

# How do you treat water based on water quality from different water sources?

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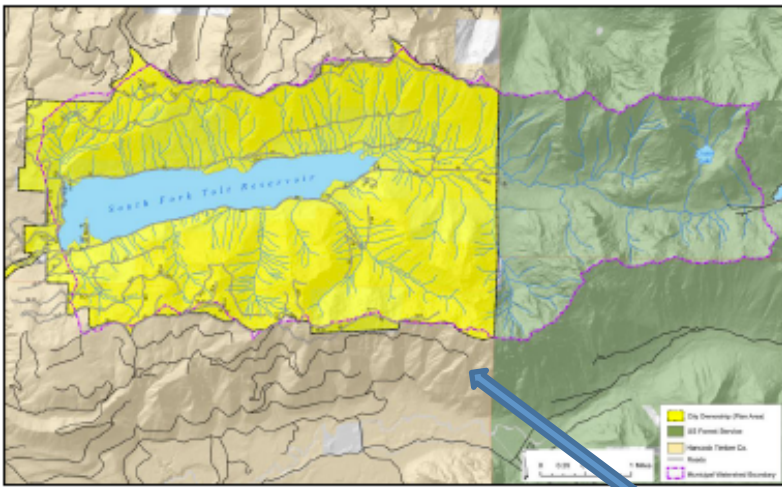
## Why?

Water from different sources will contain different contaminants, and water treatment will vary depending on these contaminants. In this activity we will investigate two very different water sources and the different processes that are used to treat the water based on water quality.

Use the information from Model 1 to answer the following questions. Be sure you have reached a consensus with your group before you write down any answers.

## Model 1

### Different Contaminants in Different Water Supplies



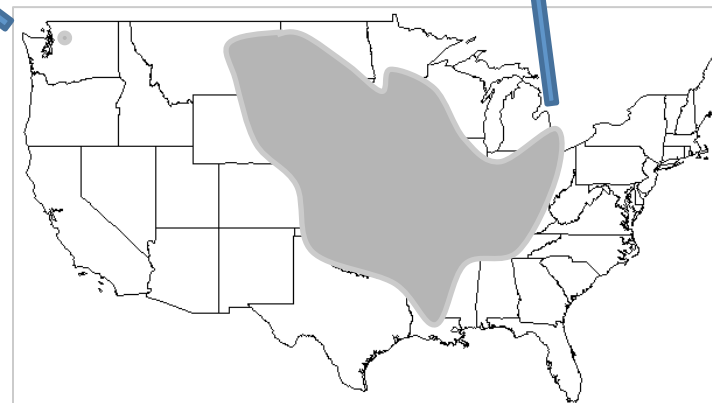
**Tolt River Watershed**



**Mississippi River Watershed**

1. Using the image of the Mississippi River Watershed, what does the light gray area represent?

Using the same image, what do the dark lines represent?



2. Why are the Tolt and Mississippi Watersheds considered watersheds?

3. Circle the best definition of a watershed.

- a. Watersheds are reservoirs of water that are maintained for human consumption.
- b. A watershed is an area of land where all of the water that is under it or drains off of it goes into the same place.
- c. A watershed is the surface water, such as streams and rivers, which drain into a larger body of water.

4. Which watershed do you think covers 1,837,000 square miles and which covers 12,500 acres? (1 square mile = 640 acres)

5. One of these watersheds is owned and controlled by a government agency. Because of this the watershed does not have any agriculture, development, or human use of any kind. Which watershed do you think is owned and controlled by a government agency? Explain your choice.

6. Would you expect more contaminants to be found in water taken from the Tolt River Watershed or the Mississippi River Watershed? Explain your answer.

7. Cut out the contaminant cards on the following page. Use your cards to sort which contaminants you would expect to find in each water source. (Some cards may be used more than once.)

**Tolt River Watershed**

**Mississippi River Watershed**

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## Cut out the following Contaminant Cards

### Protozoans

*Cryptosporidium, Giardia*

Source is human or animal feces.



### Nitrate

Chemical compound that can reduce the oxygen in blood.

Source is fertilizers or animal waste from factory farms.



### Particles

*Particles of sand, clay, organic matter from decaying plants or animals etc*

*Source is erosion in the watershed, especially during heavy rains.*

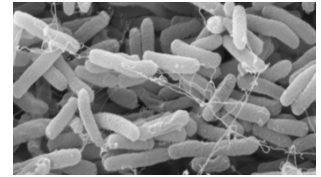
*\*\*Often has other contaminants (biological and chemical) attached to the particles*



### Bacteria

Fecal coliform such as *E. Coli, Legionella*

Source is human or animal feces.



### Industrial Chemicals

*Benzene, heavy metals such as arsenic, PAHs, dioxins*

*Source is industrial waste dumped into the water source.*



### Pharmaceuticals

*Antibiotics, anti-depressants, Ibuprofen, birth control pills*

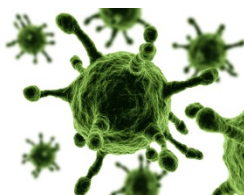
*Source is human urine or feces flushed into the sewers and treated by a wastewater facility, after which the treated water may be discharged back into the water supply.*



### Viruses

Norovirus, adenovirus, Coxsackievirus

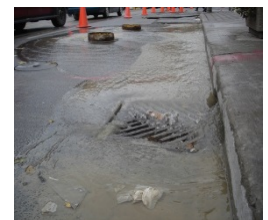
Source is typically human or animal feces.



### Urban Run Off

Heavy metals from cars or construction materials, asphalt particles, oil, nutrients from lawn and gardens, road salt

Source is rain that washes over surfaces and is led to drinking water sources by groundwater absorption or storm drains.



**LEAVE BLANK FOR CARD CUTTING**

8. Sort your contaminant cards into two piles biologic contaminants and chemical contaminants.

9. How many biological contaminants did you identify? \_\_\_\_\_ chemical contaminants? \_\_\_\_\_

10. What is your current definition for a contaminant?

11. To sort your cards, how did you define the difference between a biological vs a chemical contaminant?



12. How do your initial definitions of biological contaminants vs chemical contaminants compare to the class definition?

13. Using the class definition, sort the contaminant cards into biological and chemical contaminants. List them in the appropriate columns.

**Chemical Contaminants**

**Biological Contaminants**

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14. Which contaminant does not fit in either classification? Why?

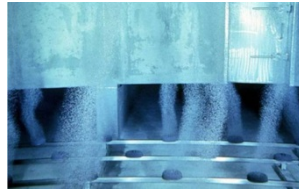
15. Why would water treatment facilities remove this contaminant if it is neither a chemical or biological contaminant?

**MODEL 2** You will now compare water treatment plants from each of the watersheds from Model #1.

**Circle** what is being treated in each step. **\*\*Note: more than one option can be chosen for each step**

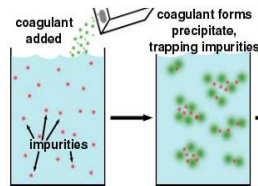
**Tolt Watershed:** The Tolt Water Treatment Plant serves the northern half of Seattle

**Step 1 – Ozone Disinfection**



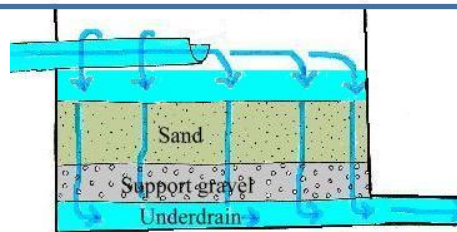
- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 2 – Coagulation**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 3 – Filtration**



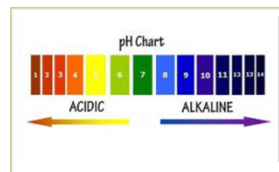
- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 4 – Chlorine Disinfection**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 5 – pH Adjustment**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

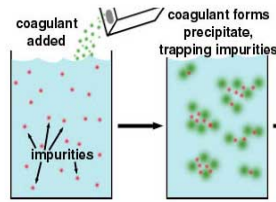
**Step 6 - Fluoridation**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control
- ?

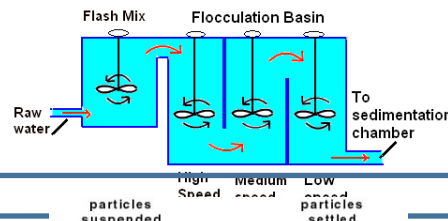
**MODEL 2 Mississippi Watershed:** The Carrollton Water Treatment plant serves the city of New Orleans

**Step 1 – Coagulation**



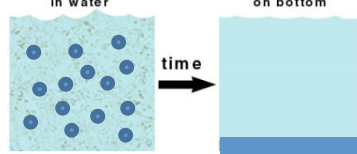
- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 2 – Flocculation**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 3 – Sedimentation Basin**



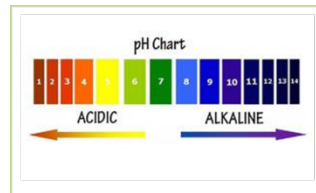
- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 4 – Chlorine Disinfection**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 5 - pH Adjustment**



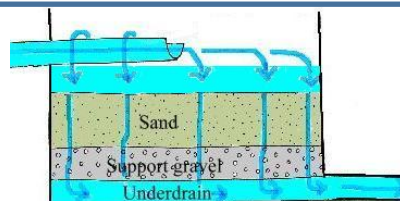
- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

**Step 6 -Fluoridation**




- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control
- ?

**Step 7 – Filtration**



- Remove Particles
- Biological Contaminants
- Chemical Contaminants
- Aesthetics (taste, appearance)
- Corrosion Control

Use both diagrams in Model 2 to answer the following questions.

16. Place a check mark  next to each processing step that happens in **both** water treatment plants. How many steps are the same in the two treatment plants? \_\_\_\_\_
17. List the steps that take place only at the Carrollton facility serving New Orleans.
18. List the steps that take place only at the Tolt facility serving northern Seattle.
19. Examining the list of steps that are the same for the two water treatment plants, describe in your own words what both plants are both doing to “treat” their water.
20. The turbidity in the lower Mississippi near New Orleans ranges from 50-100 ntu while the Tolt watershed has turbidity measurements of only 1 to 10 ntu. These measurements show that the Mississippi water is up to 100 times “cloudier” than the Tolt. Does this difference impact the water treatment choices at the two facilities? Explain your answer.
21. Ozone disinfection is highly effective, but very expensive due to energy demands to create the ozone gas that is bubbled through the water. Every step in water treatment is a trade-off weighing effectiveness of removing contaminants and costs or availability of resources. Much of the developing world gathers and treats their own water since they do not have centralized water treatment plants. Knowing that every choice has costs and limitation associated with it, what would you prioritize in your water treatment if you lived in Kenya and gathered water from local streams or lakes? Why?

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