Pluto is a planet: True or False?

by Renato Schibeci

The recent reclassification of Pluto, once a planet, now a 'dwarf planet', provides an interesting way for science teachers to highlight the human basis of scientific classifications.


How can a planet suddenly be not a planet? The story of the planet that is no longer a planet makes an intriguing episode in the progress of science, highlighting the human basis of scientific classifications.

The story before August 2006

Imagine, if you can, a large heavenly object, comprised of 65% rock and 35% ice. It is over 2,300 kilometres in diameter and orbits the Sun, whose light faintly reflects. What is this object? Is it a planet? Is it a moon? Is it an asteroid?

The American astronomer, Clyde Tombaugh, discovered this object in 1930 at the Lowell Observatory in Flagstaff, Arizona. The object, named Pluto, has long been regarded as the ninth planet. Nevertheless, its size and its orbit, usually above and below the elliptical plane of the other planets, that periodically brings it closer to the sun than Neptune, have raised doubts about Pluto’s planetary status.

The discovery of large trans-Neptunian objects, in what is called the Kuiper Belt, has also raised the spectre of astronomers having to expand the family of planets. One of these objects, 2003 UB313 or Eris, as it is now formally known, is actually larger than Pluto. Its detection is generally regarded as having precipitated the challenge to Pluto's planetary status.

‘Planetness’

The important point here is that phenomena have no meaning until we give them meaning. Moreover, meaning is greatly affected by our interests and world views. This may suggest to some readers that we are about to launch into an esoteric, philosophical discussion about the nature of reality and the social construction of knowledge. Not so. Nevertheless, the reclassification of Pluto provides an opportunity to highlight to our students the social nature of the scientific enterprise: that science is an impressive and powerful edifice constructed by human beings.

Planets are not inherently planets: there is no inherent quality of an astronomical object that we can identify as ‘planetness’. These objects are planets and because most people say that certain objects are planets we generally accept this view. What constitutes a planet is not a matter of ‘right’ or ‘wrong’, or a simple dispute between lay people and scientists. On the contrary, the contest over how to define a planet has been fought most vociferously between groups of scientists.

Supporters for Pluto being retained in the family of planets have drawn on history, culture and criteria based upon the structural characteristics of a planet. Historically, students have long been taught that Pluto is the ninth planet and there is no sound pedagogical or scientific basis for changing this understanding. Culturally, Pluto is the only ‘planet’ to be discovered by a US scientist. This has led one NASA researcher to contend that Pluto is an American planet, discovered by an American for Americans.

Planetary scientists have also pointed out that Pluto exhibits all the structural characteristics expected of a planet. That is, it is a body of sufficient mass to generate hydrostatic forces that bind its constituent particles into a round object that orbits a star; and is reflective, rather than self-illuminating.

Opponents of Pluto retaining the status of ‘planet’ have focussed primarily upon the relatively small size of Pluto and its inability to affect the dynamics of other ‘planets’ in the solar system. Some astronomers feel that Pluto is too small to be considered a planet and that planetary status was granted too soon. Shortly after its discovery, astronomers found that Pluto was much smaller than first estimated and, more recently, to be even smaller than the Earth’s moon. Up until 1968, it was thought that Pluto had about 91% of the mass of the Earth (rather than ~0.2%).

This undermined the criterion favoured by some astronomers that for an object to be classified as a planet it should have sufficient mass to exert gravitational perturbations on other planets. In fact, the discovery of Pluto was driven by Percival Lowell’s prediction that perturbations upon Uranus and Neptune were due to a planet somewhere beyond Neptune. This prediction was later found to be based on an incorrect estimate of Neptune’s mass.

A planet no more

After intense lobbying at the annual meeting held in Prague in August 2006, the voting members of the International Astronomical Union (2006) voted to reclassify Pluto as a ‘dwarf planet’, along with Eris and the asteroid Ceres (the first asteroid discovered in the asteroid belt between Mars and Jupiter), according to the following criteria:

(1) A planet is a celestial body that

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The two photographic plates on which Clyde Tombaugh discovered Pluto. The left plate was taken on January 23, 1930, and the right-hand one 6 days later. [Copyright unknown]

(a) is in orbit around the Sun,
(b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and
(c) has cleared the neighbourhood around its orbit.

(2) A ‘dwarf planet’ is a celestial body that
(a) is in orbit around the Sun,
(b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape,
(c) has not cleared the neighbourhood around its orbit, and
(d) is not a satellite.

(3) All other objects, except satellites, orbiting the Sun shall be referred to collectively as ‘Small Solar System Bodies’.

These criteria highlight the social dimension of science. What theoretical justification is there for the criterion that a planet is an object that ‘has cleared the neighbourhood around its orbit’? In fact, several scientists have remarked about the ambiguity surrounding this requirement, which was used to justify the reclassification of Pluto.

Furthermore, it appears that little effort was made to develop analytical categories that scientists could use to generate testable hypotheses, surely a goal of science. With the discovery of the trans-Neptunian objects that comprise the Kuiper Belt, large planet-like objects (‘exoplanets’) in other solar systems and confirmation of the existence of ‘brown dwarfs’, astronomy may have reached the point where there are sufficient data to begin to develop a more sophisticated and theoretically useful conceptual map of the universe. The majority of the voting members of the IAU seemed to be more concerned, however, with rectifying past errors and ensuring that the number of ‘planets’ did not keep increasing as exploration of the region intensified. Clearly, the human dimension of science is evident here.

Science teachers should not be surprised by the continuing debate over the status of Pluto and the criteria for classifying astronomical objects. As more becomes known about the universe, so scientists will seek to impede their theories and beliefs upon the data that are collected. It will be these theories of what constitutes a ‘planet’, an ‘asteroid’, a ‘star’ and the like, that will give meaning to those data.

As Smith (2006) wrote:

Let’s help students experience science as it really is, and show them how new technologies and discoveries not only give us new evidence and insights into how the world works, but challenge us to revisit our earlier definitions and ideas. Do our current ideas still hold up in light of new evidence? Do we really know everything there is to know?

References


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Classification in the science classroom

Classifications, including scientific classifications, are human constructs. Ask students to classify the items in front of them: pencil, pens, rulers and so on. This simple activity reveals the human basis of students’ different categorisations. There are no ‘right’ or ‘wrong’ classifications: there are useful and less useful ones.

Students can discuss scientific classifications such as the classification of living things, and the different criteria used by different biologists.

A well known classification is the periodic table. This has proved so useful that students may not be aware that scientists sometimes propose alternative ways of classifying the chemical elements.

The story of Pluto (the planet that was) can be followed through a number of useful links, listed below.

http://www.iau.org/ (Website of the International Astronomical Union, widely regarded as the authoritative body in astronomy.) The document that gives the (now agreed) definition of ‘planet’ can be downloaded from this website.

http://astro.berkeley.edu/~bsari/defineplanet/ (Professor Gibor Basri’s excellent lay and expert conceptual analyses of cosmological phenomena. Includes links for teachers.)

http://www.space.com/scienceastronomy/060824_planet-definition.html (Provides discussion of the IAU’s decision to reclassify Pluto as ‘dwarf planet.’ Includes links to the continuing debate over the definition of a ‘planet’ and the classification of Pluto.)

http://www.pbs.org/wgbh/nova/teachers/viewing/3302_01_nsn.html (This site from the highly regarded US public television service provides teachers with questions and notes for use before and after students watch video clips from the PBS NOVA ScienceNow program, 10th Planet.)

http://pluto.jhuapl.edu/ (NASA’s website for the New Horizons voyage begun in January 2006 and due to reach Pluto in 2016-2017.)


astro.berkeley.edu/~bsari/defineplanet/WhatsaPlanet.ppt (A PowerPoint presentation you can download on the topic: “What is a ‘planet’?”)