Lesson Plans

MOSS

McCALL OUTDOOR SCIENCE SCHOOL

University of Idaho

College of Natural Resources

Title: Turbidity
Grade Level: 5th - 8th grade

Topic:	**Turbidity**
Background:	Turbidity is a measurement of the amount of suspended particles in water. It can be increased (less clarity) by disturbing soils or erosion into a body of water. Turbidity affects water characteristics by raising the temperature, decreasing dissolved oxygen levels (due to less photosynthesis because light cannot penetrate water) and carrying pollution through a watershed.
Next Generation Standards:	**ESS2.A, ESS2.C, LS1.C, LS2.A, LS2.B, LS2.C**
Goals:	This lesson explains what turbidity is, how to measure it and how it affects the water characteristics. Students will learn how to measure turbidity using a turbidity tube and how turbidity affects water characteristics by hands on activities. Essential Questions: What is turbidity? What causes turbidity? How do you measure turbidity? How does turbid water affect water characteristics?
Objectives:	Students will be able to describe at least three effects of high turbidity (low clarity) on water characteristics. Students will be able to describe at least two factors that increase turbidity. Students will understand how higher turbidity affects fish habitat and survival.
Materials:	Two large mason jars (32 oz) Standing lamp Two laminated pictures of fish – staple to a popsicle stick. Thermometers About 6 cups each, flour, soil, sand, gravel 5 clear jars with lids per table group (4-12 oz range) Plastic vegetation (fish tank type) or pine tree sprigs Food, water and shelter cards, 25-30 of each (can use photos or colors to represent each need) Secchi sign to show as example Turbidity tube for each group Turbidity conversion chart to show entire class Pitchers for water at each group Cones, rope or other marker to lay out boundaries for Turbidity tag game.

Set up:	Prepare 25-30 cards to represent food, oxygen and shelter. Cards can be color coordinated, for example, food can be green, oxygen can be white and shelter can be yellow, or put a picture of each need on the cards. Laminate two fish pictures and attach to popsicle sticks to serve as visual for fish in different habitats. Set up your turbid vs. clear water jar samples ahead of time so they are ready to show when you start the lesson.
Classroom Time:	This lesson can be done in one long session, or broken into two sessions. You can split the measuring and making their own turbid water assignment for second session. The whole lesson should take about 2 hours.
Introduction (Engage):	Put students in small table groups, 3-4 students per table. Ask students to imagine they are a fish. Take about 5 minutes and draw a good habitat where you would like to live. What is the water like there? Share ideas in small groups and then come together as whole class and generate a list of what the fish needs in its habitat. Elicit questions about why they think the fish would feel that way about their habitat (access prior knowledge of what fish need to survive). On board write definition for Turbidity: amount of suspended particles in water. Next, have students make different turbidity levels. Give table groups 5 clear containers with water and lid and 4 different materials to add to mixture (flour, dirt, sand, pebbles) leave one sample as clear water. Put the samples in order from least to most turbid or most clear to cloudiest. Tell students to leave these on their desks; we'll come back to these later. Place two water samples in large clear jars in front of whole class. One that is clear and one that is very turbid, (mix soil into the water and shake). Ask students, "If you are a fish, which jar would you prefer to live in if you had the choice?"
Activity (Explore):	We are going to create a model of two different habitats. Have two laminated fish models attached to popsicle sticks prepared ahead of time. Put one in jar with turbid water, and one in jar with clear water. Each jar should be prepped with the water

	sample as well as some vegetation (plastic trees/plants or pine tree sprigs) and some gravel at bottom and a lamp above the jars to be the sun. Is there water that sometimes looks like the water where fish "A" lives (turbid water)? How did that water get to be that way? Next we're going to play a game to demonstrate some of the effects of turbidity on fish. **Game:** Mark rectangular outline of boundaries for a tag game. Start with 2-3 people spread out in middle who are "it" and want to tag people. They represent turbidity. Turbidity can't move their feet but can lean side to side and tag the fish. If a fish gets tagged, they join the turbidity taggers. Place cards that represent food, oxygen and shelter at the end of the playing area and students need to collect one of each card to survive and then return to side they started at. At the end of each round collect all their cards – those resources are no longer available. Time each round and see how many fish "survive". If they don't get all their needs, within a certain time limit they don't survive and join the turbidity team. Each round it should get more difficult to survive. At the beginning of each round you can narrate why turbidity is increasing (heavy rain, new recreation site, loss of vegetation, etc). If students aren't getting caught you can make the playing area narrower.
Explanation	Come back together and talk about challenges to obtaining your needs as the game went on and the water became more turbid. Go over causes of turbidity such as erosion, heavy rain, increased flow rate. Write these causes on the board and have students record. This is one way scientists like you can measure turbidity. Have an example of the Secchi symbol to show students and a large visual of cm to NTU conversion chart. Demonstrate measuring turbidity by filling a turbidity tube with a sample of water and draining the tube when you can see the Secchi symbol. Record cm height and show how to convert to NTU's using the chart. Note the inverse relationship between clarity and NTU's on the chart.

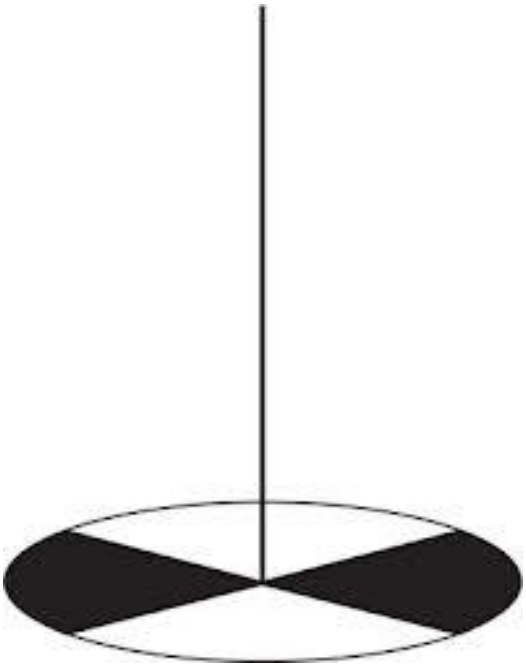
Elaboration:	Now look at the jars with turbid and clear water, what other changes in water characteristics could the turbidity cause? Look at the class list of things a trout needs to survive. Can you think of how the turbid water affects the other things a fish needs to survive (dissolved oxygen, temperature)? Have students make a hypothesis, which water sample do you think is warmer and why? Have students test temperature of each sample and record their results. Talk about why the temperature is higher in the more turbid water. Let's talk about oxygen. Plants add oxygen to the water through photosynthesis. The plants take in carbon dioxide to make sugars for food, and they release oxygen that is dissolved in the water. Which one of these jars do you think has more dissolved oxygen in it and why? Now that you know some of the ways turbidity affects water characteristics, let's measure some turbidity levels. Have each group make a turbid water solution in water pitchers of various turbidity levels using soil and flour available to add to their solution. You can assign specific amounts of what ingredient they can add to their sample so they don't go overboard. You will need enough water to fill your turbidity tube. Have each small group record the cm and convert to NTU's using the turbidity chart and share results and show water sample with class.
Evaluation:	Have students do a writing assignment to check for understanding. Tell students they are going to write a story describing how the habitat in the turbid jar got that way, and how it affected the fish's life. They should tie in concepts talked about in lesson such as temperature, dissolved oxygen, shelter, being able to find food, etc.

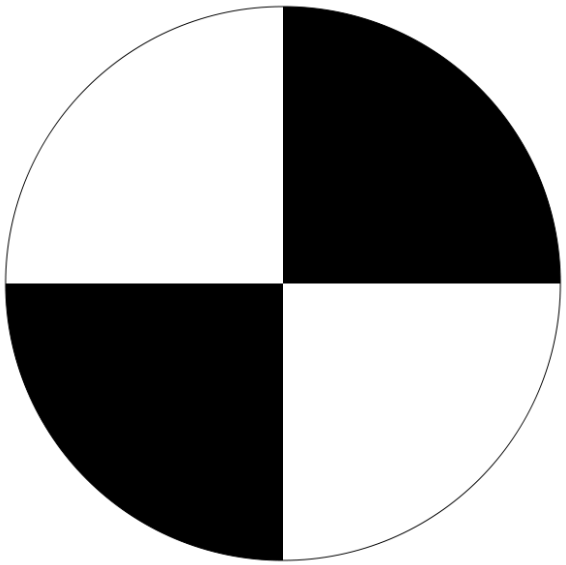
TURBIDITY

About: The amount of particulate matter that is suspended in water, which makes it look cloudy. Can be increased by disturbing soils or erosion into a body of water.
Why? High turbidity blocks sunlight from reaching aquatic plants and suspended sediment absorbs heat from solar radiation, increasing temperatures at the surface.
Directions: Fill the turbidity tube with water up to the 1m mark. One partner looks through the top of the tube at the Secchi disk while the other closes the clasp on the drain at the bottom of the tube. If you cannot see the Secchi disk at the bottom, have your partner slowly release water until you can see it. Record the reading. Convert to nephelometric turbidity units (NTU). If the reading in cm is greater than 85.4cm, then the NTU is <5 NTU's; if the reading in cm is less than 6.7cm, then the NTU is >240 NTU's.

Centimeters	NTU
6.7	240
7.3	200
8.9	150
11.5	100
17.9	50
20.4	40
25.5	30
33.1	21
35.6	19
38.2	17
40.7	15
43.3	14
45.8	13
48.3	12
50.9	11
53.4	10
85.4	5

Examples of Secchi Disks





Additional resources:
http://nationalzoo.si.edu/Education/ClassroomScience/Turbidity/Teacher/default.cfm
http://watermonitoring.uwex.edu/pdf/level1/5Transparency-Monitoring2010.pdf