SDGs in STEM Education

SCIENCE ON STAGE GERMANY

Act Now for the UN Sustainable Development Goals

FROM TEACHERS FOR TEACHERS

Digital teaching material about how to implement the 17 SDGs in STEM education

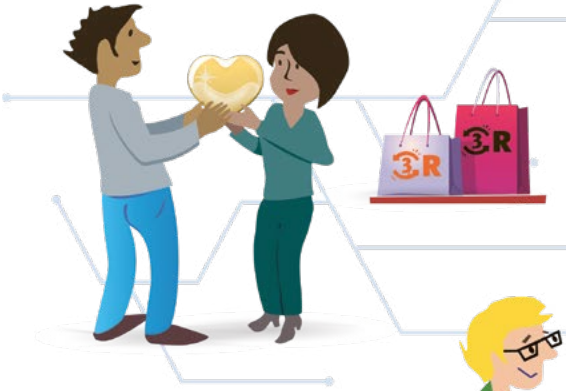
science-on-stage.eu/act-now-sdg

Sustainability and environmental protection are important topics for students throughout Europe. How we deal with these issues will shape our future. Motivated and skilled teachers are key to give children and young people the skills they need to meet the challenges of tomorrow.

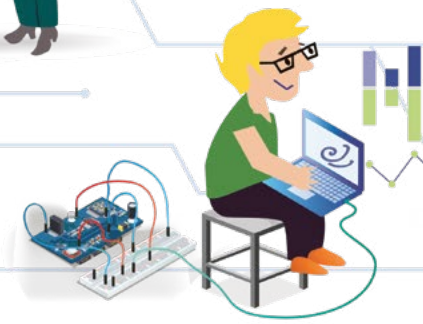
In this Science on Stage project, 20 teachers from 12 countries have worked for over two years and developed concrete teaching ideas on how to integrate the UN 17 Sustainable Development Goals into STEM lessons.

We hope that you will find many ideas for your own lessons. Act now! We need every teacher!

The 3 Rs and the Products of the Future:
Sustainable ways to create everyday products.



Climapse: What can we learn from weather data?



An Apple a Day Keeps the Climate Okay:
The apple as door opener to sustainability.

Disciplines:
all STEM subjects, geography, science in primary school

Time frame:
one lesson – project for one school year

Age level of the students:
4–18 years old

Partners for possible cooperation:
Nearby schools, local community, scientists, local companies

Curious?

In these **webinars** the authors provide an insight into the teaching units!

CO2MUCH – Think Global, Act Local:
All about CO_2 and its effects.

Adopt a Tree: Internet of Trees – What do your green spaces need?

Smart Cities: What does a smart city look like?

The digital teaching materials offer the following features:

- hands-on examples & practical instructions
- videos
- worksheets
- interactive exercises
- translatable via web browser

Climapse

primary school, secondary school

nature and technology, physics, computer science, geography

climate science, sustainability

Discover now!

"Climapse" is a blend of climate and timelapse. This teaching material consists of three parts that can be combined individually for different age groups and depending on the available equipment.

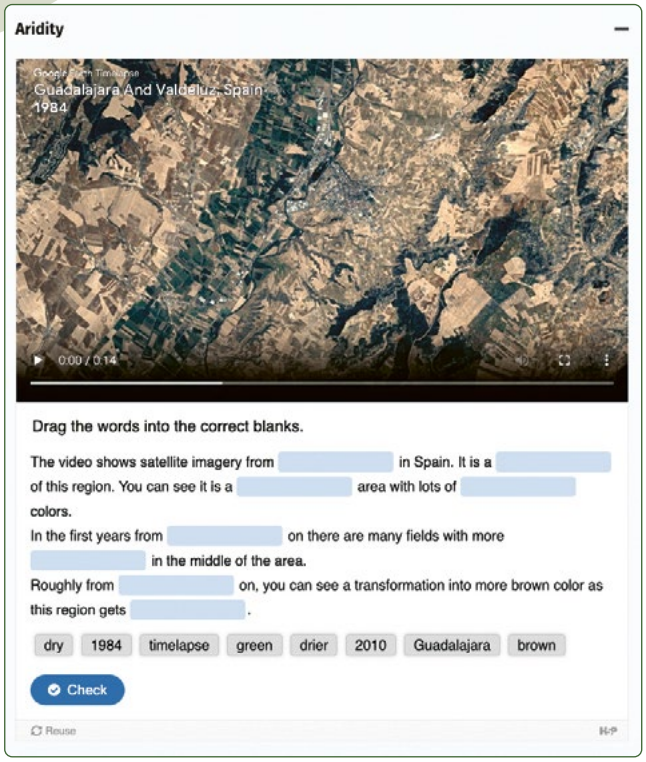
When weather is averaged over at least 30 years, we call it climate. This very rough definition shows the problem already. The period may seem long for us but is very short for our Earth.

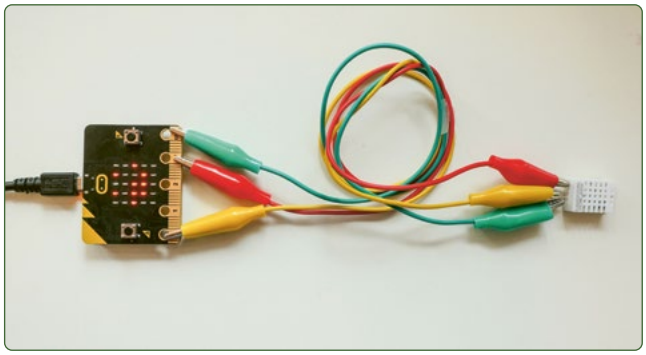
These materials raise awareness of the strong signs of climate change and its impact on nature. The students realise that we in Europe are directly affected by the increase in extreme weather conditions.

The students take over the role of scientists. They analyse extreme weather events using the Copernicus Climate Data Store database. They can also gather their own data in their hometown. With microcontrollers and sensors, they build their own meteorological or environmental measuring station.

For this, the microcontrollers Arduino and micro:bit are used. The micro:bit is a simple microcontroller that can be programmed with blocks and is very easy to use for younger students.

Are you curious? The authors of this teaching unit give an insight into Climapse in a webinar recording (→ page 2).





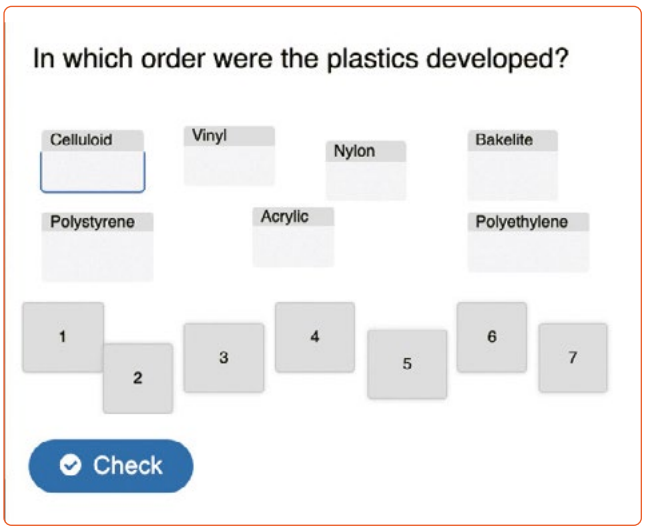
primary school, secondary school

biology, chemistry, other

biomaterials, sustainability

Discover now!

The 3 Rs and the Products of the Future



The abbreviation "3 Rs" stands for Reduce, Reuse and Recycle. This teaching unit draws attention to the unsustainable use of raw materials and shows alternatives from the areas of bioplastics, keratin, and cement. The material can be used individually for different age groups.

Are bioplastics the solution for a sustainable future? Students learn about polymers, their role in our everyday lives and the environmental consequences of their use. They investigate whether biopolymers can replace synthetic polymers. Younger students can produce plastic from milk, while older students can make a cleaning solution using plastic scraps.

The section on keratin introduces the students to the chemistry of wool. They examine wool under a microscope, dye it, extract the keratin to make their own hair conditioner, or use it to adsorb metal pollutants in water. The experiments show how wool can be reused.

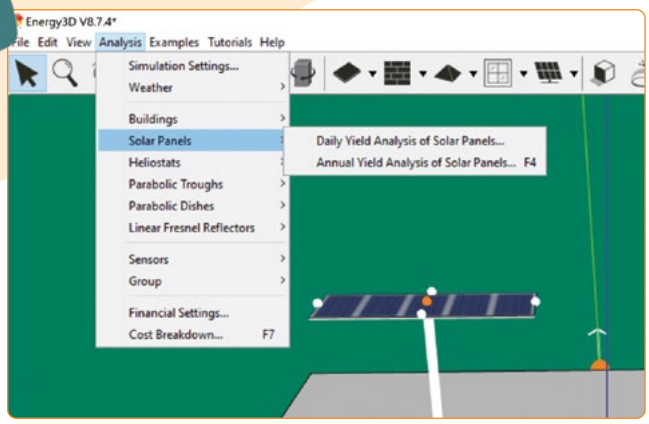
The global production of concrete is responsible for 6–8 % of the world's total emissions of CO_2. In the experiment, students produce quicklime from biomaterials: mussel shells and amorphic silica from rice husks or ash.

Are you curious? The authors of this teaching unit give an insight into the Products of the Future in a webinar recording (→ page 2).

Smart Cities –
Cities of the Future

- secondary school
- natural sciences, physics, mathematics, computer science, engineering
- clean communities, sustainability

Discover now!



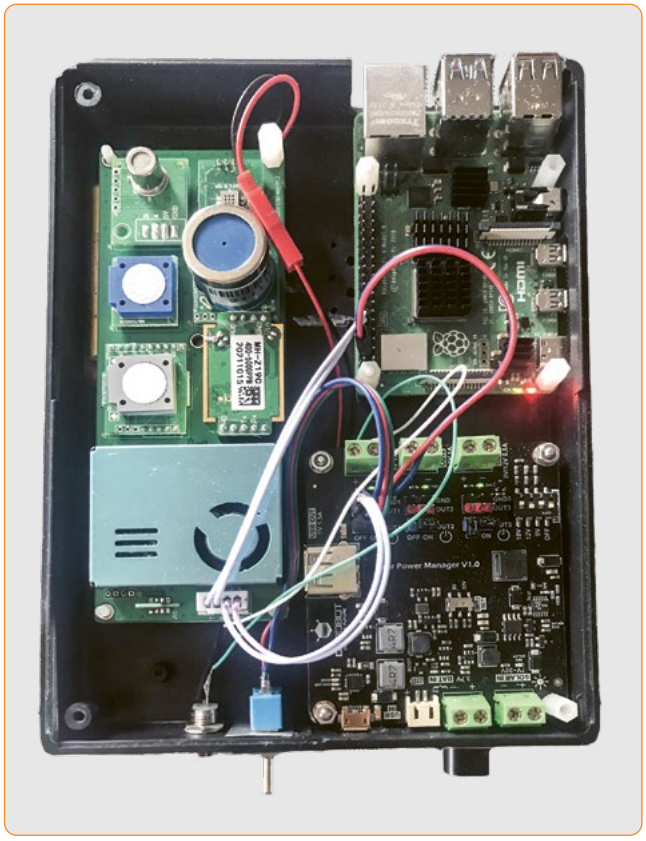
More than a half of the world's population live in cities and because of this, the sustainability of the energy resources and of the environmental conditions are crucial here. This teaching material looks at three areas: energy use, air pollution and how to analyse air quality.

Can we generate enough energy through renewable means for our cites? The students investigate the feasibility of using solar energy to power our cities in the future. Using free software, they find out how much land is needed to produce a certain amount of solar energy.

In the section on air pollution, the students learn about particulate matter in the air. They analyse the causes and effects of air pollution based on databases and research. They study the development of annual CO_2 emissions over time and compare the emissions of different countries.

Good air quality is a prerequisite for a healthy life. Students discover what are the important parameters used to establish the air quality index. Then they can build their own analyser to investigate the air quality in their environment. With sensors and different open-source platforms, they can measure the chosen air parameters.

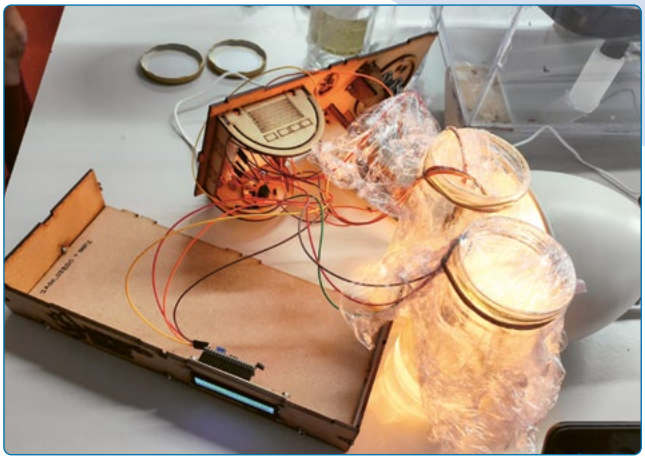
Are you curious? The authors of this teaching unit give an insight into the Cities of the Future in a webinar recording (→ page 2).

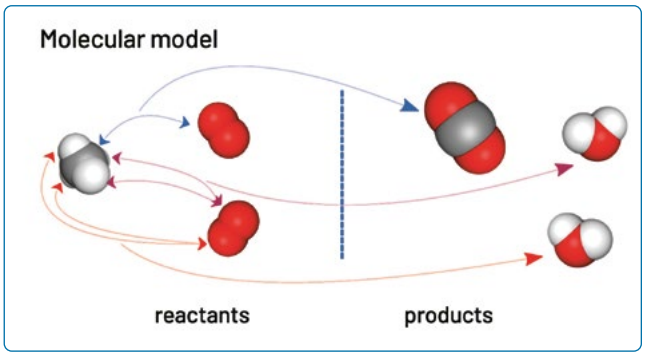


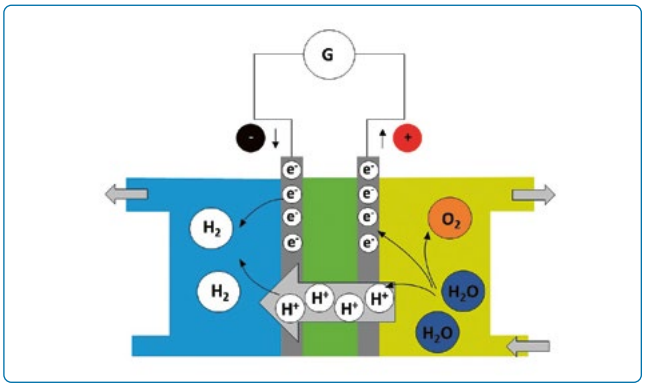
CO2MUCH – Think Global, Act Local

- secondary school
- physics, computer science, chemistry, engineering
- sustainability, greenhouse effect, climate science

Discover now!







This teaching material raises students' awareness of climate change and the acidification of oceans. Students study how scientists learn about past climate, how carbon dioxide is produced in combustion processes and how this greenhouse gas affects not only the air temperature but also the life of marine organisms.

Through videos, interactive materials, programming and laboratory activities, students explore the role of human activities in increasing carbon dioxide levels and its impacts.

They investigate the combustion of fossil fuels and prove in an experiment, that the greenhouse effect is caused by carbon dioxide. In other experiments, they measure the pH value of seawater samples and investigate how mussel shells are affected in a more or less acidic environment. In addition, the students explore hydrogen fuel cells – which do not require fossil fuels – and determine their energy efficiency.

Are you curious? The authors of this teaching unit give an insight into CO2MUCH in a webinar recording (→ page 2).

Adopt a Tree

primary school, secondary school

nature and technology, physics, biology, computer science, engineering

environmental engineering, sustainability

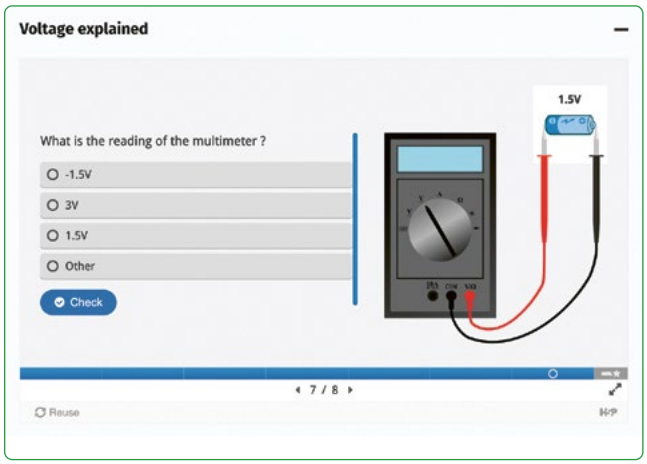
Discover now!

Forests are the green lungs of the environment. The aim of this teaching material is the construction of a tree network that contributes to the protection and conservation of our forests. This is achieved through the assembly, programming, and installation of a remote data logger on an "adopted" tree in a forest or a city park. The device records several environmental parameters. The students observe the condition of the trees and investigate how this is related to the environmental parameters.

This teaching unit is primarily a research project. The hypothesis is that the health of a tree is directly related to its sap flow.

To test the hypothesis, the students investigate photosynthesis, capillary action, and transpiration. To determine the transpiration rate, they build a simple potometer. In another experiment, the students look at voltage and current, and what they have to do with plants. They measure plant voltage with a voltmeter. Older students build their own data logger and use sensors to measure the parameters light intensity, temperature, and humidity. They can also build a data logger to monitor air quality and pollution levels to assess the health of trees.

Are you curious? The authors of this teaching unit give an insight into Adopting a Tree in a webinar recording (→ page 2).



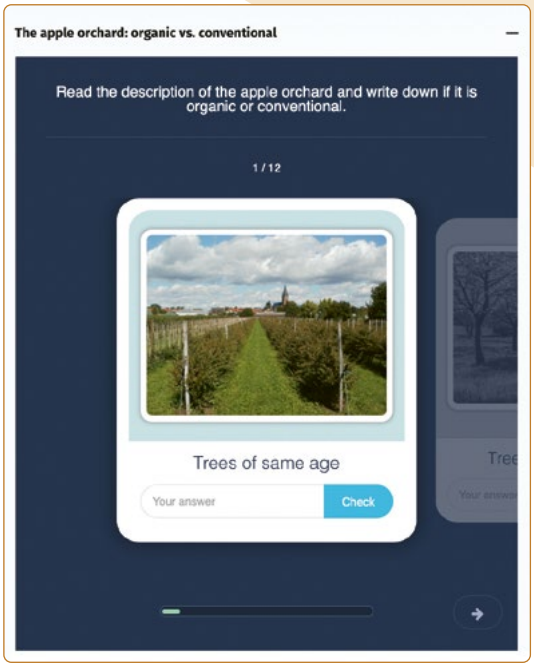
An Apple a Day Keeps the Climate Okay

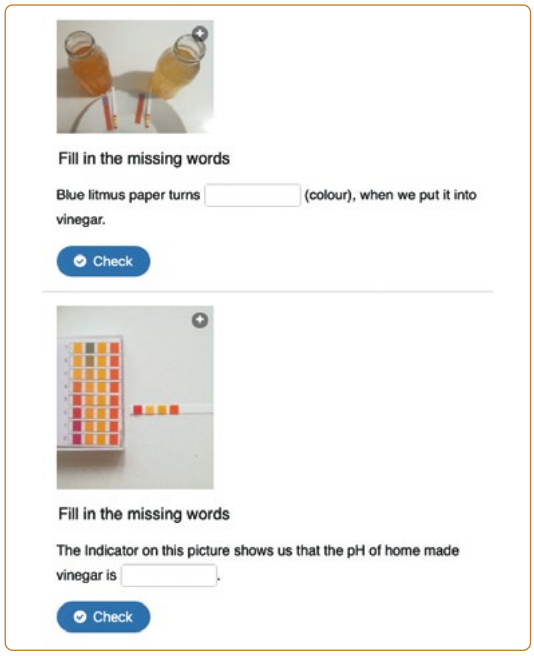
primary school, secondary school

science in primary school, biology, geography, other

food science, sustainability

Discover now!





This teaching material uses the apple as a hook to cover the topics of tree identification and biodiversity, production of apples, apple storage and apple usage. The units can be used individually or freely combined for pupils from 4 to 17 years.

In various activities, the students become familiar with apples, for example by tasting different apple varieties, planting apple trees, or studying the life cycle of an apple tree. The view is then expanded to the production of apples and the comparison of organic and conventional farming. This includes a comparison of biodiversity in the different types of cultivation. Furthermore, the focus is laid on the availability of apples year-round, leading to a discussion of the concept of food miles. In experiments, the students develop optimal conditions for storing apples. Finally, the students produce their own apple yeast or apple vinegar.

Are you curious? The authors of this teaching unit give an insight into the connection between apple growing and climate in a webinar recording (→ page 2).

17 goals to transform our schools

Education for Sustainable Development

Every day, teachers from all over the world ask themselves the same questions: what is good teaching and what characterises a good school?

In 2015, the United Nations provided globally recognised answers to these questions with the adoption of the 2030 Agenda. Good teaching enables learners to contribute to the achievement of the 17 Sustainable Development Goals (SDGs) through Education for Sustainable Development (ESD).

The 17 SDGs present a positive vision of the Earth in 2030. They are linked to measurable and verifiable targets that show how the world needs to change to enable sustainable development.

The goal of "Quality Education" promotes inclusive, equitable and quality education worldwide. A central criterion for this is education for sustainable development. For teaching, ESD represents a universal guiding principle in which lessons are linked to the target perspectives of ESD in all subject areas.

There are different strategies for implementing ESD in schools. A rather superficial integration of ESD is the addition of sustainability-oriented topics in the curriculum. The integration is much more far-reaching when ESD is firmly anchored in various areas. In the case of a deep level of integration, the entire school life and all its activities are oriented towards the guiding principle of sustainable development (Whole School Approach).

Teachers can bring about sustainable transformation processes through their work inside and outside of the classroom. They make a significant contribution to the implementation of Education for Sustainable Development.

"With this teaching material we want to change attitudes, we want to show what can be done on a daily basis. We want to promote skills and knowledge, include the whole school, the environment. Act local, think global!"

Dr. Jörg Gutschank
Project main coordinator
Chair Science on Stage Germany

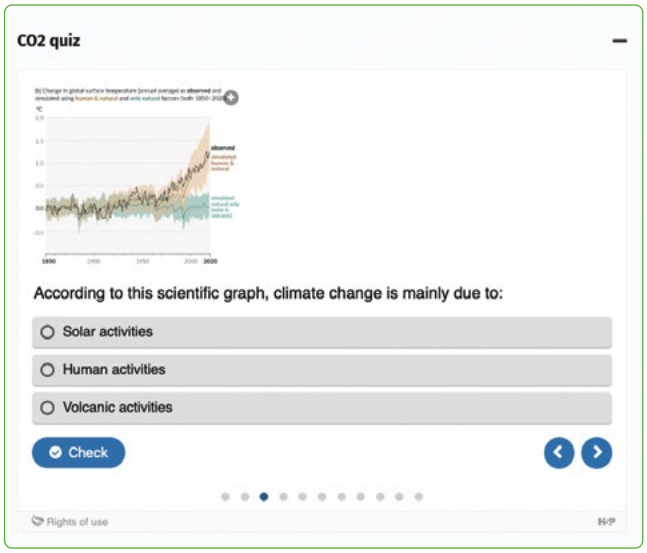
How you can use these materials in your classroom

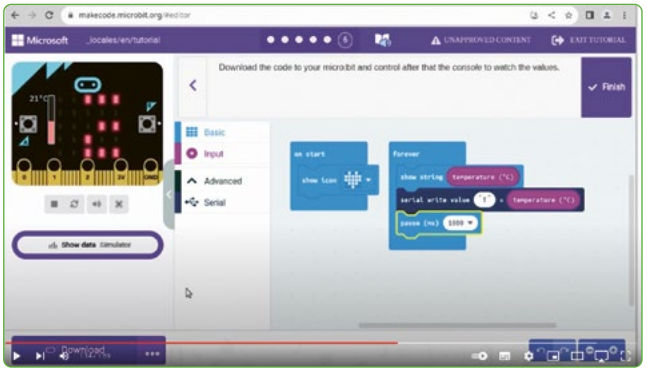
Easy to implement

Some of the teaching materials can be used for a single lesson, in others the students get involved in longer projects. The topics include all STEM fields and can be linked to the curricula of various schools easily.

There are units for many age groups and knowledge levels which can be adapted to various groups of learners and their different needs.

The digital materials come with interactive elements, such as quizzes, memory games, infographics, fill-in-the-blank texts, and videos with pop-up questions to keep the students engaged and test their knowledge. All the elements are editable and can be adapted to suit every teacher's need.





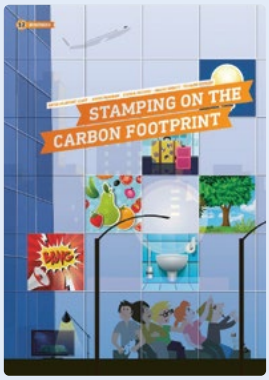
In the materials you will also find videos. They range from software tutorials to experiment videos or students presenting their projects. Every unit starts with a short interview video, in which the authors talk about the background of their teaching unit. If you want to find more information about how the authors have used the materials in class, you can watch the webinar recordings (→ page 2).

Other elements in the teaching materials include code, responsive graphs, editable and printable worksheets, presentations, and of course images.

Furthermore, sustainable development topics are an excellent way to make students curious about professions in the STEM sector. Students can learn about the variety of occupational fields that can contribute to a climate-friendly and sustainable future.

You can find more teaching materials around the topic of sustainability here:

Coding H_2O – How to Program a Solar Still
In this teaching material students learn how to test a solar still by using sensors with an Arduino micro-controller to measure its efficiency. They calculate the volume percentage of the purified water that is obtained and use different low-cost sensors to analyse the effectiveness of their designs. Depending on their skill level, the students can use either block programming or text programming.



Stamping on the Carbon Footprint – Exploring Sustainability Playfully
This teaching material looks at the sustainability of big sporting events and their negative consequences for the environment. Students are introduced to this complex topic with a card game that approaches six aspects of sustainability: Light, travel, green grass, waste, noise pollution and food. With the help of information cards, the students discuss various problems, broaden their background knowledge and learn to actively create references between their daily life and ecological questions.

Discover now!

Science on Stage offers teaching materials developed by European STEM teachers for teachers. All materials are free of charge and can be downloaded here:
www.science-on-stage.eu/teachingmaterials

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