Maps and Models Station

Cooking Up Trouble

Science SOLs Addressed: 6.7, LS.12, ES.9, BIO.9
Time Needed: 20-30 minutes

Summary
Through a "cooking demonstration," students will observe and understand what non-point source pollution is and how pollutants get into surface water. They will also observe and understand how riparian buffers (trees along a stream, creek, and river) can help keep pollution from running off into the water (with a proviso for karst topography!). Lastly, they will also understand that their actions can affect water quality both positively and adversely. This activity is easily adapted for any age group.

Objectives
Students will:
- Understand the difference between point and non-point source pollution.
- Learn that riparian buffers (trees along a creek, stream, or river) can help filter pollutants out of surface water.

Materials
-plastic storage container (shoe box size)
- Large plastic measuring cup (4 cups)
- Whisk or plastic spoon to stir pollution
- Sponge with aquarium plants to represent a riparian buffer (trees) glued in lid of container
- Nontoxic items representing litter (gum wrapper or paper), oil (soil sauce), soil (cocoa mix), manure (cinnamon or cat litter), fertilizer (green cool aid/jello mix), salt (rock salt), pesticides/herbicides (orange cool aid/jello mix), leaky septic tank (yellow cool aid/jello mix mixed with water) and acid rain (blue cool aid/jello mix mixed with water)
- chef hat and apron

Procedure
1. The students will just have identified Grand Caverns and the South Fork of the Shenandoah River on the relief map, so you can simply announce that the next activity would obviously be a cooking demonstration. Tell them the name of this (Rachel Ray) recipe is "Cooking Up Trouble". Appoint your chefs by the letters under their seats, and welcome them to the front of the class. Help them put on the apron and chef hat. Hand the student chef a measuring cup about 2/3

full of clear water, and begin to coach them with some background similar to this: this water represents all of the county's surface water. Before the water leaves the county (in the case of a stream/river), sometimes there are so many pollutants that it is very hard to clean it up. Who could possibly put the pollutants in the water? Do you think it's someone from West VA who comes over at night and puts pollution in our water? Or maybe some factories in Illinois put it there? As much as we would like to think that it is someone else's fault, the truth is, it is probably not someone else. In fact, we all cause pollution. But it is not any one of us in particular. We cannot point a finger at someone and say, "Stop polluting!" because we all cause it. We call this kind of pollution "non-point source" because no one can point a finger at the particular source.

2. There is another question to consider: what pollutants could possibly get into our water? We are going to use these pollutants as the other ingredients in our recipe. As the students name the pollutant, let them put a small amount of the "pollutant" into the measuring cup with the water. Let them come up with the pollutants; they can be prompted if needed.

Litter: Litter can be just about anything, either dropped by accident in the water or left lying on the ground in the watershed. Whenever it rains, anything on the land tends to wash down into the streams and rivers, including litter. The litter placed in the water represents all kinds of litter, from aluminum cans to old mattresses and cars. (Discuss ways to keep litter out of the water—for example, recycle or place trash in a trash can. The students may come up with other ways.)

Oil products: Ask the students if they have ever been to a shopping center and noticed beautiful rainbows on top of puddles after a rainstorm. There is oil in those puddles. Where does the oil go if it keeps on raining? It goes to the stream. The oil placed in the water represents oil, gasoline, and/or brake fluid. (Discuss ways to keep oil products out of the water—for example, keep vehicles maintained regularly to keep them from leaking. The students may come up with other ways.)

Soil: How could soil be a pollutant? Isn't it a natural substance? Here's how soil can be a pollutant—whenever trees and grass are taken off from a field or construction site, a lot of soil washes away—when it gets into the streams, they look like chocolate milk. Can fish survive in water like that? No, because they cannot breath the oxygen in the water with their gills clogged with soil. Why is it also not a good idea for topsoil to wash away into the streams and rivers? We need to keep our soil on the land, not in the water. It takes about 100 years to make an inch of topsoil, but only one big rainstorm to wash it away! Topsoil is so very important; we don't want it in the water. (Discuss ways to keep soil out of the water—for example, plant grass and trees where there is bare soil to keep soil erosion from occurring. On construction sites, they can install erosion {also called silt} fences to keep the soil from washing away. The students may come up with other ways.)

Manure: How can manure runoff into the water? Have you ever been driving by a stream or river and seen a cow or two standing in there? Are cows potty trained? No, of course not! So while they stand in the stream cooling off and drinking water, they go to the bathroom! Manure can also find its way to streams and rivers as part of runoff when it is not properly stored or utilized. (Discuss ways to keep manure out of the water—for example, fence livestock out of the water and provide them with an alternate water source, such as a trough; a manure storage shed is also an option. The students may come up with other ways.)

Fertilizer: Where is fertilizer used? [Answers can be farm, golf course, homeowners.] What happens when too much fertilizer is put on a lawn? [Answer- the extra fertilizer runs off into the stream/river.] (Discuss ways to keep fertilizer out of the water—for example, before applying fertilizer, it is a good idea to have a soil test performed. This will tell exactly how much fertilizer is needed. Also, the fertilizer should not be added right before it rains because it will all wash away. The students may come up with other ways.)

Salt: How could salt get in our rivers? Does someone pour a lot of salt out of a salt shaker? Think about the winter time. When the roads are icy, the state highway department spreads salt on the roads so that it is safer to drive. (Discuss ways to keep salt out of the water—for example, maybe it would be a good idea to not spread salt on a road that is close to a stream. Also, instead of spreading salt on our sidewalks, perhaps someone could shovel instead. The students may come up with other ways.)

Acid Rain: Where does acid rain come from? Think about it this way—when we drive our cars, the exhaust goes up into the atmosphere and contributes to acid rain. And, when we turn on all of our electric appliances, we are asking the power plant for more electricity. Most of our electricity is made by burning coal. It is almost like telling the power plant, "Hey, could you put another shovel of coal in the power plant for me?" We can get the electricity we want, but we also get the coal smoke we don't want because it causes air pollution and acid rain. (Discuss ways to decrease acid rain—for example, instead of driving our cars all the time, we can ride bicycles, walk, and carpool. Also, we can turn the lights and TV off when we leave a room instead of wasting electricity. The students may come up with other ways.)

Pesticides/Herbicides: Pesticides and herbicides are used to get rid of pests—whether they are insects or weeds. Sometimes people add pesticides and herbicides the same time they add fertilizer. And if too much is added, it also runs off into the water. (Discuss ways to keep pesticides and herbicides out of the water—for example, instead of spraying weeds with an herbicide, we can pull them out by hand. Or we could learn to live with dandelions. For insects, instead of spraying pesticides to get rid of them, we could plant certain types of flowers that they don't like [pennyroyal plants repel ants—that is just one example]. Also, we could put up bat houses in the surrounding area—they love to eat flying insects!)

Leaky Septic Tanks: Septic tanks are used to treat human wastewater in areas where public sewer is not available (rural areas). Most rural homeowners who have a well also have a septic tank. Wastewater from a house enters a septic tank where it is broken down by bacteria and distributed into the soil for filtration. But what happens when this process fails? When septic systems are not maintained, this wastewater can contaminate groundwater (potentially our drinking water). So what can be done? It is important to maintain your septic system in working order. Properly maintained septic systems should be pumped every 3 to 5 years to help prevent problems. Problems or failures with the system should be fixed immediately.

3. Stir the pollutants in the water and show the students how it has been polluted. The interesting point is that these pollution ingredients can be found and measured in the county's streams and rivers, and we need to find ways to clean them up. Wouldn't it be great if we could keep these pollutants from running off into the streams in the first place? Ask the students to think of different ways we could catch the pollutants before they got to the stream.

4. Nature already has a really good system that can take care of most of these pollutants if we would just let it! The system has trees and shrubs growing along the streams. They act like a filter or a buffer. We call them riparian (from *riparius*, Latin, which means adjacent to, or living on the bank of a river) buffers.

5. Take out the box lid with the sponge and tell the students that the sponge and vegetation represent a riparian buffer. The sponge represents the roots of the trees and other vegetation. The box lid is the watershed. Their school and homes would be on the box lid above the buffer.

6. Pour about ¼ cup down the box lid and let it pool behind the sponge. When the water finally begins to trickle though the sponge, begin to ask the students what might have happened to those ingredients in a real buffer. The soil,

fertilizer, and manure would be absorbed and used by the trees. The oil products and pesticides may be sequestered in the trees or broken down by soil bacteria. The litter can be picked up by students on Earth Day. And the clean water is gradually released into the healthy, cool stream, even in a drought.

7. Wetlands work the same way. Place a carpet "wetland" at the edge of the buffer on the boxtop watershed. Encourage the students to notice buffers at Grand Caverns, and on their ride back to the school.

8. Buffers work amazingly well (show the laminated "Benefits of Riparian Buffers", but karst topography throws them a curve. Demonstrate a sinkhole underneath the boxtop watershed with the funnel, and say "Oh-oh"…we'd better move look underground now!

Thank the chef students, and get them to fold up their apron, dump the water into the "Runoff Bucket", put clean water in the mixing cup, and return to their seats, while you bring up the Groundwater student to help demonstrate the groundwater model.

Maps and Models

Groundwater Model instructions

Fill the cylindrical flask and turn upside down into left reservoir.
Dilute two colors of food coloring with water and load a syringe of each.
Attach the pump to the Erlenmeyer flask and insert tip into a pumping well.

Invite student "K" to come up to the model to pump some water out of the well for a drink. As he/she pumps the handle, notice how much energy it takes to get groundwater out! Point out the water table, and the flow of water underground. Say that wells are not usually like lakes, but more like gravel and sand with water around them.

Saying that anything on the surface of the ground beings to percolate downward Inject a little color into one of the holes near the well, and watch briefly as it drifts toward the well…still pumping.

Say that it can take a long time and really disperse on the way, but contrast that to something that gets into a sinkhole/cave. Inject some color, notice that it's just stored in the cave, and follow up with some water, which will flush it out into the groundwater pretty fast.

When the student pumps up some color into the water from the well, make the point that it's so important to consider what goes down, might just come back up. Toxic substances can enter the groundwater through percolation, and especially fast in karst lands.