The Tapwater Tour

Setting Up The Tour | For the Instructor

Code 5972

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.

Preface

The goal of the Tapwater Tour is to have students discover their tap water for what it really is. The reagent systems used are uniquely designed to be safe, simple, and valid.

The tablets included in this kit are the same tablets used by professional water analysts. Since this method does not require sophisticated measuring devices, the tablet reactions can be explained in simple scientific terms. They are never interpreted as magic tricks.

Real Science

The Tour can be presented to your whole class or students can take the Tour individually at their own pace. Thought provoking questions and puzzles are scattered throughout and answers are provided in the answer key.

This Tour introduces students to scientific thought while stimulating curiousity and enthusiasm. "Hands-on" active participation in this lab leads to:

Cognitive Domain	Processes
Observation	Defining | Enumerating
Analysis	Organizing | Comparing
Evaluation	Judging | Choosing
Comprehension	Describing | Interpreting
Application	Applying | Generalizations | Summarizing

Line 'em up for the Tapwater Tour!

Outline

Setting Up the Tour | For the Instructor

UNIT 1 | Introduction
DISCUSSION: Tap Water
HANDOUT: Research Contracts
INTRODUCTION ACTIVITY: Request for home water samples

UNIT 2 | pH
DISCUSSION: What is pH?
HANDOUT: pH Data Sheets
HANG UP: Classroom Data Chart
pH ACTIVITY 1: Test pH-Prepared Water Samples
pH ACTIVITY 2: Test pH-Tap Water Samples & Carbon Dioxide in Water
DISCUSSION: Where Does Your Tap Water Come From?
DISCUSSION: Why Do We Test pH?
HANDOUT: pH Matching Puzzles

UNIT 3 | Chlorine
DISCUSSION: What is Chlorine?
HANDOUT: Chlorine Data Sheets
CHLORINE ACTIVITY 1: Chlorine Test-Prepared Samples
CHLORINE ACTIVITY 2: Chlorine Test-Tap Water Samples
HANDOUT: Water Scramble Puzzles

UNIT 4 | Iron & Copper
DISCUSSION: What is Iron?
HANDOUT: Iron Data Sheets
IRON ACTIVITY 1: Iron Test-Prepared Samples
IRON ACTIVITY 2: Iron Test-Tap of Water Samples
DISCUSSION: What is Copper?
HANDOUT: Copper Data Sheets
COPPER ACTIVITY: Copper Test-Tap Water Samples
HANDOUT: Water Word Search Puzzles

UNIT 5 | Hardness
DISCUSSION: What is Hardness?
HANDOUT: Hardness Data Sheets
HARDNESS ACTIVITY 1: Hardness Test-Tap Water Samples
HARDNESS ACTIVITY 2: Bubble Test
HANDOUT: Bubblegram Puzzles

UNIT 6 | Summary
SUMMARY ACTIVITY: Taste Test
HANDOUT: Water Quality Report
HANDOUT: Crossword Puzzles

Objectives

Students will be able to:

Unit 1 | Introduction

- discuss water usage and water quality
- make plans to collect and transport a water sample

Unit 2 | pH

- explain the pH scale and the effect of pH on tap water systems
- recognize that substances dissolved in water may not be visible
- recognize whether their tap water source is a private well or a community water supply
- organize their group to perform tasks
- follow written procedures individually and as a group to test samples
- match the color of reacted samples to a color chart to determine the test results
- discuss drinking water sources
- realize the connection between acidity, basicity and the pH scale

Unit 3 | Chlorine

- explain the use of chlorine as a disinfectant
- recognize the concept of dilution
- organize their group to perform tasks
- follow written procedures individually and as a group to test samples
- match the color of reacted samples to a color chart to determine the test results
- recognize patterns in class data for tap water source and chlorine test results

Unit 4 | Iron & Copper

- predict whether their tap water has high levels of iron or copper based on observations of staining
- describe the connection between pH and corrosion
- organize their group to perform tasks
- follow written procedures individually and as a group to test samples
- match the color of reacted samples to a color chart to determine the test results

Unit 5 | Hardness

- explain the difference between hard and soft water
- discuss the problems that very hard water or very soft water cause
- recognize whether they have treated water
- organize their group to perform tasks
- follow written procedures individually and as a group to test samples
- match the color of reacted samples to a color chart to determine the test results
- compare group hardness test results and choose the one with the greatest hardness
- demonstrate the difference of the reaction of soap in hard and soft water

Unit 6 | Summary

- explain where tap water comes from and how it is used
- recognize that tap water sources and quality vary
- summarize how the tap water characteristics that were studied affect tap water
- report and explain their tap water test results to their family

Organizing the Tour

Gather Materials
A shopping list is provided that contains all items necessary for the Tapwater Tour.

Prepare for Each Unit
A materials check list is provided in the Instructor section for each unit. It contains all of the items necessary for that section of the Tapwater Tour.

TesTabs®
Tablets are supplied in strips of ten tablets. Cut the tablets into singles shortly before using. Do not break foil seal around each tablet. Store cut tablets in envelopes or zipper top bags.

To order individual reagents or test kit components, use the specified code number.

Test Bags
Remove the perforated strip at the top of each bag before use.

Safety
*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. 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)

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.

Wash hands after testing.

Pour reacted and unreacted samples down the drain with excess water. Dispose of unused tablets in the trash. After testing, rinse bags with a small amount of tap water and allow them to air dry before storing them.

Follow all safety rules and guidelines provided by your school or organization regarding laboratory activities.

Get Started
The Introduction will be presented on Day 1. The students will receive a research contract to take home. They will return the next day with a sample of their home tap water (1 pint) and be ready to continue on the tour.

Activity Organization
Enough tablets and bags are provided to perform all of the activities in the Tapwater Tour when the students are divided into 10 groups. Activities are done individually by the students as indicated by on their own tap water samples or as a group indicated by .

Color Chart Poster
Students will compare the color of reacted samples to the Color Chart Poster to determine the test results for tap water samples and prepared samples. Hang the Color Chart Poster in an easily accessible location. Samples that do not give a colored reaction for chlorine, and iron should be considered to not have measurable amounts of chlorine and iron. Reacted samples should be compared to the Color Chart Poster to determine the test results. Representations of the color chart in the test procedures are provided to show which part of the Color Chart Poster should be used and are not representative of the reaction colors. The Color Chart Poster is color matched to the TesTab reactions. Comparing the reaction colors to electronic or printed images other than the Color Chart Poster may result in erroneous results.

Icon Legend

Interesting facts or suggestions for additional class activities

Handouts

Instructor only

Answers to questions posed to students or helpful comments to supplement the procedure

Hang up

Helpful information and useful facts

Organizing the Tour

Data Sheets & Puzzles

Data sheets and puzzles can be printed for distribution or filled electronically by students using a computer or tablet.

Adobe Acrobat Reader must be installed on the device in order to use the forms electronically. After downloading the free Adobe Acrobat Reader app, open the Tapwater Tour PDF with Adobe Acrobat to add the file to the Adobe Acrobat Reader file list. The Tapwater Tour PDF will appear on the file list when Adobe Acrobat Reader is opened. The Tapwater Tour file should always be opened from Adobe Acrobat Reader to ensure that all tables, forms, and puzzles function properly.

Completed data sheets and puzzles can be saved, printed and/or cleared. It is recommended that completed data sheets and puzzles be submitted, printed or saved to another location. The Clear All Forms button on the Water Quality Report will clear all fields on all data sheets, puzzles and reports containing student data. If using a tablet, and the pencil option, the Clear All Forms button may not clear the pH Matching puzzle and the Water Word Search. If they are not cleared use the device clear or undo selection.

Classroom Data Chart

Each student will complete their own Data Sheet for each activity. Students will enter data for their tap water sample and/or prepared samples. Results for all student tap water samples will be summarized on a Classroom Data Chart.

After students have compared the color of their reacted samples to the Color Chart Poster and entered their data on the Classroom Data Chart, have them visually compare their reacted samples to each other. This will naturally start a classroom discussion that could go anywhere!

Discuss expectations, actual results, discrepencies and possible reasons for unexpected results.

An example of a Classroom Data Chart is located in Handouts. A Classroom Data Chart could be created as a poster, chart, table or spreadsheet. A pdf of the Classroom Data Chart can be projected and filled in. The Classroom Data Chart should include student names, Tap Water Source, and results for the pH, Chlorine, Hardness, Iron and Copper tests.

Example of a completed Classroom Data Chart:

		Test Results				
Name	**Tap Water Source**	**pH**	**Chlorine**	**Iron**	**Copper**	**Hardness**
Student 1	private well	5	0	high	high	hard
Student 2	community system	7	low	high	none	soft
Student 3	well	6	0	low	low	hard
Student 4	well	5	0	high	high	hard
Student 5	community system	7.5	low	low	none	soft
Student 6	community system	7.5	low	low	none	soft

The students will examine the collected data to summarize and interpret the data to understand causes, patterns, relationships, and trends. They will analyze and interpret the classroom data from the Classroom Data Chart and enter their conclusions on their own Data Sheets. As an extension, data can be graphed.

Answer Key

Answers to questions within each unit will vary. Possible answers are provided in the answer key. Completed handouts and puzzles are located in the Answer Key.

Kit Contents

Quantity	Contents	Code
50	Test Bags, plastic, roll-top	0793
100	Wide Range pH Tablet	6459A
100	DPD #4R Tablet	6899A
50	*Hardness T Tablet	*6917A
50	Copper HR Tablet	3701A
100	*Iron LR Tablet	*3725A
1	Tapwater Tour Color Chart Poster	1381
1	Download Instruction Card	5972-CARD

TesTabs is a registered trademark of LaMotte Company

*WARNING: Reagents marked with a * are considered to be potential health hazards. To view or print a Safety Data Sheet (SDS) for these reagents go to www.lamotte.com. Search for the 4 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 on 4450. To obtain a printed copy, contact LaMotte by email, phone or fax. After hour emergency information for all LaMotte reagents is available from Chem-Tel (US, 1-800-255-3924) (International, call collect, 813-248-0585).

Enough tablets are provided for 50 students to complete the Tour. Replacement tablet and kit components are available separately.

Conversion Chart

3 teaspoons	=	1 tablespoon
1 cup	=	16 tablespoons
2 cups	=	1 pint
4 cups	=	1 quart
4 quarts	=	1 gallon
1 teaspoon	=	5 milliliters
1 tablespoon	=	15 milliliters
1 cup	=	240 milliliters

Shopping List

Item	Quantity
Baking Soda	1 teaspoon
Vinegar	5 drops
Aspirin	1 (uncoated)
Straws	1 for each student
Distilled water (Do not use mineral water)	4 gallons
Liquid chlorine bleach	1 teaspoon
Iron supplement tablet (available in your local pharmacy in the vitamin/mineral section)	1
Liquid soap	1 bottle **
Quart containers	3
Paper cups	2 for each student
Measuring teaspoon	1
Measuring cup (½ cup)	1
Eye dropper	1
Folders or envelopes for student data sheets & handouts	
Copies of handouts and the color chart poster	

See the Materials Checklist for each unit for additional items that are needed to do the individual activities.

**Not all liquid hand soaps will work in the Bubble Test. (Remember soap and detergent are not the same thing.) Some hand soaps such as Liquid Ivory contain more soap and fewer additives. The liquid soap you choose cannot contain the additives designed to overcome the effects of calcium and magnesium. A number of soaps will work and you may even wish to try the liquid hand soap from the school restroom.

Test the soap ahead of time. Follow the procedure for the Bubble Test in the Hardness Unit. One drop of the ideal soap in deionized water should produce a rich lather. Several drops of the soap in hard water should give no bubbles and cloudy water.

Materials Checklists

UNIT 1 | Introduction

Materials Checklist for Introduction

☐	Research Contract	1 for each student

UNIT 2 | pH

Materials Checklist for pH Test

☐	Wide Range pH Tablets (6459A)	1 for each student and 3 per group
☐	Sample bags	1 for each student and 3 per group
☐	Sample #1 - Baking soda	prepare with students
☐	Sample #2 - Vinegar	prepare with students
☐	Sample #3 - Aspirin	prepare with students
☐	Tap water sample	1 for each student
☐	Straws	1 for each student
☐	Distilled water	4 quarts
☐	Quart containers	3
☐	pH Data Sheet	1 for each student
☐	pH Matching Puzzle	1 for each student
☐	Color Chart Poster	1
☐	Classroom Data Chart	1

NOTE: It is recommended that this unit be presented in two separate sections.

Samples for pH Activity 2 can be made in advance if necessary, but it is very important for students to actually observe substances being dissolved in water for themselves.

UNIT 3 | Chlorine

Materials Checklist for Chlorine Test

☐	DPD #4 Tablets (6899A)	1 for each student and 2 per group
☐	Sample bags	1 for each student and 2 per group
☐	Sample #1	prepare with students
☐	Sample #2	prepare with students
☐	Tap water sample	1 for each student
☐	Quart container	2
☐	Liquid chlorine bleach	several drops
☐	Cup	1
☐	Teaspoon	1
☐	Eye dropper	1
☐	Distilled water	3 quarts
☐	Chlorine Data Sheet	1 for each student
☐	Water Scramble Puzzle	1 for each student
☐	Color Chart Poster	1

Materials Checklists

UNIT 4 | Iron & Copper

Materials Checklist for Iron Test

☐	*Iron LR Tablets (3725A)	1 for each student and 2 per group
☐	Iron Supplement Tablet	1 (purchase at pharmacy, containing ferrous sulfate, for example: Feosol®)
☐	Sample bags	1 for each student and 2 per group
☐	Sample #1	prepare with students
☐	Sample #2	prepare with students
☐	Tap water sample	1 for each student
☐	Distilled water	3 quarts
☐	1/2 cup measuring cup	1
☐	Cup	1
☐	Quart containers	2
☐	Iron Data Sheet	1 for each student
☐	Color Chart Poster	

Materials Checklist for Copper Test

☐	Copper HR Tablets (3701A)	1 for each student
☐	Sample bags	1 for each student
☐	Tap water sample	1 for each student
☐	Copper Data Sheet	1 for each student
☐	Water Word Search Puzzle	1 for each student
☐	Color Chart Poster	1

NOTE: Iron and copper sections are organized to be presented on the same day.

UNIT 5 | Hardness

Materials Checklist for Hardness Test

☐	*Hardness T Tablet (6917A)	1 for each student
☐	Water sample bag	1 for each student and 2 per group
☐	Tap water sample	1 for each student
☐	Liquid hand soap	1 bottle
☐	Bottled mineral water**	
☐	Piece of cardboard, 1/4" x 3"	1 per group
☐	Paper cup, small	1 per group
☐	Hardness Data Sheet	1 for each student
☐	Bubblegram Puzzle	1 for each student
☐	Color Chart Poster	1

**Required for the Bubble Test if none of the student's tap water samples are hard.

UNIT 6 | Summary

Materials Checklist for Summary

☐	Small paper cups	2-3 each student
☐	Crossword Game	1 for each student
☐	Water Quality Report	1 for each student
☐	Distilled water	2 quarts

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Teacher Tips

Preparation
Read instructions ahead of time to familiarize yourself with the procedures for each section.

Shopping List and Materials Check Lists
Be sure to have everything on hand before it is needed.

Since bleach can damage clothing, it may be wise to have your students watch while you prepare two chlorine samples.

Organizing
To avoid chaos, divide your class into groups before beginning any activity. By dividing your class into ten groups, you will have enough tablets to complete the tests as instructed. Students will test their own tap water individually and prepared samples. There will be enough sample water for ten groups.

Vocabulary
Terms like “distilled”, “hard water” and “indicator” may be new to your students, but they are part of the scientific vocabulary your students can learn on the Tour. Try to use and encourage the use of these terms as you lead your students through the Tapwater Tour. Water Words are bolded in the text and linked to Water Words definitions. This feature is not active in the instructor part of the Tour.

Record Keeping
Have students make paper or electronic folders with a water related theme to hold their data sheets and puzzles.

Display the Classroom Data Chart as a permanent record or part of a bulletin board display.

TesTabs® and Test Bags
The household products used in these activities are safe if properly used. Do not allow students to eat or drink any of the products, tablets, or solutions. A few products require additional precautions. These will be noted by a +. Read and follow the precautions for these products.

Do not allow students to pinch the tablet in the bag with their fingernails or poke at it with a pencil or pen; this may cause a leak.

After testing, rinse bags with a small amount of tap water and allow them to air dry before storing them.

Reagent Safety
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Clean Up
Dump reacted solutions down the drain with lots of running water. (Iron tablets really stink!) Dispose of tablet packaging in the trash.

Puzzles
Puzzles are provided in each section to reinforce the concepts presented for each water test. These puzzles can be used as individual or whole class activities.

Navigation
The navigation next and previous arrows will not work on a scrolling device such as an ipad®.

Understanding the Results
Help students learn from failed experiments and unexpected results. For example, a student with orange stains in his bathtub who tests negative for iron needs to know that iron is unstable in solution. The iron probably settled out of solution before testing.

Tests can also be done on water from puddles, fish tanks, pools and rainwater.

Chlorine evaporates quickly from water. Tap water samples that initially had chlorine may not contain any chlorine by the time it is tested. That’s the reason for making chlorine samples to demonstrate a positive test result.

Teacher Tips

Copper and iron are unstable and only present in small amounts in tap water. With time, they may fall out of solution in the tap water sample and not give a positive test for copper or iron by the time the sample is tested. A negative result from the copper and iron activity does not indicate that copper and iron are not present in the water sample.

Water hardness varies. If you live in an area with only soft water you can use bottled mineral water or prepare a hard water sample in the followng manner:

Dissolve 0.221 g of Calcium Chloride Dihydrate ($CaCl_2 \cdot 2H_2O$) in one liter of distilled water. This will give you a sample with 150 ppm hardness. You may be able to find Calcium Chloride in a high school chemistry lab.

Please address your suggestions or comments to:

The Tapwater Tour | LaMotte Company
PO Box 329 · Chestertown · Maryland · 21620
E-mail: mkt@lamotte.com

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?

_____

Do you have a water treatment system in your home?

_____

_____

Student Signature

Classroom Data Chart

Name	Tap Water Source	Test Results				
		pH	Chlorine	Iron	Copper	Hardness

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 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	Column B
_____ 1. its pH is about 2.3	a. very acidic
_____ 2. a pH value of 7 is _____	b. basic
_____ 3. acidic water is ____	c. corrosive
_____ 4. bleach is _____	d. distilled water
_____ 5. the gas that we exhale	e. cola drink
_____ 6. pure water	f. limestone
_____ 7. a rock that changes the pH of water	g. neutral
_____ 8. battery acid is ____	h. carbon dioxide

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? _____

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Water Scramble

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

NHRLIECO ___ ___ ___ ___ ___ ___ ___ ___

RSEGM ___ ___ ___ ___ ___

TCNFSIIDE ___ ___ ___ ___ ___ ___ ___ ___ ___

NIPK ___ ___ ___ ___

IAETACBR ___ ___ ___ ___ ___ ___ ___ ___

UMMYNOCIT ETMSSY ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

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.

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.

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

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 was 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.

Bubblegram

1 ___ ___ ___ ○ ___ ___ ___

2 ___ ○ ___ ___ ___ ___ ___

3 ___ ___ ○ ___

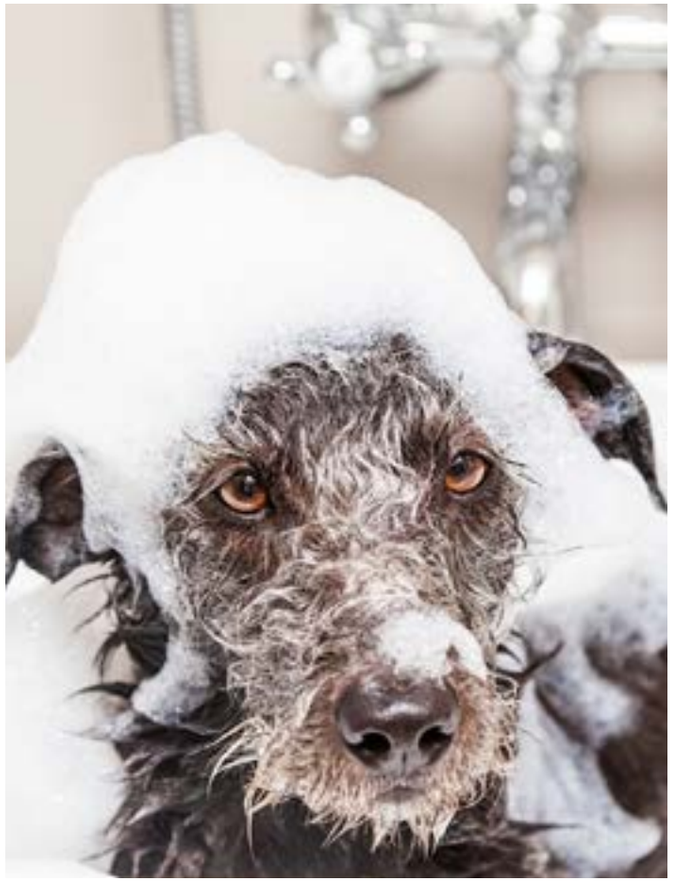
4 ○ ___ ___ ___ ___ ___ ___ ___

5 ___ ___ ___ ○ ___ ___ ___ ___ ___

6 ___ ___ ___ ○ ___ ___ ___ ___

7 ○ ___ ___ ___ ___

8 ○ ___ ___ ___

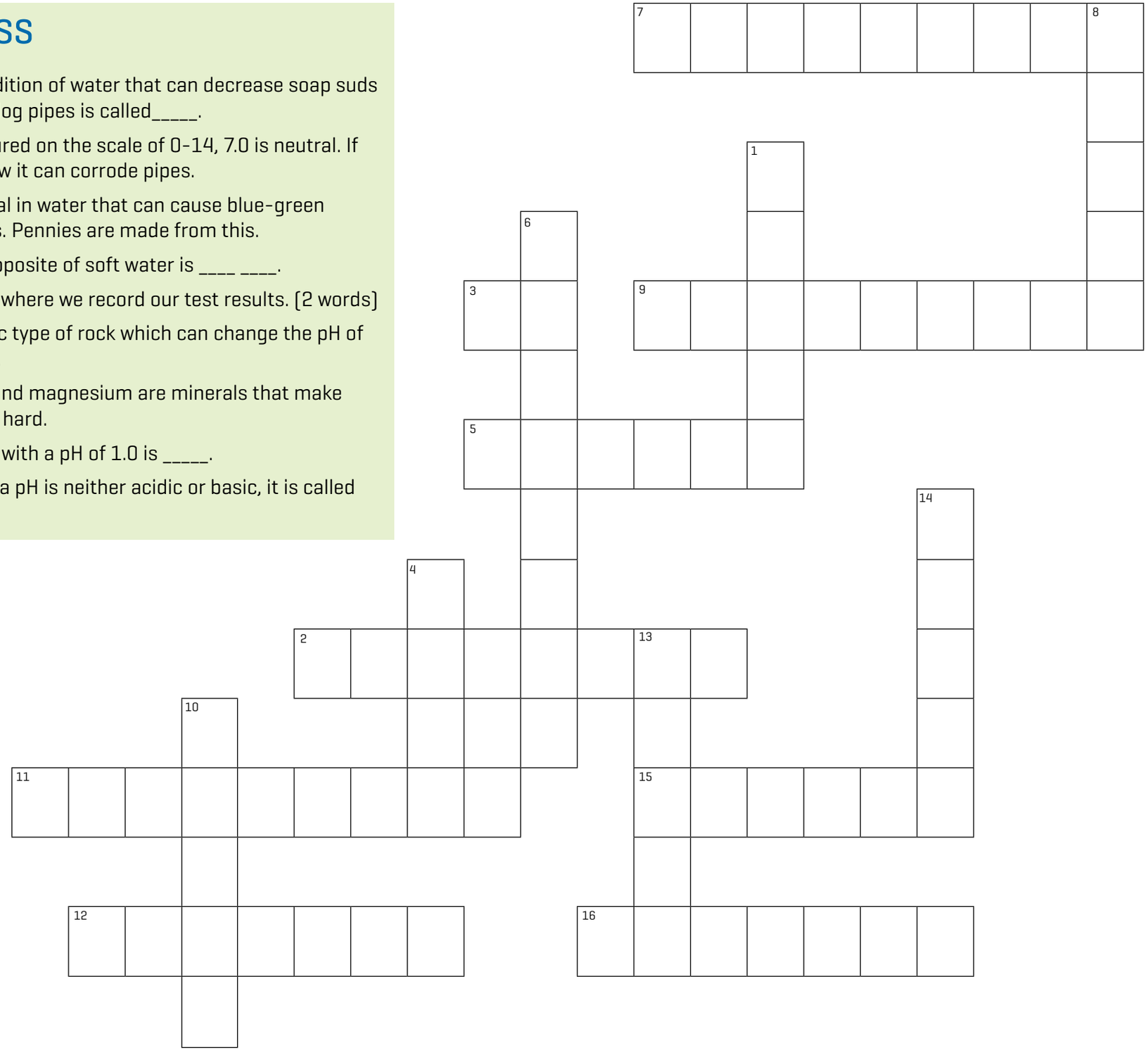


1. Place where the combination of hard water and soap make a dirty ring.
2. _____ and magnesium are minerals that make water hard.
3. _____ water takes more soap to produce bubbles.
4. Minerals that _____in water make it hard.
5. Calcium and _____ are minerals that make water hard.
6. Calcium and magnesium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

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 your 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.

Answer Key | Questions

Student answers will vary

UNIT 1: Introduction

1. **Why might some water taste bad?**

   Everyone has things in their water besides water. Some of the things in water taste bad.

UNIT 2: pH

1. **Why do you think the pH of sea water is higher than distilled water?**

   Salt water has many things dissolved in it.

2. **Why does it taste different?**

   Distilled water is pure - it has no minerals.

3. **What happens when the sun dries sea water on your skin?**

   Salt water evaporates, leaving minerals behind.

4. **How was the appearance of the sample different after you breathed into it?**

   It changed color. The pH of the sample changed.

5. **What do humans exhale?**

   *Humans exhale **carbon dioxide**. Carbon dioxide dissolves in the water.*

6. **Do you think carbon dioxide gas makes the water more acidic or more basic?**

   The pH of the water decreases, that means the carbonic acid formed from the carbon dioxide is slightly acidic. It changes the pH of the sample before your very eyes.

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

   Tap water from different sources has different mineral content. That is, different things are dissolved in the water.

8. **Do you think the pH of water in contact with limestone would increase or decrease?**

   Limestone increases pH of water. Basic pH's are high.

9. **What might people who live near the ocean have in their well water?**

   Salt!

UNIT 3: Chlorine

1. **Why is chlorine added to tap water?**

   *Chlorine is added to kill **bacteria** and germs and control **algae**. It **disinfects** the water.*

2. **Why do some people add bleach to their laundry?**

   Bleach reacts with stains on clothes in order to remove stains. At this concentration, chlorine bleach does more than disinfect.

Answer Key | Questions

UNIT 4: Iron & Copper

1. **Why do you think we remove the colored tablet coating in Step 3 while making Iron Sample #1?**

   A colored coating would interfere with the colored reaction from the TesTab.

2. **What happened to the tablet in Step 3 while making Iron Sample #1? Do you think there is any iron in the water?**

   The tablet often looks the same. It is hard to believe any iron dissolved.

UNIT 5: Hardness

1. **What task might you use more soap or detergent if you had hard water?**

   washing clothes, dishes, cars, dogs

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

   hard

UNIT 6: Summary

Taste Test

1. **Do they taste different?**

   Yes.

2. **Which type pf water tastes better to you?**

   Distilled water should taste bland or flat.

Water Quality Report

1. **Where do we get tap water?**

   See Where Does Your Tap Water Come From?

2. **Where do we use water?**

   See introduction.

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

   - pH | *corrosion, scale*
   - Chlorine | *taste, smell, bacteria*
   - Iron | *stains*
   - Copper | *taste, stains*
   - Hardness | *crusty deposits, use too much soap*

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

e 1. its pH is about 2.3

g 2. a pH value of 7 is _____

c 3. acidic water is ____

b 4. bleach is _____

h 5. the gas that we exhale

d 5. pure water

f 7. a rock that changes the pH of water

a 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

Water Scramble

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

NHRLIECO C H L O R I N E

RSEGM G E R M S

TCNFSIIDE D I S I N F E C T

NIPK P I N K

IAETACBR B A C T E R I A

UMMYNOCIT
ETMSSY C O M M U N I T Y S Y S T E M

Water Word Search

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	X	S	A	M	P	L	E
D	I	S	S	O	L	V	E	D	H	R	U	V

ACID	DISSOLVED	IRON	PIPES	SAMPLE
BLUE GREEN	DRIP	METAL	REACT	STAIN
CONCENTRATION	INDICATOR	ORANGE	RUST	TABLET

Bubblegram

1 B A T H T U B

2 C A L C I U M

3 H A R D

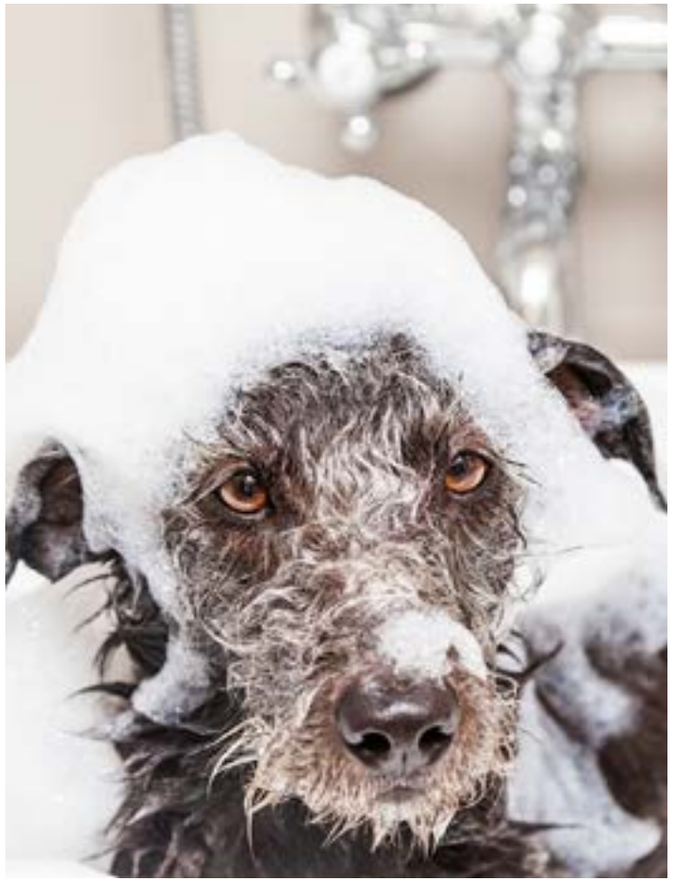
4 D I S S O L V E

5 M A G N E S I U M

6 M I N E R A L S

7 S C A L E

8 S O A P



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 has no minerals and pH of 7.0
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.

Crossword Puzzle

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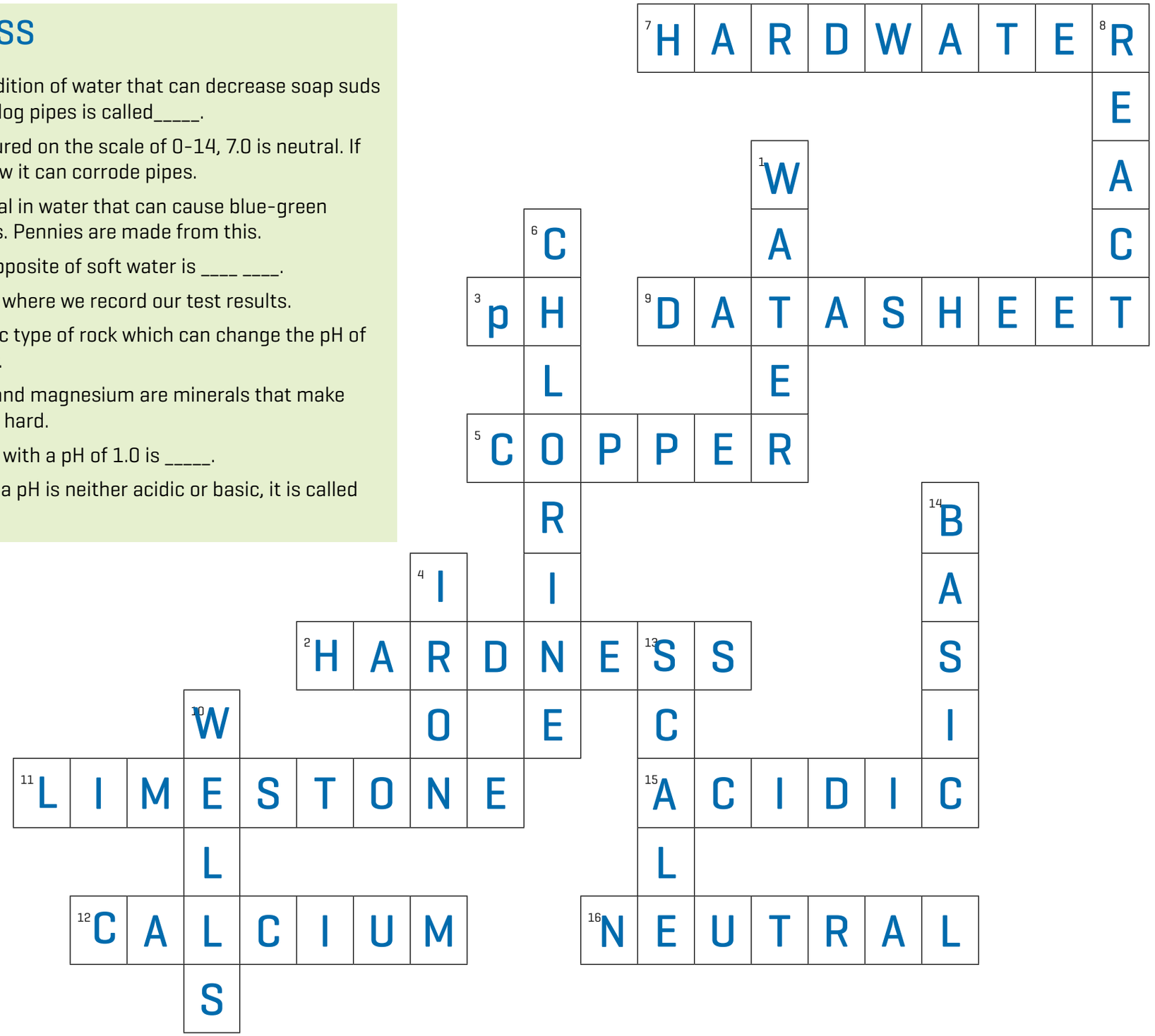

Dirty Words

- 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_2) 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.

This feature is not active in the instructor part of the Tour.

Chemistry

Test	Tablet	Composition	Chemistry	Prepared Samples (In text)
Chlorine	DPD #4R Code 6899A	N,N Diethyl-p-phenylenediamine (DPD), Buffers, Fillers	When Chlorine oxidizes DPD a pink color is formed.	Chlorine Sample #1 ~1ppm Chlorine Sample #2 ~5ppm
pH	Wide Range pH Code 6459A	Mixed pH Indicators, Fillers	Indicators are weak acids or weak bases and undergo specific color changes with changes in pH.	pH Sample #1 (Baking Soda) ~pH 8 pH Sample #2 (Vinegar) ~pH 3 pH Sample #3 (Aspirin) ~pH 5
Iron	*Iron LR Code 3725A	3-pyridyl-5, 6-bis (4-phenyl-sulfonic acid) -1, 2, 4-Triazine (PPST), Calcium Thioglycolate, Fillers	Reducing agent breaks down weakly complexed forms of iron and converts iron from the ferric to the ferrous form. Ferrous iron reacts with PPST to produce a pink color.	Iron Sample #1 ~0.6 ppm Iron Sample #2 ~0.1 ppm iron
Copper	Copper HR Code 3701A	Zincon, Buffer, Fillers	Zincon chelates with copper to produce a blue color. (Zincon is orange in solution when no copper is present.)	
Hardness	*Hardness T Code 6917A	EDTA, Eriochrome Black T, Fillers	The EDTA chelates with up to 3 grains per gallon (51 ppm) hardness, leaving the Eriochrome Black T uncomplexed. It is blue. Eriochrome Black T chelates with the excess hardness in samples above 3 grains per gallon producing a red color.	

PPM

PARTS PER MILLION:

Parts per million is a unit of concentration for very dilute solutions. It is a way of expressing how much of something is in a solution. Parts per million is very similiar to percent. 1% is one part per one hundred. 1 ppm is one part per million. In water testing, ppm is also called milligrams per Liter (mg/L).

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

Replacement Parts List

Standard Refill Package
Code R-5972

Quantity	Description	Code
50	Bags, plastic, roll top	0793
100	Wide Range pH Tablets	6549A
100	DPD #4R Chlorine Tablets	6899A
100	*Iron LR Tablets	3725A
50	Copper HR Tablets	3701A
50	*Hardness T Tablets	6917A

*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. 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).

Individual Parts

Code	Description	Quantity
0793-H	Bags, plastic, roll top	50
6459A-H	Wide Range pH Tablets	50
6459A-J	Wide Range pH Tablets	100
6899A-H	DPD #4R Tablets	50
6899A-J	DPD #4R Tablets	100
3725A-H	*Iron LR Tablets	50
3725A-J	*Iron LR Tablets	100
3701A-H	Copper HR Tablets	50
3701A-J	Copper HR Tablets	100
6917A-H	*Hardness T Tablets	50
6917A-J	*Hardness T Tablets	100
5972-CC	Tapwater Tour Color Chart Poster	1

Larger quantities are available upon request.

Contact us:

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PO Box 329 | Chestertown | Maryland | 21620
800-344-3100 | 410-778-3100 (in MD) | FAX 410 778 6394

E-mail: mkt@lamotte.com | www.lamotte.com