Stream Flow Monitoring

Chicago River Fieldtrip Activity

Summary

Students will calculate flow rate and stream flow of a local river.

Background

Flow rate measures the speed at which water in a river is travelling down the river (often reported in feet/second). Stream flow measures the volume of water moving down the river over a given time period (often reported in cubic feet/second).

When flow rate increases, water has a greater ability to erode its channel and banks. More and heavier sediment can be carried by the river. This can increase the river's turbidity (decrease its clarity). Sunlight will be unable to penetrate as deeply into the river, and aquatic plants and algae can suffer.

Because the United States Geologic Survey (USGS) (water.usgs.gov) has been monitoring stream flow for decades and continues to do so today, it is possible to look at changes in stream flow over time, the response of stream flow to a rainstorm (called a stream hydrograph), and to compare the stream flow calculated at the river to data from other places and times. More urban rivers tend to be "flashier", meaning that after a storm stream flow increases rapidly and dramatically. This creates high erosion rates. It also makes it difficult for stream bank vegetation to establish itself because stream banks are often very steep (due to high erosion) and are either well above the water line or completely inundated with water during high rain periods.

Procedure

For information on planning and organizing a field trip and for safety tips, visit our web site at www.chicagoriver.org/education, then click on field trips.

Before the field trip you may want to have students study stream flow data from the United States Geologic Survey (water.usgs.gov). Alternatively, you can have students

Grade Level: 6th – 12th

Duration: 30 min

Objectives:

1. Students use math and graphing skills to understand and calculate flow rate and stream flow.

Materials:

- Copies of Stream Flow Calculation sheet (one per small group of students)
- Stop watch (1)
- Meter stick (1-2)
- Waders (3-4)
- Long tape measure – at least 30 ft. (1)
- Oranges (2)

Standards:
11.A.3c, 11.A.4c, 11.A.5e, 11.A.3f, 11.A.4f, 11.A.3g, 12.D.5a, 12.E.3b

Compare their data to USGS data once they return from the field trip.

As always, students on field trips should be divided into small groups. There are six different roles, though it is best if at least seven students are in a group. Assign students in each group the following roles: timer (1), tape measurers (2), orange dropper (1), orange catcher (1), meter stick holder (1), recorder (1). Have students follow instruction sheets to calculate stream flow. Depending on your students, it may be helpful to review procedures in the classroom before the field trip. You will also need to decide on the number of data points you want students to take across the river. Three is minimal. The more data points, the more accurate the students' calculations will be.

Always use caution when near the river and remember to wash or sanitize hands after touching river water. For more safety tips visit our website at www.chicagoriver.org/education, then go to field trips.

Extensions

Students can take their depth measurements and graph the profile of the stream bottom. Students can look up stream flow data from the USGS to determine if the flow they found is high, low or average.

If there has been a recent storm, students can look up the data from a nearby USGS stream monitoring site from the weeks before and after the storm to understand how stream flow in the river responds to storms. Below is a list of Chicago River stream sites monitored by the USGS:

USGS Code	River Name	Gage Location	Dates Available
0553500	Skokie River	Lake Forest	1951-1999
05535070	Skokie River	Highland Park	1967-2000
05535500	West Branch of Chicago River	Northbrook	1952-2000
05536000	North Branch of Chicago River	Niles	1950-2000
05534500	North Branch of Chicago River	Deerfield	1952-2000
05536995	Chicago Sanitary & Ship Canal	Romeoville	1984-2000
05536290	Little Calumet	South Holland	1947-2000
05536290	Little Calument	Harvey	1916-1933
05536270	North Creek	Lansing	1948-2000
05536275	Thorn Creek	Thornton	1948-2000
05536210	Thorn Creek	Glenwood	1949-2000
05536210	Thorn Creek	Chicago Hights	1964-1979
05536255	Butterfield Creek	Flossmoor	1948-2000
05536235	Deer Creek	Chicago Hights	1948-2000

You can also choose to extend their stream flow studies using the classroom lesson "What Does Stream Flow Tell Us" from Friends of the Chicago River. This lesson explores the changes in peak stream flow over the last decade in the Chicago region.

Calculate Stream Flow

You are your group are going to measuring steam width, steam depth and stream velocity and then using this data to calculate stream flow (or volume of water going down the river over a given time period).

Roles

Timer: hold the stopwatch and time how long it takes the orange to travel one meter.

Tape Measurers (2): measure the width of the stream, and hold the tape measure taut across the width of the river.

Orange dropper: drop the orange when calculating stream flow.

Orange catcher: catch the orange at the end of its travel.

Meter stick holder: locate where velocity data will be taken and hold the meter stick for velocity readings.

Recorder: record all width, depth and velocity readings.

Directions

If your teacher has not already done so, choose a location to measure stream flow. Choose somewhere that represents the average conditions of your site. Everyone should gather the equipment they need and anyone wading into the river should put on hip waders and find a meter stick or long stick to use to feel the bottom of the river ahead of where they are walking.

Tape Measurers: One person should stand on the bank of the river while the other wades across the river. It is a good idea to use a long stick or meter stick to feel the bottom of the river in front of you as you walk. Make sure to walk slowly and carefully, the bottoms of rivers can be very variable. Hold the tape measures at the edge of the water and read the distance across.

Recorder: Record width.

Meter stick holder (with everyone's help): Calculate how far apart your stream velocity and stream depth points will be. Here is how:

1) Take the width minus one meter.
2) If you are taking three points, divide the river's new width (from above) by four. If you don't understand why you are dividing by four and not three, draw a picture of what you are doing and it will make more sense. If you are taking five points, divide by six, etc. This is how far apart each point is.

Recorder: Record the data interval.

Meter stick holder: Along the measuring tape being held taut across the river, measure half a meter from the edge. Then measure the calculated interval between data points. This is where the first depth and width measurement is going to be taken. With your meter stick, measure the depth of the water here. Be careful not to push the stick into the sediment.

Recorder: Record the depth

Meter stick holder: Now hold the meter stick horizontal to the top of the water, just downstream of the tape measure.

Orange dropper and catcher: Wade into the river and join the meter stick holder.

Orange dropper: Make sure the orange catcher, time keeper, meter stick holder and recorder are ready. Gently drop the orange into the river, upstream of the meter stick.

Meter stick holder: When the orange crosses the beginning of the meter stick, call start.

Time keeper: Start the stop watch.

Meter stick holder: When the oange crosses the end of the meter stick, call stop.

Time keeper: Stop watch.

Recorder: Record time.

Orange catcher: Catch the orange and give back to orange dropper.

Repeat three times at each point. Then continue across the river.

Everyone: Calculate stream velocity, using the following formula:

Stream Velocity (m^3/s) = Average Depth x Width x Average Velocity.

Answer questions at the end of the data section. Wash or sanitize your hands when you have finished collecting your data.

Stream Flow Data Sheet

Date: ____

Weather today: ____

Weather over the past two days: ________________________________

Stream Width (m): _____ Number of data points: ________ Data Interval: _____

Location (meters from edge)	**Depth** (meters)	**Velocity 1** (meter/seconds)	**Velocity 2** (meter/seconds)	**Velocity 3** (meter/seconds)

Stream Flow (m^3/s) = ____________________________

Questions:

1) Where did the maximum velocity occur? ___________________________

2) Where did the minimum velocity occur? ___________________________

3) Can you explain this? ____

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