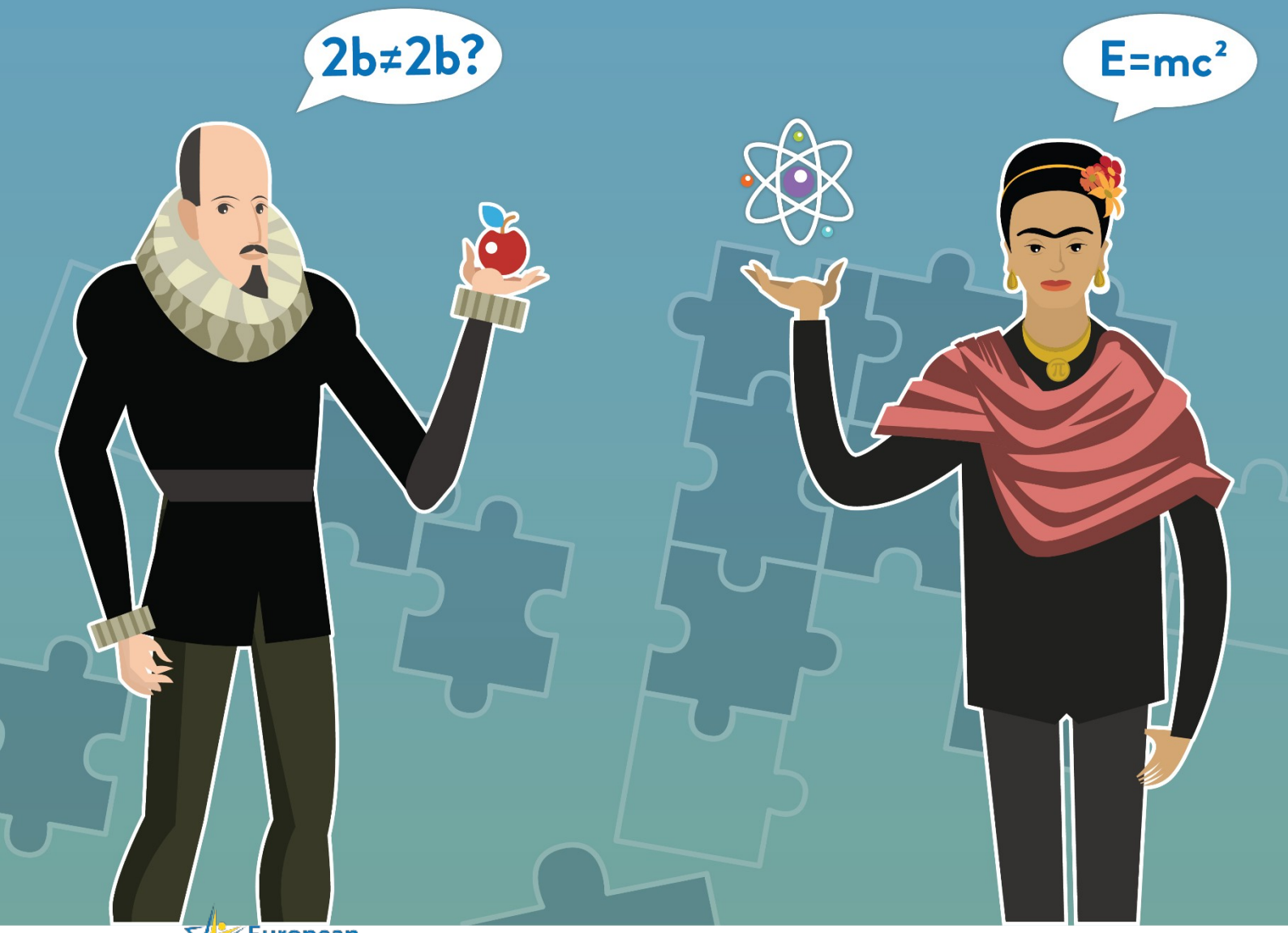
SCIENTIX
The community for science education in Europe

STEM out of the BOX
a STEM approach to non-STEM subjects

Shaking Art...

Ilias Oikonomakos



European Schoolnet

Scientix is an initiative of European Schoolnet (EUN)

Scientix Learning ScEnario

Title

Shaking Art...

Author(s)

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Summary

Shaking Art involves students into a project of artistic creation of paintings inspired by the work of the renowned American abstract expressionist artist Jackson Pollock, by using micro:bit, a number of servos and recycling material such as carton boxes and plastic water bottles.

Keywords

STEM, Jackson Pollock, micro:bit, recycle, Art

License

Overview

Subject(s)	Art, Technology, Engineering, Physics, Maths, Information Technology
Topic(s)	Creating Art with STEM
Age of students	12 - 15
Preparation time	Inspiration/Brainstorming – 10 mins Art – 10 mins Technology – 15 mins Engineering – 15 mins Physics/Maths – 15 mins ICT – 30 mins
Teaching time	Inspiration/Brain storming – 15 mins Art – 15 mins Technology – 25 mins Engineering – 25 mins Physics/Maths – 25 mins ICT – 60 mins

Online teaching material	Milanote, LearningApps, Draw.io, Mahara, Cmap/Xmind, Collaborative tool (like grafis.sch.gr)
Offline teaching material	Carton boxes, plastic water bottles (1,5 or 2 Lt), paper glue, thin rope, aluminium baking tray (light weight - size approx. A4), water colours, 3 spherical glass or metal balls (diameter approx 1cm), laptop, Nezha kit with micro:bit, 3 servomotors, rubber bands, any kind of paper (size A4), plastic membrane, scissors, pencil, measurement tape, a pair of compasses, mobile phone/tablet (for taking photos and for video recording)
Resources used	https://en.wikipedia.org/wiki/Jackson_Pollock https://en.wikipedia.org/wiki/Pythagorean_theorem https://www.mathsisfun.com/pythagoras.html https://microbit.org https://makecode.microbit.org https://wiki.elecfreaks.com/en/microbit/building-blocks/nezha-inventors-kit-v2/nezha-inventor-kit-v2/ https://milanote.com/ https://www.drawio.com/ https://mahara.org https://grafis.sch.gr https://cmap.ihmc.us https://xmind.app https://learningapps.org Scientix Learning Scenario: Wondrous encounters - Daniela Bunea Scientix Learning Scenario:Pollinators' Apocalypse Now - Emma Abbate Scientix Learning Scenario:Say NO to bullying - Tuba Gören

Aim of the lesson

After implementing this Learning Scenario students will be able to:
- know about Jackson Pollock, his style and artwork
- programme micro:bit
- distinguish the connection between abstract ideas and the real world
- apply maths/physics in real problems

Trends

Collaborative learning – focus on group work.
Peer learning – students learn from peers and give one another feedback.
Visual search and learning – images and multimedia as most powerful stimuli.
Web resources as learning materials – shift from (printed) textbooks.

Bring Your Own Device (BYOD) – students bring their own mobile devices to the classroom.
STEM learning - Science, Technology, Engineer, Art, Maths are all involved in the planned activities.
Project-Based Learning (PBL) - through the construction phases of the project, which are mostly carried out by hand, a “painting machine” and students get fact-based tasks and problems to solve, and they work in groups. This kind of learning usually transcends traditional subject boundaries.
Student-centred learning - Students and their needs placed at the centre of the learning process.

21st century skills

Creativity and innovation – students think creatively and work creatively with others, they generate ideas and learn how to respond to challenges.

Critical thinking and problem solving – students reason effectively and solve problems, they explore ideas, discuss, and consider others’ points of view.

Communication – students communicate clearly, elaborating their reading, writing, speaking and listening skills to engage in productive decision making through discussion.

Information, media and technology skills – students access, evaluate, use and manage digital information and consequently apply technology effectively.

Life and career skills – students learn how to adapt to change and how to be flexible.

Initiative and self-direction – students manage goals and time and work independently.

Social and cross-cultural skills – students interact effectively with others and work efficaciously in diverse teams.

Productivity and accountability – students manage projects.

Leadership and responsibility – students guide and lead others and become responsible towards others.

Collaboration - Students carry out activities while working in pairs and groups.

Information literacy - Students find, evaluate, organise, use, and communicate information in all its various forms, in situations that require decision making, problem solving, or acquisition of knowledge.

Media literacy - Students access and analyse media messages, they create, reflect, and take action.

ICT (Information, Communications and Technology) Literacy - Students use ICT tools effectively and efficiently during the sessions.

STEM Strategy Criteria

Elements and criteria	How is this criterion addressed in the learning scenario
Instruction	
Personalisation of learning	This LS is intended to address the different learning needs and interest of students. Also collaborative work is facilitated: each student is invited to assume a role in the team, according to his/her aptitudes and skills.
Problem and project-based learning (PBL)	Students learn about the subject by solving open-ended questions/problems both individually and collaboratively, with no solution provided by the teacher. Also students' learning is based on working on project tasks collaboratively.
Inquiry-Based Science Education (IBSE)	Students learn in a process in which different questions/problems/scenarios are presented to them, including case studies, investigation and research concerning similar projects.
Curriculum implementation	
Emphasis on STEM topics and competencies	The emphasis placed on STEM topics and competencies helps students develop STEM literacy and STEM capability.
Interdisciplinary instruction	The tasks implemented cover various disciplines, both STEM-oriented (Science: Physics) and non-STEM-oriented (Art, English as a Second Language).
Contextualization of STEM teaching	Theoretical concepts that are taught during learning are linked to practical, real-life contexts – i.e., STEM concepts and principles are connected to real-life examples, facilitating students' understanding and knowledge acquisition.
Assessment	
Continuous assessment	A portfolio evaluation is carried out, allowing for a continuous check on students' progress.

Elements and criteria	How is this criterion addressed in the learning scenario
Personalized assessment	None
Professionalization of staff	
Highly qualified professionals	This LS is intended to be implemented by collaboration of Technology, Physics, Art and ICT teachers.
Existence of supporting (pedagogical) staff	None
Professional development	Teachers' professional knowledge, competences, skills, and effectiveness will be improved.
School leadership and culture	
School leadership	The existence of a governing board and management teams.
High level of cooperation among staff	Teachers of various subjects support one another and work together.
Inclusive culture	The school environment is open and validating for all. Success is shared, and each person's uniqueness is valued and integrated in a common vision.
Connections	
With industry	None
With parents/guardians	None
With other schools and/or educational platforms	This Learning Scenario can be further implemented and expanded as an eTwinning/Erasmus+ project in relevant educational platforms since the involved activities can be easily replicated, expanded and modified according to specified needs.
With universities and/or research centers	None

Elements and criteria	How is this criterion addressed in the learning scenario
With local communities	None
School infrastructure	
Access to technology and equipment	Schools should be equipped with Internet access, as well as appropriate equipment - at least one computer/laptop and one mobile phone/tablet, an interactive screen or a smart board or a videoprojector in a standard classroom or in an ICT/Technology lab.
High quality instruction classroom materials	None

Lesson Plan

Name of activity	Procedure	Duration
Let's get organised!	- Presentation of the renowned American abstract expressionist artist Jackson Pollock, his painting style, some of his paintings etc. - PBL / Brainstorming / Lead-in Question: "Can the artist's work be imitated in a mechanical way? Any ideas?" - Answers recorded on a mind map (Cmap / Xmind) - Decision making: the "what" and "how" of the construction - Breaking the whole project to smaller fragments - Students: create teams, assign roles to each other taking into consideration members' interests, skills and capabilities, define the leader of the whole project – the teacher guides and supervises the process stages. *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	45 minutes

Well Begun is half Done!	- Accumulation of all necessary project components: materials, tools etc. on a designated working surface. *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	2 hours
Kick-off	First of all students create a sample/model of the base of the artefact using carton box. In order to perform this task effectively they will run some calculations taking into account the size of the rectangular aluminium baking tray and the diameter of plastic water bottles – 4 plastic water bottles, either 1,5 or 2 litre are needed. The 4 plastic bottles will be placed in the 4 corners of the rectangular aluminium baking tray at a distance of approx 20 cm from each edge of the rectangular aluminium baking tray. Pencil marks will be made on the carton box surface/base to designate the exact position of each component and a pair of compasses will be used to ensure that the position of the 4 plastic water bottles will be precise. Students, observed by an adult, proceed with perforating 4 holes on the base surface for the plastic water bottles to be attached in, by using a pair of scissors or something equivalent. Students are instructed to apply the Pythagorean theorem (3,4,5 and/or 6,8,10) in order to make the model of the base absolutely symmetrical and rectangular (4 angles of 90 degrees each). Using the base sample reproduce layers from carton boxes in total base thickness 7cm. Students must calculate how many layers are needed depending on the thickness of carton boxes. Subsequently students start assembling the base of the planned artefact placing layers of carton boxes one on top of the other using paper glue just like placing the layers of your favourite cake! *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	90 minutes
Putting Everything Together!	When the base surface has been completed, students fill the 4 plastic bottles with water and put them in the 4 perforated holes. Then a small hole is perforated in the 4 corners of the rectangular aluminium baking tray, using a sharp hand tool (under adult observation). After that 4 thin rope strings are cut in the same length (approx 50cm). One end of these 4 rope strings is placed around the neck of each plastic bottle and the other end of it is driven through the small hole in each corner of the rectangular aluminium baking	30 minutes

	tray. The next step is quite a challenge! We can't stress enough the fact that the rectangular aluminium baking tray MUST be horizontal and have symmetrical distance from each plastic water bottle. In order for the students to succeed in doing this, constant adjustments of the thin rope must be run. A safe way to ensure that all has been properly run, is by checking whether the rectangular aluminium baking tray shakes completely free no matter which direction it is pushed. *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	
Motion Time!	Students add all electronic and mechanical equipment according to their decisions in the decision making phase, in order to achieve motioning the rectangular aluminium baking tray in random directions and shake it in random "waves" using the 3 servomotors. The students are encouraged to be creative and find the right place for the 3 servomotors themselves by applying the principle of trial and error! *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	1 hour
Let's put it into test!	The plastic membrane sheet is placed in the rectangular aluminium baking tray covering the bottom as well as the sides so that it is not necessary to clean the bottom of the tray each time using it. An A4 sheet of paper is placed on the plastic membrane. Then the 3 glass or metal spherical balls are scattered at a random order on the A4 sheet and subsequently drops of different water colours are poured randomly. The motion mechanism is then run for a few seconds. Then the A4 paper is let to dry and the whole procedure is repeated once more with a new A4. Students need to observe that the patterns in these two A4 papers are identical, so they have to face this challenge by finding a solution to the problem, since the challenge is that the patterns need to be different for each new A4 paper. Useful Tips: - use the rubber bands or - change the frequency of the servomotor or - change the shake wave length. *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	45 minutes

Proliferate Artists!	After running some successful tests it is time to produce inspired paintings. Students are free to experiment: 2 spherical balls, 3 different water colours, 5 different water colours? The possibilities are endless! The sky is the limit! You'll be amazed to notice that all A4 papers WILL have completely DIFFERENT UNIQUE patterns. *Important Notice: Photos and video recordings by using a mobile phone or a tablet are essential.*	1 hour

Assessment

In order for this LS to be successfully applied it is not necessary to run a quiz or something similar. The "key" is students to learn on their own, to gain experience and to apply theoretical knowledge from various disciplines in practice so as to solve real, tangible problems.

An alternative approach:
- A portfolio evaluation will be carried out, allowing continuous monitoring of the students' progress (photos, video, reports).
- Recorded digitales (short interviews depicting students' impressions) using a mobile phone or a tablet.

Important Notice: Attention to GDPRS protocols.

Student feedback

When the artefact construction is completed:

a) the teacher(s) will explain to all in brief the theoretical background used to construct the artefact

b) students and teacher(s) will discuss:

- the project as a whole (problems, equipment efficiency, satisfaction gained, overall opinions, difficulties encountered, solving patterns etc.)
- alternative solutions
- possible improvements of the present construction
- goal fulfilment
- ideas for similar future projects (eg. painting gravity, painting the rain etc.)
- quality of collaboration
- problems encountered

Teachers' remarks

Construction of the artefact should be supervised by a teacher/(s) at all times and instructions should be provided when required.

Use of tools and materials must be closely attended by teachers in terms of safety.

The artefact is also possible to be constructed exclusively from recycling materials – see Annex.

Although this very construction has not yet been constructed in the form it is presented in this LS, the writer of the LS along with a student team has already constructed a forerunner similar artefact from exclusively recycled materials – see Annex.

Not all construction parameters can be catered for in this LS, as it is significant to point out that the actual construction process is dynamic and each time it is conducted it is certain that students will OBSERVE different things when problems arise and will find the appropriate solution possibly through alternative paths of action.

About Scientix

Scientix, is the number one community for science education in Europe. It aims to promote and support a Europe-wide collaboration among STEM teachers, education researchers, policymakers and other educational stakeholders to inspire students to pursue careers in the field of Science, Technology, Engineering and Mathematics (STEM).

Annex(es)

The forerunner artefact was primarily constructed from exclusively recycled materials during the 2021-2022 school year and won 1st price in a National Competition. Relevant information is provided below:

- https://drive.google.com/file/d/1qqiBxjBlZlNLem8Egv9rijmT-UGvM15s/view?usp=sharing
- https://drive.google.com/file/d/1p09t-1XogWM_LMySyNKM1ZZiDyHMLE_c/view?usp=sharing
- https://drive.google.com/file/d/1fFDJZzZmoViT0fK-f3gYtcSJDE-l8_2t/view?usp=sharing
- https://drive.google.com/file/d/1porUpo_Z5zGXZprUjSJrv2DuPGVHcWdn/view?usp=sharing
- https://drive.google.com/file/d/1lj9zg2hmLhrGGtgYk8w_h1ZBN_gBSm67/view?usp=sharing
- https://drive.google.com/file/d/1dngpSO2nTxM7kdT0SUu_CZPYGJejTgIe/view?usp=sharing
- https://drive.google.com/file/d/1Tah5Mv6ujUqDZ7MmXHpQCB_2lASzuNRo/view?usp=sharing
- https://drive.google.com/file/d/1VhLE1KH8L-CGAxqBVQXPMy20XjQi9N_e/view?usp=sharing
- https://drive.google.com/file/d/1nkkgypUZAsLw-Jiv5j8Gw2osOng2sbxr/view?usp=sharing

- https://drive.google.com/file/d/1ExvZD9wJy066MXK_sny2iQEayfmslwrs/view?usp=sharing
- https://drive.google.com/file/d/1_EnLTdZaj3B-TCRZ6NRAO0JKrXi39ShQ/view?usp=sharing