EarthComm Professional Development Program - Suggested Readings

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Introduction

The following readings will provide important background to the workshop workshop leader. It is suggested that these be read prior to beginning the workshop.

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Relationship to Standards

The relationship between EarthComm and various standards documents depends largely on the document in question. Of course, state standards vary, but most relate well to the National Science Education Standards. The publisher, Its About Time, intends to provide correlations to many states' curriculum guidelines.

- "Changing Emphases" statements of the National Science Education Standards (1996) by the National Research Council, available at http://www.nap.edu/readingroom/books/nses/html/
- The Importance of Earth Science Education. National Science Teachers Association, available at http://www.nsta.org/handbook/Earthscience.asp.

The above two readings provide support for the general approach being taken in EarthComm. They are especially helpful, in that they come from authoritative agencies, for those who have administrative barriers to reform.

- "Nature of Science" section of Science for All Americans (1990) by the American Association for the Advancement of Science, available at http://www.project2061.org /tools/sfaaol/sfaatoc.htm

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5-E Learning Cycle Model

- 5E Learning-Cycle Model of Instruction: What the teacher does. Adapted from Trowbridge & Bybee, 1996. Teaching Secondary School Science-Strategies for Developing Scientific Literacy: Prentice Hall, Englewood Cliff, New Jersey, p. 218.
- A brief description and outline (similar to those given in the "Curriculum Design" chart) are provided, as well as additional, related resources at the website: http://mvhs1.mbhs.edu/mvhsproj/learningcycle/lc.html
- Additional background can be found at: http://cte.jhu.edu/techacademy/ fellows/Ullrich/webquest/mkuindex.html

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Student Conceptions

Some of the problems that teachers might encounter with an inquiry-based program can be explained in terms of student misconceptions (also called "alternative" or "naive" conceptions.) For example, as students design experiments, they might incorporate misconceptions into the design. A student who believes that all hot things tend to rise may give very different explanations for volcanic eruptions than a scientist would, and would design related investigations accordingly. Being aware that students can hold such ideas, and what some are, can help to forestall those problems.

- There are several studies that have been done regarding various aspects of students' conceptions of Earth science phenomena. One article that summarizes several such conceptions is: "Earth Science Misconceptions" by William C. Phillips (1991). Found in The Science Teacher, February 1991, pp. 21-23.
- A particularly good website, the Bad Science site, maintained by Alstair B. Fraser for the sole purpose of improving science knowledge. The page does a nice job raising the instructional issues that misconceptions about scientific phenomena can cause: www.ems.psu.edu/~fraser/BadScience.html
- A link provided from that address, the "bad meteorology" link, provides background necessary for correcting several common Earth science misconceptions. It is at the address: www.ems.psu.edu/~fraser/BadMeteorology.html

While most of the examples in the above paper are from physics, there are several specific statements of students' incorrect science conceptions listed at the end of the paper, some of which relate more or less to Earth science phenomena.

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Inquiry

- A paper, found at the address below, provides an excellent and relatively short outline of the issues involved in discussing the meaning of "inquiry" in science instruction. One statement in particular, that "there is no authentic investigation or meaningful learning if there is no inquiring mind seeking an answer, solution, explanation, or decision," is central to the way inquiry is discussed in this manual. www.ed.gov/databases/ERIC_Digests/ed359048.html
- Another paper, provided by the Eisenhower National Clearinghouse, that raises several of the same issues but also compares traditional and reform-based curriculum nicely can be found at: ww.enc.org/focus/inquiry/ document.shtm?input=FOC-000708-index
- An analysis of classroom interactions, although at the elementary level, that helps to cue teachers as to what they might look for in students' responses to inquiry-based instruction can be found at: www.enc.org/focus/change/ document.shtm?input=FOC-000692-index
- Several other resources can be found at the index page for this topic in the clearinghouse: http://www.enc.org/topics/inquiry/
- See also the section of the National Science Education Standards called "Science as Inquiry Standards" which can be accessed at: http://www.nap.edu/readingroom /books/nses/html/6a.html#sis

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Earth System Science

- For explanations of Earth system science, go to the "Earth System Science Online" web page at http://www.usra.edu/esse/essonline/. Several papers are provided that do an excellent job explaining the development of the systems paradigm as it relates to Earth science. One is the paper that is seen when you click on "What Is Earth System Science?" Care should be taken in using the Bretherton diagram shown in that article (a full color diagram is also available as a link.) The systems concept is useful and can be understood at many levels. For the purposes of most workshops, the level of detail in the diagram may not be necessary and could deter teachers from using it with students.
- The other can be found as a link at the bottom of the page described above, referenced as: IGARSS '97 Paper - "What is Earth System Science" by Johnson, Ruzek, Kalb

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