Activity #5

How Clean is Clean?

As recently as 20 years ago, the standards for "clean" water were based upon such things as taste, odor and color. Today, by way of much improved technology, we know there can be numerous things in water that we cannot taste, smell nor see, but which can still be quite harmful to living things. It is with this in mind that government agencies have established standards for what is "safe" or "clean." Students will investigate how pollutants can contaminate groundwater by using a simple model of an aquifer.

Teacher Note: Tables of common water pollutants and drinking water standards can be found in the Appendix.

Objective: Upon completing this activity, students will understand how difficult it is to clean a water source once it has become contaminated.

NEVADA SCIENCE STANDARD 16:8

Time: Two class periods

Materials: liquid soap, salad oil, gelatin, 4 one-liter containers, 4 trays or buckets for collecting water, paper or plastic dinner plates, small containers for "pollutants," 4 large household sponges, large (16 oz.) plastic cups, 25 ml graduated cylinders

Procedure:

A. Teacher – The class will need to be divided into at least four work groups. Each group will need a large household sponge, three 16 oz. clear plastic cups, a paper or plastic dinner plate and a tray or bucket to collect water. Before class, pour each "pollutant" in a separate cup for students to take to their workstations.
   - ✳ Group #1 will be given the liquid soap.
   - ✳ Group #2 will be given the salad oil.
   - ✳ Group #3 will be given the gelatin. *(Dissolve a package in hot water before class begins.)*
   - ✳ Group #4 will be given an equal mixture of soap, oil and gelatin.

   Groups may wish to assign specific tasks to individual group members, as well as appoint one or two people to record results on the Student Observation Form. Read over the instructions with students before they proceed with their investigations.

NOTE: Provide group #2 with graduated cylinders to help them determine the volume of oil layer in each rinse after the oil separates out.

B. Students – In comparison with rivers or streams, water in the ground moves very slowly in underground rivers that may be as much as 100 miles wide. These slow-moving underground rivers are known as <u>aquifers</u>. When a pollutant is spilled on the ground, it slowly seeps down through the ground and may get into an aquifer. This might make the aquifer's water unsafe to drink. Many questions must be answered about such things. How toxic are the pollutants? How fast are they moving? How might they be removed from the water? These questions are often quite difficult to answer!

In this activity, each group will investigate a different type of pollutant and attempt to find out how difficult it is to remove. An aquifer is not exactly like a sponge, but the sponge will give us an idea of what happens when an aquifer gets contaminated.

<u>Group #1</u> – Soap is your pollutant. In this case, the ground gets contaminated when a tanker truck is involved in an accident on the highway and spills the pollutant on the side of the road. The soap is like many real pollutants, which will dissolve in water, but are not extremely hazardous to health.

<u>Group #2</u> – Salad oil is your pollutant. A truck accident has caused this spill. Oil is much like gasoline, which is hazardous and toxic, but it does not mix well with water.

<u>Group #3</u> – Gelatin is your pollutant. This pollutant has leaked into the ground from a large, old and rusty underground tank where it has been stored for many years. The gelatin is much like some pesticides that dissolve in water and are very toxic.

<u>Group #4</u> – You will have the most trouble! An explosion has occurred at a major chemical plant and all three types of pollutants – soap, oil and gelatin – have been spilled onto the ground.

Student Investigation of Pollutants

Group Instructions:

1. One student in each group should pre-moisten the sponge by soaking it in water, then squeezing it until it is just moist to the touch. Other students in the group should be sure they have the following items at their workstation:
    a. one large container of clean water
    b. two large empty cups
    c. a tray or bucket for collecting rinse water
    d. a paper or plastic dinner plate
    e. a small cup containing your “pollutant.”
2. Place the sponge on the plate and pour the liquid “pollutant” onto the sponge, letting it soak up as much pollutant as possible.
3. SLOWLY pour clean water onto the sponge, letting it soak in until the sponge is full. Pour back into the pollutant cup any excess water on the plate. You will need to know how many cupfuls of water are being used to rinse the sponge, so <u>keep track of all the water you use</u>.
4. Lift the sponge and squeeze it out completely, catching the water in an empty large cup.
5. Pour more water onto the sponge, letting it soak in.
6. Squeeze out the sponge again, this time using the other empty large cup to catch the water squeezed from the sponge.
7. Compare the two cups of polluted water. Decide which cup seems to have the <u>most</u> polluted water, and then empty this cup. Set aside the cup containing the water that looks less polluted.
8. Continue to pour water on the sponge and squeeze it out, alternating cups and, each time, comparing the water in the two cups to decide whether the water is getting cleaner each time the polluted sponge is rinsed out. <u>Count the number of times the sponge is rinsed</u>.
9. Estimate, to the nearest ¼ cup, how many cupfuls of water were used to rinse the sponge.
    a. Convert to ounces (one cup = 16 ounces).
    b. How much more rinsing – if any – must be done before the water squeezed from the sponge would be safe to drink?
10. After finishing the investigation, clean and return all materials to the proper place and record your conclusions on the *Student Observation Form.* Prepare a report to the class.

Student Observation Form

1. Were you able to get your water clean? Describe how easy or difficult it was to remove the pollutant from the sponge "aquifer."

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2. Once the sponge was contaminated with one ounce of "pollutant," how many more ounces of water were needed to clean the sponge?

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3. Group #2: How much of the oil was recovered from your sponge, as measured with the graduated cylinder? Does it appear that you can get all of the oil from the sponge?

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4. How can you tell if the sponge is clean? If you do not see any "pollutant," does that mean that none is there?

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5. Group #4: Which pollutant in your mixture was the easiest to clean up? How does this compare with what each of the groups found?

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