# TOPIC 1. WATER — NATURE'S MAGICIAN

## Chapter 1(A): Water — Visible and Invisible

### Purpose

To provide information about the properties of water and the importance of water to life, and to focus on water being around for over 4 billion years.

### Subject areas

History, Science, Language Arts, Math

### Procedure

**Note:** It is important for students to know about the different properties of water so that they can have a better idea of the forms water takes as it moves around in the hydrologic cycle.

1. Generate a class discussion with the following topics or ideas:

   - Introduce the concept that water is a magical substance by discussing some of the different properties of water. For example, ask students how water is different in winter and in summer (ice, snow, sleet as opposed to warm rains and water for swimming); encourage them to talk about where they see examples of water vapour such as steam rising from boiling kettles or condensation forming on the outsides of glasses containing cold drinks.

2. Depending on the grade level of the students, you might want to introduce more complex concepts, for example:

   - Pure water at sea level boils at 100°C and freezes at 0°C. Point out that if a substance such as salt is dissolved in water, then the freezing point is lowered — that is why we spread salt on streets in winter to prevent ice formation.

   - Water is a good cooling and heating agent. If students live near water they can feel how water absorbs the heat of the day and cools the surrounding air. More mature students could be asked to research land and sea breezes.

3. Demonstrate to students (or assign as an activity to more mature students) that water is really molecules in motion. Introduce the phrase "capillary action" and show how water moves up the stalks of plants by using celery and coloured water. Point out that in the same way, blood, which is mostly water, moves through the smallest blood vessels, called "capillaries."

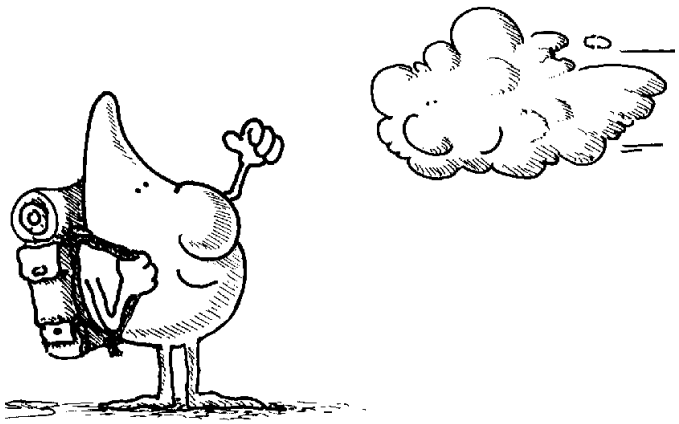
4. Ask how long they think a person can live without water. (About three days.)

## Vocabulary

| | | |
|---|---|---|
| ***atom*** | ***molecules*** | ***solvent*** |
| ***atmosphere*** | ***nutrients*** | ***vapour*** |
| ***dissolve*** | ***oxygen*** | ***vital*** |
| ***hydrogen*** | ***renewable*** | |

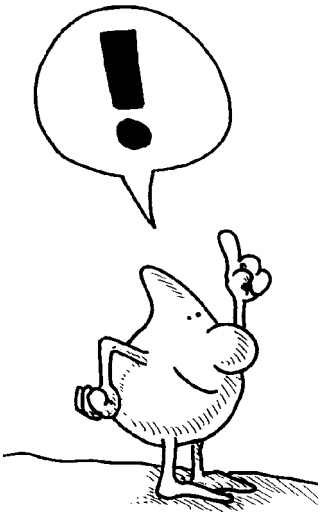
## References

- Freshwater Series A-1: "Water — Nature's Magician"
- *A Primer on Fresh Water*: "Water — Forever on the move"



# TOPIC 1. WATER — NATURE'S MAGICIAN

## Chapter 1(A): Water — Visible and Invisible



Picture this. Friday night has arrived. You're going out for the evening. You dash home after basketball practice, grab the shampoo, leap into the shower, turn on the taps, and nothing happens! One single solitary drip of water clings stubbornly to the shower head. And that's all there is.

Hello? Your father has managed to save a small bucketful of water and you can have your share? Big deal. One litre. How are you going to wash the grease from your hair, sweat from your body, and fuzz from your teeth? Not a pretty picture, is it?

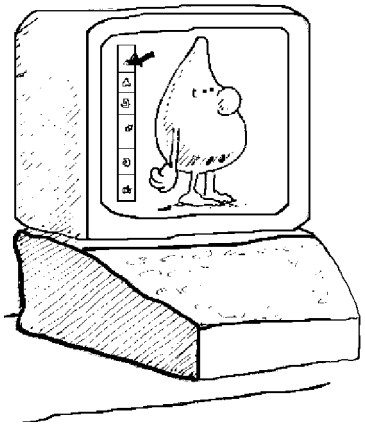
### Let's not take water for granted

The title of this material asks us not to take water for granted. Do you? Do you ever think about the importance of water? All the different forms it comes in? All the different ways we use it?

We all know that water is the stuff we let flow down the bathroom drain while we hang around brushing our teeth. But it also comes in the form of ice, snow, vapour, and sleet.

The truth is, most of us don't think too much about water. We just use it, and in some cases we waste it.

Take a minute to think about all the ways you have used water in the past twenty-four hours. After you have made your mental list, ask yourself if there is another substance you can think of which you use the way you use water. What else can you drink, swim in, skate on, make snowballs with, and wash with, among other things?



## Water as a solvent

An interesting fact about water is it can **dissolve** so many other substances. You probably dissolve substances in water every day without thinking about it. For example, when you stir sugar into a drink, or salt into your soup, you are using water as a solvent; and at school you use water to mix powdered paints to make different colours for art classes.

Because water is such a good solvent, it can dissolve **nutrients** and transfer them as **vital** food for plants and animals.

But, dissolved substances in water aren't always good. A drop of rain falling through the air dissolves atmospheric gases, and when these fall to the earth they can affect the land, lakes, and rivers. In another chapter we will look more closely at how dissolved acids in rain are transferred through the **atmosphere** and dropped on our lands, lakes, and rivers.

### Water Facts

- 50-60% of your body is made of water
- pure water has no taste, no colour, and no smell
- water has a chemical name, $H_2O$ - this means it is made up of **molecules** containing two **atoms** of **hydrogen** and one atom of **oxygen**
- blood is 82% water
- water turns to ice at 0°C and to **vapour** at 100°C
- all living things, from the tiniest insect to the tallest tree, need water to survive
- more than half of the world's animal and plant species live in the water
- water is a good **solvent** - it can dissolve many substances
- most of our food is water, for example:
  - tomatoes (95%)
  - spinach (91%)
  - milk (90%)
  - apples (85%)
  - hot dogs (56%)
  - beef (61%)
  - potatoes (88%)
- Canada has about 7% of the world's **renewable** freshwater supply
- water vapour forms a kind of "global blanket" which helps to keep the earth warm

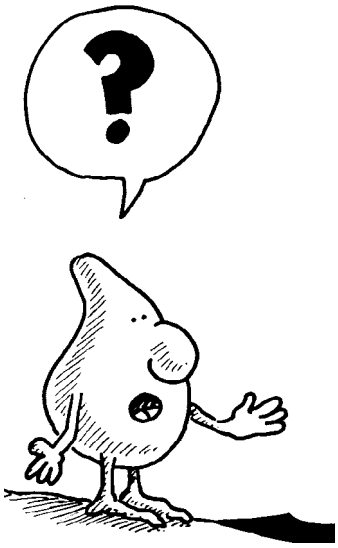
## Where did all of our water come from?

That is a difficult question to answer, although scientists say that water has been here since the planet Earth was formed over 4 billion years ago.

The big bang theory about the forming of our planet states that water was created when hot gases from inside the earth erupted through volcanoes and geysers, and then cooled as the earth cooled. The gases then condensed to form a liquid which we call water. The amount of water formed then is the same amount we have today.

### Did You Know?

Today 71% of the earth's surface is covered by salty oceans averaging 3.7 km deep. All five oceans are connected. Can you name them?



# TOPIC 1. WATER — NATURE'S MAGICIAN

## Chapter 1(A): Water — Visible and Invisible

### Activity 1 — Math

Look back at your Student Information sheets. Based on the information in "Water Facts," calculate the following:

1. You are making fresh tomato sauce and you have brought in 3 kilograms of tomatoes from the backyard. How much water is in these tomatoes?

2. i) Weigh yourself. How much do you weigh? How much of you is water? If all the water were taken from you, how much would you weigh?

   ii) Combine your weight with the weight of two other friends. How much of all three of you is water? (How much of an ordinary bathtub would this water fill?)

3. In order to get dessert, you have to eat 600 grams of spinach. How much of this is water? Does this make you feel any better about eating spinach?

4. How much water are you getting in a beef steak which weighs 500 grams?

5. Make up two questions for a friend based on "Water Facts."

## Activity 2 — History, Language Arts

Use a time line to show how long water molecules have been around and what important happenings they might have witnessed. (In the interest of saving paper and trees, limit the important events to the past 2000 years.)

***OR***

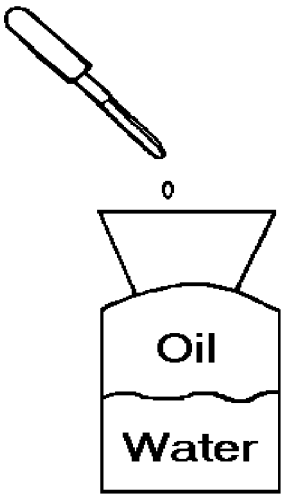
Use a water molecule to tell a story or relate a historical fact about your favourite period in history. If you could go back in time, what time would you go back to?

- when knights were around
- when dinosaurs roamed the earth
- when explorers came to Canada
- when your grandparents were children

Choose any time that interests you.

Remember, as a water molecule you can go anywhere — in the air, in water, underground, in any city or country in the world — and you can give a water-bird's eye-view of what really happened. So, make sure you point out how you (a young water molecule) were used back then.

## Activity 3 — Science



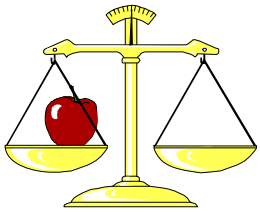

Water is the world's greatest solvent. Demonstrate to your class how water dissolves substances that other liquids will not.

- Take a small glass jar and fill it half with cooking oil and half with water. Add one drop of food colouring. Describe what happens.
- Water dissolves many substances. This can be good for us and it can be bad for us. Explain.

## Activity 4 — Math and Science

Discover for yourself how much water is in an apple (or any fruit/vegetable).

If your teacher or librarian can help you with instructions, use this exercise to make the head of an apple doll.



- Peel an apple. Weigh it. For this you will need a set of scales or weights. Record the weight of the apple.
- Put the apple in a dry place for twelve or fourteen days and wait. Keep an eye on it and you will see it begin to shrivel up.
- At the end of this time, weigh the apple again. What is the difference in weight? What percentage of its weight has disappeared? Where did it go?
- Did your experiment with the apple support the information about most of our food being water?
- Try the same experiment with another fruit or vegetable, for example, a zucchini. Compare the percentage of weight lost with the apple's loss.
- What is the main conclusion you would draw from this experiment? Write your conclusion down.

Do a reverse of this experiment:

- Take some fruits or vegetables that have already been dried, for example, apricots, prunes, apples, or raisins.
- Weigh them and record the weights. Soak them in water.
- Note the changes. What happens? How long does this take? What is the difference in weight?
- Research: Why are some fruits dried? Who uses them this way? What other foods are dried?

## Activity 5 — Science

Find out how much water is in a citrus fruit like an orange, lemon, or lime, and make a "pomander" as well.

**Note:** A pomander is a ball of mixed fragrant substances sometimes used in a closet or cupboard.

- Weigh the citrus fruit.
- Take a ribbon and tie it around the fruit. (You can hang the pomander from this later.)
- Press cloves into the skin of the fruit about one clove head apart.
- When the fruit is covered with cloves, wrap it in tissue paper and put it aside for five or six weeks.
- At the end of this time, take the fruit out and weigh it. Record the weight and compare it with the original weight. How much weight has been lost? What percentage of the original weight is this?
- Now that your experiment is finished, you have a gift for your mother or father to hang up in a closet or cupboard.

## Activity 6 — Research, Science

Check your home or your school. Does either place have a humidifier or a dehumidifier? If not, do research in your library to find out about these appliances. Prepare answers to the following:

- What is the purpose of each?
- Are there times of the year when the amount of water is more? Less? Why do you think this is so?
- Explain in detail how either works. Prepare an illustration to present your information clearly.
- Try to conduct a "hands-on" experiment to find out how much water passes through either appliance in a day or a week.

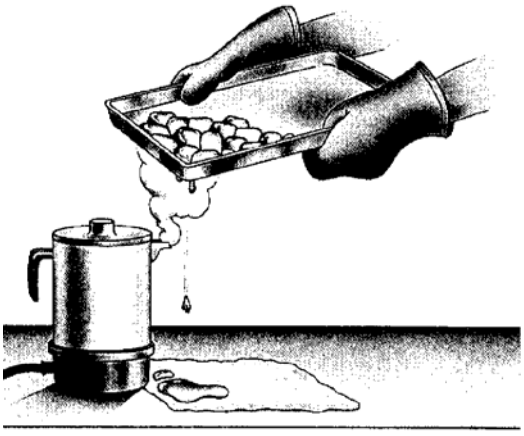
## Activity 7 — Science

This is your chance to show that different temperatures allow water to exist as a solid (ice), a liquid, and a gas (or vapour).

Ask your teacher for help (or if you are working at home, ask your parents).

You will need:

- an electric kettle
- water
- a cookie sheet (with sides)
- ice cubes
- kitchen mitts



What to do:

- boil water in an electric kettle
- using kitchen mitts, hold the cookie sheet full of ice cubes over the steam from the spout

What did you see? Answer the following questions:

- What happened to the water which boiled? (This is called evaporation. How would you describe evaporation?)
- What happened to the ice?
- What happened to the outside of the pan which contained the ice? (This is called condensation. How would you describe condensation?)
- Would the same process have occurred if the water had not been heated?
- What would happen if you placed the pan of water in the freezer?

Write a conclusion explaining how different temperatures affect the different forms of water.

# TOPIC 1. WATER — NATURE'S MAGICIAN

## Chapter 1(B): The Hydrologic Cycle

### Purpose

To review the hydrologic cycle and emphasize the endless and continuing motion of water molecules.

### Subject areas

Language Arts, Environmental Studies, Social Studies, Math, Art, Science

### Procedure

1. Using the diagram on the Student Information sheet, review the concept of the water cycle. If this is new to students, discuss tricycles, bicycles, seasonal cycles, or their school time table cycle.

    - Go over the vocabulary of the hydrologic cycle.

    - Review with students that the three **primary** kinds of water include atmospheric water or vapour, surface water, and groundwater. Ask them if they can name some of each, for example:

        atmospheric — vapour, snow, rain, hail
        surface — oceans, icecaps, wetlands
        groundwater — aquifers, artesian wells

        Each kind of water is part of the hydrologic cycle.

    - Ask if there is more water around today than there was 100 years ago.

        Point out that the water here today is the same water that their great grandfathers used 100 years ago; and the same water has been here for approximately 4 billion years since the earth was formed. This water keeps going around and around in one of nature's cycles.

2. Use a world map to point out to students where British Columbia, Brazil, and Bangladesh are located. Emphasize that the same water we use has travelled to a lot of places — a Canadian living in any province or territory has likely been rained on by water drops that fell on other countries.

## Vocabulary

| | | |
|---|---|---|
| ***condensation*** | ***groundwater*** | ***prehistoric*** |
| ***disperse*** | ***hydrologic cycle*** | ***recycling*** |
| ***evaporation*** | ***percolate*** | ***saturated*** |
| ***evapotranspiration*** | ***precipitation*** | ***transpiration*** |

## References

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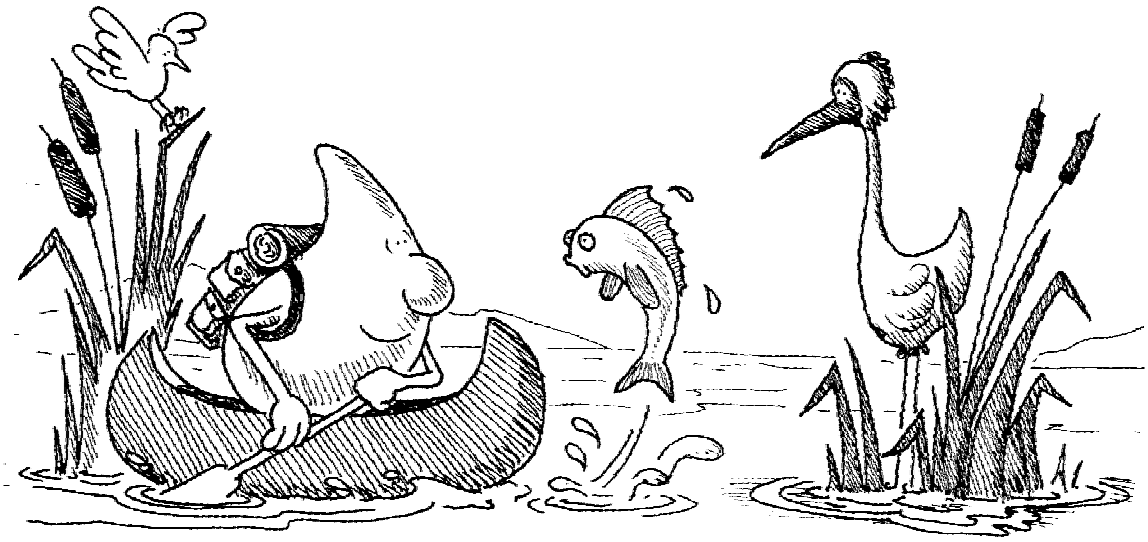
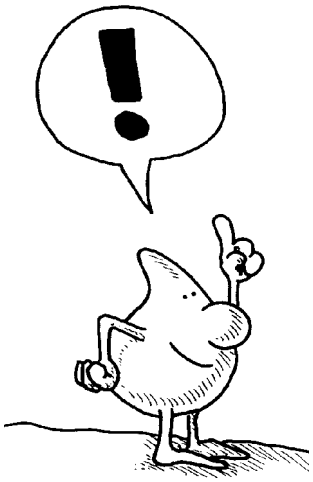




# TOPIC 1. WATER — NATURE'S MAGICIAN

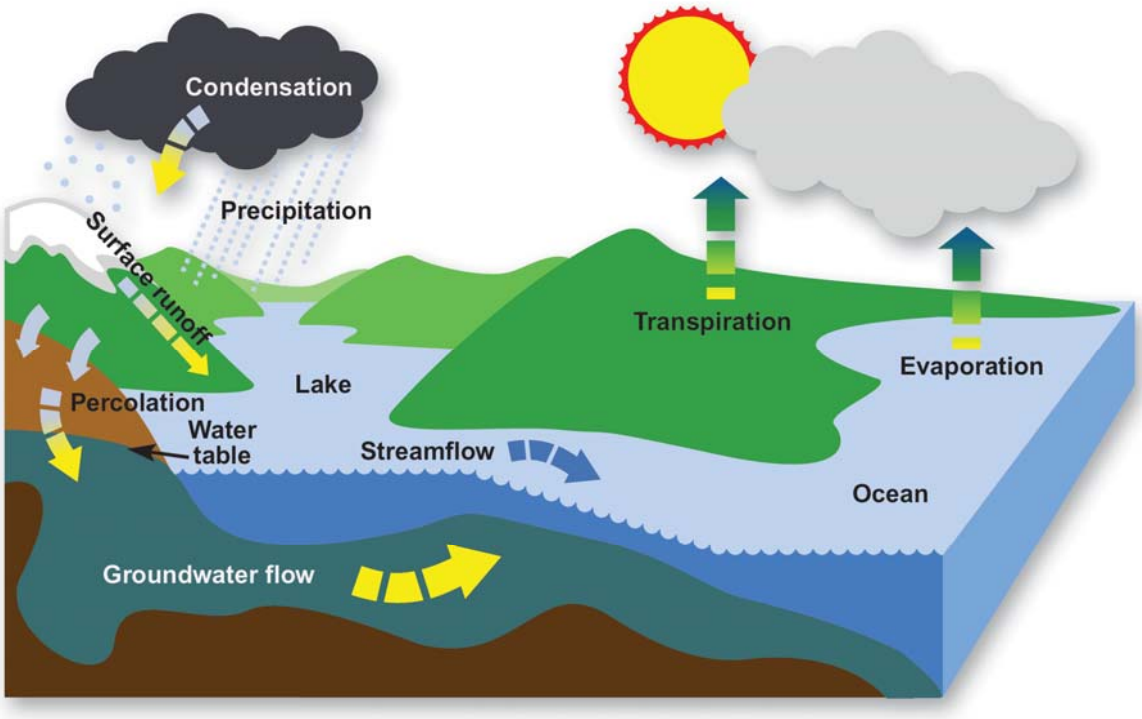
## Chapter 1(B): The Hydrologic Cycle

It's Monday morning. Very early. And you hear your Social Studies teacher say something to the class about looking at the **hydrologic cycle**.

You're probably not quite ready for something too new right now. But relax. It's the water cycle being recycled with a new name, the hydrologic cycle. The question is, how much do you know or remember about the water/hydrologic cycle?

Let's refresh our memories with the following diagram.

### The hydrologic cycle



## How the hydrologic cycle works

If you observed or performed Activity 7 the last chapter, you saw how heat changed water from liquid to steam, and from solid to liquid. In the same way, water molecules in the atmosphere need the sun's power or energy to keep moving and changing. After all, if there were no heat from the sun, the water would be frozen and we would not be here reading about it.

Water molecules group together to form clouds (this is called **condensation**), and these clouds are moved about the earth by air currents. As these clouds become **saturated**, or full of water, **precipitation** occurs and the water droplets fall to earth.

When water reaches the earth, the drops **disperse**. Some run off as surface water and others **percolate** through the ground to become part of the **groundwater** supply.

Once again, the sun's energy works on from the surface water changing the water to vapour, a process called **evaporation.** This vapour rises into the atmosphere to form new clouds and continue the hydrologic cycle. Water also enters the atmosphere from the leaves of trees — this is called **transpiration**.

And round and round the water goes, showing why this process is called a cycle.

## How old is water?

A very interesting fact about water is that it doesn't go away. The same water molecules running down your drain or resting in your water glass might be the very ones that your great, great, great grandfather used to water his crops many years ago. Or, some **prehistoric** animal may have drunk the very same molecules that you are preparing to drink right now.

Think about it. Use your imagination to consider the stories one drop of water could tell if it could talk. It's difficult to believe that we are still **recycling** the same water that a young dinosaur might have frolicked in millions of years ago.

### Did You Know?

The water cycle maintains a very delicate balance on a global scale. For every drop of precipitation which falls, an equal amount must disappear into the atmosphere through evaporation or transpiration. When this balance is disturbed, water can become unfriendly and we may get floods or droughts.

## The well-travelled water molecules

Because of wind currents and climate changes, water molecules get to visit all parts of the earth. Parts of the same rain which fell on you yesterday in Canada, may fall on the Brazilian and British Columbian rainforests next month, or they may seep into the ground through percolation and spend the next three years finding their way to the ocean or ending up in somebody's well.

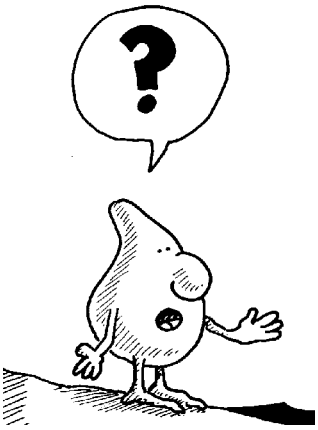
Some water molecules might spend the next 10 000 years in the underground water supply or frozen in a northern glacier!

Just think about your glass of water again. These water molecules might have been part of floods that rushed from the Himalaya Mountains and down the Ganges River to Bangladesh causing people to lose their homes, their crops and livestock, and sometimes their lives. Or, the water molecules may have just come back to the surface water supply after having spent a thousand years frozen in the Arctic ice.

We may not be exactly sure of where and when water first appeared, but we do know two facts:

1. water has been in motion constantly since it came; and

2. practically the same amount of water that was here at the beginning is still with us today — being recycled time and time again through the hydrologic cycle.

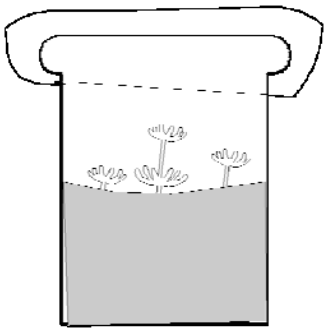


# TOPIC 1. WATER — NATURE'S MAGICIAN

## Chapter 1(B): The Hydrologic Cycle

## Activity 1 — Science, Environmental Studies

You can show how a hydrologic cycle works with a simple demonstration in your classroom or at home. Try one of the following experiments:



1. Set up a terrarium.
   - Put soil in the bottom of a large glass jar and plant a few small plants.
   - Water the plants and cover the mouth of the jar or terrarium with plastic wrap.
   - Watch your terrarium for a couple of weeks.
   - Write down what you observe. How do you think this relates to life on the planet Earth?
2. Show how plants use and transpire water within the hydrologic cycle.
   - Take a potted plant and put a plastic bag over it. Use tape to keep the bag in place and use sticks to keep the bag from touching the leaves.
   - Set the plant in a sunny window.
   - Record what happens.
   - What conclusion would you make from this experiment?

3. Make a very simple model of the water cycle.

   You will need:

   - a small glass jar — a baby food jar will do
   - a small rock to fit in the bottom of the jar
   - water that has been coloured with food colouring
   - plastic wrap or lid to seal the jar

   What to do:

   - Place the rock in the jar and partially cover it with the coloured water. (Make sure you mark the level of the water on the outside of the jar.)
   - Seal the jar, then place it in the sun.
   - Come back to the jar after it has been sitting in the sun for a day. Record your observations.
   - Move the jar back into the shade. What happens?
   - What conclusion would you make from this experiment? Write your conclusion down.

## Activity 2 — Social Studies, Language Arts

You probably wouldn't mind being able to travel to some of the exotic places that the water molecules travel to, but you wouldn't be so crazy about some of their other travels.

Take one of the following story topics and develop a story about a water molecule in motion. Give your water molecule a catchy name.

1. You are a water molecule who lives in the north and you are really keen to catch a ride to the sunny south. It takes you a whole year to get there and it is a lot of hard work. Describe what happens to you during the year.

2. A dirt cycle? You are a speck of dust lying in the yard minding your own business when the wind disturbs you and lifts you into the air, taking you higher and higher.

   You bump into a cloud where you meet millions of other specks, just like you, and you kind of enjoy this life on cloud nine, drifting around in the blue before you find yourself being covered by moisture.

   Something drastic happens to disturb your peaceful life. What is it? Tell about your awful experiences.

3. Back in the 1890s you were frozen into a glacier and you have just now been released back into the atmosphere. You don't understand what has happened to the earth in the past 100 years. Everything has changed. You try to find out from others; and you try to tell them what happened to you. Some molecules are helpful, others are not. Write about one of your conversations or write a play.

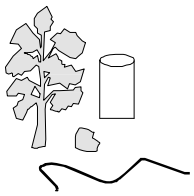
## Activity 3 — Art

Now that you know how the hydrologic cycle works, why not prepare your own colourful diagram showing in detail how it works. If you are feeling really creative, give your diagram some texture with cotton wool for clouds and other fabrics or materials for sand, grass, trees, and water.

## Activity 4 — Science, Math

As you saw in the diagram of the hydrologic cycle, trees send moisture back into the air through transpiration. How can you measure approximately the amount of water one tree sends back? First of all, you have to start small — begin your measurement with one single leaf over twenty-four hours and calculate the rest.

You will need:



- a plastic sandwich bag
- a small pebble
- some string
- a set of scales
- and, last but not least, a tree with a broad leaf such as a maple or oak

What to do:

- Place the pebble in the bag.
- Weigh the bag, pebble, and string carefully. Record the weight.
- Tie the bag (with the pebble in it) around a leaf on a tree. Be careful not to disturb or damage the branch.
- After twenty-four hours, carefully weigh it again.
- How many milligrams of water do you have in your bag?
- Make up five math questions you could ask another person based upon what you have just learned about one leaf. For example:
  - If a tree has 10 000 leaves, how much moisture will it transpire in a day? In a month? In a year?
  - If you had 20 trees in your backyard, how much moisture would they transpire?
  - How would you go about calculating the number of leaves on one tree? You really don't want to count them all, do you?

## Activity 5 — Language Arts

Create your own word search.

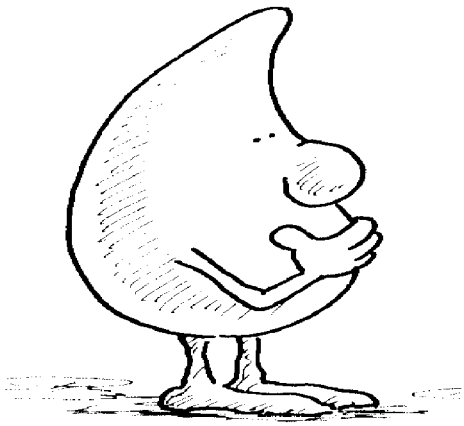
This chapter uses vocabulary that you may not be familiar with.

- Read back over the information and select words to make your own word search. (You must know the meaning and spelling of every word you include!)
- Ask your teacher for graph paper to keep your lines straight.
- Remember, the words can go in any direction — forwards, backwards, up, down, and diagonally. You can also use other water words to fill in smaller spaces.
- Whichever words you use should be included in a list underneath your puzzle.

## Activity 6 — Language Arts

Another word sometimes used to mean transpiration is the long word, **evapotranspiration**. As you can see, it is a combination of evaporation and transpiration. Try one or both of the following exercises:

1. How many four-letter words can you from evapotranspiration? List them. Remember, you are not to use a letter more times it appears in evapotranspiration, for example, you cannot use "tattle" because there are only two "t"s in evapotranspiration.
2. Make a list of the three- and four- get letter words you get from evapotranspiration that relate to allowed environmental issues. (Make a side than bet with your neighbour.)



## Activity 7 — Art, Storytelling

You may be surprised to learn that raindrops are not tear-shaped. Rather they are shaped like small hamburger buns. Combine your artistic and storytelling skills and create your own comic strip character on a journey through the hydrologic cycle.