Climate Change

Teachers notes

These lesson objectives are intended for the **KS3 Geography curriculum**, specifically focusing on the topic of **weather and climate**. However, the content can be tailored to suit different key stages, accommodating varying levels of prior knowledge and understanding.

The lesson on Climate Change can be worked through at any pace, and it can be split into multiple lessons if needed. This flexibility allows you to adjust the flow based on the class's understanding and time constraints. If some sections require more in-depth exploration, feel free to extend them over additional lessons to ensure students fully grasp the concepts before moving on.

The worksheets can be filled in during the lesson, as homework, or in individual sections, depending on the pace of the lesson.

Lesson Aim:
To define climate change, explain its natural and human causes, understand the role of greenhouse gases in global warming, and evaluate evidence for climate change, including the impact of the Industrial Revolution.

Lesson Objectives:
- To define climate change and explain the natural and human causes.
- Explain the greenhouse effect and its role in global warming, including how key greenhouse gases contribute to climate change.
- Understand the impact of the Industrial Revolution in driving climate change.
- Evaluate evidence for climate change.

Assumed Prior knowledge:
- An understanding of the factors influencing climate, such as latitude, altitude, ocean currents, and continentality.
- A brief understanding of climate change, including the basic concept that the Earth's climate can change over time and that human activities may play a role in this process.

Resources:
- Lesson 6 worksheet
- Mini whiteboards and pen
- Colouring pencils

All the blank worksheets for this lesson can be found as a separate download within the 'Lesson 6' page of The Flood Hub KS3 Geography Weather and Climate Learning section. The answers for the worksheets can be found at the end of this document.

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Notes for Each Slide:
Teachers should decide what students should copy into their workbooks. While most content is provided on the worksheet, any additional information can be recorded in the workbooks.

Slide 1 - Learning Objectives
- Slide containing the aims and objectives of the lesson. Read these to the class to clarify the focus and expectations for the session.

Slide 2 - Starter Activity
- Have whiteboards and pens ready for each student.
- Ask students to write down as many words or phrases as they can think of when they hear the term "climate change."
- Encourage them to consider the images as clues—think about industrial activities, environmental impacts, and global changes.
- Look for terms such as "global warming," "carbon emissions," "deforestation," "greenhouse gases," and "melting ice caps."

Slide 3- Climate Change Mind Map
- After a few minutes, ask for volunteers to share their words and write them on the board to create a mind map of ideas.

Slide 4- Climate Change Definition
- Read the definition aloud: "Climate change refers to long-term changes in global or regional climate patterns, often linked to an increase in average global temperatures."
- Explain that global temperatures are 1˚C higher than 100 years ago. Emphasise that 1˚C may not feel like much day-to-day, but it leads to significant effects like melting ice caps, rising sea levels, and changes in weather patterns.
- Prompt: What changes might we notice in our environment if the temperature rises by just 1˚C over time? Encourage students to think about impacts on weather, wildlife, and human activities.

Slide 5 - Climate Change Definition
- **Task:** Ask the students to note down the definition in the space on their worksheets.

Slide 6 - Causes of Climate Change
- Explain the natural causes of climate change: Climate change occurs naturally through events like volcanic eruptions, changes in the Earth's orbit, and variations in the Sun's energy.
- Introduce human causes: In recent years, global temperatures have increased more rapidly due to human activities, particularly the burning of fossil fuels (coal, oil, and gas), which release greenhouse gases into the atmosphere.
- Highlight the shift: Emphasise that while climate change has always been a natural process, the current rate of change is much faster and largely driven by human actions.

Slide 7 - Human vs Natural Causes Activity
- Ask students to get two colours (e.g., one for natural causes and one for human causes).
- On their worksheets, students will categorise the causes of climate change into natural and human causes.

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Slide 8 - Human vs Natural Causes Answers

- Review the categorisation of natural and human causes as a class.
  - Natural Causes:
    - Volcanic Eruptions: Release large amounts of CO_2 and other gases.
    - Earth's Orbit: Changes in the Earth's position relative to the Sun affect climate over long periods.
    - Solar Energy Variations: Fluctuations in the Sun's energy output influence the Earth's temperature.
  - Human Causes:
    - Burning Fossil Fuels: Releases CO_2 and greenhouse gases, trapping heat.
    - Deforestation: Reduces the Earth's ability to absorb CO_2.
    - Agriculture: Livestock and fertilisers release methane and nitrous oxide, potent greenhouse gases.
- Ask students if they have any questions or if there are any causes they found confusing.

Slide 9 - Industrial Revolution

- Explain the Industrial Revolution: Began in 1750, with rapid technological advancements, factories, and widespread use of fossil fuels (coal, oil, gas).
- Link to Climate Change: Burning fossil fuels released CO_2, and deforestation reduced CO_2 absorption, causing a sharp rise in global temperatures.
- **Task:** Students to write down the key term and date on their worksheet (The industrial revolution, 1750)

Slide 10 - The Problem

- Explain the Problem: Human activities have significantly increased greenhouse gas levels, trapping too much heat in the atmosphere and causing global warming.
- Talk Through the Pictures:
  - Deforestation: Cutting down forests reduces CO_2 absorption.
  - Air Travel: Planes emit large amounts of CO_2.
  - Meat Production: Livestock releases methane, a potent greenhouse gas.
  - Car: Vehicles burn fossil fuels, releasing CO_2.
  - Factory: Factories emit greenhouse gases during production.
  - Food Waste: Decomposing food in landfills produces methane.
  - Electricity: Energy production (coal, gas) generates CO_2.
  - Rising Populations: More people increase energy demand, deforestation, and emissions.
- Discussion: Ask students how these activities connect to their everyday lives and how they could reduce their impact.

Slide 11 - Students Impact

- **Task:** Write down ways your lifestyle produces greenhouse gases in he space on their worksheet.
- Prompts to Help Students:
  - Travel: Do you travel by car, bus, or plane?
  - Food: Do you eat meat or waste food?
  - Energy Use: How often do you leave lights or devices on?
  - Shopping: Do you buy new clothes or items regularly?
  - Waste: How much rubbish do you throw away?
- Remind students there are no right or wrong answers, this is about understanding their impact.

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Slide 12 - Greenhouse Gases

- Start by defining greenhouse gases as those that trap heat in the atmosphere, keeping the Earth warm enough to support life.
- Emphasise that some greenhouse gases are natural and essential for life on Earth, but too many can cause global warming.
- Go Through the Different Types:
  - Carbon Dioxide (CO_2): From burning fossil fuels, deforestation, and industry.
  - Water Vapour (H_2O): A natural gas that increases with rising temperatures and amplifies the greenhouse effect.
  - Methane (CH_4): Released by agriculture (e.g. livestock), landfills, and fossil fuel extraction.
  - Nitrous Oxide (N_2O): From fertilisers, industrial processes, and burning fossil fuels.
  - Fluorinated Gases: Man-made gases used in refrigeration and industry, very powerful but less common.

Slide 13 - Greenhouse Gasses Activity

- **Task:** Either as a class or individually, match the name of the greenhouse gas to its chemical symbol and its description. Record the answers on the worksheet.
- The answers are either on the next slide or in the teacher's version of the worksheet at the end of the notes.

Slide 14 - Greenhouse Gasses Answers

- Once the task is complete, go through the answers together to ensure everyone has a correct understanding.

Slide 15 - Greenhouse Effect

- Explain the key points of the greenhouse effect, highlighting how it supports life on Earth and the role of greenhouse gases in trapping heat.
- Use the diagram on the slide to guide your explanation, ensuring students understand each step of the process.

Slide 16 - Greenhouse Effect Worksheet

- Task: Explain in their own words why the greenhouse effect is necessary for life on Earth.
- Fill in the blanks to complete the process of how the greenhouse effect works.
- Circulate the room to support students and clarify any points if needed. Once everyone is finished, review the answers as a class to ensure understanding.

Slide 17 - Greenhouse Effect

- Use the diagram on the slide to explain how greenhouse gases function in the Earth's atmosphere:
  - Highlight that the Sun's energy penetrates through the atmosphere as light and heat, warming the Earth's surface.
  - Explain that some of this heat is absorbed by the atmosphere to keep the Earth warm enough for life.
  - Emphasise that while some heat escapes back into space, a portion becomes trapped by greenhouse gases like carbon dioxide, methane, and water vapour.
  - This trapped heat maintains the Earth's temperature, but an excess of greenhouse gases leads to more heat being trapped, contributing to global warming.

Slide 18 - Labelling Greenhouse Effect

- **Task:** Observe the diagram on the slide and write down the key points about the greenhouse effect on their worksheets.

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Slide 19 - Evidence for Climate Change, Temperature Records

- Introduce the idea that scientists rely on various types of evidence to study climate change and understand how Earth's climate is shifting over time.
- Draw the class's attention to the graph showing global average temperature changes.
- Ask students: What do you notice about the trend in global temperatures? Encourage them to identify key patterns, such as the steady increase in temperatures compared to the mid-20th century, reaching nearly +1˚C above the average.
- Guide the discussion:
- Highlight that this upward trend is a clear indicator of global warming.

Slide 20 - Temperature Records

- Explain to the students that temperature records are one of the most important types of evidence scientists use to track climate change.
- Key Points to Cover:
  - Global records since 1850: While older records are less precise, modern temperature measurements from the last 50 years are highly accurate.
  - What they reveal: A steady rise in global temperatures, with the last few decades featuring some of the hottest years ever recorded. Emphasise the increase of about 1˚C above pre-industrial levels.
  - Why they matter: Highlight the importance of understanding long-term trends, the connection to human activities (e.g., greenhouse gas emissions), and how these records provide real-time data for monitoring ongoing climate change.

Slide 21 - Temperature Records Task

- **Task:** Ask the students to complete the section on their worksheets where they explain what temperature records show and why they are important.

Slide 22 - Tree Rings

- Explain that tree rings provide evidence of past climate conditions, with thicker rings indicating favourable years (warm and wet) and thinner rings showing harsher conditions (cold or dry).
- By counting the rings, scientists determine a tree's age and analyse the climate conditions during each year of its life.
- This method helps track climate data for up to 10,000 years, offering valuable insights into long-term climate patterns.

Slide 23 - Tree Rings

- Read the information provided on the slide to the class, explaining why tree rings are useful for studying past climates.
- Highlight that tree rings allow scientists to uncover natural climate records from thousands of years ago, helping us identify long-term patterns and compare them to the rapid changes caused by human activity today.

Slide 24 - Tree Rings Activity

- **Task:** Instruct the students to complete the task on their worksheet. Ask them to:
  - Explain what thinner and thicker tree rings indicate.
  - Write down what tree rings can reveal about past climates.
  - Note why tree rings are helpful in understanding climate change.

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Slide 25 - Ice Cores

- Explain that ice cores provide a snapshot of past climate conditions, preserved in layers of ice that have built up over thousands of years. Each layer represents a year, capturing tiny air bubbles that contain gases like CO_2 and methane, which offer insights into atmospheric composition and temperatures from that time. Some ice cores even contain fossils or sediments, adding more clues about past environments. This makes ice cores a vital source of data for studying long-term climate change.

Slide 26 - Ice Cores

- Read the information on the slide, then emphasise the significance of ice cores. Explain how they provide an 800,000-year record of past climate data, which helps us understand natural climate cycles and the recent rapid increase in greenhouse gases since the Industrial Revolution. Highlight that this data is key in comparing past climate changes to current global warming trends.

Slide 27 - Pollen Analysis

- Explain that plant pollen, preserved in sediment layers, helps scientists understand past climates. Different plants grow in different climates, so studying ancient pollen gives clues about temperature and conditions at various times.
- Point out that tropical plants suggest warmer periods, while tundra or boreal species indicate colder times.
- This provides valuable information about climate shifts over long periods.
- **Task:** Fill the blanks on the worksheet with words from the board.

Slide 28 - Ice cover

- Explain that ice cover, including ice sheets, glaciers, and sea ice, is an important indicator of climate change.
- When temperatures rise, ice shrinks, which leads to less sunlight being reflected away (the albedo effect), speeding up warming.
- Show how changes in ice size and thickness are visual evidence of the Earth's warming climate.
- **Task:** Fill the blanks on the worksheet with words from the board.

Slide 29 - Plenary

- Encourage students to think critically about the broader implications of climate change. Ask them to consider how climate change might affect their daily lives, the environment, or the future of the planet.

Slide 30 - Homework Task

Read the homework task aloud to the class. Explain that students will demonstrate their understanding of the evidence for climate change by choosing one of the following formats:

1. **Create a Poster** – Highlight key evidence like tree rings, ice cores, temperature records, ice cover, and pollen analysis. Encourage visuals to make the poster engaging.
2. **Write an Article or Report** – Write a 1-2 page article to convince someone sceptical about climate change. Include clear explanations, supporting details, and real-world examples.
3. **Make an Infographic** – Create a digital or hand-drawn infographic summarising climate change evidence with concise text and visuals.

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Climate Change:

Write down the definition of climate change: Climate change refers to long-term changes in global or regional climate patterns, often linked to an increase in average global temperatures. Global temperatures are 1°C higher than 100 years ago

Natural and Human causes of Climate Change:

Colour coordinate the below statements into natural and human causes of climate change:

Natural causes of climate change

Human causes of climate change

Burning Fossil Fuels: Releases CO_2 and other greenhouse gases, trapping heat in the atmosphere.	**Volcanic Eruptions:** Release large amounts of CO_2 and other gases.
Deforestation: Reduces the Earth's capacity to absorb CO_2.	**Earth's Orbit:** Changes in the Earth's position relative to the Sun affect climate over thousands of years.
Solar Energy Variations: Fluctuations in the Sun's energy output can influence temperatures.	**Agriculture:** Livestock and fertilisers emit methane and nitrous oxide, potent greenhouse gases.

The Problem: Human activities have increased greenhouse gas levels, trapping too much heat and causing global warming.

Write down a list of activities you do day to day which produce greenhouse gasses:
Driving or using public transport, using electricity at home, heating your home, cooking, buying food (especially meat and dairy), throwing away waste, shopping online, flying or travelling long distances, using hot water, consuming single-use plastics, washing and drying clothes and charging devices.

Greenhouse Gasses:

Match the name of the greenhouse gas to its chemical symbol and its description:

Carbon Dioxide	H_2O	Produced by livestock (e.g. sheep and cows), waste in landfills and fossil fuel extraction.
Water Vapour	CH_4	Synthetic greenhouse gases used in industrial processes, refrigeration and air conditioning.
Methane	**HFCs, PFCs**	The most abundant greenhouse gas, intensifies the greenhouse effect as temperatures rise.
Nitrous Oxide	CO_2	Emitted by fertilisers, industrial processes, and burning fossil fuels.
Fluorinated Gases	N_2O	Released by burning fossil fuels (coal, oil, gas), deforestation and industrial processes.

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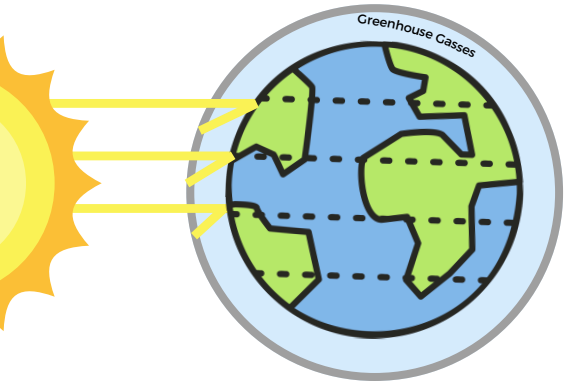
Greenhouse Effect:

Explain why the greenhouse effect is necessary to support life on earth:

Greenhouse gases are vital because they trap heat from the Sun, keeping the Earth warm enough to support life. Without them, the planet would be too cold for most plants, animals, and humans to survive.

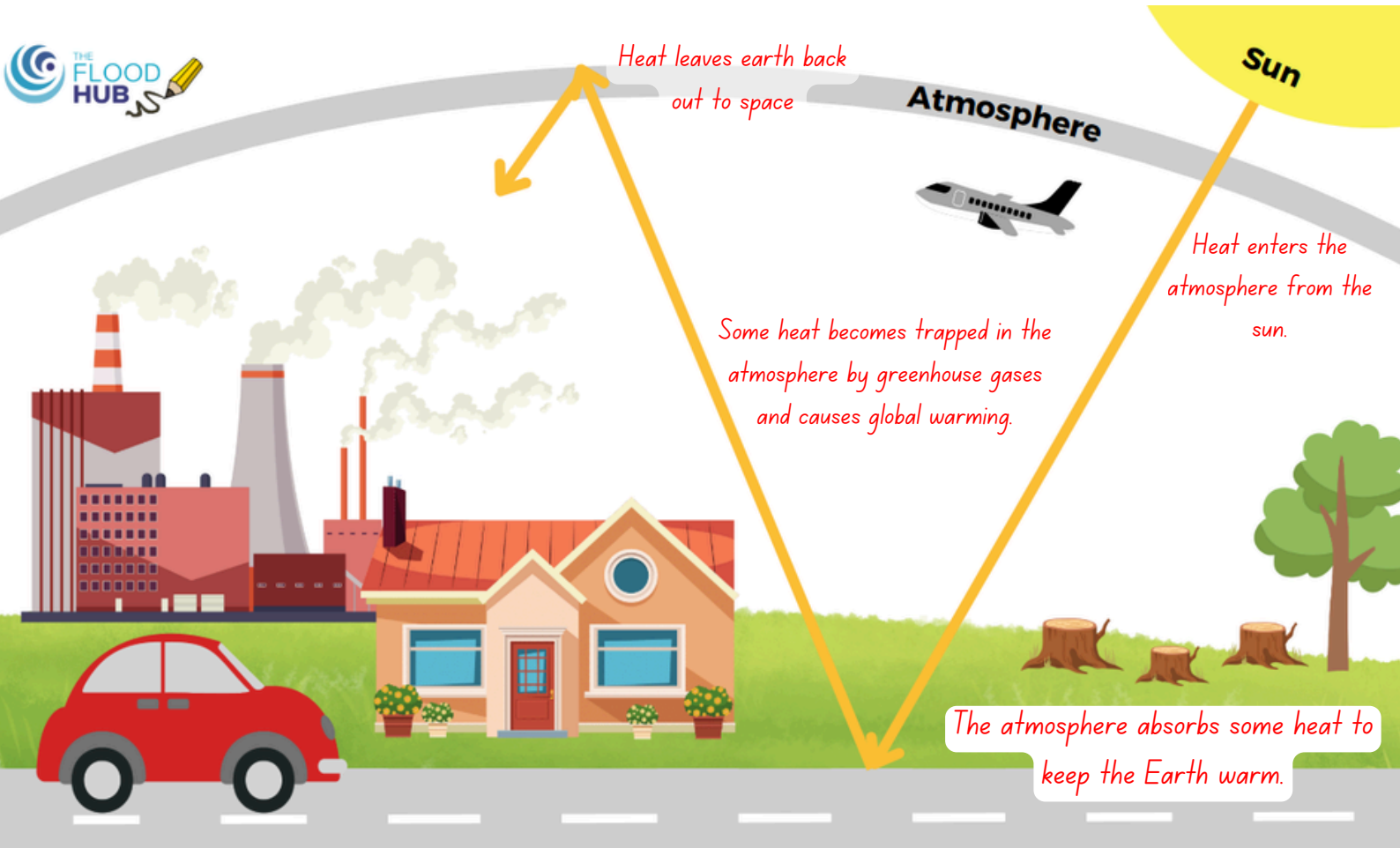
Fill the blanks on the process of the greenhouse effect:

Infrared, Energy, Atmosphere, Absorbed, Light, Trap, Heat, Releases,



- Step 1: The Sun's Energy reaches Earth as Heat and Light.
- Step 2: Some of this energy is Absorbed by the Earth's surface, warming it.
- Step 3: The Earth Releases heat back toward space as Infrared radiation.
- Step 4: Greenhouse gases like carbon dioxide (CO_2), methane (CH_4) and water vapour Trap some of this heat, keeping it in the Atmosphere and causing the Earth's surface to heat up further, a process known as global warming.

Write the label on the correct place on the diagram:



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Evidence for Climate Change:

Temperature Records

What do temperature records show?

A steady increase in global average temperatures over the past century. The last few decades have seen some of the hottest years on record, with global temperatures now around 1°C higher than pre-industrial levels.

Why are they important?

They show a clear trend of warming. The rapid rise in temperature aligns with increased greenhouse gas emissions from human activities. Unlike other evidence temperature records provide ongoing, up-to-date information about current climate changes.

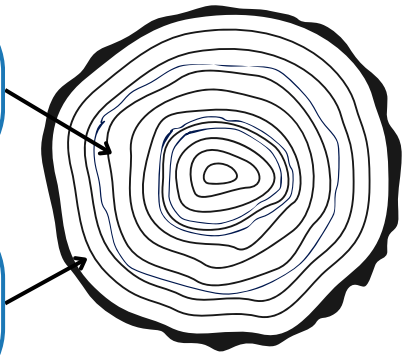
Tree Rings

Thinner tree rings:

Indicate harsher conditions, such as drought or cold weather.

Thicker tree rings:

Indicate favourable conditions for growth, such as a warm, wet climate.



What can tree rings tell us & why are they useful?

Tree rings help scientists determine a tree's age, analyse climate conditions each year, and track climate data for up to 10,000 years. Tree rings provide a natural record of past climates, including ancient changes. They offer insights into climate cycles and allow comparisons between natural climate shifts and current human-driven warming.

Ice Cores

What do ice cores show?

Ice cores contain layers of ice with trapped gases like CO_2 and methane. By analysing these, scientists can learn about past temperatures, atmospheric composition, and environmental conditions, including fossils and sediments.

Why are they important?

Ice cores from Antarctica offer data spanning 800,000 years, revealing cycles of natural warming and cooling. They also show the sharp rise in greenhouse gases linked to human activity since the Industrial Revolution.

Pollen Analysis

Fill in the gaps with the key words form the board:

Plant pollen can be preserved in *Sediment* for *Thousands* of years. By examining pollen in these layers, scientists can identify the types of plants that grew in the area during different time periods.

How does it show Climate Change?

- Different plants thrive in different climates.
- Comparing *ancient* pollen with *modern* pollen reveals how plant life — and by extension, climate—has changed over time.
  - *Warm* periods may show pollen from *tropical* plants.
  - *Cold* periods may show pollen from *tundra* or *boreal* species.

Ice Cover

Fill in the gaps with the key words form the board:

Examples of icy areas: *Arctic, Antarctica, high altitude mountains.*

Icy areas *expand* during colder periods and *shrink* as the temperatures *rises*. *Less* ice means less sunlight is *reflected* back into space, which *accelerates* global warming (known as the *albedo* effect).