# STAAR Science Tutorial 53
TEK 8.11B: Competition

TEK 8.11B: Investigate how organisms and populations in an ecosystem depend on and may compete for biotic and abiotic factors such as quantity of light, water, range of temperatures, or soil composition.

Ecosystems

- **Ecology** is the scientific study of the interactions of living organisms with their environment. **Ecologists** are scientists who study ecology.

- All of the living organisms on Earth, together with the parts of Earth that can support life, is called the **biosphere**. The biosphere can be classified into different **biomes**, all of the areas of earth with a similar climate and vegetation. Examples of biomes include tropical rain forests and deserts. An **ecosystem** is a defined single area of one biome type, together with all of the living organisms in that area and the non-living factors affecting the organisms. For example, the Chihuahuan Desert of west Texas is an ecosystem that is part of the worldwide desert biome.

- A **population** is all of the individual organisms of a single species living in a defined area. A **species** is one particular kind of organism that can breed with others of its kind to produce fertile offspring (children who will be able to have children of their own). All of the populations living in a defined area is the **community**.

- The levels of organization in the biosphere is summarized by this diagram:

Biosphere ➡ Biome ➡ Ecosystem ➡ Community ➡ Population

Ecosystem ➡ Abiotic Factors

Population ➡ Organism
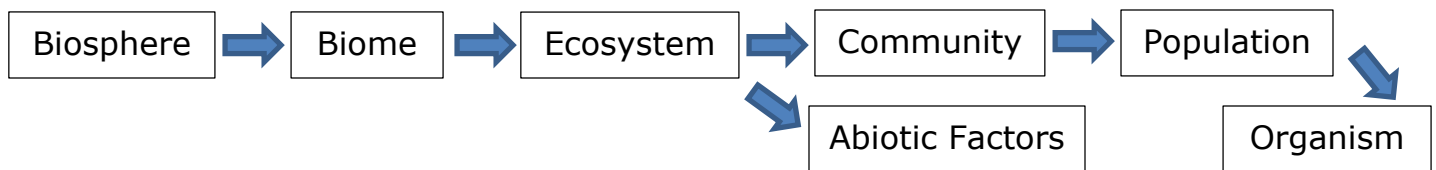
- **Biotic** (living) factors in an ecosystem includes all of the living organisms found in an area, and the interactions between those organisms, such as resource competition, predation (predator-prey relationships) and symbiosis. This tutorial describes competition in more detail below. See *Tutorial 52: Food Webs and Symbiosis* for more information on predator-prey and symbiotic relationships.

- **Abiotic** (non-living) factors include the defining characteristics of the environment, such as the climate (especially temperature range and rainfall amounts), water, sunlight, air, rock and soil types, including the availability of elements essential to life (for example, nitrogen and phosphorus).

- Each species has a **niche**, a set of biotic and abiotic conditions in which it can survive and maintain a stable population. A species' niche includes its place in the food web, the symbiotic relationships of which it is part, and the physical conditions necessary to its survival. A species' niche includes its "role" in the ecosystem.

- **Habitat** is the type of place in which an organism lives and finds all of the resources necessary for its survival. It is a specific part of the ecosystem. For example, for a bird that eats only one kind of seed, it might be as narrowly defined as a certain part of a particular species of tree.

- All habitats have limited resources. For example, the amount of grass growing in a fenced field is limited. If too many cattle are placed in the field, they will eventually eat all of the grass and starve.

Competition and Adaptations

- An **adaptation** is any inherited physical or behavioral characteristic that helps an organism to survive and reproduce in its habitat. For example, the ability of an eagle or hawk to better see prey at a distance, and the ability of a deer to better smell a predator and run fast enough to avoid being eaten, are adaptations that help them survive.

- The process by which species develop adaptations to better compete for food and other resources is called **natural selection**, which is discussed in detail in *Tutorial 51: Natural Selection*.

- In a healthy, balanced ecosystem, the population of each species grows until it reaches a stable level in which all of some limiting resource is being completely used, and no further population growth is possible. This maximum population is called the **carrying capacity** of the ecosystem for that species. The limiting resource might be food, water, sunlight or a particular nutrient. When a population exceeds the carrying capacity, the weaker members of that population are likely to die off.

- The carrying capacity of an ecosystem can vary over time. In particular, natural short-term climate cycles such as droughts, and longer term climate change, can cause populations to grow or shrink.

- When the population of any species reaches its carrying capacity, there is **competition between individuals** of that species to secure food, water and suitable shelter. Because of genetic variation within the population, some individuals will be better adapted than others, and will be more likely to survive. For example, coyotes usually hunt alone, and will starve if they are not good hunters. A coyote with a better sense of smell and who runs faster is more likely to catch prey in a drought year with limited prey.

- Prey species have to avoid being caught by predators to survive. Many grazing species travel in herds to increase their chances of survival. When the herd is attacked by predators, it is the slowest or least watchful that will be caught. The very young and very old are often targeted by predators as the easiest catch. The competition here is to not be the slowest in the herd.

- There is **competition between species** living in the same area for one or more resources with limited supply. For example, in a desert with little or no available surface water, the ability of one species to better get and store limited water may help it survive while others die. Desert plants typically have long root systems and store water in thick stems between infrequent rains. Species without these adaptations will likely die in a drought year.

- In a dense rainforest, the ability of a plant to gather more sunlight with larger leaves, or to grow higher to reach the sunlight, is an adaptation that may help it survive.

- In areas with few nutrients in the soil such as rain forests, the ability to grow longer roots to gather more nutrients from the soil, or to develop symbiotic relationships with fungi to break down decaying leaves and branches on the ground, may help it to compete with other species.

- It is common for predators of different species to all hunt some of the same prey species. The competition here is which predator species is best adapted to catch the limited supply of each prey species that they share. A species that cannot compete for a particular prey species may give up trying to catch it, focusing instead on other prey species. If a predator species is out-competed for all of its usual prey species, it will have three choices: (1) find a new prey species that is available; (2) migrate to another area with less competition or more prey, or (3) become extinct (die off) in that area.

Practice Questions

1. The _____ is all of the living organisms on Earth and the places they live.

2. All of the combined areas of earth with similar climate and vegetation is called a _____. An example is a _____ or a _____.

3. An _____ is a single connected (contiguous) area of one biome type.

4. All of the living organisms living in a defined area is called the _____.

5. A _____ is all of the individual living organisms of one species living in a defined area.

6. A _____ is one specific kind of organism that can breed with others of its kind to produce fertile offspring.

7. A _____ factor in an ecosystem includes all of the living organisms found in an area, and the interactions between those organisms.

8. _____ factors include the defining characteristics of the environment, such as the climate, water, sunlight, air, rock and soil types.

9. A species' _____ is the set of biotic and abiotic conditions in which it can survive and maintain a stable population, sometimes described as its "role" in the ecosystem.

10. A species' _____ is the place it lives and finds all of the resources necessary for its survival.

11. An _____ is any inherited physical or behavioral characteristic that helps an organism to survive and reproduce in its habitat.

12. The process by which species develop adaptations is called _____ _____.

13. Give four examples of adaptations. _____

_____

_____

_____

14. The maximum population of a species that can live in an area, due to a limited resource such as food or water, is called its _____ _____.

15. Why do individual organisms of the same species have to compete to survive?

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16. Give three examples of competition between species for <u>abiotic</u> resources, in which the better adapted species is most likely to survive. _____

_____

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17. When a predator is out-competed for biotic resources (prey) by other better-adapted predator species, what three choices can it make? (1) _____

_____;

(2) _____;

(3) _____.