



*Drexel-SDP GK-12 ACTIVITY*

## Activity: Water quality testing

**Subject Area(s)** Chemistry

**Associated Unit** Environments, module 4

**Associated Lesson** None

**Activity Title** Activity: Water quality testing

**Grade Level** 6 (4-12)

**Lesson Dependency** None.

**Time Required** 30 minutes

**Group Size** 30

**Expendable Cost per Group** \$0-\$5



### Image 1

**ADA Description:** Picture shows a water droplet.

**Caption:** A water droplet

**Image file name:** water\_droplet.svg

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### Summary

The vast majority of surface water on the planet is neither potable nor toxic. The primary uses considered for "water quality" are parameters which relate to drinking water, safety of human contact, and for health of ecosystems.

Students and all community members can engage in small, everyday activities that can have a meaningful impact on maintaining good water quality for ecosystems and the drinking water supply. This activity reviews some of the measurement criteria in determining water quality, and uses water testing strips and hand-held technology to measure the quality of the school's drinking water supply, and a sample from streetside drainage water. The water testing will be performed as a class. The activity concludes with an individual activity using a picture asking students to identify "what's wrong with this picture" with respect to water quality and water usage.

### **Engineering Connection**

Water quality engineering addresses the sources (causes), transport and treatment of chemical and biological contaminants (toxins) that affect water quality. Many universities such as U.C. Berkeley offer specialized degree programs in water quality engineering. Taking up study in water quality engineering can take a student to many parts of the world, since water quality is a critical issue in global health initiatives. Many degree programs in civil engineering offer concentrations in water quality.

### **Keywords**

Chemistry, ecology, environments, water quality, water testing

### **Educational Standards (PA)**

- Environments and Ecology: Renewable and nonrenewable resources 4.2.A. Uses, 4.2.B. Availability, 4.2.C. Management, 4.2.D. Influential factors  
Environmental Health 4.3.A. Environmental health issues, 4.3.B. Human actions, 4.3.C. Biological diversity  
Humans and the Environment 4.8.A. Societal needs, 4.8.B. Sustainability, 4.8.C. Human impacts, 4.8.D. Supply and demand
- Science: Technology Education – Science, Technology and Human Endeavors – Meeting Human Needs 3.8.B, Science, Technology and Human Endeavors – Consequences and Impacts 3.8.C
- Math: Computation and Estimation 2.2

### **Pre-Requisite Knowledge**

Be familiar with some basic elements in the periodic table

### **Learning Objectives**

After this activity, students should be able to:

- **Describe the water cycle process (rainwater to groundwater to vapor to rainwater)**
- **Give three examples of criteria by which water quality is measured**
- **Give three examples of everyday activities that harm the quality of the water supply**
- **Give three examples of small changes an individual can make to help improve water quality**

## Materials List

Each group needs:

- pH meter or pH testing strips
- Some kind of water quality testing kit or strips
- Water sample(s) (e.g. rain water, potable drinking water, distilled water)

## Introduction / Motivation

Do you drink water from the faucet at home? Mostly, we all do here in the United States. But, are you aware that in many places in the world, even in some places in the U.S., it's not safe to drink out of the faucet? The water quality in these places can make you very sick and even cause death. If you were an engineer, how would you tell someone if it's safe to drink the water? And if it's not safe, what can you do to make it so? In this exercise, we ask you to think like an engineer whose job it is to protect people from drinking unsafe water. We will be testing a water sample and measuring its contents to identify the presence of unsafe chemicals. You can bring a water sample from home in order to test the water quality from your own faucets, too.

(Excerpted from the Center for Disease Control's website: "Water is basic to life and health. Over 1 billion people worldwide have no access to safe drinking water (note: there are 6.8 billion people in the world). The United States is fortunate to have one of the best supplies of drinking water in the world. Although tap water that meets federal and state standards is generally safe to drink, threats to drinking water quality in the United States still exist. Outbreaks of drinking water-associated illness and water restrictions during droughts demonstrate that we cannot take our drinking water for granted.")

## Vocabulary / Definitions

Word	Definition
Water quality	Measurements and standards for safe drinking water, and water that is conducive to healthy ecosystem.
Water quality engineering	The study and practice of activities that address the sources (causes), transport and treatment of chemical and biological contaminants (toxins) that affect water quality.
Water cycle	The process by which rainwater is absorbed into the groundwater, which runs into our rivers and lakes, and is returned as vapors to the atmosphere to become rainwater again.
pH	A scale from 0 to 14 that measures the acidity (0 to 7) or alkalinity (7 to 14) of matter, generally in liquid form.
Conductivity	A measure of a substance's ability to conduct electricity. In water quality testing, conductivity is a good indicator of the amount of dissolved metals in the water.
Chlorine	An element in the periodic table used to sanitize water. Too

	much chlorine can be toxic to humans.
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**Procedure**  
**Background**

This activity will be conducted after some discussion of the measurement criteria for water quality. Next, we will take two samples, one of the drinking water supply from the school, and one from the streetside runoff water, and use water quality testing strips and the Pasco hand-held sending device to measure the conductivity (salinity) and pH (dissolved solids) in the water. The activity will conclude with a picture-oriented individual activity to identify what is wrong with the water usage depicted in the image. This activity also includes a picture showing the water cycle that we will discuss as a class.

Listed below are some criteria for water quality:

- Water temperature (many microorganisms, an essential part of the food chain, die in warmer waters. Also, warmer water tends to promote algae growth that limits the oxygen supply and amount of sunlight entering bodies of water)
- Water depth (water depth helps to keep waters cool in deeper waters. Cool water is essential for many organisms to survive)
- Salinity (an indicator of dissolved metals, measured by conductivity, measured in micro Siemens per centimeter)

Water Body	EC (uS/cm)
Divide Lake	10
Lake Superior	97
Lake Tahoe	92
Grindstone Lake	95
Ice Lake	110
Lake Independence	316
Lake Mead	850
Atlantic Ocean	43,000
Great Salt Lake	158,000

Absolute pure water - 0.055 S/cm  
Distilled water - 0.5 S/cm  
Mountain water - 1.0 S/cm  
Most drinking water sources - 500 to 800 S/cm  
Sea water - 56 mS/cm = 56,000 S/cm  
Max for potable water - 1055 S/cm

- Odor (a rotten egg smell can indicate the presence of toxins and influence the aesthetics of drinking water)
- Iron (rusty color; sediment; metallic taste; reddish or orange staining)
- Foaming agents (frothy, cloudy; bitter taste; odor)
- pH (Taste and odor, dissolved metals and salts (sodium, chloride, potassium, calcium, manganese, magnesium), Microorganisms such as fecal coliform bacteria (*Escherichia coli*) (remember the spinach outbreak???) This systemic outbreak was caused by the water supply), and pharmaceuticals)

Lemon- 2.5

Coffee-5-6.5

Milk- 6.2

Soapy water-7-10

Normal range for water is 6.5 - 8.5

In general, water with a low pH ( $< 6.5$ ) could be acidic, soft, and corrosive. Therefore, the water could contain metal ions such as iron, manganese, copper, lead, and zinc...or, on other words, elevated levels of toxic metals. This can cause premature damage to metal piping, and have associated aesthetic problems such as a metallic or sour taste, staining of laundry, and the characteristic "blue-green" staining of sinks and drains. May corrode pipes.

Hardness: measure of dissolved minerals. Will tend to make water more alkaline (basic) having pH  $> 7$ .

Water with a pH  $> 8.5$  could indicate that the water is hard. Hard water does not pose a health risk, but can cause aesthetic problems. These problems include an alkali taste to the water (making that morning coffee taste bitter!), formation of a deposit on dishes, utensils, and laundry basins, difficulty in getting soaps and detergents to lather, and formation of insoluble precipitates on clothing.

- Chlorine: used as a sanitizer. Will make water taste salty. 0 – 250 mg/L Acceptable, 250 – 500 mg/L Less than desirable
- Bromine: used as a sanitizer
- Total alkalinity (measure of a high pH) Concentrations less than 100 ppm are desirable for domestic water supplies. The recommended range for drinking water is 30 to 400 ppm
- Stabilizer: (used for pools and spas), should be low in our drinking water.

## Procedure:

Ask the students to record their notes and observations in a notebook.

Step 1: Obtain one or more samples of water. You can use rain water, runoff water, water from the faucet, and drinking water

Step 2: Test the pH and quality of each sample using your testing kit

Step 3: Evaluate the quality of the water based on the measurement criteria above.

Step 4: Discuss, as a class, the activity extension and ways that we can improve the quality of our drinking water.

### **Safety Issues**

- Make sure students do not taste or drink the water samples, even if they are potable.

### **Troubleshooting Tips**

Use water samples collected from the outside environment (rain water, runoff water) or Gatorade in order to have a good contrast from the tap water.

### **Investigating Questions**

If you were camping, would you feel comfortable using this procedure to test if pond water is drinkable (good answer: no! We are not testing for bacteria or any other water-borne pathogens in the water).

### **Associated Activities**

Environmental protection agency's website for children:

Activity: <http://www.epa.gov/kids/water.htm>

### **Activity Extensions**

Follow with the Activity: Visit the EPA children's interactive website

<http://www.epa.gov/kids/water.htm>

[http://www.epa.gov/safewater/kids/flash/flash\\_watercycle.html](http://www.epa.gov/safewater/kids/flash/flash_watercycle.html)

<http://www.epa.gov/OWOW/NPS/kids/whatwrng.htm>

### **Assessment**

**Pre-Activity Assessment**

None

**Activity Embedded Assessment**

Each student participates in the discussion during class.

**Post-Activity Assessment**

Ask to see the students' notebooks to ensure they have recorded the lesson notes – design a short quiz of 5-6 questions to see if the students were listening. In addition, you may use the rubric below to evaluate your observations of class members.

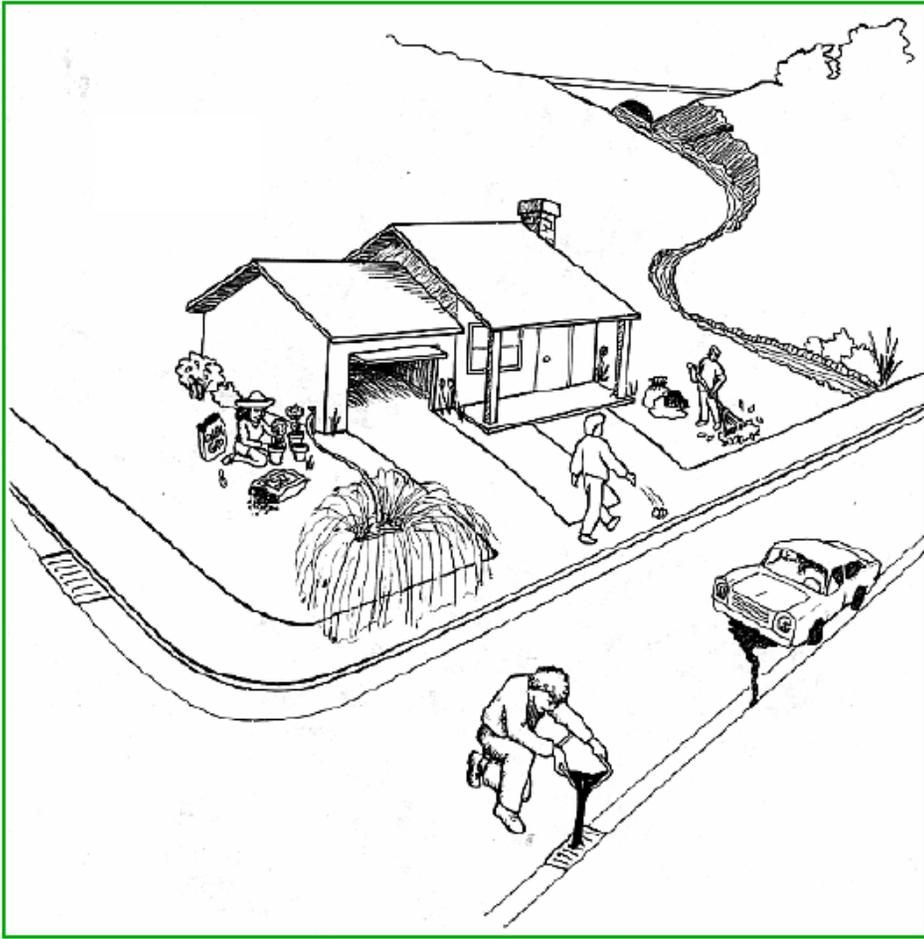
Students will be evaluated on a scale from 0 to 4 on:

_____	_____	_____
Attentiveness	Participation	Comprehension

Dara Kusic

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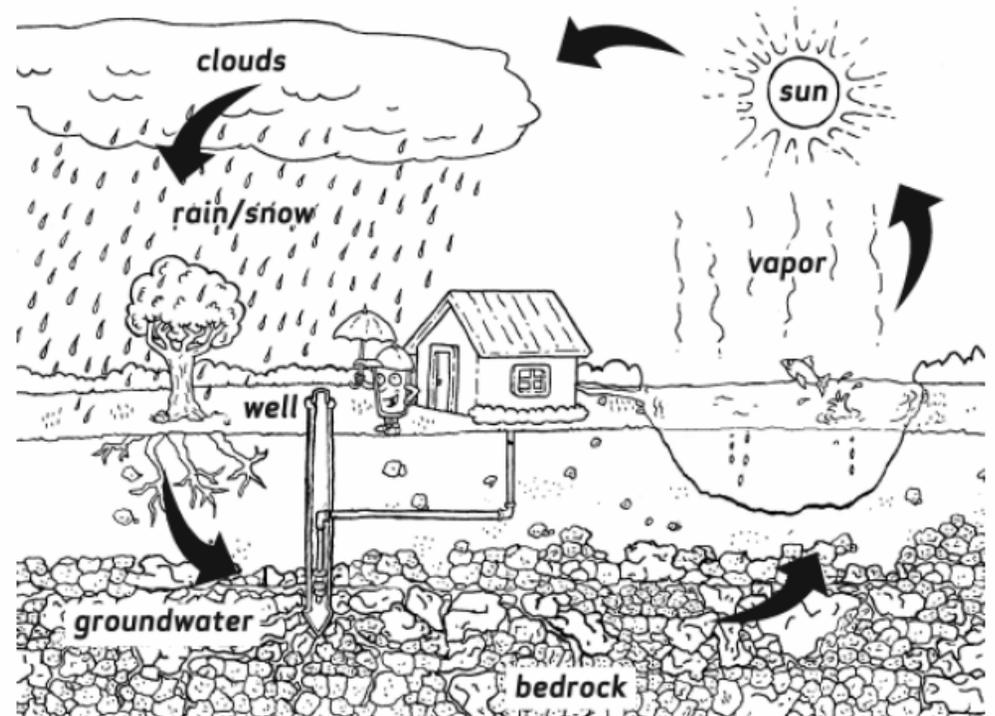
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What's **WRONG**  
With This  
Picture??



What's  
**Happening**  
In This Picture?



### **The Woman is Using Fertilizers and Pesticides for Gardening Improperly!**

Fertilizers contain large amounts of nutrients such as nitrogen and phosphorous that can wash into lakes and streams, and may cause algal blooms (overgrowth of aquatic plants that smother other aquatic life). These blooms use up the oxygen in the water that fish and other organisms need to breathe.

Pesticides (substances that kill bugs and animals) and herbicides (substances that kill weeds and plants) also contain toxic materials that are harmful to humans, fish, and "good" plants. When it rains, these toxic materials can run off into storm drains, roadside ditches, and nearby waterways.

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### **The sprinkler is watering the sidewalk!**

Place sprinklers so that the water goes **ONLY** on the lawn instead of watering the street or sidewalk.

Water the lawn or garden during the coolest part of the day, such as early in the morning, to reduce evaporation and increase the amount of water that sinks into the soil and reaches the plants' roots. Do not water on windy days, because sprinkles will be blown away and wasted.

### **This Car is Leaking Oil and Antifreeze into the Street!**

Oil and antifreeze that leaks out of cars is washed into storm drains when it rains. Check your cars for drips and leaks. If you find any, ask whomever is responsible for the car to have them fixed soon!

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### **The man throwing litter into the street!!**

Street litter, such as plastic bags, cups, and candy wrappers, often gets swept away with rain water into storm drains and ends up floating in the ocean or washing up on our beaches. A great deal of street litter is made up of plastic, which takes hundreds of years to break down and become harmless to the environment. Marine animals can mistake plastics for food and can become tangled up in it.

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### **The Man is Raking Grass Clippings and Leaves into Plastic Bags!**

Leave mowed grass clippings on the lawn as a source of nutrients for the grass, and to reduce erosion. You can also compost grass clippings and fallen leaves, and later use the compost to fertilize the soil.

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### **The man is pouring motor oil down the storm drain!**

Motor oil or antifreeze can damage or kill underwater plants animals. **NEVER** pour used motor oil or antifreeze down a storm drain, onto the soil, or into a waterway. Put used oil or antifreeze in a sturdy container and take it to a local service station or other approved center. Stencil "DUMP NO WASTE, DRAINS TO LAKE" (or river, or whatever) so others will know that allowing liquids other than storm water to get into the drain leads to pollution of lakes and streams.