EDUCATION
GEORGIA AQUARIUM

Filtration Sensation

Georgia Standards of Excellence:

- **S6E6.** Obtain, evaluate, and communicate information about the uses and conservation of various natural resources and how they impact the Earth.
    - **a.** Design and evaluate solutions for sustaining the quality and supply of natural resources such as water, soil, and air.

Next Generation Science Standards:

- **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Learning Objective:

- Students will construct a device that has the ability to filter dirty water.
- Students will distinguish important applications of water filtration.

Essential Question:

- What is the importance of water filtration for human consumption and aquarium habitats?

Key Vocabulary:

- Aeration
- Coagulation
- Sedimentation
- Disinfection
- Filtration

Materials (Per group):

- 2 Plastic bottles (500 ml)
- Cheese cloth
- Scissors
- Paper towels for spill cleanup
- Rubber bands
- Cotton balls
- Coffee filter
- Charcoal
- Sand (fine)
- Paper or plastic cups to use as scoops
- Gravel
- Clean tap water
- Simulated wastewater to filter
    - (for gallon: combine several drops of food coloring, potting soil, a quarter cup of sand and colored beads)

6-8 GRADE BAND

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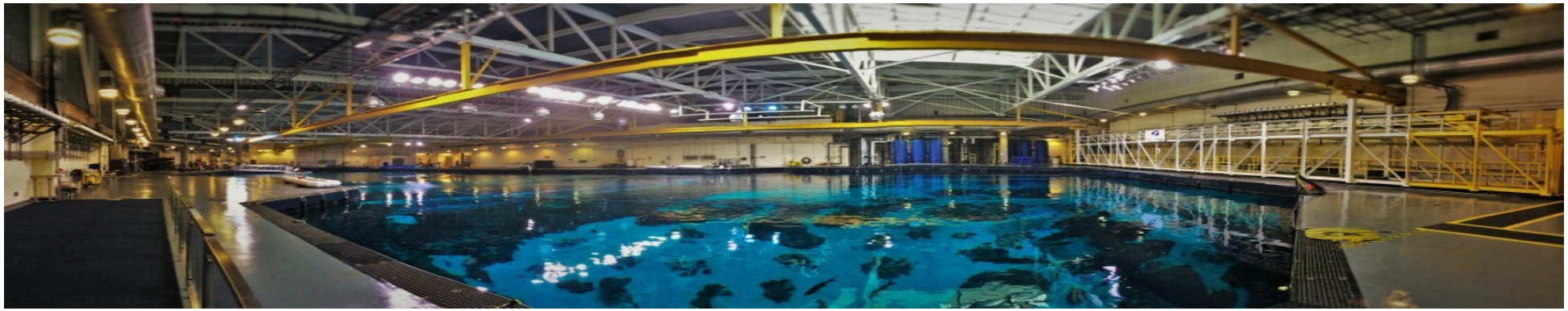
Background Information:

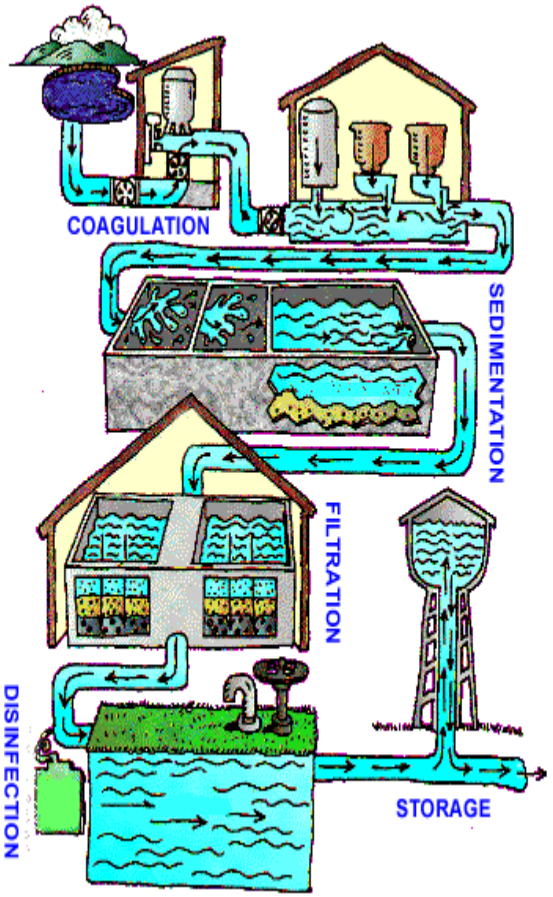
- "One of our most valuable and often overlooked resources is water. We can survive for a few weeks without food, but only a few days without water. Having clean water to drink is a luxury. The water that makes its way to our faucets does not start off as safe drinking water. In most cases, it has gone through a water treatment plant designed by engineers prior to reaching our homes. The water may contain dirt, rocks and other objects that can be easily identified. Water may also contain bacteria and other microscopic organisms that cannot be seen easily. These things need to be filtered out through mechanical, chemical and biological methods.
- Water used in our homes can be filtered and sanitized again for another round of consumption. This gives groundwater supplies time to replenish and minimizes water usage disturbances in natural ecosystems.
- Water that is recycled and used again goes through its own filtration before being put back through the original filtration system pulling from the water source.
- At Georgia Aquarium, clean water is essential to the health of our animals. We do not want to see a growth of harmful bacteria or algae, or have a growing amount of biological matter in the habitats that affects the animals health and water clarity for viewing.
- The Life Support Systems (LSS) department monitors and leads installation and maintenance of all the piping and filtration at the aquarium ensuring clean, clear water.



Filtration Sensation

Background Information:

- Water treatment is typically a five-part process that consists of aeration, coagulation, sedimentation, filtration and disinfection. This activity is only concerned with filtration. This process removes most but not all of the impurities from the water. Make sure students know that in this activity, the filtered water is still unfit to drink."
    - Aeration– Brings water and air in close contact in order to remove dissolved gases (such as carbon dioxide) and oxidizes dissolved metals such as iron, hydrogen sulfide and volatile organic chemicals (VOCs). Aeration is often the first major process at the treatment plant.
    - Coagulation- Adding a chemical such as alum (aluminum sulfate), which produces positive charges, helps to neutralize the negative charges on the particles created during aeration. The particles can then stick together, forming larger particles which are more easily removed. The coagulation process involves the addition of the chemical (e.g. alum) and then a rapid mixing to dissolve the chemical and distribute it evenly throughout the water.
    - Sedimentation- Sedimentation, or clarification, is the process of letting suspended material settle by gravity. Suspended material may be particles, such as clay or silts, originally present in the source water. Suspended material, or floc, is typically created from materials in the water and chemicals used in coagulation or, in other treatment processes, such as lime softening .
    - Disinfection– The removal, deactivation or killing of pathogenic microorganisms. Microorganisms are destroyed or deactivated, resulting in termination of growth and reproduction. Adding chlorine to the water is one method of disinfection.



Filtration Sensation

Activity Instructions:

- Review the background information with the students. Students will be making their own filter to attempt to clean wastewater.
- Divide students into groups of two to four with a large amount of table space in front of them for the filter build.
    - The filter is made from two 500 ml bottles with the bottoms cut off. The bottles will be stacked into each other to allow the wastewater to process through the filter media in the bottle's top and collect in the bottle's bottom. The challenge is for students to determine which filter media will best clean their water.
- Clearly communicate to students that the water filtration devices they are about to make will remove some impurities, but they will NOT make the water safe to drink.
- In their groups, students will:
    - Remove the label from two 500 ml plastic bottles. Remove bottle caps.
    - Use scissors to cut both bottles in half (this portion may be prepared by the teacher before class if they choose).
    - Place the two bottles according to the picture to the right.
    - Secure cheesecloth (folded as necessary to retain filter media in bottle) around the neck of the open top bottle with a rubber band.
    - Fill the top bottle half to within 1.5 inches of its top with filter media of various types and layers.
    - Document the different kinds of media, amounts, and sequence of filter media used.
    - Slowly pour 200 ml. of wastewater through each student's water filter.
    - Compare the results (clarity) among student pairs. Discuss the filter media used and results achieved.

Filtration Sensation

Evaluate:

- Discuss which filters were the most successful. Why? How was that filter assembled that gave it an advantage?
- Discuss the shortcomings of other filters. What could that group have done better? What did they learn?
- Pair the class up again into larger groups.
    - Students will build another filter combining what they have learned from the first run of the experiment to make a more efficient filter.

References:

Cho, Renee, George Janczyn, Ashley Sarbacker, "From Wastewater to Drinking Water." State of the Planet, June 18, 2018. https://blogs.ei.columbia.edu/2011/04/04/from-wastewater-to-drinking-water/.

"Water Treatment." Centers for Disease Control and Prevention. Centers for Disease Control and Prevention, January 20, 2015. https://www.cdc.gov/healthywater/drinking/public/water_treatment.html.

Extension:

- Have students read the "CDC Water Treatment" article: https://www.cdc.gov/healthywater/drinking/public/water_treatment.html
- Then fill out the worksheet provided below.

KEY:

1. Coagulation, Flocculation, Sedimentation, Filtration, Disinfection
2. Floc
3. Filtration
4. Chlorine, Chloramine
5. Fluoridation

Filtration Sensation: CDC Reading Response Questions

1. List the steps of community water filtration in order:
    i. _____
    ii. _____
    iii. _____
    iv. _____
    v. _____

2. What is formed when the positively and negatively charged particles bind together?_____

3. Which part of this process did you and your classmates just replicate?_____

4. Name two examples of a water disinfectant._____ and _____

5. When a substance is added to the water to prevent tooth decay, what is this process called?

_____