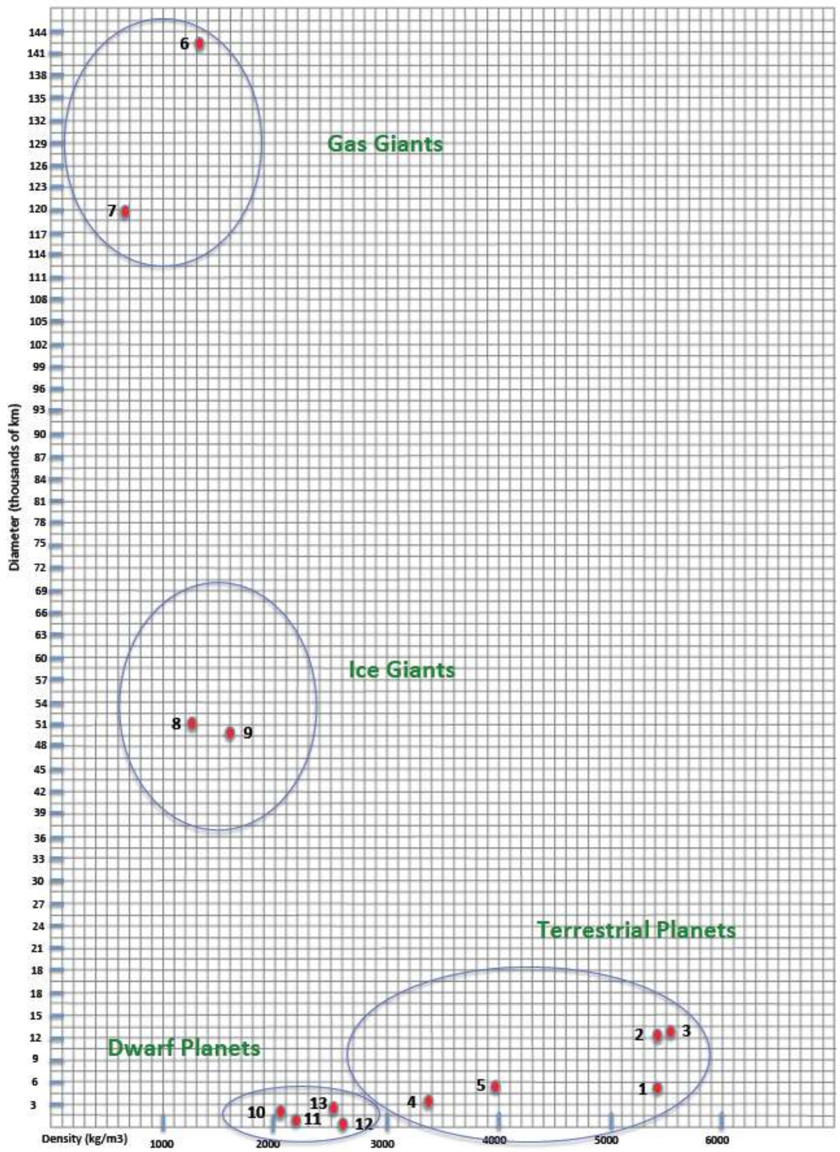
3. Which objects do you feel are the ice giants? Why?
   The ice giants have a higher density than the gas giants and lower densities than the dwarf and terrestrial planets. They are also between the terrestrial and gas giant planets in terms of their diameters.

4. Which objects do you feel are the dwarf planets? Why?
   The dwarf planets (objects 10, 11, 12, & 13) have the smallest diameters and have densities between the terrestrial and ice giant planets.

Classifying the Solar System

Object Card Key

Object #	***Solar System Object***
1	Mercury
2	Venus
3	Earth
4	Moon
5	Mars
6	Jupiter
7	Saturn
8	Uranus
9	Neptune
10	Pluto
11	Ceres
12	Eros
13	Eris



Questions for further discussion

1. Why do you think that objects #4 and #5 are so far to the left of the others in the terrestrial planet group?

   These are the Moon, and Mars. Students can research current thinking about the composition of these objects to help them explain the difference.

2. Why are the ice giants so different from the gas giants?

   These objects lack the amount of low-density gases (hydrogen and helium) that are found in the gas giants.

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