MIDDLE SCHOOL LIFE SCIENCE: ECOLOGY- POPULATIONS & INTERACTIONS

Standards Bundle:

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (SEP:4;DCI:LS2.A; CCC:Cause/Effect) [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (SEP:6; DCI:LS2.A; CCC:Patterns) [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. (SEP:7; DCI:LS2.C; CCC:Stability/Change) [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. (SEP: 7;DCI: LS2.C, LS4.D, ETS1.B ; CCC: Stability/Change, Technology) [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

In any ecosystem, there are physical and biological factors that affect the size of the populations. Availability or changes in availability of any of the factors can lead to changes in the populations of all of its members. In order to survive, organisms may compete with, feed on, or develop a dependence on another species. An ecosystem's health is measured by its biodiversity or the variety of life it contains, both in numbers of different species, and as variations that exist within a species (e.g. darker or lighter fur, or taller or shorter stems). Humans can serve to either disrupt or provide solutions for the delicate balance of an ecosystem. The availability of these resources in an ecosystem can affect individual organisms, and their populations, in an ecosystem.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- The disappearance of bees is reducing the biodiversity of flowering plants in several areas around the world.
- Apple trees in China are not producing apples.
- A decline in the Northern Spotted Owl population followed a decrease in old-growth forest.
- The population of Snowy Owls in Alaska increases after the population of lemming increases.
- As cattle walk through the grass, insects become active and are eaten by cowbirds.
- Bioblitz data shows greater species diversity before the introduction of invasive snakes in the Florida Everglades.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

A population is the sum of all of the organisms of any one species living in the same area. Through this bundle, students should understand that organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through relationships with other organisms and with their physical environment and that symbiotic relationships exist throughout the ecosystems. These same interactions can facilitate or restrain growth, and enhance or limit the size of populations, as well as maintain the balance between available resources and those who consume them. These interactions can also change the living and nonliving characteristics of the environment. Students should be able to use evidence to explain that any changes to the biotic (living organisms' biological components) and/or abiotic (nonliving, physical components) parts of the ecosystem can have an effect on the size and health of populations within the system. Students must develop an understanding that as long as conditions remain stable in an ecosystem, populations in the system will remain stable, but if conditions change, then so too will populations.

Through this bundle, students should be given opportunities to collect and interpret data showing, for example, that plentiful rainfall affects the number of plants in an area. Large numbers of plants will result in large numbers of herbivores, and large numbers of herbivores will result in large numbers of carnivores. If, however, rainfall is scarce, the number of plants becomes scarce and thus the number of herbivores and carnivores can also become scarce. The number of plants is a limiting factor for the herbivore and carnivore populations and rainfall is a limiting factor for plant population. If the animals becomes scarce, carnivores will compete for the available animals and consequently be limited in their growth and reproduction. Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Students should begin to see patterns in these cause and effect relationships and construct explanations that predict such patterns.

In this performance expectation, students should understand that an ecosystem with many different organisms and much variation within each species is a healthy ecosystem. When an event happens to disrupt the diversity, and thus the health of an ecosystem, the ecosystem is no longer stable. Small changes or events in one part of an ecosystem might cause large changes in another part. These events can be imposed by humans (e.g. pollution or urban sprawl), or by nature (as in the case of drought or disease). A healthy/diverse ecosystem can recover more easily after such an event. For example, if a disease kills out a species of trees in a forest, the forest with a diverse tree population (e.g. 25 other species of trees) will recover much more quickly than the forest with only one other species of tree.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Analyzing and Interpreting Data

- How does the biodiversity data of bee populations correlate to the biodiversity data of surrounding plants in an ecosystem?
- Analyze data from a biological survey to determine the effects of resource availability influenced by weather or climate events (natural or artificially caused).
- What is a pattern or relationship you can infer from given data graphs of the evidence of photosynthesis? Explain the causes of these patterns or relationships?

SEP Constructing Explanations and Designing Solutions

- Design a rehabilitation solution for an ecosystem that recently experienced extreme drought using data of relationships between organisms (consider mutualism, predation, parasitism, abiotic components, and herbivore/carnivore relationships).

CCC Cause and Effect

- How could the addition or removal of one population affect the population of another species in the same ecosystem?
- How could resource availability affect the reproduction rate of a population in an ecosystem?

CCC Patterns

- Identify a pattern of mutually beneficial relationships existing between pollinators and flowering plants in several ecosystems.

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Construct an explanation** that populations are in *constant fluctuation causing* their characteristics to vary over time.
- **Engage in argument from evidence** that *changes* to the biotic and abiotic components of an ecosystem *can change* all of the populations in an ecosystem.
- **Construct an explanation** that includes the *quantitative relationships* between predators and prey to demonstrate that the population of one *directly*

affects the population of the other.

- **Construct an explanation** of the relationship between organisms that are mutually beneficial to each other (symbiosis) and that these relationships *are vital* to the survival of both organisms.
- **Interpret data and show patterns** to demonstrate that populations are limited by the availability of resources such as food, water, oxygen, carbon dioxide and sunlight.
- **Construct an explanation** that includes quantitative evidence that competition for available resources (both living and nonliving) *can restrict* the size of given populations.
- **Engage in argument from evidence** to exhibit that reproduction rates and thus populations *are dependent on* the availability of living and nonliving resources.
- **Analyze and interpret data** that biodiversity is the variety of species in an ecosystem.
- **Engage in argument from evidence** that an ecosystem's health can be measured by its biodiversity.