PRISMS: Phenomena and Representations for the Instruction of Science in Middle Schools (NSF DUE 0435217)

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In a Nutshell...

The MMSA and AAAS Project 2061 are working with teams of middle school teachers to analyze approximately 1,000 digital phenomena and representations[1] connected to science benchmarks, for their alignment to middle grades content standards and for the quality of their instructional support for teachers. These resources are being assembled into a collection called PRISMS (Phenomena and Representations for the Instruction of Science in Middle Schools), designed to increase the amount of quality K-12 science educational resources accessible through digital libraries.

Why This Work is Needed

- K-12 educators have found it difficult to implement the science learning goals specified by standards-based reform because they lack instructional materials that are well-aligned to those goals.
- Middle grades may be the last opportunity for students to acquire science literacy before they begin to "specialize" in high school and beyond.
- Project 2061's evaluation of middle grades science textbooks[2] highlight the need to supplement the phenomena and representations available in current textbooks.
- Searching various digital libraries (DLs) and abstracts of currently funded NSDL projects revealed that most collections of digital educational resources are geared toward high school or undergraduate education.

Objectives

The PRISMS project will:

A. Review 1,000 phenomena and representations found in DLs and select those that are aligned to national content standards and are consistent with the research on effective teaching and student learning.

B. Describe and annotate these resources to encourage their effective use by teachers.

C. Build capacity among middle school teachers, curriculum developers, and other NSDL users to select, analyze, try out, and contribute resources to digital libraries.

Project Design and Work Plan

Development of PRISMS will involve:

Prioritizing and Systematizing the Resource Selection. We will examine state standards and select science standards based on (1) their frequency of occurrence across states and (2) which areas of science the research base in *Benchmarks for Science Literacy* (1993) shows to be the most in need of phenomena and representations to make scientific ideas plausible and comprehensible to students.

Training and Support of Analysts. Analysts will be trained in applying a subset of Project 2061's curriculum analysis criteria that is specific to phenomena and representations to determine their content alignment and quality of instructional support. Table 1 shows the criteria and examples of phenomena and representations.

	Example	Criterion and Indicators of Meeting it
PHENOMENON	When a flashlight is directed at a wall, a patch of light appears on the wall. When a card is placed between the flashlight and the wall, the patch on the wall disappears and a patch of light appears on the card.  This phenomenon may encourage students to think that light must travel from one place to another, even if it cannot be seen in between.	**Providing Vicarious Experience with Phenomena:** Does the phenomenon support the learning goal's idea(s)? *Indicators of meeting this criterion*: 1. Phenomenon targets key benchmark idea(s) rather than peripheral details. 2. Phenomenon is likely to make key benchmark idea(s) plausible to students. 3. Phenomenon is likely to be comprehensible to students. For example: • The number of steps from phenomenon to key benchmark idea is small. • Additional ideas needed to make sense of the phenomenon are appropriate (given students' grade level and prior experiences). • Reasoning skills needed are manageable (given students' grade level and prior experiences). • Set-up, experimental procedure, or intricacies of calculations related to measurements are simple and unlikely to detract from the phenomenon. 4. Phenomenon is first-hand (when appropriate or practical) or vicarious through use of video, pictures, or text.
REPRESENTATION	This representation can be used to illustrate the continuous stream of light and how shadows form. A limitation of the representation is that the droplets of spray are material whereas light is a form of energy. 	**Representing Ideas Effectively:** Is the representation of the learning goal's idea(s) accurate and comprehensible? *Indicators of meeting this criterion*: 1. Representation accurately represents relevant aspects of the key benchmark idea(s). 2. Representation is likely to be comprehensible to students. 3. Representation makes clear which aspects are represented and which are not (if one regards it as impossible or undesirable to represent certain aspects of the idea).

Table 1. Determining content alignment and quality of instructional support of a phenomenon or representation.

Analyses of Phenomena and Representations. Based on the results from the first activity (Prioritizing and Systematizing the Resource Selection) MMSA staff will assign science benchmarks and web sites for teacher analysts to review. Figure 1 shows a mock-up of the custom online utility that teacher analysts will use to review phenomena and representations. Whenever practicable, we will identify cross-connections to math and technology content standards.

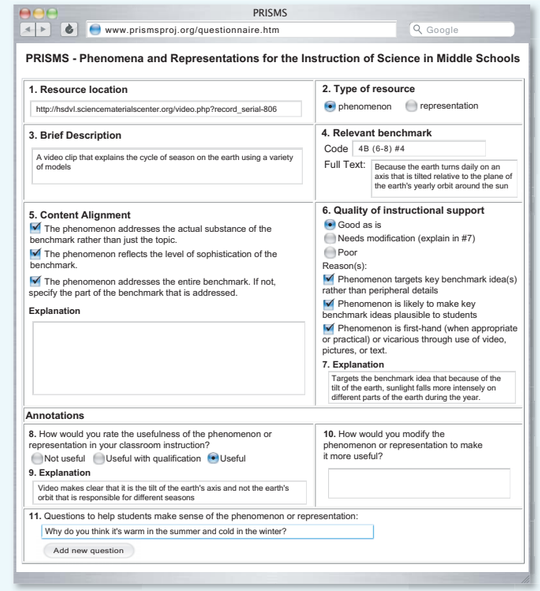

Figure 1. Preliminary mock-up of the custom online resource review utility for PRISMS with phenomenon selected as the resource type (#2). Resource analysis (top section) will be temporally separated from the addition of annotations (bottom), which are added when the resource is tried in the classroom.

Assembly, Organization, and Sharing. We will leverage applications developed by the NSDL to assemble, organize, and share the data about the selected resources as well as to generate OAI-PMH-compliant metadata.

Teacher Testing and Feedback. As the PRISMS site is built, the resources in the collection will be available to the middle school teacher analysts and other teachers working on projects with the MMSA, who will try them out with students and provide feedback in the form of annotations about their use in the classroom.

Use Scenarios. To supplement the annotated collection of relevant phenomena and representations and maximize the usefulness of PRISMS, we will develop and incorporate a "Use Scenario" section containing information for using selected sets of phenomena and representations.

Training/Technical Assistance for NSDL Grantees

As a collaborative effort to help others understand and utilize our criteria for evaluating phenomena and representations, we will invite developers of web-based collections to attend our training sessions in Maine. If the interest is significant we will consider offering a training session designed specifically for the NSDL community.

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[1] Phenomena and representations are a specific type of educational resource. "Phenomena" refers to real-world objects, systems, and events that provide evidence of key ideas (examples can be seen at: http://test.p2061.org/curriculum/test0310/phenom.htm). "Representations" refers to pictures, video clips, graphs, simulations, and analogies that can help clarify key ideas (examples can be seen at: http://test.p2061.org/curriculum/test0310/represent.htm).

[2] http://www.project2061.org/tools/textbook/mgsci/index.htm.