



Take a Taste Test! The "Big Penny"* Lab!

TIQ Learning Activity: 6th Grade

(Perfect for 5, 7, 8 to teach inquiry/scientific method in a "user friendly" way!)

A one period class lab combining inquiry, analysis and communication skills while learning more about water as a resource. . . and all for the cost of one penny!*

Arizona Academic Science Content Standards are noted.

Through inquiry, students will understand that the Valley's municipal drinking water is safe, healthy and economical due to high standards and the use of technology. (By tasting and comparing tap water from your school!)

In this inquiry, your students will divide into 4 (or 5) equal-sized groups and travel to 4 (or 5) "taste centers" to sample 4 styles of tap water (and 1 of distilled water, optional), comparing and contrasting tastes. Each center will have additional information on water as a resource, treatment technology and careers.

A Taste Log for data is provided . . . just add water!

Student Outcomes:

- I. Learners will demonstrate their ability to participate in a group inquiry by: (S06S1C1/C2/C3/C4)**
 - demonstrating safe behavior and following procedures. (S06S1C2PO1)
 - conducting investigational trials. (S06S1C2PO3)
 - recording their observations. (S06S1C2PO5)
 - analyzing data results. (S06S1C3PO5)
 - formulating a conclusion based on personal choice. (S06S1C3PO5)
 - communicating their results and conclusion. (S06S1C4PO5)

- II. Learners will recognize that their municipal drinking (tap) water is safe, economical and palatable by: (S06S2/S3/S4/S5)**
 - identifying the origins of the Valley's fresh water. (S06S6C1PO2,4) and (S06S6C2PO1,2,3,4)
 - reviewing water treatment technology and careers (S06S2C1PO2, 4) (S06S3C2PO1,2)
 - participating in a water sampling investigation. (S06S1C1-2-3-4)

* **The "Big Penny"**. . . so little can be purchased for a penny in the 21st century . . . but for just one cent, 5 gallons of fresh, pure tap water will give you all the raw materials needed to complete this lab!





Time Required: (Depends on class size, its makeup and block or self-contained scheduling; you may wish to extend the inquiry over 2 days and divide the sections.)

Set-up time 10 minutes. (removing 2 jugs from 'fridge, filling 2 water jugs, put out 1 distilled (optional), ice, (optional), slicing citrus, put out signs & water. This was "kid tested", and one 50-minute classroom period is adequate for 4 (5) tasting rotations, choice of favorite and background questions, but you may want to take 2 classes, and divide between tasting and background questions.

IDEA: Pass out the Student Directions the day or class before so that students can read and be familiar with the expectations, and be ready to start right away!

Materials Required:

- **Tap water**, right out of your classroom faucet or the drinking fountain! (Fill two 1 gallon "milk-type" jugs, 2 go in 'fridge, 2 faucet temperature)
- One drinking cup for each student, label with name (they can bring!)
- 2-3 **lemons, limes** or **oranges** sliced thin
- (Ice from cafeteria –optional-for cold water if 'fridge is not available)
- 4 well-rinsed one plastic one-gallon milk jugs (for water)
- 1 gallon of distilled water-optional-
- Student direction page (educator directions the same!) & Taste Log
- Station 1-5 Information Sheets (can also be given to students if you wish)
- Signs labeling the 4 (or 5) samples by 1, 2, 3, 4 (and 5)
- Timer/watch with alarm (rotations 8-10 minutes each or meet your needs)

Classroom Set-up:

- ✓ _____ Locate 4 or 5 desks/table tops in classroom for center rotations
- ✓ _____ Place numbered signs (1, 2, 3, 4, and 5) one on each center
- ✓ _____ Place Station water information on tables 1,2,3,4, and 5
- ✓ _____ Place one labeled water jug on each center as follows:
 - #1 Tap Water (faucet/room temperature)
 - #2 Tap with a **Twist** (faucet/room temp. with **citrus slice**)
 - #3 **Cold** Tap Water (refrigerated or make ice available)
 - #4 **Cold** Tap with a **Twist** (refrigerated or iced with **citrus slice**)
 - #5 Distilled Water (room temperature) Optional, but suggested
- ✓ _____ **Day before:** students bring & label their own cup, and read lab
- ✓ _____ **Student Directions & Taste Logs**—for hand out, 1 per student
- ✓ _____ Divide class into 4 (or 5) groups (with 5-8 students in each group)
- ✓ _____ Timer set (select rotation time to meet your needs, 8-10min. avg.)
- ✓ _____ Draw the 5 stations on board with arrows to show travel directions
- ✓ **When the room is set with water in place, the students have the Directions and Taste Log, (copied back-to-back) you quickly review the directions for the timed rotations & answer any questions. ALL GROUPS TRAVEL IN THE SAME DIRECTION DURING CHANGES!! (This is the hardest part!) You may use the signs provided or make your own.**

Sample 1

Tap Water
("Faucet" Temperature)
Price: 5 gallons for 1 cent

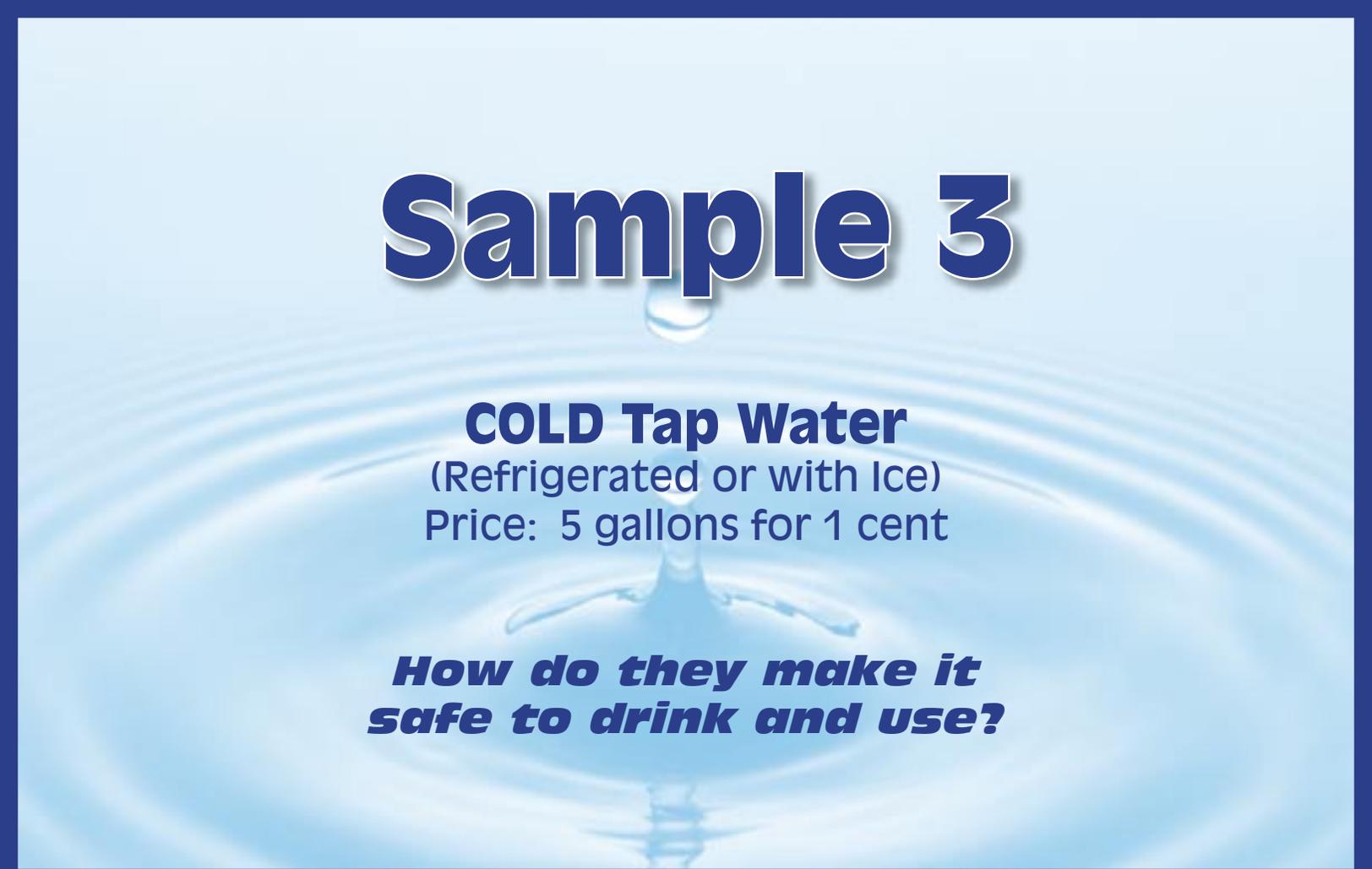
***Where does our water
come from, anyway?***

Sample 2

Tap Water with a Twist
("Faucet" Temperature)
Price: 5 gallons for 1 cent

***Who sends it to my
school or home?***

Sample 3

A close-up photograph of a single water droplet falling into a pool of water, creating concentric ripples. The background is a soft, light blue gradient.

COLD Tap Water
(Refrigerated or with Ice)
Price: 5 gallons for 1 cent

***How do they make it
safe to drink and use?***

Sample 4

A microscopic view of water molecules, showing numerous small, blue, irregular shapes that resemble the structure of water molecules. The background is a light blue gradient.

COLD Tap Water with a Twist
(Refrigerated or with Ice)
Price: 5 gallons for 1 cent

***What kind of jobs are
needed to provide this?***

Sample 5

Distilled Water

(Room Temperature)

Price: about 79 cents per gallon

What's missing?

Take a Taste Test!

Take a Taste Test!

It **doesn't matter** where you start!

You are being timed . . . **share the information!**

Record your data before you move on!



TAKE A TASTE TEST! - The “Big Penny” Lab!

Student Directions

Pizza is only enjoyable if you like what's on top . . . pepperoni, mushrooms, olives and anchovies might taste great to you but send your friends back to the phone to order something else!

It's the same way with beverages! Whether you prefer cola drinks, milk, ice with everything or ice without, water, carbonated water, or chocolate shakes, you tend to stick with what you know and like. Did you know that studies show **your body (which is 70% water!) needs at least eight 8 ounce glasses of liquids a day** for best health in hot Arizona . . . and that plain ol' water may be your best bet for most of that requirement? Have you ever tried to exercise on a hot day after drinking a large carbonated drink or chocolate milk? Sometimes the results aren't pretty! **To keep fully hydrated (that means all the water your body needs to function at top performance), plan to drink a lot of water—at home, at school, on the road or baseball diamond!**

It's all a matter of personal taste even with water! The “taste” in water comes from the minerals present. Water is made of hydrogen (H) and oxygen (O) as H₂O. It will taste “flat” if it has no minerals or elements such as sodium (Na), calcium (Ca) or iron (Fe) naturally present in it. (Water with zero minerals is “distilled” water and is used for steam irons or contact lenses, but usually not for drinking.) However, all natural waters contain minerals, just like your body!

Here's where the “Big Penny” comes in! Your city's tap water is quite a bargain, because you can have **5 gallons of it for only 1 penny!** If you've bought distilled water or drinking water at the store, you know you'll be paying anywhere from 25 cents to well over \$17.00 a gallon (16 oz. bottle @ \$2.19 each) for water that meets the same federal and state quality standards as your tap water! Carrying drinks in bottles is convenient, but to conserve resources (and save \$\$!) you could use a refillable sports bottle . . . freeze it overnight for icy drinks, or drink it room temperature, with a twist of citrus . . . whatever way you like best!

But this taste test is about water! So during this inquiry, you will be tasting your city's tap water 4 different ways at 4 different stations (and distilled water at a 5th optional station). While you are at each station here's what you and your team will do:

- ✓ You will begin at the station where your group is directed by your teacher. It does NOT MATTER which station begins your rotation. If you start at 4, go to 5, 1, 2, 3. If you begin at 2, continue on to 3, 4, 5 and finish at 1, etc. Make sure you always change in the same direction! Keep your team together and travel to the next station quickly, help each other out, learn together!
- ✓ LISTEN for your teacher and the timer; you have a limited time at each station.
- ✓ You have TWO tasks at each station (1) taste the water and make your comments, and (2) read the information about water and complete your questions about that. No time to spare, get right to work on one or the other!
- ✓ SHARE the pitcher! You can read the information first and then taste the water.
- ✓ Consider having someone read the station information aloud and discuss it together! If you have extra time, spend it on the questions!
- ✓ MAKE SURE to write down your comments and answer questions at each station before you move . . . if you don't you'll run out of time!

At the end of the rotations, check that your **data log** and **questions** are complete, and **LISTEN** for your instructor's questions as you all debrief the lab together as lab teams! **OK, now just add water!!**



TAKE A TASTE TEST: Data Log

Name: _____ Section: _____

- At each rotation you will pour an inch or so of water into your cup.
- Drink up! Think about the taste, the temperature, rate and describe it!
- Record your notes.
- Read the water information provided and answer the questions.

Water Sample#	Temperature*	"Flavor"* Taste	Describe Taste with <u>words</u>
1: Tap Water			
2: Tap with a Twist			
3: COLD Tap Water			
4: COLD & a Twist			
5: Distilled (opt.)			

* Rate each sample on a scale of 1-10 with (1= lowest (ick) -2-3-4-5-6-7-8-9- 10=highest (yum, I like!))

The water sample I rated the highest was:# _____. Lowest was:# _____.
 I enjoy drinking water at ___ room temperature, ___ cold, ___ both. (select)
 A twist of lemon or citrus added to my enjoyment: ___ yes ___ no.

Station 1: Tap Water Where does our tap water (SRP, CAP*) come from anyway?
 (*Salt River Project and Central Arizona Project provide virtually all water to the Valley of the Sun's communities)

List the 3 main sources: _____
 Average annual precipitation in the Phoenix area is: _____ per year.

Station 2: Tap with a Twist Who sends it to my school or home?
 _____ bring water to the Valley in _____.
 Who else used this system to move valley water? _____
 Then the water is sent by _____ to _____.

Station 3: COLD Tap Water How is it made safe to drink and use?
 Your drinking water must meet stringent safety and quality standards set by:
 County level: _____ (who?) AZ State level: _____ (who?)
 Federal/USA level: _____ (who?)
 Describe one treatment used: _____

Describe how fish are used to keep water safe: _____

Station 4: COLD Tap with a Twist What kind of jobs are needed to provide it? Name two careers necessary to provide safe drinking water and describe why you might be interested in them, and what strong school subjects would be needed:
 (1)

(2)

Station 5: Distilled Water What's missing? (optional station)
 What elements are present in distilled water? _____
 What is missing from distilled water that is present in drinking water? _____
 This gives the water its' _____. Tap water costs _____ for _____ gallons.

Station 1: WHERE DOES OUR TAP WATER COME FROM ?

Precipitation that seeps into the ground or flows in streams and rivers into lakes, and eventually, the ocean, is all part of Nature's hydrologic cycle. But our **Sonoran desert** here in the Valley of the Sun receives only an average of 7 inches of rainfall each year. (And in the past 10 years, our rainfall has been below average; considered a drought condition. Have you heard about this on TV or read about it?)

With the growth of our towns and cities, many sources of water were tapped . . . until today when we get our water from Salt River Project and the Central Arizona Project and their various sources.

The Hohokam used surface water from the Salt River over 2000 years ago, and that is still a major source of our water supply. Beginning in 1903, the Salt River Project (SRP) placed dams on the **Salt and Verde Rivers**, creating reservoirs. The dams help to provide hydroelectric power and control water use for agricultural and domestic (human) needs (and prevent flooding). It is from these six reservoirs that we get much of our water today.

Surface water is also brought to us through the Central Arizona Project (CAP), which was designed to help Arizona conserve our precious ground water supplies. CAP water is brought from the **Colorado River** at Lake Havasu by a 336 mile long aqueduct to Phoenix and Tucson. Way back in 1944, Arizona's leaders began working to get the CAP built, and in 1993, after 20 years of construction, water flowed all the way to Tucson through the CAP!

Early settlers also drilled ground water wells for agricultural and domestic use. Today wells are also utilized by Salt River Project and local water providers to meet water needs. Because the ground water aquifer is recharged through precipitation, (rain, snow, hail) the water table can actually drop if more water is pumped from the ground than is recharged back into it through rainfall or snowfall in the higher elevations. The population of the Valley can no longer be sustained through well water alone, so it is used only as a supplemental source to the surface water SRP and CAP bring to our area.

So there are three sources of water for the Valley of the Sun today!



Ground Water Well



Roosevelt Lake



Colorado River



CAP Canal



Station 2: WHO SENDS IT TO MY SCHOOL OR HOME?

Long before **Avondale, Chandler, Gilbert, Glendale, Mesa, Peoria, Phoenix, Scottsdale, Tempe**, or any of the cities and communities existed in the Valley of the Sun, the Hohokam utilized the limited water in the desert to their advantage! (You can visit **Pueblo Grande** to find out more!)

Before dams stopped the flow of the Salt River to divert it for other uses, these indigenous people built an amazing system of canals to bring water to their crops. Some of today's canals that bring water to your municipality's water treatment plant follow the same path of those ancient systems! (You can check them on the TIQ map!)

Salt River Project (SRP) has provided water for **hydroelectric** and **agricultural** and **domestic** uses to the Valley of the Sun since 1903! During these past 100 and more years, our area has seen enormous growth, and the need for water has increased annually.

Fortunately, since the mid 1980s, Central Arizona Project (CAP) canal (aqueduct) has also been delivering water to the Valley. CAP provides an additional source of surface water from the Colorado River and even generates some environmentally friendly hydroelectric power in the process!

SRP and CAP do not do the final treatment process that makes your water pure and sparkling. Once delivered by canals to your city Water Treatment Facility, a team of professionals takes over to assure that every drop that reaches schools, homes and businesses is pure and meets or exceeds all the stringent requirements set by **federal, state** and **county** government regulators.

Did you know that every single drop of the water that comes to you from your city Water Treatment Facility is of high **drinking water quality**? Every drop you drink, share with your pets, bathe in or flush is clean, filtered and treated . . . so it pays to be **water wise** anywhere, but especially in Arizona!



Sedimentation Facility



Biologist



Taking Water Sample



Water Treatment Plant Operator

Station 3: How is it made safe to drink and use?

Those of us who live in the city can't do what some of our grandparents and great grandparents did and take a tin cup to the well for a cool drink, or dip into a clear spring or stream when thirsty.

We depend on the town or city we live in to provide for our water needs, and that is something they take very seriously. Because water borne diseases (cholera, dysentery, Giardia) can be devastating, your municipality works with Maricopa County, the state of Arizona and even federal government regulators to assure **top quality water** reaches you when you turn on the tap!

At the federal level the Environmental Protection Agency (EPA) made history when it passed the Clean Water Act in 1973 and Safe Drinking Water Act in 1974. Together these Acts mandate for water quality at a national level. Their aim is to protect all sources of water within the United States. At our state level, the Arizona Department of Environmental Quality (ADEQ) has stringent regulations that must be met by all municipal providers of water. Additionally, the Environmental Services Department of Maricopa County (MCESD) makes sure that your water is safe. The water you are sampling today meets all **regulations** set by these agencies!

The **Water Treatment Plant** in your city or town takes the water delivered by SRP or CAP and sends it through a treatment process that is basically the same at all treatment plants :

- **water** enters the treatment plant from the **canal**,
- chemical (alum) is added so **suspended particles** coagulate (floc),
- "**floc**" **clumps** settle to the bottom in sedimentation tanks,
- the now clearer **water** flows into a filter gallery for filtering,
- sparkling **clear water** is disinfected chemically.

Pure water is then pumped to storage reservoirs and piped on to you!

A fun fact: Minnows are used at facilities as an early monitor of water quality changes. The fish are kept in a tank which is supplied with canal water. The fish are monitored. If there is a rapid change in water quality, the fish will become stressed and may die. If this occurs, the operators know they immediately need to address a change in the water quality! So the fish in the lab aren't pets of the water experts who work there, they're biomonitors!



Chlorination Tanks

Water Filters



Clean Water Reservoir



Station 4: What kind of jobs are needed to provide it?

After this many years in school, you know your strengths as well as areas that need improvement in class subjects!

If you've started to think about a **career**, you've probably also considered the types of classes you'll need in High School and at the Trade School, Community College or University level. . . . whether it's lots of math, language arts, in the sciences, or social sciences. Maybe you're a hands-on person already working on your brother's car or fixing the lamps or CD player at home!

There are a lot of careers needed to bring this Arizona natural resource from a snowy mountaintop to your tap! Here are just a few of them! (The number shown indicates years of specialized training past the HS level.)

Career	Description	If you enjoy . .
Meteorologist	Weather forecaster looks at patterns & predicts	Math, chemistry, English, physics 4+
Hydrologist	Expert in surface & ground water, predicts	Math, geology, English, chemistry, physics 5+
Hydrology Technician	Field work taking water samples, running tests	Outdoors, tools, math & sciences, English 2
Water Plant Operator	Keeps it running to provide pure water	Outdoors/in, hands-on, chem., math, English 2+
Lab Technician	Assists Chemists in lab, tests and sampling	Math, chemistry, biology, English 2+
Chemist	Runs laboratory, oversees tests/ sampling	Biology, chem., Eng. math/prob. solver 4+
Electrician	Works to electrically maintain plant equipment and instruments	Hands-on, math, tools, electricity 4
Environmental Scientist	Water and environmental quality issues,	All sciences, math, Eng. Outdoors 4+
Engineer (various)	Designs supply/treatment systems, all areas design	Math, all sciences, models, hands-on 5+
Lawyer	Works with city govts., regulators, contracts	English, debate, detail, cooperating 6+
Govt. Regulator (EPA, ADEQ, MCESD)	Insures water quality regulations are met	Background in science, law, business helpful 4+
Pipe fitter/ construction	Builds systems for treatment plants, pipelines	Hands-on, tools, building, math, outdoors 2+
Well driller	Locates and drills for water, domestic, agricultural use	Geology, math, tools, hands-on, outside 2+
Computer Services	Variety of applications, design and use	Math, computers, English, details 4+
Administrative Staff (to all above areas)	Provides support for all above, secretarial, filing	Computers, detail, are organized, people HS-2+
Mechanic	Works to maintain plant/ equipment	Hands-on, tools, outdoors, Mechanics 2

There are other jobs involved; these are just a sampling of some of the most commonly found in a city our size. Research them some more and best wishes for success in whatever you do!

Station 5: What's Missing?

You've learned that all **natural waters** contain elements and minerals from the surrounding environment. In a similar way, **plants** obtain their minerals from the soil, and we get those when we eat our salads, fruits and vegetables.

These minerals, such as calcium (Ca) and magnesium (Mg) are also present in your body, and are needed to maintain good health.

Depending on where you live, the water contains different elements and minerals, which give the water its' taste.

If elements and minerals are removed from water only hydrogen (H) and oxygen (O) are present as H₂O. Two processes used to remove minerals from water are reverse osmosis (RO) and distillation (DI). Sometimes the processes are combined producing extra pure RO-DI water. Reverse osmosis is where water is pushed through a membrane that only allows selective things to pass through. During distillation, water is boiled and the steam given off is condensed.

RO-DI water is used in medical, industrial and laboratory settings. At home, you might use RO or DI water to rinse your contact lenses or put it into your steam iron (if you iron!)

Studies have been made to learn if drinking distilled water leaches minerals from our bones over time, but the "jury is still out" on that!

When you tasted the distilled water, you may have noticed what some people call a "flat" taste . . . kind of like when your **soda** has been sitting out too long and the "fizz" is gone! Your soda has lost the mineral oxygen in the compound calcium carbonate (the "fizz"), so the taste has changed. With no minerals in water to give flavor, some consider the taste unpalatable or "flat".

Of course, not all elements or minerals naturally present in water at certain levels are healthy, and sometimes human activities impact water quality, too, so that is why regulations exist at so many levels to assure you have **pure and healthy water** reaching you at school, work or home!

Illustration of Osmosis

