Water and Our World

Teacher's Guide: Grade 9

Beaver Water District

Lesson 4: Total Suspended Solids & Turbidity in Streams

Purpose

This lesson provides students with an opportunity to learn about total suspended solids (TSS) and turbidity in streams and how this affects the health of streams.

Objective

- Students will be able to design an experiment.
- Students will learn about TSS and turbidity, where the solids may come from, and how they affect the health of the stream.
- Students will be able to interpret data, graph, and present their results.

Arkansas Framework Correlation

Science

9th Grade

PD.1.ES.6 Describe the processes of degradation by weathering and erosion

PD.1.ES.11 Describe the physical and chemical properties of water

BD.2.ES.9 Explain how limiting factors affect populations and ecosystems

SP.3.ES.2 Investigate the relationships between human consumption of natural resources and the stewardship responsibility for reclamations including disposal of hazardous and non-hazardous waste

SP.3.ES.3 Explain common problems related to water quality:

- conservation
- usage
- supply
- treatment
- pollutants (point and non-point sources)

NS.4.ES.1 Collect and analyze scientific data using appropriate mathematical calculations, figures and tables

NS.4.ES.2 Use appropriate equipment and technology as tools for solving problems (e.g., microscopes, centrifuges, flexible arm cameras, computer software and hardware)

NS.4.ES.3 Utilize technology to communicate research findings

Problem Question

What are total suspended solids (TSS) and turbidity and how do they affect the health of streams?

BACKGROUND INFORMATION

Teachers: Total suspended solids (TSS) concentrations and turbidity both indicate the amount of solids suspended in the water, whether mineral (e.g., soil particles) or organic (e.g., algae). However, the TSS test measures an actual weight of material per volume of water, while turbidity measures the amount of light scattered from a sample (more suspended particles cause greater scattering). This difference becomes important when trying to calculate total quantities of material within or entering a stream. Such calculations are possible with TSS values but not with turbidity readings. High concentrations of particulate matter can cause increased sedimentation and siltation in a stream, which in turn can ruin important habitat areas for fish and other aquatic life. Suspended particles also provide attachment places for other pollutants, such as metals and bacteria. High suspended solids or turbidity readings thus can be used as "indicators" of other potential pollutants.

TSS and turbidity values vary naturally for two main reasons – one physical, the other biological. Heavy rains and fast-moving water are erosive. They can pick up and carry enough dirt and debris to make any stream look dirty. So, heavy rainfall may cause higher TSS concentrations or turbidity, unless the additional particles are dispersed throughout large volumes of flood water.

Land use is probably the greatest factor influencing changes in TSS or turbidity in streams. As watersheds develop, there is an increase in disturbed areas (e.g., cropland or construction sites), a decrease in vegetation, and increases in the rate of runoff. These all cause increases in erosion, particulate matter, and nutrients, which in turn promote increased algal growth. For example, loss of vegetation due to urbanization exposes more soil to erosion, allows more runoff to form, and simultaneously reduces the watershed's ability to filter runoff before in reaches the stream.

Students: No background is needed

Keywords

Total Suspended Solids (TSS)
Turbitity

Timeline

This lab will require:

- one class period for instruction about the topic
- one class period for the lab
- one class period for presentations

Materials

- glass fiber filters
- distilled water
- filtering flask
- nephelometer or Jackson turbidimeter
- pump

Teacher Preparation

Collect water samples from an undisturbed location

TSS

1. Before sampling, prepare glass fiber filters by first soaking them in distilled water, drying them at 103° C, and weighing and recording their weights.
2. Place the dried, weighed glass fiber filter onto a filtering flask – wrinkled side up. Shake the sample bottle first, then pour in the water and turn on the pump. (The amount of water you need to filter may change according to water conditions. Start with 100 mL. Use less volume if the filter gets clogged too quickly and more if the water filters through very fast.) Record the volume of water filtered.
3. Dry the filter at 103 to 105° C, let it cool to room temperature, and weigh it. Dry it, cool it, and weigh it again. Continue until the fiber reaches a constant weight. Record the end weight.
4. The increase in weight represents TSS. Calculate TSS by using the equation below.

TSS (mg/L) = ([A-B]*1000)/C

Where A = End weight of the filter

B = Initial weight of the filter

C = Volume of water

Turbidity

More technical: Shake your water sample and place in a nephelometer or Jackson turbidimeter. Compare this result to a reference solution or blank. Turbidity is a measure of light scattered by particles.

Easiest: Acquire a turbidity test kit and follow the procedures listed. There are many test kits out there. Probes can be found but are more expensive. Here is a website that has turbidity and other test kits.

http://www.acornnaturalists.com/TURBIDITY-TEST-KIT-P444C390.aspx?UserID=33563908&SessionID=iPdCEhSuqrF{PrMVf37S

http://www.acornnaturalists.com/LaMotte-Water-Quality-Test-Kits-C390.aspx

Additional Resources

Resources for materials not included:
UA Center for Math & Science Education
http://www.uark.edu/~k12info/
479.575.3875
Northwest Arkansas Education Co-Op
http://starfish.k12.ar.us/web/
479.267.7450
Beaver Water District
www.bwdh2o.org
479.717.3807
Know of other resources? Please let us know!
education@bwdh2o.org or 479.756.3651

7E's Total Suspended Solids & Turbidity in Streams

Elicit

Show images from the internet of muddy streams. Ask students what might be causing the extra sediment in the stream. Show images of polluted streams that have produced a fish kill. Ask students what could have caused wildlife death.

Engage

Have students form their lab teams and discuss agricultural and urban sources that might affect BOD and turbidity. Have students research streams and look at Google Earth and explain differences in what they see in the surrounding areas of the streams. Have the teams look at their stream characteristics and list where extra sediment would be washed in.

Explore

Have students perform the lab with the collected water samples. It would be best to have the students collect the sample from the stream and see the surrounding area.

Explain

Have the teams interpret the data, graph their results, and present their findings to the class.

Elaborate

Make sure the teams explain their stream characteristics and the surrounding area. Have them list possible sources of extra sediment that has entered the stream. What nutrients might decrease the amount of oxygen present?

Evaluate

Assess the students on their lab techniques, safety, presentation, and unit test.

Extensions

Use this lesson along with other chemical tests and biological testing to determine total stream health. Form a community project to assess stream health and involve the community.