Water Quality

Learning objectives: Water - are there any natural sources of water in the area? Are these sources healthy or unhealthy? Do you want to create a source of water such as a small pond?

Curriculum Expectations

B 2.4 plan and conduct an investigation, involving both inquiry and research, into how a human activity affects water quality (e.g., leaching of organic or inorganic fertilizers or pesticides into water systems, changes to watersheds resulting from deforestation or land development, diversion of ground water for industrial uses), and, extrapolating from the data and information gathered, explain the impact of this activity on the sustainability of aquatic ecosystems [IP, PR, AI, C]

Background

Water Colour (Turbidity)

The colour of water without sediment is clear-blue because water molecules absorb red in the visible spectrum (Perlman, 2016).

But what if water is not clear-blue? What if it is coloured?

Water can be coloured differently due to the dissolved materials in it and sometimes these have negative implication for aquatic organisms in it. For example, if the water has a clear brown tea colour, it means that it has dissolved tannins in the water from the leaves and roots of dead plants. If the water is milky cloudy (particularly applicable to tap water), it could mean that there is dissolved gas in it. This usually clears up once the water settles (Perlman, 2016). Water can also appear muddy. Muddy water, or turbid water, usually indicates lots of sediment (dirt run off—usually top soils like clay and silt). Muddy water can be either gray, red, yellow or brown and the colour is determined by the different soils in the area. The problem with sediment filled or turbid water is it prevents light from penetrating the water and prevents aquatic plants from growing. (https://water.usgs.gov/edu/color.html). The level of turbidity determines the health of the water and is commonly measured in nephroletic turbidity units (NTU). Water can also be green. Green water indicates that there is a high number of phytoplankton or green algae. Algae blooms occur when the water is filled with high amounts of nutrients, like nitrogen and phosphorus (usually from fertilizers) in groundwater runoff. The problem with algae blooms is two-fold. Algae can prevent sunlight from penetrating the water, which causes other aquatic plants to die. As these plants die, they are decomposed by bacteria, which removes dissolved oxygen from the water, directly harming other aquatic organisms. ((Perlman, 2016). Red algae blooms, also known as dinoflagellates, can cause the water to appear red, pink or yellow. These are known as harmful algae blooms and usually accompany massive die offs of fish and birds that consume those fish. They can also be harmful to human beings especially those with respiratory issues like asthma. ((Perlman, 2016)

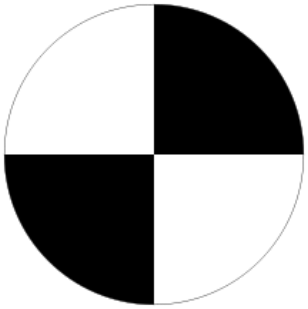
Purpose: In this study you will be plan and conduct a water quality study by examining both colour and turbidity. To do this you will need the following materials.

Materials and Procedure (Myre E & Shaw, R., 2006)
http://www.virginia.edu/blandy/blandy_web/education/Bay/TurbidityTubeConstruction&Use_Myre_Shaw.pdf

- Water from your source
- Putty
- Rubber band
- Permanent marker
- Scissors or exacto knife to cut yoghurt container
- Clear tube (graduated cylinder or fluorescent tube sleeve from local hardware store)
- Tube cap (rubber stopper)
- Viewing disk (yoghurt container cut into circle with permanent marker pattern viewable on it)
- Ruler

Procedure--Students

1. Using a scissors or exacto knife , cut yogourt container into a small circle that can easily fit the diameter of your tube. This is known as a secchi viewing disk.
2. Attach your secchi viewing disk to your rubber stopper with putty. Here is a template for a secchi disk.

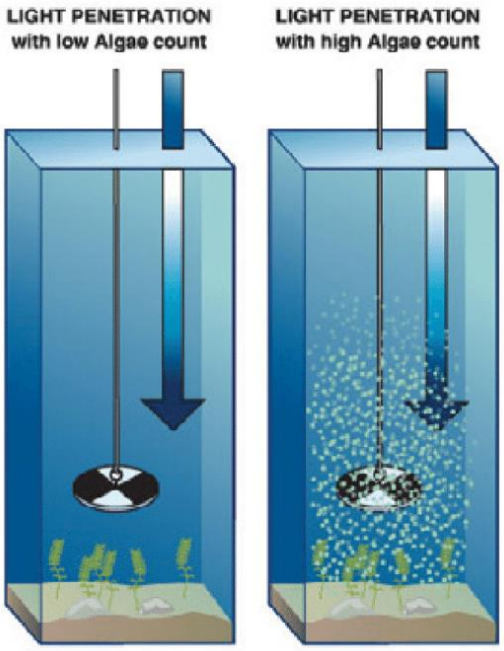


Taken from: https://en.wikipedia.org/wiki/Secchi_disk

3. Using the permanent marker, make markings on the tubes (starting from the bottom) at the lengths provided in Table 1 below.Place markings at 1 cm along the length of the tube. This can be done by using a rubber band to hold the measuring tape in place and make markings on the side of your cylinder at the lengths provided in the chart with a permanent marker.

Centimeters	NTU
6.7	240
7.3	200
8.9	150
11.5	100
17.9	50
20.4	40
25.5	30
33.1	21
35.6	19
38.2	17
40.7	15
43.3	14
45.8	13
48.3	12
50.9	11
53.4	10
85.4	5

4. Place the secchi disk in the tube until it reaches the bottom. You have now completed your turbidity meter.
5. Looking about 10-20 cm above the top, determine the level of water needed for the secchi disk to no longer be visible. To do this, slowly fill your turbidity meter with water until your secchi disk first becomes invisible (you may need to pause several times during this process if your water has air bubbles). Make sure not to take sediment from the bottom and avoid having air bubbles. If there are bubbles, let them settle before continuing fill the turbidity tube.



Taken from "https://www.researchgate.net/figure/The-Secchi-Disk-Us-army-Corps-of-engineers-albuquerque-District_fig2_296089219"

6. Observe and record the colour of the water.

Observations

To measure the quality of water from your water source, complete the table below:

Table 1: Examing the water quality by comparing turbidity, water colour and NTU from the water sample

Water Source	**Depth where turbidity tube where secchi disk disappears**	**Colour of water sample**	**NTU for your sample**

Analysis

1. Why is turbidity bad for the health of the water way that you are studying?
2. Using the chart below, determine if the body of water is healthy or not? Why?
3. Using the internet, research how bodies of water can be improved so that the health of the ecosystem is improved? (i.e. how can you reduce the turbidity of the water)
4. Using the internet, research other ways that water can be examined to determine if ecosystems are healthy or unhealthy?

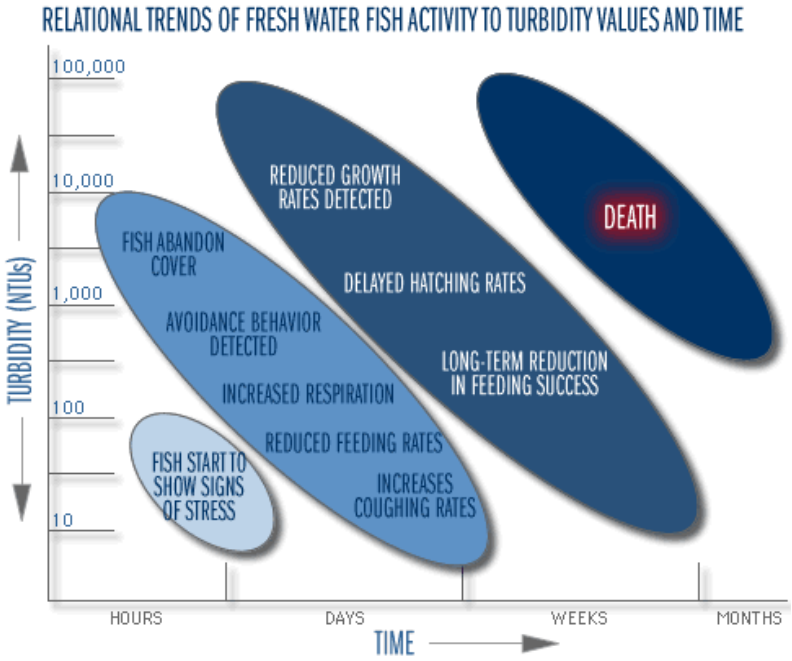
Evaluation: This activity if FOR LEARNING

Conversations—While students are conducting their field work and subsequent research, as a teacher you can go around and ask students the following questions.

1. Why is doing a turbidity study a good way to examine the health of the water?
2. Are there other methods to examine water to determine if the ecosystem is healthy or unhealthy?

(taken from http://www.lakeaccess.org/russ/turbidity.htm)

Student Criteria	Exceeds expectations	Met expectations	Has not met expectations
I (student) understand how the turbidity impacts the health of ecosystems			
I (student) have constructed my own turbidity meter with limited prompts from the teacher			
I (student) am able to analyze the depth that the secchi disk is visible and how this directly correlates to water turbidity			
I (student) have researched different methods that could be used to change water turbidity			
I (student) am able to provide suggestions of other ways that the water can be examined to determine if the ecosystem is healthy or unhealthy			



Extension: Students can also do a Benthos study to determine the health of the water that they are studying.

Here are some organizations that have programs that come to schools to help with aquatic restoration and/or benthic studies are as follows:

Peel (Brampton)

https://trca.ca/get-involved/west-humber-green-streams/

Grand River Conservation Area—Aquatic Ecosystems survey-- Apps' Mill, Guelph Lake, Shade's Mills, Laurel Creek, Rockwood

https://apps.grandriver.ca/NatureCentreApps/NatureCentreBooking/?academiclevel=5

Gray-Sauble Conservation Area--WONDERFUL WETLANDS (WETLAND COMMUNITY STUDY) *only available at the Bruce Power Visitors' Centre

http://www.brucepower.com/wp-content/uploads/2015/09/160421_DEERprogram_2017.pdf

Ausable Bayfield Conservation Authority (Exeter, ON) What's in the Water?

http://www.abca.on.ca/page.php?page=outdoor-education

Mississippi Valley Conservation (Ottawa)

http://mvc.on.ca/watershed-watch-monitoring/

St. Clair Conservation Authority (Strathroy, ON)--Stream Assessment Study

https://www.scrca.on.ca/conservation-education/just-for-high-schools/

Hamilton Conservation Authority (Hamilton, ON) Stream Ecology

http://conservationhamilton.ca/wp-content/uploads/sites/5/2015/03/HCA-Secondary-Program-Guide-002.pdf

Kawartha Conservation --Watershed Stewardship Program

https://www.kawarthaconservation.com/images/Kawartha_Conservation_Environmental_Education_Programs.pdf#page=11

Lower Thames Conservation Area Longwoods Road Conservation Area / Ska-Nah-Doht Village & Museum (Near London, ON)

https://www.lowerthames-conservation.on.ca/wp-content/uploads/2017/08/Conservation-Education-Secondary-School-Flyer-2017-2018.pdf

Credit Valley Conservation (Caledon, Brampton, Mississauga) Bring back the brook trout

https://cvc.ca/wp-content/uploads/2016/10/climate-change-teachers-guide-2016.pdf

Lakehead Region Conservation Autho rity (Thunder Bay, ON)—Watershed study

https://lakeheadca.com/application/files/5314/9073/2054/Watershed_Connesctions.pdf

Cataraqui Region Conservation Authority—Wetland Conservation

https://crca.ca/education/secondary/#1501699603695-f96b6a61-b52e

Lake Simcoe Region Conservation Authority(Bradford, ON)--Water quality indicators

https://www.lsrca.on.ca/Pages/Full%20Program%20List.aspx#water

References

Myre E & Shaw, R. (2006) Turbidity Tube: Simple and Accurate Measurement of Turbidity in the Field Dept. of Civil Engineering, Master's International Program Michigan Technological University http://www.virginia.edu/blandy/blandy_web/education/Bay/TurbidityTubeConstruction&Use_Myre_Shaw.pdf

Perlman, H. (2016) "Water Color" U.S. Department of the Interior | U.S. Geological Survey Retrieved from http://water.usgs.gov/edu/color.html