

Water Treatment Questions Answer Key:

1. There are several methods of water treatment. Which method did you look at?
 - a. **Conventional Treatment: Coagulation and Filtration**
 - b. **Biological Filtration**
 - c. **Membrane Filtration: Ultrafiltration, Nanofiltration and Reverse Osmosis**
 - d. **Disinfection: Chlorination and UV Irradiation**
 - e. **Boil Water Advisories**

2. Describe how this method works to improve water quality. What does this method remove from the water?
 - a. **Coagulation** works by adding iron or aluminum to the water. These chemicals cause the dissolved and suspended particles to bind together. The bound particles (called floc) become heavier and fall out of the water. There are two main types of **filtration**: slow sand filtration (using bacteria to consume contaminants and allowing the water to pass through the fine sand filter) and rapid sand filtration (forcing the water through a sand filter). Slow sand filtration can remove nearly all contaminants from the water, but rapid sand filtration cannot remove small particles, such as viruses.
 - b. **Biological filtration** works by using natural microbes to ingest the contaminants in the water and convert them to less harmful substances (like oxygen and carbon dioxide).
 - c. Membrane filtration works by allowing only molecules smaller than the pore-size through the filter. **Ultrafiltration** removes bacteria, protozoa, and some viruses. **Nanofiltration** removes these microbes, as well as most natural organic matter and some minerals (especially divalent ions which are responsible for hard water). **Reverse osmosis** removes turbidity, including microbes and virtually all dissolved substances. While reverse osmosis removes many harmful minerals, it also removes some healthy ones, such as calcium and magnesium.
 - d. Conventional disinfection uses **chlorine** to inactivate microbes that are in the water. Chlorination can inactivate a large number of bacteria, viruses and protozoa, but it cannot inactivate

Cryptosporidium. **UV Irradiation** uses sunlight to disinfect water. While this process was typically used for treating wastewater, it is a growing method for treating drinking water. After exposure to sunlight for several hours, the viruses and bacteria are inactivated.

e. **Boil Water Advisories** are issued by the government in cases where coliforms such as *E. coli* are detected in the treated water or when there is a new system start up. Boiling the water inactivates the disease-causing microbes but does not remove any chemicals or other contaminants.

3. Can this method be used by itself to make healthy drinking water? Why or why not?

a. **Coagulation and filtration** should be supplemented with a form of disinfection, because some coliforms, bacteria and viruses may be too small to remove with this process.

b. **Biological Filtration** is an effective treatment method. Because the process uses natural microorganisms to digest the contaminants in the water, it can produce clean water. While biological filtration should remove all contaminants from the water, it is still advisable to use a form of disinfection, to ensure that all harmful substances are removed from the water, and any bacteria that may remain do not have the opportunity to multiply.

c. **Ultrafiltration** may not remove all viruses from the water, so it is advisable to use disinfection after filtering. Water that is treated using **nanofiltration** may not be free of dissolved compounds, so additional treatment will be necessary. Water that is treated using **reverse osmosis** is pure water.

d. **Disinfection** should not be the primary water treatment method, because it may not remove all dissolved substances some of which can be hazardous. As well, when there is a high amount of dissolved matter in the water, significant amounts of chlorine must be added, because chlorine reacts with the dissolved matter before microbes can be inactivated.

e. **Boil Water Advisories** serve to alert people that their drinking water may be unsafe. However, Boil Water Advisories can last for many years, and often do not address the real issues of water contamination and inadequate methods of treatment. Boiling water

can remove bacteria and viruses, but it is insufficient to remove chemicals, such as arsenic, from the water.

4. Would you drink water that had been treated with only this method? Explain your answer and give reasons why or why not.

a. **Coagulation and filtration:** No, because there may be disease-causing microbes and chemicals still in the water. It should be disinfected after treatment using either chlorination or UV irradiation.

b. **Biological Filtration:** Yes.

c. **Ultrafiltration, Nanofiltration and Reverse Osmosis:** Yes, if it was treated by reverse osmosis.

d. **Disinfection: Chlorination and UV Irradiation:** No, because there still could be contaminants in the water.

e. **Boil Water Advisories:** Yes and no. Yes, because there would be no microbes left active after boiling. No, because there may be other contaminants (chemicals) still in the water.