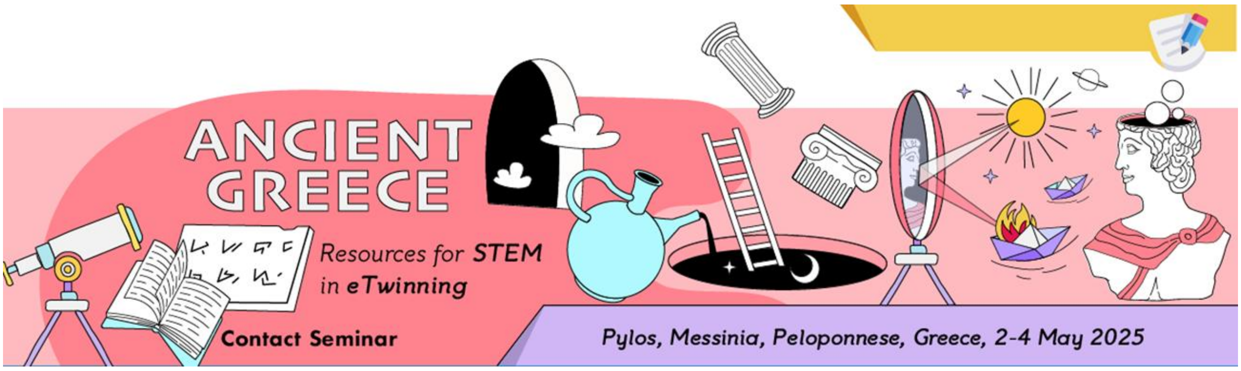
STEM Without Borders: Learning from the Past, Collaborating for the Future

Contact Seminar



Pylos, Messinia, Peloponnese, Greece, from 2-4/5/25

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Introduction

The spirit of inquiry, innovation, and scientific exploration that flourished in Ancient Greece continues to inspire STEM education today. This guide, **"STEM K-12 Activities Inspired by Ancient Greek Technologies and Innovations,"** offers a practical framework for educators to connect students with the roots of Science, Technology, Engineering, and Mathematics through hands-on projects. By building simple machines, modeling ancient experiments, and engaging in Socratic questioning, students not only learn fundamental STEM concepts but also develop critical thinking, creativity, and collaborative skills.

Designed for use within the **eTwinning** network and beyond, this collection of activities enables schools across Europe to explore shared historical heritage, foster cross-cultural dialogue, and reimagine ancient ideas for modern challenges. Through recreations of sundials, steam engines, mathematical puzzles, and engineering feats, students are encouraged to "think like ancient scientists" — questioning, experimenting, and discovering as they connect the past to the future.

Together, these projects provide a meaningful and engaging way to bring ancient Greek ingenuity into today's classrooms, empowering young learners to become the innovators of tomorrow.

Activities and Ideas

Make a Simple Ancient Greek Sun Dial

Objective:

Students will build a basic sundial to understand how the Sun's position can be used to **tell time**, just like ancient Greeks did.

Materials:

- Sturdy **paper plate** (or thick cardboard circle)
- A **sharp pencil** (or a wooden stick)
- **Marker pen**
- **Compass app** (for finding North)
- **Ruler**
- **Outdoor space** (or a very sunny classroom window)

Step-by-Step Instructions:

Preparation:

1. **Create the Base (5 min)**
   - Take the **paper plate** and poke a **small hole** exactly in the center.
   - Insert the **pencil** vertically into the hole — this is the **gnomon** (shadow stick).
2. **Mark the Plate (5 min)**
   - Around the edges of the plate, draw small tick marks (like a clock).
   - Use a **ruler** to make sure marks are evenly spaced if you want it neat.

Experiment:

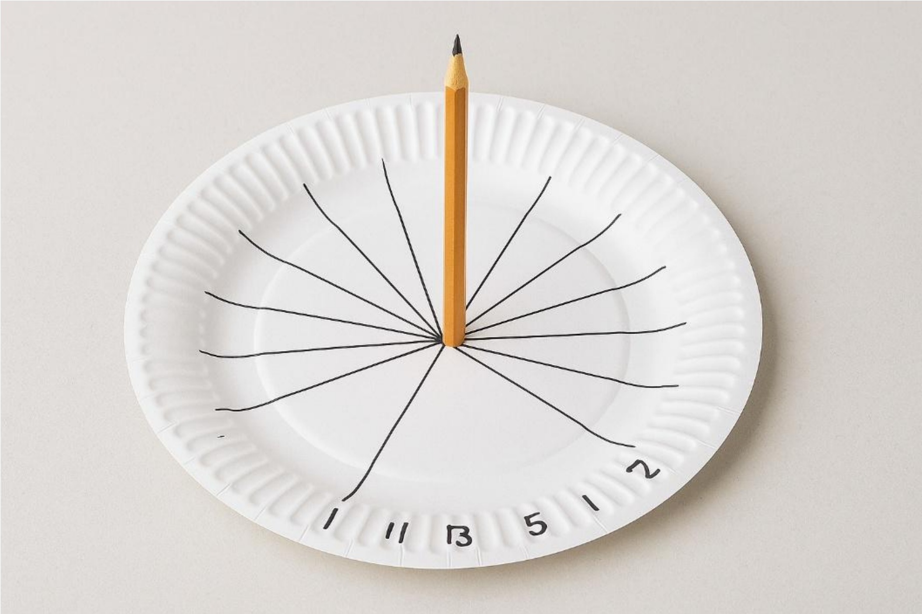
3. **Position the Sundial (5 min)**
   - Take the sundial **outside** on a sunny day.
   - **Use the compass** to make sure the plate is correctly aligned: the 12 o'clock mark points **North**.
4. **Observe and Mark (Throughout the Day)**
   - At every **hour** (e.g., 9am, 10am, 11am...), note where the **shadow of the pencil** falls.
   - Write the corresponding hour near the shadow point.
5. **Final Sundial (End of Day)**
   - After several hours, you'll have a functional **Greek-style sundial** showing the time based on the Sun's movement!

Simple Explanation:

- Ancient Greeks observed that the Sun's **position changes** during the day.

- A **sundial** works because the **shadow moves** as the Sun appears to travel across the sky.

Image **showing the** finished simple sundial



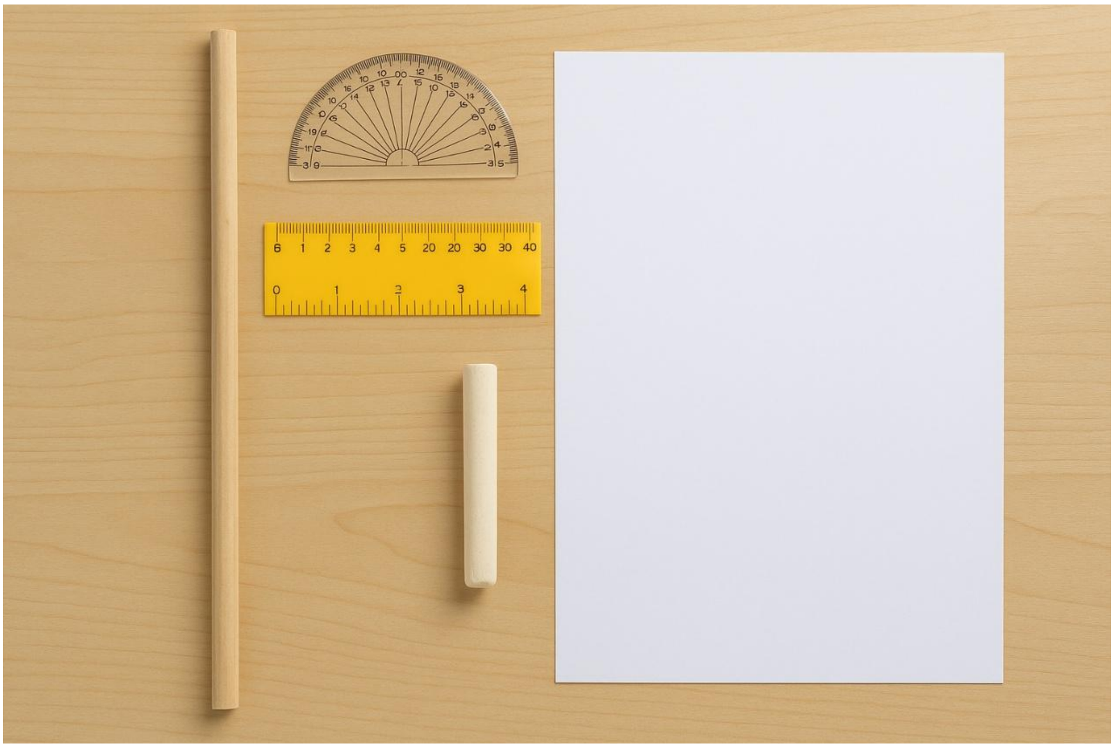
Eratosthenes' Measurement of the Earth

Objective**:**

Students will **simulate Eratosthenes' method** by measuring the **angle of a shadow** and **understanding how he calculated the Earth's circumference**.

Materials:

- **Long straight stick** (e.g., a wooden dowel, about 1 meter)
- **Measuring tape or ruler**
- **Protractor** (to measure angles)
- **Chalk** (optional, for marking shadows outside)
- **Large sheet of paper** (if inside)
- **Sunny day or flashlight** (if you can't go outside)



Step-by-Step Instructions:

Preparation:

1. **Set up the Stick (5 min)**
   - Place the stick **vertically** into the ground (outside) or tape it **straight** onto the floor (indoors with a flashlight "Sun").
2. **Measure the Shadow (5 min)**
   - At **solar noon** (or when the Sun is highest), measure the **length of the shadow** cast by the stick.
   - If inside, fix the flashlight so that it mimics the sunlight at an angle.
3. **Record Measurements (5 min)**
   - Write down:
     - **Stick height**

        - **Shadow length**
4. **Calculate the Angle (5 min)**
    - Using the formula:

$$\text{Angle} = \arctan\left(\frac{\text{Shadow Length}}{\text{Stick Height}}\right)$$

    - Or use a **protractor** to measure the angle directly from the shadow line.
5. **Estimate Earth's Circumference (optional extension):**
    - Eratosthenes used the **distance between two cities** (Syene and Alexandria) and the **measured angle** to calculate the Earth's circumference.
    - Students can **imagine** the Earth as a circle and estimate based on a fraction:

$$\text{Circumference} \approx \frac{360^\circ}{\text{Angle measured}} \times \text{Distance between cities}$$

    - (We can simulate this using two classroom groups if needed.)

Simple Explanation:

- Eratosthenes noticed that at noon in Syene, the Sun was **straight overhead** (no shadow).
- In Alexandria, **a shadow was visible** at the same time.
- By measuring the angle of the shadow and knowing the **distance** between the two cities, he calculated Earth's circumference with surprising accuracy!

Hero's Steam Engine (Aeolipile)

Objective:

Students will recreate a **basic version of the world's first recorded steam engine** invented by **Hero of Alexandria**.

Materials**:**

- Empty **soda can** (cleaned)
- String
- Thick **needle**
- Water
- Stove or safe heat source (teacher supervision)
- Oven mitts or gloves
- Bowl to catch dripping water (safety)

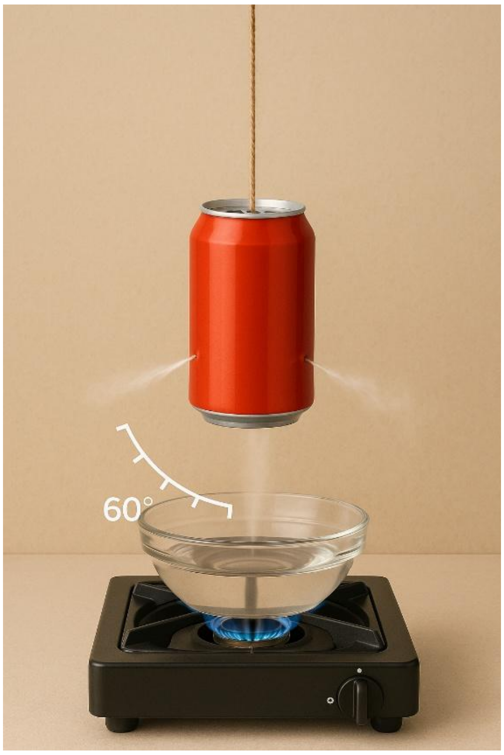
Steps:

1. **Preparation (5 min)**

    - Use the needle to **poke two small holes** near the bottom edge of the can, on **opposite sides**, **angled slightly** in the same rotational direction.
2. **String Setup (5 min)**
    - Tie a piece of **string through the pull tab** of the can so it can hang.
3. **Fill and Heat (10 min)**
    - Put **some water inside the can** (about 1/4 full).
    - Hang the can over a **safe heat source**.
    - As the water boils, **steam will escape** from the holes, and the can will **start to spin**!

Simple Explanation:

- Hero used **steam power** to make machines move.
- This was one of the earliest experiments leading to **mechanical engines** thousands of years later!



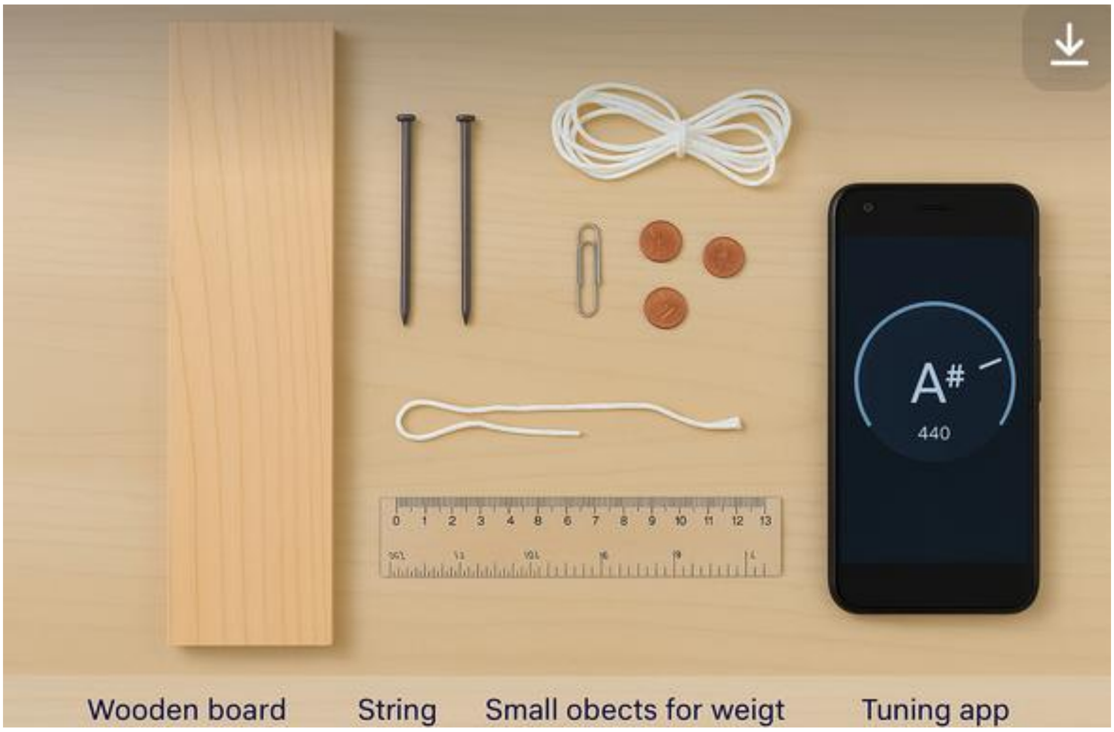
Pythagoras and Sound (Harmonics on a String)

Objective:

Students will explore how **Pythagoras discovered relationships between length, vibration, and musical pitch**.

Materials:

- A **wooden board** (~1 meter)
- **2 nails** or pegs
- **String** (sturdy, like nylon cord)
- **Small objects** (clips, coins) for weight
- Ruler
- Tuning app (optional)

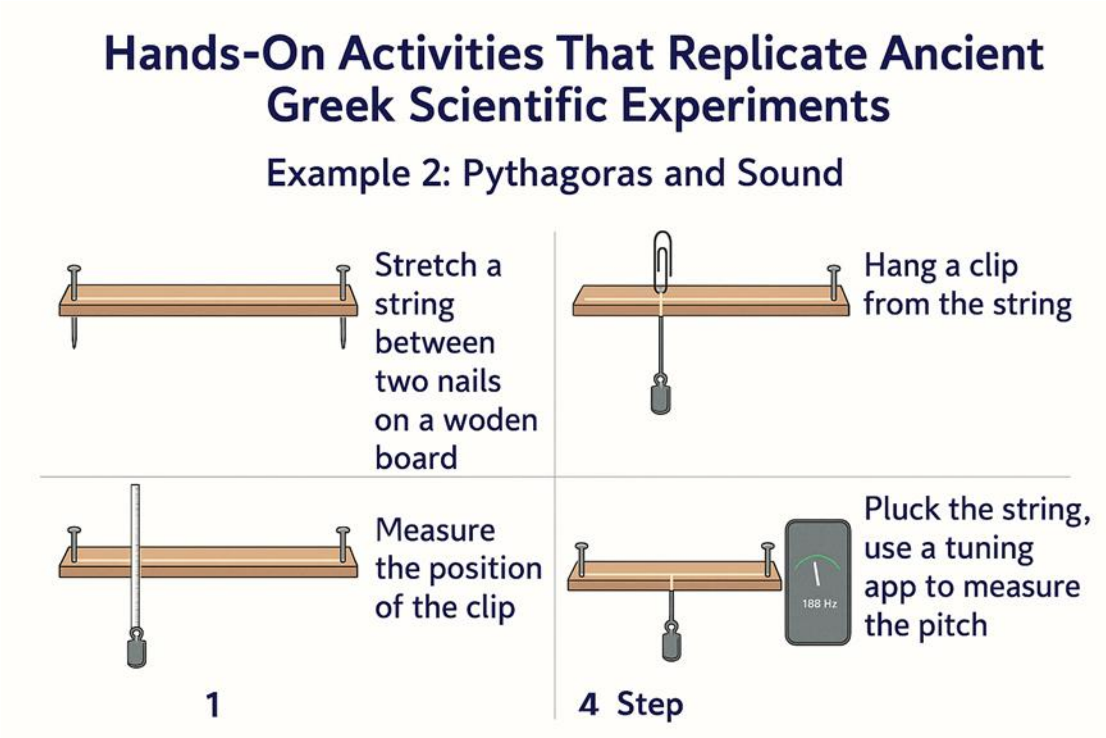


Steps:

1. **Prepare the Setup (5 min)**
   - Hammer two nails on each end of the board.
   - Tie a string tightly between the nails.
2. **Test Sounds (10 min)**
   - Pluck the string and listen to the sound.
   - Press down lightly in the middle to **halve the length** — pluck again — it sounds **higher**!
3. **Experiment with Length (10 min)**
   - Try pressing at 1/3, 1/4 of the string length and notice how the pitch changes.

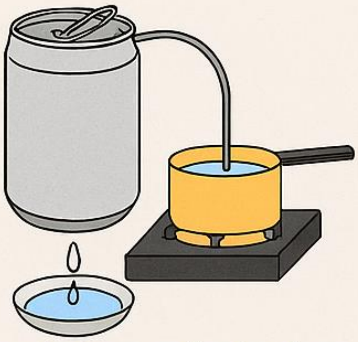
Simple Explanation:

- Pythagoras realized that **mathematical ratios** (like 1/2, 1/3, 1/4) produce **harmonic** musical notes.
- This discovery connected **math and music** in ancient Greece!



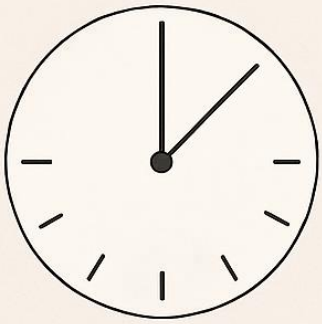
Hands-on Activities That Replicate Ancient Greek Scientific Experiments

Aristotle's Alarm Clock



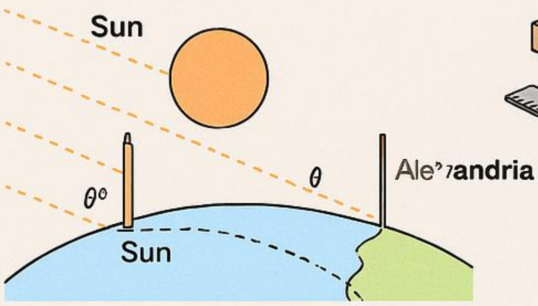
1. Punch a hole near the top f an empty can.
2. Fill the can with water and suspend it over a bowl
3. Heat the can until water dolps into the bowl
4. Observe when the can is empty the alarm goes off

A Simple Sundial



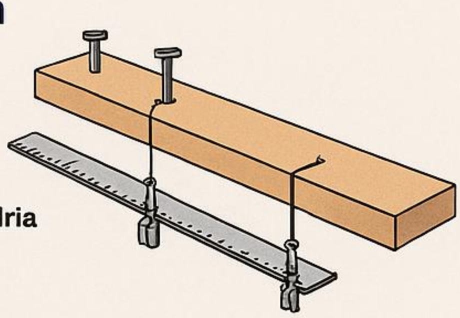
1. Make a circle on paper and cut it out
2. Insert a straight stick through the center
3. Place in sunlight and mark the tip of the shadow.
4. Return each hour to record the position of the shadow

Eratosthenes' Measurement of the Earth



1. Place vertical sticks in two locations
2. Measure the shadows at noon
3. Determine the angle between the sticks and calculence Earth's circumference

Pythagoras and Sound



1. Insert two nails in a board and attach strings
2. Place weights at equal distance below the nails
3. Pluck the strings and compare their sounds

Ancient Math Puzzle Challenge

Objective:

Students will solve and create ancient-style mathematical puzzles, **competing** in teams to **earn points**, **build critical thinking**, and **practice problem-solving**.

Materials:

- Puzzle cards (with ancient puzzles printed)
- Blank puzzle sheets (for students to invent their own)
- Timer
- Team scoreboards
- Small prizes (optional)

How It Works (Step-by-Step):

1. Introduction (5 min)

Explain that many ancient civilizations, like the Greeks, loved **puzzles** to test logic and math skills.
Today, students will be like **ancient mathematicians**, solving puzzles to **unlock knowledge!**

2. Team Formation (5 min)

- Divide students into **teams of 3–4**.

3. Puzzle Rounds (30 min)

First Challenge: Solve Ancient Puzzles!

- Each team receives a **set of ancient puzzles** (easy to medium difficulty).
- Example puzzles (below).
- Teams earn **points** based on how quickly and correctly they solve each puzzle.

Second Challenge: Create a Puzzle!

- Each team invents **their own mathematical puzzle** inspired by ancient styles.
- They then **swap puzzles** with another team!

4. Final Round: Puzzle Battle (10 min)

- Teams solve the puzzles created by their classmates.
- Bonus points for creativity and difficulty!

5. Winning Team

- The team with the most points wins **small prizes** or **titles** like "Young Pythagoreans" or "Little Archimedes"!

Pythagorean Number Puzzle:

Find three numbers that satisfy:

$$a^2 + b^2 = c^2$$

(Hint: 3, 4, and 5)

Ancient Magic Square (simplified):

Arrange the numbers 1–9 into a **3x3 grid** so that every row, column, and diagonal adds to 15.

Riddle of the Sphinx (logic riddle):

Morning (4 legs), Noon (2 legs), Evening (3 legs)?
(Answer: A human)

Ancient "Balance the Scales" Puzzle:

If two gold bars and three bronze bars weigh the same as 5 bronze bars and one gold bar, which bar is heavier?

Why It Works:

- **Fun competition** keeps energy high.
- **Puzzle-solving** builds pattern recognition, algebraic thinking, and collaboration.
- **Creating puzzles** exercises higher-order thinking and imagination.

Socratic Questioning and STEM education

Socratic Questioning and STEM education are a perfect match because they both aim to develop deep, independent thinking and problem-solving skills.

Here's how they connect:

1. Encourages Critical Thinking (STEM Goal: Analytical Skills)

- STEM requires students to analyze problems and find solutions.
- Socratic questioning pushes students to explain, justify, and reflect on their reasoning instead of just memorizing facts.

Example:

"Why do you think this design will hold weight better? What assumptions are you making?"

2. Promotes Inquiry-Based Learning (STEM Principle: Learning by Exploration)

- In STEM, students learn best by exploring ideas and testing hypotheses.
- Socratic questioning keeps the focus on asking why and how, leading students to drive their own investigations.

Example:

"What pattern do you notice in the data you collected? What might cause that pattern?"

3. Builds Communication and Collaboration Skills (STEM Goal: Teamwork)

Successful STEM projects require clear communication of ideas and questioning others constructively.

Socratic questioning teaches students to listen carefully, question politely, and build discussions based on evidence.

Example:

"Can you explain your teammate's idea in your own words? Do you agree with it? Why or why not?"

4. Develops Problem-Solving Mindsets (STEM Goal: Innovation)

- Socratic questions guide students to challenge assumptions and consider alternatives — key skills for inventing and innovating.

Example:

"If we can't use this material, what other options could we explore? How would that change our design?"

In Short:

Socratic Questioning transforms STEM education from simply "doing experiments" to "thinking like scientists, engineers, and innovators."
It empowers students to question deeply, reason carefully, and solve problems creatively — exactly what the future demands.

Socratic questioning + Hands-on activities

Archimedes' Principle Experiment Sink or Float?

Materials:

- A **clear container** (like a big bowl or aquarium) filled with **water**
- A **small ball** (like a rubber ball)
- A **piece of wood** (small block or popsicle stick)
- A **metal spoon**
- A **plastic bottle cap**
- **Play-Doh** or **modeling clay**
- A **small scale** (optional, for measuring mass)

Phases

1. **Prediction Phase:**

"What do you think will happen when we put this object in the water?"
"Why do you think some things float and others sink?"
(Let them share guesses — there are no wrong answers here!)

2. **Observation Phase:**

(After dropping each object into the water)
"What did you notice?"
"Was your prediction correct?
"How do you think the water is pushing on the object?"

3. **Deeper Thinking Phase:**

(Once they see different behaviors — some floating, some sinking)
"Is it just about weight? The spoon is small but sinks, and the wood is bigger but floats — why?"
"Could the shape of an object change whether it floats?"
"What happens if you shape the clay into a boat instead of a ball?"

4. **Conclusion Phase:**

(After reshaping clay to float)
"What do you think Archimedes discovered a long time ago about objects in water?"
"Can you explain what makes something float in your own words?"

Bonus:

If they seem ready, you can lead them to **invent** a simple version of Archimedes' Principle themselves, through questions like:
"If an object pushes away (displaces) a lot of water, what must the water be doing back to the object?"

This style turns it into a **discovery experience** instead of a lecture — which is much more exciting and memorable for students!

eTwinning Project Ideas

Project 1. From Talos to AI: Exploring the Ancient Roots of Robotics

? Project Summary:

In this cross-cultural project, students aged 11–13 will explore how the ancient Greeks laid the foundations for robotics and artificial intelligence through engineering and mythology. Inspired by historical figures like Hero of Alexandria and myths such as Talos, students from different countries will **research**, **create**, **build**, and **exchange ideas** on how ancient dreams have evolved into modern robotics.
They will collaborate through **digital platforms**, **build simple automata or robotic prototypes**, and **reflect on ethical questions about AI**.

Project Goals:

- Understand the historical and mythological roots of robotics and artificial intelligence.
- Engage in STEM activities that involve building mechanical or coded models.
- Encourage creative storytelling combining mythology and technology.
- Develop collaboration skills through international teamwork.
- Promote critical thinking about the ethical impact of AI and robotics.
- Strengthen communication skills in English (or other project languages).

Target Group:

- Students aged 11–13 (6th–7th grade)
- Mixed groups from 2 to 5 schools across Europe

Curriculum Integration:

- **STEM**: Science, Technology, Engineering, Mathematics
- **History**: Ancient civilizations (Greece, Mythology)
- **Literature**: Storytelling, myth creation
- **ICT**: Robotics, coding, digital presentations
- **Ethics/Philosophy**: Technology and humanity

Planned Activities:

Phase 1 – Kick-off and Mythology Exchange

- Virtual icebreaking activities (Padlet / Forum introduction).
- Exchange short video clips or posters introducing the myth of Talos and ancient Greek automata.
- Create an international timeline on the history of robotics (Canva or Genially).

Phase 2 – Engineering Challenge

- Students research Hero of Alexandria and ancient automata.
- Each team builds a simple **pneumatic device** or **robot** (e.g., Scratch-coded or LEGO WeDo robot) inspired by Talos or other mythological figures.
- Upload building process photos/videos in TwinSpace.

Phase 3 – My Own Myth-Robot

- Students invent a new **mythical robotic creature**.
- Draw/design it digitally or physically.
- Write a short story about its purpose, abilities, and emotional features.
- Share the creations across partner schools through collaborative e-books (Book Creator or StoryJumper).

Phase 4 – Ethics and AI Debate

- Students join virtual rooms to debate and reflect on AI's impact on society.
- Questions like: "Can a machine have emotions?" or "Should robots replace humans in jobs?" will be discussed.
- Create a collaborative infographic summarizing the main points (Canva).

Phase 5 – Final Event & Celebration

- Organize a virtual exhibition or fair.
- Vote on best myth-robot designs, most creative engineering solution, and best storytelling.
- Award digital certificates of participation.

Digital Tools to Use:

- **eTwinning TwinSpace**
- **Canva**, **Genially** (for presentations and infographics)
- **Padlet** (for introductions, brainstorming)
- **Book Creator**, **StoryJumper** (for collaborative storytelling)
- **Scratch**, **LEGO WeDo**, **micro:bit** (for robotics)
- **Google Meet / Zoom** (for virtual meetings and debates)

Timeline:

Month	Activities
October	Project launch, partner introductions
November	Mythology research, start building automata
December	Engineering challenge & sharing models
January	Creative myth-robot storytelling
February	Ethics & AI debates, collaborative products
March	Virtual exhibition and project closure

Expected Outcomes:

- Increased understanding of ancient science and its link to modern technology.
- Basic mechanical and coding skills.
- Improved English language and digital collaboration.
- Development of ethical and critical thinking around technology.
- Creative production of e-books, videos, and engineering models.

Evaluation Methods:

- Online surveys for students and teachers (Google Forms).
- TwinSpace interactions and comments analysis.
- Peer voting and awards for creative achievements.
- Final reflections through student journals.

Project Logo:

(optional: students can create logo ideas and vote for the best one)

Teacher Tasks and Partner Roles

1. Overall Project Coordination (Lead School)

Responsibilities:

- Prepare the overall project schedule.
- Set up the TwinSpace project.
- Organize monthly teacher meetings (Zoom/Google Meet).
- Ensure communication stays active (newsletters or updates every 2 weeks).
- Help troubleshoot technical or organizational issues.

Ideal for: A school/teacher experienced in eTwinning or STEM project management.

2. Mythology & History Coordinator (Partner 1)

Responsibilities:

- Prepare introductory materials about Talos and Greek automata.
- Lead the creation of a shared digital timeline (Genially, Canva) about ancient robots/myths.
- Organize a "Mythology Quiz" (Kahoot or Quizizz) among students.

Ideal for: A teacher with a background in history, literature, or classics.

3. STEM & Engineering Activities Coordinator (Partner 2)

Responsibilities:

- Propose designs for simple mechanical or pneumatic robots.

- Lead tutorials for Scratch/LEGO/micro:bit activities (short video guides or step-by-step sheets).
- Organize a "Robot Building Day" event where students share builds live or through recorded videos.

Ideal for: A science, technology, or math teacher with some experience in robotics or maker activities.

4. Creative Design & Storytelling Coordinator (Partner 3)

Responsibilities:

- Organize the "Invent Your Own Myth-Robot" challenge.
- Create a collaborative e-book using Book Creator or StoryJumper.
- Encourage students to combine art, storytelling, and technology (optional: comic creation).

Ideal for: A language, arts, or cross-curricular teacher.

5. Ethics & AI Debate Coordinator (Partner 4)

Responsibilities:

- Organize and moderate virtual debates/discussions about AI.
- Prepare question prompts (ex: "Can robots have rights?").
- Collect reflections and create a collaborative ethical "Manifesto" (one-page poster or Padlet wall).

Ideal for: A teacher with philosophy, social studies, ethics, or technology interests.

6. Digital Publishing & Dissemination Coordinator (Partner 5 - optional)

Responsibilities:

- Lead the preparation of final project materials (presentations, videos, posters).
- Help students design posters, certificates, and final summary videos.
- Share outcomes on TwinSpace and local school websites/social media.

Ideal for: A tech-savvy teacher comfortable with digital editing and online publishing.

Shared Teacher Tasks

- Approve and monitor student posts on TwinSpace.
- Support online safety and GDPR compliance.
- Encourage student collaboration through comment sections and live chats.
- Translate short messages if needed to help non-native speakers.
- Share feedback and mini-surveys throughout the project.

Optional Extras (for very active partners)

- Organize a **Talos Drawing or Robotics Design Contest**.

- Record **short interviews** with students about "What is a robot?" and "What will AI look like in 100 years?".
- Celebrate a special **Ancient Greek Day** in each school with costumes, food, and mini-Olympics.

Project 2. Bridges Across Time: Building Like Archimedes

Project Summary:

In this collaborative STEM project, students aged 11–14 will explore the ancient Greek innovations in mechanics, focusing on bridge construction, levers, pulleys, and weight distribution.
Inspired by Archimedes and ancient engineering marvels, students from different countries will **research**, **design**, **build**, and **test bridges** and mechanical devices using simple materials.
The project promotes creativity, teamwork, critical thinking, and hands-on learning by connecting ancient knowledge to modern-day engineering challenges.

Project Goals:

- Understand the contributions of Archimedes and Greek engineers to mechanical science.
- Apply principles of **forces**, **balance**, **geometry**, and **physics** in bridge construction.
- Promote teamwork and international collaboration through hands-on STEM activities.
- Enhance students' critical thinking, problem-solving, and engineering skills.
- Develop digital literacy by documenting and sharing results via eTwinning platforms.

Target Group:

- Students aged 11–14 (Grades 6–8)
- Teams from 2–5 European schools
- Mixed-level STEM background (no advanced knowledge needed)

Curriculum Integration:

- **Science**: Forces, balance, structures, simple machines
- **Mathematics**: Geometry, measurements, scale models
- **Technology & Engineering**: Design process, testing prototypes
- **History**: Ancient Greek inventions, Archimedes' legacy
- **ICT**: Digital documentation and collaborative tools

Planned Activities:

Phase 1 – Welcome & Introduction

- Icebreaker activities (students create short introductions via Padlet).

- Teachers introduce Archimedes and Greek bridge innovations via a shared Canva/Genially presentation.
- Timeline of "Bridges in History" built collaboratively.

Phase 2 – Research & Explore

- Students research types of bridges (beam, arch, suspension).
- Investigation: How did Archimedes' principles (levers, force) influence bridge designs?
- Shared infographics about simple machines used in ancient times.

Phase 3 – Engineering Challenge: Build Your Bridge!

- Design and build a **model bridge** using materials like:
  - Popsicle sticks, string, cardboard, glue, paper.
- Constraints: limited materials, must hold a minimum weight (e.g., a small book).
- Document the building process (photos, time-lapse videos).

Phase 4 – Testing & Sharing

- Students **test** their bridges and measure how much weight they hold.
- Create short videos presenting:
  - Their design idea
  - The building process
  - Test results
- Upload on TwinSpace and organize a **Virtual Bridge Expo**.

Phase 5 – Reflection & Connection to Modern Engineering

- Compare ancient principles to modern bridge building.
- Create a collaborative poster: "What We Learned from Archimedes."
- Reflect through a final Kahoot Quiz or online Survey.

Digital Tools to Use:

- **TwinSpace** (for communication and sharing)
- **Padlet** (for introductions and brainstorming)
- **Canva**, **Genially** (for infographics and presentations)
- **Flipgrid** or **YouTube (private link)** (for video sharing)
- **Kahoot**, **Google Forms** (for quizzes and evaluation)

Timeline:

Month	Activities
October	Project Launch, Icebreakers, Timeline
November	Research on Bridges and Simple Machines
December	Bridge Building and Documentation
January	Virtual Testing and Presentations

Month	Activities
February	Reflections, Final Product, Certificates

Expected Outcomes:

- Students understand mechanical principles like **leverage**, **load distribution**, and **balance**.
- Hands-on creation of bridge prototypes based on ancient and modern engineering.
- Improved international communication and collaboration skills.
- Digital products: timeline, infographics, bridge-building videos, collaborative posters.

Evaluation Methods:

- Ongoing student feedback (emoji surveys, short polls).
- Teacher observations of participation and collaboration.
- Peer voting during the "Virtual Bridge Expo" (for creativity, strength, and design).
- Final online survey about what students enjoyed and learned.

Teacher Tasks and Roles:

Partner	Task
Coordinator School	Organize timeline, communication, and project meetings.
Partner 1	Lead history research activities (Archimedes and ancient bridges).
Partner 2	Prepare STEM challenges and building guidelines.
Partner 3	Lead digital documentation (presentations, videos).
Partner 4 (optional)	Organize Virtual Bridge Expo and voting.

eTwinning Project Scenario 3,: “Eureka! Exploring Buoyancy Across Europe”

Project Title: Eureka! – Archimedes’ Principle in Action

Objective:

Students from different countries will explore the principle of buoyancy through a hands-on experiment inspired by Archimedes. They will share results, analyze differences, and reflect on scientific thinking across cultures and classrooms.

Target Group:

Students aged 9–14 (flexible), in science or STEM classes

Materials Needed (per school):

- Small objects (wood, metal, plastic, sponge, etc.)
- Water basin
- Measuring cups/jug
- Scale (optional, for weighing)
- Rulers (optional, for calculating volume)

Project Steps:

1. Kick-off & Virtual Introduction

- Teachers introduce Archimedes and the story behind his famous discovery.

- Students meet partner schools through a virtual exchange (video call, eTwinning Live, or shared Padlet).
- Each school creates a short video or poster: *"Who was Archimedes?"*

2. The Experiment

- Each school performs the same buoyancy experiment:
  - Predict whether objects will float or sink.
  - Measure displaced water volume.
  - Discuss which materials are more/less dense.
- Students record their process with photos, videos, or science journals.

3. Sharing Results

- Partner schools upload their experiment outcomes to a shared space (TwinSpace, Google Slides, Padlet, etc.).
- They compare results:
  - Did the same objects float/sink across all schools?
  - Were predictions accurate?

4. Socratic Dialogue Activity

- Each school writes 3–5 open-ended questions for the partner class:
  - *"Why do you think some objects floated that looked heavy?"*
  - *"How does the shape of an object affect its buoyancy?"*
- Partner students respond using videos or written reflections.

5. Creative Reflection

- Each team creates a **"Modern-Day Eureka!"** invention or drawing: how could the principle of buoyancy be applied today (submarines, ships, floating cities)?
- Schools exchange and vote for the most creative idea.

6. Final Product

- Joint e-booklet or digital poster:
  "Eureka Across Borders: A Collaborative Buoyancy Experiment"
- Optional: host a final online exhibition or science fair.

Learning Outcomes:

- Understand Archimedes' Principle through hands-on science
- Practice scientific observation, prediction, and measurement
- Use Socratic questioning to deepen reasoning and discussion
- Develop cross-cultural collaboration and communication skills
- Connect ancient scientific thinking to modern STEM challenges

eTwinning Project 3. Title: “Beacons of the Past: Rebuilding Ancient Lighthouses”

Age Group:

10–12 years old (upper primary / early lower secondary)

Subjects Integrated:

STEM (Science, Technology, Engineering, Math), History, Geography, Visual Arts, ICT, Language

Project Description:

In this cross-border project, students will explore the history, design, and engineering of ancient lighthouses, focusing on the legendary **Lighthouse of Alexandria** — one of the Seven Wonders of the Ancient World. Through collaborative research, model construction, and creative storytelling, they will rediscover how lighthouses served as vital communication tools and engineering marvels in ancient times. Together, students from different countries will build physical or digital models of ancient lighthouses, compare local maritime history, and reflect on how light, structure, and innovation shaped human progress.

Project Goals

- Understand the purpose and design of ancient lighthouses.
- Learn basic engineering concepts related to light, structure, and safety.
- Encourage creativity, teamwork, and digital communication.
- Strengthen collaboration across cultures using the eTwinning platform.

Phases and Activities

Phase 1: Getting to Know Each Other

Tools: eTwinning Live, Padlet, TwinSpace

- Icebreaker activity: “My City by the Sea” – students create short presentations or drawings of their hometown’s relation to the sea (real or imaginative).
- Virtual meetups or video introductions.
- Create a shared **eMap of partner schools** using Google Maps.

Phase 2: Exploring Ancient Lighthouses

Tools: TwinSpace forum, Canva, PowerPoint, Thinglink

- Research activity: Each group explores a famous ancient lighthouse (Alexandria, Rhodes, Ostia, Pharos of Leptis Magna, etc.).
- Students gather info: structure, purpose, location, historical context.
- Share findings on TwinSpace with visual posters, videos, or slides.

Phase 3: The STEM Challenge – Rebuilding the Lighthouse

Tools: LEGO, recyclable materials, Tinkercad (optional for digital modeling)

- Collaborative task: Teams build models of the Lighthouse of Alexandria (physical or digital).
- Include lighting elements (LEDs or flashlights) and basic architectural features (e.g., tiers, windows, reflecting mirrors).
- Share video walkthroughs or photo galleries of the models.

Phase 4: Science Behind the Beacon

Activities:

- Simple experiments with **reflection, mirrors, and light direction**.
- Explore how ancient lighthouses used mirrors to amplify light from fire.
- Students write hypotheses and test how to reflect and direct light in their models.

Phase 5: Socratic Reflection and Creative Output

Activities:

- Students answer open-ended questions like:
  "Why did ancient people need light from a tower?"
  "What would you do differently if you built a lighthouse today?"
- Creative task: write a diary entry of a sailor from 100 BCE seeing the Lighthouse of Alexandria for the first time.

Phase 6: Final Collaboration & Dissemination

Tools: eBook creator (Book Creator, Canva), Padlet wall

- Create a joint **digital exhibition**: "Beacons of the Past" — showcasing student models, maps, videos, and reflections.
- Share exhibition with school communities and local partners.
- Hold an online closing event or digital quiz between partner schools.

Collaboration & Communication

- Regular use of **TwinSpace** for discussions, updates, and feedback.
- Students ask and answer questions in **forum threads** (e.g., "What shape should a lighthouse be?").
- Partner schools co-design lighthouse models and exchange building advice.
- Teachers coordinate via eTwinning Live and shared planning documents.

Learning Outcomes

- Understanding ancient engineering and architecture.
- Gaining practical knowledge of light, reflection, and building design.
- Developing teamwork, communication, and digital literacy.

- Fostering appreciation of European cultural heritage.

Final Outputs

- Physical/digital lighthouse models
- Scientific reflections and drawings
- Collaborative digital exhibition
- Teacher guide & lesson plan (optional for reuse)

Robotics Extension: Automating the Lighthouse Beacon

Concept:

Students design and program a **rotating light system** to simulate how a lighthouse beacon works — mimicking the movement of light used to warn ships. They can also add **light sensors or switches** to control the beacon.

What Students Can Build:

1. Rotating Beacon System

- **Use:** a small motor (e.g., servo or DC motor) to rotate a platform with a flashlight or LED.
- **Goal:** Mimic how the lighthouse rotates its light to sweep across the sea.
- **Tools:** LEGO Spike Prime / EV3, Arduino, or Micro:bit.

2. Light On/Off Automation

- **Option A:** Program a **timed beacon** that blinks on/off like a modern lighthouse.
- **Option B:** Use a **light sensor** (e.g., photoresistor) to automatically turn the beacon on in the dark.
- **Option C:** Add a **button or remote trigger** for students to control the beacon during a presentation.

Educational Connections:

Ancient Principle	Robotics Skill	Student Learning Outcome
Fire beacon with mirror	LED + motor rotation	Understand how rotation spreads light
Manual fuel-based lighting	Code-triggered light activation	Learn automation and energy control
Lighthouse design for visibility	Use of angle, speed, and brightness	Experiment with light range and signal effectiveness

Collaboration Ideas for eTwinning:

- **Code Swap Challenge:** Schools build a beacon and exchange simple code snippets with partners to compare how the light behaves.

- **Design Showcase:** Each school presents their lighthouse with automated light in a virtual session.
- **Problem-Solving Task:** Partner teams must adjust code remotely to improve the beacon's visibility or rotation timing.

Tools You Can Use:

- **LEGO SPIKE Prime**: Easy visual coding, servo motors, and light blocks.
- **Micro:bit**: LED display, light sensor, and motor controls.
- **Arduino**: Advanced light and motion control with real electronics experience.

Lesson Plan: Rebuilding the Lighthouse of Alexandria with Robotics

Grade Level: 10–12 years old
Subject Areas: STEM, History, Robotics, ICT
Duration: 2–3 sessions (40–60 minutes each)

Title: *"Bringing the Beacon to Life: Automating an Ancient Lighthouse"*

Learning Objectives:

- Understand the historical purpose and design of the Lighthouse of Alexandria.
- Explore how light, rotation, and signal systems worked in ancient and modern lighthouses.
- Build and program a rotating light using basic robotics tools.
- Collaborate with students from partner schools via eTwinning.

Materials Needed:

- Robotics kit (LEGO SPIKE Prime, EV3, Arduino, or Micro:bit)
- LED or flashlight component
- Servo or DC motor
- Cardboard or plastic materials for structure
- Laptops/tablets with block-based or text-based programming software
- Optional: light sensor (photoresistor)

Session 1: History + Design Planning

1. Introduction to the Lighthouse of Alexandria (video, images, map).
2. Discuss how light was used as a signal in ancient times.
3. Compare with modern lighthouses and beacons.
4. Brainstorm: "How would you design a lighthouse today using robotics?"
5. Begin sketching lighthouse model (drawing or CAD).

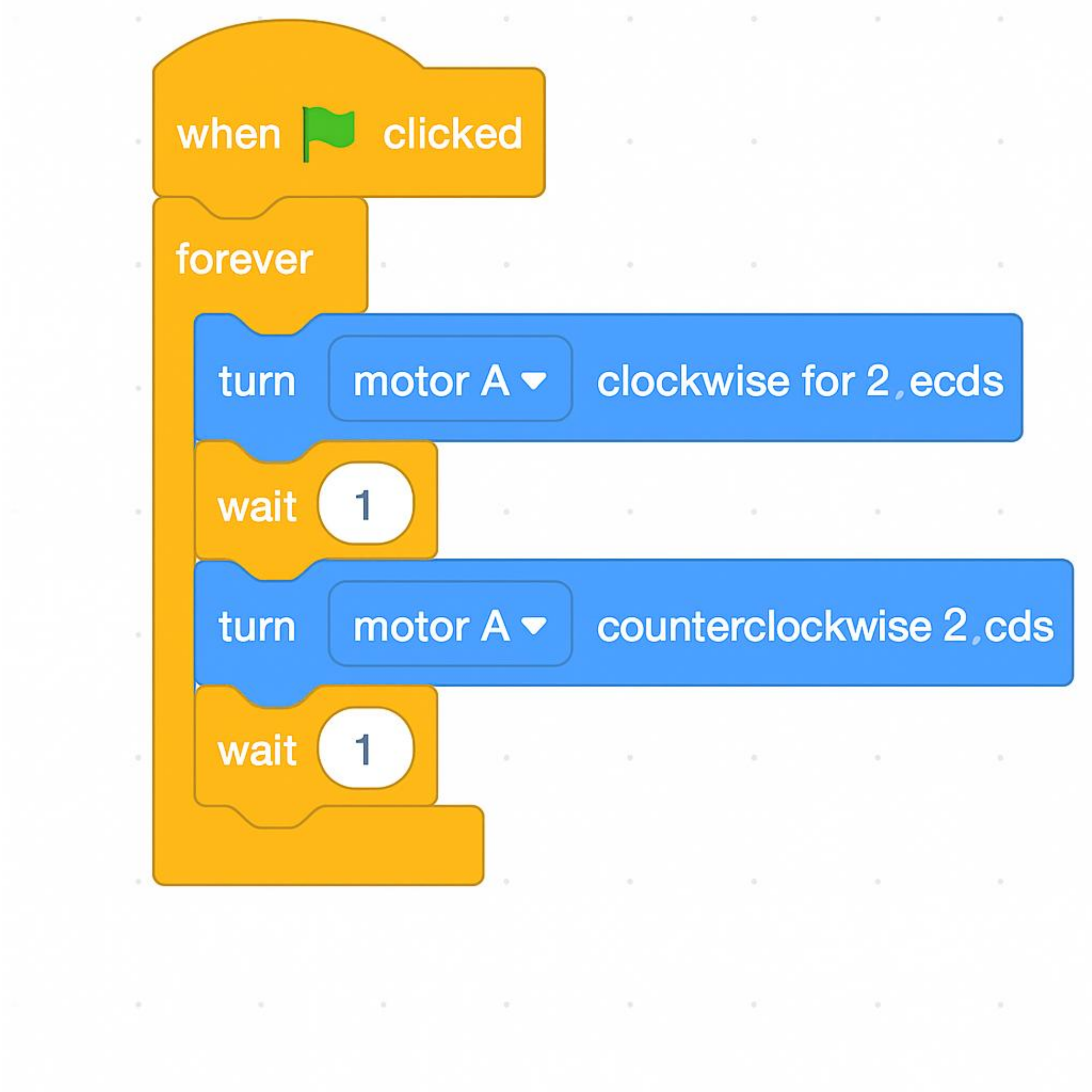
Homework/Collaborative Task:

- Exchange sketches or design ideas with partner school on TwinSpace.
- Students ask and answer design questions (Socratic-style): "Why did you place the mirror there? What would happen if the motor turned faster?"

Session 2: Building and Programming

1. Build lighthouse tower structure.
2. Install motor and LED.
3. Program beacon:
   - Option A: Rotate light slowly in a loop.
   - Option B: Blink the light on/off every few seconds.
   - Option C (Advanced): Use light sensor to trigger beacon in the dark.
4. Test and adjust design for stability and effectiveness.

Programming in Scrach



The attached Scratch program controls a motor (motor A) in the following way:

1. It starts when the flag is clicked.
2. It executes an endless loop (forever) that includes:
3. Rotate motor A clockwise for 2 seconds.
4. Pause for 1 second (wait 1).
5. Rotate motor A counterclockwise for 2 seconds.
6. Another pause for 1 second (wait 1).

Summary: Motor A continuously alternates between clockwise and counterclockwise rotation, with a 1 second pause after each phase of movement. This creates a cycle of alternating motion that repeats forever.

Optional: Share video of functioning beacon with partner schools.

Session 3: Reflection + Presentation

1. Discuss challenges: What worked? What needed redesign?
2. Peer review partner projects (video or photo) and give feedback.
3. Final presentations:
    - Demonstrate beacon.
    - Explain how ancient design inspired your model.
4. Upload presentations to TwinSpace for virtual exhibition.

Assessment Criteria:

- Design reflects understanding of lighthouse function.
- Light and rotation components operate reliably.
- Teamwork and clear explanation of design process.
- Interaction with partner schools (feedback/questions shared).

Extension Ideas:

- Integrate geometry (angles of rotation, shape design).
- Research lighthouses in partner countries.
- Write a short story from the viewpoint of a sailor using the beacon.

Tools for eTwinning Communication:

- TwinSpace forums (design discussions)
- Video exchange (building diaries)
- Digital exhibition or shared Padlet wall

Learning Outcomes:

- Students understand historical and scientific concepts around lighthouses.
- Apply STEM and robotics to solve real-world problems.
- Develop cross-cultural communication and collaborative design skills.
- Engage in creative, hands-on learning linked to European heritage.

eTwinning Project 4 Title: Water Wizards: Greek Innovations in Plumbing and Hydraulics

Pre-primary students (ages 5–6)

Project Summary:

In this playful STEM project, young learners (ages 5–6) will explore how ancient Greeks managed water through early plumbing, aqueducts, fountains, and simple machines. Through hands-on experiments, water games, storytelling, art, and collaborative digital sharing, children will **discover how water moves**, **design simple water systems**, and **create magical "water wizard" stories**, connecting ancient inventions to their everyday experiences.

The project encourages early scientific inquiry, creativity, and intercultural exchange — all through **fun, safe, sensory-based learning**!

Project Goals:

- Discover water's movement (gravity, flow, direction) through playful experiments.
- Learn basic STEM concepts: **transportation of water**, **simple mechanisms**, **problem-solving**.
- Foster creativity through storytelling about "water wizards" and ancient inventions.
- Promote international collaboration and friendship at an early age.
- Enhance digital communication skills through shared drawings, songs, videos.

Target Group:

- Pre-primary students (ages 5–6)
- 2–6 partner schools across Europe

Curriculum Integration:

- **Science**: Properties of water, movement, gravity
- **Technology**: Understanding simple devices (pipes, pumps)
- **Engineering**: Build basic water systems
- **Art**: Water-themed crafts, drawings
- **Language Development**: Storytelling and vocabulary related to water and plumbing

Planned Activities:

Phase 1 – Welcome to the World of Water!

- Virtual Icebreaker:
  Create a **"Hello from My School"** video or collage (introduce students with a favorite water toy or place).
- Common Story Time:
  Teachers read a simple illustrated story inspired by ancient Greek water inventions (custom-made story suggestion provided).

Phase 2 – Discover and Play with Water

- Sensory Play Stations:
    - Pouring, transferring, and redirecting water with cups, pipes, straws, and sponges.
    - "Can we move water uphill?" challenge using simple tubes and squeeze bottles.
- Build a Tiny Aqueduct:
    - Students create mini water channels outdoors or indoors using recycled materials (plastic bottles, tubes).

Phase 3 – Become Water Wizards!

- Students design their own **"magic water machines"** using cardboard, paper, and recyclable materials.
- Create Water Wizards:
    - Draw or dress up as "Water Wizards" who control water, inspired by ancient engineers.
- Exchange "Water Wizard" drawings across partner schools digitally.

Phase 4 – Celebration and Sharing

- Host a **Water Wizards' Parade** (live or recorded) where students showcase their creations and water experiments.
- Create a joint "Water Wizards" e-book (Book Creator) combining photos, drawings, and small sentences from each school.

3 quick example activities

a. Mini Aqueduct Challenge

Objective: Learn how water travels from one place to another using gravity.

Materials:

- Cardboard tubes (paper towel rolls or toilet rolls)
- Plastic cups or small containers
- Water
- Tape
- Funnels or scoops
- Tray or basin to catch water

Activity:

- Create a sloped path with the tubes taped to a table, chair, or boxes.
- Pour water from the top and watch it flow like an aqueduct!
- Decorate the structure with blue paper or water drop stickers.

Learning focus: Gravity, flow, and ancient water transport.

b. Squeeze and Move Water (Hydraulics for Kids!)

Objective: Introduce pressure and water movement with simple tools.

Materials:

- Plastic syringes (no needles)
- Transparent plastic tubing (aquarium tube size)
- Water and food coloring (optional)
- Two cups or small bottles

Activity:

- Connect two syringes with the plastic tubing.
- Fill the system with water and push one syringe — the other moves!
- Students can push water back and forth, watching how pressure works.

Learning focus: Pressure, movement, and teamwork.

Digital Tools to Use:

- **TwinSpace** (sharing activities and communication)
- **Padlet** (post drawings and videos)
- **Book Creator** (for the collaborative e-book)
- **Jigsaw Planet** (turn students' drawings into puzzles for partners)
- **Canva** (teachers create simple posters)

c. Create a Water Wizard Wand

Objective: Mix creativity with STEM by imagining a magical water-controlling tool.

Materials:

- Craft sticks or straws
- Aluminum foil or blue tissue paper
- Glitter glue (optional)
- Stickers, string, and ribbon
- Markers or crayons

Activity:

- Children design and decorate their own "Water Wizard Wand."
- Each child explains what their wand can do — "My wand makes a fountain!" or "It moves water up a hill!"

Learning focus: Imagination, oral expression, role-play.

Materials

Product

d. Build a Simple Water Fountain

Objective: Simulate ancient Greek fountains.

Materials:

- 1 plastic bottle
- Straw
- Playdough or clay (to seal holes)
- Water
- Basin to catch overflow

Activity:

- Make a small hole in the side of the bottle near the base.
- Insert a straw and seal with clay.
- Fill the bottle from the top—water sprays out from the straw!

Learning focus: Water pressure, flow, and early technology.

e. Water Play Station – Save the Water Race

Objective: Practice transferring and controlling water, like early engineers.

Materials:

- Sponges
- Small cups
- Bowls or buckets
- Timer (optional)

Activity:

- Children move water from one bucket to another using only sponges or cups.
- They can race against time or work in teams like little Greek plumbers.

Learning focus: Measurement, teamwork, fun with physics!

Meterials

Products

Timeline

Month	Activities
October	Welcome videos and story time
November	Water play experiments and mini aqueducts
December	Water Wizard art and magical machines
January	Digital parade and joint e-book creation
February	Project wrap-up, certificates and celebration

Expected Outcomes:

- Better understanding of basic physics and engineering through play.
- Development of fine motor skills and teamwork.
- Creation of artistic and digital products: videos, water system models, collaborative e-book.
- Greater cultural awareness and early friendship building among European children.

Evaluation Methods:

- Teacher observation grids (engagement, participation).
- Smile/sad face self-assessment charts.
- Final photo gallery showcasing key moments.
- Feedback from families if possible.

Teacher Tasks and Roles:

Partner	Task
Lead Partner	Organize project plan, oversee TwinSpace, manage timeline.
Partner 1	Prepare and share water discovery games and sensory activities.
Partner 2	Lead the storytelling and Water Wizards' creation activities.
Partner 3	Organize the Water Parade sharing and final e-book.
Partner 4 (optional)	Prepare small environmental awareness tasks (saving water tips).

Special Ideas:

- Invite a local plumber, engineer, or firefighter to show how water moves in pipes!
- Organize a "Save the Water" mini-campaign — posters drawn by students.
- Build a class "Rain Collector" together and measure rainfall.

Project Mascot Idea:

Create a **Water Wizard mascot** (simple character) that “travels” virtually between schools — teachers/students send messages and adventures from the Wizard!

Conclusions: Ancient Ingenuity, Modern Classrooms, and the Future of STEM through eTwinning

The integration of ancient Greek scientific achievements into K–12 STEM education—particularly through the eTwinning framework—demonstrates how historical heritage can become a dynamic vehicle for cross-curricular innovation. The activities and projects outlined in this guide showcase not only the brilliance of thinkers like Archimedes, Pythagoras, Hero of Alexandria, and Eratosthenes, but also how their legacy can inspire a new generation of problem-solvers, inventors, and collaborators.

Across all age groups—from pre-primary to lower secondary—students engaged in these projects are invited to "think like ancient scientists." Whether crafting a sundial, constructing a water fountain, building a robot inspired by Talos, or reimagining a lighthouse through coding and design, they are not just absorbing knowledge—they are **actively creating, questioning, and discovering**. The approach combines **Socratic inquiry**, **hands-on experimentation**, and **modern technology**, bridging over two thousand years of scientific curiosity.

What makes these projects particularly impactful is their alignment with the core values of eTwinning:

- **International collaboration** among schools fosters cultural awareness, digital citizenship, and empathy.
- **Project-based learning** allows students to engage in meaningful, tangible outcomes.
- **Transversal skills**—such as communication, teamwork, and critical thinking—are cultivated naturally through shared creative challenges.

Furthermore, the emphasis on **inclusivity and adaptability** ensures that even the youngest learners (such as in the "Water Wizards" project) are given space to explore physics and engineering through imaginative play and sensory engagement. At the same time, older students are encouraged to tackle advanced concepts like buoyancy, coding, or ethical debates about artificial intelligence.

Importantly, these activities also underscore a vital educational message: STEM is not a modern invention—it is a **continuum of human curiosity**. By anchoring our explorations in the knowledge of ancient civilizations, we offer students a chance to reflect on the **human story behind technology**, recognizing that the past can both inform and inspire our future innovations.

As this document shows, bringing Ancient Greece into the STEM classroom is not about nostalgia—it is about possibility. It reminds educators and learners alike that every gear we turn, every question we ask, and every robot we build stands on the shoulders of centuries of invention. With eTwinning as a platform, these ideas are no longer confined to one classroom or one country—they are **shared, shaped, and celebrated across borders**.

Together, we are not just teaching science; we are **reawakening ancient dreams**—and giving them new life through collaboration, creativity, and curiosity.

Panagiotis Angelopoulos
Hellenic NSO eTwinning