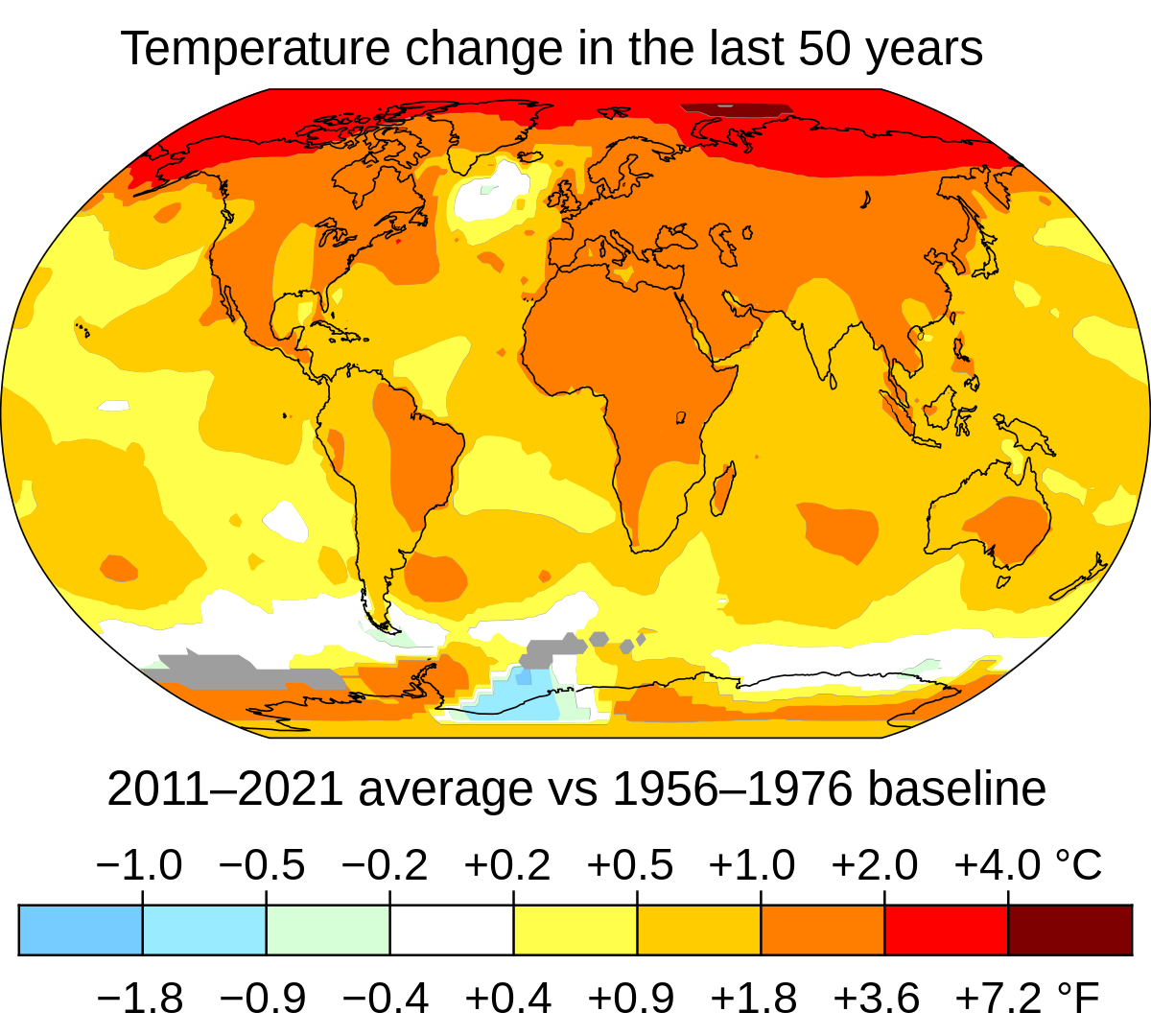
**Biology - Sustainable Ecosystems**

**Note 6 - Human Impacts on Climate Change**

Over the course of Earth’s history, our planet's climate has naturally been changing and responding to the environment. However, human activity has made an impact on how fast our Earth’s climate is changing. According to a 2019 Environment and Climate Change Canada [report](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/Climate-change/pdf/CCCR_FULLREPORT-EN-FINAL.pdf), Canada is warming at twice the average global rate, while the Arctic is warming at three times that rate. We will be exploring why climate change is occurring and how humans are impacting its change.

**What is Climate Change: (**[video](https://www.youtube.com/watch?v=G4H1N_yXBiA))

* Climate Change refers to long-term changes in temperature or weather patterns on Earth
* This can be seen by a change in average temperature or rainfall and even changes in wind direction 
* Global Warming is an increase in the Earth’s average temperature.

Based on the graphic, you can see that there have been global Temperature increases recorded all over the world, with the most profound effect being observed in our Northern hemisphere. Based on our geographical location, we have seen an increase between 1-2 degrees celsius since the baseline temperatures were recorded between 1956-1976, which has had an impact on our ecosystems and environment.

**Indicators of Climate Change**:

The main indicators of climate change are changes to greenhouse gas emissions, temperature, precipitation patterns and changes to sea ice, glacier, permafrost levels in the polar regions. All of these changes have profound effects on the Earth’s environment.

These changes have been observed through increases in the greenhouse gas levels in the atmosphere, increasing average temperatures, decreased frequency of precipitation and the melting of our polar regions.

**Causes of Climate Change:**

Greenhouse Gases trap heat within the atmosphere, which works to keep our planet warm. This is called the Greenhouse Effect. Global warming is happening due to an increase in greenhouse gas levels in the atmosphere, primarily the gas Carbon Dioxide (CO2)

Main causes:

* Emissions from burning fossil fuels (For energy production)
* Clearing down forests (For land use)

**Fossil Fuel Emissions**

Burning fossil fuels such as coal, natural gas and oil has contributed to large amounts of CO2 emissions into our atmosphere. This has contributed to the greenhouse effect that works to warm the Earth. Humans need to burn fossil fuels in order for:

* Electricity and heat production
* Powering engines (cars, airplanes,trains)
* Manufacturing goods (some manufacturing process release CO2 emissions)

**Clearing Forests**

Forests are biotic reservoirs for carbon storage. This is because plants convert carbon dioxide from the atmosphere into glucose (sugar) using photosynthesis. Clearing down forests has had a negative impact on the Earth's ability to regulate carbon dioxide in our atmosphere. When we remove trees from our environment, we lose their potential for converting and storing carbon. This indirectly has contributed to the increase in CO2 levels in the atmosphere.

([Watch to learn about the importance of the Boreal Forest](https://www.youtube.com/watch?v=c3OU--05AdQ&t=3s))

**The Impacts of Climate Change:**

Global warming has had a negative impact on many of our ecosystems and the cycles that regulate them. In Canada, there have been many cases where we have seen the impacts of climate change. These include:

* Changes to our forest ecosystems
* Melting of permafrost and glaciers
* Increased cases of wildfire
* Changes to our water quality

**Impact on Canada’s Boreal Forest** ([video](https://www.youtube.com/watch?v=U_5O_HicIqY))

Canada’s boreal forest is slowly changing due to climate change. Increased temperatures and changes to rainfall patterns have started to transform this important ecosystem.

Trees that are adapted to a colder climate are:

* Spreading north (Temperatures in the arctic are increasing, allowing for growth)
* Dying off in the south (Drought is causing some trees to die)

The increase in temperature and reduction in precipitation frequency has increased the cases of drought in southern portions of this ecosystem. This has caused some of these trees to die off, converting this ecosystem into grasslands. Grassland ecosystems have significantly less potential to store carbon than the traditional Boreal forest.

**Impact on Canada’s Arctic** ([video](https://www.youtube.com/watch?v=R8ynabSmGGs))

Rapid warming of Canada’s Arctic region has caused the thawing of permafrost, also known as snow cover. Under normal climate conditions, this permafrost layer remains frozen throughout the year. In this region, many of the buildings and infrastructure have been built on frozen ground. The melting or thawing of permafrost has caused many of these buildings to collapse, impacting many Indigenous communities living in this area.

**Impact on Canadian Wildfires** ([video](https://www.youtube.com/watch?v=4O-nv7aH-fw))

In the past 5 years, British Columbia has experienced the three worst fire seasons recorded in history. Climate change has led to an increase in wildfire:

* Season length
* Frequency (amount)
* Burned area

Forest fires cause large amounts of carbon dioxide emissions. Trees store carbon, so when they are burned, that carbon is released in the form of CO2. Wildfires are detrimental to climate change as they remove a carbon storing reservoir, while also contributing to the emissions.

**Impact on Canada’s Water Quality** ([video](https://www.youtube.com/watch?v=yqp4k_g6KNU))

Increased water temperatures due to climate change can impact the quality of our water. It can cause:

* Growth of various harmful species of algae
* Decreased oxygen levels in the water

Decreasing oxygen levels in the water reduces the carrying capacity of the ecosystem. Fish need oxygen to survive, therefore by reducing the amounts of oxygen, there is less available oxygen for the fish to breathe. Ultimately, lowering the carry capacity.

**Climate Change: A Social Justice Issue**

Indigenous peoples have respectfully lived with the natural world, and have a deep connection to the land, water, and ecosystems that are central to their cultures, languages, and livelihoods. Through this intergenerational experience and observation, Indigenous peoples were amongst the first to notice climate change and also have critical knowledge for navigating and adapting to it.

Read [this article](https://climateatlas.ca/indigenous-knowledges-and-climate-change) to learn about Indigenous knowledge on climate change

([video](https://www.youtube.com/watch?v=fNkE_QCM3Dk&t=5s)) (additional [video](https://www.youtube.com/watch?v=SjSzx0_7yPY) on the Indigenous response to climate change)

**Learning Checkpoint**

1. Which greenhouse gas is **most responsible** for causing global warming?
2. What are the **two main** human activities that are causing climate change on Earth?
3. Why do humans still require the use of fossil fuels?
4. Why is Canada’s Boreal Forest crucial for regulating climate change?
5. How has climate change impacted Canada’s Boreal Forest?
6. What is the reason behind the thawing of the Arctics permafrost?
7. Why is climate change affecting the wildfires we see in Western Canada?
8. How are Indigenous Communities leading the way for future climate change action?

**Here is a summary of what you learned in this note:**

* Climate Change refers to long-term changes in temperature or weather patterns on Earth. This has been occurring through the process of Global Warming
* Human activity has been the driving force behind global warming, through the emissions of fossil fuel and clearing of forests
* Climate Change has had a profound effect on various cycles that regulate our ecosystems, and these effects may have irreversible consequences

**Homework:**

1. What are the 4 main natural greenhouse gases? (Hint: review - [video](https://www.youtube.com/watch?v=G4H1N_yXBiA&t=2s) or do your own research)
2. Explain the TWO main reasons why wildfires have a negative impact on climate change
3. How has climate change had an impact on the carrying capacity of Canada’s lake ecosystems

Read the following article on: [Indigenous Knowledge and Climate Change](https://climateatlas.ca/indigenous-knowledges-and-climate-change)

1. According to the article, how has colonialism played a role in causing climate change?
2. What is one way that the Indigenous ways of knowing are shaping climate change solutions?

**Answers:**

1. The four main greenhouse gases are: carbon dioxide, methane, nitrous oxide and fluorinated gases. (Water vapour is also a greenhouse gas!)
2. Wildfires (1) release carbon dioxide emissions from the burning of trees (2) removing trees, removes the Earth’s natural ability to store carbon dioxide through photosynthesis.
3. Global warming is increasing water temperatures which has lowered oxygen levels in the lakes. This means there is less oxygen for the species in those lakes, effectively reducing the carrying capacity.
4. Western powers have shaped Canadian society around a particular worldview and set of values, which are different from those held by many Indigenous peoples. This western worldview disrupts people’s connection to the natural world, viewing ecosystems simply as “resources” – which can be owned and controlled.
5. Indigenous knowledge carries ancient and intergenerational wisdom that is flexible, fluid, and adaptive as it evolves through relationships with the land and other beings. This knowledge evolves from and is responsive to the natural world, which makes it ideal for developing and advancing meaningful climate solutions.