

# Water Boot Camp



# Water Boot Camp Workbook

**A practical workbook to educate youth about the water cycle, drinking water, water treatment and water protection.**

In this workbook you will explore topics and information related to water. The workbook is a general resource for education on:

Water Cycle

Drinking Water

Water Treatment

Water Protection

## **Why Water Boot Camp?**

Water is essential to our livelihood. We rely on it every day to bathe, wash our hands, prepare food, water plants, and to get hydrated. Yet it is something that can be taken for granted depending on where you live. For those of us living in a developed country; water is something we expect to have immediate access to all the time. So easily accessible that we forget what it takes to ensure constant availability of drinkable water. The Water Boot Camp curriculum was developed to better educate youth about drinking water and where it is sourced.

## Overview – for Facilitators/Teachers using the Water Boot Camp Workbook

The Water Boot Camp curriculum includes four (4) lessons related to water. Each lesson includes a vocabulary list, a student word, and writing exercises that reinforce content covered in each of the lessons. Individual lessons can be used as stand-alone lessons however comprehensive knowledge of drinking water will only be achieved by having students complete all lessons in the Water Boot Camp workbook.

Lesson 1: The Water Cycle	Time to complete Lesson: 45 minutes
Lesson 2: Water Treatment	Time to complete Lesson: 45 minutes
Lesson 3: Drinking Water	Time to complete Lesson: 45 minutes
Lesson 4: Water Protection	Time to complete Lesson: 1 hr

A pre- and post-quiz accompany each Lesson. The pre-quizzes should be given to students prior to the start of each lesson. The post-quizzes should be given to students after the completion of each lesson.

### Videos

Certain lessons incorporate videos into the lesson plan. Videos should be used to prompt discussion and further understanding of concepts presented in the video.

Lesson 2: Video: Ted Talk by Michael Pritchard

[https://www.ted.com/talks/michael\\_pritchard\\_invents\\_a\\_water\\_filter](https://www.ted.com/talks/michael_pritchard_invents_a_water_filter)

### Let's Read

Certain lessons incorporate reading relevant news articles. The news articles can be found by using the web addresses provided below.

Lesson 2: Water in the News! "From toilets to tap: How we can get water from sewage"

<http://www.cnn.com/2014/05/01/world/from-toilet-to-tap-water/>

Lesson 3: "The DDT Story"

<http://www.panna.org/resources/ddt-story>

### Learning Areas

Water cycle	Water Treatment	Water Recycling
Drinking Water	History of EPA	Water Protection
Storm Water run off	Storm Water Management	

### Resources Needed

Projector	Internet Access
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### Learning Outcomes

Workbook will teach the importance of water protection

Workbook will encourage smart water use

Workbook will facilitate conversation about water insecurity

Workbook will better connect youth to their drinking water

Workbook will expose youth to careers in water treatment and management

# 1 The Water Cycle

## Vocabulary

**Aquifer:** an underground layer of rock or earth which holds groundwater.

**Condensation:** process through which water-vapor gas condenses back into liquid water and ice.

**Groundwater:** Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

**Evaporation:** process through which liquid and frozen water becomes a water-vapor gas.

**Evapotranspiration:** the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

**Precipitation:** water released from clouds in the form of rain, freezing rain, sleet, snow, or hail.

**Surface water:** water that is on the earth's surface, such as in a lake, river, stream, or reservoir.

**Reservoir:** a man-made lake that is created when a dam is built on a river.

**Watershed:** area of land that drains all the streams and rainfall to a common outlet such as a reservoir, lake, or ocean.

**Water Cycle:** the cycle of stages and processes by which water circulates between the earth's oceans, atmosphere, and land.

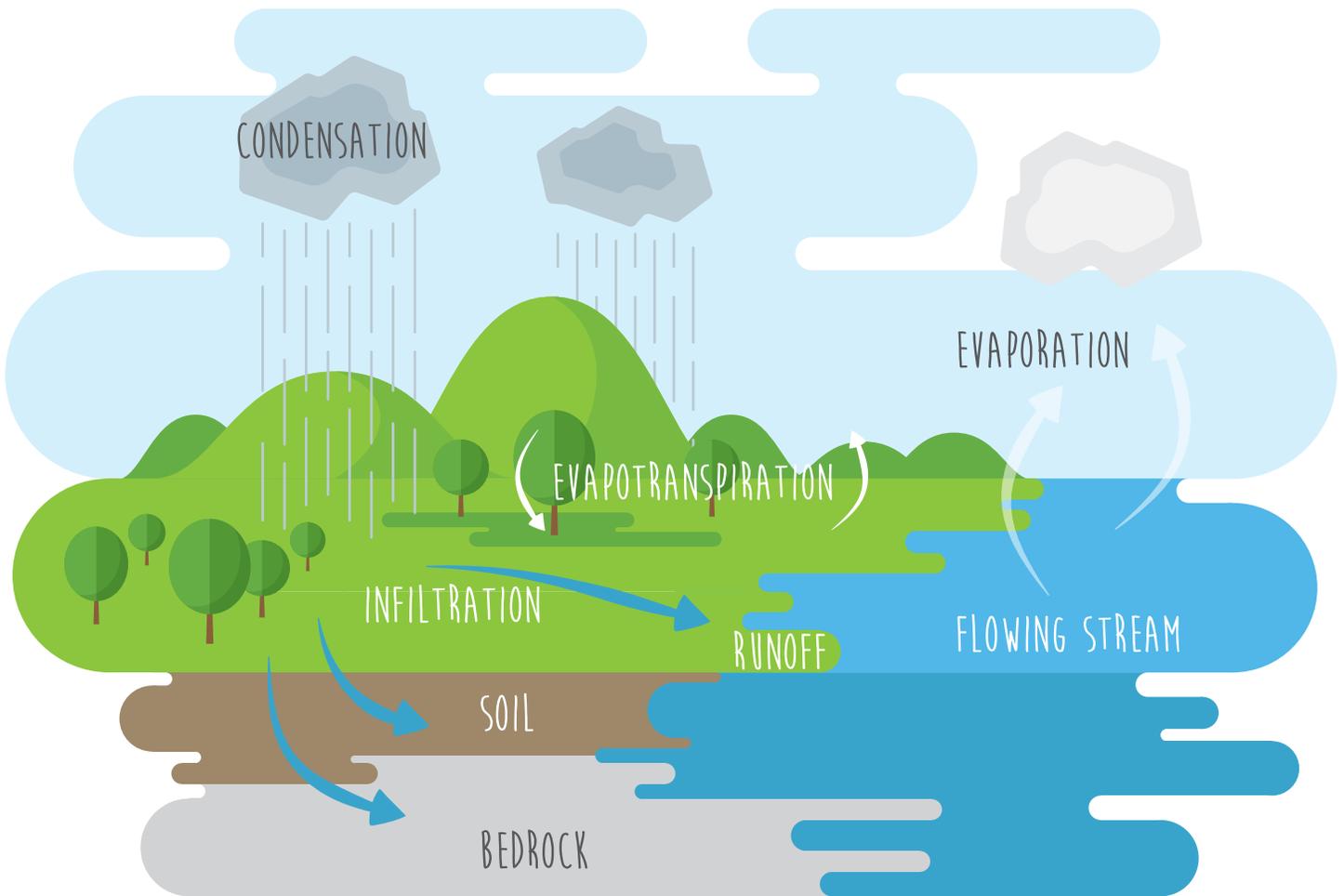
**Water Treatment:** process in which water is treated to make it safe to drink.

**Student Word:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



Earth's water is always in motion and changing states between liquid, vapor (gas), and ice (solid). The continuous movement of water is called the water cycle. It's easy to assume that each drop of rain or each glass of water is brand new water, but it has always been here and is a part of the water cycle.

### Ready To Write...

In 60 seconds or less list 8 stages or processes that are part of the water cycle.

- |    |    |
|----|----|
| 1. | 5. |
| 2. | 6. |
| 3. | 7. |
| 4. | 8. |

After you complete your list circle one word that you want to research and write it down as your student word.

## Where Does Your Water Come From?



Depending on where you live, the water you get from your faucet comes from one of two places. The typical household will get water from surface water or groundwater. Those who live in large cities or towns typically get their water from surface water (i.e. lake or reservoir). Often a reservoir is constructed and utilized to service residents in the city or town with water. In some instances, a household will source water from a well that is on their property. Well construction makes groundwater available for the individual household.

## Determine The Source of Your Water

**How would you describe where you live? (circle one)**

Urban          Suburban          Rural

**Does a family member pay a water bill?**

Yes          No          Not sure

**Is there surface water where you live?**

Yes          No          Not sure

**Where do you think the water from your faucet is sourced from?**

Stream          Reservoir          Well

**Explain why**

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Below list 5 different ways you use water. After you generate your list determine where the water goes once it is used.

Example: Wash my car down the storm drain

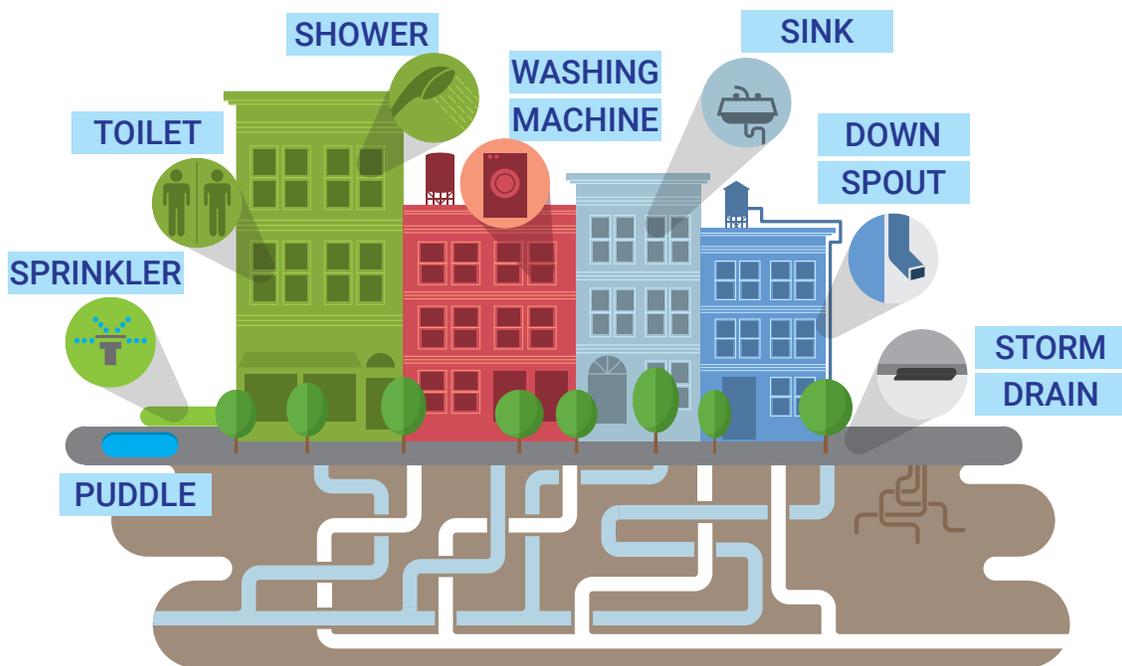
List 5 different ways you use water.

Where does it go?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

Do you notice anything about daily water use (i.e. taking a shower)? Where does it go?



Complete the exercise below using the image above.

Circle 3 words that's water would immediately go to a water treatment facility.

Box 3 words that during a rain event water goes to a nearby water body.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



**Reservoir =**

\_\_\_\_\_

**Water Treatment Plant =**

\_\_\_\_\_

**Your Address=**

\_\_\_\_\_

\_\_\_\_\_

## Data

### **Watershed Address**

Current Address:

\_\_\_\_\_

Name of City:

\_\_\_\_\_

Zip Code:

\_\_\_\_\_

### **Nearby Water Bodies**

Nearest Body of Water:

\_\_\_\_\_

Next Closest Body of Water:

\_\_\_\_\_

Closest Ocean:

\_\_\_\_\_

### **Watershed**

Name:

\_\_\_\_\_

### **Reservoir**

Name:

\_\_\_\_\_

### **Water Treatment Facility**

Name:

\_\_\_\_\_

## Data



3% of the earth's water is fresh water.



80% of the earth is covered by water.



The sun is the energy source of the water cycle.



Water makes up 83% of our blood, 70% of our brain and 90% of our lungs. Overall, our bodies are 70% water.



All living things need water to survive. People can live several weeks without food, but only a few days without water. We should drink 6 glasses of water each day.

# 2 Water Treatment

## Vocabulary

**Greywater:** wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks.

**pH:** a measure of the relative acidity or alkalinity of water. Water with a pH of 7 is neutral; lower pH levels indicate increasing acidity, while pH levels higher than 7 indicate increasingly basic solutions.

**Public Water System (PWS):** a water system that has at least fifteen service connections or which regularly serves 25 individuals for 60 days.

**Public Supply:** Water withdrawn by public governments and agencies, such as a county water department, and by private companies that is then delivered to users.

**Source Water:** Water that is used to provide drinking water.

**Suspended solids:** solids that are not in true solution and that can be removed by filtration. Such suspended solids usually contribute directly to turbidity.

**Turbidity:** the amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter. Thus, turbidity makes the water cloudy or even opaque in extreme cases

**Water Quality:** a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

**Wastewater:** water that has been used in homes, industries, and businesses that is not for reuse unless it is treated.

**Student Word:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

The diagram below illustrates the process by which a person (consumer) gets their drinking water.



Does this diagram accurately depict how all people get their drinking water? (circle one)

Yes

No

Explain your answer.

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Name the **Source Water** for your city?

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Name the **Treatment Plant** for your city?

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What type of distribution system is used to deliver water to residents in your city?  
Select the most appropriate word from the provided vocabulary list.

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## How well do you know your water after it's used?



In the above diagram circle where water most likely goes after daily use by an individual. (i.e. water used for bathing and restroom)

Explain your answer

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Is a wastewater treatment plant the same as a water treatment plant? (Circle One)

Yes

No

How does the water treatment process differ from the water cycle?

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## Water Facts



25% of the world's population is without safe drinking water.



Typically, households consume at least 50% of their water by watering their lawn.



On average about 26% of the water used in a home is used to flush the toilet.



Most public water systems put fluoride in the water to improve dental health.



The average person uses about 100 gallons of water a day at home.

## Water in the News!

Read "From toilets to tap: How we can get tap water from sewage" then answer the questions below. Circle a word from the reading that you want to research and write down as your student word.

Would you support a waste- water purification program in your city?  
(Circle one)

Yes

No

Explain your answer

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# The 7 Steps of water treatment

## 1. Water is Sourced

Water from the source water flows to the water treatment plant Treatment Plant.

## 2. Rapid Mixing

Once it arrives at the plant, the pH is adjusted and water is rapidly mixed with aluminum sulfate ( $Al_2O_3 \cdot 12S_3$ ), a coagulant that helps the impurities stick together to form bigger particles called floc.

## 3. Flocculation

After rapid mixing, the water flows into flocculation basins, where the flow of water is slowed and the floc has time to grow bigger.

## 4. Sedimentation

Next, the water flows into sedimentation basins, where the heavy floc particles sink to the bottom and are removed.

## 5. Filtration

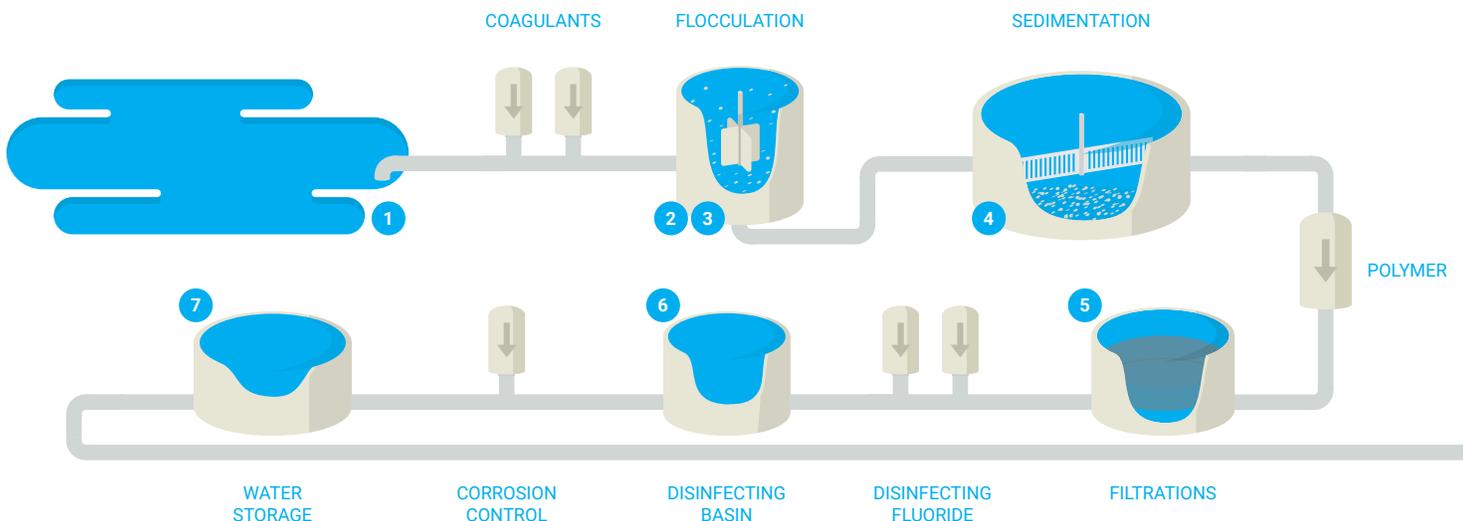
Now the water travels through large filters made of sand, gravel, and anthracite. Filtration removes any remaining microscopic particles and microorganisms.

## 6. Disinfection

Finally, the water is disinfected to protect it against bacteria. Often times chlorine dioxide ( $ClO_2$ ) is used. Fluoride is also added to support good dental health.

## 7. Distribution

The clean water is then pumped into pipes that deliver it to your home.



## Video: TED Talk by Michael Pritchard

### Reflection Questions

1. What is the personal take away from this video?

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2. How could this technology improve quality of life?

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3. Should there be an investment in this type of technology? Yes or No?  
Explain your answer.

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# 3 Drinking Water

## Vocabulary

**Clean Water Act (CWA):** law that regulates the discharge of pollutants into U.S. waterways.

**Discharge:** the volume of something that passes a given location within a given period of time. Usually expressed in cubic feet per second.

**EPA:** agency of the United States federal government whose mission is to protect human and environmental health.

**Environmentalism:** advocacy of the preservation, restoration, or improvement of the natural environment.

**Safe Drinking Water Act (SDWA):** law that ensures public drinking water meets appropriate safety standards.

**Total Maximum Daily Load (TMDL):** the maximum amount of a pollutant that can occur in a waterbody while still meeting water quality standards.

**Water Quality Standards:** Measurements set to protect water from pollution.

**Student Word:** \_\_\_\_\_

\_\_\_\_\_

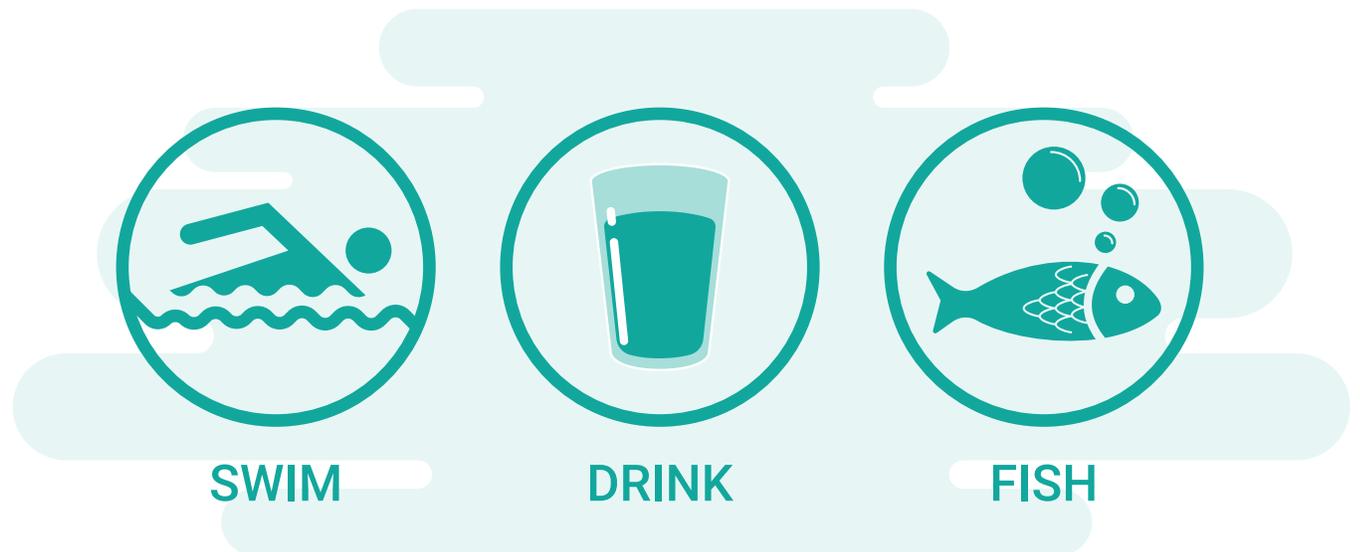
\_\_\_\_\_

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## The Clean Water Act (CWA)

The Clean Water Act established a national commitment to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The act established the basic structure for regulating discharges of pollutants into the waters of the United States. The recently formed Environmental Protection Agency (EPA) ultimately set the standards for water quality and continue to enforce laws established by the Clean Water Act in 1972. The legislation also mandated that industries and treatment plants obtain permits that set restrictions on the discharge of specific pollutants.

The Environmental Protection Agency (EPA as it is more commonly known) is an agency of the United States federal government whose mission is to protect human and environmental health. The agency was established on December 2, 1970. Its formation was in response to elevated concern about environmental pollution in the U.S. During this time the U.S. was experiencing incredible growth; Cities were growing and suburban development was expanding.



Silent Spring a book written by Rachel Carson furthered the cause for direct government action to protect nature. Carson's 1962 classic helped launch the modern idea of environmentalism and the establishment of the EPA. It also clearly pointed out that nature was vulnerable to human activities. In her book Carson highlighted the widespread use of pesticide poisoning of man and nature.

"Man's attitude toward nature is today critically important simply because we have now acquired a fateful power to alter and destroy nature. But man is a part of nature, and his war against nature is inevitably a war against himself? [We are] challenged as mankind has never been challenged before to prove our maturity and our mastery, not of nature, but of ourselves."

Up until this point in U.S. history pesticide use was widespread and regulations were limited. However Carson's findings helped move the conversation from whether pesticides were harmful to which ones were harmful, and resulted in pesticide manufacturers being held accountable and bans being put in place. An example being the ban of DDT. DDT was one of the first chemicals to be used as a pesticide. It was widely used by many Americans and accepted as a solution to insect control.

## **Safe Drinking Water Act (SDWA)**

The Safe Drinking Water Act followed the establishment of the Clean Water Act that regulates pollution in our nation's lakes, rivers, and other bodies of water. Its purpose was to ensure that public drinking water meets certain standards. The EPA is the regulatory agency that ensures compliance of standards. They retain oversight of our nations' drinking water.

Do we have to be concerned about contamination of drinking water?

Yes

No

Explain your answer \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Site an example \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Water Facts



The Clean Water Act was passed and enacted under Richard Nixon.



The Clean Water Act was passed in 1972.



Prior to the Clean Water Act our country lost an estimated 450,000 acres of wetlands each year.



The Safe Drinking Water Act was passed in 1974.

Read **"The DDT Story"** then answer the questions below. Circle a word from the reading that you want to research and write it down as your student word.

Highlight a least 3 facts from the reading.  
What fact was most alarming?

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Prior to this lesson did you know who Rachel Carson was?

Yes                  No

What do you think of her?

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## Timeline of events

To give context to the series of events that led to modern day environmentalism you will develop a timeline of the events you just learned about in this lesson. The timeline must include:

- Year Silent Spring was published
- Date and year the EPA was established
- Year Clean Water Act was established
- Year Safe Drinking Water Act was established

Include a description for each event that details its importance and value to improving the environment and/or the everyday life of people.

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Note anything you find interesting about the series of events?

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Would you add any other events that have happen in recent history?

Yes

No

Explain \_\_\_\_\_

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# 4 Water Protection

## Vocabulary

**Combined Sewer Overflows (CSOs):** when an overflow of sewage from pipes carrying raw sewage to a sewage treatment plant mix with a stormwater pipe.

**First flush:** is the initial surface runoff of a rainstorm. During this phase, water pollution entering storm drains in areas with high proportions of impervious surfaces is typically more concentrated compared to the remainder of the storm.

**Impervious surface:** surface covered by impenetrable materials.

**Non-point source (NPS) pollution:** pollution discharged over a wide land area, not from one specific location.

**Point source (PS) pollution:** a single identifiable source of pollution.

**Run-off:** the draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.

**Source water:** water from surface water or groundwater that is used for drinking.

**Source Water Protection Area (SWPA):** Area of land that surrounds the source water.

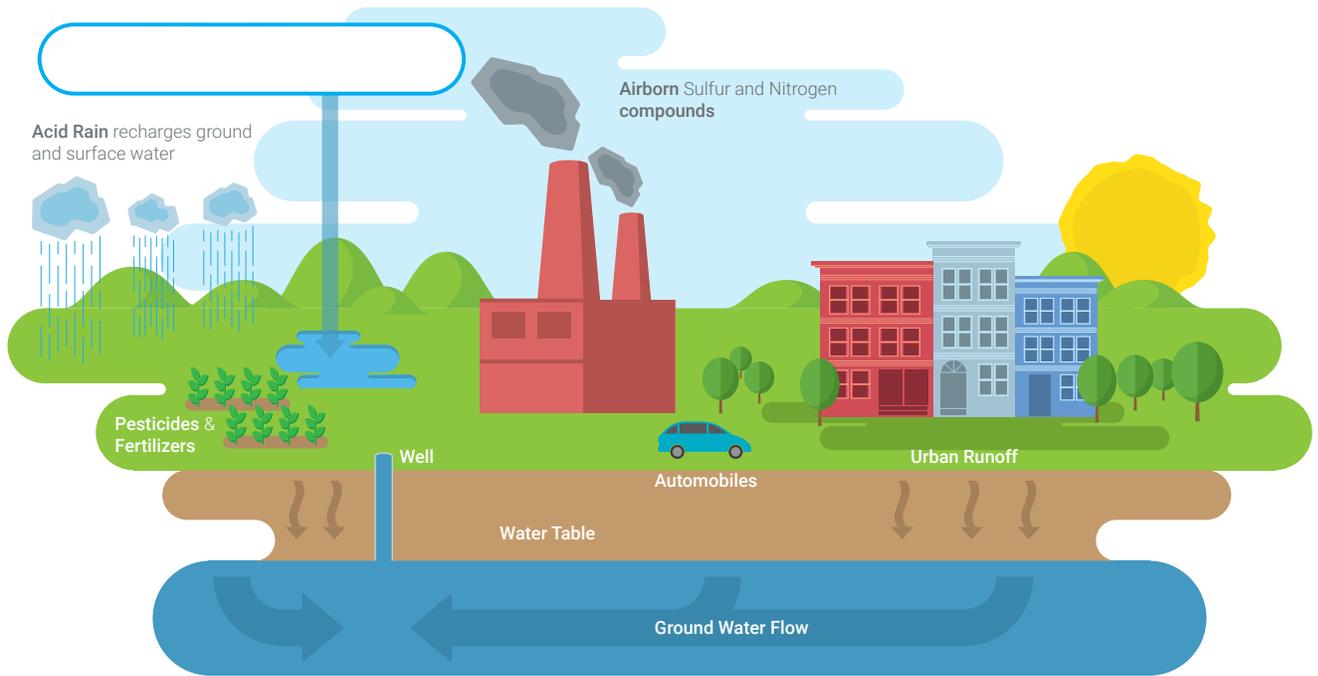
**Storm drain/sewer:** a sewer that carries only surface runoff, street wash, and snow melt from the land.

**Student Word:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



## Protecting the Source

Water protection starts with knowing your source water. Does your drinking water come from surface water or groundwater?

Drinking Water ID \_\_\_\_\_

Name of City: \_\_\_\_\_

Source Water Type: \_\_\_\_\_

Label the surface water in the above image with the correct source water type and reservoir image with the name of your city'. What is the image of the surface water missing?

\_\_\_\_\_

Protecting source water is everyone's responsibility. Everyone has a role including the EPA, water utilities, state and local governments, non-government organizations, and individuals. Individuals can make an impact by getting involved in local water protection efforts, reducing fertilizer use and eliminating the use of herbicides and pesticides use around their home, and disposing of harmful materials properly. Many products used at home contain hazardous and toxic chemicals that can contaminate ground and surface water. They can travel through the soil or flow with water to reach source water. A storm drain stenciling project is an example of a project that contributes to drinking water source protection by helping to educate the public.

The 1996 amendments to the Safe Drinking Water Act (SDWA) outline six steps for conducting source water assessments for public water systems (PWSs)

**Step 1 – Delineate the source water protection area (SWPA).**

Delineation shows the area to be protected based on the area from which the PWS draws its drinking water supplies.

**Step 2 – Inventory known and potential sources of contamination.**

The contaminant source inventory lists all documented and potential contaminant sources or activities of concern that may be potential threats to drinking water supplies.

**Step 3 – Determine the susceptibility of the PWS to contaminant sources or activities within the SWPA.**

Determining susceptibility of the PWS to inventoried threats relates the nature and severity of the threat to the likelihood of source water contamination.

**Step 4 – Notify the public about threats identified in the contaminant source inventory and what they mean to the PWS.**

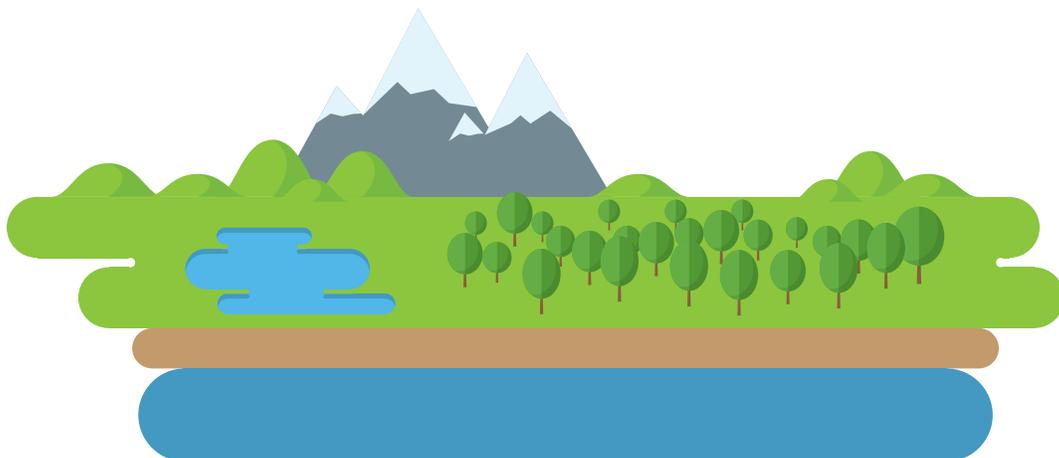
Effective programs ensure that the public has information necessary to act to prevent contamination.

**Step 5 – Implement management measures to prevent, reduce, or eliminate risks to drinking water supply.**

The assessment information can support formulation and implementation of measures to protect the source water. These measures can be tailored to address each threat or array of risks specific to each PWS.

**Step 6 – Develop contingency planning strategies that address water supply contamination or service interruption emergencies.**

Water supply replacement strategies are an indispensable part of any drinking water protection program in the event of short- or long-term water drinking water supply disruption.



Generate a list of potential source water contaminants.

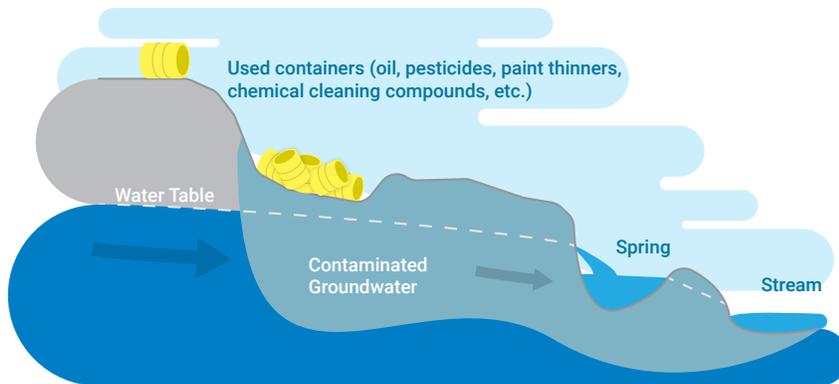
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
6. \_\_\_\_\_
8. \_\_\_\_\_

The list you generated above is critical for which of step of the six step process?  
Step \_\_\_\_ Of the 8 contaminants listed above, how many are a result of human activity? \_\_\_\_ of 8

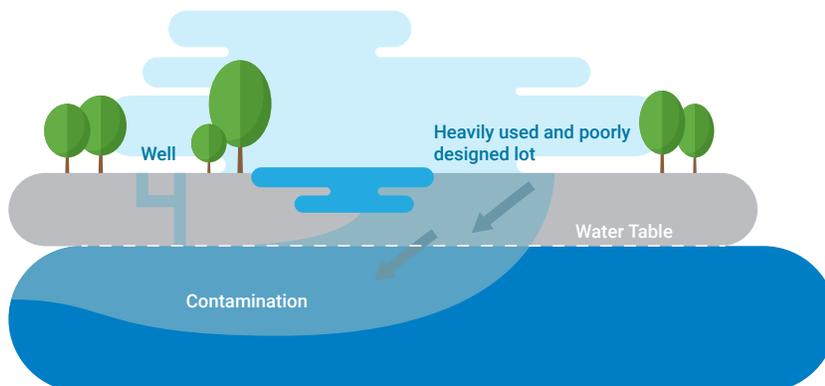
## Human Activity

Human activities (application of pesticides and herbicides and dumping of hazardous chemicals down a storm drain) is a leading cause of water contamination. The majority of water contamination is due to human activities. It's a cause of great interest because it is one that we have the most control over. While at times it can be difficult, attitudes can be changed and behaviors altered so that water contamination due to human activity is reduced.

Contaminates can be lumped into two categories. They are either point



Point Source Pollution



Non-point source pollutants

## Water Facts



Storm drains are not connected to sewage treatment plants, so pollutants captured in storm water runoff are carried directly into local rivers, streams, and other bodies of water.



Bleach, antifreeze, and paint are common household products that when disposed of improperly contribute to water contamination.

List the contaminants from the point source pollutants image.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

List some possible contaminants from the non-point source pollutants image.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

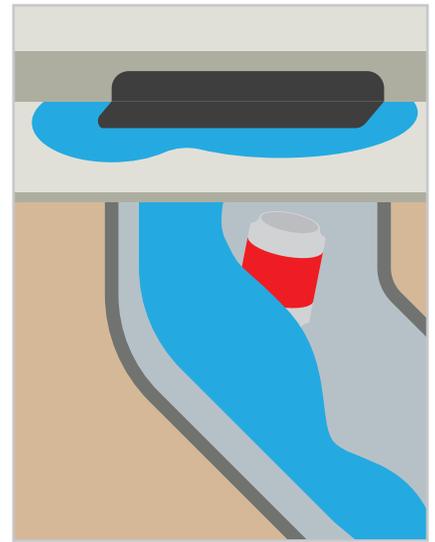
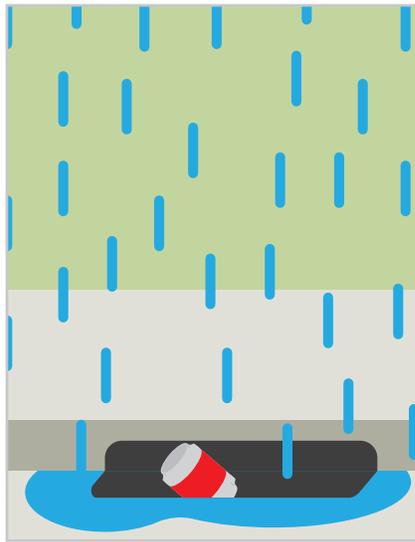
Which type is more difficult to regulate and control? (circle one)

Point source pollutants

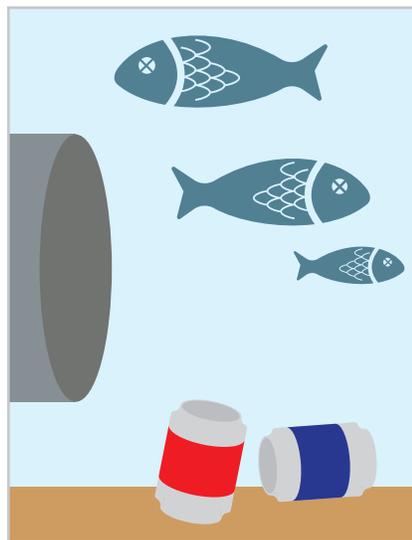
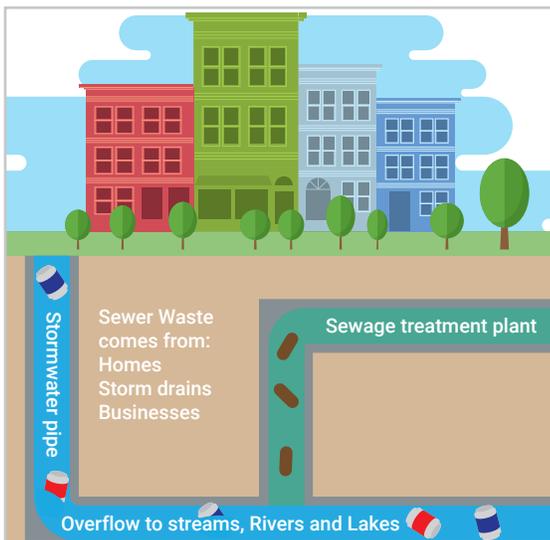
Non-point source pollutants

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

Each time something is dropped on an **impervious** surface like a sidewalk, no matter what it is, it can end up washing away and become part of stormwater runoff.



**Storm drains** were created to catch rainwater to keep streets from flooding. Most storm drains empty into a nearby body of water.



**Combined Sewer Overflows** (CSO) are when an overflow of sewage from pipes carrying raw sewage (toilet water) to a sewage treatment plant mix with a stormwater pipe. This usually happens when there is heavy rain and pipes become “backed up” and then mix and empty out into a nearby body of water.

Everything that goes into the storm drain ends up in our waterways **unfiltered!**

As expressed early, storm drain stenciling can heighten awareness and help educate the public about human activities that cause water contamination.

### Stenciling Project Proposal

Working in groups of 3-4, develop an image and slogan that could be used to stencil storm drains in your city.

In the space below generate 3 slogans.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Use the space the below for your final selection. Enlarge the text so your slogan stands out.

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In the space below list ideas for imagery you would use in your design.

Develop a final design on an 8.5 x 11 piece of paper.



