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The Five Big Ideas in Earth Science

1. The Earth and life on Earth has a history of change. The clues to understanding those changes are in the rocks.

2. Weather occurs in the atmosphere and is a result of lots of processes that act together to move heat and moisture around the Earth.

3. The surface of Earth is being worn down and reshaped by the action of water, ice, and wind. At the same time, Earth's surface is subject to mountain building that results from the activity of volcanoes and earthquakes.

4. The Earth and Moon are part of a larger solar system and all bodies in that system are in motion.

5. Earth's surface may be represented by a variety of maps and images which are generated by different kinds of technology.

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Big Idea #1

Learning Targets

for the unit

Recognizing and Observing Common Rocks

Lesson 1 - Meet the Rocks

1. I can recognize 16 common rocks and place them by their names on my placemat.
2. I can spell all 16 rock names correctly.
3. I can describe the 16 rocks with common terms.
4. I can categorize our 16 rocks as either sedimentary, igneous or metamorphic.
5. I can define what we mean by the rock cycle.
6. I can name how the rock cycle and water cycle are alike.
7. I can describe the following processes of the rock cycle:
    1. crystallization
    2. deposition
    3. lithification
    4. metamorphism
    5. weather
    6. erosion
    7. melting
8. I know the mean of the following word parts: litho-, ig-, meta-

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Big Idea #1

Learning Targets
for the unit
Recognizing and Observing Common Rocks

Lesson 2 - Texture and Composition of Our 16 Rocks.

1. I can make a drawing that shows a rock to be a mixture of mineral grains or mineral crystals.
2. I can correctly tell the difference between coarse-grained and fine-grained rocks igneous and metamorphic rocks
3. I can correctly tell the difference between coarse-grained, mediume-grained and fine-grained sedimentary rocks
4. I can tell the difference between sediment grains in sedimentary rocks and mineral crystals in igneous rocks.
5. I can correctly identify a sediment sample or a sedimentary rock as poorly-sorted or well-sorted.
6. I can correctly identify a porphyritic texture in an igneous rock.
7. I can recognize 6 common minerals - quartz, calcite, pink feldspar, white feldspar, biotite mica or muscovite mica - in a rock sample.
8. I can recognize, when present, shell fossils or plant fossils in a rock.
9. I can recognize laminations in a sedimentary rock sample.
10. I can recognize foliation and banding in a metamorphic rock.
11. I can describe 16 common rocks in terms of their texture (grain size, grain shape and grain arrangement) and composition (kinds of minerals and fragments present).

Lesson 3 - Important Vocabulary (13 words)

1. I know the meaning of the following vocabulary words: sediment, grain, crystal, sedimentary rock, igneous rock, metamorphic rock, sorting, rounding, mineral, rock, rock cycle, texture, composition.

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Big Idea #1

Learning Targets
for the unit
Processes that Make Rock and the Clues Left Behind

Lesson 1 Crystallization of magma to make igneous rock

1. I can define element.
2. I can name the 11 most common elements on and in earth and the name their symbols.
3. I can illustrate with symbolic drawings the differences among atom, molecule, element, and compound.
4. I can describe the behavior of atoms in the the three common states of matter.
5. I can describe and illustrate what happens to atoms or molecules when matter changes from the liquid state to a solid state and when matter changes from a solid to a liquid.
6. I can describe the behavior of atoms or molecules in a magma as it cools and in rock as they melt.
7. I can relate crystal size in igneous rock to how fast the magma must have cooled.
8. I can use the grain size of common igneous rocks as a clue to tell me what must have happened in the past
    9. glassy igneous rock must have cooled very rapidly on earth's surface or in the air
    10. fine-grained igneous rock cooled relatively fast on earth's surface in a lava flow or just below the earth's surface
    11. coarse-grained igneous rock cooled slowly well below earth's surface
    12. igneous rock with mix of grain sizes cooled slowly below earth's surface for sometime and then the rest of the magma cooled quickly at Earth's surface.
13. I can name places on Earth where igneous rock is forming today.
14. I can name places on Earth where igneous rock formed in the past
15. Important vocabulary: intrusive, extrusive, porphyry, variable, independent variable, dependent variable, magma, lava, molten, element, atom, molecule, compound, states of matter, solid, liquid, gas

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Big Idea #1
Processes the Make Rock and the Clues Left Behind
Learning Targets

Lesson 2: Deposition of Sediment to Make Sedimentary Rocks

1. 1. I can explain how solid rock is weathered and becomes sediment.
2. 2. I can describe the difference between mechanical and chemical weathering.
3. 3. I can describe the difference between weathering and erosion.
4. 4. I can describe and identify examples of weathering and erosion.
5. 5. I can explain why the deposition of certain sizes of sediment depends on the energy of the water in the environment of deposition.
6. 6. I can use the size of the grains in a sedimentary rock as a clue to the energy of the water during deposition, for example -
    1. 7. fine-grained sediment, like the tiny mud particles found in shale, gets deposited in low-energy environments like still water.
    2. 8. medium-grained sediment, like what's found in sandstone, gets deposited in water with moderate energy, like a beach or river.
    3. 9. coarse-grained sediment, like what's found in conglomerate, gets deposited in high energy environments like very fast moving river water.
7. 10. I can relate other features in sedimentary rock to processes of deposition:
    1. 11. ripples marks in sandstone-made by waves or river current rock was still sediment
    2. 12. stratification/bedding/laminations - layers made as deposition occurs over and over again
8. 13. I can name the environment in which the following organisms lived and died:
    1. 14. Coral lived in warm clean ocean water between 30N and 30S latitude and the coral colonies can become fossiliferous limestone
    2. 15. Plants live and die in great abundance in swamps and can become coal or organic-rich shale.
    3. 16. Invertebrates like clams, oysters and snails live near and ocean beach and can make fossiliferous sandstone or fossiliferous limestone.
9. 17. I can name places on Earth where today sedimentary rock is forming.
10. 18. I can name places on Earth where sedimentary rock formed in the past.
11. 19. I can write definitions, in my own words, for the important new vocabulary words: weathering, mechanical weathering, chemical weathering, sediment, erosion, modern environment of deposition, ancient environment of deposition, strata, bedding, and OTHER _____.

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Big Idea #3

The surface of Earth is not only worn down and reshaped by the action of water, ice, wind, but also built up by the activity of volcanoes and earthquakes.

Learning Targets for Lesson 1

Occurrences of volcanoes and earthquakes are NOT random.

1. I can plot locations on a world map using latitude and longitude.
2. I can name 12 active volcanoes and show where they are located.
3. I can explain the difference between shallow and deep earthquakes.
4. I can explain the difference between and earthquakes epicenter and focus.
5. I can name 5 places from around the world that are seismically active.
6. I can related the location of volcanoes and earthquakes to boundaries of tectonic plates.
7. I can explain why shallow earthquakes tend to be found at divergent boundaries and why deep earthquakes are found at convergent boundaries.
8. New vocabulary: volcano, earthquake, focus, epicenter, tectonic plate, plate tectonics, seismic, seismically, volcanologist, seismologist, converge, diverge

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Big Idea #3
The surface of Earth is not only worn down and reshaped by the action of water, ice, wind, but also built up by the activity of volcanoes and earthquakes.

Learning Targets for Lesson 2

Nuts and Bolts of Volcanoes

1. I can draw a simple sketch of the interior of a volcano labeling: vent, crater, magma chamber, layers of ash, layers of lava, lava flow.

2. I can name the three kinds of volcanoes (shield volcano, stratovolcano, cinder) and describe how they are different.

3. I can describe what comes out of a volcano during a volcanic eruption: ash, gases, and/or lava

4. I can relate the three kinds of volcanoes and their characteristic shapes to the kinds of material that are erupted from them.

5. I can describe difference between an explosive and a quiet eruption.

6. I can describe the different factors that cause explosive and quiet eruptions.

7. I can compare Mt Pinatubo with the eruptions I make in the laboratory.

8. I can name several ways in which volcanologists monitor a volcano.

9. I can name and describe 5 volcanic hazards and explain why they are hazardous: lava flow, ash, lateral blast, pyroclastic flow, lahar.

10. I can recognize a scientific hypothesis.

11. I can describe the plate tectonic setting for Mt. Pinatubo.

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Big Idea #2

Weather occurs in the atmosphere and is a result of lots of interacting processes that move heat and moisture around the Earth.

Learning Targets for Lesson 1

Characteristics of the Atmosphere - Section 1-1

1. I can describe the composition of the atmosphere, naming what the atmosphere is made of and how much of each.

2. I can illustrate the atmosphere as an ocean of air.

3. I can explain why air pressure decreases with altitude.

4. I can name the four layers in our atmosphere and describe how they are different from one another.

5. I can describe the changes in temperature with altitude.

6. New (re-new) vocabulary: altitude, density, heat, temperature, mass, air pressure

NAME _____ DATE _____ PERIOD____

Big Idea #2

Weather occurs in the atmosphere and is a result of lots of interacting processes that move heat and moisture around the Earth.

Learning Targets for Lesson 2

Heating the Atmosphere - Section 1-2

1. I can name the sun as the main source of energy for heating the atmosphere and the surface of the earth.

2. I can describe and give specific examples of heat transfer by radiation.

3. I can describe and give specific examples of heat transfer by thermal conduction.

4. I can describe and give specific examples of heat transfer by convection.

5. I can demonstrate that warmer air is less dense than colder air.

6. I can explain how convection currents are created and maintained.

7. I can describe what is meant by the greenhouse effect.

8. I can explain what is meant by the Earth's radiation balance.

9. I can explain the relationship between the greenhouse effect and global warming in terms of the Earth's radiation balance.

10. New vocabulary: reflected, absorbed, transmitted, radiation, (thermal, not electrical) conduction, convection, greenhouse effect, radiation balance, thermal energy

NAME _____ DATE _____ PERIOD____

Big Idea #2
Weather occurs in the atmosphere and is a result of lots of interacting processes that move heat and moisture around the Earth.

Learning Targets for Lesson 3

Wind . . . - Section 1-3
What makes wind? and Wind Patterns

1. I can explain that wind is caused by air moving from high pressure areas to low pressure areas.
2. I can explain the relationship between air pressure and wind direction at the surface of the Earth.
3. I can name pairs locations on Earth that show that the Earth is heated unequally.
4. I can convert from Celsius to Fahrenheit and vice versa.
5. I know what -40, 0, 10, 20, 100 degrees Celsius are in Fahrenheit degrees.
6. I can give a detailed explanation about how the earth is heated unequally, in terms of: (1) the fact that the Earth is a sphere and (2) that Earth's land surfaces heat differently than the oceans.
7. I can illustrate why sinking air has higher pressure than rising air using circles to represent the spacing of molecules of atmospheric gases.
8. I can label a world map with the latitudes that have long-lasting low pressure and high pressure areas and relate these areas to variations in heating.
9. I can model a non-spinning Earth and show that air would move, in a straight line from high pressure to low pressure.
10. I can illustrate the Coriolis effect with a spinning tray to show how wind currents appears to curve rather than blowing in a straight line from high pressure to low pressure.
11. I can explain the development of global wind belts in terms of unequal heating, pressure differences, convection and the Coriolis effect.
12. I can create a diagram to illustrate the global wind belts that are present at the surface of the Earth.
13. I can explain what the jet stream is and where it is.
14. I can explain the development of land and sea breezes in terms of unequal heating, pressure differences and convection.
15. I can create a diagram to illustrate how a land breeze and sea breeze develop.
16. New (and returning) vocabulary: wind, density, latitude, Coriolis effect, pressure belts, trade winds, prevailing westerlies, polar easterlies, jet stream, Fahrenheit, Celsius

BIG IDEA #4
The Earth and Moon both rotate and revolve; these motions give us day and night, seasons, and phases of the Moon.

Unit: Modeling rotation, revolution, day and night

1. I can show the meaning of degrees of latitude and longitude by imaging myself at the center of the earth and seeing the angle between my two arms as they point to imaginary objects at Earth's surface.
2. I can, on a diagram of the sun, Moon and Earth, shade the dark (or night side) of the Moon and Earth.
3. I can demonstrate rotation, revolution and axis of rotation with my tennis ball earth-globe and with my body.
4. I can explain why the sun rises in the east, not the west.
5. I can correctly position sunrise and sunset for the "where you live pin" on my tennis ball earth-globe.
6. I can demonstrate the time of day for the "where you live pin" on my tennis ball earth-globe.
7. I can visualize the force of gravity as a force that pulls things toward the center of Earth.
8. I can redefine down as in and up as out.
9. I can define a year as one period of Earth's revolution and a day as one period of Earth's rotation.
10. VOCABULARY: *latitude, longitude, rotate, revolve, period of rotation, period of revolution, axis of rotation, orbit*.

Unit: The reason for the seasons

1. I can draw pictures to explain why the earth is warmer in the tropics than it is in the polar regions.
2. I can describe the changing length of Earth's daylight period through the course of one year.
3. I can describe the changes in the time of sunrise and sunset through the course of one year.
4. I can describe the temperature changes on Earth through the course of one year.
5. I can demonstrate, at the same time, Earth's rotation, axial tilt and orbit around the sun with my tennis ball earth-globe and tennis ball sun.
6. I can show, using my model of the sun, earth and earth's orbit, where direct and indirect sunlight falls on the solstices and equinoxes.
7. I can relate Earth's position in its orbit to the season we would experience on Earth.
8. I can explain why we would not have seasons if Earth's axis of rotation were vertical.
9. VOCABULARY: *seasons, solstice, equinox, angle of incidence.*

Unit: Phases of the Moon

1. I can use my head to represent Earth, the light from the overhead project to represent Sun, and a small Styrofoam ball to represent Moon, and model Moon's orbit around Earth.
2. I can draw the phases of the moon as they occur in order, starting with the Moon directly between the Earth and Sun.
3. I can define a month as one period of Moon's revolution about Earth.
4. I can correctly name the phase when presented with a photo of Moon.
5. I can match the drawings and dates from my Moon Log with Moon's position on a diagram of Sun, Earth and Moon.
6. I can demonstrate the two kinds of eclipses with my head/overhead/Styrofoam ball model of the Earth, Moon and Sun.
7. I can explain why a solar eclipse can only happen during a new moon and why a lunar eclipse can only happen during a full moon.
8. I can explain why everyone on the dark side of the Earth can see a lunar eclipse.
9. I can explain why only limited numbers of people can see a solar eclipse.
10. VOCABULARY: *phases of the moon, solar eclipse, lunar eclipse.*

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Big Ideas 3 and 5

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Learning Targets

The Place We Call Home

1. I can explain the concepts of drainage basin, watershed and aquifer with sentences and drawings.

2. I can sketch an outline of the state of Minnesota and outline the location of the Red River Valley, the beach ridges to the east of Moorhead, Highway 10, Highway 75, Moorhead, Dilworth, Glyndon, Hawley, Detroit Lakes, and the moraines of the Lakes Country.

3. I can use Google Earth and my DNR Watershed map of Minnesota to find the Red River Valley, the beach ridges and the Lakes country.

4. I can tell the story of how glaciers impacted the landscape of our valley, beach ridges and lakes country in terms of sediment and topography.

5. I can identify a river meander, point bar, cut bank and channel in the field and on Google Earth.

6. I can calculate the cross-sectional area of a river channel.

7. I can measure calculate the velocity of river water.

8. I can measure and calculate the discharge of a river.

9. I can use a GPS unit to mark and to find waypoints.

10. I can play hide and seek with my GPS unit and can relate the game to geocaching.

11. I can relate compass directions and lat/long from my GPS unit to locations on a topo map or aerial photo.

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Big Idea 5
Earth's surface may be represented by a variety of maps and images which are generated by different kinds of technologies.

Learning Targets

Global Positioning System-GPS

9. I can name the function of the buttons on my GPS unit and navigate through the different pages (main menu, compass, satellite, etc)

10. I can force the latitude numbers to increase by walking west and to decrease by walking east AND I can force the longitude numbers to increase by walking north and to decrease by walking south. I can therefore understand the connection between cardinal directions and changes in latitude and longitude.

11. I can find a location on the surface of Earth if I am given that location's latitude and longitude. I can do this without using the "Finding a Waypoint" function on my GPS unit.

12. I can, knowing m current location and knowing a desired location, figure out what direction to walk to get to that desired location.

13. At the science center, I can go to certain coordinates by applying my GPS skills in an unfamiliar setting.

14. Important vocabulary: Global Positioning System (GOS), latitude, longitude, waypoint, degrees, minutes, satellite, compass, heading.