

# Sustainable Diets

## *Nutrition from a Climate Change Perspective*

**Do you know how much impact your diet has on climate change?**



**“Earth's Fate is in our Hands”**

***What can we do to slow down or stop the warming?***

This didactic unit is part of the Sustainable Diet Project.

Erasmus+ Programme – Strategic Partnership Project Nr: 2018-1-ES01-KA229-050651 (2018-2020)

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<sup>1</sup> Picture –Source: <https://news.stanford.edu>

## Learning Objectives

- Students understand the implications of their nutrition choices to mitigate climate change as well as the impacts of climate change on food production.
- Students know that the major problems of our time – energy, the environment, climate change, food systems and food security are systemic problems and cannot be understood in isolation.
- Students are able to back up their opinions and arguments with scientific evidence. They can search for that information on their own.
- Students grasp that climate change research not only produces reasons for concern but also for hope
- Students deal with the opportunities how they can help to save the planet by filling their plate and understand why a meat-based diet negatively affects the environment.
- Students develop reading and speaking skills and are encouraged to think about their attitudes towards the environment.

## Can we stop the burning down of rainforests by eating less meat?



- **Watch** the video [Beef Industry is burning Amazon Rainforest](#) and if you would like to get more background information (from its history up to its environmental damage from human intervention) also have a look at [Amazon Rainforest – what makes it special?](#).
- Then **explain** if and why you agree or not agree with the statements below.



- (1) The Amazon is burning, because the world eats too much meat.
- (2) Deforestation, fires, industrial agriculture and cattle ranching are systemically connected to each other.
- (3) Greenhouse gas emissions also result from land use changes, for example the conversion of tropical rainforest into pasture. Therefore, my decisions what to eat may not only be relevant to our climate but also to land use change in Brazil.

# A Is the Earth's climate changing and how do we know?

First, write out your **claim**, or answer to this question.

Then, provide **evidence** for your claim by doing some research on this topic.

Credible information sources are, for example, [NASA's website on global climate change](#) or [NOAA's page on climate](#) or use this [video](#). As you watch the video, you can refer to the table below containing content-related vocabulary to help you better understand the topic.

After that, interpret your evidence, or provide **reasoning** that uses your evidence to support or justify your claim. Use the information and evidence you have gathered from your research to make and justify a claim about whether or not the climate is changing.

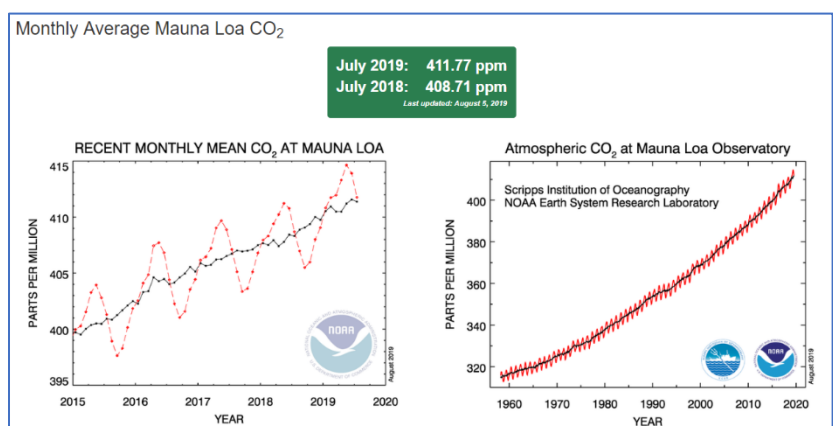
Finally, present your **Claim – Evidence – Reasoning** to your classmates through presentations, group sharing, or posters. For example, you can follow the video discussion questions<sup>2</sup> below to show your results.

- What kinds of data do scientists collect in order to study Earth's climate?
- How do clouds or soil connect to climate change?
- What data does the featured soil scientist collect and analyze data?
- What data does the featured cloud scientist collect and analyze data?
- How does the scientist who studies Earth's surface temperature collect data?
- What accounts for uncertainties in climate data?
- Why have we been underestimating warming of the ocean over the last 15 years or so?
- How can we decrease or minimize uncertainties in data?
- Do uncertainties in climate data mean that we are unsure the climate is changing?

Study the [history of atmospheric carbon dioxide](#) and the graphs on the right hand side.

Then **describe**, what is shown in the animation and on the [graphs](#).

Finally **develop** a summary for a presentation in front of policy makers.



<sup>2</sup> Source: <https://www.calacademy.org/educators/how-to-measure-a-changing-climate>

## Vocabulary<sup>3</sup>

<b>Buoy</b>	A floating object that instruments can be attached to in order to measure things like wave height, wind speed, and air temperature.
<b>Carbon dioxide (CO<sub>2</sub>)</b>	A chemical compound composed of two oxygen atoms bonded on either side of a carbon atom. Carbon dioxide occurs in the atmosphere both naturally and due to human activity and traps heat near the earth's surface.
<b>Citizen scientists</b>	Everyday people who volunteer to help scientists with their research.
<b>Climate</b>	The average, long-term conditions of temperature, precipitation, winds, and clouds in an area.
<b>Climate change</b>	A change in the long-term average weather conditions in a region or globally.
<b>Data</b>	A collection of information, such as measurements, descriptions, or observations.
<b>Heterogeneous</b>	Not the same everywhere.
<b>Ice sheet</b>	A massive layer of ice that covers more than 50 000 square kilometers of land. Ice sheets form in places where snow that falls in the winter doesn't completely melt in the summer, and thus builds up over time.
<b>Remote sensing</b>	Taking measurements of the earth from a satellite or plane.
<b>Satellite</b>	An object sent into orbit around the earth (or another planet) to collect information or for communication.
<b>Soil</b>	The loose, weathered material on Earth's surface in which plants can grow.
<b>Surface temperature</b>	The temperature measured near the earth's surface from weather stations, ocean buoys, and sometimes satellites.
<b>Uncertainty (in data)</b>	Refers to the fact that when scientists collect data about a phenomenon, they can't possibly collect data everywhere all of the time. They are also limited in how accurate and precise their measurements are by how good their measuring tool or instrument is.
<b>Weather station</b>	A place where instruments and equipment record measurements about the weather.

<sup>3</sup> Source: [https://www.calacademy.org/sites/default/files/assets/docs/pdf/flipsidescience\\_measuringclimate\\_vocabforstudents.pdf](https://www.calacademy.org/sites/default/files/assets/docs/pdf/flipsidescience_measuringclimate_vocabforstudents.pdf)

**B**

## Thinking critically about the issues with fossil fuels and what can be done to solve them

Although there are many heat-trapping gases in the atmosphere (from methane to water vapor), climate change is primarily connected with the carbon overload caused mainly when we burn fossil fuels like coal, oil and gas or cut down and burn forests.

Use this [website](#) and this [video](#) to learn, how human use of fossil fuels affects climate change. Experience, what fossil fuels are and why they are a problem for the environment. As you watch the video, you can refer to the table below containing content-related vocabulary to help you work through the associated activities.

- (1) First, estimate how many percent of the world's energy do these non-renewable fuels supply and then check, if you were right.
- (2) Describe the major types of fossil fuels and find out how much they contribute to the global temperature increase.
- (3) What happens when fossil fuels are burned? Try to generate an equation for this chemical reaction and consider why the burning of fossil fuels has an impact on global warming.

### Extension

A car has an average petrol consumption of 7,8 litres per 100 km.

- Before you calculate, make an estimation how much CO<sub>2</sub> will be produced using Octan (C<sub>8</sub>H<sub>18</sub>) with a density of 0,75 g/cm<sup>3</sup>.
- This chemical equation  $2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 18 \text{H}_2\text{O} + 16 \text{CO}_2$  may support you.
- In the end, present your findings by providing a poster.

- (4) Look at the *photos of global warming impacts* and make a summary.
- (5) Display, what you know about the commitment to emissions reduction targets as part of the 2015 *Paris Agreement*. Also search for information on the 2015 *Paris Agreement* on your own.
- (6) How did the fossil fuels form, how long did it take, and how do fossil fuels produce energy?
- (7) What have been the effects of our increased use of fossil fuels?
- (8) What is the 'greenhouse effect'? What does it do and how are fossil fuels related to the greenhouse effect?
- (9) What is a 'nonrenewable resource'? Why might using a nonrenewable resource be a problem?
- (10) What solutions have some people come up with to decrease their use of fossil fuels? What are some ways that you can *reduce your use of fossil fuels*?

- (11) What do you think ‘sustainable’ means? Can you name something that is sustainable? How about something that isn’t sustainable?
- (12) Why does CO<sub>2</sub> get [most of the attention](#) when there are so many other heat-trapping gases?

### Vocabulary<sup>4</sup>

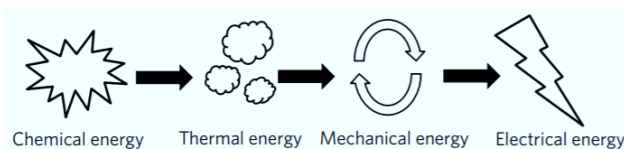
<b>Carbon dioxide (CO<sub>2</sub>)</b>	A chemical compound composed of two oxygen atoms bonded on either side of a carbon atom.
<b>Coal</b>	A type of solid fossil fuel formed mainly from fossilized plant matter that is burned to generate electricity and for other energy uses.
<b>Emissions</b>	The release of something, like pollution from a car’s tailpipe.
<b>Energy efficiency</b>	Using less energy to provide the same service.
<b>Fossil fuel</b>	An energy-rich substance such as petroleum, coal, or natural gas formed from the remains of ancient organisms.
<b>Greenhouse effect</b>	A natural, environmental phenomenon by which the sun’s thermal energy is absorbed by atmospheric greenhouse gases and re-radiated towards the planet’s surface. This increases the planet’s average surface temperature. Scientists hypothesize that Earth would be much cooler without the Greenhouse effect.
<b>Greenhouse gases</b>	Gases in Earth’s atmosphere that absorb infrared radiation and trap heat. Some greenhouse gases are naturally occurring compounds (like water vapor, carbon dioxide, methane, and nitrous oxide), while others are human-made (like gases used for aerosols).
<b>Hydrocarbon</b>	A compound made up of the elements hydrogen and carbon.
<b>Natural gas</b>	A type of gaseous fossil fuel that is burned to produce energy for heating, cooking, and generating electricity, as well as for powering certain kinds of vehicles.
<b>Nonrenewable resource</b>	A natural resource that is consumed faster than it can be replaced naturally.
<b>Ocean acidification</b>	the process by which atmospheric carbon dioxide dissolves in seawater, causing a decrease in the water’s pH and an increase in the ocean’s acidity.
<b>Peat</b>	A dark-brown soil-like material composed of decaying plant matter that, under the right temperature and pressure conditions and over a long period of time, can turn into coal.
<b>Petroleum/oil</b>	Fossil fuels that can be transformed into gasoline for cars, diesel oil for trucks and buses, and other fuels that can be used to power things. Petroleum is also made into goods like plastics.
<b>Sustainable</b>	Meets the needs of the present without compromising the ability of future generations to meet their own needs.

<sup>4</sup> Source: [https://www.calacademy.org/sites/default/files/assets/docs/pdf/fossilfuels\\_studentvocab.pdf](https://www.calacademy.org/sites/default/files/assets/docs/pdf/fossilfuels_studentvocab.pdf)

Read the **text**<sup>5</sup> below and evaluate the benefits and drawbacks of fossil fuels.

Coal, oil/petroleum, and natural gas are three main types of fossil fuels. They are called ‘fossil fuels’ because they formed from the remains of decaying plants and animals that were buried by layers of rock 300 million years ago. As this material was buried by more and more rock, high heat and pressure transformed it over millions of years. And depending on whether this occurred in vegetated swamps or plankton-filled seas, either coal, oil, or natural gas was formed.

When fossil fuels are burned - when they undergo a chemical reaction with oxygen - they release a lot of energy that we can use to power things. For example, in a coal-fired power plant, coal is burned in a boiler, releasing chemical energy that heats water into steam. The steam turns a turbine connected to a generator. The generator converts the mechanical energy of the spinning turbine into electrical energy that can be transmitted to homes and buildings through transmission lines. While coal is typically used to produce electricity, oil can be refined into a variety of liquid fuels to power cars, trucks, and airplanes and is also made into a wide variety of everyday products, including plastics, cosmetics, clothes, electronics, and more. Natural gas is commonly used for heating and cooking in homes.



Coal, oil, and gas can generate huge amounts of energy and power a wide variety of things. Fossil fuels are relatively cheap, but as they become harder to extract from the Earth, they will become more expensive. Fossil fuels are easily stored and easily transported, and thus they can be used to power things almost anywhere and anytime.

One problem with fossil fuels is that they are nonrenewable resources, meaning that we are extracting them from the Earth and using them faster than they can form. Mining or pumping fossil fuels from the ground can damage ecosystems and the environment, as can accidents like oil tanker spills that are expensive to clean up. Fossil fuels produce air pollution when they are burned. They also release carbon dioxide and other greenhouse gases into the atmosphere that not only warm the climate, but change the chemistry of the ocean.

	<b>Benefits</b>	<b>Drawbacks</b>
<b>Environmental Factors</b>		
<b>Social &amp; Cultural Factors</b>		
<b>Economic Factors</b>		

<sup>5</sup> Source: [https://www.calacademy.org/sites/default/files/assets/docs/pdf/flipsideenergy\\_fossilfuels\\_sciencetextswdiagrams.pdf](https://www.calacademy.org/sites/default/files/assets/docs/pdf/flipsideenergy_fossilfuels_sciencetextswdiagrams.pdf)



## C Why and how does a meat-based diet negatively affect the environment

**Our food systems affects climate change and climate change affects our food system.**

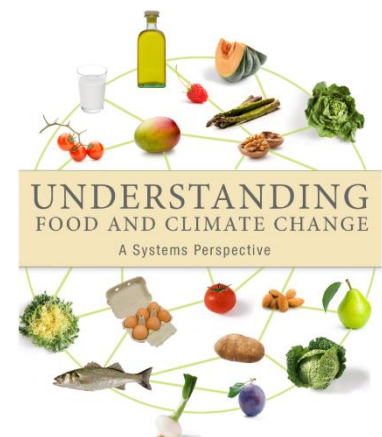
Our food must first be produced, then harvested, transported, stored, and possibly processed before it finally ends up on the retailers' shelves. The emissions caused along this chain are called "direct" emissions. In addition there are so-called "indirect" emissions which are often overlooked in the public discussion but which may significantly increase our personal "carbon footprint".

Work in *four groups* (A, B, C, D) and use the [interactive guide](#) to develop answers to the questions below.

Present your results each other in a *poster discussion session*.

Build *mixed groups* (consisting of at least one student of each group) and finally come up first with a *newspaper article* with the heading 'Our food system and climate change are strongly linked to each other' and second with a presentation including an *artistic production* to be intended for using it as an information for parents and peoples interested in this topic.

- (1) What is a food system?
- (2) How is an apple part of a system?
- (3) Why do we waste so much food?
- (4) What is needed to move food to the plate?
- (5) What do we know about climate change and how do we know?
- (6) Why does climate change affect our food system?
- (7) How does our food system affect climate change?
- (8) Why does the world's increasing population also contributes to global warming?
- (9) Are there yet ideas and plans for making decisions in response to climate change?
- (10) Do there exist strategies to adapt to or mitigate water problems associated with climate change?
- (11) What are some promising ways to reduce food waste?
- (12) How our planet can feed a growing population while mitigating climate change?
- (13) Are there soil management practices to hold carbon in soils for a longer period of time?
- (14) Why does biodiversity can help reduce the negative impact of climate change?



Group	A	B	C	D
Questions	1 to 4	5 to 8	9 to 11	12 to 14





**D Why and how is Carbon Dioxide warming the planet? But, without the greenhouse effect, Earth would be a frozen planet!**

Study the links below as well as the [simulation](#) and **make a short video**, for example based on ideas in the video [‘Why does CO<sub>2</sub> cause the greenhouse effect?’](#) explaining the CO<sub>2</sub> problem by developing specific questions on your own.

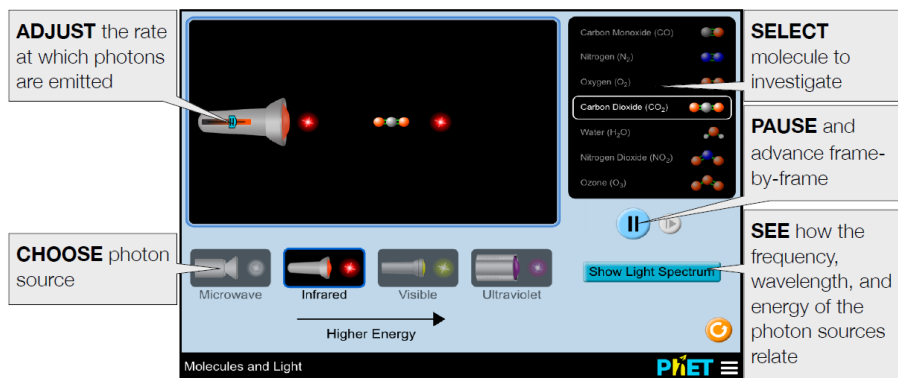
[Learn more about the physics of greenhouse gases.](#)



Carbon dioxide is [just one of several chemicals](#) that contribute to the greenhouse effect.

Why does CO<sub>2</sub> get [most of the attention](#) when there are so many other heat-trapping gases?

How can CO<sub>2</sub> can be removed from the air?



Use the simulation to specifically examine how different types of radiation interact with different atmospheric gas molecules. Record your observations for each combination in a data table. Then answer, based on your observations, the questions below.

- (1) Which atmospheric gas molecules **were not** affected by the visible or infrared radiation?
- (2) Which atmospheric gas molecules **were** affected by the visible or infrared radiation?
- (3) How were these atmospheric gas molecules affected by the radiation?
- (4) How was the radiation affected by these atmospheric gas molecules?

Finally, put all the pieces together — connect what’s happening in this simulation to what’s happening in the real world.

- a) Based on the simulation, what makes a greenhouse gas a greenhouse gas?
- b) How does energy flow in and out of Earth’s atmosphere, and how might this be related to
- c) Earth’s climate?
- d) What is one question that you are still wondering about?

**Evaluation Criteria**

- (1) Scientific approach (clarity in stating the problem, identification of important variables, appropriateness of methods and materials, extent to which the conclusion is supported by the data)
- (2) Originality (originality of the research topic and design, degree of assistance with carrying out the project, and acknowledgment of needed assistance)
- (3) Presentation (effective use of figures and tables in presenting data, degree of visual appeal, neatness and organization, writing skill)

**Level of Achievement** (high (H) / medium (M) / low (L))

<i>Activity</i>	<i>LoA</i>	<i>Suggestions for Improvement</i>
Can we stop the burning down of rainforests by eating less meat?		
<b>A</b> Is the Earth's climate changing and how do we know? <i>Claim – Evidence – Reasoning</i>		
<b>A</b> Is the Earth's climate changing and how do we know? <i>Presentation in front of Policy Makers</i>		
<b>B</b> Thinking critically about the issues with fossil fuels and what can be done to solve them <i>Questions</i>		
<b>B</b> Thinking critically about the issues with fossil fuels and what can be done to solve them <i>Benefits and drawbacks of fossil fuels</i>		
<b>C</b> Why and how does a meat-based diet negatively affect the environment? <i>Poster discussion</i>		
<b>C</b> Newspaper Article		
<b>C</b> Artistic production		

## Internet Resources (for further reading)

<https://ncar.ucar.edu/where-we-focus/climate>

Online information on climate change offered from a federally financed research organization in Boulder, Colorado.

<https://news.stanford.edu/2019/01/03/climate-change-research-produced-reasons-concern-hope-2018/>

Climate scientists and energy researchers at Stanford not only documented the devastating effects of climate change on the world, but also developed new technologies to help reduce carbon emissions and considered strategies to keep societies safe as the climate continues to change.

<https://news.stanford.edu/2018/02/14/risk-extreme-weather-events-higher-paris-agreement-goals-arent-met/>

The Paris Agreement of 2015 has aspirational goals of limiting temperature rise that won't be met by current commitments. That difference could make the world another degree warmer and considerably more prone to extreme weather.

<https://edition.cnn.com/2018/10/18/health/plant-based-diet-climate-change-food-drayer/index.html>

As the production of animal products generates the majority of food-related greenhouse-gas emissions, experts say, that sustaining a healthier planet will require a shift toward more plant-based diets.

<https://www.calacademy.org/educators/what-is-the-environmental-impact-of-feeding-the-world>

What is the environmental impact of feeding the world? To feed our rapidly growing and changing world, we need innovative solutions. In this video, we'll explore environmental issues related to the food we grow and eat.

<https://foodandclimate.ecoliteracy.org/interactive-guide/cover.xhtml#>

Understanding food and climate change – an interactive guide

[https://foodandclimate.ecoliteracy.org/interactive-guide/page\\_0003.xhtml](https://foodandclimate.ecoliteracy.org/interactive-guide/page_0003.xhtml)

Climate change basics

[https://mobil.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Climate\\_change\\_on\\_your\\_plate.pdf](https://mobil.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Climate_change_on_your_plate.pdf)

Findings from studies as part of a long-term WWF project considering the climate impact of the way we eat.