



When we get a drink of water from the water faucets in our homes, we do not have to worry about getting sick. That is because our water has been cleaned and treated at a water treatment plant. Most water treatment plants use sand and charcoal filters to clean the water. In this activity, you will make your own water treatment system and see how it works.

## Materials

- Water
- Measuring cup
- 2 Medium disposable paper cups (8 oz)
- Food coloring (red, green, or blue)
- Measuring spoons
- Dirt and grass
- Wooden craft stick
- Fragrant oil (optional – orange or lemon works best)
- 5 Small disposable paper cups (3 oz)
- Ballpoint pen
- 2 Cotton balls
- Sand (available at a hardware store)
- Quarter (25 cent coin)
- Metric ruler (15 cm)
- Activated charcoal (available at a pet store with the aquarium supplies)
- Scissors



**SAFETY!** SAFETY: Be sure to follow Milli's Safety Tips and do this activity with an adult! Do not drink any of the water samples in this activity. Eye protection must be worn by everyone performing this activity.

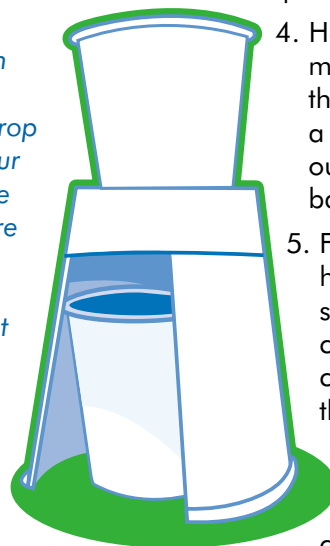
## Procedure

### Dirty Water

1. Add three quarters ( $\frac{3}{4}$ ) of a cup of water to one of the medium size paper cups.
2. Add one drop of food coloring (red, green or blue works best) to the water.
3. Add a tablespoon of dirt and grass to the water, and carefully mix everything together using the wooden craft stick.

You will use this "Dirty water" to test how well your filters work.

*ADAPTATION: As an option, you can ask an adult to add a drop of fragrant oil to your dirty water to imitate smelly things that are sometimes found in pond or lake water. Be careful—fragrant oils are usually very concentrated and can burn your eyes!*



### Sand Filter

1. To make a sand filter, ask your adult partner to push the tip of a ballpoint pen through the bottom of one of the small paper cups. *They must be careful to push the pen away from them, so that they don't poke themselves in the hand!*
2. Stuff a cotton ball into the hole that was just made for you, using the ballpoint pen to help. The cotton ball should plug the hole completely, so that the sand that you put in next will not fall out.
3. Put 5 tablespoons of clean sand into the cup.

### Filter Stand

1. Make a stand for your filter from a medium paper cup.
2. Start by turning the cup upside-down. Place a quarter in the middle of the bottom of the upside-down cup, and trace its outline using the ballpoint pen.
3. Ask your adult partner to cut along the line with scissors to make a hole in the bottom of the cup that is about 1-inch wide. You must not try to do this yourself! Don't worry if the hole is not perfectly round.
4. Holding the cup right side up, measure up from the bottom of the cup 1 centimeter and mark a line all the way around the outside of the cup using the ballpoint pen.
5. Flip the cup upside-down and have your adult partner cut straight down the side of the cup. Your adult partner should cut from the rim of the cup to the line that you just drew. Your adult partner should be careful not to cut completely through to the bottom of the cup, but to stop where you drew the line.
6. For the next cut, measure 3 centimeters over from the cut that was just made and have your adult partner make a second cut straight down the cup from the rim to the line.
7. Fold the entire flap out, and cut it off.
8. Turn the cup upside-down and place it on the table. You now have a filter stand.



### Test #1 – The Sand Filter

1. Place a small empty paper cup on the table. Write "Test #1" on the side of the cup using the ballpoint pen.
2. Put your filter stand over the top of the smaller cup. The small cup should fit inside of the filter stand. The small cup should be right side up, and the filter stand cup should be upside-down.
3. Place your sand filter on top of the filter stand. The hole with the cotton in it should be centered over the hole in the top of your filter stand.
4. Write "Sample" on the side of a new, clean small paper cup.
5. Stir your dirty water with the wooden craft stick.
6. Fill the small paper cup labeled "Sample" half full with the dirty water.
7. Pour the dirty water from the small cup labeled "Sample" slowly onto the sand filter.
8. Watch through the side of the filter stand to see what happens to the water. *If you added a fragrant oil, wave your hand over the top of the cup to bring any odors to your nose. Do not place your nose or face directly over the top of the cup. Can you smell the fragrant oil, or was it removed from the filtered water?*
9. Write down your observations in the "What did you observe?" table.

### Charcoal and Sand Filter

1. To make a charcoal and sand filter, ask your adult partner to push the tip of a ballpoint pen through the bottom of one of the small paper cups. *They must be careful to push the pen away from them, so that they don't poke themselves in the hand!*
2. Stuff a cotton ball into the hole using the ballpoint pen to help. The cotton ball should plug the hole completely.
3. Add 2 tablespoons of clean sand to the cup.
4. Add 2 tablespoons of activated charcoal to the cup. It should form a layer on top of the sand.
5. Carefully add another tablespoon of clean sand on top of the charcoal.

### Test #2 – The Charcoal and Sand Filter

1. Place a small empty paper cup on the table. Write "Test #2" on the side of the cup using the ballpoint pen.
2. Put your filter stand over the top of the smaller cup. The small cup should fit inside. The small cup should be right side up, and the filter stand cup should be upside-down.
3. Place your charcoal and sand filter on top of the filter stand, so that the hole with the cotton in it is centered over the hole in the top of your filter stand.

4. Stir your dirty water with the wooden craft stick.
5. Fill the small paper cup labeled "Sample" half full with the dirty water.
6. Pour the dirty water from the small cup labeled "Sample" slowly onto the charcoal and sand filter.
7. Watch through the side of the filter stand to see what happens to the water. Observe the water after the filtration process is complete. *If you added a fragrant oil, wave your hand over the top of the cup to bring any odors to your nose. Do not place your nose or face directly over the top of the cup. Can you smell the fragrant oil, or was it removed from the filtered water?*
8. Record your observations in the "What did you observe?" table.
9. Thoroughly clean your work area and wash your hands. Dispose of all liquids down the drain. All solids and cups must be placed in the trash.

### Try this...

Try using dirt in the place of the sand in the filter. What is the difference between dirt and sand? Which one works better? Try using a coffee filter. Does it work more like the sand filter, or more like the charcoal filter?



### Where's the Chemistry?

Sand is a very good filter for solids like dirt, grass, and trash. It works because the pieces of sand pack very tightly together with only small channels or holes in-between. There just isn't enough room for the pieces of dirt and grass to get through the layer of sand. So in this experiment, the sand was able to keep the dirt and grass from getting through, but the food coloring passed straight through.

Activated charcoal is actually burnt wood that has been dried in an

oven. Many different types of chemicals will stick to the surface of activated charcoal. Some people use charcoal filters to clean the water in aquariums. Other people use it to clean the water in their kitchen sinks. If you have a filter on your water faucet at home, it probably has activated charcoal in it.

In the second experiment, the activated charcoal removed the food coloring and the fragrant oil from the water. However, if the same filter were used for more water samples,

the food coloring would eventually start to come through. That is because the charcoal can only hold so much food coloring. Once all of the binding sites on the surface of the charcoal are full, the charcoal filter no longer works—there are no places left that can hold any more food coloring or oil. That is why you should replace the filter in your aquarium once a month.

### What did you observe?

	Test #1 Using the Sand Filter	Test #2 Using the Sand and Charcoal Filter
Water color before filter		
Water color after filter		

Was there any difference in the results of the two tests?

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What did the sand do to the dirty water?

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What did the charcoal do to the dirty water?

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The American Chemical Society develops materials for elementary school age children to spark their interest in science and teach developmentally appropriate chemistry concepts. The *Activities for Children* collection includes hands-on activities, articles, puzzles, and games on topics related to children's everyday experiences.

The collection can be used to supplement the science curriculum, celebrate National Chemistry Week, develop Chemists Celebrate Earth Day events, invite children to give science a try at a large event, or to explore just for fun at home.

Find more activities, articles, puzzles and games at [www.acs.org/kids](http://www.acs.org/kids).

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## Safety Tips

This activity is intended for elementary school children under the direct supervision of an adult. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.

### Always:

- Work with an adult.
- Read and follow all directions for the activity.
- Read all warning labels on all materials being used.
- Wear eye protection.
- Follow safety warnings or precautions, such as wearing gloves or tying back long hair.
- Use all materials carefully, following the directions given.
- Be sure to clean up and dispose of materials properly when you are finished with an activity.
- Wash your hands well after every activity.

**Never** eat or drink while conducting an experiment, and be careful to keep all of the materials used away from your mouth, nose, and eyes!

**Never** experiment on your own!

**For more detailed information on safety go to [www.acs.org/education](http://www.acs.org/education) and click on "Safety Guidelines".**

