

Structures, Processes, and Responses in Animals

6-3 The student will demonstrate an understanding of structures, processes, and responses in animals that allow them to survive and reproduce. (Life Science)

6-3.1 Compare the characteristic structures of invertebrate animals (including sponges, segmented worms, echinoderms, mollusks, and arthropods) and vertebrate animals (fish, amphibians, reptiles, birds, and mammals).

Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have previously studied animals in 2nd grade, 3rd grade, and 4th grade. In 4th grade (4-2.1), students studied specific vertebrate animal groups and their characteristics but not specific invertebrate animal groups. Students will focus on the study of the human body in 7th grade.

It is essential for students to know that the Animal Kingdom is divided into 35 different phyla.

- These phyla can be classified into two groups (vertebrates or invertebrates) based on external and internal physical characteristics.
- However, all animals share several common characteristics:
 - Their bodies are multi-cellular.
 - They are heterotrophs (cannot make their own food) and must get their energy by eating plants or other animals.
 - Their major functions are to obtain food and oxygen for energy, keep their internal conditions in balance, move, and reproduce.

Vertebrates comprise only one phylum of animals. They include fish, amphibians, reptiles, birds, and mammals. Vertebrates share certain physical characteristics:

- They have backbones, an internal skeleton (*endoskeleton*), and muscles.
- They have blood that circulates through blood vessels and lungs (or gills) for breathing.
- They have a protective skin covering.
- Most have legs, wings, or fins for movement.
- They have a nervous system with a brain that processes information from their environment through sensory organs.

Vertebrates differ in the way that they control their body temperature.

- In some (fishes, amphibians, and reptiles), their body temperature is close to that of their environment. They are considered *cold-blooded*, or *ectothermic*.
- In others (birds and mammals), their body temperature stays constant regardless of the temperature of the environment. They are called *warm-blooded*, or *endothermic*.

Examples of vertebrates include:

Fish

- Are cold-blooded (ectothermic); obtain dissolved oxygen in water through gills; most lay eggs; have scales; have fins; and live in water.

Amphibians

- Are cold-blooded (ectothermic); most can breathe in water with gills as young, and breathe on land with lungs as adults; go through metamorphosis; lay jelly-like eggs.
- The major groups of amphibians are frogs, toads, and salamanders.

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- Frogs and salamanders have smooth, moist skin, through which they can breathe and live part of their life in water and part on land.
- Toads have thicker, bumpy skin and live on land.

Reptiles

- Are cold-blooded (ectothermic); breathe with lungs; most lay eggs, although in some the eggs hatch inside the female; and have scales or plates.

Birds

- Are warm-blooded (endothermic); breathe with lungs; lay eggs; have feathers; and have a beak, two wings, and two feet.

Mammals

- Are warm-blooded (endothermic); breathe with lungs; most have babies that are born live; have fur or hair; and produce milk to feed their young.

Invertebrates comprise the remaining phyla of the Animal Kingdom. They include sponges, segmented worms, echinoderms, mollusks, and arthropods. Invertebrates share certain characteristics:

- They do not have backbones or internal skeletons.
- Some have external skeletons, called *exoskeletons*.

Examples of invertebrates include:

Sponges

- Very simple animals that have many *pores* (holes) through which water flows.
- Water moves into a central cavity and out through a hole in the top.
- Sponges obtain their food and eliminate wastes through this passage of water.
- They have specialized cells for obtaining food and oxygen from the water.

Segmented worms

- Have long tube-like bodies that are divided into segments.
- They are the simplest organisms with a true nervous system and blood contained in vessels.
- A long digestive tube runs down the length of the worm's inner body.
- Worms take in dissolved oxygen from the water through their skin.
- Examples of segmented worms may be earthworms and leeches.

Echinoderms

- Have *arms* that extend from the middle body outwards.
- They have tube feet that take in oxygen from the water and spines.
- Examples may be sea stars, brittle stars, sea cucumbers, or sea urchins.

Mollusks

- Have soft bodies; most have a thick muscular foot for movement or to open and close their shells.

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- They have more developed body systems than sponges or worms.
- They take in oxygen through gills or lungs, and some have shells.
- Examples may be slugs, snails, clams, and octopuses.

Arthropods

- Have jointed legs, segmented bodies, and some have wings.
- They have hard outer coverings called *exoskeletons*.
- They obtain oxygen from the air through gills or air tubes.
- Examples may be insects, arachnids, and crustaceans.

It is not necessary for students to know the classification systems for the vertebrates and invertebrates, life cycles of the various animal groups, other types of worms, other groups of invertebrates, or the major organs, systems or complete anatomy of each group of animals.

Assessment Guideline:

The objective of this indicator is to *compare* the characteristic structures of vertebrates and invertebrates; therefore, the primary focus of assessment should be to detect ways that these organisms are alike and different. However, appropriate assessments should also require students to *identify* specific invertebrate and vertebrate groups based on a description of characteristics; *illustrate* the different kinds of vertebrates and invertebrates by their distinctive differences; or *classify* an animal into a particular group based on its characteristics.

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6-3.2 Summarize the basic functions of the structures of animals that allow them to defend themselves, to move, and to obtain resources.

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-2.2), students explained how physical adaptations (including defense, locomotion and movement, and food obtainment) of animals allowed them to survive in their environments.

It is essential for students to know that animals have special structures that enable them to survive in their environment. These structures allow them to defend themselves, to move, and to obtain resources.

Structures for defense

- Allow an animal to hide from a predator or warn a predator (for example skin color (camouflage) or patterns (mimicry))
- Allow an animal to make a direct attack painful (for example horns, claws, quills, stingers, or venom)
- Allow an animal to change its size prevent a direct attack (for example shells, emitting smells or body fluids (ink), or mechanisms)
- Allow an animal to flee or hide from predators (for example body design), sensory organs, legs (for example for speed or for jumping), wings, or light-weight skeletons (for example flight)
- Allow an animal to construct holes or tunnels to run into and hide or to climb (for example paws or toenails)

Structures for movement

- Allow animals to move to fulfill their needs such as finding food and escaping predators (for example legs, feet and arms, tails, fins, wings, body design, skeleton)

Structures to obtain resources

- Allow an animal to chew, tear, and eat its food or drink (for example mouth parts including beaks, teeth, flexible jaws, tongues, tube-shaped)
- Allow an animal to grab and hold its food (for example tentacles, pincers, claws, fangs)
- Allow an animal to consume food found in the water (for example filtering structures for filter feeders in sponges or clams)

It is not essential for students to know the complete anatomy or any specialized structures for the various groups of animals.

Assessment Guidelines:

The objective of this indicator is to *summarize* basic functions of structures for defense, movement, and resource obtainment; therefore, the primary focus of assessment should be to generalize major points about the parts of an organism that allow for these functions. However, appropriate assessments should also require students to *identify* individual structures and their primary functions; *exemplify* or *illustrate* structures using words, pictures, or diagrams; or *classify* structures by their function.

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6-3.3 Compare the response that a warm-blooded (endothermic) animal makes to a fluctuation in environmental temperature with the response that a cold-blooded (ectothermic) animal makes to such a fluctuation.

Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-2.2), students explained how hibernation allowed animals to survive. This is the first grade students have been introduced to the concepts of endothermic and ectothermic (6-3.1).

It is essential for students to know the characteristics of endothermic and ectothermic animals and how these animals respond to changes in their environmental temperatures. Animals that are vertebrates differ in their abilities to regulate body temperature.

Warm-blooded (endothermic)

- Animals, including birds and mammals, which maintain a nearly constant internal temperature and do not change with the temperature of the environment.
- When the outside temperature is too hot, an endothermic animal can cool off by sweating, panting, changing position, or changing location. Sweating and panting generate heat loss through evaporating water. Changing position and location allow the animal to find a cooler environment in the shade or shelter.
- Endothermic animals must eat much more often than ectothermic animals since it takes energy to maintain a constant body temperature. For example, a lion must eat its weight in food every seven to ten days.

Cold-blooded (ectothermic)

- Animals, including fish, amphibians, and reptiles, which have an internal body temperature that changes with the temperature of the environment.
- They must gain heat to perform internal activities (for example digestion).
- If the environment is cold, ectothermic animals become slow moving and sluggish. Some animals must bask in the Sun (for example snakes or lizards) or move to a warmer area (for example some fish) before they can move about to hunt for food.
- If the temperature gets too hot, ectothermic animals will need to find a cooler temperature or burrow in the ground to keep its body cool.
- If an animal is cold blooded, they take on the temperature of their surroundings so they don't have to use food energy to keep warm. This means they don't have to eat as often.

It is not essential for students to understand the chemical processes involved with warm-blooded and cold-blooded animals.

Assessment Guidelines:

The objective of this indicator is to *compare* responses of cold-blooded (ectothermic) and warm-blooded (endothermic) organisms to their environment; therefore, the primary focus of assessment should be to detect similarities and differences in ectothermic to endothermic organisms. However, appropriate assessments should also require students to *identify* organisms that are cold-blooded and those that are warm-blooded; *exemplify* responses that would occur due to changes in the environment; or *classify* organisms as endothermic or ectothermic.

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6-3.4 Explain how environmental stimuli cause physical responses in animals (including shedding, blinking, shivering, sweating, panting, and food gathering).

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-2.4), students explained how changes in habitats affect the survival of plants and animals. In 4th grade (4-2.5), students explained how an organism's behavior is related to its environment.

It is essential for students to know that animals have physical responses that are caused by environmental stimuli. Examples of animal responses to temperature changes that help maintain internal temperature include:

Shedding

- To maintain internal temperatures, animals may form thick coats of fur or feathers to insulate their body from cold weather; in hot weather animals will shed this extra covering, providing a cooling effect.

Sweating

- Sweating is an organism's major way of getting rid of excess body heat.
- When sweat evaporates from the surface of the skin, it cools the animal.

Panting

- Panting is another way of getting rid of excess body heat.
- When an animal pants (breathes heavily), increased air flow causes an increase in evaporation from the animal's mouth and lungs, cooling the animal.

Shivering

- Shivering is a mammal's mechanism to increase heat production.
- Shivering is an involuntary response to a drop in the temperature outside or within the body.
- It is a method that the body uses to increase the rate at which energy is transformed into heat.

Examples of common responses to changes in environmental stimuli include:

Blinking

- Blinking is an automatic response that helps to protect the eye.
- Some animals need to blink to keep their eyes covered with a tear film.
- This tear film serves to protect the eye from drying out and from potential infection.
- The blink response also serves to protect the eye from being injured if a foreign object comes near the eye.

Food gathering

- The process of finding food by hunting or fishing or the gathering of seeds, berries, or roots, may be seasonal.
 - *Storing food:* Many animals will begin to gather and store food for the winter. Examples of such animals may be squirrels, mice, or beavers.

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- *Storing nutrition in the form of fat:* Many animals will overeat and reduce their physical activity to conserve energy in response to environmental stimuli such as cold weather or drought. Examples of such animals may be bears, penguins, walruses, chipmunks, or ants.

It is not essential for students to know the chemical mechanisms for the responses studied here.

Assessment Guidelines:

The objective of this indicator is to *explain* how environmental stimuli cause physical responses in animals; therefore, the primary focus of assessment should be to construct a cause-and-effect model of the various physical responses that animals have due to environmental stimuli.

However, appropriate assessments should also require students to *recall* physical responses of various animals; *summarize* responses that occur due to environmental stimuli; or *exemplify* ways that the environment affects animals.

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6-3.5 Illustrate animal behavioral responses (including hibernation, migration, defense, and courtship) to environmental stimuli.

Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have previously studied hibernation and animal defense in 3rd grade (3-2.2). In 4th grade (4-2.5) students explained how an organism's behavior is related to its environment.

It is essential for students to know that a complex set of responses to stimuli is called *behavior*. *Behavioral responses* refer to how animals cope with changes in their environments. Animals may respond to environmental stimuli through behaviors that include hibernation, migration, defense, and courtship.

Hibernation

- As a result of cold, winter weather (stimulus) some animals will hibernate.
- *Hibernation* is a state of greatly reduced body activity, used to conserve food stored in the body.
- Some animals hibernate for part or all of the winter.
- The animal's body temperature drops, its heartbeat and breathing slow down, and it uses very little energy.
- Examples of hibernating animals may be ants, snakes, black bears, beavers, and ground squirrels.

Migration

- *Migration* is the movement of animals from one place to another in response to seasonal changes. They travel to other places where food is available.
- Migrating animals usually use the same routes year after year.
- The cycle is controlled by changes in the amount of daylight and the weather.
- Examples of animals that migrate are monarch butterflies, orcas, caribou, and ducks.

Defense

- Defense mechanisms vary with different types of animals. Some examples are:
 - *Camouflage*: Some animals have protective coloration to survive changes in its environment. Some animals develop their camouflage in response to the weather; for example the arctic fox and snowshoe hare. They develop a white coat for the winter to blend in with the snow and a gray coat in the summer to blend in with the forest. Chameleons and other lizards change colors to blend into the environment to avoid predators.
 - *Smells*: Skunks use an offensive odor in response to fear. The skunk turns the predator's sense of smell against it by issuing a stream of oily, foul smelling musk.
 - *Stingers*: Wasps and bees use a stinger for protection when frightened or threatened.
 - *Ejection*: The black ink cloud of an octopus is a defense mechanism because it gives the animal a chance to escape from a predator. When the horned lizard gets really scared, it shoots blood out of its eyes allowing it time to escape.

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- *Mimicry*: When a weaker animal copies stronger animals' characteristics to warn off predators. Some animals may look like another more poisonous or dangerous animal that give it protection, such as a “false” coral snake or hawk moth caterpillar that looks like a snake. Certain moths have markings that look like eyes and some flower flies resemble black and yellow wasps that have a powerful sting and use this disguise to ward off predators.
- *Grouping*: This social behavior occurs when certain animals travel together in groups to protect individuals within the group or to fool a predator into thinking the group is one large organism. Examples may include herds (buffalo, zebra, cattle), packs (wolves), or schools of fish.

Courtship

- Courtship in animals is usually a behavioral process whereby adults of a species try to attract a potential mate.
- Courtship behaviors ensure that males and females of the same species recognize each other.
- Environmental stimuli, such as seasonal changes, will stimulate courtship.
- Often sensory cues (for example, chemical odor cues, sounds, or color) will serve as courtship attractants in animals.

It is not essential for students to know the chemical mechanisms for the behaviors studied here, technologies for tracking the migration of animals, or other types of animal behaviors

Assessment Guidelines:

The objective of this indicator is to *illustrate* animal behavioral responses to environmental stimuli; therefore, the primary focus of assessment should be to give examples of animal behavioral responses (including hibernation, migration, defense, and courtship) using pictures, diagrams, or words. However, appropriate assessments should also require students to *recall* information about behavioral responses; *explain* how environmental stimuli result in animal behaviors; or *summarize* animal behaviors that result from environmental stimuli.

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6-3.6 Summarize how the internal stimuli (including hunger, thirst, and sleep) of animals ensure their survival.

Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-2.2), students explained how physical and behavioral adaptations (including hibernation and food obtainment) allowed the organism to survive. In 4th grade (4-2.5), students explained how an organism's behavior is related to its environment (including the availability of food). They also studied how animals use their senses to detect signals in the environment and how their behaviors are influenced by these signals (4-2.3).

It is essential for students to know that animals have *internal stimuli*, or cues, including hunger, thirst, and sleep, that ensure their survival.

Hunger

- The importance of hunger is that it cues animals to eat.
- Animals need food for energy and, therefore, for survival.

Thirst

- The importance of thirst is that it cues animals to take in water.
- Animals need water since their bodies are mostly made of water.

Sleep

- The importance of sleepiness is that it cues the animal to sleep.
- Sleep is required to restore the body's ability to function.

It is not essential for students to know the internal chemical mechanisms for the stimuli studied here.

Assessment Guidelines:

The objective of this indicator is to *summarize* how the internal stimuli of animals ensure their survival; therefore, the primary focus of assessment should be to generalize the main points about internal stimuli (including hunger, thirst, and sleep) and their affects on animal behavior. However, appropriate assessments should also require students to *identify* internal stimuli (cues); *exemplify* responses to internal stimuli; or *compare* animals' survival responses to internal stimuli.

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6-3.7 Compare learned to inherited behaviors in animals.

Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: In 4th grade (4-2.4), students distinguished between the characteristics of an organism that are inherited and those that are acquired over time. In 7th grade (7-2.7), students will distinguish between inherited traits and those that are acquired from environmental factors.

It is essential for students to know that a behavior is an activity or action, in response to changes in the environment, which helps an organism survive.

Some animal behaviors result from direct observations or experiences and are called *learned behaviors*.

- *Imprinting* is a behavior in which newborn animals recognize and follow the first moving object they see. Usually, this moving object is the mother. The imprinting behavior cannot be reversed.
- *Conditioning* (which includes trial-and-error learning) is a behavior in which an animal learns that a particular stimulus and its response to that stimulus will lead to a good or bad result. For example, chimpanzees learn to use small sticks to dig in the soil for insects, or a child learns that touching a hot object will cause pain.

Some animal behaviors are passed from the parent to the offspring and are with the animal from birth. These are called *inherited behaviors*, or instincts. Some examples of instincts are:

- The ability to swim, for example in whales or fish, is an inherited behavior. Whales and fish do not need to be taught how to swim.
- Crying in babies is an inherited behavior that is often a response to hunger, thirst, or sleepiness.
- When a snail digs a hole to lay its eggs, a bird builds a special kind of nest, or when a fiddler crab waves its claw to attract a female, the animals are acting on instinct.

It is not essential for students to know how inherited traits are passed from parents to offspring through genetics.

Assessment Guidelines:

The objective of this indicator is to *compare* learned to inherited behaviors in animals; therefore, the primary focus of assessment should be to detect similarities and differences between behaviors that animals learn and those they are born knowing how to do. However, appropriate assessments should also require students to *identify* a particular behavior as learned or inherited; *summarize* behaviors that are learned and behaviors that are inherited; *exemplify* behaviors that would occur due to learning or inheritance; or *classify* behaviors as learned or inherited.