

What Dirties the Water? (And How Can We Clean It Up?)

Setting the Scene: The water may look clean, but...

Imagine a stream running through your neighborhood. If you're thirsty, should you lower your head and take a drink?

Of course not. It's never completely safe to drink water in nature. How did the water get dirty?

As soon as raindrops splash onto the ground, the water starts to clean everything it touches, including the trees, the earth, and our rooftops. As it cleans them, the water gets dirtier, just like a bucket of mop water fills with dirt from the floor. As the water flows from land toward the sea, it keeps on cleaning and picking up types of contamination.

Defining our Terms

Contamination: Any substance found in water that is not pure H₂O.

Pollution: Any contaminant that exists in water at harmful levels.

The basic science: Wastewater

Water in our community can contain a lot of different substances. Some of them are natural kinds of contamination, such as sewage and household waste, including shampoo, dishwashing soap, and drain water from bathing. That wastewater may be effectively cleaned in a wastewater treatment plant.

Other substances, such as oil, solvents, metals, and acids from factories and pesticides and herbicides from farms and gardens cannot be treated in a wastewater treatment plant, but most of them can be removed by specific equipment designed just for that purpose. Factories and plants that contaminate the water with these substances are required to treat the water before sending it to the wastewater treatment plant. These industries may contaminate the water, but they do not necessarily pollute it.

Only a small portion of the water in our community goes to a water treatment plant. The rest of it washes through the community as stormwater runoff. This runoff may include natural substances, such as animal droppings and dead leaves. It may also include chemicals, such as petroleum products, acids, fertilizers, or solvents, perhaps from accidents, such as spills, and sometimes, sadly, from illegal dumping on the part of criminals. There may also be metals, such as mercury and aluminum, that find their way to the water from landfills, road debris, and other sources of trash.

Until a century or two ago, wastewater in cities was collected and then transported – first by carts and tankers, and later by sewers – far enough from the population that it could be discharged without harming the public's health.

Then came the Industrial Age. Factories used chemicals, and they produced other chemicals as part of their waste. In the early days of the Industrial Age, no one really knew that these chemicals would pollute water. Once they realized the dangers, cleaning up the mess and finding ways to prevent it in the future took a lot of time and cost a lot of money. In fact, we are still learning.

Today, we as a society have several jobs to do to protect our water. First, we must take care to ensure that all the water that goes down our drain at home can be treated at the wastewater treatment plant. That includes human waste, food waste, and cleaning waste ... and no paints or chemicals! Second, we must take great care to dispose of all other waste materials properly. Used oil, for example, must go to an oil recycler rather than being dumped on the ground where it would make its way to the water. Third, we must obey all environmental laws regarding chemical dumping and water protection. Last, we must protect our health by realizing that any water in nature is probably contaminated, and we cannot drink it ... even if it is not polluted.

In your community

Most of the wastewater in our community is treated at a wastewater treatment plant or flushed into septic tanks. Our wastewater treatment process mimics the processes that nature uses to clean wastewater.

First, water is “screened” to remove the large objects, and then it flows into a settling tank where a coagulant is added to the water. The coagulant causes the remaining solid materials into the water to clump together. The clumps that result are called “floc,” and the whole process is called “flocculation.” The clumps that float are skimmed off the surface, and the clumps that sink are removed after the water is drained off. This process is called “primary treatment.”

The next step is called “secondary treatment,” and it includes using bacteria to break down the organic material even more. In some community, the water is then filtered before it is returned to the environment.

Making wastewater

You can model water contamination by using a variety of substances and then experiment with ways to clean up the mess. For this project, you will need:

Materials

- A clear plastic container about the size of a dishwashing basin (plastic storage containers work fine) about 2/3 full of tap water.
- Small quantities of contaminants, both human-made and natural. (Of course, you will use harmless, non-toxic substitutes in place of potentially dangerous substances.) You can be creative as you experiment with substances to use, but here are a few suggestions:
 - Soil
 - Sand
 - Ground up dried leaves
 - Fertilizer: cat litter or lime would be a fine substitute)
 - Waste from roads, parking lots, and highways: some floor sweepings and a few drops of household lubricating oil will do the trick
 - Waste from homes: a little shampoo, some dish or laundry detergent, vegetable oil, little pieces of toilet paper, and some mud or clay to represent human waste
 - Industrial waste: rubbing alcohol, some cola (which is dark colored and quite acidic), a little more household oil, and a little cocoa powder to represent metallic wastes

Add these materials to your water, give the brew a stir, and observe and describe your wastewater.

Suggested projects

You won't be able to get this wastewater back to its original state, but you can get it a lot cleaner than it is. Keep a careful record of the different strategies you use and how effective they are. (Also, make note of which materials should go down the drain and which should go in the garbage when you are finished.)

1. Allow the contaminated wastewater to settle in the basin. How much of it floats and how much of it settles? You can skim the floating material from the top and carefully pour out the settled water. You can also drill or poke a hole in the side of the basin midway between the top and bottom and insert a short piece of vinyl tubing (from a hobby shop). You can seal the tubing with silicone sealant or hot glue, and pinch it shut with a paper clamp. With that addition, you can draw the water from the center without disturbing the material on the surface or on the bottom.

Which contaminants does this strategy remove and which remain? Which contaminants appear to be the hardest to remove?

2. Build a filter and try different filtration media clean your water further. You can build a simple filter by cutting the bottom off of a 2-liter plastic soda bottle. Cover the neck with fine fabric and fill the neck with loose cotton or cheese cloth. Put in clean filtering media, starting with the finest media closest to the neck and the coarsest closest to the opening of the

bottle. You may want to try materials like washed sand, washed activated charcoal (from an aquarium or pet store), and washed aquarium gravel.

Filter your contaminated water and record your findings. Does activated charcoal affect the smell? Does the coarseness/fineness of the media material make a difference? Vary the experiment by changing the location and quantity of the filtration media. Observe and record any differences you might in performance.

3. Research local water quality regulations regarding the release of pesticides, herbicides, and chemicals into the environment. What regulations apply to farmers, or particular businesses and industries in your area? Who sets those regulations? Who enforces them?
4. Research the effect of chemical like solvents and oils on the performance of a wastewater treatment plant.
5. Learn about wastewater treatment in your community. Make a poster showing the processes. Talk to the people in charge of wastewater treatment. What special challenges do they face?
6. Do the geography, climate, and soil conditions of northeast Florida present particular wastewater challenges? What are they and why are they problematic?
7. How is wastewater managed in rural areas, when buildings are too far apart to be connected by sewer lines to a single treatment plant?
8. What can you, your family, and your classmates and friends do to protect the water of northeast Florida? Create a community awareness program on the importance of protecting our water resources.
9. Create a Use the Internet to learn more about wastewater, non-point-source contamination, and wastewater treatment.

Putting It Together

Display your model and your project. Explain wastewater treatment and pollution prevention, and make recommendations to your class about how everyone can work to help keep the environment clean.