



Curriculum developed at the Stroud Water Research Center by Tim Liggett of Conestoga High School, supported by a grant from the National Science Foundation's Research Experience for Teachers program. For non-commercial use only.

## **TRANSPORT OF MACROSCOPIC PARTICLES**

### **Learning Objectives**

- Visualize the flow of macroscopic particles in a stream
- Illustrate the flow of surface waters in a stream
- Understand the concept of transient storage
- Describe the effects of stream features on water flow and transient storage
- Draw an accurate map of the study reach
- Develop a hypothesis about the movement of microscopic particles as they travel in a stream

### **Materials Needed**

- Wine bottle corks (≈100 per release)
- Measuring Tape
- Net or similar devise to capture corks
- Field observation notebook / data sheets

### **Rationale**

In the teaching of stream ecology one of the most often overlooked concepts is the idea of transient storage. Students easily observe water or a fallen leaf moving through the stream, but they do not see the potential for an object, or molecule, to become trapped, and subsequently stored in an area. This concept can be readily illustrated with this experiment in which a quantity of wine bottle corks is released and their movement downstream is observed. The students will map the location of features that trap the corks. They can then quantify the amount retained in each area and can then make a hypothesis concerning the storage of microscopic particles. The other experiment in this series will explore the concept of microscopic sized particle storage more fully.

### **Procedure**

You will need to define a reach of at least 200 ft. (≈60 meters). If possible include several different stream features as listed in the table below. Besides considering which of the features are in the stream, be sure that you choose a stream with an appropriate width. If the width is too large, (over about 30 feet) you might not find some of the features. A general guideline is between 6 and 30 feet.

Table 1 - Stream Feature Codes

T = twigs	IT = in transit
Ri = Riffle	S = Seine - netting
H = herbaceous vegetation	E = edge vegetation
Ro = root wad	Ed = eddy
DD = Debris Dam	LP = leaf pack

Mark the reach with the measuring tape. By leaving the tape on the ground and marking 10' intervals with sticks or flags, students can easily measure the distance of each cork from the starting point.

Locate several students below the end of the reach so they can capture the corks that are not trapped in the reach.

When all the students are ready, release all the corks simultaneously. Allow several minutes (15 to 30) for the corks to flow down the reach. You can record the time the first and last corks arrive at the end of the reach to calculate the stream's velocity and discharge.

After the time has expired, have the students walk along the length of the tape and record the distance below the starting point where the corks were trapped. They should record the stream feature that trapped the corks and the number of corks at each feature. Remind them to count the number of corks that do not get caught in any of the features and make it to the end of the reach. They can complete a data table similar to the one below:

	Distance from start (ft)	Feature Code (Ri, E, H etc)	Number of Corks at Site
Site #1	_____	_____	_____
Site #2	_____	_____	_____
Site #3	_____	_____	_____
Site #4	_____	_____	_____
Site #5	_____	_____	_____
Site #6	_____	_____	_____
Site #7	_____	_____	_____

Add as many observation sites as you need by modifying the table.

### Results

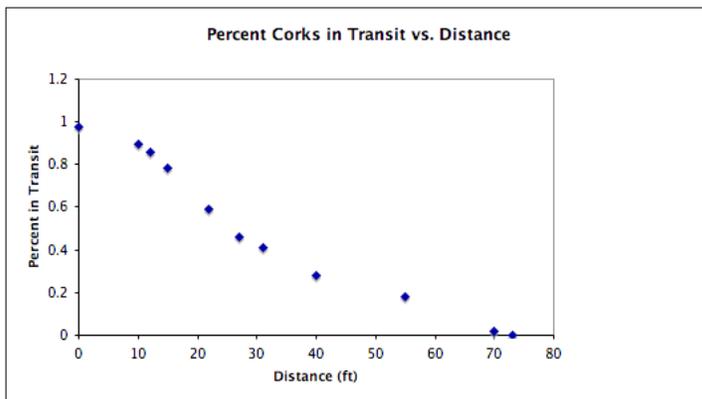
After gathering the data, students can visualize the fate of particles in streams and how the obstacles provide storage areas. Some ways include a labeled sketch of the stream, graphing the loss of matter as a parcel of water moves downstream, and which stream features play an important role in storage of matter.

First, it is important to illustrate that, as materials move down stream, there is a constant and predictable loss. This can be illustrated by graphing the percent of corks remaining in the stream as a function of distance from the release point.

### Percent of Corks in Transit - Calculations

Please refer to the [sample calculations & graphs sheet](#) to see an Excel spreadsheet and a calculator-based method to calculate the percent of corks in transit.

The final graph should look like the graph below by plotting distance vs. percent in transit:



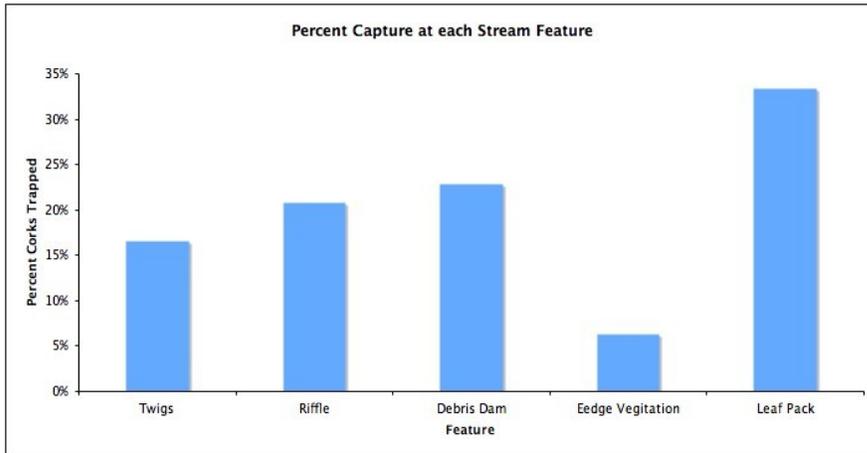
### Percent of Corks in Transit - Discussion

This experiment can be the starting point for a class discussion concerning the movement of material, especially organic matter, in a stream. Students should see that there is a constant loss of matter and that this matter feeds organisms downstream of where you are observing the loss. Another point of discussion might be to have the students speculate on what happens if humans modify the stream and its surrounding habitat. For example, if humans cut down trees that overhang the stream there will be more silt and nutrients entering the stream and this will change the species composition down stream. Also cut down trees means that few leaves enter the stream lowering the food supply for several insects that rely on the leaves. The [cork lab discussions questions sheet](#) will give you some questions to initiate this discussion.

### Percent of Corks Stored at each Stream Feature - Calculations

Please refer to the [sample calculations & graphs sheet](#) to see an Excel spreadsheet and a calculator-based method to calculate the percent of corks in transit.

The final graph should look like the graph below by plotting percent captured at each site vs. stream feature:



### Percent of Corks Stored at each Stream Feature - Discussion

This graph can be a starting point for discussions concerning the ability of a stream to hold organic matter. Discussion points might include what types of objects might be trapped in which feature. If this is one of several transect studies, have the students describe differences among transects. They could also compare the effects on the same feature between the different transects. The [cork lab discussions questions sheet](#) will give you some questions to initiate this discussion.

### Additional resources:

- Student Worksheet for the Cork Float Lab
- Cork Transport Exercise – Sample Calculations and Graphs
- Cork Lab Discussion Questions