

# Water Treatment Plant

## Grades 6-12

### **Subject**

Various, including: Science, Biology, Chemistry, Physics, and Health

### **Topic:**

Touring the community's water treatment plant

### **Time Frame**

Most water treatment plants offer guided tours and will offer a definitive time frame. You can expect to spend a half-day touring the water treatment facilities and should also allot time both before and after for discussion.

### **Objectives**

- Students will state and describe the steps of the water treatment process that must occur before water can be safely used by community residents.
- Students will compare and contrast the water treatment guidelines used in different water treatment plants. (Some water treatment plants are less stringent on regulations than others).
- Students will question the practices of their own community water treatment plant with regards to safe water treatment.

### **Methodology**

- Lecture
- Discussion
- Field trip

### **Materials**

- Water Treatment Plant Question Package. (An answer key is provided).

### **Space Requirements**

The pre and post-tour discussion can be carried out in the classroom.

## Background Information

Some drinking water treatment plants are more technologically advanced than others. Read through the Water Treatment Plant Question and Answer Package prior to starting the discussion and taking your students on the tour; students should have some basic knowledge of the process in order to get the most out of their visit. The plant operator will likely offer additional information as well. It would be extremely valuable to obtain a copy of the water quality results that are regularly performed on the municipal water supply.

## Directions/Procedure

1. Pre-tour discussion:
  - a. Open the discussion by asking students where their drinking water comes from. They might not understand that their water doesn't come straight from the ground or from a surface water supply.
  - b. Reinforce that water is actually treated prior to being sent into the homes of the community. Students should also discuss the activities in their local watershed area, locate possible sources of contamination to their own community and also actions by their community that may affect other communities.
2. Hand out a copy of the Water Treatment Plant Question Package to each student and use it as a tool to further discussion. Students will be challenged to find answers to the questions; they consume water everyday, yet are unfamiliar with the process of how clean water flows from their tap.
3. Take a tour of the water treatment plant. Students should be able to answer the questions in their question package throughout the tour. (They may need prompting and reminding... encourage them to fill in the answers throughout rather than waiting until the end when they might already be forgetting important information).  
**\*\* Teacher Note:** *Gather whatever brochures and pamphlets that are offered to you while you are there. There might also be a diagram of the plant, which would save time in drawing it.*

#### 4. Post-tour discussion:

- a. Recap the tour with the students by discussing their Water Treatment Plant Question Package answers. Also encourage students to come up with new questions of their own. This could provide an opportunity for students to undertake a major research project. If student interest in the subject is apparent, encourage them to investigate these issues and share their findings with the school and community. This is a great way to bridge classroom learning outcomes with relevant community issues.

#### **Evaluation**

The question package can be graded if desired. An extension project from the tour (as discussed above) may also be assessed. Research topics include but are not limited to:

- Comparing/contrasting a community's water treatment practices with the other neighbouring communities.
- Comparing/contrasting examples of urban, rural and First Nation water treatment processes.
- Comparing/contrasting water quality among communities, provinces and countries. You can also mark the students' participation and behaviour while on the tour.

Students may also have their own ideas of showing what they have learned. Encourage them to share their plans and work with them to develop a rubric that will outline the goals they plan to meet.

#### **References**

[www.safewater.org](http://www.safewater.org)



## **SURFACE WATER**

1. Where do you get your water from?
2. What is the size of the reservoir (area, maximum depth)?
3. What problems do you have with your reservoir?
4. Is your reservoir treated with copper sulphate or some other chemical? If so, what is the chemical and its purpose?
5. What happens to the water once it enters the treatment plant?



# Water Treatment Plant Answer Sheets

## GROUND WATER

### 1. How deep down is the water intake?

If it is a shallow well (less than 30 m or 100 feet) then chances are that the quality of water is very different from a deep well (can sometimes be more than 100 m deep). The water from a shallow well can often have low levels of salt and other contaminants. With a shallow well the major concern is often if it is under the influence of surface water. This is called Groundwater Under the Influence of Surface Water abbreviated GUDI. The main concern with being a GUDI is the potential for contamination by disease-causing microorganisms.

### 2. Does the water smell when it comes to the treatment plant before treatment is started? If so, describe the smell.

If the answer to this question is yes then chances are high that there is very little oxygen in the water. When the oxygen disappears it is called anaerobic water. In anaerobic water different chemical processes start occurring. One of these processes is the formation of hydrogen sulphide, which dissolves in the water. When an egg goes rotten it is hydrogen sulphide that makes it smell.

In addition to potentially high levels of hydrogen sulphide (which is toxic) the level of carbon dioxide increases. Both of these compounds will have to be removed before the water can be effectively treated. The simplest way of doing this is straight aeration. The addition of chlorine can also partially achieve this.

Sometimes there are concerns about nitrates in groundwater. But, if there is no oxygen in the water then the nitrate (which has three oxygen atoms for every nitrogen atom) gets transformed to ammonium. While in regular testing it may look great to have no nitrate in the water, but if the nitrate has been transformed to ammonium then a whole new set of problems occur in the treatment plant. The biggest challenge for water with ammonium in it is disinfection. The water operator needs to add 15 times more chlorine than there is ammonium before the water starts to become properly disinfected. Residual Chlorine tests for the presence of ammonium may also give false positives. There are problems determining the chlorine residuals if there is ammonium in the water.

### 3. What happens to the water once it enters the treatment plant?

What is the first treatment step? What is the second treatment step? etc.

## SURFACE WATER

### 1. Where do you get your water from?

Water quality from large rivers and lakes are often better than water from small creeks and reservoirs.

### 2. What is the size of the reservoir (area, maximum depth)?

This depends on your community.

### 3. What problems do you have with your reservoir?

In the summer some reservoirs will have large algae blooms. Frequently water from reservoirs contain high levels of microbes and may be highly coloured due to the organic material released from the decay of plant material.

What happens in the winter under the ice. Does the water start smelling late in the winter? This is an indication, similar to a groundwater system that the oxygen has disappeared and the water is now anaerobic. This can actually happen in the summer as well if the reservoir "stratifies". This means that there will be two different water layers in the reservoir/lake. A top, warmer layer, with a bottom colder layer. If the water intake is close to the bottom then anaerobic water can be sucked into the water treatment plant.

### 4. Is your reservoir treated with copper sulphate or some other chemical? If so, what is the chemical and its purpose?

Copper sulphate is often used to control algal blooms, the pesticide Diquat (Reglon A), is used to control weed growth in the reservoir. If the Copper level in the drinking water is too high, it is more likely to result from copper distribution pipes, which can generate higher copper levels than correct additions of copper to treat a reservoir.

### 5. What happens to the water once it enters the treatment plant?

What is the first treatment step? What is the second treatment step? etc.

## **WATER QUALITY**

### **1. Is our water supply considered safe for human consumption?**

The answer to this would be based upon the water quality tests which are carried out on the water in your community. Sometimes, however, a community only needs to test its water once every couple of years. Can you think of reasons why this may not be enough? Also, there are around 60 health guidelines in the Canadian Drinking Water Quality Guidelines and smaller water treatment plants may not test for compounds that can actually be present in the water. For ground water sources there should be tests for arsenic, dissolved organics, ammonium, nitrate, manganese and iron to mention a few.

### **2. What water quality tests are carried out on our drinking water supply and how often are they monitored?**

For microbiological parameters the frequency of samples is dependent upon the population served. In general, drinking water should be sampled semi-annually for all chemical substances for which a maximum acceptable or interim maximum acceptable concentration has been set. There is now a tendency to sample more frequently for bacterial indicators, the E. coli and total coliform tests, but that may not be the entire solution as most waterborne disease outbreaks have no coliforms associated with them. To get a deeper knowledge of these issues students are encouraged to continue with Template for Change also available from the SDWF. This includes presentations from Water Keepers and scientists including David Suzuki.

## **DRAWING OF OUR WATER TREATMENT PLANT**

The water treatment plant will likely have a pamphlet with sketches of the plant layout; encourage students to gather this information. If this information is not readily available, try to make arrangements to have additional information sent to the school so that a thorough follow-up of the tour can be carried out.