Environmental Science Institute
Hot Science – Cool Talks

The 2004 Mars Exploration Rover Mission:
Evidence for Water and Prospects for Life
Dr. John Grotzinger

TEKS Correlations

This file contains suggestions for incorporating material from this CD-ROM into curriculum using the Texas Essential Knowledge and Skills for Science.

§112.2. Science, Kindergarten.

(K.1) Scientific processes. The student participates in classroom and field investigations following home and school safety procedures. The student is expected to:

(A) demonstrate safe practices during classroom and field investigations; and

Slide 6 shows a rocky landscape. What would you do in order to be safe if you were walking across and studying this landscape?

(B) learn how to use and conserve resources and materials.

How would you take care of a Mars Exploration Mission Rover? [Slide 7]

(K.2) Scientific processes. The student develops abilities necessary to do scientific inquiry in the field and the classroom. The student is expected to:

(A) ask questions about organisms, objects, and events;

Slide 29 and 30 show a bed of rock. What do you think made the rock look like this?

(B) plan and conduct simple descriptive investigations;

How could water have made the lines on this rock bed? What kind of investigation could you conduct to determine if and/or how water created these lines?

(C) gather information using simple equipment and tools to extend the senses;

What kind of tools would you use to examine this rock?

D) construct reasonable explanations using information; and

(E) communicate findings about simple investigations.

What would you find out from using those tools? Did it help you decide whether or not water had made the lines?

(K.3) Scientific processes. The student knows that information and critical thinking are used in making decisions. The student is expected to:

(A) make decisions using information;
Do you think you could live on Mars? [Slide 19]
(C) explain a problem in his/her own words and propose a solution.
What problems would a person have if he or she tried to live on Mars? Propose solutions that might make it possible for a person to live on Mars.

(K.4) Scientific processes. The student uses age-appropriate tools and models to verify that organisms and objects and parts of organisms and objects can be observed, described, and measured. The student is expected to:
(A) identify and use senses as tools of observation; and
When you use a ruler to measure things, what senses are you using? When you use a magnifying glass, what senses are you using?
(B) make observations using tools including hand lenses, balances, cups, bowls, and computers.
If you had a rock from Mars, what tool would allow you to have a close-up look at its fine details?

(K.5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:
(A) describe properties of objects and characteristics of organisms;
Slide 24 shows land and water. What are the properties of the land? What are the properties of the water? How are they different?
(C) recognize and copy patterns seen in charts and graphs.
Slide 18 shows a graph. Why are there different colors on the graph? (The different colors represent different temperature ranges).

(K.6) Science concepts. The student knows that systems have parts and are composed of organisms and objects. The student is expected to:
(A) sort organisms and objects into groups according to their parts and describe how the groups are formed; What kind of things would you collect on the surface of Mars? (rocks, dust) How might you sort these things according to their parts? (rocks from one certain area in one pile, or rocks of the same kind in the same pile, dust in a separate pile from rocks, etc.).
(D) identify parts that, when separated from the whole, may result in the part or the whole not working, such as cars without wheels and plants without roots; and
What do you think would happen if a rover lost a wheel? What if it lost all of its wheels? [Slide 7]
(E) manipulate parts of objects such as toys, vehicles, or construction sets that, when put together, can do things they cannot do by themselves.
Slide 8 shows a picture of the rocket that carries the rover to Mars. The rocket has an engine. Without the engine, can the rocket go to Mars? Can the rover go to Mars without the rocket?

(K.7) Science concepts. The student knows that many types of change occur. The student is expected to:

(A) observe, describe, and record changes in size, mass, color, position, quantity, time, temperature, sound, and movement;
What happens to the position of sand when it is picked up by a dust devil? [Slide 19]
(B) identify that heat causes change, such as ice melting or the Sun warming the air and compare objects according to temperature;
What caused the dust devil in slide 19?
(C) observe and record weather changes from day to day and over seasons; and
On Mars, do you think it would be hotter or colder in the day compared to the night? Does Mars have seasons?

(K.8) Science concepts. The student knows the difference between living organisms and nonliving objects. The student is expected to:
(A) identify a particular organism or object as living or nonliving; and
Are the rocks on Mars living? Are the rocks on Earth living? What are some characteristics of living things on Earth?
(B) group organisms and objects as living or nonliving.
Name some other living and nonliving things.

(K.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:
(A) identify basic needs of living organisms;
In order to live on Mars, what would a bird need to survive? Does Mars have the things a bird needs for survival?
(C) identify ways that the Earth can provide resources for life.
How does the Earth provide water, sunlight, and food for life? Does Mars provide these things?

(K.10) Science concepts. The student knows that the natural world includes rocks, soil, and water. The student is expected to:
(A) observe and describe properties of rocks, soil, and water; and
Slide 24 is a picture of a landscape on Earth. Describe the properties of the rocks, soil, and water that are in this picture. How is this landscape different from that of Mars on Slide 19? How are the landscapes similar?
(B) give examples of ways that rocks, soil, and water are useful.
Describe ways that rocks, soil, and water are useful.

§112.3. Science, Grade 1.
(1.1) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to:
(A) demonstrate safe practices during classroom and field investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) learn how to use and conserve resources and materials.
How would you take care of a Mars Exploration Mission Rover? [Slide 7]

(1.2) Scientific processes. The student develops abilities necessary to do scientific inquiry in the field and the classroom. The student is expected to:
(A) ask questions about organisms, objects, and events;
Slide 29 and 30 show a bed of rock. What do you think made the rock look like this?
(B) plan and conduct simple descriptive investigations;
How could water have made the lines on this rock bed? What kind of investigation could you conduct to determine if and/or how water created these lines?
(C) gather information using simple equipment and tools to extend the senses;
What kind of tools would you use to examine this rock?
(D) construct reasonable explanations and draw conclusions; and
(E) communicate explanations about investigations.
What would you find out from using those tools? Did it help you decide whether or not water had made the lines?

(1.3) Scientific processes. The student knows that information and critical thinking are used in making decisions. The student is expected to:
(A) make decisions using information;
Do you think you could live on Mars? [Slide 19]
(C) explain a problem in his/her own words and identify a task and solution related to the problem.
What problems would a person have if he or she tried to live on Mars? Propose solutions that might make it possible for a person to live on Mars.

(1.4) Scientific processes. The student uses age-appropriate tools and models to verify that organisms and objects and parts of organisms and objects can be observed, described, and measured. The student is expected to:
(A) collect information using tools including hand lenses, clocks, computers, thermometers, and balances;
Slide 21 shows a rock that was investigated by the rover on Mars. Using hand lenses, computers, thermometers, clocks, and balances, how would you examine these rocks?
(B) record and compare collected information; and
What kind of information would you collect and record?
(C) measure organisms and objects and parts of organisms and objects, using nonstandard units such as paper clips, hands, and pencils.
If the rocks were the size of golf balls, would you use paper clips, hands, or pencils to measure them?

(1.5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:
(A) sort objects and events based on properties and patterns; and
Slide 37 is a picture of a rock formation with sedimentary layers. Which layers are the oldest? Which are the youngest? (Due to the Law of Superposition, we

know that the layers on the bottom are the oldest, and the layers on the top are the youngest.)
(B) identify, predict, and create patterns including those seen in charts, graphs, and numbers. Slide 18 shows a graph. Why are there different colors on the graph? (The different colors represent different temperature ranges). If red represents hot and purple represents cold, do you think that blue or green would be hotter?

(1.6) Science concepts. The student knows that systems have parts and are composed of organisms and objects. The student is expected to:
(A) sort organisms and objects according to their parts and characteristics;
What kind of things would you collect on the surface of Mars? (rocks, dust) How might you sort these things according to their parts? (rocks from one certain area in one place, rocks of the same kind in the same pile, dust in a separate pile from rocks)
(C) manipulate objects such as toys, vehicles, or construction sets so that the parts are separated from the whole which may result in the part or the whole not working; and
What do you think would happen if a Mars rover lost a wheel? What if it lost all of its wheels? [Slide 7]
(D) identify parts that, when put together, can do things they cannot do by themselves, such as a working camera with film, a car moving with a motor, and an airplane flying with fuel.
Slide 8 shows a picture of the rocket that carries the rover to Mars. The rocket has an engine. Without the engine, can the rocket go to Mars? Can the rover go to Mars without the rocket?

(1..7) Science concepts. The student knows that many types of change occur. The student is expected to:
(A) observe, measure, and record changes in size, mass, color, position, quantity, sound, and movement;
What happens to the position of sand when it is picked up by a dust devil? [Slide 19]
(B) identify and test ways that heat may cause change such as when ice melts;
What caused the dust devil in slide 19?
(C) observe and record changes in weather from day to day and over seasons; and
On Mars, do you think it would be hotter or colder in the day compared to the night? Does Mars have seasons?

(1.8) Science concepts. The student distinguishes between living organisms and nonliving objects. The student is expected to:
(A) group living organisms and nonliving objects; and
Are the rocks on Mars living? Are the rocks on Earth living? What are some characteristics of living things on earth?
(B) compare living organisms and nonliving objects.

What are the characteristics of living organisms and what are the characteristics of nonliving objects?

(1.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:
(A) identify characteristics of living organisms that allow their basic needs to be met; and What are the basic needs of a fish? Would a fish be able to get these basic needs satisfied on Mars?

(1.10) Science concepts. The student knows that the natural world includes rocks, soil, and water. The student is expected to:
(A) identify and describe a variety of natural sources of water including streams, lakes, and oceans;
Identify and describe at least three natural sources of water on Earth.
(B) observe and describe differences in rocks and soil samples; and
Slide 21 shows a large rock with smaller rocks and soil. How are the rocks different from each other? How are the rocks different from the soil that they are sitting upon?
(C) identify how rocks, soil, and water are used and how they can be recycled.
Slide 24: How are the rocks, soil, and water used and how can they be recycled?

§112.4. Science, Grade 2.

(2.1) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to:
(A) demonstrate safe practices during classroom and field investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) learn how to use and conserve resources and dispose of materials.
How should scientists take care of a Mars Exploration Mission Rover? [Slide 7] What should they do with the rover when it no longer works?

(2.2) Scientific processes. The student develops abilities necessary to do scientific inquiry in the field and the classroom. The student is expected to:
(A) ask questions about organisms, objects, and events;
Slide 29 and 30 show a bed of rock. What do you think made the rock look like this?
(B) plan and conduct simple descriptive investigations;
How could water have made the lines on this rock bed? What kind of investigation could you conduct to determine if and/or how water created these lines?
(C) compare results of investigations with what students and scientists know about the world;

Scientists say on slides 29 and 30 that these ripples were caused by downstream water current. What did your students think?
(D) gather information using simple equipment and tools to extend the senses;
What kind of tools could you use to examine this bed of rock and decide what caused the ripple formations?
(E) construct reasonable explanations and draw conclusions using information and prior knowledge; and
After hearing what scientists say what caused these ripples and comparing this to your explanation, what kind of conclusions can you come to?
(F) communicate explanations about investigations.
Share your conclusions with the class.

(2.3) Scientific processes. The student knows that information and critical thinking are used in making decisions. The student is expected to:
(A) make decisions using information;
Do you think you could live on Mars? [Slide 19]
(C) explain a problem in his/her own words and identify a task and solution related to the problem.
What problems would a person have if he or she tried to live on Mars? Propose solutions that might make it possible for a person to live on Mars.

(2.4) Scientific processes. The student uses age-appropriate tools and models to verify that organisms and objects and parts of organisms and objects can be observed, described, and measured. The student is expected to:
(A) collect information using tools including rulers, meter sticks, measuring cups, clocks, hand lenses, computers, thermometers, and balances; and
Slide 21 shows a rock that was investigated by the rover on Mars. Using hand lenses, computers, thermometers, clocks, and balances, how would you examine these rocks?
(B) measure and compare organisms and objects and parts of organisms and objects, using standard and non-standard units. What are nonstandard units of measurement? (Hands, paperclips, anything not originally intended to measure something). If these rocks were the size of baseball, what nonstandard units of measurement would you use to get an estimation of the size?

(2.5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:
(A) classify and sequence organisms, objects, and events based on properties and patterns; and
Slide 37 is a picture of a rock formation with sedimentary layers. Which layers are the oldest? Which are the youngest? (Due to the Law of Superposition, we know that the layers on the bottom are the oldest, and the layers on the top are the youngest.)
If you had a collection of different kinds of rocks from Mars, different colors, shapes, and sizes, how would you classify and sequence them?
(B) identify, predict, replicate, and create patterns including those seen in charts,

graphs, and numbers.
Slide 18 shows a graph. Why are there different colors on the graph? (The different colors represent different temperature ranges). If red represents hot and purple represents cold, do you think that blue or green would be hotter?

(2.6) Science concepts. The student knows that systems have parts and are composed of organisms and objects. The student is expected to:
(A) manipulate, predict, and identify parts that, when separated from the whole, may result in the part or the whole not working, such as flashlights without batteries and plants without leaves; working; and
What do you think would happen if a Mars rover lost a wheel? Would it still be able to move? What if it lost all of its wheels? [Slide 7]
Slide 8 shows the rocket that carries the rover to Mars. If the engine was removed from the rocket, could the rocket go to Mars?
(B) manipulate, predict, and identify parts that, when put together, can do things they cannot do by themselves, such as a guitar and guitar strings;
Wings and an engine are part of a plane. If the plane did not have an engine or wings, could it fly? Could the wings and the engine fly without the rest of the plane?

(2.7) Science concepts. The student knows that many types of change occur. The student is expected to:
(A) observe, measure, record, analyze, predict, and illustrate changes in size, mass, temperature, color, position, quantity, sound, and movement;
What happens to the position of sand when it is picked up by a dust devil? [Slide 19]
(B) identify, predict, and test uses of heat to cause change such as melting and evaporation; Slide 23 shows a picture of a body of water. If the weather were to become very hot for a period of time, what would happen to the water?
(C) demonstrate a change in the motion of an object by giving the object a push or a pull; and Slide 7 shows a picture of the rovers. If you pushed the rovers, what would happen? If you pulled the rovers, what would happen?
(D) observe, measure, and record changes in weather, the night sky, and seasons.
On Mars, do you think it would be hotter or colder in the day compared to the night? Does Mars have seasons?

(2.8) Science concepts. The student distinguishes between living organisms and nonliving objects. The student is expected to:
(A) identify characteristics of living organisms; and
What are the characteristics of a living organism such as a fish? Can fish live on Mars? Why not?
(B) identify characteristics of nonliving objects.
What are the characteristics of nonliving objects such as the rock on Slide 21? Why can this rock exist on Mars?

(2.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:
(A) identify the external characteristics of different kinds of plants and animals that allow their needs to be met; and What are the external characteristics of different kinds of plants and animals? What allow their needs to be met? Could their needs be met on Mars?
(B) compare and give examples of the ways living organisms depend on each other and on their environments. Give examples and describe how living organisms depend on each other and their environment.

(2.10) Science concepts. The student knows that the natural world includes rocks, soil, water, and gases of the atmosphere. The student is expected to:
(A) describe and illustrate the water cycle; and Look at slide 24 and describe the water cycle.
(B) identify uses of natural resources. What kind of natural resources do we have on earth? Describe how we use them. Are these resources on Mars?

§112.5. Science, Grade 3.

(3.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(3.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
(A) plan and implement descriptive investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology; Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
(B) collect information by observing and measuring;
How would you observe and measure the ripples in this bed of rock in order to collect information?
(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
What explanations can you form?
(D) communicate valid conclusions; and Are these guesses or valid conclusions?

(E) construct simple graphs, tables, maps, and charts to organize, examine and evaluate information. What type of data would you collect about this rock bed? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(3.3) Scientific processes. The student knows that information, critical thinking, and scientific problem solving are used in making decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this explanation? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars?
(C) represent the natural world using models and identify their limitations;
Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were made on the computer. What are the benefits and limitations of these computer generated models?
If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?
(E) connect Grade 3 science concepts with the history of science and contributions of scientists. What do you know about the history of space science? When did the first human walk on the moon?

(3.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:
(A) collect and analyze information using tools including calculators, microscopes, cameras, safety goggles, sound recorders, clocks, computers, thermometers, hand lenses, meter sticks, rulers, balances, magnets, and compasses; and
Slide 21 shows a rock that was investigated by the rover on Mars. How would you study and collect information about these rocks using calculators, microscopes, cameras, safety goggles, clocks, computers, thermometers, hand lenses, meter sticks, rulers, balances, magnets, and compasses?

(3.6) Science concepts. The student knows that forces cause change. The student is expected to:
(A) measure and record changes in the position and direction of the motion of an object to which a force such as a push or pull has been applied; and
Slide 7 is a picture of the rovers. What would happen to the rovers if you pushed or pulled them? How could you measure the distance that they traveled?

(3.7) Science concepts. The student knows that matter has physical properties. The student is expected to:
(A) gather information including temperature, magnetism, hardness, and mass using appropriate tools to identify physical properties of matter; and
If you had a rock from Mars, what tool would you use to measure its mass?
(B) identify matter as liquids, solids, and gases.
Out of the water, rocks, and air pictured in slide 24, which is a solid, which is a gas, and which is a liquid?

(3.11) Science concepts. The student knows that the natural world includes earth materials and objects in the sky. The student is expected to:
(A) identify and describe the importance of earth materials including rocks, soil, water, and gases of the atmosphere in the local area and classify them as renewable, nonrenewable, or inexhaustible resources; What kind of natural resources do we have on earth? Categorize these materials as renewable, nonrenewable, or inexhaustible. Why are materials such as rocks, soil, gases of the atmosphere, and water important to humans and life on earth? Which of these materials are also on Mars?
(B) identify and record properties of soils such as color and texture, capacity to retain water, and ability to support the growth of plants; Soil on earth has the capacity to retain water. Could the soil on Mars sustain plants without water?
(C) identify the planets in our solar system and their position in relation to the Sun; and
How many planets are between Mars and the sun?
You can see a picture of Earth taken from Mars in slide 16.
Slide 17 shows an Eclipse of the sun by Phobos, one of Mars' two moons.

§112.6. Science, Grade 4.

(4.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(4.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
(A) plan and implement descriptive investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology;

Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect information by observing and measuring;
How would you observe and measure the ripples in this bed of rock in order to collect information?
(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
What explanations can you form?
(D) communicate valid conclusions; and
Are these guesses or valid conclusions?
(E) construct simple graphs, tables, maps, and charts to organize, examine, and evaluate information.
What type of data would you collect about this rock bed? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(4.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this explanation? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars?
(C) represent the natural world using models and identify their limitations;
Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were made on the computer. What are the benefits and limitations of these computer generated models?
If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?
(E) connect Grade 4 science concepts with the history of science and contributions of scientists. What do you know about the history of space exploration? When did the first human walk on the moon? Has a human walked on Mars?

(4.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect and analyze information using tools including calculators, safety goggles, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, meter sticks, timing devices, balances, and compasses; and
Slide 21 shows a rock that was investigated by the rover on Mars. How would you study and collect information about these rocks using calculators, microscopes, cameras, safety goggles, timing devices, computers, thermometers, hand lenses, meter sticks, rulers, balances, magnets, and compasses?

(4.5) Science concepts. The student knows that complex systems may not work if some parts are removed. The student is expected to:
(A) identify and describe the roles of some organisms in living systems such as plants in a schoolyard, and parts in nonliving systems such as a light bulb in a circuit; and
In Slide 7, identify the role of the wheels and the engine on the rover.
(B) predict and draw conclusions about what happens when part of a system is removed.
In Slide 7, what would happen if the wheels and the engine were removed?

(4.10) Science concepts. The student knows that certain past events affect present and future events. The student is expected to:
(A) identify and observe effects of events that require time for changes to be noticeable including growth, erosion, dissolving, weathering, and flow; and
Slide 19 features dust devil on a landscape on Mars. What kind of changes do you think this landscape has gone through?

(4.11) Science concepts. The student knows that the natural world includes earth materials and objects in the sky. The student is expected to:
(A) test properties of soils including texture, capacity to retain water, and ability to support life;
Soil on earth has the capacity to retain water. Could the soil on Mars sustain plants without water?
(C) identify the Sun as the major source of energy for the Earth and understand its role in the growth of plants, in the creation of winds, and in the water cycle.
Slide 18 describes the effect of the Sun on the surface of Mars. Slide 19 shows how convection can lead to the creation of dust devils.

§112.7. Science, Grade 5.

(5.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?

(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(5.2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement descriptive and simple experimental investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect information by observing and measuring;
How would you observe and measure the ripples in this bed of rock in order to collect information?
(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
What explanations can you form?
(D) communicate valid conclusions; and
Are these guesses or valid conclusions?
(E) construct simple graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate information.
What type of data would you collect about this rock bed? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(5.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this explanation? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could support this theory?
(C) represent the natural world using models and identify their limitations;

Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were made on the computer. What are the benefits and limitations of these computer generated models?
If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?
(D) evaluate the impact of research on scientific thought, society, and the environment; and
(E) connect Grade 5 science concepts with the history of science and contributions of scientists.
What do you know about the history of space exploration? When did the first human walk on the moon? Has a human walked on Mars?

(5.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:
(A) collect and analyze information using tools including calculators, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, compasses, balances, hot plates, meter sticks, timing devices, magnets, collecting nets, and safety goggles; and
Slide 21 shows a rock that was investigated by the rover on Mars. How would you study and collect information about these rocks using calculators, microscopes, cameras, safety goggles, timing devices, computers, thermometers, hand lenses, meter sticks, rulers, balances, magnets, and compasses?

(5.6) Science concepts. The student knows that some change occurs in cycles. The student is expected to:
(A) identify events and describe changes that occur on a regular basis such as in daily, weekly, lunar, and seasonal cycles;
Does Mars have days and nights? How do you think that daytime and night time would be different on Mars? Does Mars have seasons?
Slide 17 talks about the 2 moons of Mars and how they can form an eclipse of the sun.

(5.8) Science concepts. The student knows that energy occurs in many forms. The student is expected to:
(A) differentiate among forms of energy including light, heat, electrical, and solar energy;
What kind of energy do Mars' moons (slide 17) produce?
What kind of energy does the sun produce?

(5.11) Science concepts. The student knows that certain past events affect present and future events. The student is expected to:
(A) identify and observe actions that require time for changes to be measurable, including growth, erosion, dissolving, weathering, and flow;

Slide 36: In order to measure the age of the deposition of the different layers of sediment, time must pass for the sediment to be deposited.
Identify erosive forces that may cause this landscape to change over time.
(B) draw conclusions about "what happened before" using data such as from treegrowth rings and sedimentary rock sequences; and
Use the sedimentary layers of Slide 36 for this example to answer “what happened before” questions.
Are the more recent deposits above or below the older deposits?

(12) Science concepts. The student knows that the natural world includes earth materials and objects in the sky. The student is expected to:
(A) interpret how land forms are the result of a combination of constructive and destructive forces such as deposition of sediment and weathering;
Using slides 6, 19, 24, 28, 36, 42, 43, and 44, hypothesize the different elements that caused deposition and weathering in these pictures. Compare and contrast the constructive and destructive forces that Earth and Mars have in common and do not have in common.
(D) identify gravity as the force that keeps planets in orbit around the Sun and the moon in orbit around the Earth.
What force keeps Mars in orbit around the Sun?

§112.22. Science, Grade 6.

(6.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(6.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data by observing and measuring;

How would you observe and measure the ripples in this bed of rock in order to collect information?
(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
What explanations can you form?
(D) communicate valid conclusions; and
Are these guesses or valid conclusions?
(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.
What type of data would you collect about this rock bed? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(6.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) represent the natural world using models and identify their limitations;
Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were made on the computer. What are the benefits and limitations of these computer generated models?
If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?
(D) evaluate the impact of research on scientific thought, society, and the environment; and
(E) connect Grade 6 science concepts with the history of science and contributions of scientists.
What do you know about the history of space exploration? When did the first human walk on the moon? Has a human walked on Mars? Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?

(6.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect, analyze, and record information using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, timing devices, hot plates, test tubes, safety goggles, spring scales, magnets, balances, microscopes, telescopes, thermometers, calculators, field equipment, compasses, computers, and computer probes; and
Slide 21 shows a rock that was investigated by the rover on Mars. How would you study and collect information about these rocks using beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, timing devices, test tubes, safety goggles, spring scales, magnets, balances, microscopes, telescopes, thermometers, calculators, field equipment, compasses, computers, and computer probes?
(B) identify patterns in collected information using percent, average, range, and frequency. Study the chart on Slide 31 and learn the information that it conveys. What is the range of median grain diameter (mm)? Are the numbers on the horizontal and vertical axes written in equal intervals?

(6.5) Scientific concepts. The student knows that systems may combine with other systems to form a larger system. The student is expected to:
(A) identify and describe a system that results from the combination of two or more systems such as in the solar system; and
Have students describe the systems planets have with their moons, the system the planets create with the sun, and the system our solar system creates within the universe.
(B) describe how the properties of a system are different from the properties of its parts. How is the rotation of the planets in the solar system different from the relationship between a planet and its moon(s)? How is the climate of a planet different from the properties of the solar system?

(6.10) Science concepts. The student knows the relationship between structure and function in living systems. The student is expected to:
(A) differentiate between structure and function;
What is the structure and function of the Mars rover? [Slides 4 and 7] How does this compare to structure and function in living systems?

(6.13) Science concepts. The student knows components of our solar system. The student is expected to:
(A) identify characteristics of objects in our solar system including the Sun, planets, meteorites, comets, asteroids, and moons; and
What is the order of the planets in our solar system (starting with the planet closest to the sun? Which planets have rings? Which planets have moons? What is unique about Mars?
(B) describe types of equipment and transportation needed for space travel.
Describe the equipment and transportation needed for space travel. Slides 4 and 7 show the Mars Exploration Rovers. Slide 8 shows the rocket which takes the rovers to Mars.

§112.23. Science, Grade 7.

(7.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(7.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data by observing and measuring;
How would you observe and measure the ripples in this bed of rock in order to collect information?
(C) organize, analyze, make inferences, and predict trends from direct and indirect evidence;
What inferences can you make?
(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.
What type of data would you collect about the ripples in this bed of rock? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(7.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in

the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?

(C) represent the natural world using models and identify their limitations;

Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were created on the computer. What are the benefits and limitations of these computer generated models?

If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?

(D) evaluate the impact of research on scientific thought, society, and the environment; and

(F) connect Grade 7 science concepts with the history of science and contributions of scientists.

What do you know about the history of space exploration? When did the first human walk on the moon? Has a human walked on Mars? Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?

(7.4) Scientific processes. The student knows how to use tools and methods to conduct science inquiry. The student is expected to:

(A) collect, analyze, and record information to explain a phenomenon using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, timing devices, magnets, and compasses; and

Slide 26 describes a discovery scientists made on Mars. The blueberry orbs made of hematite are a different chemical composition than the rock underlying them. Therefore, scientists hypothesized that these orbs were deposited here by dirty water. If you were the scientist, how would you test the chemical composition of these orbs and the underlying rock? How would you use tools such as beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, timing devices, magnets, and compasses?

(7.8) Science concepts. The student knows that complex interactions occur between matter and energy. The student is expected to:

(B) identify that radiant energy from the Sun is transferred into chemical energy through the process of photosynthesis.

Describe the process of photosynthesis. Does photosynthesis occur on Mars?

(7.13) Science concepts. The student knows components of our solar system. The student is expected to:
(A) identify and illustrate how the tilt of the Earth on its axis as it rotates and revolves around the Sun causes changes in seasons and the length of a day;
What causes different seasons on Earth? Do seasons occur on Mars?
and
(B) relate the Earth's movement and the moon's orbit to the observed cyclical phases of the moon. Slide 17 demonstrates that the rotation of Mars and the revolution of 2 moons around Mars can cause an eclipse of the Sun. Describe how the Earth's movement and the moon's orbit causes the observed cyclical phases of the moon.

§112.24. Science, Grade 8.

(8.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(8.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data by observing and measuring;
How would you observe and measure the ripples in this bed of rock in order to collect information?
How would you compare the similar ripple patterns on Mars and Earth? [Slides 34 and 35]
(C) organize, analyze, evaluate, make inferences, and predict trends from direct and indirect evidence;
What inferences can you make?

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.
What What type of data would you collect about the ripples in this bed of rock, and how would you organize, analyze, and display your data?
Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(8.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide sufficient evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) represent the natural world using models and identify their limitations;
Look at Slide 4. It shows a picture of a rover on Mars. This picture and the video of the Mars rover on slide 10 were created on the computer. What are the benefits and limitations of these computer generated models?
If you were build a 3-D model of the rover, what materials would you use? What would be the benefits and limitations of the model? What can the real rover do that the model cannot?
(D) evaluate the impact of research on scientific thought, society, and the environment; and
(E) connect Grade 8 science concepts with the history of science and contributions of scientists.
What do you know about the history of space exploration? When did the first human walk on the moon? Has a human walked on Mars? Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?

(8.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:
(A) collect, record, and analyze information using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, water test kits, and timing devices; and

Slide 26 describes a discovery scientists made on Mars. The small orbs made of hematite are a different chemical composition than the rock underlying them. Therefore, scientists hypothesized that these orbs were deposited here by dirty water. If you were the scientist, how would you test the chemical composition of these orbs and the underlying rock? How would you use tools such as beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, water test kits, and timing devices?

(8.5) Scientific processes. The student knows that relationships exist between science and technology. The student is expected to:
(A) identify a design problem and propose a solution;
Slide 4 describes the design of the Mars Rover and identifies all of its parts. Identify a limitation of this design and propose a solution.
(B) design and test a model to solve the problem; and
Design a model of rover with improvements that enable the rover to overcome the limitation that you identified. What materials would you use to make your model rover? How could you test the model to determine if it solves the problem?
(C) evaluate the model and make recommendations for improving the model.
Have students explain how they have improved the Mars Rover through their design. Then, after they have tested the rovers, have the students evaluate the model and make recommendations for improving the model.

(8.10) Science concepts. The student knows that complex interactions occur between matter and energy. The student is expected to:
(A) illustrate interactions between matter and energy including specific heat;
Slide 18 describes the effects of the Sun's radiation on the surface of Mars.

(8.13) Science concepts. The student knows characteristics of the universe. The student is expected to:
(A) describe characteristics of the universe such as stars and galaxies;
Describe the characteristics of Earth that make it different from all other planets. Compare and contrast Earth and Mars. How many moons does Mars have? View a Martian eclipse in slide 17. What conditions are necessary for an eclipse to occur?

(8.14) Science concepts. The student knows that natural events and human activities can alter Earth systems. The student is expected to:
(A) predict land features resulting from gradual changes such as mountain building, beach erosion, land subsidence, and continental drift;
Slides 42 and 43 exhibit land formations. Hypothesize what you think might have caused these formations.

§112.42. Integrated Physics and Chemistry.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data and make measurements with precision;
How would you collect data and measure the ripples with precision in this bed of rock?
(C) organize, analyze, evaluate, make inferences, and predict trends from data; and
What type of data would you collect about the ripples in this bed of rock? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.
How would you compare the similar ripple patterns on Mars and Earth? [Slides 34 and 35]
(D) communicate valid conclusions.
Share your conclusions with the class.

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian

rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) evaluate the impact of research on scientific thought, society, and the environment;
Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?
(D) describe connections between physics and chemistry, and future careers; and
(E) research and describe the history of physics, chemistry, and contributions of scientists.
What contributions have physicists and chemists made to the 2004 Mars Exploration Rover Mission? Would this mission have been possible without their contributions?

(4) Science concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to:
(A) calculate speed, momentum, acceleration, work, and power in systems such as in the human body, moving toys, and machines;

The rocket that carried Opportunity, one of the Mars Exploration Rovers, traveled 460 million km in 210 days. What was its average speed in km per hour?

- A. 2.19 km/hour
- B. 91.27 km/hour
- C. 91,269.84 km/hour
- D. 96,600.00 km/hour

[Answer: C]

How much force is needed to accelerate a 1,000 kg Mars Exploration Rover at a rate of 0.25 m/s^2?

- A. 125 N
- B. 250 N
- C. 1,250 N
- D. 4,000 N

[Answer: B]

(6) Science concepts. The student knows the impact of energy transformations in everyday life. The student is expected to:
(B) investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation;

The primary way gases on Mars transmit heat is by the process of —

- A. conduction
- B. radiation
- C. reflection
- D. convection

[Answer: D]

Slide 18 elaborately describes convection on Mars. Slide 19 shows a dust devil caused by the process of convection.

(7) Science concepts. The student knows relationships exist between properties of matter and its components. The student is expected to:
(A) investigate and identify properties of fluids including density, viscosity, and buoyancy;

A sample of an element from Mars has a volume of 84.5 mL and a density of 1.63 g/mL. What is the mass in grams of the sample?

- A. 137.74 g
- B. 51.84 g
- C. 32.64 g
- D. 0.02 g

[Answer: D]

§112.43. Biology.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;

Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data and make measurements with precision;
How would you collect data and make precise measurements of the ripples in this bed of rock?
(C) organize, analyze, evaluate, make inferences, and predict trends from data; and
What type of data would you collect about the ripples in this bed of rock? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) evaluate the impact of research on scientific thought, society, and the environment;
Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?

§112.44. Environmental Systems.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.

How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data and make measurements with precision;
How would you collect data and make precise measurements of the ripples in this bed of rock?
(C) organize, analyze, evaluate, make inferences, and predict trends from data; and
What type of data would you collect about the ripples in this bed of rock? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information.

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) evaluate the impact of research on scientific thought, society, and the environment;
Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?

(6) Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:
(A) summarize forms and sources of energy;
Summarize the forms and sources of energy on Mars.

§112.45. Chemistry.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Life might have been present at Meridiani (on Mars), but if so it would have had to tolerate extreme conditions involving hypersalinity, hyperacidity, and episodic dryness. On Earth, microorganisms exist under such conditions, but how would the origination of life under such conditions pose a major problem to origin-of-life scenarios? [Slide 47]
(C) evaluate the impact of research on scientific thought, society, and the environment;
Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?
(D) describe the connection between chemistry and future careers; and
(E) research and describe the history of chemistry and contributions of scientists.
What contributions have chemists made to the 2004 Mars Exploration Rover Mission? Would this mission have been possible without their contributions?

(4) Science concepts. The student knows the characteristics of matter. The student is expected to:
(A) differentiate between physical and chemical properties of matter;
Describe the physical properties of the hematitic concretions that can be observed in slide 21? What is known about their chemical properties based on the graph in slide 23?

§112.46. Aquatic Science.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and \

Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;
Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data and make measurements with precision;
How would you collect data and make precise measurements of the ripples in this bed of rock?
(C) express and manipulate quantities using mathematical procedures such as dimensional analysis, scientific notation, and significant figures;
How do you think you might use dimensional analysis, scientific notation, and significant figures in this investigation?
(D) organize, analyze, evaluate, make inferences, and predict trends from data; and
How would you organize, analyze, evaluate, make inferences, and predict trends from this data?

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
Life might have been present at Meridiani (on Mars), but if so it would have had to tolerate extreme conditions involving hypersalinity, hyperacidity, and episodic dryness. On Earth, microorganisms exist under such conditions, but how would the origination of life under such conditions pose a major problem to origin-of-life scenarios? [Slide 47]
(C) evaluate the impact of research on scientific thought, society, and the environment;

Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?
(D) describe the connection between aquatic science and future careers; and
(E) research and describe the history of aquatic science and contributions of scientists.
What contributions have aquatic scientists made to the 2004 Mars Exploration Rover Mission's search for evidence for water?

(6) Science concepts. The student knows the roles of cycles in an aquatic environment. The student is expected to:
(B) interpret the role of aquatic systems in climate and weather; and
How might lack of water on Mars influence its climate and weather?

§112.47. Physics.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of the rover? What should they do with the rover when it no longer works?

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(C) evaluate the impact of research on scientific thought, society, and the environment;
Do you think people may live on Mars someday? If so, how do you think the data collected by the rovers and the research conducted by scientists on Earth could contribute to making that possible?
(D) describe the connection between physics and future careers; and
(E) research and describe the history of physics and contributions of scientists.
What contributions have physicists made to the 2004 Mars Exploration Rover Mission? Would this mission have been possible without their contributions?

§112.48. Astronomy.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of the rover? What should they do with the rover when it no longer works?

(3) Scientific processes. The student uses critical thinking and scientific problem solving skills to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support or refute this theory?
Life might have been present at Meridiani (on Mars), but if so it would have had to tolerate extreme conditions involving hypersalinity, hyperacidity, and episodic dryness. On Earth, microorganisms exist under such conditions, but how would the origination of life under such conditions pose a major problem to origin-of-life scenarios? [Slide 47]
(C) evaluate the impact of research on scientific thought, society, and the environment;
What resources might Mars provide to future generations? What have we learned about the Earth's environment that we could use in developing resources on Mars?
(D) describe the connection between astronomy and future careers; and
(E) research and describe the history of astronomy and contributions of scientists.
What contributions have astronomers made to the 2004 Mars Exploration Rover Mission? Would this mission have been possible without their contributions?

(4) Science concepts. The student knows scientific information about the universe. The student is expected to:
(A) observe and record data about lunar phases and uses that information to model the earth, moon, and sun system; and How many moons does Mars have? Describe the position of Mars, the sun, and Phobos, one of Mars' two moons, during the eclipse that is shown in slide 17.

(7) Science concepts. The student knows how mathematical models, computer simulations, and exploration can be used to study the universe. The student is expected to:
(E) analyze the impact of the space program on the collection of data about the Earth and the universe. Discuss what kind of impacts will result if scientists find all of the answers to goals of the Mars Rover listed on Slide 3.

(9) Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to:
(B) compare the planets in terms of orbit, size, composition, rotation, atmosphere, moons, and geologic activity;
Compare Mars and Earth in terms of orbit, size, composition, rotation, atmosphere, moons, and geologic activity.
(D) relate the role of gravitation to the motion of the planets around the Sun and to the motion of moons and satellites around the planets.
Relate the role of gravitation to the role of Mars around the Sun and to the motion of Mars' two moons around Mars.
Explain the process of the eclipse in slide 17.

(10) Science concepts. The student knows how life on Earth is affected by its unique placement and orientation in our solar system. The student is expected to:
(A) compare the factors essential to life on Earth such as temperature, water, mass, and gases to conditions on other planets;
Compare the factors essential to life on Earth to conditions on Mars.

§112.49. Geology, Meteorology, and Oceanography.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
(A) demonstrate safe practices during field and laboratory investigations; and
Slide 6 shows some rocky terrain. What would you do in order to be safe if you were walking across and studying this terrain?
(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
How should scientists properly take care of a Mars Exploration Mission Rover? [Slide 7]
What should they do with the rover when it no longer works?

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:
(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;

Form a hypothesis explaining why the bed of rock in slides 29, 30, and 34 has a ripple pattern on it.
Scientists hypothesize that the ripples on Slide 29 were caused by downstream water current. What do you think of this explanation? What kind of technology do you think they used in order to study this?
(B) collect data and make measurements with precision;
How would you collect data and make precise measurements of the ripples in this bed of rock?
(C) organize, analyze, evaluate, make inferences, and predict trends from data; and
What type of data would you collect about the ripples in this bed of rock? Describe a graph, table, chart, or map that would help you organize, examine, and evaluate this information. What inferences can you make?

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
Scientists hypothesize that the ripples on slides 29, 30, and 34 were caused by downstream water current. What do you think of this hypothesis? Scientists also hypothesize that there was once water on Mars because the geology of Mars has similar characteristics to geologic characteristics that were created on Earth in the presence of water. Compare the ripples of the bed of rock from Earth on slide 34 and the ripples of the rock on slide 35. Do you see ripples in the Martian rock? Does this picture provide enough evidence to convince you that there used to be water on Mars? What additional evidence could further support this theory?
(C) evaluate the impact of research on scientific thought, society, and the environment;
Some scientists propose that life once lived in the harsh climate conditions of Mars. How have these theories posed a problem to origin-of-life scenarios? (Slide 46)
(D) describe the connections between geology, meteorology, oceanography, and future careers; and
(E) research and describe the history of geology, meteorology, oceanography, and contributions of scientists.
What contributions have geologists, meteorologists, and oceanographers made to the 2004 Mars Exploration Rover Mission? Would this mission have been possible without their contributions?

(4) Science concepts. The student knows the Earth's unique characteristics and conditions. The student is expected to:
(B) analyze conditions on Earth that enable organisms to survive.

What are the conditions of Earth that enable organisms to survive? Which of these conditions occur on Mars? Which of these conditions do not occur on Mars?