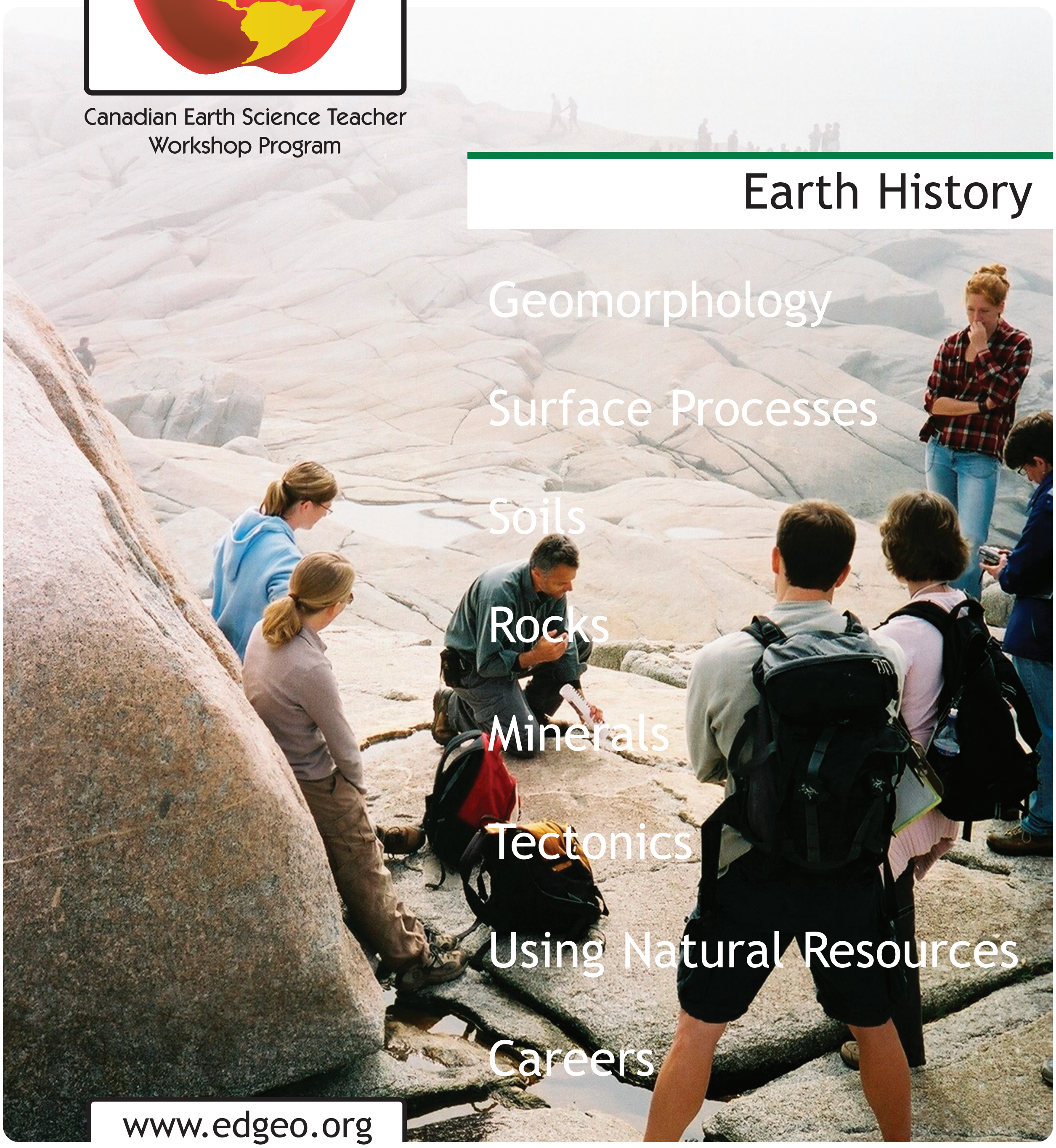
EdGEO

Canadian Earth Science Teacher Workshop Program

Bringing Earth Science to Life



Earth History

Geomorphology

Surface Processes

Soils

Rocks

Minerals

Tectonics

Using Natural Resources

Careers

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In partnership with:

Canadian Geological Foundation · Fondation Géologique du Canada · 1968

Geological Survey · Commission Géologique · Canada · 1842

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ACTIVITY INDEX

Significant Events in Earth History

Students use their prior knowledge and prediction to put in sequence significant events in the Earth's history and in the development of life.

Explanation

Earth is 4.6 billion years old, and its long history has been one of continual change.

Continents have formed, split and moved. There have been several mass extinctions of life forms, islands have risen and submerged, and climates have changed drastically. These changes continue today.

Student understanding of Earth's immensely long history is enhanced by looking at the relative sequence of events, rather than specific dates and time periods. **Relative dating** is established by studying the layers of rocks, and the chemicals and fossils they contain.

Materials

Cards (index card or postcard size)
Rope and pegs (optional)
Long paper and tape (optional)

Cautions

None

Time

Short

Grouping

Individual, pairs, or whole group

Preparation

Using the "Timeline of Significant Events in Earth History" (see Resources), label each card with a geological event or a life-form event, without any reference to time. Illustrations would be a good addition to the text on each card (see Extensions)

Prompt

Share two of the life-form cards and ask students which came first? Ask for their reasoning and accept any response.

Significant Events in Earth History

Delivery

1. Hand out the all the event cards, and ask the students to put them in sequence. Encourage them to think about what geological or life-form events had to happen first in order for more complex life forms to develop.

Sequencing can be done by:

- laying out the cards on a table (individual)
- pegging the cards onto rope (pairs)
- taping the cards onto a long paper strip (pairs)
- giving one card to each student and having them stand in sequence (whole group)

2. Share the timeline of significant events, showing the dates, and have students adjust their sequence accordingly.

Questions for Discussion

Which events did you have out of sequence?

What surprised you about what came first?

Where did life first form, on land or in the oceans?

Did humans and dinosaurs live at the same time?

Extensions

Illustrate the event cards.

Create an illustrated flow chart of Earth history.

Life-form events and geological events could be considered separately or combined. The list of events can be edited or extended to suit the students' skill and interests.

Make the list of events specific to your area, by consulting with a local museum or Earth scientist for examples. This list could include locally well-known landforms, significant geological features, fossils, etc.

Resources

Significant Events in Earth History

Timeline of Significant Events in Earth History

Geological Events	Time
Last ice sheets retreated	10 000
Most recent Ice Age began	2 mya*
Start of San Andreas fault	29 mya
Formation of Alps and Himalayas	50 mya
Formation of Rocky Mountains	80 mya
Present-day continents formed	190 mya
Formation of Appalachian Mountains	350 mya
Sudbury impact crater formed	1 800 mya
Oxygen-rich atmosphere forms	3 000 mya
Oldest Rock: Acasta Gneiss, NWT	4 060 mya
Earth forms as a planet	4 600 mya

* mya: millions of years ago

Significant Events in Earth History

Life-Form Events	Time
Modern humans (*Homo sapiens*)	35 000
Neanderthals	110 000
Hominids (first humans)	4 mya*
Horses	55 mya
Mass extinction of dinosaurs	65 mya
Flowering plants	140 mya
Birds	175 mya
Mammals	210 mya
Dinosaurs	220 mya
Reptile	270 mya
Insects	320 mya
Trees	350 mya
Amphibians	360 mya
Land plants	390 ma
Fish	480 mya
Trilobites	570 mya
Shelled marine animals	590 mya
Bacteria, algae	3 500 mya

* mya: millions of years ago

Model of Earth History

Students produce a scale model of the timeline of significant events in Earth history.

Explanation

Earth is now known to be at least 4.6 billion years old, and our human experience is but a tiny part of its immensely long history. Earth scientists have estimated the age of the Earth by studying its rocks and minerals, and by dating radioactive isotopes contained within them. As new dating methods are discovered, we will probably find that the Earth is even older. At present, the oldest known mineral is a piece of zircon that is 4.3 billion years old.

It is important to understand that the Earth is in a state of constant change. Continents have formed, split and moved, and continue to do so today. There have been several mass extinctions of life forms, islands have risen and submerged, and climates have changed drastically. These changes also continue today.

Materials

50 m rope or roll of adding machine paper
Pegs or tape
Cards, e.g. index card or postcard size
Markers
50 m measuring tape
Student Page

Cautions

None

Time

Medium

Grouping

Pairs, small groups

Preparation

Collect materials and duplicate one Student Activity Page for each pair or group.

Prompt

How old is the Earth?

How long have humans existed?

Delivery

1. For pairs or small group activity, hand out materials and Student Activity Page.
2. The students will create a timeline by:

   a) pegging event cards that they make onto the rope, or

   b) taping the event cards onto a long paper strip

Questions for Discussion

How long have humans been on Earth?

What fraction is this of the Earth's history?

How long did the dinosaurs survive?

Extensions

Include the names of geological eras on the timeline (see Resources)

Have students research additional events to add to the timeline, such as when certain dinosaurs or other now fossilized creatures appeared.

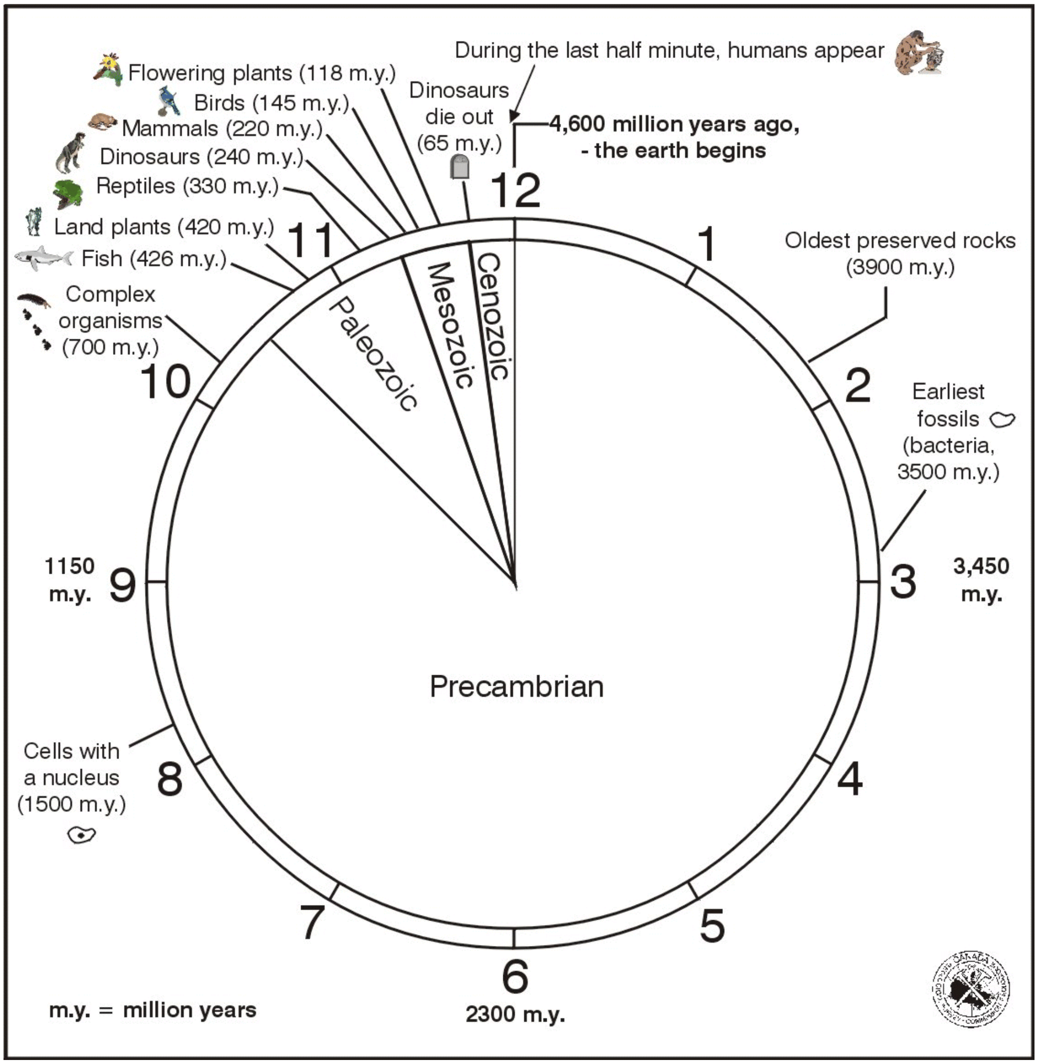
Have students produce other visual representations of geological time: based on a 12-hour clock (see Sample), their day, a chart, a calendar year, etc.

Modifications

For a whole group activity, prepare event cards as described on the Student Activity Page, and mark the rope or paper with time intervals. Hand one event card to each student and have them take up their correct position on the timeline.

Sample

Earth History on a 12-Hour Scale



Resources

Geological Time Scale

Phanerozoic Eon (542 mya to present)	Cenozoic Era (66 mya to today)	Quaternary 2.6 mya* to present day
		Neogene (23 mya to 2.6 mya)
		Paleogene (66 mya to 23 mya)
	Mesozoic Era (245 to 65 mya)	Cretaceous (146 to 66 mya)
		Jurassic (200 to 146 mya)
		Triassic (251 to 200 mya)
	Paleozoic Era (542 to 245 mya)	Permian (299 to 251 mya)
		Carboniferous (359 to 299 mya)
		Devonian (416 to 359 mya)
		Silurian (443 to 416 mya)
		Ordovician (488 to 443 mya)
		Cambrian (542 to 488 mya)
Precambrian Eon (4600 to 544 mya)	Proterozoic Era (2500 to 542 mya)	Neoproterozoic (1000 to 542 mya)
		Mesoproterozoic (1600 to 1000 mya)
		Paleoproterozoic (2500 to 1600 mya)
	Archean (3800 to 2500 mya)	
	Hadean (4500 to 3800 mya)	

Source: International Commission on Stratigraphy 2009

*mya: million years ago

Model of Earth History

You are going to make a timeline of the major events in the Earth's history, from its formation to the present day, using a scale of 1 centimetre to equal 1 million years.

Materials

50 m rope or roll of adding machine paper
Pegs or tape
Cards for the event labels
Markers
50 m measuring tape

Instructions

1. Make a card labelled for each event in the Timeline of Significant Events in Earth History, by writing the title and time of each event on a card.
2. Lay out the rope or adding machine paper. Draw a mark at one end and label it "Present Day". This is the beginning of your geological timeline.
3. Measure and mark 1 cm from the beginning of your timeline, then peg or tape the event card for "Modern Humans" at this mark.
4. Continue placing each event card on your timeline by adding the number of centimetres given in the table below for each event. Your complete timeline should measure 46 metres long.

Timeline of Significant Events in Earth History

Geological and Life Form Events	Time	cms added on
Present Day	0	Beginning
Modern humans (*Homo sapiens*)	1 mya*	1
Most recent Ice Age began	2 mya	1
Hominids (first humans)	4 mya	2
Formation of Alps and Himalayas	50 mya	21
Horses	55 mya	5
Mass extinction of dinosaurs	65 mya	10
Formation of Rocky Mountains	80 mya	15
Flowering plants	140 mya	60
Birds	175 mya	35
Present-day continents formed	190 mya	15
Mammals	210 mya	20
Dinosaurs	220 mya	10
Reptiles	270 mya	17
Insects	320 mya	50
Trees	350 mya	30
Amphibians	360 mya	10
Land plants	390 mya	30
Fish	480 mya	90
Shelled marine animals	590 mya	20
Oxygen-rich atmosphere forms	3000 mya	1200
Bacteria, algae	3500 mya	500
Oldest Rock: Acasta Gneiss, NWT	4060 mya	560
Earth forms as a planet	4600 mya	540

* mya: million years ago

Make a Fossil

Students create a fossil replica (cast) of a seashell.

Explanation

A **fossil** is a cast, an impression or the actual remains of an animal or plant preserved in rock. A fossil is formed when a dead animal or plant is covered by a sediment such as mud, sand or clay. Over thousands of years the sediment is pressed and hardened into rock, creating an imprint or preserving the animal and plant remains inside.

Materials

Plasticine
Small disposable container, e.g. margarine pot, paper cup
Paper or aluminum plate
Shell or other small hard object
Plaster of Paris
Water
Vaseline
Spoon
Student Page

Cautions

Always add plaster into water. Pouring water onto the dry plaster powder can cause a powder explosion when gas produced is trapped below the water layer.

Use a utensil to mix the plaster, never your hands. As the plaster sets, it increases in temperature and can burn.

Time

Medium

Grouping

Individual, pairs

Preparation

Set up a protected worktable for mixing the plaster of Paris, and space to store the fossils as they dry. This activity may need adult supervision and is best done in small groups.

Prompt

Show some examples of fossils, and ask how the animals were trapped in the rock?

Make a Fossil

Delivery

1. Discuss the safety concerns with the students. Distribute materials and instructions.
2. After the fossil casts have been made, let any unused liquid plaster harden and put it into the garbage. Never put dry or liquid plaster into the drain as it will cause severe blockages. Clean the plaster off spoons and tables with paper towels or cloths, and then wash off the remainder with hot, soapy water.

Question for Discussion

How probable is it that when an animal dies, it becomes a fossil?

Extensions

Mix up to 1 spoonful of sand or soil into the plaster of Paris powder. This gives a more rock-like appearance.

Paint the plaster casts of the fossils with a thick coat of liquid plastic. It will seal the plaster and yellow over time giving an ancient appearance to the casts.

Make a model of an insect trapped in amber using resin from a craft store. Be aware of the hazards of using these products and follow all recommended safety procedures.

To make a petrified fossil, place a tablespoon of plaster of Paris on a paper towel. Collect the edges around the plaster and secure with an elastic band. Cut off most of the paper towel not holding the plaster. Place the ball into a beaker and cover with dry sand. Add water to the beaker to soak the sand and let sit overnight. Remove the hardened ball from the sand and let it dry for another day. Using tongs burn off the paper towel using an alcohol lamp. The burnt paper adds to the authenticity of the appearance of the fossil. It will look somewhat like a plant bulb.

Demonstrate the effect of deformation on fossils. Make two imprints of a shell into pieces of Plasticine. Squeeze one of the pieces so that the imprint shape is deformed. Ask students to infer the direction of force or pressure acting on the "rock" to create this deformation pattern. Explain to students that fossils in metamorphic rock can provide clues about the geological history of an area, but fossils are usually destroyed during metamorphic conditions because of extreme pressure and temperature.

You are going to make a fossil replica (cast) of a seashell.

Materials

Plasticine
Small disposable container, e.g. margarine pot, paper cup
Paper or aluminum plate
Shell or other hard object
Plaster of Paris
Water
Vaseline
Spoon

Cautions

Always add plaster into water.
Always use a utensil to mix the plaster, never your hands.
Let any leftover plaster harden and put it into the garbage, never into the sink.

Instructions

1. Roll a layer of Plasticine about 2 cm thick onto the plate. Build up the edge of the Plasticine slightly higher than the middle.
2. Rub the outside of the shell with Vaseline.
3. Press the side of the shell covered with Vaseline into the Plasticine. The Plasticine should be thick enough that the shell does not push right through to the bottom. Carefully remove the shell, leaving only an imprint of the shell. This type of imprint is a **trace fossil**.
4. Put 2 spoonfuls of water in the cup.
5. Add 4 spoonfuls of plaster of Paris and mix in gently.
6. Pour this mixture into the imprint in the Plasticine. Do not fill higher than the edges of the Plasticine.
7. Gently tap the plate on the desk for a couple of minutes to allow any air bubbles in the mixture to rise to the top.
8. Let sit to dry for at least 1 hour, but overnight is better.
9. Invert the plate and press gently on the bottom to separate the fossil from the Plasticine. The plaster is a **cast or mould fossil**, a solid replica of the original shell. A small ball of Plasticine pressed into the corners of the plaster can remove any pieces of Plasticine stuck to the fossil cast.

The Button Game

Students create a classification key to sort a selection of similar objects.

Explanation

Scientists use **classification keys** to identify unknown specimens based on observations of known examples. This method is applied in Earth science to fossils, rocks and minerals.

Materials

5 to 10 similar objects, e.g. buttons, coins, pens, candies
Paper
Markers

Cautions

None

Time

Short

Grouping

Individual, pairs

Preparation

Collect sets of objects for the students to classify using observable physical characteristics. For best results, the objects should be similar, with none of them identical, e.g. button characteristics may be large, small, metallic, plastic, round, square, smooth or rough.

Delivery

1. Give each student or team of students one set of objects, paper and markers.
2. Have them put the title of their type of object at the top of the paper, e.g. “buttons.”
3. Divide the objects into two groups based on the characteristics, e.g. metal, plastic. The characteristic groups do not have to include the same number of objects. Under the title, record the names of the two groups.
4. Choose one of the two groups, and divide it into two new groups, again based on the characteristics, e.g. round,

square. Under the group name, record the names of the two new groups.

5. Continue dividing each group into two new ones, recording the names, until there is only one object in each group.

Questions for Discussion

Were there any objects that you could not identify?

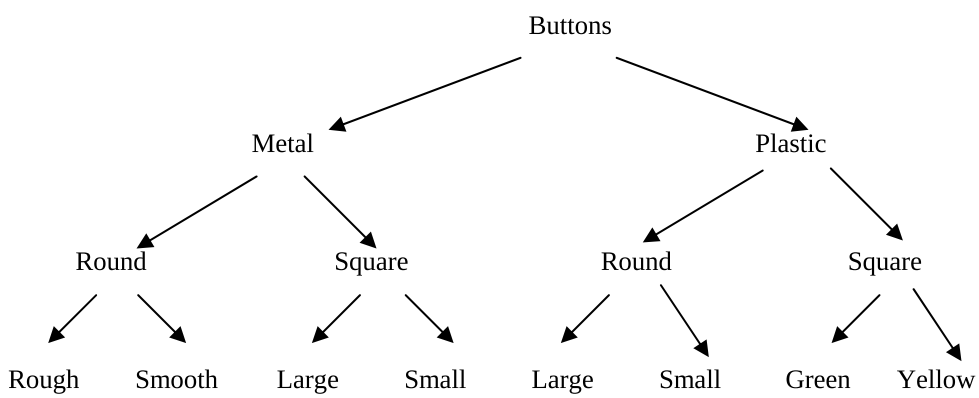
If we added other objects, how would you have to change the chart?

Extension

Have students make up classification keys for countries, cartoon characters, food groups, animals, etc.

Sample

Example Classification Key for Buttons



Fossil Characteristics

Students use a classification key to identify unknown fossils.

Explanation

Scientists use **classification keys** to identify unknown specimens based on observations of known examples. This method is applied in Earth science to fossils, rocks and minerals.

Materials

Mystery Fossils sheet
Fossil Identification Chart
Student Page

Cautions

None

Time

Short

Grouping

Individual, pairs

Preparation

Reproduce the mystery fossil images and the fossil identification chart (see Resources) onto sheets for student use.

Prompt

Play a game of "yes/no." For example, tell students you are thinking of an animal. They can ask questions to which you answer yes or no so they can find out what the animal is. This is similar to how scientists use a set of questions to identify fossils.

Delivery

Distribute materials and allow time for completion.

Optional: Have students carry out the "Button Game" activity first to devise a classification key before working with fossils.

Questions for Discussion

Were there any fossils that you could not identify?

If we added another fossil, how would you have to change the chart?

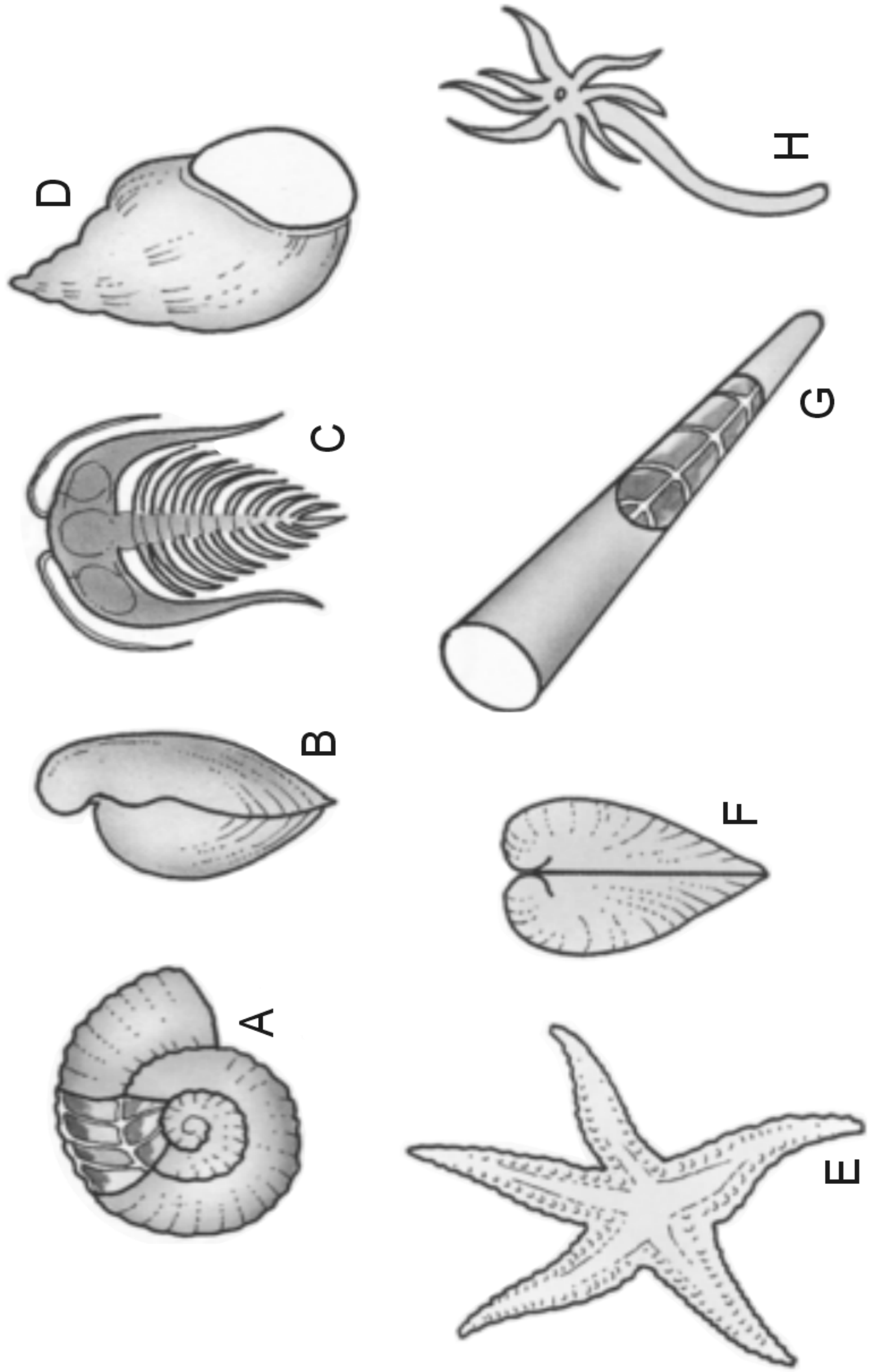
Extensions

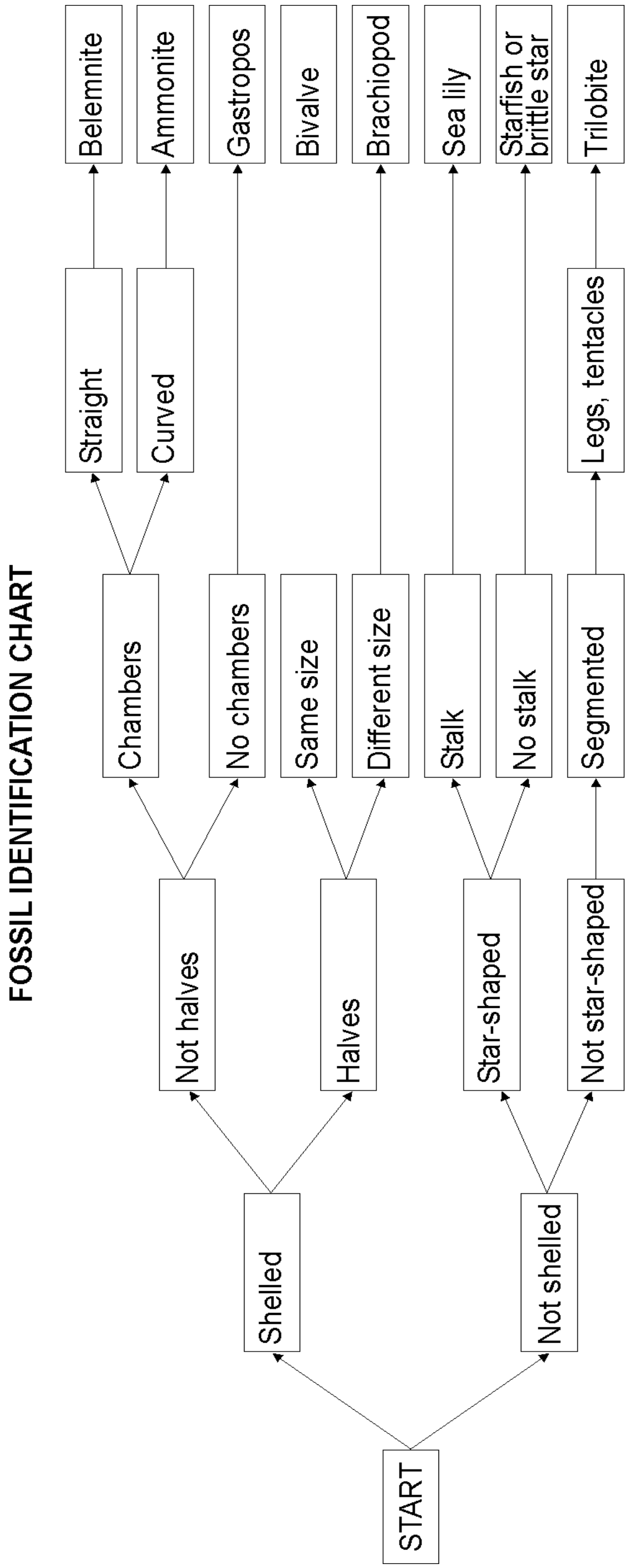
Use real fossil specimens in place of the images.

Have students create their own classification key for a new set of fossils.

Resources

Mystery Fossils




FOSSIL IDENTIFICATION CHART
START
Shelled
Not shelled
Not halves
Halves
Star-shaped
Not star-shaped
Chambers
No chambers
Same size
Different size
Stalk
No stalk
Segmented
Straight
Curved
Legs, tentacles
Belemnite
Ammonite
Gastropos
Bivalve
Brachiopod
Sea lily
Starfish or brittle star
Trilobite

You are going to use the fossil identification chart to name the 8 mystery fossils.

Materials

Mystery Fossils sheet
Fossil Identification Chart

Instructions

1. Begin at the "start" box on the left-hand side, and follow the arrows as you make observations on each fossil.
2. Record the name of each mystery fossil in the chart below.

Mystery Fossil	Name
A	
B	
C	
D	
E	
F	
G	
H	

Fossil Detectives

Students interpret fossil footprints as a record of a past event and propose a hypothesis for the event that produced the footprints.

Explanation

Paleontologists, the Earth scientists who study fossils, are detectives in the sense that they use clues in the rock and fossil records, which are often incomplete, to interpret ancient life and events. These geological clues can often be interpreted in more than one way, as more than one plausible story may explain the evidence.

Fossil footprints are examples of **trace fossils**. There are many other kinds, including borings or tracks left in sediment by burrowing animals. Interpreting trace fossils requires much ingenuity and imagination.

Materials

Footprints 1
Footprints 2

Cautions

None

Time

Medium

Grouping

Individual, pairs

Preparation

Reproduce the images of Footprints 1 and 2 (see Resources) onto sheets.

Prompt

Bring in an animal identification book or hunters' manual. Ask students how do we know which animals live in a forest? Share the identification footprints with students. Footprints can tell us more than what kind of animal made them. They can often tell us what was happening when the animal made the tracks.

Delivery

1. Fossil footprints were found by a paleontologist on the partially covered surface of a rock outcrop. Hand out the Footprints 1 page, which is a sketch of what was found.
2. Tell the students that the footprints found on the rock outcrop are actually much larger than shown in the drawing. Ask them to examine the drawing of the footprints, and write down their observations and interpretation of what could have occurred to make these tracks. Prompt observations with open questions: What kinds of animals could have made these tracks? Did they walk on two legs or four? Were the footprints made at the same time?
3. The paleontologist removed some plants and dirt from the rock outcrop and found many more footprints. Hand out the Footprints 2 page that shows the new tracks. Have students write down their new observations and interpretations of what caused the footprint pattern.

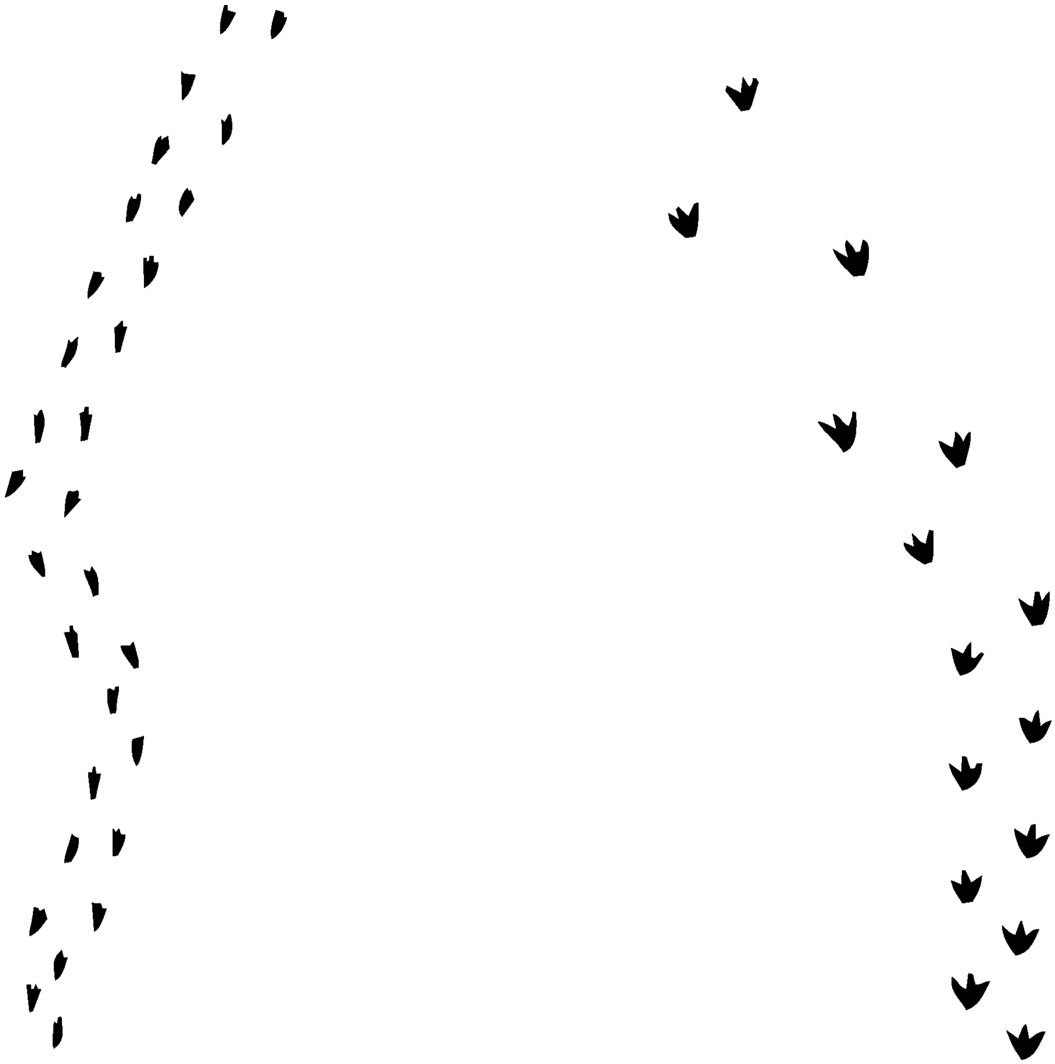
Question for Discussion

Is any interpretation more “correct” than another?

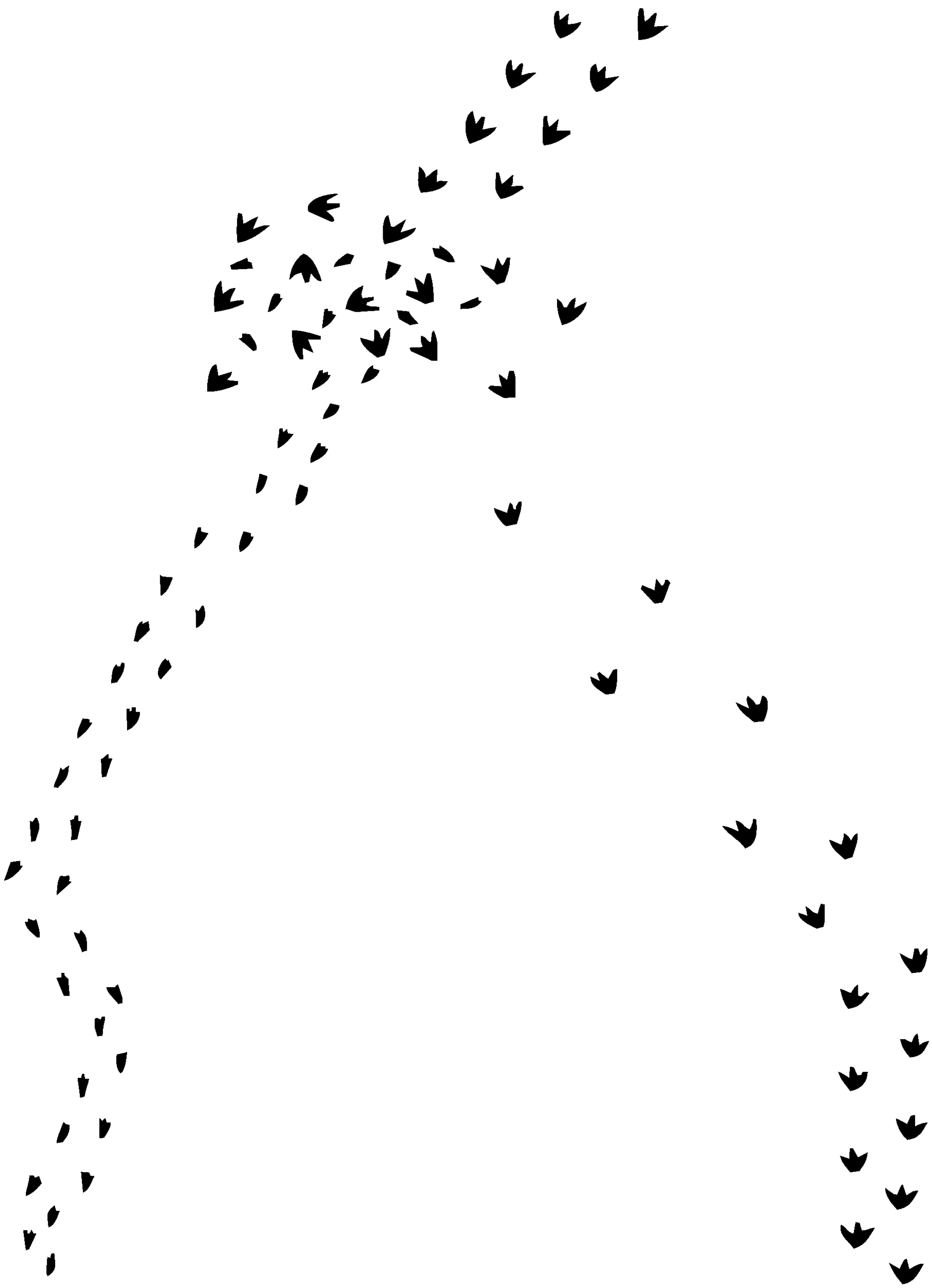
Extension

Make large footprints to create tracks on the classroom floor or outside.

Resources



Footprints 1



Footprints 2

Mapping Fossil Environments

Students map fossil occurrences, interpret the ancient environment, and extrapolate the conditions and life forms at unmapped locations.

Explanation

Earth scientists use many clues to reconstruct the geological history of an area. Often fossil evidence will help determine the age and environment where the rocks being studied were formed. In fact, the distribution of fossils was one of the first clues that led Earth scientists to suspect that the continents had not always been in the same positions that they are in today. Although it was a controversial idea until well into the 1970s, it is now well established that continents are in continual movement over the surface of the Earth. The present-day distribution of fossils is one line of evidence to reconstruct the actual position of continents and oceans in the geological past (**paleogeography**). Just as the distribution of today's animals and plants is affected by various environmental conditions, so were the organisms on the ancient Earth. The use of fossils for this purpose is termed **paleobiogeography**.

The appearance and disappearance of different fossils through time tells a story of changing environmental conditions. A study of the environmental requirements of organisms that became fossils provides the most accurate information about the ancient environment in which they lived. Studies of this type are referred to as **paleoecology**.

Materials

Grid on floor or large table
Fossil specimens or photos (see Resources)
Student Page

Cautions

None

Time

Medium

Grouping

Individual, pairs, small groups

Mapping Fossil Environments

Preparation

1. Set up a grid (5 squares by 5 squares) as large as possible on the floor or on a large table.
2. Distribute one fossil specimen or photo to each square across the grid, keeping the land-based fossils on one side and the marine-based fossils on the other to create two separate areas. There will be some empty squares. If you substitute different fossil types, ensure that the fossils used are of the same age. It is important to be accurate as some organisms became extinct before others evolved.

Prompt

Ask students what clothes they wear in winter. How do these differ from the clothes that they wear in summer? Share that our physical characteristics (like our clothing) are controlled by the environment in which we live.

Ask what animals they would see in the ocean versus what animals they would see in a forest. What characteristics are common in these two habitats?

Explain that paleontologists use the characteristics of fossils to determine the ancient environment in which they lived.

Delivery

1. Introduce students to ammonites. These are marine fossils that are now used to make jewellery and are much sought after. Tell the students that their challenge is to find more ammonite fossils in an area that has already produced some excellent finds.
2. Show them all the fossils being mapped, and discuss whether each one is a land or marine organism.
3. Hand out the Student Pages and explain the grid system. Remind the students that they are looking at the area as if they are flying over it in a plane.
4. Students must first establish their own classification keys for identifying the fossils and environments, and then they must map the fossil occurrences onto their copy of the grid.
5. Once all the fossils are mapped, the students must interpret whether each square on the grid was land or water, and colour it accordingly.
6. Finally, they must hypothesize where the boundary was between the land and the ocean, and where they would search for more ammonite fossils.

Questions for Discussion

How do they know that the spot they picked is a good choice for ammonite fossils?

Why is the land-ocean boundary in different places on different maps?

How could we find out what the environment was in squares where there were no fossils?

What do the fossils tell us about the ancient history of the area?

Extensions

Substitute different rocks for the fossil specimens and interpret how the environment changes across the region.

Use fossil specimens found locally and have students illustrate a story about what life was like in their region millions of years ago.

Expand on the concept that organisms' lives are controlled by the environment. Have students list different activities that they and other animals do for a range of seasons or weather.

Modifications

Instead of using specimens and photos, mark the fossil occurrences onto the student handout and have them begin the task at the habitat interpretation, step 3 in the student activity.

Resources


0 1 2 3 4 5 6 7
CENTIMETRES
SASKATCHEWAN
19 48
GEOLOGICAL SURVEY


CENTIMETRES


0 1 2 3 4 5 6 7
CENTIMETRES
SASKATCHEWAN
19 48


0 1 2 3 4 5 6 7
CENTIMETRES


0 1 2 3 4 5 6 7
CENTIMETRES
SASKATCHEWAN
19 48
GEOLOGICAL SURVEY


0 1 2 3 4 5 6 7

Imagine that you are a paleontologist who has come across an interesting area. The land is covered in fossils that appear to be from the same geological time period. You are very excited by this discovery, but you are looking for fossils of ammonite, an organism that lived in water. You can see fossils from organisms that lived on land, as well as some that lived in water. You need to decide what area within the fossil site you should concentrate on to find ammonites.

Instructions

1. Decide on a classification key for each type of fossil shown on the grid and record it on the legend below your map on this page. You may choose to represent each fossil in your key as a picture of the fossil or as letter.
2. Using your key, map each fossil into the same square on your map as it is found on the grid.
3. Decide on a colour scheme for the habitats and record it on your legend. For example, you may want to choose green to represent the land and blue for the water.
4. Colour each square on your map that contains fossils according to its habitat using the colour scheme you have chosen.
5. Once you have mapped all the individual fossil sites according to habitat, hypothesize where the edge of the ancient sea met the land and mark it with a line.
6. Mark a large “X” where you would look for more ammonites.
7. Write a paragraph to explain why you would concentrate your search for ammonites in the area you have chosen. Explain what your map tells you about the geological history of the area?

Map

Legend

Land	
Water	
Shark teeth	
Ammonite	
Brachiopod	
Coprolites (dinosaur droppings)	
Bivalve	
Tree leaf imprints	
Sea urchin	

Stories from the Rocks

Students match evidence from rock layers to the geological time scale, and interpret changes in the environment through time.

Explanation

We know a lot about the rocks beneath us because we can examine them when they are exposed at the surface (**outcrops**) and we can map them using various techniques (e.g. seismic or well-log cross-sections). Using the Principle of Uniformitarianism, which states that the present is the key to the past, Earth scientists can begin to reconstruct and understand ancient environments. By looking at present-day oceans, they know that limestone rock and marine organisms such as corals characterize these settings. When they find ancient limestone rocks with coral fossils, they can, therefore, surmise that the environment, at the time of deposition, must have been covered by an ocean. A variety of dating methods (e.g. radioactive dating or index fossils that correlate to a known time period) allow Earth scientists to identify where in the geological time scale the rocks fit. Putting all of this information together allows Earth scientists to recreate the story of our Earth's past based on evidence from the rocks.

Materials

Glue sticks
Scissors
Student Pages

Cautions

None

Time

Medium

Grouping

Individual, pairs

Preparation

Reproduce one of each Student Page per student.

Prompt

Where do we see rocks being formed in the present day? Possible answers may be from a volcano, on the ocean floor, on a riverbed. Discuss how the characteristics of those rocks are influenced by the environment where they are formed.

Delivery

1. Hand out the Student Page "Evidence from the Rocks."
2. Have students match each piece of evidence to the correct geological time period and paste it in place.
3. When done, ask a few students to describe their sequence and make sure everyone has the rock evidence in the correct order on the time scale.
4. Hand out the Student Page "Every Layer Tells a Story."
5. Ask the students to compare the rock evidence with the type of environment the rock would be found in, as described in the provided chart. They will use this evidence to write the story of how the environment of southern Saskatchewan has changed during geological time.

Questions for Discussion

How did you use the principle that the present is the key to the past in your interpretation?

What was the environment like during the time of *Tyrannosaurus rex*?

What is the main difference between rocks formed in shallow water and those formed in deep water?

Extension

The inferred environment information is valid for any region. Modify the rock evidence to suit the geology of your region.

Instructions

The following chart contains descriptions of rock and fossil evidence found within several different geological formations in southern Saskatchewan.

Cut out each box and match it to the corresponding period from the geological time scale. Once you know you have them in the correct order, glue them in place.

Limestone with inter-layered beds of halite (salt), clams and fossilized fish dated at 390 million years
Granite dated at 2.8 billion years
Bentonitic shale, muddy siltstone, tyrannosaurus fossil remains (66 million years old), fossilized pollen grains
Cream-coloured limestone, occasional sandstone beds, marine snails and corals dated at 170 million years
Shale and mudstone, single-celled algae fossils dated at 500 million years
Limestone and black shale, corals and clam shells, shark teeth dated at 330 million years
Glacial till, mud containing pebbles and cobbles, primitive 5000 year-old stone tools
Limestone and lime mudstone, trilobite fossils dated at 480 million years
Reddish sandstone and siltstone, fossil remains of very early dinosaurs dated at 250 million years
Soft sandstone and siltstone, coal beds, high iridium values in lower coal bed dated at approximately 65 million years

Geological Time Scale

Era	Period	Age Mya*	Evidence from the Rocks
Cenozoic	Quaternary	2.6	
	Neogene	23	
	Paleogene	66	
Mesozoic	Cretaceous	146	
	Jurassic	199	
	Triassic	251	
Paleozoic	Permian	299	
	Carboniferous	399	
	Devonian	416	
	Silurian	440	
	Ordovician	488	
	Cambrian	542	
Precambrian Eon		4600	

* mya: millions of years ago

Instructions

Use the information from this chart and your geological time scale correlation to write a brief geological history of southern Saskatchewan, starting in the Precambrian and continuing into the Quaternary. Keep in mind that you only have small pieces of evidence and that the actual geological history would be far more complex than your interpretation will be. However, this is the type of evidence that Earth scientists use when telling the "story" of the Earth's history from evidence found in rocks.

Inferred Environment	Evidence
Continental Ice Age	Glacial till, poorly sorted mixture of mud, silt, sand, pebbles and even boulders
River	Sandstone, siltstone, non-marine fossils
Swamp	Coal deposits
Catastrophic meteorite collision	Kaolinite or coal high in iridium content (radioactive element)
Shallow ocean (shelf)	Sandstone, limestone, marine fossils
Evaporating inland sea	Anyhydrite, potash and halite
Deep lake	Shale, could be bentonitic
Deep ocean	Black shale, could be fossiliferous
Shallow lake	Shale, mudstone
Land exposed to erosional forces	Period of no deposition, erosion surfaces
Active igneous intrusions	Granitic basement rock