



Shapes and Food Chains

DESCRIPTION

Students explore why plants and animals may need support systems and discover that plants are the main source of energy in the food chain. Both of these concepts may then be applied to understanding how life may form on other planets.

OBJECTIVES

Students will

- Compare and contrast the behavior of a water-filled plastic bag, both outside and inside of a container of water
- Understand the differences between environments with gravity and environments with reduced gravity
- Design and build an exoskeleton or an endoskeleton for an animal of their own invention
- Identify plants as the main source of energy in the food chain

NASA SUMMER OF INNOVATION UNIT

Life Science: Life Out There

GRADE LEVELS

4 – 6

CONNECTION TO CURRICULUM

Science

TEACHER PREPARATION TIME

1 hour

LESSON TIME NEEDED

3 hours

Complexity: Basic

NATIONAL STANDARDS

National Science Education Standards

Science as Inquiry

- Understanding of scientific concepts
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

Life Science

- Characteristics of organisms
- Organisms and environments
- Structure and function in living systems
- Diversity and adaptations of organisms

Earth and Space Science

- Structure of the Earth system
- Properties of Earth materials

Science in Personal and Social Perspectives

- Personal health
- Types of resources
- Changes in environments
- Populations, resources, and environments
- Risks and benefits

MANAGEMENT

The lesson activities are extracted from two educator's guides:

Muscles and Bones: Activities Guide for Teachers, National Space Biomedical Research Institute

http://www.bioedonline.org/resources/files/TG_muscles.pdf

Weighty Questions, pages 1 – 4 and Supporting Systems, pages 5 – 7

The Case of Zany Animal Antics: 2004–2005 NASA SCI Files™ Series

[Animal Antics](#)

Chain Games, pages 47 – 50

Since groups of four are recommended for the third activity, it is suggested that the first two activities are also completed in groups of four.

For the first activity, the teacher will need to download and copy Activity Sheet 1 on page 4, one per group. Set up requires filling snack-size plastic bags with water and adding food coloring. This may be done by the students or ahead of time by the teacher—teacher preference and discretion. It also requires a larger container of water to submerge the smaller bags within.

For the second activity, the teacher will need to download and copy Activity Sheet 2 on page 7, one per group.

For the third activity, the teacher will need to make enough copies of the Chain Game Cards (pages 49 – 50) for each group of four students to have a set. A set of labels for each group of four labeled Sun, Grass, Deer, and Wolf will need to be made. Each group will also need a ball of wadded paper (four pieces of paper per ball wadding one at a time and layering them).

CONTENT RESEARCH

The science of astrobiology is concerned with the question of whether or not life exists on other planets. Everything we know about life comes from studying our own planet, so the current strategy is to study the life that exists here to find out more about where and how to look for life beyond our own system. This collection of activities focuses on plant and animal life.

The first two activities take a look at how gravity affects the shape and the need for support of an object. The amount of gravity experienced while in orbit is about one-millionth of the normal gravity we feel at the Earth's surface. The gravity experienced in space is so weak that it is called microgravity. When gravity acts upon the object, it becomes clear that a support system is needed. Understanding the difference between mass and weight is important. For ease of understanding, the Muscles and Bones Guide, uses the words "weigh" and "weight" in their everyday sense instead of their strictest scientific interpretation.

The third activity takes a look at food chains in an established life-based world. The Sun is the energy source. As the students gain knowledge of the operation of the food chain on Earth, they will be able to consider the complexity and requirements for life on other planets. On Earth, food chains exist in all habitats and can be used to demonstrate the complexity and energy flow in an ecosystem. Producers capture the Sun's energy to make their own food in plant form, while consumers rely on other consumers or on eating those plants to get their energy.

MATERIALS

Activity 1

- Water
- Snack-size plastic zip-top bag (1 per team)
- Food coloring
- Clear container with straight sides that holds at least 1 liter of water or a glass aquarium in a central location
- Paper towels
- Copy of The Shape of Things Activity Sheet (1 per team)

Activity 2 (each group)

- Sealable plastic wrap
- 10 straws
- Clay
- Scissors
- 15 paper clips
- 2 sheets cardstock
- Tape
- Ruler
- Copy of From the Outside In Activity Sheet

Activity 3 (for each team)

- Animal labels set
- Chain game cards
- Food chain key (page 51)
- Scissors
- Wadded ball of paper

Key Concepts

- An object will float on top of a liquid if it is less dense than the liquid. An object close to the same density as the liquid will float under the surface. An object will sink if it is more dense than the liquid it displaces.
- Gravity holds us to the Earth's surface.
- The force of gravity can be counteracted by other forces.
- Land animals and plants need support systems to stand and move against forces such as Earth's gravity.
- Skeletal systems, which can be inside or outside the body, provide support for animals.
- When an animal eats a plant, it only receives 10 percent of the energy that the plant got from Sun. Likewise, when an animal eats another animal, it only receives 10 percent of the energy the animal got from the plants or other things it ate. This 90 percent energy loss at each level of a food chain is the reason there are so many low-level (primary) consumers and so few top-level consumers.
- Everything we know about life and living things comes from what we know about our own planet.
- Scientists define life in different ways, but agree that certain characteristics are common to living things. These are the ability to use energy, to grow, and to reproduce.
- At the present time, there is no positive evidence that life exists beyond Earth.

Key Terms

- **Astrobiology:** The science that studies the question of whether or not life exists on other planets.
- **Food Chain:** Representations of the predator-prey relationships between species within a habitat. In nearly all food chains, solar energy is input into the system as light and heat and utilized by autotrophs (producers).
- **Neutral Buoyancy:** Condition in which a physical body's mass equals the mass it displaces in a surrounding medium.
- **Microgravity:** The amount of gravity experienced while in orbit is about one-millionth of the normal gravity we feel at the Earth's surface. The gravity experienced in space is so weak that it is called microgravity. This is due to the spacecraft's being in a state of free fall.
- **Exoskeleton:** A hard outer structure, such as the shell of an insect or crustacean, that provides protection or support for an organism.
- **Endoskeleton:** An internal skeleton or supporting framework in an animal

LESSON ACTIVITIES

Activity 1: Weighty Questions, pages 1 – 4

Muscles and Bones: Activities Guide for Teachers, National Space Biomedical Research Institute

http://www.bioedonline.org/resources/files/TG_muscles.pdf

In this activity, the students will compare and contrast the behavior of a water-filled plastic bag, both outside and inside a container of water.

Activity 2: Supporting Systems, pages 5 – 7

Muscles and Bones: Activities Guide for Teachers, National Space Biomedical Research Institute

http://www.bioedonline.org/resources/files/TG_muscles.pdf

In this activity, the students build upon the knowledge gained from the first activity to create an internal or external skeleton designed to support an animal of their invention.

Activity 3: Chain Games, pages 47 – 50

The Case of Zany Animal Antics: 2004–2005 NASA SCI Files™ Series

http://scifiles.larc.nasa.gov/educators/episodes/2004_2005/zany_animal/Zany_Animal_2.pdf

Students explore the operation of a basic food chain from the Sun, to plants, to animals. To understand the complexity of life and where it may exist, the food chain should be examined. The teacher should relate the skeletal structure to protection.

ADDITIONAL RESOURCES

Astro-Venture's Biology Training Module

This module guides you, as a junior biologist, through your job to change the biologic features of Earth and observe the effects. You will also explore how these features work together to help make a planet habitable to humans.

<http://www.astroventure.arc.nasa.gov/biology/training/index.html>

Microgravity Educator Guide

This guide contains excellent background information accompanied by classroom activities that enable students to experiment with the forces and processes that scientists who study microgravity are investigating today.

www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Microgravity_Teachers_Guide.html

Growing the Future: Plants in Space

Find out about plants grown on the space shuttle with Educator Astronaut Barbara Morgan and others. This site has a 3-minute Quicktime video.

[Plants in Space](#)

Leafy Green Astronauts

This article discusses the necessity of using greenhouses on spacecraft to grow food for long-duration missions. There are many links to additional plant-related articles.

http://science.nasa.gov/science-news/science-at-nasa/2001/ast09apr_1/

Animals in Space

Find out about how animals adapt to flying in space.

http://www.nasa.gov/audience/forstudents/5-8/features/F_Animals_in_Space_5-8.html

DISCUSSION QUESTIONS

- What keeps us and other objects from floating off the Earth? *Gravity.*
- What happened to the shape of the water on the table? *It flattened out at the bottom.*
- Why? *Gravity pulled it down.*
- What happened to the shape of the water when submerged in the container of water? *It kept its shape.*
- Why? *Its weight was equal to the weight of the surrounding water.*
- How can you use this investigation to help you understand microgravity in space? *Answers will vary.*
- What would happen to the water on the table without the bag? *It would spread out across the table.*
- What keeps you from flattening out against the ground or floor? *My skeleton.*
- What is a food chain? *Answers will vary.*
- Where does the plant get its energy to produce food? *The Sun.*
- If life existed on another planet, would there be a food chain? *Answers will vary.*

ASSESSMENT ACTIVITIES

- Students will complete Activity Sheets 1 and 2. They may record their discoveries, thoughts, and ideas in writings and drawings, the way that working scientists do. Have the students share their findings with the class. These findings need to show that they understand why the water flattened on the table and retained its shape in the water. Help the students see the connection between the first activity and the second.
- Observe and assess student performance throughout the activities.
- Check to see that the students playing the Chain Game have the food chain in the correct order. Each team should demonstrate the chain and describe how the energy is used and changed and keeps the animals alive.

ENRICHMENT

- Ask the students to determine which careers would be necessary to study the possibility of life beyond Earth. They can research NASA careers [here](#).
- Using the knowledge about the need for a skeleton to support the body, ask the students to design a creature that might live on a planet with one-half the gravity of Earth, one-fourth the gravity of Earth, etc. Without labeling the creatures, instruct the other students to match the type of planet to the creature designed.
- What type(s) of food chains might we discover on other planets? Ask the students to explore this idea and create a presentation. The presentation should include the characteristics of the planet, the types of life forms, and who eats whom. Where does the energy come from originally?