

Climate change – Understanding global warming

This guideline provides an overview of the content and didactic context of the media in the “Climate change – Understanding global warming” media package.

1 Introduction to teaching this topic

1.1 Motivation for the topic

Global warming and the accompanying anthropogenic (man-made) climate change are two of the major challenges of our time. To be able to follow and participate in the discussion about these topics, the students need sound basic knowledge as well as an awareness of the different positions. They should be able to evaluate and weigh these positions against each other, especially in light of misinformation that is spread and the increasing climate anxiety in society.

Students encounter the topic of climate change again and again at school in different grades and in different subjects. In addition to imparting knowledge about the scientific processes, teachers must help the students develop an awareness of the problems and to show them solutions. In the process, teachers should bring up major, global approaches as well as show the students what every individual can do.

1.2 Media selection

The media contained in this media package address the following topics:

- The natural greenhouse effect
- The anthropogenic greenhouse effect
- Greenhouse gases

Subsequent media packages will build upon this media package to address the following topics:

- Impacts of climate change
- How can we limit global warming to 1.5°C?
- Tackling climate change and sustainability simultaneously

1.3 Relevance to the curriculum

The importance of climate change education has been recognized and the topic of climate change has been firmly integrated into the curricula of general education schools at the elementary and secondary levels. Causes and impacts of climate change are covered in the subject of geography. Science subjects, primarily physics and geography, deal with the natural and the anthropogenic greenhouse effect. Greenhouse gases are addressed in both chemistry and physics. The teaching of climate protection measures, as well as political, economic and social contexts, can be included in the subjects of geography, history, politics, and social studies.. Higher grade levels discuss in more depth the sociopolitical problems and conflicts with respect to climate change and sustainable development.

The topics of climate change and its impacts and measures to counteract global warming will also be debate topics in foreign language classes in the future.

In addition, these topics are also suitable for multiple-class and interdisciplinary project days or environmental project groups.

1.4 Learning objectives

The media of this media package cover the science fundamentals that enable the students to understand climate change and global warming.

The students will ...

- know the processes involved in the natural and the anthropogenic greenhouse effect.
- recognize the anthropogenic greenhouse effect as the cause of global warming.
- know the major greenhouse gases.
- compile a table/list on the formation and use of the major greenhouse gases as well as their global warming potential and their respective lifetimes, and compare and analyze this information.
- work with sources, analyze them, and evaluate their reliability.
- gather scientific information from the factual texts of the media package and external sources.
- foster their methodological competence by describing and analyzing selected diagrams.
- improve their communication, argumentation, and presentation skills through collaborative work in groups, the presentation of their results, and participation in discussions.

2 Introduction to the topic

An animation from NASA shows the monthly global deviations from the average temperature between 1880 and 2021. Viewers see how global temperatures have risen higher and higher over the course of time. After watching the video, the teacher will ask questions to guide the students to the topic. Keywords that can be named here are: climate change, global warming, greenhouse gases, combustion of fossil raw materials, greenhouse effect.

Medium: Video "[Understanding global warming – Climate spiral](#)"

3 What is the greenhouse effect?

The fact that Earth is heating up is due to the greenhouse effect. The information sheet explains the natural and the anthropogenic greenhouse effect and cites the causes of global warming. Without the natural greenhouse effect, life on Earth would not be possible. However, humans are intensifying the greenhouse effect, as can be seen in the charts. The anthropogenic greenhouse effect must be stopped, and global warming must be held stable at 1.5°C above the preindustrial level. Major efforts are necessary to this end and "successes" will not be measurable for centuries due to climate inertia.

Medium: Information sheet "[Understanding global warming – The greenhouse effect and climate change](#)"

The processes occurring in the greenhouse effect are illustrated in an interactive H5P Agamotto image sequence.

First, the sequence shows what Earth would look like without the greenhouse effect. Then the natural greenhouse effect is explained. Finally, the sequence shows the impacts of the anthropogenic greenhouse effect. The medium is available as a simple version and as a complex version with more information.

- Media: Interactive graphic "[Understanding global warming – The greenhouse effect \(simple\)](#)"
Interactive graphic "[Understanding global warming – The greenhouse effect \(complex\)](#)"

The individual graphics from the aforementioned interactive graphics are included in the media package.

- Media: Graphic "[Understanding global warming – Earth without the greenhouse effect \(simple\)](#)"
Graphic "[Understanding global warming – The natural greenhouse effect \(simple\)](#)"
Graphic "[Understanding global warming – The anthropogenic greenhouse effect \(simple\)](#)"
Graphic "[Understanding global warming – Earth without the greenhouse effect \(complex\)](#)"
Graphic "[Understanding global warming – The natural greenhouse effect \(complex\)](#)"
Graphic "[Understanding global warming – The anthropogenic greenhouse effect \(complex\)](#)"

Greenhouse gas emissions thus drive man-made/anthropogenic climate change.
What are greenhouse gases and where do they come from?

4 What are greenhouse gases?

The students are certainly familiar with the greenhouse gas CO₂ from media. However, there are other greenhouse gases whose impact is much greater than that of CO₂.

On the worksheet with the inquiry task, the students will work in groups to complete the three assignments on greenhouse gases:

- What is a greenhouse gas? Who produces these gases? Where do they occur?
Comparing the global warming potential and respective lifetimes of methane, nitrous oxide, and chlorofluorocarbons with the global warming potential of CO₂.
- Finding out the atmospheric lifetime of various greenhouse gases and answering the question "Why will global warming remain constant for centuries and millennia even if no more greenhouse gases are emitted?" based on the lifetimes.
- Clarifying the question of what chlorofluorocarbons (CFCs) have to do with the hole in the ozone layer and with global warming.

All groups should work on the first question. Afterwards, they will present their work to the entire class and collectively create an overview table.

Then each group will complete another work assignment. They will present their results to the entire class.

Media: Worksheet "[Understanding global warming – Greenhouse gases](#)" with [answer sheet](#)

The answer sheet lists greenhouse gases with their respective sources, global warming potentials, and lifetimes. The interactive H5P accordion in the media package also lists the gases at a glance. The chemical formula, origin, global warming potential, and lifetime of each of the major greenhouse gases are compiled here. This medium can be used for reference and for review.

Medium: Interactive information sheet "[Understanding global warming – Greenhouse gases](#)"

The crossword puzzle serves to solidify the knowledge acquired about greenhouse gases.

Medium: Crossword puzzle "[Understanding global warming – Crossword puzzle](#)"

4.1 Development of greenhouse gas emissions

The primary objective of measures meant to stop or curb global warming is to quickly reduce CO₂ emissions originating from the combustion of fossil fuels, ideally to zero in the coming decades. How have greenhouse gas emissions developed? Which countries are the main producers? The information module provides information that is important for the students to be able to consider countermeasures later.

Medium: Information module "[Development of greenhouse gas emissions](#)"

5 Solidifying the results

An interactive video provides summarized information on the factors that determine the climate and related tasks.

Medium: Interactive video "[Understanding global warming – The atmosphere and climate](#)"

The video is also available on the Media Portal as an individual media file without tasks.

A link list provides additional links on the topic of climate change, the greenhouse effect, and greenhouse gases. This link list includes the links for all media packages related to climate change on the Siemens Stiftung Media Portal. It is therefore more comprehensive than the topics addressed in this media package and covers several media packages.

Medium: Link list "[Climate change](#)"

6 Outlook

Earth is getting warmer. What impacts is climate change already having? What impacts will it have in the future?

These questions are addressed in the “Climate change – Impacts of climate change” media package. It describes consequences of climate change, comparing two scenarios: global warming of +1.5°C vs. +2°C.

The following topics are covered:

- Extreme weather events
- Warming of the oceans, melting at the poles
- Impacts on human systems, e.g., climate migration
- Impacts on ecosystems and biological adaptation

Additional media packages on the topic of climate change will include the following:

- “Climate change – How can we limit global warming to 1.5°C?” media package, which is scheduled for publication in 2022/2023.
This media package will highlight what is necessary to reach the 1.5°C target and to stabilize global warming at this level. It lists the global actions that the world at large must undertake; in addition, it reflects on how each individual can make a contribution.
- “Climate change – Tackling climate change and sustainability simultaneously” media package, which is also scheduled for publication in 2022/2023.
In addition to providing information, this media package will cover social evolution and critical analysis. Here it will become clear that climate change and sustainable development are closely interlinked. The countries with the lowest CO₂ emission are confronted with the greatest risks. This media package will state the United Nations sustainable development goals and analyze how sustainable development can also help limit global warming.