Activity 3: Climate Is Our Friend...Isn't It?

What You Will Do: Make an Extinction Polyhedron

Big Idea

Life on Earth depends on, is shaped by, and affects climate.

(Climate Science Principle 3)

What You Will Need

- Stiff paper or cover stock; size depends upon how large you want your polyhedron to be (see How to Do It, Step 3)
- Scissors
- Pen or pencil
- Glue
- Art supplies (if you want to make your own illustrations; see How to Do It, Step 1)
- Computer with Internet access or library resources

Trilobite *Kainops invius*.
Image courtesy Wikipedia.

We know that Earth's climate affects everything that lives on our planet; but can living things affect climate? The answer is "Yes!" Life on Earth has a major effect on heat-trapping gases in the atmosphere. The presence of these gases allows Earth's environment to have liquid water and enough warmth to support many different kinds of living organisms. During Earth's history, these organisms—including microbes, plants, and animals and humans—have significantly changed the chemical makeup of the atmosphere.

One of the reasons there are so many different kinds of organisms is that different locations on Earth have different climates, which means that they have different conditions of temperature, precipitation, humidity, and sunlight. Individual organisms require a certain range of these conditions; polar bears, for example, cannot survive in the tropical jungle. If living organisms are exposed to climate conditions outside their normal range they must adapt to the new condition or migrate to a different location. Otherwise, these organisms will die.

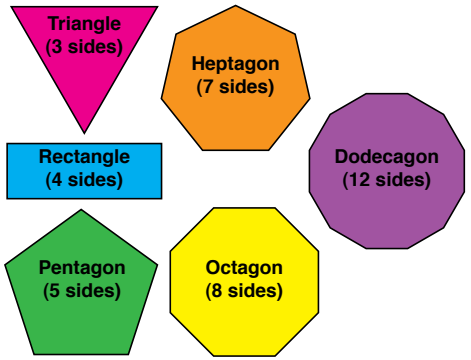
Fossils are any remains, traces, or imprints of a plant or animal that has been preserved in a rock. Some fossils are formed when the remains of an organism are replaced by minerals that keep the organism's shape. Another way fossils are formed is when an organism's remains make an imprint in a soft substance such as clay or mud that later hardens into a rock. Fossils can also be things that were made by an organism, such as footprints in mud. Fossils provide important information about organisms that were alive at various times in Earth's history. Many kinds of organisms are now extinct, which means none of them are alive today. Dinosaurs are a good example of extinct organisms, and there are millions of others. Information from fossils shows that at certain times in Earth's history, many different kinds of organisms became extinct at about the same time. When this happens, we say that a "mass extinction event" has occurred. The cause of most mass extinction events involved some type of climate change.

How to Do It

Polygons are 2-dimensional shapes that are made of straight lines in which the lines connect together to form an enclosed space (Figure 1).

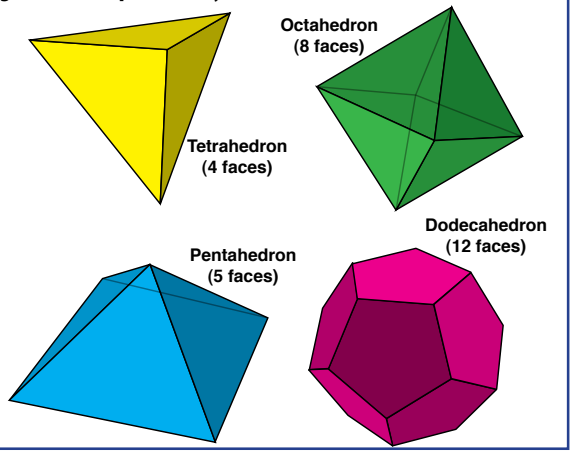
Polyhedrons are three-dimensional shapes that are made of polygons (Figure 2).

Figure 1.
Examples of Polygons



Polyhedrons are easy to make, interesting to look at, and are a great way to present and discuss information. This activity uses polyhedrons to show information about some extinct organisms, and how their extinction may have been related to climate change. First, you need to get the information together, then you can construct your Extinction Polyhedron!

Figure 2. Examples of Polyhedrons

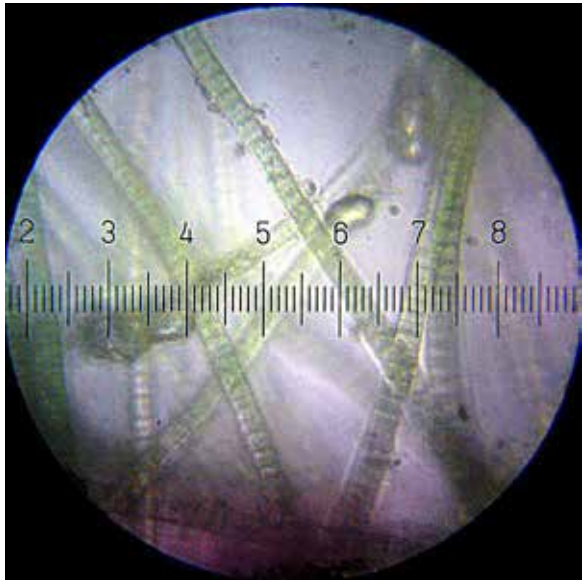


1. Use the Internet or library resources to find pictures of seven extinct organisms that look interesting or that have interesting stories (or both). You may be able to download or copy pictures directly from the sources you use, or to use these pictures as a guide for illustrations that you make yourself. When you have selected the organisms to use for your Extinction Polyhedron, Find out some interesting facts about each organism, such as when and where they lived, what they ate, when and why they became extinct, etc. Here are some suggestions:

NOTE: There are MANY other examples of extinct organisms. In fact, more than 99% of all the species that have ever lived on Earth are now extinct.

	Anomalocaris	Trilobite
2.	Placoderms	Smilodon
	Ammonoid	Arthropleura
	Mammuthus primigenius	Opabinia
	Wiwaxia	Pelycosaur
	Blastoid	Archaeocyathid
		Pterosaur

Let's add one more organism to the seven you selected in Step 1. Cyanobacteria have been a very important part of life on Earth, and actually caused one of the biggest extinctions in Earth's history! Can you find out how? Individual cyanobacteria are too small to see without a microscope, but many of these organisms produce much larger structures that are easily visible. You could also use a photograph made with a microscope or an illustration you prepare yourself for the Extinction Polyhedron.



Cynobacteria through a microscope. Image courtesy Wikipedia.

3. Decide how large you want your Extinction Polyhedron to be. The pattern in Figure 3 will produce a polyhedron with eight sides (an octahedron). Each side has the shape of a triangle whose sides are about 1-3/4 long. If you want a larger Extinction Polyhedron, use a copying machine to enlarge Figure 3, or lay it out yourself with a ruler. Cut out the pattern along the solid lines, and trace the pattern onto stiff paper (such as cover stock or construction paper). Cut the pattern out of the stiff paper, and fold along all of the dotted lines. Do not fold the pattern into its final shape yet, because it is much easier to attach pictures while the pattern is flat.

4. Cut the eight pictures so that each one will fit on one of the sides of the octahedron, then glue the pictures into place.

5. Fold the pattern with the glued-on pictures along the dotted lines, and attach the tabs to the inside of the polyhedron with tape or glue. Your Extinction Polyhedron is finished!

Some Things You Can Do With Your Extinction Polyhedron

Here are a few ideas. You can probably think of many others!

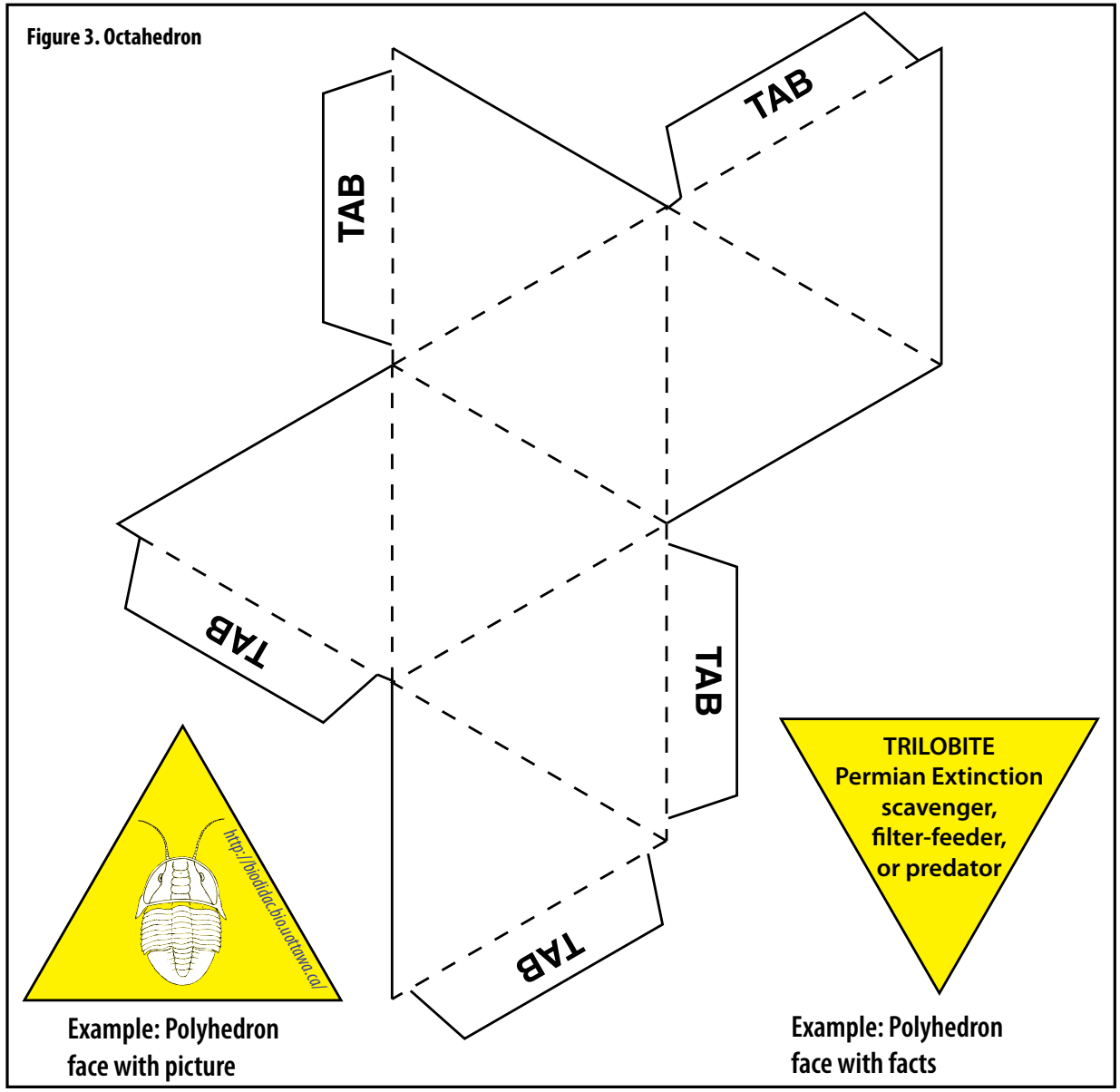
The main purpose of an Extinction Polyhedron is to present information about extinct organisms and why they became extinct. If you put your Extinction Polyhedron on a table in a room where people are present, someone will probably pick it up for a closer look. When this happens, ask the person if they recognize any of the organisms shown in the pictures. This is one way to start a conversation about extinctions and why they happen.

Another thing you can do is to make several additional Extinction Polyhedrons, and hang them onto wires or sticks to form a mobile. If you want

to make something besides octahedrons, there are many Web sites that have patterns and directions for making other shapes.

You can also make up games that use Extinction Polyhedrons. For example, you could have one polyhedron with pictures, and another polyhedron with the organisms' names written on the sides.

Figure 3. Octahedron



Example: Polyhedron face with picture

Example: Polyhedron face with facts

Player #1 drops the picture polyhedron onto a table, then turns the polyhedron over so that Player #2 can see the picture that was face down when the polyhedron landed on the table. Player #2 must turn the polyhedron with written names so that the correct name for the organism is face up. If you make more than one set of name polygons, several players can compete to see who can be the first to turn up the correct name.

Why are they extinct?

When you were gathering information about your selected organisms in Step 1, you probably noticed several things about mass extinctions. First, these events have happened many times throughout Earth's history. One of the first mass extinctions happened about 2,400 million years ago when bacteria called cyanobacteria produced large amounts of oxygen that dramatically changed Earth's atmosphere. Before this happened, Earth's atmosphere contained very little oxygen, and most living organisms were adapted to live without oxygen. An oxygen-rich atmosphere caused most of these organisms to become extinct. This mass extinction is called the Oxygen Revolution, the Oxygen Catastrophe, the Oxygen Crisis, or the Great Oxidation. This is a case in which one form of life caused the extinction of other forms of life. It is also a good example of how mass extinctions make it possible for new species to appear.

Other major mass extinctions (sometimes called "The Big Ones") include:

- The Cambrian Extinction, about 499 million years ago, when about 30% of living groups became extinct;

- The Ordovician Extinction, about 443 million years ago, when an estimated 60% of all genera became extinct;
- The Devonian Extinction, about 345 million years ago, when about 70% of all known species became extinct;
- The Permian Extinction, about 250 million years ago, when an estimated 96% of all marine species became extinct and 70% of terrestrial vertebrate species became extinct;
- The Triassic Extinction, about 200 million years ago, when about half of all known species became extinct; and
- The Cretaceous Extinction, about 65 million years ago, when dinosaurs along with 85% of all known species became extinct.

There are usually several theories about the cause of most mass extinctions. For example, the Cambrian Extinction has been linked to sharp decreases of oxygen in Earth's atmosphere along with increased levels of hydrogen sulfide. The reason for these changes is not known. The Ordovician Extinction happened when Earth's climate cooled, causing large amounts of water to be trapped in glaciers. This reduced the level of Earth's ocean, which was where most organisms lived at this time. Global cooling has also been suggested as a possible cause of the Devonian Extinction, and may have been the result of decreased carbon dioxide in the atmosphere. An asteroid impact is another suggestion, which is also believed to have been responsible for the Cretaceous Extinction. Large asteroid impacts may have a direct effect on Earth's climate, since large amounts of dust and soot in the atmosphere following such impacts can result in global cooling. It is important to remember that mass extinctions may have more than one cause, and that some extinction events happened when several things went wrong at about the same time.

It is also important to remember that living organisms can affect climate, and have probably helped cause some mass extinction events. Large land plants that covered Earth's landscape for the first time during the Devonian Period may have caused decreased carbon dioxide in the atmosphere during the Devonian Extinction.

This painting by Donald E. Davis depicts an asteroid slamming into tropical, shallow seas of the sulfur-rich Yucatan Peninsula in what is today southeast Mexico. The aftermath of this immense asteroid collision, which occurred approximately 65 million years ago, is believed to have caused the extinction of the dinosaurs and many other species on Earth. The impact spewed hundreds of billions of tons of sulfur into the atmosphere, producing a worldwide blackout and freezing temperatures which persisted for at least a decade. Shown in this painting are pterodactyls, flying reptiles with wingspans of up to 50 feet, gliding above low tropical clouds. Image courtesy NASA/JPL-Caltech.

Today, human activities have significant influence on species extinctions. Habitat destruction and over-harvesting directly affect some species, and many others are harmed by activities such as pollution and introducing exotic species that interfere with natural ecosystem processes. The effect of human activities on Earth's climate system is explored in Activity 6, "I Didn't Do It … Did I?"

Want to Do More?

Visit NOAA's Paleoclimatology Web site (*http://www.oar.noaa.gov/climate/t_paleo.html*) for information and image collections about many topics related to climate change during Earth's history.