SCHOOLS GO GREEN

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Project number: 2020-1-DE03-KA201-077258

Energy Resources and Management

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LESSON PLANS FOR TEACHERS

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Project Information

PROJECT: Schools Go Green

PROJECT TITLE: DEVELOPING A WHOLE-SCHOOL APPROACH TO PROMOTE SOCIAL CHANGE AND SUSTAINABLE DEVELOPMENT AS A RESPONSE TO ENVIRONMENTAL CHALLENGES

ACRONYM: SCHOOLS GO GREEN

PROJECT WEBSITE: https://schoolsgogreen.eu/

PROJECT NO.: 2020-1-DE03-KA201-077258

PROJECT COORDINATOR: LEIBNIZ UNIVERSITAT HANNOVER, GERMANY

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Contents

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Module: Energy Resources and Management

Topic 1 Title: European Green Deal and Introduction to energy topics

Lesson Plan 1: Energy in a nutshell and links to the EU Green Deal
(Source for Task 2: https://www.teachengineering.org/lessons/view/cub_energy2_lesson01)

Duration: 45 minutes

Short Description of the Lesson	With an introduction to the EU Green Deal goals and how important is the energy sector towards the green transition, students get familiar with the definition of energy. Students also discuss specific energy types and practical energy sources. Finally, associated hands-on activities and quizzes help them identify energy types and enhance their understanding of the concept of energy.
Learning Goals	During this activity students: • Get introduced to the EU Green Deal goals linked to the energy sector, • learn the definition and the different forms of energy, • learn about renewable and non-renewable energy and complete an energy sort.
Green Competences Linked	Can assess and question personal needs to carefully manage resources in the pursuit of longer-term goals and common interests. Knows that damaging and exhausting natural resources can lead to disasters and conflicts. Can identify processes or action that avoid or reduce the use of natural resources. Knows the difference between short, medium and long term approaches and their implications for sustainability scenarios.
Target Group	Secondary school students aged 9-12 years old
Educational Approach	Constructivist approach
Link to School Curricula (if applicable)	Science, Interdisciplinary, Physical Science
Facility/ Equipment	• Classroom • Internet access • Projector • White board
Tools/ Materials	• Printables (Worksheets no.1 and no.2)

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Main Tasks	**Task 1: Introduction to the EU Green Deal goals (10 minutes)** **You can show to your students the following video that explains the EU Green Deal goals:** **Teaser: European Green Deal package:** https://www.youtube.com/watch?v=YEgS_97ltLQ (1 min, 24 sec) **1.1 Introductory activity** Students identify repeated keywords in the above-mentioned video. A first cycle of discussions may start by asking students about this video, which are the repeated words, they are related to energy and why? Why do they think that energy is important? But wait, what is energy? **Use pg. 7 – 8 from the Teacher's Handbook and Slides 1 – 3 from the students presentation to explain the EU Green Deal goals and why is important in terms of the energy topics.** **Task 2: Introduction to Energy basics (30 minutes)** **2.1 What is energy?** You cannot always see energy, touch it or hold it in your hand, but energy is everywhere! Energy is the ability to do work, to make things happen and to cause changes. Energy cannot be made or destroyed; it can only be changed into different forms. Can you name a form of energy? (Examples: Light, heat, electricity, sound.) From where do you think we get electricity? (Possible answers: Power plant, the outlet in the wall, food.) **Video:** Energy | The Dr. Binocs Show | Educational Videos for Kids https://www.youtube.com/watch?v=Q0LBegPWzrg (4 mins and 13 sec.) **Video:** What is Energy? Energy Types for Kids - Renewable and Non-Renewable Energy Sources https://www.youtube.com/watch?v=aFpC1vAIgNc (3 mins and 42 sec.) Write the following phrases on the board and discuss with the class. **What is energy?** • The ability to do work or cause change. • Work is the application of a force through a distance. (Ask students for examples, such as moving a box across the room, sweeping, etc.) Force can put matter into motion or stop it if it is already moving. Motion is a change in position of an object with time. • To do work, energy is needed.

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From where does energy come?

- Natural energy sources: food, water, plants, trees, gravity, sun, fossil fuels, uranium, plutonium
- Ways that humans have harnessed or converted natural energy sources: hydroelectric dams, coal/oil power plants, nuclear power plants, wind turbines, solar panels, etc.

LET'S TAKE A JOURNEY AROUND THE WORLD TO SEE SOME EXAMPLES!
Explore Google Earth Voyager map 1 AND Google Earth Voyager map 2 to discover low carbon energy projects from around the world, including offshore wind, solar, geo-thermal, hydro-electric and nuclear power plants.
Hint: *Just click on the Present button on the bottom-left corner and the journey begins.*

What are different types of energy? (See the Vocabulary/Definitions section.)

- Kinetic energy: electrical, light, thermal, solar, sound, wind, hydro
- Potential energy: chemical, mechanical, nuclear, gravitational

How do we use energy?

- To break down and digest food (in our bodies)
- To heat houses and other buildings
- To illuminate lights
- To power televisions, phones, games, cars
- To run computers and appliances

This is linked to the Energy end user categories on the Teacher's Handbook on pg.11

Use **Worksheets no.1** and **no. 2** for each student in the form of short quizzes about energy definition and different energy sources.

Use pg. 8 – 10 from the Teacher's Handbook and Slides 3 – 6 from the students' presentation to introduce the energy definitions and energy sources.

Module: Energy Resources and Management

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Topic 2 Title: Energy consumption and Renewable Energy Sources	
Lesson Plan 1 – Renewable Energy Activists (https://www.golabz.eu/ils/renewable-energy-activists)	
Duration: 3-4 lessons of 45 minutes (approx. 160 minutes)	
Short Description of the Lesson	This inclusive environmental ILS was designed implementing the socioeconomic impact approach. The main objective is to promote a discussion related to the importance of renewable energy, to engage students in investigating the uptake of renewable energy in their country or region. The ILS will invite students to explore the positive and negative aspects of renewable energies, the difficulties in convincing companies and politicians to take the necessary steps towards its adoption. This project also helps students develop their organisational skills by inviting them to learn how to use a SWOT analysis to support their claims. It invites students to collaborate and cooperate towards the construction of a competing report with their findings. Several important competences will be developed along the process: critical thinking, communication skills, creativity among others.
Learning Goals	After this activity, students should be able to: • Understand the pros and cons of the main types of renewable energy sources • Be able to engage in debates about controversial topics • Understand and perform a SWOT analysis • Collect and work with real-world data • Justify and communicate their ideas
Green Competences Linked	
Target Group	Primary school students aged 10-12 years old
Educational Approach	Inquiry-based approach (Inquiry Learning Systems)
Link to School Curricula (if applicable)	Environmental Education, Climate Climatic Phenomenon (Climate) Energy
Facility/ Equipment	• Classroom • Internet access • Projector • White board
Tools/ Materials	• Computer lab • Teacher's Handbook • Students' Presentation
Main Tasks	**Introduction to the Activity and links to the previous Lesson Plan (20 minutes)**

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Explain to your students what energy consumption is! Linked to the previous Lesson Plan you may wonder: Ok now that we know how the energy is produced how can we quantify how much energy is needed for our daily activities, at a country level or globally?

Video: How much electricity does it take to power the world?
https://www.youtube.com/watch?v=tjwrG4Debc4 (5 min and 1 sec)

Video: Cities & Rising Energy Consumption 101 - Matt Ferrell x Student Energy
https://www.youtube.com/watch?v=7itJt8c0V8M(6 min and 4 sec)

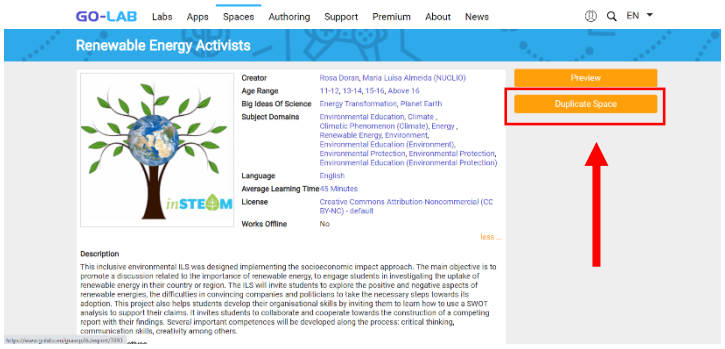
Energy consumption background info and useful maps and graphs may be found in the Teacher's Handbook on pg.18 – 22. In addition, you may let the students navigate and explore the following data:

https://ourworldindata.org/energy-production-consumption

Task 1: Prepare the activity (Renewable Energy Activists)

Teachers can use the following link to enter the educational scenario:
https://www.golabz.eu/ils/renewable-energy-activists
The activity is already set-up, the teacher has just to duplicate the scenario online (via the GoLab platform) and share the link with the students. The students work individually or in groups during this activity.
With the preview button (see image below) you can see how the activity looks like for the students!

1.1 Duplicate the activity and share the link with your classroom



1.2 Log-in to the graasp.eu platform using your Google account, or you can register as a new user with your own credentials.

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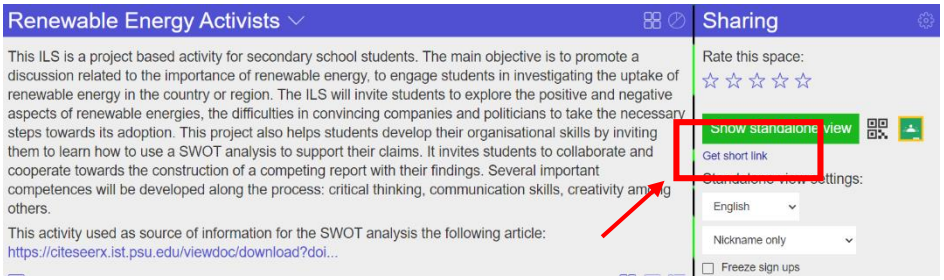
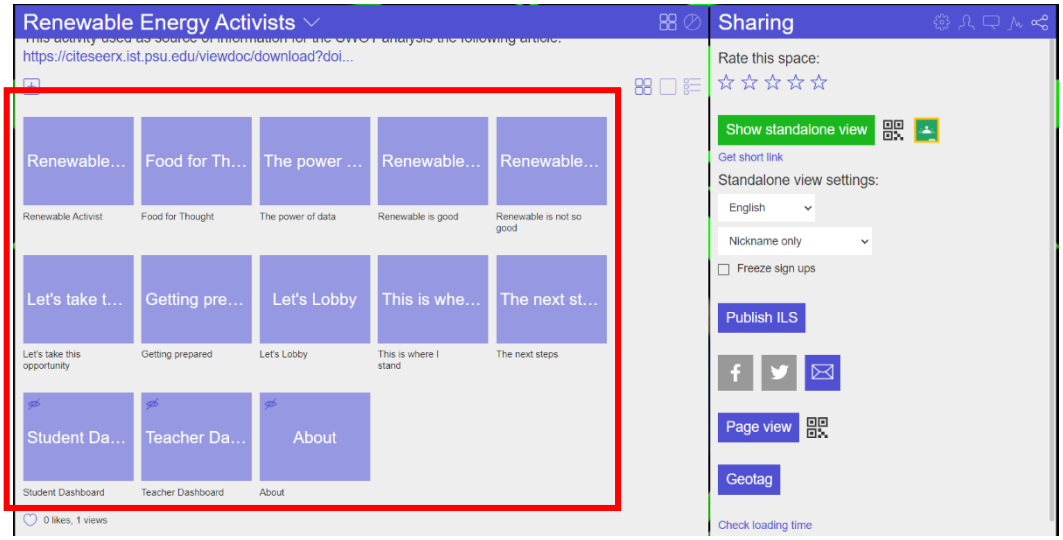
1.3 Get the short link to share with your classroom



1.4 Once you have the shareable link for the students, the activity is already set-up on the platform. Using your profile with all sections of the activity you can find and assess students' answers and results.



By selecting each one of these boxes, you can see each content's items, for instance, photos, students' answers etc.

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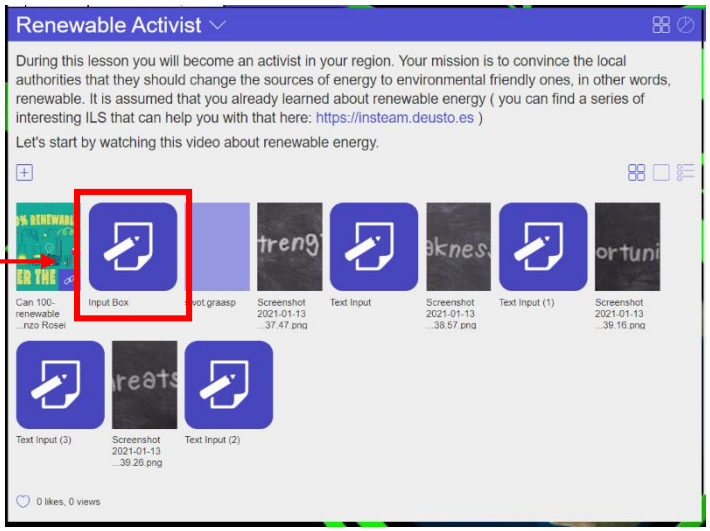
Students' answers



Task 2: Time schedule for the activity (Renewable Energy Activists)

Section 1: Renewable Activist (**6 minutes video + 15 minutes** students' work on SWOT Analysis)
Section 2: Food for Thought (5 videos of **10 minutes in total + 15 minutes** to review the SWOT steps they wrote. Alternatively, this step can last more, maybe 1 hour, if the schools and the students are willing to invite experts, scientist and people from the local community to collect further information)
Section 3: The power of data (**30 minutes** where the students justify their options, opinions and strategies about the mixture of RES they are planning to use. They work on real data, extracted from https://ourworldindata.org/ website, they analyse graphs and maps in order to have an holistic view of RES development in their country)
Section 4: Renewable is good (**15 minutes** for arguing on the positive aspects of RES)
Section 5: Renewable is not good (**15 minutes** for arguing against RES). Apart from the material presented in this Section, you can also use the following graphs from https://ourworldindata.org/ where the cost analysis for all RES is presented in graphs: https://ourworldindata.org/cheap-renewables-growth
Section 6: Let's take this opportunity (**15 minutes** to write what their local community is doing to succeed the Paris Agreement goals about the Global energy transformation)
Section 7: Getting prepared (**30 minutes** where the students will integrate and finalize their report including all of their findings)
Section 8: Let's lobby (**Optional activity – 45 minutes**, «The 6 thinking hats»)
Section 9: This is where I stand (**Optional activity – 45 minutes**, Reporting on the «The 6 thinking hats» activity)
Section 10: The next steps (Closing discussions with the students – **5 minutes**)

Module: Energy Resources and Management

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Topic 3 Title: Energy consumption and efficiency	
Lesson Plan 1 – Monitoring energy consumption and efficiency	
Duration: 2 lessons of 45 minutes (90 minutes)	
Short Description of the Lesson	Students complete three different activities to evaluate the energy consumption in a household and explore potential ways to reduce that consumption. The focus is on conservation and energy efficient electrical devices and appliances. The lesson reinforces the relationship between power and energy and associated measurements and calculations required to evaluate energy consumption. The lesson provides students with more concrete information for completing their culminating unit assignment.
Learning Goals	After this lesson, students should be able to: • Calculate energy use and analyze how changing behaviors and appliances affects energy use. • Conduct an experiment and make comparisons based on experimental evidence. • List and explain ways to conserve energy and explain how energy conservation can reduce the environmental impact of resource extraction; • Describe how buildings can be made more energy efficient and why is that so important
Green Competences Linked	
Target Group	Primary school students aged 10-12 years old
Educational Approach	Presentations, Videos, Discussions and Gamified activities
Link to School Curricula (if applicable)	Science, Physics, Earth and Environmental Sciences
Facility/ Equipment	• Classroom • Internet access • Projector
Tools/ Materials	• Computer lab • Teacher's Handbook • Student's Presentation
Main Tasks	**Introduction to the Activity and links to the previous Lesson Plan**  How you ever considered how exactly we calculate our energy consumption at home? Have you come up with some good ideas about how you might reduce your energy consumption? Have you ever heard about energy vampires? Yes, we all have energy vampires at home! In this lesson, we will explore more closely how we use energy in our homes and identify some ideas for conserving energy or using it more efficiently.

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Recall these terms:

Conservation – not using consumer energy products (for example, turning lights off, walking instead of driving)

Efficiency – benefiting from the value of using energy (for example, still being mobile), but consuming much less energy to meet same goal.

Go through pages 13-18 of the Teacher's Handbook (Energy consumption and efficiency module)

Task 1: Monitoring energy consumption at home (60 minutes)

1.1 Introduction to energy consumption (40 minutes)

You can start the activity with the following videos explaining energy consumption at a global scale as well as in our cities. Remember that students already know form the previous lesson plan (Energy production and energy sources) how energy is produced and sources of renewable and non-renewable energy.

Video: How much electricity does it take to power the world?
https://www.youtube.com/watch?v=tjwrG4Debc4 (5 min and 1 sec)

Video: Cities & Rising Energy Consumption 101 - Matt Ferrell x Student Energy
https://www.youtube.com/watch?v=7itJt8c0V8M(6 min and 4 sec)

You can use the graphs and maps in pg. 18 – 21 to illustrate energy consumption patterns and numbers worldwide. In addition, students may use these interactive maps to see the energy consumption per country and per source of energy production.

Hint: In order to be easier for the students the amount of energy used globally you can show to them the following example comparing the energy consumption (mean) per household and globally.

2 – 8 MWh / year **500.000.000 – 10.000.000.000 MWh / year**

At this point, you can use pages 22-23 of the Teachers Handbook to explain how the total energy consumption is highlighted above is distributed per sector (i.e. household, transport, industry etc.). Speaking of that, 28% of the total energy consumption is linked to the energy we are using in our houses (i.e. the 2-8 MWh/year). **Now the challenge begins!**

You may ask students if they can calculate their home energy consumption! To succeed this, they must first create a list or a drawing with the electric devices they have in their home, cooling/heating components etc.

It is also important to list all bulbs in their house (type, wattage and hours per day they lights are on - approximately)

1.2 Monitoring energy consumption at home (20 minutes)

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After the students create the drawing or the list with all devices consuming energy in their home, they may start calculating the total electricity consumption and how much does it cost using the following App:

APPLIANCE CALCULATOR

Keep in mind that the calculator works for the US, hence, it would be useful to explain to students how we convert US dollars to Euros in order to be more realistic. You may use the following calculator to make all conversions:

Google 'us dollars to euros converter'

Task 2: Managing energy consumption and efficiency at home (30 minutes)

2.1 Introduction to energy conservation and efficiency (15 minutes)
You can continue to this lesson plan by explaining to the students that ok, now we know how much energy we consume on a daily or annual basis, but, what can we do to conserve energy or increase our house energy efficiency? What is the difference between energy conservation and energy efficiency?

Let's start with an explanation of what energy conservation and energy efficiency is:

Video: Energy Conservation vs. Energy Efficiency (1 min and 32 sec.)
https://youtu.be/lqJ3ckBncyY

Video: What is energy efficiency? (1 min and 3 sec.)
https://audiovisual.ec.europa.eu/en/video/I-196319?&lg=EN

Video: Energy efficiency? (3 min and 14 sec.)
https://www.youtube.com/watch?v=D11iFUw_ImU

Go through slides 13-18 (Energy consumption and efficiency module)
Go through pages 13-18 (Energy consumption and efficiency module)

Provide 1 worksheet per students (see Printable no.4) and ask them to answer the question on it (5 min)

2.2 Mapping Vampire Energy (30 minutes)
The first simple activity to understand what energy conservation is linked to the mapping of the vampire energy!
Visit the following webpage:
https://www.saveonenergy.com/learning-center/mapping-vampire-energy/
At first, you may ask students what they think that Energy Vampires are? (10 minutes)

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Go through Slides 18-20 (Energy consumption module)

Explain to students what Energy Vampires are. You can use all info presented on Teachers Handbook (pg.19-21)

Present Energy Vampires photo (Slide 19) on the projector about energy consumption of energy vampire devices at home and ask them to go through the pages 9 and 10 of their Presentation (see Photo 1) (15 minutes)

Estimate your Energy Vampires at the school classroom, labs etc. (20 minutes)

At the bottom of the **Energy Vampires website**, you may find vampire energy calculator has the potential to help you see which devices are costing you the most. Using this tool, students will better understand how much of their school money is wasted on the electronic devices they don't use.

This application is already set-up for the United States; therefore, you can alternatively ask from students to find a city/state in the US that is located at the same parallel with their city, using the following maps:

Google Maps

Interactive map (you make drag US cities on top of Europe)

By selecting the appropriate State in the app (1st selection), students may start monitoring for 30 minutes different plugged and unplugged devices in their school.

You can use **Printable no.4 (Students Worksheet). They can work in groups of 2 – 5.**

When the students finish their energy vampires monitoring, they can start adding all devices in the online app in order to estimate their total savings!

2.3 Lighting Savings Calculator (15 minutes)

Mapping vampire energy was focused on energy conservation measures. However, energy efficiency is something different and most of the times a little bit more demanding and complex.

A simple example is shown below. You can ask from students to fill in the information they have collected from Task 1 (count the number, wattage and type of light bulbs) on the following application:

Lighting Savings Calculator

With this simple exercise students understand how we can increase energy efficiency by changing our house bulbs.

Important note: Remind to students the total annual energy consumption of a household! Having 7 bulbs working for 5-7 hours per day can reduce our energy consumption by approximately 1000 kWhs/year. Not bad! Hence, improving energy efficiency matters!

But, what if we have already changed our house bulbs to more efficient? Let's move on to the next task!

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	Task 3: Renovation wave game (45 minutes)  **3.1 Introduction to the renovation wave in Europe (20 minutes)** You may start this activity with the following videos explaining the targets and the goals of buildings renovation in Europe during the next years.  **Remember that one of the most crucial aspects of buildings renovation has an enormous societal impact (i.e. reduce energy poverty) and this must be highlighted. Energy efficiency measures have not only economic benefits!**  **Video:** EU Renovation Wave Strategy *(1 min and 16 sec.)* https://www.youtube.com/watch?v=gGK_kPaieXo  **Video:** Green sustainable and healthy buildings explained *(2 mins and 25 sec.)* https://www.youtube.com/watch?v=dDATY3av_48 **You may use Printable 4, pages 23-26 from the Teachers Handbook and Slides 21-23 from the students' presentation to explain what building renovation is, why is it important and what options do we have!**  **3.2 How to deep renovate your house (25 minutes)** Energy Renovation is fun! 4RinEU launches an online game to teach young students the benefits of deep energy renovation. This educational game has been designed to engage with citizens and, ultimately, drive behavioural change in their communities. What does deep energy renovation mean? How can I manage the budget to renovate my home? What are the most suitable technologies? Play with us and find out! The tool is based on simulations of the energy performance of a single-family house before and after the renovation. Upper primary school students can either play alone or try it in class with their teachers and friends. The game offers a great starting point to discuss about energy efficiency and how the choices we make at home may have an impact on the environment …and on our wallet!  **How to deep renovate your house?**
Extracurricular Activities Inspire others to reduce their energy consumption	Students brainstorm how to reduce everyday energy consumption at home and in school (e.g. turning down radiators, unplugging appliances not in use). Each produces a Top 10 Tips (e.g. infographic, poster, social media post) aimed at other young people. Students next test the tips with their peers. What is the most effective way to persuade others to make changes?

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Module: Energy Resources and Management

Topic 4 Title: Light Pollution Mapping

Lesson Plan 1 – Light Pollution hunters

Duration: 2 lessons of 45 minutes

Short Description of the Lesson	Students will gain an understanding of what light pollution is, how it impacts our environment, how we map light pollution and we can work with real data in order to identify changes as well as on how we can reduce and apply mitigation measures.
Learning Goals	• Describe different types of light pollution • To recognise some sources of light pollution and describe how these affect how we see stars in the night sky • To conduct an experiment to find out how artificial light can be directed and which materials and shapes would help do this
Green Competences Linked	
Target Group	Primary school students aged 10-12 years old
Educational Approach	Inquiry-based scenario
Link to School Curricula (if applicable)	Environmental education, Geography, Physics (Energy)
Facility/ Equipment	• Classroom • Internet access • Projector • White board • Personal computers
Tools/ Materials	• Sticky notes
Main Tasks	**Task 1: Introduction to Light Pollution (60 minutes)**  **1.1 Eliciting questions and Background Exploration** (10 minutes) Start by leading a brainstorm about how we use light in our daily lives.  **Video:** Light Pollution explained *(1 min and 16 sec.)* https://youtu.be/V_A78zDBwYE

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Use pages 30 – 32 of the Teachers Handbook and Slides 24 – 27 of the students' presentation to explain Light Pollution, its causes and effects!

Task 2: Light pollution monitoring and mapping (10 minutes)

You can ask students if we can see Light Pollution from space! Is this possible and how?

Use the following video as an introduction

Video: Light Pollution mapping *(2 mins and 25 sec.)*
https://youtu.be/ZYGd-llxHJE

Now let's use an online Geographic Information Systems platform to monitor light pollution at a global scale!

You can use the Dark Site Finder app in the following link:

Dark Site Finder

Let the students to navigate on the map and identify different areas of increased light pollution.

Discuss with the students their thoughts and if any correlation exists between the sites of increased light pollution and the number of people live there (big cities, industrial areas, roads etc.). This map is real, however, is a little bit enhanced in terms of the light pollution distribution, spread and colours. What is next?

TO WORK WITH REAL DATA AND DIGITAL TOOLS! LET'S DO THIS!

Task 3: Light pollution in our area/city/region using real data and tools (30 minutes)

3.1 Introduction

- **Video:** How one NASA image tells dozens of stories (5 min)
  https://youtu.be/ZYGd-llxHJE

3.2 Case study - Implementation phase

see Annex I with all technical guidelines step by step (25 minutes)

3.3 Discussion - Explanation based on evidence (10 minutes)

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Encourage your students to provide correct explanations for the topic(s) investigated. Describe ways and they can use to this end and give them directions how to discover them. You can start a conversation related to the results explanation by asking:

- What do you think that the minimum and maximum values indicate?
- Negative values point out a potential Light Pollution decrease?

On the contrary, increased positive values highlight a potential Light Pollution increase between 2012 and 2021?

3.4 Reflection - Communicate explanation (Homework)

Help the students to get familiarized and to become efficient in scientific writing or poster presentation.

Ask from students to write a short report by incorporating the scope of this Activity (the objective?), the data and the tools they used, what methodology (QGIS tools) and to present their results in the form of maps (images) by reporting the differences of Light Pollution levels between 2012 and 2021.

They can also report all potential adjustments they made (clipping areas) or any future research they want to consider (add Light Pollution data for year 2018, 2020 etc.).

The report outline could be in the form of: Introduction, Study area and Data used, Methodology (tools), Results and Discussion.

The final round to save your country!

Additional resources:

http://2050-calculator-tool.decc.gov.uk/#/calculator

Having learned everything about Energy, it's time to save your country and the whole Europe. How? Using the 2050 calculator! All changes, ideas and lesson you've learned can now be quantified in terms of the changes needed in our daily lives.

First, you have to save UK, see all success stories and mitigation strategies you have selected, then map your results and see how much space is needed for your plans to be

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	fulfilled until 2050. Based on your country's size and location (near the sea or not, has mountains, has enough solar potential or biomass potential etc.), estimate how many changes are needed to reach at least a 50% reduction of CO2 until 2050! The **2050 Calculator** lets you take control and create your own energy pathway for the country. The calculator allows you to consider the choices and trade-offs we face. It covers all parts of the economy and all greenhouse gas emissions released in the UK. The 2050 Calculator lets you take control and create your own energy pathway for the country. Hint: Do not forget to see the map with your changes and the Energy projects you propose in terms of the space needed and potentially the impact on the environment! **The purpose of the calculator is to build an energy pathway for your country that hits the 80% CO2 emission reduction target at the top of the page. As you get closer to achieving this the arrow will move to the right!**

ANNEXES

Energy in a nutshell - Worksheet1_energy2_lesson01_vocabquiz

Energy in a nutshell - Worksheet1_energy2_lesson01_vocabquiz_ANSWERS

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Energy Consumption and Efficiency - Worksheet_1_Energy-Conservation-vs.-Energy-Efficiency

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Energy Conservation and Efficiency - Printable2_Annual_costs_per_device

Energy Conservation and Efficiency - Printable_3_vampire-energy_3

Energy Conservation and Efficiency - Printable4_Renovation_ideas

Light Pollution - Appendix_Light_Pollution_Case_Study

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