

CSO: Oh NO!

Chicago River Classroom Activity

Summary

Students will understand the way that the sewer systems work in the Chicago River watershed and how these systems can contribute to pollution in the river.

Background

Dealing with sewage and stormwater (water flowing off of streets, roofs and parking lots) 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. 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 reservoir are overwhelmed) but it is much less often than without TARP. TARP is not complete, several reservoirs need to be built and completed. With their completion the river should see even further improvements.

Grade Level: 4th – 12th

Duration: 30-40 minutes

Objectives:

1. Students will understand how a combined sewer system works, how combined sewer overflows occur, and how pollutants can enter water bodies from sewer effluent.

Materials:

- ◆ Name tags for each part of sewer system (attached, 1 copy of each)
- ◆ Yarn (for nametags)
- ◆ Three large bottles of water
- ◆ Mini cups (9)
- ◆ Bucket (1)
- ◆ Coffee mug (1)
- ◆ Chocolate chips (about a cup)
- ◆ Food coloring (multiple colors)
- ◆ Candy wrappers

Standards:

3rd-5th: 13.B.3d, 13.B.2e, 13.B.2f, 17.C.2c

6th-8th: 13.B.3d, 13.B.3f

9th- 12th: 13.B.4c, 13.B.4d, 17.C.5b

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 the soil or plants absorb some of the pollution.

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.mwrldgc.dst.il.us)

In the area covered by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), 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.

Area wastewater treatment plants are not designed to remove pollutants that dissolve in water. So pollutants like chlorine bleach, household toxic cleaners, paint thinners, and medication are not removed before the cleaned wastewater is discharged into the river.

Preventing Stormwater Pollution

Some of the following actions will help prevent pollutants from reaching the river via treatment plants, storm drains or run-off:

- 1) Be careful about what you pour down the drains in your home –substances that dissolve in the water cannot be taken out at a treatment facility. If there is a CSO anything that went down the drain will end up in the river.
- 2) Never pour anything down storm drains.
- 3) Use fertilizers, herbicides and pesticides in the yard sparingly and definitely don't use them before it is expected to rain.
- 4) Dispose of household hazardous waste properly, being sure to never pour them down the drain.

Illinois holds household hazardous waste collection days in the spring and fall. To find collection dates and places in your area, consult the The Illinois Environmental Protection agency website at www.epa.state.il.us/. For year round collection contact Rockford Rock River Reclamation.

Preventing CSOs

To prevent CSOs there has to be less water entering the sewer system during storms. The completion of TARP will definitely make a large difference in the occurrence of CSOs. Citizens can also help by doing the following:

1. Use native plants in your garden (they have deeper roots to soak up more water).
2. Create rain gardens in low areas of the yard.
3. Use rain barrels to catch water coming from gutters.
4. Avoid using water during a storm. Try to refrain from taking a shower, washing clothes or dishes during a big rain. The less water going into the sewer system the less chance for an overflow.

Procedure

Before class

- ◆ Prepare the sewer system nametags. Copy one of each of the attached. Color them if you would like as it makes them stand out better. Laminate each if possible.
- ◆ Punch two holes in the top of each nametag and run a piece of yarn through it so that students can wear them around their necks.

Setting up the demonstration during class

- ◆ Explain to the students that they are modeling a combined sewer system, which is the type of system that the Chicago area has south of Dempster.
- ◆ Line up the students in the following order:
house, grocery store, restaurant, sewer pipe, storm sewer, sewer pipe, sewer pipe, sewer pipe, storm sewer, sewage treatment plant, deep tunnel, Chicago River
- ◆ The teacher should wear the “sewer water” tag. The two “rain” people will stand apart from the line.
- ◆ The teacher should take one bottle of water and the rain people take the other two.

Demonstration: I flush the toilet-where does it go?

- ◆ The “sewer water” person (teacher) should put some water in the cup of the “house” person along with some chocolate chips and explain that a person in the house goes to the bathroom and flushes the toilet. Explain that when the person flushes the toilet the water goes to the sewer pipe.
- ◆ Have the “house” pour the water and chocolate chips into the first “sewer pipe’s” cup. Explain that the sewer pipes stretch for great lengths underground so the model is using three people to represent the pipe.
- ◆ Have the students pour the water down the sewer pipes.
- ◆ Ask the students where the water would go next. (*the sewage treatment plant*)
- ◆ Have the third “sewer pipe” pour the water into the “water treatment plant’s” cup. Explain that the “water treatment plant” can take anything that floats or sinks out of the water.
- ◆ Have the “sewage treatment plant” take out the “sewage” (chocolate chips) and place it into the “treatment plant’s” other paper cup.
- ◆ Ask the students where the cleaned effluent goes next. (*Into the Chicago River*)
- ◆ Have the “sewage treatment plant” pour the water (minus chocolate chips) into the “Chicago River’s” bucket.

Demonstration: Just pour it down the toilet...

- ◆ Explain that the restaurant owner has the kitchen staff clean all of the ovens one evening after closing. After cleaning, the staff decides to pour the leftover oven cleaner down the toilet.
- ◆ Pour some water and then blue food coloring into the “restaurant’s” cup.
- ◆ Have the “restaurant” pour the water into the sewer pipes.
- ◆ When the water reaches the treatment plant, ask the students if the plant can remove the oven cleaner. (*No, because it has dissolved in the water.*)
- ◆ Have the “treatment plant” pour the water into the “Chicago River’s” bucket, explaining that the effluent cannot be cleaned anymore than that.
- ◆ Explain that the sewage treatment plant can only take out pollutants that sink or float as well as some nutrients. So anything that goes down the sinks or toilets that dissolves in water ends up in the river.

Demonstration: Storm Drains Drain Lead Where?

- ◆ Explain to the students that in the combined sewer system storm drains lead to the same sewer pipes as receive our household waste and together they both go to the wastewater treatment plants.
- ◆ Explain to the students that someone decides to work on their car engine and drains the antifreeze out into a bucket. The person then decides to dispose of the antifreeze by pouring it down the storm drain in the street.
- ◆ Pour some water into one of the “storm sewer’s” cups and add some yellow food coloring.
- ◆ Have the “storm sewer” pour the water into the sewer pipes and finally to the “treatment plant”
- ◆ Ask the students if the treatment plant can remove the antifreeze. (*No, it dissolves in water*)

- ◆ Have the “treatment plant” pour the water into the “Chicago River’s” bucket.

Demonstration: Let it Rain!

- ◆ Explain to the students that the sewer system works this way when everything is running smoothly. Ask them what they think might happen when it rains? (*A lot my water is going to get into the system via the storm sewers and the treatment plant is going to have a lot more work to do.*)
- ◆ Start the process by beginning to pour water and chocolate chips into the cups of the “house” “grocery store” and “restaurant” adding food coloring to come of it.
- ◆ Explain that people are using sinks and toilets and have the water go through the pipes to the “treatment plant” and once cleaned to the “Chicago River.”
- ◆ Keep it going at a pace in which the treatment plant can keep up with removing the sewage.
- ◆ Next, have the “rain” people begin pouring water into the “storm drains” who will spill it into the sewer pipes and to the treatment plant. While this is happening, keep the toilets flushing.
- ◆ Tell the students that they have to pour to the next person’s cup as fast as they can. They can’t wait until the “treatment plant” is ready for them.
- ◆ Soon the students will see that there is a back-up at the treatment plant as the sewage cannot be removed fast enough. The flow of waste cannot stop, so the water has to go somewhere.
- ◆ Explain that the Tunnel and Reservoir Project (TARP) is a system of underground massive tunnels and reservoirs that can hold this water from the combined sewers until the rain slows, and there is less water entering the system.
- ◆ Have the last “sewer pipe” begin to pour the water into “Deep Tunnel’s” cup.
- ◆ Soon the students will see that Deep Tunnel is getting full so the water has to be released to the Chicago River. Have “Deep Tunnel” pour the water into the “Chicago River’s” bucket.
- ◆ Ask the students to name the pollutants that are now in the river. (*Raw sewage, anything going down the toilet, sink and storm sewer. Be sure that they realize that this includes “floatables” such as toilet paper and trash because the water was never cleaned.*)
- ◆ Explain that when untreated water is released into the Chicago River, the process is called a combined sewer overflow (CSO). This is a big problem on the Chicago River and when it rains there are often CSO’s. The development of Deep Tunnel helped reduce CSOs greatly, but sometimes even Deep Tunnel is overwhelmed.

Demonstration: Separated Sewers and Pollution

- ◆ Tell students that they will now be modeling a separated sewer system. Remind students that in a separated sewer system, sewage from homes and businesses flows in a sewer pipe to a sewage treatment facility while storm drains flow in different stormwater pipes and empty into the river with no treatment.
- ◆ Tell the students that someone decides to change their oil. They decide to pour the excess down the storm drain in the street.
- ◆ Pour some yellow food coloring and water into one of the “storm sewer’s” cup and have them pour the it’s contents directly into the “Chicago River”

- ◆ Tell the students that some kids are eating candy and they throw the wrappers on the ground. It rains soon after.
- ◆ Pour some water into one of the “storm sewer’s” cup along with some candy wrappers and have them pour the contents directly into the “Chicago River.”
- ◆ Explain to the students that systems that are not combined, where the sanitary and storm sewers are separate there are no CSOs. However, in these systems, the storm sewers go directly to the river, so any water going down there doesn’t get cleaned at all (with the exception of a grate that traps some of the big trash). This means that ANYTHING going down a storm drain ends up in the river, which is the case in the watershed North of Dempster.

Discussion

Discuss with the students:

- 1) What can people do that could help prevent a CSO?
During a storm try not to use water in your home. Wash dishes, clothes and yourself AFTER the rain subsides. The less water in the system, the less likely that the sewage treatment plant will become overwhelmed.
- 2) How can people help lessen the pollutants that get into the river from everyday activities even if a CSO doesn’t occur?
Be very careful about what you throw down the drain. Dispose of any household chemicals at a hazardous waste drop-off site instead of pouring them down the sink or toilet. Never throw anything down a storm drain.
- 3) People north of Dempster do not have a combined sewer system. Why must they still be careful about what goes down the drain and storm sewers?
Sewage treatment plants can only take out anything that sinks or floats. Most substances that dissolve in water cannot be removed so they end up in the river anyway. In a non-combined sewer system, storm drains spill out directly into the river without ever being clean so everything spilled in ends up in the river.

House



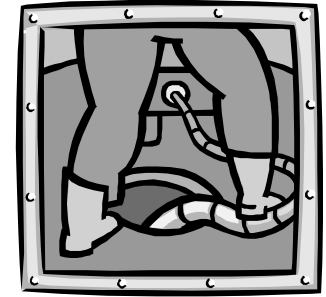
Grocery Store



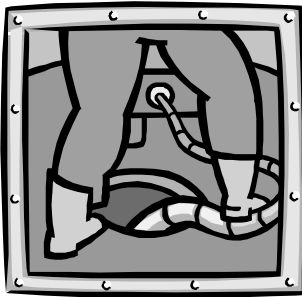
Restaurant



Storm Sewer



Storm Sewer



Sewer Pipe



Sewer Pipe



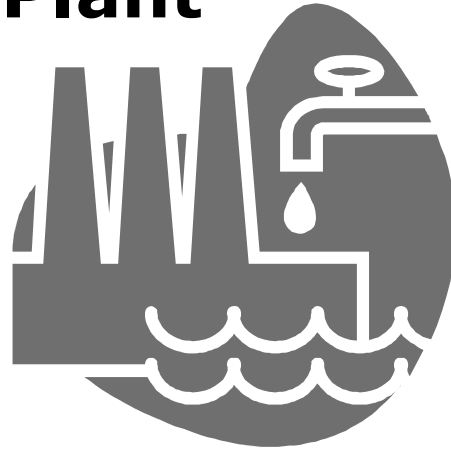
Sewer Pipe



Sewer Water



Water Treatment Plant



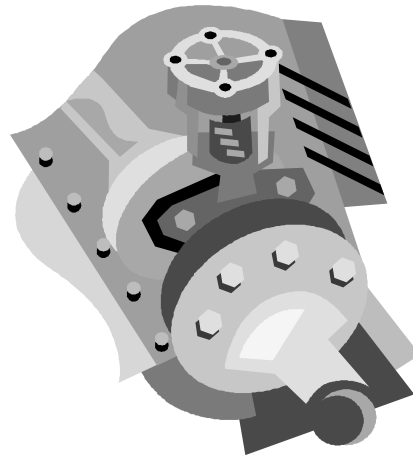
Rain



Rain



Deep Tunnel



Chicago River

