Biosphere Learning Progression

Grades 3-5: GLOBE Protocols Aligned with NASA Resources and NGSS Standards

NGSS Progression of Learning: Building on concepts developed in grades K-2 that focused on how different organisms live in different habitats and how habitats are being affected by the choices made by humans, students in grades 3-5 examine these characteristics and make inferences about how the interactions among the spheres of the Earth System affect each other. By incorporating GLOBE and My NASA Data in the classroom, educators provide students with the ability to collect data and access satellite data to answer their own questions related to Earth System interactions that affect the soil where they live. Using GLOBE and MY NASA DATA educators and students will access NASA satellite data to examine a variety of Earth system interactions. (NASA Langley GLOBE Resource Page: www.globe.gov/web/nasa-langley-research-center/home/resources)

Performance Expectations Support: (Note: the following Performance Expectations and 3 Dimensional Learning are aligned with GLOBE and NASA Resources and are meant to support the development of the associated content and skill development but may not lead to complete mastery)

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Science Practices:	Disciplinary Core Idea:	Crosscutting Concepts:
Asking Questions and Defining Problems : Ask questions based on observations to find more information about the natural and/or designed worlds(s). **Developing and Using**	**LS1.A Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) **LS1.B Growth and Development of Organisms** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)	**Patterns** Patterns of change can be used to make predictions. (3-LS1-1) **Cause and Effect** Events have causes that generate observable patterns. Cause and effect relationships are

Models:
Use a model to represent relationships in the natural world.
Develop models to describe phenomena. (3-LS1-1, 5-PS3-1, 5-LS2-1) Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Analyzing and Interpreting Data: Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

Engaging in Argument from Evidence: Construct an argument with evidence to support a claim. (3-LS4-3) Construct an argument with evidence, data, and/or a model. (4-LS1-1, 5-LS1-1)
Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

LS1.C Organization for Matter and Energy Flow in Organisms
Plants acquire their material for growth chiefly from air and water. (5-LS1-1)

LS2.A Independent Relationships in Ecosystems:
The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.
Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers". Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. (5-LS2-1)

LS2.B Cycles of Matter and Energy Transfer in Ecosystems: Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. (5-LS2-1)

LS2.C Ecosystem Dynamics, Functioning, and Resilience
When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment and some die. (3-LS4-4)

LS3.A Inheritance of Traits
Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)

LS3.B Variation of Traits
The environment also affects the traits that an organism develops. (3-LS3-2)

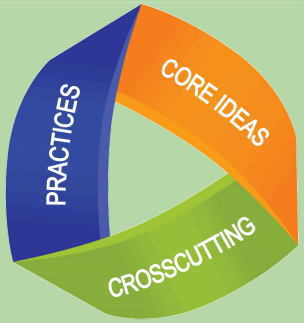
LS4.C Adaptation
For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

LS4.D Biodiversity and Humans
Populations live in a variety of habitats, and change in those habitats affect the organisms living there. (3-LS4-4)

routinely identified and used to explain change. (3-LS3-2, 3-LS4-3)

Systems and System Models
Systems in the natural and the designed world have parts that work together.
A system can be described in terms of its components and their interactions. (3-LS4-4, 4-LS1-1, 5-LS2-1, 5-ESS2-1, 5-ESS3-1)

Energy and Matter
Objects may break into smaller pieces and be put together into larger pieces, or change shapes.
Energy can be transferred in various ways and between objects. (5-PS3-1)
Matter is transported into, out of, and within systems. (5-LS1-1)



(3-LS4-4) **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation. (3-LS3-2) **Obtaining, Evaluating, and Communicating Information:** Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)	**PS3.D Energy in Chemical Processes and Everyday Life** The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter. (5-PS3-1) **ESS2.A Earth Materials and Systems:** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. (5-ESS2-1) **ESS3.C Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on land, vegetation, streams, oceans, air and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	
GLOBE Application		
Biosphere Protocols: • Air Temperature • Precipitation • Surface Temperature • Green-Up	**GLOBE Learning Activities:** (Learning activities can be used to develop concepts associated with the NGSS Performance Expectations.) • First Look at Phenology: Learners will observe, compare, and classify plants during green-up or green-down and then make inferences based on the patterns they observe. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1, 5-ESS2-1) • A Sneak-Peak at Budburst Learners will do simple explorations to observe the relationship between budburst and temperature. This	**Guiding Question(s):** 1. How would you visually represent the life cycle of a mosquito? A human? What are the key stages in each?

• Green-Down • Tree Height • Phenological Gardens **Data Sheets:** • Atmosphere Investigation Integrated 1-Day • Atmosphere Investigation Clouds 1-Day • Atmosphere Investigation Surface Temperature • Green-Up Data Sheet • Green-Down Data Sheet • Tree Height • Tree Circumference **Elementary GLOBE Storybook:** *What in the World is Happening to Our Climate?* **GLOBE Supporting Resources:** • Plant Color Guides	is a winter or dry season activity to be done prior to green-up observations. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1) • Look at the Buds: Learners will collect Green-Up Data (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1) • Why Do Leaves Change Color: Learners will investigate why leaves change color, (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1) • GLOBE Trees Seedling Science Journey: Learners will use the one-pager as they discover various aspects related to the needs and life cycles of trees. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1, 5-ESS2-1) • Be a Tree Detective: The learner will explore parts of the tree, including bark, leaves or needles, flowers, fruits, seed pods and cones. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1) • What's Hidden in Tree Buds? Learners become familiar with the structure of the buds of chosen deciduous trees, they observe the bud sprouting and changes that deciduous trees undergo in spring. (3-LS1-1, 3-LS3-2) • Build a Clinometer: Learners construct a clinometer to use in measuring tree height. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1) • Stories Trees Tell: Learners explore how dendrochronology, or the study of data from tree ring growth, can help us to understand more about a tree's age along with trauma and environmental events it has encountered over the course of its lifetime. (3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1, 5-ESS3-1) • Life Cycle of a Mosquito: Learners will investigate the life cycle of mosquitoes by observing the diagrams provided in this activity and examining water samples collected from mosquito breeding habitats. (3-LS1-1, 3-LS3-2, 4-LS1-1) • Zika Zine Mosquito Comic: Learners will love meeting Hester, Wanda and their mosquito friends while they gain information about mosquitoes life cycle stages, habitats and the dangers that	2. Think about a plant grown in a sunny spot versus the same type of plant grown in a shady spot. What differences might you observe in their traits? What evidence supports the idea that the environment caused these differences? 3. What role do resources like water, sunlight, and shelter play in determining how well an organism survives in a habitat? 4. Describe a scenario where the environment changes (e.g., a forest fire, a flood, a prolonged drought). What problems might this cause for the plants and animals living there? 5. What are some external structures of a tree? What functions do these structures serve for the tree's survival, growth, and reproduction? 6. What do you think plants need to grow? Where do these materials come from?

• Winter Twigs • Green-Up Cards • How Does Photosynthesis Work? • Elementary GLOBE Educator Implementation Guide • Elementary GLOBE Modules • GLOBE Across the Curriculum • Educator Presentations	mosquitoes pose to people and animals. (3-LS1-1, 3-LS3-2, 4-LS1-1) • Mosquito Identification Sheet: Learners will be able to use the identification sheet to help them in identifying the different stages of a mosquito's life cycle for three different species. (3-LS1-1, 3-LS3-2, 4-LS1-1) • Earth System in a Bottle: Learners set up an experiment to determine what plants need to grow. (3-LS1-1, 3-LS3-2, 3-LS4-3, 4-LS1-1, 5-LS1-1, 5-ESS2-1) • A Beginning Look at Photosynthesis: Plants Need Light: Learners develop an understanding of plants' response to light. (3-LS3-2, 3-LS4-3, 3-LS4-4, 5-LS1-1) • Site Seeing: To help learners determine that a system's boundaries are based upon the question(s) a scientist wants to answer. (All) • Getting to Know Your Terrestrial Biomes: Learners will become familiar with the Seasons and Biomes' Terrestrial Biome Classifications. (All) • Seashores on the Move: To help learners understand how sea level rise can affect coastal communities and environments. (3-LS4-4, 5-ESS3-1) • We're All Part of the Solution: To help learners understand that, while humans are contributing to climate change, we can also take action to solve this challenge. (3-LS4-4, 5-ESS3-1) • We're All Connected:To help learners deepen their understanding of interconnections among Earth's systems. (5-LS2-1, 5-ESS2-1)	7. Trace the flow of energy from the sun to a plant, and then to an animal that eats that plant? What model could you use to show this? 8. What happens to a dead plant or animal? What organisms help break it down? What are these organisms called? 9. What are some ways that individual people in a community can use science ideas to protect the environment? Think about water conservation, reducing waste, or planting trees.

NASA Assets

NASA Educator Resources:
Earth Observatory for Educators
Yearly Cycle of Earth's Biosphere

NASA Learning Activities:

- Mission Biomes
- Designer Plant
- Designer Animal
- Build a Desert
- Build a Rainforest
- NASA eClips: The Light Plants Need

My NASA Data Visualization Tool: Earth System Data Explorer (This is a resource to be used by the educator in the development of learning activities for the classroom. It is not meant to be a tool for the learner at this grade level.)

My NASA Data Supporting Resources: (To be used by educators as a background source, pieces of the content can be adapted for grades 3-5 but are not age appropriate as they are written.)

- About the Biosphere
- Elementary GLOBE Connections
- Earth System Flip-books
- Spheres of Earth
- Plant Growth Patterns
- Illustrate your Inner "STEM" Explorer
- Earth System Graphic Organizer

My NASA Data Lessons/Activities:

- Observing Annual Vegetation Changes (3-LS3-2, 3-LS4-3)
- Awanasa Goes to Camp (3-LS4-4, 5-ESS2-1)
- Earth System Satellite Images: Analyzing One Variable (3-LS3-2, 3-LS4-3, 3-LS4-4, 5-ESS2-1, 5-ESS3-1)
- Our Earth a Web of Systems (3-LS3-2, 3-LS4-3, 3-LS4-4, 5-ESS2-1, 5-ESS3-1)
- What is Earth System Science? (5-ESS2-1)
- Observing Earth's Seasonal Changes (3-LS3-2, 3-LS4-3, 3-LS4-4, 5-ESS2-1, 5-ESS3-1)
- What's Causing Sea Level Rise? Land Ice vs Sea Ice (3-LS4-4, 5-ESS3-1)
- What will Happen if Climate Variability and Change Cause Glacier and Polar Ice Cap Melting? (3-LS4-4, 5-ESS3-1)
- When Land Ice Melts (3-LS4-4, 5-ESS3-1)

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Updated by NASA Langley Research Center Science Directorate Science Education Team (2025)