Drinking water safety – Health concerns and testing **Lesson: 6**

National Science Education Standards for Grades 9-12

Content Standard E: Science and Technology: Understandings About Science and Technology

- *Science and technology are pursued for different purposes. Technology, by its nature, has a more direct effect on society than science because its purpose is to solve human problems, help humans adapt and fulfill human aspirations.*

Content Standard F: Science in Personal and Social Perspectives: Personal and Community Health

- *Hazards and the potential for accidents exist. Humans have a variety of mechanisms—sensory, motor, emotional, social and technological—that can reduce and modify hazards.*

Content Standard F: Science in Personal and Social Perspectives: Environmental Quality

- *Materials from human societies affect both physical and chemical cycles of the earth.*

Content Standard F: Science in Personal and Social Perspectives: Natural and Human-Induced Hazards

- *Human activities can enhance the potential for hazards. Acquisition of resources, urban growth and waste disposal can accelerate rates of natural change.*

Student Learning Objectives

6.1 Describe potential water contaminants.

6.2 Describe how human health is affected by the quality of drinking water sources.

6.3 Explain who is responsible for testing drinking water.

Teacher Info Table Time

Instruction time for this lesson: 45 - 65 minutes, plus homework assignment (40 mins.)

Resources, Tools, Equipment and Supplies

6.1.a. Define common drinking water concerns.

Resources

- SW.6.1.A.TM.A: *Common Drinking Water Concerns* slide
- SW.6.1.A.TM.B: *Land Use and Drinking Water Safety* slide
- SW.6.1.TM.C: *Common Water Contaminants and potential Human Health Impacts* slide
- *Sources of Groundwater Contamination*, Groundwater Foundation: http://www.groundwater.org/gi/sourcesofgwcontam.html

Equipment

Computer
LCD projector
Screen

Supplies

3.5 x 5” colored index cards for 6.1.a. Contaminant Cards: Prepare one set of cards from the table *Common Drinking Water Concerns* (SW.6.1.A.TM.A) for each small group. Each set will have three different categories of cards – uses/activities, contaminants and health impacts. On each card you will write the content from one cell in the table. Write these on three different colored cards or colored ink to differentiate the three categories; i.e., each contaminant will be written on a grey card.

6.1.b. Describe the common sources of drinking water contamination.

Resource

- SW.6.1.B.TM: *Common Sources of Potential Drinking Water Contamination, Sources of Groundwater Contamination*, Groundwater Foundation: http://www.groundwater.org/gi/sourcesofgwcontam.html

Resources, Tools, Equipment and Supplies

6.2. Describe how human health is affected by the quality of drinking water sources.

Resources

- SW.6.2.TM: *How is Human Health Affected by the Quality of Drinking Water Sources?* Slide
- *Drinking Water Contaminants*, U.S. EPA, http://water.epa.gov/drink/contaminants/index.cfm#List
- *Guidance for People with Severely Weakened Immune Systems*, U.S. EPA http://water.epa.gov/aboutow/ogwdw/upload/2001_11_15_consumer_crypto.pdf

6.3. Explain who is responsible for testing drinking water.

Resources

- SW.3.1.AS: *Drinking Water Home Inventory* worksheets students completed during Lesson 3
- *Testing Recommendations for Private Drinking Water Wells*, eXtension Drinking Water and Human Health: http://www.extension.org/pages/Testing_Recommendations_for_Private_Drinking_Water_Wells
- *Current Drinking Water Regulations*, U.S. EPA, http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm
- *Drinking Water from Household Wells,* U.S. EPA, http://water.epa.gov/drink/info/well/upload/2003_06_03_privatewells_pdfs_household_wells.pdf
- *Private Drinking Water Wells,* U.S. EPA, http://water.epa.gov/drink/info/well/index.cfm
- *Private Wells: Frequently Asked Questions,* U.S. EPA, http://water.epa.gov/drink/info/well/faq.cfm

Supplies

SW.6.3.AS: *Testing Recommendations for Private Drinking Water Wells* worksheet – one copy for each student

Key Terms

Arsenic
Bacteria
Contaminant
Copper
Cryptosporidium
Disinfectants
Disinfection byproducts
Fluoride
Inorganic chemicals
Land use
Lead
Maximum Contaminant Level
Microorganisms
Nitrate
Nitrite
Organic chemicals
Pesticides
Radon
Septic System
Storm water runoff
Uranium

SUMMARY OF CONTENT AND TEACHING STRATEGIES:

Drinking Water Contaminants

A. Examples of contaminants and drinking water standards or maximum contaminants levels

1. National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems.

2. Primary standards protect public health by limiting the levels of contaminants in drinking water.
    a. Contaminants can include:
        - Microorganisms
        - Disinfectants (above maximum residual disinfectant level)
        - Disinfection byproducts
        - Inorganic chemicals
        - Organic chemicals
        - Radionuclides
    b. Microbial contaminants:
        - Contamination by bacteria, viruses and microorganism
        - Example: *Cryptosporidium* is a parasite commonly found in lakes and rivers, especially when the water is contaminated with sewage and animal wastes
        - It is very resistant to disinfection, and even a well-operated water treatment system cannot ensure that drinking water will be completely free of this parasite
        - The current Maximum Contaminant Level Goal (MCLG) for cryptosporidium is zero
        - Systems using surface water or ground water under the direct influence of surface water (GWUDI) must use this treatment technique: disinfect and filter their water so that 99 percent of Cryptosporidium oocysts are removed or inactivated (killed). Unfiltered systems (systems that meet criteria for avoiding filtration) are required to include Cryptosporidium in their existing watershed control provisions
    c. Chemical contamination from fertilizers
        - Nitrate, a chemical commonly used as fertilizer, poses an immediate threat to infants when found in drinking water above the national standard
        - Maximum contaminant level is 10 mg/L
    d. Lead contamination
        - Lead, a metal found in natural deposits, is commonly used in household plumbing materials and water service lines

- Lead is rarely found in source water, but enters tap water through corrosion of plumbing materials
- Maximum contaminant level is .015 mg/L

B. Ensuring safe drinking water

1. Congress passed the Safe Drinking Water Act (SDWA) in 1974 to protect public health by regulating contaminants in public drinking water and protecting sources of water. In 1996, amendments to SDWA included required state assessments of drinking water sources

2. SDWA is administered by the U.S. Environmental Protection Agency (EPA). A few highlights of the SDWA include the following:
    a. Authorizes EPA to set enforceable health-based standards for contaminants in drinking water
    b. Requires public notification of water systems violations and annual reports (Consumer Confidence Reports) to customers on contaminants found in their drinking water – www.epa.gov/safewater/ccr
    c. Establishes a federal-state partnership for regulation enforcement
    d. Requires disinfection of surface water supplies, except those with pristine, protected sources
    e. Requires an assessment of the vulnerability of all drinking water sources to contamination

C. The EPA has established pollutant-specific minimum testing schedules for public water systems

1. If a problem is detected, immediate retesting requirements go into effect along with strict instructions about how the system informs the public

2. A network of government agencies monitor tap water suppliers and enforce drinking water standards to ensure the safety of drinking water.
    a. These agencies include the EPA, state departments of health and environment, and local public health departments

The EPA sets regulated standards for contaminants in drinking water (have been set for a subset of all the chemicals and other possible contaminants in existence). States can set more stringent standards. The EPA and the states enforce the regulations but water utilities do the testing.

Sources of potential contamination (from state source water assessments):

- Agriculture: Concentrated animal feeding operations, grazing, crop production, fertilizer/pesticide application, agricultural irrigation, tile or ditch drains/agricultural drainage wells

- Commercial/Industrial: Gas stations, chemical/petroleum storage, dry cleaners, leaking storage tanks, mining and industrial discharge and disposal
- Wastewater systems: Improperly functioning wastewater utilities, municipal sanitary waste treatment and disposal, improperly designed, located, constructed or maintained septic systems, large-capacity septics, sewer collection, septic (on-site) sewage disposal systems
- Transportation: Airports, railroads/subways, freeways/highways, roads/streets
- Residential: Septic systems, lawn/garden care, underground and above ground storage tanks
- Other: Pharmaceuticals and personal care products and other emerging contaminants

INTEREST APPROACH:

A look at the sources and impacts of specific contaminants clearly brings the issues of drinking water quality and land use decisions to a personal level. Students work in collaboration to compare their knowledge and to check with presented material to complete the task, promoting participation and engagement in results.

I have a (rose, vegetable, flower, rain…) garden at home and I was hoping to have a more productive garden next year. I checked out the fertilizer options at (your local garden supply store.) All the bags had three numbers on them. Can anyone tell me what those numbers mean?

Elicit student responses about nitrogen, phosphorus and potassium.

Why wouldn't I just apply the fertilizer that has the most of all three?

Explain that different plants have different nutrient needs.

So, beyond the health of my plants, is there any reason I should pay much attention to the nutrient levels of the fertilizers I use in my garden?

Let's look at just the first nutrient. Nitrogen can end up in drinking water supplies due to runoff or leaching from fertilizer applied to fields and lawns. Nitrates are converted to nitrites in the digestive system and they impact the blood's ability to carry oxygen to the cells. Infants below six months who drink water containing nitrate in excess of the maximum contaminant level (MCL) could become seriously ill and, if untreated, may die. This blood disorder in infants is called Blue Baby Syndrome . I don't think I want to add any more nitrogen than is reasonable to my garden, so it doesn't end up in the water.

Today we'll look at other contaminants, how they get into our source water and what can happen when they do.

OBJECTIVE BY OBJECTIVE:

Activity Outline and Teacher Support Information:

Lesson 6, *Drinking Water Health Concerns and Testing*, introduces students to common drinking water contaminants, their sources, and their potential human impacts, as well as water testing information. The homework activity, SW.6.SA.HW.A-C, provides an opportunity for students to become more familiar with water testing parameters and contamination data.

6.1. Describe potential water contaminants

6.1.a. Describe common drinking water concerns

This small group activity provides a brief overview of safe drinking water issues. Prepare three sets of cards from the chart *Common Drinking Water Concerns* (SW.6.1.A.TM.A) for each group. Use three different colored cards or colored ink to differentiate the three categories – uses/activities, contaminants and health impacts. Each card should have one use/activity, contaminant, or health impact written on it. The set of cards for each group should be shuffled and in no particular order.

Present the slide material from SW.6.1.A.TM.B, *Land Use and Drinking Water Safety*, and SW.6.1.A.TM.C, *Common Water Contaminants and Potential Human Health Impacts*. Divide the class into the small groups and give each a set of cards. Each group will organize their cards to match the three components together correctly; each land use/activity matches to one contaminant card and one human health impact card. When the group has a match, have them turn that set of cards over. Groups should be able to complete the task in 5-10 minutes.

6.1.b. Describe sources of drinking water contamination (from state source water assessments)

Show slide SW.6.1.B.TM to the class and ask them to brainstorm the sources of potential drinking water contamination within each of the five groups. Challenge them to think of at least three to four sources as listed on page 5. Give the class five to ten minutes to complete this activity.

6.2. Describe how human health is affected by the quality of drinking water sources.

Display and have students read through the slide material from SW.6.2.TM*, Human Health and Drinking Water Contamination.* Facilitate a class discussion about the contents of the slide. What surprised the students the most about what they read? The least? What are their concerns about their own drinking water supply or that of their community?

6.3. Explain who is responsible for testing drinking water.

Ask students to read worksheet SW.6.3.AS, *Testing Recommendations for Private Drinking Water Wells.* Have them find worksheet SW.3.1.AS: *Drinking Water Home Inventory – Analysis and Report* that they completed in Lesson 3. Ask students to review the three contaminants that were found most often in their wells, whether public or private. Ask them to note what potential health effects are associated with those contaminants (from activity SW.6.1.A.TM.A). Have all students who have private well data make a master list of their three contaminants on the board. Delete like answers. For each contaminant listed have a student read from Table 1:

1) Which wells or homes should be tested?

2) How often should homeowner test?

Facilitate a class discussion about their findings. Emphasize that private well owners are responsible for testing their drinking water on a regular basis. Well owners can check the EPA State Certification Office for Drinking Water Laboratories to find a lab to help them with their testing needs: http://water.epa.gov/scitech/drinkingwater/labcert/statecertification.cfm.

REVIEW / SUMMARY:

For this journal entry, assume the role of a concerned person who has witnessed your neighbor spreading fertilizer in his yard, such that significant amounts are sprayed onto concrete driveways, the street and sidewalks, as well as over the lot line into your yard. During the next rainfall, where will the runoff from your neighbor's driveway and sidewalk flow? What body of water will it end up in? Does the fertilizer pose a threat to surface water? To groundwater? What measures could your family and your neighbor take to minimize these threats?

APPLICATION:

SW.6.AS.HW

In this small group homework activity students will pretend they are a team of water testing and treatment specialists at the Tell City Municipal Water Association treatment plant.

Background information for students:

The Tell City Municipal Water Association treatment plant has been tested for selected contaminants since surrounding lands include farms that use heavy amounts of pesticides and fertilizer, and a new golf course that fertilizes the course. Your team's task is to evaluate the testing report and determine if action should be taken to further treat the water or take action to protect the source water. Remember, the community's water system has been contaminated, and now the system is being tested again. We must communicate the results of the report in a positive manner to the citizens of Tell City. You have data from three activity sheets to consult (SW.6.AS.HW.A *Tell City Municipal Water Test Results;* SW.6.AS.HW.B, EPA *Maximum Contaminant Levels;* SW.6.AS.HW.C, *Report to the Tell City Municipal Water Association).* The first activity sheet is the test results, the second is a list of the maximum ***contaminant levels*** set by the EPA, and the third is the report each team will provide to the Tell City Municipal Water Association. After your team has assessed the data, create the report by filling out the sections in third activity sheet.

****

SW.6.AS.HW.A

Tell City Municipal Water Test Results

Situation: You are part of a team of water testing and treatment specialists at the Tell City Municipal Water Association. You have been sent a report on a water source and need a) to determine if the water source is contaminated and b) to identify the possible source of the contamination. Your team will need to determine which contaminants are above the maximum levels. Your team will submit a report of their findings to the association.

Tell City Municipal Water Association provides water for the 11,000 people of Tell City. Water testing was recently completed at the plant and the results of the tests are below:

Contaminant	Tested level	Acceptable? (Yes or No)
2, 4-D	0.10 mg/L	
Alachlor	0.001 mg/L	
Alpha particles	15pCi/L	
Arsenic	0.009 mg/L	
Atrazine	0.002 mg/L	
Benzene	0.009 mg/L	
Bromate	0.009 mg/L	
Chloramines	3.98 mg/L	
Chlorine	3.91 mg/L	
Chlorine dioxide	0.07 mg/L	
Chlorite	0.9 mg/L	
Chromium	0.1 mg/L	
Cryptosporidium	99% of contaminant removed	
Dalapon	0.215 mg/L	
Fluoride	3.99 mg/L	
Giardia lamblia	99.9% of contaminant removed	
Lead	0.014 mg/L	
Nitrate	9.98 mg/L	
Nitrite	0.8 mg/L	
Radium 226	5pCi/L	
Radium 228	4pCi/L	
Toxaphene	0.004 mg/L	
Uranium	30ug/L	

SW.6.AS.HW.B

EPA Maximum Contaminant Levels (selected contaminants)

Disinfectants

Chloramines – 4.0 mg/L

Chlorine – 4.0 mg/L

Chlorine dioxide – 0.08 mg/L

Disinfection byproducts

Bromate – 0.010 mg/L

Chlorite – 1.0 mg/L

Inorganic chemicals

Arsenic – 0.010 mg/L

Chromium – 0.1 mg/L

Fluoride – 4.0 mg/L

Lead – 0.015 mg/L

Nitrate – 10 mg/L

Nitrite – 1 mg/L

Microorganisms

Cryptosporidium – 99% removal through treatment technique

Giardia lamblia – 99.9% removal through treatment technique

Used as an indicator of other potentially harmful bacteria. No more than 5% total coliform - positive in a month . Total coliforms (including fecal coliform and E. coli) — acte MCL violation if two consecutive samples are positive for coliform, and one is also for E. coli fecal coliforms.

Organic chemicals

Alachlor – 0.002 mg/L

Atrazine – 0.003 mg/L

Benzene – 0.005 mg/L

2,4-D – 0.07 mg/L

Dalapon – 0.2 mg/L

Toxaphene – 0.003 mg/L

Radionuclides

Alpha particles – 15 pCi/L

Radium 226 & 228 – 5 pCi/L

Uranium – 30 ug/

SW.6.AS.HW.C

Report to the Tell City Municipal Water Association

1. The following contaminants were found to be above or near the maximum contaminant levels:

_____

_____

_____

_____

2. The following (categories) were affected: (circle each category affected)

Disinfection byproducts	Microorganisms
Disinfectants	Organic chemicals
Inorganic chemicals	Radionuclides

3. For each of the affected categories circled above, following are suggestions as to the sources of contamination that should be investigated:

_____

_____

_____

4. Recommendation for action:

_____ Recommend immediate action to:

_____

_____ No action required

ACTIVITY WORKSHEET(S) – AS NEEDED:

SW.6.3.AS

Testing Recommendations for Private Drinking Water Wells[1]

While many private water systems provide water that is safe and of good quality, it is not uncommon to have one or more water quality problems. Some, such as iron or hydrogen, sulfide and sulfate, are quite noticeable. Others, particularly those that are health concerns such as nitrate and pesticides, often require testing to detect.

The EPA has established pollutant-specific minimum testing schedules for public water systems, for regulated pollutants. A network of federal, state, and local government agencies monitor tap water suppliers and enforce drinking water standards to ensure the safety of the drinking water supply.

Unlike public water systems, private well owners in most states are not required to regularly test their wells or correct water quality problems. It is each individual homeowner's responsibility to decide which tests to perform and make determinations regarding the safety and quality of the home water supply based on the water test results.

Testing recommendations often vary from state to state, however, there are a few key tests that should be regularly performed on every private well water system. Additional testing may be recommended if your well meets certain criteria. Criteria for further testing is generally based on the following:

- Types of land use or other potential sources of contamination near your well
- Geologic materials that a well is drilled into
- Components of your household plumbing system

The information presented in the Table 1 below represents testing recommendation for Wisconsin. Check the U.S. Environmental Protection Agency at http://water.epa.gov/drink/info/well/ whereyoulive_state.cfm to locate information that is specific to your community. This site will link you to agencies with private well water education responsibilities in your state.

1 Adapted from WI Dept. of Natural Resources. 2007. Tests for Drinking Water from Private Wells. WI Dept. of Natural Resources, Bureau of Drinking Water and Groundwater. PUBL-DG-023 2007.

2 Based on WI guidelines. Recommendation may vary from state to state.

EVALUATION AND ANSWERS:

SW.6.ASSESS

1. The Environmental Protection Agency is responsible for testing the water quality of private wells. True or false? _____

2. Why is it important to test drinking water for nitrates before a woman becomes pregnant and when a baby is born?

_____

_____

_____

_____

3. What potential drinking water contaminants may be of particular concern on or around farms? Choose two of these potential hazards and check your list of testing recommendations for private wells, SW.6.3.AS, for those contaminants. Record the testing recommendation for each.

Contaminants	Testing recommendations
_____	_____
_____	_____

Answers to SW.6.ASSESS

1. False
2. Nitrates convert to nitrites in the human digestive system, which can prevent blood from transporting oxygen. This is particular problematic for infants and is referred to as “blue baby syndrome.”
3.

Contaminants	Testing recommendations*
Nitrates	Well within ¼ mile of an ag field or animal feed lot; test annually
Pesticides	Wells within ¼ mile of ag fields or areas where pesticides are manufactured, stored or mixed; test once every five to ten years.

**http://www.extension.org/pages/31579/testing-recommendations-for-private-drinking-water-wells*

Table 1: Testing recommendations for private wells[1]

This table illustrates some general guidelines for performing tests on a private water system in Wisconsin. Private well owners should check with their state and local health departments to determine if specific tests are recommended for their communities.

Contaminant	Which wells or homes should be tested?	How often should I test?
Coliform Bacteria	Every well	Test once every year, or when there is a change in taste, color or odor
Nitrate	All newly constructed wells or when you first move into a new home.	Test initially, and once every 5-10 years if levels are less than 2 mg/L.
	Wells within mile of an agricultural field or animal feed lot	Test annually
	Well used by pregnant women and infants	Test before pregnancy and at time of birth.
	Wells that have levels above 2 mg/L	Test annually
Arsenic	Every well	Test once
	Wells that have detected arsenic in previous tests.	Test annually if arsenic is present or iron levels appear to be increasing.
Pesticides	Wells within 1/4 mile of agricultural fields or areas where pesticides are manufactured, stored or mixed.	Test once every five to ten years. More frequently if pesticides are a possible threat.

SW.6.3.AS *(continued)*

Contaminant	Which wells or homes should be tested?	How often should I test?
Lead	Homes with copper plumbing installed before 1985 or containing brass components	Consider one time test
	The only way to know if your home's drinking water contains unsafe levels of lead is to test the water. Possible sources: Lead enters the water ("leaches") through contact with the plumbing. Lead leaches into water through: Corrosion* of pipes, solder , fixtures and faucets (brass), fittings. The amount of lead in your water also depends on the types and amounts of minerals in the water, how long the water stays in the pipes, the amount of wear in the pipes, the water's acidity and its temperature.	
Copper	Homes with new copper plumbing.	Test initially and retest after 6 months
	Homes where water is used to prepare infant formula or homes where residents are experiencing repeated symptoms of nausea, diarrhea or abdominal cramps.	Two tests, one first draw sample in the morning and one after flushing faucet for two to three minutes.
Radium	Wells in specific geologic regions	Consult your local health department
Uranium	Every well	Test once
	Wells that have detected uranium in previous tests.	Test annually if uranium is present or iron levels appear to be increasing.
Radon	Homes with high indoor air radon that cannot be reduced by sealing basement cracks and ventilation	Generally not necessary unless methods of reducing indoor air radon fails

**Corrosion is a dissolving or wearing away of metal caused by a chemical reaction between water and your plumbing. http://water.epa.gov/drink/info/lead/leadfactsheet.cfm#one*

SW.6.3.AS *(continued)*

Contaminant	Which wells or homes should be tested?	How often should I test?
Fluoride	Wells used by infants and preschool-aged children	Test when infant is born or if first moving into new home with a well
Volatile Organic Carbons or VOCs (solvents, gasoline or fuel oil)	Wells within ¼ mile of a landfill, underground fuel or gasoline tank; or wells within mile of where solvents have been used (drycleaners, automotive garage, etc.)	Test once every five to ten years or if solvent or gasoline taste or odor is noticed.

SW.6.1.A.TM.A

Common Drinking Water Concerns		
Uses/activities	**Contaminant**	**Health impact***
Septic system	Bacteria, protozoa, viruses	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)
Fertilizer application	Nitrogen, phosphorus	Blue baby syndrome, taste/odor
Livestock Waste	Nitrogen, phosphorus, pathogens, salts, and sometimes pharmaceuticals (including hormones, arsenic, and antibiotics added to animal feed), and antibiotic-resistant bacteria.	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps), Blue baby syndrome, taste/odor, increased cancer risk
Pet waste	Bacteria, protozoa, viruses, pharmaceuticals	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)
Pesticide application	Various chemicals	Cancer, liver and kidney damage, reproductive difficulty, nervous system effects
Storm water runoff	Gasoline, oil, auto fluids, sediment, hazardous waste, bacteria, nitrate	Gastrointestinal illness, reproductive and developmental effects, increased cancer risk
Vehicle washing	Oil, degreasers, antifreeze	Kidney damage, circulatory problems, increased cancer risk, delays in physical or mental development

**Note that in some cases there could be increased risk to sensitive populations such as infants and the infirm elderly. See http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf*

POWERPOINT SLIDES – AS NEEDED:

SW.6.1.A.TM.B

Land Use and Drinking Water Safety

- Each time the use of a land area changes, it can affect the hydrologic makeup of the landscape
- Septic systems – may contaminate surface and groundwater by percolation or runoff
- Pet waste – runoff to surface waters due to rainfall on gardens and lawns
- Fertilizer and manure application – runoff of nutrients to surface waters and leaching to groundwater
- Storm water runoff – runoff of gasoline, oil, automotive fluids
- Vehicle washing – oil, degreasers, antifreeze may enter drinking water supply through rinse water
- Cropland (agriculture)—nutrients from fertilizer and pesticide runoff
- Livestock and poultry facilities – sources of nutrients, pathogens, pharmaceuticals, antibiotic-resistant bacteria, litter and dust
- Forest land – sediment and attached petroleum materials related to harvesting
- Roads – runoff of oil products, rubber, metal filings
- Other land uses with potential to impact the quantity or quality of both groundwater and surface water: Recreation areas: ski slopes, hiking trails, golf courses and parking lots

SW.6.1.A.TM.C

Common Water Contaminants and Potential Human Health Impacts

- Septic systems, pet waste, livestock and poultry waste
  - Bacteria, protozoa and viruses can cause gastrointestinal illness (diarrhea, vomiting, cramps)
- Lawn and garden, turf grass and agricultural fertilizer
  - Nitrogen may cause Blue Baby Syndrome resulting in shortness of breath and blue skin color and death in infants less than six months
  - Phosphorus may affect drinking water taste and odor
- Pesticides
  - Exposure to large amounts over a long period of time can include: cancer, liver and kidney damage, reproductive difficulties and nervous system effects
- Stormwater runoff
  - Exposure to contaminants can result in gastrointestinal illness, reproductive and developmental effects and increased cancer risk
- Vehicle washing
  - Exposure to contaminants can result in kidney damage, circulatory problems, increased cancer risk, delays in physical or mental development

SW.6.1.B.TM

Common Sources of Potential Drinking Water Contamination

Agriculture

Commercial/Industrial

Wastewater systems

Transportation

Residential

SW.6.2.TM

Drinking Water Contamination

- Actual contamination events are rare and typically do not occur at levels that will pose serious health concerns
- Health effects can be short-term (acute) or long-term (chronic)
- Certain age groups are at higher risk than the general population
  - Very young children
  - The elderly
  - People with pre-existing health conditions
  - Pregnant women
- Typical examples
  - Microbial contamination – linked to contamination by bacteria or viruses, often from human or animal wastes
    - Water can be boiled to kill microbes
    - Disinfection can kill microbes
  - Chemical contamination from fertilizers – nitrate found in fertilizers convert to nitrite in the human digestive system; prevents blood from transporting oxygen, problematic for infants, called Blue Baby Syndrome
    - Water should not be boiled to reduce nitrate, boiling can increase concentration

SW.6.2.TM *(continued)*

- Lead contamination
  - Children – exposure can result in delayed physical and mental development and slight deficiencies in attention span and learning disabilities
  - Adults – exposure can result in kidney problems and high blood pressure
  - Rare in source water; *ente*rs water from plumbing materials
  - Water should not be boiled to reduce lead contamination; boiling can increase concentration