Transparency Tube Activity

Equipment:

- 2 or 3 water samples collected from different rivers
- 2 or 3, 5-gallon pails for holding water samples
- Transparency tubes – enough for each group of 2-4 students to have one tube, plus one with a removable stopper for demonstration purposes
- Bucket (paint or ice-cream) with rope attached to handle
- Plastic cups or jars to transfer water from pails to tube (one liter works well)
- Pencils
- Datasheets for recording transparency, appearance rankings, and source of water sample
- Optional: 4 dowels or sticks, about 2.5 feet long, for stirring water samples, a camera for taking pictures of collection sites and non-mercury thermometer for measuring stream temperature.

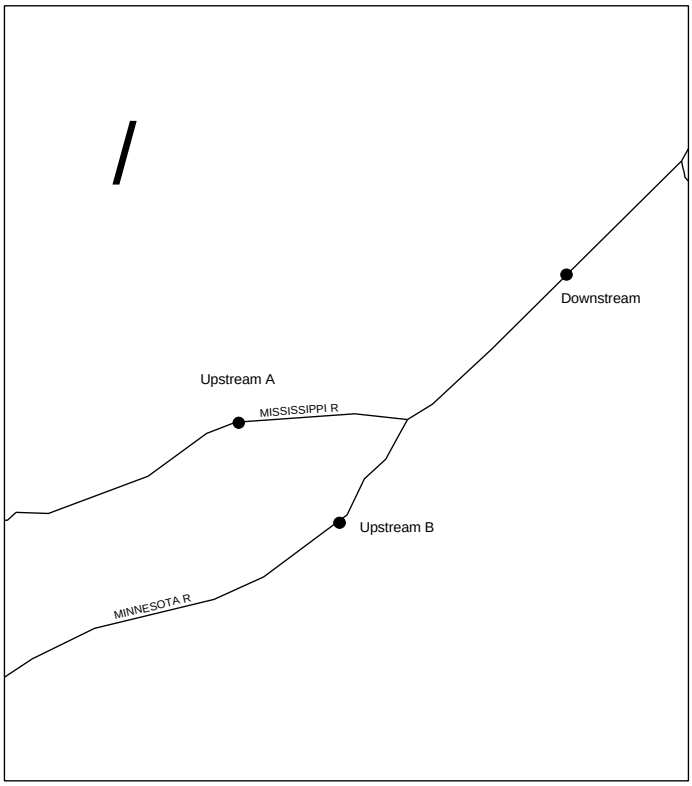
Sampling Locations:

Choose two to three separate stream locations to monitor. Each location should have sufficiently different water clarity and watershed characteristics to expect different transparency readings. In the Twin Cities, a good teaching example is found by collecting water from the following sites:

Mississippi River upstream of confluence with Minnesota River (Hidden Falls Park)
Minnesota River at Fort Snelling State Park boat launch
Mississippi River downstream of confluence with Minnesota River (Crosby Farm Park)

If you are not located in the Twin Cities, here is a general description of sampling locations to include in your project. Choose two separate streams to monitor. Locate one site on each stream, upstream of their confluence (where the streams join). Be sure each site is far enough upstream of where the two join, to avoid water backing up in the event of high water. Locate a third site downstream of their confluence, ensuring that the river has had time to mix (water should look consistent…not clear on one side of the stream and darker on the other):

Confluence of Minnesota (bottom) and Miss. Rivers



Example of sample collection points

Timing:
Samples should be collected on the same day at all sites and under similar conditions. For a short experiment, a one time sampling may be sufficient. For a longer experiment, monitor weekly and then after rainfall events (typically greater than 0.5" inches of rain, but varies by stream) to determine the role runoff plays in stream transparency.

Introductory Discussion Points: Also refer to "Primer on Stream Transparency.doc" for more background information on transparency and how it relates to water quality. Note: these discussion points are geared toward a 3rd – 6th grade audience.

Longer-term Project - If you are doing a longer-term experiment, you will want to go through these points before the project is begun.

- For longer-term projects, ask the students to develop a hypothesis regarding what they expect transparency to be at the different sites.

One-time Activity (10 minutes in length) - If you are doing a one-time activity, go through these points before taking transparency readings with the group.

- ❖ Ask students where they go to find out if they are healthy – to the doctor
- ❖ Inform them that they are going to be the doctor for the river, to find out how healthy the river is
- ❖ Ask if anyone can define transparency – go over meaning
- ❖ Discuss general background on rivers
  - What lives in a river? – hit big three – plants, 'bugs' (macroinvertebrates), fish
  - What do plants need to live? – sun, soil, water, food
  - How far can light travel in water? – as far as you can see into it
  - What do 'bugs' eat? – other bugs, plants
  - What do fish eat? – other fish, bugs, plants
  - How can light affect all of these? -Will plants grow if they don't get light? What will 'bugs' eat if the plants can't grow? What will the fish eat if there are fewer 'bugs' and plants? Get general consensus that light is important.
- ❖ We are going to use a transparency tube to measure the light that can travel in the water (transparency) and learn what kind of life we might expect to see living in the water.
- ❖ Take apart tube, show the pattern on the stopper, the tape measure (in centimeters) on the side, and how to open and shut the valve. Stress that they may need 2 hands to close the stopper, especially if it is cold outside.
- ❖ Put the stopper back in the tube and go through the use of the tube (explaining it as a 2 person activity)

Activity (10 minutes):

Work in pairs (or groups of 4). Have students pair up/separate into groups and line up behind the sample buckets. Have the first pair/group in each line start the activity.
Person 1 makes sure stopper is in tight and the clamp is closed
Person 2 stirs water (if applicable) and fills cup with water. Pour water into tube.
Person 1 puts tube on edge of pail (for balance) and looks down through the water – their job is to watch for the black and white symbol. When they see it, say 'stop.'
Person 2 opens the valve and drains the water back into the pail. When Person 1 says 'stop,' they close the valve.
Both look at the tape measure on the side and determine the transparency to the nearest centimeter. Be sure to REMEMBER this value.

One-time Activity Follow up Discussion (5-10 minutes):

- ❖ Ask for results from students – what transparencies did they get
- ❖ Discuss amount of light that gets to bottom of river
  - Would many rooted plants grow in rivers where samples were collected?
  - Could there be other plants (i.e. algae and floating plants such as duckweed)?
  - Will there be bugs?
  - Will there be fish?

- What kind of fish would we find – walleye/northern vs. carp
    - Walleye must catch their food, if they can only see 10", will they catch their food? – not very well
    - Carp suck their food off the bottom like a vacuum cleaner (discuss specialize mouth placement on bottom of face and barbels – "whiskers" – used to sense food) – do they need to see their food to catch it? – no
    - Which fish are more likely in water with low transparency? – carp, bullhead, catfish, etc.
    - Which fish are more likely in high transparency water? – Walleye, northern, trout, etc. (predators that need to be able to see distance in water to catch their prey)

❖ Tell students that the biggest source of pollution in MN waters is soil (sediment).

❖ Should the river water be clear?
- Ask students what kind of soil they have at home in their yards (fine silts and clays – very small or sandy soil – larger particles?)
- Ask who has made Kool-aid
- If you stop stirring, does it all stay mixed? – no, the sugar settles out
- Does the water still stay colored? – yes, colored small particles stay mixed
- The river works the same way, the large particles like the sugar (sand, gravel) sink to the bottom, but the colored part (small clays) stays mixed.
- Ask if any kids have dirt driveways or sandboxes – when it rains, what happens to the water that runs off the driveway/sandbox? – is it clear or muddy? This helps to explain how runoff makes the river darker (more sediment filled) after a rain storm.

❖ Discuss where students' drinking water comes from (predominantly from Mississippi River in Twin Cities area). Also remind them that people upstream used the water before they did, and that people downstream use it after them. Is it important to take care of the water? What can each of them do to help?
- Don't litter and pick up litter
- Plant grass/flowers/shrubs on bare soil
- Don't waste water
- Fix leaks in cars (drains to river via storm drains)

Longer-term Project Discussion:

❖ Compare transparency readings over time at the 3 sites – this could involve graphing the data using Microsoft Excel or some other software with graphing capability:

1. How does the transparency differ between the sites?
2. What might cause the difference? (Consider size of stream, land uses in watershed, stability of stream bank, etc.)
3. Does transparency change at a given site over time?
4. What could cause an increase or decrease in transparency?
5. Does transparency change after a large rainfall? If so, how long does it take for the stream to recover (transparency to rebound)?