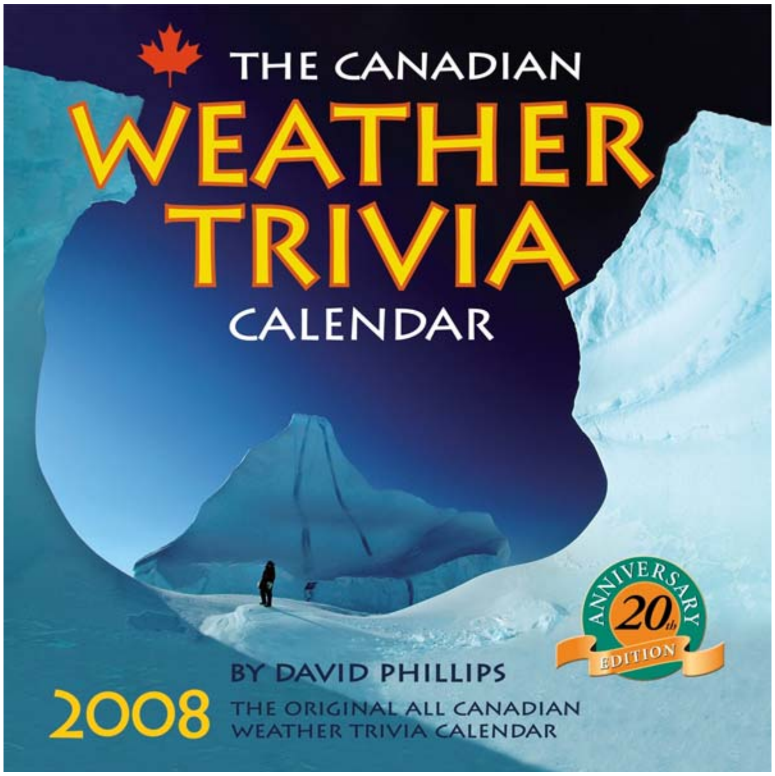


# Teacher's Guide

**A free, downloadable guide to *The 2008 Canadian Weather Trivia Calendar* available at [www.fitzhenry.ca](http://www.fitzhenry.ca)**

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FIFTH HOUSE

# Teacher’s Guide
# *The 2008 Canadian Weather Trivia Calendar*

## The Calendar

In the 2008 edition of the *Canadian Weather Trivia Calendar*, Canada’s best-selling calendar, David Phillips presents another year of the wildest weather trivia around—beautiful photographs, strange stories, challenging quiz questions, and bizarre facts. This edition features all-new Canadian weather history, record holders, safety tips, daily weather trivia, health and weather, and climate change. A conversation piece at school, home, and the office, kids will enjoy learning more about the science behind the weather in the calendar.

## The author, David Phillips

Environment Canada senior climatologist David Phillips has been called “a genuine Canadian legend” and “our unofficial weather guru,” but prefers to think of himself as Canada’s weather ambassador. He has been studying Canadian climates and promoting the importance of weather and climate in this country for thirty-eight years.

## The Teacher’s Guide

The *Canadian Weather Trivia Calendar Teacher’s Guide 2008* is an instructor resource that correlates to the *Canadian Weather Trivia Calendar 2008*. Offering four distinct components—activities, discussion questions, self-directed research, and “Time to Reflect” segments—this guide can be used individually or as a series of lessons, depending on the requirements of the teacher. Some activities have an added dimension, “Extending the Exercise” in which teachers can choose to continue with the activity in question with further discussion or student research. The activities in this guide are drawn from the Earth Sciences curriculum shared by Canada’s provinces and territories for grades five to eight.

# Activity One: Convection Currents and Thunderstorms

## Calendar Connection

Read through and discuss the pull-out poster on tornadoes found in the middle of the calendar. Highlight the fact that tornadoes are produced by rare severe thunderstorms called supercell thunderstorms. Then ask the students, "If tornadoes are formed from thunderstorms, how are thunderstorms formed?"

## Objective

To create and demonstrate convection currents to gain a better understanding of how the movement of warm and cold air in the atmosphere is a key factor in creating thunderstorms. This activity is best performed as a teacher demonstration for the entire class, rather than an activity for individuals or groups of students.

## Backgrounder

Each day tens of thousands of thunderstorms are occurring on Earth. Many thunderstorms are short-lived, lasting for less than an hour, but during that time thunderstorms can produce heavy rain, strong winds, lightning, hail, and, in the most rare and severe cases, tornadoes.

Thunderstorms occur due to convection: the action of warmer less-dense air rising and colder denser air sinking until the two masses of air collide in the atmosphere. A thunderstorm occurs when a convection current of warm moist air rapidly rises from the surface of Earth (called an updraft) and condenses to form cumulus clouds. As more warm air rises and collects, the cumulus clouds continue to grow until the water droplets and ice crystals that have formed in the clouds become too heavy for the rising air to hold. Colder heavier air in the atmosphere starts to enter the clouds and, because it is heavier than the warm air, the cold air sinks below the warm air and pulls the water droplets downwards (called a downdraft), and it starts to rain. At this point the cumulus clouds have become tall dark puffy thunderclouds with towering heads called cumulonimbus clouds. Collisions between water droplets and ice crystals in cumulonimbus clouds build up charges of negative and positive electricity. This leads to the formation of lightning and the vibrations or shock waves from the lightning bolts we hear as explosions of thunder.

## Materials Required

- Four empty bottles (the bottles should be identical; larger glass milk or juice bottles are best with the mouths of the bottles measuring at least 4 cm in diameter)
- Warm and cold water
- Blue and yellow food colouring
- Two 7.6 x 12.7 cm index cards or playing cards

## Procedure

1. Fill two of the bottles with warm water and the other two bottles with cold water. All four bottles should be filled to the brim with water. Use the food colouring to colour the warm water yellow and the cold water blue.
2. Place one of the index cards over the mouth of one of the bottles containing warm water. Hold the card in place as you turn the bottle of warm water upside down and rest its mouth on top of one of the bottles containing cold water. The bottles should be mouth to mouth, separated by the card.
3. Carefully slip the card out from in between the two bottles. Make sure to hold onto the top bottle as you remove the card. Ask the class to observe what happens to the coloured water in each of the two bottles.
4. Repeat steps 2 and 3, this time placing the remaining bottle of cold water on top of the remaining bottle of warm water. Ask the class to observe what happens.

## Conclusion

Just like warm and cold air, warm water is lighter and less dense than cold water. When the bottle of warm water is placed over top of the bottle of cold water, nothing happens to the different colours inside the bottles. The colder denser water stays in the bottom bottle and the less-dense warmer water stays in the top bottle. However, when the bottle of cold water is placed on top of the bottle of warm water the colours begin to mix as the warm water begins to rise to the top and the cold water sinks to the bottom. This movement of water is called a convection current and illustrates what is happening in the atmosphere as thunderstorms are created.

## Extending the Exercise

According to a recent cross-Canada weather study (the "Weather Winners" study briefly summarized at the back of the calendar) conducted by Environment Canada, Ontario is the province/territory with the most thunderstorm days per year. Ontario was ranked first, having an average of 21.80 days during the year with an occurrence of a thunderstorm. Saskatchewan was ranked second with 21.49 days, followed by Alberta with 20.81 days. Newfoundland and Labrador was ranked second-last with 5.71 days per year, and Nunavut was ranked last, having an average of only 1.15 thunderstorm days per year. Discuss these rankings with students and ask them what factors lead to Ontario having more thunderstorm days per year than Nunavut (relate it back to the ingredients needed for convection currents: moist air rising over a warm land surface). Ask the students to identify the time of year when thunderstorms are more likely to occur in Canada and discuss the reasons why this is so.

## Discussion—Personal Connection

Thunderstorms may be fun to watch, but they are also a dangerous force of nature that can devastate buildings and injure or kill people. There are many days throughout the calendar that attest to this fact (e.g., March 22, 27; April 30; May 21, 26, 29; June 9). Refer students to the Lightning Oddities and Ben Franklin's Quirky Lightning Tips sections at the back of the calendar. What are some other safety precautions that can be taken during a thunderstorm? Where is the safest place to be if you find yourself outside during a lightning storm? Where is the most dangerous place to be? Why?

# Activity Two: Rainbows and the Colour Spectrum

## Calendar Connection
Both May 12 and December 4 on the calendar make mention of striking rainbows appearing in the sky during or following rain showers. Raindrops in the sky act like little prisms refracting and reflecting different wavelengths of light at different angles, separating white sunlight into the various colours of the rainbow, also known as the colour spectrum. Discuss with the students how sunlight is normally viewed as white light but that it is actually a combination of all the different wavelengths of light making up the portion of the electromagnetic spectrum that is visible to the human eye.

## Objective
To create a rainbow to examine the colours that make up the colour or visible spectrum. This activity can be performed by groups of students.

## Backgrounder
Rainbows occur when sunlight strikes drops of water in the air, so rainbows are not only seen during rain showers but can also be seen when you are standing near waterfalls or water fountains. Rainbows are optical illusions that depend on the observer's location and the position of the sun. In order to see a rainbow, you must have your back to the sun and be facing the rain and the sun must be shining at a low angle to the ground.

A rainbow appears when sunlight disperses as it travels through raindrops. Sunlight is first refracted as it enters the surface of the raindrop. The refracted light travels to the inner rear surface of the raindrop and is then reflected off the back of the drop and refracted again as it leaves the drop. When the light is refracted, different wavelengths of light refract at different angles, separating the white light into different bands of coloured light.

A rainbow spans a continuous spectrum of colours, but the sequence is traditionally remembered as the seven colours Sir Isaac Newton first identified—red, orange, yellow, green, blue, indigo, and violet—often memorized with the help of the mnemonic ROY G. BIV (**R**ichard **O**f **Y**ork **G**ave **B**attle **I**n **V**ain). Different colours of light within the spectrum refract at different angles depending on their wavelength. Red light has the longest wavelength and bends the least amount. Violet light has the shortest wavelength and bends the most. Even though there are many raindrops in the sky at many different positions, sunlight will interact with each raindrop the same way, which results in the steady progression of long wavelengths (red) on the outer part of the rainbow's arch and short wavelengths (violet) on the inner part of the arch, with the yellow and green colours in between.

## Materials Required

For each group of students:

- A glass
- Water
- A sheet of plain white paper
- Two pieces of masking tape
- A flashlight

## Procedure

1. Have the students fill the glasses with water (almost to the top of the glass), and place them at the very edge of a counter or table.
2. Have students place the sheet of white paper on the floor a few centimetres away from the counter or table.
3. Have students place the two pieces of masking tape over the front of the flashlight so that the light comes out of a slit about 0.3 cm wide.
4. After making sure the classroom is dark, have the students position the flashlight above the glass of water and shine the flashlight across and down into the water until a colour spectrum can be seen on the white sheet of paper on the floor.

## Conclusion

The visible white light coming from the flashlight has been refracted to produce the separate colours of the visible colour spectrum.

## Extending the Exercise

Ask the students the following questions and discuss the answers:

1. Why do we only see a narrow band of colour when we see a rainbow even though the entire sky is filled with raindrops?
2. What are double rainbows? How are they created? How does the appearance of the colours in the secondary rainbow in a double rainbow differ from the colours in the primary rainbow?
3. What are moonbows (also known as lunar or white rainbows)? How are they created? Where are they most likely to occur? Why is it more difficult to discern the different colours in a moonbow?

## Self-directed Research

Divide the students in the class into groups and have each group select a name from the following list of scientists (or assign each group a name):

- Kamal al-Din al-Farisi (d. 1320)
- René Descartes (1596–1650)

- Isaac Newton (1642–1727)
- Thomas Young (1773–1829)
- George Biddell Airy (1801–1892)

Have each group research their scientist and give a short presentation on how their work expanded the field of knowledge on the science of rainbows, light waves, and visible light. For example, the presentations could take the form of a play where one student plays the part of the scientist being interviewed on television.

# Activity Three: Cloud in a Bottle

## Calendar Connection

Have students look at the clouds photographed for the months of June and September. Discuss with the students how the two cloudscapes differ in appearance. Discuss the traits of stratus, cirrus, and cumulus clouds and ask the students to classify the two different cloudscapes using these different traits. Discuss how different clouds are associated with different types of weather. For example, stratus clouds are associated with foggy days and light rain, drizzle, or flurries; cirrus clouds with fair weather that may change to rain; and cumulus clouds with fair weather unless they grow vertically later in the day and develop into cumulonimbus clouds, or thunderheads.

## Objective

To simulate the creation of a cloud to demonstrate cloud formation and the ingredients needed in order for clouds to form in the sky. This activity is best performed as a teacher demonstration for the entire class, rather than an activity for individuals or groups of students.

## Backgrounder

If you were to approach making a cloud like making a cake, there would be three main ingredients you would need:

- moisture—there must be enough water vapour in the air to form a cloud;
- cooling air—there must be enough cool air for the water vapour to condense to form a cloud;
- condensation nuclei—condensation nuclei are tiny particles in the air, such as smoke, dust, dirt, or pollutants, that provide surfaces around which water vapour can gather and condense to form a cloud.

All air contains water—even on a cloudless day water is still present in the sky in the form of water vapour and sub-microscopic water droplets that are too small to be seen with the human eye. Sunlight causes water on the earth's surface to evaporate into the atmosphere. This air containing water vapour is heated by solar radiation at the earth's surface and rises. As it rises, the warm air expands and cools as its pressure is reduced. As the air cools, its evaporation rate decreases more rapidly than its condensation rate until the air reaches the dew-point temperature (the temperature where the evaporation rate is less than the condensation rate). At the dew-point temperature a water droplet will condense into a cloud drop. When the temperature drops below the dew-point temperature, there is a net condensation and a cloud forms.

## Materials Required

- A one-litre clear plastic bottle
- Warm water
- A match
- A foot pump
- Safety glasses

## Procedure

1. Place some smoke particles inside the plastic bottle by lighting the match and letting it burn for a few seconds. Blow the match out and immediately place the head of the match inside the bottle. Let the smoke from the match fill the bottle.
2. Quickly place just enough warm water in the bottle to cover the bottom, and cover the top of the bottle with your hand and swirl it around a couple of times.
3. Place the nozzle of the foot pump tightly against the mouth of the bottle. Pump the foot pump ten to twelve times (more pumping may be necessary). Release the nozzle quickly from the mouth of the bottle and watch as a cloud forms inside the bottle.
4. To make the cloud "disappear," place the nozzle back over the mouth of the bottle and add more pressure to the inside of the bottle. Lift the nozzle away from the bottle again to see the cloud reappear.

## Conclusion

The warm water in the bottle provides moist air, while the smoke particles provide the condensation nuclei needed for cloud formation. Pumping air into the bottle forces the water vapour molecules to squeeze together or compress. Releasing the pressure allows the air inside the bottle to expand, and in doing so, the temperature of the air inside the bottle becomes cooler. As the air becomes cooler the molecules condense to form tiny water droplets, in other words, a cloud.

## Extending the Exercise

Discuss how various prefixes and suffixes are added to cloud names to distinguish certain traits, including how high they are in the sky. For example:

| Prefix/Suffix | Meaning |
|---|---|
| nimbo-/-nimbus | Makes precipitation |
| strato-/-stratus | Has flat wide horizontal layers |
| cirro- | High-altitude cloud whose base is above 6,000 metres above the ground |
| cumulo-/-cumulus | Looks like a pile or heap |

| | |
|---|---|
| alto- | Middle-altitude cloud whose base is 2,000–6,000 metres above the ground |

Write the cloud names "stratus," "cumulus," and "cirrus" on the board and then the list of prefixes and suffixes. Describe a cloud and then have a student come to the board and write out the name of the cloud by picking the cloud name and prefix or suffix that corresponds to the description given (e.g., cirrostratus, cirrocumulus, altocumulus, altostratus, cumulonimbus, stratocumulus, nimbostratus). Have the students quiz you by giving you a description of a cloud that you then need to write out on the board. You could also show pictures and discuss the traits of other types of clouds such as mammatus clouds, orographic clouds, and pileus clouds.

## Self-directed Research

In order to test the hypothesis that clouds are an important indicator when predicting weather, have students observe the clouds in the sky each morning before school for two weeks. Each student should be given a little sketchpad and assigned the task of observing the sky each morning. In their sketchpads they should sketch the clouds they see in the sky (if any) and identify the cloud underneath their sketch. Then judging by the cloud, have them write down a weather prediction for the day. After having kept track of the weather for two weeks yourself, at the end of that time, review the weather over the past two weeks and have the students look at their journals to see how accurate their weather predictions were. A discussion could follow about what other factors meteorologists use to forecast the weather.

# Activity Four: Wind Waves

## Calendar Connection

Quite a few days in the calendar refer to the tragic loss of lives and property due to the awesome power and unexpected destructive force of ocean and lake waves (e.g., February 29; August 9, 15; September 18; and November 27). Have the students read the trivia descriptions on these days and then ask the class how surface ocean waves or “wind waves” are formed.

## Objective

To create waves to demonstrate how wind generates waves, and to use marbles as a model of energy moving through water. This activity can be performed by groups of students.

## Backgrounder

The majority of ocean surface waves anyone sees breaking on a beach have been generated by wind. As the wind blows, pressure and friction forces disturb the equilibrium of the ocean surface. These forces transfer energy from the air to the water. A wave’s size and shape can help determine how far it has travelled. A steep choppy wave out at sea is a younger wave, probably formed by a local storm, while slow steady waves rearing into high crests near the shore and plunging into foam probably originated far away, sometimes as far away as another hemisphere.

A wave is not a mass of water moving across the ocean but a mass of energy being transferred from different water particles across the ocean. Energy, not water, moves across the ocean’s surface. Water particles move very little even though there can be a large amount of energy in a wave. Depending on the depth of the water and the height of the wave crest passing over them, water particles will move in closed orbits or can be displaced only a short distance forward. A good way to visualize the energy in a wave is to think of a long rope laid out on the ground. Imagine picking up one end of the rope and giving it a good snap. A wave of energy will travel all the way down the length of the rope, but the rope itself stays still. (Another way to demonstrate this effect is with the marbles in the below activity.) The size and shape of “wind waves” depend on three things:

- wind speed;
- the expanse of open water over which the wind has blown or waves have travelled without obstruction (called fetch); and
- the length of time the wind blows.

## Materials Required

For each group of students:

- A large flat pan, about 12 or 13 cm deep
- An electric table fan
- Buckets or jugs for filling the pans with water
- Five large marbles or ball bearings

## Procedure

1. Have the students fill the pans with 5 to 8 cm of water.
2. Have the students place the electric fans 30 cm away from the narrow end of the pans.
3. Ask the students to predict what will happen when the fan blows air across the water's surface. Ask the students to turn the fans on at low speed, and then at medium speed.
4. Have the students report what they observe. Were there waves in the pan? Did all of the water bunch up at the far end of the pan and slosh out of the pan?
5. Give each group of students a set of five marbles. Have students place four of the marbles on a desk or table, lining them up in a tight row with no space in between each marble. Ask the students to predict what will happen when the fifth marble is gently rolled so that it hits the marble at one end of the row. Then ask the students to roll the marbles and observe how only the marble at the opposite end of the row rolls away while the others do not move.

## Conclusion

The wind produced by the fan generates waves on the surface of the water in the pan. The water does not bunch up against the far edge of each pan because it is the wave of energy that moves through the water rather than the water itself. This movement of energy is also demonstrated with the five marbles.

## Extending the Exercise

Have students draw an ocean wave and label its different parts (e.g., still-water line; crest; trough; wave height; wavelength). How are waves measured? What is the "wave period" and how is it measured?

## Self-directed Research

Waves may lead to destruction, but they can be a lot of fun—just ask any dedicated surfer. Aside from aiding in pleasurable pursuits like surfing, wave power can also be harnessed as a form of renewable energy. Have the students research the answers to the following questions:

1. How does wave power work? What are some examples of the wave power systems currently being developed and tested throughout the world (e.g., What is Salter's Edinburgh Duck and how does it work?).

2. While wave power has the potential to capture tremendous amounts of energy, wave power technology faces a number of challenges that inhibit its widespread use. What are some of these challenges?

## Time to Reflect

Discuss the differences between renewable and nonrenewable forms of energy and what this means within the context of environmentalism and sustainability. Ask the students to think about their daily lives and routines (taking the bus or driving to school, watching TV, talking on the cellphone, making meals, buying clothes, taking trips), and whether these routines involve the use of nonrenewable or renewable energy sources. Why has the use of renewable energy (e.g., solar, wind, and wave power) been slow to catch on at a broad-based societal level (are there technological, economic, and political factors that play into answering this question)? How can students cut down on the use of nonrenewable energy in their day-to-day lives?