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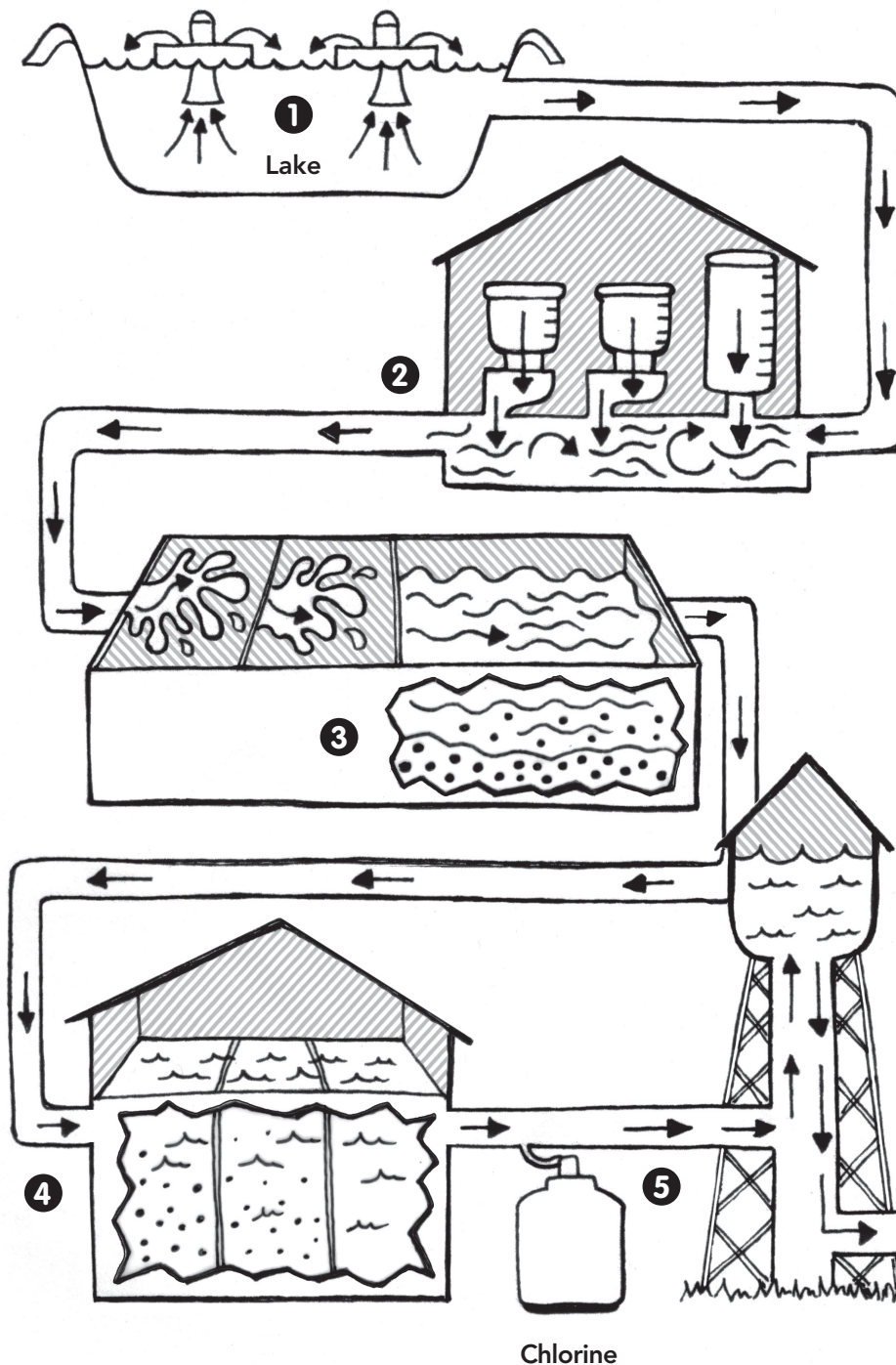
Treatment of Water

Lesson 2

Warm Up

Challenge: Design, build, test, and evaluate the effectiveness of a water filter used to change dirty water into safe and clean drinking water.

With your team, examine the following diagram of a typical water treatment plant in the United States. Read the descriptions of the stages.



1. Aeration

An initial process by which air is added to water and gasses that are trapped in water are allowed to escape.

2. Coagulation

The process by which chemicals are added so that dirt and other suspended solid particles chemically stick together into "floc" (clumps of dirt and sediment) and can easily be removed from the water.

3. Sedimentation

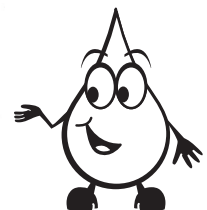
The process that occurs when gravity pulls the particles of floc to the bottom of the container.

4. Filtration

The process that removes most of the impurities remaining in water after coagulation and sedimentation have taken place.

5. Disinfection & Storage

The final process in which chemicals such as chlorine are added to water to kill harmful micro-organisms. The water is then stored in large quantities to be used by the community.



**Lesson 2****Warm Up**

Name _____

For each possible contaminant in the table below, list the stage in the treatment process in which the contaminant would be removed from water, making it safe to drink. More than one stage may be listed for any contaminant.

Contaminant	Stage(s) of Water Treatment
Bacteria	
Hydrogen Sulfide Gas	
Gravel	
Viruses	
Sewage	
Fertilizers	
Methane Gas	
Sand	
Leaves	
Worms	
Pesticides	



Name _____

Design & Build The Best Filter

In the United States we are fortunate to have some of the best water treatment systems in the world, which use the five treatment stages discussed in the Warm Up activity.

Many people in developing countries, however, lack access to safe drinking water. Often, the only stage available to them is the filtration stage, in which they filter large particles out of the water using a cloth. However, for the water to be safe to drink additional stages of the treatment process are needed, especially the disinfection stage.

This activity will focus on the filtration stage. Your job is to become an engineer and design a better filter for the citizens in developing countries. You will construct your filter, test it, and evaluate how effective it could be for supplying clean drinking water.

General materials:

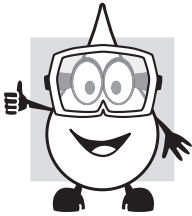
- 1 sheet of plain white paper
- Supply of paper towels for potential spills
- 4 copies of the Student Activity Packet
- 4 pairs of safety goggles

Filter apparatus materials:

- 100 mL of dirty water in a plastic cup
- 1 clear water bottle with the bottom cut off*
- 1 9oz. plastic cup (to collect filtered water)
- 1 domed "slushie" lid
- 1 coffee filter
- 1 rubber band

Filtering materials:

- Cheese cloth
- Cotton balls
- Cotton cloth
- Panty hose
- ScotchBrite pad
- Supply of aquarium pebbles, washed
- Supply of fine aquarium sand, washed
- Supply of activated granular charcoal

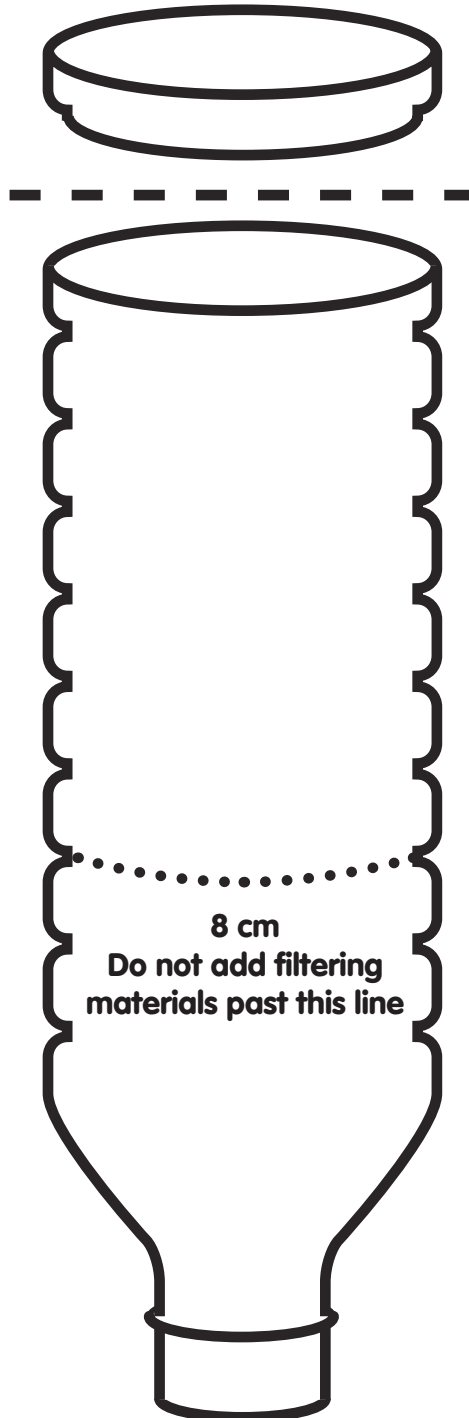


Lesson 2

Activity

Procedure Step 1: Design Your Filter

Discuss with your team the materials available for building your filter. Build your filter apparatus according to the plan (next page) and select **some or all** of the available filtering materials to use inside the apparatus.

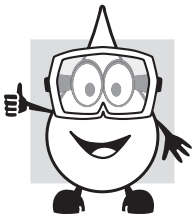


The filtration materials will be layered inside the bottle. Use the diagram (left) to design your filter. Draw in and label which Filtration materials you think will best filter the dirty water. Remember, you may use **some or all** of the available filtration materials.

Describe how each material you use in your filter will help clean the water and why you think your filter will work.

Share your design with your teacher, and obtain your teacher's signature of approval before you continue.

Teacher Signature



Lesson 2

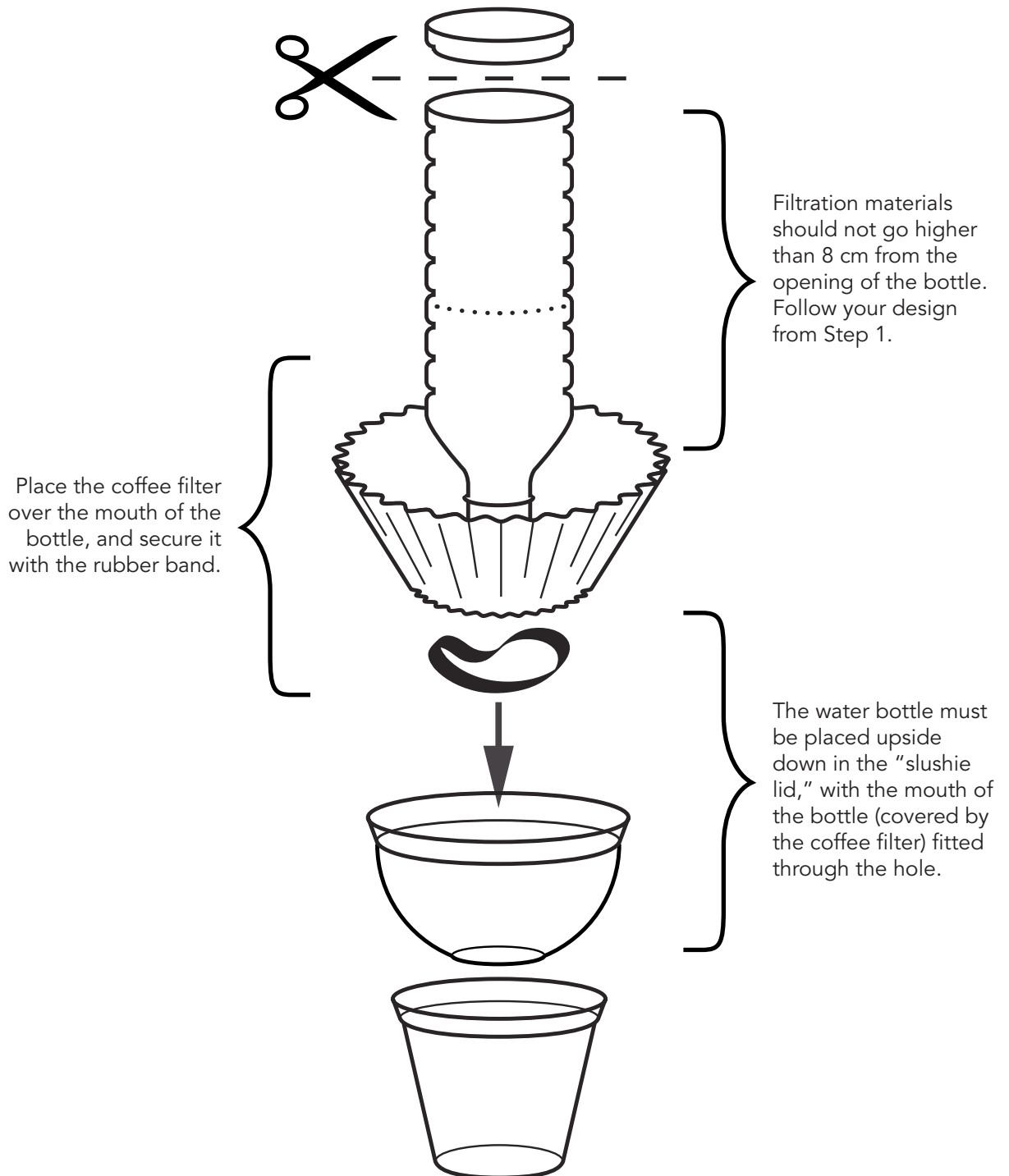
Activity

Name _____

Procedure Step 2: Build your filter

Have one or two team members obtain the Filtration and Structure materials needed to build your filter. Build your filter according to your approved design from Step 1. Be careful not to fill the bottle higher than 8 cm from the mouth of the bottle with the Filtration materials.

Wear your safety goggles at all times.





Name _____

Procedure Step 3: Test your filter

- A. Obtain 100 mL of dirty water in a plastic cup from your teacher and a piece of plain white paper. Observe the appearance and smell of the dirty water, and record your observations.

Appearance of dirty water:

Smell of dirty water:

- B. Place your filter apparatus on the plain white sheet of paper so you will be able to see clearly the water as it filters through the bottle, and slowly pour the 100 mL of dirty water over the entire surface of the filtering materials in the bottle.
- C. Watch carefully for the first drops of filtered water to appear in your collection cup. When about $\frac{1}{2}$ -1 cm of filtered water has collected in the cup, observe the appearance and smell of this water, and note any changes in appearance and smell from that of the original dirty water.

Appearance of filtered water:

Smell of filtered water:

- D. Pair up with a member of your team and visit at least two other teams in the room to observe the results of their filters. Take notes comparing your results with those of the other teams.

Observations of the first team: Did this team's filter work better than yours? Why or why not?

Observations from second team: Did this team's filter work better than yours? Why or why not?



Name _____

Procedure Step 4: Evaluate your filter

Rejoin your team and discuss the results collected from other teams. Answer the following questions:

1. What worked well with your filter?

2. What did not work as well as you had planned with your filter?

3. How could you improve your filter if you built it again? You may discuss adding materials that were not available to you in this lab.

4. Clean up all of your materials according to your teacher's instructions.



Name _____

Treatment of Water

Answer the following questions on your own using complete sentences.

1. Will your filter help improve the quality of water available to citizens in the developing world? Explain.

2. Would you personally drink the water that passed through your filter? Why or why not?

3. In addition to your filter, what other treatment processes may be required to make your water safe to drink?

4. Whose responsibility is it to make sure that your personal drinking water is safe? Explain.

5. Whose responsibility is it to make sure that people in developing countries have safe drinking water? Explain.
