



## What is the source of my drinking water? Source Water!

Lesson: 3

**National Science  
Education  
Standards for  
Grades 9-12**

### **Content Standard A: Scientific Inquiry: Abilities Necessary to Do Scientific Inquiry**

- *Design and Conduct Scientific Investigations.*

### **Content Standard F: Science in Personal and Social Perspectives: Natural Resources**

- *Humans use many natural systems as resources. Natural systems have the capacity to reuse waste, but that capacity is limited.*

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

- *Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes and recycling of nutrients.*

**Student Learning  
Objectives**

- 3.1 Describe the similarities and differences among drinking water delivery methods (public water system or private well) in homes.
- 3.2 Describe the components of private wells and public drinking water systems.

### Teacher Info Table Time

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Instruction time for this lesson: 50 minutes

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### Resources, Tools, Equipment, and Supplies

3.1. Describe the similarities and differences among drinking water delivery methods (public water system or private well) in homes.

#### Resources

- Completed inventories from Lesson 2 homework assignment (SW1.2.HW.AS: *Drinking Water Inventory Homework Activity*)
- Worksheet SW.3.1.AS – ACTIVITY: *Drinking Water Home Inventory: Analysis and Report*, one copy per student
- *Wells and How They Work*, The Groundwater Foundation, <http://groundwater.org/gi/wells.html>
- *Water on Tap: What You Need to Know*, U.S. EPA, [http://water.epa.gov/drink/guide/upload/book\\_waterontap\\_full.pdf](http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf)
- *Private Wells: Basic Information*, U.S. EPA, <http://water.epa.gov/drink/info/well/basicinformation.cfm>

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3.2. Describe the components of private wells and public drinking water systems.

#### Resources

- Handout SW.3.2.TM.A – Diagram of a Private Drinking Water Well, one copy per student
- Slide SW.3.2.TM.B – Water Sources and Water Systems
- *Wells and How They Work*, The Groundwater Foundation, <http://groundwater.org/gi/wells.html>
- *Water on Tap: What You Need to Know*, U.S. EPA, [http://water.epa.gov/drink/guide/upload/book\\_waterontap\\_full.pdf](http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf)
- *Private Wells: Basic Information*, U.S. EPA, <http://water.epa.gov/drink/info/well/basicinformation.cfm>

## Key Terms

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Bored well  
Community water system  
Consolidated well  
Groundwater  
Non-Community water system  
Surface water  
Transient water system  
Unconsolidated well

## SUMMARY OF CONTENT AND TEACHING STRATEGIES: (BACKGROUND FOR TEACHERS)

- A. The U.S. Environmental Protection Agency (EPA) sets drinking water standards under the Safe Drinking Water Act (SDWA) to protect the public from harmful contaminants in public water systems (SDWA does not regulate private wells which serve fewer than 25 individuals.). Nonetheless, drinking water safety cannot be taken for granted. Originally, SDWA focused primarily on treatment as the means of providing safe drinking water at the tap. The 1996 amendments greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. This approach ensures the quality of drinking water by protecting it from source to tap. All drinking water, including bottled water, may contain at least small amounts of some contaminants from both naturally occurring and man-made sources. The presence of contaminants does not necessarily indicate that water poses an increased health risk.
- B. Public water systems (EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards.)
  - 1. Provide water for human consumption through pipes, canals or, other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.
  - 2. Source can be groundwater, surface water or a combination of both.
  - 3. Approximately 160,000 public water systems in the United States
  - 4. Community water systems – public water systems that serve people year-round
    - a. Most people in the U.S. (300 million) receive water from this type of system
    - b. Approximately 53,000 community systems in the U.S.
  - 5. Non-community water systems – public water systems do not serve the same people year-round (approximately 107,000 systems in the U.S.)  
Two types:
    - a. Non-transient (approximately 19,000 systems) – regularly serves at least 25 of the same persons more than 6 months of the year, but not year round (example: schools)
    - b. Transient (approximately 88,000 systems) – serves the public, but not the same individuals for more than six months (examples: rest areas and campgrounds)

6. Private household wells are not regulated by EPA; local health departments and other regulations impact the construction and siting of wells.
7. Well – a hole drilled into an underground aquifer. A pipe and pump are used to pull water out of the ground; a screen is used to filter out unwanted particles. Three basic types:
  - a. Bored/shallow wells: Bored into an unconfined water source; generally 50 feet deep or less
  - b. Consolidated/rock wells: Drilled into a formation consisting of a natural rock that contains no soil; average depth about 250 feet
  - c. Unconsolidated/sand wells: Drilled into a formation consisting of soil, sand, gravel or clay material

*Note: Numbers are updated every October. See [http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/upload/new\\_Fiscal-Year-2010-Drinking-Water-and-Ground-Water-Statistics.pdf](http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/upload/new_Fiscal-Year-2010-Drinking-Water-and-Ground-Water-Statistics.pdf)*

### INTEREST APPROACH:

Sharing the inventory results of the homework assignment from Lesson 2 is a collaborative activity that develops a class-wide understanding of community drinking water resources.

Drinking water doesn't arrive at our faucets directly from the source.

*Pour a glass of drinking water.*

State the source of that water: Drinking fountain, classroom sink, etc. Ask students to speculate where the water came from before it got to the school (nearby lake, river, aquifer, soil, etc.).

*Drink the water with lip-smacking gusto.*

I wonder if

- I'd dipped the glass directly into (*the lake/river that is the school's source for water*), OR
- I dug a hole until I reached groundwater and dipped a glass out
- Would I have enjoyed drinking that glass of water as much?

*Elicit responses.*

The reason this glass of water from our tap is safer and more enjoyable to drink than one that I take directly from the source of our water is the topic of today's lesson. We'll look at what you discovered in your homework inventories, and learn about public drinking water systems and private drinking water. Tonight's homework will be to drink a big glass of water and appreciate the system that makes it safe and enjoyable.

## OBJECTIVE BY OBJECTIVE:

### Activity Outline and Teacher Support Information:

*What is the source of my drinking water? Source Water!* – The drinking water we receive from our local drinking water utilities or individual wells, comes from groundwater, streams, rivers, springs, lakes, or reservoirs in a watershed. Although most water requires some treatment before use, protecting this source water is an important part of providing safe drinking water to the public.

This lesson builds understanding of local water delivery systems. Students will examine water sources and the components of public and private drinking water systems.

3.1. Describe the similarities and differences among drinking water delivery methods (public water system or private well) in homes.

Students debrief on homework activity, SW.2.HW.AS. Divide the class into groups according to the setting they assessed: A home with a private well or a home with a public water supply. Ask students in each group to combine their data, analyze their findings, and report to the class on their findings on home drinking water resources. Have students use SW.3.1.AS, the Drinking Water Home Inventory: Analysis and Report worksheet to help them analyze their data. The first question should be answered by the entire class, before they split into groups.

3.2. Describe the components of private wells and public drinking water systems.

How does drinking water get from the source to the user?

Handout a copy of SW.3.2.A, *Diagram of a Private Drinking Water Well*, to each student. Use the diagram and slides from SW.3.2.TM.B to present the components of private wells and public drinking water systems.

General information:

1. More water systems utilize groundwater than surface water, but more people drink from surface water systems.
2. Surface water often requires more treatment than groundwater because surface water is directly exposed to the atmosphere and runoff.

### Private household wells

Are not regulated by the government, although local governments (e.g. health departments) may have siting and construction requirements for private wells. It is the responsibility of the homeowner/landowner to maintain the well and safety of the water.

Basic components:

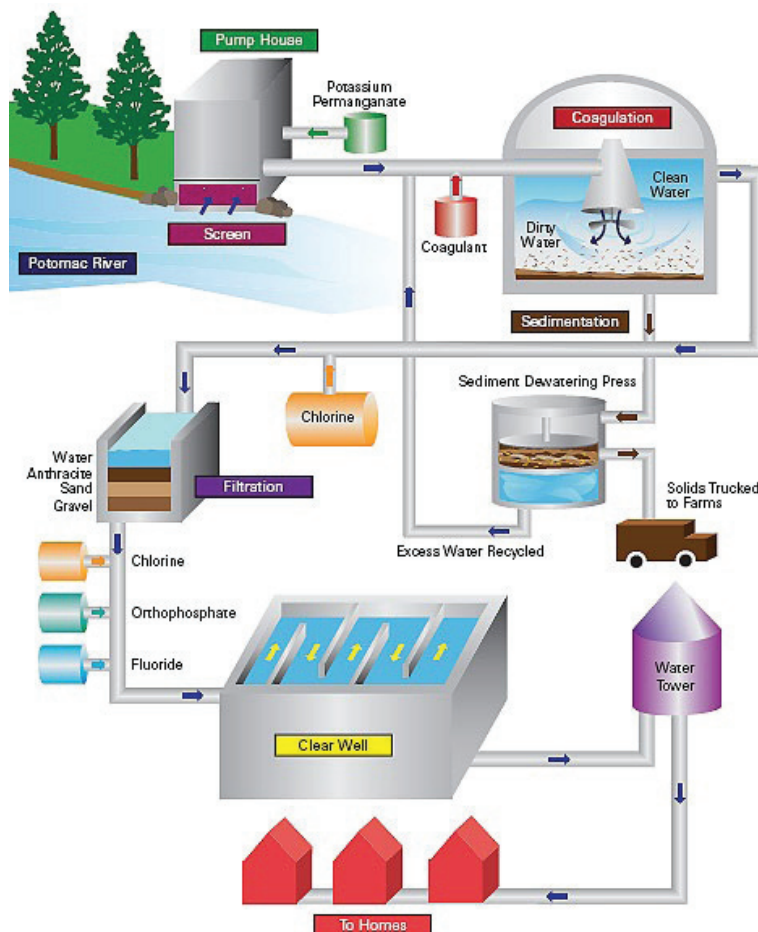
- A well – a hole drilled into an underground aquifer
- A pipe and pump – used to pull water out of the ground
- A screen to filter out unwanted particles
- Some homeowners/landowners install treatment equipment for private wells.

Three basic types of wells:

- Bored/shallow wells: Bored into an unconfined water source; generally 50 feet deep or less
- Consolidated/rock wells: Drilled into a formation consisting of a natural rock formation that contains no soil; average depth about 250 feet
- Unconsolidated/sand wells: Drilled into a formation consisting of soil, sand, gravel or clay material

### Public drinking water systems

Public water systems are regulated by the Environmental Protection Agency. EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards. This illustration shows a public water system with a river as its water source, and shows some sample treatment types.



Public water systems serve piped water from groundwater, surface water or a combination of both for human consumption to at least 25 persons or has at least 15 service connections for at least 60 days per year.

- Approximately 160,000 public water systems in the United States
- Community water systems – public water systems that serve people year round
  - Most people in the U.S. (300 million) receive water from this type of system
  - Approximately 53,000 systems in the U.S.
- Non-community water systems – public water systems that do not serve the same people year-round (approximately 107,000 systems in the U.S.)  
Two types:
  - Non-transient (approximately 19,000 systems) – serves same people more than six months of the year, but not year-round (example: schools)
  - Transient (approximately 88,000 systems) – serves the public, but not the same individuals for more than six months (examples: rest areas and campgrounds)

**REVIEW / SUMMARY:**

In your journal, note who's responsible for testing both private wells and public tap water in your community.

Summarize the main components and note the customers of a public water system and a private well in your journals. Feel free to draw and label a diagram of each as opposed to using text.

## EVALUATION AND ANSWERS:

### EVALUATION SW.3.ASSESS

1. Which of the cities listed below are most likely to draw drinking water from surface water systems? (circle as many as apply)

Chicago, IL – population 2,896,016

Deadwood, SD – population 1,380

Lincoln, NE – population 258,000

Los Angeles, CA – population 3,694,820

Santee, SC – population 740

Wisconsin Dells, WI – population 2,419

2. Describe three major differences for a homeowner between using public water supply vs. private well water.

**SW.3.ASSESS Answers**

1. Answers: Chicago and Los Angeles

More people drink from surface water systems because many larger cities utilize surface water treatment systems. People in rural areas tend to depend on groundwater for drinking water.

2. Examples of differences for a homeowner between using public water supply vs. private well water:

| <b>Examples of acceptable answers describing differences between public and private drinking water use.</b>                 |                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>Public Drinking Water</b>                                                                                                | <b>Private Drinking Water</b>                                                |
| Water utility is responsible for regular water testing, filtration and equipment costs.                                     | Homeowner is responsible for testing and associated costs.                   |
| Costs of maintaining systems or fixing problems spread over large number of users.                                          | Homeowner is solely responsible for maintenance and repair/filtration costs. |
| Homeowner is billed regularly for water use.                                                                                | No fee for using water.                                                      |
| Water utilities test for a broad range of regulated contaminants, and may monitor for unregulated or emerging contaminants. | Homeowners may not test their wells, or test for very few contaminants.      |

**ACTIVITY WORKSHEET(S) – AS NEEDED:**

**SW.3.1.AS**

**ACTIVITY: Drinking Water Home Inventory: Analysis and Report**

1. How many different sites (homes) were monitored? \_\_\_\_\_

2. What percentage of all the homes monitored drew water from:

**a. A private well** \_\_\_\_\_ %

What is the average number of people served by these wells? \_\_\_\_\_

What is the average depth of these wells? The deepest? The shallowest?

\_\_\_\_\_

On average, how often do people test their wells? \_\_\_\_\_

What contaminants were tested for most often? \_\_\_\_\_

Which three contaminants were found most often? \_\_\_\_\_

Mark the locations of the homes inventoried on a local map. Are these homes drawing groundwater from the same or different watersheds?

\_\_\_\_\_

Name the watersheds. \_\_\_\_\_

**b. A public drinking water system** \_\_\_\_\_ %

What is the average number of people served by the public utility?

On average, how often does the public utility test its water source?

\_\_\_\_\_

**SW.3.1.AS** *(continued)*

What three contaminants were tested for most often? \_\_\_\_\_

\_\_\_\_\_

Which three contaminants were found most often? \_\_\_\_\_

\_\_\_\_\_

Is the source of the public water supply surface or groundwater? Or a combination of the two? \_\_\_\_\_

If the source is surface water, name that body or bodies of water.

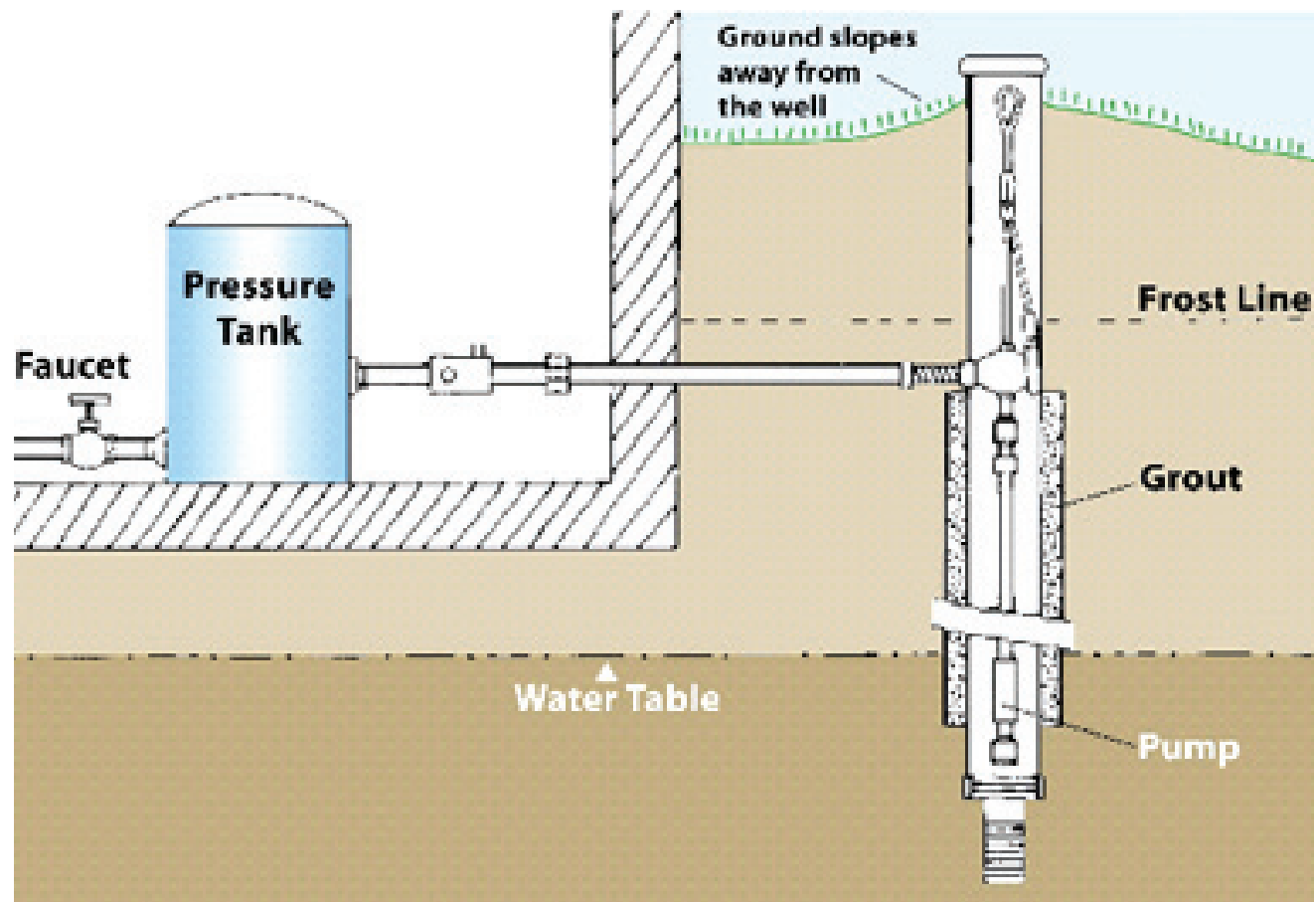
Mark the locations of the homes drawing public water on a local map. Mark the locations of the public wells that are serving those homes on the same map. Are these homes drawing groundwater from the same or different watersheds?

Name the watershed(s). \_\_\_\_\_

If surface water is the source of drinking water, mark the location of the body of water on your map.

SW.3.2.TM.A

Diagram of a Private Drinking Water Well



## POWERPOINT SLIDES – AS NEEDED:

SW.3.2.TM

### WATER SOURCES AND WATER SYSTEMS

General information about **surface water** and **groundwater**

1. More water systems utilize **groundwater** than **surface water**, but more people drink from a **surface water** system.
2. **Surface water** often requires more treatment than **groundwater** because **surface water** is directly exposed to the atmosphere and runoff from farm fields and impervious surfaces (roads and rooftops.).

#### Private household wells

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Basic components:

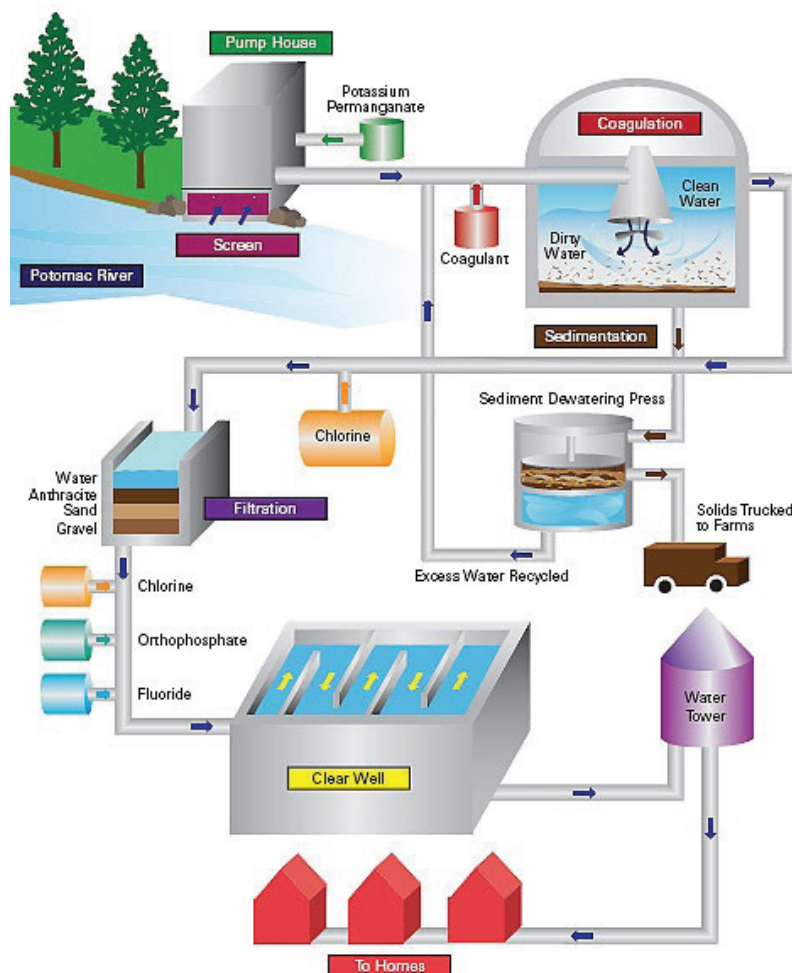
- A well – a hole drilled into an underground aquifer
- A pipe and pump – used to pull water out of the ground
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- Many homeowners/landowners install treatment equipment for private wells.

**SW.3.2.TM** (continued)

Three basic types of wells:

- Bored/shallow wells: Bored into an unconfined water source; generally 50 feet deep or less
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**Public drinking water systems are regulated by the Environmental Protection Agency.** This illustration shows a public water system with a river as its water source, and shows some sample treatment types.



**SW.3.2.TM** *(continued)*

Public water systems serve piped water for human consumption from groundwater, surface or a combination to sources that supply at least 25 persons or have at least 15 service connections for at least 60 days per year.

- Approximately 160,000 public water systems in the United States
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