Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

5-2.1 Recall the cell as the smallest unit of life and identify its major structures (including cell membrane, cytoplasm, nucleus, and vacuole).
Taxonomy level: 1.1 and 1.2-A Remember Factual Knowledge

Previous/Future knowledge: This is the first time students have been introduced to cells. In 7th grade (7-2.1), students will summarize the functions of the components of plant and animal cells, including the cell wall, the cell membrane, the nucleus, chloroplasts, mitochondria, and vacuoles).

It is essential for students to know that all organisms are made of cells.

- The *cell* is the smallest unit of living material having major structures within it allowing it to live.
- Some kinds of organisms are just one cell. This single cell is the organism's entire body.
- Many organisms are made of more than one cell.

Cells vary in size, but all cells contain these major structures:
Cell membrane

- The soft, flexible outside covering of a cell that controls what comes in and out of a cell.

Cytoplasm

- The gel-like fluid that fills most of a cell. The other organelles are found in the cytoplasm.

Nucleus

- A small structure that controls everything the cell does.

Vacuole(s)

- Are storage spaces in the cell.
- They can hold water and other nutrients that the cell needs.
- They can also store wastes until the cell can get rid of it.

NOTE TO TEACHER: It is appropriate to introduce the mitochondria (where energy is made) as a major structure common to all cells.

It is not essential for students to know the other parts of a cell (mitochondria, cell wall, or chloroplasts), to compare plant and animal cells, or to know various types of cells found in the body (blood, muscle, nerve).

Assessment Guidelines:
One objective of this indicator is to *recall* the cell as the smallest unit of life; therefore, the primary focus of assessment should be to remember that the smallest unit of all organisms is the cell.

Another objective of this indicator is to *identify* the major structures of a cell; therefore, the primary focus of assessment should be to *recall* these major structures (including cell membranes, a nucleus, vacuoles, and cytoplasm) in cells.

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

5-2.2 Summarize the composition of an ecosystem, considering both biotic factors (including populations, to the level of microorganisms, and communities) and abiotic factors.

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st and 2nd grade, students explained how distinct environments of the world support different plants (1-2.5) or animals (2-2.3). In 3rd grade (3-2.3), students recalled the characteristics of a habitat that allowed organisms to survive there. In 4th grade (4-2.2), students explained how the characteristics of distinct environments influence the variety of organism there. In 7th grade (7-4), students will demonstrate an understanding of how organisms interact with and respond to the biotic and abiotic components of their environment.

It is essential for students to know that an *ecosystem* contains all of the organisms and their nonliving surrounding environment that contribute to the functioning of the ecosystem. An example of an ecosystem is an estuary, including all of the animals, plants, water, soil, air, and sunlight present and the interactions among them.

- The living parts of the ecosystem are called the *biotic factors* and include populations and communities of organisms.
- The nonliving parts of the ecosystem are called the *abiotic factors* and include the temperature, water, soil, air, and sunlight.

The living organisms in an environment can be grouped in two ways:
Population

- All members of one kind of organism that live in a particular area.
- Some examples of a population may be all of the white-tailed deer in a forest, all rainbow trout in a stream, or all of the bald cypress trees in the swamp.
- *Microorganisms* are living things that can be a single-celled or multi-celled organism that is too small to be seen without at least a 10x magnifier.

NOTE TO TEACHER: Students only need to know microorganisms as part of a community, not individual populations.

Communities

- A group of different populations of organisms.
- Some examples of communities are all of the squirrels, acorn trees, and grass in a park; all of the microorganisms in a pond; or all of the cacti, rattlesnakes, and scorpions in the desert.

It is not essential for students to know the types of microorganisms (paramecium, euglena, and amoeba).

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

Assessment Guidelines:

The objective of this indicator is to *summarize* the composition of an ecosystem; therefore, the primary focus of assessment should be to generalize major points about the biotic and abiotic components of an ecosystem. However, appropriate assessments should also require students to *exemplify* or *illustrate* components of an ecosystem; *classify* parts of an ecosystem as biotic or abiotic; *identify* the organizational parts of an ecosystem; or *classify* organisms as populations or communities.

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

5-2.3 Compare the characteristics of different ecosystems (including estuaries/salt marshes, oceans, lakes and ponds, forests, and grasslands).
Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have previously learned about habitats and distinct ecosystems in 1st, 2nd, 3rd and 4th grade. They have learned about the characteristics of different environments and how changes can occur. Students have previously learned about rivers and streams, tropical rain forests, deserts and polar regions in 4th grade (4-2.2).

It is essential that students to know that there are different types of ecosystems (terrestrial and aquatic). These ecosystems can be divided into two types according to their characteristics:

Terrestrial

- Land-based ecosystems include forests and grasslands.
  - *Forests* have many trees (with needles or with leaves), shrubs, grasses and ferns, and a variety of animals. They usually get more rain than grasslands. Temperatures in the forests may vary depending on where the forest is located.
  - *Grasslands* have fertile soil and are covered with tall grasses. They usually get a medium amount of rain, but less than forests. Temperatures may also vary depending on where the grassland is located. Some examples of animals that live in the grasslands are prairie dogs, bison, and grasshoppers.

Aquatic

- Water-based ecosystems may be fresh water (lakes and ponds) or saltwater (oceans, estuaries and saltwater marshes).
  - *Lakes* and *ponds* are bodies of freshwater that are surrounded by land. Ponds are usually shallower than lakes and the temperature of the water usually stays the same from top to bottom. Plants and algae usually grow along the edges where the water is shallow. Some examples of animals may be different types of fish, amphibians, ducks, turtles, or beavers.
  - *Oceans* are large bodies of saltwater divided by continents. Oceans have many types of ecosystems depending on the conditions (sunlight, temperature, depth, salinity) of that part of the ocean.
    - Most organisms live where the ocean is shallow (from the shoreline to the continental shelf) because sunlight can reach deep and the water is warm making food is abundant. Some examples of organisms that live in the shallow ocean may be drifters (jellyfish or seaweed), swimmers (fish), crawlers (crabs), and those anchored to the ocean floor (corals).
    - Some organisms live in the open ocean, near the surface or down to the deep ocean bottom. Plankton float in the upper regions of the water. Some organisms swim to the surface to find food or for air (whales, turtles, sharks) while others stay live closer to the bottom (certain fish, octopus, tubeworms).

- *Estuaries* are found where the freshwater rivers meet the oceans. They are saltier than a river, but not as salty as the ocean. The amount of salt (salinity) changes as the tides come in and out. Estuaries contain *salt marshes* with grasses and marsh plants adapted to this changing water. Some examples of animals that live in the estuaries/salt marshes may be crabs, shrimp, birds such as blue heron and egrets, and muskrats.

It is not essential for students to know the different types of forests (coniferous, deciduous, rainforests), to name the specific ocean zones, or the locations of these environments on a map. Students have already studied rainforests, rivers and streams, polar regions, and deserts.

Assessment Guidelines:
The objective of this indicator is to *compare* characteristics of different ecosystems; therefore, the primary focus of assessment should be to for students to detect similarities and differences between aquatic ecosystems and between terrestrial ecosystems. However, appropriate assessments should also require students to *identify* an ecosystem based on its description; or *exemplify* characteristics of each ecosystem.

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

5-2.4 Identify the roles of organisms as they interact and depend on one another through food chains and food webs in an ecosystem, considering producers and consumers (herbivores, carnivores, and omnivores), decomposers (microorganisms, termites, worms, and fungi), predators and prey, and parasites and hosts.
Taxonomy level: 1.1-B Remember Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-2.5), students summarized the organization of simple food chains (including the roles of producers, consumers, and decomposers). In 7th grade (7-4.2), students will illustrate the flow of energy in food chains, food webs and energy pyramids.

It is essential for students to know that all organisms need energy to live and grow. This energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy.

Producers
- Plants are called producers because they are able to use light energy from the Sun to produce food (sugar) from carbon dioxide in the air and water.

Consumers
- Animals cannot make their own food so they must eat plants and/or other animals.
- They are called consumers.
- There are three main groups of consumers.
  - Animals that eat only plants are called *herbivores*.
  - Animals that eat only animals are called *carnivores*.
  - Animals that eat both animals and plants are called *omnivores*.

Decomposers
- Consumers (including microorganisms, termites, worms, and fungi) that get the energy they need by breaking down dead or decaying matter.
- These decomposers speed up the decaying process that releases nutrients back into the food chain for use by plants.

One way to show how energy is passed through an ecosystem is through a food chain.
- A *food chain* is a series of plants and animals in which each organism is a source of food (energy) for the next in the series.
- In a typical food chain, plants use the Sun's energy to make their own food and then are eaten by one kind of animal which in turn is eaten by another kind of animal.
- Most organisms are part of more than one food chain and eat more than one kind of food in order to meet their energy requirements.
- Interconnected food chains form a *food web*.
- Most food chains have no more than six organisms.
- There cannot be too many links in a single food chain because the animals at the end of the chain would not get enough food (energy) to stay alive.

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

- The role of an organism can be identified by its placement on the food chain.
- Decomposers are not typically noted on a food chain; they will break down any organism on the food chain when it dies.

An example of a grassland food chain:

Sun →	**Grass** →	**Grasshopper** →	**Toad** →	**Snake** →	**Hawk** →
	Producer	Consumer	Consumers		

Note that the arrows are drawn from *food source* → to *food consumer*

Organisms can also be identified based on how they interact with other organisms.

- *Predators* are animals that hunt and kill other animals for food.
- *Prey* are animals that are hunted and killed as food for other animals.
- A *parasite* is an organism that spends a significant portion of its life in or on a living *host* organism usually causing harm to the host without immediately killing it.
- *Hosts* are organisms or cells that serve as a home or a source of food for a parasite.

It is not essential for students to identify trophic levels found in a food chain or web, identify energy pyramids, or know other relationships between organisms (such as mutualism, commensalism, or symbiosis).

Assessment Guidelines:
The objective of this indicator is to *identify* roles of organisms in an ecosystem; therefore, the primary focus of assessment should be to recognize the roles of organism in a food chain or a food web. However, appropriate assessments should also require students to *recall* the roles of producers, consumers (including herbivores, carnivores, and omnivores), and decomposers; *recognize* from drawings or diagrams the components of a food chain or food web; or *recognize* the roles of predators and prey as well as parasites and host.

Ecosystems: Terrestrial and Aquatic

5-2 Students will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems. (Life Science)

5-2.5 Explain how limiting factors (including food, water, space, and shelter) affect populations in ecosystems.
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have previously learned about the needs of living things and the interdependence between animals and plants in their habitats (3-2), but they have not explored the concept of limiting factors. In 7th grade (7-4.3), students will explain the interactions between various environmental changes and limiting factors.

It is essential for students to know an ecosystem only has a certain amount food, water, space, and shelter to support a certain number of organisms.

- The relationship between numbers of organisms and the resources available in an ecosystem is often described as the *balance of nature*.
- A condition or resource that keeps a population at a certain size is known as a *limiting factor*.
- If any of the limiting factors change, animal and plant populations may also change.
- Some changes may cause a population to increase; others may cause a population to decrease.

Increases in population may result in overcrowding. Sometimes a population will grow too large for the environment to support. Some examples that may cause a population to increase may be:

- If there are more plants than usual in an area, populations of animals that eat that plants may increase.
- If the population of predators increases, the population of prey will decrease.
- If the population of prey increases, the population of predators will also increase because of the availability of food.

Other changes in limiting factors may cause a population to decrease. Some examples may be:

- If the water supply in an area decreases, the population that needs that water may decrease. Then the population of animals that eat that animal could decrease too.
- If trees are cut down, die because of disease or parasites, the population of the animals that use the trees for food or shelter will decrease.
- If organisms no longer have enough space to survive, they will either have to move or will die. This change in space may be due to human influence or natural hazards.

It is not essential for students to about carrying capacity or how a change in climate or how biotic factors affect population sizes.

Assessment Guidelines:
The objective of this indicator is to *explain* the how limiting factors affect populations in ecosystems; therefore, the primary focus of assessment should be for students to construct a cause-and-effect model that shows how populations change due to limiting factors. However, appropriate assessments should also require students to *recall* limiting factors; *summarize* ways that limiting factors influence the balance of nature in an ecosystem; or *exemplify* ways that the abiotic factors affect populations of organisms.