



# MIRACLE PLANET

## EPISODE 2

# Snowball Earth

The Earth endured ice and then prospered when oxygen became abundant on the planet. Over hundreds of millions of years, life grew from simple microscopic forms to the first complex creatures.

### Before Screening the DVD

1. Can you think of at least one country and one continent on Earth today that are mostly covered by ice?
2. Imagine the entire world covered by ice. Do you think any life could survive such a situation? If so, how?
3. Read the poem "Fire and Ice" written by the American poet Robert Frost. How do you think the poem might be about both the Earth and human nature?

### After Screening the DVD

1. What evidence is there that New York City was buried under ice 20,000 years ago?
2. Scientists believe that there were two "snowball" events in Earth's history when the world was covered in ice. When did they take place?
3. How do scientists think that life may have survived when the Earth was blanketed by ice?
4. Carbon dioxide is a gas that helps keep the world warm today by trapping in some of the heat that would otherwise be lost to space—a so-called greenhouse gas. But there is evidence that levels of carbon dioxide were once very low. What other gas may have served as a greenhouse gas to keep the planet warm at the time?
5. Why were the tiny organisms known as cyanobacteria so important to the history of life on Earth?
6. How did volcanoes help change the Earth's climate?
7. An Earth covered by a sea of ice was, in many ways, a disaster for life, but it may have also been important in the evolution of life into larger and more complex forms. Why?
8. What is the connection between oxygen and collagen, the material that binds cells together?

### Follow-Up Projects

1. In *Snowball Earth* you learned that England was once near the equator. Today it is roughly the same distance from the equator as Canada. Find out how the so-called continental drift changed the look of the Earth over the last couple of hundred million years.
2. Trilobites were ancient creatures that grew hard shells, possibly to make them harder to kill by predators. What other techniques do animals use today to avoid becoming another animal's dinner?
3. A lot of people today are worried about climate change and the fact that the Earth appears to be getting warmer. Many scientists believe that it may be the result of the buildup of so-called greenhouse gases given off by factories, cars and other polluters. As you saw in *Snowball Earth*, climate change has happened throughout the planet's history. How do you think that this may affect the current debate about reducing greenhouse gases?
4. The Kyoto Accord is an agreement signed by many countries, including Canada, that is attempting to reduce greenhouse gas emissions. Find out what the main points of the accord are and why some countries have refused to sign it.

Link to the Kyoto Protocol: [http://unfccc.int/essential\\_background/kyoto\\_protocol/items/1678.php](http://unfccc.int/essential_background/kyoto_protocol/items/1678.php)

#### Fire and Ice

Some say the world will end in fire,  
Some say in ice.

From what I've tasted of desire  
I hold with those who favor fire.  
But if it had to perish twice,  
I think I know enough of hate  
To say that for destruction ice  
Is also great

And would suffice.

*Robert Frost*

### GLOSSARY

**Biota:** The plant and animal life of a particular area.

**Collagen:** A chemical substance that binds cells together. Collagen is the glue that makes it possible for skin, bone and tissue to form.

**Continental drift:** The theory that the world's continents were once joined and have drifted throughout history.

**Cyanobacteria:** Blue-green bacteria that live in the oceans and were one of the earliest forms of life on Earth.

**Ediacaran:** The period in Earth's history that extended from 600 million years ago to 540 million years ago.

**Erratics:** Rocks that have been transported by glaciers and left in place when the glacier recedes or melts. Also known as drop-stones.

**Eukaryotic:** Organisms with cells that have a nucleus.

**Lava:** Rock that is in an extremely hot liquid form (molten). Before it reaches the surface, lava is known as magma.

**Methane:** A colourless, odourless gas that burns.

**Photosynthesis:** The life-sustaining process used by plants to convert the energy of light into chemical energy and store it as sugar.

**Strata:** Layers of earth that have been solidified into rocks called sedimentary.

**Thermophiles:** Bacteria that can survive in very hot water.

**Trilobites:** Ancient extinct creatures with a hard shell divided into three parts

**Vertebrate:** Any animal with a backbone or spinal cord. Creatures that don't have either are known as invertebrate.

Suitable for ages 13 to 17

**Related subjects:** Geography, biology, physics, chemistry, earth science

For more information, visit the Web site at <[www.nfb.ca/miracleplanet](http://www.nfb.ca/miracleplanet)>.

Study guide available online at <[www.nfb.ca/guides](http://www.nfb.ca/guides)>.

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