

# *Body by Design: Form and Function:* Teacher's Guide

**Grade Level:** 6-8

**Curriculum Focus:** Animals

**Lesson Duration:** Two class periods

## **Program Description**

The brightest engineering minds at M.I.T. can't hold a candle to Mother Nature. Her designs for animal bodies and how they function — eat, see, fly, run, and more — reflect an unparalleled mastery of physics, biomechanics, materials, and construction. This wondrous program explores the complex and diverse creatures of our planet.

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## **Onscreen Questions and Activities**

### Segment 1, *Body by Design: Form and Function: Part One*

- Pre-viewing questions:
  - What do you know about the causes and effects of physical adaptation?
  - As you watch how the different animal species have adapted to their environments, think about the body structure of humans. How is your body custom-made for your environment? Think about the way you get around, how you acclimate to weather changes, the position of your eyes, and the structure of your teeth.
- Post-viewing questions:
  - Choose two of the animals from the documentary and compare their body coverings. Then, determine why each is suited to the particular needs of the animal.
  - Why is your skin an ideal covering for you?
- Activity: Begin with a drawing or picture of a real fish. Then choose one body part to change. Make a new drawing that incorporates the original fish body and the change that you make. Be prepared to explain how this new adaptation will benefit the fish.

### Segment 2, *Body by Design: Form and Function: Part Two*

- Pre-viewing questions:
  - How can you determine an animal's place on the food chain by looking at its physical features?
  - What can you tell about an animal's behavior by its appearance?
  - As you watch the program, pay attention to the link between physiology and behavior. Think about how this applies to animals not featured in the documentary.

- Post-viewing questions:
    - There are about 300 pounds of insects for every pound of human on Earth. Why are insects so plentiful?
    - Discuss the attributes that allow them to survive and thrive in so many diverse environments.
  - Activity: Research the eyes of three different animals. Determine the advantages and disadvantages of each type, and choose which you would be most happy to have. Then, present your choice to the class.
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## Lesson Plan

### Student Objectives

Students will understand:

- Symbiosis is a kind of partnership between two organisms in nature.
- Mutualism is a symbiotic relationship in which both organisms benefit.
- Commensalism is a symbiotic relationship in which one organism benefits and the other neither benefits nor is harmed.
- Parasitism is a symbiotic relationship in which one organism benefits and the other is harmed.

### Materials

- *Body by Design: Form and Function* video and VCR, or DVD and DVD player
- Computer with Internet access
- Books and articles concerning symbiotic relationships in nature
- Index cards for note-taking

### Procedures

1. Provide your students with the following background information:
  - Leafcutter ants bite off pieces of leaves and carry them back to their underground nests. A type of fungus grows on the leaves; the ants care for and cultivate the fungus, and then eat it. You might say the ants and the fungi have a partnership.
  - Other pairs of organisms have also developed partnerships. Each pairing is called a symbiosis. There are three types of symbiotic relationships: mutualism, in which both organisms benefit from the pairing; commensalism, in which one organism benefits and the other neither benefits nor is harmed; and parasitism, in which one organism benefits and the other organism is harmed.



2. Divide the class into small discussion groups to talk briefly about the symbiotic relationship between leafcutter ants and the fungi they cultivate and eat. Suggest to the class that two types of symbiosis may be at work: first commensalism, in which the ants cultivate the fungi, and then parasitism, in which the ants eat the fungi.
3. Invite your students to use the research materials you have provided to find information about several other pairs of organisms that practice symbiosis. If possible, each student should find at least one example of each of the three types mentioned above. Students should take notes on index cards and use their notes later in group discussions.
4. Have the groups reconvene to discuss what the group members have learned from their research. Each member should report orally on her or his findings. Then the group can hypothesize how the symbiotic partnerships might have evolved.

### Discussion Questions

1. Discuss why evolution is described as an “ongoing play without a script or a director.”
2. Compare and contrast the way in which lizards and mammals run and breathe.
3. Discuss why it was important for evolution that reptiles developed waterproof skin.
4. Debate this statement with your classmates: “People may think that humans are the dominant species, but perhaps insect exoskeleton bodies are the shape of things to come.”
5. Explain how you can tell an animal's position on the food chain by the placement of its eyes on its head.
6. Cheetahs, bison, and leafcutter ants all have very strong jaw muscles, but they use them differently. Contrast how and why these animals use their jaws.

### Assessment

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

- 3 points: Student's research includes at least one example of each type of symbiosis; all examples correctly categorized by type; soundly reasoned hypotheses about how each relationship evolved.
- 2 points: Student's research includes at least one example of two of the three types of symbiosis; most examples correctly categorized by type; soundly reasoned hypotheses about how each relationship evolved.
- 1 point: Student's research includes few examples of symbiosis; some examples incorrectly categorized; weak hypothesis about how the relationship evolved.

### Vocabulary

#### **chitin**

*Definition:* A tough substance that forms part of the hard outer shell of insects, arachnids, and crustaceans.



*Context:* Insects, crabs, and lobsters have external skeletons all containing a tough but pliable material called chitin.

### **evolution**

*Definition:* A theory that the various types of animals and plants have their origin in other preexisting types and that the distinguishable differences are due to modifications in successive generations.

*Context:* Bone and muscles, eye and mouth, they all come from thousands of generations of slow tinkering by evolution. It is a natural process no human can match.

### **keratin**

*Definition:* Any of various sulfur-containing fibrous proteins that form the chemical basis of tissues such as hair and nails.

*Context:* Fur, feathers, scales, and beaks all are made from a versatile group of proteins called keratin.

### **pigment**

*Definition:* A coloring matter in animals and plants in a cell or tissue.

*Context:* Red is a pigment that only plants can create.

### **species**

*Definition:* A category of biological classification ranking immediately below the genus or subgenus, comprising related organisms or populations potentially capable of interbreeding.

*Context:* Over a million different species of animals exist on this earth.

### **vertebrate**

*Definition:* Any animal in the subphylum (Vertebrata) of chordates that possess a spinal column (including mammals, birds, reptiles, amphibians, and fishes).

*Context:* Animals that have internal backbones are called vertebrates.

## *Academic Standards*

### **Mid-continent Research for Education and Learning (McREL)**

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following national standards:

- Science – Life Science: Understands the structure and function of cells and organisms.
- Science – Life Science: Understands relationships among organisms and their physical environment.



- Science – Life Science: Understands biological evolution and the diversity of life.

### **National Academy of Sciences**

The National Academy of Sciences provides guidelines for teaching science in grades K-12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>

This lesson plan addresses the following national standards:

- Life Science: Structure and function in living systems
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### **Support Materials**

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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