# 16. WATER PURIFICATION

How effective are various water treatment methods on improving polluted water?

## Objectives

- Compare the effectiveness of different water treatment methods for improving water quality.

## Materials and Equipment

- Data collection system
- pH sensor
- Conductivity sensor
- Erlenmeyer flask, 250-mL
- Beakers (3), 250-mL
- Funnel with short stem to fit flask
- Stirring rod
- Coffee filters (2)
- Buffer solution, pH 4 and pH 10
- Egg whites, 5 mL
- Polluted water sample, 600 mL
- Wash bottle filled with distilled water

## Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.
- Wash hands thoroughly after handling egg whites.

## Procedure

1. Select Sensor Data in SPARKvue.

2. Connect the pH sensor and conductivity sensor to your device. Un-check the Conductivity measurement in the center menu. Make sure the Total Dissolved Solids (TDS) and pH measurements are checked, then choose the Digits template.

3. Remove the cap and storage bottle from the pH sensor and rinse the probe thoroughly with distilled water, then rinse the conductivity probe with distilled water.

*Note: Rinse the pH and conductivity probes thoroughly with distilled water before and after use in any solution, including water samples and buffer solutions. Remember to perform this procedure throughout the investigation.*

4. Select the live pH reading below the digit displays to open the pH sensor menu. Choose Calibrate Measurement and use the pH 4 and pH 10 buffer solutions to calibrate the sensor.

### *Part 1 – Sedimentation*

1. Stir the main polluted water supply and pour about 200 mL of it into a beaker.

2. Select Start to begin collecting data.

3. Rinse the pH and conductivity probes and place them in the beaker. Wait for the readings to stabilize (up to 60 seconds) and record the initial pH and TDS values in Table 1.

*Note: Always wait for pH and conductivity readings to stabilize before recording values.*

4. Allow the beaker to sit undisturbed for 20 minutes. After 20 minutes, rinse the probes and measure the final pH and TDS readings; record results in Table 1. Make a note of what time you should return to this step, then move on to Part 2 while you wait.

### *Part 2 – Sedimentation and Filtration*

1. Fold a coffee filter in half and then in half again to form a cone as shown at the top of Figure 1.

2. Place coffee filter in the funnel and set the funnel inside the flask as shown in Figure 1. Allow the edges of the filter to extend outside the funnel while the middle of the filter is centered over the funnel opening.

3. Rinse the stirring rod with distilled water. Stir the main polluted water supply and pour about 200 mL into a beaker.

4. Rinse the pH and conductivity probes and place them in the beaker. Wait for the readings to stabilize (up to 60 seconds) and record the initial pH and TDS values in Table 1.

5. Allow the beaker to sit undisturbed for 20 minutes. Make a note of what time you should return to Step 6 and move on to Part 3 while you wait.

6. After 20 minutes, slowly *decant* or pour the separated water from the beaker into the funnel without disturbing the sediment at the bottom. Hold the funnel steady while pouring. Avoid overfilling the funnel by staying well below the top of the funnel as indicated by the dotted line in Figure 1. Stop when you have collected about 100 mL of filtered water.

7. Rinse the probes and measure the final pH and TDS readings of the filtered water in the flask; record results in Table 1.

8. Dispose of the coffee filter and the sample in the flask as directed by your instructor and rinse the funnel and flask thoroughly with tap water. Perform a final rinse with distilled water.

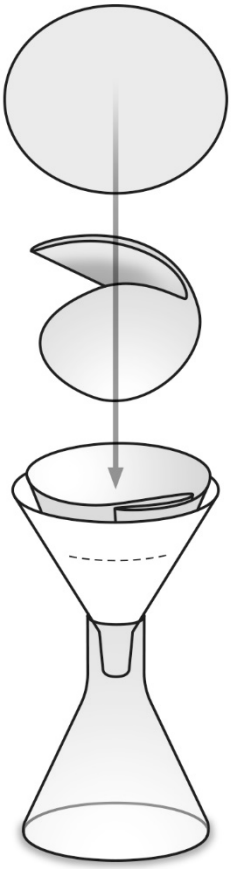

Figure 1: Flask filter

### *Part 3 – Sedimentation, Filtration, and Coagulation*

1. Rinse the stirring rod. Stir the main polluted water supply and pour about 200 mL into a beaker.

2. Rinse the pH and conductivity probes and place them in the beaker. Wait for the readings to stabilize (up to 60 seconds) and record the initial pH and TDS values in Table 1.

3. Add 5 mL of egg whites to the beaker and mix well, stirring vigorously.

4. Let the beaker sit undisturbed for 20 minutes. Make a note of when to return to Step 5.

5. After 20 minutes, set up a clean coffee filter in the rinsed funnel and flask as shown in Figure 1. Carefully filter the sample to collect 100 mL of filtered water as directed in Part 2, Step 6.

6. Rinse the probes and measure the final pH and TDS readings of the filtered water in the flask; record results in Table 1.

7. Stop collecting data. Rinse the probes. Replace the storage bottle and cap on the pH sensor.

## Data Collection

Table 1: pH and TDS measurements for polluted water before and after treatment

| Treatment | Initial pH | Final pH | Change in pH | Initial TDS (mg/L) | Final TDS (mg/L) | Change in TDS (mg/L) |
|---|---|---|---|---|---|---|
| **Sedimentation** | | | | | | |
| **Sedimentation and filtration** | | | | | | |
| **Sedimentation, filtration, and coagulation** | | | | | | |

## Questions and Analysis

1. Total dissolved solids (TDS) is a measurement of the amount of solids that are dissolved in a liquid. The environmental protection agency (EPA) states drinking water should have a TDS measurement below 500 mg/L. Compare the effectiveness of each treatment on improving the TDS of drinking water.

2. A pH measurement indicates the amount of hydrogen ions present in a solution, where low pH values indicate high concentrations of hydrogen ions. The EPA states drinking water pH should be between 6.5-8.5 with neutral water being least likely to cause damage to plumbing. Compare the effectiveness of each treatment on improving the pH of drinking water.

3. Explain why the water treated with egg whites had the highest conductivity and propose a reason why the egg whites were added.

4. Human activities can either create or solve pollution problems. What procedure(s) would you add to further treat and improve the quality of the main polluted water supply used in this investigation?

5. What are some potential consequences of *not* treating polluted water in the environment?

6. Are the water quality treatments you used in this investigation economically feasible? Explain your answer.