Fleshing Out Fossils
- Extended for the Classroom -

Developed for the Carnegie Museum of Natural History, Pittsburgh PA

GRADE LEVELS

- 4-7

TIME OF ACTIVITY

- Total lesson: 30 minutes
- Activity: 10-20 minutes
- Extension of lesson: 10 minutes

LEARNING OBJECTIVES

- Evolution is the process where species change over time due to natural selection.
- The role of comparative anatomy in understanding how animals are related evolutionarily.
- Fossils helped Darwin link ancient extinct animals to modern-day animals.
- Studying fossils helps scientists like Darwin discover the common ancestors of different modern-day organisms, and ultimately, how all life is related to each other.

MATERIALS

- One set of index cards per group of 3 students
- Paper and pencil

PREPARATION

- Cut out pictures of the animals found in the appendix section of this lesson plan and glue them onto index cards.
- Make enough sets of index cards so that each group (of approximately 3 students) has one set of cards.

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BACKGROUND INFORMATION

Charles Darwin (1809-1882) was a naturalist who developed the ideas of natural selection and evolution, or modification with descent over time. Although Darwin thought about these ideas for much of his adult life, his voyage on the *H.M.S. Beagle* to the Galapagos Islands stimulated this thinking and helped him to gather more evidence for these ideas.

In the Galapagos Islands, Darwin studied fossils of extinct organisms and noticed that they were strikingly similar to living organisms. Their similarities made Darwin think they were somehow **related**! Eventually Darwin pieced together his principle of evolution: all organisms **are related by descent from common ancestors**. Extinct species, whose fossils we can find today, are ancient ancestors of existing species today! Darwin realized that favorable traits are passed from parent to offspring in order to help them better survive and reproduce **in their particular environment**. This pressure is called **natural selection.** The accumulation of these changes over generations is called evolution. So over time, the species change to adapt to different environments. Sometimes one species will give rise to several species as they adapt to different niches (called speciation).

DISCUSSION

Use the following questions and information given to engage in a discussion with your students about Charles Darwin, fossils, and the principle of evolution.

1. Ask the students: Do you know who Charles Darwin is ? Do you know why fossils were so important to him?
    a. *Charles Darwin proposed the principle of evolution: species change overtime due to natural selection. Every species has evolved from a pre-existing species, therefore all species have evolved from a common ancestor.*
    b. *Charles Darwin traveled around the world for 5 years, carefully observing the animals and plants. In particular he found many fossils.*
    c. *Darwin collaborated with other scientists at the same time they would trade samples, drawings and taxidermy specimens.*
    d. *Darwin found fossils of species that no longer existed. He also noticed that they were very similar to living animals.*
2. Ask: What do you think Darwin's observations mean? Why would fossils of extinct animals look so similar to animals living in Darwin's time?
    a. *Explain: Darwin thought that modern animals must be somehow related to those extinct ones that he found fossils of.*
    b. *Lead to: Ancient extinct species are ancestors of modern-day species. Darwin realized that species change over time due to natural selection.*
3. Ask your students: why do you think animals would need to change over time?

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a. *Animals, and all livings things, evolve to adapt to their changing environment – the pressure of natural selection.*
b. *Natural selection refers to all the selective pressures of the environment. The changing climate, other species, new predators or predators that die out, are all factors that are part of natural selection.*

ACTIVITY

1. Tell the students that they will get a chance to draw conclusions about relatedness between extinct animals and today's animals, just like Darwin!
2. Break the students up into groups of approximately three students. Give each group a set of five cards and allow them to spread out throughout the classroom.
3. Tell the students to read the front of each card from their set and study the illustrations on each card of the extinct animal. Encourage the students to answer the questions and hypothesize about what modern-day animals could be related to this extinct animal. When they turn the card on its back, they will discover one animal that looks like the extinct animal, and a fun fact about this animal.
4. Tell the students that after they go through their set of cards, each group will present their observations and ideas that lead them to their hypothesis about the related animal. (Each group will present one card from the set.)

   Students can consider the following questions:
   - How did the ancestor live? How did it move, how did it eat?
   - How does the modern day animal live?
   - How is the modern day animal different from the ancient animal? How are they the same?
   - Why do you think this animal has undergone evolution this way? What shape did natural selection take on this species?

   The pairs are as follows:

Extinct Ancestor	*Living Descendant*
New Zealand Giant Moa	Ostrich
Columbian Wooly Mammoth	Indian Elephant
Irish Elk	Fallow Deer
Quagga	Plains Zebra
Hyrachyus	Rhinoceros

EXTENSIONS

Using their knowledge about evolution by descent, ask the students to imagine that they have just found a new fossil! Ask them to relate their fossil to a modern-day animal. Using what they know about this modern-day relative, ask your students to write a journal entry about their extinct animal. Use the following questions as suggestions:

- Where do you think this animal lived?
- How did it move from place to place?
- What did it eat?
- Where would someone like Charles Darwin have found these fossils?
- What can fossils tell us about animals that are no longer alive?

If there is a history museum located near your school, consider taking a field trip to explore fossils further. Find fossils, real and replicas, and discover how scientists use the evidence they have to reconstruct extinct animals.

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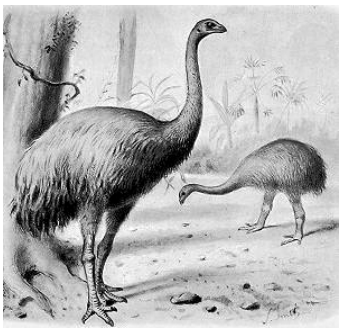
APPENDIX: ILLUSTRATION OF CARD LAYOUTS

Card #1: Front

New Zealand Giant Moa

Notice that the Giant Moa has a long neck and long legs. What other animal looks like this?

How do you think it moved from place to place?



Card #1: Back

Ostrich

The ostrich looks like the Giant Moa, with its long neck and legs.

The Giant Moa walked at a speed of 1.86-3.11mph. The ostrich can run up to 40mph!

Card #2: Front

Wooly Mammoth

Look at the mammoth's large body and long trunk! What other animal looks like this?

How do you think the mammoth ate food?

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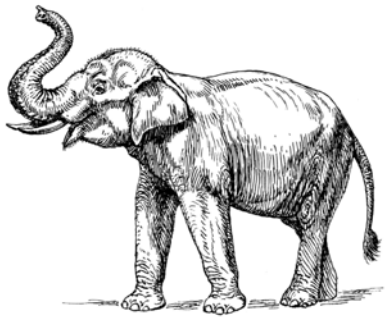
Card #2: Back

Indian Elephant

The Indian Elephant looks a lot like the ancient Mammoth!

Both the Elephant and the Mammoth eat by using their trunks to move food from the ground to their mouths!



Card #3: Front

Irish Elk

What type of modern-day animal does the Irish Elk look like?

Look at how large its antlers are!

Card #3: Back

Fallow Deer

The Fallow Deer is related to the ancient Irish Elk.

The Irish Elk was one of the largest deer that ever lived!

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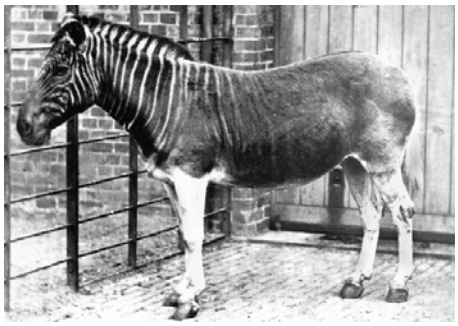
Card #4: Front

Quagga

Notice the stripes surrounding the head of the the Equus Horse. Which modern-day animal does this remind you of?

What do you think the stripes are for?



Card #4: Back

Plains Zebra

The modern-day Zebra has stripes like the Equus Horse all over its body.

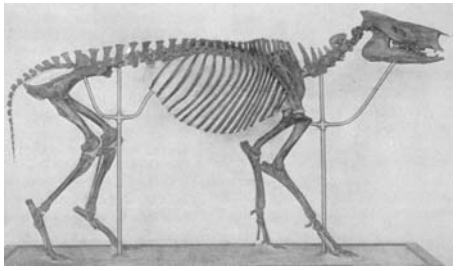
Each stripe pattern is unique to each individual; the stripes are believed to be a form of camouflage.

Card #5: Front

Hyrachyus

What animal do you think that the ancient Hyrachyus looks like?

What do they have in common?



Card #5: Back

Rhinoceros

The Rhinoceros shares a common ancestor with the Hyrachyus.

Although the Hyrachyus looks like other animals as well, it shares extremely similar teeth structures with the Rhinoceros.

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