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Water Quality and Human Impacts

Background

Why is water quality important?

The US EPA has set water quality standards in accordance with the Clean Water Act.

> Water quality standards are important because they help to protect and restore the quality of the Nation's surface waters, consistent with the requirements of the Clean Water Act. Standards help to identify water quality problems caused by, for example, improperly treated wastewater discharges, runoff or discharges from active or abandoned mining sites, sediment, fertilizers, and chemicals from agricultural areas, and erosion of stream banks caused by improper grazing practices.
> http://water.epa.gov/scitech/swguidance/standards/imp.cfm

The impacts of nitrates and phosphates on water have been gaining increased press. But, from the list above, one can see that these are not the only impacts that need attention.

1. Have students use the following resources to read about the impacts of impervious surfaces on water quality.
www.prep.unh.edu/resources/pdf/theimpactsof-nhep-04.pdf
ga.water.usgs.gov/edu/impervious.html

Students should ideally have some field experience. This could take the form of collecting macroinvertebrates to complete a stream quality index, a visit to local freshwater ecosystems, or chemical testing of water to determine the amounts of ammonia, nitrites, nitrates, phosphates and dissolved oxygen. A classroom project that helps is to have students start **model freshwater ecosystems** in aquariums. Students use water collected from established ecosystems, add plants and invertebrates (snails, crayfish, etc) to see if they can observe the nitrogen, phosphorus (through chemical tests) and water cycles in their systems.

2. Once students have visited areas that they can compare, use topographic maps and/or Google Earth to survey the watershed areas upstream from the places observed. This lesson includes a six square mile area. I have provided an example comparing the Olentangy River to the Darby Creek. We visited the Wilma Schiermeier Olentangy River Wetland Research Park on the Olentangy River and monitored stream quality by kick-seining just south of the low-head dam along the Olentangy bike path. We visited the Battelle Darby Creek Metro Park at the confluence of the Little Darby and Big Darby, just south of the streamside study area. (See **GoogleEarth SQM Data** handout)

Nitrates create bigger problems in marine ecosystems, while phosphorus is the limiting factor in freshwater ecosystems. Algae can grow rapidly in the presence of phosphorus that runs off fields and gets deposited in lakes creating problems for human health, thus affecting recreation, tourism and jobs.

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3. View this webinar for background info or show to kids:
http://ohiowatersheds.osu.edu/education/best-practices/algae-blooms-and-land-use-practices
Some key points:
-Harmful algae blooms (HAB's) are created by the growth of cyanobacteria due to increased nutrients and warm water temperatures (warm temperatures is not sufficient to promote HAB
-Cyanobacteria can fix nitrogen and move up and down in the water column and some produce harmful toxins
-Nitrogen : phosphorus ratios greater than 20:1 promote filamentous and **good** planktonic algae; ratios of 10:1 or less promote development of HAB's
-External loading seems to be the culprit; however, the sediment (black mud) on the water bottom can be an additional factor
-Water stratification can create a layer of depleted oxygen on top of the phosphorus-rich bottom, releasing phosphorus; even ones that do not stratify can release phosphorus
-Lake retention time is long—can encourage HAB's; low retention time less prone to HAB's
-Wet springs followed by dry summers increase probability of HAB's
-Alum can be used to remove the phosphorus from the water column

Phosphorus can take two forms: dissolved phosphorus and particulate phosphorus. Dissolved phosphorus is much more "bioavailable" to algae than the particulate phosphorus.

4. Read these two documents to determine the differences between dissolved phosphorus and particulate phosphorus.
Dissolved Phosphorus from Cropland Runoff: Why is it such a Big Problem?
A Comparison of Particulate and Dissolved Phosphorus
http://www.heidelberg.edu/academiclife/distinctive/ncwqr/p

Here is a question based on the tables included in the above handouts:
Total phosphorus is 95% of dissolved P is available to algae while only 30% of particulate P which is attached to eroded sediments is available to algae. If there are 1864 metric tons of particulate P and 644 metric tons of dissolved P added to Lake Erie in a year from the Maumee River, what is the amount of each available to algae?
612 of P from diss P
559 metric tons from part P

5. Have students design and test a water quality aspect using the **water quality testing protoco**l. This might take the form of testing for nitrates and phosphates, or the effect of impervious surfaces, manure use or any other factor they can think of.