Empowering Youth through Environmental Storytelling

Climate change 101:
What is it and why is it happening?

Fossil fuels, greenhouse gases, and temperature increase

Co-funded by the European Union

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With special thanks to Enock Wanderema, Ruth Jepkemoi Singen, and Juan Pablo Arellano for their expertise throughout, and to all pilot school educators and students for their invaluable feedback.

The Empowering Youth through Environmental Storytelling is a collaboration between The Environment and Human Rights Academy (TEHRA), News Decoder and the Young Educators European Association (YEEA).

The purpose of these educational materials is to help young people understand the climate crisis on a systems level through engaging with the topics and foster agency through the skills and techniques of journalism.

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Published: 3rd October 2025

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Learning objectives

1. **Understand the physical drivers of the climate system** and their interconnections with human activities, and analyze their impacts on natural and human systems
2. **Communicate complex climate-related topics to a young audience**

Unit guide

We recommend that you begin your class with the Opening Activity, to get an understanding of what your students already know and to get them thinking of key words and concepts within the climate crisis.

The Project Instructions can be shown to students before going through the Learn section, to have them understand what their task will be following the text.

Optional Activities are included in case you wish to spend more time on this unit, while Deeper Dives provide information on topics that may suit your class or interest your students.

Here is the link to the **lesson slides**

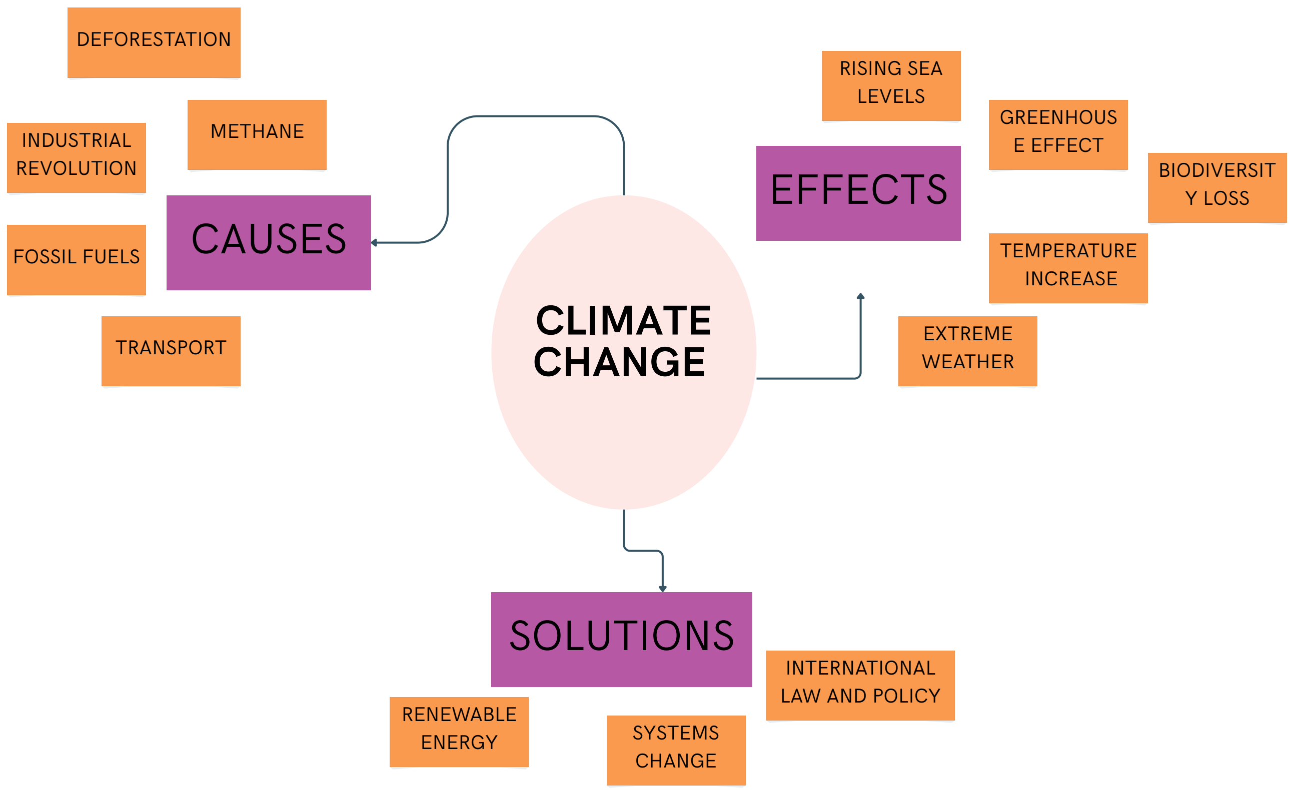
Draw a mind map

What comes to mind when you think about climate change?
(5 minutes)

Climate change is the long-term change in temperature and weather patterns as a result of human activity on Earth. What words and concepts come to mind when you hear the term "climate change"?

Either draw individually or together on the board.
Write words, ideas, or draw symbols connected to climate change.
Add what is missing to your map while going through the concepts in the LEARN section together.

Here is an example:



Storytelling

Telling the story of the climate crisis

Narrating the story of climate change, you can start to see climate change as a narrative — with causes, consequences, and human impact — and begin to see yourselves as climate storytellers.

When we talk about storytelling, we are talking about the art of telling stories so that an audience understands a given topic better. '

The elements of a story:

Characters: Who are the actors and stakeholders? Who is causing greenhouse gas emissions, and who is being impacted by climate change? Think: fossil fuel companies, governments, youth, local communities, ecosystems.

Setting: Where is the crisis playing out?

Conflict: What are the stakes? (What could be lost should the crisis continue?)

Turning points: What could change the course? What examples do you know of that are working to address climate change?

Let's zoom out for a second, and give the context of climate change – the background on why all the stories of people doing something about the climate are interesting and relevant.

Your task: write an explainer

Write the story of the climate crisis (max 300-400 words) for an audience that is younger than you.

After going through the class, note down the **who** (stakeholders/actors), **what** (what's at stake), **when**, **where** (setting), and **why** (why is temperature increasing) of climate change.

Then turn this into a few paragraphs as if you're writing an explainer for a news site, a video script, or a short podcast. Be creative with metaphors, expression, and format, but don't include your own opinion.

Start with the hook: e.g "If governments and other powerful actors don't act fast, humans everywhere could soon be living on a planet that cannot keep itself stable". Come up with your own hook. Why is this a big story? Why should people care?

Include the background: How the crisis began, who is affected, what is responsible, and what might happen next. Turn your final product into a news article, a video, or a podcast.

Modern humans, *Homo Sapiens*, have been around for 300,000 years. Yet in this short amount of time in Earth's 4.5 billion years' existence, we have managed to deeply impact the way that Earth looks and functions.

1. Why is it a crisis?

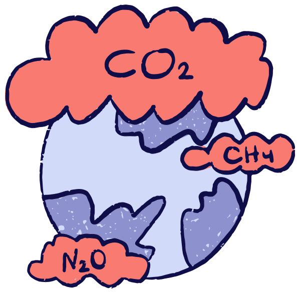
Why are we referring to climate change and climate injustice issues as 'crises'? As this section will outline, the impacts on the global climate, people and biodiversity are profound and accelerating. To avoid or limit these impacts, action from across the globe, but especially from those most responsible, must happen now.

2. What is driving these impacts?

In the simplest terms, the impacts on climate, people, and biodiversity are brought about by activities such as burning of fossil fuels (like oil, coal and gas), and using natural resources (which includes fossil fuels, but also land, water, minerals, animals, wood, food we grow, etc.).

These activities are used to power, feed and house our everyday lives and cause the release of greenhouse gases such as carbon dioxide (CO_2) into the atmosphere. CO_2 is the biggest contributor to global warming. Land and ocean carbon sinks absorb around 55% of annual CO_2 emissions,[1] out of which around 31% is absorbed by the ocean[2].

However, the amount of CO_2 emitted is so large that the other 44% still has disastrous effects on Earth's functioning and the global climate, people and biodiversity.



3. CO_2

3.1. Why is CO2 important for climate change?

The concentration of CO_2 in the atmosphere is one of the most important metrics in the context of climate change. CO_2 is the main greenhouse gas released with the burning of fossil fuels and the main cause of increased global average temperatures and changes to the global climate.

CO_2 can stay in the atmosphere for hundreds to thousands of years. Even though some of it is absorbed quickly by oceans and plants, a significant portion remains in the atmosphere for centuries, continuing to trap heat and affect the climate long after it's been emitted. That's why today's emissions will impact future generations.

CO_2 concentrations and emissions are also used as a more general indicator of how much a certain activity, country or group of people is contributing to the causes of the climate crisis.

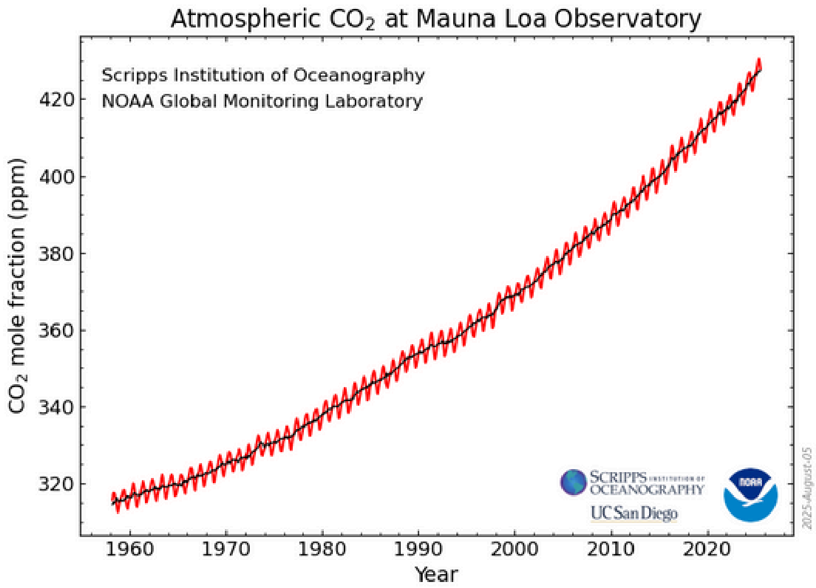


Figure 1: Keeling Curve, showing atmospheric CO_2 concentrations between 1958 and the present day as measured at the Mauna Loa Observatory, Hawaii. Graph from NOAA.[3]

3.2. How do we measure CO2 increase?

The rapid increase of CO_2 emissions is shown in Figure 1 above. The data has been taken from an observatory in Hawaii which has been measuring atmospheric CO_2 emissions with very high precision since 1958 (Figure 1).

Atmospheric CO_2 concentrations are most often measured in and expressed as parts per million (or ppm). Parts per million is a unit of measurement used to describe the concentration of something in air, water, or other mixtures.

When we say CO_2 levels are 420 ppm, it means that for every one million molecules of air, 420 of them are carbon dioxide molecules.

3.3. How does CO2 warm the atmosphere?

Greenhouse gases are a naturally occurring part of our atmosphere. Thanks to the greenhouse gas effect, which traps heat in the atmosphere, pre-industrial global average temperatures are at a very liveable 14˚C. Without these gases and their trapping of heat, Earth would be at a very cold average -17˚C.[4]

Greenhouse gases are therefore essential for the survival of all living beings. However, the exact amount of greenhouse gases present in the atmosphere is key.

The pre-industrial global average temperature (so up to around 1750) of 14˚C was kept in place by CO_2 concentrations of around 280 ppm (parts per million). This pre-industrial baseline is important as it allows us to measure human impact against it, and is often referred to as the baseline when making comparisons. Humans have impacted the world before industrialisation, but not at the scale and speed enabled by industrial progress.

However, as of April 24th 2024, CO_2 concentrations have reached 428.42 ppm.[5] You need to go back at least 800,000 years to find atmospheric CO_2 levels of 300 ppm,[6] and over 3 million years for levels of 400 ppm.[7] However, it is not just the amount of CO_2 that has been added to the atmosphere that is dangerous, but the speed at which it has been doing so.

The below Figure 2 shows CO_2 concentrations from the last 800,000 years of Earth's history. We can see that CO_2 concentrations do fluctuate with natural cycles. The current anthropogenic (caused by humans) rise in CO_2 is clearly faster and bigger than any natural cycle.

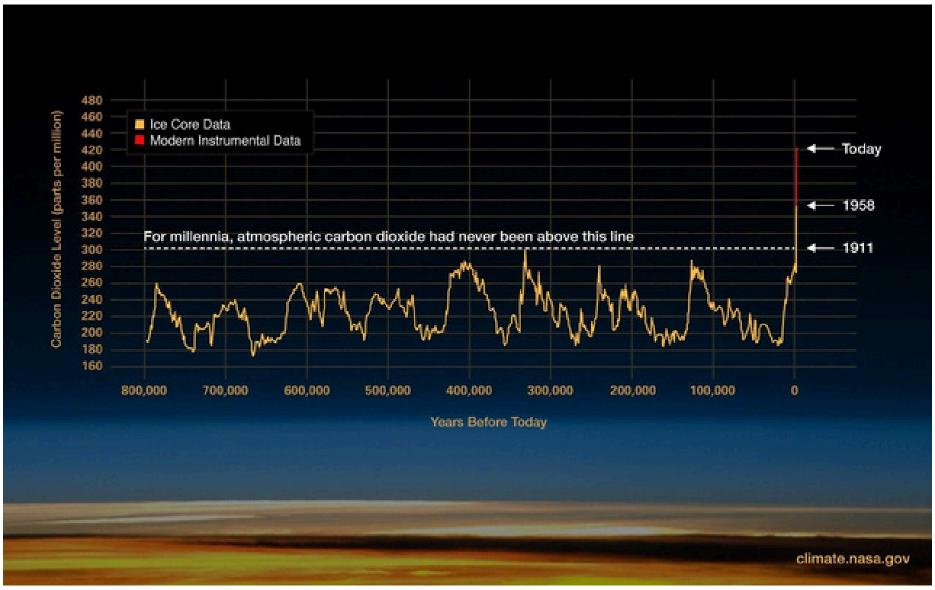


Figure 2: CO_2 concentrations from the last 800,000 years. Data taken from both ice core measurements and from modern instruments, the latter of which are the same measurements seen in the Keeling curve. Graph from NASA.[8]

Our emissions have severely altered the context within which all systems and processes on Earth (including climate, people and biodiversity) are able to function. This dramatic rise in CO_2 causes more heat to be trapped in the atmosphere, meaning global average temperatures rise along with CO_2. Even though the relationship between CO_2 and temperature is well established, there are a couple of important points to note.

First, as it takes a while for the released CO_2 to start trapping heat in the atmosphere and for this heat to build up, there is a delay or lag effect between emitting a certain amount of CO_2 and being able to observe its warming effects.

Therefore, it's important to question what is meant by a specific level of global warming — is it warming we've already experienced, or warming that is expected due to past emissions? As of July 2024, the Earth's atmospheric temperature has warmed by about 1.17˚C compared to pre-industrial times, but enough CO_2 has already been emitted to eventually cause around 1.4˚C of warming.

Second, it is important to note that the Earth is a system made up of many interconnected, smaller systems. These smaller systems include ecosystems, patterns of movement of air and water, chemical processes in the atmosphere, the water cycle, and so on.

The complex nature of Earth's systems and the many ways in which they interact makes it very difficult to predict exactly how much Earth will warm due to a specific increase in CO_2. However, it is clear that even current levels of warming are already having a profound impact on the climate, people and biodiversity globally.

4. Temperature

It's important to note that Earth's climate has changed before: there have been ice ages, warm periods, and natural shifts over millions of years. But what's different now is the speed of change.

The rate at which temperatures are rising today is unprecedented in human history. Changes that used to take thousands of years are now happening in just decades. This rapid shift makes it much harder for ecosystems, wildlife, and human societies to adapt in time.

When hearing or reading about global warming, you will most likely encounter the use of 1.5˚C and 2˚C warming. What does this mean?

A global temperature increase of 1.5˚C or 2˚C above pre-industrial levels means that the average atmospheric temperature increases by 1.5˚C or 2˚C compared to just before humans started emitting large amounts of CO_2 with the start of industrialisation (around 1750). Just as with CO_2 levels, a pre-industrial baseline is commonly used in the context of quantifying global warming.

To help understand the effect of a higher temperature on Earth's system, we can compare Earth to a human body. If your body temperature increases by 'only' 2˚C from 37˚C to 39˚C, you have a fever and you will not be able to function properly.

Raising the temperature doesn't just make everything a little warmer: key functions, systems and organs will stop functioning properly as they are simply not designed to work under such circumstances.

Similarly, when global average atmospheric temperature increases by 2˚C, different systems start to break down as temperature affects the basic parameters of their functions and any key drivers or factors.

Apart from their global political relevance, this is one of the reasons why 1.5˚C and 2˚C warming are often used as the amount to which warming should be limited. Although it should be noted that climate scientists were already warning that 1˚C was a dangerous amount.

Allowing warming to go beyond 2˚C is extremely dangerous for the functioning of many parts of Earth's systems.

5. What can be expected at various levels of warming?

Below are a few examples of what can happen at a certain level of global warming. The effects of warming are not limited to the examples below, as these effects often have knock-on effects for other systems and processes, and warming affects many systems across the globe. As global warming intensifies, its effects on the climate, people and biodiversity become more widespread and dangerous too.

5.1. What is happening at the current 1.1˚C increase?

At a current warming of 1.1˚C, we are already seeing an increase in extreme weather and climate events, such as extreme heat, fires, drought, heavy precipitation and floods. This is already strongly impacting the health and livelihood of humans, both terrestrial and aquatic ecosystems (and thereby millions of plant and animal species), water and food security, settlements, infrastructure, and many more systems and processes on Earth [9] .

Sea-level rise is one of the consequences of climate change. The picture above is an art piece by Jason Decaires Taylor on sea-level rise. Sea-level rise is already causing many problems to coastal communities, especially small island states.

You can check out this StoryMap to see how climate change is forcing migration on people from Kiribati, a small island state in the South Pacific which is extremely vulnerable to climate change.

5.2 What could happen at a 2˚C increase?

At 2˚C warming, we can expect many mountain glaciers to have completely melted[10]. This will have disastrous effects for those living in mountainous regions. Humans, animals and plants alike rely on these glaciers as their main (and in many cases only) source of fresh water. In spring and summer, seasonal glacier melt feeds many rivers and streams, and if glaciers disappear so will many of these water sources. Fresh water scarcity will pose an especially big threat in Central Asia, South Asia, western South America and southwestern North America [11] .

These areas at higher risk are in countries that emit lower levels of CO_2 and which therefore have little responsibility for causing the climatic changes which led to glacial melt.

The shortage of fresh water will not only affect those living in mountainous areas. It will also affect around 2 billion people who live in lowlands around mountains globally and rely on the same mountain glacier fresh water [12].

Melting glaciers also contribute to sea level rise. Although sea level rise in the long term will be driven mainly by the melting of much bigger ice sheets, mountain glaciers are currently the main contributor [13].

The melting of glaciers therefore also has global impacts, as globally 267 million people live within 2 metres above sea level and so are at risk of rising sea levels[14]. The vast majority of these people live in countries that emit lower levels of CO_2.

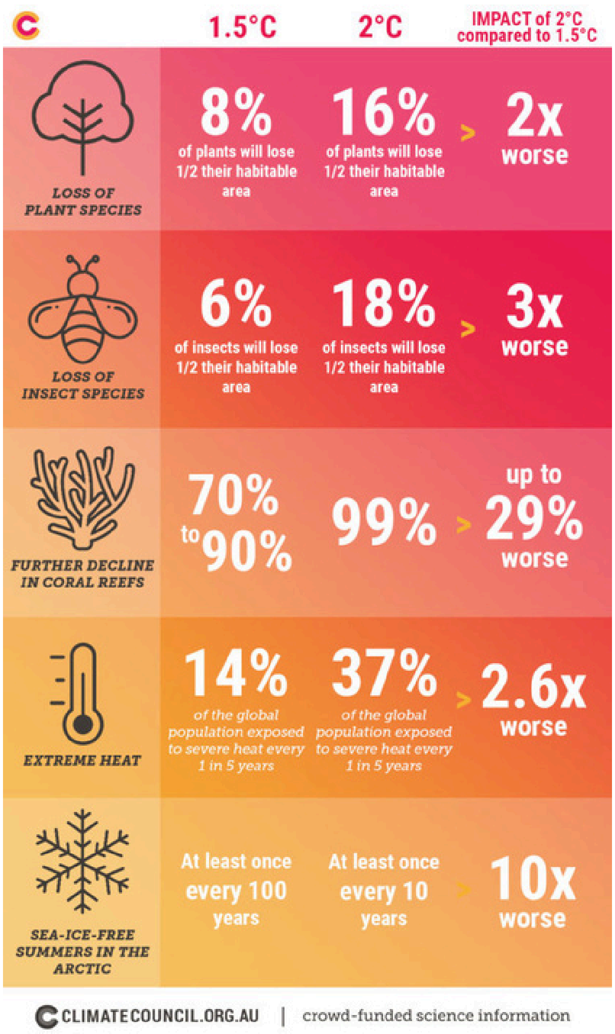


Figure 3: Differences in impacts of climate change between 1˚C and 2˚C warming. (Source: Climatecouncil.org.au, Infographic: The difference between 1.5 and 2 degrees warming)

5.3. Comparisons in impacts of 1.5˚ and 2˚C warming

Even half degree of warming brings more unprecedented challenges.

For example, with 1.5˚C warming there will be a 100% increase in flood risk, while with 2˚C the increase is projected at 170%[15]. Critical ecosystems can be completely crippled with a half degree difference. While 70% of coral reefs are projected to bleach as a response to increasing ocean temperatures, virtually all of them will be lost by 2100. Ice-free summers could occur in the Arctic every 100 years with 1.5˚C.

With 2˚C warming, ice-free summers are projected to happen every 10 years, making it a 10 times difference[16]. These examples show that there is non-linearity with increases of risk as warming continues. This is partly because of reinforcing factors and feedback loops, a topic explained in our Unit on Tipping Points.

5.4. Possible consequences of a 3˚C and 4˚C warmer planet

At around 3˚C of warming, rising temperatures could disrupt major atmospheric and oceanic circulation patterns, such as monsoons — seasonal wind systems that drive rainfall and regulate water availability over large parts of the world[17]. Changes to these vital systems could lead to even larger shifts in rainfall patterns, prolonged droughts, and intensified storms.

Illustration: Betje Ton

At 4˚C, entire ecosystems could be pushed beyond their limits, with forests and other natural carbon sinks no longer able to absorb CO_2 as they do today. Instead, they could start releasing large amounts of carbon, because of the rise in forest fires and tree die-off, further accelerating global warming[18]. If we continue burning fossil fuels and the 'business as usual' behaviour, these scenarios could occur by 2080 or 2100. This seems far, but 2080s are as close as the 1960s are — and you probably know someone who was born in the 60s.

The systems affected by global warming and climate change are just a few select examples of what we can expect with increasing degrees of warming. Countless other systems, including more directly human-related ones, such as agricultural systems, will be affected too.

It is clear that with higher levels of global warming, the effects on climate, biodiversity and people become more severe. This severity is due to both the intensity of individual effects increasing as well as more systems breaking down at warmer temperatures. The Unit on Tipping Points will explore the mechanisms of how these systems are affected and can even affect each other.

If you would like to see a visual representation of how ice melts in the Arctic, sea level rise, ocean warming and other climate change effects are manifesting, and are projected to unfold, visit NASA's website.

Roleplay: Youth address the UN

This is an activity *best suited for older students.*

Skills: speech writing, solutions-oriented thinking
Time: depends on class size, but likely 20-30 minutes
Type: in groups

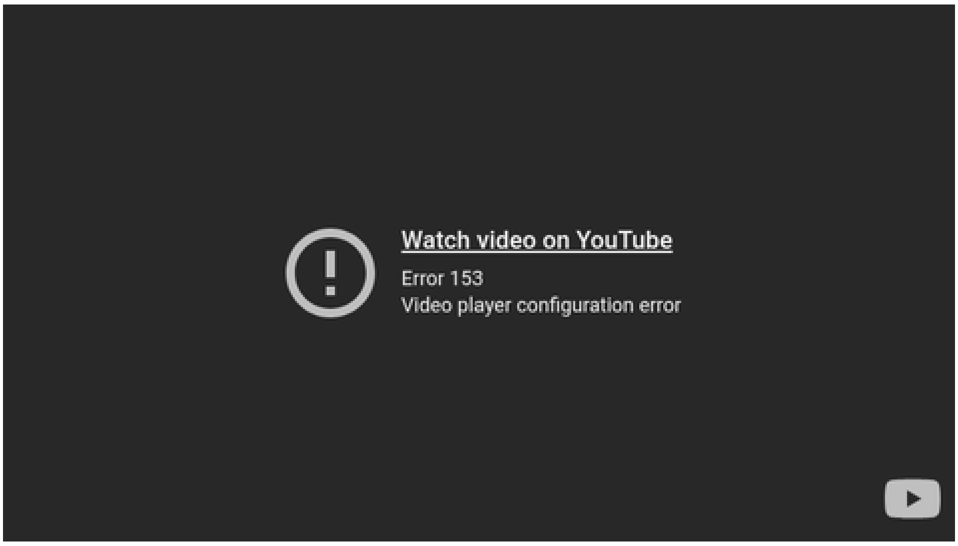
First, to inspire your students to do the following activity, play this speech of Mia Mottley (from 03:58), the Prime Minister of Barbados at COP26.

After listening to the speech, tell students that they will engage in a role-play activity:

You've just been invited to speak at the United Nations in New York because of your deep concern about climate change and commitment to climate justice. The world is listening and this is your chance to influence real change.

10 minutes: In groups of 4 (or adjust group size depending on your class) think of a 5-minute speech that raises your concerns and provides at least 2 solutions. How is the climate crisis playing out in your country? Which industries or groups of people are being impacted? How do you think we should address this?

5 minutes per group: Present your speech to the rest of the class. While one group is presenting to the UN General Assembly, the rest of the class acts as country delegates, who can question arguments of the presenters or the information provided (evidence-based arguments only).



Temperature perspective: the Ice Age

This activity puts temperature increase into perspective.

Ask students: Now that you have gained some insight on how much each degree change impacts our Earth systems, would you like to guess how much colder average temperatures on Earth were during the last Ice Age, around 20,000 years ago? If the average pre-industrial temperature on Earth is currently 14˚C, what was the average during the Ice Age?

Answer: Global temperatures were about 6˚C cooler than today, at an average of around 8˚C. In just 150 years, human activity has already caused at least 1.1˚C of warming, which is 18% of the total warming that took place over 10,000 years at the end of the last Ice Age.

Under intermediate, high and very high emissions scenarios, where limited or no action is taken on climate change, our planet will reach at least 3˚C warming by 2100[19]. This would represent around half of the difference in temperature between pre-industrial temperatures and the Ice Age.

Discuss:

Can you imagine how different the world looked during the last Ice Age?

Can you imagine how our world would look at 2˚ or 3˚C warming?

The Greenhouse Gas Game

This *is a game for younger students.*

If you have a group of younger students, and an indoor or outdoor space that can accommodate all your students to participate in a game that physically mimics the greenhouse gas effect, look up the Greenhouse Gas Game here.

Ocean acidification

Use this text and diagram if there is interest/capacity to discuss the effects of climate change on oceans.

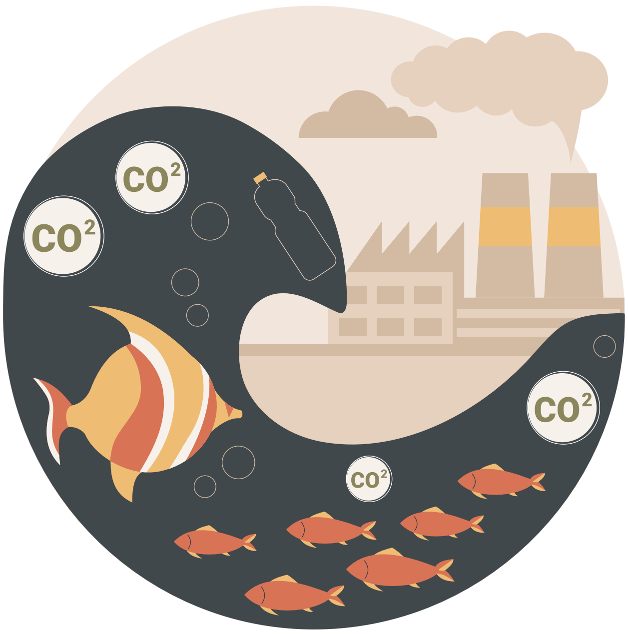
Ocean absorption of CO_2 emissions doesn't come without a cost. When the ocean absorbs carbon dioxide from the atmosphere, a chemical reaction happens.

The CO_2 mixes with seawater and forms a weak acid called carbonic acid. This causes the ocean to become more acidic, which is not directly dangerous to humans, but enough to cause problems for marine life.

When marine life is affected, so are the ecosystem services (like food provision or wave buffering) that humans get from marine ecosystems, thereby indirectly impacting humans as well.

Why does this matter?

- It makes it harder for shellfish, corals, and some plankton to build their shells and skeletons, which are made of calcium carbonate.
- Weaker shells mean these creatures can die off more easily, affecting entire marine food chains.
- Coral reefs, vital for marine biodiversity, are especially at risk, as acidification weakens their structure.



The Holocene is a stable climate epoch, but are we entering a new one: the Anthropocene?

Use this text in your class if there is an interest/capacity for discussing geological epochs.

Earth is about 4.6 billion years old. Over that time, it has gone through significant changes such as ice ages, mass extinction events, or the rise and fall of different species such as the dinosaurs.

To make sense of the Earth's long and complex history, scientists use geological timescales. This timescale is like a giant calendar for Earth's past. It's divided into eons, eras, periods, and epochs, each marked by big changes in the planet's climate, life forms, or geology.

Scientists divide these periods by looking at big changes noted in rocks and fossils, which can show us approximately when big changes happened. For example, the Mesozoic Era was the age of dinosaurs, while the Cenozoic Era, where we are now, is often called the age of mammals.

The epoch we live in, called the Holocene and which belongs to the Cenozoic Era, has been marked by a remarkably stable climate.

This geological epoch began about 11,700 years ago, after the last Ice Age. Many scientists believe that this long period of climate stability made it possible for human civilizations to grow and flourish.

With predictable seasons, steady temperatures, and reliable rainfall patterns, people were able to develop agriculture, build settlements, and live in large societies. This is an important example of how deeply human life depends on a stable climate. The ecosystems we rely on have all developed in this stable period.

Many scientists have argued that we have entered a new geological epoch, the Anthropocene, because we would be able to trace human impact millions of years from now.

Some markers indicating the start of the Anthropocene that have been suggested include radioactive isotopes from nuclear weapons, plastic pollution, heavy metals and chemical pollution, altered nitrogen and phosphorus cycles, mass species extinction patterns and presence of invasive species, as well as a marked rise in CO_2 emissions.

The age of the humans, or the Anthropocene, is not recognised as an official epoch yet, but is gaining traction.

You can watch the below video which goes into more detail of a case study.

Ecosystem disruption at 3˚C and 4˚C

Use this text if there is a capacity/interest to dive into the Earth's systems at play.

Disruption of monsoon systems (3˚C warming)

The climate on our Earth is heavily shaped by large-scale atmospheric circulation systems which redistribute heat and moisture across continents.

Monsoons — large-scale seasonal wind and rain systems — are crucial for providing rainfall to entire regions.

In Western Africa and the Sahel, the West African monsoon supports agriculture, water supply, and livelihoods for millions. This system is already showing strain due to climate change, increasing the frequency and severity of droughts.

At 3˚C warming, this system is projected to become highly erratic, leading to a dangerous combination of longer droughts and more intense rainfall. This could severely threaten food and water security, increasing the vulnerability of communities across the region.

Collapse of the boreal forest carbon sink (4˚C warming)

Boreal forests, spanning Canada, Russia, and Scandinavia, store about one third of all terrestrial carbon, mostly in soils, peat, and trees[20].

With continued warming towards 4˚C, these forests will face extreme heat, droughts, fires, and pest outbreaks, impairing their ability to absorb carbon. At current ~1˚C warming, boreal forests are already undergoing substantial changes, with observed increases in wildfires, tree mortality and insect pests and a general pole-ward shift[21].

In Russian Siberia, burnt boreal forest area increased by around 50% between 1996 and 2015[22]. North American boreal forests have already released more CO2 between 1986 and 2016[23] than they have captured CO2.

At 4˚C warming, boreal forests would both stop absorbing a large proportion of CO2 emissions, but also release vast amounts of additional CO2 into the atmosphere through forest fires, amplifying existing global warming[24].

Endnotes

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