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<b>Lesson Plan Title:</b> Sediment Transfer: Glacial and Fluvial	<b>State:</b> MA
<b>Lesson Time Frame:</b> Two 45-minute class periods	<b>Inspired by an Earthwatch Expedition:</b> Icelandic and Alaskan Glaciers
<b>Student Level:</b> Middle School	

**Introduction:**

This lesson plan was inspired by my work on the Icelandic glaciers Earthwatch team. In the field we studied both glacially and fluvially deposited sediment. We learned that there are distinctive characteristics of sediment that has been carried by glaciers or by running water. Often sediment can be carried by a glacier first and then carried further by running meltwater. This lesson plan shows students some of the characteristics of sediment deposited glacially or fluvially, and also helps them to model the action of what occurs in nature. This lesson plan will be used with my 50 seventh grade students at the Bancroft School during our erosion and deposition unit.

**Abstract:** In this activity students will model both sediment deposition by ice and also by running water. Students will see that sediment deposited by a glacier is unsorted (“till”) and that with the addition of running water sediments can quickly become sorted. These dynamic processes often occur in combination at the foot of a glacier.

**Goal:** Students will learn why some sediments are sorted and some are unsorted, and how both sorted and unsorted sediments can occur in close proximity.

**Performance Indicators:** Students will be able to demonstrate that they understand the difference between sorted and unsorted sediment, and can also explain why both patterns of deposition can result.

**Background Information:** Students should have background knowledge of glacial structure and fluvial systems.

**Materials:**

- Access to a freezer
- Water
- Plastic cups
- Plastic wrap
- Rubber bands
- Mixed sediment (gravel, sand, silt)

## Stream table

Pictures of various types of sediment (mine were taken on my Earthwatch trip July 2005)

### **Instructional Procedure:**

#### Introduction:

- 1) Ask students what kinds of clues sediments may give in showing how they were deposited. If needed guide them to think of shape of sediments, patterns of deposition, scratches on the sediments, etc.
- 2) Explain the process of plucking, where a glacier picks up sediment for transport.

#### Activity:

- 1) Day one: Each pair of students (or in a small class each student) creates a “glacier.” Give each pair of students a plastic cup and have them write their names on the cup in permanent marker.
- 2) Fill the cup half full of water and add a 3cm layer of mixed sediment on the bottom of the cup.
- 3) Cover the cup with plastic wrap and seal with a rubber band to prevent spills.
- 4) Place the cups in a freezer overnight.
- 5) Day two: Remove the cups from the freezer. The students have now created a “glacier” complete with entrained sediment.
- 6) Peel away the plastic cup to expose the “glacier.” Place the “glaciers” at the top of the stream table and allow them to melt. Have students observe what the pattern of deposition is from a glacier. Explain that a glacier has the ability to pick up and deposit sediment of all sizes and explain the concept of till. Show pictures of Icelandic till (see pictures below).



- 7) Ask the students what they will think will happen to the sediment when running water is added to the mix. Their hypotheses can be written on the board.
- 8) Turn on the stream table and have the students observe what happens to their sediment as running water moves across it. They should observe a pattern of the finest grains moving the farthest and the gravel moving the least.
- 9) Compare what happened on the stream table to their original hypotheses.
- 10) Explain that not only does the running water move the smallest particles furthest, but the faster flowing the water the larger particles the water can carry. Ask the

students what kinds of sediment fast flowing flood water might carry. Show them a picture of a giant boulder (Kötluklettur) deposited by the 1918 jökulhlaup (glacial outburst flood) in south Iceland and explain that flood water can carry immense boulders if it is flowing fast enough.

Closure:

- 1) Review concepts of till, plucking, sorted and unsorted sediments.
- 2) Ask students if they think the characteristics they have learned are important to a scientist studying a new landscape. What kinds of clues do sorted or unsorted sediments immediately tell the scientist? Can you have sorted sediments next to unsorted sediments? Talk about the scenario near a glacier where this can happen.

**Assessment:** Students will be assessed on their understanding of sorted and unsorted sediments and the processes needed to form these patterns of sedimentation. Questions will be added to the unit test relating to this activity.

Sample test questions (answer in 3-5 sentences):

- 1) Describe till. Explain why you may find till in a particular region and how till forms.
- 2) How does a glacier move sediment?
- 3) How can till become sorted? What does sorted sediment mean?

Sample answers (accept all reasonable responses):

- 1) Till is unsorted sediment of various sizes deposited by a glacier. You will find till in regions where there have been or presently are glaciers. Glaciers can carry sediment of all sizes and the sediment is deposited together in a mixed state.
- 2) A glacier moves sediment by plucking. Sediment of various sizes freezes to the bottom of the glacier and is deposited when the glacier melts. The result is piles of sediment of mixed sizes, called till.
- 3) Till can become sorted when running water moves the sediments. This can occur when glacial meltwater moves over the till. Sorted sediments are sediments that have been deposited according to size. The faster moving the water, the larger the sediments it can carry.

**Connection to Other Content Areas:** This could become an interdisciplinary unit if the history of the glacial outburst flood (jökulhlaup) in Iceland were explored. This has impacts not only scientifically but also culturally and in terms of the way the government of Iceland handles natural disasters. This would tie into a geography or social studies class.

**Extensions:** Students could explore the movement of sediment within a glacier, not solely by the glacier. Also, students will have additional lessons about glacial landforms formed by sediment and water such as moraines, eskers, drumlins and kettles.