Sixth Grade Companion Document

6-Unit 3: Composition, Properties, and Changes of the Earth

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Introduction to the K-7 Companion Document
An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. . The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
a. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

a. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
a. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing "hands-on" activities.
a. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
a. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
a. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
a. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

6th Grade Unit 3:
Composition, Properties, and Changes of the Earth

Content Statements and Expectations

Code	Statements & Expectations	Page
E.SE.M.4	**Rock Formation – Rocks and rock formation bear evidence of the minerals, materials, temperature/pressure conditions and forces that created them.**	1
E.SE.06.41	Compare and contrast the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.	1
E.SE.M.1	**Soil – Soils consist of weathered rocks and decomposed organic materials from dead plants, animals, and bacteria. Soils are often found in layers with each having a different chemical composition and texture.**	2
E.SE.06.11	Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments.	2
E.SE.06.12	Explain how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.	3
E.SE.06.13	Describe how soil is a mixture, made up of weather-eroded rock and decomposed organic material, water, and air.	3
E.SE.06.14	Compare and contrast different soil samples based on particle size.	4
E.SE.M.6	**Magnetic Field of Earth – Earth as a whole has a magnetic field that is detectable at the surface with a compass.**	4
E.SE.06.61	Describe the Earth as a magnet and compare and contrast the magnetic properties of the Earth to that of a natural or manufactured magnet.	4
E.SE.06.62	Explain how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.	5

6-Unit 3: Composition, Properties, and Changes of the Earth

Big Ideas (Key Concepts)

- Earth materials have properties that make the materials useful.
- Earth materials and the surface of the Earth change gradually and rapidly.
- The Earth has magnetic properties.

Clarification of Content Expectations

Standard: Solid Earth

Content Statement – E.SE.M.4

Rock Formation – Rocks and rock formations bear evidence of the minerals, materials, temperature/pressure conditions and forces that created them.

Content Expectation

E.SE.06.41 Compare and contrast the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.

Instructional Clarifications

1. Compare and contrast means to show similarities and differences between the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.
2. All rocks are similar because they are composed of minerals.
3. Rocks, over time can be transformed into other types of rocks.
4. There are three different types of rocks—igneous, metamorphic, and sedimentary.
5. The three rock types are different in the way in which they are formed. Igneous rocks are formed from melted minerals that have cooled and hardened. Metamorphic rocks are formed by intense heat pressure and chemical reactions. Sedimentary rocks are formed either from the compaction and cementation of sediment (pressure) or chemical precipitation in water.
6. The rock cycle is a conceptual model that depicts rock changing and rock forming processes.

Assessment Clarifications

1. All rocks are similar because they are composed of minerals.

2. There are three different types of rocks—igneous, metamorphic, and sedimentary.
3. The three rock types are different in the way in which they are formed. Igneous rocks were formed from melted minerals that have cooled and hardened. Metamorphic rocks were formed by intense heat pressure and chemical reactions. Sedimentary rocks were formed from rocks and soil that have been pressed together and cemented together.
4. The rock cycle is a process of natural changes that cause one type of rock to become another type of rock.

Content Statement – E.SE.M.1

Soil – Soils consist of weathered rocks and decomposed organic materials from dead plants, animals, and bacteria. Soils are often found in layers with each having a different chemical composition and texture.

Content Expectations

E.SE.06.11 Explain how physical and chemical weathering lead to erosion and the formation of soils and sediments.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally how physical and chemical weathering lead to erosion and the formation of soils and sediments.
2. Weathering breaks down rock.
3. Abrasion, freeze-thaw, thermal expansion/contraction, pressure unloading, and plants and organisms cause physical weathering. Abrasion occurs when water or wind carrying debris acts with a scouring action on rock surfaces. Freeze/thaw occurs when water is trapped in the spaces of rock and repeatedly frozen and thawed. Thermal expansion/contraction occurs when solar radiation causes minerals to heat and cool at various speeds producing stresses in rock over time.
4. Plant roots and the actions of organisms can also physically break down rocks.
5. Chemical processes cause chemical weathering. Water is the main agent at work in this process and causes the composition of the mineral or rock to change. Primary minerals in rock are broken down to secondary minerals and this material can be carried away in solution.
6. As soon as a rock particle is loosened by weathering and moves it is called erosion.
7. Eroded rock is one of the main components of soil.

Assessment Clarifications

1. Weathering breaks down rock.
2. Abrasion, freeze-thaw, thermal expansion/contraction, pressure unloading, and plants and organisms cause physical weathering. Abrasion occurs when water or wind carrying debris acts with a scouring action on

rock surfaces. Freeze/thaw occurs when water is trapped in the spaces of rock and repeatedly frozen and thawed. Thermal expansion/contraction occurs when solar radiation causes minerals to heat and cool at various speeds producing stresses in rock over time.

3. Chemical processes cause chemical weathering. Water is the main agent at work in this process and causes the composition of the mineral or rock to change. Primary minerals in rock are broken down to secondary minerals and this material can be carried away in solution.
4. As soon as a rock particle is loosened by weathering and moves it is called erosion.
5. Eroded rock is one of the main components of soil.

E.SE.06.12 Explain how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.
2. Rock can be eroded by wind, water (including waves), and glacial movement.
3. Processes of erosion in part determine the shapes of landforms.
4. Fragments of rock that are produced by erosion and transported are called sediment.
5. Sediment that is transported by the energy of wind or water is deposited when that energy level decreases.

Assessment Clarifications

1. Rock can be eroded by wind, water (including waves), and glacial movement.
2. Processes of erosion in part determine the shapes of landforms.
3. Fragments of rock that are produced by erosion and transported are called sediment.
4. Sediment that is transported by the energy of wind or water is deposited when that energy level decreases.

E.SE.06.13 Describe how soil is a mixture, made up of weather-eroded rock and decomposed organic material, water, and air.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how soil is a mixture, made up of weathered eroded rock, decomposed organic material, water and air.
2. One of the components in soil is mineral, which is made from many tiny pieces of eroded rock.
3. Another component in the soil is the organic material that comes from decaying plants and animals.

4. Minerals and organic material make up approximately half of soil. In addition there is air and water.

Assessment Clarifications

1. One of the components in soil is mineral, which is made from many tiny pieces of eroded rock.
2. Another component in the soil is the organic material that comes from decaying plants and animals.
3. Minerals and organic material make up approximately half of soil. In addition there is air and water.

E.SE.06.14 Compare and contrast different soil samples based on particle size.

Instructional Clarifications

1. Compare and contrast means to show similarities and differences between different soil samples based on particle size.
2. The main particle sizes of soil from largest to smallest are: sand, silt, and clay.

Assessment Clarifications

1. Compare and contrast means to show similarities and differences between different soil samples based on particle size.
2. The main particle sizes of soil from largest to smallest are: sand, silt, and clay.

Content Statement – E.SE.M.6

Magnetic Field of Earth – Earth as a whole has a magnetic field that is detectable at the surface with a compass.

Content Expectations

E.SE.06.61 Describe the Earth as a magnet and compare and contrast the magnetic properties of the Earth to that of a natural or manufactured magnet.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how the Earth acts as a magnet and compare and contrast means to show similarities and differences between the magnetic properties of the Earth and those of a natural or manufactured magnet.
2. The Earth acts as a giant magnet.
3. The Earth like any natural or manufactured magnet exhibits a north and south magnetic pole.
4. The Earth's liquid outer core spins as the Earth rotates creating a magnetic field.

Assessment Clarifications

1. The Earth acts as a giant magnet.
2. The Earth like any natural or manufactured magnet exhibits a north and south magnetic pole.

3. The Earth's liquid outer core spins as the Earth rotates creating a magnetic field.

E.SE.06.62 Explain how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.
2. A compass is composed of small, light-weight magnet, called a needle, that is balanced on a point
3. The Earth acts like a giant magnet and exhibits a North and south magnetic pole. One pole of the magnet will be attracted and point toward the North Pole. By convention this is called the north pole of the magnet.
4. Compasses can be used for navigation from any point on the Earth due to the Earth's magnetic field.

Assessment Clarifications

1. A compass is composed of small, lightweight magnet, called a needle that is balanced on a point.
2. The Earth acts like a giant magnet and exhibits a North and south magnetic pole. One pole of the magnet will be attracted and point toward the North Pole. By convention this is called the north pole of the magnet.
3. Compasses can be used for navigation from any point on the Earth due to the Earth's magnetic field.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications

Inquiry Process
S.IP.06.11 Generate scientific questions based on observations, investigations, and research concerning energy and changes in matter.
S.IP.06.12 Design and conduct scientific investigations to understand energy and changes in matter.
S.IP.06.13 Use tools and equipment (models, thermometers) appropriate to scientific investigations of energy and changes in matter.
S.IP.06.14 Use metric measurement devices in an investigation of energy and changes in matter.
S.IP.06.15 Construct charts and graphs from data and observations dealing with energy and changes in matter.
S.IP.06.16 Identify patterns in data dealing with energy and changes in matter.
Inquiry Analysis and Communication
S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions on energy and changes in matter.
S.IA.06.12 Evaluate data, claims, and personal knowledge through collaborative science discourse about energy and changes in matter.
S.IA.06.13 Communicate and defend findings of observations and investigations about energy and changes in matter using evidence.
S.IA.06.14 Draw conclusions from sets of data from multiple trials about energy and changes in matter using scientific investigation.
S.IA.06.15 Use multiple sources of information on energy and changes in matter to evaluate strengths and weaknesses of claims, arguments, or data.
Reflection and Social Implications
S.RS.06.11 Evaluate the strengths and weaknesses of claims, arguments, and data regarding energy and changes in matter.
S.RS.06.12 Describe limitations in personal and scientific knowledge regarding energy and changes in matter.
S.RS.06.13 Identify the need for evidence in making scientific decisions about energy and changes in matter.
S.RS.06.14 Evaluate scientific explanations based on current evidence and scientific principles dealing with energy and changes in matter.
S.RS.06.15 Demonstrate scientific concepts concerning energy and changes in matter through various illustrations, performances, models, exhibits, and activities.
S.RS.06.16 Design solutions to problems on energy and changes in matter using technology.
S.RS.06.17 Describe the effect humans and other organisms have on the balance of the natural world when matter is changed and/or energy is transferred.
S.RS.06.18 Describe what science and technology in regards to energy and changes in matter can and cannot reasonably contribute to society.
S.RS.06.19 Describe how science and technology of energy and changes in motion have advanced because of the contributions of many people throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
igneous metamorphic sedimentary rock cycle erosion minerals weathering soils sediments abrasion thermal expansion/contraction glaciers gravel sand silt clay organic material particle size magnetic field poles navigation	gradual formation

Instruments, Measurements, Representations

Magnets, compass

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is ***NOT*** *a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.*

Instructional Examples

Rock Formation: E.SE.06.41, E.SE.06.11, E.SE.06.12, E.SE.06.13, E.SE.06.14, E.SE.06.61, E.SE.06.62

Objectives

- Describe formation of rock types (igneous, metamorphic, and sedimentary) and differences between the types - using the rock cycle model.
- Describe physical and chemical weathering lead to erosion and the formation of soils and sediments.
- Explain how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas.
- Explain that soil is a mixture, made up of weather-eroded rock and decomposed organic material.
- Describe how soil samples can be characterized based on particle size and texture.
- Describe the Earth as a magnet and tell how the magnetic properties of the Earth are similar/different to natural or man-made magnets.
- Explain how a compass works using the magnetic field of the Earth, and how a compass is used for navigation on land and sea.

Engage and Explore

- Give each student a piece of bubble gum, and tell him or her it represents a sedimentary rock. Have them put it in their mouth and begin chewing it. Ask the students to think scientifically about what they are doing to the gum (Leading questions: Is it cold inside their mouth? NO! Are they

applying heat? YES! What is happening when their teeth come down on the gum? Are they applying pressure? So is the gum being changed? Yes!) Have students pull the gum out of their mouth and place it somewhere clean. (E.SE.06.41)

- Now open up a packet of nerds or similar candy and pour some onto the gum. Then kind of squeeze or fold them into the gum. Hold up the gum and say this represents an Igneous Rock. Now have students place the gum (igneous rock) into their mouth and chew. Ask the students: What they are doing? Hopefully they will answer, applying heat and pressure. Here pressure is enough to crush the candy (crystals). Pull out the gum and say what this represents (Metamorphic Rock). Explain to the students that they have just modeled the rock cycle! (E.SE.06.41)
- Students can take sandstone and place it in a glass jar of water to model physical weathering. By shaking the jar vigorously for 1 minute they will find that sediment is created and that the rock has changed.
  Many other earth models can be used to show these concepts. Sand can be blown with straws, water can be dripped through cups with holes in them, ice blocks can be used to model glaciers etc. (E.SE.06.11, E.SE.06.12)
- Have students use particle size charts (can be made or found online) to compare the particle sizes of various Earth materials. Magnifiers and microscopes are helpful here. Texture of soil samples can also be explored at this time. (E.SE.06.14)
- Have students explore the Earth as a magnet using compasses. This can be done as a scavenger hunt activity outdoors. They can also make a temporary magnet and compass. (E.SE.06.61, E.SE.06.62)

Explain and Define

- The students can now define the characteristics of each rock type. (E.SE.06.41)
- Types of physical and chemical weathering should be discussed and defined here. (E.SE.06.11, E.SE.06.12)
- After testing various samples of soil – soil should be properly defined by the students. (E.SE.06.13)
- Students should be able to describe how they used magnets on their scavenger hunt to find certain objects and then discuss how they could use them to navigate on the sea. This is also a good time to discuss how the Earth compares to other magnets. E.SE.06.61, E.SE.06.62

Elaborate and Apply

- Many examples of each rock type can now be explored and identified by the students. E.SE.06.41
- Students can be given various pictures of Earth features and asked to determine which Earth process caused the Earth to look this way and to describe the process. E.SE.06.11, E.SE.06.12
- Students could be taken to various outdoor sites and asked to determine the soil properties at each site. E.SE.06.13

- Students could write a paper on the importance to sea navigation in history using magnets. E.SE.06.61, E.SE.06.62

Evaluate student understanding

Formative Assessment Examples
- Check on students understanding as they classify rock types themselves.
- Check student understandings on Earth feature description work from pictures.
- Check for student understandings as students perform their own soil properties tests.
- Check for student understandings in their papers on sea navigation.

Summative Assessment Examples
- Give students real rock samples for them to classify as Igneous, metamorphic or sedimentary.
- Students are shown various geological formations and asked to pick which kind of Earth process is responsible for this formation.
- Various soils could be described and students could identify the type of soil being described.
- Students could be asked to explain how the Earth is similar to a natural magnet. Students could also be asked to identify some useful properties of magnets.

Enrichment

- Take the student's to a rock quarry or site of geological interest and have them create their own rock and mineral collection. At least three of each type should be included to complete their collection. E.SE.06.41
- Take the student's to various sites and ask them to work in groups and try to explain the weathering forces at work to sculpt the land to look like it does. E.SE.06.11, E.SE.06.12
- Students could be given sand samples from various sites and asked to compare/contrast them with each other using particle size charts. E.SE.06.14
- The Earth's magnetic field can be shown using a galvanometer and a 50ft extension cord. Connect the galvanometer to the extension cord and swing in large arcs like a jump rope. Determine what is happening and why. E.SE.06.61, E.SE.06.62

Intervention

- For the rock cycle it may be important to show the model of the rock cycle more that one time. Gum and different candies should be used again. Also another good model would be using cookies to show the component parts of rock – chocolate chip cookies are often used for this. Taking trips and looking at real rocks outside will make this more authentic and repeating this many times makes it easier to do.
- There are many land changes around us. Taking walking trips to look at these changes and writing a list of what is observed is very powerful proof that these changes are real and occurring around us.
- Have students all bring in samples of soil from around their house. By comparing these samples with other student samples in groups of four students can start to see the differences and similarities between samples taken at different locations. Then students can look at the samples from other groups over the course of a few days and start to write down the observable properties. The teacher can guide and help build strategies to find these differences and define them.
- Some students need to have extended real experiences with magnets to determine their properties and start to understand non-contact forces. Once these properties are seen as consistent and useful they can be expanded upon and defined more easily by the student.

Examples, Observations, and Phenomena (Real World Context)

Rock formation can provide us with glimpses into the way our world was formed. It can also provide us more locally with information on how our area was shaped.

Changes in rock usually take thousands of years to happen it is therefore important to show students the shorter-term changes we can see (like potholes in a road or the wearing down of their sled hill by the school). Soil quality is important for agriculture and therefore all people. By looking at the properties of soil we can begin to learn the properties that are most useful to growing various types of crops with the highest yields possible. Magnets were very important to the history of navigation by people on Earth. Without this tool many were lost at sea or did not attempt open sea voyages. They are still widely used today even with the increasing use of GPS systems for navigation. Magnets are also used in many electrical circuits, generators, and motors. Magnets are used in the generation of electricity at municipal power plants.

Literacy Integration

Reading

R.IT.06.01 analyze the structure, elements, features, style, and purpose of informational genre, including research reports, “how-to” articles, and essays.

R.IT.06.03 explain how authors use text features including footnotes, bibliographies, introductions, summaries, conclusions, and appendices to enhance the understanding of central, key, and supporting ideas.

R.CM.06.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.06.02 retell through concise summarization grade-level narrative and informational text.

R.CM.06.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Writing

W.GN.06.03 formulate research questions using multiple resources and perspectives that allow them to organize, analyze, and explore problems and pose solutions that culminate a final presented project using the writing process.

W.PR.06.02 apply a variety of pre-writing strategies for both narrative and informational writing.