OVERVIEW

DIVERSITY OF LIFE COURSE

WELCOME TO LIFE

Life is the most improbable thing on Earth. We usually know it when we see it, but what is it? What is life? We know lots of things about life. It is a temporary condition experienced for various lengths of time by all living things. It is packaged in carbon-based units of various sizes known as organisms. It is characterized by a handful of mandatory processes that require interaction with the environment. It is driven by the electromagnetic force. It has the ability to assume millions and millions of physical forms. Life has an irrepressible enthusiasm for reproducing itself. And one of those forms—perhaps only one—has consciousness. In the final analysis life is just chemistry, albeit the most complex chemistry known, or partially known, to humanity.

This course introduces students to the big picture of life on Earth. It's important for young people on the brink of independence to appreciate the fact that they live on a small, crowded planet among millions of other kinds of organisms. The diversity is awesome. It is good for them to know, too, that life has a history on Earth, and that for virtually all of that history humans were not players. It is our hope that, in their efforts to answer the question what is life? and in their introduction to diversity, students will develop a personal interest in life in all its forms.

FOSS AND NATIONAL STANDARDS

The **Diversity of Life Course** for grades 6–7 emphasizes the use of knowledge and evidence to construct explanations for the structures and functions of living organisms. This course supports the following National Science Education Standards.

SCIENCE AS INQUIRY

Develop students' abilities to do and understand scientific inquiry.

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.

CONTENT: LIFE SCIENCE

Develop students' understanding of life science.

- Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels include cells, tissues, organs, organ systems, and whole organisms.
- All organisms are composed of cells—the fundamental unit of life. Most organisms are single cells; other organisms are multicellular.
- Cells carry on the many functions needed to sustain life.
- Specialized cells perform specialized functions in multicellular organisms.
- All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. Behavior is one kind of response an organism can make to an internal or environmental stimulus.
- Millions of species of animals, plants, and microorganisms are alive today.

SCIENCE AND TECHNOLOGY

Develop students' understandings of science and technology.

- Technology influences society through its products and processes.

HISTORY AND NATURE OF SCIENCE

Develop an understanding of science as a human endeavor that has taken place over time.

- Scientists formulate and test their explanations of nature, using observations, experiments, and models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation.

FOSS MIDDLE SCHOOL PROGRAM COMPONENTS

FOSS Middle School is a general science curriculum for students and their teachers in grades 6–8. The curriculum is organized into topical courses in three strands: **Earth and Space Science**, **Life Science**, and **Physical Science and Technology.** Each course is an in-depth unit requiring 9–12 weeks to teach.

The **Diversity of Life Course** is designed for students in grades 6–7 and includes the following interconnected components:

- A detailed ***Diversity of Life Teacher Guide*** in a three-ring binder, including overview, materials preparation, goals and objectives, at-a-glance investigation chart, science background, lesson plans, transparency masters, teacher answer sheets, assessments with masters and scoring guides, CD-ROM user guide, and references (books, multimedia, websites). The chapters of the teacher guide are separated by tabs for easy use. The **Diversity of Life Course** has ten investigations, each with two or three parts.
- **Kit of student laboratory equipment** packaged for classes of 32 students each. Kits are available for one class of 32 students, or for five classes of 32 students. Classroom packages, with enough materials for an additional class of 32 students are also available. The kits also contain class resource materials such as videos and posters, and a set of **overhead transparencies** for the investigations.
- ***FOSS Diversity of Life Resources*** **book,** containing images, data and readings for each student.
- ***FOSS Diversity of Life Lab Notebook*** containing student sheets and organizers for the investigations. This can be a consumable book for each student or serve as a set of duplication masters for the teacher. Students sheets have three-holes and are perforated so students can remove a page to put it in a binder. The backs of some of the pages are printed with a grid where students can take notes, illustrate organisms, or graph results.
- The ***FOSS Diversity of Life*** **CD-ROM** for use as a whole-class demonstration tool as well as an individual or small-group interactive instructional tool. The CD-ROM is woven into the instruction and is linked to each investigation through the built-in Teacher Guide.

	SYNOPSIS	SCIENCE CONCEPTS	THINKING PROCESSES
1	**What Is Life? (5 sessions)** Students think about characteristics that are common to all living organisms to develop an operational definition of life that will be used throughout the course.	• Any free-living thing—plant, animal, or other—is an organism. • All living organisms exhibit common characteristics; they grow, consume nutrients, exchange gases, respond to stimuli, reproduce, need water, and eliminate waste.	• Categorize pictures of objects and organisms into living and nonliving groups. • Investigate unknown materials by placing them in aquatic environments and observing them for evidence of life. • Analyze data.
2	**Introduction to the Microscope (3–4 sessions)** Students develop their skills with an important piece of scientific technology. They use a microscope to observe and study microorganisms.	• Optical power is the product of the magnification of the eyepiece and the objective lens. • A microscope image appears reversed and inverted. • Focal plane is a thin plane at a fixed distance from the objective lens where the image is in focus.	• Use the microscope to study layers in a sample and structures of brine shrimp. • Draw scale representations of images seen in a microscope to estimate size accurately. • Explain how focal plane affects the image seen through a microscope.
3	**Microscopic Life (5–6 sessions)** Students discover cells and begin to understand their importance as the basic units of life. *Elodea* and *Paramecium* are studied in depth, and students search for other microorganisms in pond water.	• The cell is the basic unit of life. • Cells have the same needs and perform the same functions as more complex organisms. • Paramecia have structures that have certain functions.	• Observe single-celled microorganisms with a microscope and investigate structure-function relationships. • Generate evidence to support the idea that paramecia are organisms. • Compare microorganisms.
4	**The Ribbon of Life (2 sessions)** Students become familiar with biological structures and functions at different levels of organization: cells, organs, tissues, organ systems, and whole organisms.	• Humans, and allother complex life-forms, are made of cells. • Cells have defining structures, such as membranes, cell walls, nuclei, chloroplasts, ribosomes, mitochondria, and cytoplasm.	• Compare structure and function of cells from different organisms. • Relate the structure and function of cells, tissues, organs, systems, and organisms.
5	**Seeds of Life (5 sessions)** Students recognize that seeds are living organisms in a dormant state. They observe and describe the first development stages of a plant.	• Seeds contain the dormant, living embryo of a plant. • Germination is the onset of growth and differentiation in plant seeds. • The cotyledon is the primary source of energy for seed germination.	• Dissect seeds to discover their structures. • Investigate the effect of light on germinated seeds. • Compare the development of two groups of complex plants—monocots and dicots.

FOSS CD-ROM	FOSS READINGS	EXTENSIONS
Lab Living/Nonliving Game	• Life on Earth	• Modify the environment
Lab Virtual Microscope Lab-Technique Videos Database • Brine shrimp		• Maintain the brine shrimp
Database • *Elodea* leaf tissue • Collection—Paramecium • Collection—Microorganisms Lab • Lab-Technique Videos	• *The Lowly Paramecium*	• Model paramecium feeding
Database • Cheek cells Lab • Cells and the Ribbon of Life	• *Cell: The Basic Unit of Life*	
Lab • Lab-Technique Videos Database • Collection—Roots • Collection—Seeds	• *Seeds and Roots*	• Grow monocots and dicots • Pull a few weeds

	SYNOPSIS	SCIENCE CONCEPTS	THINKING PROCESSES
6	**Transpiration (6 sessions)** Students conduct investigations to understand how the vascular system transports water through a plant and how leaves regulate the rate of water flow through a plant.	• Xylem is the system of tubelike connected cells that transport water from the roots to all structures of the plant. • Stomates are openings on leaves that are controlled by guard cells.	• Design an experiment to determine what happens to water in a celery stalk. • Collect and analyze data to develop evidence for an explanation for how water enters a plant's roots and flows through the plant during transpiration. • Relate transpiration to the water cycle.
7	**Plant Reproduction (2–3 sessions)** Students investigate the reproductive systems in flowers to understand the origin of seeds. They explore plant adaptations for seed dispersal.	• Pollen from the anthers on stamens and eggs in the ovules of the pistil are the male and female cells that combine during sexual reproduction to develop into a seed. • Sepals, petals, stamens, and pistils are the major structures of typical flowers.	• Investigate the structure-function relationships of plant flowers. • Make observations to develop a general model of how seeds disperse. • Explain how seed-dispersal mechanisms contribute to a plant's survival.
8	**Land Snails (7 sessions)** Students design and conduct an experiment to determine environmental preferences of land snails. Students observe structures and behaviors of a multicellular organism.	• Snails are gastropods with a muscular foot, a head with sensory organs, and a shell for protection. • Anthropomorphism is attributing human thoughts and feelings to nonhuman organisms.	• Design and conduct an experiment safely and appropriately, using a living organism. • Collect data and draw conclusions. • Determine the difference between scientific observations and inferences.
9	**Cockroaches (4–5 sessions)** Students design and conduct an experiment to determine environmental preferences of an insect—the Madagascar hissing cockroach. They observe structures and behaviors of a multicellular organism.	• Adaptations are structures or behaviors of organisms that enhance their chances to survive and reproduce in their habitat. • Insects have three body parts, six legs, and two antennae.	• Design and conduct an experiment safely and appropriately, using a living organism. • Collect data and draw conclusions. • Relate structure to function in an insect.
10	**Kingdoms of Life (5 sessions)** Students are introduced to the great diversity of microorganisms found all around us—bacteria and fungi. They are introduced to the system of five kingdoms of living organisms.	• Microbe is the general name for microscopic bacteria and fungi, especially those that cause disease and promote fermentation. • Bacteria, fungi, and algae have the characteristics of living organisms. • Bacteria have a cell membrane but no internal organelles.	• Use lab procedures to inoculate agar plates with bacteria and fungi from natural sources. • Make observations and collect data to draw conclusions. • Compare bacteria and fungi to plants, animals, and protists.

FOSS CD-ROM	FOSS READINGS	EXTENSIONS
Database • Collection—Stomates • Collection—Leaves • Collection—Stems Lab Cells and the Ribbon of Life	• *Stems and Leaves*	• Calculate total transpiration • Investigate celery further • Demonstrate guard-cell operation
Database • Collection—Flowers • Collection—Pollinators • Collection—Seeds Pollination Game	• *Flowers to Seeds* • *Seed Dispersal*	
Snails	• *Gliding through Life: The Snail*	• Investigate calcium • Investigate snail structures • Raise snails • Investigate aquatic snails • Obtain seashell books
Database • Collection—Insects Ecoregions	• *The Insect Empire* • *Those Amazing Insects*	• Find out about local endangered species
Explore the House I.B.T.L.	• *Kingdoms of Life*	

FOSS TEACHER GUIDE

The ***Diversity of Life Teacher Guide*** is just that—a guide. It is designed to be an information and planning tool to help you understand and enjoy your excursion through the diversity of life, much like an interpretive brochure might guide your visit to historic Williamsburg. A good guide will suggest the best path to follow, and will enrich your visit with history, facts, and lore as you proceed. Like any good guide it will also point out places to rest and where to stop for refreshments. You should feel comfortable and confident that you know what you are doing as you go along.

Like a good guide it may be pressed into service less as you become more and more familiar with the territory. On your third visit to Williamsburg you might head straight for Main Street, passing by some of the introductory exhibits, and you might visit your favorite spots in a slightly different order than you did before. You might even leave the trail here and there to drink in some of the historical ambiance in a way quite different from that intended by the preparer of the guide brochure.

The first time you visit the **FOSS Diversity of Life Course,** we hope you will follow our suggested sequence to get the lay of the land. The guide is filled with information to help you have an excellent first use of the course. It may seem overwhelming at first, but in a short time you will discover how to use it effectively. Here's what we suggest.

Look at the **Table of Contents** to see how the teacher guide is assembled. You'll notice that the guide is subdivided into 19 chapters. Turn each tab to see how much information there is in each section.

Next read the **Overview** chapter completely. This describes the scope of the course content and discusses issues of instruction, assessment, management, and safety.

Now turn all the pages in the guide, pausing to read the **Goal and Objectives** of each investigation carefully. In this way you will be able to get a very good sense of the curriculum.

Finally digest Investigation 1, *What Is Life?* thoroughly. Read the science background carefully and study the **at-a-glance chart** to see how the investigation is subdivided. The chart also provides a dissected overview of the several days of classroom actions, including the use of media (CD-ROM, video, and readings) and the assessments. Project the actions you read about into your classroom. Visualize students grappling with the issues and working with materials in small groups. If you have the kit at hand, bring out the materials as you read, and do the investigations. Then read Investigation 2 carefully, then 3, 4, 5, and so forth. Keep the *Diversity of Life Teacher Guide* close at hand (even in hand) during your first trip into life on Earth to ensure a safe and productive adventure.