FORESTS OF CHANGE (Part II)

GRADE Grade 6

PART 2 of 3

TOPICS Wildfire, climate change, greenhouse effect

CURRICULAR CONNECTIONS

Grade 6 Science

Topic E – Trees and Forests

1. Identify reasons why trees and forests are valued. Students meeting this expectation should be aware that forests serve as habitat for a variety of living things and are important to human needs for recreation, for raw materials and for a life-supporting environment
3. Describe the role of trees in nutrient cycles and in the production of oxygen.
8. Identify human uses of forests, and compare modern and historical patterns of use
9. Identify human actions that enhance or threaten the existence of forests
10. Identify an issue regarding forest use, identify different perspectives on that issue, and identify actions that might be taken

OVERVIEW

Students begin this lesson by learning about the greenhouse effect and the greenhouse gases that make life on Earth possible. They will gain an appreciation for the natural balance that exists within the carbon cycle and how this cycle is being disrupted by human activities. Next students will continue their investigation of wildfire by turning their attention to the way that climate change is predicted to affect wildfires in the future.

OBJECTIVES

- Students will understand the importance of the greenhouse effect for life on Earth
- Students will understand that human activities are contributing to the greenhouse effect through the burning of fossil fuels
- Students will investigate the relationships between wildfire and weather
- Students will understand the components that are necessary for wildfire and how climate change is intensifying wildfires

KEY TERMS

- **Carbon cycle** – a process where carbon dioxide travels from the atmosphere into living organisms and the Earth, then back into the atmosphere
- **Climate change** – a change in the average conditions – such as temperature or rainfall – in a region over a long period of time
- **Fossil fuel** – a fuel formed in the earth from fossilized plant or animal remains (e.g. coal, oil, or natural gas)
- **Greenhouse effect** – a process that occurs when gases in the Earth's atmosphere trap the Sun's heat
- **Greenhouse gas** – gases in the atmosphere that trap energy from the sun. These include water vapour, carbon dioxide and methane

GUIDING QUESTIONS

- How do greenhouse gases contribute to the diversity of life on Earth?
- How does the burning of fossil fuels contribute to the greenhouse effect?
- What are the ingredients for destructive wildfires?
- How is the climate expected to change in the Canadian Rockies in the future?
- How could climate change affect forest fires in the future?

BACKGROUND ESSAY

We live on an amazing planet with an incredible diversity of plants, animals, fungi and bacteria. All of these species are able to exist because of something called the **greenhouse effect**. Just like in a greenhouse, energy from the sun shines through the atmosphere. Through the day the Earth's surface warms up. At night the Earth's

surface cools and heat is released back into the air. Some of that heat is trapped by naturally occurring **greenhouse gases** like carbon dioxide. This process makes the Earth warmer than it would be without an atmosphere and makes life on Earth possible. Without the greenhouse effect, the Earth would not be habitable.

Like all things in nature, the greenhouse effect depends on a balance called the **carbon cycle** in order to maintain life on Earth. Forests and other plants help to balance the greenhouse effect by taking in carbon dioxide and releasing oxygen. If the amount of greenhouse gases in our atmosphere – such as carbon dioxide – increases faster than trees and other plants can remove them, the Earth's atmosphere will trap more and more heat

Human activities are contributing to the greenhouse effect. For example, burning **fossil fuels** to produce the electricity needed to power our phones produces carbon dioxide. The increase of carbon dioxide and other greenhouse gases in the atmosphere means that the Earth's atmosphere is trapping more heat than it has in the past. This leads to rising average temperatures as well as long term changes in rainfall patterns. These long term changes in conditions are called **climate change**.

How could climate change affect wildfires in the future? In order to understand this we must answer two questions: ***What are the ingredients for destructive wildfires*** and ***how is the climate expected to change in the Canadian Rockies in the future?***

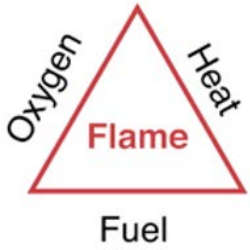
DURATION 10-15 minutes

MATERIALS

- Candle
- Candle holder
- Jar
- Scissors
- Matches/lighter

ACTIVITY – FIRE TRIANGLE

Students will start thinking about the things that fire needs to ignite and to continue burning by looking at a candle. Students will then compare the needs of the fire at a small (candle) scale to the needs of a fire at a large (forest) scale.



1. Ask students to brainstorm what things are needed for fire. Organize these ideas into the fire triangle.

2. Position students in such a way that they can all view a burning candle safely. Use the candle to demonstrate that if any side of the triangle is missing, there will be no fire.

3. Start by having students look at the candle and figure out what is missing. Why is it not burning? (heat, source of ignition) What are sources of ignition in forest fires?

4. Light the candle. Cover it with the jar and wait until the flame goes out. What is missing from the triangle? (oxygen) What factors would impact the availability of oxygen to a forest fire?

5. Light the candle again. Use scissors to cut the wick or burn the candle to the end. What is missing from the triangle? (fuel)

6. Ask students to scale up the demonstration to the wildfire scale at each step of the demonstration. How could changes in weather affect forests (fuel)? How might weather affect wildfires?

BACKGROUND ESSAY

What are the ingredients for destructive wildfires?

A wildfire requires the same three things as our candle in the 'Fire Triangle' activity: fuel, heat, and oxygen.

1. **Fuel** – Wildfire spreads based on the types and amount of fuel. Fuel includes trees, underbrush, grass and human structures. Think back to the discussion in Part I about human attitudes towards wildfire and fire suppression over the past century. What impact has this had on the types and amounts of fuel available for wildfire?

2. **Heat** – For a wildfire to start, the fuel need to come into contact with a heat source that allows it to burn. This process is called ignition and can be either naturally-caused or human-triggered. Most natural wildfires are caused by lightning strikes. The rest are caused by human activities, for example, unattended campfires, dropping burning substances such as cigarette butts or errant sparks from vehicle engines.

3. **Oxygen** – Oxygen makes up about 21% of the atmosphere. It is in the air around us and is a necessary ingredient for wildfire to burn. Wind can supply wildfires with additional oxygen.

How is climate expected to change in the Canadian Rockies in the future? How could these changes affect wildfires in the future?

Scientists use historical data, the best available information and computer modeling to predict how the climate in the Canadian Rockies and beyond is likely to change in the coming decades. Climate is predicted to change in the following ways, which will affect wildfires in the future:

1. **Temperature** – Canada has been experiencing a trend of warmer average temperatures, with the largest increases in the winter. Warmer weather quickly dries out grass, brush and trees, as well as soil. This creates more combustible fuel that is more likely to catch fire and to stay burning. In addition to

higher average temperatures, Canada has been experiencing more extreme hot days when compared to the past 30 years, which increases fire potential.

2. **Precipitation** – More precipitation is expected to fall as rain rather than snow in the winter. When less precipitation falls as snow on the mountains in the winter, there is less water to be released during drier summer months. Furthermore, Alberta is expected to experience a decrease in precipitation during the summer months. An overall drier climate increases the risk of wildfire.

3. **Extreme weather events** – Rising temperatures promote the development of more storms capable of producing lightning. Lightning is the source of ignition in more than half of all wildfires. Extreme weather events are also associated with higher winds, which fan the flames of wildfires and make them more challenging to extinguish.

When we put all of these factors together, climate change can be linked to the risk of wildfire, the potential for wildfire to spread, and the length of the wildfire season. While natural wildfire is crucial for the long-term health of forests, species that have adapted to fires may not by able to tolerate the more ***severe*** wildfires that we will continue to experience due to climate change. If we add the predicted impacts of climate change to higher fuel loads and decreased lack of forest diversity owing to decades of fire suppression we are left with a recipe for more frequent and intense forest fires.

These wildfires can significantly disrupt ecosystems, damage property, put people and communities at risk, and create air pollution problems even far away from the source.

DURATION 20-30 minutes

MATERIALS

- Matches (2 different coloured heads, e.g. waterproof and non-waterproof)
- Clay
- Cookie sheet x2 (or more)
- Matches/lighter
- Desk fan, spray bottle (optional)

ACTIVITY – MATCHSTICK FOREST

In this wildfire simulation, students will make predictions and observations about how different variables related to fire suppression, topography, wind and climate change will affect the rate and amount of 'forest' that burns.

1. Draw an 8" x 8" box on a cookie sheet using a sharpie or masking tape. Spread a layer of clay or playdough over the 8 x 8 area. The clay should be thick enough that you can stick a match into it upright.

2. Recreate historic and modern-day lodgepole pine forests by placing matches upright in the clay. For the historic forest place about 20 matches total in well-spaced clumps of ~5 matches. For the modern-day forest cover the entire 8 x 8 area with matches, approximately ½" from each other.

3. Further distinction can be made between the two types of forest by using two different coloured matches (e.g. waterproof and non-waterproof).

4. Ask the students to make predictions about how the different matchstick forests will burn. Students can record both quantitative and qualitative measurements from the experiment (% trees burned, # trees burned, and speed of burn).

5. Repeat the experiment as many times as desired to explore different variables. Ask students to think about how these variables fit into the three parts of the fire triangle and the three key ingredients for destructive wildfires. Ask students to predict how they might worsen with the effects of climate change.

6. *Extension: Demonstrate how different variables (e.g. slope, wind, moisture, density) affect the way the matches catch fire. Add different slope angles by elevating one side of the baking sheet. Use a desk fan to create wind from different directions. Lightly mist the matches using a spray bottle to represent humidity or precipitation. Ask the students to make predictions about how these variables will affect the wildfire and relate them back to the ways that climate change in predicted to affect wildfires in the future.*

This activity has been adapted from "Matchstick Forest Lesson Plan" from the Arizona College of Education. View the original lesson plan, detailed setup, and videos of the historic and modern-day matchstick forests burning with different slope angles at www.coe.arizona.edu/trlessons.

REFERENCES

Bush, E. & Lemmen, D.S. (2019). *Canada's Changing Climate Report.* Government of Canada, Ottawa, ON. 444 p.