Iowa - The Rivers of Her Valleys 4.0

REAP Resource Enhancement and Protection

UNI University of Northern Iowa
Earth and Environmental Sciences

Title - Sandbar Combing - Learning through Picking
Audience - Middle School Students
Lesson Description - Students will visit a river sandbar or sand and gravel quarry with abundant sediments of varying sizes and types. In small groups, they will make a diverse materials collection. By engaging with the materials, and using prior knowledge and resources for Iowa rock types and rock cycle processes, they will begin asking questions and constructing a scenario for the sources and histories of the different rock types they observe. Each group member will take ownership of one of the materials and research its origin, formation, and the processes that brought it to its place on the sandbar (or sand and gravel quarry). Alternative plans, if a field trip is not feasible… Obtain samples of sandbar sediments and observe them in the classroom. Each group should receive a plastic container or bucket with a range of sediment sizes (primarily sand and pebbles) of varying rock types and classes. If there is space on school grounds, obtain a dump truck load of mixed sediments from a sand and gravel quarry located in the nearest river valley. ***Big Ideas / Big Questions* - Iowa Core, NGSS and Earth Science Literacy** http://www.earthscienceliteracy.org/document.html
Time Needed to Complete - 7 class periods for complete cycle

Iowa Science Standards/NGSS -

MS-ESS2-2.Construct an explanation based on evidence, how geoscience processes have changed Earth's surface at varying time & spatial scales.

[Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. **Emphasis is on geoscience processes that shape local geographic features, where appropriate.**]

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	Sustainability Implications & Practices
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4), (MS-ESS2-2)	**ESS2.A: Earth's Materials and Systems** ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **ESS2.C: The Roles of Water in Earth's Surface Processes** ● Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)	**Scale Proportion and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	**Resources are distributed unevenly around the planet** ● Resource distribution is a result of how and where geologic processes have occurred in the past, and has extremely important social, economic, and political implications. ● Rivers and their valleys are important sources of sand and gravel for use in construction. Globally, these resources are being extracted faster than they can regenerate.

Students will…	Students will	Students will	Students will
Construct an explanation for how the evidence found on a river sandbar formed and moved to its current location.	**Construct a geologic history of their river valley that represents dynamic geologic processes over varying periods.**	**Apply knowledge of the rock cycle and use information from Iowa's bedrock strata, glacial maps, and river valley satellite images to explain their observations.**	**Investigate current and former sand and gravel mines and their relationship to the river and recreation areas.**

Student Objectives

I-can statements

I can identify the origin, formation, and the processes that brought my sample to its place.

I can apply knowledge of the rock cycle and other resources to tell the geologic story of my river and valley.

I can use evidence found on a river sandbar to tell the geologic story of my river and valley.

Resources - links to more information on each of these topics

Iowa Rocks and Minerals (Resource 1, Resource 2, Resource 3, Resource 4/maps)

Iowa Bedrock Map

Iowa Rock Cycle

Iowa Fossils

Chart: Iowa's bedrock history

Map: Iowa's glacial history

Geodes

Artifacts and commonly used raw materials

Evidence of Learning

Each group member will take ownership of one of the materials in the group's collection and research its origin, formation, and the processes that brought it to its place on the sandbar (or sand and gravel quarry). Together, they will produce an illustrated timeline that explains the geologic history of our area through the evidence they found. The timeline will include when, where, and how each object formed and the time periods and rock cycle processes involved in altering and moving the materials to their current location.

5-E Format

Engagement/ Excitement Day 1	**Find out: What do students already know about the types of rocks and other sediment found on sandbars?** Take the class to a sandbar with abundant rocks. Teach students how to skip rocks (if they already know how, ask for a volunteer to demonstrate). Have a rock skipping contest! As an alternate, watch this Mark Rober Video on the science of rock skipping. Discuss what to look for in a great skipping rock, then assess prior knowledge through discussion. Even students who remember the rock cycle often have difficulty connecting those materials and processes to things they observe in their environment. Expect a range of answers and do not attempt to correct or channel them at this point. Use the responses to guide your choices about supplementary materials students will need for their exploration. ● What kind of rock is it? (Most good skipping rocks in Iowa are flat pieces of limestone or dolostone that are light gray to pale tan in color.) ● How/when did it form? ● How did it get to be here? Ask students about the rocks that are not good for skipping. What are the common characteristics of most of these rocks? (not flat, range of colors) ● What rock type(s) are these? (Much of the gravel on a sandbar along major rivers in Iowa is igneous or metamorphic in origin.) ● How/when did it form? ● How did it get to be here? Assign small groups to create a shared collection that includes the most diverse materials they can find. Each group should have at least some **sand** and **examples of the major rock classes**, and, if possible, a fossil, evidence of recent plant or animal life, and evidence of recent human use of the river valley. Let them know that their project work depends on this collection. ● Note: if students find arrowheads or other Native American artifacts, these should be photographed and left at the site.
Exploration Day 2	**Students identify the materials in their collections.** Prerequisite information: rocks vs minerals, characteristics of major rock classes (chemical/clastic sedimentary, metamorphic, extrusive/intrusive igneous) Each student in a group takes charge of at least one of the materials in their shared collection for this stage of the project. They record the evidence used to justify each step in their identification. ● Is it a rock or mineral? What is your evidence? ● Which major rock class does it belong to? Evidence? ● Can you narrow the identification to a more specific rock type? What evidence do you need? ● Does it contain a fossil(s)? Evidence?

	Materials needed: ● Cleaning and or breaking the samples may be helpful for identification. ● Buckets, brushes ● Rock hammers, safety goggles ● Field guides to rocks, minerals, and fossils ● If available, sets of specimens of different rock types for comparison ● Iowa Rock Cycle ● Iowa Minerals ● Iowa fossils Follow-up Question: How did all of these diverse materials end up in the same place at the same time?
Explanation Day 3-4	**Students investigate how each material formed, changed, and moved to its current location.** Each group needs to include at least one of each of these in their exploration: an igneous or metamorphic pebble or rock, a sedimentary rock or fossil, and sand. Each student uses online or print resources, starting with The Rock Cycle in Iowa to complete a chart giving a plausible explanation for its current characteristics and location including processes that formed the material, processes that changed it to its current form, and processes that transported it to its location at the sandbar. Sandbar Materials Exploration Chart Students may need the teacher's guidance in: ● understanding how sand relates to rocks and different rock types; how weathering affects different minerals ● connecting the materials to the distribution of earth materials in Iowa: bedrock, glacial deposits, alluvial deposits Materials (maps, models, and explanations): Iowa specific rock cycle page 1, page 2 Iowa landforms interactive map Iowa bedrock geology map stratigraphic column of Iowa geologic time scale of Iowa bedrock map showing Iowa's global position during the geologic period during which the sedimentary bedrock formed (an example is linked for the Devonian, but this will vary by location in state)

	Lab activities to supplement or precede this work: Depositional environments lab Model glacier lab
Evaluation Day 5-7	**Students work in groups to create an illustrated timeline of the geologic history of their river that includes each of their researched materials and present their work to the class.** Timeline elements: ● Time scale ● Images of sandbar samples that represent each time period ● Descriptions and illustrations of the past environments under which the materials formed, changed, and moved ● Maps ● Illustration of the sandbar where the materials were found at present ● Projection of what will happen to the sandbar in the next 100 years Materials needed: ● Examples of illustrated timelines from various fields such as geology, literature, or history ● Computers, apps (such as Timeline from ReadWriteThink or simply Google Slides), cameras (phones) for electronic timelines ● Paper, drawing supplies, printer, glue/tape for physical timelines (rolls of butcher paper could work well for this) Prerequisite information/skills or cross-disciplinary connections ● Concept of scale - teacher can assign the scale to be used or involve students in how to include the different geologic periods (even eras if considering the origin of the igneous/metamorphic rocks) in a single timeline. An interesting example is the Cosmic Calendar. ● Illustrated timelines are also used in historical and literary analysis Alternative assessment idea: Individual students write the biography of their rock specimen after "asking it" this series of interview questions ("Interview with a Rock Star") 1. What kind of rock would you say you are? Why? 2. What is your earliest memory? How did it help make you what you are today? 3. What were you like when you were young? What events helped form you? 4. What are the most memorable things that have happened to you? How did they change you? 5. Where have you traveled during your career? 6. How did you get here?

	7. How did your travels change you? 8. What are your hopes and plans for the future? How will you achieve them?
Enrichment/ Elaboration/ Extension	**Investigate current and former sand and gravel mines and their relationship to the river and nearby recreation areas. Using new understanding of Iowa's past and resources, predict where in Iowa you would find sandbars with the most good skipping rocks.**

Rubric

'Criteria'	**Emerging**	**Developing**	**Proficient**
Construct an explanation for how the evidence found on a river sandbar formed and moved to its current location. Three parts - Identification of Sample, Explanation of Processes which formed Sample, Explanation of how sample arrived in location.	• Student incorrectly identifies the sample or evidence does not logically connect to their claim. • Student's explanation of processes is inaccurate or missing key evidence. • Student's claim is inaccurate, missing key points or evidence, or evidence does not logically connect to the claim about how the sample reached the location.	• Student may accurately identify their rock sample; however their explanation is limited to a single source. • Student's explanation of the processes involved is incomplete and/or connections between explanation and evidence is weak. • Student's claim is only partially accurate or missing key elements or evidence is minimal regarding how the sample reached the location.	• Student accurately identifies their rock sample and backs up their claim with evidence from observations and research. • Student accurately describes the processes that formed their sample, citing sources for their description. Description is complete. • Student makes a reasoned claim, backed up by evidence, about how their sample got to the sand bar.

Use knowledge of the rock cycle and representations of bedrock strata, maps of glacial advances, and satellite images of their river valley to explain the sources of their finds.	Student's work relies on a single source or no sources presented.	Student's work relies on few of the listed/available sources. Student is beginning to make connections between sources.	Student's work cited at multiple different sources of information of those listed/available. Student is able to make connections between information from various sources.
Construct a geologic history of their river valley that includes different time periods and geologic processes.	Timeline covers only vague past, present, future without specifics/details. Timeline has multiple inaccuracies. Predictions of the future are not reasonable given evidence, are missing, or evidence lacking.	Student timeline presents an incomplete model of the river and/or each time period is represented with one/few details. Model accuracy could be improved.	Student timeline presents an accurate model of the history of their river, including all time periods represented by the samples they collected. Multiple details about each time period are included. Predictions of the future of the river are reasoned.