Earth's Materials and Changes

3-3 The student will demonstrate an understanding of Earth's composition and the changes that occur to the features of Earth's surface. (Earth Science)

3-3.1 Classify rocks (including igneous, sedimentary, and metamorphic) and soils (including humus, clay, sand, and silt) on the basis of their properties.
Taxonomy level: 2.3-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-4.1), students recognized that Earth was composed of rocks, sand, soil, and water. Sand and rocks were classified by physical appearance (1-4.2) and soil was sorted by properties (1-4.3). Students have not previously identified the names or properties of the types of rocks or soils. Students will further develop the concept of soil properties in 7th grade (7-4.4) and will explain the relationships between the types of rocks in the rock cycle in 8th grade (8-3.4).

Classify Rocks
It is essential for students to know that there are three classifications of rocks – igneous, sedimentary, and metamorphic. Rocks can be classified by properties, such as how they are formed, color, visible crystals or minerals, grain pieces, patterns in the rock such as stripes.

Igneous
- Igneous rock was once melted but it has cooled and hardened.
- The melted material is called *magma* or *lava*.
- Igneous rocks may be glassy or grainy with crystals of different types of minerals in them.
- Granite is an example of an igneous rock.

Sedimentary
- Sedimentary rocks are usually made up of pieces of rock called *sediments* that have been pressed and cemented together.
- Some may contain pieces of animal shells or skeletons or other remains of plants or animals.
- Sandstone and limestone are examples of sedimentary rocks.

Metamorphic
- Metamorphic rock was once another type of rock deep inside Earth, but heat and the pressing of the rocks above caused the minerals to change.
- Rocks that were pressed down could have the minerals line up in rows or bands.
- Sometimes the heat just changes the size of the mineral crystals.
- Marble and slate are examples of metamorphic rocks.

It is not essential for students to know classifications within each type of rock. The relationship between the groups of rocks as explained by the rock cycle is also not necessary here.

Classify Soils
It is essential for students to know that soil can be classified based on content, texture, or grain size. Types of soil include humus, sand, clay, and silt.

Humus
- Humus is soil that is made up of decayed parts of once-living organisms.
- It is dark, soft, and very crumbly.

Sand
- Sand has large grains with large spaces between the grains.
- This lets water leave it quickly. Sand feels gritty.

Clay
- Clay has very small grains, much smaller than sand or silt, and holds water easily.
- This makes clay sticky when wet, but when it dries, it forms hard clumps.

Silt
- Silt has pieces that are smaller than sand. It feels like powder.

Some soils are combinations of these soil types. For example, "*loam*" soil has large and small grains with lots of humus. This makes it dark and rich soil for plants. Another example, "*potting soil*" or "*topsoil*"; also has a lot of humus. Once some sand has been added to it, it is also good for growing plants.

It is not essential for students to know soil profiles or the layers of soil. The relationship between the groups of rocks is explained by the rock cycle. Soil conservation is also not necessary but can be a good class discussion because of the importance of soil as a resource.

Assessment Guidelines:
The objective of this indicator is to *classify* types of rocks and soil; therefore, the primary focus of assessment should be to group rocks and soils by the properties used to describe them. However, appropriate assessments should also require students to *recognize* a particular rock or a soil type based on the description; *exemplify* rocks that are classified as a particular type; or *recall* how a particular rock type was formed.

3.3.2 Identify common minerals on the basis of their properties by using a minerals identification key.
Taxonomy level: 1.1-A, B Understand Factual, and Conceptual Knowledge

Previous/Future knowledge: Minerals are introduced as new material for 3rd grade. They will be further studied in 8th grade (8-3.5) when students will summarize the importance of minerals, ores, and fossil fuels as Earth resources on the basis of their physical and chemical properties. In high school Earth Science (3.7), students will classify minerals and rocks on the basis of their physical and chemical properties and the environment in which they were formed.

It is essential for students to know that *minerals* are solid, formed in nature, have never been alive, and have properties by which they can be identified. Some examples of physical properties of minerals may be:

Hardness
- Hardness refers to whether the mineral can be scratched or can scratch something else.
- The harder a mineral, the fewer things can scratch it.
- The hardness is numbered 1-10 with 1 being the softest and 10 being the hardest. Diamond is the hardest mineral.

Color
- Color can be used along with other properties to help identify a mineral.
- Since many minerals have the same color, it cannot be used as the only property for identification.

Luster
- Some minerals can be very shiny, pearly, or glassy and other minerals are dull.

Special Properties
- If an acid (vinegar) is placed on a mineral, it may bubble or fizz.
- Some minerals split into thin sheets. Some minerals have magnetic properties.

A *mineral identification key* is a chart that will give information about the properties of the minerals listed on the key. Properties of a given mineral are compared to those listed on the key and the mineral can be identified. Some common minerals with very observable properties might include calcite, feldspar, mica, talc, gypsum, quartz, and fluorite. A sample mineral identification key is provided.

Sample: Minerals Identification Key

Mineral	**Properties**			
	Hardness (scratch test)	Color	Luster	Special Properties
Calcite	3 scratched by nail	White	Dull/Glassy	Bubbles with acid
Feldspar	6 scratches glass	Pink or white	Dull/Pearly	---
Mica	2 scratched by fingernail	Black/Gray	Shiny	Splits into thin sheets
Talc	1 easily scratched by fingernail	White	Dull	---
Gypsum	2 scratched by fingernail	White/Gray	Dull	---
Quartz	7 scratches glass	Various colors	Glassy	
Fluorite	4	Various colors		

It is not essential for students to know about crystal shape of minerals or the breakage properties of minerals. They do not need to know about the Mohs scale of hardness. The streak color of a mineral formed when the mineral is scratched across a ceramic plate is interesting but may be beyond the understanding for 3rd grade identification.

Assessment Guidelines:
The objective of this indicator is to *identify* minerals based on their properties; therefore, the primary focus of assessment should be to locate a mineral by its properties by using the information found on an identification key. However, appropriate assessments should also require students to *identify* mineral properties; or *recall* what would be observed when making an identification of a particular property.

3.3.3 Recognize types of fossils (including molds, casts, and preserved parts of plants and animals).
Taxonomy level: 1.1-A Remember Factual Knowledge

Previous/Future knowledge: Fossils are introduced as new material for 3rd grade. They will be studied further in 8th grade (8-2.2) when students will summarize how scientists study Earth's past environment and diverse life forms by examining different types of fossils (including molds, casts, petrified fossils, preserved and carbonized remains of plants and animals, and trace fossils). In high school Earth Science (6.3), students will summarize how fossil evidence reflects the changes in environmental conditions on Earth over time.

It is essential for students to know that a *fossil* is the remains of a living thing that lived long ago that has turned to rock. There are several types of fossils:

Mold
- A *cavity* or opening in a rock that has the shape of once living thing.
- Fossil imprints of leaves and other thin objects, such as wings, feathers, and footprints are also molds.
- The leaves or animal parts rotted away long ago.

Cast
- A mold that has been filled in with sediments which harden and take the shape of the once living thing.

Preserved parts
- Actual parts of the living thing such as shells, bones, or teeth that have turned to stone.
- For example, sometimes an insect long ago was trapped in tree sap.
- That sap hardened into a rock called amber.
- The insect was preserved in the amber stone.

It is not essential for students to know about carbonized imprint fossils. It may be interesting to discuss that some fossils are frozen remains or remains found in tar pits but these are not necessary for assessment.

Assessment Guidelines:
The objective of this indicator is to *recognize* types of fossils; therefore, the primary focus of assessment should be to locate a fossil type (including molds, casts, and preserved parts of plants and animals) based on the information presented about that fossil. However, appropriate assessments should also require students to *identify* a particular fossil from a drawing or picture; or *recall* types of fossils as stated in the indicator. –

3.3.4 Infer ideas about Earth's early environments from fossils of plants and animals that lived long ago.
Taxonomy level: 2.5-B Understand Conceptual Knowledge

Previous/Future knowledge: Fossils and their relationship to the early environments of plants and animals is new material for 3rd grade. They will be studied further in 8th grade (8-2.2) when students will summarize how scientists study Earth's past environment and diverse life forms by examining different types of fossils (including molds, casts, petrified fossils, preserved and carbonized remains of plants and animals, and trace fossils) and in high school Earth Science.

It is essential for students to know that fossils can give information about what the environment was like in the location where the fossil was found. For example,

- Fossils of a water organism found in an area that is now mountains means that area was possibly once under water.
- Fossils of trees or tree parts that are found in a desert mean that area was possibly once a forest.
- Fossils of plants that are found in very cold areas of Earth means that area at one time possibly had a warmer climate.

Every time a new fossil is found, more information about life on Earth and the environment of Earth is discovered.

It is not essential for students to know any specific times of early Earth history like the Paleozoic Era or the Jurassic Period. The exact names of organisms that lived long ago might be an interesting discussion, but it is not necessary for this indicator.

Assessment Guidelines:
The objective of this indicator is to *infer* early Earth environments from fossil information; therefore, the primary focus of assessment should be to make a conclusion about the early environment in an area on the basis of the fossil organism. However, appropriate assessments should also require students to *compare* environments of early Earth with environments today; or *exemplify* organisms that might help determine an environment.

3-3.5 Illustrate Earth's saltwater and freshwater features (including oceans, seas, rivers, lakes, ponds, streams, and glaciers).
Taxonomy level: 2.2-A Understand Factual Knowledge

Previous/Future knowledge: The identification of specific water features found on Earth is new to this grade. In 1st grade (1-4.5), students illustrated the locations of water on Earth. In 4th grade (4-2.2), students will explain the characteristics of environments that include rivers and streams. In 5th grade (5-2.3), students will compare ecosystems that include oceans, lakes, and ponds.

It is essential for students to know that there are many places on Earth where water is found. Sometimes the water is saltwater and other times it is fresh water. Most of the water on Earth is saltwater. Water is mostly in liquid form in these features, but sometimes it can be solid (ice). Earth's water features include:

Oceans
- Oceans are large bodies of salt water that surrounds a continent.

Seas
- Seas are large bodies of salt water that is often connected to an ocean.
- A sea may be partly or completely surrounded by land.

Rivers
- Rivers are large, flowing bodies of fresh water that usually empty into a sea or ocean.

Streams
- Streams are small, flowing bodies of fresh water that flow into rivers.

Lakes& ponds
- Lakes and ponds are areas where water, usually freshwater, are surrounded by land.
- Lakes and ponds differ in size with ponds usually being smaller than lakes.

Glaciers
- Glaciers are huge sheets of ice that cover land.
- They are found where temperatures are very cold, for example, high in the mountains or near the poles of Earth.

It is not essential for students to name specific bodies of water.

Assessment Guidelines:
The objective of this indicator is to *illustrate* Earths saltwater and freshwater features; therefore, the primary focus of assessment should be to give or use illustrations to show understanding of Earth's water features (including oceans, seas, rivers, lakes, ponds, streams, and glaciers).

However, appropriate assessments should also require students to *identify* oceans on a world map; *compare* the size of oceans, lakes, and ponds; or *identify* where glaciers might be found.

3.3.6 Illustrate Earth's land features (including volcanoes, mountains, valleys, canyons, caverns, and islands) by using models, pictures, diagrams, and maps.
Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: The identification of specific land features found on Earth is new to this grade. In 5th grade, students will explain how volcanic eruptions affect the land (5-3.1) and will compare continental and oceanic landforms (5-3.3). In 8th grade (8-3.7), students will illustrate the creation and changing of landforms including volcanic eruptions and mountain-building.

It is essential for students to know that Earth's surface has many natural shapes or features called *landforms*. Earth's land features that can be seen on models, pictures, diagrams, and maps include:

Volcanoes
- An opening in Earth's surface from which lava flows.
- As the lava hardens and builds up, a *volcanic mountain* forms.

Mountains
- A place on Earth's surface where the land is much higher than the land that surrounds it.
- Some mountains are tall and rocky and others are rounded and covered with trees.
- A mountain area that has a flat top is called a *plateau*.

Valleys
- A lowland area between higher areas such as mountains.
- Sometimes rivers can wear away land to form valleys.

Canyons
- A deep valley with very steep sides.
- They are often carved from the Earth by a river.

Caverns
- A large cave or underground chamber.
- Caverns or *caves* are formed underground when water wears away the rock.

Islands
- An area of land that is entirely surrounded by water.
- Sometimes islands are located in lakes, or they may be out from the seashore as barrier islands.

It is not essential for students to name specific landforms such as Rocky Mountains or Carlsbad Caverns.

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Assessment Guidelines:

The objective of this indicator is to *illustrate* Earth's land features; therefore, the primary focus of assessment should be to give or use illustrations to show understanding of land features of Earth (including volcanoes, mountains, valleys, canyons, caverns, and islands). However, appropriate assessments should also require students to *identify* a feature on a world map or model; *compare* features based on their descriptions; or *identify* where a feature might be found.

3.3.7 Exemplify Earth materials that are used as fuel, as a resource for building materials, and as a medium for growing plants.
Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-4.6), students gave examples of Earth materials used for building structures or for growing plants. In 5th grade (5-3.6), students will study the conservation of natural resources. In 7th grade (7-5.6), students will focus on the resources as renewable or nonrenewable. Students will further develop this concept in 8th grade (8-3.5) to include the importance of fossil fuels as Earth resources. Fuels are new Earth materials for this grade.

It is essential for students to know that Earth is rich in useful resources that can be used for various purposes:

Fuels — Earth materials come from inside Earth and are used as fuels. For example, fuels such as oil and coal can be burned to produce heat or made into gasoline to help run cars and other vehicles.

Building structures — Earth materials can be mined from Earth and used to make building blocks or other building materials. For example, granite, marble, and sandstone have been used to make blocks for homes and office buildings. The mineral calcite is used to make cement for building.

Growing plants — Earth materials can be used as a medium for growing plants. For example, soil is made up of weathered pieces of rocks, minerals, and humus which supply water, nutrients and support for growing plants. Different types of soil are needed depending upon the type of plants that need to grow in the soil.

It is not essential for students to know less common materials such as natural gas or propane for fuels, or peat moss or vermiculite as growing mediums for plants. Students do not need to identify or classify Earth resources as renewable or nonrenewable at this time.

Assessment Guidelines:
The objective of this indicator is to *exemplify* uses of Earth materials; therefore, the primary focus of assessment should be to give examples of uses for Earth materials as fuel, as building materials, and as a growing medium for plants. However, appropriate assessments should also require students to *identify* a resource that would meet one of the criteria.

3.3.8 Illustrate changes in Earth's surface that are due to slow processes (including weathering, erosion, and deposition) and changes that are due to rapid processes (including landslides, volcanic eruptions, floods, and earthquakes).
Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-4.4), students recognized that water flows downhill. This concept can be used as background for understanding weathering and erosion. All the other concepts are new to 3rd grade but can be tied to other indicators such as 3-3.1, 3-3.5, and 3-3.6. Students will further develop this concept in 5th grade (5-3.1) to include how these natural processes affect the land and oceans in constructive and destructive ways.

It is essential for students to know that the surface of Earth does change in natural ways. Sometimes the change can be caused by a very slow process and at other times it can be caused by a rapid process. There is often evidence on the surface that these processes have caused a change.

Changes Due to Slow Processes

Weathering — When weathering is occurring, Earth materials, for example rocks are being broken apart. Little or big cracks in the rock are evidence that weathering is taking place.

Erosion — When erosion is occurring, Earth materials, like rock, sand, and soil, are being carried away from their original location. Water and wind are often the causes for erosion.

Deposition — When deposition is occurring, Earth materials that have been eroded are put in a new location. When the wind stops blowing, sand and soil may be put down in piles as large as dunes. Water may deposit its material at the end of a river and form a delta.

Changes Due to Rapid Processes

Landslides — When a landslide is occurring, Earth materials, like rock, sand, and soil, on the side of a slope or cliff drop down to a lower location. Water soaking into the ground often makes this happen.

Volcanic Eruptions — When a volcanic eruption is occurring, Earth material called *lava* comes out of the volcano flows down the side of the volcanic mountain (or is sent up into the air and lands nearby) where it hardens. The hardened volcanic rock forms new Earth material and often makes the volcanic mountain larger.

Floods — When a flood is occurring, a lot of water causes rivers and streams to overflow their banks over the surrounding land around them. Heavy rainfall in the area is usually the cause of a flood.

Earthquakes When an earthquake is occurring, the surface of the ground shakes and rolls causing damage to the Earth's surface, like cracks and other openings, and damage to roads and buildings.

It is not essential for students to know runoff across Earth's surface as part of the water cycle. They do not need the geology of why a landslide, a volcanic eruption, or earthquake occurs.

Assessment Guidelines:
The objective of this indicator is to *illustrate* natural changes to Earth's surface; therefore, the primary focus of assessment should be to give illustrations of these concepts or use illustrations to show understanding of changes that occurs because of identified slow and rapid processes. However, appropriate assessments should also require students to *interpret* a before and after picture to identify an event or describe the change; or *compare* the slow and rapid processes as to end result, amount of damage, or effect on manmade structures.