

## CLASSROOM ACTIVITY

# Aiming High: The Search for Ultra High-Energy Cosmic Rays

Research scientists use the Scientific Process to investigate the natural world. This feature is a good illustration of the tools scientists use to gather data. In this feature, scientists at the Pierre Auger Observatory, using 1,600 detectors covering 3,000 square kilometers and 24 telescopes, collect data in an effort to determine the origin of ultra high-energy cosmic rays.

## CLASS DISCUSSION

### Establish Prior Knowledge

Call on students to share what they know about cosmic rays. If necessary, direct them to this website:

[http://imagine.gsfc.nasa.gov/docs/science/known\\_1/cosmic\\_rays.html](http://imagine.gsfc.nasa.gov/docs/science/known_1/cosmic_rays.html)

Explain that ultra high-energy cosmic rays have 100 billion times more energy than cosmic rays. Tell students that in the video they are about to see; scientists in a unique setting strive to find the origin of these ultra-high energy cosmic rays.

### Exploration

Before watching the video have students read the synopsis. As they watch the video, have students take notes about how the observatory uses two different detection techniques to collect data. Have students view the Feature. Use the following to guide a class discussion.

- What is it that the scientists at the Pierre Auger Observatory want to find out?  
(Answer: They want to find the origin of ultra high-energy cosmic rays.)
- Why is it difficult to collect data on ultra high-energy cosmic rays?  
(Answer: They are very rare.)
- What two detection techniques does the observatory use and what does each measure?  
(Answer: One technique uses an array of 1,600 detectors covering 3,000 square kilometers. The array measures the energy level of the cosmic ray. The other technique uses 24 telescopes that record the direction of the cosmic ray's descent.)
- How does the array of ground detectors work?  
(Answer: The array detects evidence of high-energy particles. When a cosmic ray particle strikes air molecules high in the atmosphere it triggers a shower of particles that fall to Earth, distributing the energy of the original particle. When these particles hit water in the detector tanks they create light. This data is sent to the observatory.)
- How do the telescopes work?  
(Answer: As the particles fall they emit fluorescent light. The telescopes detect this light and create a movie showing the shower's descent.)
- Using the data from both detection techniques, where do scientists hypothesize these ultra high-energy cosmic rays originate?  
(Answer: From the data scientists can determine the direction of these ultra high-energy cosmic rays. They have hypothesized that they originate in huge jets coming from the center of active galaxies.)

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# Aiming High: The Search for Ultra High-Energy Cosmic Rays (cont'd)

**Wrap-Up**

Use the following question to wrap up your discussion:

- Recently a larger data sample did not support scientists' hypothesis that ultra high-energy cosmic rays originated in the center of active galaxies. What do you think their next move will be? Do you think a rejected hypothesis is as valuable as one that is supported by evidence? Why?  
(Answers will vary.)