NGSS Meets the Outdoors: Teaching Elementary Science Outside

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http://tinyurl.com/MSTAtso2016

Technion
Israel Institute of Technology

CREATE for STEM Institute

W. K. Kellogg Biological Station
MICHIGAN STATE UNIVERSITY

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2. Overview of teaching science outdoors (5, 1010-10:15)
3. Watershed Observation Activity (60, 10:15-11:15)
    a. Water Cycle Refresher
    b. What is a watershed?
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    d. Debrief: Choose best questions for further investigations
4. NGSS - asking good questions (20, 11:15-11:35)
5. Debrief: How to use this in your classroom (10, 11:35-11:45)

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- Birder,
- Naturalist
- Environmental Educator,
- ‘Get people outside’ champion

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- NGSS champion

In collaboration with

Tali Tal, informal education expert and science education researcher

from the Technion Institute in Israel

How Well Do You Understand the new Michigan Science Standards (MSS), Framework for K-12 Science Education, and NGSS?

1. *I don't. Should I?*
2. *I've heard of the MSS, Framework and NGSS, but don't really know how it impacts students.*
3. *I'm familiar with the Framework and NGSS, but I have questions and would like more specifics*
4. *I'm very familiar with the Framework and NGSS. I may be able to help others understand what it is and its impact.*

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Teaching Science Outdoors, program overview

- Week long professional development for K-5 teachers

  - –Focused on confidence and creativity with content
  - –NGSS
  - –Technology

- Environmental Protection Agency EE grant: 2016-17
  - –15 teachers each summer

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Format for lesson

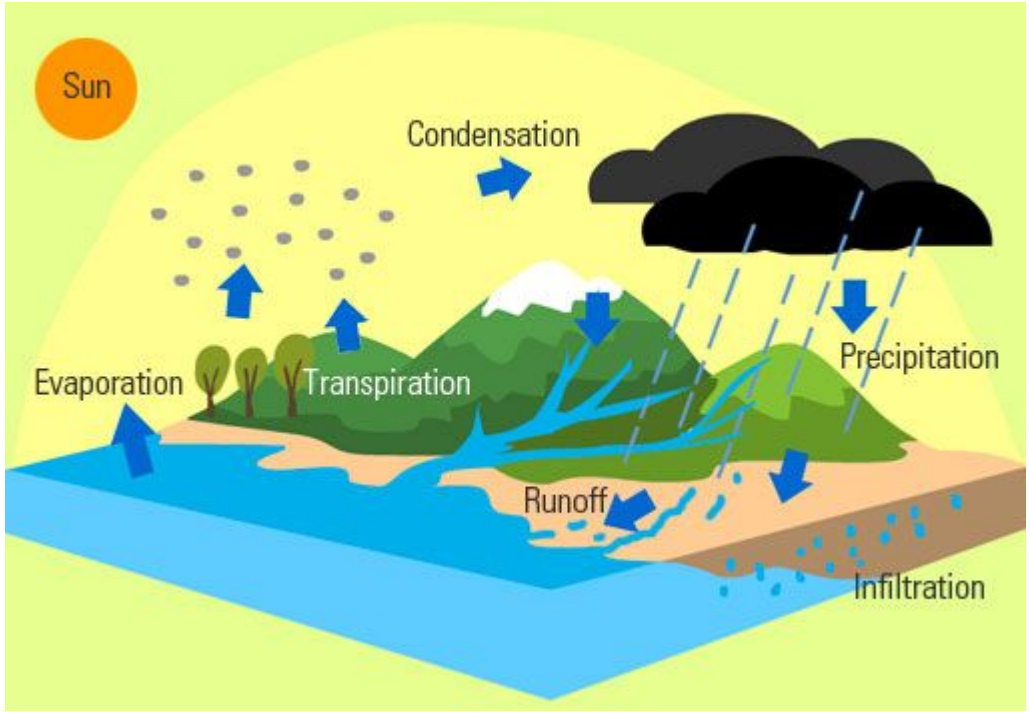
In class preparation: reviewing content and gathering materials

Outdoor activity: gathering evidence

Return to the classroom: apply what was learned and plan future investigations

Watershed Observation Activity: **Water Cycle Refresher**

- The Water Cycle by Foster Brown 0:18-0:56
- Act out how water moves

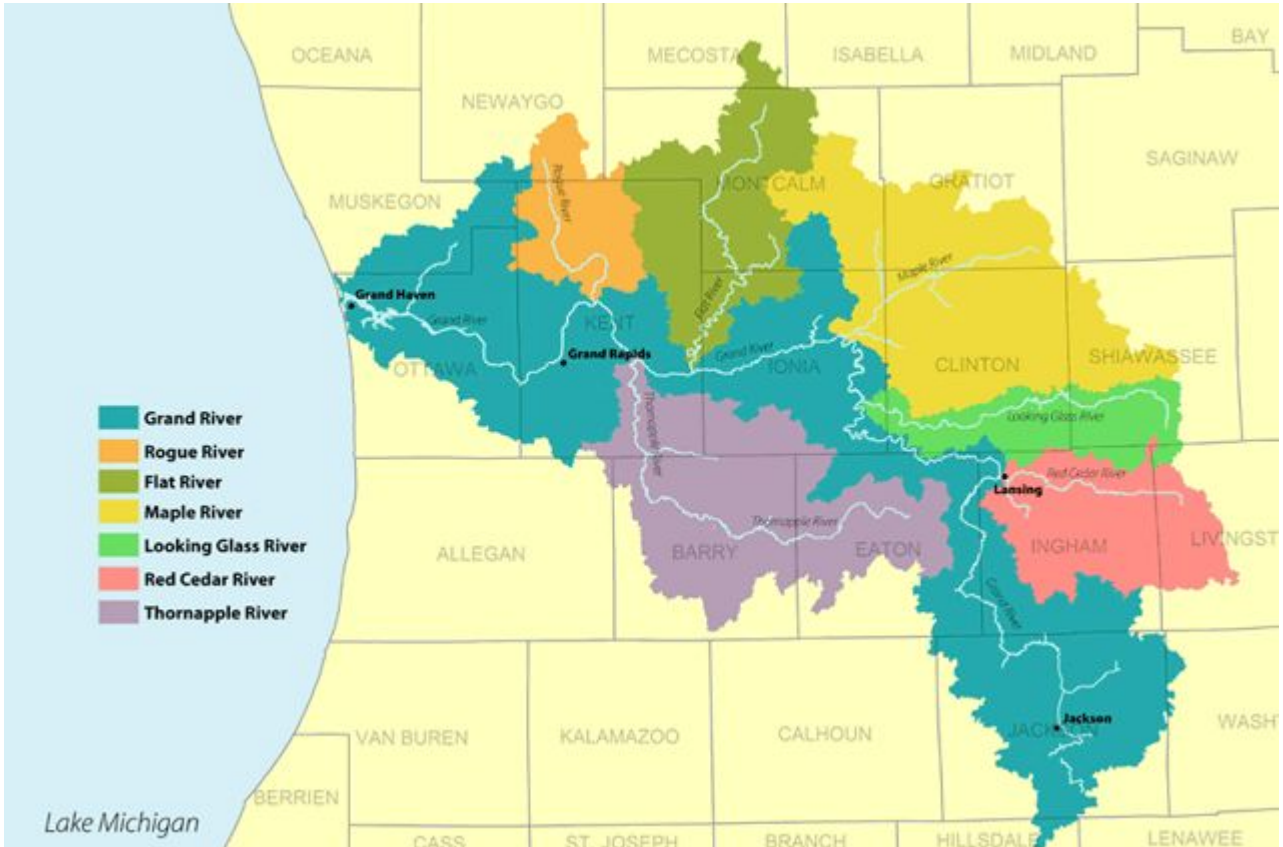


What is a watershed?

- A **watershed** is the area of land where all of the water that is under it or drains off of it goes into the same place.
- Watersheds come in all shapes and sizes. They cross county, state, and national boundaries. In the continental US, there are 2,110 watersheds; including Hawaii Alaska, and Puerto Rico, there are 2,267 watersheds.
- **The schoolyard is part of a watershed. Our conference hotel is part of a watershed...**

What watershed are we in today?

The Grand River Watershed



Field Assignment: What is the Grand River Watershed like?

Collect evidence to:

- Show how humans are impacting the watershed;
- Show what lives in the watershed;
- Describe the climate we live in;
- Show the effects of weathering/erosion;
- Identify the components of the water cycle.

Examples of evidence: pictures, written observations, drawings

Field Assignment: What is the Grand River Watershed like?

1. How many people use Twitter and have their smartphone?

Explore the grounds of the Radisson:

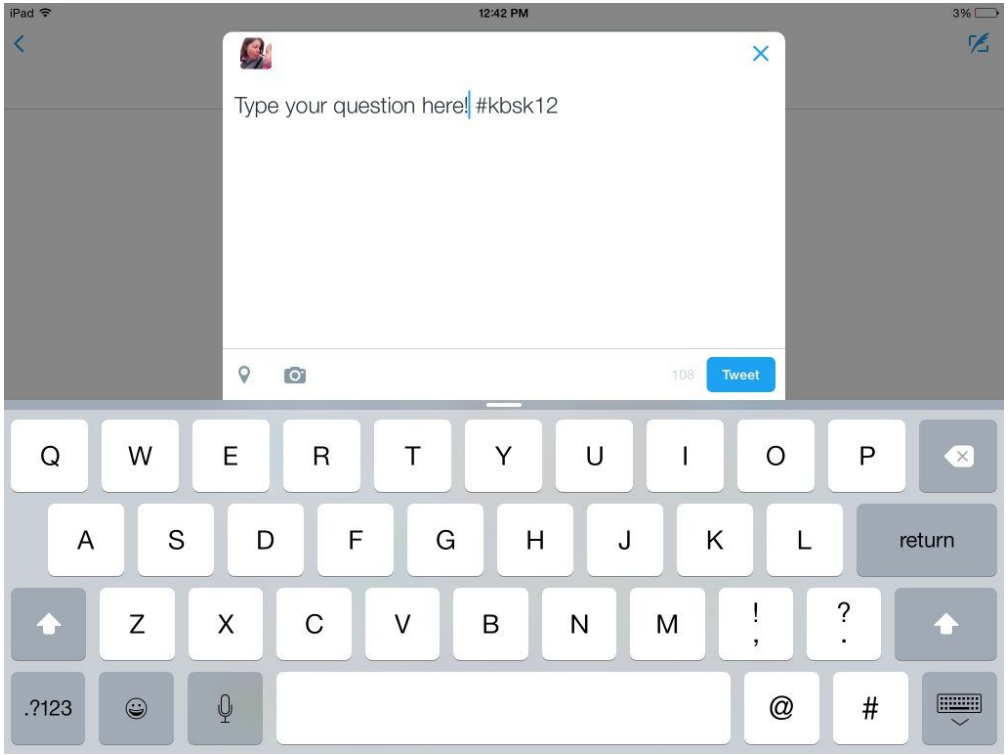
2. Collect evidence (pictures) of our place in the watershed.
    a. #KBSK12, **Tweet** using Ipads/smartphones
    b. Draw
3. Ask questions about what you observe (type into Twitter or write down)

get into small groups

If you are a Twitter user and have your smartphone/tablet. Please raise your hand and form groups with at least one person with the technology.

How to use Twitter - mini-tutorial!

1. Press the 
2. Press the 
3. Take photo of evidence!
4. Type question or description
5. #KBSK12



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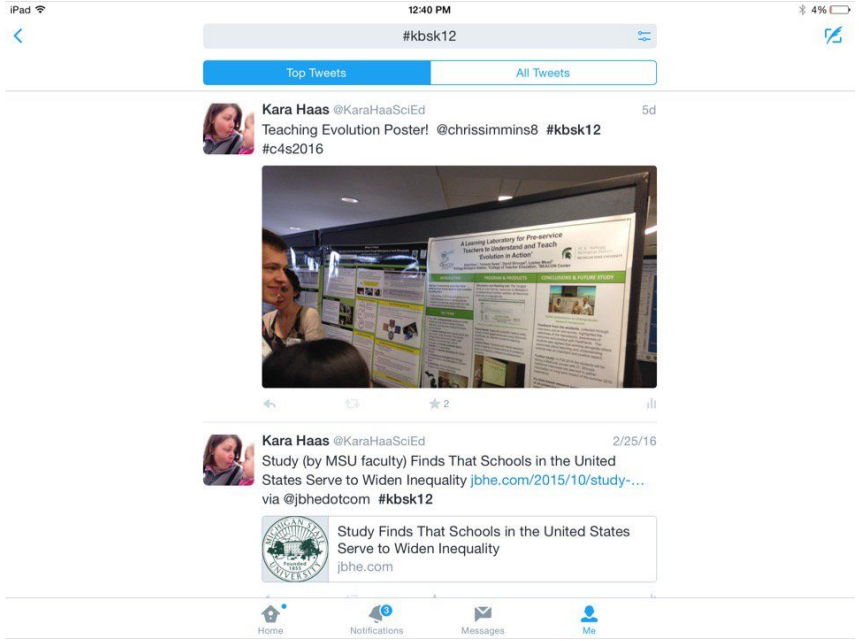
Debrief

1. Look at the Evidence collected
   a. On Twitter search #KBSK12
   b. Written observations or drawings - tape onto walls
2. Each group write 2-3 questions on post-it notes and put up on walls
3. Take a ‘gallery walk’ around the room to see questions



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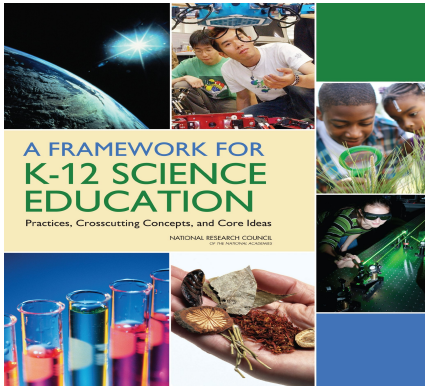
Debrief: NGSS can guide us to ask good questions

All questions are good, but not all questions make good inquiry questions. Here is where we can use NGSS to guide us.

What's new in the MSS ?



NEXT GENERATION SCIENCE STANDARDS

1. Focus on **explaining phenomena** or **designing solutions** to problems
2. **3-Dimensional Learning**
   a. Disciplinary core ideas (DCIs)
   b. Scientific and engineering practices
   c. Crosscutting concepts (CCCs)
3. Instruction builds toward **performance expectations (PEs)**
4. **Coherence:** building and applying ideas across time

What do we mean by 3-Dimensional Learning

- Blending the three dimensions (DCIs, CCCs, and practices) to focus instruction and assessment

- Shifts the focus of the science to **explore, examine, and to explain** how and why **phenomena** occur or design **solutions to problems**

Key features of DCIs

- Disciplinary significance
- Explanatory Power
- *Generative*
- *Relevant to people's lives*
- *Usable from K to 12*

Disciplinary Core Ideas

Life Science	Physical Science
LS1: From Molecules to Organisms: Structures and Processes LS2: Ecosystems: Interactions, Energy, and Dynamics LS3: Heredity: Inheritance and Variation of Traits LS4: Biological Evolution: Unity and Diversity	PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth and Human Activity	ETS1: Engineering Design

What are Crosscutting Concepts?

Ideas that cut across and are important to all the science disciplines. Provides different “**lens”** to examine phenomena.

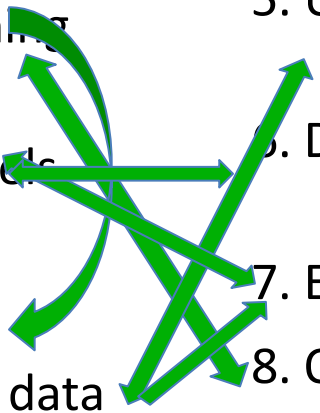
1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

What are Scientific and Engineering Practices in NGSS?

The multiple ways of knowing and doing that scientists and engineers use to study the natural world and design world.

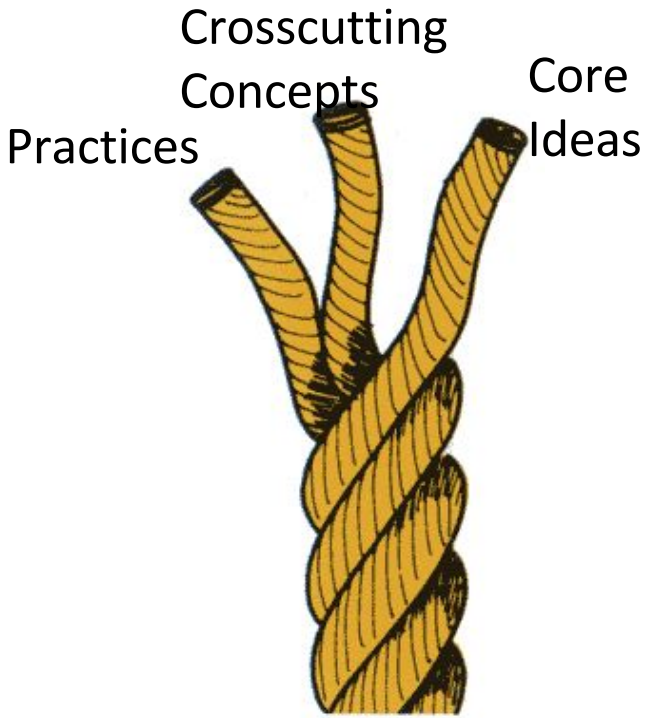
The practices work together – they are not separated!

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information



Content and Practice Work together to Build Understanding

- Scientific ideas are best learned when students engage in practices
- Practices are learned best when students use them to engage with learning specific scientific ideas
- Content and practices co-develop – 3-dimensional learning



Example of a Michigan Science Standard (from NGSS)

Students who demonstrate understanding can:

4-ESS2-1. **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**ESS2.A: Earth Materials and Systems** • Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **ESS2.E: Biogeology** • Living things affect the physical characteristics of their regions.	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change.

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels:
2.ESS1.C ; **2.ESS2.A** ; **5.ESS2.A**

Common Core State Standards Connections:
ELA/Literacy -
W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1)

Selected Elementary Performance Expectations

K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (cause and effect)

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. (structure and function)

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area. (size, proportion, scale)

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world. (systems/ systems thinking)

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (systems/ systems thinking)

Michigan Science Standards -Michigan Specific PEs

2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area.

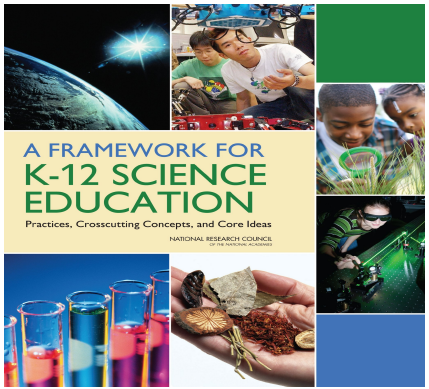
2-ESS2-2 MI Develop a model to represent the state of Michigan and the Great Lakes, or a more local land area and water body.

Find Michigan Science Standards at https://www.michigan.gov/documents/mde/K-12_Science_Performance_Expectations_v5_496901_7.pdf

MSS are Different

- Standards expressed as performance expectations (PEs)
- Combine practices, core ideas, and crosscutting concepts into a single statement of ***what is to be assessed at the end of grade for K – 5 and grade band for 6 – 8 and 9 – 12.***
- They are not instructional strategies or objectives for a lesson.
- PEs CANNOT be attained in one lesson.

Revisited: What's new in the MSS?



NEXT GENERATION SCIENCE STANDARDS

1. Focus on **explaining phenomena** or **designing solutions** to problems
2. **3-Dimensional Learning**
   a. Organized around disciplinary core explanatory ideas
   b. Central role of scientific and engineering practices
   c. Use of crosscutting concepts
3. Instruction builds towards performance expectations (PEs)
4. **Coherence:** building and applying ideas across time

Progression across grades

Greater sophistication

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Connections to multiple MS and HS ESS-2 PEs

Practices: Asking questions and defining problems throughout K – 12:

Greater sophistication

Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Builds on prior experiences and progresses to simple descriptive questions that can be tested	Builds on K-2 experiences and progresses to specifying qualitative relationships	Builds on K-5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models	Builds on K-8 experiences and progresses to formulating, refining, and evaluating testable questions and design problems using models and simulations

Asking Good Questions

1. Are fruitful - meaning they lead to other questions
2. Not yes/no
3. Require further investigation
4. Testable
5. Measurable
6. What would happen if…?

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Think, pair, share...
Go back and look at questions that we generated.
Which questions are good research questions?
How would you continue the investigation?

Examples:

1. Make a model of the watershed.
2. How do humans interact with the space? Could you engineer something to solve a problem?

How would you collect data? Would you need to return to collect more evidence?

Turn to ‘shoulder partner’ and discuss.

Debrief

- Which scientific practices did we use?
- How could you use your schoolyard in the same way?
- What would be the next steps to talk about human impact on the watershed?
- Format of the activity - in class and outdoor time

Thank you!

Questions?

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