Teaching Mineral Resources with an Emphasis on the NGSS Practices & Crosscutting Concepts

Aida Awad, Maine East High School, NAGT Past President
Ed Robeck, American Geosciences Institute, Director Center for Geoscience & Society
Alex Speer, Executive Director, Mineralogical Society of America
Susan Sullivan, Coop. Inst. for Research in Enviro. Sciences, NAGT Past President
learning goals of this workshop:

➢ I can adapt InTeGrate module materials to align with NGSS crosscutting concepts, practices and DCIs.
➢ I can explain how and why managing mineral resources is a global challenge that depends both on geological (mineral forming) processes and non-geological factors with various impacts on the environment and communities.
InTeGrate website:

[Image of the InTeGrate website]

**Summary**

Despite humans' heavy reliance on Earth's mineral resources, few think about where the products they use come from and what it took to produce them. This module addresses that disconnect by combining learning about rocks and minerals (and how these become the products students use), methods of mineral resource discovery and extraction, and the impact of mineral resource use. This module allows important geoscience concepts to be taught in the context of important and immediate societal issues while also asking students to confront human issues such as environmental justice, economics, personal choice, and politics that may arise due to obtaining, beneficiating, transporting, trading, using, and disposing of natural resources.

**Strengths of the Module**

- Incorporates systems thinking inherent to the study of the rock cycle. It expands beyond the geosphere to include parts of the hydrosphere and atmosphere and how they are affected by mining.
- Uses real-life examples of issues related to resource management and extraction for collaborative problem solving. These problems incorporate ideas from economics, social, and environmental justice, and the geosciences.
- Content is delivered using a variety of student-centered activities, including group discussions, concept mapping, lectures, and cooperative learning.
- Several student activities are hands-on, developing skills including analysis of actual geoscience data, model-building, and hypothesis formation and testing.
- The module is extremely flexible, allowing for reorganization of units and even picking and choosing only select activities and/or units.

**Table of Contents**

- Instructor Materials: Overview of the Mineral Resources Module
- Unit 1: People, Products, and Minerals
- Unit 2: Boom and Bust: How Econ 101 Relates to Rocks
- Unit 3: Mining and Mining Impacts
- Unit 4: Mineral Resources Created by Sedimentary Processes
- Unit 5: Resources Created by Igneous and Metamorphic Processes
- Unit 6: Mining, Society, and Decision Making
- Student Materials
- Assessment
- Instructor Stories
- Join the Community

**Instructor Stories**: How this module was adapted for use at several institutions

[Link to the InTeGrate website: http://goo.gl/AuVwy6]
spreadsheet access to materials:

<table>
<thead>
<tr>
<th>Unit</th>
<th>activity</th>
<th>link to Google doc version</th>
<th>description</th>
<th>practice / crosscutting concept alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre / overarching</td>
<td>concept map</td>
<td><a href="https://docs.google.com/document/d/1H4uJGqOOkMgGgDQgHxKYo.x66h6Q4TFQK8s5KwTABLE/1/edit">https://docs.google.com/document/d/1H4uJGqOOkMgGgDQgHxKYo.x66h6Q4TFQK8s5KwTABLE/1/edit</a></td>
<td>students/groups choose a mineral resource to track their learning throughout the entire module adding new nodes to the concept map as they progress.</td>
<td>the activity supports interpretation of graphical data.</td>
</tr>
<tr>
<td>pre / overarching</td>
<td>concept map rubric</td>
<td><a href="https://docs.google.com/document/d/1Q8PEH46Q0W9bheM4G4M/edit">https://docs.google.com/document/d/1Q8PEH46Q0W9bheM4G4M/edit</a></td>
<td>grading rubric for the concept map - should be shared with students at the start of the module when assigning the concept map.</td>
<td>CCR: pattern, scale, proportion, quantity.</td>
</tr>
<tr>
<td>InTeGrate page</td>
<td></td>
<td><a href="http://serc.carleton.edu/integrate/modules/mineral-resource-assessment.html">http://serc.carleton.edu/integrate/modules/mineral-resource-assessment.html</a></td>
<td>this page contains useful links to information on using concept maps and a sample concept map.</td>
<td></td>
</tr>
<tr>
<td><strong>Earth Science Week</strong></td>
<td>Discover the resources offered through this international event, organized by AGI each October to promote better understanding and appreciation of Earth science and encourage stewardship of the planet. <a href="http://www.earthsciweek.org/classroom-activities">http://www.earthsciweek.org/classroom-activities</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Big Ideas in Earth Science</strong></td>
<td><strong>Big Ideas videos</strong> bring to life the &quot;big ideas&quot; of Earth science—the nine core concepts that everyone should know. Teachers can use the videos in many ways. <a href="http://www.earthsciweek.org/big-ideas">http://www.earthsciweek.org/big-ideas</a></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Center for Geoscience and Society** | **Education Resource Network** – The geoscience education resources on this site come from a variety of providers. The site provides visitors with the widest possible collection of curricula, classroom activities, teacher professional development opportunities, science education standards, virtual field trips, teaching ancillaries, and much more. [http://geocntr.org/education-resources/](http://geocntr.org/education-resources/)  
**Critical Issues Program**  
The Critical Issues Program provides a portal to decision-relevant, impartial, expert information from across the geosciences. [http://www.americangeosciences.org/critical-issues](http://www.americangeosciences.org/critical-issues) |
| **K-5 Geosource** | If you are involved in elementary science education in any way, this Web site is for you. The site has a rich store of content, activities, services and links for you to explore, but this is only the beginning. [http://www.k5geosource.org/index.html](http://www.k5geosource.org/index.html) |
Mineralogical Society of America resources:

Mineralogy 4 Kids
Mineralogy 4 Kids is the educational outreach website for the Mineralogical Society of America (MSA). This interactive website is designed to help children of all ages learn about mineral groups, properties, and identification. Visitors to the site can also learn about the rock cycle, crystals, and minerals used in homes. Additional resources are also listed.

Mineral Identification: MSA Mineral Collector’s Corner
The Mineralogical Society of America provides an online Mineral Identification Key to help users recognize the attributes of many kinds of minerals. The site gives information about mineral properties, environments, and associations. The Mineral Identification Key website is primarily focused on the needs of collectors, including a description of how basic mineral identification kits can be assembled.