

# AI and Environment

An Open Educational Resource

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## About this OER

*Content, Learning Objectives, and Prerequisites for this OER*

This OER offers a structural framework, content, and teaching ideas for a module on the influence of AI on the environment. It addresses ecological aspects. Other social aspects of sustainability are not covered.

This OER pursues the following learning objectives:

- The students understand the lifecycle of ChatGPT.
- The students can name the environmental impacts of ChatGPT.
- The students know cases where AI is used to benefit the environment.

The proposed content is suitable for middle school students. The following prior knowledge is required:

- Students can roughly explain what AI is.
- Students understand the difference between AI programs and normal programs.
- Students can name possible application areas of AI.

This prior knowledge can be conveyed using the [OER "AI and Society"](#) (sections: Introduction and Use Cases).

# Introduction

Artificial Intelligence (AI) is a program that interprets input data, learns from it, and uses what it has learned to achieve specific goals [1]. AI programs are provided with a structured framework for learning and developing their own rules for solving tasks based on data [1].

AI is advancing rapidly and is already being used in various everyday applications. As we will see later, AI also impacts our environment. To promote responsible use of AI, it is necessary to reflect on its environmental effects.


Teaching Idea: Review and reinforce the prerequisites for this teaching module through questions posed to the students.

## The Lifecycle of AI Using ChatGPT as an Example

The company “OpenAI” developed the AI application “ChatGPT.” This AI application generates appropriate responses to human queries. For example, it can generate a short story when prompted with: “Write me a short story using the following words: ...”.

Teaching Idea: Project ChatGPT on a screen and let participants ask ChatGPT a question.

The following explains how ChatGPT was created (see [6]).

Image	Step	Environ. Impact
 <p>Source: Wikipedia, CC BY-SA 1.0, via Wikimedia Commons [a Wikipedia-Article]</p>	<p><b>Data Collection</b></p> <p>Initially, many texts were selected from the Internet...</p>	



Source: HenryNewman12, CC BY-SA 4.0, via Wikimedia Commons [Internet cables plugged into a server]



D-Kuru, CC BY-SA 3.0 AT, via Wikimedia Commons [Storage]

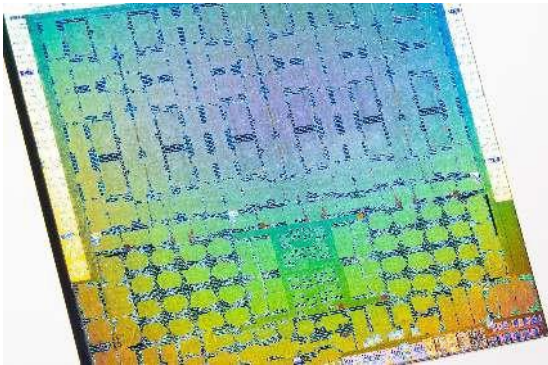


... and transported via connections, for example, from Wikipedia's storage to OpenAI's storage.






Source: Project Kei, CC BY-SA 4.0, via Wikimedia Commons [a processor]

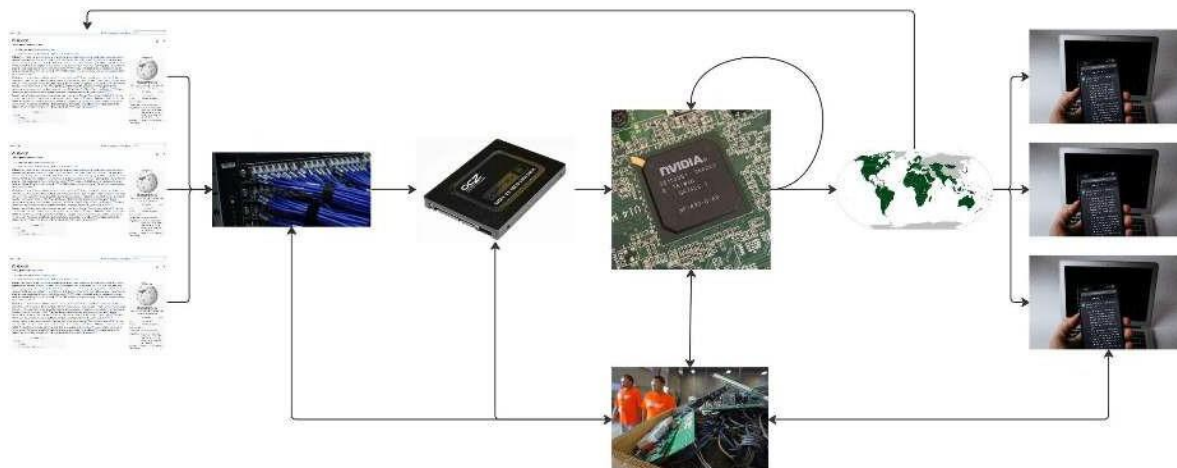
### Learning

If you have a large number of texts, you can learn a lot from them, for example, which words and word groups belong together. For instance, you can learn that "big" and "elephant" or "how" and "are you" belong together, or that the answer "good, and you?" often follows the question "how are you?". If you don't know the word "exquisite" but read the sentence "This soup is good, it tastes exquisite," you can deduce that "exquisite" is similar to "good." You can also learn that a sentence often follows the structure "subject - verb - object," and that questions end with "?". These are the kinds of things that AI learns from all these texts.

 <p>Source: Fritzchens Fritz from Berlin, CC0, via Wikimedia Commons [the inside of a processor]</p>	<p>To make AI work as effectively as possible, it needed to learn as much as possible—texts were thoroughly processed using special computers, the processors, and a lot of information about the texts, sentences, and words was stored and compared.</p> <p><b>Testing and Improving</b></p> <p>The AI’s learning process was continuously improved—many experiments and tests were necessary to make it successful!</p>	
 <p>Source: M.Bitton, CC BY-SA 3.0, via Wikimedia Commons [the countries where ChatGPT is available are green]</p>	<p><b>Publishing</b></p> <p>Once the AI calculated sufficiently good results, it was made accessible to others over the Internet.</p>	
 <p>Source: Jernej Furman from Slovenia, CC BY 2.0, via Wikimedia Commons [Smartphone with ChatGPT]</p>	<p><b>Using</b></p> <p>Now we can use AI from home. To do this, we connect our device (e.g., a laptop or smartphone) to the Internet and access the ChatGPT website. Then we enter our query. ChatGPT processes the query and calculates a response, which is then sent back to us over the Internet.</p>	

 <p>Source: 최광모, CC BY-SA 4.0, via Wikimedia Commons [WLAN-Router, der Geräte zu Hause mit dem Internet verbindet]</p>		
	<p><b>Learning New Things</b></p> <p>Since new events are constantly happening, the process of collecting data and AI learning must be repeated regularly.</p>	
 <p>Source: USEPA Environmental-Protection-Agency, Public domain, via Wikimedia Commons</p>	<p><b>Replacing Hardware</b></p> <p>The hardware (processors, storage) used for AI also wears out, or better hardware is developed. The old hardware is then disposed of, possibly recycled, and replaced with new hardware.</p>	

Teaching Idea: Print out the images and explain the lifecycle of ChatGPT using the images. Attach the cards to the board in the correct order and create a diagram (in conversation with the participants). The diagram could look something like this:



## Environmental Impacts of AI Using ChatGPT as an Example

Throughout its entire lifecycle, AI has environmental impacts. These impacts are presented below using ChatGPT as an example (see [6]).

<p><b>Electricity</b> The production and use of storage, computers, and connections require electricity. This is generated, for example, in coal or nuclear power plants, but also in solar plants, hydroelectric plants, and wind farms.</p>	<p><b>Raw Materials</b> Storage, computers, connections, and our PC are made from raw materials such as copper and silicon. Silicon comes from sand and rock [3], which must first be extracted using machines and then transported to a factory.</p>
<p><b>Water</b> The production of raw materials, electricity, and cooling of the devices (which become very hot during large text processing and calculations) require water.</p>	<p><b>Waste</b> During the production of raw materials and when storage and computers wear out, waste is generated that must be disposed of.</p>

Teaching Idea: Present the lifecycle of AI to participants. You can, for example, print and display the images. Then ask at which points in this process the environment is directly impacted. This can be discussed in a plenary session when you distribute printed symbols (e.g. Electricity as Thunder, Raw Materials as Diamond, Water as Droplet, Waste as Trashcan) and ask participants to attach the symbols to the images where they believe the step has this impact. Ein Diskussionspunkt, der aufkommen kann, sind die langen Ketten von Auswirkungen. A discussion point that may arise is the long chain of impacts. For example: machines are needed to extract raw materials, and these machines require other raw materials to be processed. There are also many indirect effects beyond the direct impacts.

# Applications of AI for the Benefit of the Environment

AI does not only have negative impacts on the environment but can also have positive effects. This technology can be used to help the environment. Here are some examples:

## **Storage for Renewable Energy**

When designing new storage methods for renewable energy, computers must perform complex calculations to check whether the new design is promising [2]. These calculations take many days [2]. Instead, AI can be used, which learns from past calculations and predicts the results of new ones [2]. This shortens the calculation process, and promising designs are identified faster [2]. Since fewer complex calculations are needed, less electricity is consumed for the same result. That's the theory. In practice, no AI has yet been created that predicts calculation results with sufficient accuracy [2].

## **Climate Models**

AI is used to simulate rainfall in models of the Earth [4]. This works faster and uses less electricity than conventional mathematical methods [4]. Climate models and their changes can be improved using AI [4]. This allows us to assess the future development of the climate, verify if we are on the right track, and test which measures would help mitigate changes.

## **Air Conditioning Systems**

In buildings such as offices or data centers, there are systems to heat or cool the building. AI can learn to optimally adjust these systems to the time of day and surrounding conditions [5]. For instance, it ensures that the building isn't overheated, reducing the need to cool it later [5]. This saves energy.

## Summary & Conclusion

AI encompasses many different intelligent programs that are increasingly being used in various areas of our lives. Like any new technology, AI also has an impact on our environment. Therefore, it is important to weigh whether the advantages of using AI outweigh the potential disadvantages for the environment.

Teaching Idea: Ask students to write down in three sentences what they are taking away from this lesson.

## Sources

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