American Museum of Natural History
Science Bulletins

CLASSROOM ACTIVITY

Brown Dwarfs: The Success of Failed Stars

The range of objects in the Universe is enormous. The biggest limitation to finding some of these objects is technology—it is still not sensitive enough to see everything. Brown Dwarfs, cosmic bodies that are not planets and not quite stars, are some of the objects astronomers search for. They are visible using advanced technologies, such as the adaptive optics system on the Keck II telescope.

CLASS DISCUSSION

Establish Prior Knowledge
Call on students to name some of the objects in the Universe. Ask them if they are familiar with Brown dwarfs and what they can tell you about them. If necessary, use the following questions to facilitate a discussion:

- How does a star form?
  (Answer: The temperature at the center of a cloud of contracting gas becomes so large that hydrogen begins to fuse into helium, releasing an enormous amount of energy.)
- What causes a star to shine?
  (Answer: The energy that is released causes the star to shine.)
- How does a planet form?
  (Answer: Particles of dust left over from star formation collide and stick together.)
- Do planets shine?
  (Answer: No, planets might appear to shine, but they merely reflect light from other celestial bodies.)

Tell students that Brown dwarfs are also created during star formation. Their masses are between that of a giant planet, like Jupiter, and the smallest stars. Explain that in the video they are about to see they will learn how scientists study Brown dwarfs and what they are learning.

Exploration
As students watch the feature, allow them to take notes.

- Why don't Brown dwarfs shine?
  (Answer: They don't have enough mass to produce the temperatures and densities in their core that lead to nuclear fusion. Nuclear fusion causes stars to shine.)
- How does the Adaptive Optics System help astronomer Quinn Konopacky study Brown dwarfs?
  (Answer: the Earth's atmosphere is turbulent and it distorts light coming from space. The Adaptive Optics System measures the turbulence in the atmosphere and then sends that information to a deformable mirror which takes out the effects of the turbulence and allows the astronomer to get a sharp picture of the brown dwarfs she is studying.)
- How can Quinn determine the mass of a brown dwarf?
  (Answer: How quickly or how slowly an object orbits another object depends on how massive it is. By measuring the speed of the orbit, Quinn can determine a brown dwarf's mass.)
- Theorists create computer models to make predictions about how massive an object is by measuring how hot, how bright, and how old it is. Often the data Quinn collects does not match up with their predictions. How does this help theorists?
  Based on the new data, they can tweak their computer models to make them more accurate.)

CLASSROOM ACTIVITY

Brown Dwarfs: The Success of Failed Stars (cont'd)

Wrap-Up
Use this question to wrap up the discussion.

- Why is studying brown dwarfs critical to our understanding of the Universe?
  (Answer will vary and may include: Brown dwarfs are the most common outcome of star formation so understanding brown dwarfs is essential to understanding star formation.)