LESSON 3 - WATER AND SEWAGE TREATMENT

Overview:
Through notes, discussion and research, students learn about how water and sewage are treated in rural and urban areas. Through discussion and online research, the sources, safety, treatment and cost of bottled water are considered. Using this information, students then share their views on bottled water.

Suggested Timeline: 2 hours

Materials:
- Watery Facts (Teacher Support Material)
- Water and Sewage Treatment (Teacher Support Material)
- A Closer Look at Water Treatment – Teacher Key (Teacher Support Material)
- All Tapped Out? – A Look At Bottled Water (Teacher Support Material)
- materials for bottled water demonstration:
  - plastic cups
  - 3 or more brands of bottled water
  - a sample of municipal tap water
  - a sample of local well water
- Water and Sewage Treatment (Student Handout – Individual)
- Water and Sewage Treatment (Student Handout – Group)
- A Closer Look at Water Treatment (Student Handout)
- All Tapped Out? – A Look At Bottled Water (Student Handout)
- student access to computers with the Internet and speakers

Method:

INDIVIDUAL FORMAT:
1. Have students read and complete the questions on 'Water and Sewage Treatment' (Student Handout – Individual).
2. Using computers with Internet access and speakers, allow students to research answers to questions on 'A Closer Look at Water Treatment' (Student Handout)
3. If possible, use one or more of the ideas on 'All Tapped Out? – A Look At Bottled Water' (Teacher Support Material) to spark students' interest in the issues associated with bottled water.
4. Using computers with Internet access, have students complete the research on bottled water on 'All Tapped Out? – A Look At Bottled Water' (Student Handout).
5. Have students hand in their answers to questions for your feedback.

GROUP FORMAT:
1. Share 'Watery Facts' (Teacher Support Material) with students. Use the last facts about water and sewage treatment to lead into a discussion of urban and rural water and sewage treatment.

   Key Q: Where is our town/city water treatment plant? What do you know about it?
   Key Q: Who has a well for water and/or a septic tank for sewage? How is this different from living in a city or town with a water treatment plant?

2. Use ‘Water and Sewage Treatment’ (Teacher Support Material) to guide students in filling in their hand out ‘Water and Sewage Treatment’ (Student Handout – Group).
3. Introduce some of the issues surrounding bottled water using the ideas on ‘All Tapped Out? – A Look At Bottled Water’ (Teacher Support Material).
4. Allow students to research bottled water on the Internet by using their handout ‘All Tapped Out? – A Look At Bottled Water’ (Student Handout).
5. Discuss the answers to students’ questions and their views on purchasing bottled water.

Assessment:

- Assessment of student’s understanding of water and sewage treatment through questioning
- Assessment of student’s ability to form an informed opinion on the issues surrounding bottled water

Extension:

- Organize a field trip to your local water and/or wastewater treatment plant
- Organize a field trip to a farm to learn about water and wastewater treatment
- Discuss the issue of safe drinking water in Canada and the many communities that live for years with a boiled water advisory
- Have students write a position paper on bottled water after doing additional research on the subject

Watery Facts

- Water use in the 20th century increased more than sixfold and continues to increase about twice as fast as the human population is increasing!

- The current average North American diet requires over 1 800 m^3 of water per person per year from both natural rainfall and irrigation; the diet of an average African living in the sub-Saharan region is produced with less than 650 m^3 of water per person per year. (An Olympic sized swimming pool has a volume of about 2500 m^3)

- It takes 48.3 gallons (about 183 litres) of water to produce one eight-ounce glass of milk when you add together the amounts of water needed to provide food and water for the cows, to keep the dairy barns clean, and to process the milk.

- It takes about 45% more water to make a slice of white bread (10.6 gallons/40 litres) than a slice of brown bread (7.3 gallons/28 litres) because more flour is used and because that flour requires more processing to remove the brown colour.

Source: Environment Canada website

- In Saskatoon, you can refill a 355ml (12oz) glass of water approximately 9,700 times for the same cost as a six-pack of pop.

- The City of Saskatoon's Water Treatment Plant treats 130 million litres of water a day.

- It costs 22 cents to treat every cubic metre of sewage.

Source: City of Saskatoon website

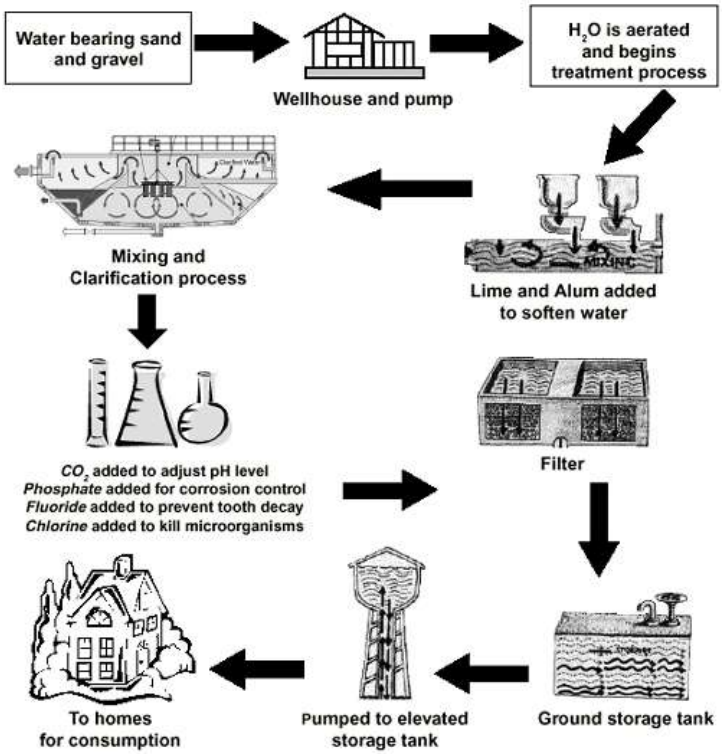
Water and Sewage Treatment

WATER TREATMENT

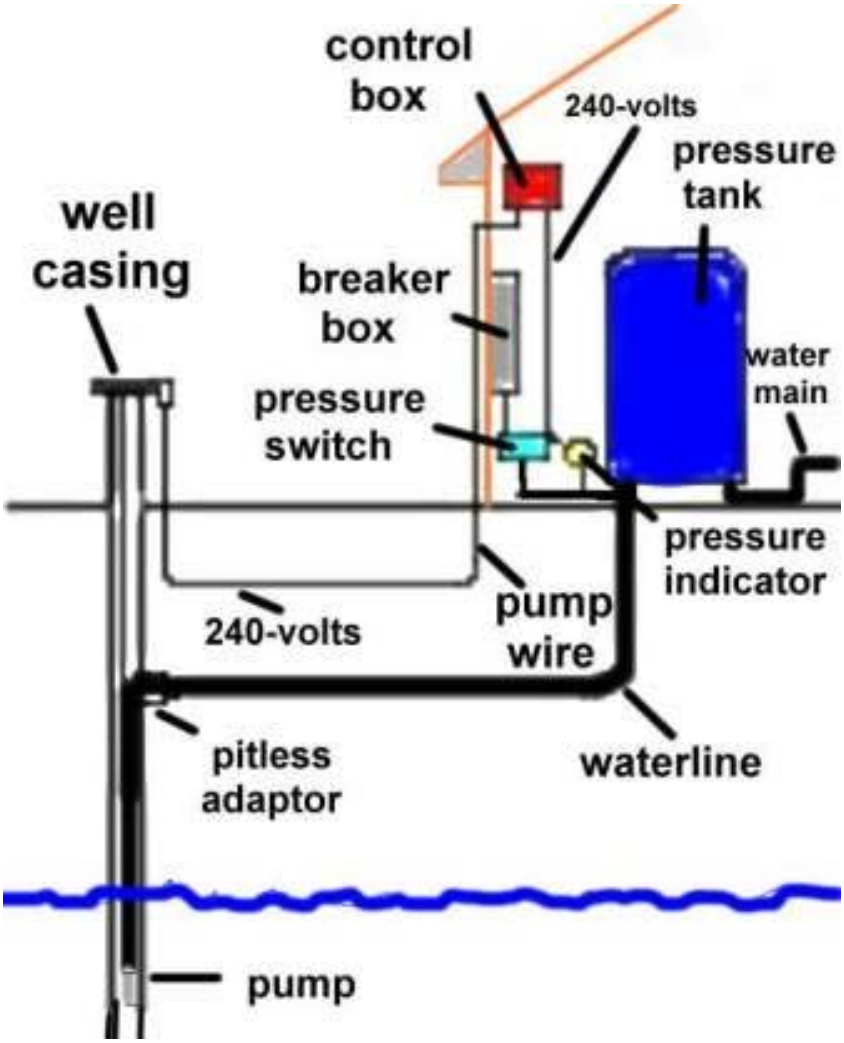
- Your water supply comes from your local watershed – an area that collects all precipitation. It includes lakes, rivers, streams, marshes and groundwater.

- Before this water is piped into your house, it must be treated so that it is safe for human consumption. Water is treated in different ways, depending on the area in which you live.

  Urban Areas – To ensure that freshwater is safe to drink, communities build water treatment plants. Water treatment removes living organisms, dissolved minerals and human caused pollutants. When the water is finished being treated, it is pumped to homes through the water main.



  Rural Areas – People living in rural settings may not have access to treated water and may have to dig a well on their land. A water pump then moves the water to and through the house. Home owners need to get a water sample tested to ensure that it is safe for consumption. Yearly testing is recommended.


control box
240-volts
pressure tank
well casing
breaker box
water main
pressure switch
pressure indicator
pump wire
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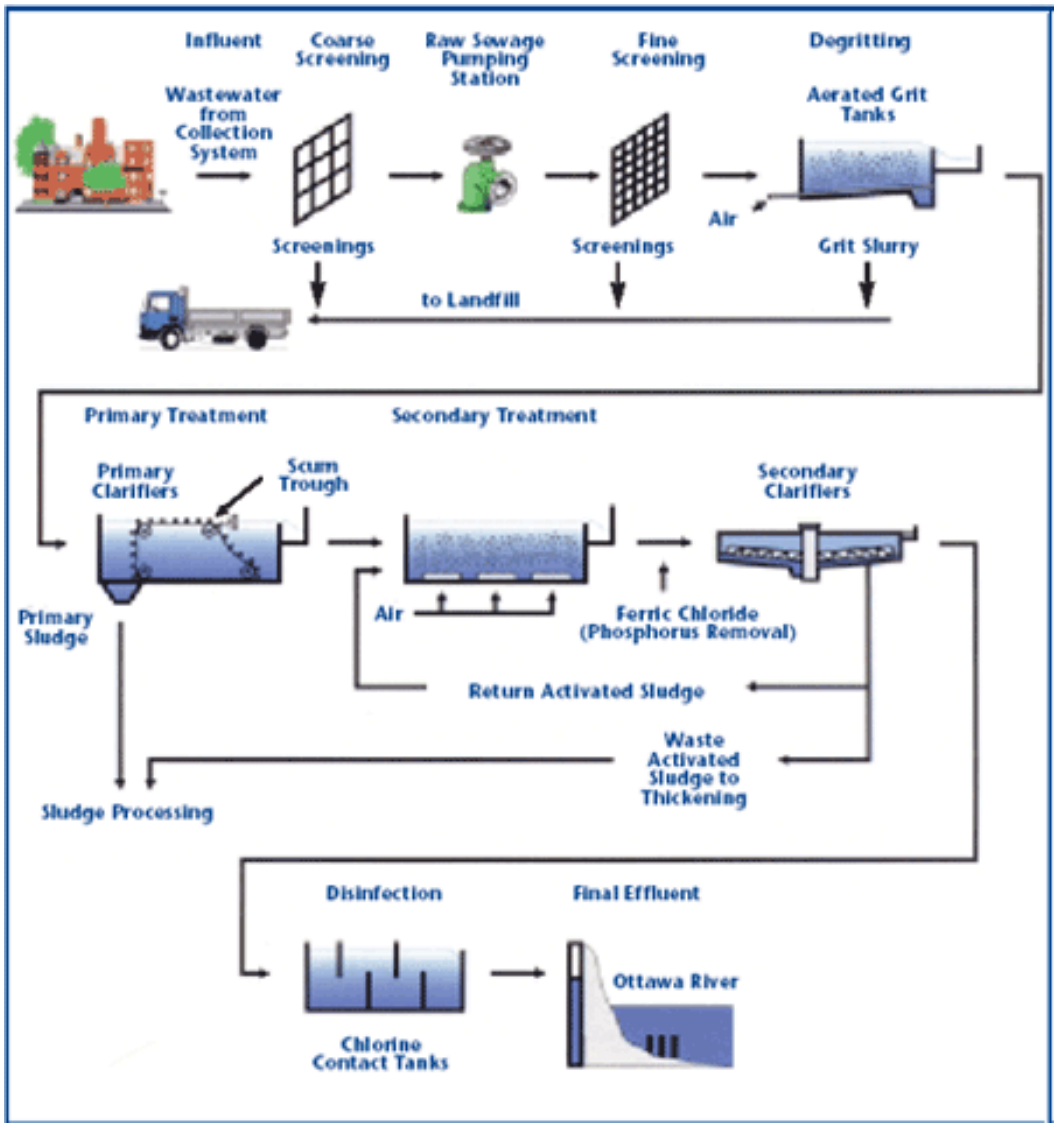
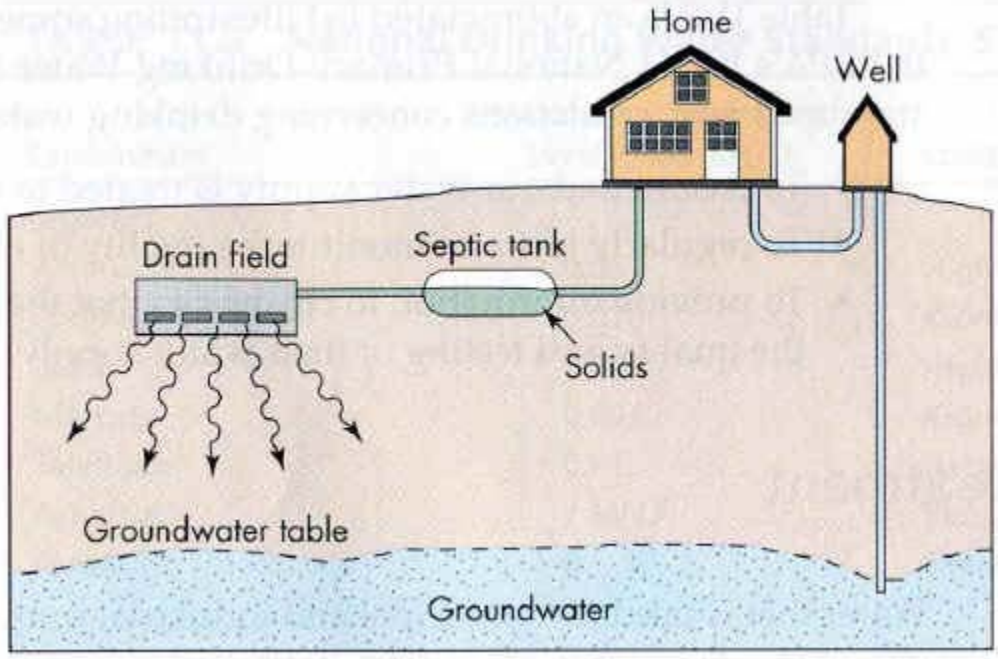
waterline
pump

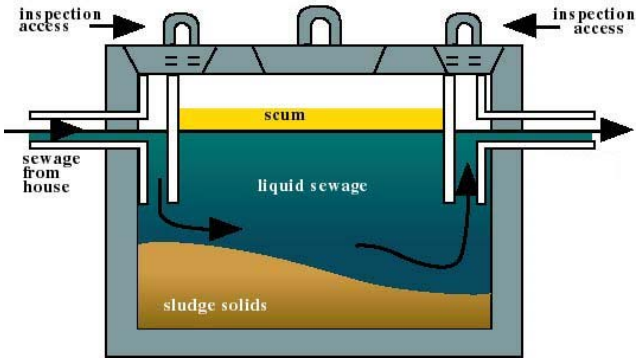
SEWAGE TREATMENT

Urban Areas – Once the water has been used in your household, it must be treated before it can be returned to the environment. Solids are settled out of the sewage water and aeration of the left over water helps speed up the decomposition of the organic matter. The treated sewage is usually then pumped into a large body of water, such as a nearby river.



Rural Areas – Rural homes that are not connected to a community sewer system will use a septic tank to contain their waste. Solids settle to the bottom of the tank and bacteria helps to decompose the organic matter. A septic truck must then come and pump out the sewage and truck it to a nearby treatment facility.





A Closer Look at Water Treatment

Teacher Key

Go to
http://www.city.saskatoon.sk.ca/org/water_treatment/water_treatment/water_treament_home.asp
and click on the icon to watch the video on the water treatment facility in Saskatoon. Use the information to answer the following questions:

1. How many liters of water per day does the average Saskatoon citizen use?

   230

2. What body of water supplies the water for treatment? South SK River

3. The chemical first added to the water as it enters the water treatment facility is potassium permanganate. What does it do?

   Eliminates any odor or taste.

4. Separators in the plant remove sand and chemicals are added to soften the water.

5. Chloramine is added to kill bacteria. Fluoride, also present in your toothpaste, is added (to harden the enamels of your teeth and prevent tooth decay).

6. How long does the treatment of water take? 3-4 hours

7. Once the water is treated, how does the city ensure that it is safe to drink?

   testing - >50,000 water quality tests done per year

8. Where is the treated water stored? In one of three large reservoirs

All Tapped Out?

A Look at Bottled Water

Materials

- a series of plastic cups, each numbered
- 3 or more brands of bottled water
- a sample of municipal tap water
- a sample of local well water

Procedure

Set out the numbered cups, each with a sample of water in it. Have a volunteer come to the front and taste the samples of water. Which one does he/she prefer?

Points for Discussion

Use the article *Bottled Water – Quenching a Planet's Thirst* at http://www.cbc.ca/news/background/consumers/bottled-water.html as a catalyst for the discussion of the cost of bottled water, water quality and a comparison of bottled water and municipal water. Another article on the subject: *Bottled Twaddle* – preview available on the Scientific American website at http://www.sciam.com/article.cfm?id=bottled-twaddle

Brainstorm alternatives to buying bottled water:

- bringing your own bottle and refilling it with tap water, being sure to choose the type of bottle wisely (BPA free – stainless steel or #5 plastic)
- if reusing a water bottle, be sure to wash it regularly so that the water quality is not compromised

Discuss what the contents of the label of a bottle of water mean (use on purchased bottle of water as an example). If students don't know, tell them that they will find out during their research!

Discuss the environmental impact of drinking bottled water – plastic waste, shipping costs

Teacher Key To Online Student Research

Go to the Health Canada website http://www.hc-sc.gc.ca/fn-an/securit/facts-faits/faqs_bottle_water-eau_embouteillee-eng.php

Use the information to answer the following questions:

1. Why has the consumption of bottled water increased in Canada in the last few years?

   Sometimes it is a matter of personal taste and preference for bottled water over tap water. Consumers may also be concerned about the safety of municipal tap water, thinking that bottled water is always safer (this is not necessarily the case).

2. Is there bacteria in bottled water? Yes

3. If your bottled water says "mineral water" or "spring water" on it, what does this mean?

This means that it has come from an underground source and CANNOT come from a public water supply. The composition of the water cannot be changed through the use of chemicals – carbon dioxide or ozone may be added to protect freshness.

4. a) Where does bottled water that does not state "mineral water" or "spring water" on it, come from?

   It comes from any source, so it could be tap water or well water. The label say that the water was treated in some way – for example, distilled or carbonated.

   b) In what other ways is it different from mineral or spring water?

   The water may have gone through more treatments than mineral or spring water. The label must also state how it was treated (unlike mineral or spring water)

5. Why should bottled water be refrigerated when opened or when stored for long periods of time?

   To prevent or slow the growth of bacteria.

6. How long is the "shelf-life" of bottled water? ie: what is the best-before time period?

   2 years (although Health Canada recommends 1 year)

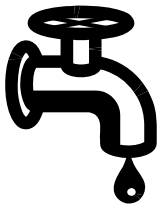
7. Tap water is much cheaper than bottled water. For example in most North American cities, tap water costs around 50 cents for 1000 litres. Bottled water may cost up to $1 per litre. Do you think that bottled water companies are charging too much? Why or why not?

8. a) Do you and/or your family regularly buy bottled water?

   b) What is your reason(s) for buying or for not buying it?

   c) Will the information that you have learned in this class about bottled water influence your choice to buy bottled water in the future? If yes, how?

Student Handout INDIVIDUAL



Water and Sewage Treatment

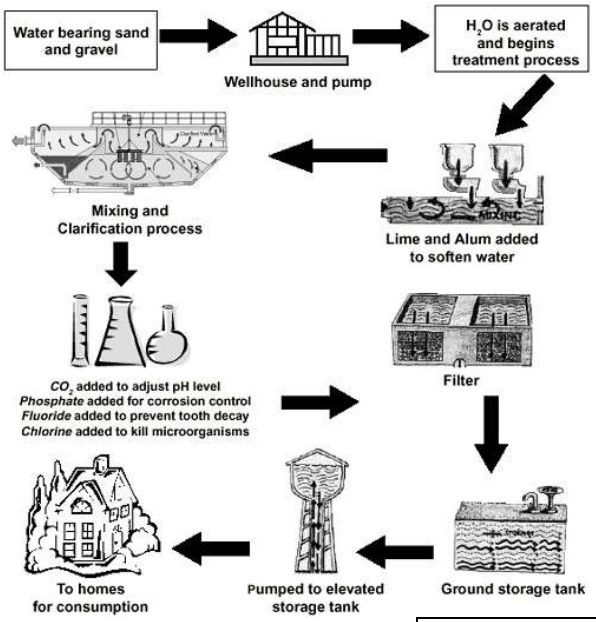
Instructions – Read the following information and answer the questions that follow.

Water Treatment

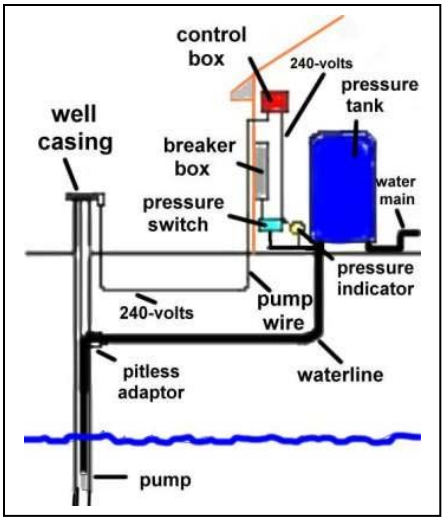
Your water supply comes from your local watershed – an area that collects all precipitation. It includes lakes, rivers, streams, marshes and groundwater.

Before this water is piped into your house, it must be treated so that it is safe for human consumption. Water is treated in different ways, depending on the area in which you live.

Urban Areas – To ensure that freshwater is safe to drink, communities build water treatment plants. Water treatment removes living organisms, dissolved minerals and human caused pollutants. When the water is finished being treated, it is pumped to homes through the water main.



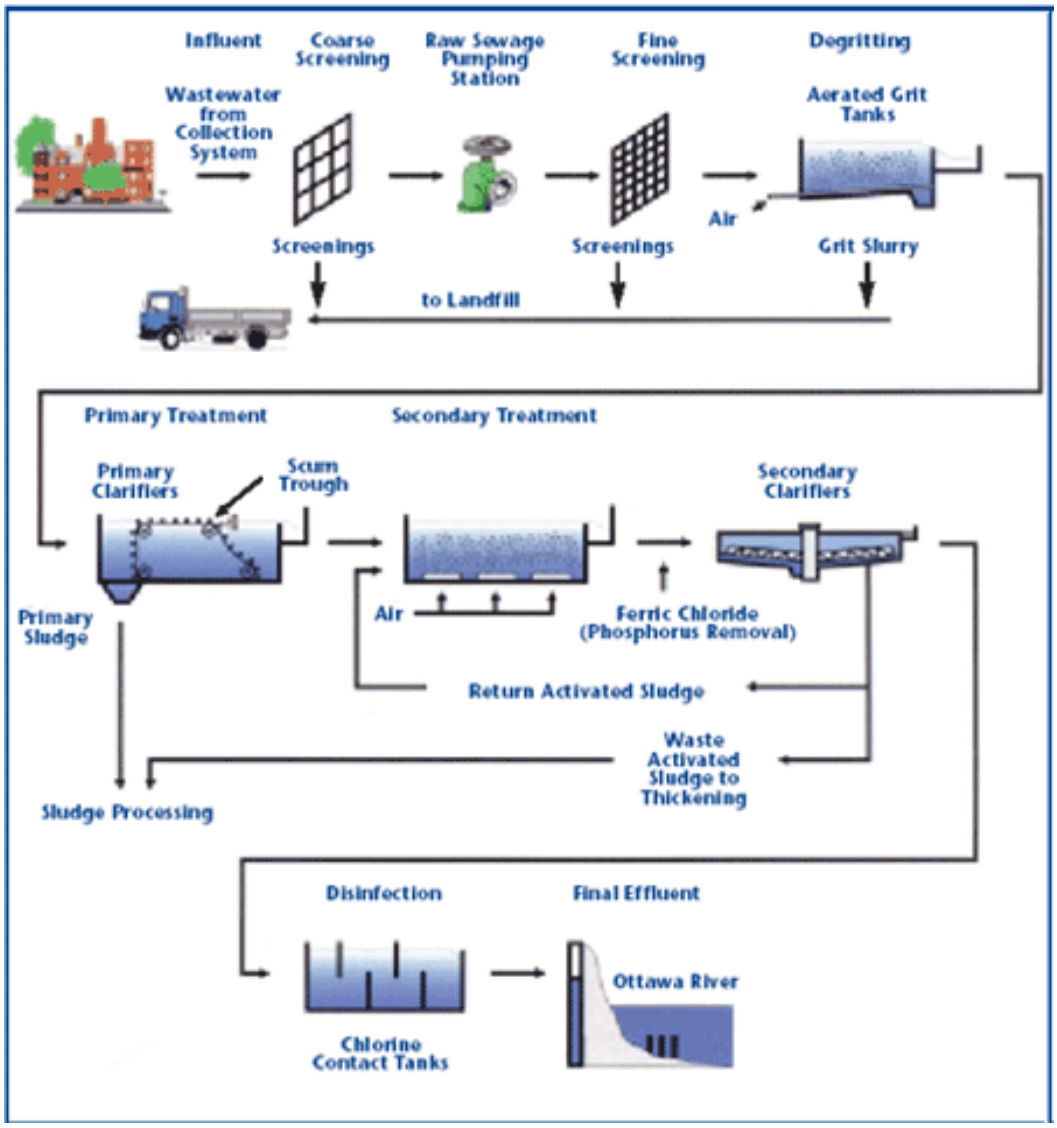
Rural Areas – People living in rural settings may not have access to treated water and may have to dig a well on their land. A water pump then moves the water to and through the house. Home owners need to get a water sample tested to ensure that it is safe for consumption. Yearly testing is recommended.



Student Handout INDIVIDUAL

Sewage Treatment

Urban Areas – Once the water has been used in your household, it must be treated before it can be returned to the environment. Solids are settled out of the sewage water and aeration of the left over water helps speed up the decomposition of the organic matter. The treated sewage is usually then pumped into a large body of water, such as a nearby river.



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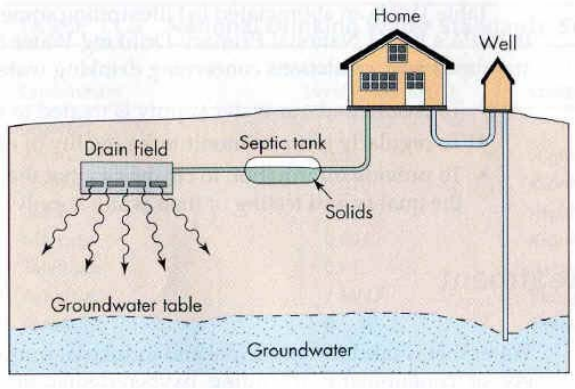

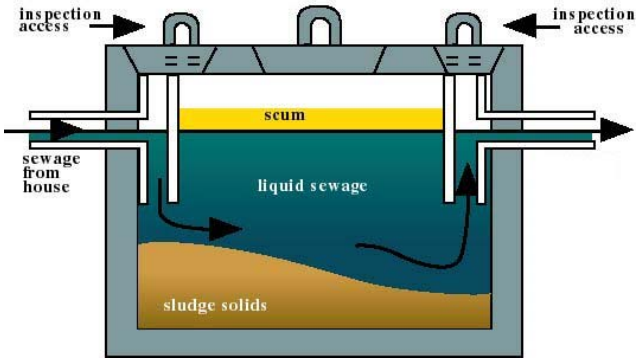

Questions:

1. a) What is a watershed? _____

   _____

   b) Why do you think that the protection of watersheds is so important?

   _____

   _____

2. What is added to water in a water treatment facility to soften it?

   _____

3. What *is* soft water (Hint: You may have to research this)?

   _____

4. List the role of each of the following in treating water:

   a) CO_2 _____

   b) phosphate _____

Student Handout INDIVIDUAL

c) chlorine _____

d) fluoride _____

5. Where does the waste that is initially removed from sewage go? (HINT: Look at your diagram)

_____

6. What is effluent? _____

Student Handout GROUP

Water and Sewage Treatment

Water Treatment

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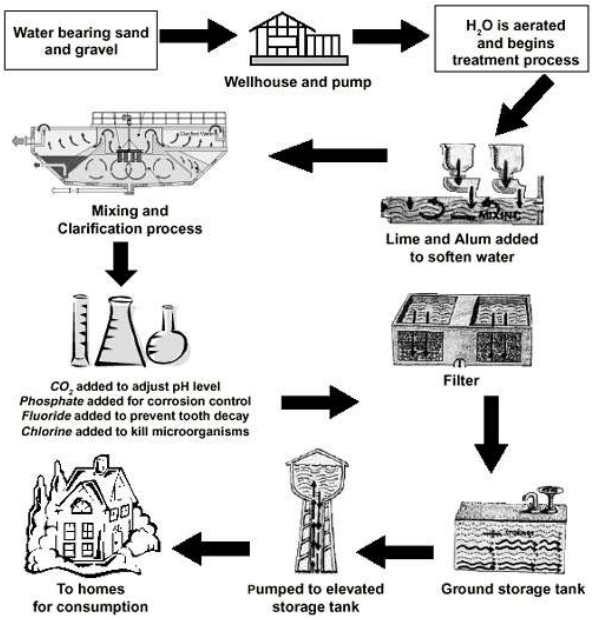

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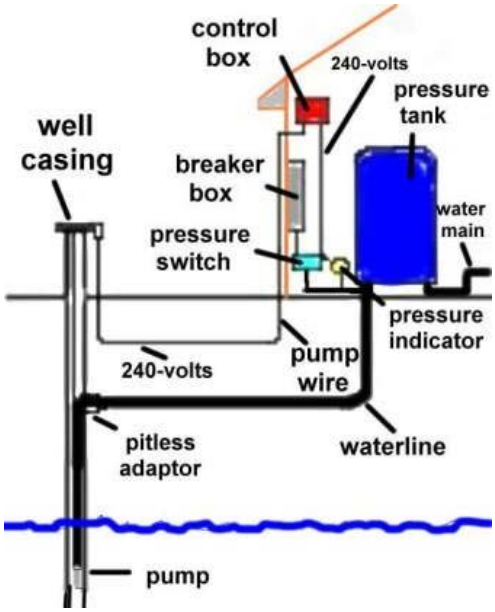

Sewage Treatment

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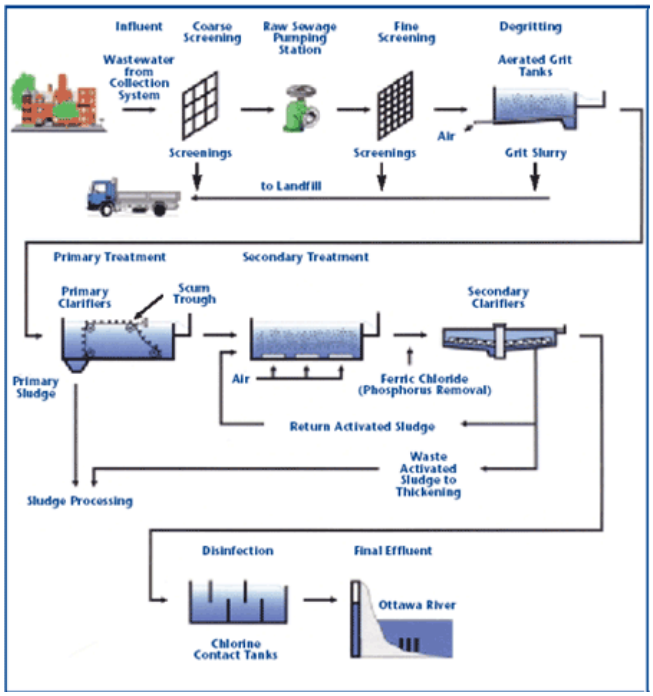

Student Handout GROUP

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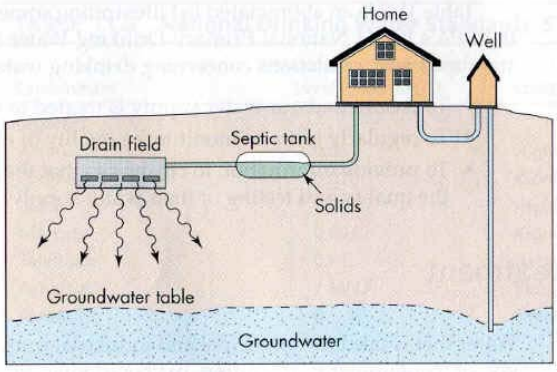

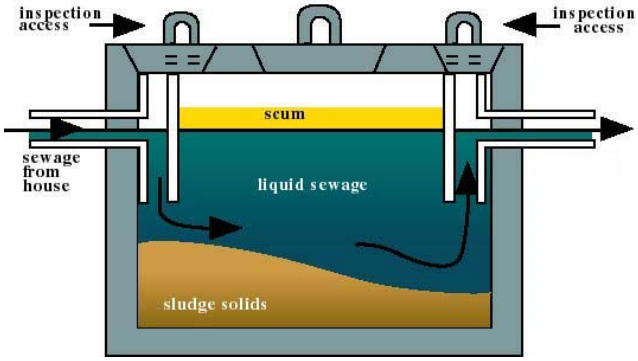

Questions:

1. a) What is a watershed? _____

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Student Handout GROUP

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Student Handout

Name: _____ Date: _____ Period: ___

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Student Handout

All Tapped Out?
A Look at Bottled Water

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Use the information to answer the following questions:

1. Why has the consumption of bottled water increased in Canada in the last few years?

   _____

   _____

   _____

2. Is there bacteria in bottled water? _____

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   _____

   _____

4. a) Where does bottled water that does not state “mineral water” or “spring water” on it, come from?

      _____

   b) In what other ways is it different from mineral or spring water?

      _____

      _____

      _____

      _____

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   _____

   _____

Student Handout

6. How long is the "shelf-life" of bottled water? ie: what is the best-before time period?

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   _____

   _____

   _____

8. a) Do you and/or your family regularly buy bottled water? _____

   b) What is your reason(s) for buying or for not buying it?

   _____

   _____

   _____

   c) Will the information that you have learned in this class about bottled water influence your choice to buy bottled water in the future? If yes, how?

   _____

   _____

   _____

   _____