

Learning about wind

Learning scenario



About this learning scenario

"Learning about wind" is one of four learning scenarios developed as part of the adaptation of the **WindEurope Teacher Toolkit for Primary Schools**, carried out by **European Schoolnet (EUN)** in partnership with **WindEurope**, within the framework of the **Scientix® STEM Alliance** initiative. [Learn more about this partnership here.](#)

WindEurope's teachers' toolkit: Learning wind energy in primary schools

The **WindEurope Teacher Toolkit for Primary Schools** is an educational resource developed by **WindEurope**, in partnership with **Singelijn Primary School in Brussels**, to help primary school teachers, particularly those teaching the final years of primary education, introduce students to the fundamentals of wind energy. The toolkit provides practical materials that connect renewable energy topics with classroom learning and aims to make wind energy accessible to young learners without requiring any prior background knowledge from teachers or students.

The toolkit comprises **four cross-disciplinary modules**, each structured as a lesson plan with interactive activities and supplementary resources. The modules link subjects such as science and technology, mathematics, history, geography, and language learning with real-world wind energy topics, helping students understand how renewable energy relates to everyday life and global sustainability challenges.

The toolkit was **piloted with a class of 12-year-olds (6th grade) at Singelijn Primary School in Brussels between November 2020 and April 2021**. The curriculum was co-designed by the teacher and a class of 20 students and adapted to match their learning objectives and interests. The resource is available in **Danish, Dutch, English, French, Polish and Spanish**, and was reviewed by the **Science Communication Committee of the European Academy of Wind Energy**.

[Access the Toolkit here.](#)

From toolkit to learning scenarios: The adaptation

The four original modules have been reviewed and adapted using the Scientix® methodology – a pedagogical quality review process that supports the development of high-quality STEM resources for teachers across Europe. The original toolkit provides engaging classroom activities about wind energy. The adapted learning scenarios retain these activities while enriching them with pedagogical guidance, curriculum mapping, assessment strategies, and links to European STEM and sustainability education frameworks. **As a result, teachers receive not only ready-to-use classroom activities, but also complete, curriculum-ready teaching resources that are easier to integrate into classroom practice across different European education contexts.** The adaptation also introduces three key enhancements:

1. Integration of GreenComp: Each learning scenario has been mapped to relevant competences from GreenComp, the [European Sustainability Competence Framework](#) developed by the European Commission's Joint Research Centre. GreenComp defines 12 competences organised into four areas –



Embodying Sustainability Values, Embracing Complexity in Sustainability, Envisioning Sustainable Futures, and Acting for Sustainability – to help learners of all ages develop the knowledge, skills, and attitudes to think, plan, and act sustainably.

2. Integration of industry involvement: Real-world industry applications have been embedded into each learning scenario. This includes profiles of wind energy professionals and the diverse roles they play – from engineers and environmental scientists to project developers and grid specialists – as well as references to real wind energy sites and technologies, examples of how wind turbines are designed, built, and tested, and connections to the broader challenge of the energy transition and Europe's path to climate neutrality. This aims to inspire curiosity, demonstrate the relevance of STEM subjects, and motivate young learners to imagine their future in these fields.

3. Mapping to the Scientix STEM School Label (SLL) criteria: The adaptation includes mapping activities to the SLL criteria, allowing school leaders and teachers to see how each learning scenario addresses key STEM areas and competencies and how it can fit into their school's STEM strategy. To learn more about the Scientix STEM School Label, [visit this page](#).

European Schoolnet (EUN) developed the pedagogical adaptation of this resource and takes full responsibility for the pedagogical adaptation and the pedagogical and STEM-educational content introduced through this adaptation.

The four learning scenarios

The scenarios are intended to be used in sequence but can also be used as stand-alone resources. They can be accessed below.

1. Learning about energy.
2. Constructing an anemometer and taking measurements.
3. Understanding wind turbine technology.
4. Learning about wind.

Project partners

This learning scenario has been made possible through the collaboration of key partners. [WindEurope](#) is the voice of the wind energy sector in Europe, promoting wind energy as a key part of the transition to a sustainable energy system. By joining the Scientix® STEM Alliance, WindEurope connects classrooms with real-world renewable energy examples, supporting STEM learning, inspiring young learners, and highlighting potential career pathways in the sector. [European Schoolnet \(EUN\)](#) is a network of over thirty Ministries of Education across Europe, supporting schools and teachers in the adoption of innovative teaching practices, professional development, and evidence-based approaches to learning for the 21st century. [Scientix®](#) is Europe's largest STEM education community, connecting teachers, researchers, and policymakers through training, resources, and collaborative projects. The [Scientix® STEM Alliance](#) enables industry partners to actively contribute to STEM education, engage directly with educators, and support the development of innovative teaching practices across Europe.



Learning scenario ID

Title

Learning about wind

Summary

This learning scenario engages students in an interdisciplinary investigation of wind as a natural phenomenon, a geographical resource, and a driver of technological innovation. Across four lessons, students investigate how wind forms through experiments (Lesson 1), explore why some places are windier than others and analyse global wind patterns (Lesson 2), use real wind-energy data and digital mapping tools to compare countries and make evidence-based recommendations about future wind-energy development (Lesson 3), and explore how humans have harnessed wind from ancient sailing to modern wind turbines (Lesson 4). Throughout the scenario, students develop their ability to explain natural processes, analyse evidence, and understand how wind technologies have evolved to meet human needs over time.

Keywords

Wind, air pressure, atmospheric pressure, wind formation, scientific method, local and global wind patterns, wind atlas, geographical analysis, data analysis, evidence-based decision-making, wind energy, history of wind technology, renewable energy, sustainability, GreenComp.

Aim of the lesson

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

- Explain how wind forms through differences in air pressure and temperature using scientific investigation.
- Describe why wind conditions vary between places by exploring regional and global wind patterns.
- Analyse and represent wind-energy data, compare countries using different indicators, and combine multiple sources of evidence to make and justify recommendations about future wind-energy development.
- Explain how wind technologies have evolved over time to meet human needs.
- Recognise the role of wind energy in renewable electricity generation and future energy decisions.

Licence

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Note for Educators: You are welcome (and encouraged!) to translate, adapt, and customise the worksheets and text for use in your own classroom.

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Overview

Subject(s)	Science, Geography, Technology, Language, Mathematics, Social Studies/Citizenship, History											
Topic(s) and curriculum connections	This learning scenario connects to curriculum areas commonly found in upper-primary education across Europe. The curriculum connections were developed through a review of representative upper-primary curricula from several European countries to identify shared learning objectives and curriculum strands, rather than align the resource to a single national curriculum. Teachers can use these strand descriptions to identify the relevant sections of their own national or regional curriculum and adapt the activities accordingly¹. <table><tr><th>Subject</th><th>What is covered</th><th>Curriculum connections across European countries</th></tr><tr><td>Natural Science (Lesson 1)</td><td> • How wind forms through differences in air pressure and temperature. • Convection and air movement. • Scientific enquiry through hands-on experiments. </td><td>1) Forces and the atmosphere: air pressure, temperature differences, and movement of air. 2) Weather systems: understanding wind as part of atmospheric processes. 3) Scientific enquiry: forming hypotheses, carrying out experiments, observing, and explaining results.</td></tr><tr><td>Geography (Lesson 2)</td><td> • Local and global wind patterns. • The influence of landscape and location on wind conditions. </td><td>1) Weather, climate, and natural resources: how wind varies between places.</td></tr></table>			Subject	What is covered	Curriculum connections across European countries	Natural Science (Lesson 1)	• How wind forms through differences in air pressure and temperature. • Convection and air movement. • Scientific enquiry through hands-on experiments.	1) Forces and the atmosphere: air pressure, temperature differences, and movement of air. 2) Weather systems: understanding wind as part of atmospheric processes. 3) Scientific enquiry: forming hypotheses, carrying out experiments, observing, and explaining results.	Geography (Lesson 2)	• Local and global wind patterns. • The influence of landscape and location on wind conditions.	1) Weather, climate, and natural resources: how wind varies between places.
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¹ Subject boundaries vary across European curricula. At this age level, History, Geography, Social Studies/Citizenship, and Technology content is sometimes taught within broader integrated subjects – such as a combined natural and social sciences area, or general STEM learning – rather than as standalone subjects. The strand descriptions in the table reflect the intended learning outcomes and curriculum strands, regardless of how these are organised within a particular national or regional curriculum.



	Using maps and digital wind-resource tools.	2) Map skills and geospatial technologies: interpreting maps and digital data layers.
Technology (Lessons 2, 3, and 4)	Using digital tools such as the Global Wind Atlas and spreadsheets to investigate wind resources, analyse and visualise data, and exploring how wind technologies have evolved from ancient sailing to modern wind turbines.	1) Digital literacy: using digital tools to access, analyse, visualise, interpret, and communicate information. 2) Technology in everyday life: recognising how technologies are developed to address human needs.
Language (Lessons 2 and 4)	- Developing subject-specific vocabulary. - Recording observations. - Explaining ideas. - Presenting research findings and recommendations.	1) Vocabulary development: using scientific, geographical, and technological terminology. 2) Communication skills: writing, presenting, discussing evidence, and justifying conclusions.
Mathematics (Lesson 3)	- Organising, comparing and representing real wind-energy data. - Calculating averages (mean with median as extension). - Identifying patterns. - Using data to support evidence-based recommendations.	1) Data handling: organising, comparing, representing and interpreting numerical data. 2) Mathematical reasoning: using data patterns and calculations to justify conclusions.
Social Studies / Citizenship (Lessons 3 and 4)	- Considering different factors involved in wind energy decisions. - Understanding how wind technology has influenced societies over time.	1) Education for sustainable development: understanding why renewable energy is important for society. 2) Active citizenship: considering different perspectives when making decisions about

		issues that affect society.
History (Lesson 4)	The evolution of wind technologies, from sailing and traditional windmills to electricity-generating wind turbines and modern wind farms.	1) Life in the past: investigating how inventions and technologies influenced people's lives. 2) Historical enquiry: researching historical developments and communicating findings.
A full assessment framework linked to these curriculum strands – including subject-specific descriptors at three levels of achievement – is provided in the Assessment section .		
Age of the learners	11–12 years old.	
Preparation time	Approximately 2 hours across the four lessons (including ~1 hour for the teacher to familiarise themselves with the wind phenomena covered in Lesson 2).	
Total implementation time	4 lessons of 45 minutes each.	
Teaching material	Lesson 1 – What is wind and how does it form? Annex 1: Wind formation investigation sheet – student worksheet (print one per student). - Suggested videos for Experiment 1: one glass, water, a piece of stiff card, a sink or tray (one set per group). - Suggested videos for Experiment 2: one empty plastic bottle, one balloon, one bowl of hot water and one bowl of cold water (one set per group). - Video – Air Pressure Experiment: Homemade Science With Bruce Yeany. (2024, August 29). <i>Upside Down Water Glass Experiment Improved</i>. YouTube. https://www.youtube.com/watch?v=D4liUf9AfbM. (0:59). - Video – Air Pressure Experiment – Alternative Demonstration: MocomKids. (2012, January 16). <i>Upside Down Glass Of Water Trick – Science Experiment</i>. YouTube. https://www.youtube.com/watch?v=65T4ReLkCg. (0:45). - Video – Temperature Experiment: Playing With Rain. (2021, February 2). <i>Hot And Cold Balloon Experiment</i>. https://www.youtube.com/watch?v=tzjHwwFTaBl. (0:59). - Video – Temperature Experiment – Alternative Demonstration: Jolly Battle. (2021, November 22). <i>Self-Inflating Balloon. Hot And Cold Air Science Experiment For Kids. Cold And Hot Balloon Trick</i>. https://www.youtube.com/watch?v=oR3T18o3oc. (3:22). Lesson 2 – Why is it windier in some places than others? - Wind phenomenon suggested research sources (in English): - Sea breeze: NOAA JetStream – <i>The Sea Breeze</i>: https://www.noaa.gov/jetstream/ocean/sea-breeze	

- Föhn: MeteoSwiss – *Foehn*:
<https://www.meteoswiss.admin.ch/weather/weather-and-climate-from-a-to-z/foehn.html>
- Mistral: Windy.app – *How does the mistral form*:
<https://windy.app/textbook/how-does-the-mistral-form.html>
- Trade winds: NOAA NESDIS – *What Are Trade Winds?*:
<https://www.nesdis.noaa.gov/about/k-12-education/atmosphere/what-are-trade-winds>
- For your local wind, and if you're teaching in a language other than English, we recommend checking your national meteorological service's website, which will usually have an accessible explanation in your own language.

- [Annex 2: Wind patterns investigation sheet](#) – student worksheet (print one per student).
- Global Wind Atlas. (n.d.). *Global Wind Atlas 3.0*. Technical University of Denmark (DTU) and the World Bank Group. Available at: <https://globalwindatlas.info/en/>

Lesson 3 – How do we decide which places could be suitable to build wind farms?

- [Annex 3: Wind energy investigators – Future energy advisors](#) – student worksheet (print one per student).
- [Spreadsheet: Wind energy investigators – Future energy advisors](#).
- WindEurope. (2025). *Wind Energy in Europe: 2024 Statistics and the Outlook for 2025–2030*. Available at: <https://windeurope.org/data/products/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030/>

Lesson 4 – How have humans used wind throughout history?

- Poster paper or A3 sheets, markers and other poster-making materials, sticky notes or labels for arranging the timeline, printed images of historical wind technologies (optional, for supporting poster creation and the class timeline).

The learning scenario activities

Activity plan

Name	Procedure	Duration	STEM & GreenComp Alignment ²
Lesson 1: What is wind and how does it form?	Activity 1: Our driving question and what we already think (7 min) Introduce the driving question for the scenario:	45 min	SSL 1.3 SSL 2.1 SSL 2.2

² Each lesson is tagged with codes referring to the STEM Strategy Criteria (SSC) and GreenComp (GC) competences it addresses. SSC codes relate to the Scientix STEM Strategy Criteria, a framework used to identify and support high-quality STEM teaching practice across schools in Europe. GC codes relate to GreenComp, the European Sustainability Competence Framework developed by the European Commission's Joint Research Centre. A full explanation of each code, along with how this learning scenario addresses it, is provided in the "Reflection on Practice" section at the end of this document.



Science

Why is it windier in some places than others, and how have people used this knowledge throughout history and today?

Explain that today's lesson explores how wind is formed. Students spend 2 minutes writing what they already know about wind ([Annex 1 – Part A](#)). Then, hold a quick true/false class vote on the following statements without revealing the answers:

- *Wind is made by trees moving.*
- *Wind comes from clouds.*
- *Cold air creates wind.*
- *The Earth spinning creates the everyday wind we feel.*

Keep the results visible to revisit at the end of the lesson.

Activity 2: Quick recap – Renewable energy (5 min)

Briefly recap the difference between renewable and non-renewable energy sources.

Ask: *Why is wind a renewable energy source? Why is understanding how wind forms important for producing renewable energy?*

Activity 3: Thinking like scientists – Our investigation plan (5 min)

Explain that students will investigate like scientists by following the scientific method: hypothesise → experiment → observe → explain → reflect.

Introduce the purpose of each experiment:

- Experiment 1 investigates atmospheric pressure.
- Experiment 2 investigates how heating and cooling affect air.

Together, these explain how wind forms.

Activity 4: Experiment 1 – Does air really push? (10 min)

For classroom management, the teacher runs this one as a demo, with 1-2 student volunteers assisting, while the rest of the class watches: fill a glass to the brim with water, cover it with a piece of card, and (over a sink or tray!) slowly turn it upside down (see video for reference in the [Overview table](#)).

Before the demo, all students record their hypothesis in [Annex 1 – Part B](#). As the demo runs, they record their observations and discuss in pairs why they think the card stays in place.

SSL 3.1
SSL 7.1

GC 1.3
GC 2.1
GC 4.2



The teacher then formalises the explanation: the air outside is pushing up on the card with more force than the water is pushing down. This pushing force of the air all around us is called atmospheric pressure, and differences in atmospheric pressure are the key to understanding how wind forms.

Write the key terms on the board:

- Atmospheric pressure
- Air pushes (in all directions)
- Pressure difference

Activity 5: Experiment 2 – Why does warm air rise? (10 min)

In small groups: stretch the neck of a balloon over the mouth of an empty plastic bottle. Place the bottle first in a bowl of hot water, then in a bowl of cold water (see video for reference in the [Overview table](#)).

Students first record their hypothesis in [Annex 1 – Part C](#), carry out the experiment, record their observations, and discuss in pairs why they think the balloon changes size in hot and cold water.

The teacher then formalises the explanation: the air inside the bottle warms up, expands, and becomes less dense. Because warm air is less dense than cool air, it rises. In cold water, the air cools, contracts, and becomes denser, so it sinks. This process happens in the atmosphere too: uneven heating causes differences in air temperature and density, which contribute to pressure differences and wind formation.

Write the key terms on the board:

- Warm air → less dense → rises → low pressure
- Cool air → denser → sinks → high pressure

Activity 6: Connecting the dots – How wind is born (5 min)

Bring both experiments together by asking students to complete the wind formation diagram in [Annex 1 – Part D](#). As a class, discuss each step of the process:

- The Sun heats the Earth's surface unevenly.
- Warm air becomes less dense and rises, creating low pressure.
- Cool air becomes denser and sinks, creating high pressure.
- Air moves from areas of high pressure to areas of low pressure. This moving air is called **wind**.



	This is also a good opportunity to revisit the idea that energy can change from one form to another. Ask students: <i>When the wind turns a turbine, what happens to the energy?</i> Activity 7: Wrap-up – Questions and open ideas (3 min) Use this time to answer any questions students still have about how wind forms – there are likely to be some after two hands-on experiments.		
Lesson 2: Why is it windier in some places than others? Geography Technology Language	Before the lesson: Teacher preparation Before this lesson, take ~1 hour to read up on the five wind phenomena students will investigate (sea breeze, Föhn, Mistral, trade winds, and your local wind), so you can support groups and check their findings. Refer to the Overview table for suggested resources. Activity 1: Recall and today's question (5 min) Return to the true/false statements from Lesson 1, Activity 1, and reveal the correct answers. Ask 2–3 students to explain, in their own words, how wind is formed. Students then revisit their initial ideas in Annex 1 – Part A, correcting or adding to them in a different colour, based on what they now know. Introduce today's question: <i>Why do some places have much stronger, steadier winds than others?</i> Activity 2: Investigating local, regional, and European winds (20 min) Divide the class into five groups and assign one wind phenomenon to each: Sea breeze, Föhn, Mistral, Trade winds, and the prevailing winds in the students' region (selected by the teacher). Using books, teacher-approved websites, or other reliable sources, groups investigate: • Where does this wind occur? • Why does it form? • How does this wind affect people's daily lives? • Would it be suitable for wind energy? Why or why not? Groups write their answers in their own words and prepare a one-minute presentation for the class. Groups present in the order above, so the class gradually builds its understanding from regional wind systems to global wind patterns, before applying this understanding to their own region. As each	45 min	SSL 1.2 SSL 2.1 SSL 2.2 SSL 2.3 SSL 3.1 SSL 6.1 SSL 7.1 GC 1.1 GC 1.3 GC 2.1 GC 3.3



	group presents, the rest of the class completes Annex 2 – Part A using notes from the presentations. Activity 3: Our local winds (5 min) Building on the "prevailing winds" presentation, ask the class: - Based on today's investigation, do you think your region is likely to be windy? Explain your reasoning. - What landforms or coastlines influence the wind here? - Would you build a wind farm here? Students complete Annex 2 – Part B. Activity 4: Exploring the global wind atlas (15 min) As a class (projected) or in pairs on devices, open the Global Wind Atlas – a free, real tool built by the Technical University of Denmark and the World Bank. Let students explore first, then guide the discussion: - Explore the map freely for a minute. What patterns do you notice? - Which places seem windiest? - What do they have in common? Why? - Does the Global Wind Atlas support your prediction about your region from Activity 3? Why or why not? Students complete Annex 2 – Part C.		
Lesson 3: How do we decide which places could be suitable to build wind farms? Mathematics Social Studies / Citizenship Technology	Activity 1: Today's question (3 min) Recap Lesson 2 by asking students: <i>Why are some places windier than others?</i> Take a few answers, then introduce today's question: <i>We now know some places are windier than others. But how do the different groups involved in wind energy development decide which locations could be suitable for a wind farm?</i> Activity 2: Meet the challenge – Future energy advisors (2 min) Divide the class into small groups or pairs. Explain the scenario: a national energy agency wants to understand how European countries currently use wind energy. The class has been hired as energy advisors to analyse the data, spot patterns, and recommend a country that may deserve further investigation for future wind-energy development. Activity 3: Organise, analyse and represent the data (20 min)	45 min	SSL 1.2 SSL 2.1 SSL 2.2 SSL 2.3 SSL 3.1 SSL 6.1 GC 2.2 GC 2.3 GC 3.1 GC 4.2



Students investigate real 2024 wind energy data for 12 European countries³. They rank the data, calculate the mean, identify countries that stand out from the overall pattern, compare wind share and installed capacity, and create a sketch graph to visualise and interpret these patterns. This can be completed on paper ([Annex 3](#)) or digitally ([Future Energy Advisors – Spreadsheet](#)) using the accompanying spreadsheet, depending on classroom resources.

Teacher note: the exact difference from the mean and the median are optional extensions in both formats. A scatter plot comparing share and capacity is available as an additional extension in the digital version only, since spreadsheet charting removes the time cost of plotting by hand – this isn't included in the paper version. Choose the format per class based on device access.

The teacher circulates throughout the activity, supporting groups with calculations or spreadsheet formulas where needed, and encouraging students to explain their mathematical reasoning. Once completed, compare answers together as a class and discuss any differences – particularly which country each group identified as standing out, since this feeds directly into Activity 4.

Activity 4: Think like an energy advisor (15 min)

Using [Annex 3 – Part C](#), students take the country they identified in Part A (or another country flagged in [Part B](#)) and investigate it using the [Global Wind Atlas](#), combining evidence from the data table with evidence from the wind resource map to write a recommendation.

Conclude with a whole-class discussion, comparing each group's recommendations, the country each group chose, and the evidence they used to justify their choice.

Activity 5: Beyond the numbers (5 min)

Ask students whether different groups could reach different recommendations using the same evidence. Discuss how sustainable energy decisions involve balancing multiple factors, not just one dataset, linking back to [Part D](#). Then brainstorm what additional information would be needed before making a final decision (e.g., wildlife, costs, nearby communities, grid connections, protected areas).

³ 2024 was the most recent complete dataset available at the time this learning scenario was developed. If more recent data is available when implementing this activity, teachers are welcome to update the figures in Annex 3 or the accompanying spreadsheet – for example, using data from WindEurope Intelligence Platform (<https://windeurope.org/data/>).



Lesson 4: How have humans used wind throughout history?

History
Language
Technology
Social Studies /
Citizenship

Activity 1: Recall and hook (2 min)

Recall Lesson 3's conclusion: choosing a suitable location for a wind farm requires looking at evidence and considering different factors, such as the environment, communities, and energy needs. Then ask: *Before modern wind farms and electricity existed, how did humans use the power of wind?*

Ask students: *How old do you think wind power is – tens of years, hundreds, or thousands?*

Take a few guesses before revealing that humans have harnessed wind for thousands of years. Explain that wind technologies have changed over time as people developed new needs and faced new challenges.

Introduce today's question: *How has wind technology changed over time to solve different human problems?*

Activity 2: Research and poster creation (25 min)

Divide the class into four teams, each choosing one era to research and summarise on a poster for a class timeline:

- **Ancient sailing and early windmills** – how ancient civilisations used sails; the earliest grain- and water-pumping windmills.
- **Medieval and early modern windmills in Europe** – how windmills spread across the Netherlands, Belgium, and northern Europe to grind grain, drain land, and saw wood.
- **The first wind-electricity experiments (late 1800s)** – James Blyth in Scotland and Poul la Cour in Denmark, who both built some of the earliest machines to generate electricity from wind, around 1887–1891.
- **The birth of the modern wind turbine (1970s–today)** – how the modern three-bladed turbine design was developed, and how turbines have grown from a few metres tall to today's giants, moving onshore, then offshore, and now floating far out at sea.

For their era, each team answers four questions:

- What problem did people face?
- What invention or technology did they create to solve it?
- How did it improve people's lives?
- How did it prepare the way for the next stage of wind technology?

Activity 3: Presentations and class timeline (15 min)

45 min

SSL 1.2
SSL 2.1
SSL 2.2
SSL 2.3
SSL 3.1
SSL 5.2

GC 1.1
GC 2.1
GC 3.1
GC 3.3



Each team presents its poster to the class. Arrange the posters in chronological order along one wall of the classroom to create a shared class timeline.

Activity 4: Final reflection – Closing the scenario (3 min)

As a class, return to the driving question: *Why is it windier in some places than others, and how have people used this knowledge throughout history and today?*

A few volunteers share their answer aloud, closing the learning scenario.

Assessment

Assessment in this learning scenario is continuous and integrated across all four lessons. Rather than relying on a single final task, students demonstrate their learning through experimental investigation, research, data analysis, discussion, presentation, and written reflection.

How to use this rubric. The assessment framework below is organised by subject and aligned with the curriculum strands presented in the [Overview table](#). For each competence, the table identifies the lesson activity or student artefact that provides evidence of learning, together with descriptors for three levels of achievement – **Beginning (1)**, **Developing (2)**, and **Proficient (3)**. The rubric is intended to support ongoing observation during the lessons, provide structured feedback on written recording sheets, and evaluate students' progress across the learning scenario.

Competence	Beginning (1)	Developing (2)	Proficient (3)
NATURAL SCIENCE (Lesson 1)			
Apply the scientific method Lesson 1: Annex 1, Parts B–C	Completes the experiments but cannot state a hypothesis or explain the observations	States a hypothesis, records observations, and partially explains the results	States a clear hypothesis, records accurate observations, and explains the results using appropriate scientific concepts
Explain how wind forms Lesson 1: Annex 1, Part D; class discussion	Identifies that temperature or air pressure is involved but cannot explain how wind forms	Explains that warm air rises and cool air sinks, linking this to wind with some support	Clearly explains how uneven heating creates pressure differences that cause wind, using correct scientific vocabulary
GEOGRAPHY (Lesson 2)			
Explain how wind varies between places Lesson 2: Annex 2, Parts A–B	Identifies that some places are windier than others but gives little explanation	Explains that geographical features or wind patterns influence wind conditions	Clearly explains how geographical features and regional or global wind patterns make some places windier than others
Interpret maps and digital geospatial tools Lesson 2: Annex 2, Part C (Global Wind Atlas)	Uses maps or the Global Wind Atlas with significant support	Interprets information from maps and the Global Wind Atlas to answer simple questions	Accurately interprets maps and digital wind data to compare locations and support conclusions
TECHNOLOGY (Lessons 2, 3 and 4)			
Use digital tools to investigate information	Uses the digital tool with significant support	Finds and interprets information from the Global Wind Atlas	Independently uses the Global Wind Atlas (and spreadsheet software, where used) to

Competence	Beginning (1)	Developing (2)	Proficient (3)
Lessons 2 and 3: Global Wind Atlas (Lesson 3: Part C); Lesson 3 (digital version only): spreadsheet software		and/or spreadsheet tools with some support	investigate, analyse, and compare wind conditions and data
Understand technological development Lesson 4: poster; timeline; presentation	Describes a wind technology without explaining its purpose	Explains how a wind technology addressed a human need	Explains how a wind technology addressed a human need and improved the way people lived or worked
MATHEMATICS (Lesson 3)			
Organise, calculate, and represent data Lesson 3: Annex 3, Parts A–B	Completes some calculations or graphs correctly with significant support	Correctly organises, calculates, and represents most of the data	Accurately organises, compares, and represents real wind-energy data using appropriate tables and graphs, and calculates averages (mean, and median where attempted) to identify patterns
Interpret data and support conclusions Lesson 3: Annex 3, Parts C–D	States conclusions with little reference to the data	Uses one or more pieces of evidence to support conclusions	Interprets data accurately and uses evidence to justify well-reasoned conclusions
LANGUAGE (Lessons 2 and 4)			
Use subject-specific vocabulary Lessons 2 and 4: written work and presentations	Uses everyday language with few scientific, geographical, or technological terms	Uses some subject-specific vocabulary correctly	Uses accurate scientific, geographical, mathematical, historical, and technological vocabulary confidently in written and oral communication
Communicate ideas clearly Lesson 2: presentation Lesson 4: poster and presentation	Shares ideas with limited structure or supporting information	Presents information clearly with some organisation and relevant detail	Presents and justifies ideas clearly, logically, and confidently using appropriate evidence
CITIZENSHIP AND SOCIAL STUDIES (Lessons 3 and 4)			
Recognise the importance of renewable energy Lesson 3: class discussion Lesson 4: final reflection	Identifies wind energy as a source of renewable energy	Explains one reason why wind energy is important	Explains how wind energy contributes to a more sustainable future, using examples from the learning scenario
Consider different perspectives Lesson 3: recommendation task and class discussion	Recognises only one point of view	Identifies that different groups may have different priorities	Explains how different perspectives can influence decisions about wind energy development and justifies a viewpoint using evidence
HISTORY (Lesson 4)			
Explain how wind technologies influenced people's lives Lesson 4: team poster and presentation	Describes a historical wind technology with limited explanation of its purpose or impact	Explains the problem the technology addressed and how it improved people's lives	Clearly explains the problem people faced, the technology they developed, and how it improved people's lives, using relevant historical examples
Carry out historical enquiry	Finds information with significant support and	Selects relevant historical information	Selects, organises, and communicates relevant historical

Competence	Beginning (1)	Developing (2)	Proficient (3)
Lesson 4: research; poster; presentation	presents limited relevant information	and presents it with some organisation	information clearly and accurately using appropriate historical vocabulary

Reflection on practice

This section explains how the learning scenario connects to established quality frameworks for STEM education ([Scientix STEM School Label](#)) and sustainability competences ([GreenComp, the European Sustainability Competence Framework developed by the European Commission's Joint Research Centre](#)). For each criterion or competence addressed, you'll find a short explanation of where and how it is reflected across the four lessons. Teachers can use this section to understand the pedagogical reasoning behind the activities, identify the competences their students are developing, and see how the scenario can support their school's wider STEM or sustainability strategy.

STEM Strategy Criteria (SSC)

1. Instruction

- ☐ 1.1 Personalisation of learning
- ★ 1.2 Problem- and project-based learning (PBL)
- ★ 1.3 Inquiry-based science education (IBSE)

1.2 Students investigate a real-world question about wind and apply evidence to recommend a country that may deserve further investigation for future wind-energy development. (Lessons 1–4; particularly Lesson 3).
 1.3 Students formulate hypotheses, carry out experiments, record observations, and explain how wind forms using the scientific method. (Lesson 1).

2. Curriculum implementation

- ★ 2.1 Emphasis on STEM topics and competencies
- ★ 2.2 Interdisciplinary instruction
- ★ 2.3 Contextualisation of STEM teaching

2.1 Students develop scientific, geographical, mathematical, and technological knowledge and skills through hands-on investigations and data analysis. (Lessons 1–4).
 2.2 The scenario integrates Natural Science, Geography, Mathematics, Technology, History, Language, and Citizenship around a common driving question. (Lessons 1–4).
 2.3 Students investigate real wind phenomena, use the Global Wind Atlas, analyse authentic wind-energy data, and explore the history of wind technologies. (Lessons 2–4).

3. Assessment

- ★ 3.1 Continuous assessment
- ☐ 3.2 Personalised assessment



Learning is assessed continuously through experiments, research, discussions, presentations, and data-analysis tasks. (Lessons 1–4).

4. Professionalisation of staff

- ☐ 4.1 Highly qualified professionals
- ☐ 4.2 Existence of supporting (pedagogical) staff
- ★ 4.3 Professional development

4.3 The learning scenario provides structured lesson plans, teacher guidance, and ready-to-use classroom materials that support teachers in implementing interdisciplinary STEM activities.

5. School leadership and culture

- ☐ 5.1 School leadership
- ★ 5.2 High level of cooperation among staff
- ☐ 5.3 Inclusive culture

5.2 The interdisciplinary nature of the learning scenario allows implementation through collaboration between teachers from different subjects.

6. Connections

- ★ 6.1 With industry
- ☐ 6.2 With parents/guardians
- ☐ 6.3 With other schools and/or educational platforms
- ☐ 6.4 With universities and/or research centres
- ☐ 6.5 With local communities

6.1 Students investigate authentic wind-energy applications and take on the role of energy advisors, using real wind-energy data, spreadsheet software, and the Global Wind Atlas to make evidence-based recommendations. (Lessons 2–3).

7. School infrastructure

- ★ 7.1 Access to technology and equipment
- ★ 7.2 High quality instruction and classroom materials

7.1 Students use simple scientific equipment, the Global Wind Atlas, and spreadsheet software to investigate wind. (Lessons 1–3).
7.2 The scenario includes structured lesson plans, worksheets, experiments, authentic data, and teacher guidance. (Lessons 1–4).

GreenComp (GC)

1. Embodying sustainability values

- ★ 1.1 Valuing sustainability



☐ 1.2 Supporting fairness

★ 1.3 Promoting nature

1.1 Students explore wind energy as a renewable resource and its role in future energy systems. (Lessons 2–4).
 1.3 Students investigate wind as part of natural systems and how atmospheric processes and landscapes influence renewable energy. (Lessons 1–3).

2. Embracing complexity in sustainability

★ 2.1 Systems thinking

★ 2.2 Critical thinking

★ 2.3 Problem framing

2.1 Students connect natural processes, geography, technology, and human energy needs to understand wind energy systems. (Lessons 1–4).
 2.2 Students analyse real data, compare evidence, and evaluate whether a country may warrant further investigation for wind-energy development. (Lesson 3).
 2.3 Students explore wind-energy development as a complex decision involving environmental, geographical, technological, and social factors, recognising that data alone is not sufficient for a final decision. (Lesson 3).

3. Envisioning sustainable futures

★ 3.1 Futures literacy

☐ 3.2 Adaptability

★ 3.3 Exploratory thinking

3.1 Students reflect on the evolution of wind technologies and the future role of renewable energy. (Lessons 3–4).
 3.3 Students combine knowledge from different disciplines to investigate wind energy from multiple perspectives. (Lessons 1–4).

4. Acting for sustainability

☐ 4.1 Political agency

★ 4.2 Collective action

☐ 4.3 Individual initiative

4.2 Students collaborate in groups to investigate, discuss findings, and develop shared recommendations. (Lessons 1–4).



Annexes

Annex 1: Wind formation investigation sheet

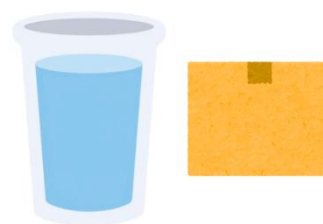
Part A – Before we start

Write everything you already know or think about wind. Where does it come from? What can it do?



Part B – Experiment 1: The upside-down glass (air pressure)

My hypothesis (what I think will happen, and why):



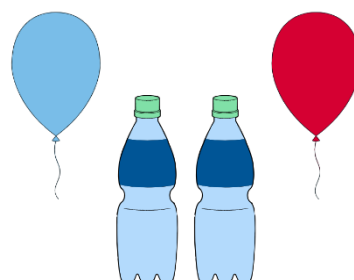
My observation (what actually happened):



My explanation (why did this happen?): (Hint: think about the air pushing on the card).

Part C – Experiment 2: The balloon and the bottle (temperature)

My hypothesis (what I think will happen, and why):



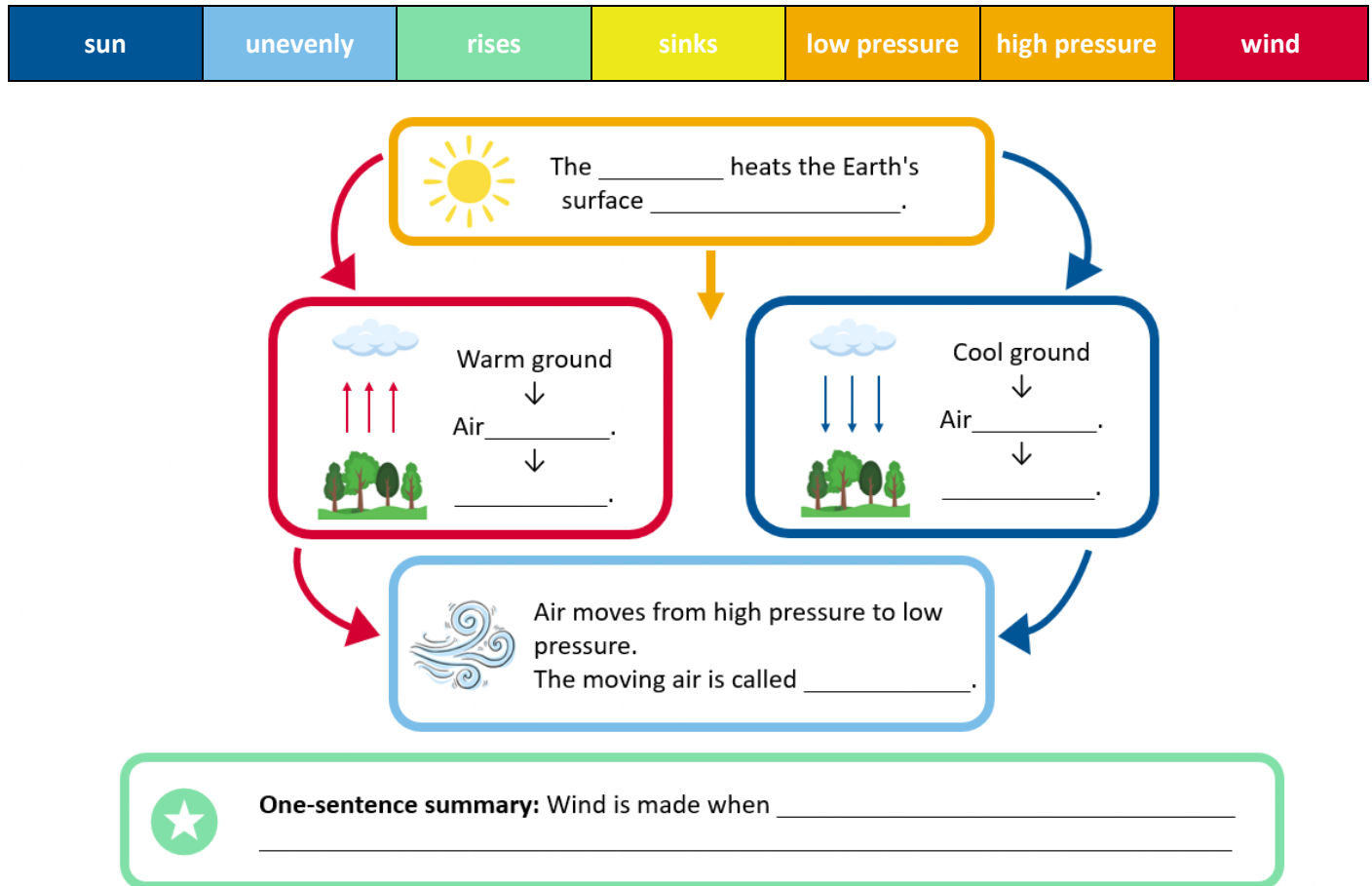
My observation (what actually happened):

My explanation (why did this happen?): (Hint: think about air becoming less dense when warm and denser when cold).



Part D – Putting it all together

Look at the diagram below. Use the words in the box to fill in the blanks.



This diagram brings together Experiment 1 (air has pressure) and Experiment 2 (heating and cooling change density and pressure) to explain how wind forms.

Annex 2: Wind patterns investigation sheet

Part A – Investigating European winds

Your group has been assigned ONE wind phenomenon. Research it using books, teacher-approved websites, or other reliable sources. Write your answers in your own words and be ready to explain them to the class.

Our wind	
Where does this wind occur?	
Why does it form?	
How does this wind affect people's daily lives?	
Would it be suitable for wind energy? Why or why not?	

As the other groups present, use this space to take notes on each wind:

Wind	Where?	Why does it form?	Useful for wind energy?
Sea breeze			



Föhn			
Mistral			
Trade winds			
Our region's prevailing winds			

Part B – Our local wind

1. Based on today's investigation, do you think your region is likely to be windy? Explain your reasoning.

2. What landforms or coastlines influence the wind here?

3. Would you build a wind farm here?



Part C – Global Wind Atlas

Explore <https://globalwindatlas.info/en/> as a class or in pairs.

1. What patterns do you notice?

2. Which places seem windiest? What do they have in common? Why?

3. Does the Global Wind Atlas support your prediction about your region from Part B? Why or why not?



Annex 3: Energy data challenge – Future energy advisors

You are a team of **energy advisors**. A national energy agency wants to understand how European countries currently use wind energy, and has asked you to analyse the data, spot patterns, and **recommend a country that may deserve further investigation for future wind-energy development**.

Source: <https://windeurope.org/data/products/wind-energy-in-europe-2024-statistics-and-the-outlook-for-2025-2030/>

Country	Share of electricity from wind	Approx. total installed wind capacity
Denmark	56%	8 GW
Ireland	33%	5 GW
Sweden	31%	17 GW
Germany	30%	73 GW
Netherlands	29%	12 GW
Spain	25%	31 GW
Belgium	16%	6 GW
Poland	14%	10 GW
Romania	12%	3 GW
France	11%	24 GW
Italy	8%	13 GW
Czechia	1%	0.4 GW

Before you start: remember – a country with the most wind turbines is not always the country where wind provides the largest share of its electricity. Look at both columns before drawing conclusions.

Part A – Organise and analyse the data

1. Rank the 12 countries by wind share, from highest to lowest.

Rank	Country	Wind share
1 (highest)		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12 (lowest)		

2. Calculate the mean wind share.

- Add together all 12 wind-share percentages.



- Divide your total by 12 (the number of countries).
- Round your answer to 1 decimal place.

Mean = _____ %

3. Which country's wind-share value stands out the most from the rest of the data? Explain your answer.

4. Extension: How might this unusual value affect the mean?

5. Extension: Calculate the median too.

- Use your ranked list – it's already in order.
- With 12 countries, find the 6th and 7th values in your list.
- Add those two values together and divide by 2 – this is your median.



Median = _____ %

6. **Extension:** Is it close to the mean, or different? What might that mean?

Part B – Visualise and interpret the data

1. **Make a quick sketch graph** of all 12 countries' wind share, in the same order as your ranked list (highest to lowest). Label your vertical axis 0–60% and write the country names along the horizontal axis.

2. **Compare the wind-share and capacity columns.** Does the country with the highest share also have the highest capacity? Does the country you identified in Part A also stand out visually on your graph?



3. Are there any other countries where share and capacity seem to disagree – e.g. a high share but low capacity, or the reverse? This is an important clue for Part C.

Part C – Investigate and recommend

The data has shown you which countries are interesting, but a real energy advisor needs more evidence before making a recommendation.

1. Choose your country. Pick either:

- the country you identified in Part A, or
- a country from Part B where share and capacity seemed to disagree.

Chosen country: _____

Why this country stood out in your analysis

2. Check the Global Wind Atlas (as in Lesson 2):

- Search for your chosen country on the map.
- Does it have areas with strong wind resources – stronger wind speeds or higher wind power potential?
- Does this evidence support or challenge your first ideas about this country?

3. Write your conclusion:

- **Evidence from the table:** The country has _____% wind electricity share and _____ GW capacity.
- **Evidence from Global Wind Atlas:** _____
- **I recommend / do not recommend** investigating _____ further **because**



Part D – Reflection

Did the table and the Global Wind Atlas give you enough information to make a final recommendation? What information is still missing?



"Learning about wind" is one of four learning scenarios developed as part of the adaptation of the WindEurope Teacher Toolkit for Primary Schools, carried out by European Schoolnet (EUN) in partnership with WindEurope, within the framework of the Scientix® STEM Alliance initiative.

[Learn more about the partnership and discover the other learning scenarios.](#)