Seventh Grade Companion Document

7-Unit 4: Fluid Earth Systems and Human Activities

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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.
b. **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.

c. **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.
d. **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.
e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
f. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
g. **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.
h. **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.

7th Grade Unit 4:
Fluid Earth Systems and Human Activities

Content Statements and Expectations

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7 – Unit 4: Fluid Earth Systems and Human Activities

Big Ideas (Key Concepts)

- The Sun is the major source of energy for phenomenon on Earth.
- The Sun's warming relates to weather, climate and the water cycle.
- Human interaction and use of natural resources affects the environment.
- The Earth's atmosphere is a mixture of gases and water vapor.

Clarification of Content Expectations

Standard: Earth Systems

Content Statement – E.ES.M.1
Solar Energy – The sun is the major source of energy for phenomena on the surface of the Earth.

Content Expectations

E.ES.07.11 Demonstrate, using a model or drawing, the relationship between the warming by the sun of the Earth and the water cycle as it applies to the atmosphere (evaporation, water vapor, warm air rising, cooling, condensation, clouds).

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations the relationship between the warming of the Earth by the sun and the water cycle.
2. The water cycle describes the continuous movement of water from the ocean and other bodies of water to the atmosphere, precipitation to the Earth's surface, through runoff and groundwater to streams, and back into the oceans, lakes, rivers, and streams.
3. The Sun send energy to the Earth in the form of light/radiation, and this energy is transformed into thermal energy after it arrives at Earth.
4. Heat causes water to evaporate. Evaporation is the process by which liquid water changes into a gas called water vapor and enters the atmosphere.
5. Warm air in the atmosphere rises. Surrounding cooler air pushes it up.
6. The cooling temperatures in the upper atmosphere cause water vapor to change state and condense as a liquid.
7. The cooled water in the atmosphere forms clouds. The water droplets in the cloud collide and form larger droplets until they are pulled to the ground by gravity in the form of precipitation.

Assessment Clarifications

1. The water cycle describes the continuous movement of water from the ocean and other bodies of water to the atmosphere, precipitation to the Earth's surface, through runoff and groundwater to streams, and back into the oceans, lakes, rivers, and streams.
2. The Sun send energy to the Earth in the form of light/radiation, and this energy is transformed into thermal energy after it arrives at Earth.
3. Heat causes water to evaporate. Evaporation is the process by which liquid water changes into a gas called water vapor and enters the atmosphere.
4. Warm air in the atmosphere rises.
5. The cooling temperatures in the upper atmosphere cause water vapor to change state and condense as a liquid.
6. The cooled water in the atmosphere forms clouds. The water droplets in the cloud collide and form larger droplets until they are pulled to the ground by gravity in the form of precipitation.

E.ES.07.12 Describe the relationship between the warming of the atmosphere of the Earth by the sun and convection within the atmosphere and oceans.

Instructional Clarifications:

1. Describe means to tell or depict in written or spoken words how the sun's warming of the atmosphere is related to convection in the atmosphere and oceans.
2. The atmosphere is the envelope of gases that surrounds Earth.
3. Convection is the transfer of heat energy through liquids and gases by moving particles. Convection currents move warmer air through the atmosphere and warmer water through the oceans.
4. Air will rise if it is warmer than the surrounding air.
5. If cool air is present, warm air will rise to great heights.
6. Eventually the rising air will cool.
7. Cool air holds less water vapor than warm air. Water vapor in a cooling air mass will condense into liquid water at a certain temperature and pressure.
8. The water vapor may produce clouds and precipitation.

Assessment Clarifications

1. Convection is the transfer of heat energy though liquids and gases by moving particles. Convection currents move warm air through the atmosphere and warm water through the oceans.
2. The atmosphere is the envelop of gases that surrounds Earth.
3. Air will rise if it is warmer than the surrounding air.
4. If cool air is present, warm air will rise to great heights.
5. Eventually the rising air will cool.
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7. The water vapor may produce clouds and precipitation.

E.ES.07.13 Describe how the warming of the Earth by the sun produces winds and ocean currents.

Instructional Clarifications

1. Describe means to tell or depict in written or spoken words how the warming of the Earth by the sun produces winds and ocean currents.
2. Wind is the movement of air from areas of high pressure to areas of low pressure.
3. Areas of high or low pressure are caused by differences in the Earth's temperature. Differences in Earth's temperature are due to the sun's uneven heating of the Earth's surface.
4. The air that moves is affected by the rotation of the Earth.
5. An ocean current is the movement of ocean water.
6. The uneven heating and density of the ocean waters cause Ocean currents. On a global scale ocean currents can be classified as cold or warm resulting from the latitude of origin. In some places cold currents result when deep water ascends to the surface.

Assessment Clarifications

1. Wind is the movement of air from areas of high pressure to areas of low pressure.
2. Areas of high or low pressure are caused by differences in the Earth's temperature. Differences in Earth's temperature are due to the sun's warming.
3. The air that moves is affected by the rotation of the Earth.
4. An ocean current is the movement of ocean water.
5. Ocean currents are made up of hot or cold water.
6. The movement of ocean water is similar to the movement of warm and cold air in the atmosphere.

Content Statement – E.ES.M.4
Human Consequence – Human activities have changed the land, oceans, and atmosphere of the Earth resulting in the reduction of the number and variety of wild plants and animals sometimes causing extinction of species.

Content Expectations

E.ES.07.41 Explain how human activities (surface mining, deforestation, overpopulation, construction and urban development, farming, dams, landfills, and restoring natural areas) change the surface of the Earth and affect the survival or organisms.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawings), demonstrations, written reports or verbally how human activities change the surface of the Earth and survival of organisms.

2. Examples of human activities that affect habitats and the survival of organisms include surface mining, deforestation, overpopulation, construction and urban development, farming, dams, landfills, and restoring natural areas.
3. Human activities change animal habitat.
4. Change in animal habitat affects the survival rate of organisms.
5. The strongest force in rapid habitat loss is human activity.

Assessment Clarifications

1. Human activities change animal habitat.
2. Habitat destruction is due to surface mining, deforestation, overpopulation, construction and urban development, farming, dams, landfills, and restoring natural areas.
3. Change in animal habitat affects the survival rate of organisms.
4. The strongest force in rapid habitat loss is human activity.

E.ES.07.42 Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere, (car exhaust, industrial emissions, acid rain, and natural sources), and how pollution impacts habitats, climatic change, threatens or endangers species.

Instructional Clarifications

1. Describe means to tell or depict in written or spoken words the origins of pollution in the atmosphere, geosphere, and hydrosphere.
2. Pollution is the presence of harmful substances in the air, water, and land.
3. The atmosphere is the envelope of gases that surround the Earth.
4. The geosphere is the land that makes up the Earth.
5. The hydrosphere is the bodies of water that make up the Earth.
6. The major causes of air pollution come from automobiles, fuel consumption in buildings, and coal-burning power plants.
7. Air pollution damages plants and causes health problems in animals. Most air pollution is the result of burning fossil fuels (such as coal, oil, gasoline, and diesel fuel) due to the release of particles and gases when burned.
8. Damage to plants causes a loss of habitat.
9. Loss of habitat threatens or endangers species.
10. Fossil fuels, aerosols, pollution, and land use influence climate change.
11. Burning fossil fuels releases carbon dioxide into the air.

Assessment Clarifications

1. Pollution is the presence of harmful substances in the air, water, and land.
2. The atmosphere is the envelope of gases that surround the Earth.
3. The geosphere is the land that makes up the Earth.
4. The hydrosphere is the bodies of water that make up the Earth.
5. The major causes of air pollution come from automobiles, fuel consumption in industry and buildings, and coal-burning power plants.
6. Air pollution damages plants and causes health problems in animals. Most air pollution is the result of burning fossil fuels, such as coal, oil, gasoline, and diesel fuel due to the release of particles and gases when burned.
7. Damage to plants causes a loss of habitat.

8. Loss of habitat threatens or endangers species.
9. Fossil fuels, aerosols, pollution, and land use can influence climate change.
10. Burning fossil fuels releases carbon dioxide into the air.

Content Statement – E.ES.M.7
Weather and Climate – Global patterns of atmospheric and oceanic movement influence weather and climate.

Content Expectations

E.ES.07.71 Compare and contrast the difference and relationship between climate and weather.

Instructional Clarifications
1. Compare and contrast is to tell in written form the similarities and differences between climate and weather.
2. Weather is the mix of events that happen each day in the atmosphere including temperature, rainfall and humidity.
3. Climate is the average weather pattern in a place over many years.
4. Climate is useful for weather forecasting.

Assessment Clarifications
1. Weather is the mix of events that happen each day in the atmosphere including temperature, rainfall and humidity.
2. Climate is the average weather pattern in a place over many years.
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E.ST.07.72 Describe how different weather occurs due to the constant motion of the atmosphere from the energy of the sun reaching the surface of the Earth.

Instructional Clarifications
1. Describe means to tell or depict in written or spoken words how weather is due to the motion of the atmosphere from the sun's warming of the Earth.
2. Most weather occurs at the lower portion of the atmosphere.
3. An air mass is a huge body of air that has similar temperature, humidity, and air pressure at any given height in the atmosphere.
4. Temperature changes in air masses and upper air currents cause air masses to move in the atmosphere.
5. The sun is the major cause of the heating of our atmosphere.
6. The Earth gets the same amount of light each day, but since the Earth is tilted on its axis, the light is unevenly divided into two hemispheres. The hemisphere that is tilted toward the sun and is receiving more of the direct light is experiencing spring and summer. The hemisphere that is tilted away from the sun is receiving less direct light and is experiencing fall and winter.
7. Rising warm air eventually cools.

8. Cool air is eventually warmed.

Assessment Clarification

1. Most weather occurs at the lower portion of the atmosphere and is due to changes in the temperature of air masses.
2. An air mass is a huge body of air that has similar temperature, humidity, and air pressure at any given height in the atmosphere.
3. Temperature changes in air masses cause them to move in the atmosphere.
4. The sun is the major cause of the heating and cooling of our atmosphere.
5. The Earth gets the same amount of light each day, but since the Earth is tilted on its axis, the light is unevenly divided into two hemispheres. The hemisphere that is tilted toward the sun and is receiving more of the direct light is experiencing spring and summer. The hemisphere that is tilted away from the sun is receiving less direct light and is experiencing fall and winter.
6. Rising warm air eventually cools.
7. Cool air is eventually warmed.
8. The more hours of sunlight mean more solar heating.

E.ES.07.73 Explain how the temperature of the oceans affects the different climates on Earth because water in the oceans holds a large amount of heat.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawings), demonstrations, written reports or verbally how the temperature of the oceans affects climates.
2. The Sun is the main source of the Earth's energy.
3. Both oceans and land absorb solar energy.
4. Oceans make up 70% of the Earth's surface.
5. Oceans absorb more energy from the Sun than land.
6. Oceans store a lot of heat energy.
7. The oceans store and transport heat energy that is related to climate.

Assessment Clarifications

1. The Sun is the main source of the Earth's energy.
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E.ES.07.74 Describe weather conditions associated with frontal boundaries (cold, warm, stationary, and occluded) and the movement of major air masses and the jet stream across North America using a weather map.

Instructional Clarification

1. Describe means to tell or depict in written or spoken words.

2. Frontal boundaries refer to the boundary that forms between warm and cold air masses.
3. Air masses are huge bodies of air that have similar temperature, humidity, and air pressure at any given height in the atmosphere. Warm and Cold air masses do not mix readily.
4. Warm air masses are forced to rise and expand over and above cold air masses, and cold air masses wedge underneath warmer air masses. Cool air is more dense and tends to sink. Warm air is less dense and tends to rise.
5. As the warm air cools, the moisture condenses to form clouds. Rain or snow may form if the warm air continues to rise and expand.
6. A cold front is a situation where a cold air mass is advancing upon a warm air mass.
7. A warm front is a situation where a warm air mass is advancing upon a cold air mass.
8. A stationary front is a situation where a cold air mass and warm air mass meet and neither mass is displacing the other.
9. An occluded front occurs when warm, cool, and cold air masses come together. They are not as common as cold, warm, or stationary fronts.
10. The jet stream is the concentrated, high-altitude streams of fast moving wind that blow from west to east across the northern and southern Hemispheres. It is responsible for the movement of major weather features from west to east across North America and the Earth as a whole.
11. Big thunderstorms in the summer and snowfalls in the winter are the weather conditions associated with cold fronts.
12. Steady, long-lasting rains in the summer and steady snowfalls in the winter are weather conditions associated warm fronts.
13. Weather conditions associated with an occluded front can be divided into three categories, before passing, while passing, and after passing.
14. Stationary fronts occur when neither warm nor cold air advances. The two air masses reach a stalemate. Neither front is moving. These types of conditions can last for days, producing nothing but Altocumulus clouds. Temperatures remain stagnant and winds are gentle to nil.

Assessment Clarifications

1. Frontal boundaries refer to the boundary that forms between warm and cold air masses.
2. Air masses are huge bodies of air that have similar temperature, humidity, and air pressure at any given height in the atmosphere. Warm and Cold air masses do not mix readily.
3. Warm air masses are forced to rise and expand over and above cold air masses, and cold air masses wedge underneath warmer air masses. Cool air is more dense and tends to sink. Warm air is less dense and tends to rise.
4. As the warm air cools, the moisture condenses to form clouds. Rain or snow may form if the warm air continues to rise and expand.
5. A cold front is a situation where a cold air mass is advancing upon a warm air mass.

6. A warm front is a situation where a warm air mass is advancing upon a cold air mass.
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13. Stationary fronts occur when neither warm nor cold air advances. The two air masses reach a stalemate.

Content Statement – E.ES.M.8
Human consequence – Water circulates through the four spheres of the Earth in what is known as the "water cycle."

Content Expectations

E.ES.07.81 Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff and ground water occur within the cycle.

Instructional Clarifications
1. Explain is to clearly describe by means of illustrations (drawings), demonstrations, written reports or verbally the water cycle.
2. The water cycle describes the continuous movement of water from the ocean and other bodies of water to the atmosphere, precipitation back to the Earth's surface, through runoff and groundwater to streams, transpiration from plants, and returning into the oceans, lakes, rivers, and streams.
3. Earth's water is always in motion, and the water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the Earth.
4. Evaporation is when the sun heats up water in rivers or lakes or the ocean and turns from liquid water to water in a gaseous state (water vapor). The water vapor or steam leaves the river, lake or ocean and goes into the air.
5. Plants absorb water from the soil and move it through the plant to all parts of the plant. Excess water leaves the plant through openings in the leaves, which is called transpiration.

6. Condensation takes place high in the atmosphere and at ground level. Water vapor rises and cools collecting around particles of dust, smoke, or salt to form water droplets. The process happens close to the ground. Fog develops when air having a relatively high humidity content (i.e., moist) comes in contact with a colder surface, often the Earth's surface, and cools to the dew point. Additional cooling leads to condensation and the growth of low-level clouds. (USGS)
7. Clouds form in the atmosphere because air containing water vapor rises and cools. Condensation takes place to complete the process. See Item 6 above for details.
8. For precipitation to occur, cloud droplets or ice crystals must grow heavy enough to fall through the air. One way that cloud droplets grow is by colliding and combining with other droplets and particulate matter in the atmosphere. As the droplets grow larger, they move faster and collect more small droplets. Finally, the droplets become heavy enough to fall out of the cloud as raindrops.
9. Infiltration occurs when precipitation remains in the shallow soil layer, then move through the soil and subsurface. Eventually the water enters a stream by seepage or filters down to become ground water.
10. Runoff is when rain falls on saturated or impervious ground and flows downhill as runoff.
11. Large amounts of water are stored beneath the surface of the Earth as groundwater. Rain soaks into the ground until it reaches layers of rock or clay that has tiny particles that are packed closely together. The water travels and fills the spaces between soil, rocks, and sand. The ground water stays within the aquifers withing the ground until it seeps out as a spring, connects to rivers or lakes, or people use it by digging wells.
12. A common misconception is that ground water is in the form of rivers and lakes beneath the surface of the Earth.

Assessment Clarifications

1. The water cycle describes the continuous movement of water from the ocean and other bodies of water to the atmosphere, precipitation back to the Earth’s surface, through runoff and groundwater to streams, and returning into the oceans, lakes, rivers, and streams.
2. Earth's water is always in motion, and the water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the Earth.
3. Evaporation is when the sun heats up water in rivers or lakes or the ocean and turns it into vapor or steam. The water vapor or steam leaves the river, lake or ocean and goes into the air.
4. Plants absorb water from the soil and move it through the plant to all parts of the plant. Excess water leaves the plant through openings in the leaves, which is called transpiration.
5. Condensation takes place high in the atmosphere and at ground level. Water vapor rises and cools collecting around particles of dust, smoke, or salt to form water droplets. The process happens close to the ground. Fog develops when air having a relatively high humidity content (i.e., moist) comes in contact with a colder surface, often the Earth's surface, and

cools to the dew point. Additional cooling leads to condensation and the growth of low-level clouds. (USGS)
6. Clouds form in the atmosphere because air containing water vapor rises and cools. Condensation takes place to complete the process. See Item 6 above for details.
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8. Infiltration occurs when precipitation remains in the shallow soil layer, then move through the soil and subsurface. Eventually the water enters a stream by seepage or filters down to become ground water.
9. Runoff is when rain falls on saturated or impervious ground and flows downhill as runoff.
10. Large amounts of water are stored beneath the surface of the Earth as groundwater. Rain soaks into the ground until it reaches layers of rock or clay that has tiny particles that are packed closely together. The water travels and fills the spaces between soil, rocks, and sand. The ground water stays within the aquifers withing the ground until it seeps out as a spring, connects to rivers or lakes, or people use it by digging wells.

E.ES.07.82 Analyze the flow of water between the components of a watershed, including surface features (lakes streams, rivers, wetlands) and groundwater.

Instructional Clarifications
1. Analyze is to examine methodically by separating into parts and studying their interrelations the flow of water between the components of a watershed.
2. A watershed is the land area that is drained by a river.
3. Streams and rivers that join another river become a larger watershed.
4. One watershed is divided or separated from another by a ridge or rise in the land.
5. Some of the precipitation that falls onto the land infiltrates into the ground to become ground water. Once in the ground, some of this water travels close to the land surface and emerges very quickly as discharge into streambeds, but, because of gravity, much of it continues to sink deeper into the ground. If the water meets the water table (below which the soil is saturated), it can move both vertically and horizontally. Water moving downward can also meet more dense and water-resistant non-porous rock and soil, which causes it to flow in a more horizontal fashion, generally towards streams, the ocean, or deeper into the ground. (From USGS)

Assessment Clarifications
1. A watershed is the land area that is drained by a river.
2. Streams and rivers that join another river become a larger watershed.

3. One watershed is divided or separated from another by a ridge or rise in the land.

Content Statement – E.FE.M.1
Atmosphere – The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different physical and chemical composition at different elevations.

Content Expectations

E.FE.07.11 Describe the atmosphere as a mixture of gases.

Instructional Clarifications
1. Describe means to tell or depict in written or spoken words the atmosphere as a mixture of gases.
2. The atmosphere is the envelope of gases that surrounds Earth.
3. The atmosphere is primarily composed of nitrogen and oxygen. The atmosphere is 78% nitrogen and 21% oxygen and 1% trace gases.
4. Trace gases include argon, carbon dioxide, neon, helium, methane, krypton, and hydrogen.
5. The combination of gases in Earth's atmosphere makes conditions on Earth suitable for living things.

Assessment Clarifications:
1. The atmosphere is the envelope of gases that surrounds Earth.
2. The atmosphere is primarily composed of nitrogen and oxygen. The atmosphere is 78% nitrogen and 21% oxygen and 1% trace gases.
3. The combination of gases in Earth's atmosphere makes conditions on Earth suitable for living things.

E.FE.07.12 Compare and contrast the atmosphere at different elevations.

Instructional Clarifications
1. Compare and contrast is to tell in written form or verbally the similarities and differences of the atmosphere at different elevations.
2. The atmosphere has different properties at different elevations.
3. At higher elevations the temperature of the air is generally colder (there are some exceptions) the air pressure is lower, and the density is lower.
4. The concentration of oxygen at sea level is about 21% and the barometric pressure averages 760 mmHg. As altitude increases, the concentration remains the same but the number of oxygen molecules per breath is reduced. At 12,000 feet (3,658 meters) the barometric pressure is only 483 mmHg, so there are roughly 40% fewer oxygen molecules per breath.
5. The atmosphere stretches high above the Earth and gets thinner at higher elevations. At an elevation of 80 kilometers (50 miles) there is very little air at all.

Assessment Clarifications

1. The atmosphere has different properties at different elevations.
2. At higher elevations the temperature of the air is generally colder.
3. The atmosphere stretches high above the Earth and gets thinner at higher elevations. At an elevation of 80 kilometers (50 miles) there is very little air at all.

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

Inquiry Processes
S.IP.07.11 Generate scientific questions about fluid earth systems and human activities based on observations, investigations, and research.
S.IP.07.12 Design and conduct scientific investigations on fluid earth systems and human activities
S.IP.07.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens, thermometer, models, sieves, microscopes, hot plates, pH meters) appropriate to scientific investigations of fluid earth systems and human activities.
S.IP.07.14 Use metric measurement devices in an investigation dealing with fluid earth systems and human activities.
S.IP.07.15 Construct charts and graphs from data and observations dealing with fluid earth systems and human activities.
S.IP.07.16 Identify patterns in data regarding fluid earth systems and human activities.
Inquiry Analysis and Communication
S.IA.07.11 Analyze information from data tables and graphs to answer scientific questions concerning fluid earth systems and human activities.
S.IA.07.12 Evaluate data, claims, and personal knowledge through collaborative science discourse on fluid earth systems and human activities.
S.IA.17.13 Communicate and defend findings of observations and investigations dealing with fluid earth systems and human activities.
S.IA.07.14 Draw conclusions from sets of data from multiple trials of a scientific investigation to draw conclusions on fluid earth systems and human activities.
S.IA.07.15 Use multiple sources of information on fluid earth systems and human activities to evaluate strengths and weaknesses of claims, arguments, or data.
Reflection and Social Implication
S.RS.07.11 Evaluate the strengths and weaknesses of claims, arguments, and data regarding fluid earth systems and human activities.
S.RS.07.12 Describe limitations in personal and scientific knowledge regarding fluid earth systems and human activities.
S.RS.07.13 Identify the need for evidence in making scientific decisions about fluid earth systems and human activities.
S.RS.07.14 Evaluate scientific explanations based on current evidence and scientific principles dealing with fluid earth systems and human activities.
S.RS.07.15 Demonstrate scientific concepts through various illustrations to depict fluid earth systems and human activities.
S.RS.07.16 Design solutions to problems about fluid earth systems and human activities using technology.
S.RS.07.17 Describe the effect humans and other organisms have on the balance of the natural world in terms of the water cycle and the sun's warming of the Earth.
S.RS.07.18 Describe what science and technology can and cannot reasonably contribute to society when dealing with fluid earth systems.
S.RS.07.19 Describe how science and technology concerning fluid earth systems have advanced because of the contributions of many people throughout history and across cultures.

Vocabulary

Critically important-State Assessable	Instructionally Useful
water cycle	pollutant
atmosphere	oxygen
evaporation	nitrogen
water vapor	trace gases
condensation	altitude
clouds	particle size
convection	hold water
ocean currents	solar energy
wind	habitat destruction
weather	endangered species
climate	extinct species
frontal boundaries	potable
cold front	non-potable
warm front	
stationary front	
occluded front	
air mass	
jet stream	
transpiration	
cloud formation	
precipitation	
infiltration	
surface runoff	
groundwater	
absorption	
watershed	
elevations	
surface mining	
deforestation	
overpopulation	
construction and urban development	
farming	
dams	
landfills	
air pressure	
barometric pressure	
acid rain	
fog	
dew	
radiation	
conduction	
energy	
sun	
pollution	

Instruments, Measurements, Representations

Measurements	Instruments	Units
temperature	thermometers	Celsius, Fahrenheit
wind velocity	wind vane or sock	north, south, east, west, kilometers/hour
barometric pressure	barometer	in/Hg

Representations of the water cycle are made through models and drawings of how the water in the atmosphere moves in a cycle.

A model of the water movement in a watershed demonstrates how smaller streams and rivers feed the largest river in a given landmass. The addition of ridges and elevations demonstrates the boundaries between watersheds.

Weather maps are representations of different weather conditions and demonstrate the movement of frontal boundaries.

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

Solar Energy: E.ES.07.11, E.ES.07.12, E.ES.07.13
Human Consequences: E.ES.07.41, E.ES.07.42
Weather and Climate: E.ES.07.71, E.ES.07.72, E.ES.07.73, E.ES.07.74
Water Cycle: E.S.07.81, E.ES.07.82
Atmosphere: E.FE.07.11, E.FE.07.12

Objectives

- Explain how the sun's warming of the Earth creates movement of air and water and affects weather and climate.
- Describe the affects of human activity on the atmosphere, hydrosphere, and geosphere.
- Describe the atmosphere as a mixture of gases.

Engage and Explore

- Conduct a brainstorming session to determine students' initial ideas about the water cycle. Write the following statement on the board or chart paper: *Earth's water is moving all the time.* Ask students to discuss their ideas in small groups and make diagrams of how they think the water on Earth is moving all the time and circulates through the atmosphere, on land, and in the oceans. Have students share their ideas of how a raindrop is made and where it goes after it falls to the ground. (E.ES.07.11, E.ES.07.12, E.ES.07.81, S.IP.07.11, S.IP.07.12, S.IA.07.13, S.IA.07.14, S.RS.07.15)
- To test student ideas about the water cycle make a model that demonstrates how water can circulate on land, water, and air. Use a container that is clear and can be a closed system. Place sand or soil in the bottom of the container and moisten the soil. Place a container or tub

of water in the model to represent a body of water. Close the system with a lid or plastic wrap to keep air from going into the model or coming out of the model. Place a clamp lamp or light bulb over the model. Position or direct the lamp over the body of water. Place a baggie of ice on one side of the lid so that it is positioned over the land (sand or soil) and have students make observations and record their findings. (E.ES.07.11, E.ES.07.12, E.ES.07.81, S.IP.07.11, S.IA.07.13, S.IA.07.14, S.RS.07.15)

- Demonstrate ocean currents using blue food coloring and hot water and icy cold water. Fill a container with hot tap water and place a few drops of dark blue food coloring in the hot water. Have the students make observations of the water and describe what they think is happening. Repeat the procedure with a container of icy cold water. Have students compare their observations between the two containers. Give students the opportunity to ask some what would happen if… questions and mess about with mixing hot and cold water and ice cubes to the containers and observe. (E.ES.07.11, E.ES.07.12, E.ES.07.13, S.IP.07.11, S.IA.07.13, S.IA.07.14, S.RS.07.15)
- Investigate the role of evaporation on pure water and salt water. Have students make a solar still by placing a small cup of water into a closable bag and place in the sunlight. Have students make one still with salt water and one still with pure water and make observations over a period of time. (E.ES.07.11)

Explain and Define

- Provide posters or other resources that illustrate the water cycle for students to use to compare their observations of the model of the water cycle and solar stills. Ask students to describe how the model demonstrates what happens in the atmosphere. (E.ES.07.11, E.ES.07.12, E.ES.07.13, E.ES.07.81)
- As a class determine a working definition of the water cycle and then introduce the terms evaporation, condensation, precipitation, and transpiration. Only after students have determined a meaning on their own, have them refer to a resource that helps to explain the definition of the terms. (E.ES.07.11, E.ES.07.81)
- Relate the model of the solar still to the water cycle and ask students the part of the water cycle where evaporation is key. Explain the role of the sun's warming of the Earth in the water cycle. (E.ES.07.11, E.ES.07.81)
- Discuss the sun's warming of the oceans. Explain that the oceans are vast bodies of salt water and represent 3/4ths of the Earth's surface.
- Explain that the sun's warming of the atmosphere also causes movement or currents in the air (wind) similar to the currents in the ocean. (E.ES.07.11, E.ES.07.12, E.ES.07.13)
- Compare weather and climate and explain how movement of water in the oceans and atmosphere affect weather and climate. Explain that weather is the daily conditions of temperature, precipitation, wind, and humidity and climate is the long term, year-to-year conditions of temperature,

precipitation, wind, and humidity. (E.ES.07.71, E.ES.07.72, E.ES.07.73, E.ES.07.74)

Elaborate and Apply

- Elaborate on the concept of the sun's warming of the Earth, the water cycle, and ocean currents to weather and climate. Have students study weather maps and weather reports to make connections between weather fronts and boundaries. Have students determine how the sun's warming of the Earth's land, water, and air affect the make-up of the different climates on Earth and daily weather changes. (E.ES.07.81, E.ES.07.74)
- Make real world connections to students' lives by relating the effect of human activity on the environment and how it affects plant and animal life. Have students do research on green house gases and global warming. Make connections to pollution in the atmosphere, hydrosphere, and geosphere. (E.ES.07.41, E.ES.07.42)
- The movement of water in the water cycle can be elaborated on by following the flow of water after it falls to the ground. Students investigate and make models of ground water and the movement of water in local watersheds. Have students identify different habitats that exist in the watersheds and how pollution and human activity has affected populations and quality of life. (E.ES.07.81, E.ES.07.82)
- Challenge the class to design and carry out a procedure that would clean polluted water. Encourage students to use what they have learned about the water cycle and evaporation through the solar still to clean the polluted water sample. (E.ES.07.41, E.ES.07.42)

Evaluate Student Understanding

Formative Assessment Examples
- Demonstrations and explorations
- Experiment design and conclusion
- Classroom discussion
- Student journal entries
- Quick Writes

Summative Assessment Examples
- End of unit test
- Poster, brochure, or Power Point presentation on the water cycle and how the sun's warming of the Earth causes ocean and air currents.
- Written report on the effect of human activities and action steps that can be taken.
- Models of water cycle, solar still, design for cleaning a sample of polluted water.

Enrichment

- Students take local soil and water samples to determine the level of pollution.
- Keep a long-term log of precipitation and compare it to records of 25 years and 50 years ago.
- Make a solar still to capture and clean rainwater.
- Research and report on acid rain and other environmental issues.
- Have students follow a drop from a cloud to the ocean.
- Research the role the Great Lakes play in the supply of fresh water on Earth.

Intervention

- Students design investigations to rank the particle size of different Earth materials, soil, sand, silt, clay, and pebbles. Students layer the water from largest to smallest particle size (top to bottom) and make observations of the flow of water underground and around different material.
- Use a sponge to demonstrate how water moves between the particles of soil.
- Watch daily weather reports and determine where the cold and warm fronts are located in the United States and the resulting weather from the fronts.
- Ask a local meteorologist to talk to the students and explain Doppler radar and how it is used to track different weather fronts.

Examples, Observations, and Phenomena (Real World Context)

The usual path of air masses in the northern hemisphere is from west to east. As air moves up a mountain range, it cools, and is less able to hold water. Precipitation often occurs and most of the water contained in the clouds falls to the ground on the west side of the mountain range. The land on the east side of the mountain range is dryer than the land on the west side. The east side of some mountain ranges is where some deserts are located.

Dew, fog, and clouds form when water vapor condenses on surfaces such as dust, smoke particles, and sea salt crystals. These small particles in the air are a necessary part of the water cycle for condensation to occur in the atmosphere.

Global warming and the effect of carbon emissions is a real world issue for students to study and make connections between the cycles and conditions that are necessary for life on Earth and how the activities of humans have threatened the survival of the planet.

Literacy Integration

Reading

R.IT.07.01 Students will analyze the structure, elements, features, style, and purpose of informational genre including persuasive essay, research report, brochure, personal correspondence, autobiography and biography.

R.CM.07.01 Students will connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.07.02 Students will retell through concise summarization grade-level narrative and informational text.

R.CM.07.04 Students will apply significant knowledge from grade-level science, social studies, and mathematics texts.

Books:
The Inside Story of Earth, Tam O'Shaughnassey, 2007
Living Green, John Johnson, Jr., 2008
A River Ran Wild, Lynne Cherry

Writing

W.GN.07.02 Students will write a research report using a wide variety of resources that includes appropriate organizational patterns (e.g., position statement/supporting evidence, problem statement/solution, or compare/contrast), descriptive language, and informational text features.

W.GN.07.03 Students will formulate research questions using multiple resources, perspectives, and arguments/counter-arguments to develop a thesis statement that culminates in a final presented project using the writing process.

W.PR.07.01 Students will set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PR.07.02 Students will apply a variety of pre-writing strategies for both narrative (e.g., graphically depict roles of antagonist/protagonist, internal/external conflict) and informational writing (e.g., position statement/supporting evidence, problem statement/solution, or compare/ contrast).

W.PR.07.03 Students will revise drafts to reflect different perspectives for multiple purposes and to ensure that content, structure, elements of style

and voice, literary devices, and text features are consistent.
Students will...

W.PS.07.01 Students will exhibit personal style and voice to enhance the written message in both narrative (e.g., personification, humor, element of surprise) and informational writing (e.g., emotional appeal, strong opinion, credible support).

Speaking

S.CN.07.01 Students will adjust their use of language to communicate effectively with a variety of audiences and for different purposes by using specialized language related to a topic and selecting words carefully to achieve precise meaning when presenting.

S.DS.07.02 Students will respond to multiple text types in order to anticipate and answer questions, offer opinions and solutions, and to identify personally with a universal theme.

Mathematics Integration

N.MR.07.04 Convert ratio quantities between different systems of units.

N.MR.07.02 Solve problems involving derived quantities such as density, velocity, and weighted averages.

A.PA.07.01 Recognize when information given in a table, graph, or formula suggests a directly proportional or linear relationship.

A.PA.07.11 Understand and use basic properties of real numbers.

D.RE.07.01 Represent and interpret data using graphs.

D.AN.07.03 Calculate and interpret relative frequencies and cumulative frequencies for data sets.