Working with K-12 Teachers

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Pasadena City College

July 16, 2009
Overview of Presentation

• Types of K-12 Education programs
• Support for pre-service teachers
• Support for in-service teachers
• Types/examples of activities
• Types/examples of assessments
Overview of Presentation

- Types of K-12 Education programs
- Support for pre-service teachers
- Support for in-service teachers
- Types/examples of activities
- Types/examples of assessments
K-12 Education Programs

• Undergraduate programs
  – K-5 and Middle School programs
  – Often leads to an education degree
  – Students most likely non-science majors

• Graduate programs
  – All levels including High School
  – Compressed schedule
  – Wide diversity of student backgrounds and educational levels
Overview of Presentation

- Types of K-12 Education programs
- **Support for pre-service teachers**
- Support for in-service teachers
- Types/examples of activities
- Types/examples of assessments
What they need from us

- Courses that integrate into their education program
  - Modeling of inquiry and hands on activities
  - Opportunities to produce work for graduation portfolios (alternative assessments)
  - An awareness of course content relevance to society
  - Connections between content and local state education standards
What they want from us

• Relevance of course to their career
• Scaffolding (especially for non-science majors)
• Explanation for our chosen pedagogical style
Relevance

• Geoscience in the news assignment
• Use of K-12 materials in class
  – Supplementary readings from K-12 texts
  – Lesson plan assignments
Scaffolding for Non-science Majors

- Graphing skills
- Algebra, trigonometry and manipulation of units
- Conceptions of map and cross section views
- Reading and writing skills
Scaffolding for Topographic Maps

• Topographic maps very abstract
• Paper activities can’t reach all students
• Activity
  – Make mountain
  – Trace water levels
  – Draw map
  – Draw cross section
  – Proceed to paper activity
Science Standards

• National Science Education Standards
  – Established by National Research Council
  – Guidelines for what students should know
  – Constructivist approach

• State standards

• Connections to course content
Standards and Course Content

Alignment between Georgia Performance Standards
Draft Earth Systems Curriculum

and

Essentials of Geology by Stephen Marshak
Compiled by students in GEOL7021 summer 2006

Co-Requisite - Content

**SES1**: Students will investigate the composition and formation of Earth systems, including the Earth's relationship to the solar system.

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>Stephen Marshak Essentials of Geology</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Describe the early evolution of the Earth and solar system, including the formation of Earth's solid layers (core, mantle, crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics.</td>
</tr>
<tr>
<td></td>
<td>Chapter 1</td>
</tr>
<tr>
<td></td>
<td>Chapter 19: section 19.2</td>
</tr>
<tr>
<td>b.</td>
<td>Explain how the composition of Earth's crust, mantle, and core is determined and compare it to that of other solar system objects.</td>
</tr>
<tr>
<td></td>
<td>Chapter 1.11 &amp; 1.12</td>
</tr>
<tr>
<td>c.</td>
<td>Describe how the decay of radioactive isotopes is used to determine the age of rocks, Earth and solar system.</td>
</tr>
<tr>
<td></td>
<td>Chapter 10.8</td>
</tr>
<tr>
<td>d.</td>
<td>Describe how the Earth acquired its initial oceans and atmosphere.</td>
</tr>
<tr>
<td></td>
<td>Chapter 1.8 &amp; 1.9</td>
</tr>
<tr>
<td></td>
<td>Chapter 19: section 19.2</td>
</tr>
<tr>
<td>e.</td>
<td>Identify the transformations that make up the rock cycle, hydrologic cycle, and carbon cycle.</td>
</tr>
<tr>
<td></td>
<td>Interlude B (Pages 175-180). Chapter 14.2</td>
</tr>
<tr>
<td></td>
<td>Chapter 19.4 (page 517) &amp; pg. 535</td>
</tr>
</tbody>
</table>

**SES2**: Students will understand how plate tectonics creates certain geologic features, materials, and hazards.

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>Stephen Marshak Essentials of Geology</th>
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<tbody>
<tr>
<td>a.</td>
<td>Distinguish among types of plate tectonic settings</td>
</tr>
<tr>
<td></td>
<td>Chapter 2: 2.8, 2.9 Divergent Plate Boundaries.</td>
</tr>
</tbody>
</table>
Overview of Presentation

- Types of K-12 Education programs
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SCALE

• Systemwide Change for All Learners and Educators
• Week-long institute for grade-specific earth science topics for in-service teachers at LAUSD
• Five essential features of inquiry
**Overarching Institute Outcomes**

*As a result of participating in this 1-week institute, participants will*

- implement the FOSS Water Planet and supplements from the Weather Forces and Prediction Immersion Unit in their classrooms,
- understand the CA 5th grade Science Content and I&E Standards and Frameworks that students learn in the units,
- develop the abilities to teach the units using the instructional model, conceptual flow, and inquiry framework designed in the unit,
- develop an understanding of inquiry as described by the five Essential Features of inquiry as defined by the *National Science Education Standards*,
- develop an implementation plan for teaching the units that is aligned with the instructional guide and periodic assessment.

**Evidence that participants reached the intended outcomes**

*As a result of participating in the 1-week institute, participants will be able to effectively*

- identify the points during the units at which key concepts are introduced, practiced, and applied,
- apply their understanding of the rationale for the conceptual flow, instructional model, and inquiry in the units to implement the units as designed,
- attend a follow up session bringing timely implementation questions and student work samples to share with colleagues and facilitators as part of a larger learning community,
- develop a personal planning timeline that explicitly shows when the units will be taught in the next school year.
<table>
<thead>
<tr>
<th>Time</th>
<th>Purpose</th>
<th>Activities</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:05-2:30</td>
<td>Model effective teacher moves for supporting data analysis.</td>
<td>Implement Lesson <strong>IU 2.1</strong> as designed and written in the Immersion Unit Implementation Guide. (Elizabeth) Implement Lesson and <strong>IU 2.2</strong> as designed and written in the Immersion Unit Implementation Guide. (Diana)</td>
<td>Lesson 2.1 materials Lesson 2.2 materials</td>
</tr>
<tr>
<td>2:30-2:45</td>
<td>Discuss challenges and solutions for facilitating data analysis.</td>
<td>Use a Think-Pair-Share to create a t-chart of teacher moves and effects on learners in these lessons. Ask teachers to record in their colored paper what they think will be most challenging about facilitating data analysis. Attempt to have other participants provide solutions. Facilitator can use experiences teaching these lessons with LA students (Jackie).</td>
<td><strong>Challenges &amp; Solutions</strong> Chart Materials for Wall</td>
</tr>
<tr>
<td>2:45-2:50</td>
<td>Reflect on conceptual flow and possibilities for integration.</td>
<td>Begin the <strong>TeacherWall</strong> and explain its structure and purpose. Walk participants through the Wall columns. Focusing on key concepts and purpose of the lessons. Discuss the time constraints and the low emphasis of the Solar System and I&amp;E standards on the assessments. Generate a class chart of ideas participants have for minimizing the time spent on these standards (e.g., do Swingers during first week of school, address the solar system standards in Open Court Unit 2 --Unit Opener activity?). (Diana)</td>
<td>Pre-made Teacher Wall for Investigation 1 posted on wall and a typed handout</td>
</tr>
<tr>
<td>2:50-3:00</td>
<td>Wrap-up</td>
<td><strong>“Gots ‘n Needs”</strong> Remind about snacks Introduce and explain the “Gots and Needs”—a formative assessment tool for facilitators and have participants complete a post-it for each. Review start time for Tuesday, share that tomorrow we begin by reviewing their “Gots and Needs”. Remind about snacks.</td>
<td>“Gots ‘n Needs” chart Sticky Notes Snack sign-up</td>
</tr>
</tbody>
</table>

**2:50-3:00 Wrap-up**

- **To wrap-up the day, formatively assess participants, and prepare for tomorrow.**
  - “Gots ‘n Needs” Remind about snacks Introduce and explain the “Gots and Needs”—a formative assessment tool for facilitators and have participants complete a post-it for each. Review start time for Tuesday, share that tomorrow we begin by reviewing their “Gots and Needs”. Remind about snacks.
  - “Gots ‘n Needs” chart Sticky Notes Snack sign-up
Lesson Title

FOSS 3.1
EVAPORATION

Key Concepts

Some water evaporates into the air as water vapor

Work Students Do

- Made observations
- Thinking about scientific Q's
- Posed questions
- Engaged students

Key Teacher Moves

- Collaboration
- Research
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Examples of Hands on Activities

(Hall-Wallace, 1998; JGE, v. 46, p. 439-449)
Example of Inquiry

- Play around a little
- Predict what will happen when it rains
- Spray mist on diatomaceous earth
- Make picture/describe what did happen
- Compare prediction and result
- Repeat
Tomorrow’s Scientist: Earth Science

◆ Spring 2005: 1-unit course (ESCI 300 Lab)
◆ 4-week Monday program - instructed by Nagy-Shadman
◆ 4-week Wednesday program - instructed by Simila
◆ Each program:
  🌍 24 CSUN students and 24 6th grade students from Patrick-Henry Middle School (LAUSD)
  🌍 1.5 hour lessons instructed in two class-rooms by six CSUN students
California Science Standards

Standard 1a (Grade 6) - PLATE TECTONICS

Students know evidence for plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.
Standard 1a (Grade 6)  
PLATE TECTONICS

Puzzle-piece fitting of continents
- Chocolate bars broken into 7 pieces

Web worksheet (plate tectonics)
- [http://library.thinkquest.org/27026](http://library.thinkquest.org/27026)

Label diagram of earth’s layers
- Hardboiled eggs

BINGO
Standard 4c (Grade 7) - SEDIMENTARY ROCKS

Students know that the rock cycle includes the formation of new sediment and rocks and that rocks are often found in layers, with the oldest generally on the bottom.
Standard 4c (Grade 7)  
SEDIMENTARY ROCKS

Clay models of different kinds of layered rocks  
Food models, too! (crackers, cheese, ham)  
- sandstone vs. conglomerate

Rock cycle worksheet

Games
- Word search puzzle  
- Jeopardy  
- BINGO
Standard 1d (Grade 6) - EARTHQUAKES AND VOLCANOES

Students know that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.
Standard 1d (Grade 6)
EARTHQUAKES AND VOLCANOES

Volcano model
- baking soda, colored vinegar, soap

Earthquake demos
- slinky waves, bending chopsticks

Games
- Crossword puzzle
- Jeopardy
- Word search
California Science Standards

Standard 2b (Grade 6) - RIVERS, SEDIMENT, AND EROSION

Students know rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
Standard 2b (Grade 6)
RIVERS, SEDIMENT, AND EROSION

Wave tank
- examined shoreline processes

Stream tables
- examined river formation

Games
- Word scramble
- BINGO
<table>
<thead>
<tr>
<th>B</th>
<th>I</th>
<th>N</th>
<th>G</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EROSION</strong></td>
<td><strong>RIVERS</strong></td>
<td><strong>SEDIMENT</strong></td>
<td><strong>WIND</strong></td>
<td><strong>GLACIERS</strong></td>
</tr>
<tr>
<td><strong>WAVES</strong></td>
<td><strong>DELTAS</strong></td>
<td><strong>SAND</strong></td>
<td><strong>KALPANA</strong></td>
<td><strong>ROCK</strong></td>
</tr>
<tr>
<td><strong>WATER</strong></td>
<td><strong>ICE</strong></td>
<td><strong>WEATHERING</strong></td>
<td><strong>LANDSLIDES</strong></td>
<td><strong>MOUTH</strong></td>
</tr>
<tr>
<td><strong>SHEENA</strong></td>
<td><strong>SHORELINE</strong></td>
<td><strong>SOIL</strong></td>
<td><strong>STREAMS</strong></td>
<td><strong>WAVE TANK</strong></td>
</tr>
<tr>
<td><strong>DEPOSITION</strong></td>
<td><strong>OCEAN</strong></td>
<td><strong>ERODE</strong></td>
<td><strong>STREAM TABLE</strong></td>
<td><strong>RITA</strong></td>
</tr>
</tbody>
</table>
Students should become familiar with the nature of science (NOS)

i.e., how scientific knowledge develops
There is a single scientific method agreed upon and used by those involved in science.

There is no such thing as a single scientific method.
Because science is based on evidence, it can be used to answer any question.

Science and its methods cannot answer all questions.
Imagination and creativity play a significant role in the work of a scientist.

Agree? Disagree? WHY OR WHY NOT?

Scientific activity requires both being logical/systematic and creative/imaginative.
Scientific laws and theories are open to debate and can be changed.

Scientific knowledge is durable but tentative.
Because science is based on fact, bias does not play a significant role in scientific activities.

Because of social, historical, and cultural influences, science can be subjective and have bias.
ACTIVITY

Place students in groups of about four

Roles: facilitator, recorder, presenter, materials manager
RESULTS

Each group will use the same “pieces of evidence” in different ways

Each group will adjust their story based upon new evidence
This is analogous to the development and advancement of a theory.

For example, the theory of plate tectonics changes as new evidence is collected.
In the past, people believed that the sun and planets of our solar system revolved around the earth. Today we know that the sun is at the center of our solar system. Choose one of the Nature of Science tenets to explain how this change in our understanding of the solar system illustrates how scientific knowledge develops.
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Portfolios and Alternative Assessments

• Alternative assessments
  – Strongly favored by education establishment
  – Examples
  – Grading rubrics

• Portfolios
  – As an assembly of alternative assessments for a class
  – Student’s demonstration of competence for graduation
  – Program evaluation
Examples of Alternative Assessments

• Burning questions journal
• Crystal growing experiments
• Scrapbook
• Writing a children’s book
Earth Science Scrapbook Assignment

- Items are collected over course of semester
- Can use adds, news articles, postcards, travel brochures, etc.
- Items come from diverse sources
- Items relate to a range of topics
- Student writes a caption for each item
Captions

- Describes connection between item and course content
- Contains content information unfamiliar to student prior to taking class
- Identifies connection to a National Science Education Standards Earth Science content standard (optional)
- Evaluated based on correctness and sophistication
- Iterates through 1st and 2nd draft
As lava cools, trapped gases are released into the atmosphere. The recycling of gases maintains balance between the atmosphere and the lithosphere.

National Geographic Adventure, October 2000

D (9-12): Geochemical Cycles. Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.

22. Tibetan mountain valley showing typical V-shaped valley.

Outdoors Photographer, Aug 1999

NSES D (9-12) Energy in the Earth System. "Heating of earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds, (rain) and ocean currents."
### Analytical Rubric for Earth Science Scrapbook: Total 25 points

<table>
<thead>
<tr>
<th></th>
<th>Best</th>
<th>Good</th>
<th>Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># captioned items (15%)</strong></td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Variety (15%)</strong></td>
<td>at least 3 topics* 4 or more sources*</td>
<td>at least 2 topics* at least 3 sources*</td>
<td>at least 2 topics* at least 2 sources*</td>
</tr>
<tr>
<td>(also see comments below)</td>
<td>2 mix of pictures and news stories or articles</td>
<td>heavily articles or news stories; only pictures</td>
<td>all articles or news stories</td>
</tr>
<tr>
<td><strong>Content: % correct (25%)</strong></td>
<td>&gt; 50%</td>
<td>&gt; 70%</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td><strong>Quality of content (15%)</strong></td>
<td>Earth science content information unfamiliar to lay persons is applied to each item, in many cases caption includes information about geologic processes. Caption is in student’s own words and it is clear that ideas have not been cribbed from item’s source.</td>
<td>Earth science content information unfamiliar to lay persons is applied to each item, in some cases caption includes information about geologic processes. Caption is in student’s own words.</td>
<td>Two thirds of the captions include Earth science content information unfamiliar to lay persons. Caption is in student’s own words.</td>
</tr>
<tr>
<td><strong>Professionality of presentation (10%)</strong></td>
<td>Items are neat and aesthetically presented, organized by topic, captions typed, all items are fully referenced</td>
<td>Items are neat, most items are referenced, captions are typed.</td>
<td>Captions are legible, most items are referenced, some items missing parts of references.</td>
</tr>
</tbody>
</table>

Done
Children’s Book

• Student writes an illustrates a children’s book
• Book contains science content
• Emphasis on putting ideas in their own words
• Iterates through 1^{st} and 2^{nd} draft
• Evaluated on sophistication and correctness of concepts
Riley’s Wild & Crazy Vacation through the Water Cycle

Story by Erica Wooldridge
Illustrations by Greg Watford
“My wonderful relaxing vacation

Riley is not very familiar with transpiration because he usually
hugs out in the surface water and evaporates his way home. He
did not think about going home a different way just because
he was in groundwater. So, he shuts the door, crosses his fingers, and
steps on to the platform. Before he can say ‘transpiration,’ he
is back home! He was shot straight up the roots of a tree
and disappeared right out of the leaves! “That was so much
fun!” exclaimed Riley!
### Analytical Rubric for Children's Book - Total 25 points

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Science concepts are correctly discussed or illustrated.</td>
</tr>
<tr>
<td>4</td>
<td>Science concepts are mainly correct with only minor misconceptions.</td>
</tr>
<tr>
<td>2.3</td>
<td>Science concepts contain one or more major misconceptions.</td>
</tr>
<tr>
<td>0.1</td>
<td>Science concepts were mostly misconceptions.</td>
</tr>
<tr>
<td>4</td>
<td>A number of related concepts or a single concept with several sub-concepts, unfamiliar to lay persons are illustrated.</td>
</tr>
<tr>
<td>4</td>
<td>Some concepts are missing, but most concepts are unfamiliar to a lay person.</td>
</tr>
<tr>
<td>2.3</td>
<td>Few science concepts are discussed or illustrated, concepts would be familiar to a lay person.</td>
</tr>
<tr>
<td>0.1</td>
<td>No Science concepts are included.</td>
</tr>
<tr>
<td>4</td>
<td>Book is at the proper cognitive level for middle school.</td>
</tr>
<tr>
<td>4</td>
<td>Mainly a children's book but some parts is at too high or too low of a cognitive level for middle school.</td>
</tr>
<tr>
<td>2.3</td>
<td>Partially a children's book but much of it is at too high or too low of a cognitive level for middle school.</td>
</tr>
<tr>
<td>0.1</td>
<td>Almost none of it is a children's book. It is mostly at too high or too low of a cognitive level for middle school.</td>
</tr>
<tr>
<td>4</td>
<td>The book has a story line that is original and easy to follow.</td>
</tr>
<tr>
<td>4</td>
<td>Most of the story line is original and easy to follow.</td>
</tr>
<tr>
<td>2.3</td>
<td>Only some of the story line is original or story line is disconnected didn't make sense.</td>
</tr>
<tr>
<td>0.1</td>
<td>None of the story is original or there is no clear story line.</td>
</tr>
<tr>
<td>4</td>
<td>Original illustrations convey information/illustrate concepts and add to the book's ability to teach.</td>
</tr>
<tr>
<td>4</td>
<td>Original illustrations convey information/illustrate concepts in the book.</td>
</tr>
<tr>
<td>2.3</td>
<td>All illustrations are original and not copied from books or the Web but are related to the story line in a superficial way.</td>
</tr>
<tr>
<td>0.1</td>
<td>None of the illustrations are original or illustrations are not related to story.</td>
</tr>
</tbody>
</table>

### Analytical Rubric for Earth Science Scrapbook - Total 25 points

#### # captioned items (15%)
- **Best**: 10
- **Good**: 8
- **Passing**: 5

#### Variety (13%)
- **Best**: at least 3 topics*
- **Good**: 4 or more sources**
- **Passing**: a mix of pictures and news stories or articles

#### Content: % correct (25%)
- **Best**: > 80%
- **Good**: > 70%
- **Passing**: > 60%

#### Quality of content (35%)
- **Best**: Earth science content information unfamiliar to lay persons is applied to each item, in many cases caption includes information about geologic processes. Caption is in student's own words and it is clear that ideas have not been cribbed from item's source.
- **Good**: Earth science content information unfamiliar to lay persons is applied to each item, in some cases caption includes information about geologic processes. Caption is in student's own words.
- **Passing**: Two thirds of the captions include Earth science content information unfamiliar to lay persons. Caption is in student's own words. Captions are legible, most items are referenced, some items missing parts of references.

#### Professionalism of presentation (10%)
- **Best**: Items are neat and aesthetically presented, organized by topic, captions typed, all items are fully referenced.
- **Good**: Items are neat, most items are referenced, captions are typed.
- **Passing**: Captions are legible, most items are referenced, some items missing parts of references.