

# The Tapwater Tour

Code 5972

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Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

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# UNIT 1: Introduction

## Tap Water

Three-fourths of the earth is covered with water. Only 0.8% of this is fresh water and less than one half of that fresh water is available for us to use in our homes. We all take water for granted and use more than you think. The average person uses five gallons of tap water just to brush their teeth! The average family of four uses 300 gallons of tap water each day. Where else is tap water used in your home?

Because water is so important, we have to make sure that it tastes good enough to drink and doesn't damage our plumbing.

Some scientists are water quality scientists. Their job is to test water and adjust it before we drink it. You will be testing your own tap water and other water samples in exactly the same way. You will test for **corrosive** pH, smelly **chlorine**, rusty iron, bitter copper and soap scum hardness. Soon, each of you will become a home drinking water expert.



1. Why might some water taste bad?



**HAND OUT: Research Contracts**

*Remember to bring a tap water sample and research contract tomorrow.*



# Research Contract

The members of \_\_\_\_\_'s class are about to begin an exciting research project on tap water. They will be testing drinking water from their home. Upon completion of this research, they will bring home a report on the quality of the tap water.

Please remind them to collect a tap water sample for [date] \_\_\_\_\_ in the following manner:

**#1**

Rinse out a pint size plastic bottle or jar several times with tap water. [No rusty lids please!]

**#2**

Let the water run for several minutes.

**#3**

Fill the bottle or jar and cap tightly. Write your name on the container.

## Questions

Do you have water from a community source of treated water [water treatment plant] or private ground well water?

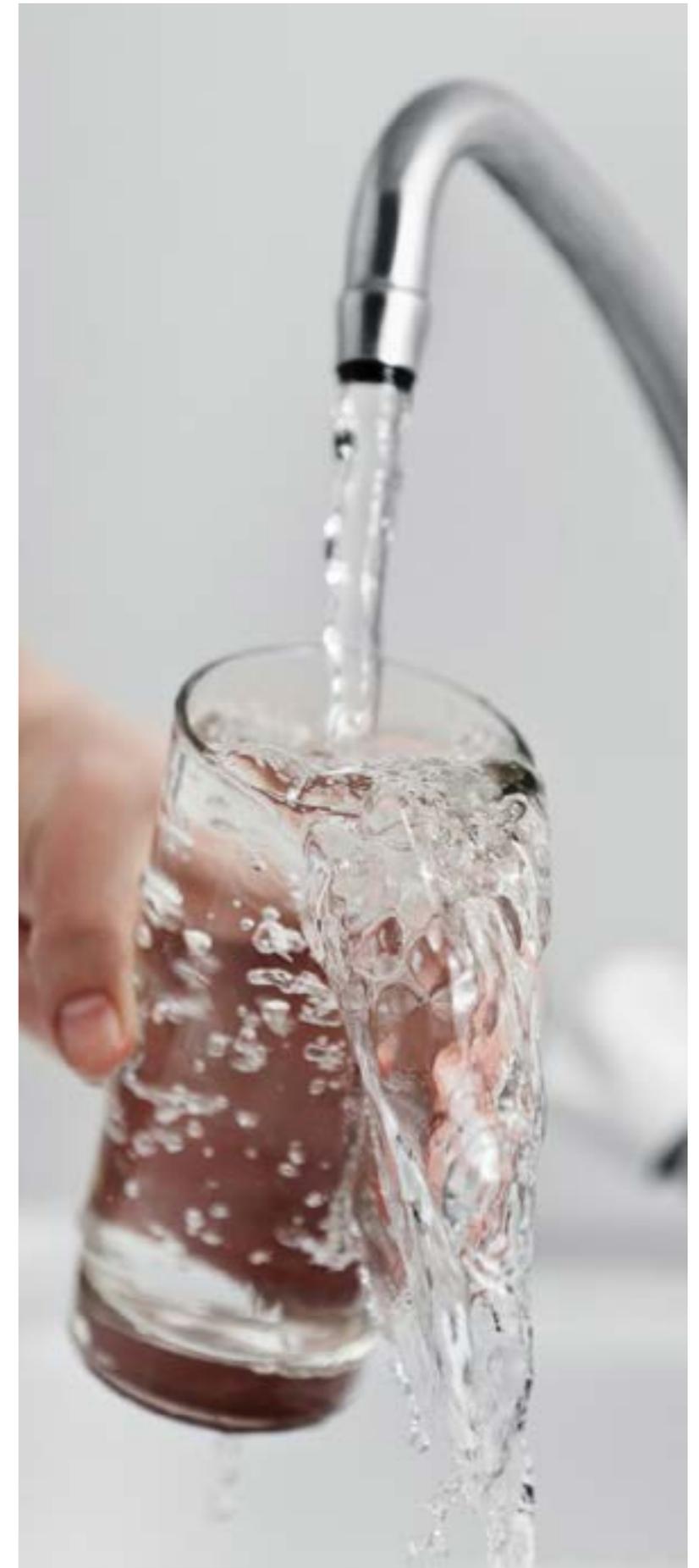
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Do you have a water treatment system in your home?

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Student Signature



# UNIT 2: pH

## What is pH?

**pH** is a measure of how **acidic** or **basic** things are. We assign numbers to things to tell us just how acidic or basic they are. pH is measured on a scale which goes from 0 to 14.

Battery acid is very acidic with a pH of almost zero. Bleach is very basic with a pH of 12.6. pH 7 is at the middle of the scale. This is the neutral pH. That is, it is neither acidic nor basic. **Distilled water** has a pH of 7 because it has no minerals in it. It is pure water.

The pH of water can be influenced by the plants and animals that live in it and the minerals and rocks it flows through.

Strong acids and bases are dangerous. In your home the bleach is probably stored high up in a cabinet so your little brother or sister can't drink it. Weak acids, like lemon juice, and bases, like baking soda, are part of everyday life.

Can you tell, by looking at water, if anything is dissolved in it? Let's do the activity and see.



1. Why do you think the pH of sea water is higher than distilled water?
2. Why does it taste different?
3. What happens when the sun dries sea water on your skin?

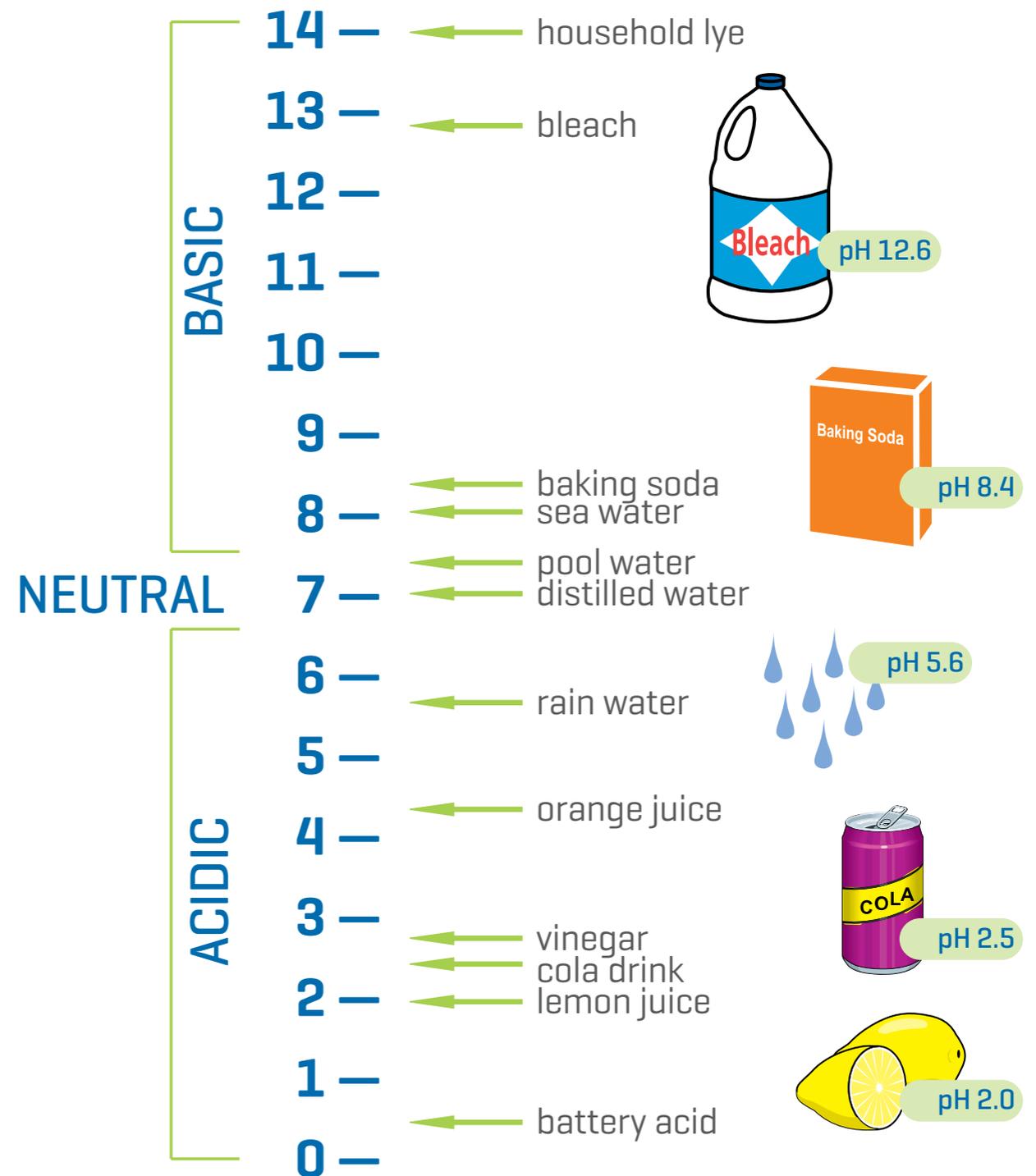


**HAND OUT:** pH Data Sheets, Wide Range pH Tablets (6459A) and sample bags



**HANG UP:** Classroom Data Chart or create a digital Classroom Data Chart

# pH Scale



# pH Data Sheet

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Research Team: \_\_\_\_\_

## pH Activity 1

### pH Sample #1 Result

What was added: \_\_\_\_\_

Color: \_\_\_\_\_

pH: \_\_\_\_\_

### pH Sample #2 Result

What was added: \_\_\_\_\_

Color: \_\_\_\_\_

pH: \_\_\_\_\_

### pH Sample #3 Result

What was added: \_\_\_\_\_

Color: \_\_\_\_\_

pH: \_\_\_\_\_

## pH Activity 2

### My Tap Water Result

Color: \_\_\_\_\_

pH: \_\_\_\_\_



## Classroom Data

Look at the Classroom Data Chart

1. Name one person whose tap water had a pH was greater than 7? \_\_\_\_\_
2. Name one person whose tap water had a pH that was less than 7? \_\_\_\_\_
3. Who had the most acidic water? \_\_\_\_\_
4. Who had the most basic tap water? \_\_\_\_\_

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

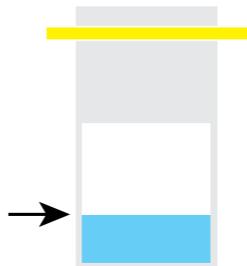
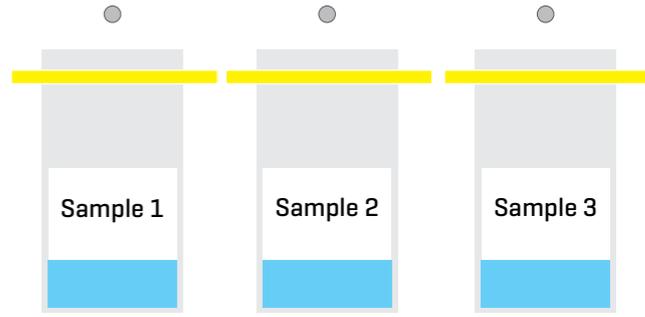
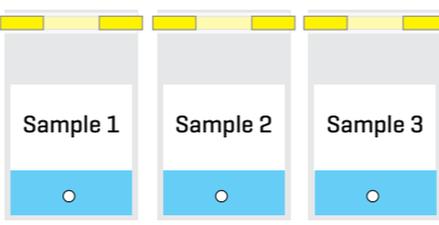
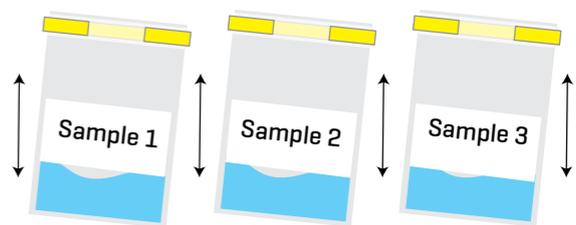
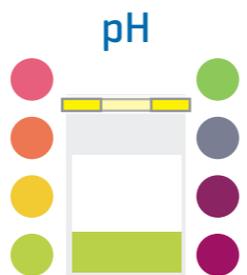
# pH Activity 1

## Sample Preparation

<b>pH Sample #1</b>	Dissolve one teaspoon of baking soda in one quart of distilled water.
<b>pH Sample #2</b>	Add 5 drops of vinegar to one quart of distilled water.
<b>pH Sample #3</b>	Dissolve one aspirin in one quart of distilled water.

Divide into ten groups.

### Test Procedure | pH Samples

<p>1. Have someone in the group fill a bag to <b>the bottom of the white strip</b> with pH <b>Sample #1</b>.</p> <p>Have someone else fill another bag to <b>the bottom of the white strip</b> with pH <b>Sample #2</b>.</p> <p>Have someone else fill another bag to <b>the bottom of the white strip</b> with pH <b>Sample #3</b>.</p>		<p>2. Have someone else remove three Wide Range pH Tablet [6459A] from the packaging and drop one into each bag.</p>	
<p>3. Roll the tops of the bags down 3 times. Fold the yellow tabs around the bag.</p>		<p>4. Hold the tops of the bags. Shake to dissolve the tablets.</p>	
<p>5. Compare the colors of the reactions to the Color Chart Poster. Answer the questions and record the pH result on your pH Data Sheet.</p>		<p>6. Rinse the bags with tap water.</p>	

*Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.*

\*WARNING: Reagents marked with an \* are considered to be potential health hazards. To view or print a Safety Data Sheet [SDS] for these reagents go to [www.lamotte.com](http://www.lamotte.com). Search for the four digit reagent code number listed on the reagent label, in the contents list or in the test procedures. Omit any letter that follows or precedes the four digit code number. For example, if the code is 4450WT-H, search 4450. To obtain a printed copy, contact LaMotte by email, phone or fax. Emergency information for all LaMotte reagents is available from Chem-Tel: [US, 1-800-255-3924] [International, call collect, 813-248-0585].

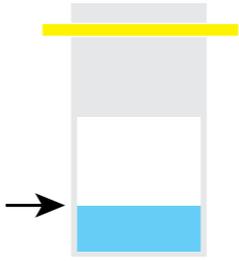
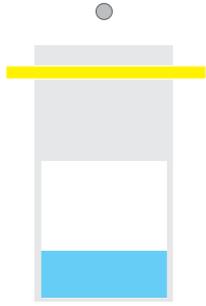
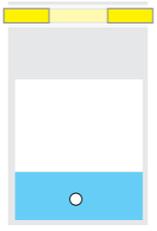
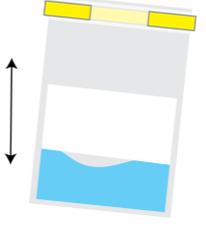
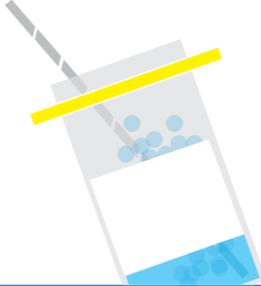


**4. Why do you think everyone's tap water did not have the same pH?**

# pH Activity 2

Divide into ten groups. Give your group a Research Team name.

## Test Procedure | Tap Water

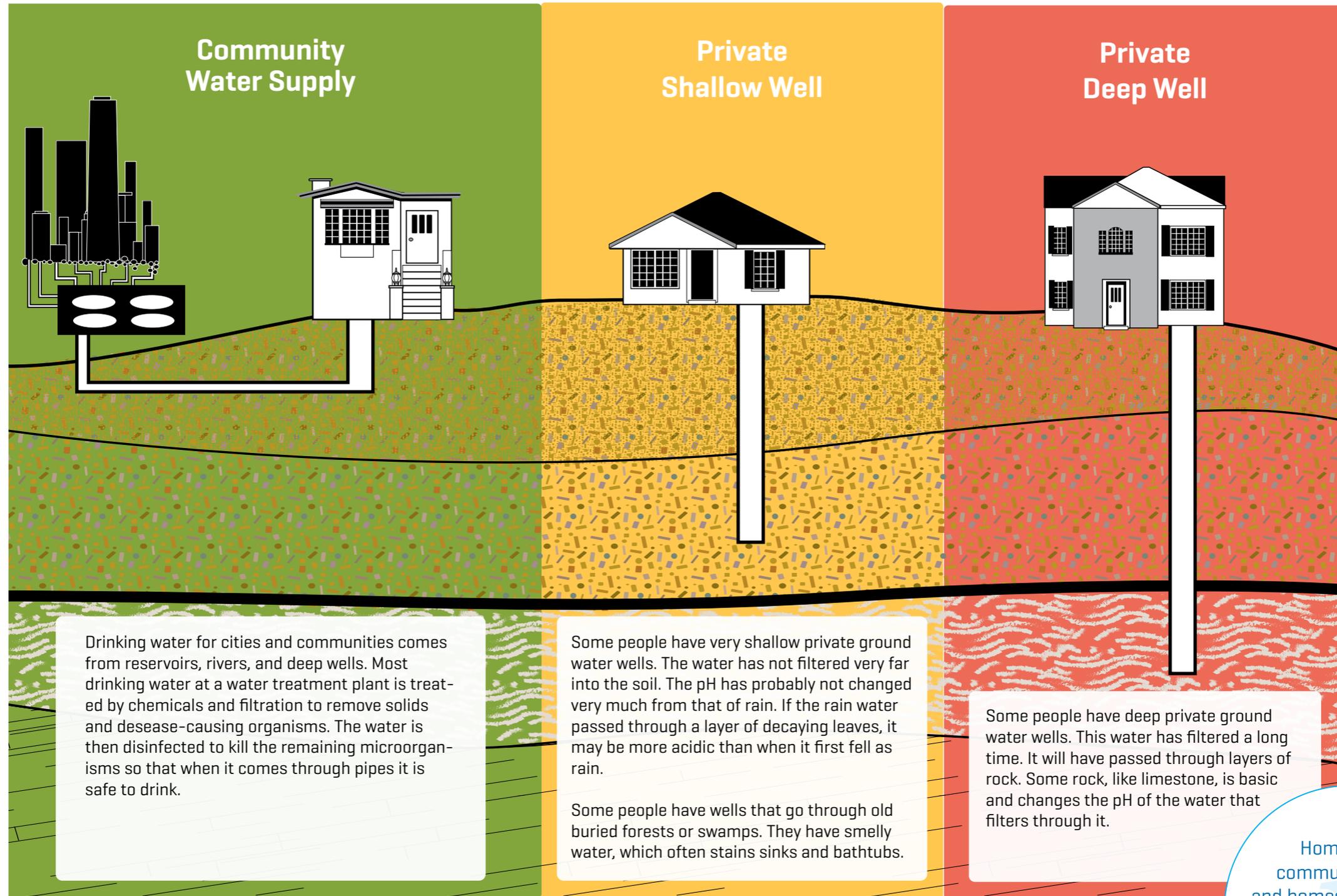
<p>1. Test your own tap water sample. Fill a bag to <b>the bottom of the white strip</b> with your <b>tap water</b>.</p> 	<p>2. Remove one Wide Range pH Tablet (6459A) from the packaging and drop it into the bag.</p> 
<p>3. Roll the top of the bag down 3 times. Fold the yellow tabs around the bag.</p> 	<p>4. Hold the top of the bag. Shake to dissolve the tablet.</p> 
<p>5. Compare the color of the reaction to the Color Chart Poster. Answer the questions and record your pH result on your pH Data Sheet. Record your pH result on the Classroom Data Chart.</p> 	<p>6. Open the bag and gently blow into the sample with a straw for a minute or two. <b>DO NOT</b> drink the liquid.</p> <p><b>Do not drink the solution.</b></p> 
<p>7. Rinse the bag with tap water.</p>	

*Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.*



5. How was the appearance of the sample different after you breathed into it? What does this indicate?
6. What do humans exhale?
7. Do you think **carbon dioxide** gas makes the water more acidic or more basic?

# Where Does Your Tap Water Come From?



Homes with community water and homes with private well water may also have household water treatment systems.

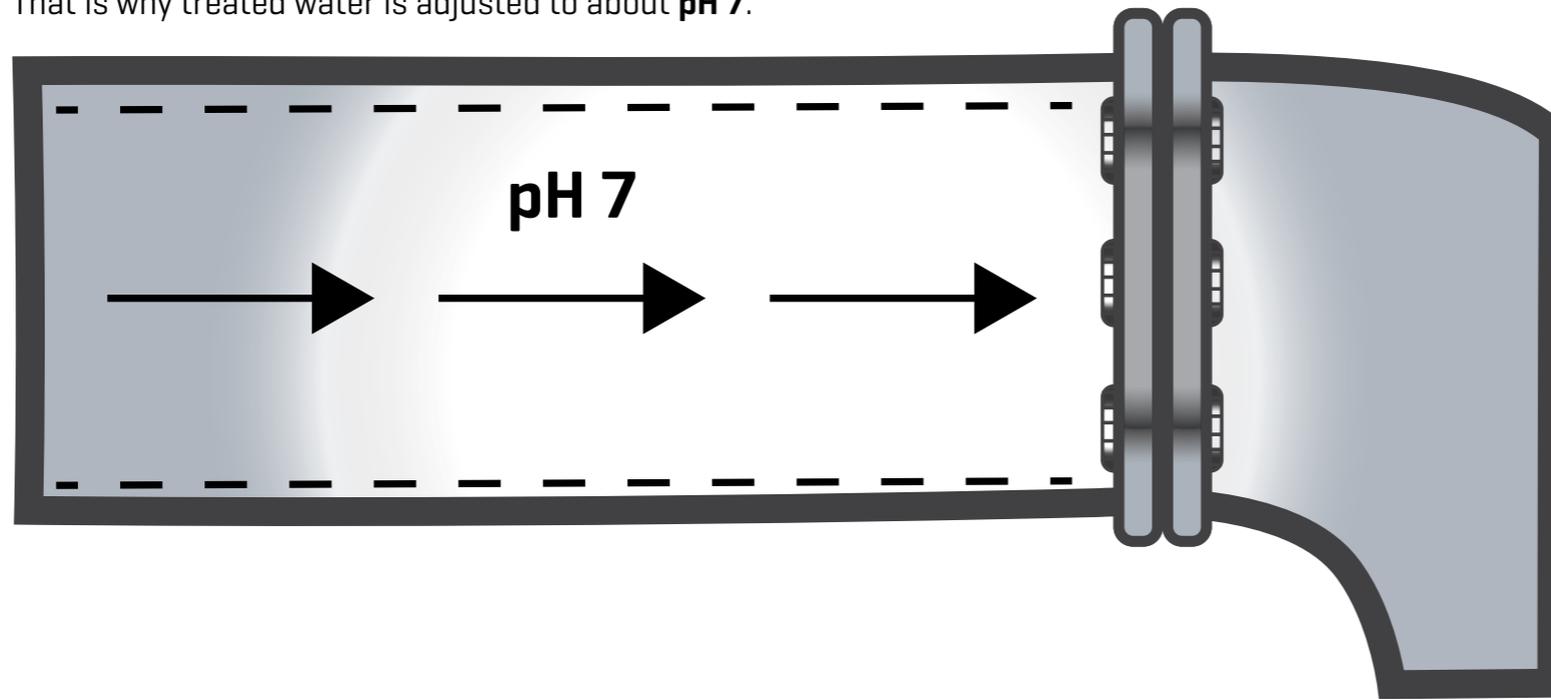


8. Do you think the pH of water in contact with limestone would increase or decrease?
9. What might people who live near the ocean have in their well water water?

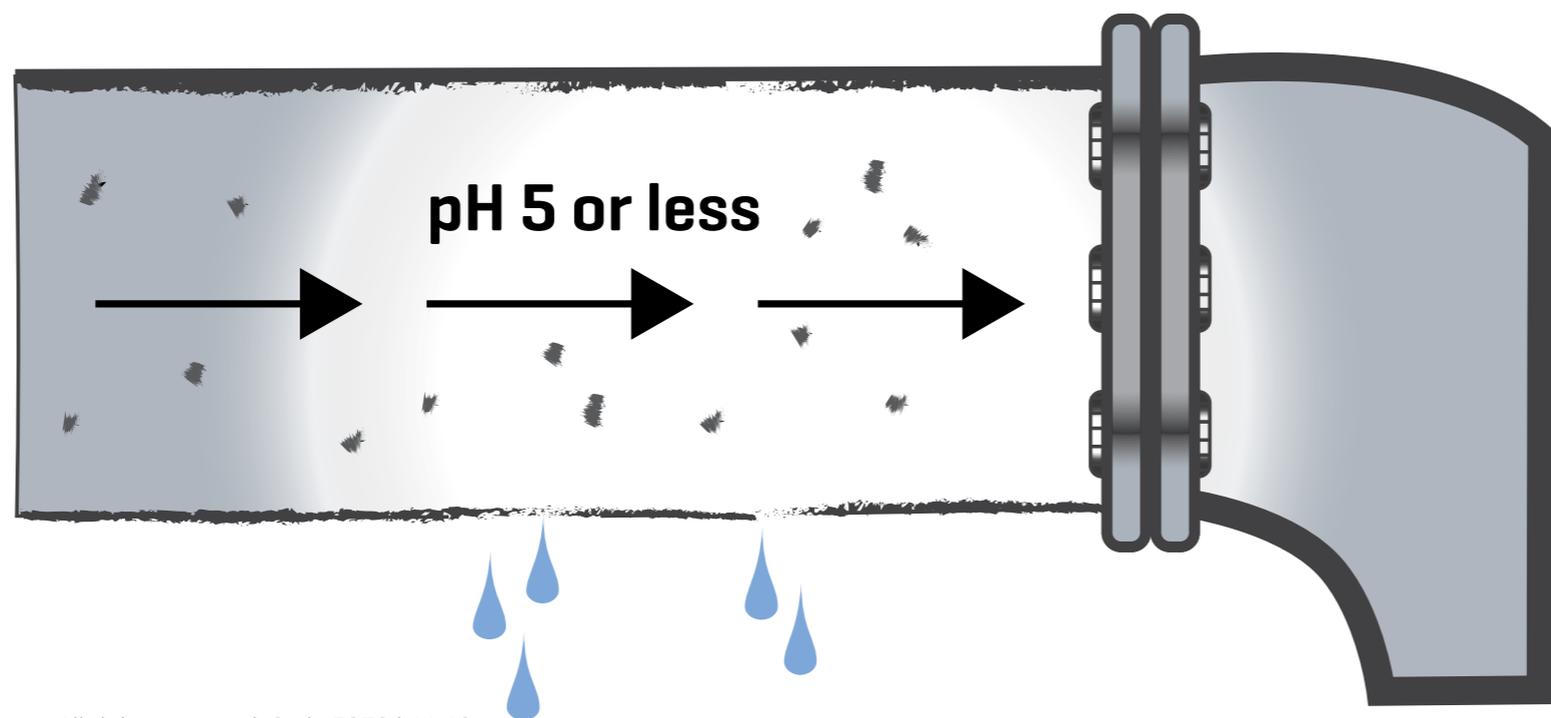
# Why do we test pH?

Water at an incorrect pH can damage pipes and plumbing. This is a very expensive problem.

That is why treated water is adjusted to about **pH 7**.

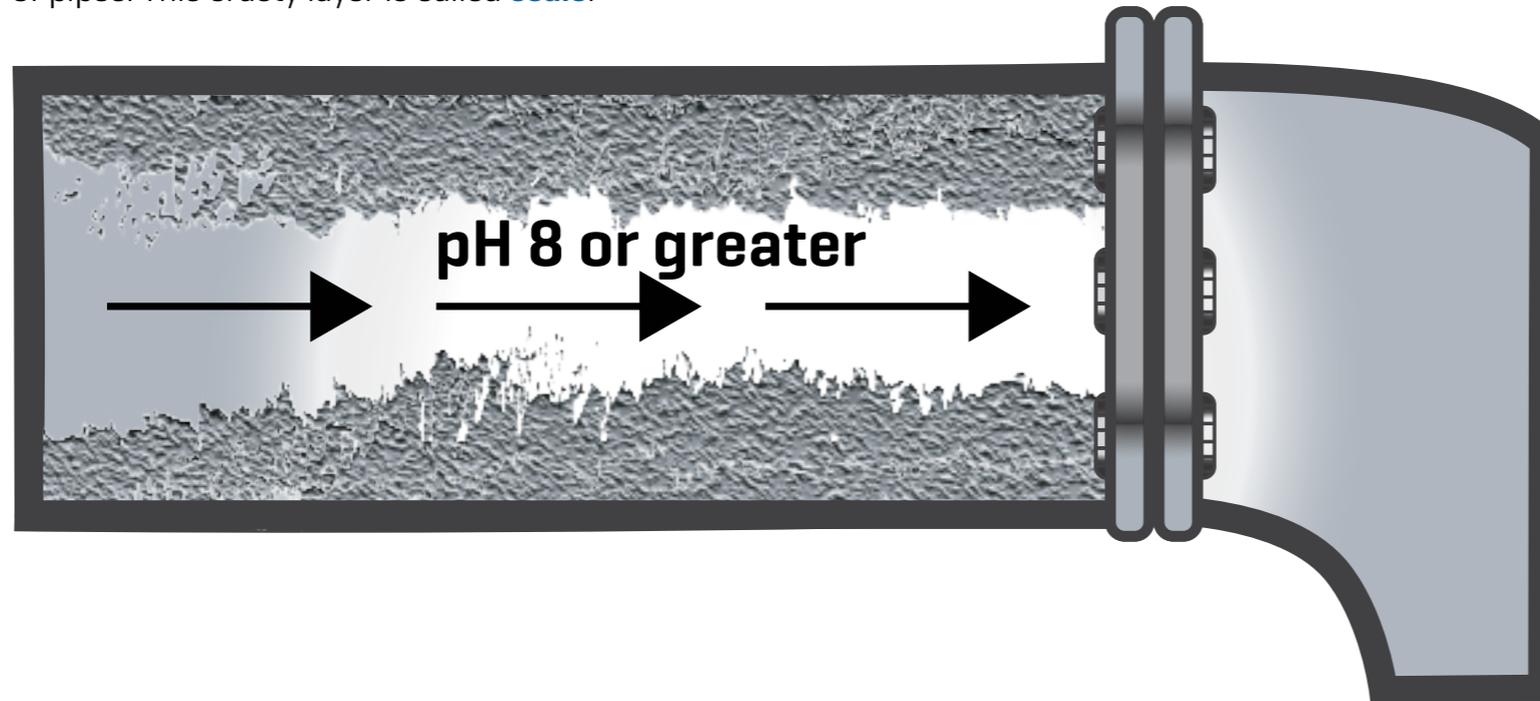


Corrosive water (around **pH 5** or less) will react with the metal pipes in your home and "eat them away". Eventually the pipe will develop a hole in it and it will leak.



# Why do we test pH?

Water which is **pH 8** or greater and contains large amounts of minerals, such as **calcium** and **magnesium**, clogs pipes. A rock-like layer builds on the inside of pipes. This crusty layer is called **scale**.



## HAND OUT: pH Matching Puzzles



Visit the plumbing section of a hardware store and look at the different materials used in plumbing parts. Obtain two copper or brass washers for your experiment.

Place a folded white paper towel on each of two saucers. Moisten one towel with vinegar and one with distilled water. Place a copper or brass washer on each paper towel and cover the saucers tightly with plastic wrap. Check every day and add more vinegar or distilled water if the towels start to get dry. In this experiment, the vinegar [an acid] represents corrosive water and the distilled water is a control. Observe the color of the paper towel and the formation of corrosion on the washers.

Why are different materials recommended for plumbing parts?

Use the same procedure to test other metals used in construction — iron, steel, galvanized steel, zinc plated, stainless steel, aluminum, or painted metal.

Do research to find how acid rain is formed and to learn what metals are used in statues, bridges, and buildings. Find out how metal surfaces can be protected from acid rain. Design an experiment to test the methods of protection.

# pH Matching

Match the question from **Column A** with an answer from **Column B**. Draw a line to connect the matched items if using a tablet. Type the letter of the answer from column B in the space in front of the question in Column A if using a computer.

## Column A

- \_\_\_ 1. its pH is about 2.3
- \_\_\_ 2. a pH value of 7 is \_\_\_\_
- \_\_\_ 3. acidic water is \_\_\_\_
- \_\_\_ 4. bleach is \_\_\_\_
- \_\_\_ 5. the gas that we exhale
- \_\_\_ 6. pure water
- \_\_\_ 7. a rock that changes the pH of water
- \_\_\_ 8. battery acid is \_\_\_\_

## Column B

- a. very acidic
- b. basic
- c. corrosive
- d. distilled water
- e. cola drink
- f. limestone
- g. neutral
- h. carbon dioxide



# UNIT 3: Chlorine

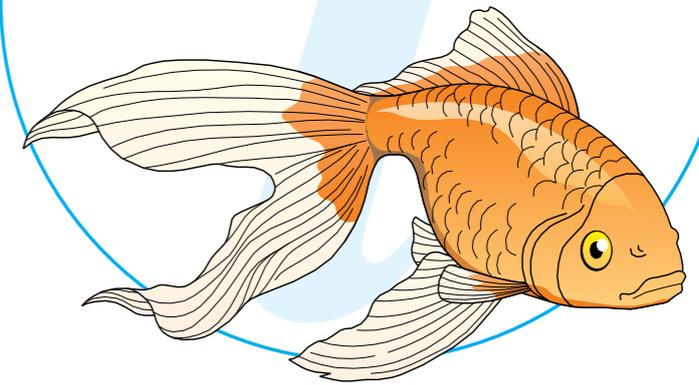
## What is Chlorine?

Chlorine is not found naturally in water. Chlorine is added at community water treatment plants to disinfect the water by killing **bacteria**. Chlorine is the most widely used **disinfectant** because it is effective against a wide range of germs.

Too much chlorine smells and tastes bad and can irritate your skin. It can also kill plants and fish.

The average swimming pool has twice as much chlorine as your drinking water. The bleach your parents add to the laundry has 15,000 times as much chlorine as drinking water.

Chlorine is harmful to fish so you should never fill up an aquarium with water straight from the tap if the tap water contains chlorine. Treatment chemical can remove chlorine from aquarium water before fish are added.



1. Why is chlorine added to drinking water?
2. Why do some people add bleach to their laundry?



1. Pour real pool water (or tap water with chlorine in it) into two shallow bowls. Measure the chlorine level of each sample at the beginning of the experiment and each day thereafter. Choose one sample and put your dirty hand in it each day and splash around like a swimmer. Do not touch the other bowl. Record and graph your daily chlorine measurements.
2. Use a fine net to collect a sample of algae from a stream, fish pond, or aquarium. Divide it into several portions, and add it to samples of distilled water, treated tap water, and pool water. Measure the chlorine level of each sample at the beginning of the experiment and each day thereafter. Record your measurements and observations.



**HAND OUT:** Chlorine Data Sheets, DPD #4R Tablets (6899A), and sample bags.

# Chlorine Data Sheet

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Research Team: \_\_\_\_\_



## Chlorine Activity

### Chlorine Sample #1 Result

How many drops of diluted chlorine bleach were in the water sample?

\_\_\_\_\_

Was the sample pink?

\_\_\_\_\_

What level of chlorine was in the water sample?

\_\_\_\_\_

### Chlorine Sample #2 Result

How many drops of diluted chlorine bleach were in the water sample?

\_\_\_\_\_

Was the sample pink?

\_\_\_\_\_

What level of chlorine was in the water sample?

\_\_\_\_\_

Was there more chlorine in Sample #1 or Sample #2?

\_\_\_\_\_

### My Tap Water Result

Was the reaction pink?

\_\_\_\_\_

Does your tap water contain chlorine?

\_\_\_\_\_

Was the color of your sample closer to the color of Sample #1 or Sample #2?

\_\_\_\_\_

What level of chlorine was in your water sample?

\_\_\_\_\_

## Classroom Data

Look at the Classroom Data Chart

1. Did all of the tap water samples have chlorine in them? \_\_\_\_\_
2. Did the tap water samples with chlorine come from private ground water wells or a community water supplies? \_\_\_\_\_

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

# Chlorine Activity 1

## Sample Preparation

- Chlorine Sample #1**
- Mix one teaspoon [5 mL] of liquid chlorine bleach with three teaspoons [15 mL] of water in a cup.
  - Use an eye dropper to add one drop of this dilute bleach solution to one liter [one quart] of distilled water. This equals about the same amount of chlorine you'll find in the average drinking water.

NOTE: Undiluted bleach is too strong for the tablets. It will bleach out the color of the reaction.

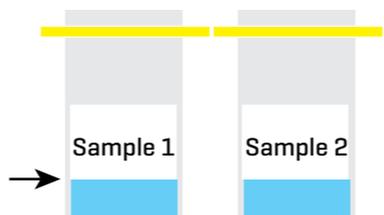
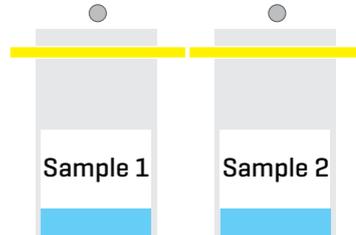
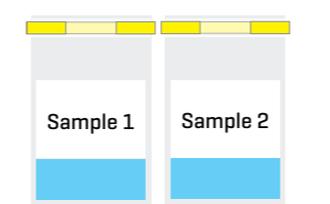
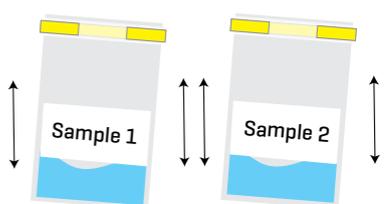
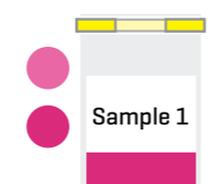
- Chlorine Sample #2**
- Use the eye dropper to add 10 drops of the dilute bleach solution [from step #1 above] to one quart [one liter] of water. This is about the same amount of chlorine you'd find in a hot tub. This is far too much chlorine for drinking water.

+ Chlorine bleach may irritate eyes and skin and damage clothing. Read label before use. Use with care.



Divide into ten groups.

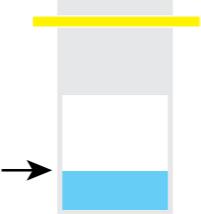
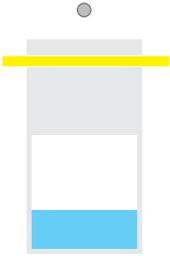
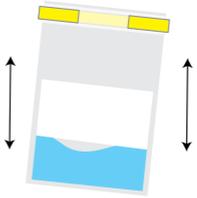
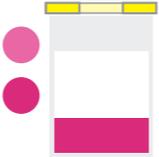
## Test Procedure | Chlorine Samples

<p>1. Have someone in the group fill a bag to <b>the bottom of the white strip</b> with <b>Chlorine Sample #1</b>.</p> <p>Have someone else fill another bag to <b>the bottom of the white strip</b> with <b>Chlorine Sample #2</b>.</p>		<p>2. Have someone else remove two DPD #4 Tablets [6899A] from the packaging and drop one tablet into each bag.</p>	
<p>3. Roll the top of the bags down 3 times. Fold the yellow tabs around the bags.</p>		<p>4. Hold the tops of the bags. Shake to dissolve the tablets.</p>	
<p>5. Compare the color of the reactions to the Color Chart Poster. Answer the questions and record your results on your Chlorine Data Sheet.</p>	<p><b>Chlorine</b></p> 	<p>6. Save the reacted samples to compare to your tap water sample.</p>	

To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.

# Chlorine Activity 2

## Test Procedure | Tap Water

<p>1. Test your own tap water sample. Fill a bag to <b>the bottom of the white strip</b> with your <b>tap water</b>.</p>		<p>2. Remove one DPD #4 Tablet [6899A] from the packaging and drop it into the bag.</p>	
<p>3. Roll the top of the bag down towards you 3 times. Fold the yellow tabs back around the bag.</p>		<p>4. Hold the top of the bag. Shake to dissolve the tablet.</p>	
<p>5. Compare the color of the reaction to the reacted Chlorine Sample #1 and Chlorine Sample #2 bags and the Color Chart Poster. Answer the questions and record your chlorine result on your Chlorine Data Sheet. Record your chlorine result on the Classroom Data Chart.</p>	<p><b>Chlorine</b></p> 	<p>6. Rinse all of the bags with tap water.</p>	

*To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.*



**HAND OUT: Water Scramble Puzzles**

# Water Scramble

Unscramble the letters to make words that appeared in the Chlorine unit.

NHRLIECO \_\_\_\_\_

RSEGM \_\_\_\_\_

TCNFSIIDE \_\_\_\_\_

NIPK \_\_\_\_\_

IAETACBR \_\_\_\_\_

UMMYNOCIT \_\_\_\_\_

ETMSSY \_\_\_\_\_



# UNIT 4: Iron & Copper

## What is Iron?

Iron is found naturally in most water. Too much iron can stain sinks, bath tubs, showers, and clothes. You may have noticed an orange stain where the water drips in your bathtub. A lot of iron will make tap water taste bad.

Sometimes iron metal reacts with oxygen in the air to form rust. Where have you seen rust? To react means to change chemically. In rusting, iron goes from a strong metal to a flaky orange solid.

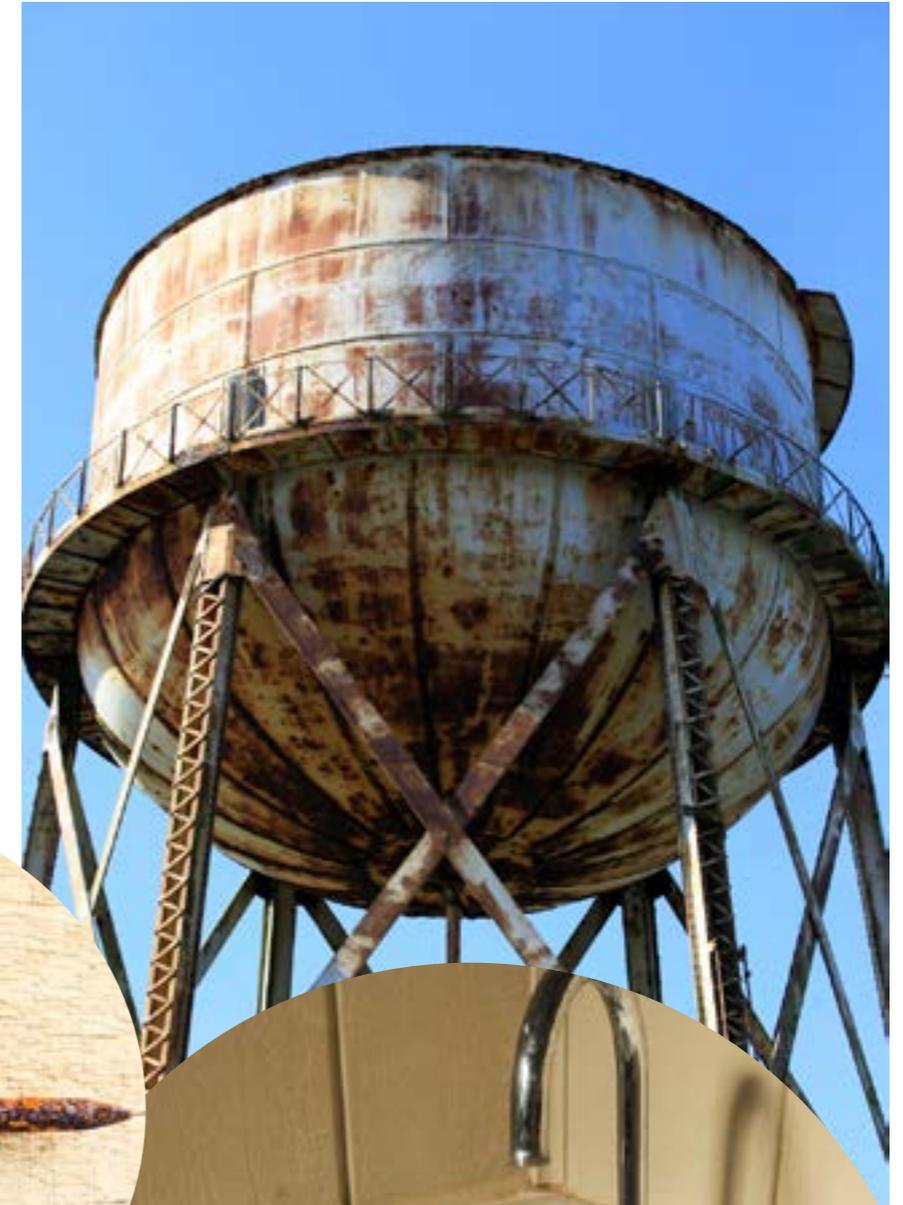
Low pH [acidity] causes **corrosion** of the metal pipes in the water system and in our houses. Water with low pH dissolves metal in the pipes and may result in high iron levels in drinking water. To prevent this from happening, operators of water systems test for dissolved iron in tap water and adjust the pH of our drinking water to be slightly basic. Some people have water treatment systems in their homes to remove iron.



1. Why do you think we remove the colored tablet coating in Step 3 while making Sample #1?
2. What happens to the tablet in Step 4 while making Sample #1? Do you think there is any iron in the water?



**HAND OUT: Iron Data Sheets, \*Iron LR Tablets (3725A), and sample bags.**



# Iron Data Sheet

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Research Team: \_\_\_\_\_



## Iron Activity

### Iron Sample #1 Result

Was the reacted sample purple?

\_\_\_\_\_

What level of iron was in the sample?

\_\_\_\_\_

### Iron Sample #2 Result

Was the reacted sample purple?

\_\_\_\_\_

How much iron was in the sample?

\_\_\_\_\_

Was Sample #1 or Sample #2 darker? Why?

\_\_\_\_\_

### My Tap Water Result

Do you think you have iron?

\_\_\_\_\_

Do you have orange iron stains in your bathroom sink or bathtub?

\_\_\_\_\_

Did your tapwater sample turn purple?

\_\_\_\_\_

What level of iron do you have in your tap water?

\_\_\_\_\_

## Classroom Data

Look at the Classroom Data Chart

1. Whose tap water sample had the highest level of iron? \_\_\_\_\_
2. Do the homes with high levels of iron in the tap water have orange iron stains on the sinks, bathtubs, showers, clothes, or dishwasher? \_\_\_\_\_
3. What is the pH of their tap water? \_\_\_\_\_

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

# Iron Activity 1

## Sample Preparation

- Iron Sample #1**
1. Fill one quart container with distilled water. Leave one empty.
  2. Put one iron supplement tablet in a cup and add 3 teaspoons [15 mL] of distilled water.
  3. Swirl to dissolve the tablet coating.
  4. Put your uncoated tablet in 1 quart [1 liter] of distilled water. Mix for 30 seconds.
  5. Promptly pour the water into the empty container. Be careful not to pour in the iron supplement tablet.
- 
- Iron Sample #2**
1. Measure out  $\frac{1}{2}$  cup of sample #1.
  2. Put it in an empty, clean, 1 quart container.
  3. Fill the container with distilled water.

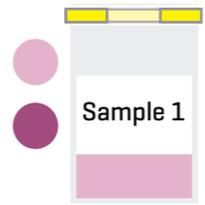
+ \*Iron LR tablets [3725] may irritate skin. Avoid handling tablets with wet hands.

Divide into ten groups.



## Test Procedure | Iron Samples

<p>Have someone in the group fill a bag to <b>the bottom of the white strip</b> with <b>Iron Sample #1</b>.</p> <p>Have someone else fill another bag to <b>the bottom of the white strip</b> with <b>Iron Sample #2</b>.</p>	<p>4. Have someone else remove two *Iron LR Tablets [3725A] from the packaging and drop one tablet into each bag.</p>
<p>5. Roll the top of the bags down 3 times. Fold the yellow tabs around the bags.</p>	<p>6. Hold the tops of the bags. Shake to dissolve the tablets.</p>

<p>5. Compare the color of the reaction to the Color Chart Poster. Answer the questions and record your results on your Iron Data Sheet.</p>	<p>Iron</p> 	<p>6. Rinse bags with tap water.</p>
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To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.

## Iron Activity 2

### Test Procedure | Tap Water

<p>1. Test your own tap water sample for iron. Fill a bag to <b>the bottom of the white strip</b> with your <b>tap water</b>.</p>	<p>2. Remove one *Iron LR Tablet [3725A] from the packaging and drop it into the bag.</p>
<p>3. Roll the top of the bag down 3 times. Fold the yellow tabs around the bag.</p>	<p>4. Hold the top of the bag. Shake to dissolve the tablet.</p>
<p>5. Compare the color of the reaction to the Color Chart Poster. Answer the questions and record your iron result on the Iron Data Sheet. Record your iron result on the Classroom Data Chart.</p>	<p>6. Rinse the bag with tap water.</p>

To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.

# What is Copper?

Small amounts of copper are found in natural water. Sometimes people put copper in water to control **algae**. Algae in water supply reservoirs can cause drinking water to taste or smell bad. Copper can also dissolve in your water from copper pipes and fittings. Only acidic water dissolves copper from the inside surface of pipes.

People who have copper in their water sometimes have blue-green stains in their bathtub, showers, sinks, and swimming pools. Copper may make tap water taste bitter.



Place a penny in vinegar. Check it several times a week. The acidic vinegar will eventually dissolve some of the copper. If enough copper dissolves, the solution will become blue. This demonstrates how acidic waters can dissolve metals out of pipes.



**HAND OUT:** [Copper Data Sheets](#), \*Copper HR Tablets [3701A], and sample bags.

# Copper Data Sheet

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Research Team: \_\_\_\_\_



## Copper Activity

### My Tap Water

Do you think you have copper in your tap water?

\_\_\_\_\_

What is the pH?

\_\_\_\_\_

Do you have acidic water?

\_\_\_\_\_

Do you have blue-green stains in your bathtub or sinks?

\_\_\_\_\_

What color was the reacted sample?

\_\_\_\_\_

What level of copper do you have in your tap water?

\_\_\_\_\_

## Classroom Data

Look at the Classroom Data Chart

1. Whose tap water had the highest level of copper? \_\_\_\_\_
2. Do the homes with high levels of copper in the tap water have blue-green stains in the sink, showers and bathtubs? \_\_\_\_\_
3. What is the pH of their tap water? \_\_\_\_\_

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

# Copper Activity

Divide into ten groups.

## Test Procedure | Tap Water

<p>1. Test your own tap water sample. Fill a bag to <b>the bottom of the white strip</b> with your <b>tap water</b>.</p>	<p>2. Remove one Copper HR Tablet [3701A] from the packaging and drop it into the bag.</p>
<p>3. Roll the top of the bag down 3 times. Fold the yellow tabs around the bag.</p>	<p>4. Hold the top of the bag. Shake to dissolve the tablet.</p>
<p>5. Compare the color of the reaction with the Color Chart Poster. Answer the questions and record your Copper result on your Copper Data Sheet. Record your copper result on the Classroom Data Chart.</p>	<p>6. Rinse the bag with tap water.</p>

*To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.*



**HAND OUT:** [Water Word Search Puzzles](#)

# Water Word Search

Circle the words with the pencil tool or select a letter by clicking the checkbox above that letter.

M	E	T	A	L	N	Q	C	H	M	N	E	I
Q	R	L	U	T	A	B	L	E	T	G	B	I
I	N	D	I	C	A	T	O	R	N	Z	M	R
A	F	G	T	A	V	E	D	A	S	N	K	O
C	O	N	C	E	N	T	R	A	T	I	O	N
I	J	X	O	R	B	O	P	L	S	M	B	D
D	Y	P	P	S	T	A	I	N	U	D	I	T
P	O	W	P	A	W	S	P	E	R	R	F	C
B	L	U	E	G	R	E	E	N	K	I	J	G
Z	Y	I	R	A	Q	P	S	A	M	P	L	E
D	I	S	S	O	L	V	E	D	H	R	U	V



ACID  
BLUE GREEN

CONCENTRATION  
DISSOLVED

DRIP  
INDICATOR

IRON  
METAL

ORANGE  
PIPES

REACT  
RUST

SAMPLE  
STAIN

TABLET

# UNIT 5: Hardness

## What is Hardness?

“Hardness” is a measure of the amount of calcium and magnesium in water. Calcium and magnesium are minerals that get into water when rocks above and below the ground dissolve. Rocks such as sandstone and limestone, which contain large amounts of calcium and magnesium, dissolve easily to produce hard water.

**Hard water** leaves deposits of calcium and magnesium in pipes, heaters, and appliances. The deposits, called “scale”, clog openings and reduce the flow of water through pipes. Hard water reduces the amount of sudsing from soap, leaves a film on clean dishes and clothes, and causes a buildup of white deposits on cooking pots and coffee makers.

A **water softener** removes calcium and magnesium from water, making it softer. The minerals in water softeners replace the calcium and magnesium with minerals which do not form scale deposits.

Water with little or no dissolved minerals is called “soft” water. Soft water is very good at dissolving materials and for cleaning. Distilled water, containing no dissolved material, is an example of very soft water. Rain and melted snow are also very soft.

When soft water contacts surfaces containing calcium or magnesium, such as plaster swimming pool walls, it dissolves the plaster material and may damage the surface. Swimming pool operators add chemicals to soft water to raise hardness levels and protect the pool walls. They adjust the pH of the pool water for the same reason. Industrial and drinking water systems must also be monitored and treated so soft water does not dissolve metal surfaces and hard water does not form deposits or scale.



**HAND OUT: Hardness Data Sheets, \*Hardness T Tablets (6917A) and sample bags.**

# Hardness Data Sheet

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

Research Team: \_\_\_\_\_

## Hardness Activity 1

### My Tap Water

Does the bathtub or shower get a soapy scum ring?

\_\_\_\_\_

Based on the presence or absence of a soap scum ring, did you think your tap water is hard or soft?

\_\_\_\_\_

What color was the reacted sample?

\_\_\_\_\_

Did the test result show that your tap water is hard or soft?

\_\_\_\_\_

## Hardness Activity 2

### Bubble Test

Who's hard water sample did you use?

\_\_\_\_\_

How many drops of soap did the distilled water take to make bubbles?

\_\_\_\_\_

How many drops of soap did the hard water sample take to make bubbles?

\_\_\_\_\_



Did the hard water sample or the distilled water sample take more drops of soap to make bubbles?

\_\_\_\_\_

Is distilled water soft?

\_\_\_\_\_

## Classroom Data

Look at the Classroom Data Chart

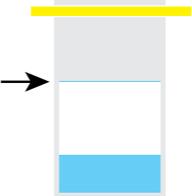
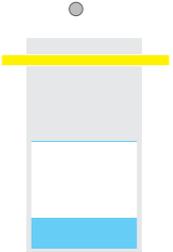
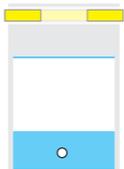
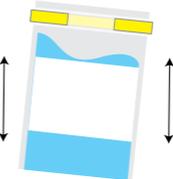
1. Name one person whose tap water was hard? \_\_\_\_\_
2. Name one person whose tap water was soft? \_\_\_\_\_
3. Which of your classmates need more shampoo to get soap bubbles when they wash their hair? \_\_\_\_\_
4. Was their tap water from a private well or community water system? \_\_\_\_\_

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

## Hardness Activity 1

Divide into ten groups.

### Test Procedure | Tap Water

<p>1. Test your own tap water sample. Fill a bag to <b>the top of the white strip</b> with your <b>tap water</b>.</p> 	<p>2. Remove one *Hardness T Tablet (6917A) from the packaging and drop it tablet into the bag.</p> 
<p>3. Roll the top of the bag down 2 times. Fold the yellow tabs around the bag.</p> 	<p>4. Hold the top of the bag. Shake to dissolve the tablet.</p> 
<p>5. Compare the color of the reaction with the Color Chart Poster. Answer the questions and record your hardness result on your Hardness Data Sheet. Record your hardness result on the Classroom Data Chart.</p> 	<p>6. Rinse the bag with tap water.</p>

*To avoid touching tablets, push the tablet through the foil into the bag. Do not pinch or squeeze the tablets when they are in the bag or the bag may be damaged.*

The ring in your bathtub is formed when soap reacts with the calcium and magnesium in tap water. If the soap is reacting with calcium and magnesium, it gets all used up and it can't remove dirt. It might take twice as much shampoo to wash your hair in hard water as in soft water.



**1. What tasks might use more soap if you had hard water?**



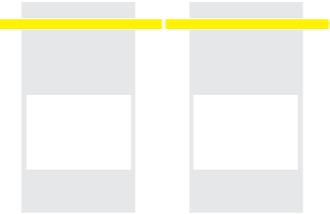
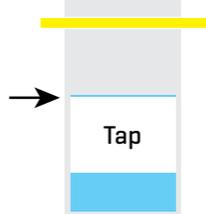
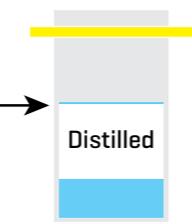
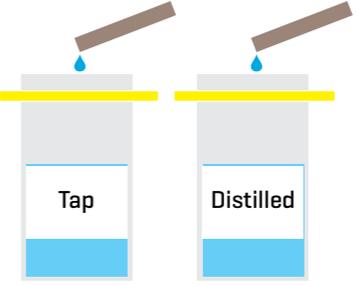
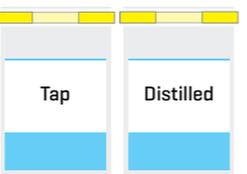
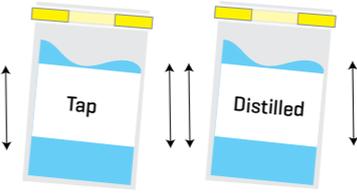
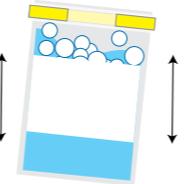
1. Get a sample of very hard water. Use seawater collected at the beach or get a sample of salt water from a tropical fish store. Put the sample in a clean glass or jar. Put an equal amount of distilled water in a second glass or jar. Leave both containers in a warm dry place and allow the water samples to evaporate. Observe the results.

2. If you have a tea kettle, coffee maker or vaporizer, ask an adult to help you look for scale or deposits inside them. Collect the scale and experiment by using drops of distilled water, tap water, and vinegar to try to dissolve it.

# Hardness Activity 2

## Bubble Test

 Test Procedure | Hard Tap Water

<p>1. Have someone get two bags for the team.</p> 	<p>Look at the Classroom Data Chart to determine who in your group had the tap water with the greatest hardness.</p> <p>Have someone else fill one bag to <b>the top of the white strip</b> with the <b>hard tap water sample.**</b></p> 
<p>2. Have someone else fill the other bag to <b>the top of the white strip</b> with <b>distilled water</b>.</p> 	<p>3. Have someone else use the cardboard strip to add one drop of soap to each bag. [They may need to practice making drops.]</p> 
<p>4. Roll the tops of the bags down 2 times. Fold the yellow tabs around the bags.</p> 	<p>5. Hold the tops of the bags and shake. Are there bubbles in the bags? If not, add one more drop of soap to the sample that doesn't have bubbles yet. Shake.</p> 
<p>6. If there still are no bubbles, keep adding soap one drop at a time and shake after each drop. Do this until there are bubbles. Record the number of drops of soap that was needed to for each sample to form bubbles on your Hardness Data Sheet.</p> 	<p>7. Rinse the bags with tap water.</p>

**\*\*If no one has hard tap water try using bottled mineral water.**



2. Would you have to use more soap in hard water or soft water if you were washing a dog?



**HAND OUT:**  
Bubblegram Puzzles



# Bubblegram

1 \_\_\_\_\_ ○ \_\_\_\_\_

2 \_\_\_\_\_ ○ \_\_\_\_\_

3 \_\_\_\_\_ ○ \_\_\_\_\_

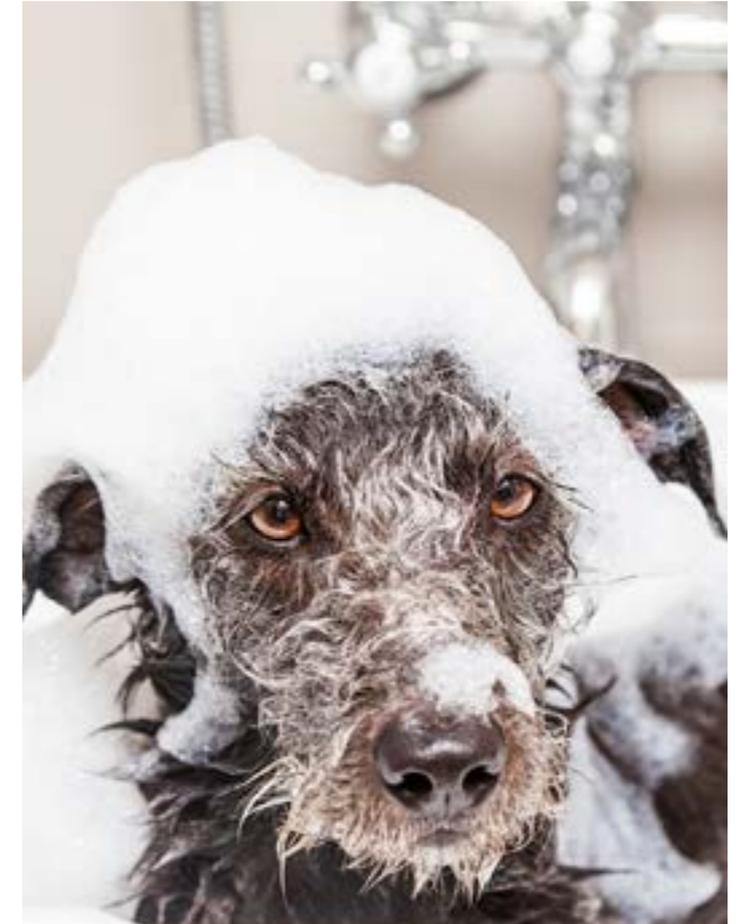
4 \_\_\_\_\_ ○ \_\_\_\_\_

5 \_\_\_\_\_ ○ \_\_\_\_\_

6 \_\_\_\_\_ ○ \_\_\_\_\_

7 \_\_\_\_\_ ○ \_\_\_\_\_

8 \_\_\_\_\_ ○ \_\_\_\_\_



1. Place where the combination of hard water and soap make a dirty ring.
2. \_\_\_\_\_ and magnesium are minerals that make water hard.
3. \_\_\_\_\_ water takes more soap to produce bubbles.
4. Minerals that \_\_\_\_\_ in water make it hard.
5. Calcium and \_\_\_\_\_ are minerals that make water hard.
6. Calcium and magnesium are \_\_\_\_\_.
7. The crusty stuff that clogs up pipes.
8. It stings when it gets into your eyes.

# UNIT 6: Summary

## Taste Test

Put some distilled water into a clean cup. Pour tap water in another clean cup. Taste them.

**Do they taste different?** \_\_\_\_\_

**Why?** \_\_\_\_\_

**Which one tastes better to you?** \_\_\_\_\_



**HAND OUT: Crossword Puzzles and Water Quality Report.**

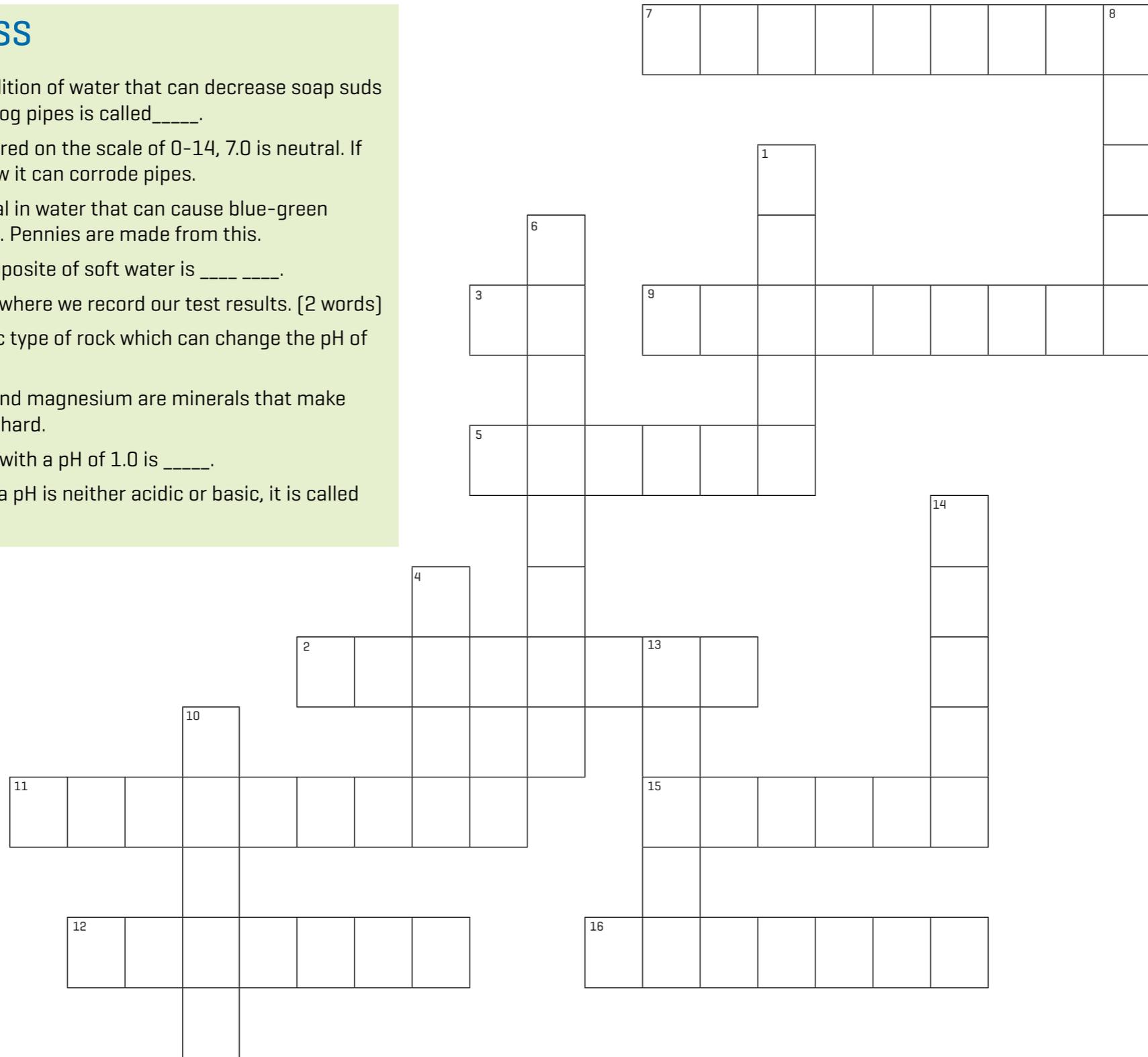
Summarize the Tapwater Tour by filling out your Water Quality Report.



# Crossword Puzzle

## ACROSS

2. A condition of water that can decrease soap suds and clog pipes is called\_\_\_\_\_.
3. Measured on the scale of 0-14, 7.0 is neutral. If too low it can corrode pipes.
5. A metal in water that can cause blue-green stains. Pennies are made from this.
7. The opposite of soft water is \_\_\_\_\_.
9. Paper where we record our test results. [2 words]
11. A basic type of rock which can change the pH of water.
12. \_\_\_\_\_and magnesium are minerals that make water hard.
15. Water with a pH of 1.0 is \_\_\_\_\_.
16. When a pH is neither acidic or basic, it is called \_\_\_\_\_.



## DOWN

1. Three fourths of the earth is covered with \_\_\_\_.
4. A metal dissolved in water can cause this orange stain.
6. A substance added to tap water, swimming pools, and laundry to make water safe.
8. Iron metal will \_\_\_\_\_ with oxygen to form rust.
10. A source of water; some are shallow, some are deep.
13. Crusty stuff on the inside of some pipes.
14. Water with a pH of 14.0 is \_\_\_\_\_.



# Water Quality Report

Scientist's Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Questions

1. Where do we get tap water?

\_\_\_\_\_

2. Where do we use tap water?

\_\_\_\_\_

3. How do these factors affect the characteristics of tap water?

- pH \_\_\_\_\_
- Chlorine \_\_\_\_\_
- Iron \_\_\_\_\_
- Copper \_\_\_\_\_
- Hardness \_\_\_\_\_

## My Tap Water

### Test Results

What is the pH of your tap water?

\_\_\_\_\_

Look at the pH Scale. Which example has a pH closest to the pH of your tap water?

\_\_\_\_\_

What results did you get for the following tests?

Chlorine    no    yes    Level

Iron        no    yes    Level

Copper     no    yes    Level

Hardness    Hard    Soft

### Questions

1. Does your tap water come from a community water supply or a private well?

\_\_\_\_\_

2. Did you find something in your water that you didn't expect? What?

\_\_\_\_\_

3. Did you expect to find something in your water that you didn't find after all? What? What made you think it was there? [Example: colored stains, smells, etc.]

\_\_\_\_\_

Clear All Forms

Warning: This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

# Water Words

- **Acidic**            see pH
- **Algae**             Simple rootless plants that grow in sunlit waters in relative proportion to the amount of nutrients available. They can affect water quality adversely by lowering the dissolved oxygen in the water. They are food for small aquatic fish and animals.
- **Bacteria**          Microscopic living organisms. Some can cause disease.
- **Basic**                see pH
- **Calcium**            A naturally occurring metal which is found in limestone, chalk and gypsum. Calcium in water contributes to the overall hardness.
- **Carbon Dioxide [CO<sub>2</sub>]**    A colorless, odorless, non-poisonous gas, which results from fossil fuel combustion and is normally a part of ambient air.
- **Chlorine**            Added to disinfect water by destroying bacteria and algae.
- **Corrosive**           Having the tendency to deteriorate metal parts which are slowly eaten away by oxidation or rusting.
- **Corrosion**          The process where metal parts are slowly eaten away by oxidation or rusting. Corrosion usually occurs when oxygen comes into contact with metal surfaces.
- **Disinfectant**        A substance that kills pathogenic organisms in water by a chemical or physical process. Chlorine is often added to disinfect sewage treatment effluent, drinking water supplies, wells and swimming pools.
- **Distilled Water**     Water that has been purified by the process of boiling so that the steam condenses to a pure liquid and the pollutants remain in a concentrated residue.
- **Evaporate**          To change from a liquid to a gas or vapor.

- **Hard Water**        Alkaline water containing dissolved salts that interfere with some industrial processes and prevent soap from lathering.
- **Magnesium**        A naturally occurring metal. Magnesium in water contributes to the overall hardness.
- **pH**                    Based on the number of hydrogen ions there are in a substance. A pH scale from 1-14 is used to define whether a substance is acidic, basic, or neutral. The midpoint of the scale 7.0 indicates a neutral substance, readings below 7.0 are acidic and readings above 7.0 are basic.
- **Scale**                 Crusts or flakes which are deposited on the surface of metal parts, often composed of calcium and magnesium.
- **Water Softener**     Special devices which remove minerals such as calcium and magnesium from the water supply.



Click on the word to go to page where it appears.





## Links

### Interactive Water Games and Activities

Environmental Protection Agency

<https://www3.epa.gov/safewater/kids/gamesandactivities.html>

### Drinking Water Bloopers

Environmental Protection Agency

<https://www3.epa.gov/safewater/kids/bloopers.html>

### Drinking Water Activities for Students and Teachers

Environmental Protection Agency

<https://www3.epa.gov/safewater/kids/bloopers.html>

### Water Science School

US Geological Society

<https://water.usgs.gov/edu/>

### Water Education Poster, Quizzes, Plays and Surveys

US Geological Society

<https://water.usgs.gov/edu/teachers-water.html>

### Compare your Drinking Water Taste to Drinking Water from Around the World

US Geological Society

<https://water.usgs.gov/edu/activity-watertaste.html>

### The Story of Drinking Water

American Water Works Association – Kids Place

<http://www.drinktap.org/kids-place/the-story-of-drinking-water.aspx>

### Water Videos

American Water Works Association – Kids Place

<http://www.drinktap.org/kids-place/water-videos.aspx>

### Drinking Water Standards and Regulations

Environmental Protection Agency

<https://www.epa.gov/dwstandardsregulations>

### Groundwater Tools, Resources, Ideas and Activities

The Groundwater Foundation

<http://www.groundwater.org/kids/welcome.html>