

## CLASSROOM ACTIVITY

# Our Expanding Universe

In 1998, two independent teams of astrophysicists discovered a baffling phenomenon: the Universe is expanding at an ever-faster rate. The current understanding of gravity can't explain this cosmic acceleration. Scientists think that either a mysterious force called dark energy is to blame—or a reworking of gravitational theory is in order. Travel to the University of California's Lick Observatory to learn how astrophysicists use distant stellar explosions to observe the expansion of space. Then watch a team at Fermilab assemble the Dark Energy Camera, a new device researchers hope will find compelling evidence of what's propelling the Universe to expand at an increasing pace.

## CLASS DISCUSSION

### Establish Prior Knowledge

Point out to students that during the last 100 years our ideas of the Universe have changed immensely. Albert Einstein, for example, theorized that the Universe was static—neither collapsing nor expanding, an idea held by many scientists of his time. But in 1929, Edwin Hubble discovered that the Universe is actually expanding. More recently scientists have discovered that, not only is the Universe expanding, but it's expanding at an accelerated pace and scientists don't know why. Tell students that in the feature they are about to see, they will learn how scientists are studying this phenomena and what they are learning.

### Exploration

Before watching the feature have students read the essay, "Will Dark Energy Please Come to Light?" As students watch the feature video, allow them to take notes.

- How did the Universe begin? (*Answer: In a cataclysmic explosion call the Big Bang.*)
- What event made scientists theorize that the Universe was expanding at an accelerated pace. (*Answer: Two teams of scientists were studying supernovae—exploding stars—at large distances from Earth. The exploding stars seemed fainter than what the scientists expected them to be. The simplest explanation was that the expansion of the Universe has been speeding up over that last 5 billion years.*)
- How did this finding affect scientists' conventional understanding of the expansion of the Universe? (*Answer: Scientists expected that over time the expansion of the Universe would be slowing down because of their understanding of gravity and the behavior of matter. All the matter in the Universe is attracting all the other matter. Therefore, the expansion of the Universe would be slowing.*)
- What is redshift? (*Answer: Redshift corresponds to how quickly an object is receding from Earth—the rate of expansion of the intervening space.*)
- How did scientists measure how the expansion rate changed over time? (*Answer: They plotted the redshift of a number of supernovas on a graph. Some were very bright and close by, signifying that they happened relatively recently. Others were dim and very distant showing that they occurred much earlier in the Universe's history. So the graph showed the rate of the Universe's expansion over time.*)
- What did the analysis of the data show? (*Answer: It showed that for the first 8 billion years of its history, the Universe expanded as expected and then began to slow down. But about 5 billion years ago the expansion rate began to accelerate.*)

### Wrap-Up

Use this question to wrap-up the activity:

- Scientists say that the accelerating expansion may be due to dark energy, a property of space that opposes gravity. Other scientists question whether their theory of gravity was correct to begin with. Which of these two statements do you agree with and why? (*Answers will vary.*)