



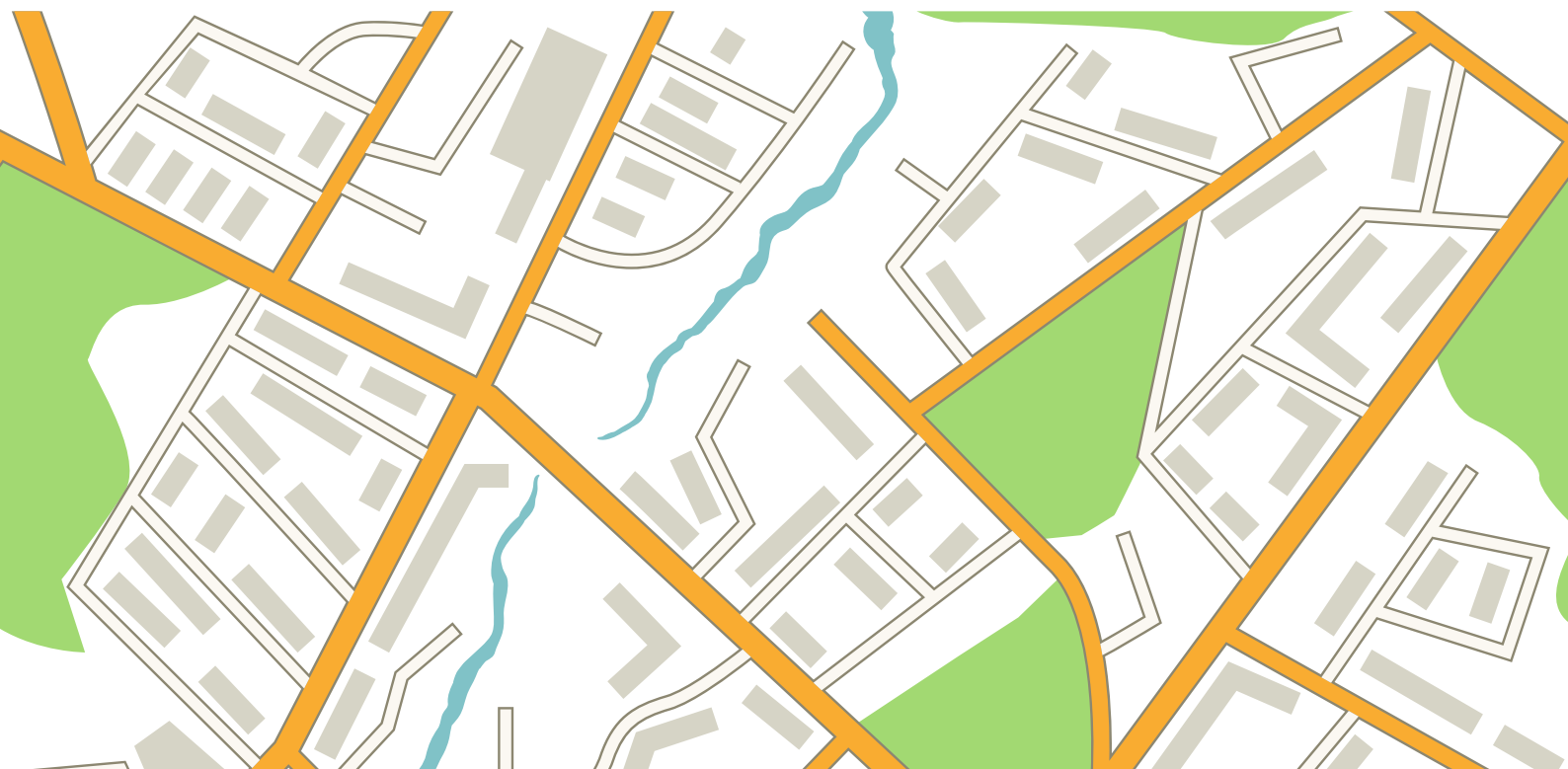
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# GEO-ACADEMY

GEO-Hub for teachers in Europe

## A Teacher's Guide to the GEOBSERVE portal



# 2023 2025

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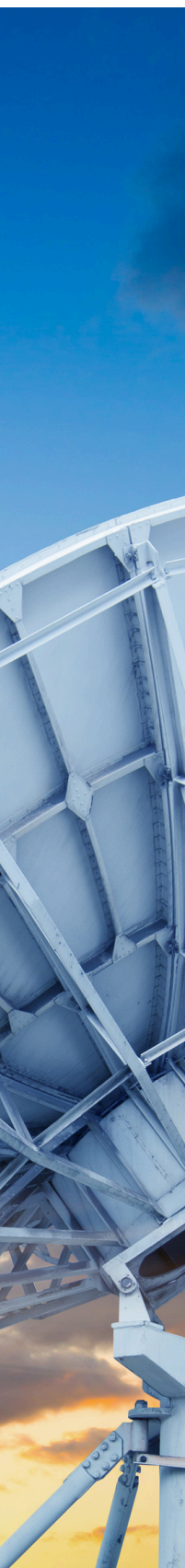


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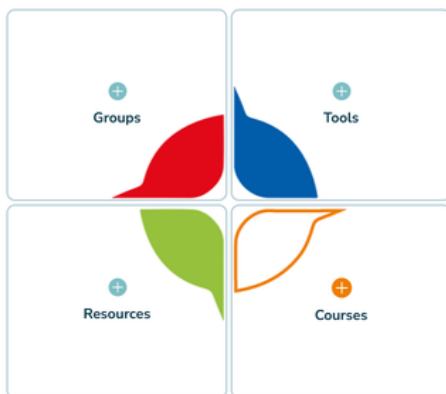
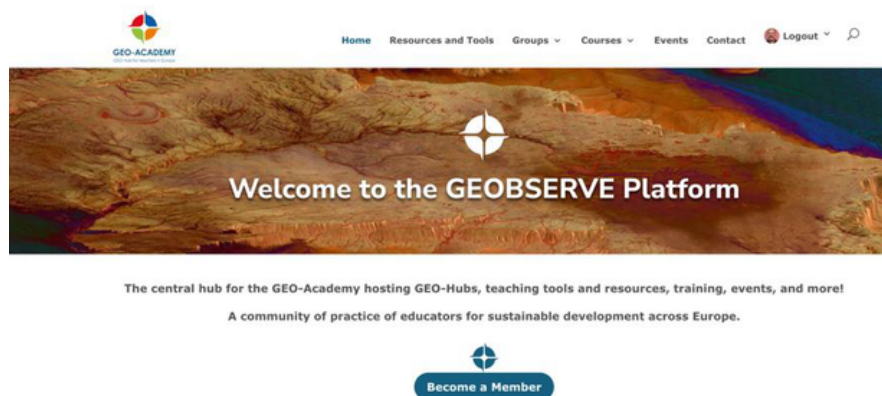
# GEO-Academy

GEO-Academy is an Erasmus+ project, aiming to develop a network offering tailored teacher training and development to incorporate Geographic Information Systems (GIS), Remote Sensing (RS) and Earth Observation (EO) along with Geospatial Storytelling in environmental and Sustainable Development education topics through tools and materials. The project developed the GEOOBSERVE platform, hosting trainings and materials, as well as resources and guides to support implementation in the classroom, available free and accessible everywhere.

## GEOOBSERVE



GEOOBSERVE is a virtual meeting space for teachers where they can exchange best practices, access and share tools and resources, and training materials which are stored and distributed through the GEO-Academy Hubs.



The **“Groups”** feature are spaces where the members of the specific GEO-Hubs (National and International) can find their common areas to share best practices, exchange ideas, connect to their peer colleagues.

Within the **“Tools”** feature, tools such as a software, web service or application that can be used to explore geographical information such as maps, satellite imagery etc, are included.

The **“Resources”** feature includes online repositories of educational materials such as lesson plans, presentations, videos and similar.

The **“Courses”** feature consists of courses will include e-learning modules, courses and training activities for international professional development, aimed at empowering teachers to incorporate GIS, EO, RS and Geospatial Storytelling within sustainability development education in schools

## How will my students benefit from the GEO-Academy portal - GEOBSERVE?

First, students need to know what they are learning. **Much of the content you will find on the Geo-Academy portal is *interdisciplinary* and is covered in “E-modules”.**

The good news for teachers is that this means there are many entry points to choose from among the wide range of offerings on the Geo-Academy portal.

Secondly, students need to know whether they have learned what they were supposed to learn. For this reason, the Geo-Academy portal includes a section specifically dedicated to assessment.

**However, it is best for teachers to *start with* the content covered in the various *E-modules*.**

**In summary, there are three main areas in the portal:**

1. *E-modules* related to *spatial, digital, and green competencies*
2. Details about the *interdisciplinary* aspect of the *E-modules*
3. Details on the *assessment* for achieving the learning objectives

**The Geo Academy portal even has a section where you can find support within a professional community.**

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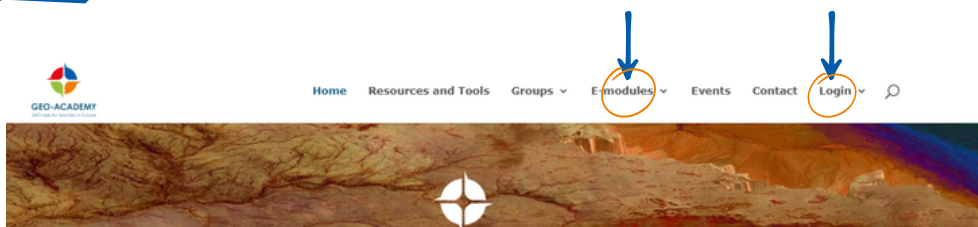
However, it is best for teachers to start with the content covered in the various *E-modules*.

**Base map to the content covered in the *E-modules*:**

Go to the portal: <https://portal.geoacademy.eu/>

If you haven't registered on the website yet, you should do so now (this will give you access to all the goodies and supporting materials available there!).

Here's how: Follow the LINK at the top right of the website! Now you can go directly to the *E-modules*! You will find the LINK in the middle of the website header.





## How will my students benefit from the GEO-Academy portal - GEOBSERVE?

Together, the E-modules cover five major content groups:

- (1) Cartography & Spatial Thinking
- (2) GIS for Earth Sciences
- (3) Earth Observation (EO), Remote Sensing (RS) & Sat Apps
- (4) Map Storytelling
- (5) Coding for Urban Sustainability

### Why „spatial, digital and green“?

Engage your students with the world they live in! Environmental topics make learning relevant and exciting—especially when combined with digital tools that bring real-world data to life. Many of today’s challenges are complex and interconnected, making it all the more important to visualize them clearly—maps help reveal patterns and relationships in space and time. Empower your students to explore, understand, and act—right where they are.

### And what about the “tools and resources” on the Geo-Academy Portal?

The portal provides many starting points and ideas for implementation in your own teaching. External tools are often used for this purpose, which are available on a wide variety of web platforms. All of the selected tools are free of charge for teachers. The individual E-modules rely on the use of these tools and link to them where necessary. An overview can be found independently under the menu item “Resources and Tools” on the portal website.

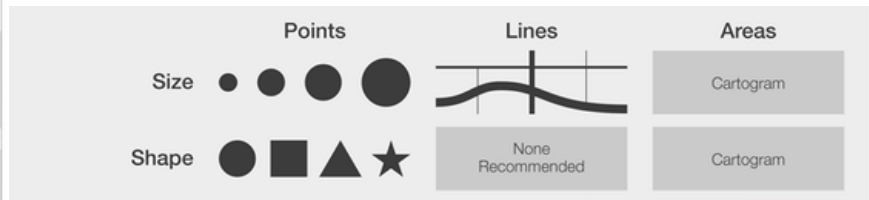
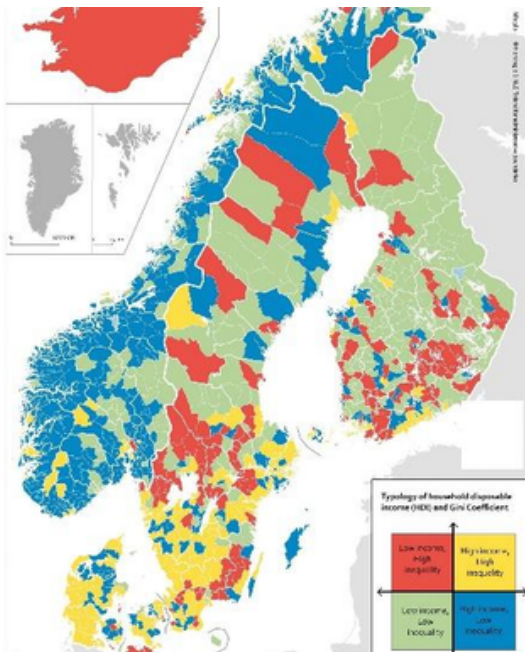
## Cartography & Spatial Thinking



Cartography and Spatial Thinking consists of both tangible and mental visualizations of spatial entities and phenomena. Many students learn best when accessing data and information that is presented visually. Thus, integrating maps into the classroom helps students to **understand the world that surrounds them and develop spatial thinking**. Understanding maps, and subsequently developing map literacy, is an important skill, not just for navigation purposes but for comprehending the living environment and underlying viewpoints. **Spatial thinking enables a person to visualise and analyse spatial relationships between objects and phenomena in geographic space**. It allows students to describe and analyse the spatial patterns and organisation of people, places, and environments. Thinking spatially about something (whether it is a place, a human issue, or a physical system) is a fundamental part of everyday human reasoning. Hence, map literacy and spatial thinking are essential across a wide range of disciplines, including science, mathematics, engineering and technical education, social studies, and arts.



## Cartography & Spatial Thinking



This e-module offers educators and students the opportunity to explore the **transformative potential of cartography and thematic mapping in teaching and learning for sustainability and beyond**.

Teachers will learn how to leverage geovisualization and thematic mapping to enhance students' spatial thinking and skills to deepen their understanding of geographic space, while simultaneously enhancing their green, technological, digital, and problem-solving skills. The module provides guidance on accessing ready-made lesson plans and introduces users to basic mapping software and apps.

Income and inequality in Scandinavian countries. Source: Nordregio at [www.nordregio.org](http://www.nordregio.org).  
 Cartographer: Gustaf Norlén <https://nordregio.org/maps/income-and-inequality-typology-2017/>

Step-by-step instructions are provided through video lectures and supplemental materials, along with resources for locating and downloading data that can be used for thematic maps creation. The course has been designed especially for teachers and no prior expertise in the field of map-making or map-reading is required. It offers a structured journey from the very basics of cartography, visualization, map literacy and spatial thinking, all the way to designing project-based classroom activities. Finally, the course provides a learning hub for making maps for students with visual impairments, addressing **inclusion in the classroom**.

We start with the basics. **We introduce the notion of geovisualization which refers to a set of tools and techniques supporting the analysis of geospatial data using interactive visualization.** The first module goes on to present basic notions of **cartography and maps since maps are the most prominent displays of geospatial data.** This theoretical module attempts to answer the question **why we can read maps** and subsequently guides teachers into the notions of visual perception and Gestalt theory. Moreover, it attempts to provide insights into the use of more than two dimensions for cartographic representations since technological advancement allows us to visualize three and even the fourth dimension (time). Finally, it gives guidelines on integrating the topics of geovisualization and cartography into the curriculum.

After introducing these theoretical foundations, **the second part guides you through the notions of thematic mapping and thematic maps, which are core building blocks of geovisualization.** Some basic information on the different types of thematic maps as well as of design issues of such maps are given throughout the module. Issues regarding the distinction between quantitative and qualitative spatial data, on spatial data classification and levels of measurements, as well as the visual variables and the underlying symbolization decisions are discussed during this module. Finally, exercises on making thematic maps are provided so that teachers can begin to familiarize themselves with the map-making process while in parallel learn to use an open-source software (QGIS) to this end.



## Cartography & Spatial Thinking

The fourth part focuses on spatial skills and spatial thinking and how maps and cartography help in their development. Spatial thinking has been recognized as a multifaceted ability at the forefront of human intelligence. Spatial thinking is a multi-dimensional ability comprising different cognitive mechanisms for manipulating objects (small-scale spatial skills) or interacting with the environment (large-scale spatial skills). The module comprises learning materials on the use of maps and state-of-the-art web mapping services such as Google Maps and how this endeavour can foster students' spatial skills. Finally, ideas of lesson plans where students learn to use maps for reasoning and decision-making are provided. Teachers can customize these lesson plans to their students' educational needs as well as to the region of their school as they think appropriate.

(a) Bird's eye and (b) oblique views of a 3D-printed map. Which represents two phenomena: (a) continent population density/km<sup>2</sup> and (b) population distribution per continent. Zacharogiorga-Sourdi, A., Kokla, M., & Tomai, E. (2022). Evaluating the usability of 3D thematic maps: A survey with visually impaired students. *British Journal of Visual Impairment*, 41(3), 646-661. <https://doi.org/10.1177/02646196221099157> (Original work published 2023)

Finally, the course includes a fifth module on cartography for people with visual impairments (VI).

The majority of people think that maps are suitable only for visual communication of spatial entities and phenomena, however, there are 2.2 billion people with some kind of VI in the world according to the World Health Organization. For this reason, there is a need to go beyond the visual channel and nowadays technology can help in the direction of adding more than visual cues into maps, such as audio and tactile ones. You are guided through the notions of **auditory and tactile maps and cartography and the respective auditory and tactile variables** used in these kinds of maps. Practical issues of how to make audiovisual and haptic maps are tackled with and some models for creating 3d-maps with the use of a 3d-printer are also provided.



(a)



(b)

Why should you join this course? Because map-making and map-reading endorse many different abilities such as deciphering a symbol, orienting yourself in space, adopting a perspective on your surroundings, reasoning about quantities and evaluating qualities and the list goes on! It provides students the ability to visualize spatial phenomena, to analyze and understand real-world problems, and to reason about the underlying complexity of the world while fostering creativity. The course is flexible, hands-on, and adaptable to any school context. By the end, you'll not only have learned how to use maps but, you'll have discovered how to integrate them into your school practices and inspire your students to visualize the world differently.

# GIS (Geographic Information Systems) for Earth Sciences

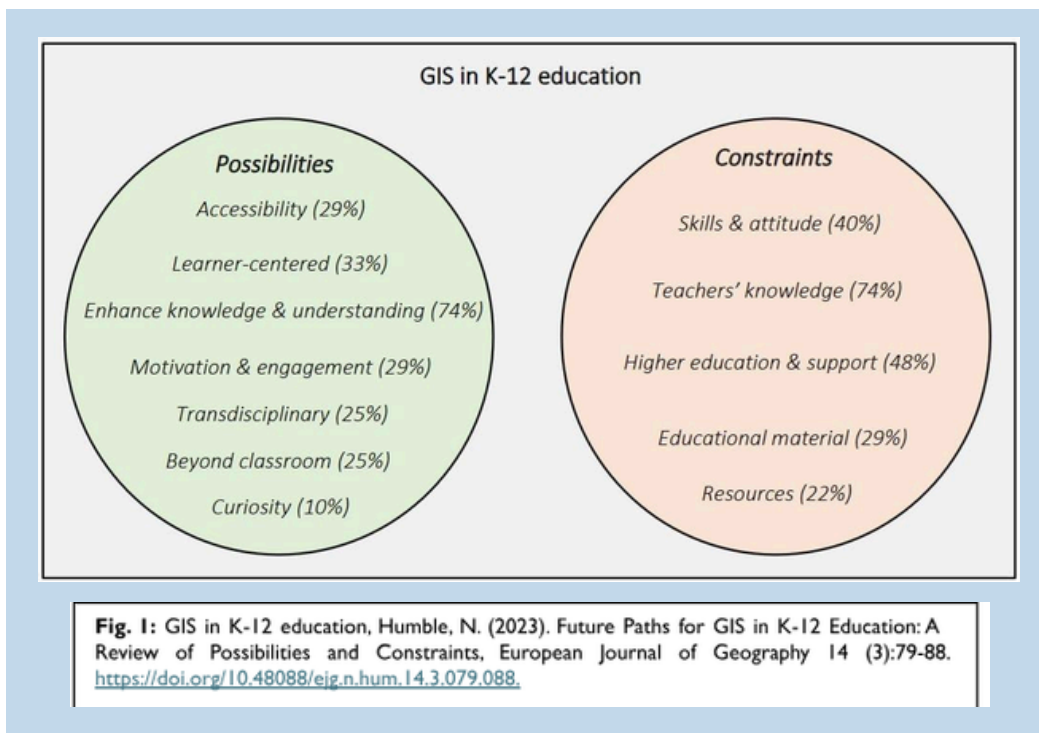


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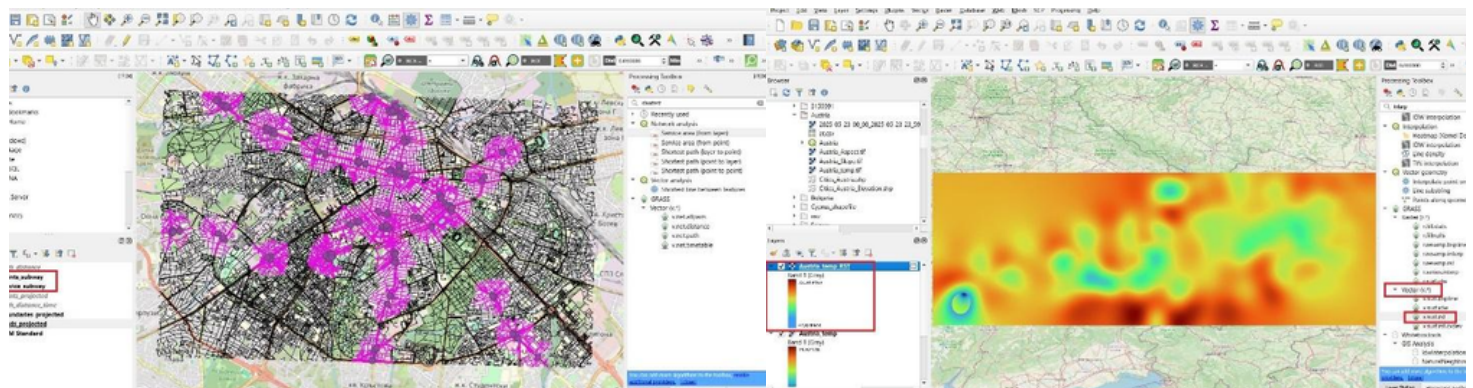
Geographic Information Systems (GIS) may sound technical at first, but at their heart they are simply tools for asking and answering where, why, when and how questions. Where should we place renewable energy infrastructure? Where are the safest routes during floods? Why is biodiversity in danger? When does the sea ice in the Arctic have its minimum volume? For schools, GIS opens up a whole new way of teaching, where maps come alive with data, and students become active problem-solvers. Integrating GIS technologies into the curriculum provides teachers and students with the opportunity to utilise the same tools employed in high-demand careers to investigate geographic questions, perform spatial analyses, and explore various themes and disciplines related to geospatial technologies. In this vein, **the GIS for Earth Sciences training course allows educators and students to explore the transformative potential of GIS technology in teaching and learning for sustainability and beyond.**

Thus, teachers and students can discover relationships, patterns, and trends through maps, spatial analysis, reports, and charts by working with real-world data on diverse sustainability challenges. **These skills are essential across a wide range of disciplines, including science, mathematics, engineering, technical education, social studies and the humanities.** Teachers will learn how to leverage geospatial information and technologies to engage students by utilizing spatial analysis to deepen their understanding of historical and contemporary events, while simultaneously enhancing their green, technological, digital, and problem-solving skills.

The course guides teachers to enhance their knowledge and skills on GIS by applying, at the same time, ready-made but easily adjustable lesson plans across various subject areas. Step-by-step instructions are provided through lectures and supplemental materials, along with resources for identifying, downloading and processing geospatial data. This course has been designed especially for teachers, and no prior GIS expertise is required. It offers a structured journey from the very basics of spatial thinking, all the way to designing project-based classroom activities and transforming your school into a Living Lab (LL) for sustainability. The structure follows a gradual learning curve, so you can build your confidence step by step! You don't always have to stick to the more complex digital pathway we show in some lessons.



## GIS (Geographic Information Systems) for Earth Sciences



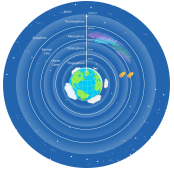
**Fig 2:** Identifying the service areas of all Metro stations in Sofia, Bulgaria, using QGIS and network analysis. Send a letter to the city Mayor to highlight all potential areas where the Metro line and stations should be expanded!

**Fig 3:** Interpolating and creating weather forecasts for Austria, using the data of the Austrian Meteorological Agency. Let your students create and debate on weather reports!

Take ideas, get inspired, and let your imagination guide you in creating activities, whether that's with printed maps, interactive digital platforms, or the huge world of geospatial data out there.

We start with the basics. What is GIS? Why is it important for schools and Earth Science education? **This first part of the course lays the foundation by exploring the essential elements of Geographic Information Systems (GIS) and their value in education (see Fig.1).** You'll understand how GIS can be used not only to teach sustainability, geography and science, but also to foster critical thinking, spatial reasoning, and data literacy across the curriculum. Through concepts like coordinate systems and spatial data types (vector and raster data), as well as desktop or web-GIS, you will gain a solid grasp of what GIS is, how it works, and why it matters. This part is designed to be approachable for all teachers; no prior GIS experience needed! Once the foundations are set, we dive into the tools. Now that you've built a conceptual foundation, **the second part introduces practical tools and platforms for visualizing and accessing spatial data.** You'll explore web-based GIS platforms, data repositories, and get hands-on experience with QGIS, an open-source desktop GIS application that supports beginners while offering advanced capabilities. You'll learn how to download and visualize geospatial data, connect to web services for visualizing or even downloading spatial data, and perform basic editing tasks like digitizing new map features or importing data from Excel files (Fig. 2). This section empowers you to navigate real-world data sources and start creating your own GIS-based resources.

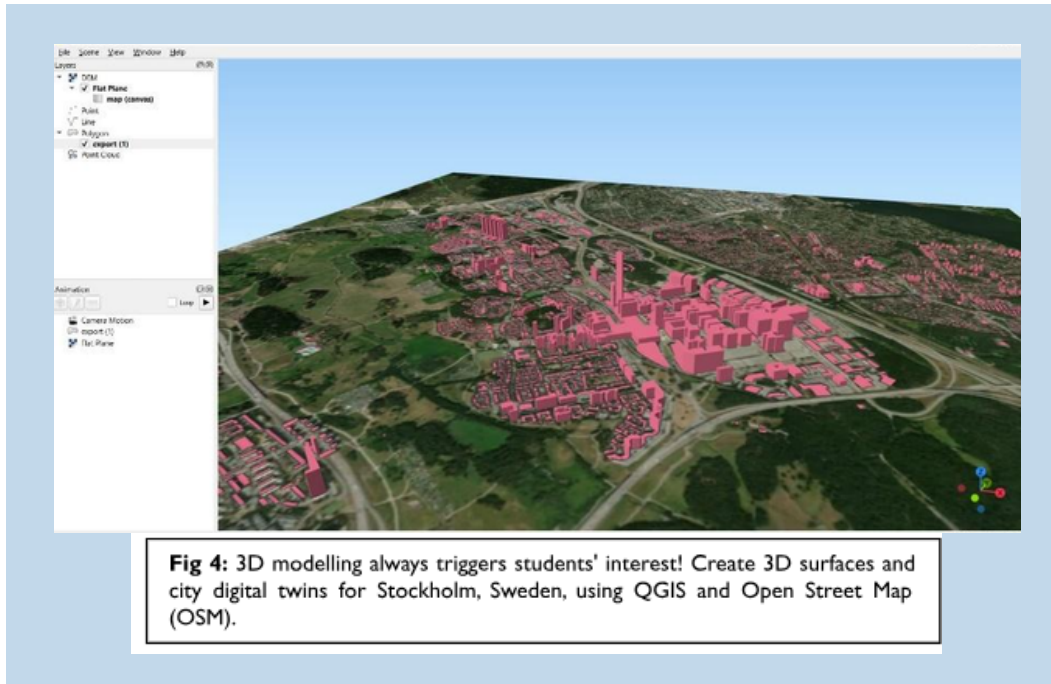
In the third course, we explore where GIS becomes powerful and creative. In this part, you'll learn how to use QGIS to conduct spatial analyses such as buffering, clipping, network routing, surface analysis, and multi-criteria problem-solving. These techniques are essential for tackling real-world environmental questions, from planning an offshore wind farm to mapping urban climate risks (Fig. 3) and creating 3D models (Fig. 4). But don't worry if it feels a bit technical at first; the goal is not to master everything, but to get inspired. You'll discover how to turn GIS tools into meaningful project-based or hands-on learning activities, bridging STEM education, sustainability, and digital skills development in your own classroom. Finally, the course culminates in creativity and practice, and the last part is the most fun and creative! You'll dive into ready-made lesson plans, inquiry-based activities, and the GEO-Lab methodology, a transformative model where your school becomes a living laboratory for geospatial exploration and environmental learning.



## GIS (Geographic Information Systems) for Earth Sciences



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Explore topics like Renewable Energy, Nature-based Solutions, Geo-Inquiries, and STEM-based activities and discover how to adapt these resources to your local context. Whether you're working indoors with digital maps or outdoors with printed maps and students' ideas (see Fig. 5), this section offers inspiration, flexibility, and ready-to-use resources to make GIS an exciting part of your educational toolkit.

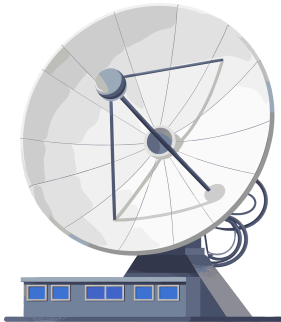
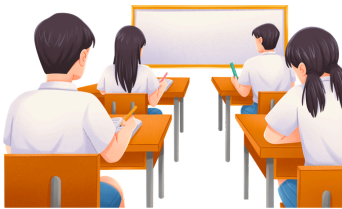
**Why should teachers join this course?** Because GIS is more than a set of digital and spatial skills, it's a way of thinking! It gives students the tools to analyze, visualize, and solve real-world problems while fostering collaboration, creativity, and sustainability competencies. The course is flexible, hands-on, and adaptable to any school context. By the end, you'll not only have learned the fundamentals of GIS, but you'll have discovered how to integrate it into your school practices and inspire your students to see the world differently.



**Fig 5:** You don't like the digital way? That's totally fine, create and use printed maps to solve multi-criteria problems! Where are the optimal locations for offshore wind turbines or solar panels in Greece? Let's find out by using the hands-on Multi-Criteria Problem-Solving approach!



## Earth Observation (EO), Remote Sensing (RS) & Sat Apps



One of the geo-concepts identified by the Geo-Academy team is “Earth Observation (EO), Remote Sensing (RS) and Satellite Applications (Sat Apps)” (EO-RS-SatApp).

**Earth Observation (EO)** is increasingly important to map and monitor the Earth in several dimensions, such as, for example, environmental and climate change domains, or human land use and management of the planet’s resources. **EO** requires data collection about the Earth’s physical, biological and chemical systems, which are then processed and analyzed to extract information useful for a large diversity of application areas.

The main data sources used for EO are collected with **Remote Sensing (RS)**, which is the science dedicated to gather data that enables the extraction of information about the objects of interest without being in direct contact with them. For EO, this is achieved with data collected by sensors installed mainly in satellites or aerial platforms.

Due to the important developments made recently in science and technologies related to EO, including data collection platforms as well as data and exploration platforms availability, these areas have nowadays a **wide range of applications**, that may be explored by non-experts to get several types of information, for example, about:

- Where are residential, industrial and commercial areas located? How are they evolving over time?
- Where are agricultural fields and which type of agriculture is made in each region? Which changes are observed over time?
- Which forest species are growing in each region of the world and how are their habitats changing (increasing or decreasing)?
- Where are the water resources and how is their dimension and quality changing?
- Which areas are affected by extreme events, such as forest fires, floods or earthquakes?



Figure 1 – Sentinel-2 Earth Observation Satellite (left). Very high-resolution Earth surface image (right).

# Earth Observation (EO), Remote Sensing (RS) & Sat Apps



Figure 2 – Wildfires in Greece  
([https://commons.wikimedia.org/wiki/File:The\\_wildfire\\_emergency\\_continues\\_in\\_Greece.jpeg](https://commons.wikimedia.org/wiki/File:The_wildfire_emergency_continues_in_Greece.jpeg)).

The Geo-Academy team developed courses that can provide some knowledge on areas related to EO, RS and possible areas of application. The courses are structured in three main parts with the following structure.

## Part 1: Introduction to visual interpretation

- 1.1. Around the World in One Day
- 1.2. Basic course on EO satellite images
- 1.3. Introduction to spectral reflectance
- 1.4. Educational platforms to bring Earth observation to your classroom

## Part 2: Working with freely available tools and online resources

- 2.1. Copernicus Browser (Familiarize yourself with Copernicus Browser)
- 2.2. SentinelHub and Copernicus Data Space Ecosystem (Some examples)
- 2.3. Google Earth (A Powerful Tool for Science Teaching and Lesson Planning)
- 2.4. Common Online Data Analysis Platform (CODAP) (Insight into a heap of data)
- 2.5. DataTalk (Read the data-filled world)
- 2.6. Living Atlas of the World (ESRI)
- 2.7. Earth Explorer

## Part 3: Applications using satellite images and EO

- 3.1. Wildfires (EO Browser)
- 3.2. Analysing Fires Using MODIS Active Fire Data (FIRMS)
- 3.3. Zoom Earth and GLOBE Observer
- 3.4. Mapping parties / Open mapping (OpenStreetMap)
- 3.5. Using Global Forest Watch / Land cover analysis



## How maps help us learn and teach better stories

**Narratives** have already been acknowledged as the main way humans understand the world. Stories provide structure and context for events and important happenings, facilitating the connection between cause, effect and meaning. As such, they have always been the most efficient means of communication and knowledge transfer. This structure allows people to deeply understand and memorize the information, better than isolated data.

Additionally, narratives have a crucial role in facilitating empathy and connection, as they assist in gaining insights to the perspective of a certain event, person or experience. This assists in overcoming cultural, social, or generational boundaries and helps people and communities to connect.

Stories are also important for teachers and leaders, as they are often used for inspiring and persuading the broader audience not only to understand a certain piece of information but also to stimulate action. In such a way, narratives influence thinking, action and consequently societal change.

**Maps** on the other hand have been used since the ancient years to not only navigate from A to B but also to provide the essential context to better understand large amounts of data by unveiling patterns and complex relations. As a visual language, maps provide an overview of an event or phenomenon, increasing our understanding and enabling us to raise the right questions in order to gain new knowledge.



They are very important, as they take data and represent it in a way that is easy to understand by revealing relationships and patterns. Alternatively, this information could be only captured on tables or text form, which is not always very easy to comprehend. For example, they can display the transmission of diseases, the location of natural resources, or migration patterns in a visual manner that enables us to unveil connections immediately. This ability to interpret complex topics in a simple way makes them a very powerful tool in different sectors such as education, research, infrastructure development etc. to mention just a few.

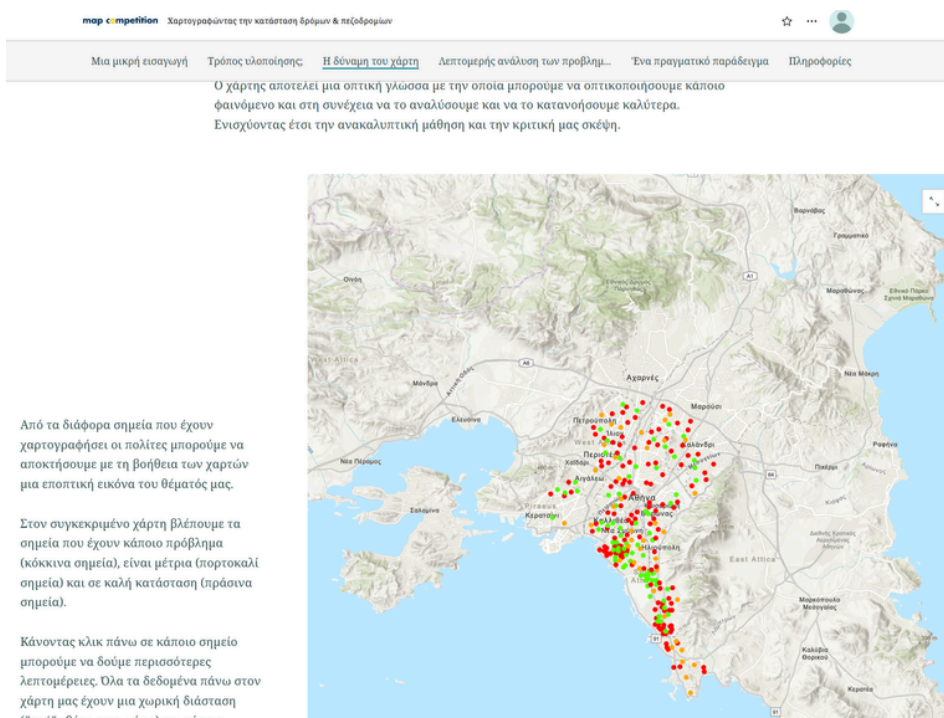


Figure 1 – Understanding relationships and patterns based on maps



Figure 2 – Examples of Storymaps prepared by schools in the context of the Panhellenic School Map Competition (<https://mapcompetition.gr/psifiaki-vivliothiki/> - in Greek)

**Map Storytelling** is a newly introduced concept combining the power of narratives and the power of maps creating new learning experiences. Tools such as MapStories, ESRI ArcGIS Storymaps, etc. enable teachers and students, with an internet connection, to design and publish narratives that are geographically grounded.

In such a way the content of the story doesn't simply show where things are, but also why the location is important and how it is related to different other stories and data.

In the educational sector, map storytelling can be a powerful educational tool, providing contextual learning experiences and fostering inquiry-based approaches.

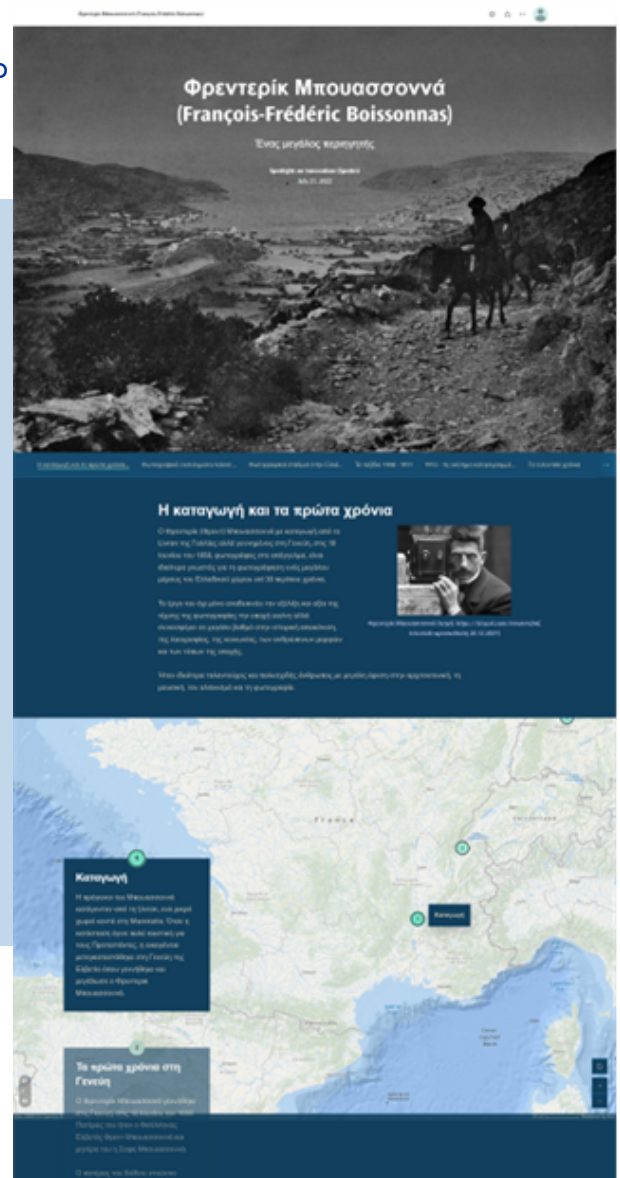


Figure 3 – Examples of map storytelling with the use of the ArcGIS Online Storymap service

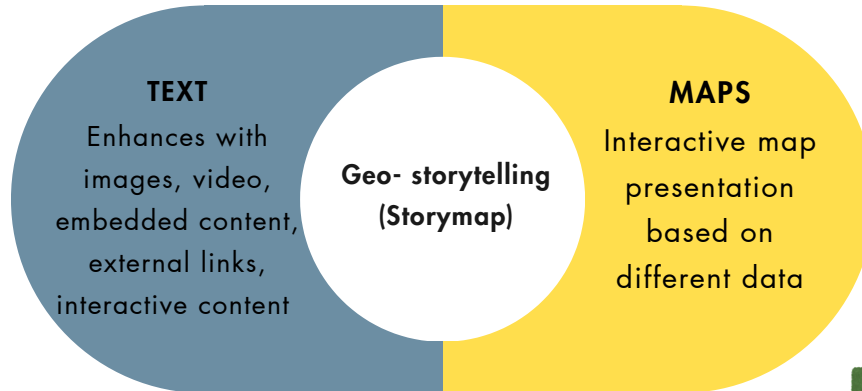


CLICK HERE

## Map Storytelling



The main components of a map story are narrations, multimedia content (images, videos, recordings etc) and digital maps.



Map stories are supposed to be digital and web based, so as to easily share and disseminate the content and reach out to a broader audience without the need for special software or hardware.

In the classroom, Map Storytelling can be used in 3 ways:

- By reuse of ready made geostories such as the [ArcGIS StoryMaps collection](https://arcgis.com/storymaps) or the [Mapstories Gallery](https://mapstories.reedu.de/en/gallery/all) (<https://mapstories.reedu.de/en/gallery/all> (in German))
- By preparing a learning course by the teacher in a map storytelling form
- By encouraging students to prepare a geostory for a specific topic



Map Storytelling is a relatively new concept and many synonyms can be found such as: geo-storytelling, map storytelling, geographic storytelling, geo-narratives, storymaps, narrative map, storytelling maps, storybook, geostories.

To learn more, you can visit the Map Storytelling Module in GEOBSERVE platform:

**Course 1: Introduction to Map Storytelling**

**Course 2: Map Storytelling in the classroom: Hands-on training**

**Course 3: How to implement a Map Storytelling project in the classroom**

**Course 4: Map Storytelling: Examples and thematic application for the classroom**



## Coding for Urban Sustainability




This course provides a comprehensive introduction to robotics and its integration into STEAM (Science, Technology, Engineering, Arts, and Mathematics) education. It covers foundational robotics concepts, technical components, practical applications, and research methodologies, preparing learners to engage with modern robotics challenges and educational practices. The course emphasizes hands-on learning, interdisciplinary approaches, and real-world problem solving to cultivate critical thinking and creativity.

**Sub-module 1** provides an overview of robotics, including Isaac Asimov's Three Laws of Robotics and the history and definitions of robots. It explains the core robotic process of data input through sensors, processing by CPUs and AI, and output by actuators. The sub-module highlights robotics' role in industry and education, introduces the STEAM framework integrating arts into STEM, and discusses pedagogical approaches such as inquiry-based and project-based learning to develop creativity and teamwork.

**Sub-module 2** covers the key components of robots: CPU, sensors, actuators, and controllers. It explains various sensor types and categories (analog versus digital sensors) and their functions. Different types of actuators such as electric, pneumatic, hydraulic, and shape memory alloys are described along with their applications. The sub-module introduces controllers including microcontrollers, PLCs, embedded PCs, and dedicated robot controllers. It also details control system concepts including open-loop, closed-loop, PID control, fuzzy logic, and AI-based control algorithms.

**Sub-module 3** focuses on practical robotics projects and applications. It introduces line-following robots using IR sensors, robotic arms programmable for diverse tasks, autonomous vehicles equipped with sensors like LiDAR and ultrasonic devices, and environmental monitoring robots for collecting data such as air quality or radiation. Hands-on exercises with microcontrollers like micro:bit and kits like NEZHA provide opportunities to practice programming and control principles. It also explores the history and development of autonomous vehicles and their challenges.

**Finally sub-module 4** emphasizes research and data management skills critical for robotics and STEAM education. It covers the importance of data analysis in research, differentiating qualitative and quantitative data. Data collection methods such as questionnaires, interviews, surveys, focus groups, observation, experiments, and case studies are presented with their advantages and limitations. The sub-module explains Project-Based Learning (PBL) as a teaching method centered on real-world problems, active learning, collaboration, and tangible outcomes. It also introduces robotics competitions like the International STEM Competition and World Robot Olympiad, fostering creativity and problem-solving skills.




Instructor  
Robotics And Coding Team

Category  
Geo-Concept: STEAM Education, Robotics, And Coding | Skills:  
Digital | Skills: Green

## STEAM education, robotics, and coding – Part 1

10 Weeks
All Levels
11 Lessons
1 Quiz
9 Students



Free

Start Now

Overview
Course Curriculum
Instructor



# Coding for Urban Sustainability

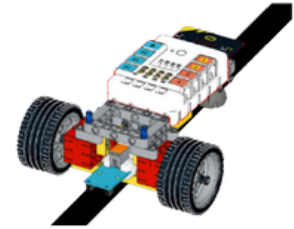
## Practical Robotics Applications

The module showcases four main robotics applications that effectively demonstrate STEAM principles:

### 1. Line-Following Robot

This fundamental project introduces students to:

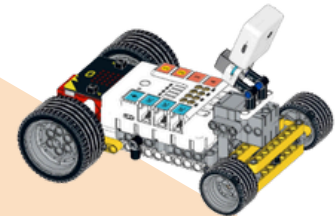
- Sensor Technology: IR sensors for line detection
- Programming Logic: Decision-making algorithms
- Physics Principles: Light reflection and absorption
- Problem-Solving: Navigation and path optimization



### 2. Robotic Arm

Students explore:

- Mechanical Engineering: Joint movement and actuator control
- Precision Control: Servo motor programming
- Coordinate Systems: Spatial positioning and movement planning
- Real-World Applications: Manufacturing and automation concepts



### 3. Autonomous Vehicle

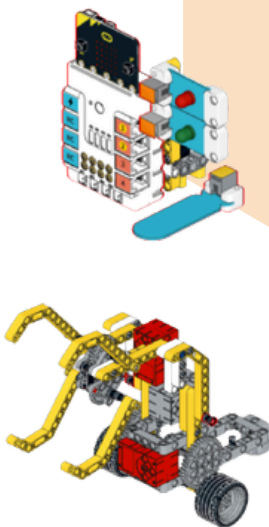
This advanced project covers:

- Sensor Integration: Combining multiple sensor types (ultrasonic, cameras, LiDAR concepts)
- AI Fundamentals: Basic machine learning and decision-making
- Safety Systems: Collision avoidance and environmental awareness
- Future Technology: Preparation for autonomous systems careers

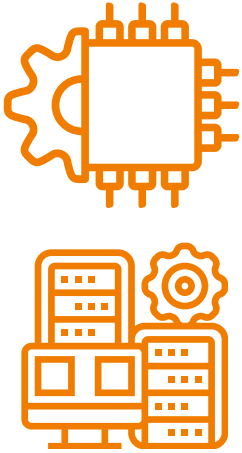
### 4. Environmental Monitoring Robot

Students engage with:

- Environmental Science: Air quality, temperature, and humidity measurement
- Data Collection: Sensor readings and environmental analysis
- Social Responsibility: Understanding climate change and pollution
- Community Impact: Real-world problem-solving for environmental challenges



## Coding for Urban Sustainability



### Hardware and Software Integration

Our approach uses accessible technology platforms:

#### Hardware Components:

- NEZHA Inventor's Kit: Comprehensive robotics platform
- Micro:bit: User-friendly microcontroller
- Various sensors: IR, ultrasonic, environmental sensors
- Actuators: Servo motors, DC motors, and mechanical components

#### Software Development:

- Block-based programming: MakeCode for beginners
- Visual programming: Accessible to students of all ages
- Progression pathway: From visual to text-based coding
- Real-time feedback: Immediate results from programming efforts

### Detailed Lesson Plan: Line-Following Robot Project

#### Lesson Overview

**Duration:** 3-4 class periods (45 minutes each)

**Age Group:** 12-16 years

**Class Size:** 15-20 students (working in pairs)

**Subject Integration:** Physics, Mathematics, Technology, Engineering

#### Learning Objectives

• Students will understand the principles of light reflection and sensor technology • Students will design and program a robot to follow a predetermined path • Students will apply mathematical concepts to solve navigation problems • Students will develop problem-solving and debugging skills • Students will collaborate effectively in teams to achieve project goals

#### Materials Required

• NEZHA Inventor's Kit (1 per pair) • Micro:bit microcontrollers (1 per pair) • Black electrical tape for creating tracks • White poster board or floor space • Computers/tablets with MakeCode software • Measuring tools (rulers, protractors)

#### Lesson Structure

- Session 1: Introduction and Theory (45 minutes)
- Session 2: Construction and Basic Programming (45 minutes)
- Session 3: Advanced Programming and Testing (45 minutes)
- Session 4: Challenges and Presentation (45 minutes)

## Resources and Tools



The Geo-Academy portal not only supports teachers with suitable teaching scenarios through ready-made E-modules (<https://portal.geoacademy.eu/e-modules/>), but it also directs teachers to the necessary resources and tools available on the internet (<https://portal.geoacademy.eu/resources-and-tools/>). Some of these tools are showcased below.

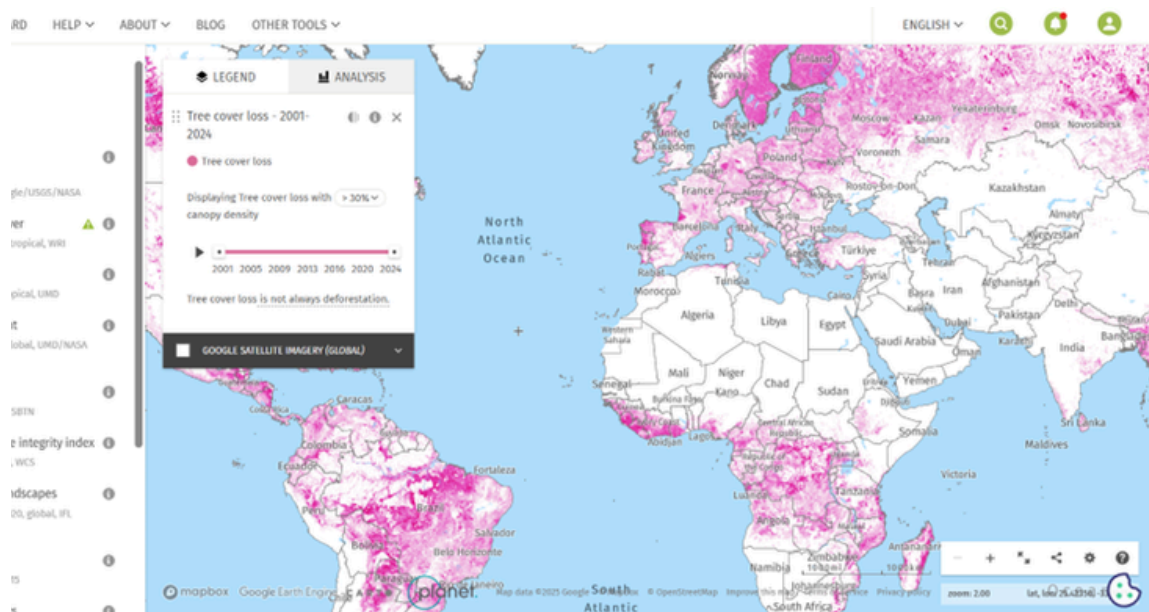
### Bring the World into Your Classroom with Forest Maps

Maps are powerful tools to help students understand complex global issues in a clear and engaging way. One example is the use of **world forest maps**, such as those provided by **Global Forest Watch** (<https://www.globalforestwatch.org/map/>). These interactive maps allow teachers to show students how forest cover has changed over time and to explore the causes and consequences of deforestation.

By integrating such maps into lessons, teachers can:

- **Visualize real data:** Students see authentic information on forest loss, tree cover, and land use across the globe.
- **Strengthen critical thinking:** Comparing regions and time periods encourages students to ask questions, identify patterns, and think about underlying factors.
- **Connect global issues to local action:** Discussions about worldwide forest loss can be linked to sustainable practices in students' own communities.
- **Foster interdisciplinary learning:** Forest maps can enrich geography, science, environmental studies, and even social science lessons.

Using digital maps in the classroom not only makes abstract environmental issues more tangible but also equips students with essential spatial and digital skills. Starting with world forest maps, teachers can help their students see how human activity shapes our planet—and inspire them to imagine solutions for a more sustainable future.



Source: <https://www.globalforestwatch.org/map/>



### See Change Over Time: Google Earth Engine Timelapse

Bring the dynamics of our changing planet right into your classroom using **Google Earth Engine Timelapse** (<https://earthengine.google.com/timelapse/>). This powerful tool lets students explore decades of satellite imagery — seeing how cities grow, glaciers shrink, forests disappear or recover, rivers meander, and coastlines shift — all through an interactive, zoomable, time-lapse view.

By using Timelapse in lessons, teachers can:

- **Make change visible and compelling:** Seeing change over 30+ years helps students really grasp environmental, social, and geographical transformations.
- **Prompt curiosity and questioning:** Students can explore “why did this region change like that?”, “what human or natural factors are driving the changes?”, “what might happen in the future?”
- **Integrate learning across subjects:** Geography, environmental science, history, economics and civics can all be enriched. Timelapse lets you look at urbanization, land-use change, water resource stress, desertification etc.
- **Develop digital and spatial thinking skills:** Navigating satellite imagery, timelines, reading changes in land cover, understanding scale and resolution — all valuable competencies in modern science and society.
- **Connect local to global:** Students can compare what is happening in distant parts of the planet with what is happening in their own region. This builds awareness and responsibility.



## Resources and Tools

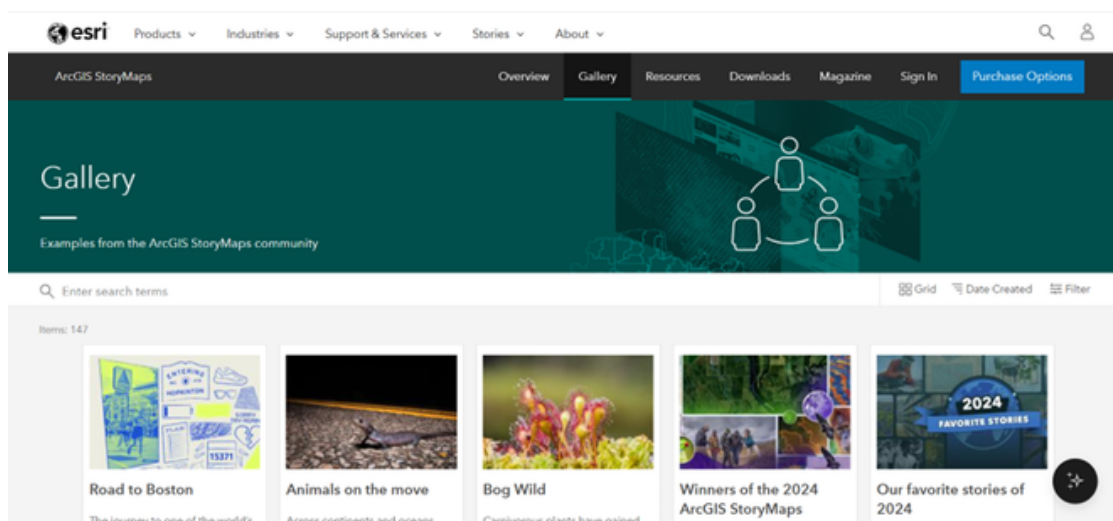


### Tell Compelling Stories with Maps: ArcGIS StoryMaps

Transform how students learn and engage by using **ArcGIS StoryMaps** (<https://storymaps.arcgis.com/>) in your lessons. This tool lets teachers combine interactive maps, narrative text, photos, videos, data visualizations, and other multimedia into immersive stories.

Using StoryMaps in classroom work gives teachers and students the chance to:

- **Fuse geography with storytelling:** Instead of just showing maps, you can build a narrative—explaining places, how they change over time, and how people interact with them. Maps aren't just backdrops, but central parts of the story.
- **Engage multiple senses and media types:** Add photos, videos, embedded content, charts alongside your maps. This variety helps students with different learning styles stay interested.
- **Present dynamic, up-to-date content:** Embed live maps or data, or integrate web scenes. This gives students a chance to see current changes (e.g. in land use, climate impacts, urban sprawl) and compare with the past.
- **Encourage critical thinking & local-global connections:** Students can investigate causes, effects, and implications—for local regions and globally—and present findings in a narrative format. What led to deforestation in one place? What urban sprawl looks like in another? What about water-resources or natural disaster risk?
- **Develop digital literacy & spatial understanding:** Students learn skills in map reading, interpreting legends/pop-ups, understanding scale, embedding digital media—all integrated with narrative form.
- **Flexible sharing & presentation:** Teachers and students can publish their StoryMaps, share with specific groups, or with the public. They can also build collections or briefings to present work in class.



Source: <https://doc.arcgis.com/en/arcgis-storymaps/gallery/>

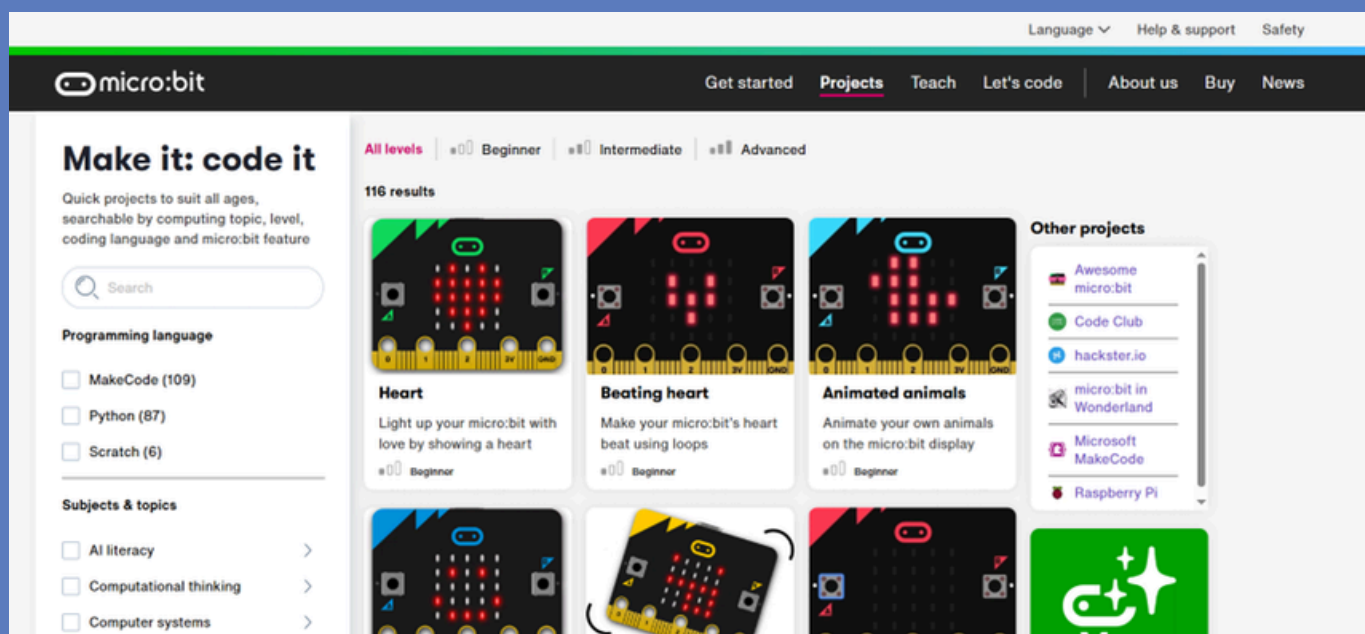


### Bring Coding to Life with micro:bit “Make It: Code It”

Spark creativity, curiosity, and computational thinking in your students with **Make It: Code It** from micro:bit (<https://microbit.org/projects/make-it-code-it/>) — a rich collection of projects designed for learners of all ages, levels, and interests. Whether you’re teaching coding or science, there’s something here to make lessons hands-on, relevant, and fun.

It offers:

- **Variety of project ideas:** Over a hundred quick projects covering many topics — from beginner through advanced.
- **Multiple themes & disciplines:** Projects tie into geography, sciences, data literacy, AI awareness, and more. Teachers can choose topics that align with curriculum goals.
- **Device features & real-world sensors:** Many projects let students use LEDs, buttons, accelerometers, light sensors, radio, etc., to build things that respond to the real world.
- **Scaffolding & progression:** With levels from beginner to advanced, the resource supports differentiation. Students who are new to coding can get started, while more experienced ones can push themselves.
- **Hands-on, engaging learning:** Code turns into something visible and interactive right away.
- **Linking theory and practice:** Concepts and data can be taught via doing, testing, improving.
- **Cross-curricular potential:** Use **Make It: Code It** not just in computer science, but in mathematics (data logging), science (environment sensors), geography (mapping with sensors), language (interactive stories), etc.
- **Skill building for the future:** Computational thinking, coding proficiency, problem-solving, debugging, iteration — all skills that are increasingly relevant in many spheres.



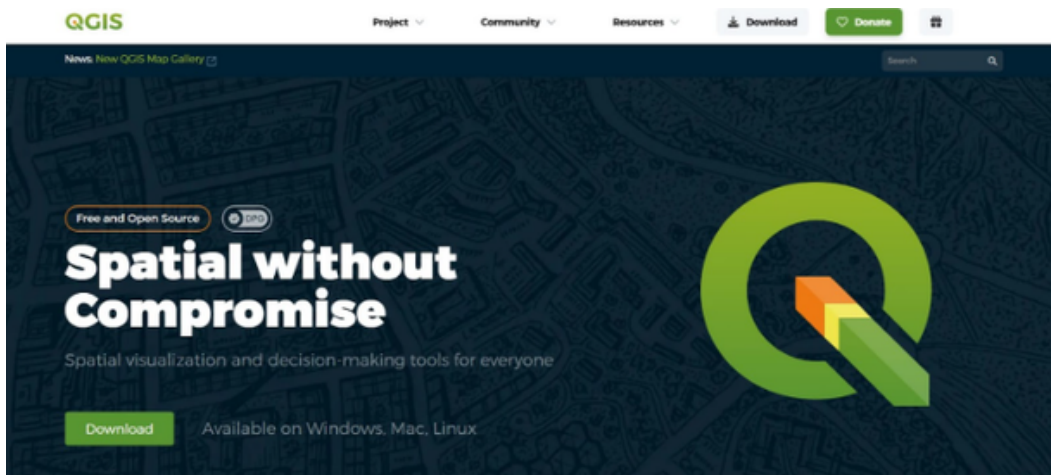
Source: <https://microbit.org/projects/make-it-code-it/>

## Resources and Tools

### Desktop GIS Platforms

Desktop GIS software provides powerful tools for visualizing, analyzing, and mapping spatial data. These platforms enable teachers and students to explore geographic information, create detailed maps, and conduct spatial analysis. With features such as layering, geoprocessing, and customizable map symbols, desktop GIS offers a dynamic environment for working with spatial data. Its ability to handle large datasets and perform advanced analysis makes it a valuable resource for integrating geography, environmental studies, and other subjects into the classroom.

Several leading tools for visualizing spatial data and creating maps within GIS encompass Esri's ArcGIS Pro suite and ArcGIS Online, renowned for its extensive mapping functionalities and spatial analysis tools. QGIS, an open-source GIS software, is similarly esteemed for its strong features and the support of its community.



### QGIS Tutorials for Beginners and Educators:

- **QGIS Training Manual ([link](#)):** This tutorial will be showing you how to use QGIS easily and efficiently. If you are new to GIS, we will tell you what you need to get started. If you are an experienced user, you will see how QGIS fulfills all the functions you expect from a GIS program, and more!
- **QGIS Tutorials and Tips ([link](#)):** This website contains a series of tutorials and tips that show you how to use it to tackle common GIS problems. You may use these tutorials as a self-paced course to learn the software thoroughly. However, each section is fairly independent, so those familiar with QGIS can jump into any section.
- **QGIS Learning Resources ([link](#)):** In addition to these tutorials, I also create and maintain hundreds of hours of free learning resources that includes free courses, videos and articles. Click on the link below to see my structured learning guide to access all the content.

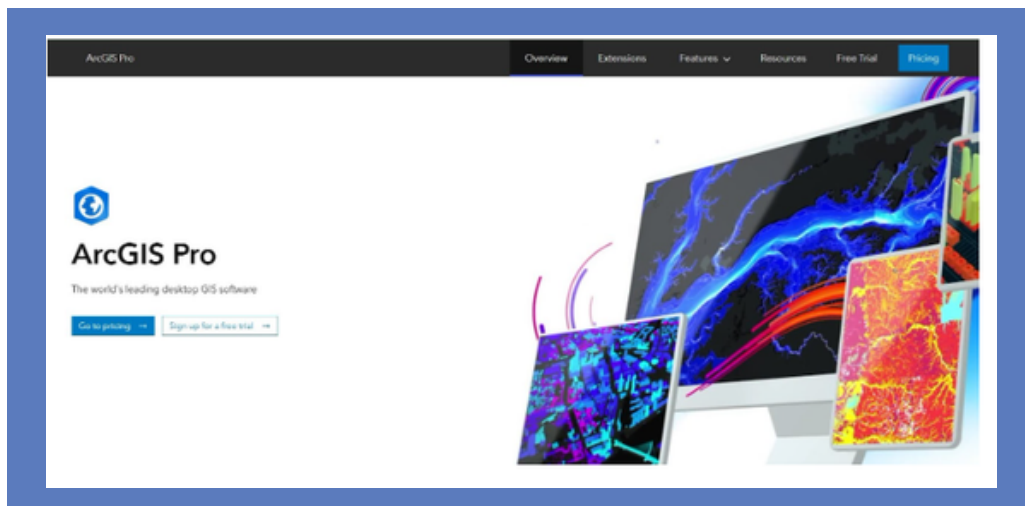
**Follow E-Module 2 about GIS for Earth Sciences** if you need more tangible processing examples using different types of open source data! Also, in one of the lessons, we are exploring the GOSTEAM lesson plans, based on QGIS capabilities!

## Resources and Tools

### ArcGIS Pro Tutorials for Beginners and Educators:

- **ArcGIS Pro quick-start tutorials ([link](#)):** The ArcGIS Pro quick-start tutorials introduce you to many aspects of ArcGIS Pro. They cover basic operations, such as adding data and navigating in 3D, as well as complete workflows, such as authoring maps, sharing maps to ArcGIS Online, and building geoprocessing models. The tutorials range from 15 to 60 minutes and include a video that summarizes the workflow.
- **Resources for teaching with ArcGIS Pro ([link](#)):** Tutorial series for you and your students to become familiar with ArcGIS Pro.
- **Teacher resources ([link](#)):** A collection of on-boarding activities, tips and tricks, and educator activities.

**Follow E-Module 4** about Map Storytelling in your Classroom if you need more learning experiences with ArcGIS Pro and ArcGIS Online! Also, in the lessons of E-module 2 (GIS for Earth Sciences), we are exploring the [Geolnquiries collection](#), based on ArcGIS Online Teaching Resources!



### Online GIS Platforms: MapMaker

A new way to teach and learn with maps. MapMaker supports student learning with high-quality, curated map content, powerful mapping tools, and teacher support. Today's students will solve the world's problems. As an educator, you can use maps to give them the knowledge and tools they need to find solutions. Use MapMaker in your lessons to help students build spatial thinking skills and develop knowledge about the world by exploring interactive maps.



## Resources and Tools



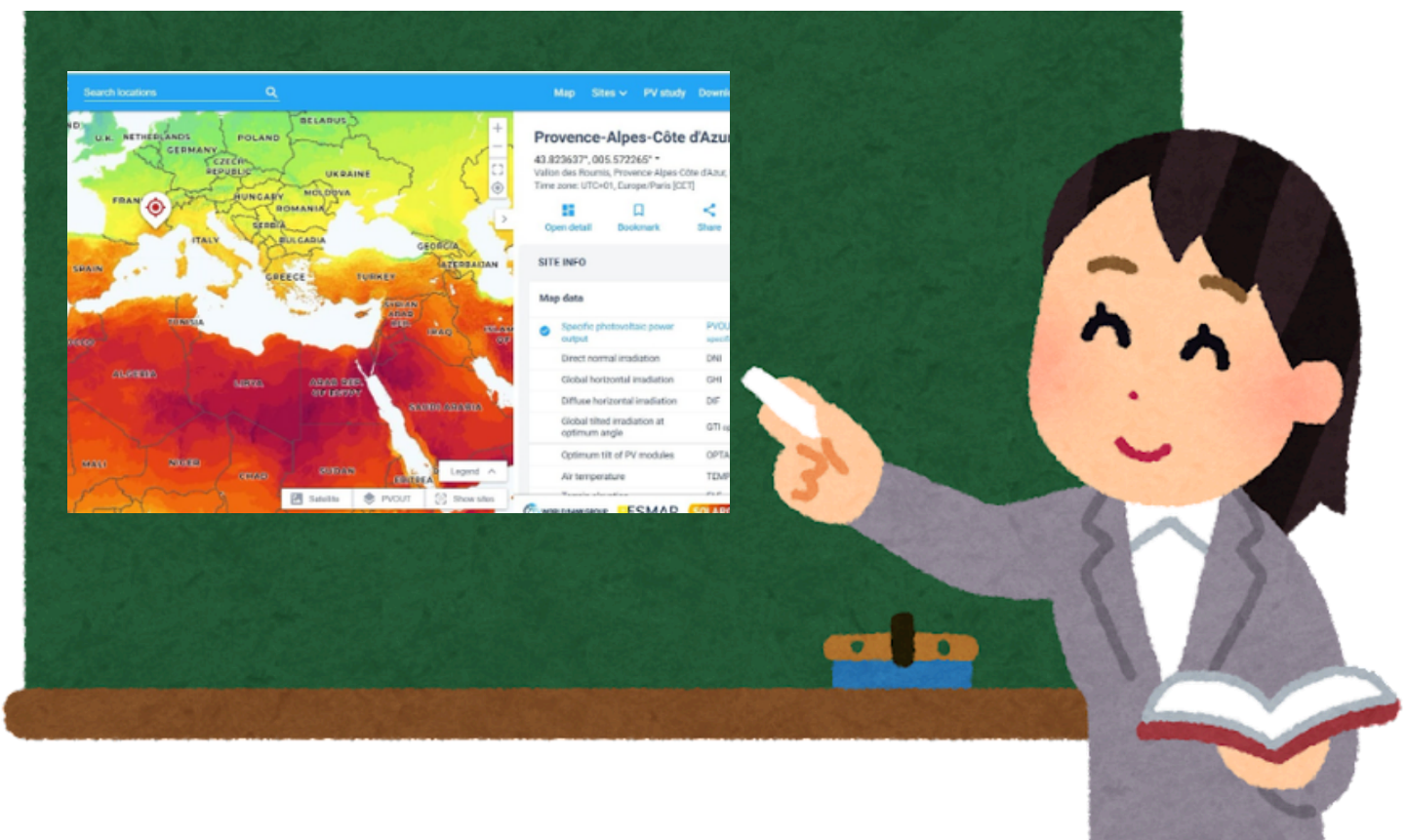
### Useful educational resources on how to use MapMaker:

- **MapMaker Collection ([link](#)):** This collection contains educational resources specifically designed to accompany National Geographic MapMaker, a Geographic Information System (GIS) tool for the classroom, developed by National Geographic and Esri. Maps allow us to find our way, analyze and visualize complex datasets, solve problems, and tell stories. They also facilitate learning.
- **MapMaker Geolnquiries ([link](#)):** Geolnquiries™ are short, standards-based inquiry activities for teaching map-based content found in commonly used textbooks. Each activity is designed using a common inquiry model and can be presented quickly from a single computer and projector or modified for students' hands-on engagement. Collections of 15–20 activities per topic enhance your curriculum throughout the year. Also, follow sub-module 4 of this course and check our step-by-step guide on how to use MapMaker and Geolnquiries!

**Follow E-module 2:** GIS for Earth Sciences to explore the MapMaker capabilities in Geography and Environmental classes. Students will be able to explore, analyze, and create interactive maps, visualize data, identify patterns, and understand spatial relationships like climate change impacts or biodiversity distribution.

### Weather Data & Apps: Global Solar and Global Wind Atlas, Windy

The Global Solar Atlas (GSA) is a free, online, map-based application that provides information on solar resource and photovoltaic power potential globally. It features the online interactive map tools, simplified photovoltaic (PV) power calculator, reporting tools and the extensive download section. It is intended to provide policy makers, academia, and renewable energy stakeholders to raise awareness in the solar energy domain, support the development of policies and plans, and for initial zoning and site identification purposes.

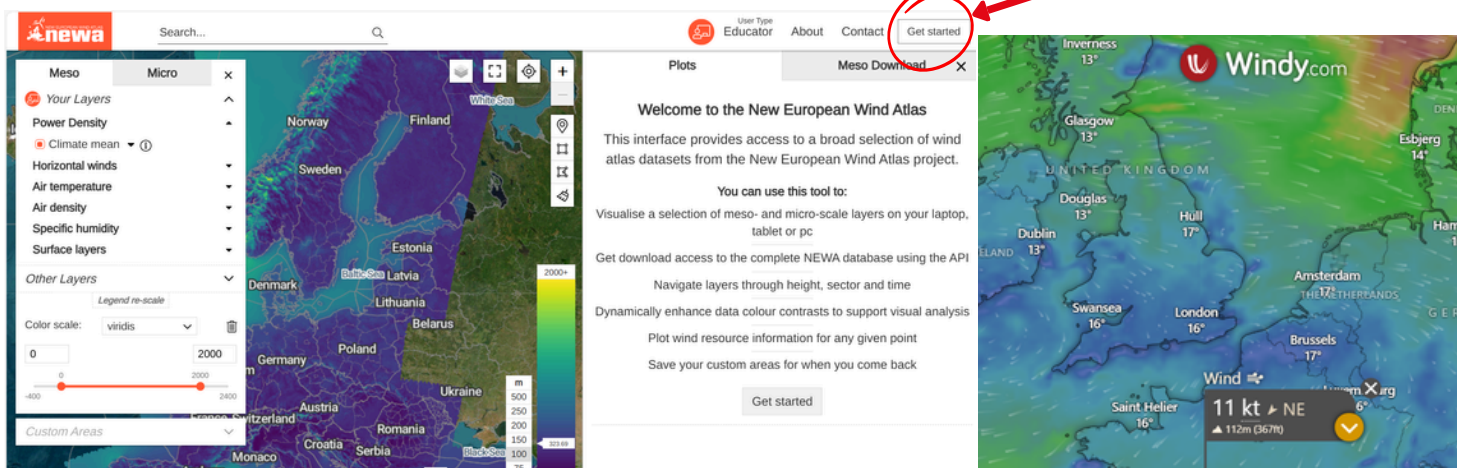


## Resources and Tools

### Tutorials and Useful Guide for Global Solar Atlas:

- **User guide (link):** Solar resource information presented in the Global Solar Atlas offers an excellent opportunity to do site prospection and pre-evaluation of the potential of solar energy in different countries and areas. Check out how to run your analysis!
- **Getting Started (link):** Explore all functionalities of Global Solar Atlas.

The New European Wind Atlas (NEWA) and the Global Wind Atlas web pages offer educators access to a wide range of wind atlas datasets from the New European Wind Atlas project. This comprehensive project involved the precise mapping of wind conditions, the development and testing of new downscaling methods, and atmospheric field experiments to validate the models. Teachers can use these resources to introduce students to wind energy, meteorology, and environmental science, providing hands-on data for exploring renewable energy and the science behind wind patterns.

The screenshot displays the NEWA website interface. On the left, there is a sidebar with 'Your Layers' including Power Density, Climate mean, Horizontal winds, Air temperature, Air density, Specific humidity, and Surface layers. The main area shows a map of Europe with a color scale for wind power density. On the right, a 'Plots' panel is visible, and a 'Get started' button is circled in red with an arrow pointing to it.

Press the 'Get Started' button (see Image above) and explore the full capabilities of the New European Wind Atlas by letting your students identify windy areas, analyze graphs and suggest potential areas for either offshore and onshore wind turbines! Or check the following video with the Gloabal Wind Atlas (similar to the New European Atlas) capabilities!

At last, Windy.com (and the Windy app) is an exceptional tool for visualizing weather forecasts. It's fast, intuitive, detailed, and one of the most accurate weather apps available. Trusted by professionals in fields such as aviation, sports, and environmental monitoring,

Windy can also be a valuable resource for educators. Teachers can use it to enhance lessons on weather patterns, data visualization, geography, and environmental science, helping students engage with real-time data and gain a deeper understanding of the natural world. Invite your students to step into the role of meteorologists for a day! In this activity, they will:

- observe the weather and collect data,
- present it as if they were delivering a live TV forecast.
- record daily weather conditions (temperature, wind, precipitation, cloud cover),
- create simple weather maps or charts to visualize their findings and.
- write a short forecast for the next day based on their observations.

## Resources and Tools



GEO-ACADEMY  
GEO-Hub for teachers in Europe



### GIS Platforms for Sustainable Development

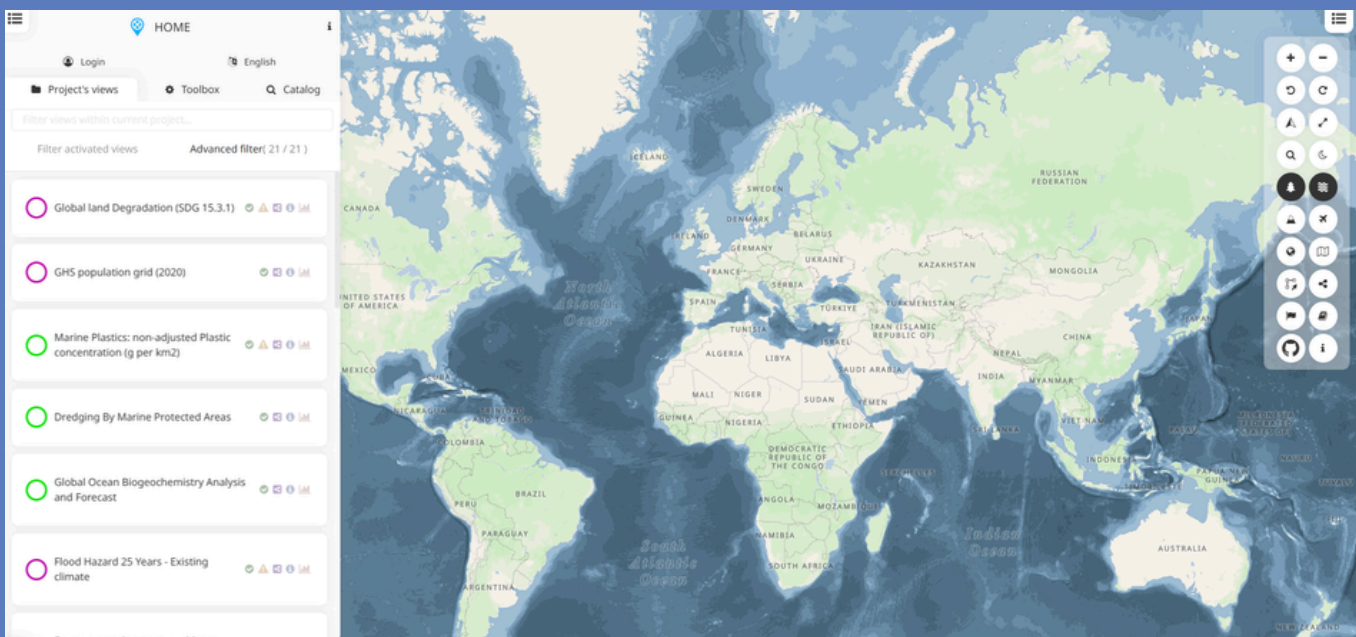
The **United Nations Environment Program (UNEP) MapX platform**, developed by the United Nations Environment Programme (UNEP), is a cloud-based geospatial tool designed for environmental data visualization, analysis, and decision-making. It integrates spatial data from various sources, enabling users to explore environmental datasets interactively.

The platform specializes in environmental data, offering high-resolution global and regional datasets related to biodiversity, pollution, climate change, land use, and marine ecosystems. These datasets are curated by UNEP and its partners, ensuring reliable and up-to-date information. Users can view and analyze spatial datasets in various formats, including vector-based (points, lines, polygons) and grid (raster) data. Some layers are available for download, allowing further analysis in GIS software like QGIS. MapX also includes advanced data exploration and analysis tools. Users can perform spatial queries, extract information from specific locations, and use time-series visualizations to track environmental changes over time. Additionally, basic statistical and analytical tools are available to support geospatial assessments. As a cloud-based platform, MapX requires no installation, making it accessible from any device with a web browser. It also supports multiple languages, ensuring accessibility for a diverse range of users worldwide.

Potential Uses for Educators:

Teaching students how to navigate GIS interfaces and explore real-world environmental data.

Using datasets for climate change and sustainability lessons in geography, science, and environmental studies.



## Uniform Competency Model

In addition to these five thematic E-modules, there are also two universally applicable modules. The E-module “**Unified Competence Framework**” uses examples to show how networked thinking can be promoted in everyday school life. The E-module “**Assessment**” emphasizes the importance of making students' learning progress visible.






### (E-Module+) Unified Competence Framework

#### The Unified Competence Framework

#### Empowering Teachers for a Green, Digital, and Spatial Future

How do we prepare students for the complex challenges of climate change, digital transformation, and global interconnection? *The Unified Competence Framework (UCF)* gives teachers practical tools, ready-to-use lesson plans, and a holistic approach that integrates **sustainability, digital literacy, and spatial citizenship**.

## The Unified Competence Framework – PART 1


 Lifetime
  All Levels
  4 Lessons
  0 Quizzes
  2 Students

Overview


**Course Curriculum**

Instructor

### Overview Of The GreenComp Framework


 Introduction to the GreenComp Framework | UCF-1.1.1  
1 hour

[Preview](#)


 Understanding Greenwashing | UCF-1.1.2  
1 hour

[Preview](#)

### GreenComp In Practice

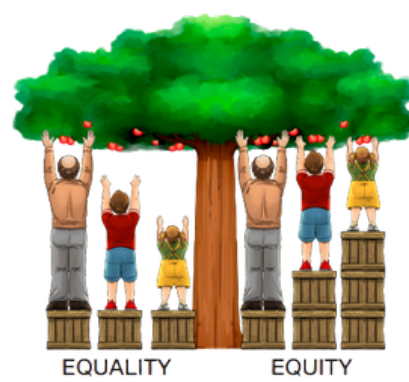
 Water Use in Consumer Goods | UCF-1.2.1  
2 days

[Preview](#)

 From Farm to Fork: Tracking our food around the world | UCF-1.2.2  
8 hours

[Preview](#)

## Assessment



### Why It Works

- ✓ Ready-to-use lesson plans with worksheets and activities
- ✓ Cross-curricular integration of geography, science, and civic education
- ✓ Focus on real-world problems that matter to students
- ✓ Builds teacher confidence in digital and geospatial tools

The Unified Competence Framework isn't just another set of resources—it's a way to **transform teaching** by uniting green, digital, and spatial skills for a sustainable future.

### (E-Module+) ASSESSMENT

When talking about innovating in how students learn, we must also talk about how they are assessed. In learning approaches that privilege student agency and accommodate for the growing diversity of classes, student assessment must be designed to capture each student's growth and empower them to go further.

Furthermore, when education goes beyond content memorisation and challenges students to learn how to apply the knowledge in real situations and to develop competencies, assessment methods must become more robust and diversified.

In the Geoacademy Assessment e-module, educators can find a balanced blend between personal reflection, concise theory and guided action to adjust their student assessment methods and promote stronger student development.

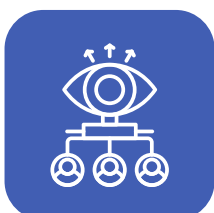
The module is developed according to the following:

**Part 1** - Reflecting on WHY we assess students. This lesson encourages and supports educators in defining their assessment intentions and laying the groundwork for an effective and meaningful assessment strategy.

**Part 2** - Reflecting on students' diversity and WHO we are assessing. This lesson promotes a reflection about the existing diverse student needs in each classroom and offers insight into how they can be accommodated by making simple shifts in the assessment strategies.

**Part 3** - Deciding WHAT should be assessed. This lesson guides educators to go beyond assessing content knowledge and to focus on students' ability to apply such knowledge through the development of competencies, attitudes and skills.

**Part 4** - Defining HOW and WHEN students will be assessed. Although there are endless ways to effectively assess students, this module guides educators on achieving a perfect blend between formative and summative assessment to capture students' development in a holistic way.



## Resources and Tools

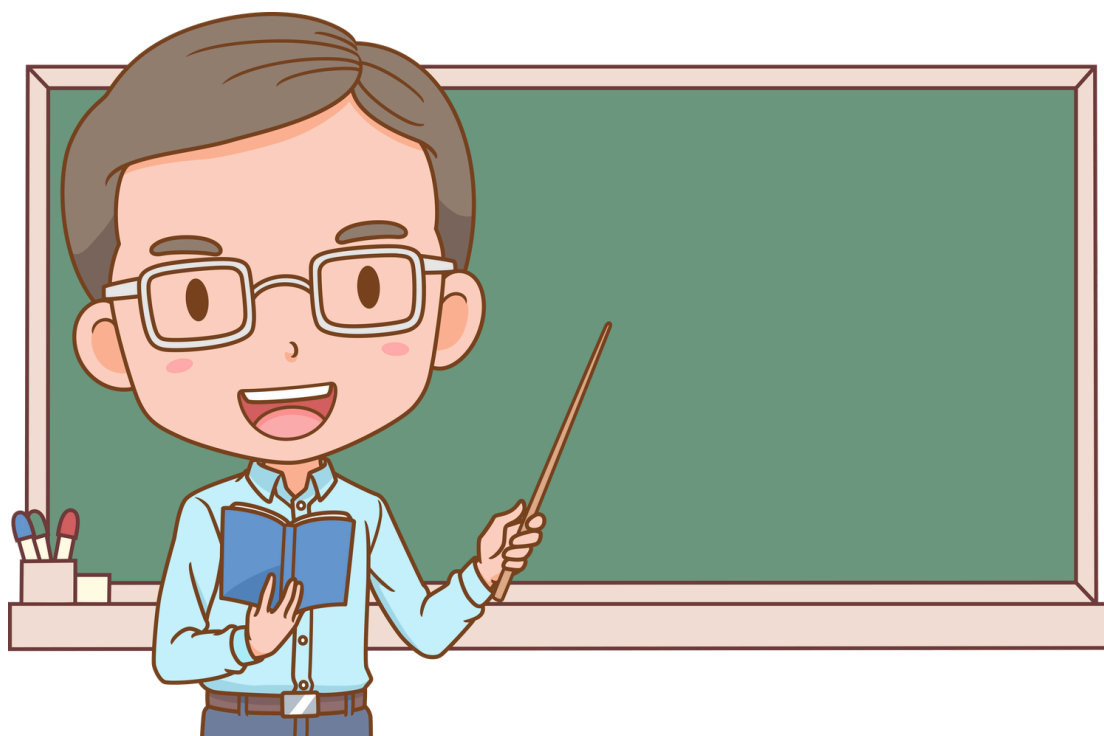
### Acting for sustainability (primary education level)

INDICATORS	DESCRIPTORS				
	1	2	3	4	5
<b>Political Agency:</b> To navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.	Does not seem to be aware of the existence of environmental and sustainability policies	Seems to be aware of but shows no interest in environmental and sustainability policies.	Demonstrates curiosity about environmental and sustainability policies and can propose alternative pathways for sustainability.	Knows some relevant stakeholders for sustainability in their community (e.g. local parish, NGO's, municipalities, etc.); Is willing to engage in civic activities for sustainable development.	Is motivated to become an agent of change to achieve sustainability; Demonstrates initiative to participate in democratic decision making (within a school setting) and civic activities for sustainable development.
<b>Collective Action:</b> to act for change in collaboration with others.	Does not seem to be aware of the importance of working with others to act for sustainable change.	Appears to be aware of the importance of working with others to act for sustainable change but does not seem to put it in practice.	Knows the importance of collaboration to promote a more sustainable future and seeks this collective effort.	Seeks collaboration and acts in line with common goals.	Demonstrates worry and willingness to adapt personal behaviour for a more inclusive and fair future; Wants to give back to the community and nature.
<b>Individual initiative:</b> To identify own potential for sustainability and to actively contribute to improving prospects for the community and the planet	Does not show awareness that every action has an impact.	Knows that every action has an impact even if not immediate but does not show initiative to contribute to a more sustainable future.	Knows that every action has an impact, and that inaction is also a choice.	Shows initiative to use fewer resources, do better with fewer resources, and reuse the same resources. Advocates for individual and collective care for those in need and for the planet	Recognizes that everyday action matters and cares proactively for the planet. Knows one's potential to bring about positive environmental change and can overcome one's own resistance to change.

### From Portal to Practice

The Geo-Academy portal is more than a collection of resources—it is a gateway to innovative, future-oriented teaching. By exploring its modules, teachers can confidently integrate green, digital, and spatial competences into their lessons. Start your journey today and inspire your students to see the world through new perspectives.

**All it takes is a first step—log in, explore, and let the Geo-Academy portal inspire new ways of teaching and learning.**



## Geo-Academy E-module “Cartography & Spatial Thinking”

### Lesson Plan:

Grade Level: VERSION 1: 12 to 15 years old VERSION 2: 16 years old

Duration: VERSION 1: 2 to 3 class periods (90–135 minutes)/ VERSION 2: Homework, presentation and discussion of outcomes in the classroom 1 class period

Subjects: Thematic Cartography, Socioeconomic Indices, Mathematics and Statistics, Geography

Core Skills: Critical thinking, Problem solving, Spatial reasoning, Evaluating outcomes, Data Visualization, Analysis, and Interpretation

Digital Tools: QGIS

### 1. Learning Objectives

Learning objectives for proportional symbol maps focus on understanding how symbol size represents data quantity, interpreting spatial patterns (clusters, trends), and designing effective maps by choosing appropriate symbols, scaling them to data, and managing visual clarity, especially with overlaps, to convey precise numerical relationships intuitively. Students will critically evaluate design choices to enhance the clarity and communicative power of their maps. Students should learn to distinguish these from choropleth maps and apply them to count data like population or earthquake magnitudes.

### 2. Background for Teachers

Proportional symbol maps scale the size of symbols (e.g., a circle, square, a pictorial symbol, etc.) proportionally to the data value found at that location. This type of map is based on the following concept: the larger the area of the symbol (for 2d symbols), the greater the value of the phenomenon at that location.

The most common method used is to scale the symbols directly proportionate to the data.

Proportional symbol maps may be used to visualize a phenomenon that:

- occurs at points in space and thus the thematic data refers to point spatial entities, e.g., cities, stores, industries.
- at areas in space but the data are aggregated at points within areas usually the centroids of enumeration units, e.g., countries, provinces, blocks, etc.

This type of map is suitable for visualizing:

- Total (absolute) values (e.g., population, tons of cargo transported to ports) which is the most common case.
- Derived values, such as proportions (e.g., ratio of students to teachers, ratio of hospital beds per 10,000 inhabitants) or percentages (e.g. % of the population aged 20-39).

### 3. Materials

#### 3.1 Reading Material

Please refer to all theoretical sections of the course [Introduction to Thematic Mapping](#) on Geobserve

#### 3.2 Data

For this exercise you need the French Administrative boundaries (Regions), which you can download this shapefile file (shp) from [here](#). This dataset comes in the form of a zip folder. Download this folder and store it locally on your device. Unzip it using the appropriate application. Do not remove, delete or move any of the files/contents of the unzipped folder to another location, otherwise, the QGIS will not be able to load and manage the dataset.

The non-spatial dataset that will be used for this exercise is an Excel file containing GDP information for the French regions. The data are derived from the French Institute National Institute of Statistics and Economic Studies and are registered as Regional GDP and regional value added from 2000 to 2023 Regional accounts (2020 base). They can be downloaded from [here](#).

### 4. Lesson Procedure

VERSION 1: The activity has been developed for lower secondary school students (age 12 – 15), its duration is 2-3 academic periods and is divided into 4 steps, including:

1. Teachers introduce the problem and provide background information
2. They show their students different proportional symbol maps
3. They guide students through the proportional symbol map creation (detailed guidelines on Geobserve platform, [here](#)) as a hands-on implementation course where teachers perform the steps of the creation. Teachers can make their choices on map symbols sizes and colors and present different alternatives to students,

1. They encourage students to ask questions, request clarifications, and make their own assessments of the visualizations (maps) that were created.

VERSION 2: 16 years-olds can make the map themselves. They are also encouraged to find their own datasets if they wish and try to create a different map. They present their map(s) in the classroom to their peers. They assess the maps that were created.

## 5. Student Worksheet (Copy/Paste Ready)

Not Applicable

## 6. Assessment

### Formative assessment:

- Participation during discussion
- Data Collection (VERSION 2)
- Map creation (VERSION 2)

### Summative assessment:

- Short presentation of the maps that were created (VERSION 2)
- Evaluation of the maps

Assessment may focus on the:

#### Spatial skills

- Correct interpretation of thematic maps
- Thematic content of maps (VERSION 2)
- Map symbolization decisions (VERSION 2)

#### Quantitative & Analytical Skills

- Correct decision of symbol sizes, classification of data, and other cartographic representation issues
- Use of given data

#### Digital tools

- Use of QGIS (VERSION 2)
- Searching the Web for suitable data (VERSION 2)

#### Collaboration & Communication

- Clear presentation of the process, the decisions made and the conclusions (VERSION 2)

## Coding for Urban Sustainability

Geo-Academy E-module "Coding for Urban Sustainability"

Lesson Plan:

Grade Level: 11 to 14 years old

Duration: 2 to 4 class periods (90–180 minutes)

Subjects: Computer Science, Geography/Physics (Seismology), Engineering

Core Skills: Block-based programming, Physical computing, Data analysis, Scientific modeling

Digital Tools: BBC micro:bit (x2), MakeCode Platform, Computer/Laptop

### 1. Learning Objectives

By the end of the lessons students will know:

- Learn to operate the micro:bit and use the MakeCode platform.
- Build a functional seismometer system using a transmitter (sensor) and a receiver (monitor).
- Apply block coding concepts (Radio, Input, Logic, Data Logger) to enable communication between devices.
- Interpret Z-acceleration data to categorize seismic intensity levels (Weak, Light, Moderate, Strong)

## 2. Background for Teachers

There is no need for a background for the teacher as the lesson plan is giving instructions step by step.

## 3. Materials

2 x micro:bits (one for transmitting, one for receiving)	Computers with Internet access	2 x Battery boxes (one for micro:bit, one for DC motor)	Bottle cork (to simulate vibration)
USB Cable	AAA Batteries	DC Motor	Isolated platform (e.g., a table) for testing

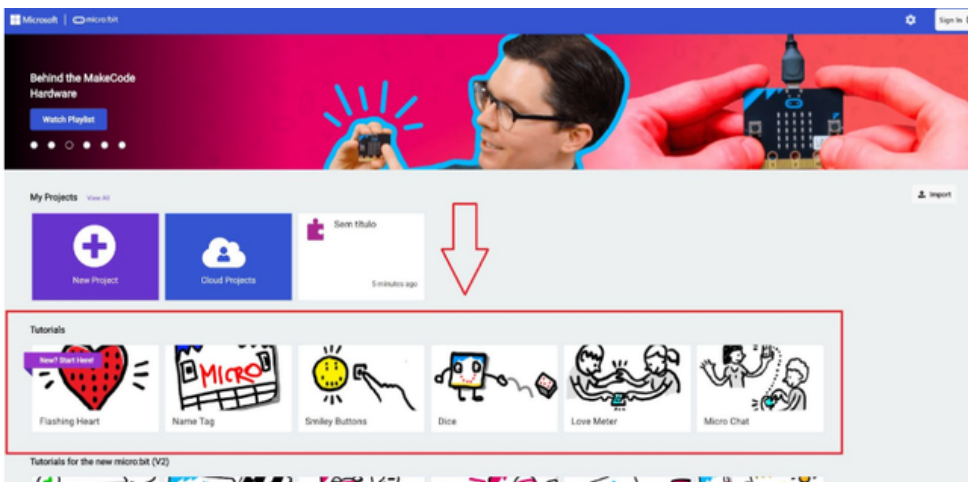
## 4. Lesson Procedure

First steps

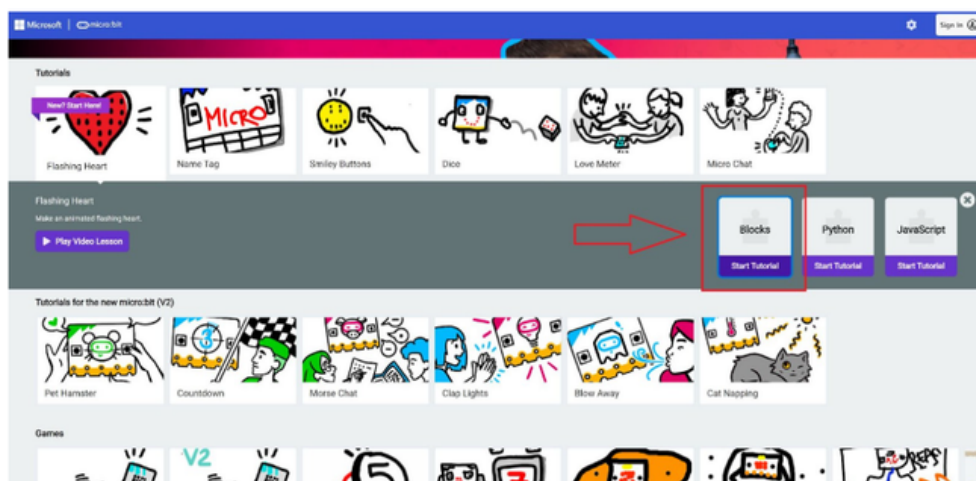
Before use the micro:bit let's get familiar with Makecode platform.

Enter the makecode platform

- It's recommended to use the Chrome Browser so that you can connect your micro:bit without any issue.
- It's preferable to sign in on the platform, so all your work will be saved automatically. To sign in, tap the Sign In button and login with your email or google account.
- It's recommended for you to do the Tutorials on the makecode home page to get familiar with the MakeCode platform. Do at least the six initial tutorials:

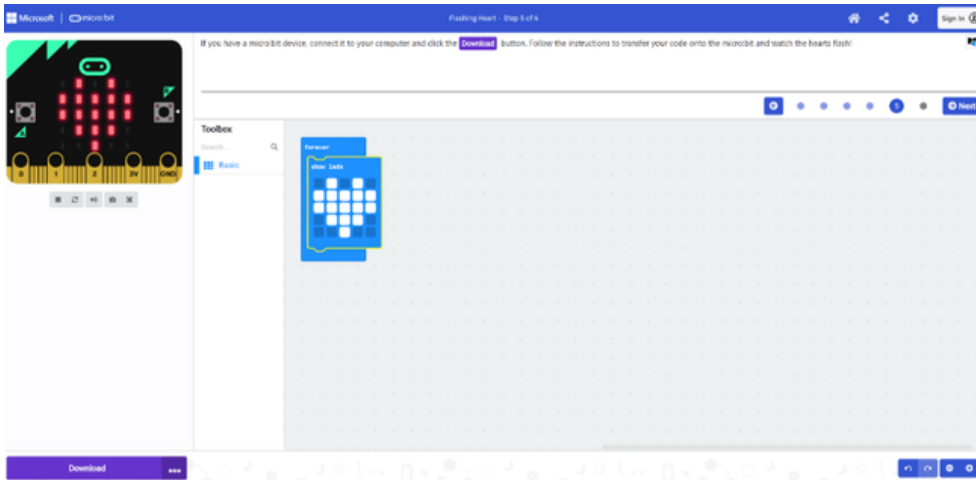


Choose the Block option. We will use Block programming to build our seismometer.

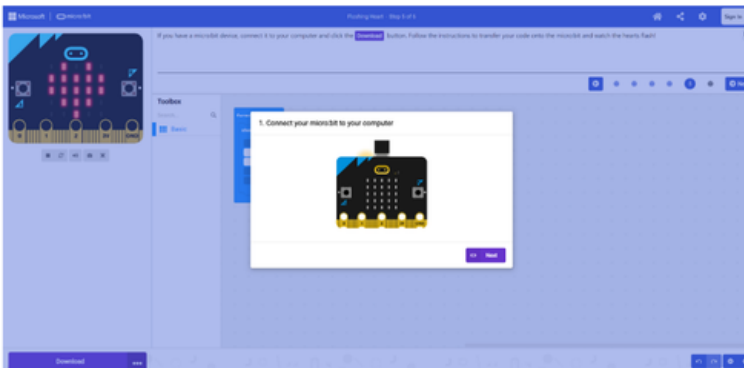


Follow all the steps to finish the tutorials.

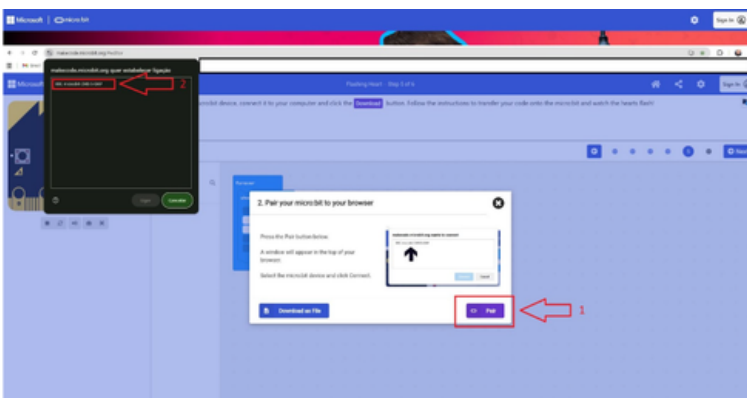
When you enter the Download step (see the image bellow), you will do the follow steps to connect your micro:bit



- Get the micro:bit on your Geo-kit. Connect the micro:bit to the computer through the USB cable.
- Click on Download and follow the steps:



- Click on "Pair" then you click on "BBC micro:bit CMSIS-DAP" and connect.



- Next click on download and your program will be downloaded into the micro:bit.

## Building a Seismometer

If you're in this section, we assume you're already familiar with block-based programming on the MakeCode platform and have worked with the micro:bit, or at least completed the six recommended tutorials.

Follow all the steps to finish the tutorials.

When you enter the Download step (see the image bellow), you will do the follow steps to connect your micro:bit

In this phase, you will engage in hands-on experimentation by assembling the seismometer, connecting two micro:bits via radio communication, and simulating vibrations using a DC motor with a bottle cork. You will program the micro:bit transmitter to detect and send vibration data and the receiver to interpret and display seismic intensity levels.

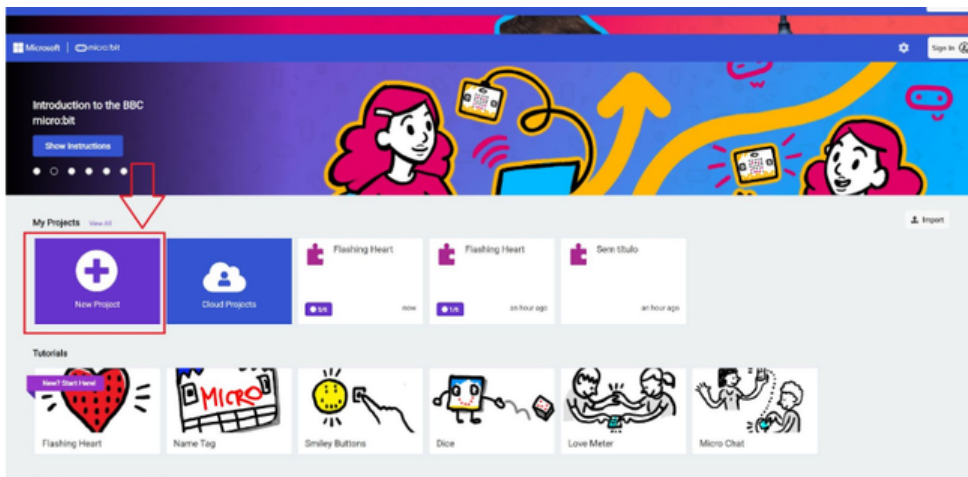
Planning to Assemble the Seismometer:

- Connect two micro:bits via radio communication.
- Attach a DC motor with a bottle cork to simulate vibrations.
- Program the micro:bit to detect and send data based on ground movement intensity.
- Record and visualise data on a computer.

Programming the micro:bit Transmitter (Vibration Sensor):

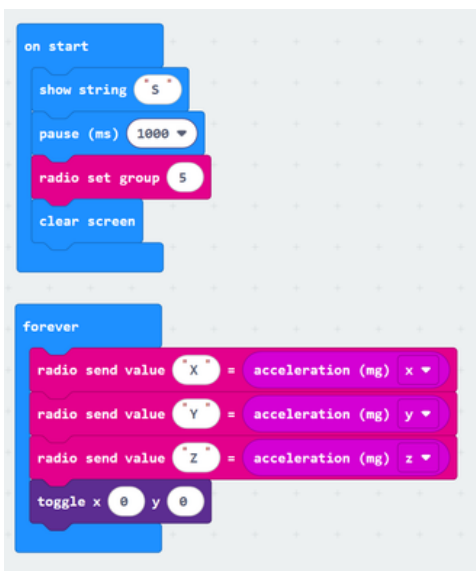
The transmitter will detect vibrations caused by the DC motor and send them to the receiver via radio.

1. Enter the [makecode platform](#)
2. First we will create a New Project on the makecode home page. Click on "New Project":

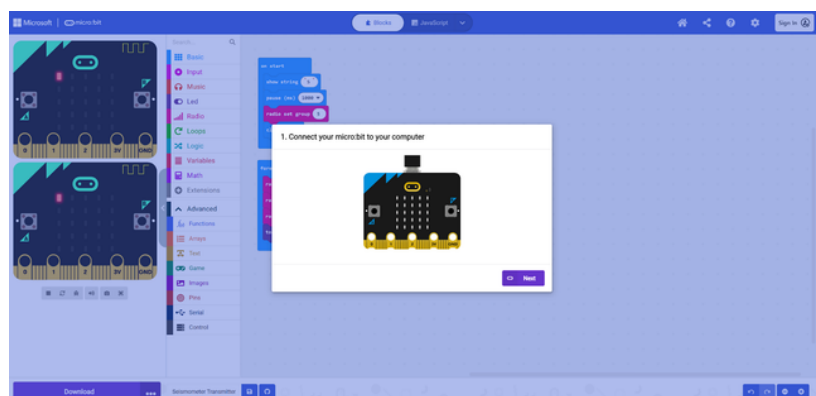


3. Give your project a name, for example "Seismometer Transmitter"

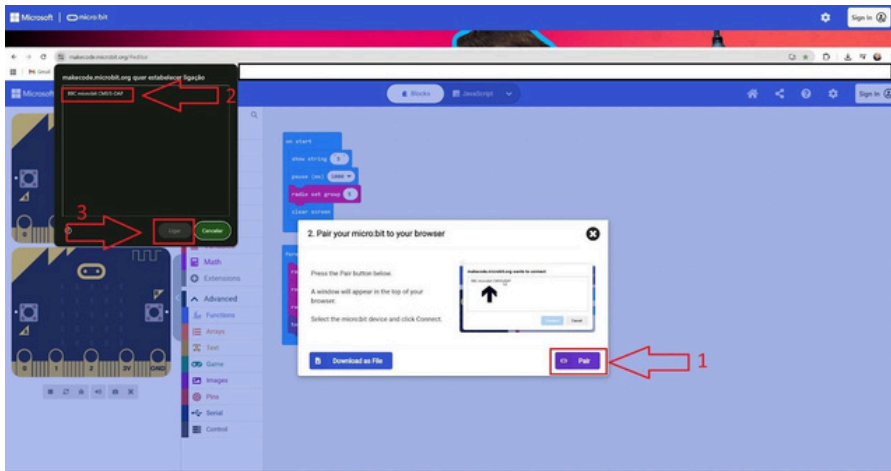
4. Replicate the block programming below using the "Basic", "Input", "Radio", "Led" Menus. If you follow the colour code it will be easy.



5. Connect your micro:bit to the computer using the USB cable. Click on Download and follow the steps to connect your micro:bit



6. Click on "Pair" then you click on "BBC micro:bit CMSIS-DAP" and connect.



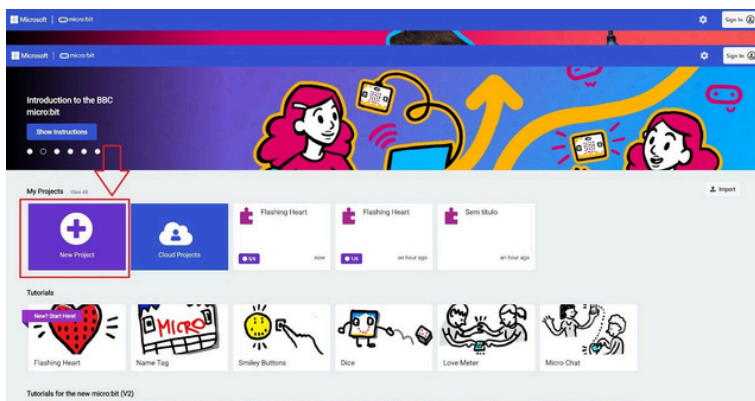
7. Next click on download and your program will be downloaded into the micro:bit.

8. Disconnect your micro:bit from the computer and save it to use later. On the Next step we will use other micro:bit from the Geo-kit.

## Programming the Micro:bit Receiver (Seismic Monitor):

The receiver will receive the vibration data, display different levels of seismic events.

1. For the Seismic Monitor (the receiver) we will enter the MakeCode home page and create a New Project:

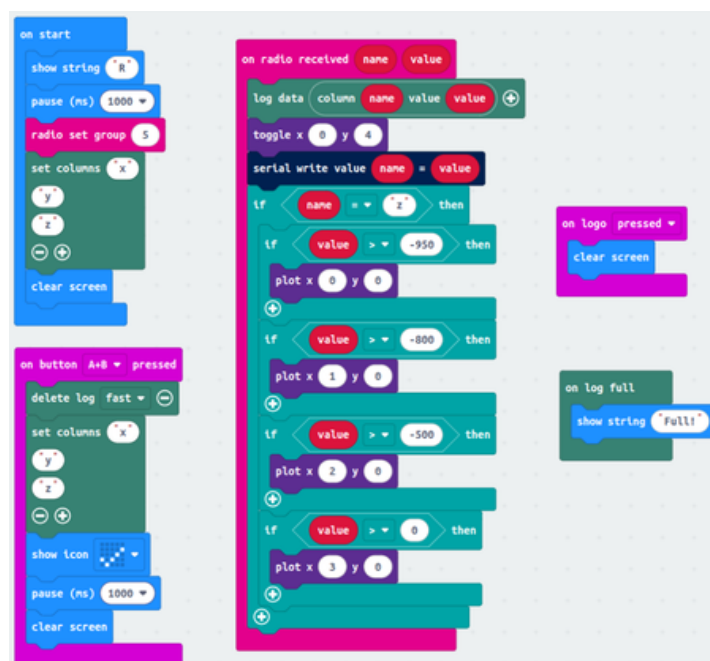


2. Give your project a name, for example "Seismic Monitor"

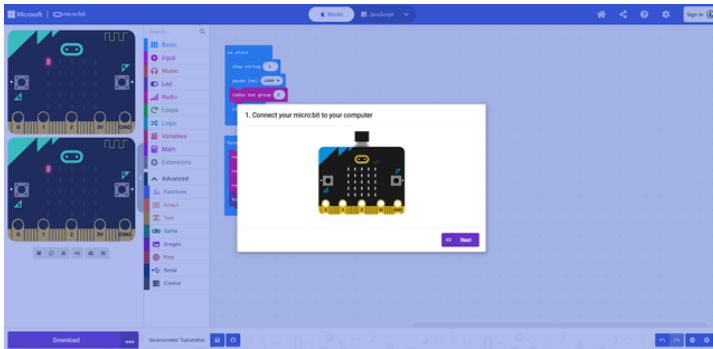
3. Replicate the block programming below using the "Basic", "Input", "Radio", "Logic", "Variable", "Led", "Data Logger" and "Serial" Menus. If you follow the colour code it will be easy.

**Tip 1:** to find "Data Logger" menu, click on "Extensions" menu and click on "Data Logger".

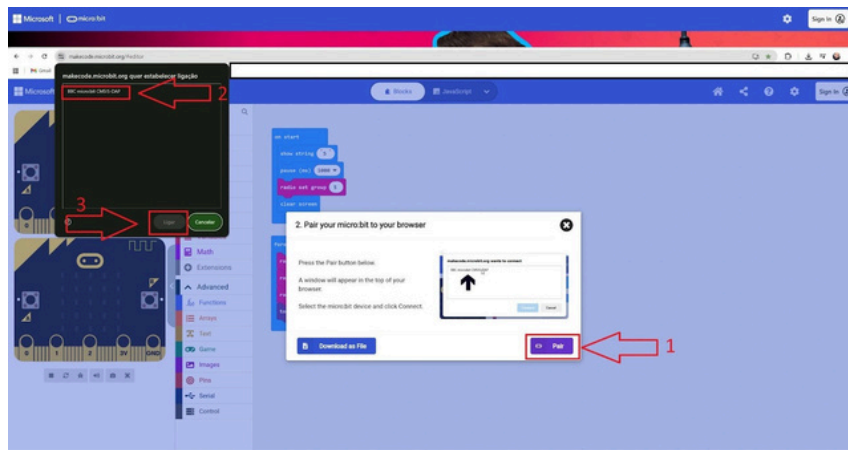
**Tip 2:** Click on "Advanced" menu to find the "Serial" menu.



4. Connect the other micro:bit to the computer using the USB cable. Click on Download and follow the steps to connect your micro:bit.



5. Click on "Pair" then you click on "BBC micro:bit CMSIS-DAP" and connect.

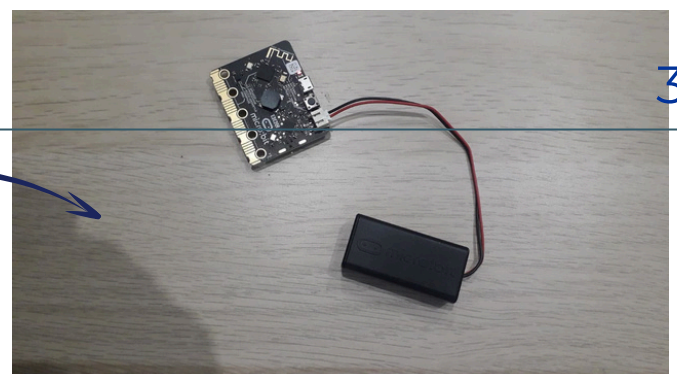
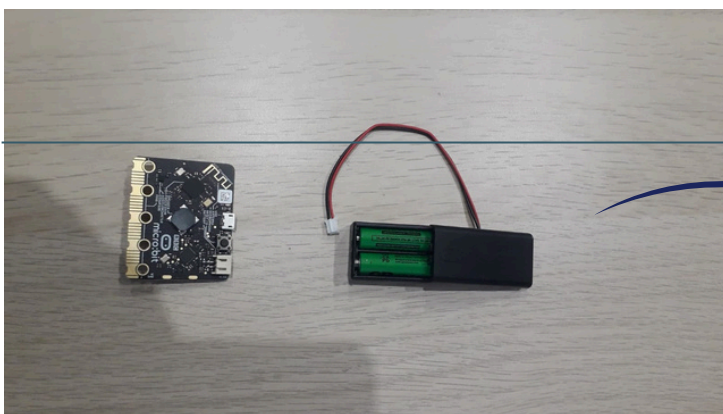


6. Next click on download and your program will be downloaded into the micro:bit.

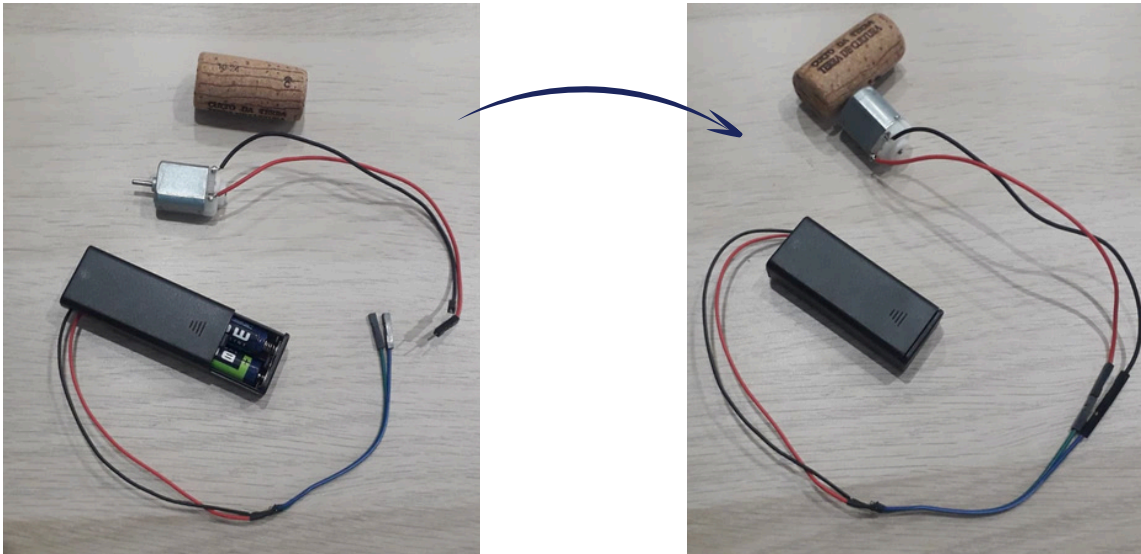
7. Keep your micro:bit connected to your computer.

### Assembling the seismic transmitter:

1. Connect the battery box to the seismic transmitter micro:bit, put two AAA battery inside the box and close it.
2. Connect the battery box to the DC Motor as show in the picture. Put two AAA battery inside the box and close it. Put (by force) the bottle cork on the DC Motor as show in the picture.

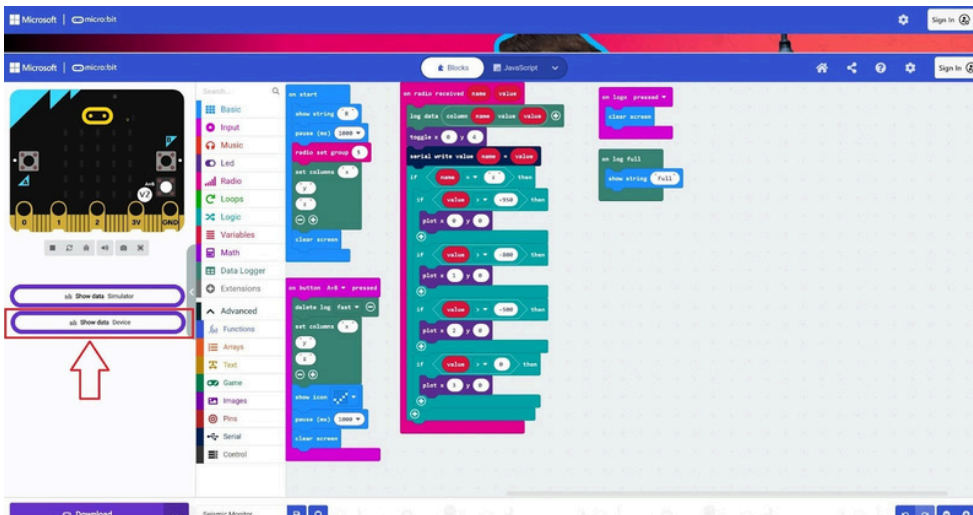


3. Turn the battery box On, the DC Motor must start to rotate the bottle cork. If not, open the battery box and see if you put the batteries in the right way. Verify the cables connections. Turn all off.



### Collect data with the Seismometer:

1. Connect the battery box to the seismic transmitter micro:bit, verify if the micro:bit has a light on.
2. The receiver micro:bit must be connect to you PC, with the "Seismic Monitor" program opened.
3. Click on "Show data Device" to observe the Seismic data from the transmitter.



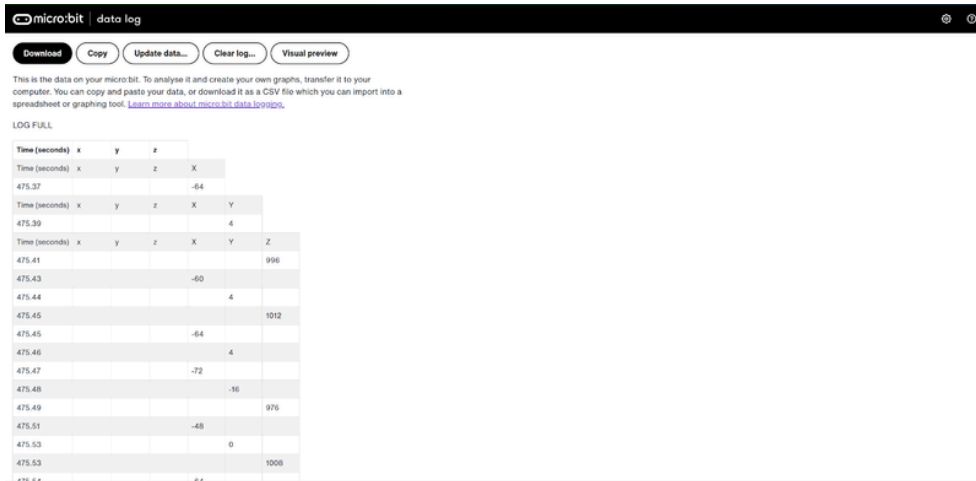
4. Observe the received life data. Try to move the transmitter micro:bit and observe the data variation on your monitor



5. Put the transmitter micro:bit and the DC Motor on an isolated platform, as a table without vibration. Try to fix to DC motor in a way that the bottle cork can rotate freely.
6. Turn the DC Motor on and observe the received data on the computer
7. To collect the data in a file, go to "my computer" on your PC and enter the microbit drive, as if it were a Pen Drive:

Nome	Data de modificação	Tipo	Tamanho
ASSERT.TXT	22/03/2016 16:30	Documento de Te...	1 KB
DETAILS.TXT	22/03/2016 16:30	Documento de Te...	1 KB
MICROBIT.HTM	22/03/2016 16:30	Avast HTML Docu...	1 KB
MY_DATA.HTM	22/03/2016 16:30	Avast HTML Docu...	124 KB

8. The last data will be recorded on "MY DATA.HTM" file. Just open it and collect your data.



micro:bit data log

Download Copy Update data... Clear log... Visual preview

This is the data on your micro:bit. To analyse it and create your own graphs, transfer it to your computer. You can copy and paste your data, or download it as a CSV file which you can import into a spreadsheet or graphing tool. [Learn more about micro:bit data loggers.](#)

LOG FULL

Time (seconds)	x	y	z	X	Y	Z
475.37						-64
475.39						4
475.41						996
475.43						-60
475.44						4
475.45						1012
475.45						-64
475.46						4
475.47						-72
475.48						-16
475.49						976
475.51						-48
475.53						0
475.53						1008
475.54						-64

9. If you want a new set of data, close the "MY DATA.HTM" file, click on the A and B button of the microbit at the same data. The data will be deleted and it will star to collect a new set of data. Wait the time you need to collect the new data and open again the "MY DATA.HTM" file to collect it.

You can interpret the simulated data with the following table.

#### Levels of "Seismic" Alerts Conversion:

Z-acceleration detected (Micro:bit)	Levels of "Seismic" alerts
[-950, -800[	Weak
[-800, -500[	Light
[-500, 0[	Moderate
>0	Strong

Through testing different vibration levels, modifying the cork position, and adjusting the distance between the vibration source and the micro:bit, you will explore how sensor readings change and relate the findings to real earthquake intensity and epicentre distance.

- Test different levels of vibration to observe the variation in seismic activity readings.
- Analyze data collected from the micro:bit and compare it with their initial hypotheses.

## 5. Student Worksheet (Copy/Paste Ready)

### 6. Assessment

**Below are some reflection questions:**

Did the student successfully pair the micro:bits and assemble the motor setup?

Does the transmitter send data and the receiver display the correct levels?

Can the student correctly identify "Strong" vs "Weak" seismic events based on the data graph?

## Earth Observation (EO), Remote Sensing (RS) & Sat Apps

### Geo-Academy E-module "EO, RS & Sat Apps"

Lesson Plan: Exploring Urban Heat Islands with My NASA Data

Grade Level: 12 to 16 years old

Duration: 2 to 4 class periods (90–180 minutes)

Subjects: Science, Geography, Earth & Environmental Science

Core Skills: Data literacy, spatial thinking, critical thinking, interpreting maps & graphs, systems thinking

Digital Tools: My NASA Data — Earth System Data Explorer

### 1. Learning Objectives

By the end of the lesson, students will be able to:

1. Explain what an urban heat island (UHI) is and describe the physical processes that cause it.
2. Use the My NASA Data Earth System Data Explorer to visualize satellite data for land surface temperature and land cover.
3. Interpret real NASA data to identify spatial patterns and compare urban and rural areas.
4. Ask meaningful data-driven questions and formulate hypotheses about causes of observed patterns.
5. Connect satellite data to real-world issues in urban planning, sustainability, and climate change.

### 2. Background for Teachers

Urban heat islands occur when cities replace natural vegetation with buildings, asphalt, and other materials. Satellite sensors measure land surface temperature, providing an excellent dataset for exploring UHIs. My NASA Data provides curated datasets and visualization tools appropriate for educational use without requiring advanced technical skills.

### 3. Materials

- Computers or tablets with internet access
- Projector/interactive board (optional)
- My NASA Data Earth System Data Explorer
- Printable or digital version of the **Data Literacy Cube** (optional)
- Student worksheet (included below)

## 4. Lesson Procedure

### Step 1: Engagement

Guide a short discussion on what might influence local temperatures (vegetation, pavement, buildings). Introduce the concept of an urban heat island. Explain that students will use real NASA satellite data to investigate whether the effect can be seen from space.

### Step 2: Data Exploration in My NASA Data

Guide students to:

myNASAdata

<https://mynasadata.larc.nasa.gov/>

- 🔗 Visualize Data 🔗 Earth System Data Explorer
- 🔗 Search for places (e.g., major cities and their surrounding areas)

Dataset Selection:

- 🔗 Geosphere 🔗 Skin Temperature 🔗 Monthly Daytime Surface (Skin) Temperature 🔗 Select a date (e.g., August 2025)

Analysis Tools:

- 🔗 Compare Two / Swipe 🔗 Biosphere 🔗 Vegetation 🔗 Monthly Normalized Difference Vegetation

Tasks for students:

1. Select the Land Surface Temperature dataset for a recent year and month (e.g., July 2025).
2. Zoom in to a city and its surrounding rural area.
3. Note visible patterns: Where are temperature values highest? Lowest?
4. Add the vegetation dataset and compare: Do the hottest areas overlap with urban regions?

Students record observations on their worksheet.

### Step 3: Interpretation & Data Literacy

Use the **Data Literacy Cube** (<https://mynasadata.larc.nasa.gov/data-literacy-cubes-graphs-maps-and-data-tables>) prompts, such as:

- *Identify a pattern in the temperature map.*
- *What questions does this dataset raise?*
- *What could be causing the variation in temperature?*
- *What additional data would help confirm your ideas?*

### Step 4: Explanation & Class Discussion

Bring students together to discuss:

- Why are urban areas hotter?
- How does vegetation influence temperature?
- What factors besides land cover might affect surface temperature?

Encourage students to connect explanations to evidence from the satellite data.

### Step 5: Application

#### Compare Two Cities

Students choose two cities in different climates or of different sizes and investigate differences in their heat patterns.

#### Time Series Analysis

Examine temperature or land-cover changes across several years to explore long-term trends.



## 5. Student Worksheet (Copy/Paste Ready)

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Exploring Urban Heat Islands with My NASA Data

#### 1. Observations from Satellite Data

City/Region Studied: \_\_\_\_\_

Datasets used: \_\_\_\_\_

a. Where are the hottest areas on the map?

b. Where are the coolest areas?

c. What land cover types correspond to hot vs. cool areas?

#### 2. Data Literacy Cube Prompts (choose any 2–3)

Prompt #1: \_\_\_\_\_

Answer:

Prompt #2: \_\_\_\_\_

Answer:

Prompt #3: \_\_\_\_\_

Answer:

#### 3. Explanation & Hypothesis

Based on the data, why do you think certain areas are hotter than others?

#### 4. Extension

Compare your city to another one or suggest actions to reduce heat islands.

#### 6. Assessment

##### Formative assessment:

- Participation during discussion
- Completion of data exploration tasks
- Quality of responses to data prompts

##### Summative assessment:

- Short written report or presentation summarizing findings
- Evaluation of the worksheet

## Geo-Academy E-module "GIS for Earth Sciences"

### Lesson Plan:

**Grade Level:** 12 to 15 years old

**Duration:** 5 to 6 class periods (300 - 360 minutes)

**Subjects:** Multi-criteria analysis, Spatial Modelling, Renewable Energy Resources, Offshore Wind Farms

**Core Skills:** Critical thinking, Problem solving, Spatial reasoning, and Team collaboration

**Digital Tools:** Google Earth Pro, QGIS (Optional for more advanced versions of the activity, where the students may create the printed maps)

### 1. Learning Objectives

By the end of the learning activities, students will be able to:

1. Analyse, and map interrelationships within environmental systems in order to understand interactions between natural and human-driven processes in different environmental project contexts.
2. Explain and evaluate the spatial complexity that governs natural and anthropogenic systems using spatial reasoning and geospatial representations.
3. Apply basic digital and spatial tools to design and test solutions addressing a range of sustainability challenges.
4. Identify spatially defined problems and formulate relevant research questions, analyse spatial data, and evaluate alternative solution pathways.
5. Apply structured problem-solving approaches, such as Multi-Criteria Analysis, to assess trade-offs related to resource allocation.
6. Integrate and analyse multiple data layers to assess environmental, social, and economic dimensions within sustainability contexts.
7. Use digital and spatial technologies to co-design solutions in sustainability-oriented decision-making processes.

### 2. Background for Teachers

Many of the problems we face today are complex, involving multiple and often conflicting interests, values, and possible solutions. Addressing such challenges requires diverse groups of experts to collaborate effectively, negotiate trade-offs, and reach compromises in order to identify solutions that are both optimal and feasible in real-world contexts.

A large proportion of these challenges have a strong spatial or geographic dimension. For this reason, the use of Geographic Information Systems (GIS), combined with appropriate analytical frameworks, can significantly support the decision-making process. One widely used approach is Multi-Criteria Decision Analysis (MCDA), which facilitates the systematic consideration and comparison of multiple, often conflicting criteria. When integrated with GIS, MCDA enables the transformation and combination of spatial data and value judgments, taking into account geographic data models, the spatial characteristics of evaluation criteria, and alternative decision options in order to address complex spatial problems.

A representative application of GIS-based MCDA is Offshore Wind Farm planning. This includes decisions related to turbine types, foundation structures, energy generation capacity, and environmental constraints. In this context, it is also important to understand the broader rationale for harvesting wind energy and the reasons Offshore Wind Farms have been developed since the early 1990s, particularly in regions such as the Baltic and North Seas, where favorable wind coAccording to the American Geoscience Institute [1], the advantages and disadvantages of Offshore Wind Energy are:

#### Advantages:

- Offshore wind speeds tend to be faster than on land. Small increases in wind speed yield large increases in energy production: a turbine in a 8 meters/second wind can generate twice as much energy as a turbine in a 6 meters/second wind. Faster wind speeds offshore mean much more energy can be generated.
- Offshore wind speeds tend to be steadier than on land. A steadier supply of wind means a more reliable source of energy.
- Many coastal areas have very high energy needs, especially in different European countries. Building offshore wind farms in these areas can help to meet those energy needs from nearby sources.
- Offshore wind farms have many of the same advantages as land-based wind farms since they provide renewable energy; they do not consume water; they provide a domestic energy source; they create jobs; and they do not emit environmental pollutants or greenhouse gases.

## Geo-Academy E-module "GIS for Earth Sciences"

### Lesson Plan:

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- Offshore wind farms have many of the same advantages as land-based wind farms since they provide renewable energy; they do not consume water; they provide a domestic energy source; they create jobs; and they do not emit environmental pollutants or greenhouse gases.

## Disadvantages:

Offshore wind farms can be expensive and difficult to build and maintain. In particular:

- It is very hard to build robust and secure wind farms in water deeper than around ~70 m, or over half a football field's length. However, floating wind turbines are beginning to overcome this challenge.
- Wave action, and even very high winds, particularly during heavy storms or hurricanes, can damage wind turbines.
- The production and installation of power cables under the seafloor to transmit electricity back to land can be very expensive.
- Effects of offshore wind farms on marine habitats, marine mammals and birds are not fully understood (!!!!).
- Offshore wind farms built within view of the coastline (up to 40 km offshore, depending on viewing conditions) may be unpopular among local residents and may affect tourism and property values.
- As shown in the videos above, the key criteria to identify optimal areas include (you may use the maps and .gif images in the .ppt file attached):

Key Site-Selection Criteria we should keep in mind (or any site-selection criteria)

1. **Mean Wind Speed:** Students evaluate wind availability, a key requirement for energy production.
2. **Bathymetry:** Depth affects construction costs and technology types (floating vs fixed turbines).
3. **Marine Protected Areas:** Shows environmental constraints; students must avoid impacting protected ecosystems.
4. **Distance to Onshore Grid:** Cables must connect to the onshore grid; longer distances increase cost and energy loss.
5. **Distance to Ports:** Proximity to ports is important for logistics during installation, maintenance and decommissioning.
6. **Distance to Shore (or Settlements):** Proximity to the shoreline and/or settlements is a critical social criterion influencing the final location of a wind farm. Visual impact and social opposition to such large projects are always key issues.

[1] American Geoscience Institute: [What are the advantages and disadvantages of offshore wind farms?](#)

## 3. Materials

Support Material ([link](#)):

1. Step-by-step guide on GEOBSERVE ([link](#))
2. Activity Presentation (in English)
3. Students' worksheet (in English)
4. NBS Cards for Offshore Wind Farms (in English)
5. Teacher Guide and Students' Worksheets (In Greek)
6. Case studies/Printed Maps (Greece, Cyprus, Portugal)

## 4. Lesson Procedure

The activity has been developed for upper primary or lower secondary school students (age 12 – 15), its duration is 5-6 hours and is divided into 4 steps, including:

1. Introducing the problem and providing background information
2. Identifying optimal areas using printed maps (Multi-Criteria Analysis)
3. Building the offshore wind farm (i.e. number of wind turbines, cable length and route, sending the energy to nearby cities/towns/islands) and estimating the costs
4. Integrating Nature-based Solutions (NBS) concepts for mitigating environmental impacts and estimating the additional costs
5. Evaluating students' results and the optimal areas they selected (you may invite an expert to discuss with the students and analyse their results by showing them real case studies and actual offshore areas proposed for offshore wind development)

## 5. Student Worksheet (Copy/Paste Ready)

OFFSHORE WIND FARM CONSTRUCTION STUDY

CLASS: \_\_\_\_\_

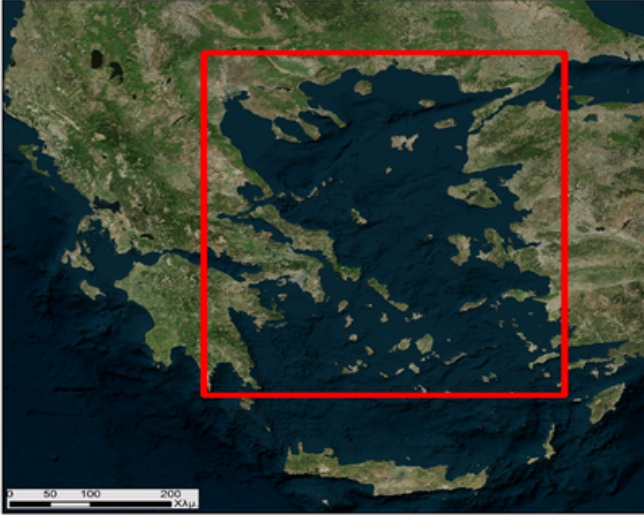
GROUP or NAME: \_\_\_\_\_

GROUP

MEMBERS:

\_\_\_\_\_

Your team has been assigned to study the construction of an offshore wind farm in the XXXX (Study Area) as shown on the map below (exemplary map for Greece):



## STAGE 1: FINDING THE SUITABLE AREA

To do this, you must take into account the following basic factors:

1. Offshore Wind Potential (Wind speed, in meters per second)

Wind potential refers to the intensity of the wind prevailing in an area. For the construction of an (offshore) wind farm, we prefer areas with high wind potential.

\* We do not exclude areas with low wind potential (6-7 meters/second), as long as these areas meet the other criteria (e.g., shallow depth).

2. Bathymetry (Depth, in meters)

For the construction of the offshore wind farm, we prefer areas with shallow depth, up to 70 meters, as it is easier to install wind turbines and the construction cost is reduced.

This does not mean that we cannot install offshore wind farms at greater depths of up to 500 or 1000 meters; it simply costs considerably more.

\* Usually, great depths are located at a great distance from the coast, resulting in stronger winds.

### 3. Distance from the energy transmission lines on land (in kilometers)

The wind farm needs to be close to a 150kV transmission line of the national network. Wind turbines produce low-voltage electric current at approximately 700V. The energy is transferred from the offshore wind farm via a 20 kV medium-voltage network to a Substation at sea, where the voltage is raised from 20 to 150kV. From the Substation at sea, it is transferred to a Substation on land, where it is distributed to the main transmission network.

\* If we choose an area located at a great distance from the network (> 100 km), the cost increases since longer cables are needed as well as higher wind intensity. Conversely, when we are very close to the network (< 20 km), the cost is significantly reduced.

### 4. Distance from areas of environmental interest

(Offshore) wind farms are not developed in protected areas, protected natural monuments, wetlands, and biodiversity conservation areas.

### 5. Distance from ports for construction and maintenance of the project (in kilometers)

The nearest ports to the area we will select are examined so that the routes taken by ships for the construction and repair of wind turbines are as short as possible. Areas with distances up to 60km are preferred.

\* As the distance from ports increases, so does the cost to install, repair, and remove wind turbines.

### 6. Distance from the coastline (in kilometers)

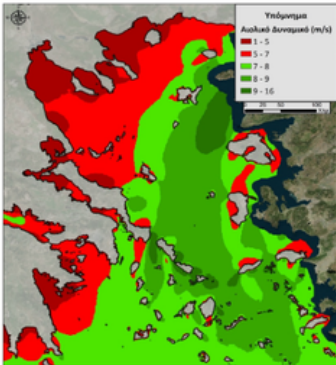
The distances from the coast are examined on the corresponding map. We do not want the Offshore Wind Farm to be either too close (less than 10 kilometers) or too far (e.g., more than 40 kilometers) from the coast. Our goal is to ensure that the wind turbines are not highly visible from settlements and cities that are near the sea. Areas with distances of 10 – 40 kilometers are preferred, without however prohibiting going closer or farther.

As the distance from the coastline increases, so does the cost to install, repair, and remove the wind turbines, as well as the cable cost.

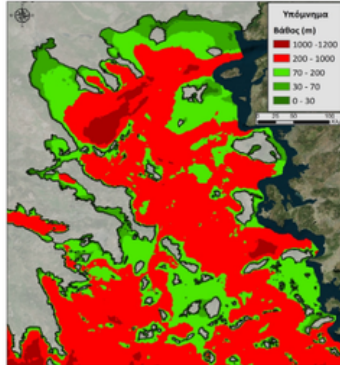
## HOW TO FIND SUITABLE AREAS?

*\*FOR TEACHERS: THE MAPS SHOWN BELOW ARE INDICATIVE FOR GREECE*

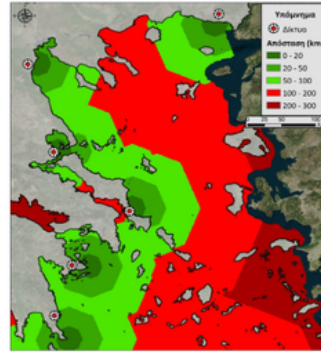
Wind Speed



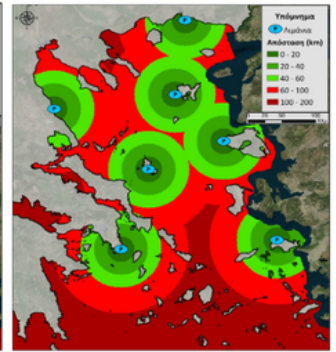
Bathymetry



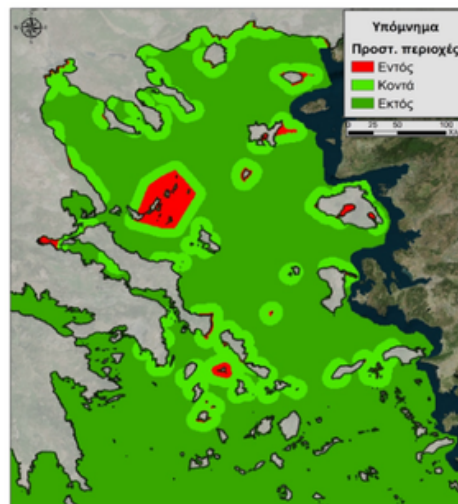
Distance from the onshore grid



Distance from Ports



Marine protected areas (NATURA areas)



Wind Potential: Find 3 areas on the printed wind potential map that you consider suitable and circle them.

Bathymetry: Find 3 areas on the printed depth map that you consider suitable and circle them.

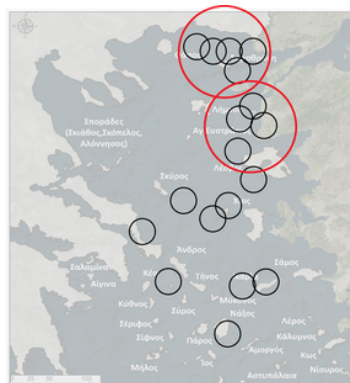
Distance from the energy transmission lines on land: Find 3 areas on the printed distance map that you consider suitable and circle them.

Distance from areas of environmental interest: Find 3 areas on the printed map with areas of environmental interest that you consider suitable and circle them.

Distance from ports: Find 3 areas on the printed map of distances from ports that I consider suitable and circle them.

Distance from the shore: Find 3 areas on the printed map of distances from the shore that you consider suitable and circle them.

Place one map on top of the other and identify the areas where the circles you have drawn coincide (intersect). The more circles coincide with your 5 or 6 criteria, the better the area selection you have made.



## GIS (Geographic Information Systems) for Earth Sciences

Select from the table of the number of houses per city, town, or island(s) that follows, which one of them (or more than one) you will help and how many wind turbines you will install. Take into account:

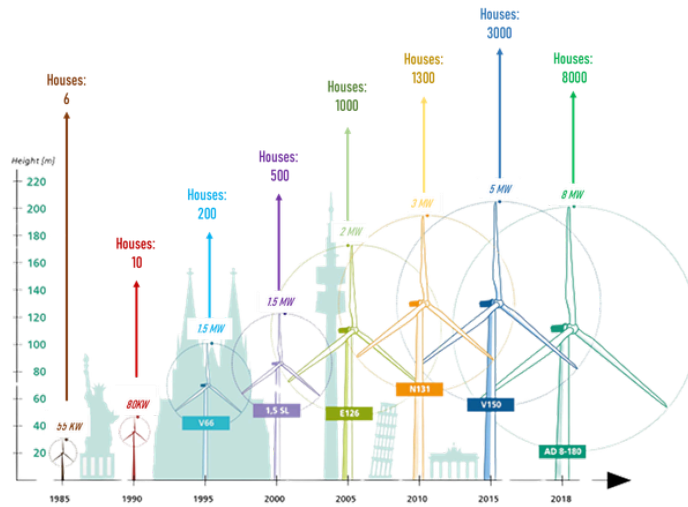
- The area you have already selected to build the offshore wind farm based on the criteria.
- The results from the application in which you designed the wind turbine.
- The variations in energy needs for many areas during the tourist season (like for example in Greece).

We will install \_\_\_\_\_ wind turbines that will give me a total power equal to \_\_\_\_\_ MW so as to cover the energy needs of the city (cities) and island (or islands) of \_\_\_\_\_.

\*You already know the number of houses per city/town/island from the following table!

Island / City	Number of houses
<b>Euboea</b>	60000
<b>Andros</b>	5000
<b>Syros</b>	6000
<b>Paros</b>	7000
<b>Naxos</b>	9000
<b>Tinos</b>	7000
<b>Mykonos</b>	14000
<b>Koufonisia</b>	500
<b>Donousa</b>	80
<b>Samos</b>	12000
<b>Chios</b>	18000
<b>Lesvos</b>	25000
<b>Sporades</b>	10000
<b>Aegina</b>	5000
<b>Athens</b>	1000000
<b>Thessaloniki</b>	150000

\*Use the cards with the sizes of wind turbines and the houses that each wind turbine can cover to make your calculations.

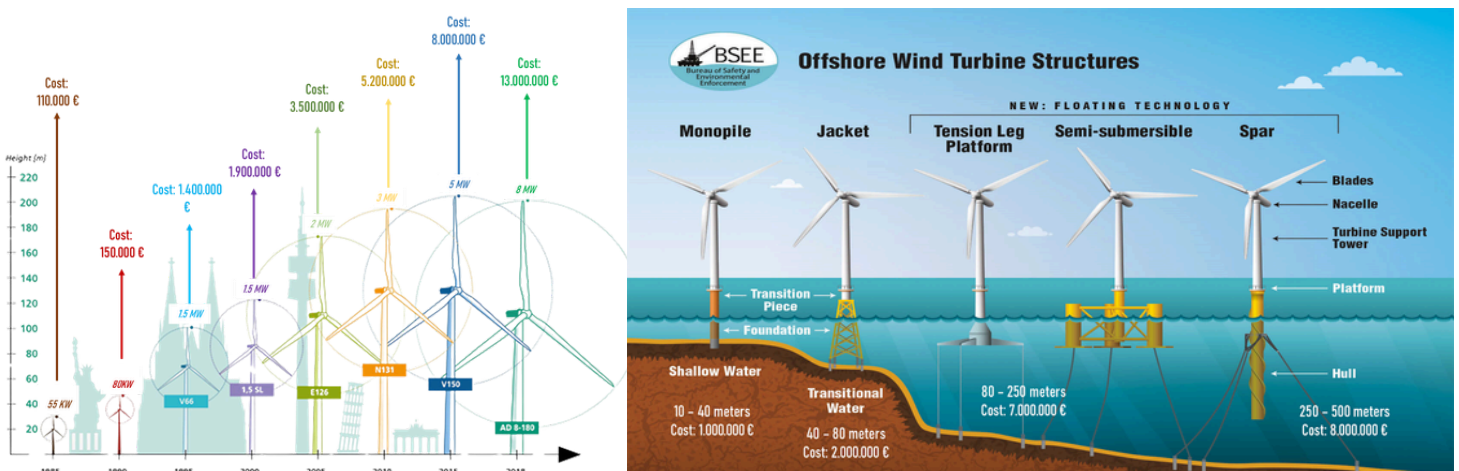


Record your conclusions from the study you conducted.



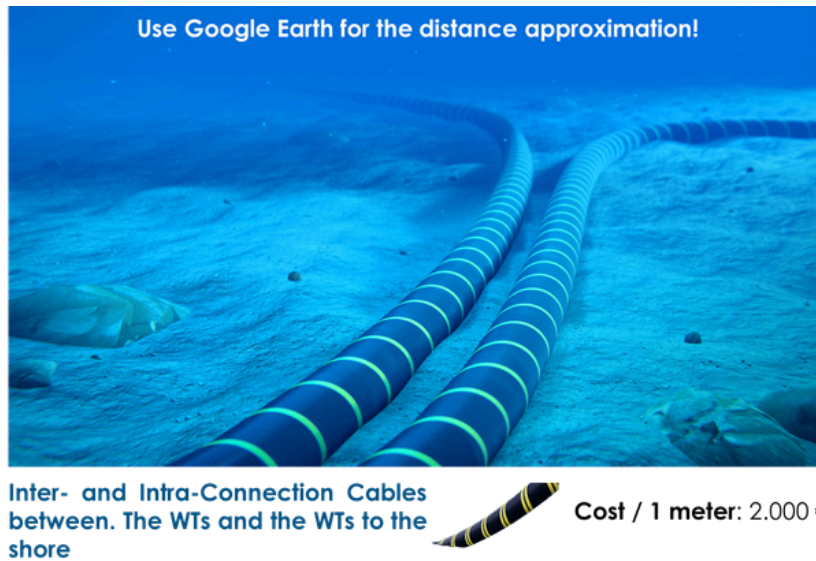
## STAGE 2: COST CALCULATION

In Stage 2, you can calculate the cost of the Offshore Wind Farm, utilizing the cost cards provided per wind turbine!



ATTENTION: You will need to calculate the cost for each wind turbine (above the water surface), for the foundation (depending on the depth), as well as the cable length (with the help of Google Earth Pro)





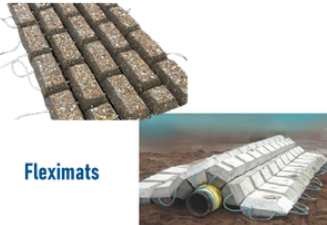

# GIS (Geographic Information Systems) for Earth Sciences



## STAGE 3: MINIMIZING ENVIRONMENTAL IMPACTS

In Stage 3, after we have calculated the cost for installing our Offshore Wind Farm, we can utilize Nature-based Solutions in order to reduce the environmental impacts from the installation of wind turbines and cables.

To succeed, we will rely on the cards with the installation costs of artificial reefs per wind turbine and the 'covers' for underwater cables!

 <p><b>Reef Balls</b></p>	 <p><b>Layer Cakes</b></p>	 <p><b>Cube Reefs</b></p>	 <p><b>Reef Cells</b></p>	 <p><b>Fleximats</b></p>	 <p><b>ECOConcrete</b></p>
Cost / Wind Turbine	Cost / Wind Turbine	Cost / Wind Turbine	Cost / Wind Turbine	Cost / 1 meter	Cost / Structure
400.000 €	600.000 €	300.000 €	1.000.000 €	100 €	1.500€
<b>Superpower:</b> Concentrating a few marine species and enhancing biodiversity	<b>Superpower:</b> Concentrating several marine species and enhancing biodiversity	<b>Superpower:</b> Concentrating a few small marine species and enhancing biodiversity	<b>Superpower:</b> Concentrating many different marine species and enhancing biodiversity	<b>Superpowers:</b> Cable protection, reduce magnetic fields, biodiversity increase	<b>Superpowers:</b> Enhanced ecosystem growth as oysters, worms, bryozoans and coral algae grow. Absorption of carbon dioxide (CO <sub>2</sub> )

## LET'S CALCULATE THE FINAL COST OF THE OFFSHORE PARK!

### 6. Assessment

Formative assessment:

- Participation during discussion
- Completion of data, printed cards and map exploration tasks

Summative assessment:

- Short presentation (or poster) summarizing the process they followed and their findings
- Evaluation of the worksheet (after removing the maps and the cards)

You may assess students' competencies by reviewing both the process and outputs of the activity. Evidence includes the correct interpretation and overlay of thematic maps to identify suitable areas, the justified consideration and interpretation of multiple criteria and trade-offs (wind potential, depth, distances, cost, and environmental constraints), the accuracy and consistency of energy and cost calculations, and the appropriate identification of environmental constraints and mitigation measures. Additional evidence is provided through the effective use of digital tools (e.g. distance measurements via Google Earth) and clear group communication and collaboration, as observed during the activity and reflected in students' written conclusions and their final presentations. In particular, you may focus on the:

## Spatial skills

- Correct interpretation of thematic maps (wind, depth, distances)
- Overlay and intersection of multiple spatial layers/data
- Identification of suitable areas using different spatial criteria

## Systems Thinking

- Understanding trade-offs between technical, environmental, and social criteria
- Justification of final site selection based on multiple factors

## Quantitative & Analytical Skills

- Correct estimation of energy needs, turbine numbers and size
- Accurate cost calculations (turbines, foundations, cables)
- Use of given data, cards, and measurements (e.g. distances)

## Sustainability & Environmental Awareness

- Identification of environmental constraints (protected areas)
- Application of Nature-based Solutions to reduce impacts

## Digital tools

- Use of Google Earth / maps for distance estimation
- Handling spatial and numerical information effectively

## Collaboration & Communication

- Group coordination and task sharing (any roles distribution?)
- Clear presentation of the process, the decisions made and the conclusions

## Map Storytelling

### Geo-Academy E-module “Map Storytelling”

Lesson Plan: Developing SDGs related projects in the classroom

Grade Level: 11 to 16 years old

Duration: 6 to 7 class periods (90–180 minutes)

Subjects: Map Storytelling Project for SDGs

Core Skills: Critical thinking, Problem solving, Spatial reasoning, and Team collaboration, spatial thinking, storytelling

Digital Tools: ArcGIS Online - Storymaps application

#### 1. Learning Objectives

1. Understanding of the 17 UN Sustainability goals
2. Interpretation of maps for learning about SDG related topics
3. Use evidence to for questions and gain new knowledge
4. Understand map storytelling as a communication method that combines multimedia, text and maps
5. Create a map storytelling project
6. Develop collaboration and presentation skills
7. Fostering digital, spatial and green skills

#### 2. Background for Teachers

It is understood that Storytelling is embedded in our everyday lives. Via narration, we are able to communicate with each other, share our views and understanding of the world as well as obtain new knowledge. The power of maps has already been acknowledged as a way to connect people, places, and ideas.

**Maps** provide an overview of a certain topic or phenomenon via the visualization of geolocated data and information. This enables us in a user-friendly way to reason about what we see on the map, ask the right questions, gain new knowledge, and finally take action. This is of high importance in the educational sector where the main goal is to teach students how to learn, meaning how to transform observations and data from their environment to new knowledge. By using map storytelling in the classroom, teachers and students benefit to the fullest from the advantages of narration, geolocated information and visualization facilitating the “connection of the dots” of the learning material in an interactive and playful manner.

### 3. Materials

- Infrastructure
  - Computers/laptops
  - Internet connection
- Software
  - Online Map Storytelling Service: [Storymaps](#)
  - In order to obtain a school license, contact your [local ESRI distributor](#). For EU countries visit [here](#).
- Lesson for teachers on the Geobserve platform:
  - Map Storytelling in the classroom: hands on training ([Follow the course](#)). Step by step guide for teachers on how to use Storymaps for creating Map Storytelling projects.
  - How to setup a map storytelling project in the Classroom ([Follow the course](#)). Step by step guide for teachers on how to design a Map Storytelling project, best practices
- Additional Resources
  - Collection of Storymaps for SDGs ([link](#))
  - Interactive maps for SDGs ([link](#))
  - The 17 UN Sustainable Development Goals ([link](#))

### 4. Lesson Procedure

The activity has been developed for upper primary or lower secondary school students (age 11 – 15), its duration is 5-6 hours and is divided into 4 steps, including:

#### Step 1: Introduction on SDGs

Teachers introduce the notion of SDGs to the students. A discussion takes place about what each goal is about.

#### Step 2: Understanding SDGs with the aid of maps

Teachers explain the power of maps and how to represent important information about SDGs via maps by showing “[Interactive maps for SDGs](#)” in the classroom. A discussion will take place about the differences of the countries in achieving the goals and how we get the information from the maps

#### Step 3: Getting familiar with Map Storytelling

Teachers introduce the concept of map storytelling to the students and present examples from the “[Collection of Storymaps for SDGs](#)”. In small groups, students review and analyze the Storymaps, then give a brief oral presentation highlighting the key information and maps from each one.

Teachers give access to Storymaps so and in a hands-on session explain how the service works

#### Step 4: Map Storytelling for SDGs

Whole working in groups and after a brainstorming session, student decide to focus on one of the 17 goals and develop a Map Storytelling project. Basic steps for the development of the project include:

- Collection of material (texts, images, videos, applications etc)
- Creation of digital maps
- Compilation of the material in the Map Storytelling form by using ArcGIS Storymaps.

### 5. Student Worksheet (Copy/Paste Ready)

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Exploring SDG topics

1. Which are the SDGs?

- a. Choose one of the SDGs to focus on?
- b. What kind of information would you need to draft your Storymap?
- c. What type of maps would you include in the Storymap?

2. Explanation & Hypothesis

Based the information you collected why do you think the goal you chose is important?

3. Extension

What kind of projects have already been implemented based on the goal you chose?

### 6. Assessment

#### Formative assessment:

- Participation during discussion
- Creation of Storymap
- Preparation of Digital maps

#### Summative assessment:

- Short written report or presentation summarizing findings and lessons learned both about the SDGs and the Map Storytelling as well as for the process (team work, collaboration, inquiry based learning etc)
- Evaluation of the project development (online form)





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