Name:___________________________________ Class period_____________

How can you improve raw (untreated) drinking water?

Why?

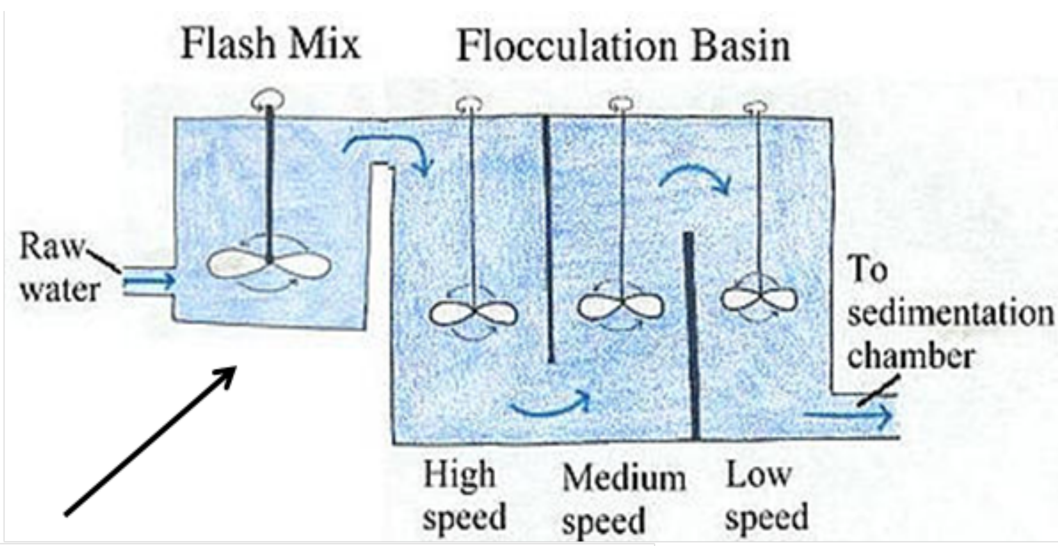
The quality of drinking water varies greatly. In this activity you will explore the chemical and physical processes involved in common water treatment methods by simulating a coagulation/flocculation reaction and designing a filtering chamber with different media to determine the most effective method of removing additional organic wastes.

The World Health Organization confirmed the central role of water and sanitation in sustainable development and the major contribution expanded access to safe drinking water and adequate sanitation can make to poverty alleviation.

http://www.who.int/water_sanitation_health/wsh0404summary/en/

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: Coagulation and Flocculation Reactors



$$FeCl_3 \rightarrow Fe^{3+} + 3\,Cl^-$$

$$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_{3(am,s)} + 3H^+$$

1. Model 1 shows a chemical reaction and water chambers. What chemical is added to the flash mix?

2. What product of the flash mix is used in the secondary reaction to produce a solid precipitate?

3. What is the solid precipitate that is formed from these two processes?

Coagulation / flocculation/ filtering Learning Targets:

- **Simulate Coagulation and Flocculation process to remove particles**
- **Measure Change in turbidity after coagulation/flocculation processes.**
- **Create an effective Filter to remove dissolved organic material**
- **Measure change in concentration indirectly through absorbance readings.**
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Materials:

• 1 M NaOH • 0.616 M $FeCl_3$ • FD & C No. 2 Blue Dye • Untreated Water • 250 ml Glassware • 5 ml pipette and pipette tips • Syringe	• Turbidity Probe • Spectro Vis Plus Probe or Calorimeter • Cuvettes • Turbidity Vials • Timer

teacher notes:

- Calibrate Turbidity Sensor with Distilled water.
- Calibrate Spectra Vis Probe with untreated water
- After filtering water re-calibrate spectra Vis with distilled water.

Student Directions:

1. Collect a source of untreated water
2. Mix collected sample to resuspend solids, then pour 200 ml into 2 different beakers, a control and reaction beaker.

3. Create Dilute Dye Solution by mixing 3 drops of dye into 100 ml of Dissolved Water.
4. Add 5 ml of diluted blue dye into each beaker.
5. After dye has dispersed, collect approximately 1.5 ml from each beaker, add to a cuvette and gather light absorbance reading.
6. Collect 7.5 ml from each beaker, add to one turbidity vial and record pre treatment turbidity reading.
7. Add stir bar to beakers and increase stir speed until vortex is created.
8. Add 0.35 ml of NaOH into reaction beaker, then add 0.2 ml of $FeCl_3$. Allow to mix for 1 minute at high speed (with vortex).
9. Turn stir bar to lowest speed and mix for an additional 10 minutes.
10. Allow flocs to settle.
11. Collect 60 ml of supernatant to test with each filtration device.
12. Collect filtrate for final absorbance reading.
13. Collect turbidity reading.

Constructing a Simple Filter

Different filter mediums and volumes will yield different particulate and solute removal rates and effectiveness. You will be building three separate filters to examine their effectiveness.

Supplies Needed:

- 500 ml plastic bottle with cap
- Scissors or hobby knife
- Nail
- Fine Sand
- Coarse activated carbon particles (4-14 mesh suggested)
- Fine activated carbon particles (-20+40 mesh suggested)
- Gravel
- Small cotton ball (.5g)

Procedure for filter construction:

In this section you will be creating 3 separate filters. 1 filter will be using sand as the filtration medium and will be the same for everyone. The other 2 will be using different sized particles of activated carbon for the filtration medium and you will have some design flexibility with.

1. Using a scissors or hobby knife, remove the bottom of each bottle by cutting a few centimeters from the base.
2. Remove the caps and use the nail to puncture a small hole in them.
3. Insert a small cotton ball in to the neck of each bottle, screw the caps back on to the bottles.
4. Using a stir stick or similar push the cotton ball against the cap to seat it in position.
5. To construct the sand filter, measure out between 20 and 60 grams of sand and gently pour it into the bottle. Then gently fill up the bottle with gravel until the halfway point on the bottle. Record how much sand you selected to use in the data table at the end of this lab.
6. To construct the fine carbon filter, measure out 15 g of sand and gently pour it into the bottle. Then select an amount of fine carbon between 10 to 25 grams to measure out and gently pour in to the bottle. Record how much carbon you selected to use in the data table at the end of this lab.
7. Fill up the bottle with gravel until the halfway point.

8. To construct the coarse carbon filter, measure out 20 g of sand and gently pour it into the bottle. Then select an amount of coarse carbon between 10 to 25 grams to measure out and gently pour in to the bottle. Record how much carbon you selected to use in the data table at the end of this lab:

9. Fill up the bottle with gravel until the halfway point.

10. Run a small amount of clean water through each filter, this will help wash out any impurities and settle the various layers.

Water Sample Testing

In this section you will be removing water samples and running them through your filters. After which you will be examining the filtered samples for traces of dye, which will indicate how well the filter has worked.

Supplies needed

- Syringe
- Spectrometer
- Graduated collection vial

Procedure:

1. Place your filter over a collection vial.
2. Run the coagulated water you have previously collected through the filter.
3. Collect 20 ml of fluid and discard, quickly place the collection vial back under the filter.
4. Collect an additional 10 ml of fluid and keep for analysis.
5. Repeat this procedure for each of the three filters.

Analysis:

1. Prepare 3 cuvettes, each having a sample of water from 1 of the filters.
2. Ensure the spectrometer has been calibrated with distilled water.
3. Place the cuvette in the spectrometer and record the concentration value for each sample.

	Mass of Filter Media	Concentration Value
Sand Filter		
Coarse Carbon Filter		
Fine Carbon Filter		

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