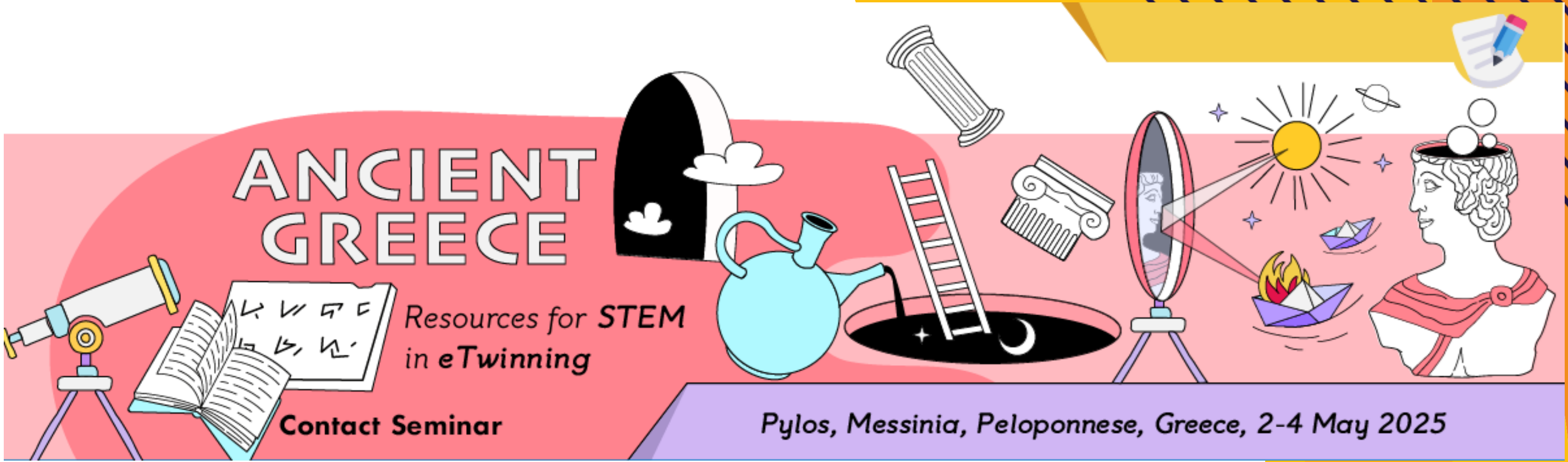
Ancient Greece resources for STEM in eTwinning



Angelopoulos Panagiotis
HNSO eTwinning

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ Υπουργείο Παιδείας και Θρησκευμάτων
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Unlocking the STEM Legacy of Ancient Civilizations

- What if I told you that the foundations of robotics, engineering, and even computing were laid more than 3,000 years ago
- STEM stands for Science, Technology, Engineering, and Mathematics — four fields that drive innovation and problem-solving in our world. In the classroom, STEM education encourages critical thinking, creativity, and hands-on learning, helping students connect knowledge with real-world applications.

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The Legacy of Ancient Greek STEM Innovations

- **Mathematics & Geometry**

The impact of Euclid and Pythagoras on geometry and mathematical reasoning.
How their methods still influence modern-day STEM applications.

- **Engineering & Technology**

Archimedes’ inventions (e.g., the screw pump, levers, pulleys) and their relevance in physics and mechanics.
The Antikythera Mechanism: an ancient analog computer and its role in computational thinking.

- **Astronomy & Physics**

Aristarchus' heliocentric model and its connection to space sciences today.
Eratosthenes’ measurement of the Earth's circumference and its significance in geography and geodesy.

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The Intersection of Ancient Knowledge and Modern STEM Education

Applying Ancient Greek Methods to Classroom Learning

Teaching logic and reasoning using Socratic questioning.

Hands-on activities that replicate Ancient Greek scientific experiments.

Innovative Teaching Tools Inspired by Ancient Greece

Gamification: Using ancient mathematical puzzles to develop critical thinking.

Robotics: How concepts from automata in Ancient Greece inspire modern-day AI and robotics.

Interdisciplinary Learning

Blending history with STEM to create engaging cross-curricular projects.

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Socratic Questioning Combines with STEM Education Principles and Goals

What is Socratic Questioning?
Socratic questioning is a method where the teacher doesn't simply provide answers but instead asks a series of open-ended, guiding questions. The goal is to lead students to discover answers on their own, to think more deeply, and to build logical reasoning step-by-step.

1. **Encourages Critical Thinking (STEM Goal: Analytical Skills)**
2. **Promotes Inquiry-Based Learning (STEM Principle: Learning by Exploration)**
3. **Builds Communication and Collaboration Skills (STEM Goal: Teamwork)**
4. **Develops Problem-Solving Mindsets (STEM Goal: Innovation)**

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.

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Hands-on activities that replicate Ancient Greek scientific experiments

Build and Test a Simple Water Clock (Klepsydra)
Objective: Students will replicate the way Ancient Greeks measured short periods of time using a water clock.

Materials:

- 2 plastic cups (per group)
- Water
- Stopwatch or a timer
- Small nail or pushpin
- Measuring jug
- Tape
- Marker pen
- Tray or basin (to catch water)

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Step-by-Step Instructions:

1. Prepare the Cup (5 min)
- Take one plastic cup and carefully poke one small hole in the bottom using the nail or pushpin (teacher supervises).
- Place the pierced cup over the second, empty cup (to catch the dripping water).

2. Mark the Water Levels (5 min)
- Fill the top cup with about half full of water.
- Start the stopwatch.
- Every 30 seconds, use the marker to draw a small line at the current water level on the side of the cup.

3. Calibrate Your Water Clock (5 min)
- Empty and refill the cup to the top line you marked. Start timing again: this time, as the water drips, students can tell the time by watching how fast the water reaches each line.

4. Test and Compare (10 min)
- Students can predict how much time will pass until the next line.
- Groups can compare how accurate each water clock is: Is it always exactly 30 seconds between lines? What could change the result? (hole size, water amount, air bubbles, etc.)

Water Clock, 5th century BC (pottery)

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Influence of Ancient Greek Automata on Modern Robotics and AI

- Ancient Greece: Birthplace of automata concepts (e.g., mechanical birds, self-moving statues)
- Notable inventors: Hero of Alexandria, Philo of Byzantium
- Early automata symbolized human ambition to mimic life
- Mechanical engineering principles from antiquity prefigured automation ideas
- Inspiration for self-operating machines → foundation for robotics
- Philosophical roots: Myths (e.g., Talos) depicted intelligent, autonomous beings
- Legacy: Ancient visions influence modern AI goals – autonomy, imitation of life
- Technological parallels: Automata mechanisms vs. modern algorithms and robotics

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Ancient Greek Automata

Talos was a mythical guardian of Crete. He was gigantic, anthropomorphic, and had a body made of bronze. He is considered the first robot ever constructed or created from imagination. Apollodorus says that he was made by the god Hephaestus and given to King Minos to guard Crete. Plato considers him a real person, the brother of Rhadamanthus. Apollonius of Rhodes says that he was a gift from Zeus to Europa, who then gave him to her son Minos.

While details are shrouded in the mists of time, ancient texts describe **Archytas' flying pigeon** as a marvel of ingenuity. This wooden bird, powered by an internal mechanism possibly fueled by steam, could flap its wings and take to the skies for short distances

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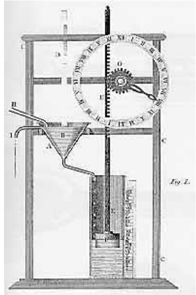
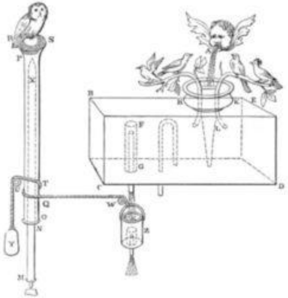
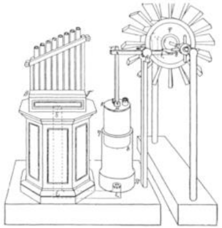
Ancient Greek Automata

Ktesibios was a keen student of the priniciples of pneumatics and was known to have created a large number of **water-powered Automata**

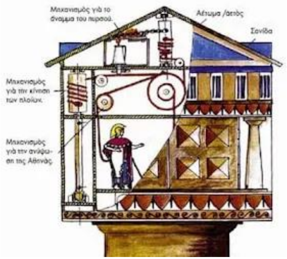


Hero of Alexandria, devised a water basin that featured metal birds which sang





Hero's "cinema" presented the Myth of Nauplion, who wants to take revenge on the Achaeans who killed his son Palamedes in Troy.



Philon the "Byzantine", also known as "Philo the Engineer". Among his many inventions was an **anthropomorphic robot**, which performed the duties of a servant...

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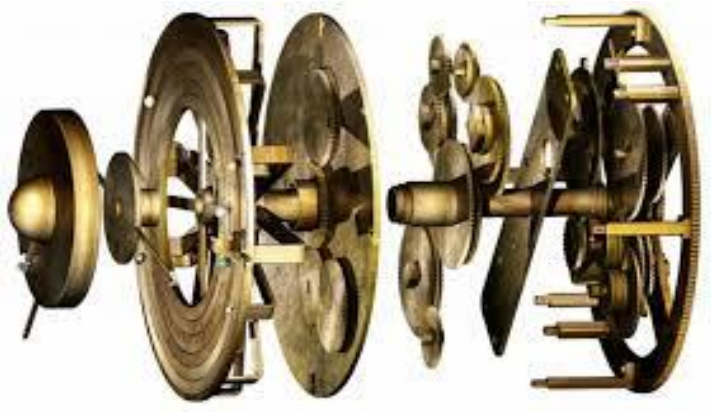
The Antikythera mechanism

The **Antikythera mechanism** is an Ancient Greek hand-powered orrery (model of the Solar System). It is the oldest known example of an analogue computer It could be used to predict astronomical positions and eclipses decades in advance It could also be used to track the four-year cycle of athletic games similar to an Olympiad, the cycle of the ancient Olympic Games.



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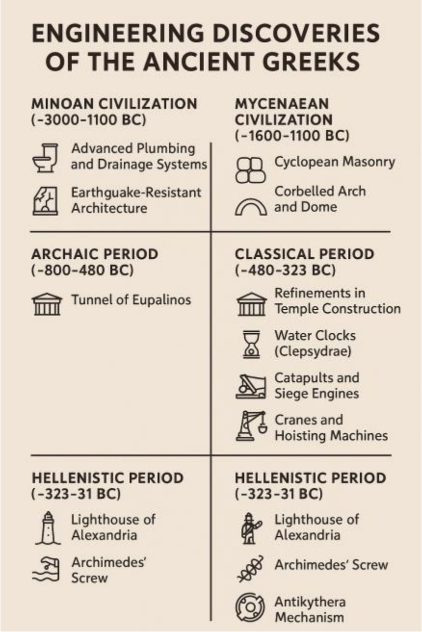
Engineering Key Themes Across the Period from 3000 - 33 BC

- Water management (plumbing, aqueducts, irrigation devices).
- Construction technology (earthquake-resistant design, cranes, monumental architecture).
- Mechanical engineering (catapults, automata, computational devices).
- Military engineering (siege technology, fortifications).



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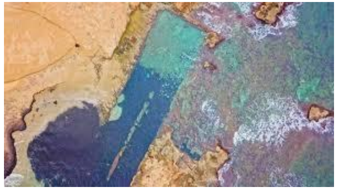
Minoan Civilization (~3000–1100 BC)

1. **Advanced Plumbing and Drainage Systems**
The Minoans in Crete (especially at **Knossos**) developed sophisticated water management systems, including **flushing toilets**, **drainage**, **sewage systems**, and **aqueducts**.

2. **Earthquake-Resistant Architecture**
Multi-story buildings with flexible timber-reinforced walls to better survive frequent earthquakes.

3. **Harbor Engineering**
At Minoan ports like **Amnisos**, they constructed sheltered harbors, using natural landforms and added breakwaters.



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Mycenaean Civilization (~1600–1100 BC)

Cyclopean Masonry
Massive stone fortifications at places like Mycenae and Tiryns, using enormous limestone boulders fitted tightly without mortar.

Corbelled Arch and Dome
In the Treasury of Atreus, Mycenaeans constructed a large corbelled tholos (beehive-shaped) tomb, a significant step in architectural engineering.

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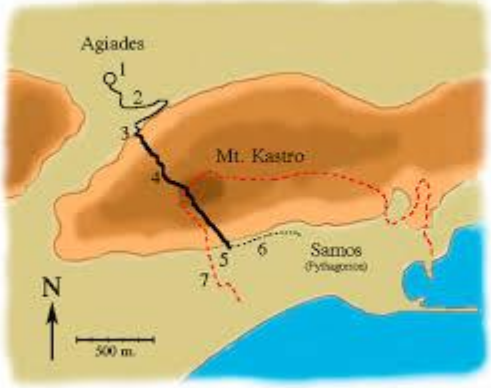
Archaic Period (~800–480 BC)

Tunnel of Eupalinos (Samos, ~6th century BC)
One of the greatest feats of ancient engineering: a 1 km long aqueduct tunnel **dug from both ends simultaneously with astonishing precision**, under the guidance of **Eupalinos of Megara**.



Classical Period (~480–323 BC)

Refinements in Temple Construction
Parthenon in Athens (447–432 BC): Use of **entasis** (subtle curvature in columns) and optical corrections to counter visual distortion.

Water Clocks (Clepsydrae),
Used for timing legal speeches and scientific experiments; demonstrated an early form of fluid mechanics application.

Catapults, Siege Engines, Meteorological stations
Development of early mechanical artillery like **torsion-powered catapults** (ballistae) during the late 5th and 4th centuries BC.

Cranes and Hoisting Machines
Use of compound pulleys and cranes for moving heavy loads, essential for major building projects.

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Hellenistic Period (~323–31 BC)

Lighthouse of Alexandria (~280 BC)
One of the Seven Wonders, combining large-scale construction with advanced lighting technology (mirrors and open flame).

Archimedes' Engineering (3rd century BC)
Archimedes' Screw for raising water.
Defense mechanisms against Roman siege (including purported use of giant claws and mirrors).

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Building Mycenaean Irrigation System (K-12 STEM Project)

1. **Title:** *"Water for the Fields: Reconstructing Ancient Irrigation Systems"*
2. **Objective:** Students explore how the ancient civilization like Mycenae managed water in challenging environments, then apply engineering principles to build small-scale, working models of those irrigation systems.
3. **Age Group:** Ages 10–13 (adaptable for younger or older students)
4. **Historical Focus**: **Mycenae:** Use of terracing, small aqueducts, cisterns, and agricultural drainage techniques.

Materials:

- Shallow trays or large plastic bins (to simulate terrain)
- Soil, sand, stones
- Watering cans or bottles
- Straws, plastic tubing, or bamboo sticks (for canals)
- Modeling clay or cardboard (for gates or levees)
- Rulers, small plants or seeds (optional)

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Steps

Research Phase:

Students investigate how either civilization stored, redirected, and used water.

Compare challenges: floods (Mesopotamia) vs. water scarcity (Mycenae).

Design Challenge:

Teams sketch irrigation layouts: rivers, fields, canals, and gates.

Plan to control water flow from a "river source" to farmland.

Build the Model:

Construct terrain with raised areas and carved canal paths.

Install clay levees, straw canals, and gates to control water.

Pour water into the "river" and observe its movement.

Iterate and Improve:

Test water flow. Do fields flood? Are canals too steep or blocked?

Redesign or adjust based on real irrigation logic.

Reflection and Sharing:

Discuss: What worked? What would improve ancient water systems?

Share photos or video reports with eTwinning partner schools.

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Collaboration & Learning Outcomes

eTwinning Collaboration Ideas:

Partner school builds the alternate civilization's model and compares engineering choices.

Host a **"Water Engineers of the Ancient World" day** where each team presents.

Write a short story or diary entry from the perspective of a farmer using the system.

Learning Outcomes:

Understand the environmental challenges and engineering innovations of early civilizations.

Apply physics and design thinking to real-world problems.

Develop teamwork, experimentation, and revision skills.

Practice intercultural learning through shared historical STEM heritage.

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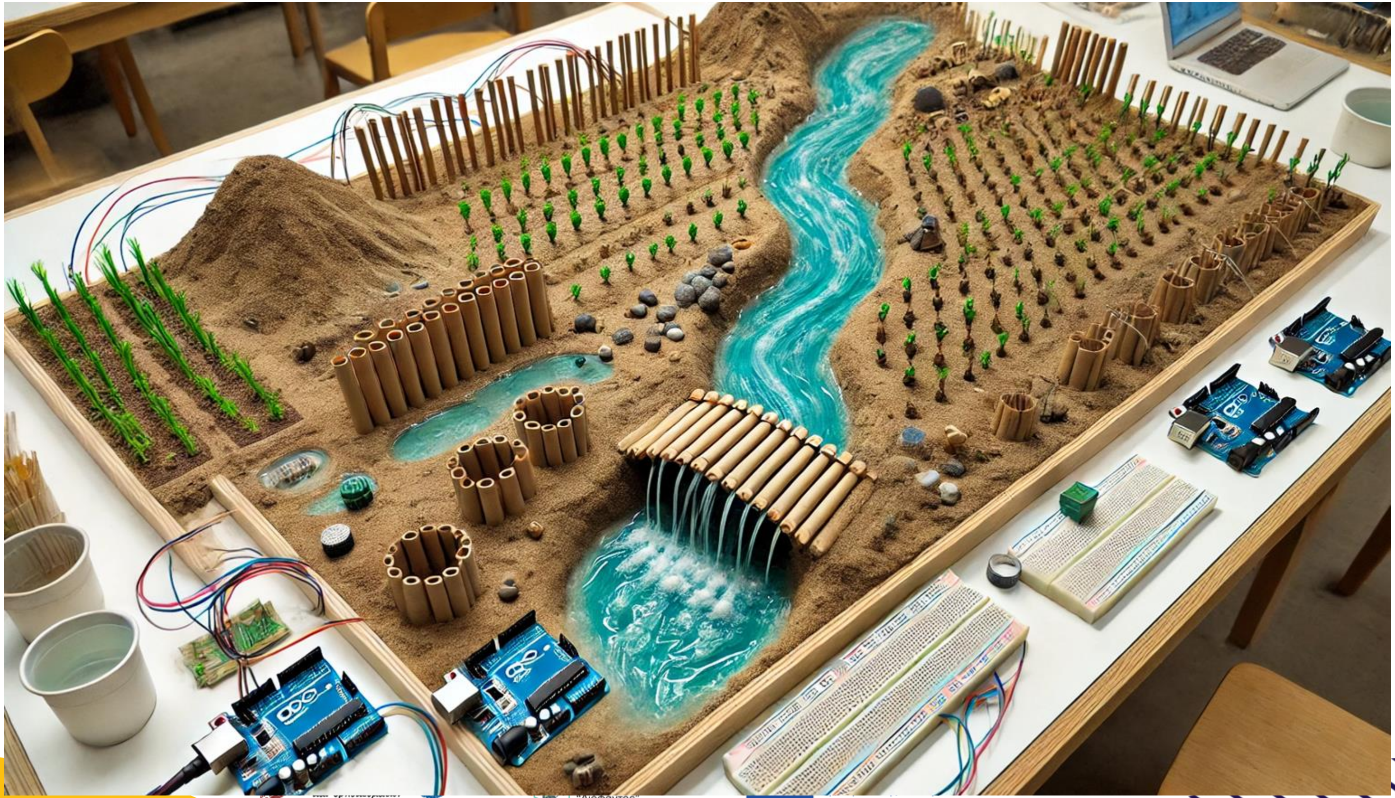
Arduinos to control the dams and the flow of water



Why Ancient STEM accomplishments is Perfect for eTwinning

- **Collaboration Across Borders**: Students from different countries co-develop models of ancient technologies (e.g., catapults, aqueducts), fostering teamwork and shared learning.
- **Creativity & Innovation**: Reimagining ancient tools using modern STEM methods (e.g., coding a virtual sundial or 3D printing an ancient artifact) nurtures innovation through historical inspiration.
- **Inclusion & Accessibility**: Projects can be adapted for all learners—hands-on, visual, digital—ensuring full participation regardless of background or ability.
- **Interdisciplinary Learning**: Combining history, engineering, art, and science reflects real-world problem-solving and supports holistic education—core to eTwinning's learning goals.
- **Intercultural Understanding**: Comparing ancient technologies from different cultures (Greek, Egyptian, Mesopotamian, etc.) promotes respect and curiosity about diverse traditions and knowledge systems.
- **Student-Centered Learning**: Learners become researchers, designers, and creators—investigating how ancient knowledge still shapes our world today.
- **Project-Based Methodology**: Designing, testing, and presenting reconstructions or digital models mirrors inquiry-based learning, a foundational eTwinning practice.
- **Use of ICT & Digital Tools**: Integrating technology (e.g., coding, simulations, virtual tours) to explore ancient STEM ideas modernizes traditional content and keeps students digitally engaged.
- **Promotes Key Competences**: Encourages critical thinking, communication, digital literacy, and cultural awareness aligned with EU key competences promoted by eTwinning.

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In Short

1. It naturally combines **science**, **technology**, **art**, **history**, and **ethics**.
2. It encourages students to **think like inventors** and **storytellers**.
3. It's highly visual, hands-on, NT can be used and collaborative—ideal for international teamwork!
4. Activities and Ideas at https://etwinning.gr/ms2024agmstem

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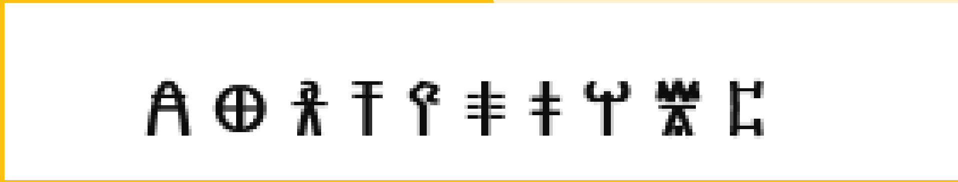
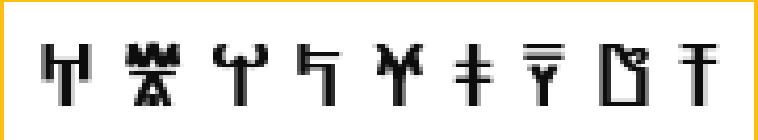


: Thank you for your attention



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National Support Organisation

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ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Υπουργείο Παιδείας και Θρησκευμάτων

ΙΤΥΕ "ΔΙΟΦΑΝΤΟΣ"
Ινστιτούτο Τεχνολογίας Υπολογιστών & Εκδόσεων "Διόφαντος"

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