

Constructing an anemometer and taking measurements

Learning scenario



About this learning scenario

"Constructing an anemometer and taking measurements" 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 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

Constructing an anemometer and taking measurements

Summary

This learning scenario engages students in an authentic engineering investigation into wind energy. Across five lessons, students work through the engineering design process by designing an anemometer (Lesson 1), building and testing it (Lesson 2), collecting and analysing wind data (Lesson 3), conducting a controlled experiment on arm length and rotation speed (Lesson 4), and applying mathematical concepts related to circles and Pi to interpret their findings (Lesson 5). By the end of the project, students use scientific evidence to evaluate the suitability of wind energy at their school while developing STEM knowledge and sustainability competences.

Keywords

Anemometer, wind speed, renewable energy, wind energy, measurement, engineering design, scientific method, data collection, sustainability, inquiry-based learning, STEM, GreenComp

Aim of the lesson

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

- Explain how wind speed is measured and why it matters for energy decisions.
- Design and build a simple cup anemometer using readily available materials.
- Collect, record, and compare outdoor wind data.
- Design and carry out a controlled experiment to test the effect of arm length on rotation speed.
- Discover experimentally the relationship between circumference and diameter and apply the formula $C = \pi \times D$.
- Connect their measurements to a real-world question: is this location suitable for wind energy?

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, Mathematics, Technology		
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 accordingly.		
	Subject	What is covered	Curriculum connections across European countries
	Natural Science (Lessons 1–5)	- Wind as a natural phenomenon and energy resource. - Function and design of anemometers. - Scientific enquiry and measurement (rotation counts, wind speed as relative measure). - Forming and testing hypotheses. - Controlled experimentation (effect of arm length). - Data collection, recording, averaging, and interpretation. - Connecting scientific evidence to real-world energy decisions.	1) Scientific enquiry / working scientifically: observing, measuring, recording, comparing, and communicating findings. 2) Forces, motion, and energy: understanding wind as a kinetic force and its relationship to energy production. 3) Environmental awareness and sustainability: connecting renewable energy to environmental impact and climate.
	Technology (Lessons 1–2) ¹	Engineering design process: analysing the problem, producing labelled scale drawings, selecting materials, constructing a prototype, testing and troubleshooting.	1) Design and make / engineering design: applying a structured design process to build a functional artefact 2) Understanding technological systems: recognising that scientific principles are applied in the

¹ Subject boundaries vary across European education systems. In particular, Technology at upper-primary level is often integrated within science or broader STEM learning rather than taught as a standalone subject. The curriculum connections presented in this learning scenario therefore refer to the intended learning outcomes and curriculum strands, regardless of how these are organised within a particular national or regional curriculum.



		- Understanding how a cup anemometer works as a measuring instrument. - Connecting the instrument design to real professional practice in wind energy.	design of instruments used by professionals.
	Mathematics (Lessons 3–5)	- Counting rotations, using a stopwatch, recording in a table. - Calculating averages of three trials. - Comparing numerical data across teams. - Measuring circumference and diameter of circular paths. - Discovering the ratio $C \div D \approx \pi$ (Pi). - Applying the formulae $C = \pi \times D$ and $C = 2 \times \pi \times r$; extension: area of a circle $A = \pi \times r^2$.	1) Measurement and data handling: using standard and non-standard units, recording and comparing data, calculating means. 2) Geometry and number: properties of circles, relationship between circumference and diameter, applying Pi; multi-step calculations; use of calculators for precision. 3) Mathematical reasoning in context: interpreting results, explaining differences between predictions and outcomes, discussing measurement error.
A full assessment framework linked to these curriculum strands – including subject-specific rubrics at three levels of achievement – is provided in the Assessment section .			
Age of the Learners	11–12 years old.		
Preparation time	Approximately 1-2 hours across the five lessons.		
Total implementation time	5 lessons of 45 minutes each.		
Teaching material	Lesson 1 – Designing and building an anemometer - Image – Wind Farm BoP (2017, October 23). <i>Met mast, weather vane and anemometer</i>. https://www.windfarmbop.com/how-to-measure-wind-resource/. - Video – Somethingnew-k. (2022, December 5). <i>Anemometer (Measure Wind Speed)</i>. YouTube. https://www.youtube.com/shorts/Hbmd37r9Zp8. (0:09). - Map – New European Wind Atlas. https://map.neweuropeanwindatlas.eu/. - Commercial handheld anemometer for demonstration. - Graphing paper for sketch. Lesson 2 – Building the anemometer - Students' design sketches from Lesson 1. <u>Option A: Paper cup anemometers (recommended²)</u>		

² This option is recommended because it requires no woodworking or advance kit preparation: all materials are low-cost, widely available, and students assemble everything themselves in class using scissors and a pushpin.



Materials per team:

- 4 small paper cups (same size, ~200 ml)
- 1 pushpin
- 1 sharpened pencil (with eraser end)
- 2 strips stiff corrugated cardboard (13-23 cm long × 2-3 cm wide)
- 85g modelling clay (¼ cup – for base weight)
- Scissors
- Marking pen
- Ruler
- Stapler

Assign half of the teams a 13 cm arm length and the other half a 20 cm arm length to enable comparison during the investigation.

Source: Video – Teach Engineering. (2017, June 7). *Build an Anemometer*. YouTube. <https://www.youtube.com/watch?v=l7BUZUrD5Kg>. (1:14, English, transcript available).

Option B: Wooden anemometers

An alternative to paper straws is to build the arms from balsa wood or foam board, which students can cut safely with scissors or a craft knife. Use the same arm length split as Option A: assign half the teams a 13 cm arm length and the other half a 20 cm arm length, keeping the base and shaft consistent across all teams so that arm length remains the only variable. Suggested dimensions for all teams: base 15 × 15 cm, vertical shaft 30 cm high.

Additionally, per each team:

- Balsa wood or foam board strips (pre-cut to arm length, or cut in class)
- 4 yoghurt pots or small plastic cups
- 1 screw
- 2 washers and 1 bead (rotation mechanism)
- Wood glue or strong tape
- Ruler
- Scissors
- A4 paper
- Marker

Lesson 3 – Taking wind measurements outdoors

- [Annex 1: Wind measurement recording sheet](#) – investigation sheet (one per student).
- Completed anemometers.
- Coloured sticker or marker (one per team)
- Stopwatch or phone timer (one per team)

Lesson 4 – Experimenting with arm length

- [Annex 2: Experiment recording sheet](#) – experimentation sheet (one per student).

- Two or three completed anemometers with different arm lengths
- One electric fan (adjustable speed preferred)
- Stopwatch
- Tape measure or ruler (to keep a constant distance from the fan)

Lesson 5 – Discovering Pi and the circle

- [Annex 3: Pi discovery sheet](#) – calculations sheet (one per student).
- Completed anemometers
- String
- Rulers
- Calculators (recommended)

The learning scenario activities

Activity plan

Name	Procedure	Duration	STEM & GreenComp Alignment ³
Lesson 1: Designing an anemometer Science Technology Mathematics	Activity 1: Setting the scene (10 min) Ask students to look outside and describe what they can see the wind doing. Then ask: <i>Where does the electricity in our homes come from?</i> Take a few answers. Explain that many countries are changing how they generate electricity because burning coal and gas releases greenhouse gases that contribute to climate change. Wind is one important alternative because it is a renewable source of energy and produces no emissions while generating electricity. Teacher note: If students have completed the learning scenario <i>Learning About Energy</i>, invite them to recall what they learnt about how wind can be used as an energy resource. Use their ideas as a bridge into the investigation. Introduce three key ideas: • Wind energy is one of the fastest-growing sources of electricity in Europe. • Wind turbines convert the movement of wind into electricity. • Before a wind farm is built, engineers must find out whether a location is windy enough.	45 min	SSC 1.2 SSC 1.3 SSC 2.1 SSC 2.2 SSC 2.3 SSC 6.1 GC 1.1 GC 1.3 GC 2.1 GC 2.3 GC 3.1 GC 3.3

³ 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.



Name	Procedure	Duration	STEM & GreenComp Alignment ³
	Show the New European Wind Atlas and ask students to find roughly where their school is and look at nearby wind speeds. Give a reference: a gentle breeze is about 3–5 m/s; a turbine typically starts generating electricity at around 3–4 m/s. Some students may be unfamiliar with metres per second (m/s). Explain that, like kilometres per hour (km/h), it describes how far something moves in a certain amount of time. Ask students: <i>Looking at the Wind Atlas, do you think our school is in a good location for a wind turbine? What would you need to know before you could be sure?</i> Take a few answers. Tell students: by the end of these five lessons, they will have collected real data to help answer that question. Activity 2: The instrument engineers use (10 min) Show a photograph or video of a real cup anemometer on a meteorological mast (e.g., here and here). Explain: • A cup anemometer spins in the wind. The faster the wind, the faster it spins. • A sensor counts the rotations and converts them into wind speed in metres per second. • In real life: before approving a wind farm, engineers install a mast like this and leave it running for 12–24 months. Today, students will do something similar – just at a much smaller scale and in much less time. If you have a commercial handheld anemometer, pass it around: students blow gently, then harder, and watch the reading change. Activity 3: Designing the anemometer (25 min) Divide the class into teams and assign each team their arm-length variant (see Overview table). Explain that all teams are building the same type of device with different arm lengths – this is intentional, so the class can compare results later. Before touching any materials, each team discusses and answers these three design questions: • How will you attach the cups so they all catch the wind from the same side? • How will you fix the arms to the shaft so they spin freely without wobbling? • How will you make the base stable enough so the anemometer stays upright?		



Name	Procedure	Duration	STEM & GreenComp Alignment ³
	Each team produces a labelled scale drawing (top view and side view) with measurements. Suggest a simple scale: 1 cm on paper = 5 cm in reality.		
Lesson 2: Building the anemometer Science Technology	Activity 1: Building (30 min) Distribute materials (see Overview table). Students build according to their sketch from Lesson 1. Construction reminders to share as needed: • Cups must all face the same direction (like a pinwheel) so the wind always pushes from behind. • The pivot needs to be secure but not so tight that it resists spinning – test it with a finger flick. • Modelling clay or a wide base prevents toppling; add more if needed. Activity 2: Spin test and troubleshooting (15 min) Each team does a spin test: hold the anemometer near an open window or fan and check that it rotates freely. Teams identify and fix any problems.	45 min	SSC 1.2 SSC 2.1 SSC 2.2 SSC 3.1 SSC 7.1 SSC 7.2 GC 3.3 GC 3.2
Lesson 3: Taking wind measurements outdoors Science Mathematics	Activity 1: Preparing the measurement (5 min) Show students how to count rotations reliably: • Attach a coloured sticker to one cup. This is the counter marker. • One student holds the anemometer steady; another counts how many times the marker passes the starting position in 30 seconds; a third operates the stopwatch and records. Distribute Annex 1. Each team notes their arm length and location before going outside. Teacher note: students will record rotations per 30 seconds, which is a relative measure of wind speed, not metres per second. Real anemometers contain electronics that convert rotation counts into m/s. In today's lesson we are tracking relative wind speed – a count of rotations that lets us compare locations with each other (for example, “the playground gave 45 rotations while the fan on low gave 20”). Students should not leave thinking that their rotation count is the actual wind speed in m/s. Activity 2: Outdoor measurement (40 min) Take the class to an open area of the playground, away from large buildings. Give teams 30 minutes to take three	45 min	SSC 1.3 SSC 2.1 SSC 2.2 SSC 2.3 SSC 3.1 SSC 6.1 SSC 7.1 GC 2.1 GC 2.2 GC 3.1

Name	Procedure	Duration	STEM & GreenComp Alignment ³
	measurements and calculate their average. Use the remaining time to share results as a class using the class results table in Annex 1 .		
Lesson 4: Experimenting with arm length Science Mathematics	Activity 1: Reviewing class data (5 min) Display the class results table from Lesson 3. Ask: - Which anemometers spun the most? Which spun the least? - Can you spot any pattern related to arm length? - Can we represent the results in a graph to make any pattern easier to see? If time permits, create a simple graph using the class averages, with arm length (cm) on the x-axis and average rotations in 30 seconds on the y-axis. Discuss whether the graph reveals any relationship between arm length and the average number of rotations. Take a few observations, then say: <i>Our results show differences, but we did not control all variables outdoors. Today we will design a controlled experiment to isolate arm length.</i> Activity 2: Forming a hypothesis (5 min) Write on the board: <i>A hypothesis is a prediction about what we expect to happen, based on what we already know. It must be testable.</i> Ask the class: <i>Why might arm length change how fast the cups rotate? What is different about the circle each set of cups makes?</i> Let students discuss their ideas briefly as a class to spark reasoning. Following the discussion, have each team write their own specific prediction on Annex 2 using the format: <i>The anemometer with [shorter/longer] arms will rotate faster because [their reason].</i> Activity 3: The controlled experiment (35 min) Set up one fan at the front of the classroom. Select two anemometers with clearly different arm lengths. If available, add a third intermediate size. Procedure: - Place the first anemometer 50 cm from the fan on the lowest setting.	45 min	SSC 1.3 SSC 2.1 SSC 2.2 SSC 3.1 SSC 7.1 GC 2.2 GC 2.3 GC 3.3



Name	Procedure	Duration	STEM & GreenComp Alignment ³
	- Count full rotations in 30 seconds. Record on Annex 2. - Repeat at exactly the same fan speed and distance for the second (and third) anemometer. - Repeat each measurement three times and calculate the average. Teacher note: fan speed, distance, and measurement time are kept constant so that any difference in results can be attributed only to arm length. Remind students: this is what makes it a controlled experiment. Compile results on the board. Ask: - Do our results match the hypothesis? - Which anemometer spun fastest? Which slowest? - Why might shorter arms produce more rotations? (Guide students to: because the cups travel around a smaller circle, the anemometer may complete more rotations in the same amount of time.) Teacher note: In theory, shorter arms complete more rotations because the circumference of their circle is smaller. However, in practice, if friction at the pivot is high or the fan speed is low, longer arms provide more leverage (torque) and may actually spin more easily. If your class results show this discrepancy, treat it as a valuable data-analysis opportunity – ask students why the real-world result might differ from the theoretical prediction. Teachers should use their professional judgement when exploring this idea; for some groups, it may be helpful to test the setup beforehand to ensure results align with the prediction, as discrepancies between theory and experiment can be challenging for younger learners to interpret.		
Lesson 5: Discovering Pi and the circle Science Mathematics	Activity 1: The maths challenge (5 min) Remind students of the conclusion from Lesson 4: the cups move in a circle, and the circle is shorter when the arms are shorter. Ask: <i>But do we actually know how long these circles are? How could we measure them?</i> Allow two or three suggestions. Give each student their anemometer and a piece of string. Ask them to find a way to measure the circumference of the circle the cups make when the anemometer rotates. Activity 2: Measuring the circle (15 min)	45 min	SSC 1.3 SSC 2.1 SSC 2.2 SSC 2.3 SSC 3.1 SSC 6.1 SSC 7.2 GC 1.1 GC 2.1 GC 3.1



Name	Procedure	Duration	STEM & GreenComp Alignment ³
	Students wrap string around the circular path of the cup tips and measure the string. Bring the class together to agree on the best method. Each student records on Annex 3: • Circumference (C) – the full length of the circular path. • Diameter (D) – a straight line from one cup tip, across the centre, to the opposite cup tip. • Radius (r) – the distance from the exact centre to the very outer tip of the cup. Activity 3: Discovering Pi (15 min) Each student divides their circumference by their diameter: $C \div D$. Share results across the class. Ask: • <i>Did everyone get the same answer?</i> • <i>Are the answers close to 3? More than 3? Less than 3?</i> Students will find that $C \div D \approx 3.14$, regardless of circle size. Introduce Pi: • The ratio of the circumference of any circle to its diameter is always the same number. We call it Pi, written as π. • $\pi \approx 3.14$ • Circumference formula: $C = \pi \times D$ • Since $D = 2 \times r$, also: $C = 2 \times \pi \times r$ Students verify using their measurements: $C = \pi \times D$. Discuss small differences from measurement error – precision matters in science too. Teacher note: Multiplying by 3.14 produces multi-digit decimals that can slow students down or produce errors that obscure the geometric concept. Calculators are strongly recommended for this activity. If calculators are not available, guide students to round arm lengths to whole centimetres and use the approximation $\pi \approx 3$ for a quick estimate, then refine with 3.14. Activity 4: Applying the formulae (5 min) Students complete the formula section of Annex 3: • Circumference of the circle their anemometer makes: $C = \pi \times D$		



Name	Procedure	Duration	STEM & GreenComp Alignment ³
	Extension for students who finish early: introduce the area formula $A = \pi \times r \times r$. Ask them to calculate the area of the circle their anemometer sweeps. Activity 5: Final reflection (5 min) Students complete the final section of Annex 3 individually. They write three sentences: • What they did across the five lessons. • What surprised them. • How what they learnt connects to a real decision – for example: <i>would they recommend wind energy for their town, and what evidence would they use?</i> Optional extension: If students previously participated in the stakeholder role-play from the learning scenario <i>Learning About Energy</i>, invite them to revisit their stakeholder roles and use the evidence collected during this investigation to support or revise their position on wind energy.		

Assessment

Assessment in this learning scenario is continuous and integrated across all five lessons. Rather than relying on a single final task, students demonstrate their learning through hands-on construction, outdoor measurement, experimental investigation, 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 practical and outdoor activities, provide structured feedback on written recording sheets, and evaluate students' progress across the full investigation.

Competence	Beginning (1)	Developing (2)	Proficient (3)
NATURAL SCIENCE (Lessons 1, 2, 3, 4, and 5)			
Understand wind as a source of energy Lesson 1: class discussion; Lesson 5: final reflection (Annex 3)	Can name wind as an energy source but cannot explain how wind speed relates to energy potential	Describes that stronger wind produces more energy and gives a reason linked to turbine rotation	Explains the relationship between wind speed, rotation, and energy production using correct scientific vocabulary
Apply scientific inquiry skills Lessons 3 and 4; Annex 1 and Annex 2 recording sheets; oral contributions	Observations unclear or incomplete; records data without structure; little independent thinking	Records measurements with some structure; calculates average with support; identifies patterns in data	Records and explains observations clearly; calculates averages accurately; identifies cause-and-effect relationships between variables



Competence	Beginning (1)	Developing (2)	Proficient (3)
Design and carry out a controlled experiment Lesson 4: Annex 2 (hypothesis and results); class discussion	States a guess without explaining reasoning; does not identify variables	Writes a testable hypothesis; identifies the independent variable; keeps most conditions constant	Writes a clear, testable hypothesis; correctly identifies all variables; explains why results may differ from predictions
Connect evidence to real-world decisions Lesson 5: Annex 3 final reflection (Activity 5)	Makes a recommendation without using any evidence	References their own data when making a recommendation about wind energy suitability	Uses class data and knowledge of wind energy to make a well-reasoned recommendation, acknowledging limitations
TECHNOLOGY (Lessons 1–2)			
Apply an engineering design process Lesson 1: design drawing; Lesson 2: constructed anemometer	Produces an incomplete or unlabelled sketch; does not consider construction requirements	Produces a labelled sketch with approximate measurements; builds a functional anemometer with some support	Produces a clear labelled scale drawing with measurements; constructs a functional anemometer and explains design decisions
Test and improve a design Lesson 2: spin test and troubleshooting (Activity 2)	Cannot identify a fault or does not attempt to fix it	Identifies a fault and describes a fix, with teacher support	Identifies faults independently, adapts the design, and explains why the change improves performance
MATHEMATICS (Lessons 3– 5)			
Collect, record, and average data Lessons 3 and 4: Annex 1 and Annex 2 (Parts A and B)	Records some values but cannot calculate an average; data is incomplete	Records three trials and calculates an average with minor errors; completes the class table with support	Records all trials accurately; calculates averages correctly; contributes data to the class table and uses it to draw conclusions
Measure and compare quantities Lesson 5: Annex 3 (Activities 2 and 3)	Measures circumference or diameter with significant errors; cannot compare the two	Measures both circumference and diameter with reasonable accuracy; calculates $C \div D$ with some errors	Measures accurately using string and ruler; calculates $C \div D$ and identifies the value as approximately π ; explains what the ratio means
Apply the formula $C = \pi \times D$ Lesson 5: Annex 3 (Activity 4)	Cannot recall or apply the formula without copying	Applies $C = \pi \times D$ correctly using given values; interprets the result	Applies the formula fluently; explains its meaning; attempts the extension (area = $\pi \times r^2$) with understanding

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 The scenario is framed around a genuine question: *is our school location suitable for wind energy?* Students design (Lesson 1), build (Lesson 2), and use a real instrument (Lesson 3) to collect data that feeds into a final conclusion (Lesson 5).

1.3 Students review real-world data and raise questions about wind suitability (Lesson 1), collect field measurements (Lesson 3), then form a testable hypothesis, run a controlled experiment, and discuss whether results match predictions (Lesson 4).

2. Curriculum implementation

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

2.1 The scenario develops scientific inquiry, engineering design, mathematical reasoning and technological problem-solving through the real-world context of renewable energy.

2.2 Science, Technology, Engineering and Mathematics are all genuinely present and interlinked across the five lessons.

2.3 Learning is situated within the authentic challenge of assessing whether a location is suitable for wind energy generation. Students use real wind data, build instruments similar to those used by engineers and connect classroom learning to renewable energy and climate change.

3. Assessment

- ★ 3.1 Continuous assessment
- ☐ 3.2 Personalised assessment

3.1 Assessment is distributed across all lessons, giving the teacher a running picture of each student's progress.

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 encourages teachers to strengthen their knowledge of integrated STEM teaching by combining science, mathematics, engineering design and sustainability education within a single project. It promotes the use of inquiry-based learning, engineering design processes and authentic data sources (e.g., the New European Wind Atlas), supporting teachers in developing innovative pedagogical approaches that can be transferred to future 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 scenario naturally encourages collaboration between teachers of different subjects. For example, science and technology teachers may lead Lessons 1–4, while mathematics teachers may lead Lesson 5.

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 The learning scenario connects classroom learning with the renewable energy industry by introducing students to the methods used by wind energy engineers. Students investigate real wind data, build and test an anemometer based on professional instruments, and evaluate whether a location is suitable for wind energy generation. These authentic engineering activities provide insight into careers and technologies in the renewable energy sector.

7. School infrastructure

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

7.1 Students use engineering materials, measuring equipment, stopwatches, calculators, fans and, where available, commercial anemometers and the New European Wind Atlas to investigate wind measurement.
7.2 The scenario includes structured lesson plans, engineering drawings, data recording tables, experimental protocols and scaffolded worksheets (Annexes 1–3).

GreenComp (GC)

1. Embodying sustainability values

- ★ 1.1 Valuing sustainability
- ☐ 1.2 Supporting fairness
- ★ 1.3 Promoting nature

1.1 Students reflect on the importance of renewable energy and use scientific evidence to evaluate whether wind energy is suitable for their community. The final reflection encourages informed sustainable choices (Lesson 5).
1.3 Students learn how wind energy provides a renewable alternative that reduces greenhouse gas emissions and supports environmental sustainability (Lesson 1).



2. Embracing complexity in sustainability

- ★ 2.1 Systems thinking
- ★ 2.2 Critical thinking
- ★ 2.3 Problem framing

2.1 Students explore the links between wind, energy production, engineering design and mathematics, recognising how evidence informs renewable energy decisions (Lessons 1, 3 and 5).
 2.2 Students analyse experimental data, compare results with their hypotheses and explain differences between predictions and outcomes (Lessons 3–4).
 2.3 Students investigate whether their school is suitable for a wind turbine by designing investigations and conducting controlled experiments to answer a real-world sustainability question (Lessons 1 and 4).

3. Envisioning sustainable futures

- ★ 3.1 Futures literacy
- ★ 3.2 Adaptability
- ★ 3.3 Exploratory thinking

3.1 Students use collected evidence to consider future energy decisions and justify whether they would recommend wind energy for their school.
 3.2 Students troubleshoot, modify and improve their anemometer designs based on testing, demonstrating flexibility throughout the engineering process (Lesson 2).
 3.3 Students design prototypes, investigate different arm lengths and combine science, engineering and mathematics to explore and evaluate solutions (Lessons 1, 2 and 4).

4. Acting for sustainability

- ☐ 4.1 Political agency
- ★ 4.2 Collective action
- ☐ 4.3 Individual initiative

4.2 Students work collaboratively to investigate a sustainability-related question: whether their school location may be suitable for wind energy. They share measurements, compare results and use class-wide evidence to draw conclusions about renewable energy potential (Lessons 3–5).



Annexes

Annex 1: Wind measurement recording sheet

Team Number:
Arm Length (cm):

Date:
Location:

Part A: Your team's measurements

Measurement	Rotations in 30 seconds	Notes
Trial 1		
Trial 2		
Trial 3		
Average		

Part B: Class results table

***To calculate the average:** $\text{Average} = (\text{Trial 1} + \text{Trial 2} + \text{Trial 3}) \div 3$

Team	Arm length (cm)	Trial 1	Trial 2	Trial 3	Average*
1					
2					
3					
4					
5					
6					
7					

Part C: Observations and questions

- Write one thing you noticed about the class results.



2. Write one question the results raise for you.

3. Based on today's measurements alone, do you think this location might be suitable for wind energy? What additional information would engineers need before deciding?



Annex 2: Experiment recording sheet

Team:

Date:

Part A: Our hypothesis

The anemometer with the _____ arms will rotate the _____ because

Part B: Variables

Controlled variables (what we keep the same):

Fan speed:

Distance from fan:

Measurement time:

Independent variable (what we change):

Dependent variable (what we measure):

Part C: Results

Anemometer	Arm length (cm)	Trial 1	Trial 2	Trial 3	Average
Shortest arms					
Longest arms					

Part D: Conclusions

- Did our results match our hypothesis? Yes / No / Partly (circle one)
- Look at your results. Did the shorter or longer arms rotate more times? Why do you think that happened?



Annex 3: Pi discovery sheet

Name:

Team:

Date:

Part A: Measuring your circle

Use your anemometer. Measure the circle that the tips of the cups make when it rotates.

- **Step 1:** Wrap a piece of string around the circular path the cup tips follow. Measure the string.
Circumference (C) = _____
- **Step 2:** Measure the diameter – a straight line from one cup tip, across the centre, to the opposite cup tip.
Diameter (D) = _____
- **Step 3:** Measure the radius – from the exact centre to the very outer tip of one cup.
Radius (r) = _____

Part B: Looking for a pattern

Divide your circumference by your diameter: $C \div D = \text{_____} \div \text{_____} = \text{_____}$

Compare your answer with your classmates:

Team	Arm length (cm)	C (cm)	D (cm)	$C \div D =$
1				
2				
3				
4				
5				
6				
7				

What do you notice about the values in the last column?



Part C: Introducing π

The number you found – approximately 3.14 – is the same for every circle, no matter how big or small. We call this special number Pi, written as the Greek letter π .

$\pi \approx 3.14$

Formula for circumference: $C = \pi \times D$

Formula for area: $A = \pi \times r \times r$ (optional extension)

Part D: Applying the formula

1. Use $C = \pi \times D$ to calculate the circumference of your circle.

Answer: $C =$

2. Extension: Use $A = \pi \times r \times r$ to calculate the area of the circle your anemometer sweeps.

Answer: $A =$

Part E: Final reflection

1. What I did across these five lessons:

2. What surprised me:

3. Would I recommend wind energy for my town? What evidence from these lessons would I use to support my answer?



"Constructing an anemometer and taking measurements" 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.](#)