

Assignment Discovery Online Curriculum

Lesson title:

Living Fossils

Grade level:

6-8, with an adaptation for older students

Subject area

Life Science

Duration

Two to three class periods

Objectives:

Students will

1. understand what is meant by the term *living fossils*;
2. understand some possible reasons why these fossils have survived; and
3. understand how to form a hypothesis and use scientific data to determine whether the hypothesis is accurate.

Materials:

- Computers with Internet access (optional but very helpful)
- Pens and paper
- Large sheets of paper
- Copies of the Take-Home Activity Sheet: Exploring a Living Fossil

Procedures:

1. Begin the lesson by asking students if they know of any animals that have been living on Earth since the time of the dinosaurs. Once you've discussed several examples, write the following animals on the board:
 - a. Coelacanths (a prehistoric fish, pronounced SEE luh canth)
 - b. Crocodiles
 - c. Horseshoe crabs
 - d. Cockroaches
2. Discuss with students how long ago each of these animals first appeared. The coelacanth lived 410 million years ago; cockroach, 350 million years ago; horseshoe crab, 250 million years ago; and crocodile, 200 million years ago. Point out that these animals lived at the same time as the dinosaurs, yet unlike the dinosaurs, they have survived. Tell students that scientists are still debating why these animals have survived.

3. To help students address that problem, discuss the more accepted scientific theories about why dinosaurs became extinct, or died out. Theories include increased volcanic activity; gradual climate change; an asteroid, meteor, or comet hitting Earth; changes in the types of vegetation available; and the arrival of new predators. Discuss each of these theories. Make sure that students understand how each could have led to the extinction of the dinosaurs. For example, a change of climate could have led to a change in vegetation, making it impossible for plant-eating dinosaurs to find food. Or a change of climate—from tropical to arid, for example—would also have resulted in depletion of the food supply.
4. Discuss ways that other prehistoric species, such as the coelacanth and the crocodile, could have survived an asteroid hitting Earth that caused the dinosaurs to die off. Explain that some animal species are generalists, which means that they can adapt to a wide variety of habitats and climates. Other animal species are specialists, which means that they are specifically suited to a habitat that has remained largely unchanged for millions of years. Ask students to think about how generalists and specialists might be able to survive an event or change that wipes out other types of animals. For example, a generalist might be able to survive by adapting to a radically different type of food, while a specialist adapted to life on the ocean floor might not be affected by an event that destroys other habitats.
5. Show students pictures of the four animals introduced at the beginning of the lesson. Then share the following facts about each with the class:
 - a. *Coelacanths* are fish that date from 410 million years ago, but of the original 120 species, only one survived the event that killed the dinosaurs 65 million years ago. The surviving species was small; ate cuttlefish, squids, snipe eels, small sharks, and other fish; and was dark blue, much like the color of its ocean habitat.
 - b. *Crocodiles* have been on Earth more than 200 million years. They have successfully adapted to their environment and have undergone few anatomical changes. They are generalists and eat a wide variety of food. They also are extremely tough and can survive serious injuries.
 - c. *Horseshoe crabs* have changed little over the past 250 million years. They have a hard, curved shell that protects their soft bodies. They can go a full year without eating. Horseshoe crabs also can survive severe temperatures and high levels of saltwater found in some parts of the ocean.
 - d. *Cockroaches* first appeared 350 million years ago and have changed little over that time. They can be found all over the world in every possible climate, from hot, dry deserts to warm, wet tropical forests to the cold, dry mountain temperatures. Cockroaches can eat just about anything, making them extremely adaptable.
6. Hand out copies of the Take-Home Activity Sheet: Exploring a Living Fossil. Ask each student to pick one of these animals as a subject of in-depth research. Before beginning the

research, have students develop a hypothesis about why their animal did not become extinct. They should write their hypothesis on Part A of the sheet. Tell students that a hypothesis is a theory or prediction based on current knowledge. Students should base their hypotheses on the facts discussed during step 5, as well as the discussion about why dinosaurs became extinct. Below is a sample hypothesis explaining why coyotes might survive if conditions on Earth changed dramatically and other species were killed off.

Because coyotes are generalists and will eat just about anything, they have a good chance of surviving in the event of a dramatic climate change or a major event, such as a meteor hitting Earth.

7. Have students conduct research at the Web sites below or in the library to find evidence to support or refute their hypotheses. Give students time to work on this project in class and then have them finish their work for homework. Students can use the questions on Part B of the sheet to guide their research. They may find it helpful to discuss ideas with other students working on the same animals, but each student should answer the questions on his or her own sheet. Have them explain whether their hypothesis was correct in Part C of their Take-Home Sheet.

Web Sites

Coelacanth

- The Fish Out of Time: <http://www.dinofish.com>

Horseshoe crab

- Horseshoe Crab: Living Fossil: <http://www.aqua.org/animals/species/prhcrab.html>
- Horseshoe Crabs: The Ancient Mariners: <http://www.beach-net.com/horseshoe/Bayhorsecrab.html>

Crocodile

- NOVA Online: Crocodiles: <http://www.pbs.org/wgbh/nova/crocs>

Cockroach

- Star Insects: Champions of Evolution:
http://www.insectia.com/beta/e/iv_c202015.html

8. During the next class period, discuss students' research. Did it support or refute their hypotheses? Why do students think these animals survived?

Adaptation for older students:

Before beginning the lesson, have students discuss or write paragraphs summarizing the concepts of evolution and natural selection, including

- the process by which one animal species evolves into a new species; and

- two examples of prehistoric animals that were the ancestors or early relatives of modern-day animals (e.g., saber-toothed tigers and modern-day tigers; early hominids and *Homo sapiens*).
- Then assign each student a living fossil to research. Ask students to develop a hypothesis explaining why their fossil has survived, possibly including information about natural selection. Then ask them to research their animal to find out what scientists know about why it survived. The students' final reports should include a picture, time line, discussion of their hypothesis, and a discussion of how the process of natural selection might have helped animals survive.

Questions:

1. Describe the characteristics that might make an animal species likely to survive during a time when many other species are becoming extinct.
2. Name some animals you commonly see in densely populated cities. Why do you think these animals are able to survive in this environment? Give reasons to support your ideas.
3. Hypothesize the pros and cons of an animal species being a specialist, tolerating only a very narrow range of habitats or foods. Under what circumstances might this species be more or less likely than others to survive a period of mass extinction?
4. Explain the purpose of developing a hypothesis before conducting scientific investigation.
5. Explain the potential effects of humans on the survival of the animal you studied. How much longer do you think this animal will survive? Give reasons to support your ideas.
6. Compare and contrast how the following two scenarios would affect life on Earth as we know it today: a catastrophic event such as a meteor and a gradual change in climate.

Evaluation:

Use the following three-point rubric to evaluate students' work during this lesson:

Three points: actively participated in class discussions; wrote a logical hypothesis based on careful consideration of the information available; worked cooperatively with group members to research the animals and answer all questions on the Classroom Activity Sheet; wrote a clear and logical report that includes a revised hypothesis that takes into consideration new information about the animal as well as the other required components.

Two points: participated in class discussions; wrote a logical hypothesis based on some of the information available; worked somewhat cooperatively with group members to research the animals and answer some of the questions on the Classroom Activity Sheet; wrote a somewhat

clear and logical report that includes a revised hypothesis that takes into consideration new information about the animal as well as the other required components.

One point: participated minimally in class discussions; wrote a hypothesis that did not reflect careful consideration of the information available; did not work very cooperatively with group members to research the animals; answered few of the questions on the Classroom Activity Sheet; wrote a report that was not clear and logical and did not include a revised hypothesis.

Extensions:

Why Some Animals Are Endangered

Have students research the giant panda, the black rhino, or another endangered animal species to discover why these animals are approaching extinction. Ask each student or group of students to focus on the geographic region where the animal lives naturally. Have them research the region to learn what other animals live there. Ask them to choose one animal from that region that is not endangered and write several paragraphs comparing and contrasting the two animals. Their paragraphs should describe the animals' habitats and behaviors and explain the reasons that only one of animals is endangered.

Hardy Species of the Future

Ask students to brainstorm the animal species they think have done a particularly good job of adapting to human environments. They might mention coyotes, ants, cockroaches, and pigeons. Have them research these species and write paragraphs explaining why the species have been successful. Have students write additional paragraphs predicting how the species will fare over the next hundred years. Do students think the animals will continue to thrive, or will human development eventually destroy them?

Suggested Reading:

The Tales Fossils Tell

Jonathan R. Gallant. Benchmark Books, 2001.

Fossils have intrigued and confused people for many centuries. Our gradual understanding of what fossils are is outlined in this excellent, illustrated introduction to the subject. Covering scientific thinking through the centuries, the final chapter explains what we now know about how fossils are formed and how their age is determined.

A Fish Caught in Time: The Search for the Coelacanth

Samantha Weinberg.

HarperCollins, 2000.

In 1930, a museum curator in southern Africa found an unusual 5-foot fish in a trawler's haul. She tried to identify it and finally sent a drawing to an amateur ichthyologist (a fish specialist), who recognized it to be a fish thought only found in fossils. This book recounts the 14-year search to find a living specimen and the ensuing international debate over who "owned" the fish. Black-and-white photographs are included in this exciting true story.

Vocabulary:

coelacanth [SEE luh canth]

Definition: A prehistoric fish that lives in the Indian Ocean and off the coast of Sulawesi, Indonesia.

Context: The **coelacanth** is an animal that has survived millions of years in the same form as its prehistoric ancestors.

extinction

Definition: The total disappearance of a species, so that it no longer exists anywhere.

Context: Scientists know that the dinosaurs died off about 65 million years ago, but they're still not sure what caused that **extinction**.

generalist

Definition: An organism that has adapted to survive in different habitats.

Context: Cockroaches are notorious **generalists** because they can adapt well to many habitats.

hypothesis

Definition: A tentative assumption made in order to draw out and test its logical or empirical consequences.

Context: You should learn as much as possible about a subject before writing your hypothesis, but you cannot support or refute the **hypothesis** until you conduct research or a scientific experiment.

living fossil

Definition: A prehistoric animal species, generally one that lived during the time of the dinosaurs, that continues to survive in its ancient form today.

Context: The horseshoe crab is a **living fossil** because it has survived for more than 200 million years and continues to flourish today.

specialist

Definition: An organism that has adapted to a specific habitat at the expense of flexibility in surviving in different habitats.

Context: Koalas are **specialists** and eat only certain types of eucalyptus leaves; this specialization means that when they are kept in captivity, zoos must provide the right types of eucalyptus trees.

Academic standards:**Grade level:**

6-8

Subject area:

Science: Nature of Science

Standard:

Understands the nature of scientific inquiry.

Benchmark:

Designs and conducts a scientific investigation (e.g., formulates hypotheses, designs and executes investigations, interprets data, synthesizes evidence into explanations, proposes alternative explanations for observations, critiques explanations and procedures).

Grade level:

6-8

Subject area:

Science: Life Science

Standard:

Understands biological evolution and the diversity of life.

Benchmark:

Knows that the fossil record, through geologic evidence, documents the appearance, diversification, and extinction of many life-forms.

Grade level:

6-8

Subject area:

Science: Life Science

Standard:

Understands biological evolution and the diversity of life.

Benchmark:

Understands the concept of extinction and its importance in biological evolution (e.g., when the environment changes, the adaptive characteristics of some species are insufficient to allow their survival; extinction is common; most of the species that have lived on the Earth no longer exist).

Grade level:

6-8

Subject area:

Science: Life Science

Standard:

Understands biological evolution and the diversity of life.

Benchmark:

Knows basic ideas related to biological evolution (e.g., diversity of species is developed through gradual processes over many generations; biological adaptations, such as changes in structure, behavior, or physiology, allow some species to enhance their reproductive success and survival in a particular environment).

Credit

Betsy Hedberg, freelance curriculum writer and teacher.

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Exploring a Living Fossil

Name of living fossil:

Part A. Write Your Hypothesis

Before you begin your research, write a hypothesis about why your animal did not become extinct as the dinosaurs did.

Part B. Research Your Animal

As you research your animal, answer the following questions:

1. How long has your animal existed?
2. Describe what your animal looks like. How do you think its physical structure contributed to its survival?
3. Where does your animal live? Has its habitat changed over the time it has existed?
4. Can your animal live in a variety of habitats, or does it need a specific habitat?
5. How does your animal reproduce? Does this strategy contribute to the animal's survival?
6. What are your animal's predators, if any?

Part C. Consider Your Hypothesis

Was your hypothesis accurate? Explain.