



CORE CONCEPTS

Created by Mining Matters

Backgrounder and Evaluation Strategies

**At the core of it all, successful
classroom implementation matters!**

BACKGROUND:

Mining Matters Core Concepts are standalone classroom ready activities that reflect key foundational ideas in Earth science. Sourced from our archives of curriculum-linked teacher resources, each activity reflects an integral part of many important concepts and theories in the various disciplines that comprise the Geosciences.

In an effort to be of service to all of our teacher-partners, these activities have been assembled as a way to support individual teachers without the need to attend a pre-requisite teacher training workshop. All the contents of the Core Concepts resource support current teaching practices that values hands-on experience where students take an active role in learning. Any rocks and minerals samples as well as print resources required for successful classroom delivery can be sourced through **Mining Matters**.

CURRICULUM STANDARDS AND EXPECTATIONS

The activities contained within are correlated to the National Science Foundation and the Earth Science Literacy Initiative (2009) entitled, Earth Science Literacy Principles. The document, which can be downloaded free of charge from the Earth Science Literacy Initiative website (www.earthscienceliteracy.org) outlines nine Big Ideas that represent the most important concepts of Earth science, and provide an excellent overview of what should be included in Earth Science curricula.

Here is a summary of the nine Big Ideas contained in the Earth Science Literacy document:



1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.

Scientists learn about Earth using many different methods and techniques in both the laboratory and the field, such as radar, sonar, seismic waves, and magnetic fields.

2. Earth is 4.6 billion years old.

Scientists use measurements of radioactive decay, analysis of rock and sediment structures and properties, an understanding of geologic processes and observations of other objects in the solar system to determine the age of Earth.

3. Earth is a complex system of interacting rock, water, air, and life.

Earth's systems include the atmosphere, biosphere, geosphere and hydrosphere. Energy and matter cycle through these systems, and they are interconnected in a complex manner.

4. Earth is continuously changing.

The geosphere is changed by many factors and processes including plate tectonics, weathering, erosion, and living organisms.

5. Earth is the water planet.

Water is necessary for life, and is an important component of Earth's systems. Less than 3 percent of the surface water is fresh, and less than 1 percent is drinkable.

6. Life evolves on a dynamic Earth and continuously modifies Earth.

Evolution is an ongoing process in which life adapts to changing habitats. Extinctions occur when conditions change more quickly than species can adapt. Living organisms cause changes in Earth's conditions, such as by producing oxygen and fossil fuels.

7. Humans depend on Earth for resources.

Natural resources are limited and unevenly distributed. Water, soil and minerals are essential for agriculture and manufacturing, and oil and gas play a part in many components of modern life. Developing renewable energy resources will contribute to sustainability.

8. Natural hazards pose risks to humans.

Natural hazards including earthquakes, volcanoes, floods, fires, hurricanes and tsunamis influence societies by driving migration and changing the size of populations. Human activity can increase the probability of some natural disasters such as landslides, floods and fires.

9. Humans significantly alter the Earth.

Human activities impact Earth systems by causing climate change, altering land surface and water quality and availability, increasing erosion and causing habitat loss leading to decreased species diversity.

Using the Big Ideas to shape instruction has been shown to be an effective way to build enduring understanding at the K-12 level. However, the Big Ideas of the ESLI are not meant to replace regional prescribed learning outcomes and while its aims are broader than K-12 education, its results will play an important role in shaping the future of K-12 Earth science education.

Source: <http://earthscienceliteracy.org/document.html>

INSTRUCTIONAL MODEL USED TO PRESENT THE ACTIVITIES

The 5 **E's** is an instructional model based on the constructivist approach to learning, which operates under the premise that learners build or construct new knowledge over older ideas. This model is an ideal framework for inquiry based learning.

Each of the 5 **E's** describes a phase of learning, and each phase begins with the letter "**E**": **Engage, Explore, Explain, Elaborate, and Evaluate**. The 5 **E's** allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept.

Engage: This phase of the 5 **E's** starts the process. It should involve an activity which will focus student's attention, stimulate their thinking, and access prior knowledge.

Explore: This phase of the 5 **E's** provides students with a common base of experiences. They identify and develop concepts, processes, and skills. During this phase, students actively explore their environment or manipulate materials.

Explain: This phase of the 5 **E's** helps students explain the concepts they have been exploring. They have opportunities to verbalize their conceptual understanding or to demonstrate new skills or behaviors. This phase also provides opportunities for teachers to introduce formal terms, definitions, and explanations for concepts, processes, skills, or behaviors.

Elaborate: This phase of the 5 **E's** extends students' conceptual understanding and allows them to practice skills and behaviors. Through new experiences, students can expand and solidify their thinking and/or apply it to a real-world situation.

Evaluate: This phase of the 5 **E's** encourages learners to assess their understanding and abilities while providing an opportunity for the teacher to assess student performance and/or understandings of concepts, skills, processes, and applications.

Sources: WGBH Boston. (2002). Enhancing Education: The 5 E's. Retrieved from <http://enhancinged.wgbh.org/research/eeeeee.html>
Eisenkraft, A. (2003). Expanding the 5-C Model. *The Science Teacher*, 70. National Science Teacher Association.



CONTACT INFORMATION FOR COMPLEMENTARY RESOURCES

If you are interested in placing an order of any products featured in this resource, you may place your order by contacting **Mining Matters**.

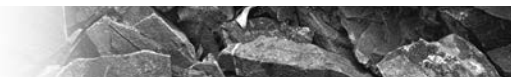
Please state, "**Core Concepts order request**" in the subject line of the email/fax.

Telephone (416) 863-6463

Fax (416) 863-9900

Email schoolprograms@miningmatters.ca

CORE CONCEPTS – EVALUATION CONTENT



Core Concept	Activity	Task	Evaluation content *new
1.0 Structure of the Earth	1.1 Tectonic Plates – The Moving Foundations of the Earth’s Crust	<ul style="list-style-type: none"> • Read Information Bulletin (IB) • Look at world map, map of plates • Cut out continents, combine as pangea 	<ul style="list-style-type: none"> • Written questions: <ul style="list-style-type: none"> - Describe plate tectonic theory - Locate two spreading boundaries - Definitions
	1.2 Heat – A Powerful Force in the Earth	<ul style="list-style-type: none"> • Read IB • Observe and record convection with oil and food colour • Written questions • Layers of Earth • Definitions 	<ul style="list-style-type: none"> • Draw a diagram illustrating convection in their daily lives
	1.3 Earthquakes	<ul style="list-style-type: none"> • KW(L) for earthquakes • Stick slip experiment • Map 16 global events • Read IB • Watch animation on wave propagation and global events • Overlay plate boundary map with event map • Map events over 2 -3 weeks 	<ul style="list-style-type: none"> • Exit question index card: <i>What is the most important information about earthquakes that you think someone living in Canada should know?</i>
	1.4 Volcanoes: The Rumbblings Within	<ul style="list-style-type: none"> • KW(L) for volcanoes • View video of Hawaii • Discuss impact of volcanoes • Map global volcanoes • Read IB • Chart & describe shield, composite, cinder cone • Visit Volcano Virtual Fieldtrips 	<ul style="list-style-type: none"> • In peer group, complete “L” in KWL chart. • Compare the responses to the volcano chart, identifying and clarifying any differences with reference to the lesson material. • Make any amendments necessary.
	1.5 Folding and Faulting	<ul style="list-style-type: none"> • Build Play-Doh layers and folds • Build popsicle stick and Play-Doh faults • Read IB 	<ul style="list-style-type: none"> • Compare and contrast chart for folding and faulting • Identifying folded rocks and mountains in photos
2.0 Rocks and Minerals	2.1 Mineral Identification	<ul style="list-style-type: none"> • Learn 8 tests • Apply tests to identify mystery mineral 	<ul style="list-style-type: none"> • <i>**Teacher observation of lab skills using rubric</i>
	2.2 Minerals – The Building Blocks of Rocks	<ul style="list-style-type: none"> • Observe granite and its components • Learn definition of rock and mineral 	<ul style="list-style-type: none"> • Compare and contrast chart for rocks and minerals • Concluding statement about rocks and minerals
	2.3 The Rock Cycle and the Three Rock Groups	<ul style="list-style-type: none"> • Observe rock samples and brainstorm formation • Study diagram and IB of rock cycle and three rock groups • Complete labels on their own diagram • Written questions on rock types 	<ul style="list-style-type: none"> • <i>*Create analogy or diagram of products, processes and pathways in rock cycle, with given criteria that can be used to assess.</i>



Core Concept	Activity	Task	Evaluation content *new
	2.4 Rock Strata and Fossils	<ul style="list-style-type: none"> • Look at dolostone • Discuss dating • Read IB • Complete passage on geological history • From fossil photos, fill in sketch & ages of 8 main types • Written questions on timescale and life forms 	<i>*One minute report to panel discussion: what evidence is there that the Earth has changed through time</i>
	2.5 Rock Classification Challenge	<ul style="list-style-type: none"> • Review rock cycle diagram from 2.3 • Observe 13 rock samples • Match observations to given properties and ID rocks • Written interpretation questions 	<i>*Design an instruction card from someone to tell if a rock is sedimentary, metamorphic or igneous.</i>
3.0 Soil and Erosion	3.1 Weathering and Erosion	<ul style="list-style-type: none"> • 3 Demonstrations: <ul style="list-style-type: none"> - Freeze thaw with balloon in plaster - Crush chalk in ice - Steel wool oxidise - Complete prediction of results • 2 Activities: <ul style="list-style-type: none"> - Vinegar and chalk - Pencil line and eraser • Read IB • Match activities to which kind of weathering • Answer written questions 	<i>**Design an experiment to test what increases or decreases the amount of one type of weathering.</i>
	3.2 Soil Formation	<ul style="list-style-type: none"> • Observe results of demonstration from 3.1 • Record observations next to predictions • Read IB • Explain how each experiment is related to soil formation 	<i>*Discuss as plus, minus, interesting points "What if we could stop all erosion?"</i>
	3.3 Characteristics of Soil	<ul style="list-style-type: none"> • Investigate: <ul style="list-style-type: none"> - Components of soil - Water holding capacity - Presence of air - Capillary action 	<i>*Chart each soil type and rank for water holding, air content and capillary action.</i>
	3.4 Types and Uses of Soil	<ul style="list-style-type: none"> • Read IB • Research soils in their area 	Match type of soil to use
	3.5 Importance of Soil Conservation	<ul style="list-style-type: none"> • Review soil and process of erosion • Observe demonstration of mulch above soil to retain water • Observe demonstration of wind erosion on dry & wet sand, peat mix, and sand with grass • Complete crossword puzzle 	<i>*Create a public service announcement convincing people what they can do to reduce soil erosion and why it is important.</i>



Core Concept	Activity	Task	Evaluation content *new
	3.6 Glaciers and Landforms	<ul style="list-style-type: none"> • Review weathering and erosion • Observe ice abrasion • Read IB on glaciers & answer questions • Research glacial features • Complete two concept overview charts 	<i>*Concept definition charts for two glacial landforms</i>
4.0 Mining Cycle	4.1 Mine Types and Technology	<ul style="list-style-type: none"> • View posters • Read IB • Compare and contrast discussion underground & surface mines • View Command for Underground • View Ground Rules 	<i>**Pros/cons grid for surface and underground mining</i>
	4.2 Reclamation and Rehabilitation	<ul style="list-style-type: none"> • Brainstorm impact of mines • Look at before and after photos • Read rehabilitation brochures • Create rehabilitation plan for local mine/quarry 	<i>*Self-evaluation responses of their presentation</i>
	4.3 The Mine Discovery Process	<ul style="list-style-type: none"> • 1 in 100 demonstration • Read IB • Answer written questions on IB • Watch careers video. • Research career of choice 	<i>*Sticky note response: what are the most important ideas related to the mine discovery process?</i>
	4.4 Recycle and Reuse	<ul style="list-style-type: none"> • Read IB • Write song, poem, anagram, etc about recycling • Survey community about recycling activities 	<i>*Design an evaluation tool</i>
5.0 Social and Environmental Responsibility	5.1 Operating a Surface Mine	<ul style="list-style-type: none"> • Read IB • Look at surface mine poster • Model surface mine: draw, extract, reclaim • Questions on impact of mining model 	<i>Before/after Photo interpretation: write 3 things done</i>
	5.2 Wakima – A Case Study	<ul style="list-style-type: none"> • Look at town map • Read IB • Written questions 	<i>*Vote with your body: how would you feel if a mine operation were proposed close to where you live?</i>
	5.3 Wakima – Research and Roles	<ul style="list-style-type: none"> • Role play to develop opinion and strategy towards mine proposal • Present point of view in role • Prepare solutions to issues raised 	<i>(*Carried over into 5.4)</i>
	5.4 Wakima – Debate and Decision	<ul style="list-style-type: none"> • <i>*Plan debate presentation based on evaluation criteria</i> • Classroom debate with presentations from each role group • Individuals vote yes/no for mine 	<ul style="list-style-type: none"> • Teacher assessment of debate performance based on given criteria



Interpret data	<ul style="list-style-type: none"> • 1.5 (photo) • 4.1 mine types pros and cons • 5.1 (photo) reclamation
Design an experiment	<ul style="list-style-type: none"> • 3.1 weathering and erosion
Questions on lab done	<ul style="list-style-type: none"> • 3.3 soil characteristics
Ongoing diagnostic process through 5E cycle	
Rubric	<ul style="list-style-type: none"> • 2.1 mineral testing
Teacher observation of performance	<ul style="list-style-type: none"> • 2.1 mineral testing • 5.4 Wakima debate
Student interview	
Portfolio	
Problem based learning product	<ul style="list-style-type: none"> • 5.1 reclamation photos to interpret
Video segment	
Journal	
Drawing	<ul style="list-style-type: none"> • 1.2 convection in life (record) • 2.3 rock cycle diagram (devise)
Performance task	<ul style="list-style-type: none"> • 1.5 interpret photos, label model • 3.5 public service announcement
What do you think about ...	
Why do you think ...?	
What evidence do you have ..?	<ul style="list-style-type: none"> • 2.4. evidence that the Earth has changed throughout time
What do you know about the problem ..?	
What is the most important	<ul style="list-style-type: none"> • 4.3 Ideas related to discovering a mine?
How would you decide about ...	
What criteria would you use to assess ...?	
How is a good model for this concept?	
Writing	
Test	
Exit questions (quick)	<ul style="list-style-type: none"> • 1.3 earthquake info
Respond to analogy	
Explain in own words	
Explain similarities and differences between analogy and target	
Detail limitations of analogies & models	
Create analogy or model following given rubric	<ul style="list-style-type: none"> • 2.3 rock cycle: analogy or diagram
Debate	<ul style="list-style-type: none"> • 3.2 soil formation: debate what if we could stop all weathering? • 5.4 Wakima mine
Make a [booklet] to convince others	<ul style="list-style-type: none"> • 2.5 rock type instructions • 3.5 public service announcement
Write letter	
Find other examples of	
What would you tell About this?	<ul style="list-style-type: none"> • 1.3 earthquakes
Explain ...	



Panel discussion	<ul style="list-style-type: none">• 2.4 evidence that the Earth has changed throughout time
Present your view	<ul style="list-style-type: none">• 5.2 Wakima town map
Poster	
Record most confusing point	
Index card	
minute paper	<ul style="list-style-type: none">• 2.4 rock strata evidence of change
Clicker question	
Brainstorm new investigations	
Compare personal ideas to given theory/articles	
Evaluate own progress and peers	<ul style="list-style-type: none">• 1.4 volcano chart
Develop a scoring tool or rubric	<ul style="list-style-type: none">• 4.4 recycle poem/song evaluation (done before they write)
Design a question that needs evaluate phase	
Self evaluation	<ul style="list-style-type: none">• 4.2 rehabilitation plan
Peer review	<ul style="list-style-type: none">• 1.4 volcano chart
Make a presentation	<ul style="list-style-type: none">• 4.2 rehabilitation plan
Discuss conclusions with evidence	
Compare and contrast graphic organizer	<ul style="list-style-type: none">• 1.5 Folding and faulting• 2.2 Rocks and minerals
Concept definition graphic organizer	<ul style="list-style-type: none">• 3.6 glacial features





Mining Matters is a charitable organization dedicated to bringing knowledge and awareness about Canada's geology and mineral resources to students, educators and the general public.

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