Virtual River (Part 1): River Discharge

Lesson source: Geology Labs On-Line at
http://nemo.sciencecourseware.org/VirtualRiver/Files/page04.html

Focus on Inquiry

The student will calculate river velocity and discharge by collecting and graphing river data through an on-line river lab.

Lesson Overview

This activity is an online laboratory intended for individual or small groups of students to work through independently. The online laboratory uses a series of visuals, simulations, explanations and questions to help students discover basic concepts about how rivers work. In order to progress through the laboratory, students must correctly answer formative evaluation questions.

Duration	Setting	Grouping	PTI Inquiry Subskills
1.5 – 2 hours	Computer lab	Individual or small groups of 2-3	2.6, 3.1, 3.2, 3.5, 3.6, 3.7, 3.8, 4.1, 4.2, 4.4, 5.2, 5.4, 7.1, 7.2

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5-8 min.	4.1, 5.2	Computer; projector (optional)	2	Using photos of rivers, ask students to describe characteristics of rivers and discuss "Where do rivers get their water? How is river discharge measured?"
Explore	55 min.	2.6, 3.1, 3.2, 3.5, 3.6, 3.7, 3.8, 4.2, 4.4	Computer with internet access; Simulation	3	On the activity website, each group completes a series of simulated activities to understand basic concepts of how river works, how to measure velocity and compute the total discharge of a stream/river.
Explain	20 min.	5.2, 5.4, 7.2		2	Teacher engages students in a discussion of the major concepts covered in this lab.
Expand	15 min.	7.1	Internet (optional)	2	Students read and discuss other ways of river charge measurements that scientists use.
Evaluate	varies		Computer with internet access		The certificate of completion provided by the site may be used as part of an evaluation.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

National Science Education Standards – Inquiry

Design and conduct a scientific investigation.
Use appropriate tools and techniques to gather analyze, and interpret data.
Develop descriptions, explanations, predictions and models using evidence.

National Science Education Standards – Earth Science

Water circulates through the crust, oceans, and atmosphere in what is known as the "water cycle."
Water is a solvent. As it passes through the water cycle, it dissolves minerals and gases and carries them to the oceans.

Louisiana Grade Level Expectations – Inquiry

Gr. 8, Inquiry GLE#6 – Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
Gr. 8, Inquiry GLE#7 – Record observations using methods that complement investigations (SI-M-A3)
Gr. 8, Inquiry GLE#8 – Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
Gr. 8, Inquiry GLE#9 – Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3)

Gr. 8, Inquiry GLE#10 – Identify the difference between description and explanation (SI-M-A4)
Gr. 8, Inquiry GLE#11 – Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
Gr. 8, Inquiry GLE#12 – Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
Gr. 8, Inquiry GLE#22 – Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
Gr. 8, Inquiry GLE#31 – Recognize that there is an acceptable range of variation in collected data (SI-M-B3)

Louisiana Grade Level Expectations Earth Science

Gr. 8, GLE#24 – Investigate and explain how given factors affect the rate of water movement in the water cycle (e.g., climate, type of rock, ground cover) (ESS-M-A10)

Materials List (per group)

- Computers with Internet access

Advance Preparation

1. Review the technical considerations and system requirements for running the activities on the website (http://nemo.sciencecourseware.org/tester/index.php?app=vr). Install any hardware or software necessary.
3. Review the demonstration version of the activity at the website.
4. Determine whether students will work individually or in small groups to complete the website activities.
5. It may be helpful to go through the activities first to review and record the correct answers. Students will not be able to advance without entering correct answers, so you can have the correct answers available to help them if the need arises.
6. Print and make copies of the page at http://ga.water.usgs.gov/edu/bridgegaging.html for each student for the Expand activity.

Other Information

Learning Objectives

The learners will:

- be introduced to some basic concepts about rivers/streams
- discover how a rivers discharge is determined
- simulate the use of a velocity sensor
- decide where the river flows the fastest/slowest
- determine the average velocity of a stream
- use graphing skills throughout the activity

Prior Knowledge Needed by the Students

- Students need to know how to calculate an average.
- Students need to know how to plot points on a graph and to read values from a graph.

Procedure

Engage

1. Ask students to name important rivers in the world. List student responses on the board.
2. Show the pictures of four rivers at http://www.classzone.com/books/earth_science/terc/content/investigations/es1301/es1301page01.cfm. Ask them to describe the characteristics of the four rivers they observe in the picture (e.g., depth, width, flow). Next ask students to provide explanations for the following questions: “Where do rivers get their water? How do you measure the flow of water in the river? What is river discharge? How is river discharge measured? Why is it important?”

Explore

3. Students will work through an online lab activity at (http://nemo.sciencecourseware.org/VirtualRiver/Files/page04.html) that will introduce how various parameters of steams are measured, such as discharge, which is measured in m^3/s, and velocity, which is measured in m/s.
4. A velocity sensor will be introduced so that students will see how the water is measured in both area and velocity. Next, the groups will determine the average of the velocity of the stream and will create a depth verses velocity graph.
5. Students will be introduced to the "six-tenths rule" in order to approximate the depth one would have to measure to obtain an "average" velocity for the stream.
6. Finally, using the stream's depth, width and velocity the discharge will be calculated.

Explain

7. Once the class has completed the online activity, the teacher should engage students in a discussion of the major concepts covered in this lab. Students should be able to explain in their own words where the average velocity of a river should be measured, how to calculate discharge, and the meaning of the following vocabulary: meander, riffle, point bar, cut banks.

Expand

8. Have students read about other ways that scientists use in measuring river discharges. Provide each student with a copy of the web page (http://ga.water.usgs.gov/edu/bridgegaging.html) or have them read online. Here's an abstract of a second scientific article that describes a case study of estimating river discharge from very high-resolution satellite data: http://www3.interscience.wiley.com/journal/108562472/abstract?CRETRY=1&SRETRY=0.
9. Have groups discuss their readings and what additional ways might be used in the future.
10. If time permitting, students can browse through the pages http://www.classzone.com/books/earth_science/terc/content/investigations/es1301/es1301page01.cfm at the site about factors impacting river flow changes over time.

Evaluate

9. Students are asked to answer a number of questions online as they progress through the lab activity. Students must answer each question correctly in order to proceed. At the conclusion of the lab a certificate can be printed for each group.

Blackline Master

- None.

Supplementary Resources

USGS
http://ga.water.usgs.gov/edu/bridgegaging.html
This web page describes several ways in measuring river discharge used by scientists.

InterScience Journal
http://www3.interscience.wiley.com/journal/108562472/abstract?CRETRY=1&SRETRY=0
This recent scientific article describes a case study of estimating river discharge from very high-resolution satellite data. A brief abstract is provided.

McDougal Littell, Exploring Earth: How does stream flow change overtime?
http://www.classzone.com/books/earth_science/terc/content/investigations/es1301/es1301page01.cfm
This resource provides images of rivers, ways for measuring discharge, charts of discharge data and other factors with investigative questions that guide students to consider how stream flow change overtime and what factors contribute to the changes. The teacher can use all the ten pages or select a couple to engage students or as an extension activity.