Unit 5: Where Do We Get Our Drinking Water?

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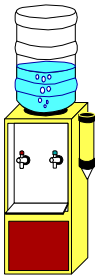


Objectives: Each student will be able to:

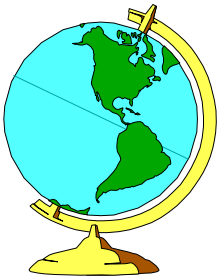
- Compare the land to water ratio on our planet earth.
- List sources of drinking water
- Discuss how Alabamians get drinking water.
- List the steps in cleaning water in a **water treatment plant**.
- Describe the natural filtering process of groundwater.
- Explain the danger of not testing drinking water from private wells.

Words to Remember:

- **aquifer**
- **alum**
- **bacteria**
- **chlorine**
- **contaminant**
- **water treatment plant**
- **disinfection**
- **filter**
- **filtration**
- **floc**
- **flocculation**
- **glacier**
- **groundwater**
- **impurities**
- **intake screens**
- **lime**
- **fluoride**
- **pollutants**
- **sedimentation basin**
- **soluble**
- **surface water**
- **debris**

Background Information

Look at a globe or map of the earth. You will see most of the earth is covered with water. This is where our planet earth gets its nick-name "The Blue Planet." About 97% of the earth's water is in the oceans. Ocean water contains salt and cannot be used for drinking. We get our drinking water from fresh water supplies. Only a little bit (about 3%) of the earth's water is fresh water. Fresh water can naturally contain small amounts of salt, but it is generally not too salty to drink.



Where is the fresh water located? Much of our fresh water is frozen in **glaciers** and ice caps at the north and south poles. We cannot use this frozen water. Our drinking water comes from only about 1% of the earth's supply of water (Figure 5.1).

Sources of Drinking Water. There are two sources of drinking water: **surface** water and **groundwater**. Surface water is water found on the outside, or surface, of the earth. Examples of surface water are lakes, rivers, and reservoirs. (The unit *How Water Is Used* has more facts about reservoirs).

In Alabama, surface water from lakes and reservoirs often supplies water for drinking. Alabama has 14 major river systems (see Figure 1.2 in Unit 1). There is usually plenty of rainfall to renew these rivers (Figure 5.2). Many reservoirs have also been built on Alabama's rivers. One purpose for these reservoirs is to store water for drinking water supplies. Fifty-six per cent of Alabama's population use surface water as a source of drinking water.

However, most of our fresh water, about 98%, is located inside the earth. The name for water inside the earth is **groundwater**. Groundwater is found in special places called **aquifers** (refer to Unit

1). Aquifers are layers of rock, gravel or sand below the ground. These aquifers absorb water like a sponge. To reach water in aquifers, we must dig wells and pump out the water.

About 44% of Alabamians use groundwater supplies for drinking water. Groundwater obtained from wells is commonly used in rural areas. Plentiful supplies of good quality water are found in aquifers in the southern part of the state (Figure 5.3).

Treatment of Drinking Water from Public Supplies. All drinking water must be safe to drink. Treating or cleaning water makes it safe to drink. The place where water is treated is called a **water treatment plant** (Figure 5.4). Water is brought into water treatment plants through large pipes. The way water is treated in a water treatment plant may vary in different plants, but there are usually the six following steps:

(1) Step one is the **Pre-treatment Process**. **Intake screens** strain out large pieces of **debris** which may be found in surface water. Examples of debris are fish, plants, garbage, or sticks. This step is not necessary for groundwater that has already been screened by surface layers of the earth.

(2) Step two is the **Chemical Addition** process. The water is pumped into a tank. Chemicals are added to the water in the tank. Examples of these chemicals are **lime, alum** and **chlorine.** The chemicals remove or aid in the removal of **impurities** and kill **bacteria**. Another name for impurities is **contaminants**.

(3) Step three is the **Mixing Chamber.** Here, the water is stirred to mix the chemicals evenly. Some impurities come out of solution as very tiny particles. The **alum** will stick to the impurities and form large heavy particles called **floc.** The name of this process is **flocculation**. These heavier particles will then sink to the bottom in the next step.

(4) In step four, the water will sit for a while in the **Sedimentation Basin**. This allows most contaminants in the form of the large particles to settle from the water. The leftover water is then sent to the next step.

(5) Step five is the **Filtration** process. In this chamber, beds of sand and gravel, and in some cases, special materials like coal or charcoal, **filter** the water after it has left the sedimentation basin. This removes any additional impurities.

(6) Step six is the **Disinfection** process. Chlorine is added again. The chlorine kills any remaining bacteria and protects the water during storage and distribution. Sometimes **fluoride** is added. Fluoride helps prevent tooth decay. Many of Alabama's public water systems add fluoride to drinking water.

After water passes through water treatment plants, it is tested. The testing makes sure the water is safe to drink. The safe water is stored in large holding tanks (step seven) and water towers (step eight) until it is carried through pipes to our homes.

Treatment of Drinking Water From Private Supplies. Groundwater in private wells has not been treated. The only way to make sure that water is safe to drink is to test it. People with private wells should have their water tested at least once per year.

Groundwater is naturally filtered by layers of earth and fractured rock. It usually contains less impurities than surface water. But, it also dissolves salts from rocks. And, chemicals introduced by people, such as industrial solvents, pesticides and used motor oil, can soak through the ground to reach groundwater. When this happens, the groundwater may become too contaminated to drink. Bacteria can also contaminate well water.

Many of these impurities are **soluble** in

water. Soluble means that they can be dissolved in water and are not screened out by normal filtering. Things that contaminate water can also be called **pollutants**. In large enough amounts, pollutants can make water unsuitable for many uses. Some pollutants are just a nuisance but others cause health problems in drinking water.

In Alabama, bacteria is the most common contaminant that causes health problems in private well water. Animal wastes and human wastes are the most common sources of this bacteria. Bacteria from septic tank failure is the single most frequent source of contamination to drinking water wells. (We will learn about septic tanks in the unit *The Treatment of Wastewater*).

People who use water from private wells should have their water tested to make sure it is safe enough to drink. Local health departments can provide information on how to properly get a water sample for testing.

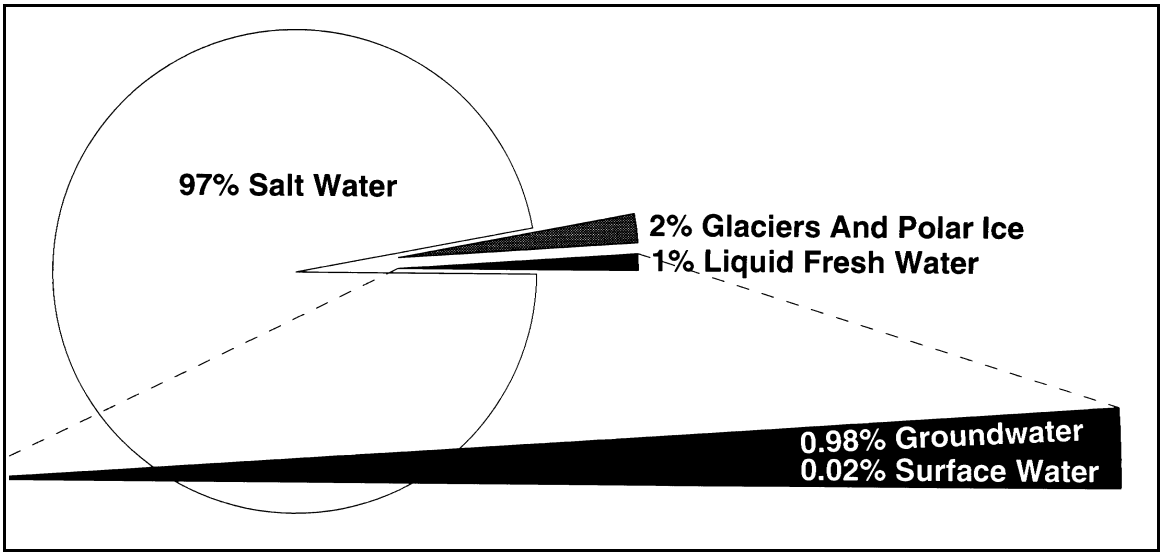
Questions for Review

1. What percentage of our earth is water?
2. Why is our planet called the "blue planet"?
3. How much of the earth's water is fresh water?
4. Where is most fresh water located? Why can we not use most of this water?
5. Where do the people in Alabama get their drinking water?
6. How are the water sources in Alabama renewed?
7. Where is 98% of our liquid fresh water located?
8. What percentage of Alabamians use groundwater supplies?
9. Where is public drinking water cleaned before it is sent to homes through a pipe system?
10. What steps are required to clean public water?
11. Once water is safe to drink, where is it stored until it is distributed to our homes?
12. How is groundwater naturally filtered?
13. What is not filtered out during this natural filtering process?
14. In Alabama, what is the most common contaminant of private well water?

Questions for Thought

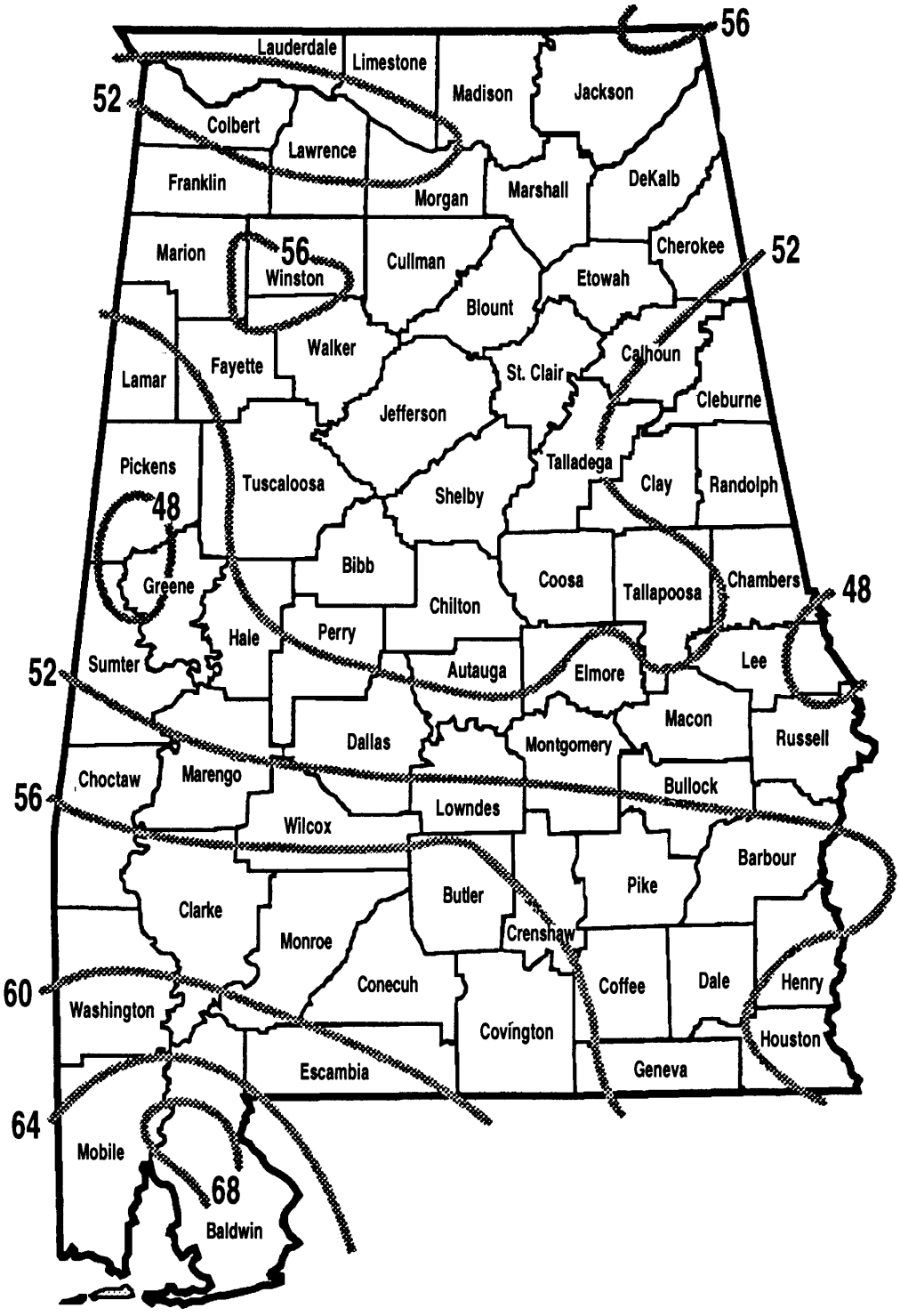
1. Why is it important that the people on earth protect the sources of water?
2. What are some ways that we can help preserve our water supplies?
3. What are some everyday activities that can pollute our water supplies if precautions are not taken?
4. Do you know anyone who has their own well? How do they ensure that their water supply is safe to drink?
5. Imagine a spring and summer with either very little or no rainfall. How would water supplies be affected? What would happen to our water supply if rainfall amounts were a lot lower for two or three years in a row? How do you think this would affect farmers? What are some ways that municipal governments would handle that water shortage?

FIGURE 5.1: Availability of Fresh Water



Source: Owen 1985.

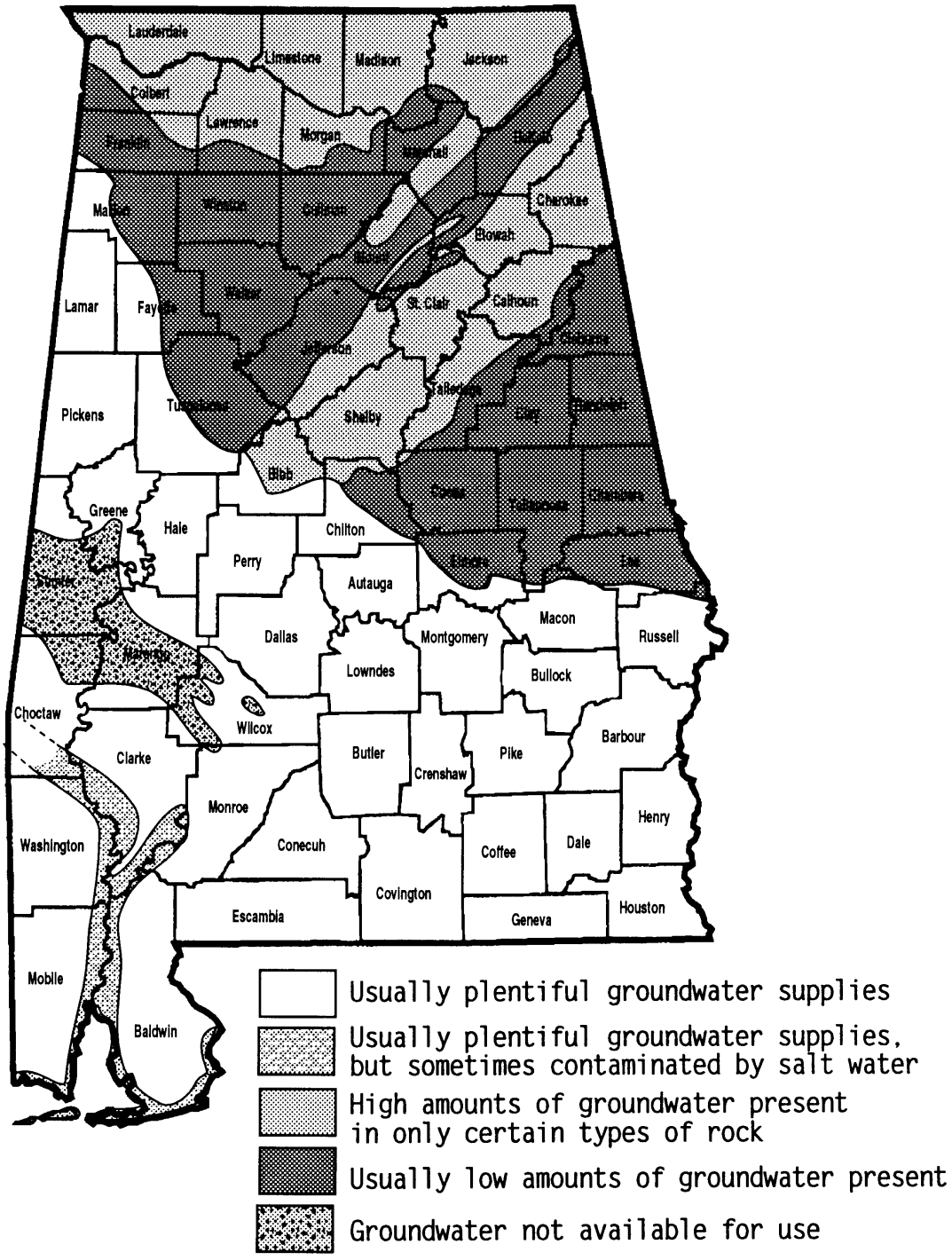
FIGURE 5.2: Annual Precipitation in Alabama



Annual rainfall in inches

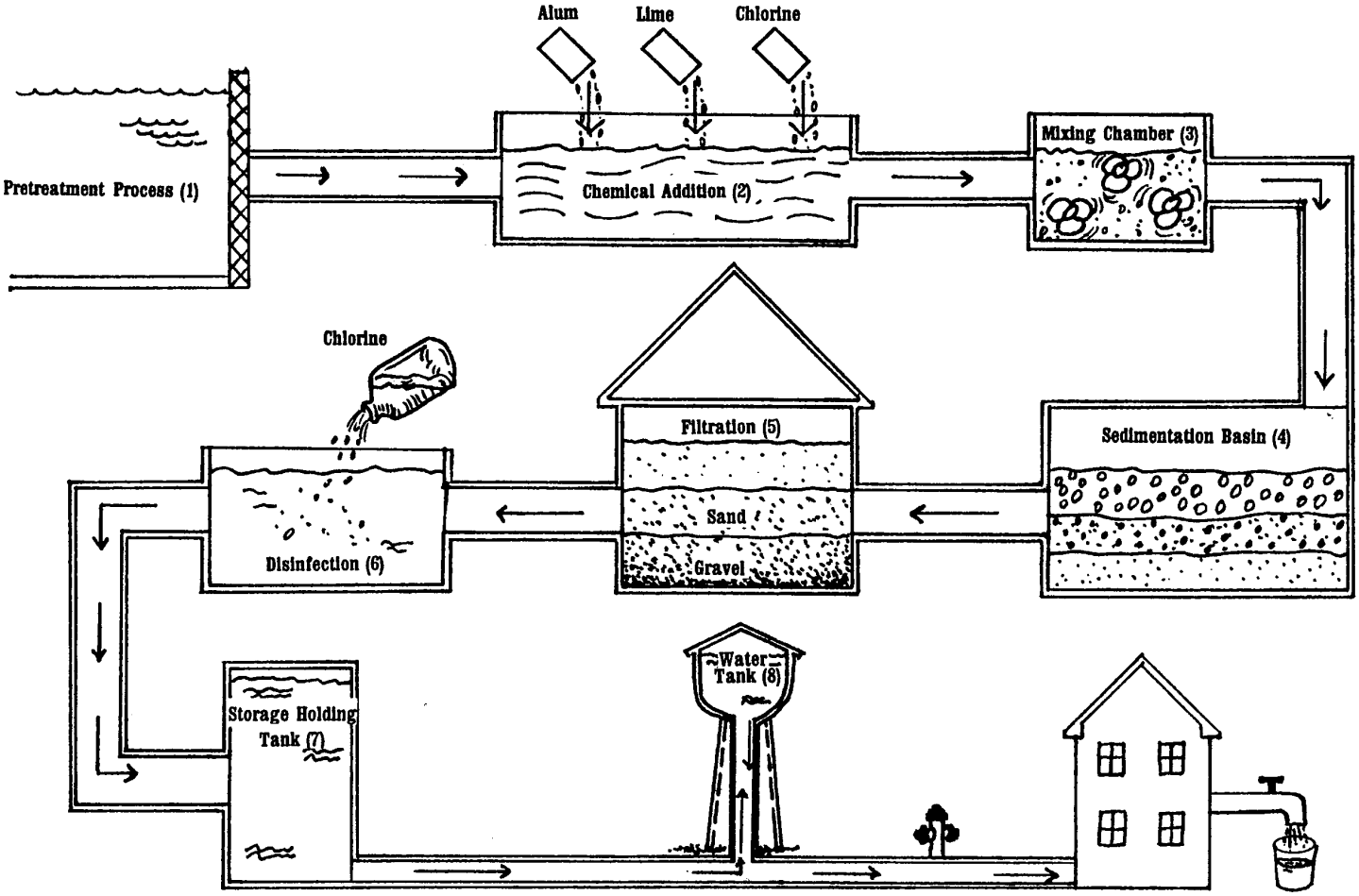
Source: Moore et. al. 1992

FIGURE 5.3: Groundwater Supplies in Alabama



Source: Moore et al. 1992.

FIGURE 5.4: The Process of Treating Drinking Water



FACT SHEET: Where Do We Get Our Drinking Water?

Interesting facts to remember about where we get our drinking water:

1. Most of our planet is covered with water; this is why it is called the blue planet.

2. Ninety-seven percent of the water on earth is in the oceans and is too salty to drink.

3. Much of the 3 percent of fresh water on the earth is frozen in glaciers and in the ice caps at the north and south poles and is not available for people to use.

4. Only about 1 percent of the earth's supply of water is in liquid form and can be used for drinking and other purposes.

5. The two sources of liquid water for drinking and other uses are surface water and groundwater.

6. Alabama has 14 major river systems that help supply our liquid fresh water.

7. Most drinking water in the United States and Alabama is treated in water treatment plants to ensure it is safe enough to drink.

8. Although groundwater has a natural filtering system, some pollutants or contaminants are not filtered out.

9. Private water supplies should be tested for purity before they are used as drinking water.

10. The local health department provides information on how to test private water supplies.

GLOSSARY: Where Do We Get Our Drinking Water?

aquifer An underground area of water that collects between spaces in rocks, gravel or sand.

alum A chemical added to water in treatment plants which causes small particles in the water to stick together; the larger particles then settle to the bottom of the tank.

bacteria One-celled organisms which sometimes cause disease.

chlorine A chemical element sometimes used to purify water because it kills bacteria.

contaminant Any substance that reduces the quality of water for some use; a pollutant.

debris (Pronounced de-bree´) Materials such as leaves and sticks or pieces of garbage that can be easily filtered from water.

disinfection A chemical or physical process which kills disease-causing organisms.

filter A device most commonly used to remove solid particles from water or other fluids, by means of a screen or other material with tiny holes, to sort out large pieces of material.

filtration The process of using a filter to remove solid particles from liquids.

floc Particles which have clumped together to form larger particles; these particles are then heavy enough to settle to the bottom of a liquid.

flocculation The process of forming floc in water treatment plants; floc settle to the bottom of the water or are filtered out.

fluoride An element sometimes added to treated drinking water; it has been shown to help prevent tooth decay.

glacier	A very large sheet of ice that moves slowly down mountains; it is formed from packed snow on tops of mountains.
groundwater	Water which is found underground, such as in aquifers; it is the water which supplies wells.
impurities	Substances which, when present, make another substance not pure or clean.
intake screens	The screens located at the opening pipes of a water treatment plant; they separate out large particles in the first step of treatment.
lime	A white powdery substance that is sometimes added to water to make it less acidic.
pollutants	Substances which harm the quality of air, land or water.
sedimentation basin	The large tank in a water treatment plant where flocculation occurs; large particles settle to the bottom of the tank in this step.
soluble	The ability to be mixed completely or dissolved in another material.
surface water	Water which is found on the exterior surface of the earth, such as in rivers and lakes.
water treatment plant	A plant which cleans and treats water to make it safe and pure enough to drink; this process involves several steps.

WORKSHEET 5.1: Definitions

Directions: In the left column are definitions to the *Words to Remember* and in the right column are the words. Match the words with the correct definitions. Place the letter of the correct definition in the blank to the left of the word.

_____ 1. Particles which have clumped together to form larger particles; these particles are then heavy enough to settle to the bottom of a liquid.

_____ 2. A white powdery substance that is sometimes added to water to make it less acidic.

_____ 3. Any substance that reduces the quality of water for some use; a pollutant.

_____ 4. A plant which cleans and treats water to make it safe and pure enough to drink; this process involves several steps.

_____ 5. A very large sheet of ice that moves slowly down mountains; it is formed from packed snow on tops of mountains.

_____ 6. A chemical or physical process which kills disease-causing organisms.

_____ 7. Water which is found on the exterior surface of the earth, such as in rivers and lakes.

_____ 8. A chemical element sometimes used to purify water because it kills bacteria.

A. alum
B. bacteria
C. chlorine
D. contaminate
E. disinfection
F. filter
G. floc
H. fluoride
I. glacier
J. impurities
K. intake screens
L. lime
M. sedimentation basin
N. soluble
O. surface water
P. water treatment plant

_____ 9. Substances which, when present, make another substance not pure or clean.

_____ 10. A chemical added to water in treatment plants which causes small particles in the water to stick together; the larger particles then settle to the bottom of the tank.

_____ 11. An element sometimes added to treated water; it has been shown to help prevent tooth decay.

_____ 12. The ability to be mixed completely or dissolved in another material.

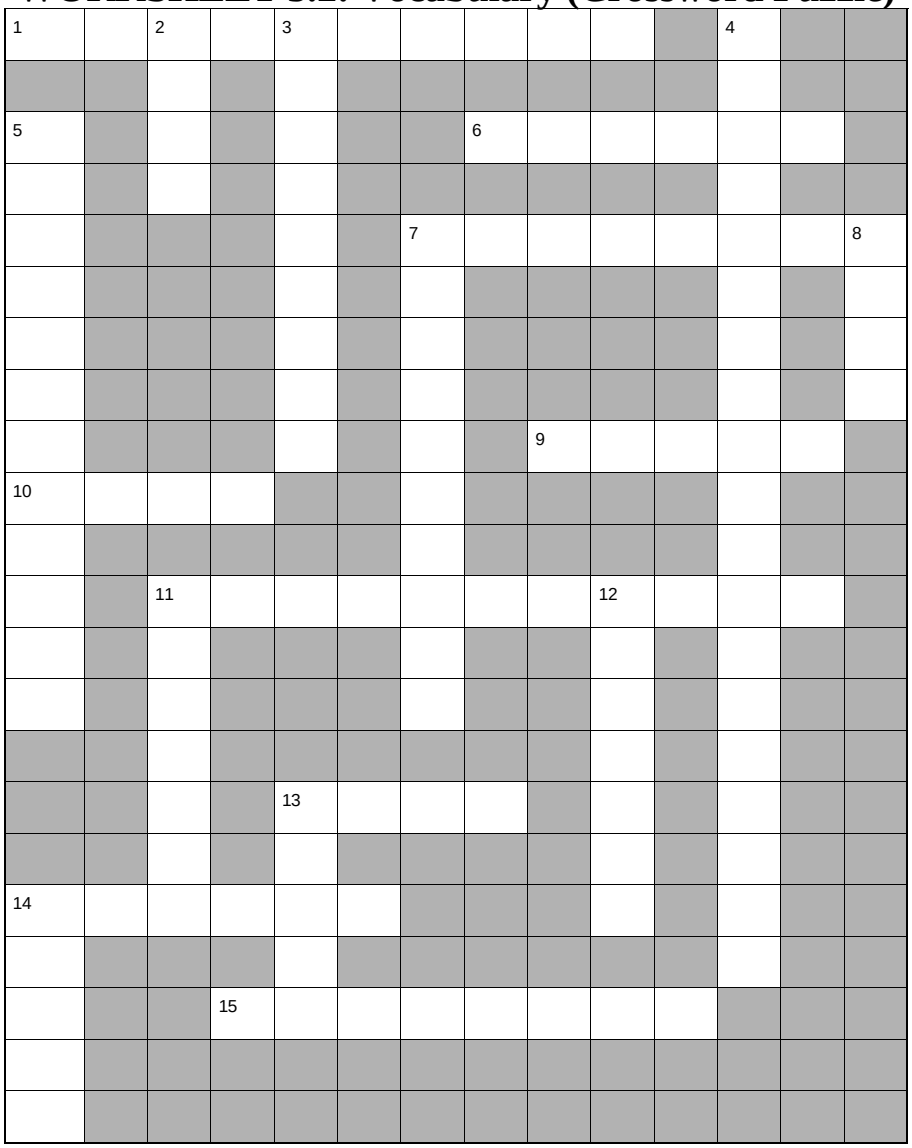
_____ 13. This tank is found in one of the steps of a water treatment plant.

_____ 14. One-celled organisms which sometimes cause disease.

_____ 15. A device most commonly used to remove solid particles from water or other fluids, by means of a screen or other material with tiny holes, to sort out large pieces of material.

_____ 16. The screens located at the opening pipes of a water treatment plant; they separate out large particles in the first step of treatment.

WORKSHEET 5.2: Vocabulary (Crossword Puzzle)



ACROSS:

1. The process of passing materials through a filter.
6. This Department gives advice on how to test your water.
7. One-celled organisms which sometimes cause disease.
9. This body of water contains salt water.
10. People who have their own private supply of drinking water may dig one of these.
11. Water which is found underground.
13. Particles which have clumped together when alum is added in water treatment plants.
14. An intake _____ is located at the beginning of a water treatment plant to separate out large pieces of material.
15. A chemical used to treat water because it kills bacteria.

DOWN:

2. A type of surface water.
3. A type of surface water created when a dam is built on a river.
4. A plant which cleans up water to make it safe for drinking.
5. Type of water found in lakes, rivers and reservoirs.
7. The earth is sometimes called this because so much water is found on our planet.
8. A chemical added in water treatment plants which makes particles clump together.
11. A large mass of frozen water.
12. An underground area of water that collects between spaces in rocks, gravel or sand.
13. Only about 3% of Earth's water is this type.
14. Plentiful supplies of good quality water are found in aquifers in this part of Alabama.

WORKSHEET 5.3: Facts About Where We Get Our Drinking Water

Directions: Below are sentences with words left out. Write the best answer in the blank. You may use the *Background Information* to help you.

1. Because most of the earth's surface is water, it is often called the _____. planet.

2. Approximately 97 percent of the earth's water is in the _____.

3. We cannot drink the water that is in the ocean because it contains _____.

4. The 3 percent of the earth's water that is not in the oceans is _____ water.

5. Much of the fresh water is frozen in _____ and in the _____ caps at the north and south poles.

6. The two sources of fresh water used for drinking are _____ water and _____ water.

7. For people living in Alabama, reservoirs often supply drinking water for public supplies, while private supplies often come from _____.

8. Groundwater is found inside the ground in _____.

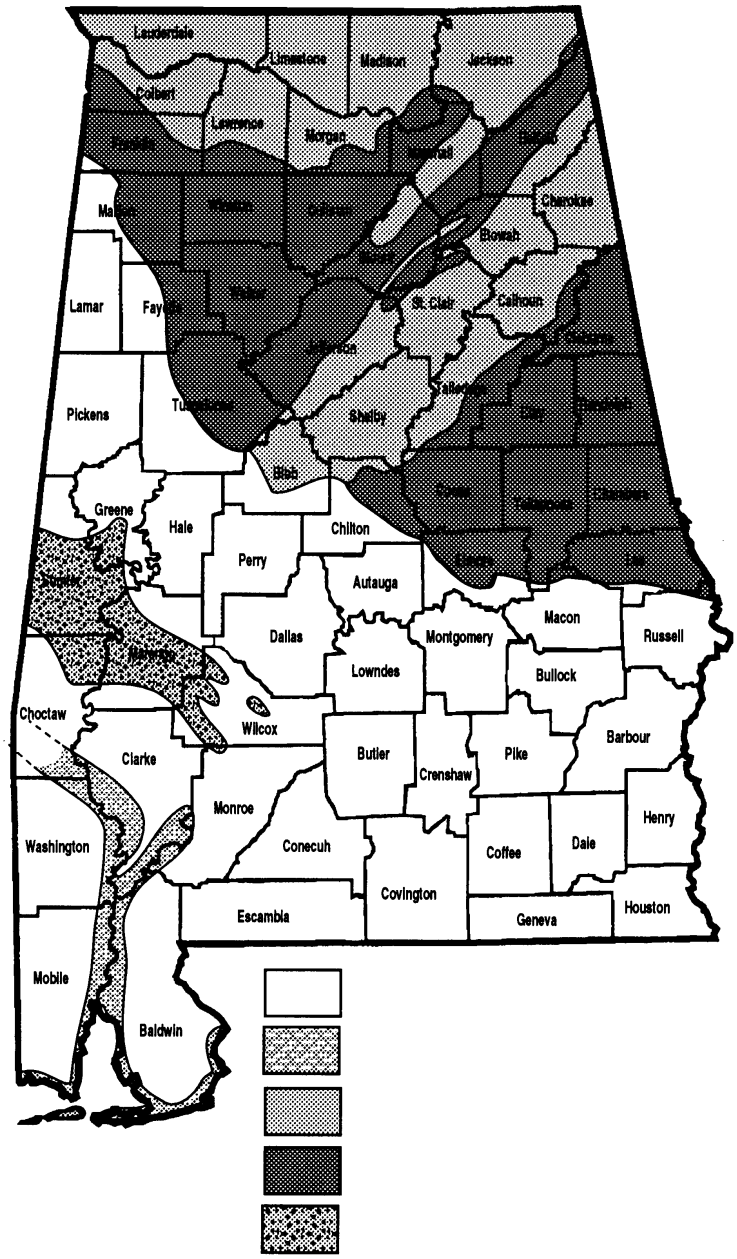
9. A place where water is treated is a _____ _____ _____.

10. Chemicals from the surface of the ground can _____ groundwater by soaking into the ground.

11. Harmful substances that dissolve in water are _____.

WORKSHEET 5.4: Groundwater Supplies in Alabama

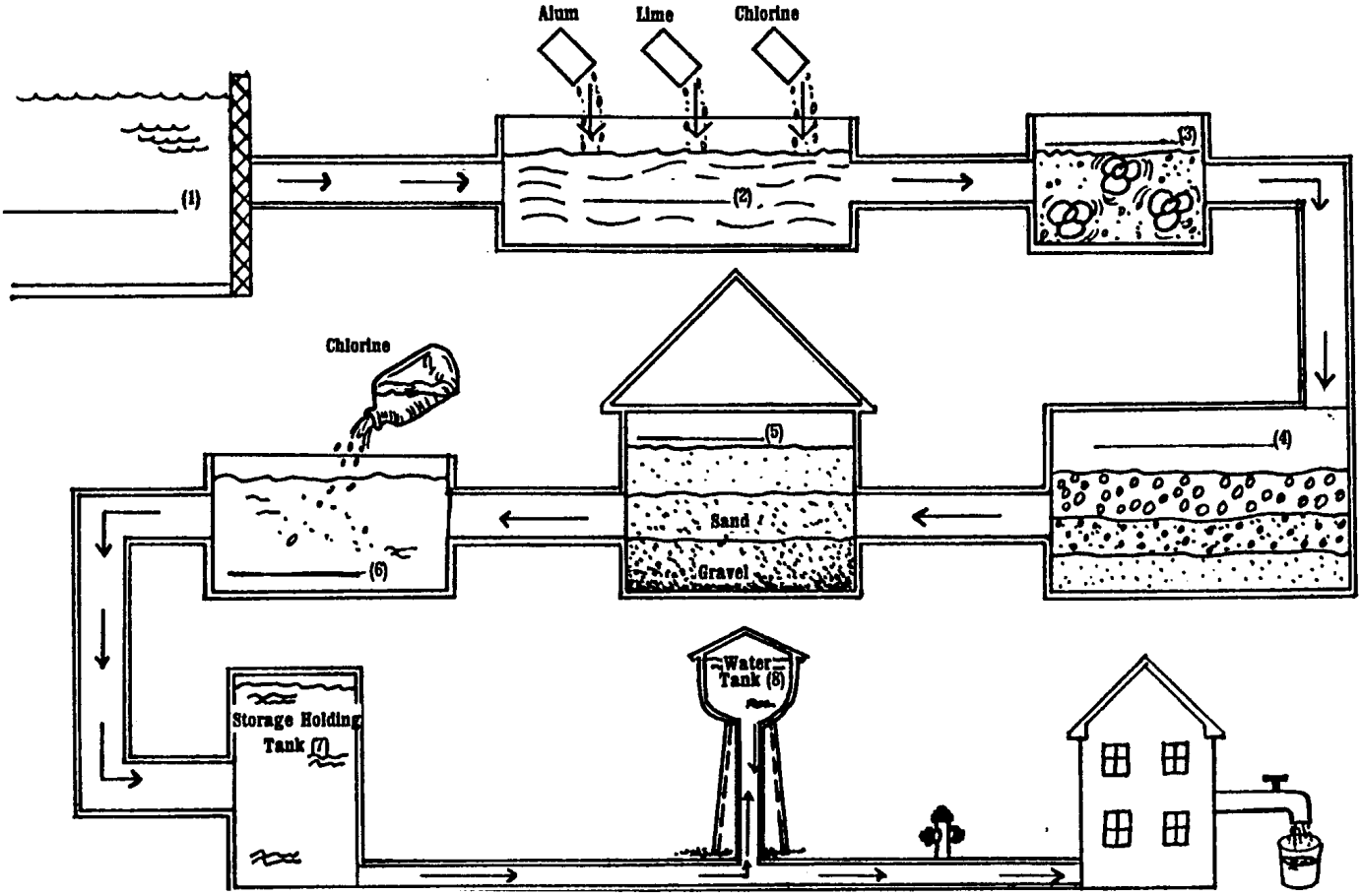
Directions: Using Figure 5.3 as a guide, write the correct letter in the boxes corresponding to the availability of Alabama's groundwater resources.



Source: Moore et al. 1992.

A. Groundwater not available for use.
B. High amounts of groundwater present in only certain types of rock.
C. Usually plentiful groundwater supplies, but sometimes contaminated by salt water.
D. Usually low amounts of groundwater present.
E. Usually plentiful groundwater supplies.

WORKSHEET 5.5: The Process of Treating Drinking Water



Match the Step number with the correct process.

Sedimentation Basin _____ Chemical Addition _____

Filtration _____ Pretreatment Process _____

Disinfection _____ Mixing Chamber _____

ACTIVITY 5.1: Weather Sleuthing[1]

Goal:

To understand the principle of annual rainfall.

Objective:

- To calculate rainfall for a month.
- To compare actual rainfall amounts with expected rainfall amounts.

Materials:

- ○ television or radio
- ○ chart for recording rainfall
- ○ paper and pencil
- ○ calculator (optional)

Procedure:

1. Listen to the weather forecast for a month or keep track of local rainfall in your newspaper.[2]
2. Keep a chart of the amounts of rainfall. You may use the chart provided.
3. Total the amount of rainfall recorded.[3]
4. If the amount of rain that you recorded this month fell every month, then how much rain would fall where you live in one year?
5. Compare this amount to the amount on Figure 5.2.
6. How does the amount of rainfall that you predicted for a year compare with the expected amount of rainfall? Is it more, less, or the same as the amount listed in Figure 5.2?
7. Prepare a report and give to the class.

Discussion:

We depend on rain to renew our water supplies on earth. When we keep a tally of how much rain we receive in our community, we have a greater appreciation of the actual amount of rain we receive. By comparing this amount to average amounts, we see if we're having a "dry" month or "wet" month. We can project this amount to predict yearly rainfall.

Desired Outcome:

Rainfall amount will be projected for one year. Comparisons between projected amounts and expected amounts will be made.

Evaluation:

Did students accurately record and (measure) rainfall for one month? Were the comparisons correct (i.e., more, less, or the same)?

Teacher Notes:

[1] This may be a group or an individual activity.

[2] An alternate method would be to keep track of rainfall using a rain gauge. If this method is used, a demonstration of how to use a rain gauge should be given.

[3] Depending on the ability and level of students, a review of how to use decimals may be helpful.

ACTIVITY 5.1: Weather Sleuthing

Chart for Recording Rainfall

Date	Inches of Rain
	TOTAL

ACTIVITY 5.2: How Treating Water Improves Its Quality

Goal:

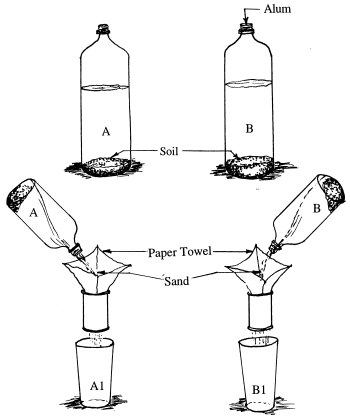
To cleanse water.[1]

Objective:

- To compare 2 processes, **sedimentation** and **filtration**, for treating water.
- To report observed differences in the 2 processes used to treat water.

Materials:[2]

- ○ 2 plastic 2-liter soft drink bottles (with caps)
- ○ 2 clear drinking glasses (opening large enough to fit soup cans)
- ○ 1 cup soil
- ○ water
- ○ 2 Tablespoons alum[3]
- ○ piece of heavy stock paper
- ○ Paper towels
- ○ 2 soup cans (empty and cleaned)
- ○ sand
- ○ hammer and nail



Procedure:

1. Label the 2 plastic soda bottles: label one A and one B.
2. Label the 2 clear drinking glasses: label one A1 and one B1.
3. Pour about 1/2 cup soil into each plastic soda bottle. You may use a piece of folded heavy stock paper as a funnel to make it easier to pour the soil into the plastic soda bottle.
4. After adding the soil, fill each plastic bottle about 2/3 full with water.
5. Cap the plastic bottles and shake to mix well.
6. Add 2 Tablespoons of alum to bottle B, shake to mix well.
7. Let bottles A and B sit for several minutes.
8. While bottles A and B are sitting, take hammer and nail and puncture several holes in the bottom of the 2 soup cans.
9. Place a paper towel in the bottom of each punctured soup can and fill about 1/2 full with sand.
10. Place one soup can over clear glass A1 and one over clear glass B1.

Teacher Notes:

[1] Safety Note: Water in the experiment has not been disinfected with chlorine; therefore, the water in the experiment is not safe to drink.

[2] Ideally, there should be enough materials for each student to perform the experiment independently; however, the experiment (continued next page)

11. After bottles A and B have been sitting for several minutes, record on paper any differences between the appearance of the water in the two bottles.
12. Carefully pour the top layer of water from bottle A into the soup can over glass A1, being careful not to disturb the sediment in the bottom of the bottle.
13. Pour the top layer of bottle B into the soup can over B1, being careful not to disturb the sediment as above.

    14. Record the appearances of the water after it has filtered through the sand in glasses A1 and B1.

Discussion:

Sedimentation and **filtration** are two processes of cleaning water. These methods are commonly used at water treatment plants. Alum, a chemical, helps the sedimentation process. The alum attached to materials in the water (forming floc) to allow them to clump together. When allowed to sit for a few minutes, the floc will settle out. When the water is then filtered through sand, it becomes even cleaner.

Discussion Questions:

1. Were there any differences in the water in bottles A and B before filtering their water through the sand?
2. What difference did the alum make in the appearance of the water?
3. Were there any differences in the water in glasses A1 and B1?
4. After some of the water has been poured through the soup cans, observe the leftover water in bottles A and B. How does it look when compared to the water in glasses A1 and B1?
5. Is the water clean enough to drink in glasses A1 and B1? (see note at beginning of this activity)
6. What two processes for treating water were just observed?
7. What are possible uses for this water?

Desired Outcome:

The appearance of the water treated by two difference processes will be observably different. And, the water with alum added will form floc.

Evaluation:

The experiment will be followed so that there are observable differences in two processes of treating water and the effect of the addition of alum to the water. Students will record and report the observed differences. Did students identify each of the water treatment processes?

References:

Lucas,E. Water: A Resource In Crisis. Chicago: Childrens Press, 1991.

The Water Sourcebook: Grades 3-5. Tennessee Valley Authority, 1993.

Water Wizards. Boston: Massachusetts Water Research Authority, 1987.

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could be performed equally as well with each group of 4 or 5 students having a set of materials. It is very important that each student be allowed to view the experiment at close range.

An alternate way to conduct the experiment is to divide the group into thirds. One-third would use the sedimentation process, one-third would use the filtration process, and one-third would use alum in addition to one of the other processes. Each of the three groups would record what happened to the water that they treated. They would then compare their results with the results of the other groups.

[3] Alum is potassium aluminum sulfate. This product (chemical) is available at the spice section of a grocery store or at a pharmacy.

ACTIVITY 5.3: Testing for Impurities from Water Runoff

Goal:

To increase awareness that water that mixes with impurities (e.g., oil from cars) can pollute our water supply.

Objective:

- To test runoff (water) from certain areas such as streets, parking lots, and playgrounds, for substances and impurities.

Materials:

- Samples of rain water[1]
- Small glass jars[2]
- petri dishes[3]
- pH paper[4]
- pencils and paper
- Optional: Plexiglass Groundwater Model (available for loan at ACES regional offices--see Equipment and Materials in Bibliography and Resource Materials

Procedure:

1. Use small glass jars to collect samples of water from streets or puddles soon after a rain.[5]
2. Number each sample.
3. On a piece of paper, make a chart and record the condition and color of the water sample.
4. Test each sample with pH paper.[6]
5. Record results on the chart.
6. Place the water into petri dishes and allow to evaporate.
7. Record the results (condition and color of sample).
8. For comparison, test the pH of tap water, then place the tap water into a petri dish and allow to evaporate.
9. Record the results (pH, condition and color of sample).

Discussion:

This exercise helps the students understand how impurities can get into our water supply through passive ways. Explain the importance of not littering and the proper disposal of harmful substances. Discuss how some substances are harmful to the environment. This will help the students to comprehend why water treatment is essential for clean water.

Discussion Questions:

1. Why are all of the water samples not clear?

Teacher Notes:

[1] After a rain or shower, samples of rain water may be taken from a small puddle or pool of water that has collected.

[2] Small jars such as baby food jars or small commercial food jars may be used in collecting water samples.

[3] A good substitute for petri dishes is clean fruit jar lids. Make sure that no contaminants, such as food particles or soap, are allowed to remain on the lid.
(Continued next page)

2. What is the name for the substances that may be in the water, but do not belong?
3. How did these substances get into the water sample?
4. How can these substances affect water supplies?
5. What is left in the petri dishes after the water has evaporated?
6. After observing this experiment, do you think that the water is safe for human use before it is treated?
7. What can we do to help protect our water supply?

Desired Outcome:

Difference in the pH of the water will be observed and recorded. There should also be some sediment left in the petri dish after the water has evaporated. Water from the tap that has been treated should leave not sediment in the petri dish.

Evaluation:

1. Were results recorded?
2. Were comparisons made between the sediment left in the 2 petri dishes (from the rain water and the tap water)?
3. Were the results recorded and reported?

Service Idea:

Collect water samples from various places within the community. Perform this experiment again on the water samples. Try to narrow down a particular part of the community that appears to have a potential problem with pollutants from surface water. Ask a chemist to analyze the impurities in the water for you. Research the damage that the known impurities can do to the local water supply. Develop a plan to solicit help to get the pollutants stopped. Enlist the help of parents and local environmental specialists. Make your findings public. Some examples of making your findings public would be a) asking to speak to civic groups, b) writing articles for the local paper, or c) asking fora place on the agenda at a city council meeting.

Adapted from "Water Runoff," My World, My Water And Me, used by permission of The Association of Environmental Authorities.

(continued from previous page)

One way to ensure that the jar lids are clean is to run them through a dishwasher on a high temperature cycle.

[4] pH paper may be purchased at the pharmacy, an aquarium store or from a school supply.

[5] Collect samples from various places, such as a parking lot, play-ground, etc. This will provide a variety of areas to test.

[6] Take a strip of pH paper and dip it into the water. It may change colors. Match the color with the pH number on the chart.
Note: For a good visual demonstration of groundwater pollution from runoff, borrow the plexiglass groundwater model from an Extension regional office.

ACTIVITY 5.4: Treating Water with Chemicals[1]

Goal:

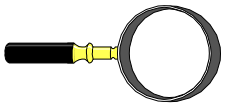
To allow students to observe why most water must be treated with chemicals before we can use it.

Objective:

- To demonstrate how water is cleaned by chlorine by observing treated and untreated rainwater under a microscope or magnifier.

Materials:

- microscope (or 10x hand lens magnifier)
- rainwater, or water from lake, pond, etc.
- tap water
- bleach
- microscope slides with cover slips
- medicine dropper
- rubber or latex gloves
- safety goggles



Procedure:[2]

1. Put a drop of rainwater or pond water on a microscope slide, cover with a cover slip, and let the students observe it through the microscope. They should see various types of microbes.[3]
2. Next, place a drop of bleach on the water, cover with a cover slip, and have the students observe the water again.[4]
3. Place a drop of tap water on another slide and observe it under the microscope. Add a drop of bleach to this slide and re-examine it.
4. Record your observations on the chart at the end of this activity.

Discussion:

Students should be able to see some small organisms and dirt in the sample of rainwater. Bacteria and viruses are not visible because they are too small. The tap water slide should appear cleaner. When bleach is added to the water, it should kill some of the organisms, so the water will be purer.[5]

Discussion Questions:

1. Were there any differences in the water on the different slides?
2. What did you observe in the sample of untreated rainwater?
3. Which sample of water appeared to be cleaner?

Teacher Notes:

[1] This activity could be presented as a teacher demonstration only due to the caustic nature of chlorine bleach.

[2] Safety Note: Caution students against drinking water in the experiment.

[3] Microorganisms or germs

[4] Be careful not to touch the bleach. It can cause blisters on skin. Wear

(Continued next page)

4. What happened to the water when bleach was added?
5. What types of life could be present in the rainwater?
6. What happened to this life when bleach was added?
7. How was adding the drop of chlorine to the water sample similar to treating our drinking water?

Desired Outcome:

Untreated water sample should have microbes or dirt in it. Chlorine should destroy some of the impurities in the water sample.

Evaluation:

Did students perform experiment accurately so that differences between rainwater and tap water could be observed? Did the water appear cleaner after the bleach (chlorine) was added? Could students draw a conclusion about the affect of chlorine as a water treatment?

Service Idea:

Investigate the types of impurities that were found in the water. (A local chemist may be able to help with this step.) Determine the potential problems that these impurities could cause in the water supply. Plan a course of action to bring these potential problems to the attention of individuals who could help eliminate or reduce such problems. To insure a success, data must be collected over a period of time and a record kept. Research must be conducted (i.e., impact of potential problems, who makes decisions concerning this, who should be contacted, etc.) This activity would possibly involve learning about city and county governments and policy making processes and might also include letter writing.

Adapted from "Treatment By Chemicals," Water Wizards, used by permission of Massachusetts Water Resources Authority.

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rubber gloves and safety glasses when handling bleach.

Chlorine will kill microorganisms in the process known as **disinfection**.
Note: The bleach ratio in this experiment (1:1) is much higher than necessary for normal disinfection. (Normally, a solution of 1:10 water:bleach is what is used)

ACTIVITY 5.4: Treating Water With Chemicals

Write down your observations of the water samples on each slide. Try to be as descriptive as possible.

Observations

rainwater _____

_____

_____

tap water _____

_____

_____

rainwater + bleach _____

_____

_____

tap water + bleach _____

_____

_____

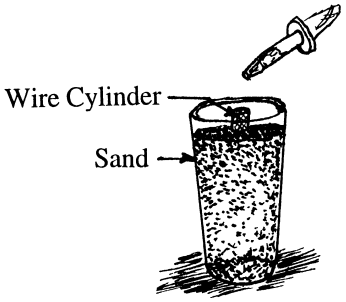
ACTIVITY 5.5: Wells and Groundwater[1]

Goal:

To construct a model of an aquifer and a well.

Objective:

- To simulate how an aquifer stores water.



Materials:

- ○ large diameter pen or pencil (about 1/2" wide)
- ○ very fine mesh wire screening[2]
- ○ twist-tie wire
- ○ very coarse sand[3]
- ○ large clear drinking glass
- ○ medicine dropper
- ○ water
- ○ Optional: Plexiglass Groundwater Model (available for loan at ACES Regional offices--see Equipment and Materials in Bibliography and Resource Materials

Procedure:

1. Roll the fine wire screening around a pencil and fasten it with the twist-tie so that it will not unroll.[4]
2. Put the cylinder of wire into the glass and carefully fill the glass around the cylinder with sand, making sure the sand does not enter the cylinder.
3. Pour water into the sand. Water will enter the sand and the cylinder.
4. With the medicine dropper, remove some of the water from the cylinder. Observe what happens to the level of the water in the sand when water is removed from the cylinder.
5. Add a little more water to the sand and observe what happens to the water in the cylinder.

Discussion:

The sand in the glass represents an aquifer. When water is added to the glass, this resembles rainfall filtering down to the aquifer to be stored as groundwater. The cylinder acts like a well, permitting us to withdraw the groundwater. When the water is withdrawn by the medicine dropper, the level of the water in the aquifer drops. Groundwater is renewed when more water is added, just as precipitation recycles water in the water cycle.

Discussion Questions:

1. What would happen if more water was taken out of the well than was being renewed by adding more water?
2. What do you think would occur if very heavy clay material was used instead of sand in this model?

Teacher Notes:

[1] This activity may be used as a teacher demonstration only.

[2] Available at hardware stores.

[3] Can be purchased at garden centers or hardware stores.

[4] Teacher or leader may need to have wire cylinders made in advance. If students work with wire, protective covering for hands may be needed to prevent cuts. **Note:** Try to borrow plexiglass groundwater model for a demon-stration of groundwater pollution.

3. What is the function of the sand?

Evaluation:

The wire cylinder in the middle of the sand and the water simulates the function of a well. After building a model, students will explain how a well and an aquifer function.

Desired Outcome:

When water is added to the sand the first time, water should seep into the cylinder (well). Removing the water from the cylinder should decrease the water in the sand (aquifer). Then when water is added back, water in the cylinder should increase.

References:

Groundwater: A Vital Resource. Student Activities. Knoxville, TN: Tennessee Valley Authority.

Lucas, E. Water: A Resource in Crisis. Chicago: Children's Press, 1991.

ANSWER KEY
WORKSHEET 5.1: Definitions

Directions: In the left column are definitions to the *Words to Remember* and in the right column are the words. Match the words with the correct definitions. Place the letter of the correct definition in the blank to the left of the word.

G 1. Particles which have clumped together to form larger particles; these particles are then heavy enough to settle to the bottom of a liquid.

L 2. A white powdery substance that is sometimes added to water to make it less acidic.

D 3. Any substance that reduces the quality of water for some use; a pollutant.

P 4. A plant which cleans and treats water to make it safe and pure enough to drink; this process involves several steps.

I 5. A very large sheet of ice that moves slowly down mountains; it is formed from packed snow on tops of mountains.

E 6. A chemical or physical process which kills disease-causing organisms.

O 7. Water which is found on the exterior surface of the earth, such as in rivers and lakes.

C 8. A chemical element sometimes used to purify water because it kills bacteria.

A. alum
B. bacteria
C. chlorine
D. contaminate
E. disinfection
F. filter
G. floc
H. fluoride
I. glacier
J. impurities
K. intake screens
L. lime
M. sedimentation basin
N. soluble
O. surface water
P. water treatment plant

J 9. Substances which, when present, make another substance not pure or clean.

A 10. A chemical added to water in treatment plants which causes small particles in the water to stick together; the larger particles then settle to the bottom of the tank.

H 11. An element sometimes added to treated water; it has been shown to help prevent tooth decay.

N 12. The ability to be mixed completely or dissolved in another material.

M 13. This tank is found in one of the steps of a water treatment plant.

B 14. One-celled organisms which sometimes cause disease.

F 15. A device most commonly used to remove solid particles from water or other fluids, by means of a screen or other material with tiny holes, to sort out large pieces of material.

K 16. The screens located at the opening pipes of a water treatment plant; they separate out large particles in the first step of treatment.

ANSWER KEY
WORKSHEET 5.2: Vocabulary (Crossword Puzzle)

1 F	I	2 L	T	3 R	A	T	I	O	N		4 W		
		A		E							A		
5 S		K		S			6 H	E	A	L	T	H	
U		E		E							E		
R				R		7 B	A	C	T	E	R	I	8 A
F				V		L					T		L
A				O		U					R		U
C				I		E					E		M
E				R		P		9 O	C	E	A	N	
10 W	E	L	L			L					T		
A						A					M		
T		11 G	R	O	U	N	D	W	12 A	T	E	R	
E		L				E			Q		N		
R		A				T			U		T		
		C							I		P		
		I		13 F	L	O	C		F		L		
		E		R					E		A		
14 S	C	R	E	E	N				R		N		
O				S							T		
U			15 C	H	L	O	R	I	N	E			
T													
H													

ACROSS:

1. The process of passing materials through a filter.
6. This Department gives advice on how to test your water.
7. One-celled organisms which sometimes cause disease.
9. This body of water contains salt water.
10. People who have their own private supply of drinking water may dig one of these.
11. Water which is found underground.
13. Particles which have clumped together when alum is added in water treatment plants.
14. An intake _____ is located at the beginning of a water treatment plant to separate out large pieces of material.
15. A chemical used to treat water because it kills bacteria.

DOWN:

2. A type of surface water.
3. A type of surface water created when a dam is built on a river.
4. A plant which cleans up water to make it safe for drinking.
5. Type of water found in lakes, rivers and reservoirs.
7. The earth is sometimes called this because so much water is found on our planet.
8. A chemical added in water treatment plants which makes particles clump together.
11. A large mass of frozen water.
12. An underground area of water that collects between spaces in rocks, gravel or sand.
13. Only about 3% of Earth's water is this type.
14. Plentiful supplies of good quality water are found in aquifers in this part of Alabama.

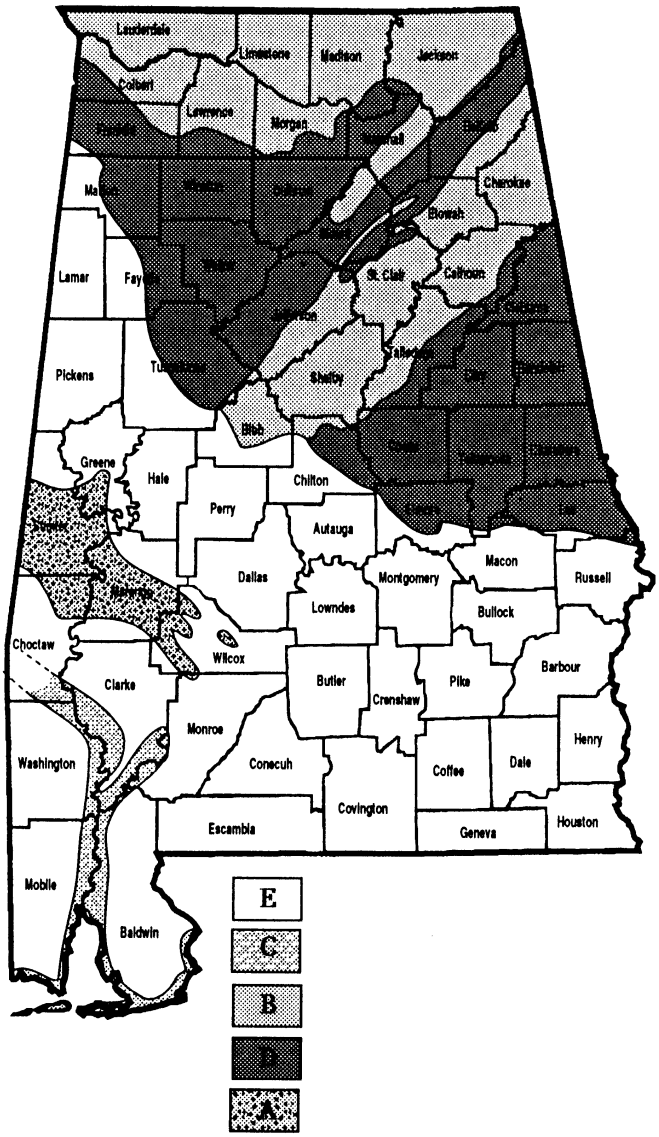
ANSWER KEY
WORKSHEET 5.3: Facts About Where We Get Our Drinking Water

Directions: Below are sentences with words left out. Write the best answer in the blank. You may use the *Background Information* to help you.

1. Because most of the earth's surface is water, it is often called the **BLUE** planet.
2. Approximately 97 percent of the earth's water is in the **OCEANS**.
3. We cannot drink the water that is in the ocean because it contains **SALT**.
4. The 3 percent of the earth's water that is not in the oceans is **FRESH** water.
5. Much of the fresh water is frozen in **GLACIERS** and in the **ICE** caps at the north and south poles.
6. The two sources of fresh water used for drinking are **SURFACE** water and **GROUND** water.
7. For people living in Alabama, reservoirs often supply drinking water for public supplies, while private supplies often come from **WELLS**.
8. Groundwater is found inside the ground in **AQUIFERS**.
9. A place where water is treated is a **WATER TREATMENT PLANT**.
10. Chemicals from the surface of the ground can **CONTAMINATE** groundwater by soaking into the ground.
11. Harmful substances that dissolve in water are **POLLUTANTS**.

WORKSHEET 5.4: Groundwater Supplies in Alabama

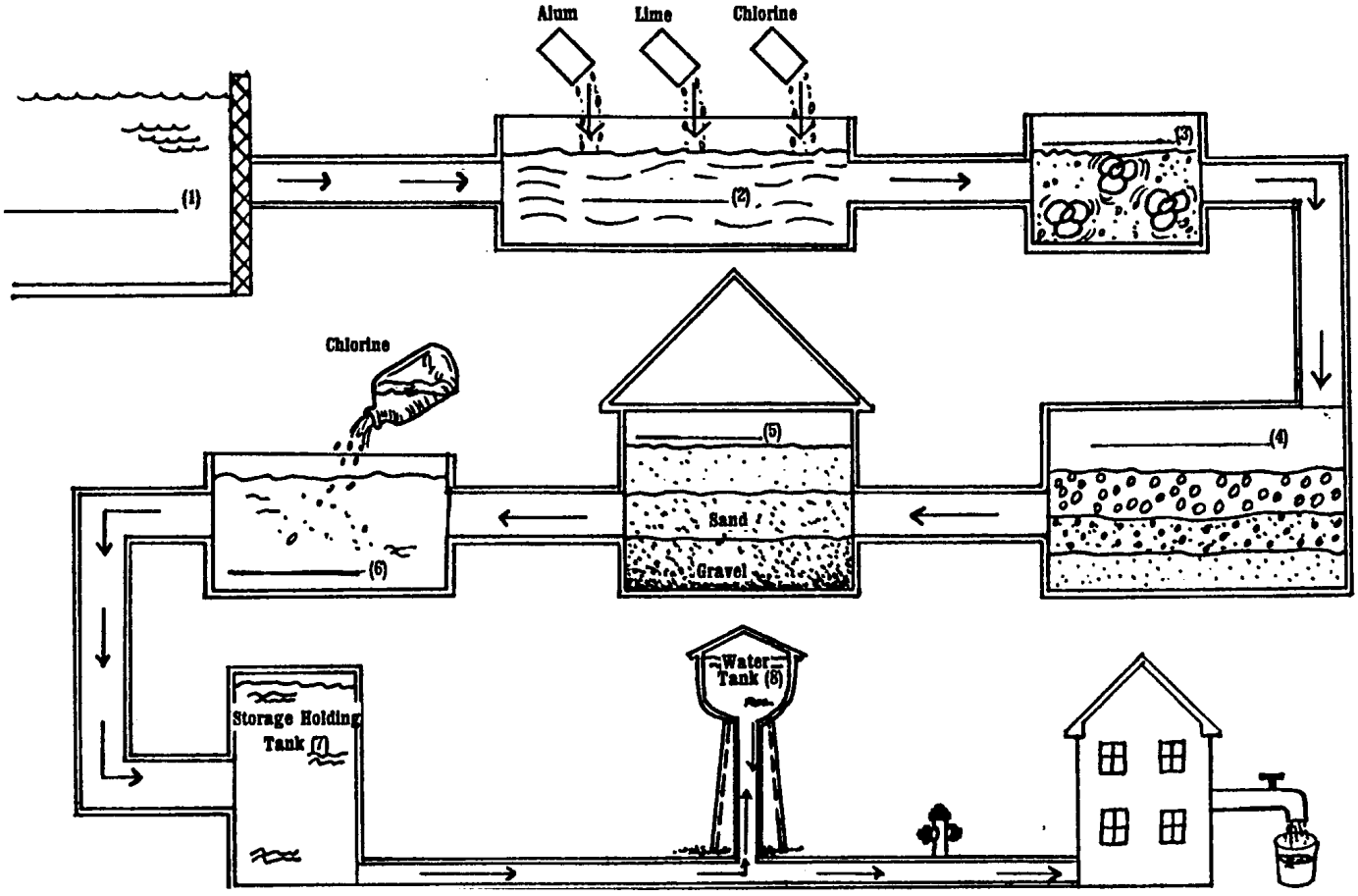
Directions: Using Figure 5.3 as a guide, write the correct letter in the boxes corresponding to the availability of Alabama's groundwater resources.



Source: Moore et al. 1992.

A. Groundwater not available for use
B. High amounts of groundwater present in only certain types of rock.
C. Usually plentiful groundwater supplies, but sometimes contaminated by salt water.
D. Usually low amounts of groundwater present.
E. Usually plentiful groundwater supplies.

WORKSHEET 5.5: The Process of Treating Drinking Water



Match the Step number with the correct process.

Sedimentation Basin **STEP 4** Chemical Addition **STEP 2**

Filtration **STEP 5** Pretreatment Process **STEP 1**

Disinfection **STEP 6** Mixing Chamber **STEP 3**

HOW AM I DOING?

Page	Yes	No	Date
5-3 Practice reading and saying **Words to Remember**			
5-5 Answer **Questions for Review**			
5-5 Answer **Questions for Thought**			
5-10 Read **Fact Sheet**			
5-11 Review **Glossary**			

Page	Possible Score	My Score	Date
5-13 **Worksheet 5.1: Definitions**	16		
5-14 **Worksheet 5.2: Vocabulary (Crossword Puzzle)**	19		
5-15 **Worksheet 5.3: Facts About Where We Get Our Drinking Water**	11		
5-16 **Worksheet 5.4: Groundwater Supplies in Alabama**	5		
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Page	Complete	In-Complete	Date
5-18 **Activity 5.1: Weather Sleuthing**			
5-20 **Activity 5.2: How Treating Water Improves Its Quality**			
5-22 **Activity 5.3: Testing For Impurities From Water Runoff**			
5-24 **Activity 5.4: Treating Water With Chemicals**			
5-27 **Activity 5.5: Wells and Groundwater**			