

Grade 5 Science, Quarter 3, Unit 3.1  
**Processes That Shape Earth—Weather**

**Overview**

**Number of instructional days:** 15 (1 day = 45 minutes)

**Content to be learned**

- Diagram and label the processes of the water cycle, including evaporation, precipitation, runoff, condensation, transpiration, and groundwater.
- Explain the processes of the water cycle.
- Identify the composition and layers of Earth’s atmosphere.
- Explain how differential heating and convection affect Earth’s weather patterns.
- Predict temperature and precipitation changes related to the passing of various weather fronts.

**Science processes to be integrated**

- Diagram and label the structures and processes within a system.
- Explain the interaction between structures and processes that cause change within a system.
- Describe how a change in a system affects all parts of the system.
- Describe and predict changes caused by heating.
- Use models and collect data to make predictions and explain changes that occur over time.

**Essential questions**

- How does water change and move through the water cycle?
- What are some basic characteristics of each layer of Earth’s atmosphere? (See Current Learning section for clarification.)
- How do heating and cooling affect Earth’s weather patterns?
- How do weather fronts affect temperature and precipitation?

## Written Curriculum

### Grade-Span Expectations

**ESS1 - The earth and earth materials as we know them today have developed over long periods of time, through continual change processes.**

***ESS1 (5-8) SAE–2***

*Explain the processes that cause the cycling of water into and out of the atmosphere and their connections to our planet’s weather patterns.*

**ESS1 (5-6)–2 Students demonstrate an understanding of processes and change over time within earth systems by ...**

**2a** diagramming, labeling and explaining the processes of the water cycle including evaporation, precipitation, and run-off, condensation, transpiration, and groundwater.

**2d** identifying composition and layers of earth’s atmosphere.

***ESS1 (5-8) SAE+ POC –4***

*Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate.*

**ESS1 (5-6)–4 Students demonstrate an understanding of processes and change over time within earth systems by ...**

**4a** explaining how differential heating and convection affect Earth’s weather patterns.

**4e** predicting temperature and precipitation changes associated with the passing of various fronts.

### Clarifying the Standards

*Prior Learning*

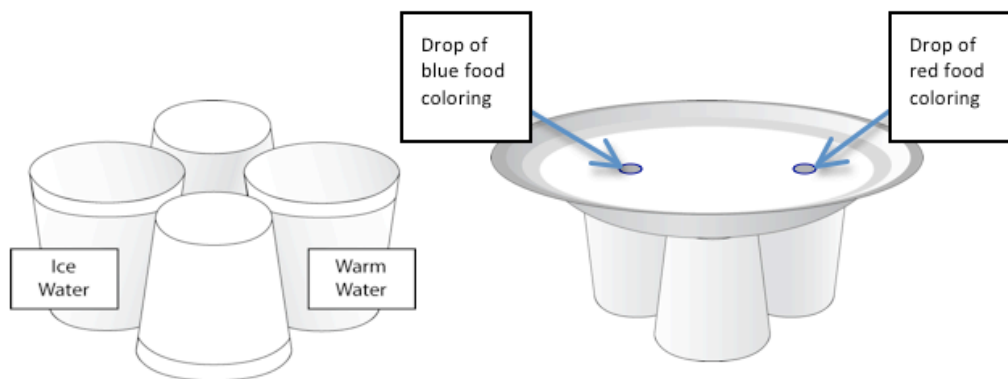
In grades K–2, students used scientific tools to extend senses and gather data about weather (e.g., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/rulers: snow depth; rain gauges: rain amount in inches). Students recorded and summarized local weather data, and they observed and recorded seasonal and weather changes throughout the school year. Students also observed how clouds are related to forms of precipitation (e.g., rain, sleet, snow).

In grades 3 and 4, students explained how the use of scientific tools helps extend senses and gather data about weather, (i.e., weather/wind vane: direction; wind sock: wind intensity; anemometer: speed; thermometer: temperature; meter sticks/ruler: snow depth; rain gauges: rain amount in inches). Students selected appropriate tools for a given task and described the information they will provide. They observed, recorded, compared, and analyzed weather data to describe weather changes or patterns. Students described water as it changes into vapor in the air and reappears as a liquid when it is cooled, and they explained how this cycle of water relates to weather and the formation of clouds.

### Current Learning

In grade 5, students continue to build on prior knowledge of the water cycle—how water changes to vapor and reappears as a liquid when cooled. Students at this level are expected to use appropriate terminology as they diagram, label, and explain the processes of the water cycle, including *evaporation*, *precipitation*, *runoff*, *condensation*, *transpiration*, and *groundwater*. As students create diagrams with labels to show each part of the water cycle, they should begin to develop an understanding of the atmosphere. They should identify the layers of the atmosphere and begin to understand that each layer has some important characteristics. Using diagrams or models of the atmosphere, students learn that the atmosphere has five layers. The atmosphere is made of gases, with the most abundant gas being oxygen. The air is thickest (most dense) closest to Earth, and the air gets thinner (less dense) with each successive layer. The average temperature decreases as you go higher in the atmosphere, and the weather that you experience occurs in the troposphere. Commercial airplanes and jets avoid the weather by flying above it in the stratosphere, and the ozone layer is contained within the stratosphere.

Students have previously learned that the sun’s energy warms the land and water found on Earth. Fifth graders use this prior learning to begin to understand how differential heating of land and water causes convection currents that affect Earth’s weather patterns. However, the concepts of differential heating and convection are abstract and difficult for students to comprehend. Thus, these concepts are taught at the developmental level. Students are introduced to the idea that land heats and cools faster than water, which causes differences in the temperature of the air above land and water. These differences in air temperature cause air masses to move. These moving masses of air create changes in the weather. In the classroom, students can explore these concepts through a series of activities. They can use thermometers to observe the relative speed in which soil heats and cools as compared to water. To develop an understanding of convection (i.e., the movement that results through heating and cooling), students could observe/conduct an investigation by dropping food coloring into a pan of water that is heated on one end and cooled on the other using a cup of warm water and a cup of ice water (see diagrams). (Since both water and air are fluids, they behave in similar ways. Water can be used to model the convection currents that occur when air is heated.)



<sup>1</sup> Image from *Elementary Core Science Units: TEKS based activities in core science*. Charles A. Dana Center at the University of Texas at Austin. 2009.

In prior grades, students gathered and recorded weather data and used this information to describe weather changes or patterns. After learning about differential heating and convection, fifth graders are ready to learn how the movement of air affects the weather. According to the standards, students predict changes in temperature and precipitation with the passing of a front. To address this concept in the classroom, students could study weather data gathered from various sources, including a school weather station. Using these data as well as local weather maps, they should notice that when a front passes, it brings a change in weather. By studying these phenomena, students develop the ability to use the observable patterns in weather to make predictions.

### *Future Learning*

In grade 6, students will explain how condensation of water vapor forms clouds that affect climate and weather. Students will develop models to explain how humidity, temperature, and altitude affect air pressure and how this affects local weather, and they will describe events and the effect these events may have on climate (e.g., El Niño, deforestation, glacial melting, an increase in greenhouse gases). Students will describe how differential heating of the oceans affects ocean currents, which in turn influence weather and climate, and they will explain the relationship between differential heating/convection and the production of winds. Students will analyze global patterns of atmospheric movements to explain effects on weather.

In grades 7 and 8, students will explain cause-and-effect relationships between global climate and energy transfer, and they will use evidence to make inferences or predictions about global climate issues.

### **Additional Findings**

A major goal of science in the middle grades is for students to develop an understanding of the four major interacting components of the earth system—geosphere (crust, mantle, core), hydrosphere (water), atmosphere (air), and biosphere (the realm of all living things). Some fundamental concepts include that water, which covers the majority of Earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the *water cycle*. Water evaporates from Earth’s surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, and soil and in rocks underground. The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor, and it has different properties at different elevations. Clouds formed by the condensation of water vapor affect weather and climate. Global patterns of atmospheric movement influence local weather. Oceans have a major effect on weather and climate because water in the oceans holds a large amount of heat. In addition, the sun is the major source of energy for phenomena on Earth’s surface (e.g., winds, ocean currents, the water cycle). (*National Science Education Standards*, pp. 158–161)

According to *Benchmarks for Science Literacy*, water offers another important set of experiences for students at this level. They can conduct investigations that go beyond the observations made in the earlier grades to learn the connection between liquid and solid forms, but recognizing that water can also be a gas, while much more difficult, is still probably accessible. Perhaps the main thrust for students should be to try to figure out where water in an open container goes. This is neither self-evident nor easy to detect. However, the water cycle is of such profound importance to life on Earth that students should certainly have experiences that in time contribute to their understanding of evaporation, condensation, and the conservation of matter. (p. 68)

By the end of the 3–5 grade span, students should know that air is a material that surrounds them and takes up space and whose movement they feel as wind. When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets or frozen crystals of water. The weather is always changing and can be described by measurable quantities such as temperature, wind direction and speed, and precipitation. Large masses of air with certain properties move across the surface of Earth. The movement and interaction of these air masses is used to forecast the weather. (*Atlas for Science Literacy, Vol. 2, p. 21*)

According to the *Atlas of Science Literacy, Vol. 2*, although upper elementary students may identify air as existing even in static situations and recognize that it takes up space, recognizing that air has weight may be challenging even for high school students. Students of all ages, including college students, may believe that air exerts force or pressure only when it is moving and only in a downward direction. Few middle school students use the idea of pressure differences between regions of the atmosphere to account for wind; instead, they may account for winds in terms of visible moving objects or the movement of Earth. (p. 20)

Before students understand that water is converted to an invisible form, they may initially believe when water evaporates that it ceases to exist, that it changes location but remains a liquid, or that it is transformed into some other perceptible form (e.g., fog, steam, droplets). With special instruction, some students in grade 5 may be able to identify the air as the final location of evaporating water. Students must accept air as a permanent substance before they can identify air as the final location of evaporating water. For many students, difficulty understanding the existence of water vapor in the atmosphere persists in middle school years. Students can understand rainfall in terms of gravity once they attribute weight to little drops of water (typically in upper elementary grades), but the mechanism through which condensation occurs may not be understood until high school. (*Atlas of Science Literacy, Vol. 2, p. 20*)



**Grade 5 Science, Quarter 3, Unit 3.2**  
**Characteristics of Living Organisms**

**Overview**

**Number of instructional days:** 10 (1 day = 45 minutes)

**Content to be learned**

- Use data and observations to recognize that all organisms have different features and behaviors for meeting their needs to survive.
- Describe structures and behaviors that work in a coordinated way to help organisms survive in their environment (e.g., defense, obtaining nutrients, reproduction, eliminating wastes).
- Investigate and compare a variety of plant and animal life cycles.
- Identify cells as the building blocks of organisms.

**Science processes to be integrated**

- Use data and observations of organisms to describe relationships among structures, behaviors, and function.
- Investigate and compare changes that occur over time.
- Use science tools to make observations and identify structures.

**Essential questions**

- How do plant and animal life cycles compare?
- How do the structures and behaviors of animals work together to help them survive?
- What structures and processes do all living things have in common? Why?
- How do the structures and behaviors of plants work together to help them survive?

## Written Curriculum

### Grade-Span Expectations

**LS1 - All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).**

***LS1 (5-8) – INQ+ SAE- 1***

*Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem.*

**LS1 (5-6) – 1 Students demonstrate understanding of biodiversity by...**

**1a** recognizing that organisms have different features and behaviors for meeting their needs to survive (e.g., fish have gills for respiration, mammals have lungs, bears hibernate).

***LS1 (5-8) SAE+FAF –2***

*Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).*

**LS1 (5-6) – 2 Students demonstrate understanding of structure and function-survival requirements by...**

**2a** describing structures or behaviors that help organisms survive in their environment (e.g., defense, obtaining nutrients, reproduction, and eliminating waste).

***LS1 (5-8) POC -3***

*Compare and contrast sexual reproduction with asexual reproduction.*

**LS1 (5-6) –3 Students demonstrate an understanding of reproduction by ...**

**3c** investigating and comparing a variety of plant and animal life cycles.

***LS1 (5-8) FAF –4***

*Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.*

**LS1 (5-6) –4 Students demonstrate understanding of differentiation by...**

**4a** identifying cells as the building blocks of organisms.



## Clarifying the Standards

### *Prior Learning*

In grades K–2, students demonstrated an understanding of classification of organisms by distinguishing between living and nonliving things. Students identified and sorted based on similar or different external features, and they observed and recorded the external features that make up living things, (e.g., roots, stems, leaves, flowers, legs, antennae, tail, shell). They demonstrated an understanding of structure and function-survival requirements by observing that plants need water, air, food, and light and that animals need water, air, food, and shelter to grow. Students identified the specific functions of the physical structures of a plant or animal (e.g., roots for water; webbed feet for swimming). Students demonstrated an understanding of reproduction by observing, scientifically drawing (e.g., recording shapes, prominent features, relative proportions; organizing and differentiating significant parts observed), and labeling the stages in the life cycle of a familiar plant and animal, and they sequenced the life cycle of a plant or animal when given a set of pictures.

In grades 3 and 4, students demonstrated an understanding of classification of organisms by citing evidence to distinguish between living and nonliving things. Students identified, sorted, and compared based on similar and/or different external features, and they recorded and analyzed observations/data about external features (e.g., within a grouping, which characteristics are the same and which are different). Students cited evidence (e.g., prior knowledge, data) to draw conclusions explaining why organisms are grouped/not grouped together (e.g., mammal, bird, fish). They demonstrated an understanding of structure and function-survival requirements by observing that plants need water, air, food, light, and space and that animals need water, air, food, and shelter/space to grow and reproduce. Students identified and explained how the physical structure/characteristic of an organism allows it to survive and defend itself, and they analyzed the structures needed for survival of populations of plants and animals in a particular habitat/environment (e.g., populations of desert plants and animals require structures that enable them to obtain/conserves/retain water). An understanding of reproduction was demonstrated by observing changes and recording data to scientifically draw and label the stages in the life cycle of a familiar plant and animal and by sequencing the life cycle of a plant or animal when given a set of data/pictures. Additionally, students compared the life cycles of two plants or two animals when given a set of data/pictures.

### *Current Learning*

At the developmental level of instruction, fifth graders students learn to identify that cells are the building blocks of organisms. In the classroom, students should have opportunities to look at plant and animal cells under microscopes, talking about observable similarities and differences. They can also watch videos and use textbooks, trade books, and online resources to learn about cells. The focus in grade 5 should be that all living organisms are made up of cells, and you can observe the evidence under a microscope. Students at this level do not need to know the structures found within a cell or their functions. Observing and understanding that cells have a cell wall and visible inner parts, that those structures have specific functions, and that cells are found in all living organisms is enough.

Students at this level also recognize that organisms have different features and behaviors that are needed to meet their needs to survive, and they describe structures and behaviors that are used in a coordinated way to ensure survival in a continually changing environment. For example, fish have gills and mammals have lungs. These organs work in coordinated ways with other internal and external structures to ensure that the organisms have the oxygen needed for respiration. In addition, organisms have behaviors that work in conjunction with body structures for meeting organisms' survival needs. For example, bears

hibernate and birds migrate. The animals' body structures work in a coordinated way with these behaviors to help organisms with defense, obtaining nutrients, reproduction, and eliminating waste. These concepts should be taught from the reinforcement level through the drill-and-practice level of instruction. In classrooms, students should observe and research different behaviors and structures of organisms, and they should discuss how organisms use structures and behaviors in a coordinated way to survive within an ecosystem.

Additionally, students investigate and compare a variety of plant and animal life cycles. Since students have studied the life cycles of plants and animals since kindergarten, this concept should be taught at the drill-and-practice level of instruction. In the classroom, students can investigate plant and animal life cycles using text, videos, and hands-on investigations. They can use graphic organizers such as Venn diagrams to document the similarities and differences found in the life cycles of plants and animals.

### *Future Learning*

In grades 6, students will demonstrate an understanding of reproduction by defining reproduction as a process through which organisms produce offspring and describe reproduction in terms of being essential for the continuation of a species. They will demonstrate an understanding of differentiation by recognizing and illustrating the structural organization of an organism from a cell to tissue to organ to organ systems to organisms.

In grades 7 and 8, students will demonstrate an understanding of biodiversity by giving examples of adaptations or behaviors that are specific to a niche or role within an ecosystem and explaining how organisms with different structures and behaviors have roles that contribute to each other's survival and the stability of the ecosystem. They will demonstrate understanding of structure and function-survival requirements by explaining how the cell, as the basic unit of life, has the same survival needs as an organism. Students will observe and describe individual cells as seen through a microscope targeting cell membrane, cell wall, nucleus and chloroplasts, and they will observe, describe, and chart the growth, motion, and response of a living organism. Students will demonstrate an understanding of reproduction by explaining it as a fundamental process by which the new individual receives genetic information from parents. Students will describe forms of asexual reproduction that involve the genetic contribution of only one parent, and they will describe sexual reproduction as a process that combines genetic material of two parents to produce a new organism. They will demonstrate an understanding of differentiation by explaining that specialized cells perform specialized functions. Students will compare individual cells of tissues and recognize the similarities of cells and how they work together to perform specific functions, and they will explain how each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

### **Additional Findings**

In the middle school years (grades 5–8), students should progress from studying life science from the point of view of individual organisms to recognizing patterns in ecosystems and developing understandings about the cellular dimensions of living systems. Students should understand that all organisms are composed of cells—the fundamental unit of life. Reproduction is a characteristic of all living systems. Because no living organism lives forever, reproduction is essential to the continuation of every species. All organisms must be able to obtain and use resources to grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. Behavior is one kind of response an organism can make to an internal or environmental stimulus. Behavioral responses are determined in part by heredity and in part from experience, and an organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to

danger is based in the species' evolutionary history. (*National Science Education Standards*, pp. 155–157)

According to *Benchmarks for Science Literacy*, students in grades 3–5 should have the opportunity to learn about an increasing variety of living organisms, both the familiar and exotic, and should become more precise in identifying similarities and differences among them. Although the emphasis can still be on external features, finer detail than before should be included in students' observations. Hand lenses should be used routinely, and microscopes should come into use, not to study cell structure, but to begin exploring the world of organisms that cannot be seen by the unaided eye. (p. 103) Students should also begin to look for ways in which organisms in one habitat differ from those in another and consider how some of those differences are helpful to survival. The focus should be on the consequences of different features of organisms for their survival and reproduction. Students should know that individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing. (p. 123) Students should explore how various organisms satisfy their needs in the environments in which they are typically found. They can examine survival needs of different organisms and consider how the conditions in particular habitats can limit what kinds of living things can survive. Their studies of interactions among organisms within an environment should start with relationships they can directly observe. (p. 116)

