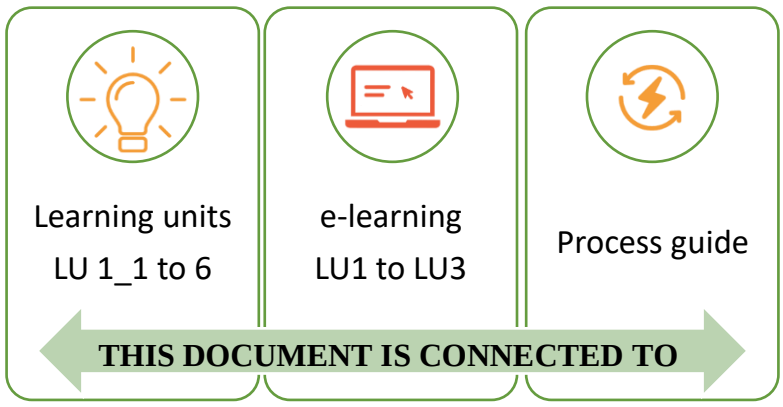
Our Solar Town

Learning Unit 1.2

Sun and solar renewable energy

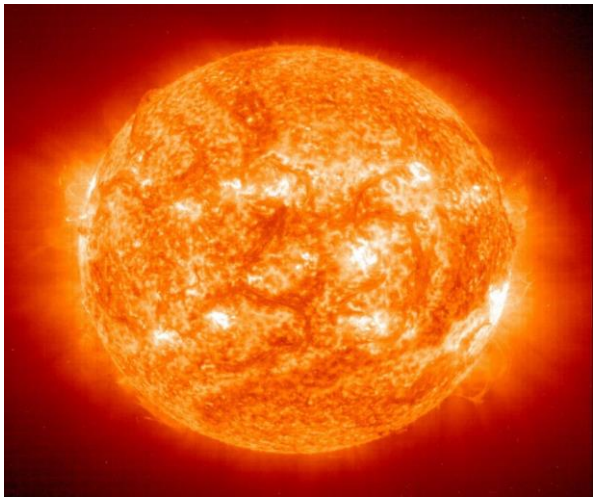


Co-funded by the Erasmus+ Programme of the European Union

Learning Unit 1.2 - Learning Plan

Sun and solar renewable energy

The sun is one of billions of stars in our galaxy. It is the most important energy source for life on Earth and is located in the centre of our solar system. It was formed approximately 4.6 billion years ago from a giant cloud of dust and gasses being slowly condensed into a rotating hot ball.



The mass of the sun is comprised of mostly hydrogen (73%), helium (25%) and some other chemical elements. In the core of the sun the temperatures reach around 15.000.000 °C. In the Sun the process of nuclear fusion takes place. Hydrogen melts to form helium, releasing different types of radiation such as heat, light and other radiations being detected on Earth.

From the mass of the sun, 332.608 Earths could be formed. Because of this giant mass, the gravitational force is having an impact even on the outskirts of our solar system. Therefore, all moons, asteroids, planets and other objects orbit around the sun. Without it everything would fly off into space.

The sun is also creating a giant magnetic field, protecting our entire solar system against cosmic radiation. In addition to heat and light, it radiates particles known as solar wind, which on Earth can sometimes be seen as northern lights (Aurora borealis).

When all the suns hydrogen is used up, the star will lose its power and turn into a dead star. It is estimated, that the sun will be shining for another 5 billion years.

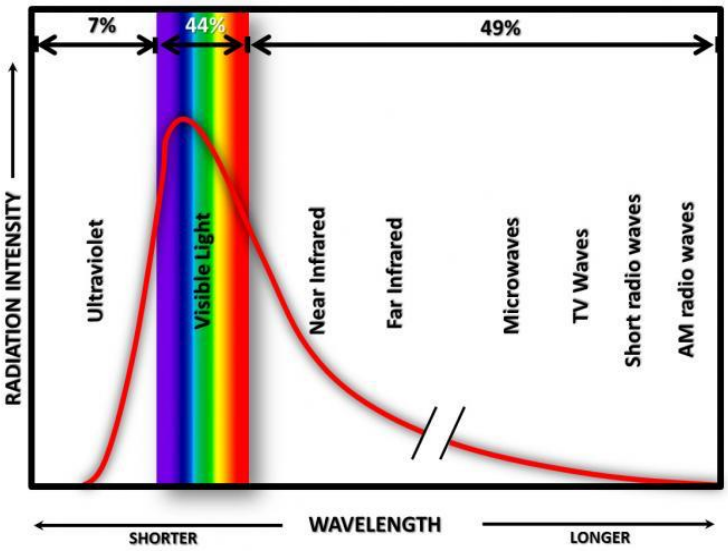
The Earth turns on its own axis in 24 hours, causing night and day. At the same time, it is traveling around the Sun at 30km/sec, which takes approx. 365 days. Due to Earth's axis being slightly tipped to the side, the duration of night and day variates on Earth, causing the seasons.

Just a small part of the sunlight reaches the Earth. Half of it is either reflected ~~away~~ or ~~is~~ absorbed by the atmosphere. White light, as seen on Earth is actually electromagnetic radiation comprising of all colours of the rainbow. Each colour has a specific wavelength. When the light hits non-transparent coloured surfaces, part of it is reflected, which is seen as different colours (white reflects most of the light, black absorbs it).

Co-funded by the
Erasmus+ Programme
of the European Union

Visible light is just a small part of the sun radiation spectrum, comprising of: ultraviolet, visible and infrared light as well as radio waves.

Electromagnetic spectrum of the sun



The most relevant aspect of the sun's energy is its big impact on the development of life on Earth. In the process of photosynthesis, plants use sunlight, to produce glucose (sugar) from water and carbon dioxide to grow and develop. A By-product of this process is oxygen, which most lifeforms need for breathing.

The sun creates a habitable environment on Earth for all organisms. Humans took it one step further by learning how to convert solar energy into electric and heat energy. They are renewable sources of energy.

SOURCES:

-https://www.youtube.com/watch?v=2HoTK_Gqi2Q *(National Geographic; Sun, 5 min video)*

-https://www.youtube.com/watch?v=YbD4O_MQJ1U *(360° video, Sun and black hole, 1min)*

-http://botanika.biologija.org/spoznavamonaravo7/Spoznavamo-naravo-7-vzorcna-poglavja-02.pdf

-https://en.wikipedia.org/wiki/Sun

-http://www.ces.fau.edu/nasa/module-2/radiation-sun.php

-http://www.andros.si/vesolje/sonce.html

-https://en.wikibooks.org/wiki/High_School_Earth_Science/Energy_in_the_Atmosphere

-http://eucbeniki.sio.si/nar6/1541/index1.html

Co-funded by the Erasmus+ Programme of the European Union

Learning unit 1.2 – Teaching plan

Sun and solar renewable energy

In this unit pupils discover that the white visible light ~~is~~ actually contains all rainbow colours and that different types of sun rays have different effects on us and our surroundings. Furthermore, through experiments they can find out how we can protect ourselves from harmful sun rays.

TIME: 45 min

CLASS ORGANISATION: group work, frontal

METHODOLOGY: Video presentation, discussion, experimental work

LESSON GOALS:
Topic of the project: Sources of energy
Pupils learn:
- the importance of the sun as the main source of energy
- temperature measurement

Additional goals:
- in the white light we can find all colours of the rainbow
- the sun spectrum comprises different wave lengths

MATERIALS:
- computer and projector, video
- materials for different experiments (see the description of the experiments below)

INTRODUCTION/MOTIVATION (10 minutes):
The class watches a 5 min video by National Geographic. The topics covered in the video are: how the sun was formed, its composition, age and how it produces energy. The video is in English. The teacher could simultaneously translate it, it could be watched in English class or by opening the “Settings”, subtitles can be activated in the preferred language. The discussion can already take place while watching.

MAIN PART (30 minutes):
Teacher divides the class into three groups. Each group conducts one experiment, using the given worksheets. The teacher makes sure that the pupils now what to do and only steps in when necessary.

ASSESSMENT (10 minutes):
Each group presents their experiment to the whole class. Afterwards they present their results:

1. The spectroscope splits white light into the rainbow colours.
2. Only IR light made the water temperature increase.
3. UV light makes tonic water blue. High amounts of UV light are dangerous to all living creatures. The experiment also presented solutions on how to protect ourselves.

Co-funded by the Erasmus+ Programme of the European Union

Learning unit 1.2 – Experiment 1

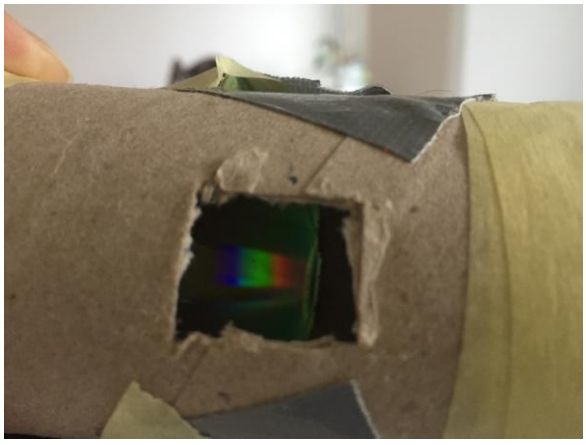
Rainbow and white light

MATERIALS:
- glass prism (demonstration)
- torch/flashlight
- 3 cardboard rolls (from toilet paper, one should already have a small window and a slot, see photo)
- CD disc
- scissors and tape
- cardboard

1. Demonstration: Irradiate the glass prism with light from a certain angle to project a rainbow onto the wall. Change the flashlight angle and see if the rainbow changes.

2. You will make a spectroscope, a simple device separating visible white light into different colours. The three cardboard rolls should be taped into one long tube. Place the roll with the window and the slot on one end. The open parts of the tube should now be closed with firm paper. Make a slot on the opposite end of the roll (see arrow). Insert a CD disc into the bigger slot and look through the small window. Do you see the rainbow? Go around the classroom and search for different types of light. Is the sun light producing a different rainbow than lights in the classroom?

RESULTS:



Draw a rainbow. Explain how it is formed inside the spectroscope.

Co-funded by the
Erasmus+ Programme
of the European Union

Learning unit 1.2 – Experiment 2

The spectrum of the sun

MATERIALS:
- 3 petri dishes
- thermometer
- white / IR / UV lamp
- permanent marker
- stopwatch

Write “white”, “infrared” and “ultraviolet” on the petri dishes. Add a small and equal amount of water into each petri dish. Use a thermometer to measure the starting temperature. Write down the number. Then, start irradiating each petri dish with the specific light for 4 minutes, then measure the water temperature again and write the numbers down. Wait another four minutes and measure again. Use a stopwatch to measure the time.

	Starting T (°C)	After 4 min (°C)	After 8 min (°C)
White light			
Infrared light			
Ultraviolet light			

RESULTS:
Explain the measurements and what you think they mean.

Co-funded by the Erasmus+ Programme of the European Union

Learning unit 1.2 – Experiment 3

Effects of the sunlight

MATERIALS:

- 5 plastic cups
- cling film
- scissors
- permanent marker
- white/IR/UV lamp
- tonic water
- sun-cream SPF50 / olive oil / cotton handkerchief or napkin

Label the plastic glasses as in the table below. Fill tonic water into four cups (approx. half full) and water into the last cup. Place cling film on top of each cup and cover three of them with the different substances (sun-cream, olive oil, cotton napkin). One cup with tonic water and the cup with normal water are only covered with the cling film. Irradiate each cup with the different types of lamps and observe.

	White light	Infrared light	Ultraviolet light
Tonic only			
Sun protective cream			
Olive oil			
Cotton handker-chief or napkin			
Water			

RESULTS:
Explain your observations and what you think they mean.

Co-funded by the Erasmus+ Programme of the European Union

CONTACTS: SOLARTOWN.EU

Contacts:

WEBSITE: https://solartown.eu/

NATIONAL CONTACTS:

akaryon GmbH, Austria

Website: http://www.akaryon.com/

Climate Alliance Austria

Website: http://www.klimabuendnis.at/

Solar Heat Europe/ESTIF

Website: http://www.solarheateurope.eu/

KPE Pertouliou Trikkeon, Greece

Website: https://blogs.sch.gr/kpepertoul/

VseUK Institute, Slovenia

Website: http://www.vseuk.si

Co-funded by the Erasmus+ Programme of the European Union