Full text of O L O W Earth And Space conference

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|Unifying Concepts and Processes | Science As Inquiry | Physical Science | Life Science |
| Earth & Space NEW | Science & Technology | Personal & Social Perspectives NEW | History & Nature of Science NEW | Other topics |

Earth and Space

Please add ocean content under the appropriate standard

http://books.nap.edu/html/nses/

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Developing Student Understanding

Item 1 **Peter Tuddenham** *Oct 22, 2004 17:53*

Developing Student Understanding. Extracts from the text and links to the text at for this set of standards

Extracts from Page 130 NSES on the K-4 standards

http://books.nap.edu/html/nses/6c.html#es

Young children are naturally interested in everything they see around them--soil, rocks, streams, rain, snow, clouds, rainbows, sun, moon, and stars. During the first years of school, they should be encouraged to observe closely the objects and materials in their environment, note their properties, distinguish one from another and develop their own explanations of how things become the way they are. As children become more familiar with their world, they can be guided to observe changes, including cyclic changes, such as night and day and the seasons; predictable trends, such as growth and decay, and less consistent changes, such as weather or the appearance of meteors. Children should have opportunities to observe rapid changes, such as the movement of water in a stream, as well as gradual changes, such as the erosion of soil and the change of the seasons.

Children come to school aware that earth's surface is composed of rocks, soils, water, and living organisms, but a closer look will help them identify many additional properties of earth materials. By carefully observing and describing the properties of many rocks, children will begin to see that some rocks are made of a single

substance, but most are made of several substances. In later grades, the substances can be identified as minerals. Understanding rocks and minerals should not be extended to the study of the source of the rocks, such as sedimentary, igneous, and metamorphic, because the origin of rocks and minerals has little meaning to young children.

Playgrounds and nearby vacant lots and parks are convenient study sites to observe a variety of earth materials. As students collect rocks and observe vegetation, they will become aware that soil varies from place to place in its color, texture, and reaction to water. By planting seeds in a variety of soil samples, they can compare the effect of different soils on plant growth. If they revisit study sites regularly, children will develop an understanding that earth's surface is constantly changing. They also can simulate some changes, such as erosion, in a small tray of soil or a stream table and compare their observations with photographs of similar, but larger scale, changes.

See the example entitled "Weather"

By observing the day and night sky regularly, children in grades K-4 will learn to identify sequences of changes and to look for patterns in these changes. As they observe changes, such as the movement of an object's shadow during the course of a day, and the positions of the sun and the moon, they will find the patterns in these movements. They can draw the moon's shape for each evening on a calendar and then determine the pattern in the shapes over several weeks. These understandings should be confined to observations, descriptions, and finding patterns. Attempting to extend this understanding into explanations using models will be limited by the inability of young children to understand that earth is approximately spherical. They also have little understanding of gravity and usually have misconceptions about the properties of light that allow us to see objects such as the moon. (Although children will say that they live on a ball, probing questions will reveal that their thinking may be very different.)

Students can discover patterns of weather changes during the year by keeping a journal. Younger students can draw a daily weather picture based on what they see out a window or at recess; older students can make simple charts and graphs from data they collect at a simple school weather station.

Emphasis in grades K-4 should be on developing observation and description skills and the explanations based on observations. Younger children should be encouraged to talk about and draw what they see and think. Older students can keep journals, use instruments, and record their observations and measurements.

Extract from Page 158 NSES on the 5-9 standards

http://books.nap.edu/html/nses/6d.html#es

"A major goal of science in the middle grades is for students to develop an understanding of earth and the solar system as a set of closely coupled systems. The idea of systems provides a framework in which students can investigate the four major interacting components of the earth system--geosphere (crust, mantle, and core), hydro-sphere (water), atmosphere (air), and the biosphere (the realm of all living things). In this holistic approach to studying the planet, physical, chemical, and biological processes act within and among the four components on a wide range of time scales to change continuously earth's crust, oceans, atmosphere, and living organisms. Students can investigate the water and rock cycles as introductory examples of geophysical and geochemical cycles. Their study of earth's history provides some evidence about co-evolution of the planet's main features--the distribution of land and sea, features of the crust, the composition of the atmosphere, global climate, and populations of living organisms in the biosphere.

By plotting the locations of volcanoes and earthquakes, students can see a pattern of geological activity. Earth has an outermost rigid shell called the lithosphere. It is made up of the crust and part of the upper mantle. It is broken into about a dozen rigid plates that move without deforming, except at boundaries where they collide. Those plates range in thickness from a few to more than 100 kilometers. Ocean floors are the tops of thin oceanic plates that spread outward from midocean rift zones; land surfaces are the tops of thicker, less-dense continental plates.

Because students do not have direct contact with most of these phenomena and the long-term nature of the processes, some explanations of moving plates and the evolution of life must be reserved for late in grades 5-8. As students mature, the concept of evaporation can be reasonably well understood as the conservation of matter combined with a primitive idea of particles and the idea that air is real. Condensation is less well understood and requires extensive observation and instruction to complete an understanding of the water cycle.

The understanding that students gain from their observations in grades K-4 provides the motivation and the basis from which they can begin to construct a model that explains the visual and physical relationships among earth, sun, moon, and the solar system. Direct observation and satellite data allow students to conclude that earth is a moving, spherical planet, having unique features that distinguish it from other planets in the solar system. From activities with trajectories and orbits and using the earth-sun-moon system as an example, students can develop the understanding that gravity is a ubiquitous force that holds all parts of the solar system together. Energy from the sun transferred by light and other radiation is the primary energy source for processes on earth's surface and in its hydrosphere, atmosphere, and biosphere.

By grades 5-8, students have a clear notion about gravity, the shape of the earth, and the relative positions of the earth, sun, and moon. Nevertheless, more than half of the students will not be able to use these models to explain the phases of the moon, and correct explanations for the seasons will be even more difficult to achieve.

and an extract from page 187 for 9-12

http://books.nap.edu/html/nses/6e.html#es

"During the high school years, students continue studying the earth system introduced in grades 5-8. At grades 9-12, students focus on matter, energy, crustal dynamics, cycles, geochemical processes, and the expanded time scales necessary to understand events in the earth system. Driven by sunlight and earth's internal heat, a variety of cycles connect and continually circulate energy and material through the components of the earth system. Together, these cycles establish the structure of the earth system and regulate earth's climate. In grades 9-12, students review the water cycle as a carrier of material, and deepen their understanding of this key cycle to see that it is also an important agent for energy transfer. Because it plays a central role in establishing and maintaining earth's climate and the production of many mineral and fossil fuel resources, the students' explorations are also directed toward the carbon cycle. Students use and extend their understanding of how the processes of radiation, convection, and conduction transfer energy through the earth system.

In studying the evolution of the earth system over geologic time, students develop a deeper understanding of the evidence, first introduced in grades 5-8, of earth's past and unravel the interconnected story of earth's dynamic crust, fluctuating climate, and evolving life forms. The students' studies develop the concept of the earth system existing in a state of dynamic equilibrium. They will discover that while certain properties of the earth system may fluctuate on short or long time scales, the earth system will generally stay within a certain narrow range for millions of years. This long-term stability can be understood through the working of planetary geochemical cycles and the feedback processes that help to maintain or modify those cycles.

As an example of this long-term stability, students find that the geologic record suggests that the global temperature has fluctuated within a relatively narrow range, one that has been narrow enough to enable life to survive and evolve for over three billion years. They come to understand that some of the small temperature fluctuations have produced what we perceive as dramatic effects in the earth system, such as the ice ages and the extinction of entire species. They explore the regulation of earth's global temperature by the water and carbon cycles. Using this background, students can examine environmental changes occurring today and make predictions about future temperature fluctuations in the earth system.

Looking outward into deep space and deep time, astronomers have shown that we live in a vast and ancient universe. Scientists assume that the laws of matter are the same in all parts of the universe and over billions of years. It is thus possible to understand the structure and evolution of the universe through laboratory experiments and current observations of events and phenomena in the universe."

Response 1:1 **Margaret Tower** *Oct 30, 2004 21:52*

Only 5% of the knowledge about the space around us is known. That means that you in pre-kindergarden,

primary school, middle school and high school can discover the other 95% and have fun doing it! Since only 8% of US college students major in science, we need YOU to learn the scientific method and help us keep our standing in the world in science.

9-12 Energy in the earth system

Item 2 **Peter Tuddenham** *Oct 22, 2004 17:53*

9-12 Energy in the earth system

Response 2:1 **Margaret Tower** *Oct 30, 2004 21:28*

What about the role of carbon dioxide that is given off by the huge amounts of biomass below the surface of the oceans? How does that impact greenhouse gases? Might it be more than the earth and man produces? How much energy do the volcanoes give off, as they create weather conditions here on earth, as El Nino. Why is it that a planet in our galaxy has the same pollution as the earth, yet no one lives on it?
Isn't it exciting for a learner, and possibly future scientist to realize that only 5% of the knowledge about earth in space is known?

5-8 Structure of the earth system

Item 3 **Peter Tuddenham** *Oct 22, 2004 17:54*

5-8 Structure of the earth system

Response 3:1 **Susan Snyder** *Oct 26, 2004 11:06*

Content topics: Characteristics of the seafloor (eg. intertidal zone, continental shelf, continental slope, islands, deep ocean, deep ocean trenches), general plate tectonics, seafloor spreading

Response 3:2 **Gabrielle Johnson** *Oct 27, 2004 18:04*

As part of examining the seafloor structure, one could also include mapping exercises such as bathmetry and reading contour maps.
Understanding the different plate boundaries, especially where crust is created and destroyed

K-4 Properties of earth materials

Item 4 **Peter Tuddenham** *Oct 22, 2004 17:54*

K-4 Properties of earth materials

Response 4:1 **Sarah Schoedinger** *Oct 26, 2004 23:37*

The following were noted in the survey [with my comments in brackets like this]:

The properties of water [water being a material of the earth].
Ocean water is salty. Freshwater is not.
The physical nature of oceans [such as???]
Because of the properties of water, oceans influence our weather.

Response 4:2 **Gabrielle Johnson** *Oct 27, 2004 18:02*

Sandy beach dynamics can be used to model erosion and the geology of an area. Watershed dynamics could also be included.
Examining different sand samples from around the world one can conclude many things about the local geology (photographs available on-line)

Response 4:3 **Francesca Cava, Nat. Geo. Society, Santa Barbara, California** *Oct 28, 2004 10:45*

Simple ocean dynamics (ie, effects of tides, beach erosion, movement of sand after a storm)

9-12 Origin and evolution of the earth system

Item 5 **Peter Tuddenham** *Oct 22, 2004 17:55*

9-12 Origin and evolution of the earth system

Response 5:1 **Patricia DuBose** *Oct 27, 2004 16:14*

we are in the Bible belt... we do this "discretely"!!! they even tried to take it out of the science curriculum when it was revamped last year!!! they also wanted to take the Civil War out of the high school history curriculum... controversy? remove it!!!

i focus on the difference in age between the continental margins and the sea floor... sea floor spreading... Pangea... i also offer the Biblical age of the earth and state the ocean will be even younger... regardless of how old the earth is, the ocean floor is younger... seems to satisfy most of the radicals!!!

Response 5:2 **Gabrielle Johnson** *Oct 28, 2004 12:55*

one could also include the evolution of the atmosphere and how that related to the biological component

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Response 5:3 **Margaret Tower** *Oct 30, 2004 21:39*

The earth is still evolving. All that action down by the hydrovents,at the top of volcanoes, contributes to new life, and new climates.

5-8 Earth's history

Item 6 **Peter Tuddenham** *Oct 22, 2004 17:55*

5-8 Earth's history

Response 6:1 **Susan Snyder** *Oct 26, 2004 13:14*

Content topic: Historic record of rising and falling sea level is evident (eg. prevalence of marine fossils on continents, submerged beaches and beach terraces)

Response 6:2 **Margaret Tower** *Oct 30, 2004 21:31*

Earth's history is being made today, at the hydrovents, deep in the ocean, on top of volcanoes. New life is being created there, as it has for centuries.
Volcanic eruptions not only lead to new life, they also lead to different climates throughout the world.

K-4 Objects in the sky

Item 7 **Peter Tuddenham** *Oct 22, 2004 17:55*

K-4 Objects in the sky

Response 7:1 **Gabrielle Johnson** *Oct 27, 2004 18:05*

influence of moon and sun on tidal cycles.

9-12 Origin and evolution of the universe

Item 8 **Peter Tuddenham** *Oct 22, 2004 17:56*

9-12 Origin and evolution of the universe

5-8 Earth in the solar system

Item 9 **Peter Tuddenham** *Oct 22, 2004 17:56*

5-8 Earth in the solar system

Response 9:1 **Sarah Schoedinger** *Oct 27, 2004 14:42*

What about comparisons of conditions on earth (i.e., water) and those on other planets and what it takes to make a planet habitable for any living thing?

Response 9:2 **Susan Snyder** *Oct 27, 2004 20:57*

I like your idea, Sarah. It would be especially interesting to compare Earth to Mars since evidence points to the fact that Mars had water in its past.

Response 9:3 **Susan Snyder** *Oct 27, 2004 20:57*

Content topic: Earth/Sun/Moon relationships affect the oceans (eg. Earth's tides are caused by the gravitational attraction between the earth and moon and are affected by the relative positions of the earth, moon, and sun in space).

K-4 Changes in earth and sky

Item 10 **Peter Tuddenham** *Oct 22, 2004 17:57*

K-4 Changes in earth and sky

Response 10:1 **Francesca Cava, Nat. Geo. Society, Santa Barbara, California** *Oct 28, 2004 10:48*

The dynamics between the sun and the ocean (ie, although we feel the effect of the sun on land, the sun can not uniformly warm the ocean because of its depth, currents, etc.) Why is the water warmer at the beach in shallow, slow moving areas? Will the ocean always be warmer on sunny days?

Response 10:2 **Margaret Tower** *Oct 30, 2004 21:58*

What are volcanoes? Is there any evidence of one around you, either in the past or in the present? Are any volcanoes underwater? Do they give off heat and gases and affect today's weather where you live?

9-12 Geochemical cycles

Item 11 **Peter Tuddenham** *Oct 22, 2004 17:58*

9-12 Geochemical cycles

Response 11:1 **Patricia DuBose** *Oct 27, 2004 16:11*

i focus on oxygen, carbon, water, nitrogen and phosporous... we then show how all of them are really one BIG cycle! they all link together in a healthy system!!!

Response 11:2 **Gabrielle Johnson** *Oct 27, 2004 18:08*

Resource management might fall under this

Response 11:3 **Gabrielle Johnson** *Oct 28, 2004 12:46*

It might also be interesting to include coccolithophorids vs diatom succession in the north sea, where diatoms bloom first follwed by coccolithophorids which fix carbon via a carbonate cycle coinciding with calicification.

K-12 Other earth and space topics

Item 12 **Peter Tuddenham** *Oct 22, 2004 18:27*

K-12 Other earth and space topics

Response 12:1 **Gabrielle Johnson** *Oct 27, 2004 18:07*

Middle school can examine tide charts and examine its relationship to the lunar cycle.
El Nino influence on climate which could ultimately tie into economic states