

LESSON PLAN

Area and/or Course: Groundwater Protection Education #4: Nitrate

Teacher Goal(s):

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

Lesson Title: Nitrate in the Southern Willamette Valley **No. Periods:** 1 – 50 minute

Objectives:

The student will be able to (TSWBT).

1. Define nitrate. Understand regulations, sources, and potential health effects of nitrate.
2. Identify the declared Southern Willamette Valley Groundwater Management Area.
3. Learn to perform a nitrate test on well water

Standard met by Objectives:

1. H1. Structure and Function: A systems characteristics form, and function, are attributed to the quantity, type, and nature of its components.
2. H3S2. Conduct a controlled experiment, field study, or other investigation to makes systemic observations about the natural world including the collection of sufficient and appropriate data.

Materials, Equipment, Audio-visual aids: <ol style="list-style-type: none">1. Students samples of home well water, Sample A – Control (0 ppm), Sample B (over 7 ppm)2. LaMotte Nitrate Test Kits3. Extra test tubes with stoppers, syringes, racks, safety equipment (gloves, eye protection)4. Computer, Whiteboard, PowerPoint Projector	References: Southern Willamette Valley Groundwater Management Action Plan
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Anticipatory Set/Introduction/Motivation/Interest Approach:

Show students a water bottle filled with Sample B. Ask “Who would drink this water?” “Does it look/smell safe?” Pass the sample around while shaking a test tube of Sample B with the N2 tablet added. The sample in the tube should start turning to a bright red. Hide the tube so students can’t see the result.

Record results of the previous two questions, then bring out the positive sample – have a student read level of nitrate which ideally is over well over 10ppm. Let’s figure out together if this water is safe to drink.

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
<p>1. What is nitrate? Nitrate is an inorganic compound that doesn't occur naturally in groundwater. Levels of 2 parts per million and less are commonly found in groundwater supplies due to human activities on the land surface.</p> <p>Nitrate is a common non-point source contaminant found in the Southern Willamette Valley. (non-point source means that there isn't one direct source of the contaminant that can be identified as the cause of the contamination, but instead many smaller contributors that lead to the problem).</p> <p>What is the difference between nitrate and nitrite? Nitrogen is present in many forms in our environment. Nitrogen undergoes a variety of chemical reactions and changes that result in the production of nitrogenous compounds, two of which are nitrate and nitrite. Nitrate (NO_3^-) is the form that is most commonly found and measured in soil and water. Nitrite (NO_2) is also part of the nitrogen cycle and is the ion that gets converted into nitrate. This is the Nitrogen cycle between the soil and atmosphere. nitrate goes through a different chemical pathway in the human body.</p> <p>Sodium Nitrite (NaNO_2) is an additive that is added to many processed foods as a preservative. Foods that commonly contain the highest amounts of nitrite are lunch meats, smoked items, and jerky.</p> <p>2. Sources of nitrate Nitrate is a form of Nitrogen. The most common sources of nitrate in our local area that may cause water quality problems are plant fertilizers, excess animal and wildlife manure, and malfunctioning septic systems.</p> <p>3. How does nitrate get into groundwater? Nitrate moves easily with water because of its negative charge, NO_3^-. Therefore, nitrate is not adsorbed by the negatively charged soil particles. Without this attraction, nitrate does not bind to the soil and is leached through the soil with water.</p>	<p>Room should be set with needed lab supplies.</p> <p>This short lecture style can be done with the short PowerPoint provided on website.</p> <p>The question of sodium nitrite comes up fairly routinely with media coverage of nitrite. This is good reference material to have just in case.</p> <p>Ask students to brainstorm a list on the board of potential nitrate sources. After the list is created do a quick poll of what contamination sources each person could identify at their home (this is voluntary).</p>

4. **Is there a potential health risk involved with drinking water that is high in nitrate?**

Scientific studies have found nitrate to be associated with methemoglobinemia and potentially diabetes, human reproductive issues, and various forms of cancer. Research findings have been mixed and evidence is not conclusive. A limited number of studies have also found links to thyroid dysfunction, impaired immune response, decreased liver function, and respiratory infection and again, results have not been well confirmed.

Currently the only confirmed risk is methemoglobinemia or blue baby syndrome.

5. **What is methemoglobinemia?**

Methemoglobinemia is the illness most commonly linked to elevated nitrate levels and is the basis of the federal health standards. Also known as “blue-baby syndrome”, this is a blood disorder that primarily affects fetuses and infants younger than 6 months.

When nitrate is consumed it is converted by bacteria in the body to another chemical form, nitrite. This nitrite conversion is a different chemical pathway than in the nitrogen cycle – other ions in the human body help drive this conversion. Nitrite then interacts with the hemoglobin in red blood cells and reduces their ability to carry oxygen. If the blood cannot deliver enough oxygen to the body’s tissues, cells begin to die and the skin takes on a blue tinge. The majority of cases do not result in death and are resolved when the source of nitrate is removed, however this can be pretty scary and if left untreated oxygen deprivation of the body can result in other serious consequences.

6. **What can we do about nitrate once it is in the groundwater?**

Treatment for drinking water is limited to reverse osmosis.. The best thing we can do is not add anymore nitrate to the system.

How would feel about consuming water with high levels of nitrate without having any definitive research that proves nitrate can be a factor in all of these health risks?

Review risks from other class – overview is fine if this is a standalone class

What are some ways to protect groundwater from nitrate?
Brainstorm list with the class. Add any that they might miss.

Divide class into groups of 2 or 3.

Review testing instructions page and demonstrate how to do one screening.

This is the time to talk about respecting individual's privacy if there are positive tests for nitrate.

Each group should have several personal samples, and two control samples. Sample A (0 ppm) and Sample B (over 7 ppm). As the tests are completed have students record the results on postcards/results sheets.

Assignment: As the tests results are being waited for, students can roughly sketch a diagram of their household, yard, land around them. As they are drawing they should be identifying potential nitrate sources and what steps can be taken to protect the groundwater from those sources.

Closure/Summary/Conclusion

Wrap-up. After the screenings are done, ask who was surprised by the results?

This would make a great project for individuals and groups to do for leadership or community service for your community. Volunteers with interest can contact a member of the Southern Willamette Groundwater Management staff for more information and assistance in setting up a nitrate screening in the your community.

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

A unit exam perhaps or as part of other units, ex: soil

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

Sample screenings