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***INTEGRATED EXPLORATION:
CREATIVE THINKING AND
SUSTAINABLE SOLUTIONS***

2024-1-PL01-KA210-SCH-000243609

Small-scale partnerships in school education (KA210-SCH)

EXPLORING THE FUTURE: Creative Education Journey

Digital Content Guide

MODULE 1

Coding and Robotics
Basics

MODULE 2

Arts and Science
Integration

MODULE 3

Sustainability and
Environmental Science



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International School
of Wrocław



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How to Use This Guide

This Digital Guide is the core learning resource of the Erasmus+ project "Integrated Exploration: Creative Thinking and Sustainable Solutions" (KA210-SCH). It is designed to support students aged 10–14 and their teachers across three partner countries: Poland, Germany, and Turkey.

Structure of the Guide

The guide is organised into three self-contained modules, each aligned to an LTT mobility activity of the project. Every module contains:

- 5 structured lesson plans (each 45–60 minutes)
- A 5-day intensive workshop programme
- Assessment tools: pre/post quiz, performance rubric, and self-reflection

Pedagogical Approach

All activities are grounded in inquiry-based learning, STEAM methodology, and 21st century skills development. Teachers are encouraged to adapt materials to their national curriculum context while maintaining the interdisciplinary spirit of the project.

Key Icons Used in This Guide:

 Learning Objectives  Materials Needed  Time Required
 Teacher Tips  Real-World Connection  Assessment Moment



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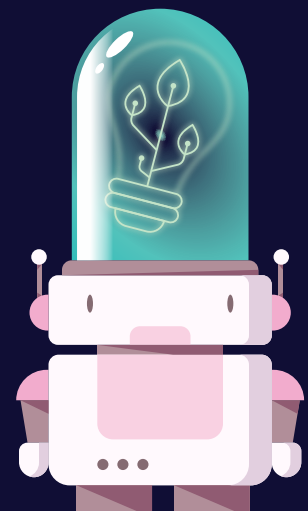
Small-scale partnerships in school education (KA210-SCH)

MODULE 1

Coding and Robotics Basics

Digital Content Guide · Student & Teacher Edition

5 Detailed Lesson Plans



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How to Use This Guide

This guide provides everything a teacher needs to deliver Module 1 of the Integrated Exploration curriculum — a STEAM programme designed for secondary school students aged 10–14. No prior coding or robotics experience is required from the teacher.

Each of the five lessons is self-contained and can be delivered in a standard 60-minute class period. The five-day workshop at the end of this module brings the lessons together in an intensive format — ideal for a school project week, summer programme, or cross-school event.

What This Guide Contains

-  **Five 60-minute lesson plans with full teaching notes, differentiation tips, and vocabulary support**
-  **A 5-day intensive workshop programme adaptable to any school or community setting**
-  **Pre/post knowledge quiz, performance rubric, peer feedback tools, and self-reflection sheets**
-  **Designed for culturally mixed groups — all activities work in multilingual settings**
-  **Connects forward to Module 2 (Arts & Science) and Module 3 (Sustainability)**

Module Overview

Module 1 introduces students to the world of coding and robotics through five progressive lessons. The journey begins with unplugged algorithm activities that require no technology at all, moves through block-based programming in Scratch, and culminates in students building and programming their own robots to navigate an obstacle course autonomously.

Throughout, the emphasis is on developing computational thinking — a set of problem-solving skills that are valuable far beyond coding itself. Every activity is designed to be creative, collaborative, and connected to the real world.

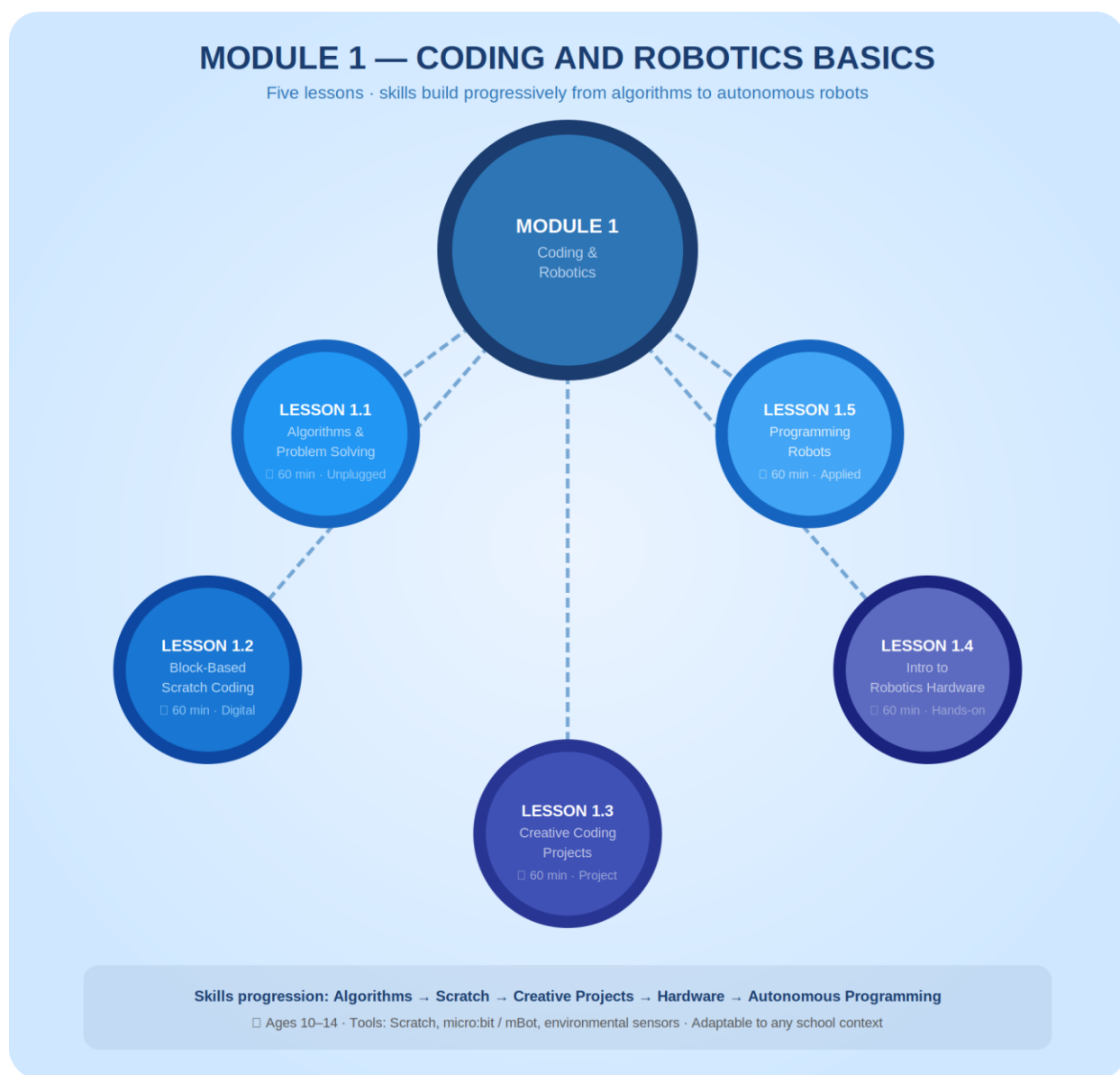


Figure 1 — Module 1: five lessons building progressively from unplugged algorithms to autonomous robots

At a Glance

-  **Target Group:** Students aged 10–14 and their teachers
-  **Lesson Time:** 5 × 60-minute lessons + 5-day intensive workshop
-  **Tools:** Scratch (scratch.mit.edu), micro:bit or mBot, environmental sensors
-  **Assessment:** Pre/post quiz, performance rubric, self-reflection, peer feedback
-  **Key Skills:** Algorithmic thinking, block-based coding, robotics, debugging, teamwork

The Computational Thinking Framework

Before any coding begins, students develop the underlying thinking skills that make coding meaningful. Computational thinking is a problem-solving approach that applies far beyond computers — in science, art, design, and everyday life.

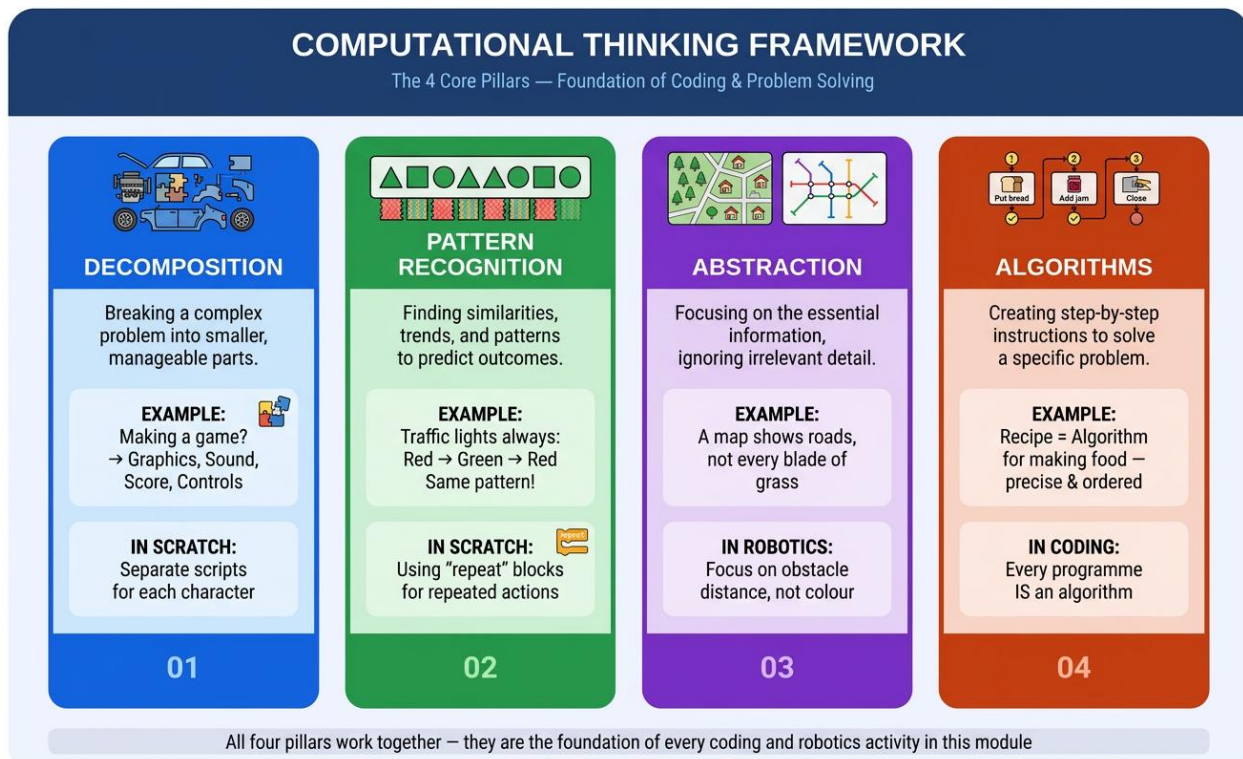


Figure 2 — The four pillars of computational thinking: the foundation for all Module 1 activities

Pillar	Applied in Lesson 1.1	Applied in Lessons 1.2–1.3	Applied in Lessons 1.4–1.5
Decomposition	Break maze challenge into single steps	Separate Scratch scripts per character	Divide robot build into sub-tasks
Pattern Recognition	Spot repeating moves in robot game	Identify loops to reuse across projects	Predict sensor patterns on course

Pillar	Applied in Lesson 1.1	Applied in Lessons 1.2–1.3	Applied in Lessons 1.4–1.5
Abstraction	Focus only on key instructions	Name sprites and variables meaningfully	Use distance threshold, ignore noise
Algorithms	Write step-by-step maze solution	Complete Scratch project script	Robot programme for obstacle avoidance

LESSON PLANS

Lesson 1.1 — Introduction to Coding & Algorithms

Duration	Materials	Grouping	Lesson Type
60 minutes	Algorithm cards, printed grid maze, whiteboard	Pairs, then groups of 4	Unplugged + Discussion

Learning Objectives

Learning Objectives:

1. Define 'algorithm' and give everyday examples
2. Write a clear sequence of instructions to solve a maze challenge
3. Identify and fix errors (bugs) in an algorithm
4. Use key vocabulary: sequence, input, output, bug, debug

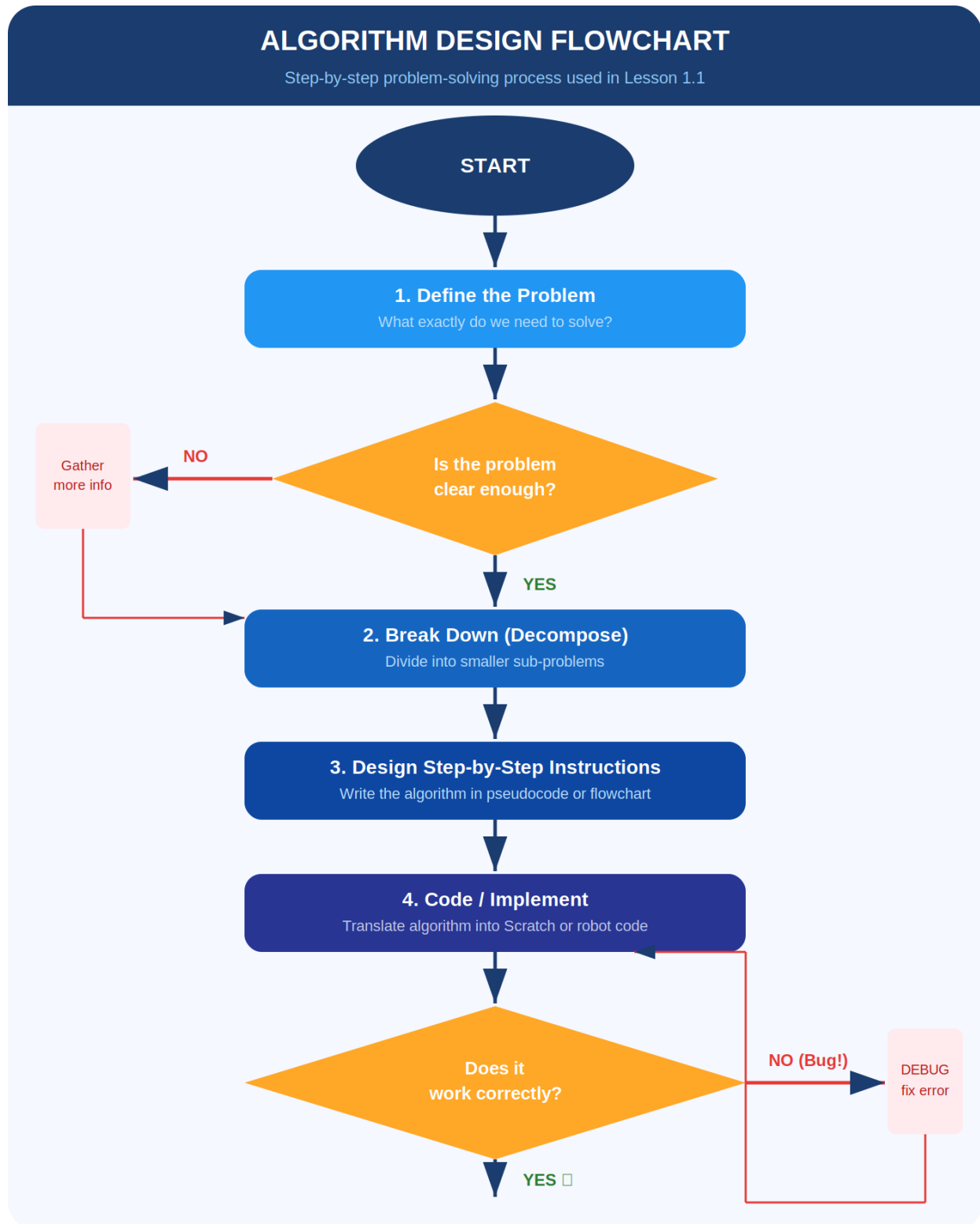


Figure 3 — Algorithm design flowchart: the problem-solving process students apply in this lesson

Lesson Flow

Part 1 — The Robot Game (15 minutes)

Divide students into pairs. One is the 'robot', one is the 'programmer'. The programmer gives precise verbal step-by-step instructions to guide the robot to a target. No touching allowed. After two minutes, swap roles. Debrief: what happened when instructions were imprecise? Introduce: BUG (mistake) and DEBUG (fix).

Part 2 — What is an Algorithm? (15 minutes)

Show three everyday examples on the board: making a cup of tea, tying shoelaces, looking up a word in a dictionary. Ask: what do these have in common? Guide students to discover: a clear start, unambiguous steps, correct order, a clear end. Key point: algorithms are everywhere — search engines, traffic lights, playlist recommendations all use them.

Part 3 — Unplugged Maze Challenge (20 minutes)

Distribute printed 6×6 grid maze cards with instruction cards (FORWARD, TURN LEFT, TURN RIGHT, PICK UP, PUT DOWN). Students write a complete algorithm to get their character to the treasure. Groups of 4 then swap cards and try to follow another group's algorithm — marking any bugs they find.

Part 4 — Vocabulary Consolidation (10 minutes)

Build a vocabulary wall together. Students complete an exit ticket: 'One algorithm I use every day without thinking is _____. A bug I fixed today was _____.'

Term	Student-Friendly Definition	Everyday Example
Algorithm	A step-by-step recipe for solving a problem	Following a recipe to bake a cake
Sequence	Steps that must happen in the correct order	Get dressed: socks before shoes
Bug	A mistake or error in an algorithm	Wrong turn in the maze
Debug	Finding and fixing a bug	Going back and correcting the wrong turn
Decomposition	Breaking a big problem into smaller parts	Cleaning a room = floor + desk + shelves

💡 Differentiation: For students who finish early, create a harder maze. For students who struggle, reduce to a 3×3 grid with one turn. The arrow/icon versions of instruction cards support students with lower literacy levels.

Lesson 1.2 — Block-Based Programming with Scratch

Duration	Materials	Grouping	Lesson Type
60 minutes	Computers/tablets with Scratch (scratch.mit.edu), student guide sheet	Individual, paired support	Hands-on digital

Learning Objectives

🎯 Learning Objectives:

1. Navigate the Scratch interface: Stage, Sprites, Block Palette, Scripts Area
2. Use Motion, Looks, Sound, and Events blocks to create an animation
3. Start a programme with 'when green flag clicked'
4. Save and share a Scratch project

Lesson Flow

Part 1 — Guided Interface Tour (15 minutes)

Teacher-led live demonstration on screen. Walk through each area of Scratch. Then allow 5 minutes of free exploration — students click anything, drag blocks, see what happens. Deliberately allow 'chaos': this builds familiarity and reduces anxiety about making mistakes.

Part 2 — My First Animation (25 minutes)

Step-by-step tutorial written on the board and provided as a printed reference:

1. Drag 'when green flag clicked' (Events) to the Scripts Area
2. Connect 'move 10 steps' (Motion) below — click the flag and watch
3. Change 10 to 50 — what's different? Why?
4. Add 'say Hello for 2 seconds' (Looks)
5. Click the Costumes tab → choose a new look for your sprite
6. Click the Sounds tab → add and play a sound
7. Challenge: make the sprite respond to a key press (Events → 'when space key pressed')

Students are encouraged to personalise throughout: choose their own sprite, costume, and record a sound (clap, hum, word) rather than using a preset.

Part 3 — Interaction (15 minutes)

Introduce 'ask and wait' (Sensing) and the 'answer' variable. Students programme their sprite to ask the user's name and say it back. Pairs test each other's projects and leave one comment.

Part 4 — Share and Save (5 minutes)

Save to class account. Students write one comment on a partner's project: 'I noticed that your sprite...'

🌐 **Real-World Connection:** Scratch was created by MIT Media Lab and is used by over 100 million young people worldwide. The same coding concepts — events, sequences, loops — are used in professional languages like Python and JavaScript. The skills students build today transfer directly.

Lesson 1.3 — Creative Coding Projects

Duration	Materials	Grouping	Lesson Type
60 min + optional home time	Computers, Scratch, planning paper	Groups of 2–3	Project-based learning

Learning Objectives

🎯 Learning Objectives:

1. Use loops (repeat, forever) and conditionals (if/then/else) independently
2. Apply design thinking to plan a project before coding
3. Give structured peer feedback (2 Stars & a Wish)
4. Write a brief artist's statement linking creative choices to coding concepts

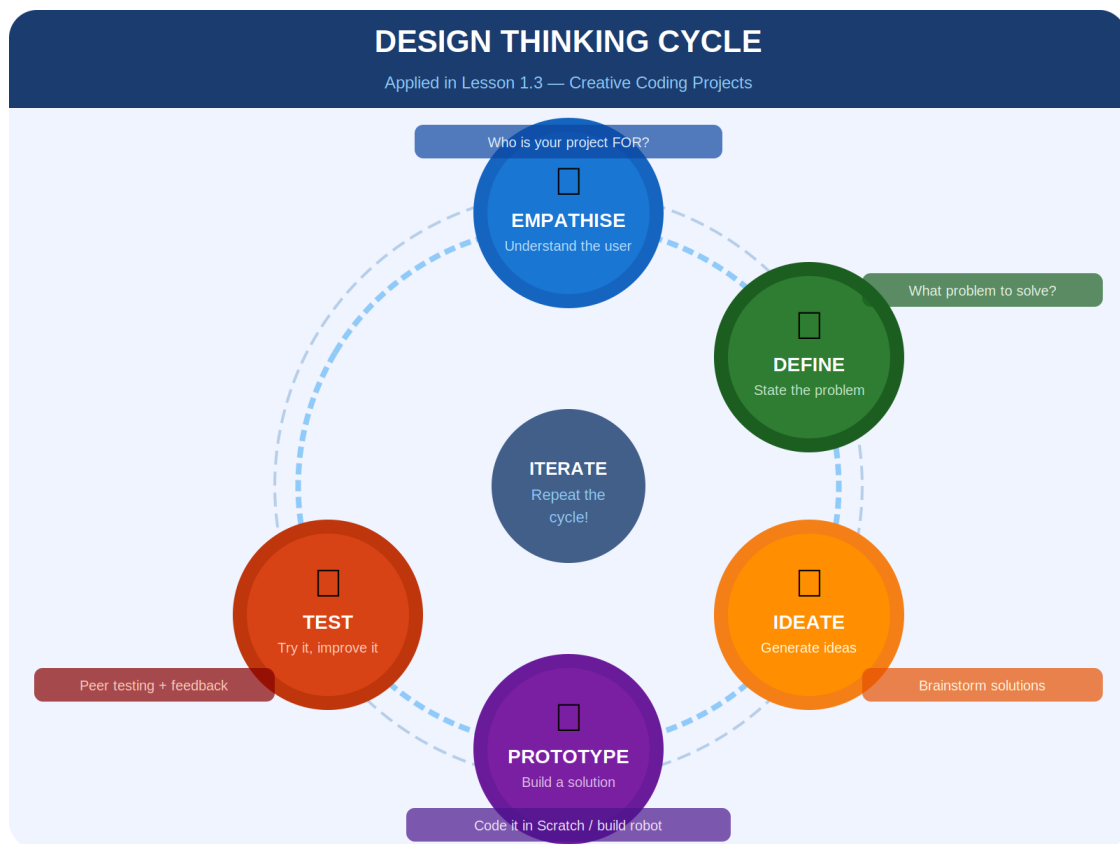


Figure 4 — The design thinking cycle applied to creative coding projects

Lesson Flow

Part 1 — New Concepts: Loops & Conditionals (15 minutes)

Live Scratch demonstration: 'repeat 4' + 'move 100' + 'turn 90' draws a square. Change 4 to 3 (triangle), then 5. Add 'forever' + 'if on edge bounce' for continuous movement. Show a score conditional: 'if score > 10 then say YOU WIN'. Students predict what each change will produce before running it.

Part 2 — Design Thinking Sprint (10 minutes)

Students answer on paper (2 minutes each): Who is this project for? What will they do or feel? List 5 ideas — circle the most exciting. Sketch a rough plan.

Part 3 — Project Build (30 minutes)

Option	Description	Required Coding Elements
A — Animated Story	Interactive story on a theme the student cares about. Characters speak, move, and change costumes.	2 sprites, 3 scenes, user interaction
B — Quiz Game	A quiz on any topic the student knows well. Player answers and receives feedback.	Score variable, 5+ questions, conditional feedback
C — Interactive Artwork	Digital artwork responding to mouse or key input. Focus on visual beauty.	Mouse/key input, loop, colour effects

Part 4 — Peer Feedback (5 minutes)

Swap computers. Complete 2 Stars & a Wish: two specific positives, one specific improvement suggestion.

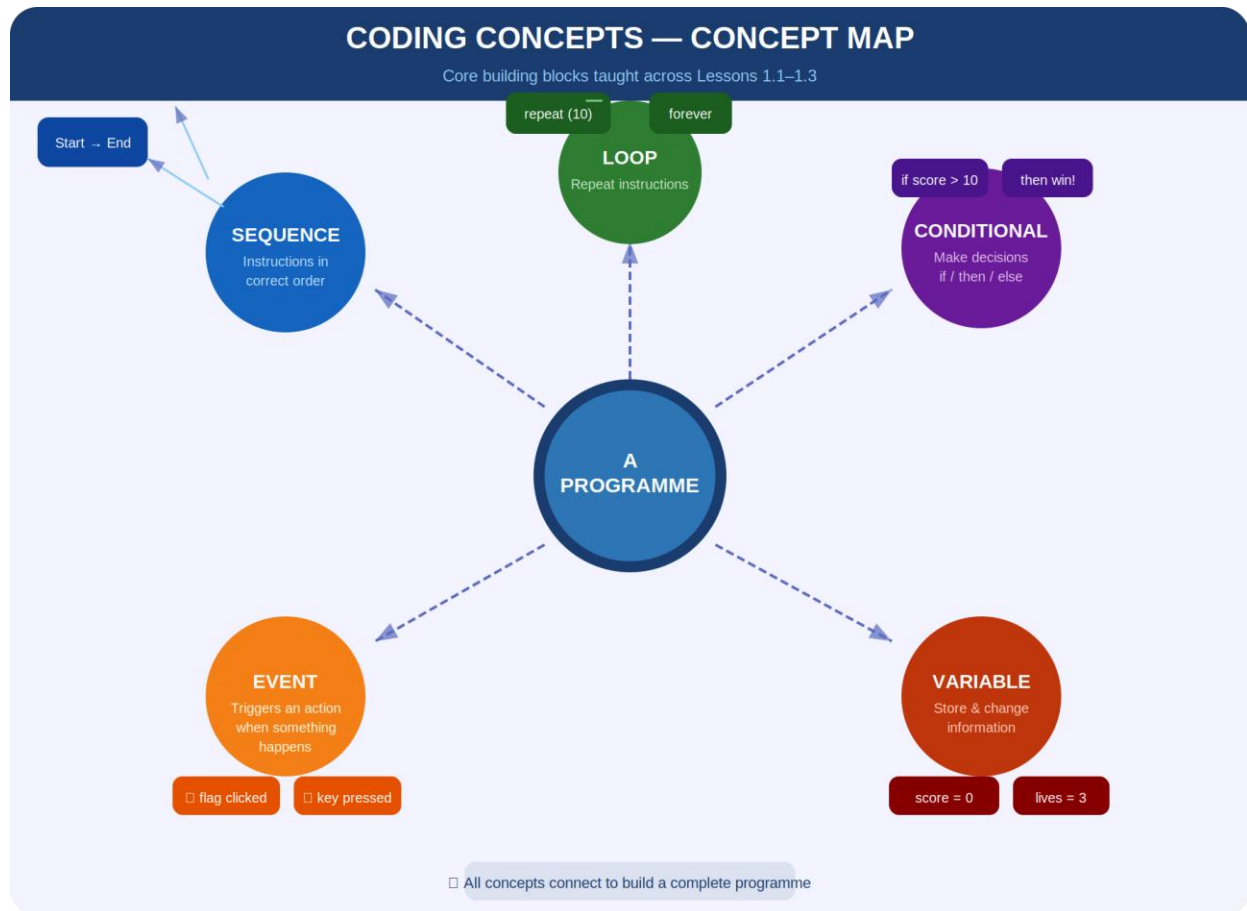


Figure 5 — Coding concepts map: all five building blocks and their Scratch implementations

Lesson 1.4 — Introduction to Robotics

Duration	Materials	Grouping	Lesson Type
60 minutes	Robotics kit (mBot, LEGO Mindstorms, or similar), component cards, worksheet	Groups of 3	Hardware exploration + assembly

Learning Objectives

🎯 Learning Objectives:

1. Define 'robot' and identify examples across diverse industries
2. Identify and label key components: sensors, controller, actuators
3. Assemble a basic wheeled robot from a kit
4. Connect and test at least one sensor

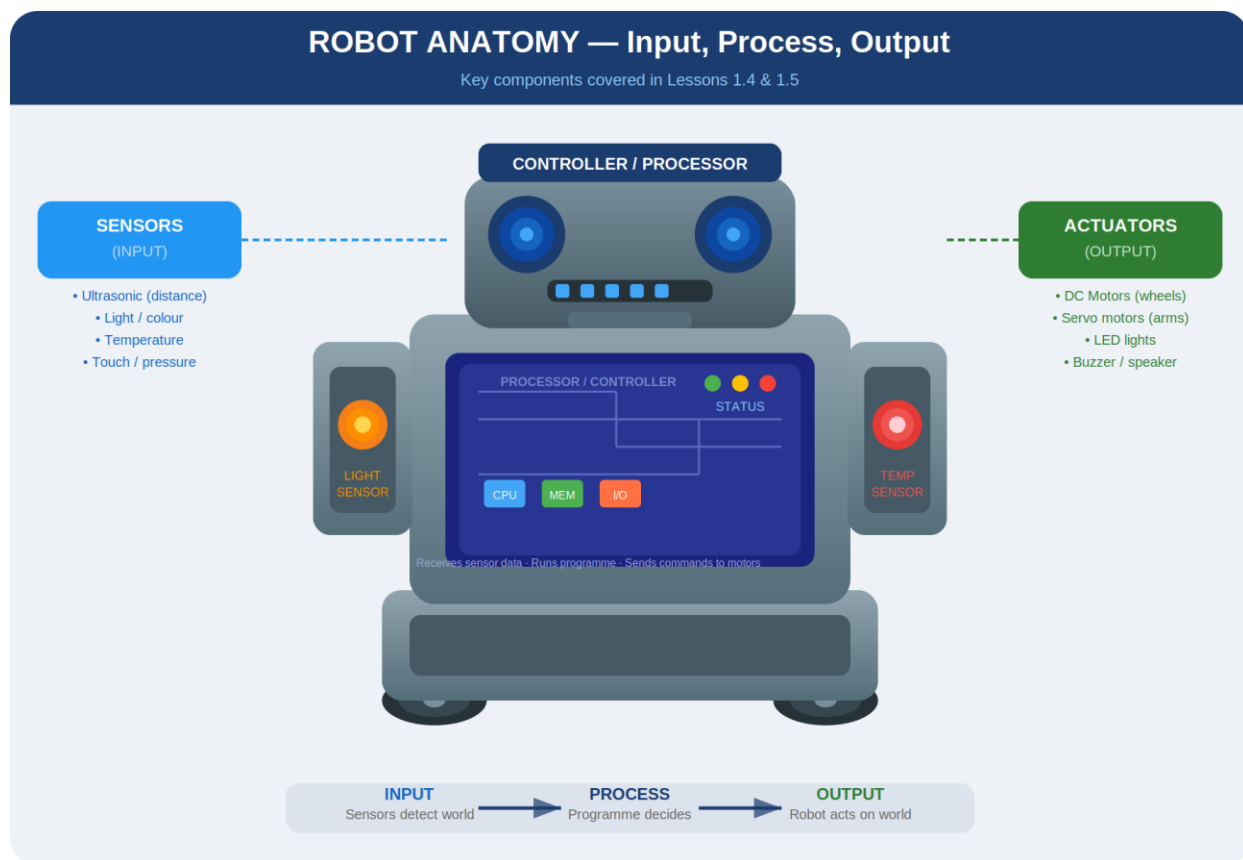


Figure 6 — Robot anatomy: input (sensors), process (controller), output (actuators)

Lesson Flow

Part 1 — What is a Robot? (15 minutes)

Show a 2-minute video montage of diverse robots (surgical, agricultural, warehouse, art robots). Students write on mini-whiteboards: what do ALL robots have in common? Guide them toward the three essentials:

All Robots Have...	Examples	Computing Term
Something to sense the world	Camera, distance sensor, touch sensor, microphone	INPUT
Something to think and decide	Microcontroller chip running a programme	PROCESS
Something to act on the world	Motor, wheel, robotic arm, speaker, LED	OUTPUT

Part 2 — Parts Identification (15 minutes)

Spread all kit components on the table. Students identify and label each on the Robot Anatomy worksheet. Key discussion: Why does the robot have TWO independent motors? What units does the ultrasonic sensor measure in?

Part 3 — Assembly (25 minutes)

Groups follow illustrated assembly cards. Teacher demonstrates uploading a test programme. Goal: get the robot moving forward and stopping. First group to make a controlled square movement wins a small recognition.

Part 4 — Robotics Careers (5 minutes)

Field	How Robots Are Used	Connection to Students
Healthcare	Precision surgery, rehabilitation, dispensing	Biology + Engineering
Agriculture	Harvesting drones, soil analysis, irrigation	Science + Computing
Environmental	Ocean monitoring, reforestation drones	This module's theme
Arts	Animatronics, drone light shows, interactive art	Module 2 connection

Lesson 1.5 — Programming Robots

Duration	Materials	Grouping	Lesson Type
60 minutes	Assembled robots from L1.4, computers with IDE, challenge course tape	Groups of 3	Applied programming + challenge

Learning Objectives

🎯 Learning Objectives:

1. Write a programme to control robot movement (forward, turn, stop)
2. Use sensor data in a conditional to create obstacle-avoiding behaviour
3. Debug a robot programme through testing and iteration
4. Explain what makes a robot 'autonomous'

Connecting Scratch to Robots

Scratch Concept	Robot Equivalent	Example
Events (when flag clicked)	When power on / button pressed	Robot starts on button press
Motion blocks (move 10 steps)	Motor power + duration	Move forward at 80% for 1 second
Loop (forever)	Main programme loop	Continuously check sensors
Conditional (if/then)	If sensor value > threshold	If distance < 20cm → turn right
Variable (score)	Stored sensor reading	distance = sensor.read()

Lesson Flow

Part 1 — Movement Programming (20 minutes)

Teach the motor control blocks in the IDE. Live code: make the robot draw a square on the floor. Students first predict what the code needs, then write and test it. Most groups need 3–5 iterations — celebrate the debugging process, not just the final result.

Part 2 — Sensor-Based Autonomy (25 minutes)

Introduce the ultrasonic distance sensor. Programme: IF distance < 20 cm THEN stop and turn right. Test with a hand as obstacle. Extension challenges:

8. Obstacle on left → turn right; obstacle on right → turn left
9. Reverse and turn if blocked straight ahead (wall-following behaviour)
10. Add LED colour changes based on sensor readings (bridge to Module 2)

Part 3 — Challenge Course (15 minutes)

Achievement	Points	Note
Robot moves without crashing	10	Basic movement working
Robot avoids at least one obstacle	20	Sensor conditional working
Robot completes full course	40	Full autonomous navigation
Bonus: incorporates LED art or sound	15	Cross-module creativity bonus
Bonus: logs environmental sensor data	15	Bridge to Module 3

💡 Assessment note: A robot that partially succeeds with a well-reasoned, clearly explained approach should score as highly as one that completes the course accidentally. The rubric rewards thinking, not just outcome.

5-DAY INTENSIVE WORKSHOP PROGRAMME

Five-Day Workshop — Coding and Robotics Basics

This workshop brings together all five lessons in an intensive format over five consecutive days. It is ideal for a school project week, a cross-school collaboration, a community coding camp, or a holiday programme. It works equally well within a single school or with mixed groups from multiple schools.

Groups should be mixed across year groups, gender, and ability wherever possible. Mixed groups consistently produce more creative outcomes and develop stronger interpersonal skills than homogeneous ones.

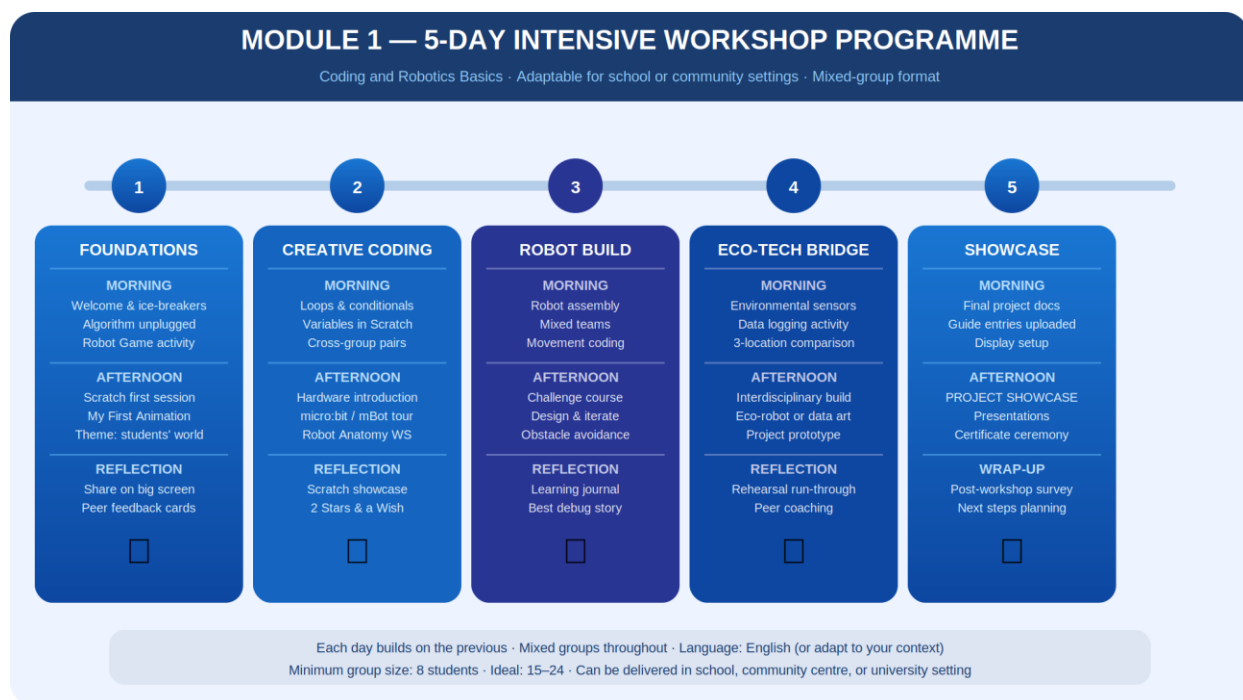


Figure 7 — Five-day workshop programme: one thematic day builds on the next

Workshop Logistics

Element	Recommendation
Group size	8–24 students; groups of 3–4 for all collaborative tasks
Facilitators	1 lead teacher per 8 students; coding knowledge helpful but not required
Session length	Morning session 09:00–12:30, afternoon 13:30–17:00 (can be adapted)
Language	Can be delivered in any language; multilingual settings encouraged

Element	Recommendation
Technology	Computers/tablets (1 per student ideal, 1 per pair minimum); robotics kit (1 per group of 3)
Assessment	Pre-quiz on Day 1 morning; post-quiz on Day 5 afternoon; rubric completed Day 5
Documentation	Photograph all projects; record Day 5 presentations; upload to shared platform

Day-by-Day Focus Areas

Day	Theme	Morning Focus	Afternoon Focus	Reflection Activity
1	Foundations	Welcome, ice-breakers, algorithm unplugged games	Scratch first session — My First Animation	Big-screen sharing; peer feedback cards
2	Creative Coding	Loops, conditionals, variables; cross-group pair coding	Hardware tour; Robot Anatomy worksheet	Scratch showcase; 2 Stars & a Wish
3	Robot Build	Assembly in mixed groups; movement programming	Challenge course design, test, and iterate	Learning journal: best debug story of the day
4	Eco-Tech Bridge	Environmental sensors; data logging from 3 locations	Interdisciplinary project: eco-robot or data visualisation	Rehearsal presentations; peer coaching
5	Showcase	Final project completion and documentation	Project SHOWCASE and presentations	Post-workshop survey; next steps planning

 **Multilingual facilitation:** Use visual instructions alongside written ones. Pair-programming works across language barriers — one student codes, one navigates. Accept home-language discussion; ask for English summary. Celebrate multilingualism as a strength.

 **Celebrate failure:** When a robot fails the course, ask 'What did you learn?' before asking 'How will you fix it?' The process of debugging is where most real learning happens.

 **Document everything:** Photographs and video of student work are essential. They provide evidence for assessment, content for the digital guide, and lasting memories for students.

ASSESSMENT TOOLS

Pre/Post Knowledge Quiz — Coding & Robotics

Administer the same quiz before the module begins (to establish a baseline) and again after completing the five lessons or the workshop. The change in scores is the most important measure — not the absolute score.

#	Question	Correct Answer
1	What is an algorithm?	B — A step-by-step set of instructions to solve a problem
2	In Scratch, what does the 'forever' block do?	B — Runs the script in a continuous loop
3	Which component is an INPUT sensor on a robot?	C — Ultrasonic distance sensor
4	What does 'debugging' mean?	B — Finding and fixing errors in code
5	An 'if/then' block is an example of:	C — A conditional
6	The purpose of a LOOP in coding is to:	B — Repeat instructions multiple times
7	Robots interact with the world using:	C — Both sensors AND actuators
8	To keep a score in a game, you would use a:	B — Variable
9	Environmental sensors can collect data about:	B — Air quality, temperature, and light
10	Decomposition means:	C — Breaking a problem into smaller, manageable parts

Performance Rubric — Coding & Robotics Project

Criterion	Beginning (1)	Developing (2)	Proficient (3)	Exemplary (4)
Algorithm Design	Cannot write a clear sequence	Basic sequences with frequent errors	Correct sequences with minor errors	Efficient; anticipates edge cases
Coding (Scratch)	Cannot use blocks independently	Uses basic blocks with support	Loops, conditionals, events independently	Advanced concepts; well-structured code
Robotics	Cannot assemble or programme	Assembles with help; basic movement	Programmes robot for specific task	Autonomous sensor-based behaviour
Problem Solving	Gives up; needs teacher to fix errors	Attempts with frequent teacher help	Debugs independently; systematic	Proactive; finds root causes; helps peers
Collaboration	Does not engage with group	Participates minimally	Contributes meaningfully to team	Takes leadership; includes all voices

Criterion	Beginning (1)	Developing (2)	Proficient (3)	Exemplary (4)
Communication	Cannot explain the project	Basic description of what was made	Explains decisions and challenges clearly	Engaging; uses evidence; invites questions

Student Self-Reflection — Module 1

Question	Response Format
Before this module, how confident did you feel about coding? (1–5)	Circle: 1 2 3 4 5
After this module, how confident do you feel? (1–5)	Circle: 1 2 3 4 5
What was the most exciting thing you made or programmed?	Open text (2–3 sentences)
What was the hardest moment? How did you deal with it?	Open text (2–3 sentences)
What coding concept could you now explain to a friend?	Open text (1 sentence)
How well did your group work together? (1–5)	Circle: 1 2 3 4 5
What would you like to learn next?	Open text (1 sentence)

Teacher Observation Checklist

Observable Behaviour	Yes	Partial	Not Yet	Notes
Student can define 'algorithm' and give an everyday example	☒	☐	☐	
Student writes and runs a Scratch programme independently	☒	☐	☐	
Student assembles a robot from a kit using instructions	☒	☐	☐	
Student identifies and fixes a bug without teacher direction	☒	☐	☐	

Observable Behaviour	Yes	Partial	Not Yet	Notes
Student uses loops and conditionals correctly	☒	☐	☐	
Student shows resilience when their programme doesn't work	☒	☐	☐	
Student explains their project clearly to an unfamiliar listener	☒	☐	☐	
Student connects coding/robotics to a real-world application	☒	☐	☐	

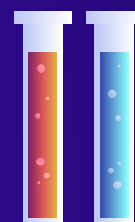
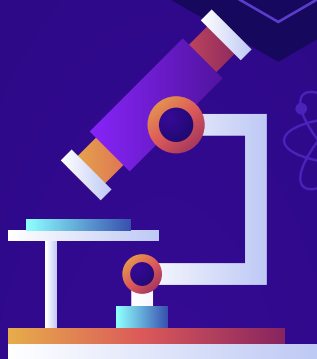


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MODULE 2

Arts and Science Integration

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5 Detailed Lesson Plans

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How to Use This Guide

Module 2 can be used as a standalone STEAM unit or as the second part of the full Integrated Exploration curriculum. Students do not need to have completed Module 1, though those who have will be able to bring their Scratch skills into their creative projects.

The module works best when students have access to both physical art materials and digital tools. All activities scale from low-resource settings (basic drawing materials, a shared computer) to fully equipped classrooms.

What This Guide Contains

-  Five 60-minute lesson plans covering gallery exploration, data art, digital creativity, group projects, and exhibition
-  A 5-day intensive workshop programme that culminates in a public Grand Exhibition
-  Pre/post quiz, project rubric with radar chart, peer gallery feedback form, and self-reflection
-  Compatible with art, science, computing, and cross-curricular project weeks
-  Builds on Module 1 Scratch skills; connects forward to Module 3 sustainability projects

Module Overview

Module 2 explores the rich relationship between artistic expression and scientific thinking. Students discover that these two disciplines are not opposites — they share a commitment to observation, curiosity, and communication. By combining them, students produce something neither discipline can achieve alone.

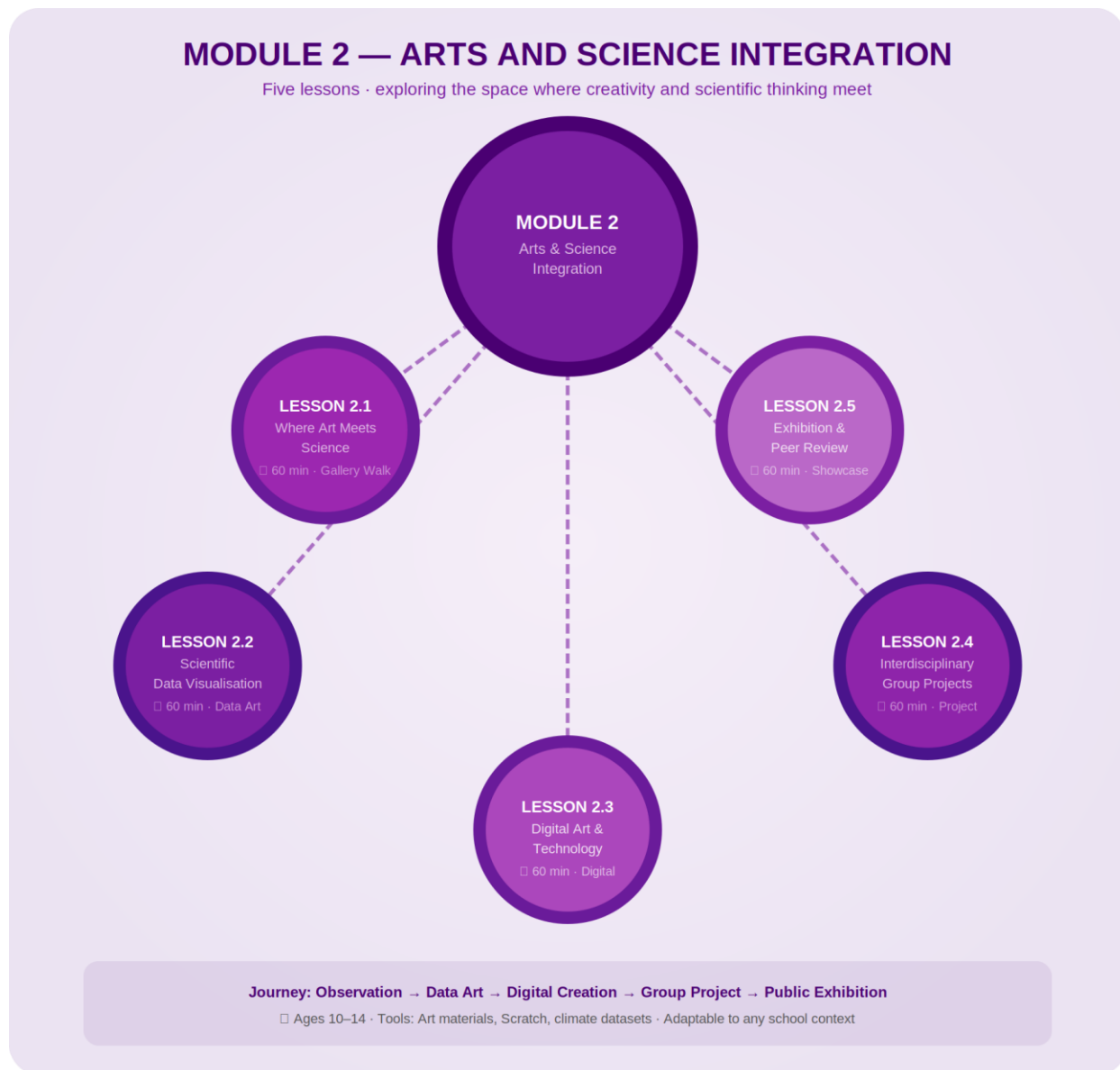


Figure 1 — Module 2: five lessons building toward a public art-science exhibition

At a Glance

- 🎯 Target Group: Students aged 10–14 and their teachers
- 🕒 Lesson Time: 5 × 60-minute lessons + 5-day intensive workshop

-  Tools: Art materials, Scratch, climate data sets, digital cameras (optional)
-  Assessment: Pre/post quiz, project rubric, peer gallery feedback, self-reflection
-  Key Skills: Observation, data literacy, creative thinking, scientific communication

The STEAM Framework — Why Arts Belongs

STEAM adds Arts to the STEM disciplines — not as decoration, but as a critical thinking and communication tool. In this module, art is the primary vehicle through which students communicate, interrogate, and deepen their scientific understanding.

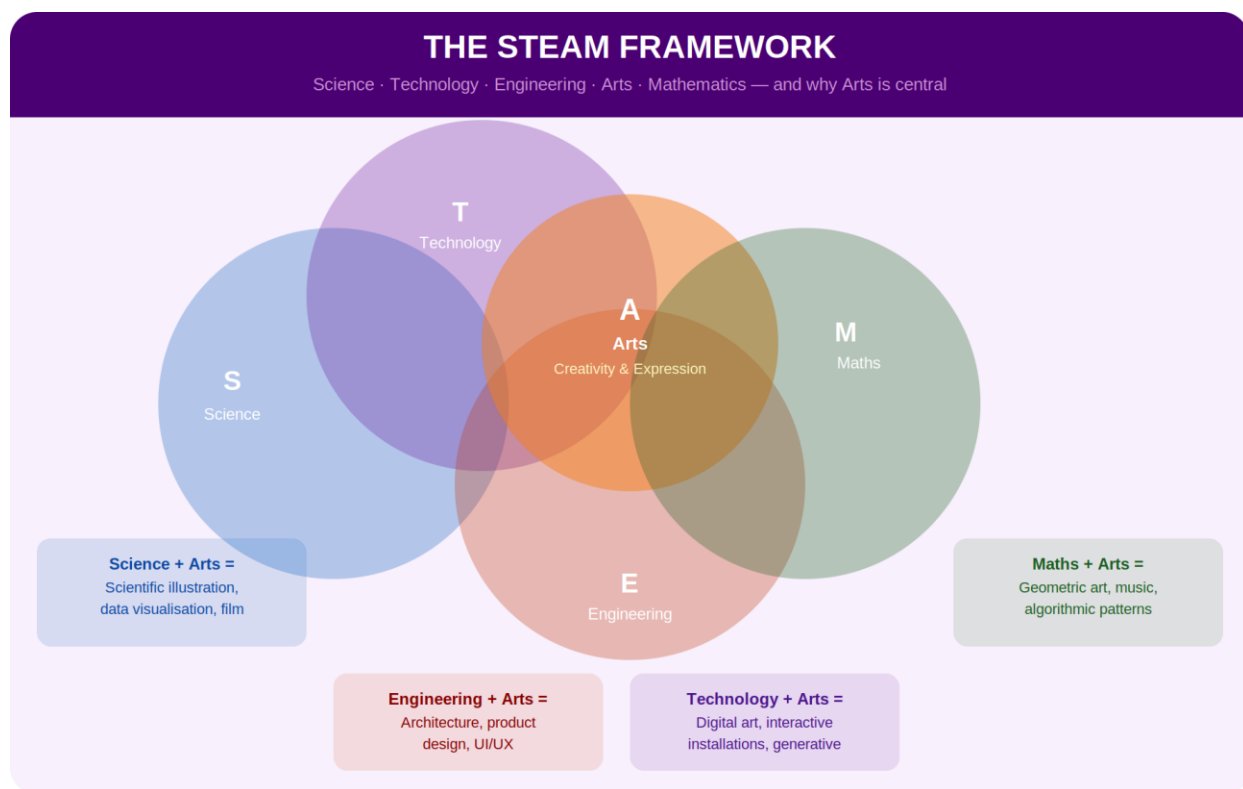


Figure 2 — STEAM: Arts sits at the centre, connecting all other disciplines

Shared Value	In Science	In Art
Observation	Recording data precisely; noticing anomalies	Observational drawing; noticing light and texture
Curiosity	Asking 'What if?' and designing experiments	Asking 'What if?' and experimenting with materials
Communication	Presenting findings to peers and public	Expressing ideas to an audience
Revision	Testing, failing, refining a hypothesis	Iterating on a sketch; editing a piece
Pattern recognition	Finding trends in data sets	Finding rhythm, repetition, and form

Art–Science Pioneers

One of the most powerful ways to inspire students is to show that the boundary between art and science is a human invention. These six figures refused to choose between the two disciplines — and their work is richer for it.

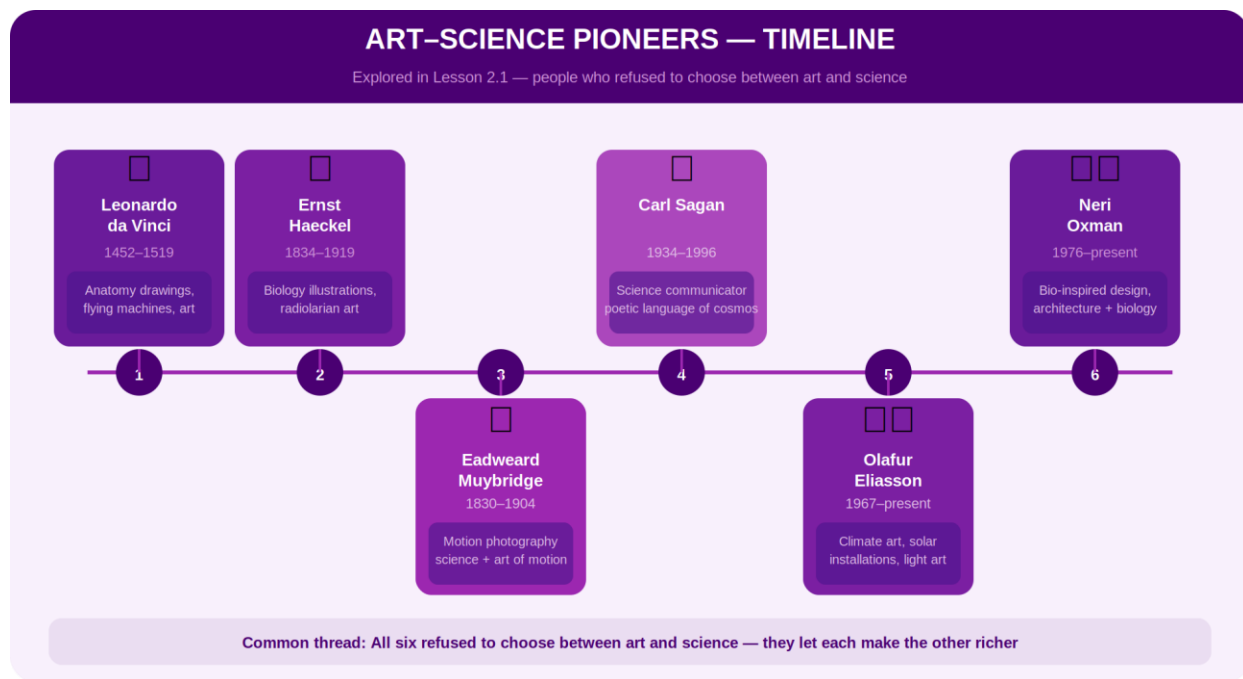


Figure 3 — Six pioneers who crossed the art-science boundary: from Leonardo da Vinci to Neri Oxman

LESSON PLANS

Lesson 2.1 — Where Art Meets Science

Duration	Materials	Grouping	Lesson Type
60 minutes	Pioneer cards/slides, natural objects, drawing paper, pencils, sticky notes	Individual, then pairs	Gallery walk + observational drawing

Learning Objectives



Learning Objectives:

1. Name at least three figures who worked across art and science
2. Make a detailed observational drawing of a natural object
3. Compare scientific and abstract representations of the same subject
4. Complete the exit sentence: 'Art and science are similar because ___ and different because ___'

Lesson Flow

Part 1 — Gallery Walk (15 minutes)

Display 8–10 images at stations (printed cards or projected). Include: Haeckel's radiolarian illustrations, da Vinci's anatomy notebooks, a NASA climate spiral, a wind map data visualisation, Olafur Eliasson's 'The Weather Project'. Students move with sticky notes, writing one word per image. Collect and build a class word cloud.

Part 2 — Pioneer Presentations (15 minutes)

Pre-assigned student groups present their pioneer in 2 minutes each. Focus question: What motivated these people to cross boundaries? Guide discussion: both science and art require deep observation; both communicate ideas to others; both involve repeated testing and revision.

Part 3 — Observational Drawing Challenge (25 minutes)

Each student chooses a natural object (leaf, stone, feather, seed pod, shell). Two rounds:

1. SCIENTIFIC DRAWING (10 min): As accurate as possible; label at least 3 features
2. ABSTRACT VERSION (10 min): Inspired by the same object; viewer should not immediately recognise it

Pin both side by side. Discussion: What does each version reveal that the other cannot? Which contains more information? Which communicates more feeling?

Part 4 — Exit Ticket (5 minutes)

Each student completes: 'Art and science are similar because ____ and different because ____.' Collect the cards — return them at the end of the module as a 'how has your thinking changed?' comparison.

Lesson 2.2 — Scientific Visualisation Through Art

Duration	Materials	Grouping	Lesson Type
60 minutes	Printed climate data sets, graph paper, watercolour or coloured pencil, collage materials	Individual	Data art creation

Learning Objectives

🎯 Learning Objectives:

1. Read and interpret a simple data set (e.g., monthly temperature averages)
2. Transform data into a visual artwork using at least one deliberate visual encoding
3. Annotate the finished work explaining each visual choice
4. Give structured feedback on a peer's data artwork

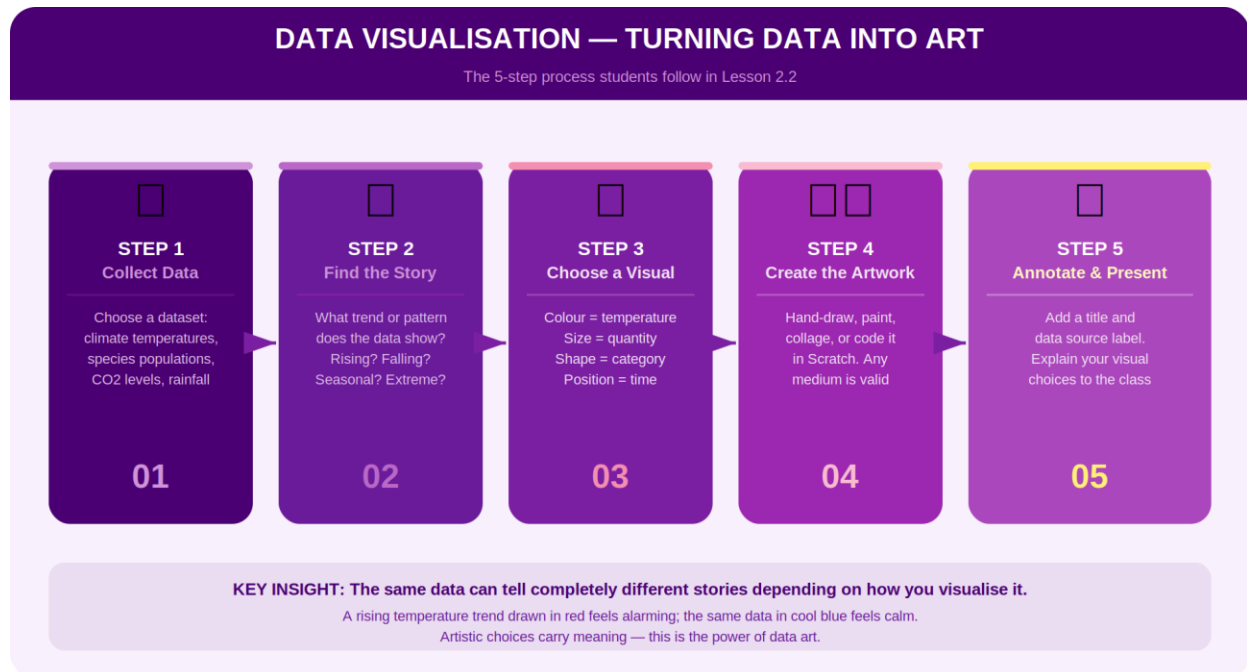


Figure 4 — The 5-step data visualisation process: from raw data to annotated artwork

Lesson Flow

Part 1 — What is Data Visualisation? (10 minutes)

Show four compelling examples: Ed Hawkins' Climate Stripes, a real-time wind map, the Dear Data project (hand-drawn personal data), a NASA temperature anomaly map. For each: What data is shown? What emotion does it evoke? Could a standard bar chart do the same?

Part 2 — My Climate Data Art (35 minutes)

Each student receives a data card: monthly average temperatures for a region over 30 years. The data shows a clear warming trend. Rules for the artwork:

- The trend must be visible to a viewer who has not seen the data
- Use at least one clear visual encoding: colour = temperature, size = value, etc.
- Any medium permitted: drawing, painting, collage, or digital
- Annotate with: data source, what visual elements represent, trend identified

💡 Prompts for students who are stuck: What colour IS the temperature of 1990? Of 2020? If each year were a thread in a fabric, what would the fabric look like? What shape would you draw if you could FEEL the warming in your hands?

Part 3 — Gallery Critique (10 minutes)

Pin up all artworks. Structured sticky-note feedback: 'The data I can read from this artwork is...' This forces engagement with the scientific content, not just the aesthetic.

Part 4 — Bridge to Lesson 2.3 (5 minutes)

Preview: the same data can be visualised interactively in Scratch. An interactive version can respond to the viewer — what might it do that the hand-made version cannot?

Lesson 2.3 — Digital Art and Technology

Duration	Materials	Grouping	Lesson Type
60 minutes	Computers with Scratch, starter code file, audio recording (optional)	Individual, paired support	Digital creation + experimentation

Learning Objectives

🎯 Learning Objectives:

1. Create an interactive artwork in Scratch that responds to mouse or key input
2. Use Scratch pen tools to generate visual patterns with loops
3. Write a two-sentence artist's statement connecting creative choices to coding
4. Describe one example of generative or algorithmic art

Lesson Flow

Part 1 — Generative Art Examples (10 minutes)

Show three examples: Sol LeWitt's Wall Drawings (instructions that generate art), a Processing generative pattern, a Scratch pen project drawing spirals and mandalas. Question: Does knowing this was made by code make it less artistic? Is writing the algorithm an artistic act? Encourage genuine debate — there is no correct answer.

Part 2 — Interactive Digital Artwork (35 minutes)

Distribute the starter Scratch file (pen drawing enabled, no output yet). Students modify and extend it. Challenge levels:

Level	Challenge	Scratch Concepts
🌀 Starter	Draw a continuous spiral by changing move and turn amounts	Loop, pen, motion
🌀 Developing	Artwork responds to mouse position — distance changes line thickness or colour	Sensing, variables, conditionals
🌀 Advanced	Gradually shifting colours or expanding patterns that reset and repeat	Incrementing variables, nested loops
★ Creative	Encode the temperature data from Lesson 2.2 into the visual pattern	All concepts + personal data integration

Part 3 — Sound Extension (10 minutes)

Record a sound using the Scratch recording tool. Add it to the artwork on a key press. Discussion: music also has algorithmic structure — beats, bars, patterns. Is music generative art?

Part 4 — Artist's Statement (5 minutes)

Two sentences in the learning diary: (1) Name your artwork. (2) 'I used [coding concept] to create [visual effect] because [creative intention].'

Lesson 2.4 — Interdisciplinary Group Projects

Duration	Materials	Grouping	Lesson Type
60 min + project time	Project planning canvas, all previous materials, computers and art supplies	Groups of 3–4	Design thinking + project-based

Learning Objectives

🎯 Learning Objectives:

1. Choose a project type that combines a scientific concept with an artistic medium
2. Apply the SCAMPER brainstorming technique to generate 10+ ideas
3. Complete a Project Planning Canvas with all required sections
4. Assign team roles and create a task timeline

INTERDISCIPLINARY PROJECT TYPES — Lesson 2.4
Six creative directions for art-science integration projects — choose one or combine



Visual Artwork

Scientific basis: biodiversity data
Artistic form: mosaic, painting, or collage using natural materials

Skills: observation, data reading, artistic composition, colour theory
Links to Module 3: Biodiversity



Digital Installation

Scientific basis: sound frequency
Artistic form: interactive Scratch programme visualising music

Skills: coding (Module 1), audio analysis, interactive design
Links to Module 1: Scratch coding



Engineering Sculpture

Scientific basis: structural engineering
Artistic form: sculpture that must bear weight while being beautiful

Skills: physics, materials science, 3D design, creative problem-solving
Links to Robotics: structural design



Science Performance

Scientific basis: human body systems
Artistic form: choreography representing cells, organs, or the nervous system

Skills: biology, movement, spatial awareness, teamwork, storytelling
Links to Module: body awareness



Photo Documentation

Scientific basis: seasonal change
Artistic form: photo series with data overlays and annotations

Skills: observation, photography, data recording, composition
Links to Module 3: climate change



Documentary Film

Scientific basis: animal migration
Artistic form: short documentary with infographic overlays

Skills: research, storyboarding, narration, editing, data literacy
Links to Module 3: ecosystems

Figure 5 — Six interdisciplinary project directions: scientific basis meets artistic form

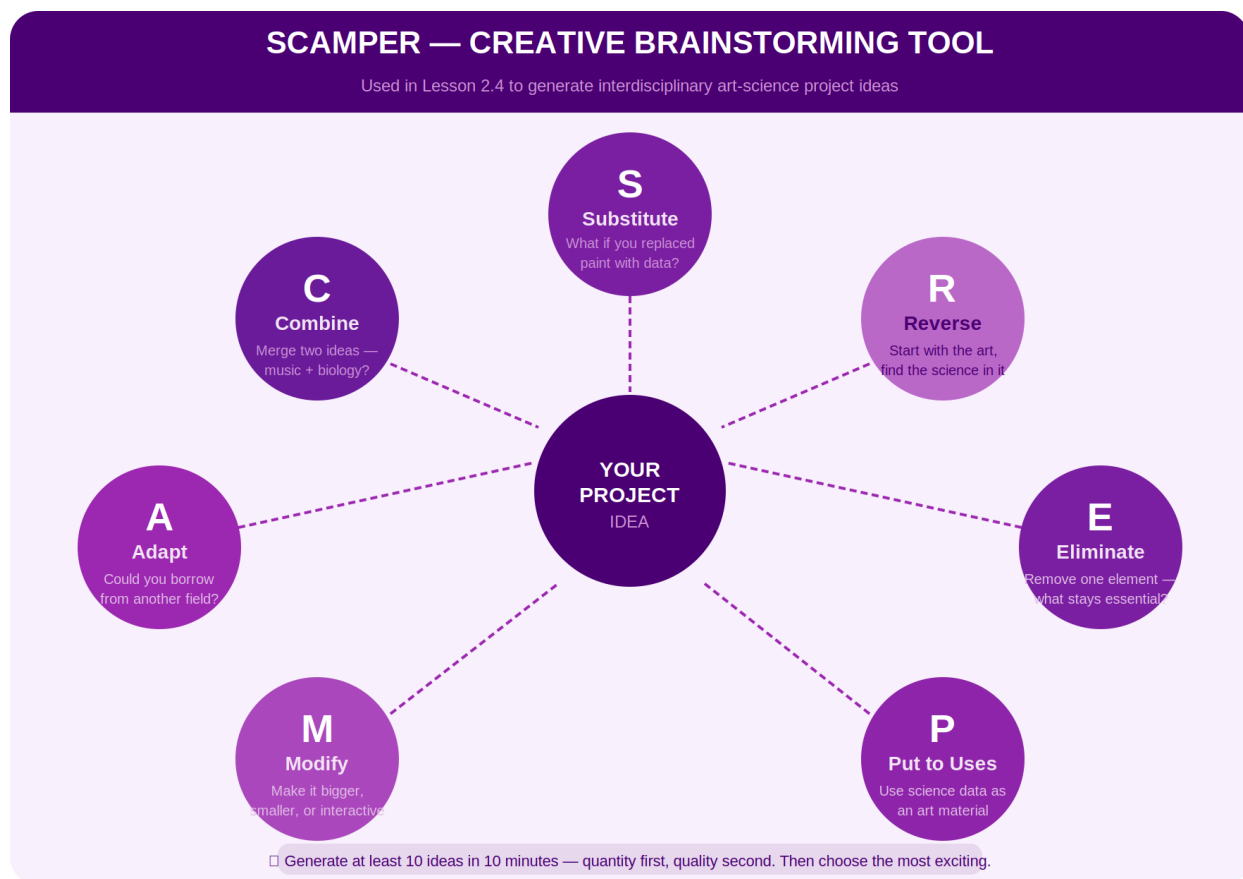


Figure 6 — SCAMPER: seven prompts for generating creative project ideas

Lesson Flow

Part 1 — Project Brief and SCAMPER Sprint (20 minutes)

Project requirements: (1) a genuine scientific concept or real dataset as foundation, (2) expressed through an artistic medium, (3) communicating a message to an identified audience. SCAMPER sprint: 10 minutes, 10 ideas minimum. Quantity over quality. Then vote for one.

Part 2 — Project Planning Canvas (25 minutes)

Canvas Section	What to Complete	Why It Matters
Project Title	A creative, evocative name	Creates ownership and identity
Scientific Basis	Which concept, dataset, or phenomenon?	Ensures genuine STEAM — not decoration
Artistic Medium	Exactly what will be made	Focuses effort; guides material planning
Target Audience	Who will see or experience this?	Shapes design and communication choices

Canvas Section	What to Complete	Why It Matters
Key Message	What should the audience think, feel, or know?	Connects back to scientific content
Integration Statement	How does the art ENHANCE the science?	The critical STEAM thinking challenge

Part 3 — Role Assignment and Begin (15 minutes)

Assign roles: Lead Artist, Lead Scientist, Technology Coordinator, Communication Lead. Each leads their area but everyone contributes to all. Spend the final 10 minutes making the first move — first sketch, first code line, first data lookup.

Lesson 2.5 — Exhibition and Peer Review

Duration	Materials	Grouping	Lesson Type
60 minutes	Completed projects, display space, feedback forms, award certificates	Groups + whole class	Public exhibition + critique

Learning Objectives

🎯 Learning Objectives:

1. Set up and present an interdisciplinary project to an audience
2. Give specific, evidence-based feedback on peers' projects
3. Receive and respond constructively to critique
4. Reflect on the learning journey across all five lessons

Exhibition Standards — What Every Project Must Include

Required Element	Purpose	Format
The artwork itself	Central piece — what the audience experiences	Physical, digital, performance, or installation
Scientific explanation	Shows the STEAM connection	150 words maximum, displayed beside artwork
Artist's statement	Explains creative choices and intentions	100 words, first person, written by team
Data source	Grounds the work in real science	Citation of dataset or research used
Interaction guide	Tells viewer how to engage	QR code, instructions, or invitation to participate

Lesson Flow

Part 1 — Exhibition Set-Up (10 minutes)

Groups prepare their display. Teacher checks: Is the science accurate? Is the artist's statement in first person? Does the display invite the viewer in?

Part 2 — Gallery Rotation (30 minutes)

Visitors rotate in groups of 3–4. At each station: 3 minutes to engage, then complete structured feedback form: What scientific concept does this communicate? What is the most effective artistic choice and why? One question for the creators.

Part 3 — Presentations (15 minutes)

Each group presents for 2 minutes: What is our project? What is the scientific basis? What artistic choices did we make and why? What did we learn about how art and science enhance each other? What would we do differently?

Part 4 — Awards (5 minutes)

Award	What It Recognises
Most Creative	Most original combination of art form and scientific concept
Best Science Communication	Science most clearly and accurately expressed through the artwork
Most Impactful Message	Message you will still remember in a month
Best Integration	Art and science most inseparably connected — neither could exist without the other

5-DAY INTENSIVE WORKSHOP PROGRAMME

Five-Day Workshop — Arts and Science Integration

This workshop is the intensive version of Module 2. Students arrive on Day 1 having at least some familiarity with the art-science connection (ideally having completed the five lessons). The week culminates in a Grand Exhibition open to the wider school community or public.

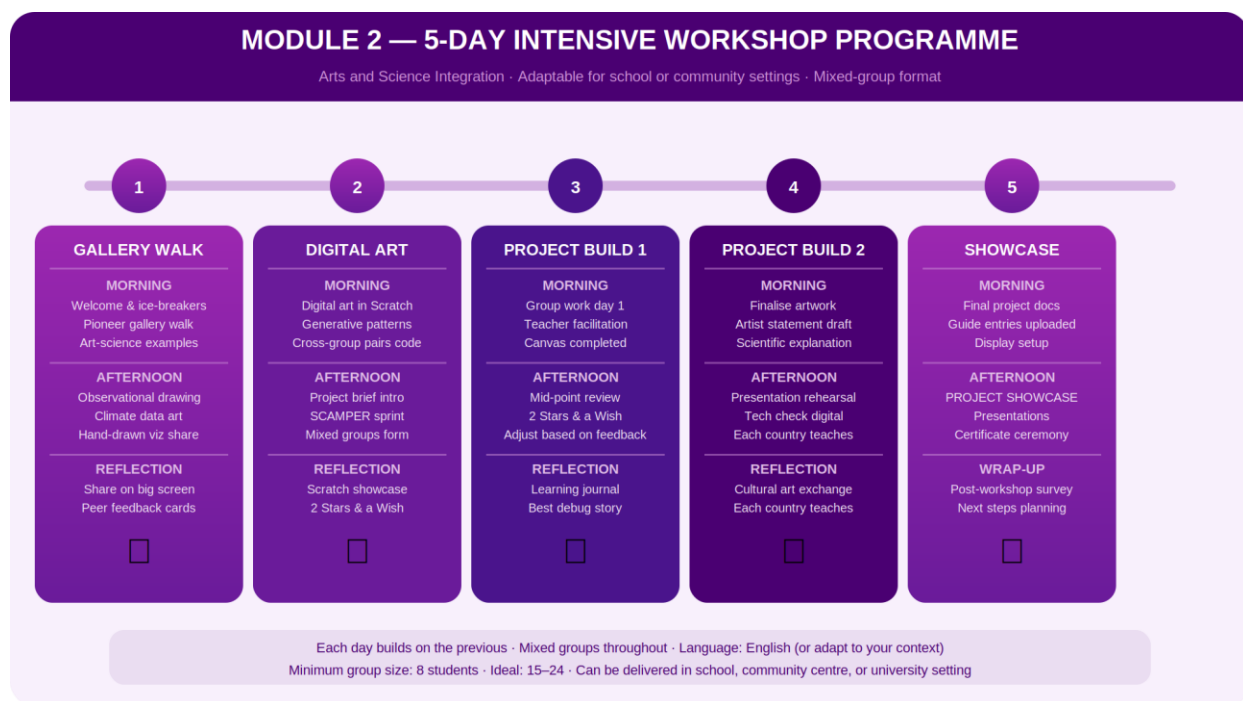


Figure 7 — Five-day workshop: building toward the Grand Exhibition on Day 5

Day	Theme	Morning Focus	Afternoon Focus	Reflection Activity
1	Observation	Gallery walk; pioneer introductions	Observational drawing; climate data art	Class word cloud review; how has thinking changed?
2	Digital Creation	Digital art in Scratch; cross-group pairs	Project brief intro; SCAMPER sprint; groups form	Evening site visit: gallery, museum, or science centre
3	Build Day 1	Group project work; teacher facilitation	Mid-point peer review: 2 Stars & a Wish	Reflection journals: biggest learning so far
4	Build Day 2	Finalise artwork; artist's statement draft	Presentation rehearsal; peer coaching	Cultural art exchange: each group shares a creative tradition

Day	Theme	Morning Focus	Afternoon Focus	Reflection Activity
5	Grand Exhibition	Final prep; display setup; QR codes	Grand Exhibition open to community; award ceremony	Post-workshop survey; exit ticket comparison with Day 1

🧠 Protect the artistic voice: Resist correcting aesthetic choices. The science must be accurate; the art is the student's expression. A 'wrong' colour choice is a creative decision.

🔍 Science accuracy is non-negotiable: Review each group's scientific explanation before the exhibition. The data must be real; the scientific statement must be correct.

🌐 Language of art is universal: In multilingual groups, students can communicate through sketches, gestures, and shared creative work. This is a feature, not a barrier.

👥 Mixed groups throughout: Homogeneous groups produce more predictable work. Mixed groups consistently generate more creative and unexpected combinations.

ASSESSMENT TOOLS

Pre/Post Knowledge Quiz — Arts & Science Integration

#	Question	Correct Answer
1	Which of these people was both a scientist and an artist?	B — Leonardo da Vinci
2	What is 'data visualisation'?	B — Representing information through visual elements
3	STEAM stands for:	A — Science, Technology, Engineering, Arts, Maths
4	Which artist is known for climate science installations?	C — Olafur Eliasson
5	Generative art is art that:	B — Is created using algorithms or rules, often with code
6	Observational drawing in science is used to:	B — Record accurate visual details for scientific purposes
7	In a STEAM project, Arts contributes by:	B — Adding creative expression and communication of ideas
8	Which communicates a scientific message through art?	B — An animated film about ocean pollution
9	What does 'interdisciplinary' mean?	B — Involving multiple fields of study working together
10	The best peer feedback on an art-science project:	C — Gives specific observations about strengths and improvements

Project Rubric — Arts & Science Integration

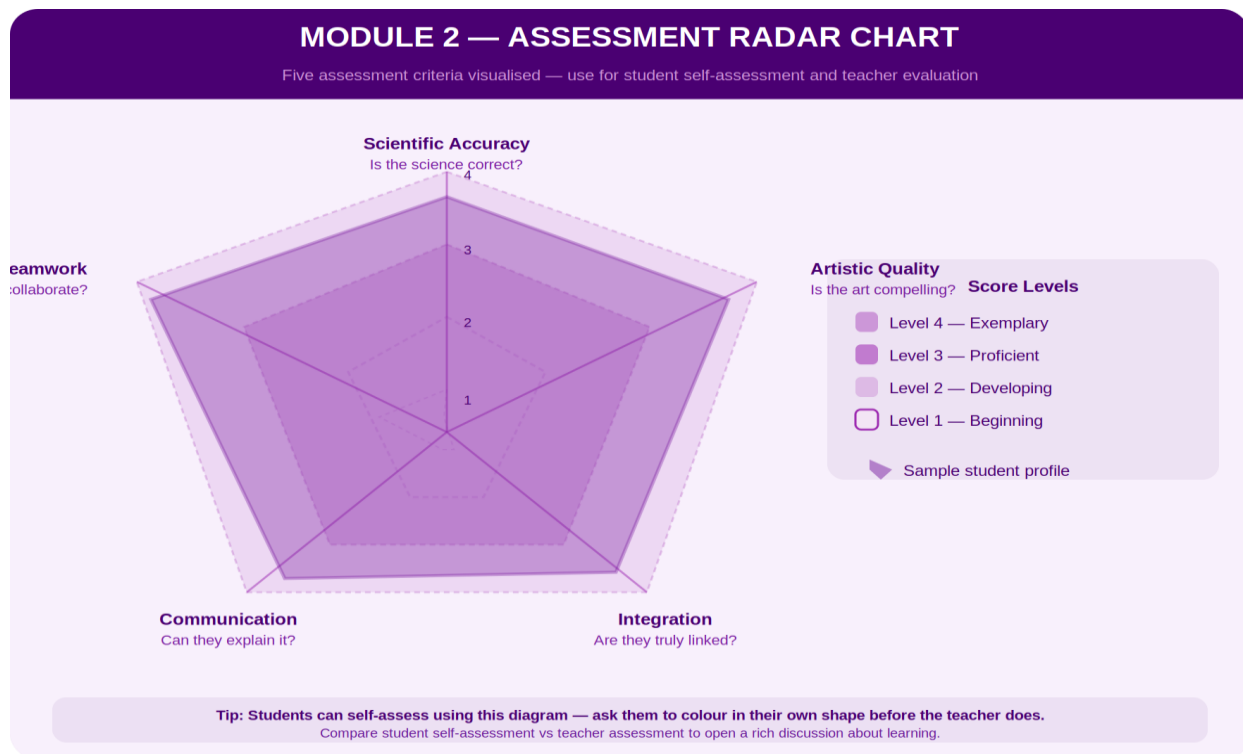


Figure 8 — Assessment radar: five criteria visualised — for both self-assessment and teacher evaluation

Criterion	Beginning (1)	Developing (2)	Proficient (3)	Exemplary (4)
Scientific Accuracy	Concept absent or substantially wrong	Basic concept with significant errors	Concept accurate and clearly identified	Deep understanding; evidenced with data
Artistic Quality	Incomplete or unintentional	Basic effort; limited creative choices	Clear decisions; artwork complete and coherent	Original, compelling; mastery of medium
Integration	Art and science separate; no genuine link	Loose connection; art illustrates but doesn't enhance	Meaningfully connected; art deepens the science	Inseparable; science cannot be as well understood without the art
Communication	Cannot explain the project	Basic description of what was made	Scientific basis and creative choices explained clearly	Engaging; articulates learning; handles questions
Teamwork	No collaboration evidence	Participates minimally	All voices visible in the work	Peer teaching; constructive conflict resolution

Student Self-Reflection — Module 2

Question	Response Format
What surprised me most about the art-science connection?	Open text (2–3 sentences)
Which scientific concept did I understand better through making art?	Open text (2–3 sentences)
What artistic skills did I develop or strengthen?	Open text (1–2 sentences)
My confidence combining art and science before this module (1–5):	Circle: 1 2 3 4 5
My confidence combining art and science after this module (1–5):	Circle: 1 2 3 4 5
The project I am most proud of from this module is:	Open text (1 sentence + reason)
One question I am now asking that I wasn't asking before:	Open text



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INTEGRATED EXPLORATION: CREATIVE THINKING AND SUSTAINABLE SOLUTIONS

2024-1-PL01-KA210-SCH-000243609

Small-scale partnerships in school education (KA210-SCH)



MODULE 3

Sustainability and Environmental Science

Digital Content Guide · Student & Teacher Edition

5 Detailed Lesson Plans

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How to Use This Guide

Module 3 is designed to empower students as agents of change — not to overwhelm them with the scale of environmental problems. Every session balances an honest look at a challenge with a concrete, achievable response. Students leave with increased environmental knowledge, a functional prototype, and a personal commitment to action.

The module works as a standalone environmental science unit or as the culminating part of the full Integrated Exploration curriculum. Students who have completed Modules 1 and 2 will be able to bring coding, robotics, and art-science skills directly into their Eco-Tech projects.

What This Guide Contains

-  Five 60-minute lesson plans covering global challenges, renewable energy, circular economy, eco-tech design, and community action
-  A 5-day intensive workshop programme culminating in a Community Showcase
-  ☒ Pre/post quiz, Eco-Tech project rubric, Impact Report template, self-reflection, and action commitment cards
-  Integrates all three modules: coding (M1), art-science (M2), and sustainability (M3)
-  Designed to connect global environmental challenges to local, actionable responses

Module Overview

Module 3 brings together everything students have learned and directs it toward the most urgent challenges of their generation: climate change, resource depletion, biodiversity loss, and pollution. Students understand the science, recognise the systems at play, and design practical, technology-enhanced solutions. They then present these solutions to a real community audience.

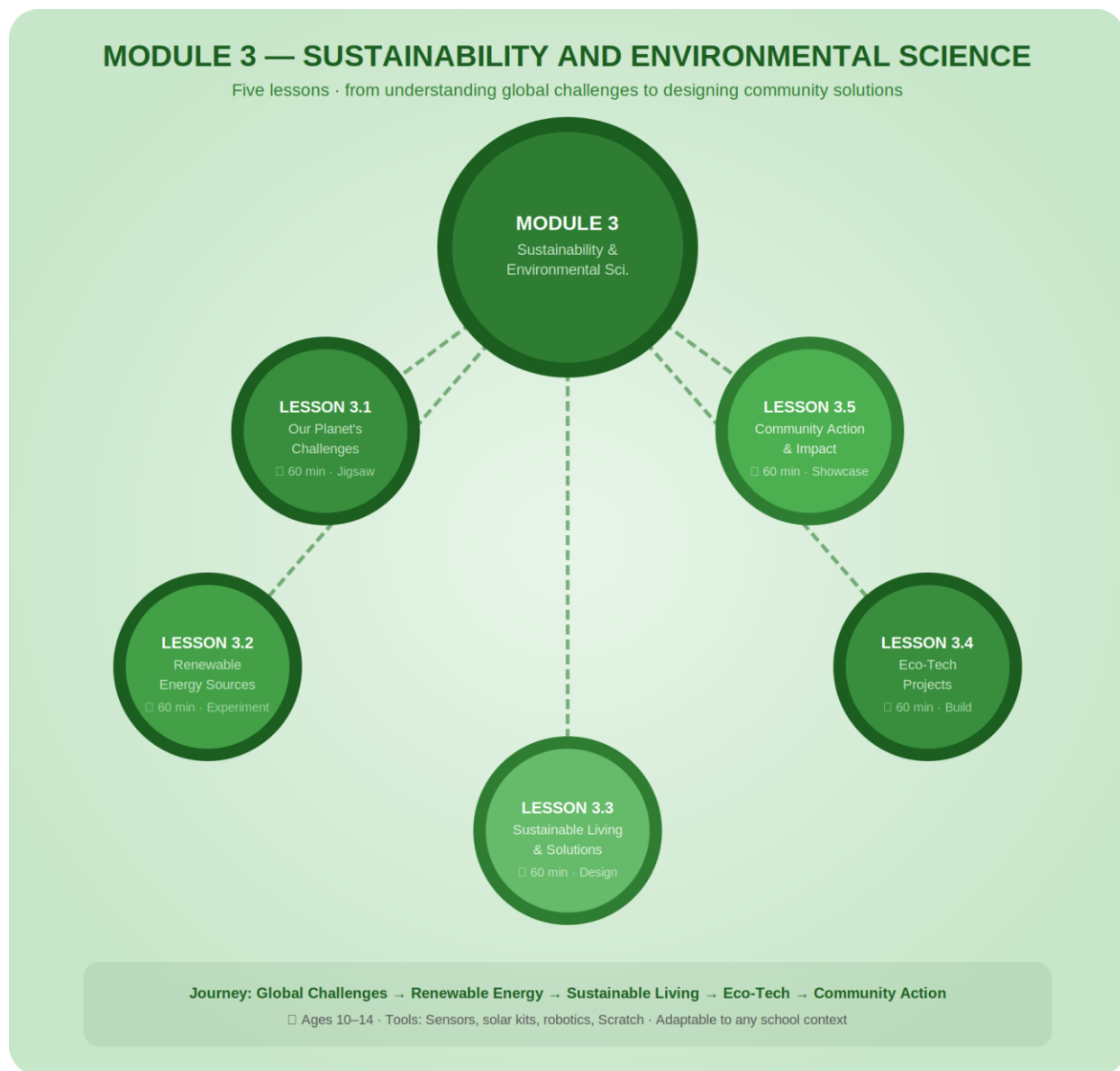


Figure 1 — Module 3: five lessons building toward a Community Showcase

At a Glance

- 🎯 **Target Group:** Students aged 10–14 and their teachers
- 🕒 **Lesson Time:** 5 × 60-minute lessons + 5-day intensive workshop

-  **Tools:** Environmental sensors, solar/wind kits, robotics (optional), Scratch, recycled materials
-  **Assessment:** Pre/post quiz, Eco-Tech rubric, Impact Report, self-reflection, action commitments
-  **Key Skills:** Environmental literacy, systems thinking, sustainable design, civic science communication

Six Global Environmental Challenges

Before students can develop solutions, they need clear scientific grounding in the problems. These six challenges were selected because they are well-documented, relevant globally and locally, actionable at multiple scales, and deeply interconnected.



Figure 2 — Six global environmental challenges: cause, measurable effect, and existing solutions

Systems Thinking — How Problems Connect

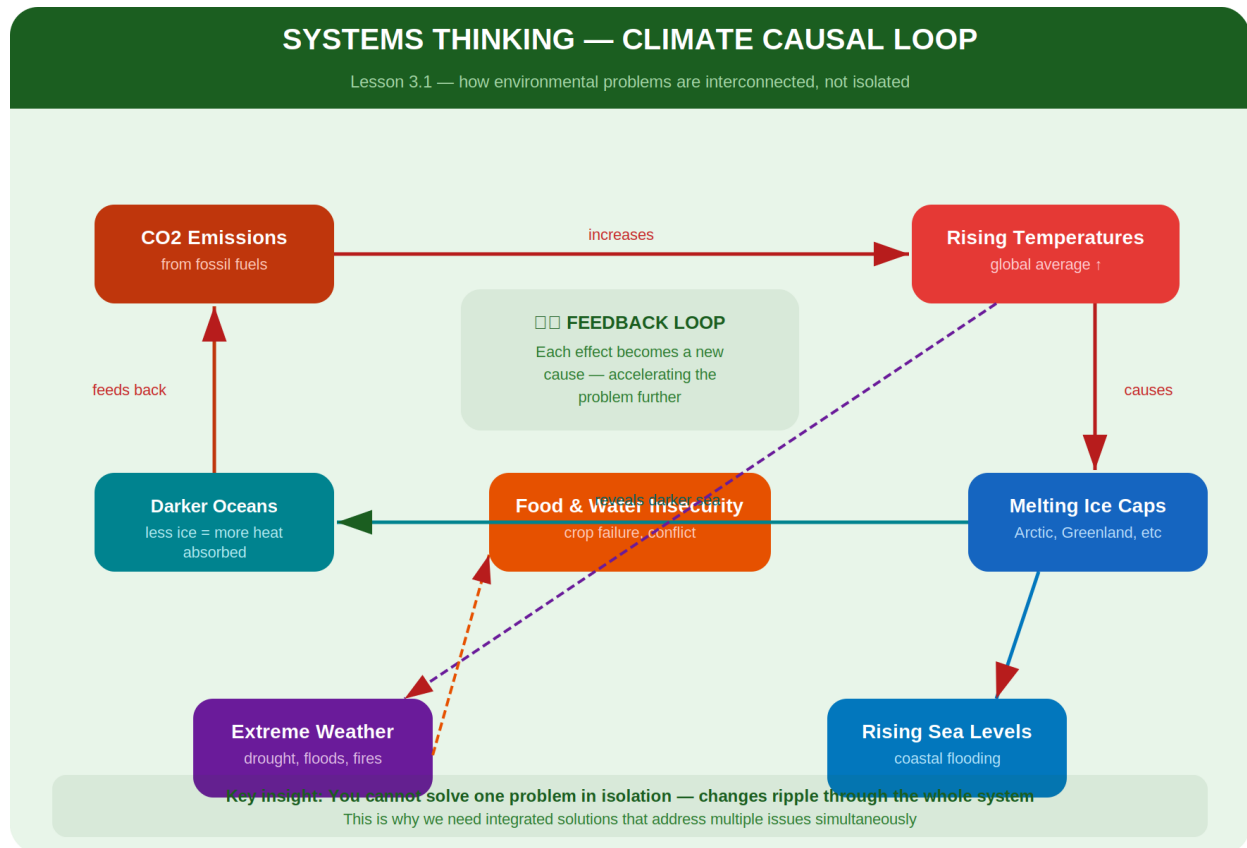


Figure 3 — Climate causal loop: how warming, ice melt, and extreme weather reinforce each other

The causal loop diagram shows that environmental problems cannot be solved in isolation — each effect becomes a new cause. This is why integrated solutions addressing multiple issues simultaneously are more powerful than single-issue interventions.

LESSON PLANS

Lesson 3.1 — Our Planet's Challenges

Duration	Materials	Grouping	Lesson Type
60 minutes	Six challenge fact sheets, causal loop handout, 2050 scenario cards, world map	Groups of 5–6, then reformed	Jigsaw + systems thinking

Learning Objectives

🎯 Learning Objectives:

1. Name and explain at least three global environmental challenges
2. Describe cause, effect, and one solution for their 'expert' challenge
3. Draw a simple causal loop connecting two environmental problems
4. Connect a global issue to a local example from their own community

Lesson Flow

Part 1 — 2050 Scenario Cards (15 minutes)

Pairs receive two scenario cards: life in 2050 under the current trajectory, and under a sustainable future. Mark: What is different? What decisions led to each future? Debrief: what would need to change, and at which level — individual, business, government, international? All three must act simultaneously.

Part 2 — Jigsaw Expert Groups (25 minutes)

Six groups study one challenge each (10 minutes). Prepare to explain: What is the problem? What causes it? Most alarming statistic? One existing solution? Reform into groups of six — one expert per challenge. Each expert teaches the others.

Part 3 — Local Connections (15 minutes)

Each student identifies one environmental issue visible in their neighbourhood or country. Draw a 3-step causal loop. Share in pairs: how does the same global trend show up differently in different places?

Part 4 — Systems Thinking Introduction (5 minutes)

Draw the simplified climate causal loop on the board. Introduce: feedback loop, interconnection, tipping point, leverage point. Preview: Lesson 3.2 explores how renewable energy can break this loop.

Environmental Issue	Key Statistic	One Existing Solution
Climate Change	Global average temperature +1.2°C since pre-industrial times	Renewable energy transition; energy efficiency standards
Biodiversity Loss	1 million species currently threatened with extinction	Protected areas; rewilding; sustainable agriculture
Water Scarcity	2 billion people lack access to safe drinking water	Water conservation; smart irrigation; desalination
Air Pollution	7 million deaths per year attributed to air pollution	Clean transport; industrial filters; urban green space
Plastic Waste	8 million tonnes of plastic enter oceans every year	Reduce single-use; chemical recycling; biodegradable materials
Deforestation	10 million hectares of forest lost per year globally	Sustainable forestry; reforestation; plant-based diets

Lesson 3.2 — Renewable Energy Sources

Duration	Materials	Grouping	Lesson Type
60 minutes	Mini solar panels, LEDs, wires, angle protractors, energy data cards	Groups of 3	Experiment + data analysis

Learning Objectives

- 🎯 Learning Objectives:
1. Describe how at least three renewable energy sources generate electricity
 2. Build a functional solar circuit and measure output at different angles
 3. Explain why solar potential varies by region and season
 4. Calculate how many panels would be needed to power their classroom

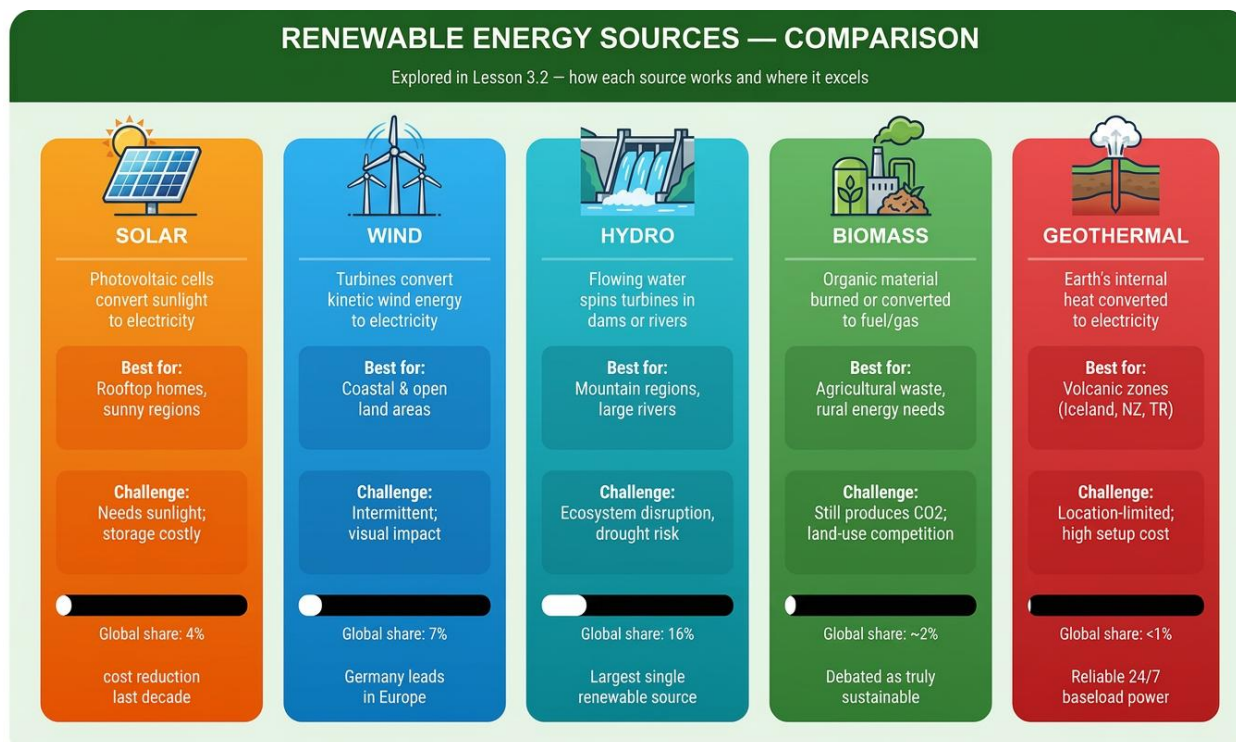


Figure 4 — Five renewable energy sources: how each works, its strengths, and its challenges

Lesson Flow

Part 1 — Energy Source Sort (15 minutes)

Card sort: students categorise 12 energy sources as Renewable/Non-renewable, then Produces CO₂/Does not produce CO₂. Discuss anomalies: nuclear (not renewable but low-carbon), biomass (renewable but produces CO₂). Key vocabulary: photovoltaic, kilowatt-hour, turbine, carbon neutral, intermittency.

Part 2 — Solar Circuit Build (25 minutes)

Groups build a solar panel → LED circuit. Conduct and record three experiments:

1. **ANGLE EXPERIMENT:** Test panel at 0°, 30°, 60°, 90° to light source. Which angle gives brightest LED?
2. **DISTANCE EXPERIMENT:** Move light source 20cm, 40cm, 60cm, 80cm away. Record output change.
3. **COVERAGE EXPERIMENT:** Cover ¼, ½, ¾ of panel. At what coverage does output drop to zero?

Part 3 — Real-World Calculation (15 minutes)

Challenge: how many solar panels would be needed to power your classroom for one school day? Provide: classroom daily electricity use (~8 kWh), typical solar panel output (0.15–0.2 kWh/m²/day in good conditions), and regional sun-hour data for students to look up. Compare results across climates. What does this tell us about where solar energy makes most economic sense?

Part 4 — Energy Transition Discussion (5 minutes)

Germany generates over 50% of electricity from renewables during peak hours — achieved through policy (feed-in tariffs), long-term investment, and citizen energy cooperatives. What combination of factors would be needed in your country to make a similar transition?

Lesson 3.3 — Sustainable Living and Solutions

Duration	Materials	Grouping	Lesson Type
60 minutes	Printed footprint calculator, circular economy case study cards, design challenge materials	Individual, then groups of 3	Reflection + design sprint

Learning Objectives

🎯 Learning Objectives:

1. Calculate and interpret a personal ecological footprint
2. Distinguish between linear and circular economy models
3. Design a product or service applying at least one circular economy principle
4. Write one SMART personal sustainability commitment

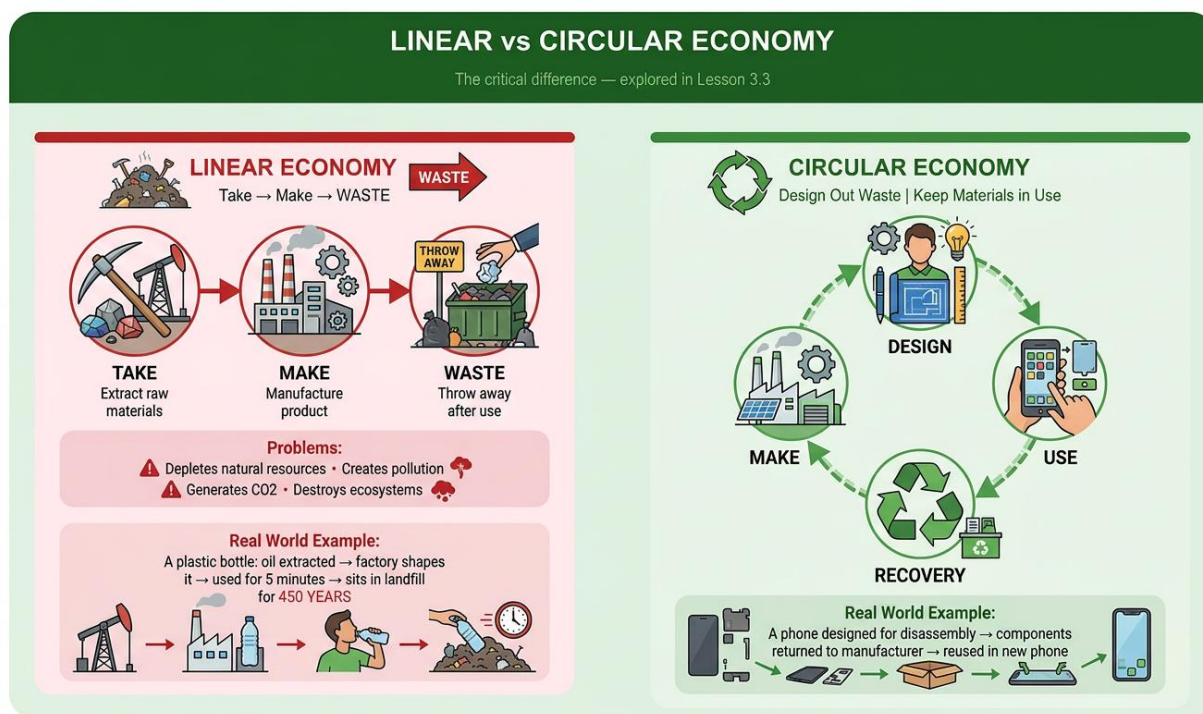


Figure 5 — Linear economy (Take → Make → Waste) vs Circular economy (design out waste, keep materials in use)

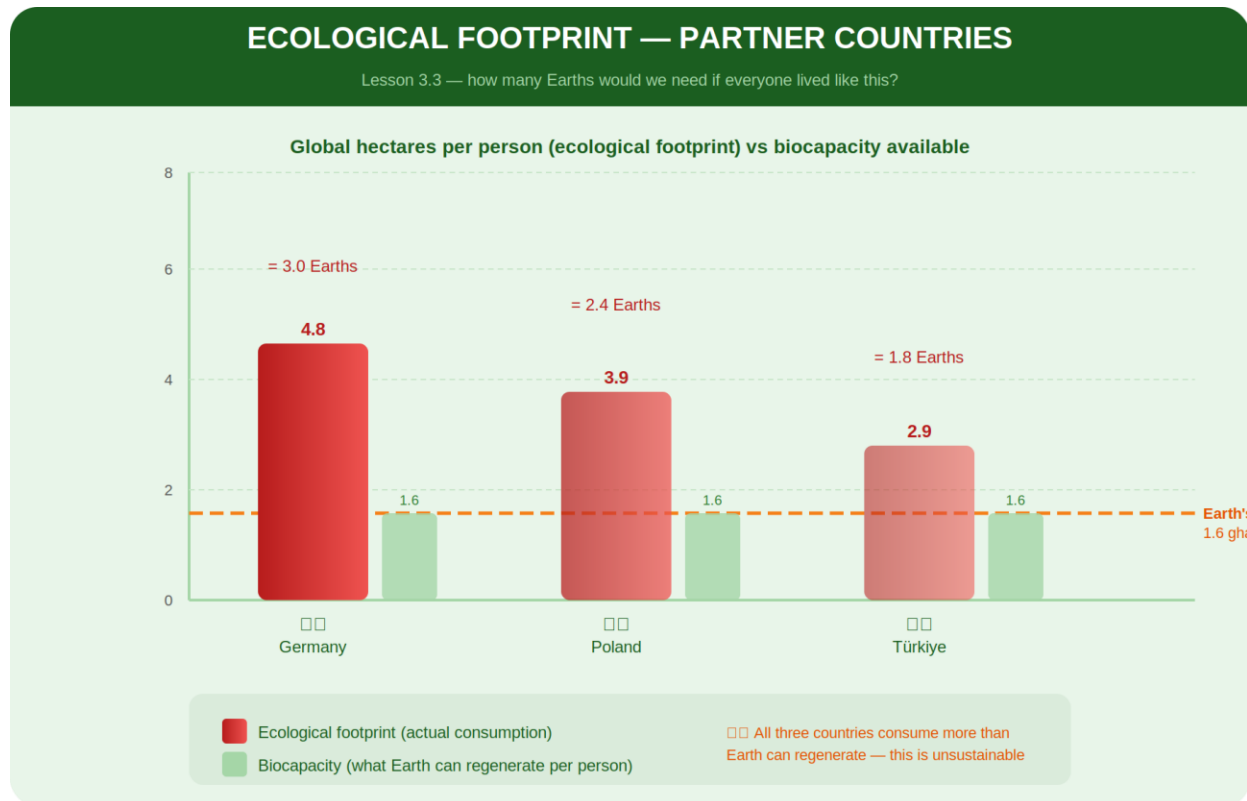


Figure 6 — Ecological footprint comparison across different regions — vs Earth's available biocapacity per person

Lesson Flow

Part 1 — Personal Footprint Calculator (20 minutes)

Students complete the footprint questionnaire covering food, transport, home energy, and consumption. Calculate a class average. Key question: if everyone on Earth lived like our class average, how many Earths would we need? Discuss: which category has the biggest impact? Which is most within our individual control?

Part 2 — Circular Economy Case Studies (15 minutes)

Three short case studies, one per group member — read and share:

4. Fairphone: smartphone designed for disassembly. Users replace any component. Currently lasts 5+ years vs industry average 2.5 years.
5. Mud Jeans: denim subscription model. Wear them, return them, they become new jeans. Reduces cotton water use by 70% per pair.
6. Loop Industries: chemical recycling of plastics that cannot be mechanically recycled — breaks down to molecular level and rebuilds indefinitely.

Groups answer: What circular principle does each use? (Repair / Reuse / Recycle / Redesign) What barrier prevents this from being the default everywhere?

Part 3 — Sustainable Design Sprint (20 minutes)

Challenge card: design a product or service to replace a wasteful item students use regularly. Required outputs: sketch of the product/service, circular principle applied, target user, one obstacle and a possible response. Present in 60 seconds each.

Part 4 — SMART Commitment Cards (5 minutes)

Each student writes one SMART action: Specific, Measurable, Achievable, Relevant, Time-bound. Example: 'I will eat one meat-free day per week for four weeks and note it in my phone.' Cards are collected and returned at the workshop Day 5 — students review whether they kept their commitment.

Lesson 3.4 — Eco-Tech Projects

Duration	Materials	Grouping	Lesson Type
60 min + project time	Environmental sensors, micro:bit/Arduino, robotics kits (optional), solar panels, recycled materials	Groups of 3–4	Design + prototype build

Learning Objectives

🎯 Learning Objectives:

1. Complete an Eco-Tech Project Canvas integrating all three module themes
2. Connect an environmental sensor and record real data from three locations
3. Begin building a functional prototype
4. Draft a preliminary Impact Report answering: who benefits and how much?

ECO-TECH PROJECT CANVAS

Used in Lesson 3.4 — plan your technology + sustainability + art project

PROJECT TITLE: _____

TEAM MEMBERS (countries): _____

□ ENVIRONMENTAL PROBLEM
Which specific problem does your project address?

□ TECHNOLOGY USED
Sensors / coding / robotics / renewable energy?

□ ARTISTIC ELEMENT
How does art communicate your environmental message?

□□ SUSTAINABILITY PRINCIPLE
Circular economy / renewable energy / waste reduction?

□ POTENTIAL IMPACT
Who benefits? How many people / how much CO2 saved?

□□ MAIN OBSTACLE
What would need to change for this to scale up?

Figure 7 — Eco-Tech Project Canvas: the planning tool for Module 3 projects

Lesson Flow

Part 1 — Eco-Tech Case Studies (10 minutes)

Project	Technology	Environmental Problem	Lesson
Air Quality Egg	Sensors + IoT network	Urban air pollution monitoring	Low-cost sensors can give communities data previously only available to governments
Seabin	Floating pump + mesh bag	Marine plastic in marinas	Simple engineering + consistent use = 1.5kg debris per day per device
Plantix	AI + smartphone camera	Pesticide overuse in agriculture	10 million farmers now identify plant disease without chemicals

Discussion: what made each possible? Low-cost sensors, open data, creativity, and determination — not large companies or big budgets.

Part 2 — Project Canvas Design (20 minutes)

Groups complete the Eco-Tech Canvas. Integration requirement: projects must connect all three modules.

Module Connection	How It Appears in the Project
Module 1: Coding/Robotics	Some form of sensor, coding, or physical computing
Module 2: Arts & Science	An artistic element that communicates the environmental message
Module 3: Sustainability	A genuine environmental problem with a quantifiable impact

Key facilitation question: 'How does the technology make this solution better than without it? What can it do that a human cannot do alone?'

Part 3 — Sensor Data Collection (25 minutes)

Groups connect their sensor and collect data from three locations (e.g., different rooms, inside vs outside, near a road vs away from it). Record in a data table. Analysis questions: Where is the air quality worst? Is it better or worse than the outdoor reading? Why might this be?

💡 If sensors are unavailable: provide pre-collected data sets from real schools in different climates. Students analyse the data and build a Scratch visualisation — bridging back to Module 2 data art.

Part 4 — Impact Report Draft (5 minutes)

Two written questions to start the Impact Report: (1) If our project worked perfectly, who or what would benefit, and how? (2) What would need to be true for this to exist in 100 schools instead of one?

Lesson 3.5 — Community Action and Impact

Duration	Materials	Grouping	Lesson Type
60 minutes	Completed projects, Impact Report template, action worksheets, invited guests if possible	Groups + whole class	Public showcase + civic engagement

Learning Objectives

🎯 Learning Objectives:

1. Present an Eco-Tech project to a non-specialist audience
2. Complete a structured Impact Report with realistic estimates
3. Write and submit one specific action proposal to school leadership
4. Articulate the single most important insight from the full module

Lesson Flow

Part 1 — Community Showcase (25 minutes)

Each group presents for 3 minutes to an invited audience (ideally school leadership, parents, or community members):

7. The problem: 'The environmental issue we are addressing is...' (10 seconds)
8. The solution: 'Our project uses [technology] to...' (40 seconds)
9. The art element: 'We communicate our message through... because...' (20 seconds)
10. The impact: 'If scaled to [X] schools/locations, this could...' (40 seconds)
11. The ask: 'To make this real, we would need...' (10 seconds)

Part 2 — Impact Report (20 minutes)

Section	What to Include
Problem statement	Scientific evidence cited with source
Solution description	Technical explanation of how the project works
Beneficiaries	Who and how many could benefit if scaled
Environmental impact	Quantified reduction in harm or measurable improvement
Implementation needs	Resources, policy, and support required
Obstacles and responses	Realistic barriers and specific responses to each

Part 3 — School Action Proposals (10 minutes)

Each student writes one proposal to submit to school leadership. Must be: specific (not 'improve sustainability'), achievable within one year, and evidence-based (linked to project findings).

Part 4 — Module Synthesis (5 minutes)

Each student completes: 'The most important thing I now understand that I did not before this project is...'
Read aloud (anonymously if preferred). These responses become the most powerful evidence of learning transformation in any impact report.

5-DAY INTENSIVE WORKSHOP PROGRAMME

Five-Day Workshop — Sustainability and Environmental Science

This workshop is the intensive version of Module 3. Students who have completed Modules 1 and 2 arrive with coding, robotics, and art-science skills ready to deploy. The Community Showcase on Day 5 is a real event — not a school exercise. Real community members are invited; the audience matters.

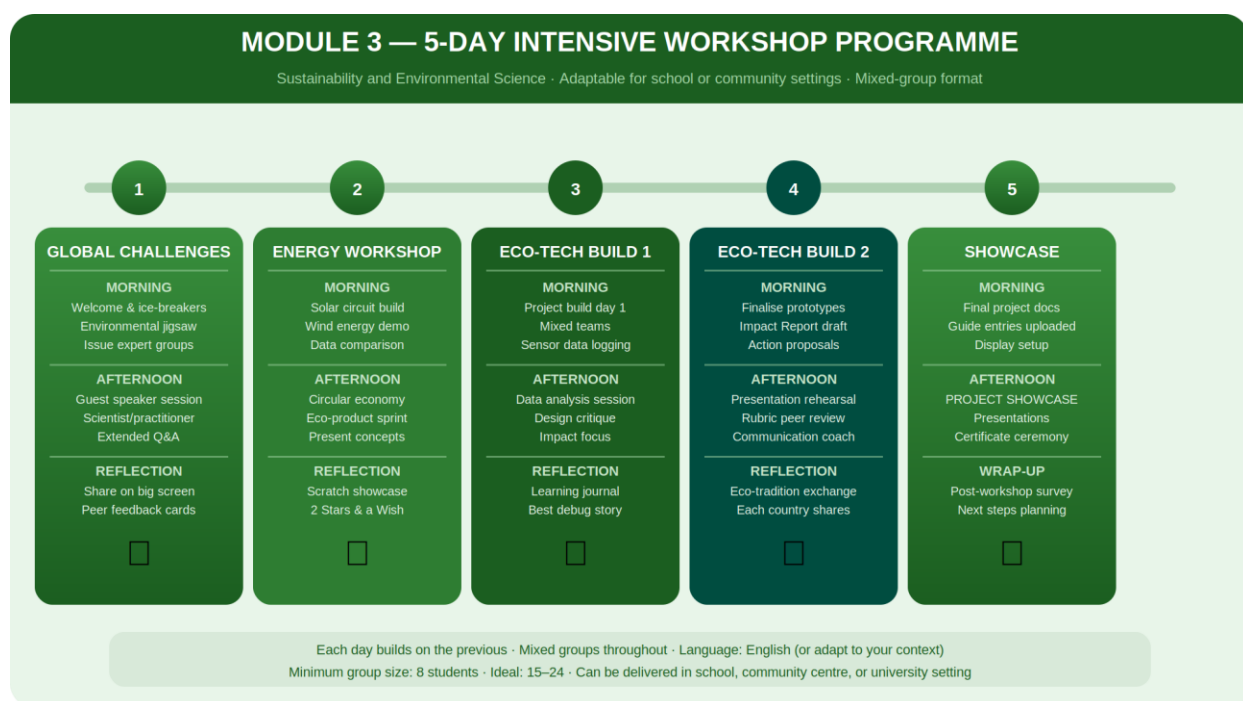


Figure 8 — Five-day workshop: five focused days building to a Community Showcase

Day	Theme	Morning Focus	Afternoon Focus	Reflection Activity
1	Challenges	Environmental jigsaw; local connections; guest speaker or video	Q&A; what surprised you most? Systems thinking intro	Evening: sustainability quiz; compare notes across participants
2	Energy & Design	Solar circuit build; renewable energy comparison; regional data	Circular economy workshop; eco-product design sprint	City/neighbourhood walk: find one example of sustainability in action
3	Build Day 1	Eco-Tech project build; sensor setup;	Data analysis; design critique: is	Progress sharing: biggest challenge + what help is needed

Day	Theme	Morning Focus	Afternoon Focus	Reflection Activity
		data logging from 3 locations	technology solving or decorating?	
4	Build Day 2	Finalise prototypes; complete Impact Report; write action proposals	Presentation rehearsal; rubric peer review; communication coaching	Cultural exchange: each group shares a sustainability tradition or law from their context
5	Showcase	Final prep; SMART commitment cards distributed; documentation uploaded	COMMUNITY SHOWCASE open to wider audience; award ceremony	Commitment card read-out; post-workshop survey; synthesis sentence

-  Hope, not despair: Environmental education can overwhelm students. Every session should end with at least one concrete, achievable solution. The Day 5 commitment cards make action feel personal and possible.
-  Real data only: Eco-Tech projects must use actual sensor readings, not invented numbers. This is what separates a genuine contribution from a school exercise.
-  Community Showcase is not optional: A real audience changes the quality of student work. Invite parents, local council members, sustainability professionals, or university partners.
-  Document everything: Photographs, video of presentations, and uploaded project entries create a lasting legacy for students and provide evidence for any reporting requirements.

ASSESSMENT TOOLS

Pre/Post Knowledge Quiz — Sustainability & Environmental Science

#	Question	Correct Answer
1	What does 'renewable energy' mean?	B — Energy from sources that naturally replenish
2	Which of these is NOT a greenhouse gas?	C — Oxygen
3	What is biodiversity?	A — The variety of life on Earth
4	The circular economy aims to:	B — Design out waste and keep materials in use
5	Which energy source produces NO CO ₂ during generation?	C — Wind power
6	What is an ecological footprint?	B — The impact of a person's lifestyle on the environment
7	Global temperatures have risen approximately how much since pre-industrial times?	C — 1.2°C
8	Sustainable development means:	B — Meeting present needs without compromising future generations' ability to meet theirs
9	Deforestation contributes to climate change mainly by:	A — Releasing stored CO ₂ into the atmosphere
10	Which is a personal sustainability action?	B — Choosing products with less packaging

Eco-Tech Project Rubric

Criterion	Beginning (1)	Developing (2)	Proficient (3)	Exemplary (4)
Environmental Understanding	No clear problem; significant scientific errors	Problem identified but poorly understood	Accurate problem with scientific evidence cited	Deep understanding of cause, effect, and systemic connections
Technical Solution	No prototype or plan; no technology used	Concept without working prototype	Functional prototype using sensor/coding to address the problem	Innovative solution; technology is essential, not decorative

Criterion	Beginning (1)	Developing (2)	Proficient (3)	Exemplary (4)
Sustainability Principles	No genuine principle applied	Sustainability mentioned without specificity	Clear application of at least one principle	Multiple principles integrated coherently with evidence
Artistic/Communication Element	Absent or tokenistic	Present but disconnected from the message	Artwork enhances communication and engages audience	Artwork is inseparable from the message; science cannot be as well communicated without it
Impact Awareness	Cannot describe impact	Vague or unrealistic claims	Realistic impact with rough quantification	Detailed Impact Report: beneficiaries, quantities, implementation path, honest obstacles
Presentation	Unclear or absent	Basic description; limited engagement	Clear, structured presentation covering all required elements	Compelling; uses real data; confident handling of questions

Student Self-Reflection — Module 3

Question	Response Format
Which environmental issue concerns me most and why?	Open text (2–3 sentences)
What is the most important thing I learned about sustainability?	Open text (2–3 sentences)
Has my behaviour or thinking changed? If so, how?	Open text (2–3 sentences)
What action am I committing to in my school or community?	One specific, measurable action
How confident am I in explaining sustainability to a non-expert? (1–5)	Circle: 1 2 3 4 5
How much do I believe young people can make a real difference? (1–5)	Circle: 1 2 3 4 5
One sentence I would say to a younger student about why this matters:	Open text

Cross-Modular Final Project Guide

The Cross-Modular Final Project is the culminating achievement of the entire 'Integrated Exploration' programme. It challenges students to combine skills and knowledge from all three modules to create a meaningful, original project that addresses a real-world challenge.

Project Requirements

- Must integrate elements from at least 2 of the 3 modules (Coding/Robotics + Art/Science, Art/Science + Sustainability, or all three)
- Must address a genuine environmental or social problem faced by young people
- Must have a clearly identified target audience and a communication strategy
- Must include a self-assessment using the cross-modular rubric
- Should be submitted to the Digital Guide platform for sharing with the wider community

Project Ideas by Integration Type

Integration	Project Example	Skills Used
Coding + Art	Interactive digital mural about climate using Scratch, data from sensors, generative patterns	Coding, data visualisation, digital art
Art + Sustainability	Sculpture made from ocean plastic waste with an accompanying scientific data display	Circular economy, artistic expression, impact communication
All Three Modules	Sensor-equipped eco-robot that paints a record of air quality data as it moves	Robotics, coding, environmental data, generative art
All Three Modules	Community campaign: short film + petition + data report on local air quality	Environmental science, digital art, data communication, civic engagement

Submission to the Digital Guide Platform

Each final project should be documented with: a short description (200 words), the scientific basis (50 words), the artistic approach (50 words), the environmental connection (50 words), a photo or video, and the names and countries of the creators. Projects will be published on the platform and accessible to other schools across Europe.

Teacher's Implementation Notes

Adapting for Your National Curriculum

All materials in this guide can be mapped to national curriculum frameworks in Poland, Germany, and Turkey. Teachers are encouraged to identify specific curriculum standards met by each lesson and note these in their lesson planning documentation. Contact your school's curriculum coordinator for support with alignment.

Working with Mixed-Language Groups

During LTT mobilities, participants will speak English as the project language. Some strategies that support inclusion:

- Use visual instructions alongside written ones
- Pair programme: one student codes, one navigates — both contribute
- Use universal symbols (✓, X, ?, !) for quick communication
- Allow students to discuss in their home language, then share findings in English
- Celebrate multilingualism: knowing three languages is a superpower

Digital Guide Platform: Teacher Guide

Feature	Teacher Action	Student Benefit
Lesson Content	Assign lessons as pre-reading or in-class activity	Independent or guided learning at own pace
Interactive Quizzes	Set pre/post quiz before and after each module	Instant feedback; learning progress visible
Project Upload	Review and approve project submissions	Work is shared with international audience
Community Forum	Monitor and moderate discussions	Connect with peers from partner countries
Progress Dashboard	Track individual and class completion	Students see own growth journey
Resource Library	Add local resources and links	Contextualised additional learning

GDPR and Child Safety Online

All student data and project uploads are subject to GDPR regulations. Schools must obtain parental consent before students create accounts on the platform. Student profiles should use first name and

country only — no surnames, photos of faces, or location information beyond country level. Full guidance is available in the project's data protection annex.

Reporting and Impact Measurement

Teachers are asked to submit a brief activity report after each module using the template in the platform. Report data will be aggregated for the project's Impact Report, which forms part of the final Erasmus+ reporting requirements. Reports should take no more than 15 minutes to complete.

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