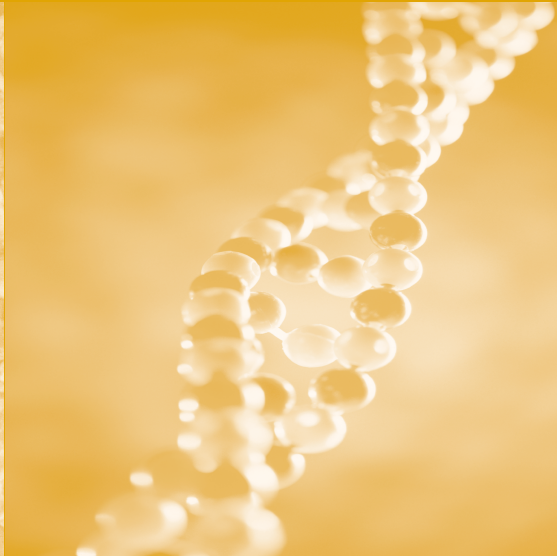
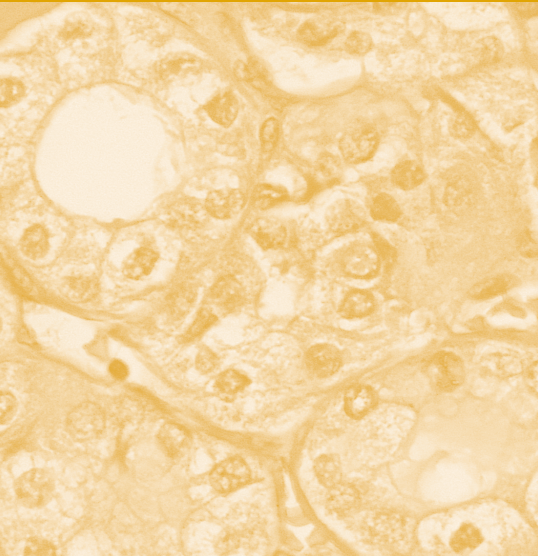


CAMBRIDGE CORE SCIENCE SERIES: BIOBASICS
INTERDEPENDENCE OF LIFE
Teacher's Guide



INTRODUCTION

This Teacher's Guide provides information to help you get the most out of the *BioBasics: Interdependence of Life* video program. This program is the eighth of the eight-part *BioBasics* life sciences series. The information in this guide will allow you to prepare your students before using the program, and to present follow-up activities to reinforce the program's key learning points.

The *BioBasics* series is intended to excite young people about science and teach them concepts that meet national educational standards for science literacy. Science, in its multiple disciplines, is inherently fascinating and helps explain the world in and around us. In addition to fulfilling our natural curiosity, there are numerous practical benefits to studying science: it teaches critical thinking skills that help us make informed and reasoned decisions, solve problems, think creatively, and continue learning.

LEARNING OBJECTIVES

By viewing *Interdependence of Life*, students will be able to:

- Define the terms biome and ecosystem, and name examples of each type.
- Explain the flow of energy through an ecosystem.
- Describe the role of producers and name examples.
- Describe the roles of the various types of consumers and name examples.
- Define each trophic level of an ecosystem and provide examples.
- Describe the four types of biogeochemical cycles.
- List ways the tropical rainforests are essential to life on our planet.

EDUCATIONAL STANDARDS

The content of this program has been aligned with the following national and state educational standards and benchmarks.

NATIONAL STANDARDS

Science

The activities in this Teacher's Guide were created in compliance with the following *National Science Education Standards* from the Association for the Advancement of Science.

- As a result of activities in grades 9-12, all students should develop abilities necessary to do scientific inquiry, and understandings about scientific inquiry.
- As a result of their activities in grades 9-12, all students should develop an understanding of the cell, molecular basis of heredity, biological evolution, interdependence of organisms, matter, energy, and organization in living systems, and behavior of organisms.

Reprinted with permission from National Science Education Standards © 1999 by the National Academy of Sciences, courtesy of the National Academies Press, Washington, D.C.

English Language Arts Standards

The activities in this Teacher's Guide were created in compliance with the following *National Standards for the English Language Arts* from the National Council of Teachers of English.

- Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.
- Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

Standards for the English Language Arts, by the International Reading Association and the National Council of Teachers of English, Copyright 1996 by the International Reading Association and the National Council of Teachers of English. Reprinted with permission.

Technology Standards

The activities in this Teacher's Guide were created in compliance with the following *National Education Technology Standards* from the National Education Technology Standards Project.

- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

The National Education Technology Standards *reprinted with permission from the International Society for Technology Education.*

PROGRAM OVERVIEW

Interdependence of Life provides an introduction to the interdependence of organisms in ecosystems. It covers the structure of an ecosystem, types of ecosystems, the flow of energy through food webs, and the cycling of matter. It uses an extended example of the tropical rainforest to dramatically illustrate interdependence at the global level and the effects of human activities on the ecosystems.

MAIN TOPICS

Topic 1: The Tropical Rainforests

The rainforests have an impact that reaches far beyond their own boundaries—they affect all other life on the planet. Rainforests provide a prime example of the interdependence of life, from species relying on other species, to the global carbon cycle and the production of oxygen. Half of all the world's plant and animal species live in tropical rain forests, which cover less than 6% of Earth's land surface.

Topic 2: Earth's Ecosystems

The Earth's biosphere contains many types of biomes, or ecosystems. A biosphere is the sum of all the organisms on Earth, and an ecosystem includes all the organisms living together in one geographic location, their interactions with each other, and their environment. Types of ecosystems include aquatic, desert, forest, grassland, and tundra.

Topic 3: Energy Flow through Food Webs

The biotic elements of an ecosystem include producers and consumers. Energy flow in the ecosystem occurs through the predator/prey dynamics of its food web. Producers, or autotrophs, are organisms that supply their own food. They use carbon dioxide as their sole carbon source, and use either light (photosynthesis) or chemical compounds as their energy source. Consumers, or heterotrophs, are organisms that consume other organisms. They break down complex organic molecules to obtain energy. Examples include animals, fungi, and most bacteria. Each level in the food web is a trophic level.

Topic 4: The Cycling of Matter through the Ecosystem

The Earth is a closed system, in which no matter enters and none is removed. Most matter in an ecosystem cycles from its organisms to the environment and back again. Matter is re-used, which is unlike the energy cycle (energy enters as light and exits as heat). These processes are called the biogeochemical cycles, which include the carbon cycle, the nitrogen cycle, the phosphorous cycle, and the hydrological cycle.

FAST FACTS

- Rainforests are found mainly in South America, Africa, and Asia, as well as on some tropical islands. The largest is in the Amazon Basin, covering roughly 2.5 million square miles.
- The rainforest growing season is year-long due to warm temperatures, high humidity, and rainfall.
- Half the world's plant and animal species live in tropical rain forests.
- An average of 50 to 260 inches of rain falls per year in the rainforest.
- Rainforests cover less than six percent of Earth's land surface.
- Tropical rainforests produce 40% of Earth's oxygen.
- Twenty-five percent of the medicines we use come from rainforest plants. Scientists estimate that more than 1,400 tropical rainforest plants provide potential cures for cancers.
- Seventy percent of the plants in the rainforest are trees. A tropical rain forest has a greater variety of trees than any other type of biome. For example, a 100 acre area in Malaysia was found to have over 835 species (compared to less than 100 species of trees in all of North America).
- The aquatic ecosystem is the largest, as 75% of the Earth is covered in water.
- Deserts cover 20% of the Earth's surface and receive less than 20 inches of rain each year.
- Thirty percent of land is forest, and is primarily made up of trees and woody plants.
- Grasslands are lands that are dominated by grasses instead of trees and shrubs.

VOCABULARY TERMS

biennial: A plant with a lifespan of two years.

biodiversity: The total variation in life, including the number of species, the degree of genetic variation within species, the different types of ecosystems, and the ecosystems' functions.

biome: One of the largest recognizably distinct ecosystems on earth; the plant and animal communities and associated soils that are characteristic of a given regional climate type.

community: A group of populations of different species occupying a given place at a given time that are viewed as interdependent.

cryptogams: Nonvascular plants such as lichens and mosses that make up the ground or surface layer of vegetation.

dispersal: The transport of buds or other offshoots away from the parent.

diversity: The total number of species and the relative abundance of each.

ecological succession: The development of an ecosystem through a predictable series of communities until a final, stable community (the climax community) in balance with the regional climate is attained.

ecology: The science that studies the relationships between organisms and their environment.

ecosystem: A community of species that function together as a coherent unit with the surrounding environment to maintain a flow of energy and to acquire, store, and recycle nutrients.

environment: The physical, chemical, and biotic conditions surrounding an organism.

environmental resistance: Factors of the environment that prevent reproduction or inhibit development of a species and determine the extent of its distribution area.

formation: A group of communities in a single region or continent with similar structure and related climatic and environmental conditions.

function: How something works.

grass: A member of the Graminae family of flowering plants.

growthform: The overall morphology of a plant species, including its stature, leaf type, and habitat.

landscape ecology: The study of patterns of ecosystems of a given area and the interactions among those various ecosystems.

niche: The total requirements and tolerances of a species; its way of life, including how it traps energy and otherwise uses its habitat or microhabitat.

parasite: A plant without chlorophyll that obtains its nutrients by tapping into the branches, stems, or roots of living green plants.

perennial: A plant that lives more than two years.

pioneer species: A species that is an early occupant of newly created or disturbed areas.

population: The individuals of a given species that occupy the same locality and form the interbreeding group in that location.

structure: The physical arrangement or spatial patterns of the components of an ecosystem, especially the plant life. Structure includes growthforms, number of canopy layers, degree of cover, and distribution patterns of species within the ecosystem. Structure may also refer to the organization of the ecosystem in terms of trophic levels.

PRE-PROGRAM DISCUSSION QUESTIONS

1. Why do you think the overpopulation of some parts of the world is a significant issue in the interdependence of life?
2. How do species become endangered?
3. Why are endangered species a problem for the interdependence of life?
4. What do you think are some of the benefits of living in groups (as humans do)?
5. What do you think are some plant adaptations against predators?

POST-PROGRAM DISCUSSION QUESTIONS

1. Environmental resistance is a factor (or set of factors) in the environment that prevents reproduction or inhibits development of a species, and that determines the extent of a species' distribution area. What do you think some environmental resistance factors might be?
2. How do plants and animals aid one another in their life processes? How do they harm one another?
3. In what way are rainforests significant?
4. What is the difference between a niche and a habitat?
5. What do you think is the most significant discovery about the interdependence of life?

GROUP ACTIVITIES

Working Together!

When a hungry elephant uproots an acacia tree or browses on bushes, it opens space for other plants and grasses to grow, providing food for grazing animals. Thirsty elephants often dig water holes during a drought, creating a crucial water source for the whole ecosystem. Elephants plant new forests when they disperse plant seeds in their dung. An elephant's dung is also a rich source of food for monkeys, since more than half of an elephant's intake is undigested. Without the elephant, a lot of animals would be hungry and thirsty. Have students form groups and research and report on a similar ecosystem at work.

Ecosystem Investigation

Divide the class into group, then take the groups outside the classroom to investigate the first ecosystem they find.

Materials

- An outdoor area like a field or patch of garden
- String
- Magnifying glass
- Thermometer
- Popsicle sticks
- Paper
- Small gardening tools

Procedure

- Locate a small patch of land to examine.
- Use string to partition a segment into an "ecosystem."
- Record observations about the ecosystem, including all living and non-living things.
- Record temperatures in your ecosystem.
- Turn over a small patch of the turf and observe what's beneath the surface.

Conclusions

- Consider the variety of living things in your ecosystem. Which was the largest population?
- How are the survival needs (air, food, water, and sunlight) being met in your ecosystem?

Extension Ideas

- How can you do this activity in an urban area? Ask students to brainstorm for solutions.
- Think of other populations that could survive in your ecosystem. Think of populations that could not.

Interdependence of Life Crossword

Using the vocabulary list from *Interdependence of Life*, have each group of students develop a crossword puzzle or wordfind and an answer key. Groups should exchange projects and solve.

INDIVIDUAL STUDENT PROJECTS

Ecosystem Self-Awareness Journal

Everything we do impacts the environment around us. For one week, keep a journal of the actions and behaviors that impact the natural world. Examples may include those that have positive impacts, such as recycling plastic bottles, reusing wet towels, or pulling weeds, as well as those that have negative impacts, such as littering, leaving the television on when not watching, etc. Categorize by type of impact, and then indicate which positive ones you will continue to engage in, as well as which negative behaviors or actions you plan to reduce or eliminate. Explain how you will do that.

Essential Water

Safe drinking water is vital for all life processes—and it's never too early to learn about water safety. Using one of the following subtopics (or one of your own), develop a fun and educational game or activity for K-6 students and arrange to share it with an elementary school class. Suggestions may include wordfinds, puzzles, crosswords, dioramas, coloring books, map searches, etc.

Subtopics

- Sources of drinking water
- How do we know water is safe to drink? How do we make water safe to drink?
- What lives in our water?
- How our bodies use water
- Plants and water
- Animals and water
- How ancient cultures used water
- Water around the world

INTERNET ACTIVITIES

Aquifer Alert!

An aquifer is a geologic formation that will yield water to a well in sufficient quantities to make the production of water feasible. Ask students to use the Internet to investigate and report back on a specific aquifer, its location, uses, type, history, and geographic and geologic conditions.

Great Discoveries!

Ask students to use the Internet to explore the lives and accomplishments of those scientists who were “firsts” in uncovering the mysteries of the interdependency of life.

The Wetlands

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil throughout the course of a year. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils.

Ask students to use the Internet to investigate America's wetlands and answer the following questions:

- What are wetlands and how do they work?
- What are the different types of wetlands?
- What are the functions and values of wetlands?
- What are the best ways to determine their health?

ASSESSMENT QUESTIONS

Q: Where is the largest rainforest?

A: The largest rainforest is located in the Amazon Basin in South America.

Feedback: This rainforest covers approximately 2.5 million square miles.

Q: What percentage of the Earth's oxygen is produced by tropical rainforests?

A: 40%

Feedback: Forty percent of the planet's oxygen comes from tropical rainforests.

Q: A biosphere includes all the organisms living together in one geographical location, and their interactions with each other and their environment. (*True or False*)

A: False

Feedback: That is the definition of a biome or ecosystem. A biosphere is sum of all the organisms on Earth.

Q: Which of the following is a type of ecosystem?

- a) Aquatic
- b) Deserts
- c) Wetlands
- d) All of the above

A: d) All of the above

Feedback: Additional types of ecosystems include forests, grasslands, and tundra.

Q: Which ecosystem is primarily made up of trees and woody plants?

A: Forest

Feedback: Thirty percent of land is made up of forests.

Q: Producers consume other organisms. (*True or False*)

A: False

Feedback: Producers, or autotrophs, are organisms that supply their own food.

Q: Herbivores make up which trophic level of the food web?

A: Second

Feedback: Herbivores are primary consumers of producers, which make up the first trophic level.

Q: Which of the following is not a biogeochemical cycle?

- a) Carbon
- b) Oxygen
- c) Phosphorous
- d) Nitrogen

A: b) Oxygen

Feedback: The hydrological cycle is the fourth biogeochemical cycle.

Q: In the aquatic food web, dissolved _____ are absorbed by plants and algae.

A: phosphates

Feedback: These phosphates are in turn consumed by plankton and other organisms.

Q: Approximately 78% of Earth's atmosphere is made up of _____.

- a) nitrogen
- b) oxygen
- c) carbon
- d) phosphorous

A: a) nitrogen

Feedback: Nitrogen is essential for many biological processes. It is a crucial component of proteins and amino acids, as well as the four bases that make up nucleic acids such as DNA.

ADDITIONAL RESOURCES

WEB SITES

Atlas of the Biosphere

www.sage.wisc.edu/atlas

World Wildlife Federation

www.panda.org

Basic Science and Remote Sensing Initiative:

Rain Forest Report Card

www.bsrsi.msu.edu

Palaeos: The Trace of Life on Earth

www.palaeos.com

Blue Planet Biomes

www.blueplanetbiomes.org

US Fish and Wildlife Service

www.fws.gov

BOOKS

Biology: Science for Life

By Colleen M. Belk and Virginia M. Borden

Prentice Hall, 1st edition; July 7, 2003; Paperback, 477 pages

ISBN: 0130892416

Biology: Concepts and Connections (4th Edition)

By Neil A. Campbell, Jane B. Reece, Lawrence G. Mitchell, and Martha R. Taylor

Benjamin Cummings; June 22, 2002; Hardcover, 781 pages

ISBN: 080536627X

Biology for Dummies

By Donna Rae Siegfried

For Dummies; September 15, 2001; Paperback, 384 pages

ISBN: 0764553267

OTHER PRODUCTS

Life Cycles, VHS/DVD, Films for the Humanities & Sciences

The life cycles of plants, animals, and humans are studied close-up in this outstanding biology program. Narrated film action scenes show plant and animal reproduction, then show the budding of leaves, and the emergence of baby chicks from their shell. The growth stage depicts a caterpillar's metamorphosis into a butterfly, and a tadpole's emergence as a frog. Mature penguins, sheep, ducks, and baboons forage for food, while plants drink in sunlight and humans find their food at the supermarket! Decomposing fruit and bread are used as examples of how the final life cycle, death, produces new life—in these cases, bacteria, and mold. (21 minutes)
Order #: 6896, www.films.com, 1-800-257-5126

The Continuity of Life, CD ROM, Films for the Humanities & Sciences

This CD-ROM concentrates on reproductive processes. It begins with a survey of cell components and cell reproduction, and includes information on DNA, RNA, and the formation of tumors. Human reproduction is the focus of lesson two with sections on meiosis, human sexuality, fertilization, and birth control. Lesson three features a more in-depth look at pregnancy and birth. Stages of pregnancy are outlined along with special sections on birth defects, effects on the mother, and the fetal period. Genetics is reviewed in lesson four, with a discussion of genetic traits, dominant and recessive genes, chromosomes, and mutations. Lesson five continues with a look at phenotypes, natural selection, artificial selection, and the extinction and formation of species. Genetic engineering rounds out the program with a review of engineering techniques, gene splicing, commercial applications, combating illnesses, and concerns in society. © 1997. A Shopware Production. (Macintosh; also available for Windows)
Order #: 8250, www.films.com, 1-800-257-5126

Riddle of the Sands: Interdependence in a Scottish Ecosystem, VHS/DVD, Films for the Humanities & Sciences

An estuary in Scotland illustrates an ecosystem in action. We see the interdependence of animals in every phylum. Spectacular footage of bizarre feeding habits provides an interesting means of contrasting behaviors among the various species, and allows viewers to follow the flow of energy from the sun through the complex food chain. The impact of humanity is examined within the context of how people can avoid harming other species and their environments, and the extent to which we should intervene in natural processes is discussed. A BBC Production. (50 minutes)
Item no: 7477, www.films.com, 1-800-257-5126

The Nature of Biology, VHS/DVD, Cambridge Educational

Why study biology? What's it all about? Why does it matter? This is the video that helps answer these common questions about biology. Images from the natural world reinforce the sense of wonder and excitement involved in studying life science. Interviews with science professionals help viewers appreciate the impact of biology on society. The program is organized around the following themes: Diversity of Life, Heredity, Cells, Interdependence of Life, Flow of Matter and Energy, and Evolution of Life. A Cambridge Educational Production. One 30-minute video and guide.
Order #: 8181, www.cambridgeeducational.com, 1-800-468-4227

Earth: A Special Case, VHS, Films for the Humanities & Sciences

Beginning with a look at the nightmarish conditions on other planets, this program illustrates how Earth's position in the solar system is crucial to its life-sustaining properties. The immense diversity of life forms inhabiting the planet and the elaborate interdependence of all species throughout the biosphere are explored. (20 minutes)

Order #: 11669, www.films.com, 1-800-257-5126



For information on other programs

**VISIT OUR WEBSITE AT
WWW.CAMBRIDGEEDUCATIONAL.COM**

2572 Brunswick Pike, Lawrenceville, NJ 08648

Toll Free: 1 800/468-4227

Fax: 1 800/FAX ON US