Name_____ Date_____

TEKS 5.B.11.B Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.11) **Science concepts.** The student knows that biological systems work to achieve and maintain balance. The student is expected to (B) investigate and analyze how organisms, populations, and communities respond to external factors;

STANDARD REVIEW

A population consists of all the individuals of a species that live together in one place at one time. Every population tends to grow because individuals tend to have multiple offspring over their lifetime. A population grows when more individuals are born than die in a given period. But eventually, limited resources in an environment limit the growth of a population.

When population size is plotted against time on a graph, the population growth curve resembles a *J*-shaped curve and is called an exponential growth curve. An exponential growth curve is a curve in which the rate of population growth stays the same, and as a result, the population size increases steadily.

However, populations do not usually grow unchecked. Their growth is limited by predators, disease, and the availability of resources. Eventually, growth slows, and the population may stabilize. The population size that an environment can sustain is called the carrying capacity.

As a population grows, limited resources (that is, resources in short supply) eventually become depleted. When this happens, the growth of the population slows. The population model can be adjusted to account for the effect of limited resources, such as food and water. These resources are called density-dependent factors because the rate at which they become depleted depends upon the population density of the population that uses them.

The population model that takes into account the declining resources available to populations is called the logistic model of population growth, after the mathematical form of the equation. The logistic model is a population model in which exponential growth is limited by a density-dependent factor. Unlike the simple model, the logistic model assumes that birth and death rates vary with population size. When a population is below carrying capacity, the growth rate is rapid. However, as the population approaches the carrying capacity, death rates begin to rise and birth rates begin to decline. Competition for food, shelter, mates, and limited resources tends to increase as a population approaches its carrying capacity. The accumulation of wastes also increases. As a result, the rate of growth slows. The population eventually stops growing when the death rate equals the birth rate.

Name_____ Date_____

TEKS 5.B.11.C Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.11) **Science concepts.** The student knows that biological systems work to achieve and maintain balance. The student is expected to (C) summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems;

STANDARD REVIEW

Microorganisms have both positive and negative effects on ecosystems. Bacteria play a key role in the nitrogen cycle by fixing nitrogen, which makes nitrogen available to plants and animals. Together with fungi, heterotrophic bacteria are the principal decomposers of the living world; they break down the bodies of dead organisms and make the nutrients available to other organisms. A significant fraction of the world's photosynthesis is carried out by bacteria. By carrying out photosynthesis, these bacteria are the first stage in food chains and provide food for living things in their environment.

Microorganisms also have both positive and negative effects on organisms. One way that microorganisms are beneficial to living things is in the digestive system. For example, a thriving colony of bacteria live in the human colon. These microbes synthesize many compounds that your body needs and cannot get easily from the food you eat, including vitamin K and several B vitamins. In addition, bacteria aid in transforming and compacting the undigested materials into the final waste product, feces.

Microorganisms can also cause disease. For example, one species of *Staphylococcus* can secrete a poison into food. This poison causes nausea, diarrhea, and vomiting in people who eat the *Staphylococcus*-contaminated food. Many bacteria obtain nutrients by secreting enzymes that break down organic structures in their environment and then absorbing them. If that environment is your throat or lungs, this can cause serious problems. For example, tuberculosis, a disease of the lungs, is caused by *Mycobacterium tuberculosis*. Tuberculosis was once a common cause of death. Other diseases caused by bacteria include anthrax, bubonic plague, cholera, dental cavities, Lyme disease, and typhus.

Malaria is caused by several species of protists of the genus *Plasmodium* and is spread by the bite of certain mosquitoes. *Plasmodium* has a complex life cycle that involves a mosquito, human blood, and liver cells. Malaria is one of the most deadly diseases occurring in humans. Other diseases caused by protists include African sleeping sickness, amoebic dysentery, giardiasis, and toxoplasmosis.

Some fungi cause human disease. *Candida albicans* is a yeast that causes thrush, a disease in which milk-white lesions form on the mouth, lips, and throat. Other fungi can cause skin diseases, such as athlete's foot and ringworm.

Name_____ Date_____

TEKS 5.B.11.D Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.11) **Science concepts.** The student knows that biological systems work to achieve and maintain balance. The student is expected to (D) describe how events and processes that occur during ecological succession can change populations and species diversity.

STANDARD REVIEW

An ecosystem, or ecological system, consists of a community and all the physical aspects of its habitat, such as the soil, water, and weather. Earth's ecosystems may seem stable, but they are not static. They change seasonally, they can change suddenly, and they can even change over time. Climate change is one way that ecosystems can change. They can also change through a regular, progressive process called succession.

When a volcano forms a new island, a glacier recedes and exposes bare rock, or a fire burns all of the vegetation in an area, a new habitat is created. This change sets off a process of colonization and ecosystem development. The first organisms to live in a new habitat where soil is present tend to be small, fast-growing plants, called pioneer species. They may make the ground more hospitable for other species. Later waves of plant immigrants may then outcompete and replace the pioneer species.

Succession is the somewhat regular progression of species replacement. Succession that occurs where life has not existed before is called primary succession. Succession that occurs in areas where there has been previous growth, such as in abandoned fields or forest clearings, is called secondary succession. It was once thought that the stages of succession were predictable and that succession always led to the same final community of organisms within any particular ecosystem. Ecologists now recognize that initial conditions and chance play roles in the process of succession. For example, if two species are in competition, a sudden change in the climate may favor the success of one species over the other. For this reason, no two successions are alike.

Name_____ Date_____

TEKS 5.B.12.A Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (A) interpret relationships, including predation, parasitism, commensalism, mutualism, and competition among organisms;

STANDARD REVIEW

Ecologists have described four main ways that species and individuals affect each other: competition, predation, symbiotic relationships, and coevolution.

When two or more individuals or populations try to use the same resource, such as food, water, shelter, space, or sunlight, the result is called competition. Because resources are in limited supply in the environment, their use by one individual or population decreases the amount available to other organisms.

Many interactions between species consist of one organism eating another. The organism that is eaten is called the prey. The organism that eats the prey is called the predator.

Symbiosis is a close, long-term association between two or more species. Symbiotic relationships are classified into three groups: mutualism, commensalism, and parasitism. Mutualism is a relationship between two species in which both species benefit. A symbiotic relationship in which one organism benefits and the other is unaffected is called commensalism. A symbiotic association in which one organism benefits while the other is harmed is called parasitism. The organism that benefits is called the parasite. The organism that is harmed is called the host.

Relationships between organisms change over time. Interactions can also change the organisms themselves. When a long-term change takes place in two species because of their close interactions with one another, the change is called coevolution.

Name_____ Date_____

TEKS 5.B.12.B Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (B) compare variations and adaptations of organisms in different ecosystems;

STANDARD REVIEW

A characteristic that helps an organism survive and reproduce in its environment is called an adaptation. Adaptations may be physical, such as having a long neck or striped fur. They may be biochemical factors, such as having proteins that can withstand very high temperatures. Adaptations may also be behaviors that help an organism find food, protect itself, or reproduce.

Natural selection is the process by which organisms that are better adapted to their environment survive and reproduce more successfully than less well-adapted organisms. Populations of species can have a variety of different traits. Environmental factors determine which traits in a population are favorable. For example, the polar bear's white fur enables it to hunt successfully in its snowy environment. In a warmer environment, having white fur would no longer be an advantage.

Name_____ Date_____

TEKS 5.B.12.C Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (C) analyze the flow of matter and energy through trophic levels using various models, including food chains, food webs, and ecological pyramids;

STANDARD REVIEW

Everything that organisms do in ecosystems—running, breathing, burrowing, growing—requires energy. The flow of energy is the most important factor that controls what kinds of organisms live in an ecosystem and how many organisms the ecosystem can support.

Ecologists study how energy moves through an ecosystem by assigning organisms in that ecosystem to a specific level, called a trophic level, in a graphic organizer based on the organism's source of energy. Energy moves from one trophic level to another. The path of energy through the trophic levels of an ecosystem is called a food chain. However, in most ecosystems, energy does not follow simple straight paths because individual animals often feed at several trophic levels. This creates a complicated, interconnected group of food chains called a food web.

The lowest trophic level of any ecosystem is occupied by the producers, such as plants, algae, and bacteria. Producers use the energy of the sun to build energy-rich carbohydrates. Many producers also absorb nitrogen gas and other key substances from the environment and incorporate them into their biological molecules.

At the second trophic level are herbivores, animals that eat plants or other primary producers. They are the primary consumers. Cows and horses are herbivores, as are caterpillars and some ducks. At the third trophic level are secondary consumers, animals that eat other animals. These animals are called carnivores. Tigers, wolves, and snakes are carnivores. Some animals, such as bears, are both herbivores and carnivores; they are called omnivores. Many ecosystems contain a fourth trophic level composed of those carnivores that consume other carnivores. They are called tertiary consumers, or top carnivores.

In every ecosystem there is a special class of consumers called detrivores, which include worms and fungal and bacterial decomposers. Detrivores are organisms that obtain their energy from the organic wastes and dead bodies that are produced at all trophic levels.

The energy at each level of the food chain can also be seen in an energy pyramid. An energy pyramid is a diagram that shows an ecosystem's loss of energy. The energy pyramid has a large base and a small top. Less energy is available at higher levels because only energy stored in the tissues of an organism can be transferred to the next level.

Name_____ Date_____

TEKS 5.B.12.D Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (D) recognize that long-term survival of species is dependent on changing resource bases that are limited;

STANDARD REVIEW

The global rate of population growth has been declining. The United Nations projects that the world's population will stabilize at 9.7 billion by the year 2050. However, population growth rates are uneven across Earth. Population growth tends to be the highest in countries that can least afford it. Already limited resources are strained further, and natural resources—groundwater, land for farming, forests—are ever more quickly depleted or polluted.

No one knows whether Earth can support six billion people indefinitely, much less the far larger population that lies in our future. Building a sustainable world is the most important task facing humanity's future. The quality of life available to your children in this new century will depend to a large extent on our success.

One industry where sustainable practices can help support human activity without depleting natural resources is agriculture. Sustainable agriculture refers to farming that remains productive and profitable through practices that help replenish the soil's nutrients, reduce erosion, and control weeds and insect pests.

In an ecosystem, decomposers return mineral nutrients to the soil. However, when the plants are harvested and shipped away, there is a net loss of nutrients from the soil where the plants were growing. The amount of organic matter in the soil also decreases, making the soil less able to hold water and more likely to erode.

One way to protect soil is through the planting of cover crops. After harvest, farmers can plant cover crops such as rye, clover, or vetch, instead of letting the ground lie bare. Cover crops keep the soil from compacting and washing away, and they help the soil absorb water. They also provide a habitat for beneficial insects, slow the growth of weeds, and keep the ground from overheating. When cover crops are plowed under, they return nutrients to the soil.

Rotational grazing can also protect land resources. Farmers who raise cattle and sheep can divide their pastures into several grazing areas. By rotating their livestock from one area to another, they can prevent the animals from overgrazing the pasture. This allows the plants on which the animals feed to live longer and be more productive. Water quality improves as the pasture vegetation becomes denser. Animals distribute manure more evenly with rotational grazing than they do in feed lots or unmanaged pastures.

Name_____ Date_____

TEKS 5.B.12.E Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

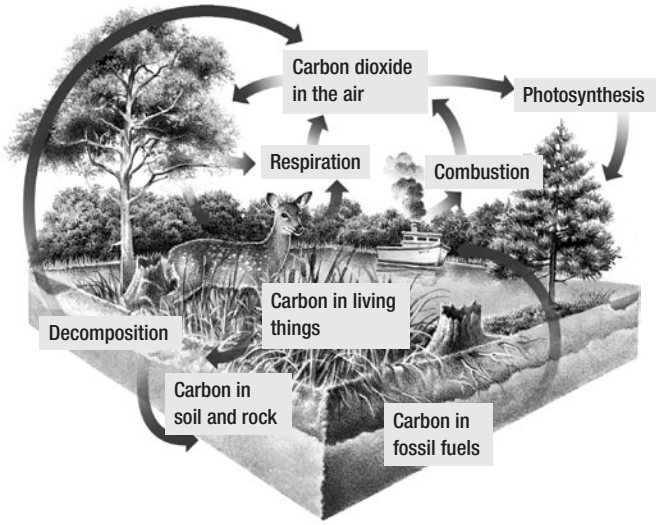
(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (E) describe the flow of matter through the carbon and nitrogen cycles and explain the consequences of disrupting these cycles;

STANDARD REVIEW

Carbon is an essential substance in the fuels used for life processes. Carbon moves through the environment in a process called the carbon cycle. Part of the carbon cycle is a short-term cycle. In this short-term cycle, plants convert carbon dioxide from the atmosphere into sugars and starches. Plants use these substances for energy, releasing carbon dioxide into the air. Other organisms eat the plants to get the carbon. Like plants, the organisms break down sugars for energy, releasing some of the carbon back into the air. The decay of dead organisms and wastes also releases carbon into the air.

Part of the carbon cycle is a long-term cycle in which carbon moves through the Earth system over a very long period. Carbon is stored in the geosphere in buried plant or animal remains. Fossil fuels, which contain carbon, formed from plant and animal remains that were buried millions of years ago. Carbon is also stored in a type of rock called a carbonate. Carbonate forms from shells and bones of once-living organisms.

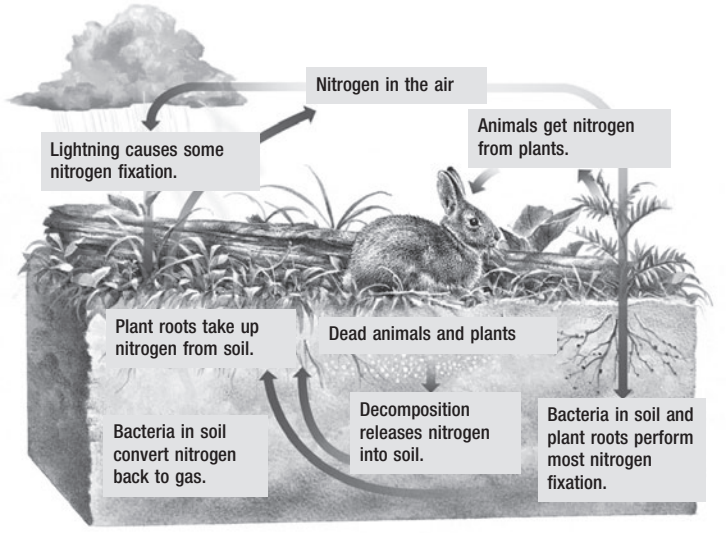
CARBON CYCLE



Name_____ Date_____

TEKS 5.B.12.E Biology

The movement of nitrogen between the environment and living things is called the nitrogen cycle. About 78% of Earth's atmosphere is nitrogen gas. Most organisms cannot use nitrogen gas directly. However, bacteria in the soil are able to change nitrogen gas into forms that plants can use. This process is called nitrogen fixation. Other organisms may then get the nitrogen they need by eating plants or eating organisms that eat plants. When organisms die, decomposers break down the remains. Decomposition releases a form of nitrogen into the soil that plants can use. Finally, certain types of bacteria in the soil convert nitrogen to a gas, which is returned to the atmosphere.



Name_____ Date_____

TEKS 5.B.12.F Biology

INTERDEPENDENCE WITHIN ENVIRONMENTAL SYSTEMS

The student will demonstrate an understanding of the interdependence and interactions that occur within an environmental system and their significance.

(B.12) **Science concepts.** The student knows that interdependence and interactions occur within an environmental system. The student is expected to (F) describe how environmental change can impact ecosystem stability.

STANDARD REVIEW

There are many problems that can affect the survival of individuals and entire species in an ecosystem. The following factors can negatively affect the environment.

- **Pollution** Pollution is an unwanted change in the environment caused by substances such as wastes or by forms of energy such as radiation. Anything that causes pollution is called a pollutant. Many pollutants are human-made, such as garbage or chemical wastes in water, soil, or the atmosphere.
- **Resource Depletion** A renewable resource is one that can be replaced at the same rate that the resource is used. Solar and wind energy are renewable resources, as are some kinds of trees. A nonrenewable resource is one that cannot be replaced or that can be replaced only over thousands or millions of years. Most minerals and fossil fuels, such as oil and coal, are nonrenewable resources.
- **Exotic Species** Often without knowing it, people carry other species with them when they travel. An organism that makes a home for itself in a new place outside its native home is called an exotic species. Exotic species often thrive in new places where they have fewer predators. Exotic species can become pests and compete with native species.
- **Human Population Growth** Advances in medicine, such as immunizations, and advances in farming have made human population growth possible. Some people argue that there may eventually be too many people on Earth. Overpopulation occurs when the number of individuals becomes so large that the resources needed for survival are not available to everyone.
- **Habitat Destruction** When land is cleared so it can be used for construction, crops, mines, or lumber, the topsoil may erode. Chemicals may pollute nearby streams and rivers. The organisms that were living in these areas may be left without food and shelter and may die. An organism's habitat is where it lives. Every habitat has its own number and variety of organisms, or biodiversity. If a habitat is damaged, biodiversity is lost.