LESSON PLAN

Area and/or Course: Groundwater Protection Education #3: Water Quality Issues

Teacher Goal(s):

1. To help students gain general knowledge about groundwater protection in the Southern Willamette Valley.

Lesson Title: Southern Willamette Valley Factors of Movement and Quality Issues
No. Periods: 1 – 50 minute

Objectives:

The student will be able to (TSWBT).

1. Describe and define factors that affect water movement through the soil.
2. Describe and define factors that affect contamination movement to the aquifer.
3. Identify common well water quality issues in the SVGWMA.

Standard met by Objectives:

1. H2. Interaction and Change: The components in a system can interact in dynamic ways that may result in change. In systems, changes occur with a flow of energy and/or transfer of matter.

Materials, Equipment, Audio-visual aids:	**References:**
1. Set samples of different soils types in half liter bottles 2. Contaminated Water 3. Power point of Smart board 4. Large map of the GWMA 5. Well and Septic System Home Assessments	**Southern Willamette Valley Groundwater Management Action Plan**

Anticipatory Set/Introduction/Motivation/Interest Approach:

Review Well Log assignments from Lesson #2, write down concerns that students may have about the wells.

SET: Have several different soil types set-up in a 2 liter bottle style. Label the bottles with types – Ex: Sand, Silt, Clay. Each of the soil types will have 2 cups of a brightly colored solution added. The color added to the water solution represents a form of contaminant that could be on the surface. For example, in the abandoned wells set of pictures from Lesson 2 what potential contaminants could have found its way into the aquifer from an old well.

Students should make a hypothesis prior to the instructor adding the colored solution to each container of soil. Ask the students, what do you think will happen in each container when contaminated water is added, and provide a short explanation of your hypothesis?

Subject Matter Outline/Problem Stated (Application Points lace in throughout lesson). Modeling/Guided Practice/Checking for Understanding	Strategy/Objectives Met/Handout Points/Student Activity/Method/ Approach
Common Water Quality Issues in the Southern Willamette Valley 1. Iron Reddish brown discolored water, can be hard on plumbing, fixtures, and clothing. Comes from natural deposits No known health risk. Can be filtered out. There is also an iron bacterium which is a different quality problem. The brownish color that appears in the water but doesn't precipitate out of the water. The iron bacterium looks like little reddish-brown flecks in the water. The bacterium may appear slimy and unappealing in drinking water, but there is no known health risk. Can be treated with routine shock chlorination, however, typically once iron bacteria is in your well water it can be a recurring problem. 2. Manganese Brownish to blackish stains on fixtures and laundry, affects color and taste of water. Found in conjunction with iron most of the time. Natural deposits in geology. No known health risks. 3. Hydrogen Sulfide Characterized by a rotten egg smell. No known health effects. Comes from naturally occurring sources and the levels can vary throughout the year. Hydrogen sulfide is easily filtered out with a simple activated charcoal filter. 4. Calcium Carbonate Also known as "hard" water. Characterized by white spotting on fixtures, build-up in pipes, excessive fading of laundry. No known health risks. Can be treated with ion exchange (water softener). 5. Arsenic No visible taste or smell, naturally occurring	**For each factor – ask for student input on the definition of the term and their interpretation.** Many students will have dealt with at least one of these quality factors in their home wells. For example: iron water and using bleach in the laundry actually makes white clothes appear dingier. Rust colored staining in sinks and toilets is another example.

deposits. Typically found in certain wells drilled near the foothills of the Willamette Valley. Can also be found in many manufactured electronic items, which is just one of the reasons that electronic waste should be properly disposed of at a designated recycling center. Because of health concerns associated with arsenic, well water should be tested at a certified laboratory. Levels above 0.05ppm are unsafe for human consumption by the EPA. However, lower levels of arsenic may still be dangerous. Arsenic may build up the human body, being stored in the brain, bones and other tissues. Arsenic can also be found in food sources, the Oregon Department of Human Services arsenic fact sheet puts the normal dietary intake about .025 to .05ppm per day. With prolonged consumption there may be increased risk of cancer, skin, nervous, and circulatory disorders. Treatment options for well water are limited to reverse osmosis, distillation, or a specialized media system.

What is one commonality that all of these quality issues share? These first 5 contaminants are naturally occurring in the Southern Willamette Valley. These are not quality issues which occur from human activities. Most arsenic found in groundwater in this area is naturally occurring, but can also be found in electronic waste, which also has potential to contaminate water.

Look at the soil experiment and see how it is going so far. Ask the students which soil looks like it is infiltrating water the fastest? Which soil is holding the most water, reducing the leaching of contaminants? Observe the color of the water that has passed through the soil and has collected in the bottom of the bottle. What do you observe? The clay soil should have the slowest infiltration rate and the water that has passed through should be clearer than the sandy soil. Is the clay soil doing the best job of filtering out the potential contaminants compared to the other soil types? Why?

6. Coliform bacteria/ e.Coli
   No visible taste or smell. Coliform bacteria

reside on the surface of the ground and most of them are not harmful. One type of well known Coliform bacteria is e. Coli. It is not natural for any e. Coli to be found in groundwater. e.Coli contamination comes from human and animal wastes that are leaching into the groundwater. Coliform bacteria found in domestic wells is an indicator contaminated surface water is rapidly reaching groundwater. Consuming water that contains e.coli can cause gastrointestinal disorders like vomiting, diarrhea, and cramps. To detect presence of Coliform bacteria, a commercial laboratory should be used to test a water sample. Anytime there is a positive result for Coliform bacteria or e.Coli, the well should be shock chlorinated and not used until another water sample tests negative. Some wells may never come back negative with shock chlorination. In these cases, expensive treatment systems with continual chlorination or ultraviolet light may be used to make the water safe for consumption.

7. Nitrate-Nitrogen
No visible taste or smell. Byproduct of many land uses. Some sources of nitrate are: pesticides, fertilizers, animal manure, and malfunctioning septic systems. Levels over 10 parts per million (ppm) have been linked to methemoglobinemia or blue baby syndrome in which the nitrate interacts with the oxygen carrying capacity in the blood of infants and fetuses. Pregnant women and small children are advised to not drink water that has high nitrate levels. There are some studies that suggest that there are other potential health risks, but currently there isn't enough research to draw definitive conclusions.

Water quality is monitored in public water supplies. Private domestic well owners should also monitor and test for the quality issues that cause health problems, such as nitrate and bacteria.

Questions to ask students:

Who regulates Drinking water standards? EPA

Professionals recommend to have domestic wells tested every 1 to 3 years for Nitrate and Coliform bacteria

Who enforces the regulations in Oregon? Oregon DEQ, DHS, and County Health Departments all work together to ensure safe public drinking water supplies.

Do you think cities want to meet the EPA regulations or exceed them? Why?

Do any of you know if your family's domestic well has ever been tested by a commercial lab for any of these quality issues? If so, which ones?

Why would routinely monitoring water for nitrate and bacteria be important?

Assignment: Take home the Well and Septic System Home assessments. You can fill these out by yourself or have your parent help you. If you live in town and do not have a well or septic system, you can see if an out of town friend, relative, or classmate would be willing to help you complete the assessments.

Closure/Summary/Conclusion

Check back in on the soil experiment. What additional conclusions can you make? Which soil type do you feel would provide the most protection from nitrate and other contaminants getting to groundwater? Which would provide the least protection?

As part of the next class we are going to do a nitrate screening on a water sample of your choice. Bring to class a ½ cup of well water in a clean, water tight container that is labeled with your name. You may have your own water tested or you may choose to bring in a sample from a friend, neighbor, or relative. If you live in the city feel free to bring in a sample from your home tap and we can see if your town meets the EPA regulations. If you do live in town you also have the option of getting a sample from someone that lives out of town.

Evaluation: (Authentic forms of Evaluation, Quizzes, Written exam?)

Assignments: (Student Activities involved in lesson/designed to meet objectives.)

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