Sand, Silt and Salmonids

Description of Activity

Students will investigate soil along the river and how it may affect salmonids.

Objectives

1. Students will be able to describe sand, silt, clay and gravel.
2. Students will learn how the life in the river, especially salmonids, is affected by sedimentation.

Materials

The Sand, Silt and Salmonids field trip kit will supply all that up to 24 students will need. The materials are designed for four groups of 4-6 students. The materials in the kit need to be divided so that ***each of the four groups will have***:

✓a set of sieves,
✓4 - 6 handlenses
✓a 32 oz. plastic drink bottle with cap
✓funnel with large spout hole
✓data sheets and clipboards for each member of the group
✓one can
✓a rag
✓one ruler

2-4 buckets will be needed for the class , as a whole, to use

The teacher will need to provide:

✎a copy of the data recording sheets for each student

✎clipboards for each student

Grade: all, with modifications; 3 and up recommended

Subjects: soil science, erosion, sedimentation, watershed management, aquatic ecosystems

Time: 45 minutes, 30 minutes minimum

Group size: 1 - 16 is ideal, 24 maximum, divided into smaller groups of 4-6

Background

Note: A vocabulary list is near the end of this lesson.

The major rivers in the Central Valley start as rain and snow high in the Sierra Nevada mountains. Ever since these mountains were formed millions of years ago they have been breaking down bit by bit. In addition to the ongoing geologic activity in the region, wind, water and ice erode away the rocks that make up these mountains.

One way that water causes erosion is by running down into cracks in the rocks. When the water freezes it expands and breaks the rocks into smaller pieces. These smaller rocks either fall down or are carried down the mountain by water. Newly broken rocks are jagged and irregular in shape. Bigger rocks become smaller rocks; smaller rocks become gravel; gravel becomes sand and so on. Older rocks have been smoothed and rounded by rubbing and banging on other rocks and sand as they travel down the river. (Compare river rocks to rocks found on a dry hillside.) Nutrients are released from the rocks during this process. These nutrients are essential for all life forms in the rivers and streams.

The rocks and gravel moving down the river help shape and scour away plants and debris out of the river channel. This helps to maintain a river channel that is large enough to carry the higher flows that come on a regular basis.

Before the dams were built on the rivers in the Valley, in the spring the streams and rivers had fast-moving, powerful water flowing in them that carried or pushed large rocks for great distances and smaller particles much farther. As the summer approached and the snow pack dwindled, the amount of water in the rivers decreased and slowed down. The river's ability to move gravel and maintain its channel was reduced during this time of year. Most of the gravel settled out. The gravel that was deposited by the river and left in the river bottom provided habitat for fish, algae, bacteria, and insects. Today, many of the rivers are dammed. Dams do not allow gravel to flow downstream. After the gravel downstream from the dam is washed away in high river flows there is not a new supply of gravel being allowed to come downstream from the hills to replace it. This means that there is no longer gravel in that stretch of the river for fish to spawn in.

Another factor in the speed and strength of a river's flow is the slope. As water flows through steep mountain and foothill streambeds it has more speed and strength. As the water flows into the flatter valley riverbeds it slows and loses strength. The larger rocks are the first to be dropped out of the flow as the flow reduces. The river continues carrying the smaller rocks and particles until it becomes too sluggish to carry them either and they settle to the bottom. The tiniest material often makes it to sea. This is why rivers form deltas, gravelbars and sandbars.

The goldminers capitalized on the concept of "stream power" because gold is very heavy. When they panned for gold or used sluice boxes they could separate the gold from the other sediments.

A related concept is turbidity. Turbidity is a measure of how much material, or "suspended solids" are suspended in water. Common types of suspended solids in rivers include small pieces of soil, (such as silt and sand), industrial waste, sewage, and microorganisms. Plant roots normally keep soil from being blown or washed into rivers or streams. When poor land management practices destroy or remove plants from the soil, erosion may result. Natural disasters can also increase turbidity.

As turbidity becomes high, water loses it ability to support aquatic life. The suspended solids prevent sunlight from reaching aquatic plants. Without light, photosynthesis cannot take place. When photosynthesis is curtailed, green plants cannot produce oxygen. This reduces the concentration of dissolved oxygen in the water. Dissolved oxygen is necessary for fish survival and other aquatic life.

Increased turbidity causes more solids to settle to the bottom of a stream, especially where the water flow is slow. As solid matter settles, it may cover bottom-dwelling plants and animals, reducing their ability to survive and reproduce.

Particle size table *(diameter in inches):*

large cobble	*5-10*
small cobble	*2.5-5*
gravel	*0.08-2.5*
sand	*<0.08*
silt/clay	*<0.0024*

Sizes are approximate.

How does this relate to salmonids?

In order for spawning to be successful, certain conditions must be present in the stream.

- The water flow must be consistent enough and deep enough for adults and juvenile fish to migrate downstream and back upstream. If, during critical times of the year, the flow of water in the river is too small to allow fish to swim through stretches of the river, the fish population cannot survive.

- The gravel must be large enough and free of silt so that water and oxygen can flow to the eggs. A mixture of gravel sizes is required. Smaller gravel provides spaces for water to flow through while keeping the eggs from bouncing around and causing damage to the developing fish. Large gravel hold the smaller gravel in place not only by weighing them down but also by bearing the brunt of the strong water flows keeping the water from washing the smaller gravel away.

- Once the young fish emerge, they must be able to find cover and food. Cover may be among rocks and plants. Food is organisms that drift by or active bottom invertebrates. For example they may eat a hodgepodge of terrestrial insects, adult and larval aquatic insects, amphipods, snails, and when they get bigger, smaller fish.

- There must be overhanging trees that provide shade. Shade keeps the water cooler. Salmon will begin to die in water warmer than 65°F. Rainbow trout can survive in water that is up to about 82°F.

Excessive amounts of sediments in a river or stream can affect the waterway and the habitat it provides in many ways.
One major adverse effect from large amounts of fine sediments, (sand-sized particles and smaller), in a stream or river is reduced water flow through the salmon or trout nest. If the small spaces between the gravel are filled with silt or sand and bury the eggs and alevin, they will suffocate because of the lack of water, and therefore, lack of oxygen flowing by.

Another adverse effect of sedimentation is that it may fill in all the spaces between the gravel and trap the young fish by burying them and causing them to starve as well as suffocate.

This excess sediment may come from land along the river. Poorly managed lands allow a lot of erosion. This eroded soil flows into rivers and streams causing the problems we just described.

There is a delicate balance of water, gravel, sand, silt, and nutrients required for salmonids to survive. Just like humans that start eating a more balanced diet and get healthier, there are many positive things we can do to return balance to our rivers and streams and restore them.

Set Up

Before you leave school:

- Make copies of the student data recording sheets for each student.
- Divide students into groups. You may even want to assign group member jobs. Each group will need a reader/reporter, a recorder, a getter, and a starter.

At the field trip site:

- Divide the equipment into four sets.
- Make sure the sieves are stacked so that the container with the solid bottom is on the bottom. The sieve with the smallest holes should be stacked next ending with the sieve with the largest holes on top. The lid should be removed.
- Fill at least two buckets with water. There should be enough water available for the students in each group (in every rotation) to fill their

bottles to the blue line.

Procedure

1. Begin by distributing the clipboards and data sheets to each student. Review terms and names equipment, (i.e. sieves, diameter). Ask the students to use the table of particle sizes and the ruler and look around them. Can they find large cobbles, small cobbles, and gravel?

2. Divide students into four groups and distribute equipment.

3. Fill the can with a soil sample from the riverbank or close to the river.

4. Pour the soil sample into the top of the stack of sieves. Shake the stack gently and without tipping them until nothing else can fall through the top sieve.

5. Unstack the sieves and compare the particles at each level. Feel the different types of particles. Look at them through a handlens. Which is gravel, silt and sand?
   On their data sheets, students can draw what was collected in each sieve.

6. When everyone in the group is finished drawing, use the can and the funnel to pour a soil sample into the bottle up to the **red** fill line.

7. For this step, two or more containers (buckets) of water will be needed. Each group will dip water out of a bucket with the can and, using the funnel again, fill their bottle with water up to the **blue** fill line.

8. Screw the cap on securely and shake the bottle vigorously for a moment.

9. ***Looking at a river bed or lake bottom--*** Stop shaking and set the bottle down and don't touch it. Watch while the sediments settle. What happens to the sediments that were floating in the water?

10. Draw what is observed on the diagram of the bottle on your field study sheet.

11. Record what happened on the field study sheet.

12. **Looking at the flow of water in a river--** Now let each group member slowly and gently rock the bottle back and forth while holding it horizontally. What happens to the soil when there is wave motion similar to what might be in a river or stream? Is it the same as when the bottle was shaken? Which sediment floats in the moving water? Which sediments move along the bottom? How do the larger sediments move? The students can record their observations on their field study sheets.

Vocabulary

erosion – the wearing away of the land surface by water, wind, ice, or gravity; the breaking apart and moving of soil or rock pieces by water, wind, ice, or gravity.

streambed – the channel where a stream flows

turbidity – a measure of how much solid stuff stays mixed in water without sinking; Water with high turbidity is hard to see through.

dissolved oxygen – the amount of oxygen that is dissolved in a liquid, in this case, water

sediments – soil, sand, clay, or other small pieces of stuff that settle in the bottom of liquid like a lake or river

Discussion Questions

1. What is sediment and what is it made of?
2. How is sediment made?
3. How does sediment move?
4. How does sediment affect a river or stream?
5. How does sediment affect salmonids?
6. What can people do to help keep rivers and streams healthy?

Complementary Activities

- Design a class mural to show a healthy river environment.
- Write a story. "I was a. . ."
- Shake a bottle of water and sediment and let it sit in your classroom. How long does it take for the water to get clear? Does it get as clear as it was when you started? How is this cloudy water like air pollution?

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Sand, Silt and Salmonids
Field Study Sheet #1

Name_______________________________

Date_______________________________

Take a look around you.

With your group use the particle size chart to find large cobbles? Can you find small cobbles? Can you find gravel?

With your group. . .

You will see what is really in the soil with this experiment.
You will need the can and the stack of sieves.

1. Fill the can with soil from your study area.

2. Make sure the sieves are stacked right.

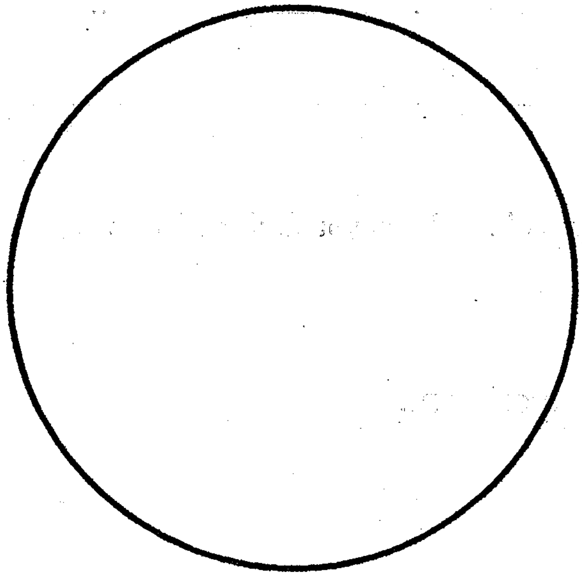
3. Pour the soil into the top sieve.

4. Do not tip the stack of sieves. GENTLY shake the stack of sieves. Shake until nothing else can fall through the top sieve.

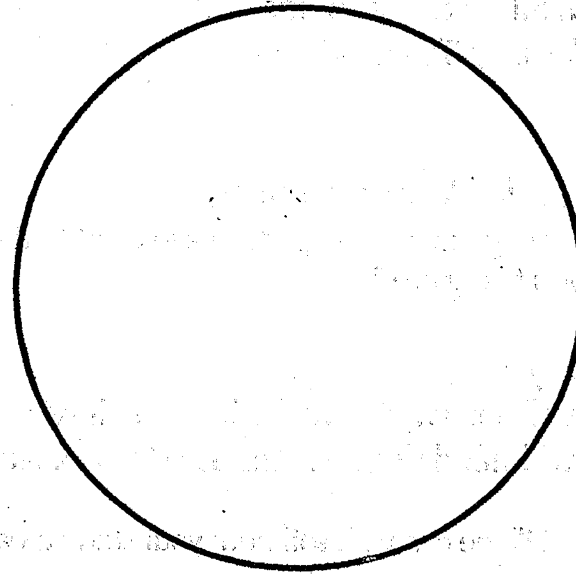
5. Unstack the sieves. How is the soil in each sieve different? Look at the soil through a handlens. Which is gravel? Which is silt? Which is sand?

6. In the circles on the next page, draw what you collected in each sieve and the bottom tray. Label your drawings.

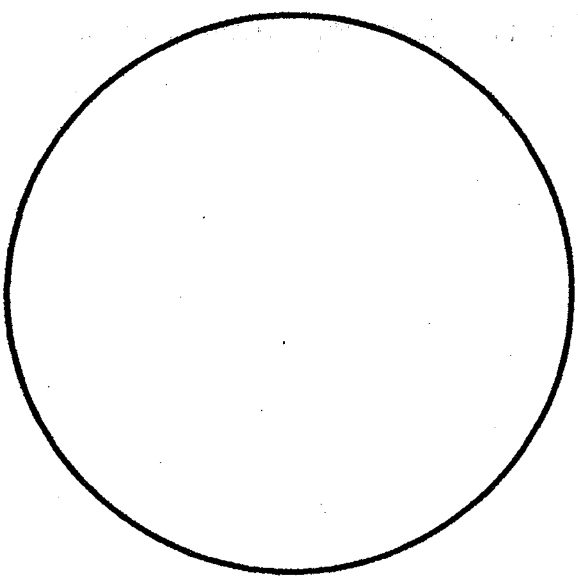
7. After everyone is done drawing, you are done with the sieves. Put the sieves out of your way.



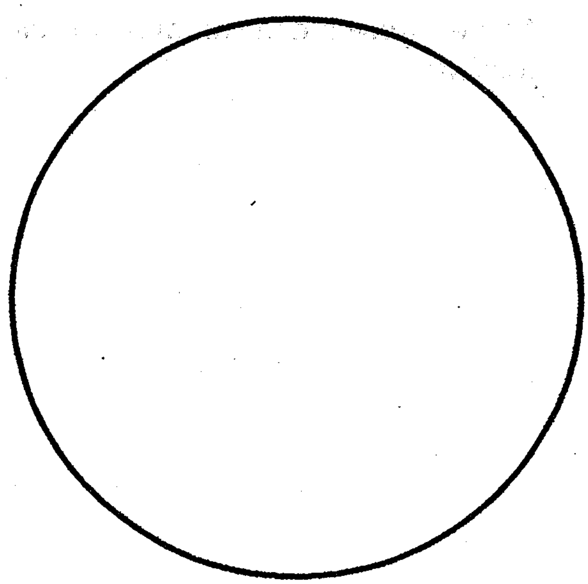
Top sieve



Second sieve



Third sieve



Bottom tray

Sand, Silt and Salmonids
Field Study Sheet #2

Name________________________________

Date________________________________

No you will see what sediments do at the bottom of a river or lake. You will need the can, the plastic bottle and the funnel.

1. Fill the can with more soil.

2. Put the small end of the funnel into the plastic bottle.

3. Pour the soil into the bottle up to the red line.

4. Empty the can onto the ground.

5. Fill the can with water from the bucket.

6. Use the funnel again. Fill the bottle with water up to the blue line.

7. Put the cap on the bottle. Make sure it is on tightly.

8. Shake the bottle while you count to 30. Get all the soil off of the bottom of the bottle.

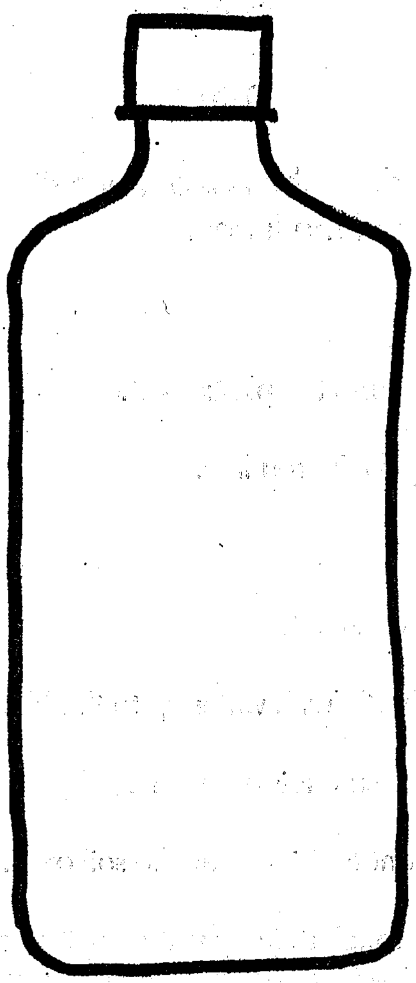
9. Set the bottle down and don't touch it. Keep watching the soil in the bottle. What is happening? Look closely. Are the pieces of soil on the bottom bigger or smaller than the ones on top? ________________

   Why?____

   Is the water clear?_________ Why?____

   ____

10. Draw what you see in the bottle.



11. Write about what you saw.

What happened after the bottle was shaken?

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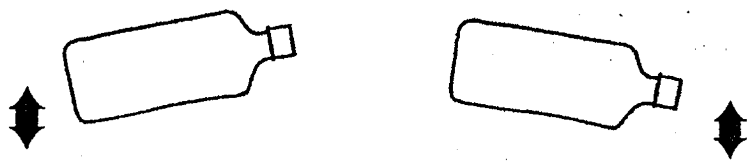
12. Gently pick up the bottle.

13. Hold the bottle like the picture shows. SLOWLY and GENTLY rock the bottle back and forth. Watch what happens !



14. What happens to the soil? Is any soil floating in the water? Is any soil staying on the bottom? Does some soil move faster than other soil?

15. What happens to the soil when there is a wave?

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16. Does the soil look the same as when the bottle was shaken?

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17. What is floating in the moving water? What is moving along the bottom?

In the water. . .

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Along the bottom. . .

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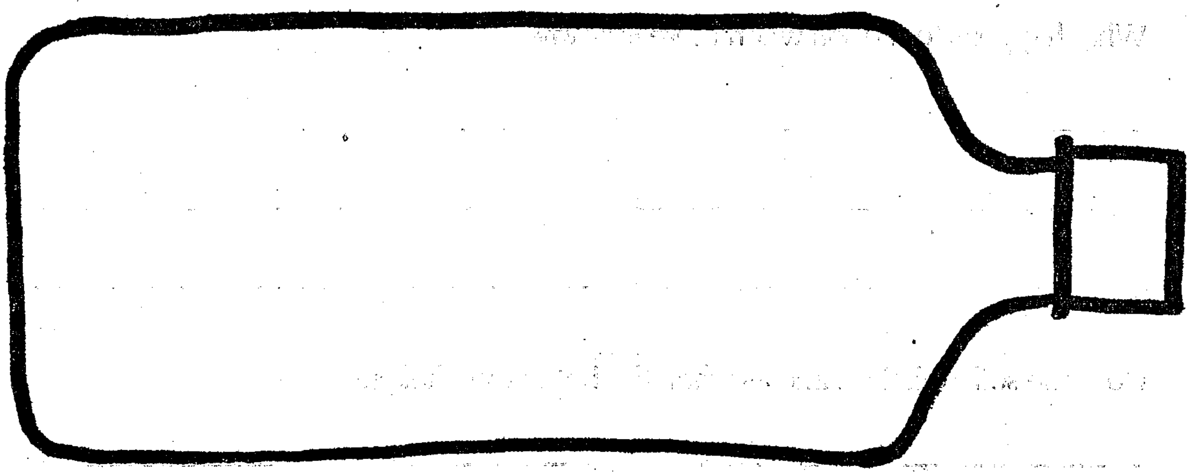
18. How do the larger pieces of soil move?

19. Draw what you see in the bottle. Label your drawing.



20. How does sediment affect salmon and trout?

21. What can people do to help keep rivers and streams healthy?