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# A Few Good Materials

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## Series Introduction

The following three articles: “Landforms and Change,” “Matter and Molecules,” and “Plants and Growth,” are a series of articles based on presentations at this year’s MSTA conference. The presentations and the articles all share a common theme, audience, and emphases.

A constant theme in these articles is “a few good materials”. Our aim in exploring any topic in the science curriculum is the use of relatively few, but exceptionally rich materials that illustrate science concepts, with increasing depth, breadth, and integration. While this article focuses on using a few good materials in Earth science, the other two articles use the same theme to focus on topics in physical science (*A Few Good Materials: Matter and Molecules*) and life science (*A Few Good Materials: Plants and Growth*). Our focus on a few good materials is more than a nod toward the current fiscal crisis in K-8 schools; it is an acknowledgment of our belief that *less can be more* when it comes to science activities and materials. An over-abundance of materials, even really good materials, can change the focus of science learning from an integrated “hands-on, minds-on” approach to merely a fun activity in which it is difficult for students to progress in understanding science content and processes.

## Teachers as Learners

The audience for these articles is *K-8 teachers* rather than K-8 students. Our goal is to deepen, clarify, and simplify science concepts for teachers’ understanding and to show connections across all the grades in the K-8 science curriculum. In so doing, we hope to better prepare teachers for whatever changes may come in terms of grade assignment or curricular alignment. Even though we focus on what teachers need to know, we are well aware that this science understanding needs to be translated to



grade-appropriate content, language, and activities, and who better to do that than the experts themselves - K-8 teachers?

## Big Ideas

The three articles in this series all emphasize big ideas along with related misconceptions and real world examples. We focus on three levels of big ideas - grade level content expectations, big ideas within the science disciplines, and foundational big ideas. The science content in these articles is closely aligned to Michigan’s K-7 grade level content expectations (GLCEs). We realize that the GLCEs are the reality of the science classroom for most teachers. Our goal is to make the GLCEs user-friendly by showing the natural progression of science concepts across the grade levels within each area of science. Thus, each article includes a map of selected GLCEs that logically fol-

low one after the other leading to an eventual understanding of one (or more) of the standards within a discipline. For example, in this article on landforms and change, we show the development of content understanding in the standard “*Understand gradual and rapid changes in Earth materials and features on the surface of Earth*” by focusing on a few selected GLCEs (Figure 1).

Teachers familiar with *The Atlas of Science Literacy* will see the similarity of our approach to this document of the American Association for the Advancement of Science (2001; 2007). Both the atlas and our work are based on the big ideas within each science discipline and use a mapping approach to show the progression of big ideas across big ideas and the inter-connections between content areas. For example, one big idea of geology is that Earth’s surface changes (i.e., it gets worn down and built back up). This disciplinary big idea matches the K-7 solid Earth standard mentioned above. Thus, early elementary teachers are actually laying the foundation for students to understand this disciplinary big idea when they provide learning experiences that let students explore sand and clay and gravel - evidence of the wearing down of Earth’s surface.

At a deeper level, the big ideas in all science disciplines rest on a foundation of a few basic concepts. We call these the “foundational big ideas” and focus on three.

- Matter can change (in physical and chemical changes), yet is still conserved.
- Energy can change (in transfers and transformations), yet is still conserved.
- When matter changes, energy’s involved.

The power of these foundational big ideas lies in their ability to integrate the GLCEs across different science disciplines. Thus, for K-8 teachers who typically teach topics in life, Earth, and physical science each year, these foundational big ideas form connections between topics so the teaching and learning of science doesn’t become an exercise in memorizing a million disconnected facts. Each of the articles in this series emphasizes one or more of the foundational big ideas as the cornerstone of content. In this article, the foundational big idea that’s highlighted is “When matter changes, energy’s involved”.

In addition to the science content GLCEs that focus on what students need to *know*, there are also science process GLCEs that focus on what students must be able to *do*. Thus, the GLCEs emphasize both the “what” and the “how” of science learning. In simple terms, the science process expectations are the actual skills that students (and scientists) use in learning new science content. Each article in this series highlights the use of several of these science process expectations (such as making observations and using models), building these processes of ►

Figure 1. Landforms and Change: Three Levels of Big Ideas

<i>GLCEs</i>	K - Identify Earth materials that occur in nature (sand, rocks, soil, water). 2 - Describe major landforms of Earth’s surface. 3 - Describe natural causes of change in the Earth’s surface. 6 - Explain how waves, wind, water, and glaciers reshape the land surface. 6 - Demonstrate how earthquakes, volcanoes, and mountain building result from plate motions.
<i>Disciplinary Big Idea</i>	<b>Earth’s surface undergoes sudden and gradual changes.</b>
<i>Foundational Big Idea</i>	<b>When matter changes, energy’s involved.</b>

science into the context of specific content.

## Misconceptions and Real World Examples

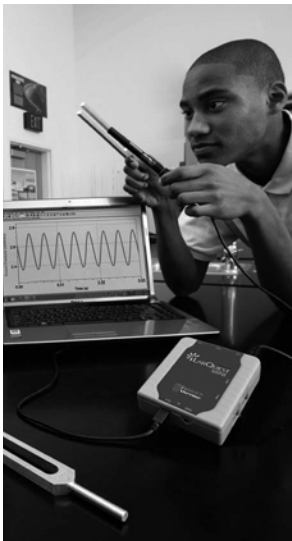
In addition to emphasizing big ideas, we also highlight misconceptions and real world examples drawn from people's daily lives. We explicitly confront common misconceptions that often act as barriers to new and deeper understanding. However, most people have not only misconceptions that get in the way of new learning, but they also have missing conceptions that are

obstacles since there is no basis for connecting new ideas. Thus, we begin with the most basic concepts and work forward from that point. Finally, we rely on the use of everyday examples in people's own lives to illustrate the big ideas of science.

In the description that follows you'll see each of the above points illustrated for the topic of landforms and change. The other two articles in this series will illustrate these points within the context of physical science (matter and molecules) and life science (plants and growth).

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