ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

ECOS Inquiry Template

1. Contributor's Name: NATHAN GORDON

2. Name of Inquiry: GO WITH THE FLOW: SEDIMENTS UP AGAINST THE DAM

3. Goals and Objectives: To illustrate for students the sedimentation effects caused by river dams.

a. Inquiry Questions: Which grain sizes move with the river water? When a dam is built across a river, where does the sediment go? Why is this good or bad?

b. Ecological Theme(s): Sedimentation and the effects of dams on river ecosystems.

c. General Goal: Teach students that dams collect more than just water.

d. Specific Objectives:

Academic: Fine particulate sediments move with water flow and are deposited at the base of dams.

Experimental: Collection of river sediments of varying sizes, constructing a flowing river model, and damming the river to observe sedimentation.

Procedural/Technical: Sampling from the environment. Executing a dynamic experiment.

e. Grade Level: 1-2

f. Duration/Time Required:

→ Prep time: 2-3 hours to construct the river model. 1 hour of time at the local river, stream, pond, or other source of sediments.

→ Implementing Exercise During Class: 30 minutes

→ Assessment: 15-30 minutes to answer questions and discuss

4. Ecological and Science Context:

a. Background (for Teachers): Rivers are much more than moving water. They also consist of organisms and particulate matter that live in and move with the water. Dams stop the movement of organisms and particles at a specific point, and everything the river is carrying with it gets deposited behind the dam. This lack of moving sediments can actually result in increased erosion downstream.

"A dam holds back sediments, especially the heavy gravel and cobbles. The river, deprived of its sediment load, begins to recapture it by eroding the downstream channel and banks, undermining bridges and other riverbank structures. Riverbeds are typically eroded by several meters within a decade of first closing a dam; the damage can extend for tens or even hundreds of kilometers below a dam. Within nine years of closing Hoover Dam in the US, the riverbed below the dam had lowered by more than 4 meters. Riverbed deepening will also lower the groundwater table along a river, threatening vegetation and local wells in the floodplain and requiring crop irrigation in places where there was previously no need. The depletion of riverbed gravels reduces habitat for many fish that spawn in the gravelly river bottom, and for invertebrates such as insects, molluscs and crustaceans. Changes in the physical habitat and hydrology of rivers are implicated in 93% of freshwater fauna declines in North America." - from the International Rivers Network.

Removing a dam releases the water that has collected behind it in a lake or reservoir. It also releases the sediments that the water has dropped as it approached the dam. That sediment can replenish riverbanks and beaches downstream, thereby improving river topography. However, sediment can also redistribute pollutants that had been sequestered behind the dam.

b. Background (to present to Students): Instructors can provide preliminary knowledge about sediment particle size and movement in water. This exercise should fit well within a unit on pebbles, sand, and silt. If students have some experience with different sized particles, then they can predict which portions of the river sediment will move and which ones will remain in place. Otherwise, the instructor may want to discuss the moving nature of river sediments. Discuss the different sizes of river sediment particles. Do some float better than others? Which ones might tend to be carried downstream by the flow of a river? How might sediments and debris in a river be important to plants and animals? How does a dam affect this ecology?

5. **Motivation and Incentive for Learning: A trip to the river to collect rocks and sand is always fun for kids! Students also love science fair-type demonstrations - especially those with rocks and running water!**

6. **Vocabulary:**

   Sediment: Clay, sand, silt, or other particles washed from the land into the water.

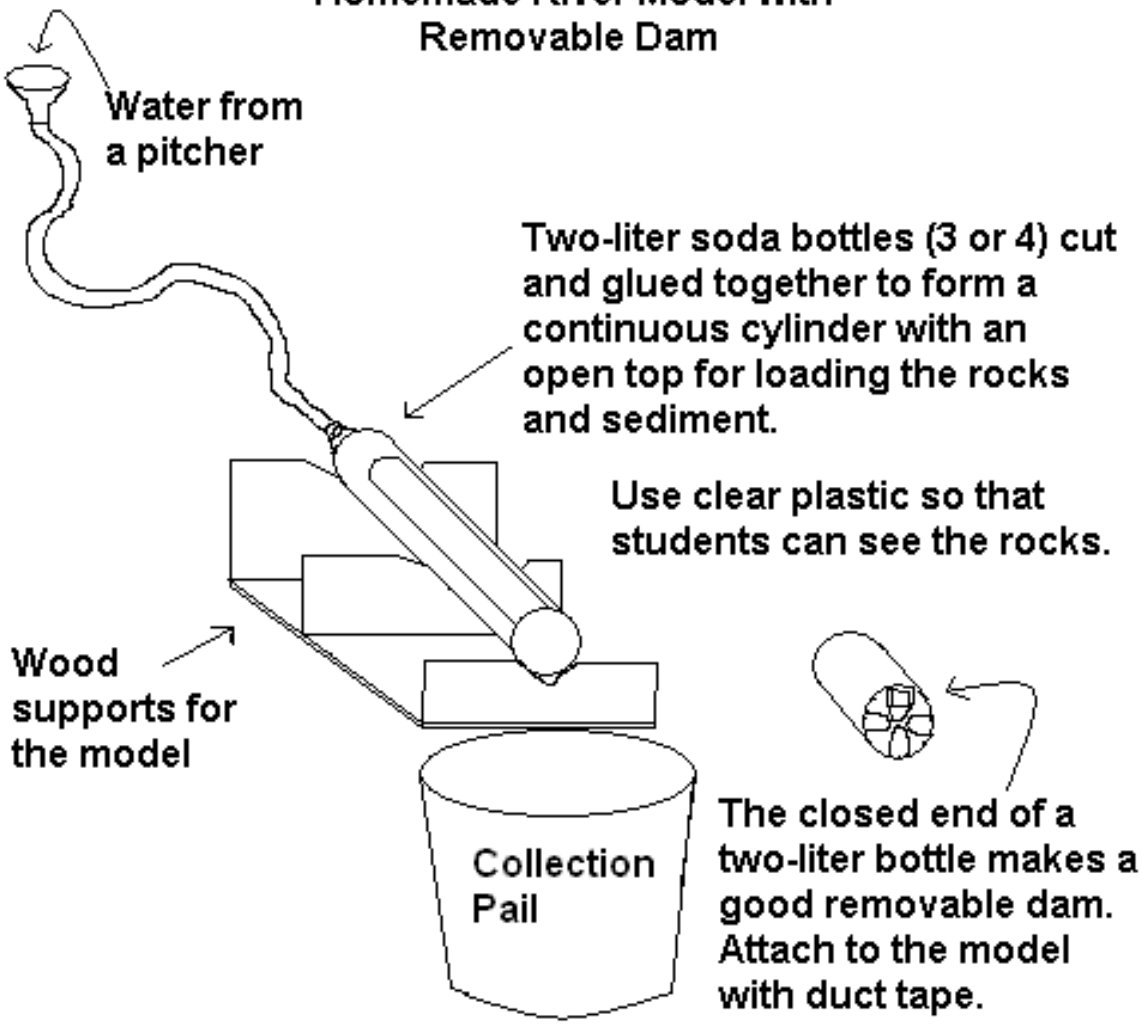
   Sedimentation: The process of sediment accumulating along the riverbed.

7. **Safety Information: Be careful around the water!**

8. **Materials List (including any handouts or transparency masters):**

   - Worksheets attached to this inquiry
   The river model (see pictures below):
   - Scrap wood to build the sloped river model frame (size may vary)
   - Funnel
   - Two-liter soda bottles to build walls and a dam for the river
   - Hose to connect the funnel to the entry point for the river
   - Collection pail to catch runoff
   - Pitcher for pouring water (a one gallon milk jug is great)
   - River material (bucket load or two of sediment from the local stream or river)
   Optional: colored sand works well for visualization of moving particles
   NOTE: Try to use an inconspicuous site. Always return river sediments to their original location after the demonstration. Re-naturalize the affected site as well as possible.

Homemade River Model with Removable Dam



9. Methods/Procedure for students:

a. Pre-investigation work: Following discussion of the range of particle sizes in the river, sediment should be collected. Students can help load the sediment into the river model. Have the students draw their idea of a river dam and discuss the pre-investigation questions on the worksheet.

b. Investigation work: The amounts of sediment, rock and flowing water will need to be adjusted for optimum effect. Pour a pitcher-full of water into the funnel and tell the students to observe which river particles are moving with the flow of the river. The students should be able to see some smaller particles (sand, silt, organic material) moving down the "river" and collecting in the pail. We used some colored sand from an arts and crafts store to help the students see fine particles moving with the water. Now install the "dam" over the end of the model and pour another pitcher of water through the river. Do particles continue to flow through the system, or are the stopped by the dam? The dam can be removed at some point, and the students can observe what happens to the water, rocks and sand built up behind the dam. Then the sediments can be remixed and reloaded into the river.

1) What evidence (data, samples) do students collect?
Students observe the flow of the river model and sketch and/or label (on the worksheet) where certain particle sizes end up.

2) How do students present the evidence (data)? They draw what happened to the particles on their worksheet.

3) What conclusions are drawn from the evidence students collect?
Which sediment particles have moved with the water? Where do they end up? What happens when the dam is removed?

4) Include examples of data sheets.

10. Assessment: Evaluation of understanding can be monitored with the drawings and pre- and post-exercise questions on the worksheet. With our first and second graders we had them draw their schema of a river dam with sediment particles before and after viewing the river model in action. We discussed the impacts of the dam on the river ecosystem and movement of sediment particles. We did not have the students answer the worksheet questions individually, but that may be appropriate for higher grade levels.

11. Extension Ideas: We combined this inquiry with a field trip to a real dam (Milltown Dam, Montana) to discuss the principles illustrated by the river model. A fish biologist that studies the effects of the dam on local trout populations gave our classes a tour of the dam and discussed how it works and how it has affected the community and the ecosystem.

12. Scalability: Higher grade levels could actually build the river model and discuss additional ecological impacts of dam construction and removal.

13. Science Standards Accomplished:

1) Earth and Space Science

- Observe and develop a growing curiosity about the physical world
- Observe, describe, and sort earth materials based on properties, using different techniques
- Acquire the vocabulary associated with earth material

14. References:

- **Environmental Protection Agency:**
  http://www.epa.gov/region8/sf/sites/mt/milltowncfr/home.html
- **International Rivers Network:**
  http://www.irn.org/basics/ard/index.php?id=sr- sediments.html
- **The Missoulian:**
  http://www.missoulian.com/articles/2003/04/16/news/local/news01.txt
- **The Ecology of Dams:**
  http://chamisa.freeshell.org/dam.htm

15. List of Experts and Consultants:

16. Evaluation/Reflection by Fellows and Teachers of how it went:

Teacher comments:

This was a very helpful lesson in allowing students to see what happens when a dam is put into a river. It helped them grasp an otherwise difficult concept!

In November 2006, we led the inquiry on river sediment movement and the effects of a dam on the river ecosystem. The students were asked to reflect on the previous exercises with pebbles, sand and silt and draw their idea of a river dam. Then we filled the river model with river rocks of different sizes and had students predict which rocks would be transported by the flow of water. We then ran water through the model with and without a dam, and discussed what was moving downstream. As a wrap-up, students drew a river dam again with their newly acquired knowledge of sediment movement.

Students really loved the inquiry and were able to make really good predictions about the effects of a dam on a river ecosystem. They discussed potential effects on fish, drinking water and contaminated sediment transport.

The next week we took both 1st/2nd grade classes on a field trip to the Milltown Dam in Milltown, Montana. A fish biologist that studies the effects of the dam on local trout populations gave our classes a tour of the dam and discussed how it works and how it has affected the community and the ecosystem. The field trip provided the students with an excellent real-life example of what we had learned about rivers and dams through the river model inquiry.

GO WITH THE FLOW: SEDIMENTS UP AGAINST THE DAM

WORKSHEET (page 1)

Pre-investigation questions:

1) Which grain sizes (pebbles, sand, silt) will move with the river water?_____

2) When a dam is built across a river, where does the river sediment go?_____

3) Is this good or bad?_____ Why?_____

4) Draw a river dam with different sized rocks in the river. Draw what you think will happen to the different size particles:

GO WITH THE FLOW: SEDIMENTS UP AGAINST THE DAM

WORKSHEET (page 2)

Post-Investigation questions:

1) Which sediment particles moved with the water?_____

2) Where did they end up?_____

3) What happened to the fine sediment when the dam was removed?_____

4) Draw the river and dam again. Include what actually happened to the size particles: