Science Benchmark Clarification, Instruction, and Assessment

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Describe major features of the Earth's surface. (SCI.V.1.E.1).

Benchmark Clarification
The Earth's surface has many different kinds of physical features.
Students will:

- Describe the Earth's surface in different locations
- Distinguish between features such as mountains/hills, mountains/ plains, mountains/valleys, grasslands/deserts, oceans/lakes, rivers/waterfalls, and lakes/stream.

Key Concepts (voc.)
Types of landforms:

- mountains
- plains
- valleys
- deserts

See (*link to SCI.V.2.E.2*).

Bodies of water:

- rivers
- oceans
- lakes

Real-World Context
Examples of Michigan features:

- hills
- valleys
- rivers
- waterfalls
- Great Lakes
- pictures of global land features:
  - mountains
  - deserts
  - valleys
  - plains

Instructional Example SCI.V.1.E.1

Benchmark Question: What is the Earth's surface like?
Focus Question: How could you describe the major features of the Earth's surface?

The teacher will pose the focus question. The students will look for pictures in old magazines or online that reflect all of the key concepts. Upon completion of their research, students will classify their pictures based on physical features. During the classification process, students will come to a consensus on how to describe the features. The students will present their pictures and explain the reasoning for their classifications orally. The teacher should monitor students for misconceptions.
What might be some misconceptions that students would have?

Constructing: (*link to SCI.1.E.1*), (*link to SCI. I.1.E.5*).

Reflecting: (*link to SCI. II.1.E.1*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.1.html

Earth from Above: uses the Flash format to feature the amazing photos of Yann Arthus-Bertrand. Images exist for all sorts of physical and cultural phenomena, especially agriculture. Choose images by geographic locale or from an index. Animated clips and screensavers are also available.

http://home.fujifilm.com/efa/

Color Landform Atlas of the U.S. offers shaded relief maps (large file size), county maps, black and white maps, satellite image, 1895 maps (Big: 1.92 Mb), and postscript file maps for printing of all 50 states.

http://fermi.jhuapl.edu/states/states.html

Geomorphology from Space: "237 plates, each treating a geographic region where a particular landform theme is exemplified. Commentary, photographs, locator maps, and sometimes a geologic map accompany each plate."

http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_HOME_PAGE.html

Cole, Joanna. *The Magic School Bus: Inside the Earth.* Scholastic, 1989.

Earth's features.
http://encarta.msn.com/

Physical features.
http://walrus.wr.usgs.gov/docs/ask-a-ge.html

Stille, Darlene. *Deserts*. TRUE BOOKS ECOSYSTEMS SERIES. Children's Press, 1999.

Classroom Assessment Example SCI.V.1.E.1

Students will illustrate and write descriptions of six or more major features of the Earth's surface.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Number of illustrations	Illustrates four or fewer major features of the Earth's surface.	Illustrates five different major features of the Earth's surface.	Illustrates six different features of the Earth's surface.	Illustrates more than six different features of the Earth's surface.
Completeness of descriptions	Writes four or fewer descriptions of major features of the Earth's surface.	Writes five descriptions of major features of the Earth's surface.	Writes six accurate descriptions of major features of the Earth's surface.	Writes more than six descriptions of major features of the Earth's surface.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Recognize and describe different types of Earth materials (SCI.V.1.E.2).

Benchmark Clarification
The Earth's surface is made of many different materials, such as minerals, rocks, boulders, gravel, sand, clay, and soil.

Students will:
- Classify many types of materials
- Recognize and locate where these materials can be found locally

Key Concepts (voc.)
Materials:
- mineral
- rock
- boulder
- gravel
- sand
- clay
- soil

Tools:
- hand lens

Real-World Context
Samples of natural Earth materials:
- rocks
- sand
- soil
- minerals

Instructional Example SCI.V.1.E.2

Benchmark Question: What is the Earth's surface like?
Focus Question: How would you recognize the different natural materials found on the Earth's surface?

The teacher will give students samples of each of the materials found in the Key Concepts

Students will study the samples using various science processes and tools such as a hand lens, balance, and ruler. During their observations, students will discuss questions about rocks, minerals, and soil (including gravel and sand) such as:

- What does it look like?
- What does it feel like?
- How is it like the others?
- How is it unlike the others?
- Where would you find this locally or in the state?
- How would you use it?

Students will record their observations in a data table.
Small groups of students will write their observations using the answers to the questions.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.4*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.5*).

Resources/References:

Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.2.html

Collecting Rocks: "Describes the origin of major rock types and how rocks can provide clues to the Earth's history. Includes suggestions for starting a rock collection, identifying specimens, and housing such a collection."

http://pubs.usgs.gov/gip/collect1/collectgip.html

National Resources Conservation Service Educational Resources: an introduction for K-6 level students answering basic questions about the physical, chemical, and biological properties of soil with a special emphasis on soil conservation.

http://www.nhq.nrcs.usda.gov/CCS/squirm/skQ13.html

Nasa's Soil Science Education Page: "This page contains a lot of new, exciting, fun and informative material on the soil."

http://ltpwww.gsfc.nasa.gov/globe/index.htm

Bains, Rae, 1985, ROCKS AND MINERALS: Mahwah, New Jersey, Troll (Venture into Reading Series), 32 p.
Cole, Joanna. *Magic School Bus: Inside The Earth*. Scholastic, 1989.
Gans, Roma. *Let's Go Rock Collecting*. Harper, 1997.
How Would You Use It? (*link to V.1.E.5*).
Ostlund, Karen. *Science Process Skills. NSTA, 1992.*
VanCleave, Janice. Janice *VanCleave's Rocks & Minerals*. Wiley, 1999.
Wooley, Allan. *Rocks & Minerals*. Usbourne, 2001.

Classroom Assessment Example SCI.V.1.E.2

The teacher will give students Earth materials and a hand lens. Each student will identify the Earth materials by sorting the samples into pre-labeled containers.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Identification of Earth materials	Identifies less than 70% of the Earth materials correctly.	Identifies 70% of the Earth materials correctly.	Identifies 80% of the Earth materials correctly.	Identifies more than 80% of the Earth materials correctly.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Describe natural changes in the Earth's surface. (SCI.V.1.E.3).

Benchmark Clarification
Water, wind, gravity, and glaciers cause many changes in the Earth's surface.

Students will:

- Recognize evidence that forces such as water, wind, gravity, and glaciers erode the Earth's surface
- Describe how volcanoes, earthquakes, and glaciers change the Earth's surface

Key Concepts (voc.)
Causes of changes:

- volcanoes
- earthquakes
- erosion (water, wind, gravity, glaciers)

Results of change:

- valleys
- hills
- lakes
- widened rivers
- mountains
- cracks
- movement of Earth materials such as boulders, gravel, sand, clay

Real-World Context
Examples around the school where erosion has occurred:

- gullies formed in down-hill gravel areas
- cracks in asphalt

Examples beyond the school where changes have occurred:

- volcanic mountains
- shorelines
- landslides
- sand dunes
- slopes
- river valleys

Instructional Example SCI.V.1.E.3

Benchmark Question: How do the Earth's features change over time?
Focus Question: How does water erosion change the Earth's surface over time?

The teacher will pose the focus question and facilitate a discussion to assess the students' prior knowledge.

Students will create their own models of a hill using Earth materials (boulders, gravel, sand, clay). Students will describe their models in writing, orally, or in a labeled drawing. Using a cup with small holes in the bottom, students then will pour water, one cup at a time, to simulate a rainstorm. After each cup, students will describe the changes in their models and the process (erosion) that causes these changes. In this way, students will demonstrate how the process of erosion, caused by moving water, changes the Earth's surface.

Students will discuss the changes that occur due to the process of erosion.

Students will predict the effects on their model if a heavy rainfall occurs over many days. The teacher will correct any misconceptions. (List some possible misconceptions that students might have like weathering and erosion being synonymous. Weathering breaks down the material IN PLACE whereas erosion involves the TRANSPORT of material away from the original site)

Results of erosion:

- gullies
- movement of Earth material
- lakes
- rivers/streams
- hills
- valleys

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.4*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.4*).

Resources/References:

Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.3.html

Images of River Landforms
http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_4/GEO_CHAPTER_4_TABLE.HTML

Images of Weathering
http://www.geo.duke.edu/geo41/wea.htm

All Along a River created by high school students, this site uses animation to portray river erosion, volume, transportation, and velocity.

http://www.thinkquest.org/library/lib/site_sum_outside.html?tname=28022&url=28022/body.html

Cole, Joanna. *Magic School Bus- Blows Its Top: A Book About Volcanoes*. Scholastic, 1996.
Cole, Joanna. *Magic Schools Bus- Inside the Earth.* Scholastic, 1989.

Erosion.
http://encarta.msn.com/

Classroom Assessment Example SCI.V.1.E.3

The teacher will give students the following scenario:
In the spring, road construction began on the highway near Jose's house. Jose observed a cone-shaped pile of soil approximately six feet tall left by the construction crew. A heavy rain occurred lasting two days. After the rain, Jose noticed the pile had changed.

Each student will write a paragraph describing the cause and effect of changes in a pile of soil after a heavy rainstorm. Students will describe at least three changes Jose observed, including the process (erosion).
Students should refer to the Real-World Context in this benchmark in their answers.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.3

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of description of erosion	Describes a single change, not a process, without using the word "erosion."	Describes a process of change without including the term "water erosion."	Describes a process of change as water erosion.	Describes a process of change as water erosion and other forces (wind, gravity, or glaciers) that cause erosion.
Completeness of description of effects of change	Describes fewer than two effects/changes caused by erosion.	Describes two effects/ changes caused by erosion.	Describes three effects/ changes caused by erosion.	Describes more than three effects/changes caused by erosion.

Science Benchmark Clarification, Instruction, and Assessment

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Explain how rocks and fossils are used to understand the history of the Earth (SCI.V.1.E.4).

Benchmark Clarification
The history of the Earth can be explained by examining rocks and fossils. The bottom layer of rock is usually the oldest.

Students will:
· Explain how fossils are a record of the existence of plants and animals
· Interpret how the layers of rocks explain the age of the Earth

Key Concepts (voc.)
- fossils
- extinct plants and animals
- ages of fossils
- rock layers

See (*link to SCI.III.4.E.1*).

Real-World Context
- fossils found in gravel, mines, and quarries
- beaches (Petoskey stones)
- museum displays
- Michigan examples of layered rocks
- specific examples of extinct plants and animals such as dinosaurs

Instructional Example SCI.V.1.E.4

Benchmark Question: How are rocks and fossils used to understand the history of the Earth?
Focus Question: How do different layers of the Earth represent the history of the Earth?

The teacher will pose the focus question to the class to introduce the lesson.
Then students in small groups will fill a grocery bag with daily collections of classroom scraps and shredded colored paper. This collection will be created over a period of time.

Each time period is designated by the use of different colored shredded paper. (At least two different colors should be used.) After the collection period, each group will cut a wide strip down one side of the bag, showing a window revealing all layers. Measuring the height of the bag in centimeters, students will cut a strip of paper equal to the height of the bag and will measure and record the contents of each layer. Based on the students' data, the group will determine the events that occurred during the different time periods. The students will identify that the bottom layer represents the oldest layer.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.1.E.1*).

Resources/References:

Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.4.html

Fossils, Rocks, and Time—This 24-page free booklet explains the basics of how fossils are used in establishing time sequence in geology. 94-0054

http://pubs.usgs.gov/gip/fossils/

Michigan Stratigraphy (rock layers): The Michigan Department of Environmental Quality (DEQ) archives a number of maps dealing with Michigans stratigraphy.

http://www.deq.state.mi.us/gsd/freepaga.html#TOP

Dinosaurs Fact and Fiction: "contains answers to some frequently asked questions about dinosaurs, with current ideas and evidence to correct some long-lived popular misconceptions."

http://pubs.usgs.gov/gip/dinosaurs/

Geological Time Machine: The University of California at Berkeley Museum of Paleontology offers the easily navigable Geological Time Machine with sections on stratigraphy with information about deposition, nomenclature, and strata identification; ancient life with an overview of major biological events, including origin and extinction of important groups; localities with resources about particular fossil localities, and tectonics which discusses continental migrations, changes in global circulation, and climate change. This site also offers links to K-12 educational resources and museum exhibits.

http://www.ucmp.berkeley.edu/help/timeform.html

Kittinger, Jo. *Stories in Stone: The World of Animal Fossils*. Watts, 1999.
Manning, Mick. *What's Under The Bed?* Watts, 1998.

Classroom Assessment Example SCI.V.1.E.4

Students will construct a labeled graphic representation of each shredded paper time period that identifies and labels the time periods. The graphic representation should visually demonstrate different lengths of time.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.4

Criteria	Beginning	Developing	Achieving	Exceeding
Accuracy of graphic representation	Creates a graphic representation that inaccurately represents the time periods.	Creates a graphic representation of the time periods that is incomplete.	Creates a graphic representation of the time periods that is complete.	Creates a graphic representation of the time periods that is complete and includes details.
Accuracy of labels	Labels only one layer accurately.	Labels some layers accurately.	Labels most layers accurately.	Labels all layers accurately.
Correctness of order	Does not arrange layers in time order.	Arranges some layers in time order.	Arranges most layers in time order.	Arranges layers in time order.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Describe uses of materials taken from the Earth (SCI.V.1.E.5).

Benchmark Clarification
Materials taken from the Earth are used in our daily lives:

- oil into gasoline
- oil into plastics
- sand into glass
- metallic ores into metal
- gravel into concrete and asphalt
- coal burned for electricity
- uranium for nuclear power
- water for drinking, cleaning, and cooling

Students will:

- Describe some of the uses of materials taken from the Earth

Key Concepts (voc.)

- transportation
- building materials
- energy
- water

See (*link to SCI.V.2.E.3*).

Real-World Context
Examples of uses of Earth materials:

- gravel into concrete for walls
- gypsum into drywall
- sand into glass for windows
- road salt
- ores into metal for chairs
- oil into gasoline for cars
- coal burned to produce electricity
- water for hydroelectric power

Samples of manufactured materials:

- concrete
- drywall
- asphalt
- iron
- steel

Instructional Example SCI.V.1.E.5

Benchmark Question: How are materials taken from the Earth used?
Focus Question: How do people use materials from the Earth?

The teacher will pose the focus question and will facilitate the discussion. The teacher will place students in small groups and give each group a pencil. The teacher will ask the students what materials were used to make this pencil. In small groups, students will discuss the parts of the pencil and what Earth materials were used to make it: wood, pencil lead, metal bands, eraser, paint. They will organize their information into a data table and label each column.

	Parts of the Pencil				
	Wood	***Lead***	***Eraser***	***Paint***	***Metal Band***
Earth	Maple Trees	Graphite	Rubber Tree Sap	Petroleum	Aluminum Ore
Materials		Carbon		Oil	

As a whole group, discuss what Earth materials were used to make the pencil and address any misconceptions. List some misconceptions that students might have like Earth materials are non-renewable natural resources that come from the geosphere, such as aluminum ore, petroleum, etc. Maple trees and rubber trees are renewable natural resources that are part of the biosphere. Earth materials are listed in Benchmark Clarification.

Each student will choose an object listed in the Real-World Context and research the Earth materials used to make the object.

Students will present their findings to the class in a speech with a visual aid.

Constructing: (*link to SCI.I.1.E.1*).

Reflecting: (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:

Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.5.html

General Pencil Company.
http://www.generalpencil.com/

Seaboard Pencil Company.
http://www.pencils.co.uk/

Coal Education: educational resources, images, and lesson plans sponsored by the Kentucky Coal Council.

http://www.coaleducation.org/

Suzuki, David. *Nature in the Home*. Stoddard Kids, 1996.

Classroom Assessment Example SCI.V.1.E.5

Students will select five objects found around school. (A bit of guidance will be needed here given that so many everyday objects are combinations of several materials (ex. brass, most clothing, wood. A teacher provided list would allow students to choose from appropriate objects.) Each student will create a booklet that illustrates each object and lists the Earth materials that were used to make the object.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.5

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of illustrations	Illustrates fewer than three objects found around the school.	Illustrates three or four objects found around the school.	Illustrates five objects found around the school.	Illustrates more than five objects found around the school.
Completeness of lists of Earth materials	Creates a list that includes an Earth material for fewer than three objects found around the school.	Creates a list that includes an Earth material for three or four objects found around the school.	Creates a list that includes an Earth material for each of the five objects found around the school.	Creates a list that includes an Earth material for more than five objects found around the school.
Quality of construction	Includes no table of contents, two covers, no title, and no cover design.	Includes table of contents, two covers, title, and no cover design.	Includes table of contents, two covers with binding, and a basic cover design.	Includes table of contents, two covers with binding, and a unique cover design.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 1. All students will describe the Earth's surface; describe and explain how the Earth's features change over time; and analyze effects of technology on the Earth's surface and resources. (Geosphere)

Benchmark
Demonstrate ways to conserve natural resources and reduce pollution through reduction, reuse, and recycling of manufactured materials (SCI.V.1.E.6).

Benchmark Clarification
Manufactured materials can be reduced, reused, and recycled to conserve natural resources.

Students will:
- Investigate ways to conserve natural resources
- Reduce pollution through reduction, reuse, and recycling of manufactured materials

Key Concepts (voc.)
Materials that can be recycled:
- paper
- metal
- glass
- plastic

Conservation and anti-pollution activities:
- reduce
- reuse
- recycle

Real-World Context
- collections of recyclable materials
- plan for recycling at home and school
- composting
- ways of reusing or reducing the use of paper

Instructional Example SCI.V.1.E.6

Benchmark Question: What effects has technology had on the Earth's surface and resources?
Focus Question: What can be done with school trash to conserve natural resources?

The teacher will pose the focus question to facilitate discussion and then will review how natural resources are used to produce the products we use in our lives on a daily basis.

The teacher will present students with a container of trash. The trash should be poured from the container onto a mat. Students will wear latex gloves and sort the trash into piles of recyclable materials and non-recyclable materials. Students will discuss questions such as:

- What can we do to recycle these objects more effectively at school?
- What happens to these items when they reach the dump (or landfill)?
- How does this waste affect the environment?
  NOTE: Students might think that all plastics and papers are recyclable. It isn't too early to educate students on what types of plastics (#2 HDPE) and paper are able to be recycled locally. Local recycle center coordinators are usually happy to visit the classroom and/or provide educational materials.
- What natural resources are conserved by reducing, reusing, and/or recycling these materials?
- What technology is used to recycle these materials?
- Who was instrumental in studying the relationship between deterioration of the planet and industrial growth and waste? Warren Washington (*link to Biography*).

Warren Morton Washington (1936-)
METEOROLOGIST WHO STUDIES THE GREENHOUSE EFFECT

Born in Portland, Oregon on August 28, 1936, Warren Morton Washington went on to graduate from both Oregon State University with a B.S. degree in physics, and from Pennsylvania State University where he received a Ph.D. in meteorology. In fact, Dr. Washington was only the second Afro-American in history to receive a doctorate in that subject. His research efforts were initially in the area of meteorology, but more recently he has studied the greenhouse effect and its deterioration of our planet.

As an introduction to the greenhouse effect, we must understand that it is not entirely bad --- the Earth is able to support life because of the greenhouse effect. Without it, the Earth surface would measure about 20 C below zero instead of 13 C above zero. Problems with this natural phenomena occur because of man's pollution and neglect, to the point where a natural balance is getting more and more difficult to maintain. Basically, our biggest concerns are with the gases that we add to the atmosphere because these are increasing the warming effect.

We all understand the general principle that the earth is warmed by the sun – that the sun emits energy and the earth and its atmosphere absorb that energy. Most of the

sun's energy covers the ultraviolet [UV], visible and near-infrared regions. Only a small fraction of this energy is intercepted by the earth.

In order for there to be some balance of energy flow, the earth itself emits energy flow, the earth itself emits energy back to space. However, the earth emits energy at longer wavelengths because it is much colder than the sun, and the sun emits energy at the shorter wavelengths. The earth's emissions are in what are called thermal infrared regions.

Here is where the earth's atmosphere comes into the picture. The atmosphere behaves differently at different wavelengths. Of all the solar energy entering the planet, about 30% is reflected back to space by clouds, the earth's surface and atmospheric gases. Another 20 % is absorbed by atmospheric gases, mostly by the ozone which absorbs energy in the UV and visible ranges. Water vapor and carbon dioxide is absorbed into the near-infrared region. The earth's surface absorbs the remaining 50 % of the sun's emissions, so the surface of our planet becomes warmer.

Thermal energy emitted by the earth seeks a different atmosphere – clouds, water vapor and carbon dioxide – which are strong absorbers of radiation at the thermal infrared wavelengths. So, the earth's atmosphere is warmed as much by thermal infrared radiation from its surface as by the energy (radiation) from the sun.

And, the atmosphere itself emits thermal infrared radiation. Some goes out into space, while the rest comes back toward earth. Thus, the earth's surface is warmed not only by the sun, but also by the earth's own atmosphere in the form of thermal infrared radiation. This is the naturally-occurring greenhouse effect.

The dangers to our atmosphere come with the many gases we emit during our everyday activities. These gases are very strong absorbers of thermal infrared radiation. And, as they accumulate in our atmosphere, the atmosphere is better able to absorb and emit them, so more energy is emitted downward to the earth's surface than normal. The result is that the earth's surface is warmed beyond what would normally occur, and its natural balance is disturbed.

This can lead to an atmosphere which holds more water vapor, which is itself a greenhouse gas, thus adding to the warming greenhouse effect. Snow and ice are good reflectors of solar radiation, so they help cool the planet. But, with a warmer earth, there is less snow and ice, and less reflection of solar radiation back to space. These along with other environmental and climatic changes due to the build-up of greenhouse gases, add to the warming effect of our planet and further upset the balance of nature.

Dr. Warren Washington is currently director of a division of the National Center for Atmospheric Research.

References

Greenhouse Effect and it Impact on Africa.
London: Institute for African Alternatives, 1990.

Policy Options for Stabilizing Global Climate. Hemisphere Pub. Corp, New York, 1990.

Our Drowning World: Population, Pollution and Future Weather. Antony Milne. Prism Press, Dorset, England: Avery Pub. Group, New York, 1988.

Constructing: (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.3*), (*link to SCI.II.1.E.4*), (*link to SCI.II.1.E.5*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.1.E.6.html

Recycle City.
http://epa.gov/recyclecity/

Recycling Crossword Activity

http://www.epa.gov/students/waste_no_words.htm

"Municipal Solid Waste (msw) Factbook - Internet Version," an electronic reference containing over 250 screens of information about household waste management practices. «

http://www.epa.gov/students/municipal_solid_waste_factbook.htm

The Consumer's Handbook for Reducing Solid Waste

http://www.epa.gov/students/consumers_handbook_for_reducing.htm

Women in Science.
http://crux.astr.ua.edu/4000ws/4000ws.html

Classroom Assessment Example SCI.V.1.E.6

Small groups of students will design a plan to reduce, reuse, or recycle a waste product from school. They will estimate the volume/weight of the natural resources that will be conserved by this plan.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.1.E.6

Criteria		Beginning	Basic	Achieving	Exceeding
Completeness of plan		Incomplete plan.	Complete plan, but missing details.	Complete plan with details.	Complete plan with details and a budget.
Completeness of estimates		No estimates of natural resources conserved by the plan.	Estimates some of the natural resources conserved by the plan.	Estimates most of the natural resources conserved by the plan.	Estimates all of the natural resources conserved by the plan.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 2. All students will describe the characteristics of water and demonstrate where water is found on Earth; describe how water moves; and analyze the interaction of human activities with the hydrosphere. (Hydrosphere)

Benchmark
Describe how water exists on Earth in three states (SCI.V.2.E.1).

Benchmark Clarification
Water is found on the Earth as a liquid, solid, and gas:

- Liquid: visible, flowing, melting, dew
- Solid: visible, hard, freezing, ice
- Gas: invisible, water vapor, moisture, evaporation

Students will:

- Describe water in its various states

Note: A BIG misconception (firmly embedded in college students) is that clouds or steam rising from a pan of boiling water is water vapor. Can students see oxygen, nitrogen, or unpolluted air? No. Teachers must stress that water vapor is invisible. If a student can "see" water then it is ONLY in the liquid or solid state.

Key Concepts (voc.)
Liquid (K-2):

- visible
- flowing
- melting
- dew

Solid (K-2):

- visible
- hard
- freezing
- ice

Gas (3-5):

- invisible
- water vapor
- moisture
- evaporating

See (*link to SCI.IV.2.E.1*).

Real-World Context

- examples of water in each state, including dew, rain, snow, ice
- evidence of moisture in the air such as “fog” on cold bathroom mirrors
- examples of melting, freezing, and evaporating

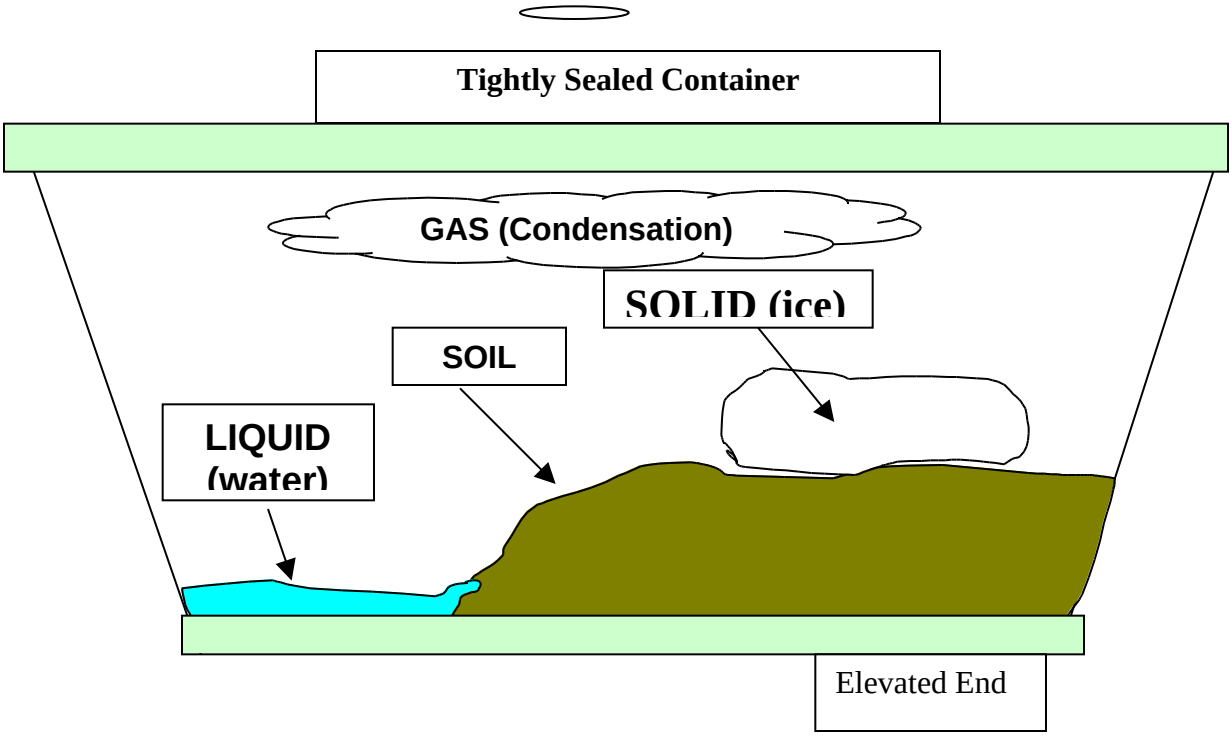
Instructional Example SCI.V.2.E.1

Benchmark Question: Where is water found on Earth and what are its characteristics?
Focus Question: What are the different states of water on the Earth’s surface?

In the teacher-guided demonstration, the teacher will place soil or sand in a plastic container with a cover (clear rectangular works best). Using a scale, students will weigh the tightly sealed container and record their findings. The teacher will add ice to the container, seal it, and re-weigh the container. Students will record this data. The container should be moved to an observable place and slightly elevated at one end. The teacher should pose the focus question and allow students to record a prediction. Using a table to record date and time, students should draw or describe their observations after the container is sealed for five days. The students will make several observations of the sealed container and record and draw (or describe) their observations. Students will participate in discussions around the focus question.

On the last day of the demonstration, the teacher will weigh the container. The students will compose written draw conclusions based on their observations and the class discussions in regard to the focus question. They will also include a comparison between their predictions and results of the demonstration.

Note: If the container is tightly sealed there should be little change in the weight of the container.



Constructing*:* *(Link to SCI.I.1.E.1) (Link to SCI.I.1.E.2), (Link to SCI.I.1.E.4), (Link to SCI.I.1.E.6)*

Reflecting: *(Link to SCI.II.1.E.4)*

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.2.E.1.html

EPA Office of Water

http://www.epa.gov/students/clean_water_basics.htm

Water Science for Schools: offers information on many aspects of water, along with pictures, data, maps, and an interactive center where you can give opinions and test your water knowledge.

http://www.epa.gov/students/clean_water_basics.htm

Cast, C. Vance. *Where Does Water Come From?* THE CLEVER CALVIN SERIES. Barron's, 1992.
McKinney,Barbara. *Drop Around The World*. Dawn, 1998.

Classroom Assessment Example SCI.V.2.E.1

Students will use the data collected in the Instructional Example to answer the focus question: "What are the different states of water on the Earth's surface?" Students will include the different states of water on Earth and the data collected in the demonstration to write a summary paragraph.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.2.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Accuracy of description	Writes a description using key concepts that is an inaccurate connection to the collected data and table.	Writes a description that uses fewer than four key concepts connected to the collected data and table.	Writes a description that uses at least five key concepts connected to the collected data and table.	Writes a description that uses seven or more key concepts connected to the collected data and table.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 2. All students will describe the characteristics of water and demonstrate where water is found on Earth; describe how water moves; and analyze the interaction of human activities with the hydrosphere.(Hydrosphere)

Benchmark
Trace the path that rainwater follows after it falls (SCI.V.2.E.2).

Benchmark Clarification
After rainwater falls, it follows a downward path to a water body.
Examples of water paths:

- gutters
- playground
- drains
- streams
- wetlands

Students will:

- Illustrate the path that rainwater follows to a water body

Note: This is not the water cycle.
This benchmark can be related to the concept of a watershed, streamshed, or creekshed.

Key Concepts (voc.)
Precipitation
Flow:

- downhill
- to rivers
- into the ground

See Precipitation (*link to SCI.V.3.E.1*).

Bodies of water

- streams
- rivers
- lakes
- oceans

See Bodies of water (*link to SCI.V.1.E.1*).

Real-World Context
Examples of water flowing locally:

- gutters
- drains
- streams
- wetlands

Instructional Example SCI.V.2.E.2

Benchmark Question: How does water move?
Focus Question: Which way does water flow?
Students will work in groups to determine that water flows downhill. The teacher will ask students about their visits to lakes or rivers and what they have observed about the movement of the water. The teacher then will pose the focus question and set up the following model of a river (See River Model Diagram below).

- Cut one piece of aluminum foil 24" long.
- Fold it in fourths to make a trough.
- Cut a V-shaped notch out of the top of the Styrofoam cup, fill the cup with water, and add two to four drops of food coloring.
- Put the cup on the table and cradle the aluminum foil trough in the "V" in the cup. This allows one end of the trough to be elevated.
- Have the other end extend just over the edge of the table.
- Place a bucket under the lower end of the trough.
- Fill a spray bottle about halfway with water.

The teacher will ask students to spray different parts of the model and observe where the water flows. Students will explain how the water flowed on the model. During discussion, be sure to include how water flows down hillsides or slopes. The teacher will ask students what each part of the model represents: cup = mountain, trough = river, bucket = lake, spray = rain.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.2*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.V.2.E.2.html

River Cutters. GEMS.
http://www.lhs.berkeley.edu/GEMS/

Follow a Drip Through the Water Cycle
http://www.epa.gov/students/clean_water_basics.htm

The Water Cycle
http://www.epa.gov/students/clean_water_basics.htm

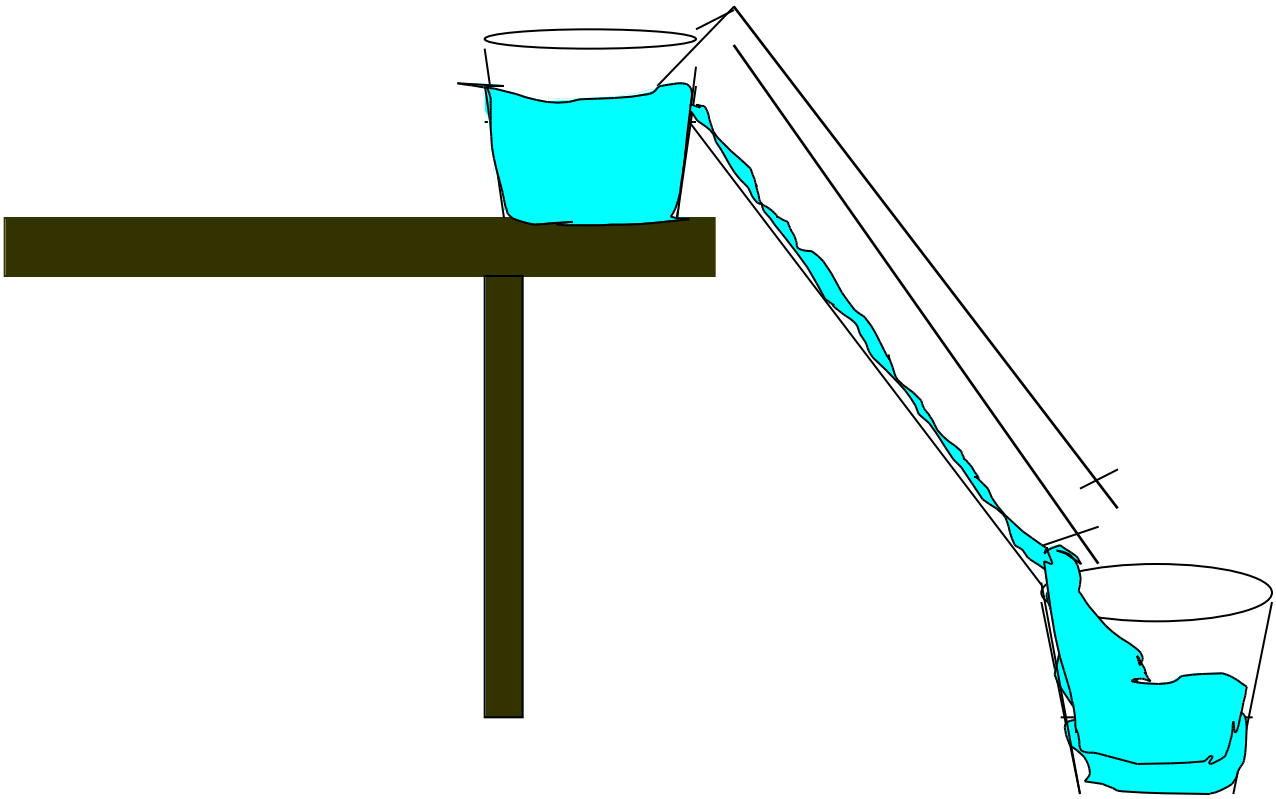
2nd Graders' View of the Water Cycle
http://www.epa.gov/students/clean_water_basics.htm

Water Use Poster
http://water.usgs.gov/outreach/poster1/images/OutReach1.jpg

Water Poster Explanation for Elementary Schools
http://water.usgs.gov/outreach/poster1/grade_school/Page1.html

Cole, Joanna. *Magic School Bus- Wet All Over: A Book About the Water Cycle*. Scholastic, 1999.
Dorros, Arthur. *Follow The Water From Brook to Ocean*. LET'S READ & FIND OUT SCIENCE BOOK. Harper, 1993.

River Model Diagram



Classroom Assessment Example SCIV.2.E.2

Students will draw and label the path of rainwater from a mountain or hillside to a lake.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.2.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Accuracy of drawing	Creates a drawing.	Creates a drawing without rainwater.	Creates an accurate drawing including rainwater, mountain or hillside, and lake.	Creates an accurate drawing including rainwater and other forms of precipitation.
Correctness of labels	Labels a drawing that is lacking a pathway.	Labels a drawing with an incorrect pathway.	Labels a drawing with an accurate pathway.	Labels a drawing with more than one correct pathway.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 2. All students will describe the characteristics of water and demonstrate where water is found on Earth; describe how water moves; and analyze the interaction of human activities with the hydrosphere. (Hydrosphere)

Benchmark
Identify sources of water and its uses (SCI.V.2.E.3).

Benchmark Clarification
Water comes from different places such as wells, springs, the Great Lakes, and rivers. Water has many uses such as:

- household uses (e.g., drinking, cleaning, food preparation)
- public uses (e.g., to generate electricity or for recreation, irrigation, transportation, industry, farming)

Students will:

- Identify various sources of water
- Identify uses of water

Key Concepts (voc.)
Water sources:

- wells
- springs
- Great Lakes
- rivers

Household uses:

- drinking
- cleaning
- food preparation

Public uses:

- generate electricity
- recreation
- irrigation
- transportation
- industry

Real-World Context
Examples of local sources of drinking water:

- wells
- rivers
- lakes

Examples of local water usage:

- car wash
- swimming
- fire hydrants
- drinking
- food preparation
- cleaning
- watering lawn
- bathing
- fishing
- boating
- shipping on Great Lakes

Instructional Example SCI.V.2.E.3

Benchmark Question: How do human activities interact with the hydrosphere?
Focus Question: How is water used in your community?

The teacher will pose the focus question.

Students then will brainstorm uses of water in their community. While brainstorming, students will discover that water is used for many purposes in their community. They will use a variety of resource materials to estimate how much water is used in their community. Some possible resources include resource people, interviews, field trips, and media materials. Students will compile the results of their research in a graph and will share the results of their research with an audience.

Constructing: (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.2.E.3.html

Water Use Poster
http://water.usgs.gov/outreach/poster1/images/OutReach1.jpg

Water Poster Explanation for Elementary Schools
http://water.usgs.gov/outreach/poster1/grade_school/Page1.html

How we use Water- Water Poster
http://water.usgs.gov/outreach/poster3/images/OutReach3.jpg

Wastewater use Explanation for Elementary Schools
http://water.usgs.gov/outreach/poster3/grade_school/Page1.html

Water use in the United States
http://www.epa.gov/students/clean_water_basics.htm

Cole, Joanna. *Magic School Bus- At The Waterworks*. Scholastic, 1998.

Classroom Assessment Example SCI.V.2.E.3

Students may choose to work alone, with a partner, or in a small group to create a project describing at least three uses of water in their community. This project may take the form of a report, poem, short story, photo essay, or multimedia presentation.

Extension: These projects could ultimately be combined to produce a classroom book or performance for the community.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.2.E.3

Criteria	Apprentice	Basic	Meets	Exceeds
Correctness of concepts	Creates a project that reflects an understanding of one use of water in the community.	Creates a project that reflects an understanding of two uses of water in the community.	Creates a project that reflects an understanding of three uses of water in the community.	Creates a project that reflects an understanding of more than three uses of water in the community, including the source of the water.
Quality of project	Poor quality.	Average quality.	Above average quality.	Excellent quality.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 3. All students will investigate and describe what makes up weather and how it changes from day to day, from season to season, and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)

Benchmark
Describe weather conditions (SCI.V.3.E.1).

Benchmark Clarification
At any given time, various weather conditions occur on the Earth. These conditions change in a predictable pattern. Daily changes and severe weather can be observed.

Students will:

- Observe weather conditions:
  - temperature
  - cloud cover
  - precipitation
  - wind
- Distinguish among different types of severe weather:
  - tornadoes
  - blizzards
  - thunderstorms
  - hurricanes
  - lightning
  - high winds
  - droughts (students are more likely to experience this than tornadoes)

Key Concepts (voc.)
Atmosphere is a blanket of air around the Earth; air is a substance
Attributes of substances
See Atmosphere (*link to SCI.IV.1.E.1*).

The temperature of air is:

- cold
- hot
- warm
- cool

Cloud cover:
- clear
- cloudy
- partly cloudy
- foggy

Precipitation:
- rain
- snow
- hail
- freezing rain

Wind:
- breezy
- windy
- calm

Severe weather:
- tornadoes
- blizzards
- thunderstorms
- lightning
- high winds (of greatest importance to students would be the dangerous impact of cold temperatures and wind chill. Wind chill and its effects should be included in the discussion of high winds)
- drought

Tools:
- thermometer
- wind sock
- rain gauge

Real-World Context
- daily changes in weather
- examples of severe weather

Instructional Example SCI.V.3.E.1

Benchmark Question: What makes up weather and how does it change from day to day, from season to season, and over long periods of time?
Focus Question: What are the daily changes in weather?

Students will keep a daily graphic representation of weather conditions including:

- Air temperature – cold, hot, warm, cool
- Cloud cover – cloudy, partly cloudy, foggy, clear
- Precipitation - rain, snow, hail, freezing rain
- Wind - windy, calm

The teacher will lead a discussion on the data students collect and help them to see patterns.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.3.E.1.html

Climate Effects on Human Health: long term effects of how temperature, humidity, wind, and pressure affect human health.

http://www.ciesin.org/docs/001%2D338/001%2D338.html

Weather Topics: indexed weather topics in the easy to read format characteristic of USA Today.

http://www.usatoday.com/weather/index/windex.htm

Weather Animations: USA Today archives a number of effective and quick loading animated gifs depicting weather phenomena relating to air masses, air pressure, El Nino, floods, hurricanes, lightning, optical effects, seasons, storms, winds, and more.

http://www.usatoday.com/weather/wgraph0.htm

Artell, Mike. *Weather Whys: Questions, Facts & Riddles About Weather*. Goodyear Publishing, 1995.
Cole, Joanna. *Magic School Bus- Inside A Hurricane*. Scholastic, 1996.
Cole, Joanna. *Magic School Bus- Kicks Up A Storm*: *A Book About Weather*. Scholastic, 2000.
Gibbons, Gail. *Weather Words & What They Mean.* Holiday House, 1990.
White, Nancy. *Magic School Bus- Twister Trouble*. Scholastic, 2001.

Classroom Assessment Example SCI.V.3.E.1

Each student will compose a shape poem, weather story, picture, or cinquain (a five-line stanza) describing weather and containing at least three of the Key Concepts. The student will present his or her description of weather conditions to the class. The teacher will send a copy of the students' completed project to a local weather forecaster.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.3.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Description of key concepts	Describes one key concept accurately.	Describes two key concepts accurately.	Describes three key concepts accurately.	Describes all weather conditions including severe weather or tools used to measure it.
Quality of project	Poor quality.	Average quality.	Above average quality.	Excellent quality.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 3. All students will investigate and describe what makes up weather and how it changes from day to day, from season to season, and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)

Benchmark
Describe seasonal changes in Michigan's weather (SCI.V.3.E.2).

Benchmark Clarification
Michigan's weather changes with the seasons.
Changes in weather will include:

- Temperature
- Precipitation (rain, snow)
- Number of hours of sunlight

Students will:

- Compare and contrast seasonal changes in weather (e.g., fall, winter, spring, summer)
- Describe the effects of seasonal changes on:
  - vegetation
  - human activities

Key Concepts (voc.)
Seasons and types of weather:

- fall – cool nights and warm days, day length getting shorter
- winter – snowy and cold, getting dark early in the evenings
- spring – warmer days, often rainy with thunderstorms, day length getting longer
- summer – warm or hot days and warm nights, daylight lasting until late in the evenings

Real-World Context
Examples of visible seasonal changes in nature

Instructional Example SCI.V.3.E.2

Benchmark Question: What are the relationships between human activities and the atmosphere?
Focus Question: How do the temperature and precipitation for each season affect what we wear?

The teacher will ask students, "What are the four seasons?" Students might come up with the names of the seasons: spring, summer, fall, and winter. The teacher will ask students how they use their senses to know it is spring, summer, fall, or winter. The teacher will compile the students' observations in a data table. The teacher will ask questions that will help students make connections between changes in temperatures and kinds of precipitation.

The teacher will ask students to talk about the temperature and precipitation for each season and discuss the type of clothing appropriate for each season. Students will add this information to the data table.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.3.E.2.html

What Causes the Seasons? What makes this site notable is that it is one of the few science sites that tailors the explanation of the seasons according to beginning, intermediate, and advanced levels, although the latter two are often the same. The site is thus truly compatible to the needs of a K-16 audience.

http://windows.arc.nasa.gov/cgi-bin/tour_def/the_universe/uts/seasons1.html

Baxter, Nicola. *Autumn.* SEASONS SERIES. Children's Press, 1997.
Burke, Jennifer. *Cloudy Days*. WEATHER REPORT…SERIES. Children's Press, 2000.
Gibbons, Gail. *The Reasons for the Seasons. Holiday House, 1995.*

Classroom Assessment Example SCI.V.3.E.2

Students will draw a series of pictures in the order of the seasons. The pictures will show precipitation and people wearing appropriate clothing for each season. Students will compare and contrast their pictures with others in small groups (i.e., students will compare winter coats, hats, and mittens with summer shorts, t-shirts, and swimsuits).

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.3.E.2

Note: Precipitation will be perceived differently by different students. We are taught early on how "wet" it is in spring; while statistically, the most precipitation comes in the summer because warm air can "hold" more moisture. The driest season, statistically also happens to be the snowiest, namely, the winter.

Criteria	Apprentice	Basic	Meets	Exceeds
Correctness of order	Incorrect order with no labels for seasons.	Correct order with some incorrect labels for seasons and no details.	Correct order with correct labels for seasons and some details.	Correct order with correct labels for seasons and many details.
Correctness of precipitation	Incorrect precipitation for more than one season.	Incorrect precipitation for one season.	Correct precipitation for all seasons and some details.	Correct precipitation for all seasons and many details.
Appropriateness of clothing	Incorrect clothing for more than one season.	Incorrect clothing for one season.	Correct clothing for all seasons and some details.	Correct clothing for all seasons and many details.
Quality of project	Poor quality.	Average quality.	Above average quality.	Excellent quality.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 3. All students will investigate and describe what makes up weather and how it changes from day to day, from season to season, and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)

Benchmark
Explain appropriate safety precautions during severe weather (SCI.V.3.E.3).

Benchmark Clarification
Appropriate safety precautions need to be taken during severe weather. Safety precautions include moving to safe locations, listening for sirens, and monitoring radio broadcasts for severe weather watches and warnings.

Students will:
- Explain safety precautions during severe weather such as high wind chill events, high heat index, ozone alert, thunderstorms, tornadoes, and blizzards
- Demonstrate safety precautions they should take during a high wind chill events, high heat index, ozone alert, thunderstorm, tornado, and blizzard

While tornadoes, thunderstorms, and blizzards are significant events and students need to know how to properly respond to these events. The frequency of these events, however, is less than days when the wind chill and heat index are high. Students need to know what type of precautions to take for these two events as well.

Key Concepts (voc.)
Safety precautions:
- safe locations
- sirens
- radio broadcasts
- severe weather watch and warning. Students need to know the difference between a watch (conditions favorable) and a warning (tornado has actually been sited on the ground.

See Atmosphere (*link to SCI.IV.1.E.1*).

Real-World Context
Examples of local severe weather that changes with the seasons:

- thunderstorms
- tornadoes
- blizzards
- wind chill
- heat index

Examples of local community safety precautions:

- weather bulletins
- tornado sirens

Instructional Example SCI.V.3.E.3

Benchmark Question: What are the relationships between human activities and the atmosphere?
Focus Question: Where is a safe place in severe weather?

The teacher will direct a discussion based on the focus question. The students will research school and local community safety precautions and present their findings to the class.

Students will use art materials to create a picture of a severe weather condition and show an appropriate location for safety.

Constructing: (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.3*), (*link to SCI.II.1.E.4*).

Resources/References:

Webliography.
http://mtn.merit.edu/mcf/SCI.V.3.E.3.html

National Severe Storms Laboratory: access current research efforts with Radar, Satellite, Software Development, Modeling, Tornadoes, Thunderstorms, Damaging Winds, Lightning, Hail, Winter Weather, Flooding.

http://www.nssl.noaa.gov/

The Storm Encyclopedia: from the Weather Channel, this site, "can answer your questions on severe and extreme weather."

http://www.weather.com/newscenter/

Lampton, Christopher. *Blizzard*. A DISASTER BOOK. Millbrook, 1994.

Classroom Assessment Example SCI.V.3.E.3

Students will present their pictures to the class and will describe the safest location for their chosen weather condition and the appropriate safety precautions.

(Rubric not required.)

Scoring of Classroom Assessment Example SCI.V.3.E.3

This assessment is evaluated on a pass or fail basis. The presentation will accurately describe the safest location for the chosen weather condition and the appropriate safety precautions.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 4. All students will compare and contrast our planet and Sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe. (Solar System, Galaxy, and Universe)

Benchmark
Compare and contrast characteristics of the Sun, Moon, and Earth (SCI.V.4.E.1).

Benchmark Clarification
Within our solar system, the Sun, Moon, and Earth have similarities and differences. These similarities and differences can be observed and measured. Similarities and differences include size, shape, location, and capable of producing their own light.

Teacher Note: Earth produces its own geothermal heat but the production site is within the mantle and core so light isn't visible. Jupiter, a gaseous giant and perhaps a failed star produces its own heat but again not within the visible portion of the spectrum. It is enough for students at this level need to know that planets are capable of producing their own light. Many students in college incorrectly believe that the moon phases are produced through clouds or through its own power. Stress that the only way the moon or earth can be seen is through the sun's illumination.

Students will:
- Compare the similarities among the Sun, Moon, and Earth
- Contrast the differences among the Sun, Moon, and Earth

Key Concepts (voc.)
- planet
- star
- sphere
- space
- solar system
- larger/smaller
- closer/further
- solid/gaseous
- heat
- light

Real-World Context
Observations of the Moon, Earth, and safe observations of the Sun.

Instructional Example SCI.V.4.E.1

Benchmark Question: Compare and contrast characteristics of the Sun, Moon, and Earth.
Focus Question: How are the Sun, Moon, and Earth alike and different?

The teacher will pose the focus question.

Chart	Size	Shape	Location	Capable of producing its own light?"	Star? Planet?
SUN					
MOON					
EARTH					

Students will be divided into three groups. Each group will be given a set of books dealing with one of the following: the Sun, the Moon, or the Earth.

Each group will present to the class a description of their topic including the size, shape, location, and the production of heat and light. Students will take notes on each presentation.

Students will work in small groups and create a three-sided mobile that contains characteristics of the Sun, Moon, and Earth. One side each will be for the Sun, Moon, and Earth. The students will attach the information on the correct side of the mobile. After constructing the mobile, students will present their projects to the class.

The teacher should correct misconceptions during the discussion of presentations; students should correct their three-sided mobiles.

Constructing: (*link to SCI.I.1.E.1*).

Reflecting: (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.4.E.1.html

Branley, Franklin. *What Makes Day & Night*? Franklin, 1986.
Cole, Joanna. *Magic School Bus- Lost in the Solar System*. Scholastic, 1990.
Fowler, Allan. *Energy From The Sun*. ROOKIE READ- ABOUT SERIES. Children's Press, 1998.
Nicholson, Cynthia. *Earth*. STARTING WITH SPACE SERIES. Kids Can Press, 1997.
Stott, Carole. *I Wonder Why Stars Twinkle & Other Questions About Space*. Kingfisher, 1997.
Van Cleave, Janice. *Janice Van Cleave's Solar System*. Wiley, 2000.

Classroom Assessment Example SCI.V.4.E.1

Students will use the information from their notes to complete a Venn diagram that compares and contrasts the Sun, Moon, and Earth.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.V.4.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Correctness of similarities (of Sun, Moon, and Earth)	Few similarities are correct.	Some similarities are correct.	Many similarities are correct.	All similarities are correct.
Correctness of differences (of Sun, Moon, and Earth)	Few differences are correct.	Some differences are correct.	Many differences are correct.	All differences are correct.
Correctness of labels	Few labels are correct.	Some labels are correct.	Many labels are correct. .	All labels are correct.

Strand: V. Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts

Content Standard: 4. All students will compare and contrast our planet and Sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe. (Solar System, Galaxy, Universe)

Benchmark
Describe the motion of the Earth around the Sun and the Moon around the Earth (SCI.V.4.E.2).

Benchmark Clarification
The Earth travels around the Sun while the Moon travels around the Earth. This motion can be recorded on a calendar as months, years, and Moon's phases. The motion of one body around another body is called revolution/revolving. The path that the Earth and Moon take as they revolve is called an orbit.

Students will:

- Describe the motion of the Earth around the Sun as revolving in an orbit
- Explain that the motion of the Earth around the Sun follows a path called an orbit and can be measured as one year
- Describe the motion of the Moon around the Earth
- Explain that the motion of the Moon around the Earth follows a path called an orbit and can be measured as one month

Note: This motion is not rotation/rotating/spinning on an axis. The Earth spins on its axis once every twenty-four hours and is measured as a day or day and night. A entrenched misconception, present in college, is that rotation and revolution are synonymous. Having students spin in place and then walking around a central point are good ways to differentiate the two concepts. A fun activity is having students both spin and walk around a central point, mimicking the actual rotation and revolution of the earth around the sun.

Key Concepts (voc.)

- revolve
- revolution
- orbit
- month
- year
- observed movement of the Sun and stars across the sky
- observed movement of the Moon from day to day
- calendar

Real-World Context

- Outdoor observation of the Sun's and stars' motions during the night and the Moon's motions over several days

Instructional Example SCI.V.4.E.2

Benchmark Question: Describe the motion of the Earth around the Sun and the motion of the Moon around the Earth.
Focus Question: How does the Moon move around the Earth?

The teacher will pose the focus question.

Students, working in small groups, will design a model of how the Moon moves around the Earth.

Students will collect the materials they need and will create their models. Groups will have some time to practice how they will present their models. Teachers should avoid "correcting" misconceptions at this point.

Each group will present their model. After presentations, the class will discuss similarities and differences among the models. The teacher may guide discussion to correct student misconceptions through inquiry. Groups then will be allowed to alter their presentations and to make corrections. The groups then will present their models again.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography.
http://mtn.merit.edu/mcf/SCI.V.4.E.2.html

Bourgeois, Paulette. *Moon*. STARTING WITH SPACE SERIES. Kids Can Press, 1997.
Fowler, Allan. *So That's How The Moon Changes Shape*! ROOKIE READ- ABOUT SCIENCE SERIES. Children's Press, 1991.

Classroom Assessment Example SCI.V.4.E.2

Students will draw and label a diagram of the path of the Moon as it moves around the Earth. Students must include a title for the diagram.

(Give students rubric before activity.)

Scoring for Classroom Assessment Example SCI.V.4.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Correctness of moon's orbit	Draws moon's orbit incorrectly.	Draws moon's orbit correctly.	Draws moon's orbit correctly.	Draws moon's orbit correctly, and includes Earth's orbit around Sun.
Completeness of labels	None/Few labels or title for diagram.	Some labels and title for diagram.	Many labels and title for diagram.	All labels and title for diagram.