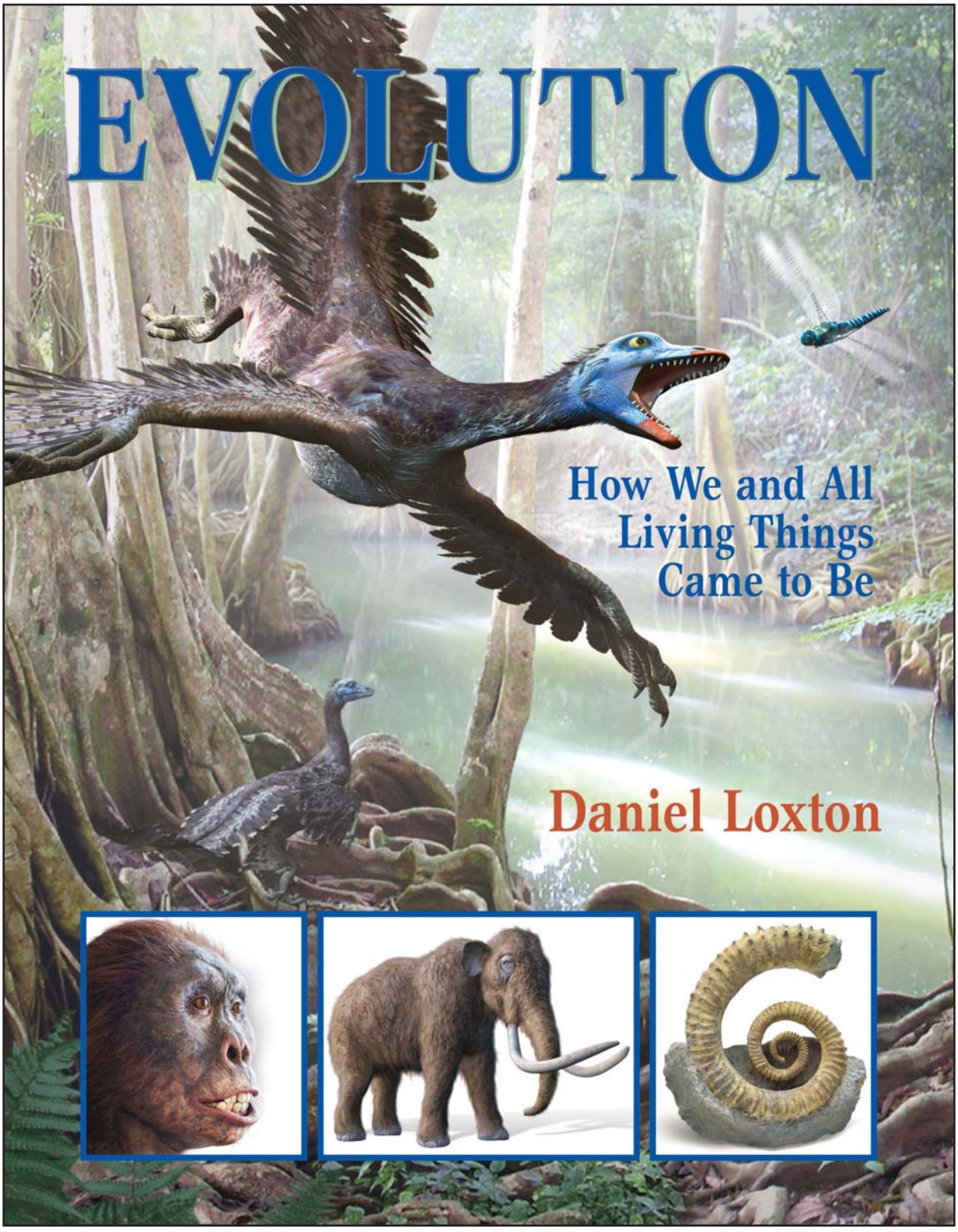
LEARNING RESOURCE MATERIAL



About Evolution

Evolution has shaped every facet of the living world, from the petals on a rose to the lungs of a whale to the scales of a long-extinct dinosaur. Daniel Loxton's *Evolution* tells the story of nature's changes in an engaging yet easy to understand way. As the story unfolds, children will learn how Charles Darwin developed his concept of natural selection 150 years ago and came up with his theory of evolution. Then they'll learn how modern-day science has added to our understanding of evolution.

About the Author and Illustrator

Daniel Loxton is Editor of *Junior Skeptic*, the children's section of *Skeptic* magazine, a quarterly science education and science advocacy magazine published by the nonprofit Skeptics Society. The magazine has been called "stimulating and provocative" by Carl Sagan, "clearly superior ... gutsy" by Edward O. Wilson and "the best journal in the field" by Stephen Jay Gould. This book is based on a two-part *Junior Skeptic* story.

The illustrations are a mix of hand-drawn cartoons (colored using an illustration program) and computer-generated images (CGI). To make the CGI image of the *Archaeopteryx* on the front cover, for example, Daniel went on location to the Caribbean island nation of Dominica to photograph an appropriate background. Completely virtual 3D creatures were then designed and posed on a computer. Finally, the virtual *Archaeopteryx* and the background photograph were merged using photographic editing software. The result is a highly realistic scene featuring a creature that has been extinct for more than 150 million years.

Discussion Questions and Activities

The following activities are suitable for children aged 8–13 studying science, mathematics and language arts.

1. Layers of Life

Scientists can look back at life in ancient times by studying fossils of plants and animals preserved in layers of rock. You can make a miniature cross section of rock layers embedded with "fossils" to spark discussion.

Materials:

- a glass bowl or small aquarium
- sand, dirt, flour and small pebbles to make four layers, each about 2 in. deep in the bowl
- five "fossils," such as different buttons or small toys

Method:

- pour a layer of sand into the bottom of the bowl and embed a "fossil" in this layer, near the side of the bowl where it can be seen.
- pour a second layer of dirt and embed two "fossils" in it. Both "fossils" should be visible and in the same layer, but on opposite sides of the bowl.
- add a layer of flour and finish with a layer of pebbles. Embed one "fossil" per layer.

Explain to your students that they are like scientists looking at layers of rock that contain fossils. Some questions to ask:

- What can you tell about the fossil in the bottom layer? (It was the oldest fossil because it's in the first layer of rock.)
- What can you tell about the two fossils in the same layer? (They lived about the same time because they are in the same layer of rock.)
- Point to one fossil and ask: Is this fossil older or younger than the one above it? (It is older.)
- How do you think scientists find fossils and

KIDS CAN PRESS
Kids Can Press is a Lorus™ Entertainment company

record where they were in the layer? (They dig very carefully, sometimes using something as small as a toothbrush, to uncover fossils. When they find a fossil they record it's location on a 3-D "map" that shows which layer it was in and where it was in that layer.)

2. Rabbits, Rabbits, Rabbits

If two rabbits had two babies and each of them had two babies and so on, you would soon have a huge number of rabbits. But Charles Darwin realized that populations don't grow unchecked in nature. Predators and limited resources, such as food and water, keep a population in check. That way, only the fittest survive to pass along their genes to the next generation.

This game, a variation on musical chairs, demonstrates some of the pressures on the population.

Materials:

- one 8" x 11" piece of paper for each student
- a radio

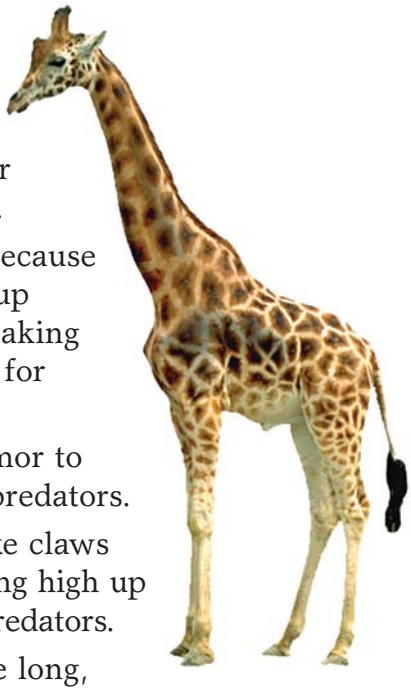
Method:

- arrange the papers in a big circle with spaces between them.
- on one of the papers write: NO FOOD. On another: EATEN BY A FOX. On another: BAD WEATHER. On another: STRONGEST. On another: FITTEST.
- remove one of the papers so that there is one fewer than the number of players.

Tell the children they are rabbits who must walk in a big circle around the circle of papers on the floor. When the music stops (use the radio for music), they must find a piece of paper to stand on. Warn them that there are dangers, such as NO FOOD, EATEN BY A FOX and BAD WEATHER. If they land on one of these danger squares, or if they do not find a square to stand on, they will be out of the game. If they land on STRONGEST, FITTEST or a blank square, they are safe. As the game progresses, continue to remove blank squares, so that there is always one fewer than the number of remaining players. At the end of the game, only the two strongest and fittest players will survive. Explain that Darwin noticed that a population of living things had pressures on it to keep it from unlimited growth. In nature, only the strongest and fittest animals would survive to reproduce.

3. Handy Adaptations

Show students photographs of unusual-looking animals, such as a giraffe, zebra, armadillo, sloth and hummingbird. Each of these animals has an obvious physical adaptation that has been passed along because it offers some advantage. Discuss these adaptations with your students:



- Giraffes have a long neck to reach leaves and other vegetation that other animals can't get to.
- Zebras are striped because the striping breaks up their body shape, making them more difficult for predators to see.
- Armadillos have armor to protect them from predators.
- Sloths have hook-like claws to allow them to hang high up in trees and avoid predators.
- Hummingbirds have long, straw-like beaks to let them sip nectar that would be otherwise hard to get to.

Ask students to look at their own bodies and see what adaptations they have that are beneficial. Some examples are: opposable thumbs to make grasping things easier; two legs to make walking upright possible, leaving the upper limbs free to use tools and carry things; eyelashes and eyelids that act like windshield wipers, keeping out dirt; a larynx (voice box) that allows humans to form words and communicate.

4. Nature Journal

Charles Darwin came up with his theory of evolution after close observation of nature. He kept a journal of his voyage on the *Beagle* to South America, New Zealand and Australia in 1831 to record his observations. Here is one passage from *The Voyage of the Beagle*, in which he reports an encounter with tortoises on Chatham Island:

"The day was glowing hot, and the scrambling over the rough surface and through the intricate thickets, was very fatiguing; but I was well repaid by the strange Cyclopean scene. As I was walking along I met two large tortoises, each of which must have weighed at least two hundred pounds: one was eating a piece of cactus, and as I approached, it stared at me and slowly walked away; the other gave a deep hiss, and drew in its head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, seemed to my fancy like some antediluvian animals. The few dull-coloured birds cared no more for me than they did for the great tortoises."

Ask students to write a journal entry in which they describe a real or imagined encounter with a wild animal. Their description should include details about the appearance of the animal, its behavior and the surroundings. If they wish, students could also include sketches of the animals or parts of the animal or surrounding vegetation.

5. An Interview with Charles Darwin

The originator of the theory of evolution, Charles Darwin, died in 1882. But what if he were to appear in your classroom, ready to answer questions about his life and about his work? Ask for five volunteers to be Charles Darwin. Each "Darwin" should research one part of his life: his childhood; his journey on the *Beagle*; his preparation leading up to the publication of the theory of evolution; his later life. Other students should be the journalists and research and write up one question each to submit in advance of the interview. Then, on the day of the interview, students ask their Charles Darwins the questions they have submitted. Some sample questions:

- How did you get interested in nature?
- How old were you when you took your first voyage on the *Beagle*?
- What did you feel like when you came up with the theory of evolution?
- What did you think when Alfred Russel Wallace came up with the same theory before you had made it public?
- What was the reaction to your theory of evolution?

Some answers will require facts; others will allow for more imaginative answers that require your Charles Darwins to put themselves in the shoes of the real Darwin.