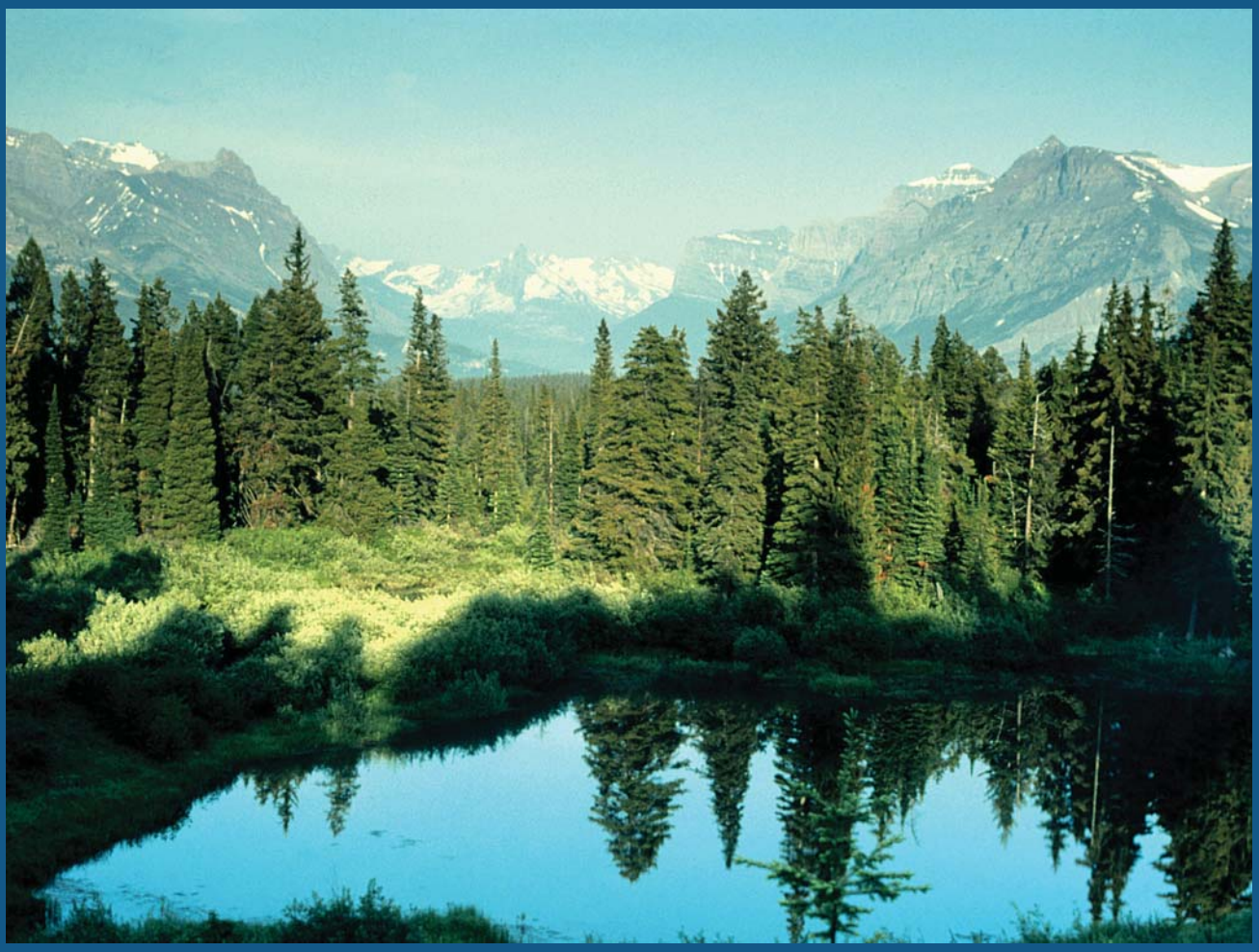
Cambridge Core Science Series: GeoBasics

OUR PLANET EARTH



Cambridge Educational

Teacher's Guide

Introduction

This Teacher's Guide provides information to help you get the most out of *Our Planet Earth,* Part 1 of the *GeoBasics* series. The contents in this guide will allow you to prepare your students before they use the program, assist them as they navigate through the program, and present follow-up activities to reinforce the program's key learning points.

The *GeoBasics* 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 around us. In addition to fulfilling our natural curiosity, studying science and learning critical thinking skills provides numerous practical benefits, including helping us make informed and reasoned decisions, solve problems, think creatively, and continue to learn.

This 21-minute video provides students in grades 7 through 12 with an introduction to the size, composition, age, and history of our planet, but the program is not limited to usage by this audience. Because science literacy is important for all people, the information presented in *Our Planet Earth* could also be presented to vocational/technical schools or in adult education courses that focus on science.

Learning Objectives

After watching *Our Planet Earth*, students will understand how to:

- Recognize how processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the Earth and its history.
- Demonstrate an understanding of the size, composition, and age of the Earth.
- Describe how our Earth was formed and discuss the vast time periods over which it has evolved.
- Explain the fundamental concepts, principles, and interconnections of the life/physical and Earth/space sciences, and understand the historical perspectives, scientific approaches, and emerging scientific issues associated with Earth and space sciences.

Educational Standards

The *Our Planet Earth* video program correlates with the following Standards: the National Standards of the National Academy of Sciences National Science Education, International Society for Technology in Education (ISTE), National Educational Technology Standards (NETS), and National Council of Teachers of English; and the State Standards of Florida, California, and Ohio for Earth and Space Sciences, Processes that Shape the Earth; How Living Things Interact with Their Environment; and Listening, Viewing, and Speaking.

- Develops an understanding of energy in the earth system, geochemical cycles, origin and evolution of the earth system, and origin and evolution of the universe. *(National Academy of Sciences National Science Education Standards)*

- Recognizes that processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the Earth. *(Florida State Standards: Processes that Shape the Earth; How Living Things Interact with Their Environment; Listening, Viewing, and Speaking)*

- Understands that Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. *(California State Earth Science Standards)*

- Demonstrates an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth; demonstrates an understanding of how concepts and principles of energy, matter, motion, and forces explain Earth systems, the solar system, and the universe; and understands historical perspectives, scientific approaches, and emerging scientific issues associated with Earth and space sciences. *(Ohio State Earth and Space Science Standards)*

Program Overview

The *Cambridge Core Science* series is a 40-part series composed of subsets of programs addressing Life Science, Earth Science, Physical Science, Human Body Systems, and Space Science. The series is designed as a whole to give high school and some college students a basic scientific understanding of themselves and the world around them.

The *GeoBasics* video program series consists of eight titles:

- Our Planet Earth
- Plate Tectonics
- Rocks and Minerals
- Oceans and Seas
- Geocycles
- Atmosphere, Climate, and Weather
- Energy and Resources
- Environmental Issues and Human Impact

This first title in the series, *Our Planet Earth*, provides an overview of the many branches of Earth Science, describes the general physical characteristics of the Earth, and presents a geological and evolutionary history of the Earth.

Main Topics

Topic 1: Introduction
The first program in the series kicks off with an introduction to planet Earth. Geology professors discuss various hypotheses on the origin of the Earth, from the Big Bang Theory to the Solar Nebular Hypothesis. They continue by explaining the elemental composition of the Earth and solar system, Earth's three main layers (crust, mantle, and core), and the four subsystem divisions of the Earth System—lithosphere, hydrosphere, biosphere, and atmosphere.

Topic 2: How Old is the Earth?
Touching upon how modern geologists act like detectives to discover the history of Earth, the program's geological experts attempt to answer the question about the age of the planet on which we live. Viewers are presented with various perspectives such as catastrophism and James Hutton's uniformitarianism, as well as with in-depth looks into both relative age dating and absolute age dating.

Topic 3: The History of the Earth
In this section, the evolutionary timeline of the history of the Earth is creatively revealed in terms of a single calendar year in order to highlight the major events of evolution and demonstrate the infancy of the human race in relation to the geologically "deep time" of our planet.

Topic 4: Conclusion
The program concludes with a dialog on what the science of geology is and why it is important.

Fast Facts

- The Earth consists of an iron-rich core with a radius of 2,100 miles. Ninety-six percent of the volume of the core is liquid, but the other 4% is a solid inner core with a radius of 720 miles. The core is surrounded by a 1,680-mile-thick mantle of mostly silicon, magnesium, and oxygen, and a 50-mile-thick crust.

- Earth is the third planet from the sun in our solar system. Four of the other eight planets are smaller than the Earth (Pluto, Mercury, Mars, and Venus) and four are much larger (Neptune, Uranus, Saturn, and Jupiter).

- The Earth is 4.5 to 4.6 billion years old, but the oldest known rocks are about 4 billion years old. Rocks older than 3 billion years are rare. The oldest fossils of living organisms are less than 3.9 billion years old.

- You can research reports of all the earthquakes that occurred in the previous week in the Unites States and adjacent areas with a magnitude of greater than 2.5, and in the rest of the world with a magnitude of 4.0 or greater, via the Web site earthquake.usgs.gov.

- The Earth has been in an Ice House Climate (where there is ice at the North and South Poles) for the last 30 million years. The last expansion of the polar ice sheets (a.k.a. the last "Ice Age") took place about 18,000 years ago.

- March 2004 marked the first time in 120 years that geologists added a new time period to Earth's chronology. Named the Ediacaran Period, it lasted about 50 million years (from 600 million years ago to about 542 million years ago) and was the last period of the Precambrian's Neoproterozoic Era. It was during this time that multicelled organisms first appeared.

- The known geological history of Earth since the Precambrian is subdivided into three eras—Paleozoic, Mesozoic, and Cenozoic—each of which includes a number of periods which, in turn, are subdivided into epochs and ages.

- Fossils—the recognizable remains, such as bones, shells, or leaves, or other evidence such as tracks, burrows, or impressions of past life on Earth—are fundamental to the geologic time scale. Scientists who study fossils are called *paleontologists* (from the Greek *palaios* which means ancient, and *onta* which means existing things) because they study ancient forms of life.

- The discovery of radioactivity gave scientists a means for measuring time spans, and led to the process of absolute age dating.

- Stratigraphy is the study of strata (layers) in the Earth's crust. The Law of Original Horizontality states that sedimentary strata are deposited in layers that are horizontal or nearly horizontal, parallel to or nearly parallel to the Earth's surface; thus, rocks that we now see inclined or folded have been disturbed since their original deposition. The Law of Stratigraphic Superposition states that because of Earth's gravity, deposition of sediment will occur, depositing older layers first, followed by successively younger layers; thus, in a sequence of layers that have not been overturned by a later deformational event, the oldest layers will be on the bottom.

Vocabulary Terms

absolute age dating: The determination of the age of an object based on the rate of radioactive decay; also called "chronometric dating."

atmosphere: The gaseous mass or envelope surrounding the Earth and retained by the Earth's gravitational field.

Big Bang theory: The theory that the universe originated 10-20 billion years ago from the cataclysmic explosion of matter at extremely high density and temperature.

biosphere: The part of the Earth and its atmosphere in which living organisms exist or which is capable of supporting life.

catastrophism: The doctrine that major changes in the Earth's crust result from catastrophes rather than evolutionary processes.

core: The central portion of the Earth below the mantle, probably consisting of iron and nickel. It is made up of a liquid outer core and a solid inner core.

crust: The outer layer of the Earth.

geology: The scientific study of the origin, history, and structure of the Earth.

evolution: The theory that groups of organisms change with the passage of time, mainly as a result of natural selection, so that descendants differ morphologically and physiologically from their ancestors.

fossil: A remnant or trace of an organism of a past geologic age, such as a skeleton or leaf imprint, embedded and preserved in the Earth's crust.

hydrosphere: The watery layer of the Earth's surface; includes water vapor.

lithosphere: The solid outermost shell of the Earth, which includes the crust and the uppermost layer of the mantle.

mantle: The layer of the Earth between the crust and the core.

relative age dating: The arrangement of artifacts or events in a sequence relative to one another, in a typological sequence.

solar system: The sun together with the nine planets and all other celestial bodies that orbit the sun.

tectonic plate: Section of the Earth's crust that moves, floats, and sometimes fractures, whose interaction with other plates causes continental drift, earthquakes, volcanoes, mountains, and oceanic trenches.

Uniformitarianism: The theory that all geologic phenomena may be explained as the result of existing forces having operated uniformly from the origin of the Earth to the present time.

Pre-Program Discussion Questions

1. What do you know about the solar system and the Earth's existence in it? How does the Earth differ from the other planets?

2. What understanding do you have about the origin of the Earth, and where did you get the information? Have you heard more than one theory about it throughout your life? If so, why do you think there are varying or conflicting opinions? Do you think what is taught about the history of the Earth could change in the future? Why or why not?

3. How would you answer the question, "Of what is our planet made?" How many different ways can you think of to answer that question? (Hints: the Earth's main layers, percentage of water versus land masses, names of continents, etc.)

4. What do you think "absolute dating" and "relative dating" are, and what do you think the differences are between them? Can you think of any examples of each that you see in your daily life?

5. Considering what you already know about the history of the Earth and humankind, create an evolutionary timeline. Each student should make at least one contribution, including an event's location in time in relation to the others in the timeline. (If possible, save the timeline so you can reference it for the first Post-Program Discussion Question.)

Post-Program Discussion Questions

1. Now that you have viewed the program, what events can you add to the evolutionary timeline, and what further details can you provide? Looking at the timespan itself and remembering the program's analogy of a calendar year, what changes can you make to construct a more accurate timeline?

2. Have one student list the names of everyone in her/his immediate family in order from the oldest to the youngest, without listing the ages of any member. Is there any way to know from this information what the exact age is of any member of the family? What information would be needed to determine the absolute age of each person?

3. Have another student list all family members in random order on the board. What questions could you ask that would help you determine who is older or younger relative to the other family members? Have the student answer the questions other students pose and see if the class can determine the relative ages of the family members.

4. Where in your neighborhood have you seen examples of the following: the law of superposition; the law of original horizontality; the principle of cross-cutting relationships? What examples can you cite in the nation or in the world?

5. Why is it important for scientists to study the history of the Earth and humankind? Why does looking to our past help us better prepare for our future?

Internet Activities

- Using search engines such as www.google.com, www.search.msn.com, www.yahoo.com, etc., research and write a paper of 3-5 pages in length on the latest discoveries being made and/or research projects scientists are undertaking regarding the evolution of humankind or the history of the Earth.

- Using search engines and science-related Web sites, research what is currently being done to investigate the "Moho," a boundary formally known as the Mohorovicic discontinuity, which marks the division between Earth's crust and mantle. Do you think it is possible to drill into the center of the Earth? Why or why not? If you believe it cannot currently be done, how soon do you think it will be possible? Write a 2- to 3-page paper on your findings.

Group Activities

- Divide the class into four groups, assigning each group to one of the following: Eratosthenes, Emile Picard, Jean-Baptiste Delambre and Pierre Méchain, and the Toronto Colloquium of the International Association of Geodesy and Geophysics. Have each group research how their subject sought to measure the circumference of the Earth, as well as the success and accuracy of the measurement. Then, as a class, compare and contrast the various methods and measurements and discuss what caused the accuracy to improve over time.

Individual Student Projects

- Imagine that tens of thousands of years from now a geologist is looking back to the events of the second and third millennia. What fossils do you think he or she would find? Create an evolutionary history of what has happened and what you think could happen in the future, remembering to include supporting reasons for your ideas.

- Select one of the following national parks and write a research paper on the fossils discovered there, and what likely caused them to form:
    - — Agate Fossil Beds National Monument, Nebraska
    - — Badlands National Park, South Dakota
    - — Channel Islands National Park, California
    - — Death Valley National Park, California / Nevada
    - — Delaware Water Gap National Recreation Area, Pennsylvania / New Jersey
    - — Dinosaur National Monument, Colorado / Utah
    - — Florissant Fossil Beds National Monument, Colorado
    - — Fossil Butte National Monument, Wyoming
    - — Grand Canyon National Park, Arizona

— Guadalupe Mountains National Park, New Mexico / Texas
— Hagerman Fossil Beds National Monument, Idaho
— John Day Fossil Beds National Monument, Oregon
— Petrified Forest National Park, Arizona
— Theodore Roosevelt National Park, North Dakota
— Yellowstone National Park, Montana / Idaho / Wyoming

Assessment Questions

Q1: What is the Big Bang?
A: The Big Bang Theory is a scientific theory asserting that the universe emerged from an enormously dense and hot state about 13.7 billion years ago.

Q2: What is a nebula?
A: A nebula is an interstellar cloud of dust, gas, and plasma. "Nebula" comes from the Latin word for "mist."

Q3: What is the Solar Nebular Hypothesis?
A: The nebular hypothesis was first proposed in 1755 by Immanuel Kant, who argued that nebulae slowly rotate, gradually condensing and flattening due to gravity, eventually forming stars, planets, and our solar system.

Q4: What are the three main layers of Earth?
A: Crust, mantle, and core.

Q5: What does the Earth System comprise?
A: Solid earth, hydrosphere, biosphere, and atmosphere.

Q6: What are the two main methods for dating rocks, and which method is more accurate?
A: Relative age dating and absolute age dating are the two main methods. Absolute age dating is a more accurate method, as it measures decay, while relative age dating measures events in a sequence relative to one another.

Q7: What is the Principle of Uniformitarianism as it relates to geology?
A: Within geology, "uniformitarianism" refers to the principle that the same geologic processes that shape the universe today worked in much the same way over geologic time, and that the same laws of physics apply to all parts of the knowable universe.

Q8: What is the Law of Superposition?
A: This law states that a sedimentary rock layer in a tectonically undisturbed sequence is younger than the one beneath it and older than the one above it, since a younger layer cannot slip beneath a layer previously deposited. This law allows sedimentary layers to be viewed as a form of vertical time line, providing a very powerful tool for the dating of rocks and strata.

Q9: What is the Law of Original Horizontality?
A: This law states that sediments settling out from bodies of water are deposited horizontally or nearly horizontally in layers that lie parallel or nearly parallel to the Earth's surface.

Q10: What is the Principle of Cross-cutting Relationships?
A: This principle says that faults are younger than the rocks they cut, so if a fault is found that penetrates some formations but not those on top of it, then the formations that were cut are older than the fault, and the ones that are not cut must be younger than the fault.

Additional Resources

USGS Education: Science for a Changing World
www.usgs.gov/education

Educypedia: The Educational Encyclopedia
http://users.pandora.be/educypedia/education/geology.htm

NASA's Science Mission Directorate Website
http://science.hq.nasa.gov

The Center for International Earth Science Information Network (CIESIN)
www.ciesin.org

The Earth Institute at Columbia University
www.earthinstitute.columbia.edu

The WWW Virtual Library: Earth Science
http://vlib.org/EarthScience

Earth Science Week
www.earthsciweek.org

National Earth Science Teachers Association
www.nestanet.org

Additional Resources at www.filmsmediagroup.com

Available from Films Media Group • www.filmsmediagroup.com • 1-800-257-5126

Earth Science I Video Library

- **VHS #30977**
- **VHS #30992—in Spanish**
- **DVD #30962**
- **Closed captioned**
- **Correlates to National Science Education Standards**
- **Includes a User's Guide**

Contains 18 video clips on the history of the Earth, fossils, paleontology, and mapping the Earth. Clips include *Introduction to Earth History, Thermal Features, Blue Hole, Extinction, Glaciers, Fossil Hunter, Fossil Voyage, Amber, Mammoth, Rhino Fossils, Fossil Tunnels, Early Maps, Remote Sensing, Global Positioning System, Mountains, Seafloor Maps, Measuring Latitude, Measuring Longitude*. A User's Guide is included, containing an overview; a numbered index of clips, with brief descriptions and lengths; time codes (VHS only); suggested instructional strategies; and a list of additional resources. A Discovery Channel/FFH&S Production. © 2003.

Earth Science II Video Library

- **VHS #30978**
- **VHS #30993—in Spanish**
- **DVD #30963**
- **Closed captioned**
- **Correlates to National Science Education Standards**
- **Includes a User's Guide**

The *Earth Science II Video Library* contains 24 video clips on volcanoes, earthquakes, oceans, seasons, weather, and climate. Clips include *Introduction to Volcanoes, Birth of a Volcano, Death and Destruction, Types of Volcanoes, Volcanology, Plate Tectonics, Earth in Motion, San Andreas Fault, Seismology, Earthquake-Proof, Earthquake Zone, Introduction to Oceans, Coral Reefs, Waves and Tides, Fish Harvesting, Currents, Introduction to Weather, Polar Weather, Man-Made Weather, Rain, Violent Weather, Heat and Weather, Weather Systems, Water Cycle*. A User's Guide is included, containing an overview; a numbered index of clips, with brief descriptions and lengths; time codes (VHS only); suggested instructional strategies; and a list of additional resources. A Discovery Channel/FFH&S Production. © 2003.

Earth Story

- **8-part series**
- **VHS/DVD-R #8503**
- **"Extremely well done!" —*Booklist***

Beginning with the first land formations that emerged from a primordial ocean 4 billion years ago, this eight-part series explores how all geologic phenomena, from volcanoes to earthquakes, are intertwined. Journeying from the sea bottom to the highest peak in the Andes, the series presents the latest theories on plate tectonics, earthquakes, volcanoes, land formations, and continental drift. An indispensable resource for teaching earth science and geology. A BBC Production. (50 minutes each)

The series includes *Dating the Earth, Journey to the Ocean Floor, Continental Drift: Legacy of Fire, Death of the Dinosaurs, Winds of Change, Noah's Children, Oxygen: The Poison Gas, The Earth and the Moon.*

Landforms

- **CD-ROM #6978 (Windows only)**

What causes volcanoes and earthquakes? Why do tsunamis and floods occur? How do river beds and coastlines change? And what challenges do the forces that shape the Earth pose for people? Using this highly interactive CD-ROM, students can freely explore the Geodome, a virtual laboratory of geologic landforms. Learning stations provide targeted opportunities to manipulate 3-D topographical models, conduct simulations of natural disasters, examine hundreds of slides, and watch video clips. Plus, info/quiz features offer additional background and test comprehension. Headline-making catastrophes and issues of geologic concern drive home the present-day relevance of earth science, geology, and physical geography. Plate tectonics and seismology, eruptions and erosion, landslides and sedimentation—this disc has it all.

The Life and Times of El Niño

- **VHS/DVD-R #34956**
- **Closed captioned**

It has been linked to famines, epidemics, even the fall of empires. This program follows El Niño's deadly path through human history and the progress science has made in understanding the once-mysterious phenomenon. The effects of El Niño are presented in detail, including an 1878 outbreak of yellow fever in Tennessee, a concurrent drought that ravaged much of China, and more recent calamities that have brought the true nature of this climatic occurrence to light.

Focusing on high-tech advances in meteorology, the video outlines El Niño's significance in the global warming debate and illustrates the use of computer models that can predict its next appearance. A BBCW Production. (50 minutes) © 2005.

Man and the Biosphere

- **12-part series**
- **VHS/DVD-R #2333**
- ***Recommended by Science Books & Films***

Using an integrated interdisciplinary approach combining the natural and the social sciences, these videos look at the relationships between living beings and their environments. The work of botanists, biologists, geologists, and demographers is used to examine the realities of ecological concerns in the framework of political realities. From the tops of the Himalayas to the bottom of the sea, from empty deserts to overcrowded cities, these videos show life where it thrives and where it has died out. Based on UNESCO's ground-breaking Man and the Biosphere Program, they illustrate the problems and concerns of preserving life, including human life, on Earth, and demonstrate numerous environmental projects that have successfully met the needs of both humankind and nature. (28 minutes each)

The series includes *Life in Arid and Semi-Arid Lands; The Desert as Laboratory; Life at the Top*; *Equilibrium in a Mountain Habitat; The Tropical Rain Forest; Preserving the Rain Forest; Coastlines; Ecology of the Coral Reef; Lagoons; Wetlands and Pinelands; Urban Ecology; Toward a Livable City.*

BioBasics

- **8-part series**
- **VHS/DVD-R #33833**
- **Preview clip online at www.films.com (Search on 33833)**
- **Includes viewable/printable Teacher's Guide**
- **Correlates to National Academy of Sciences National Science Education Standards and the American Association for the Advancement of Science Benchmarks for Science Literacy**
- **"A welcome replacement for outdated life science programs."—*School Library Journal***

Use the comprehensive 8-part *BioBasics* series to excite your students about life science as you present the fundamental concepts they'll need for a firm foundation in biology. An engaging blend of computer graphics, interviews with scientists, and animations will hold their attention as they open their minds to a wide range of essential life science topics.

The series includes *Introduction to Life Science; Cells: The Building Blocks of Life;Genetics and Evolution; Organization and Diversity; Life Processes of Animals; Life Processes of Plants; Microorganisms; Interdependence of Life.* A Cambridge Educational Production. Viewable/printable teacher's guides are available at www.cambridgeeducational.com. (25 minutes each) © 2005.

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

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