Model Lesson for Outdoor School
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TITLE: Understanding Topographic Maps, Watersheds, and the Water Cycle

Overview: This lesson is intended to be done as part of an Outdoor School program and therefore done outside. This lesson includes four distinct activities to better understand the water cycle, topographic maps and watersheds. The activities include:

- Observation activity
- Learning about and exploring the features of a topographical map
- Water cycle discussion
- Hands on activity building a model watershed in which students apply their understanding of topography, the water cycle, and human interactions with the system.

National Geography Standards:

#1. How to use maps
#7. Shaping the earth's systems
#14. Human actions modify the environment

Oregon Geography Content Standards:

6.11. Distinguish among different types of maps and use them to analyze an issue in the Western Hemisphere.

6.14. Identify physical features of the Western Hemisphere and explain their effects on people and events.

Oregon Science Content Standard (NGSS):

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

MS-ESS2-4 Develop a model to describe the cycling of water through Earth's system driven by energy from the sun and the force of gravity

Objectives:

To understand how topography, the water cycle, and watersheds all interact and how humans impact water health and movement.
In completing these activities, students should be able to:

- Describe topographic features on a topographic map
- Describe the main elements of the water cycle
- Be able to describe how topography, the water cycle, and watersheds all interact
- Describe how humans can impact water and water movement within a watershed

Grade Levels: 6th (can be adapted for other grade levels)
Time: 2-3 hours

Materials:

- An outdoor space with access to sand or dirt for digging
- 1 thin plastic table cloth or other thin plastic sheet (at least a few feet wide/long) per group
- 1 spray bottle per group
- Food dye or other substance that you can introduce as "pollution" to the watershed
- Small shovels or other tools to dig (optional)
- 1 topographic map per group (at least one of your local watershed suggested). Can print free ones here: http://www.natgeomaps.com/trail-maps/pdf-quads
- Either the attached student notebook (Appendix A) or a clipboard and paper for each student to write on
- Writing utensil
- Poster depicting the water cycle (examples can be found online)

Background:

Watersheds are defining physical features of any area or region. Understanding watersheds is critical to understanding water as a resource and how humans both benefit from and impact the flow of water through the landscape. The flow of water is impacted both by the energy of the sun and the force of gravity and moves both underground and on the surface of the earth. For more information on watersheds please visit:

http://water.usgs.gov/edu/watershed.html
http://www.thewatershedproject.org/LearnMore/LearnMore.html

Procedures:

This lesson is intended to be done as part of an outdoor school program and therefore done outside. Being near a water feature (pond, river, lake, etc. is best, but if no water feature is available it will still work). However, some kind of sand or dirt is necessary for building the model watersheds (for an alternative please see the extensions section at the end of this document). There is a field journal (Appendix A) that can be used for this lesson and there are pages for each activity.

Essential Questions:

Question #1: Why is water important?
Question #2: How does water move around the globe and how do physical and human features make an impact on that movement?
Question #3: How do topography, the water cycle and watersheds all interact?

Intro (10 minutes):

Student should already have been introduced to the idea of a watershed and the water cycle in class. Explain that today the goal is to learn how to read a topographic map and to understand how the topography of an area, a watershed, and the water cycle all interact. Additionally, explain that they will be doing four different activities. Before starting the first activity, ask students to have a discussion about what they already know about the topics that will be covered. Listen for understanding and misunderstandings.

Part 1 (20-30 minutes): Observation Activity-Sit Spot

Students will be asked to find a place to sit to make observations of their surroundings. They should be away from other students, but within view of the teacher and within the given boundaries. Have them stay in their spot for a minimum of 10 minutes, however longer is better. The longer they are able to sit, they more the will observe. Many teachers worry about students not being able to sit for this long, but in fact most students love the activity and describe it as one of the most important parts of their time at Outdoor School. Rarely do students have the opportunity to just sit and observe and this will give them time to connect with their surroundings and develop observation skills. They will have their field journals with questions to consider and they can be told that once they do thorough observations, they can just sit quietly to think, reflect, or daydream. Remind the students to use all of their senses (taste is optional or can be off limits depending on your students and the surroundings).

Once students are called back from their sit spot have a group discussion about what students observed. Review the journal prompts and answer any questions that arose.

Part 2 (15 minutes): The Water Cycle

Ask students to spend about 30 seconds thinking to themselves about what they already know about the water cycle. Ask for a few volunteers to share. Next, have a full discussion about the water cycle using a visual model (poster), and include the vocabulary: evaporation, condensation, precipitation, percolation, and runoff. Have students take notes in their field journals during the discussion.

For additional information and ideas for teaching about the water cycle:

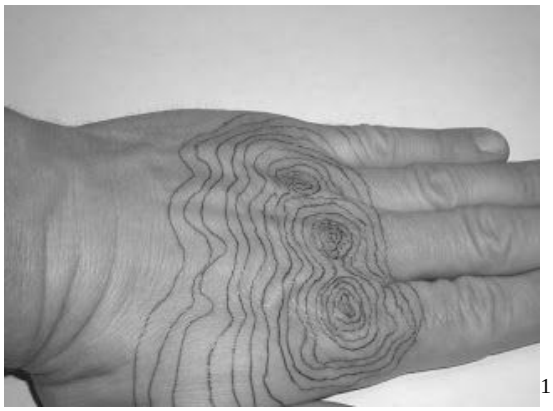
http://uncw.edu/marinequest/documents/TheIncredibleJourney.pdf

http://www.projectwet.org/resources/materials/discover-incredible-journey-water-through-water-cycle

Part 3 (30 minutes): Exploring Topographic Maps

Give each group a topographic map and ask them to spend 5-10 minutes making observations about their maps. Have them use the questions in their their journals and record their observations and thoughts.

After the set amount of time, bring students back together for a discussion and lesson about topographic maps. Ask students to discuss the questions they answered in their field journals. Once the discussion has finished, use what came out of the discussion to teach the key components of what makes a topographic map unique. Discuss the map's key, the contour lines, and landscape features depicted. One way to help students understand how contour lines works, is by drawing them on your hand. When your hand is in a fist, that represents the landscape, when it is flat, it represents the map. A map is flat and therefore the contour lines depict a 3-D landscape, in a 2-D model (a map). Here is an example:



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After the discussion and lesson on topographic maps, ask student to draw an example of a topographic map in their journals. Remind them that they must include a key and the cardinal directions.

For more information on teaching about topographic maps here are a few links:

http://egsc.usgs.gov/isb//pubs/teachers-packets/mapshow/activity4.pdf

http://www.classzone.com/science_book/mls_grade7_FL/212_215.pdf

[1] http://www.scouterlife.com/blog//2012/05/topographic-map-activity.html

Part 4 (45 min): Building a model watershed

This is the most hands on part of the lesson in which students have the opportunity to get their hands dirty and demonstrate understanding!

Begin by talking about your local area and what watershed you are in. Discuss the idea that there are watersheds, within watersheds. For example, Portland, OR is in the Bull-Run Watershed, which is within the Columbia River Watershed, that covers multiple states and river systems. Give the definition of a watershed and ask students if they could describe what a watershed is to a partner.

In small groups (2-6 students) ask students to work together to build a model watershed in the sand/soil. The model should include a variety of landscape features, including hills and valleys.

Once students have completed building their model watershed, have them all gather around one model at a time for the final demonstration. Take a plastic sheet and carefully place it over the model watershed, so that it molds to the contours of the model. Ask students to predict where the water will flow and pool when sprayed from above to mimic "rain". Next, spray the model and have students make observations about what is happening

Finally, introduce "pollution" to the watershed by adding a drop of dye or other colored substance. Have students observe what happens.

Repeat the process with each model watershed and have students observe similarities and differences with each model. How does the topography differ between models and how does that affect the flow of water? Add "pollution" to different places in each model. How does the placement of "pollution" affect where it ends up and who is impacted?

Here is more information about teaching with watershed models:

http://wd.northwestern.edu/assets/Activity-2-Watershed-Model-ALL.pdf

Discussion Questions (also found in the student journal):

- What force was acting upon the water that had the water travel where it did?
- How does water get back to the top of the watershed?
- What would happen if water fell on the other side of the top ridge in your model watershed?
- When "pollution" was introduced to the watershed what happened? How are people/ecosystems downstream affected?

- What might happen if people along the watershed were to remove water from the system either through catchment or diversion?
- How does the topography affect the flow of water? For example: steeper slopes.

Wrap-up (10-15 min): Conclude the lesson with a group discussion, linking ideas and the activities.

Possible questions to ask:

- What did you learn?
- What was surprising?
- What happened when water was sprayed on your model watershed? Why did the water move where it did?
- How can people help to protect their watersheds?
- How do the actions of people upstream effect people/ecosystems downstream?
- How does the topography of an area affect how water moved through the landscape?
- How does the water cycle affect how water moves through the landscape?

Assessment: Students will complete work in a field journal that will include their observations, notes, predictions, and analysis. A rubric is attached (Appendix B) that can be used to assess student performance.

Extensions and/or Adaptations:

The watershed activity could be adapted to be done without access to sand or dirt. Instead of using sand or dirt, students can use crumpled up paper or other similar material and then place the plastic sheet on top of the paper.

Appendix A.

Student Field Journal:

Understanding Topographic Maps, Watersheds, and the Water Cycle

Essential Questions:

1. Why is water important?
2. How does water move around the globe and how do physical and human features make an impact on that movement?
3. How do topography, the water cycle and watersheds all interact?

Observation Activity:

- What do you see, hear, smell, and feel? Be detailed.
- Write and/or draw your observations.
- What do you observe around you that depends on or interacts with water in someway? How does it depend on or interact with water? Are there non-living things that interact with water? What are they?

The Water Cycle:

Notes:

Understanding Topographic Maps:

Questions to think about while exploring your map:

- What do you notice about your map?
- How is it different or similar to other maps you have seen before?
- Find North, East, West and South?

- What is the “scale” of the map?
- What do you think the map is depicting?
- Do you see any rivers?
- Where is the map’s key? Is there anything that stands out to you?

Notes:

Use this space to create your own topographic map:
(Be sure to create a key!)

Building your Watershed:

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With your team, develop a model watershed in the soil/sand with a variety of topographic features. Create hills, valleys, a flat area, etc.

Once you are finished, make predictions about where you think water will run and pool in your watershed if it were to "rain".

[2] http://www.thewatershedproject.org/LearnMore/LearnMore.html

Discussion Questions:

- What force was acting upon the water that had the water travel where it did?

- How does water get back to the top of the watershed?

- What would happen if water fell on the other side of the top ridge in your model watershed?

- When “pollution” was introduced to the watershed what happened? How are people/ecosystems downstream affected?

- What might happen if people along the watershed were to remove water from the system either through catchment or diversion?

- How does the topography affect the flow of water? For example: steeper slopes.

Appendix B.

Assessment Rubric:

Objective	Met objective	Partially met objective	Did not meet objective
Be able to describe topographic features on a topographic map	Journal is complete and accurate. Fully participated in activity and group discussion.	Journal is partially complete and/or information is not fully accurate. Partial participation in activity and group discussion.	Journal is incomplete and/or inaccurate. No participation in activity or discussion.
Be able to describe the main elements of the water cycle	Journal is complete and accurate. Fully participated in activity and group discussion.	Journal is partially complete and/or information is not fully accurate. Partial participation in activity and group discussion.	Journal is incomplete and/or inaccurate. No participation in activity or discussion.
Be able to describe how topography, the water cycle, and watersheds all interact	Journal is complete and accurate. Fully participated in activity and group discussion.	Journal is partially complete and/or information is not fully accurate. Partial participation in activity and group discussion.	Journal is incomplete and/or inaccurate. No participation in activity or discussion.
Be able to describe how humans can impact water and water movement within a watershed	Journal is complete and accurate. Fully participated in activity and group discussion.	Journal is partially complete and/or information is not fully accurate. Partial participation in activity and group discussion.	Journal is incomplete and/or inaccurate. No participation in activity or discussion.