

CLASSROOM ACTIVITY

The Cosmic Microwave Background: A New View From the South Pole

The icy South Pole desert is a harsh and desolate landscape in which few life forms can flourish. But the extreme cold and isolation are perfect for astronomical observations. Taking advantage of the severe conditions, scientists are using the new South Pole Telescope—the largest ever deployed in Antarctica—to observe the oldest light in the Universe, the cosmic microwave background (CMB).

CLASS DISCUSSION**Establish Prior Knowledge**

Call on students to describe the Big Bang theory. If necessary, allow students to do an Internet search to gather more information. Students' responses should include these points:

- The Big Bang theory is an explanation of how the Universe began.
- Approximately 13.7 billion years ago, the Universe was a hot and dense mass that began to rapidly expand.
- At the beginning of this expansion the Universe was an opaque cloud of neutrons, protons, electrons, anti-electrons, photons, and neutrinos.
- As the Universe cooled, the subatomic particles combined to form neutral atoms and the Universe became transparent.
- The light left over from the Big Bang is called the Cosmic Microwave Background and it is the earliest light that can be observed.
- By studying the Cosmic Microwave Background, astrophysicists can picture what the Universe looked like 13.7 Billion years ago.

Tell students that in the video will see scientists study the Cosmic Microwave Background in Antarctica.

Exploration

As students watch the video, encourage them to take notes. Use the following questions to guide a discussion.

- Why did the astrophysicists choose Antarctica as the site to set up the telescope? (*Answers may include: The site chosen was 10,000 feet high. The cold climate freezes water vapor in the air so the air is very clear. During the winter, Antarctica experiences 6 months of darkness. This enables the astrophysicists to work around the clock.*)
- What is cosmic inflation? (*Answers may include: Cosmic inflation is a the idea that immediately after the Big Bang the Universe expanded at a rapid rate.*)
- What evidence are scientists looking for that would help support the cosmic inflation theory? (*Answers will include: They are looking for a polarization signal. If cosmic inflation occurred, gravitational waves would be created. These waves would impart some polarization on the light from the cosmic microwave background. If astrophysicists can find a polarized signal they can infer that there were gravitational waves and therefore, cosmic inflation.*)
- Why is the new camera important to the astrophysicists' work? (*Answers will include: the camera allows the astrophysicists to see not only the brightness of the cosmic microwave background but also the polarization.*)

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The Cosmic Microwave Background (cont'd)

Wrap-Up

Call on students to research and report on the role of polarized light in their everyday lives: polarized sunglasses, LCD screens, 3-D movies, etc.

Students may wish to conduct a simple experiment to gain a better understanding of polarized light.

- http://www.exploratorium.edu/snacks/polarized_sunglasses/index.html