

Forces & Energy (Flowing Water)

Teacher's Guide

Subject: Integrated Science (Physical; Earth-Space)

Topic: This field lab introduces students to the concepts of balanced and unbalanced forces together with potential and kinetic energy through the study of water in a Karst feature.

Summary:

Students will examine the hydrologic conditions present at the natural bridge. They will create a model that illustrates the hydrologic conditions. They will use their model to predict the hydrologic conditions under high and low water situations. They will develop a model for capturing the kinetic energy in the system to do work.

After completing the field lab, students will be able to:

Objective(s):

1. Describe the hydrologic mechanics behind the natural bridge feature.
2. Create and operate a simple model illustrating the hydrologic mechanics and use it to predict high flow and low flow conditions.
3. Create a model using available materials to demonstrate how the kinetic energy in the system can be used to do work.

Ecosystem(s): Karst Ecosystems

Equipment:

- 3 x 2' pieces of clear hose
- 3 x 2 liter soda bottles or milk jugs
- 3 hose clamps
- tape measure
- level
- Duct tape
- Scissors
- Markers

Background:

Vocabulary: Aquifer, Limestone, Equilibrium, Karst, Karst Window, water table, pressure

Reference Material:

Equipment Training: none

Procedure (Engage; Explore; Explain)

1. Engage the students by asking a specific question that gets to the heart of the activity: "What determines the rate of flow of the water passing under this natural bridge?" Use the students' answers to ascertain what they already know, clarify any misconceptions, and then ask them to formulate their own hypothesis relating to their own expectations of the outcome of the lab.
2. The students should take some time to closely examine the site around the natural bridge with special emphasis on the following: Which direction water is coming from, which direction the water is going to (horizontally and vertically, esp. at the "Brett's Toilet Bowl" feature), and the water level at each location. (Note that this area will look differently through the day with the tide coming in and going out).
3. After examining the conditions, students should use the materials provided to make a model that demonstrates the hydrologic connections behind natural bridge feature. They should spend ~20 minutes creating their model.
4. Once their model is created, the students should demonstrate the effects of high flow conditions and low flow conditions and document the results based on how their model responds to these conditions.
5. After completing the lab, allow the students to answer the discussion questions as a group and explain their answers relating them to the concepts, processes and skills associated with the activity. Students should record their answers individually. At this time, facilitators can introduce/explain the specific concepts and explanations in a formal manner.
6. Model Rubric: High Score: The model has water in reservoirs on both ends with water in the tube connecting them. The tube is covered by something to represent the limestone.

Forces & Energy (Flowing Water)

Student Data Sheet

General Information

Full Name:		Date:	
------------	--	-------	--

Hypothesis:

The water on either side of the natural bridge is (**choose one**: connected/not connected) because (the evidence I immediately observe is):

Field Observations

After carefully examining the natural bridge feature make a cross section drawing that you think illustrates the feature. Then, examine the materials available to you and use the space below to draw a picture of the model you plan to make.

Drawing of cross section of natural bridge	Drawing of proposed model

What happens to the water when one end is raised higher than the other end?

What happens when you quickly add water to one end of the model without adjusting the height of the other end?

How do you know when the pressure at each end of the model has reached equilibrium?

Forces & Energy (Flowing Water)

Assessment

1. Draw a picture of the actual model you made (include any changes or adjustments from your original plans).

2. At what tide did you observe the natural bridge? Did this affect the level of the water? Why or why not?

3. Was your hypothesis supported by your data? If not, why?

4. How might your result have been different if your tube had many holes in it?

5. Explain how your model did or did not simulate the actual tendencies of the water flow.

6. Think about what you learned in this lab; has it generated any new questions? Write a new question (related to the subject) about something you want to learn more about.
