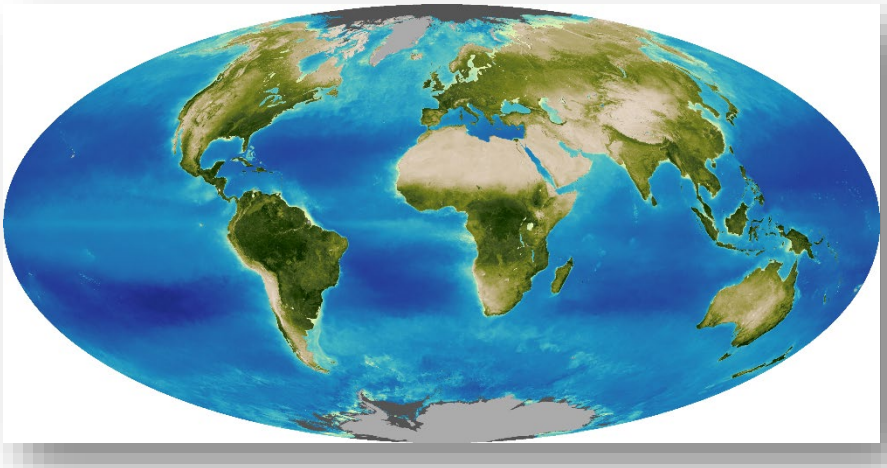
All the Water in the World



Start with one liter of water to represent all of the water on Earth. Participants pour portions off to represent various sources of water. Surprisingly, only a very small amount, less than 1 mL is available for all the people in the world to drink and use!

Question to investigate

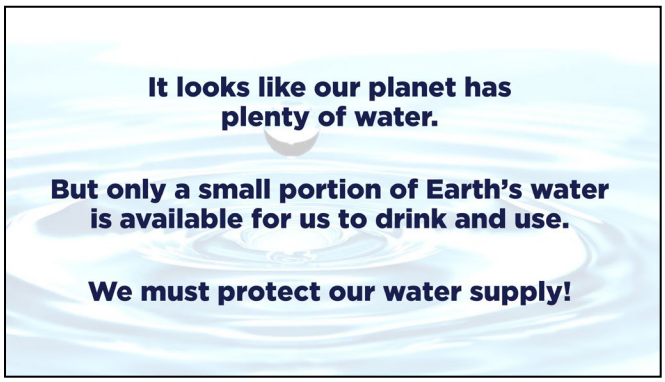
- **How much of Earth's water is available for us to drink and use?**

Chemistry concepts

- Water is a natural resource.
- Models are useful to help us understand very large or very small quantities.
- One liter is 1000 mL.
- A percent is a way to think about a part of 100.

Activity logistics

- This activity works well with upper elementary, middle, and high school students.
- This activity serves up to 100 participants over a period of 2 hours, with each iteration of the activity lasting approximately 5 minutes.
- Because this is more of an interactive presentation than a hands-on activity, one facilitator can comfortably manage one entire table of up to 10 participants at a time.



Prepare in advance

What you'll need

- 1 one-liter bottle of water with a securely-fitting cap
- Red food coloring
- Salt
- 3 medicine cups, 30 mL size, or
    - 3 graduated cylinders, 50 mL
- 1 waste container
- 50 paper towels, just in case
- 1 set of color copies
    - *The Water Planet*, one card
    - *Saltwater and Fresh Water*, two cards
    - *Sources of Fresh Water*, three cards

Notes about the materials

- We use red food coloring so that the water shows up well in translucent medicine cups. You may choose not to color the water, or use a different color, especially if using clear containers for measuring, such as graduated cylinders.
- If you would like to continue to reuse the same bottle and water for multiple iterations, use either sea salt or Kosher salt. Table salt contains an anticaking agent that may make the water appear cloudy.
- If presenting this demo many times for an extended period, bring a few one-liter bottles of water and switch them out as the solution becomes saturated.

Prepare the cards for the activity

1. Make double-sided color copies of each of the three documents required for this activity. Each station requires its own set of cards.
    - *The Water Planet*, one card
    - *Saltwater and Fresh Water,* two cards
    - *Sources of Fresh Water*, three cards

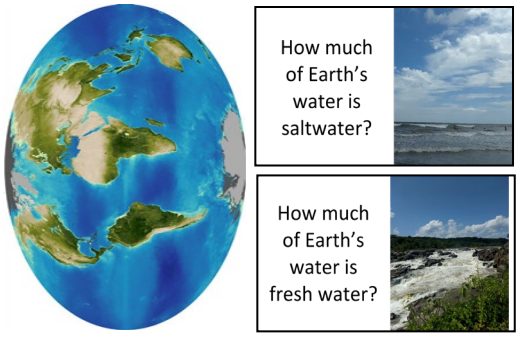
2. Cut the three pages as shown to form the double-sided cards.

3. If you plan to do present this demonstration multiple times, or at different events, you may choose to laminate the pages, in particular the three *Sources of Freshwater* cards. In the activity, participants place small containers of water on these cards. Laminating the cards will protect them from any water that may spill.

Prepare on-site

Prepare the bottle of water

1. Remove the label from the one-liter bottle. Fill the bottle with tap water.
2. Add 20 drops of red food coloring to the bottle.
3. Place the cap on the bottle securely. Shake the bottle until the color dissolves.



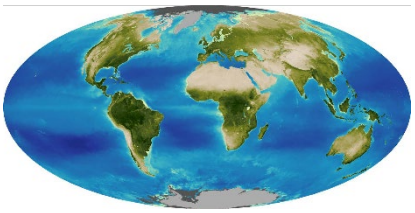
Group materials on your table

1. Arrange the materials as shown at your table.
2. Place the remaining items aside.

Facilitate the activity

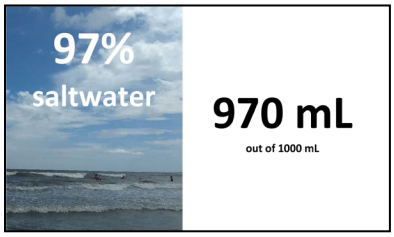
Invite participation

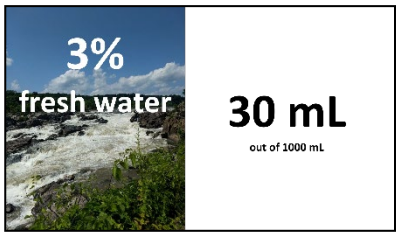
1. **Introduce the activity by asking: How much of Earth's water is available for us to drink?**
   When you consider all the planets in our solar system, Earth is noticeably different. You could call it the *Water Planet*. In fact, 71% of Earth's surface is water. The rest, 29%, is land. Look at this flat representation of our round Earth: Where in the world can you find Earth's water? *Oceans*, *lakes, rivers etc.* We definitely have a lot of water on our planet, but how much of this water is easy enough for us to get to drink and use. In this activity, we will find out about how much, or how little, we can drink and use.



2. **Introduce the model and consider how much of the liter should represent saltwater and how much should represent all the fresh water in the world.**
   This bottle of water is a **model** that represents all the water in our world. In our model, all of the water on our planet is represented by just 1-liter of water.
   - How many milliliters are in one liter? *1000 mL*.
   - What percentage of this water do you think represents all of Earth's saltwater?
     [Have participants guess quickly as it is unlikely that anyone knows the answer.]
   - What percentage of this water do you think represents all of Earth's fresh water?
     *[Point out that guesses for saltwater and freshwater should add up to 100 because **percent** means "out of 100."]*

[Note that we are not including the amount of water vapor in our atmosphere, water in clouds, nor biological water stored in organisms such as people, plants, and animals. This amount is comparatively very small.]





[Flip the cards for saltwater and fresh water to reveal the percentage, and number of mL to use, to represent both types of water on Earth.]

Support exploration

3. **Separate the fresh water from the saltwater in your model.**
   I am going to pour 30 mL of water from this liter into a cup (or graduated cylinder) to represent the 3% of water that is fresh water.
   [Place the water on the fresh water card as shown.]

This leaves 970 mL of water in the bottle. To show that this amount represents all the saltwater in the world, I am going to pour some salt into the bottle.

[Pour enough salt in the water to be dramatic, but not enough to saturate the solution. You want to be able to present this demo using the same bottle several times.]

[Place the cap on the bottle securely and hand the bottle to a volunteer to shake until the salt dissolves. Then place the bottle of water on the saltwater card.]

At first glance, it looks like there is plenty of water in our world for us to drink and use, but ocean water is too salty for us to drink. Removing the salt is difficult.

4. **Consider the three main sources of fresh water.**
   This leaves us with just 3 % of Earth's water that we can drink.

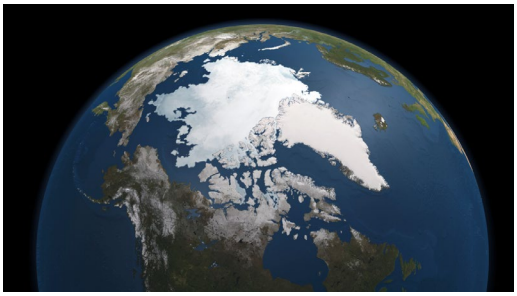
   [Point to the cup containing 30 mL of fresh water.]
   This cup of 30 mL represents 100% of the freshwater on our planet.

[Place the three freshwater cards on the table question-side up.]
These pictures are hints at where the world keeps its freshwater.

Where in the world can you find fresh water?
Fresh water is frozen in ice caps and glaciers, is hiding underground, and can be seen in lakes, rivers, and streams.
[Allow time for participants to share what they know about these sources of water.]

5. **Reveal the amount of water found in each of the three main sources of fresh water and pour water to update the model.**

What percent of the world's fresh water do you think is frozen in ice caps and glaciers?



Give participants a little time to guess. Then flip the top card over to reveal that 68% of Earth's fresh water is frozen in ice caps and glaciers.

Ask a volunteer to pour 19 mL into a separate small graduated cup and place it on the ice caps & glaciers card.

How easy is it to get and use this water? *It is not easy!*
So, this source of fresh water is not really available for us to drink and use.

What percent of the world's fresh water is ground water?

Flip the card and ask a participant to pour 10 mL into a separate cup and place it on the ground water card.

How easy is it to get and use this water?
It is not easy.

Even though some people do drink and use ground water, it is not easy to dig wells and pump water up out of the ground. Ground water basins are only in certain areas. So, for the most part, this water is not available for people to drink and use.

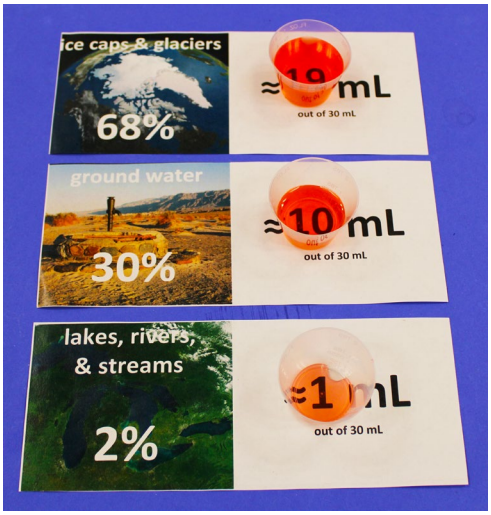
What percent of the world's fresh water is left?

68% + 30% = 98%
*100% - 98% = **2%***

Flip the card for lakes, rivers, and streams and place the remaining cup on it.

How easy is it to get and use the water from lakes, rivers, and streams? *This is the easiest to get.*

Out of all the water in the world only a very small amount is available for all the humans and all the animals to drink and use!



Deepen understanding

6. Discuss what this model reveals and conclude with a call to action.

How is this model useful?
[Give participants a chance to share their ideas.]

Models are especially useful when we want to understand very large or very small things. Even all of the water found in lakes, rivers, and streams, represented by this small amount of water, is so big that it is hard for us to imagine.

[Optional] Do you know of any ways people use water, such as saltwater, that we set aside and said we could not drink?
[Give participants a chance to share their ideas. Examples may include desalination water treatment plants, wells to access ground water, or melting lake ice in winter for drinking water.]

What are some reasons that some of the water in lakes, rivers, and streams, might not be available for us to drink and use?
[Give participants a chance to share their ideas. Examples may include water contaminated by waste or other sources of pollution.]

It might seem like our planet has an endless supply of water, but only a small amount can become water that we can drink and use. We must protect it!

[Flip the Water Planet card over to reveal the call to action.]

What are some ways that we can protect our water supply?
[Give participants a chance to share their ideas. Examples may include turning the water off when you brush your teeth, taking shorter showers, or not throwing trash in waterways.]

Clean-up

Reset for the next group

1. Pour the water from the small cups back into the bottle. Place the cap on the bottle securely and shake the bottle to mix well.
2. Wipe the medicine cups with a paper towel and put them aside.
3. Use the waste container for paper towels or excess liquid as needed.
4. Turn all the cards over to their question side.
5. Arrange the cards as shown and place the three cards showing the sources of fresh water aside.

Note

After several iterations, it may be necessary to change or replace the bottle of water.

Proper disposal

The water used in this activity may be poured safely down a sink.