Choices Make a Difference

Chicago River Classroom Activity

Summary

This lesson can be used as a pre-lesson before a Friends of the Chicago River classroom program. The lesson comes from *WET in the City*, a K-12 Curriculum and Activity Guide by the Council for Environmental Education (pp.217-225). Added here are IL state standards, an introduction and some optional extensions.

For a copy of the *WET in the City* lesson write-up to be sent to you, please email friends@chicagoriver.org and provide your name and mailing address. The entire *WET in the City* guide is available by attending WET trainings. For more information, go to: http://www.wetcity.org/

Background

Dealing with sewage and stormwater has always been a challenge. How that challenge has been met, greatly affects the quality of local rivers and lakes.

In the Chicago area, Chicago and close-in suburbs have combined sewers. Outer suburbs have separated sewers.

Combined Sewers

The wastewater treatment plants in the greater Chicago area are some of the largest in the world, with a capacity to treat two billion gallons a day. Even so, the wastewater treatment plants can get overwhelmed during a heavy rainstorm when five billion gallons can rush into the combined sewer pipes. As a result, raw sewage, mixed with stormwater, dumps directly into the Chicago River – a combined sewer overflow.

To remedy the situation, the Metropolitan and Water Reclamation District of Greater Chicago, developed the Tunnel and Reservoir Project (TARP). As the name suggests, TARP is a series of huge tunnels and reservoirs underground.

Grade Level: 5^{th} – 6^{th}

Duration: One to three class periods, depending if any of the extensions are included.

Objectives:

1. Students will understand that wastewater treatment plants discharge into local rivers.
2. Students will know that wastewater treatment plants do not remove all pollutants.
3. Students will be able to list an alternative cleaning product.

Materials:

See your copy of the *WET in the City* lesson plan and within each of the optional extensions

Standards:

11.A.2b, 11.A.2e, 13.B.2f, 15.B.2a, 17.C.2c

NGSS:

3-5-ETS1-3, SL.4.5, 5-ESS3-1

In heavy rains much of the huge quantity of combined sewage and stormwater is shunted to the tunnels and reservoir for storage until the storm passes and the wastewater treatment plant can handle the excess. This has made a huge difference to the water quality of the Chicago River. Since the first sections of TARP came online in 1985, thirty species of fish have returned to the river. Raw sewage still reaches our river, (when even the tunnels and reservoirs are overwhelmed) but it is much less often than without TARP. TARP still has several reservoirs needing building and completion, with their completion the river should see even further improvements.

Separated Sewers

In newer suburbs and cities, like the northern suburbs of Chicago, two sets of pipes were built – one for sewage and one for stormwater. Separating sewage and stormwater prevents raw sewage from ever reaching the river. However, as rainwater washes over the streets it picks up salt, oil, pesticides, and dirt and this stormwater is not treated before entering the river. In the best cases the stormwater flows into a detention basin first. Here some of the water seeps into the ground, the larger debris settles out, and some of the pollution is absorbed by the soil or plants.

Wastewater Treatment

Chicago area wastewater treatment plants use primary and secondary treatment to treat their incoming sewage and stormwater.

Primary Treatment

1. Screens remove debris that can clog machinery.
2. Wastewater flows into chambers where heavy solids such as sand and grit sink to the bottom. These solids are washed before being deposited in landfills.
3. The wastewater then goes to a settling tank where a large percentage of the organic solids settle to the bottom, while fats and oils rise to the top. Revolving "arms" simultaneously scrape the solids from the bottom and skim the grease from the top.

Secondary Treatment

1. The wastewater then flows through a series of aeration tanks full of microbes. Air is pumped through the tank to help the microbes breathe and grow, eating up much of the remaining organic material and nutrients in the wastewater.
2. The wastewater (now full of well fed microbes) flows into a second settling tank. The microbes clump together and settle to the bottom of the tank and are removed. (About 85% of the microbes are recycled and reused.) The cleaned water then flows out the top of the settling tank and flows into the river. (www.mwrd.org)

In the area covered by the Metropolitan Water Reclamation District of Greater Chicago, the wastewater is not disinfected before being released into the Chicago River. Consequently, disease causing bacteria and viruses reach the river. Outside the MWRDGC area, the water is disinfected to kill bacteria and viruses.

In all wastewater treatment plants pollutants that dissolve in water are not removed. Examples include chlorine bleach, household toxic cleaners, paint thinners, and medication.

Procedure

- Before beginning the *Choices Make a Difference* lesson, ask students where the water that goes down the drain ends up.
- Trace with students the path that water takes. Emphasize that our wastewater is eventually discharged into the Chicago River.
- Let students know that wastewater treatment plants are regulated as to the quality of water they may discharge into our rivers and canals. Wastewater treatment plants clean many pollutants out of the wastewater, but they cannot clean all pollutants out of the water. Chemicals that are dissolved in the water can pass through the wastewater treatment plant. Examples of chemicals that would not be removed are chlorine bleach, other household cleaners, paint thinners.
- Follow the instructions to the *Choices Make a Difference* lesson.

Extensions

1. Non-Toxic Cleaning Products Campaign

Have students develop a campaign to convince parents, the school, or the community to use alternative cleaning products.

2. Build Your Own Sewage Treatment Facility

Materials

- Materials to build a mock sewage treatment facility such as: straws, cups (which can be cut or hole punched), coffee filters, craft sticks, tape, glue, scissors, modeling clay, cotton balls, mesh
- Clear glasses or bottles (about 10)
- River model: This can be as simple or creative as you would like. At its simplest it is a bucket filled with tap water. A more elaborate version is a bucket whose outside is decorated with reeds, trees, flowers and river animals.
- Buckets or used plastic bottles (1 for each group of students) to be filled with mock sewage water
- Mock sewage water (water containing a variety of dissolved and particulate pollutants, such as food coloring, pieces of paper, sticks, sand, vegetable oil, soap, etc), at least 2 gallons

Before Class

- Mix up some "sewage water": add such things as food coloring, pieces of paper, sticks, sand, vegetable oil, soap, etc. to tap water. Make at least 2 gallons. (Items added should either be visible or students should have a test to identify them (ex. pH paper). This will enable students to assess whether they removed the pollutant or not.)
- Make the river model.

Procedure

- Tell the students that they are responsible for cleaning up the sewage water before it enters the river. Show them the model of the clean river that their treated sewage water will be dumped into.
- Divide the class into groups and give them a wide variety of wastewater treatment building materials and a bucket of mock sewage water.
- Advise students that they may want to try out several ideas, before committing to one idea. They also might want to link up several ideas into a series of treatments.
- When students have finished their design, have the students run one cup of mock sewage water through their model and then collect the treated water in their clear cup.
- Collect all the students treated wastewater.
- Compare the different student groups' cups to each other and to a glass of tap water and a glass of the original sewage water.
- Then dump all the students treated sewage water into the river and compare that water to tap water and the original sewage water.
- Have the students answer the following questions:
  - Did their sewage treatment facilities clean-up the water?
  - Did the addition of their treated wastewater impact the river?
  - What do they think the consequence would be for the plants, animals and people depending on the river?
- At the end you can present how water treatment plants in Chicago treat their sewage and compare how we currently treat our sewage to the different ideas the students came up with. (Note that one step used in the secondary treatment plants of the Chicago area involves microbes, which the students don't have access to.)

3. Down the Drain: Make a Mural of Water and Wastewater Systems in Your City or Town

This lesson is from Ecological Citizenship – Precious Water by the Chicago Academy of Sciences, Peggy Notebaert Nature Museum.

NOTE: The lesson explains the water system in Chicago. The situation is fairly similar in other Chicago River watershed cities and towns. Everyone in the watershed gets their water from Lake Michigan. In northern Cook County and Lake County there are separate stormwater and sewer pipes underground. The stormwater pipes are directed directly into a river or canal, while the sewer pipes are directed to a sewage treatment plant. For details, call your local water utility.

As an add on to the lesson, you can talk about the Tunnel and Reservoir Project (TARP) and have your students add the deep tunnels and reservoirs to their mural. See background section at beginning of lesson for more information on TARP.

Introduction/Background for Activity

In this lesson, the students will investigate their own city water works system. Where does our water come from? How does it become safe enough for our use? Where does it go once we've used it? Most of Chicago's water comes from Lake Michigan and is filtered by one of two water filtration plants located near the lake. Here, the lake water is chemically treated and travels through a series of filters. The purified water travel through tunnels and eventually to our faucets. After the water is used it becomes wastewater (used or dirty water). The water then travels down our drains, combines with stormwater running off our streets, and travels into the city sewer system. The water is reclaimed (cleaned) by the Metropolitan Water Reclamation District of Greater Chicago. After treatment the water can be discharged to a nearby waterway (in our case the North Shore Channel, the Chicago Sanitary and Ship Canal, and the Cal Sag Channel).

The students will create a water works mural. The mural will show the connecting water lines from the lake to the filtration plant to the students' homes to the wastewater treatment plant and back into a river.

Lesson Objectives

The students will:

- Predict where the water in their homes comes from
- Infer where the water goes when it leaves their home
- Create a mural displaying the Chicago water works system

Recommended Time Allotment for Activity

45-60 minutes

Materials

- Large piece (approx. 6 feet) of butcher paper
- Drawing paper
- Crayons
- Tape

Tap Prior Knowledge

Divide the students into pairs. Instruct each pair to think of two possible water sources for Chicago. How do they think the water gets from the source to their homes? How does the city clean the water? Take suggestions from several of the pairs.

Share with Your Neighbor

Explain to the students that most of Chicago's water comes from Lake Michigan. There are water intake cribs located out in Lake Michigan. Find out if anyone has ever seen these from the shore. Does anyone know why they are so far off shore? The cribs are located 2 miles off the shore and away from the Chicago River where contaminated (from the city's sewage) water used to enter Lake Michigan. The water flows through tunnels to purification plants. There are two plants in Chicago, the Jardine Filtration Plant by Navy Pier and the South Water Purification Plant on the lake shore by 79th. At the purification plants chemicals are added (chlorine for sterilization, alum and polymer to settle out impurities, fluoride to prevent dental cavities) and the water flows through sand and gravel filters. Three large tunnel systems take the water to 12 pumping stations throughout the city. Pumps move the water to distribution mains that then bring the water to our faucets.

Hands on Activity

Pass out drawing paper and crayons and have students create a floorplan or cross-section of their houses or apartment buildings showing the location of all the faucets and drains. Don't forget outside faucets too. Have the students tape their pictures on the butcher paper to create an imaginary city street. Instruct students to draw in the pipes connecting their faucets to the main water line (under the street). Connect the main water line to a pumping station, then to the water filtration plant and out to the water crib in Lake Michigan.

Introduce Scientific Principal

Once the students have finished the water purification part of their mural, ask if anyone knows where the wastewater (used and dirty water) goes? Explain that wastewater (from toilets, sinks, storm drains in our streets) travels into the city sewer system and to one of the seven Metropolitan Water Reclamation plants. The water is reclaimed (cleaned) and then discharged into a nearby waterway – the North Shore Channel, Chicago Sanitary and Ship Canal and the Cal Sag Channel. With this new information in mind, have the students complete the mural by adding a city sewer line, storm water drains, a water reclamation plant and a waterway for discharge.

Courtesy of The Chicago Academy of Sciences, Peggy Notebaert Nature Museum