IO1. STEAMitUp Toolkit

Lesson Plans

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Overview of the Lesson Plans (Learning activities)

Various Interdisciplinary learning activities have been produced by the consortium which are embedded within a total of 12 Lesson plans of 2 teaching periods each. These can be freely used and adjusted to the needs of each course to promote STEAM education practices across EU.

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Lesson Plan 1

Course: Mathematics	
Lesson 2: Coding and Programming	
Area: Programming, Technology, Mathematics	
Number of students: 22 (2 classes with 11 students each)	
Date :13/10/2020 and 20/10/2020	
Grade Level: 6	Timeframe: 80 minutes

Lesson Overview (Please edit accordingly):

- In this course students are introduced to the concept of coding and programming, using programming software by programming the Robot Pro – Bot.

Objectives

At the end of the course students must be able to:

- Understand the concepts of programming and algorithms through specific examples.
- Program the robot Pro – Bot to solve various problems.
- Use various programming software to solve different educational missions-scenarios.

Material/ resources

- 3 computers
- 2 Robots Pro - Bot
- 5 Tablet

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- A.L.E.X. - free app
- Large cardboard (A1)

Activities

1. **Introduction (10 minutes)**
   Children are introduced to basic knowledge of control systems, algorithm and programming/coding, through different examples. Introduction to robots and the areas used.

2. **Presentation and engagement with stations (60 minutes)**

   The teacher presents the three stations with which the students will work.

   STATION 1: Students will work with Pro–Bot to schedule it to perform various missions on the activity mat.

   STATION 2: Students will work on A.L.E.X. programming software to fulfill missions. In the end, they design and plan their own educational mission.

   STATION 3: Students work on the computer through the www.code.org website, in order to program their hero to pass all stages.

   Note: Due to the health pandemic protocols there will be no rotation of stations.

3. **Repeat - Completion of the course (10 minutes)**
   Each student presents his work to the others. Geometric patterns can be exposed in the school lobby.

   Rating (5 minutes)

   Students are asked to fill out an online form in order to evaluate, reflect and self-assess their understandings and skills on the subject matter (available in Greek ONLY).

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https://forms.office.com/Pages/ResponsePage.aspx?id=z-jb7DjOmkS2fbqA5mVJGkiaFcr7yaROoqDpunL4nzlURVZSWkRBQVc2NlhWQVZVSFUxTTM4RUo2Qi4u
Instructions for teachers Through this course students are invited to code through the use of various programming software, ground robots and the code.org website. The activities require design skills, decision-making and cultivation of computational thinking through problem-solving. The teacher support and guides students through mentoring, as a medium to encourage students to work constructively and remain focus for the accomplishment of their goal.

Lesson Plan 2

Course: Mathematics	
Lesson 1: Geometry Solids – Relationships between edges, faces and vertices	
Area: Mathematics, Technology	
Number of student: 21 (10 & 11)	
Date:12/10/2020 and 19/12/20	
Grade Level: 6	Timeframe: 80 minutes

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Lesson Overview:

- In this course students explore three-dimensional shapes, learning their names, characteristics and exploring through illustration the relationship between edges, faces and vertices.

Objectives

At the end of the course students must be able to:

- Name, describe and classify three-dimensional shapes (cube, pyramid, rectangular parallelogram, sphere, cylinder, cone) using mathematical terminology (edges, faces, vertices) and associate them with relevant objects of the environment.
- Recognize and construct cube, rectangular parallels, prims and pyramids nets, using various means and software.

Material/ resources

- 5 sets of geometric solids
- Educational video: https://www.youtube.com/watch?v=t7-XsrSBIlc
- Website link: https://illuminations.nctm.org/Activity.aspx?id=3521
- Website link: https://www.learner.org/wp-content/interactive/geometry/eulers-theorem/

Activities

1. **Reflection (7 minutes)**
   The following scenario is presented to children: They should teach children of younger ages the three-dimensional shapes, a concept that, in order to be understood, needs children to have hands-on experience and experiment with the material. Due to the lack of educational materials in school, the students have to co-create their own artefacts. The teacher, therefore, asks the students to study the geometric solids, which will be the subject of their lesson.

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2. **<u>Reflection on previous knowledge</u> (8 minutes)**
   Students use various geometric solids and they try to group them according to their characteristics (prisms, pyramids, cylinders, cones, sphere). Then, they write their names on stickers.

3. **<u>Exploration of geometric solids and discovery of the relationship between the edges, faces, and vertices (40 minutes).</u>**
   Students enter the https://www.learner.org/wp-content/interactive/geometry/eulers-theorem/ website and explore the spreads, edges, faces and vertices of geometric solids. Then, they complete Worksheet 1.

4. **Construction of geometric solids using materials (15 minutes)**
   Students construct geometric solids using different geometric shapes. They choose the appropriate shapes (triangles, squares, etc.) to construct the geometric solids requested and complete Worksheet 2.

5. **<u>Revision (5 minutes)</u>**
   Through the use of a relevant software, the teacher revives the knowledge acquired by the students during the teaching course and provides Euler's Theorem. Suggested application via https://www.learner.org/wp-content/interactive/geometry/eulers-theorem/ ed.

6. **Assessment (5 minutes)**
   Students are evaluated through a short test using Quizlet, where the teacher can easily and quickly get the results and see whether the course objectives have been achieved
   https://quizizz.com/join?gc=28788642

Instructions for teachers

The geometry course is one of the most difficult to understand topic of mathematics and makes it difficult for students to comprehend the elements of

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geometric solids. This is why through this course students will have the opportunity to interact with geometric solids in various ways: Through experimentation with real solids, the use of technology and construction using different materials.

In this way, the students will have the opportunity to explore geometric solids, discovering their capabilities and developing a greater understanding of 3D geometry. Thus, the course will meet the needs of all students, but at the same time will enhance the interest and motivation of the students. The teacher will support and guide the students, providing adequate feedback when needed.

Lesson Plan 3

Course: **STEAM**	
Lesson: **Spread of Virus and Face Masks Creation**	
Area: **Science, Technology and Art**	
Grade Level: **8-9** (ages 13-15)	Timeframe: **90 min** (2 didactic hours)

Lesson Overview:

Six activities for two didactic period of 90 min include how germs and viruses are spreading, how we can measure virus contagious, and how we can stop them from spreading. One of our practices to stop germs from spreading is to use a face mask. So, in this lesson plan we give guidelines on how to design and create face masks for each student using unused and cheap materials.

Objectives:

Upon completion of this Lesson students will be able to:

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- Describe how germs and viruses are spreading
- Explain how to stop viruses from spreading
- Measure the virus contagious according to "r0" (mathematical problem)
- Identify the technology and the materials used for face masks
- Design a personal artistic shape of a face mask
- Create a simple face mask for protection (hands-on activity)

Material - Resources:

- Interactive boarding application (optional): e.g. padlet, lino etc.
- How do germs spread (Infographic): https://visual.ly/community/Infographics/health/how-do-germs-spread
- How can we stop virus from spreading?
- How do air filters work? (YouTube video): https://www.youtube.com/watch?v=WhiTlkZlwl4
- How coronavirus spreads through a population and how we can beat it (Simulation): https://www.theguardian.com/world/datablog/ng-interactive/2020/apr/22/see-how-coronavirus-can-spread-through-a-population-and-how-countries-flatten-the-curve
- CDC on Homemade Cloth Face Coverings (Instructions): https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-make-cloth-face-covering.html
- How to make your own face mask
- Face mask differences (Project: Protect Instructions): https://projectprotect.health/#/
- WHO - Coronavirus disease pandemic (Info): https://www.who.int/emergencies/diseases/novel-coronavirus-2019
- Material: Old t-shirts, pens-markers, scissors, rubber bands, strings (for the mask creation)
- Free Resources and Lessons for COVID-19 https://ngl.cengage.com/assets/html/covid19

Lesson Activities:

The plan can be completed in two didactic hours, the first one with 3 activities related to the germs - virus spreading and the second with also 3 activities related to the technology - materials of a face mask and its design - creation.

1. Brainstorming on how germs and viruses are spreading (15')

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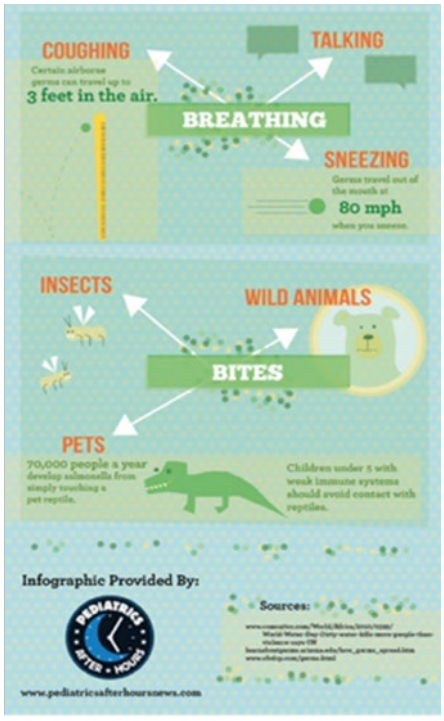
The teacher explains the differences between germs and virus and starts a small brainstorming session with the students that share their ideas and them dividing them into categories, about how germs and viruses spread (e.g. touching, eating, drinking, breathing, bites).



After the discussion s/he presents the *proposed infographic*, comparing their findings with the facts of the infographic. S/he can also distinguish the spreading of covid-19 through contact and in the air, and not by pets and insects. They also discuss, as a short reminder on how we can *stop covid-19 from spreading*.

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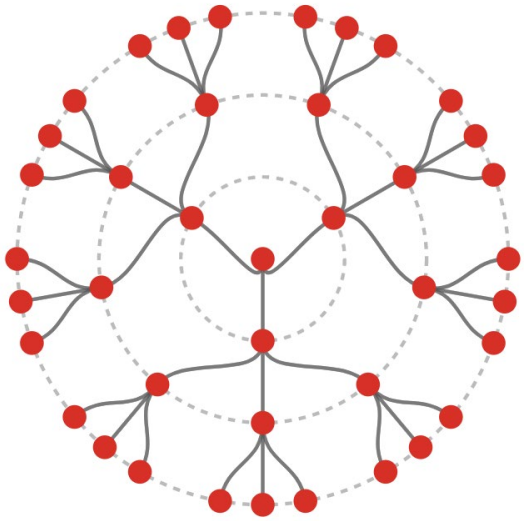
2. Simulation and measurement of how coronavirus spreads through a population (25')

During this activity students form small groups and try to measure how contagious virus can be. Students, with their teacher's help, measure the most usual basic reproduction number (r0 as an integer to make this simpler), which indicates how many new cases one infected person generates.



Students will be asked to find a mathematical expression for calculating the infected person according to the r0 parameter and the number of phases (in the figure r0=3, phases=3 and 39 people infected by the 1st in the center).

3. Our means to stop germs from spreading (5')

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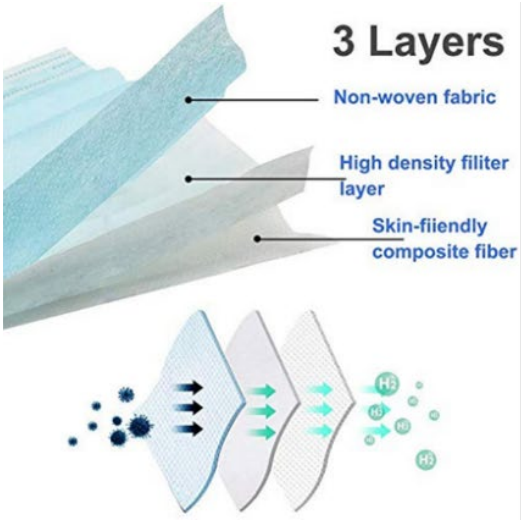
A small closing discussion about what and why do we use in order to stop germs from spreading (soap, alcohol-based solutions, bleach, face masks) and what we don't use! Students can also watch the following YouTube video: "How do air filters work?": https://www.youtube.com/watch?v=WhiTlkZlwl4

4. Technology and the materials for face masks (5')

The teacher presents 2-3 slides that aim to excite students' imagination on how many types of masks there are, what materials they are made of, and the different uses.



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Face Mask Differences

*Project*Protect
In partnership with Intermountain Healthcare, University of Utah Health and Latter-day Saint Charities

Type	Protection	Appropriate for	Use Guidelines	Reuse	Fabrication
Homemade Cloth Mask	May protect the wearer and those around them from large droplets coming from coughs or sneezes	For community members following use guidelines	Wearers should practice physical distancing, handwashing, and avoid touching their faces	Can be reused when properly cleaned.*	Can be easily made at home using breathable materials such as cotton or cotton blend
Clinical Mask	Resistant to fluids and will filter small particles	For frontline health workers	Health workers should follow institutional protocol	Health workers should follow institutional protocol	Must be made using medical-grade polypropylene following fabrication guidelines
N95 Respirator	Filters 95% of very small particles when tightly fitted	For frontline health workers. Community use is discouraged so more masks are available for healthcare workers.	Requires professional fit-testing to be fully effective	Extended use or reuse requires following CDC guidelines	Manufactured using specialized materials and processes

*Cleaning instructions for homemade cloth masks

- To wash, launder the mask often in your washing machine in HOT water using soap or detergent that leaves no residue.
- Dry on HOT in your dryer.

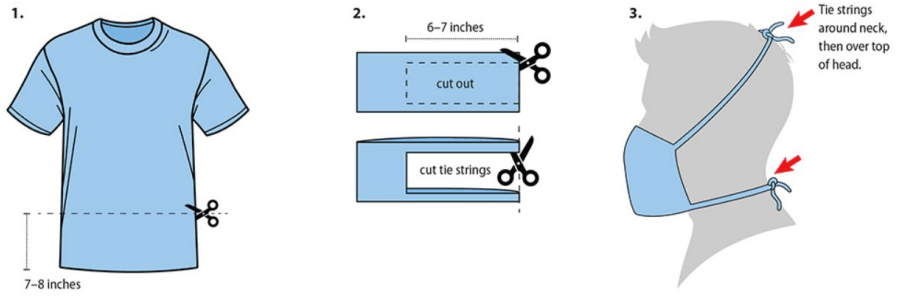
5. Face mask design (20')

Design one face mask for each student in small groups, with unused or cheap materials (e.g. old T-shirts, pens-markers, scissors, rubber bands, strings etc.). Students could design a digital artifact for their mask and print this outsource. This activity could be more structured if an Art teacher could co-teach the lesson.

6. Face mask creation (15')

The creation of the masks could follow the guidelines given by WHO or Intermountain Healthcare, University of Utah Health and Latter-day Saint Charities.

Tutorial



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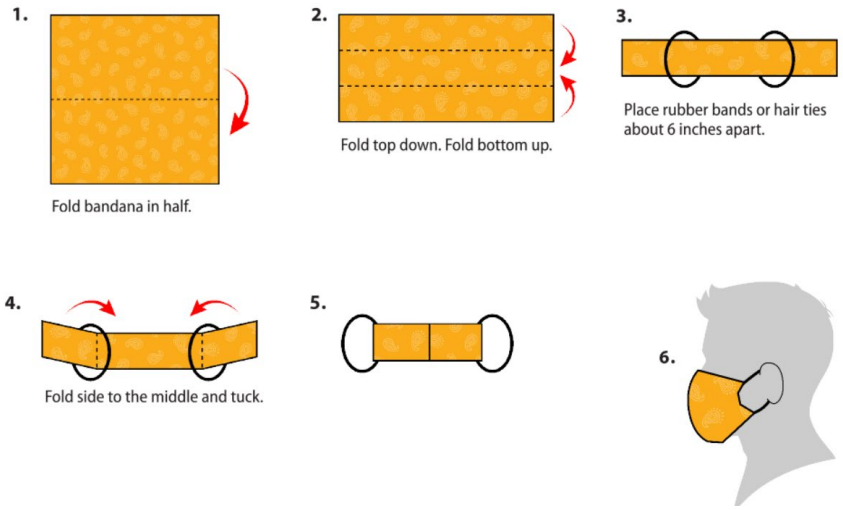
Tutorial



At the end of this lesson plan, students will be able to share the opinions (another way is to create a short evaluation form for students to express their satisfaction).

Instructions for teachers

The main methodologies and techniques of the course are based on brainstorming, discussion, collaboration, information access, problem solving, teamwork, and minimal time of presentations.

It is important for the teacher to challenge the ideas of his students, retrieving their previous knowledge and then comparing them with the existing sources and facts, focusing on possible misconceptions.

The most important approach is to design a personal face masks for each student, which can be created in collaboration within small groups.

There are no assessment activities, only comparisons with good practices.

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Lesson Plan 4

Course: STEAM course	
Lesson 1: Balloon Tower Challenge	
Area: Physics, Engineering, Mathematics, Art	
Grade Level: Primary School (years: 2-4)	Timeframe: 45 min – 1 hour

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Lesson Overview:

- Students are asked to build the tallest, most cost-effective, free-standing tower using only balloons and paper tape. The classroom is divided into groups of four. The teacher provides them with the appropriate material and give them instructions on how they will work. Each student is assigned with a specific role, as in order to build a stable and tall tower they will have to work as a team that each of its members will be responsible for a certain part. In the groups of four there are 3 roles: the architect that draws and calculates the tower's height, the 2 builders that are responsible for constructing the tower following architect's instructions and the economist whose role is to calculate and advise his/her team on how they will spend their available resources. Moreover, when they use the balloons and the paper tape pieces they have to be careful as 'they have to pay'. At the end the team that wins the challenge is not only the one who built the tallest tower but also the one who spent less money.

Objectives:

Upon completion of this Lesson students will be able to:

- Understand why it is difficult to build a stable tower using balloons (physics)
- Calculate the height of the tower using the appropriate equipment (math)
- Understand the importance of resources
- Understand the different roles in teams and in jobs and how important each of them is
- Work during limited time, more concentrated using organizational strategies

Material/ resources

- Balloons (multi-colored)
- Paper tape
- Ruler
- Blank sheets

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- Pencils
- Eraser

Lesson Activities

1. Assigning Roles (5 minutes)

   This lesson plan can take place either in the classroom or in the laboratory, in both cases teacher has to make sure that students have enough space in their tables in order to build their towers. In this first activity students, in groups of four, discuss and choose the role they want to have in their team. Each student describes his/her interests and tries to find the role that fits more to him/her.

2. Designing (10 minutes)

   The team has 10 minutes to design the tower. In this activity the whole team discuss, and the 'architect' is responsible for drawing the tower. If team has enough time and they wish, they can decide on which colours they will use so that they will make their tower look more appealing. However, during this activity it is important to remember that the most important element is the stability as due to the lack of weight it is not an easy task for the tower to be stable.

3. Building the tower (20 minutes)

   Now the teams are ready to start building the tower. They will have only 20 minutes, so in this case they should also work carefully and all together. In this activity students will understand important concept of physics and also, they will have to manage the given time. Students will 'buy' their materials by the teacher. That means that they also have to be careful on how much money they spend. At the end of this activity, students use their rulers so as to calculate the tower's height.

4. Calculate the cost (10 minutes)

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In this last activity, the team reports to the economist how many balloons and paper tape pieces they used. Then the economist sums the money spent.

At the end of the activities, teacher could ask his/her students which tower is more appealing to them. The tower that got the most votes wins 10 extra points.

Instructions for teachers

- In each stage the teacher is responsible for following the course of this lesson plan. Students are asked to work in teams with separated roles. This lesson plan is a project-based lesson.
- For the assessment the teacher fills out the following table. The team that has a stable, taller and most effective tower wins the challenge.

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Points will be awarded as follows:

Height of Tower	Cost Efficiency
Tallest tower – 15 points	Cheapest tower – 15 points
2nd tallest – 13 points	2nd cheapest – 13 points
3rd tallest – 10 points	3rd cheapest – 10 points
4th tallest – 8 points	4th cheapest – 8 points
5th tallest – 6 points	5th cheapest – 6 points
6th tallest – 4 points	6th cheapest– 4 points
7th tallest – 2 points	7th cheapest – 2 points
8th tallest – 1 point	8th most expensive – 1 point

Reference list (include if needed)

- N/A

Other Comments

Costs

- Balloons: 2€/ balloon
- Paper Tape: 1€/ piece

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Lesson Plan 5

Course: STEAM in the classroom	
Lesson: STEAM Females	
Area: STEAM females in computer programming (Technology and combination or areas)	
Grade Level: 5-6th Class (10-12 years)	Timeframe: 2 x 40 minutes

Lesson Overview

- Students will research STEAM role models with a focus on female role models of the past initially. They will research those making a contribution to science past and present using a WebQuest challenge. They will research their biography including background, education, career path and achievements and impact on the STEAM industry. They will analyse the potential role model for characteristics, choices and decisions that impacted their knowledge, skills and attitudes critical to their success. They will also consider any other influences critical to the STEAM female's success based on their research including challenges as well as supports. This first challenge focuses on Ada Lovelace and computer programming.

Objectives:

Upon completion of this Lesson students will be able to:

- Identify potential Female Role Models in the STEAM industry (past and present).
- Identify STEAM pioneers who shaped the course of history.
- Analyse the career path of potential role models for critical decisions that impacted their career path.

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- Identify and list any critical factors that improve the chances of success in a career trajectory.
- Describe the key achievements of the scientist.
- Identify any potential role models in the life of the STEAM expert.
- Research, identify and describe the contribution of the expert to their field of interest.
- Consider if they are interested in any aspects of the STEAM career or imagine themselves in any part of the field.

Material/ resources

1. Laptop and interactive white board or computer lab.
2. Record the evidence in an online format.
3. Web sources of interest:
   - Britannica (2020) {https://www.britannica.com/biography/Ada-Lovelace}
   - World Science Festival (2013) https://www.worldsciencefestival.com/2013/10/happy_ada_lovelace_day/
   - Wilpott, Z. (2017) Ada Lovelace The Original Woman in Tech, TedX Bucharest, (2017)https://www.youtube.com/watch?v=1QQ3gWmd20s
   - Evans, Claire, The Story Behind The World's First Computer Programmer, https://www.youtube.com/watch?v=Tkg8FdwfvlU
   - Sullivan, Crystal (2018) "Ada Lovelace The First Computer Programmer" https://www.youtube.com/watch?v=IZptxisyVqQ
   - Adafruit Industrie, (2020) https://www.adafruit.com/about (Adafruit industries, 2020)

Lesson Activities

Identifying Significant STEAM Females of the past and present (2 x 40 minutes)

Students will be challenged to research STEAM females of the past and present beginning with Ada Lovelace.

Using a WebQuest challenge. Students will research STEAM Female biography including background, education, career path and achievements, impact on the STEAM industry. They will analyse the potential role model for characteristics,

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choices and decisions that impacted their knowledge, skills and attitudes critical to their success. They will also consider any other influences critical to the STEAM females success based on their research including challenges as well as supports.

- Setting: Classroom based using interactive whiteboard and iPads or a computer lab.
- Project based Learning
- Group work and research work
- Standard elementary class group 25-27 children.
- Ages 10-12 years.
- Using digital competences,
- Developing Information and Data Literacy, browsing, searching and filtering data, information and digital content.
- Communication and Collaboration
- Digital content creation through
- Problem Solving through research-based methods.
- Evaluating the evidence generated by an investigation.

4. **Identifying Significant STEAM Females of the past (Ada Lovelace) (40 minutes).**

Students will be challenged to research STEAM females of the past and present beginning with Ada Lovelace.

Using a WebQuest challenge, students will research STEAM Female biography including background, education, career path and achievements, impact on the STEAM industry. They will analyse the potential role model for characteristics, choices and decisions that impacted their knowledge, skills and attitudes critical to their success. They will also consider any other influences critical to the STEAM females success based on their research including challenges as well as supports.

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5. **Identifying Significant STEAM Females of the past (Ada Lovelace) (40 minutes) Assessment.**

Students will be assessed based on how they carry out the investigation in the form of a WebQuest in pairs/small groups of 3 (depending on the class size). They will be observed and assessed as they investigate and inquire through web searches and discussion. They will also be observed in their planning, identifying of alternatives, and assessing/evaluating the information as well as in the context of the digital competences.

Student's learning will be **assessed** using **the digital competence framework** and using their response to the learning objectives:

- **Information and data literacy:** in the context of the WebQuest, observe and assess how students locate and retrieve data, the decisions they make on storing, managing and organising the content one of the most critical aspects; evaluating its relevance.
- **Communication and collaboration:** students will be communicating and working in the classroom as well as online on the digital platform. How the students work together in class and on the digital platform, how they share their research digitally, and make decisions on how they present their research should be observed. Students should be aware of behaving responsibly online, and will be observed in how they demonstrate this, this is described as "netiquette".
- **Digital Content Creation:** students will observe content online and respond accordingly, creating their own records through completing the WebQuest. At the end of the WebQuest, the students can be asked to develop an infographic, showing the timeline and key points in Ada's career. With this output at the end, teachers will observe the process by which students assess, interpret the data, modify, and add their own viewpoint and knowledge to the existing body of online data. In summary the re-interpretation of data and integration of new ideas, opinions or viewpoints.

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- **Safety:** Students will demonstrate awareness of staying safe online, assessing awareness of following safe online practices, keeping identity safe, etc.
- **Problem solving**: the overall task enables students to engage in problem solving and inquiry-based learning; in this case a digital means which can be assessed. Students gain awareness of their own digital competence, and their ability to work together on task.

Reference: EU digital competence framework 2020: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

Instructions for teachers

Using the WebQuest challenge to research STEAM female role models, teachers can adapt the lesson to suit the learning styles of the students. The web research provides visual learners with visual material, videos, diagrams, representations of data on the subject. At the same time, aural learners can listen to the information being shared online, hearing the data on the subject. All the while, the experiential learner is engaged in the whole process. The project-based and enquiry-based learning brings all learning styles together in the group task.

It is important for the teacher to demonstrate what is required, using a search engine for a specific idea/article prior to issuing the challenge.

The teacher then completes the following steps:

1. Ask all students if they know what computer programming is? Ask them to share their ideas and definitions with the class.
2. Read aloud the challenge, while displaying the WebQuest on the interactive board. If delivering the session in the computer lab, teachers need to demonstrate where the students need to go online, following the challenge. The teacher should use the WebQuest challenge worksheet in hard or soft copy.
3. Read aloud the scenario from the WebQuest challenge:

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(Today you are going to travel back in time to research who the first computer programmer was. Imagine this person was the beginning of the computer technology you have in your hands! Without this person, you might not have computers, mobile phones, televisions and more!

You are using this persons' invention and so begin by searching for them and bring back as much relevant information as you can)

4. Open the search engine and look for the world's first computer programmer.
5. What do you need to find out about this person?
   - **Background**, education, career path and achievements, impact on the STEAM industry.
   - Any potential role models or people in their life who influenced them.
   - Look for characteristics, choices and decisions that impacted their knowledge, skills and attitudes critical to their success.
   - Did the challenges impact their life choices, their career?
   - What may have been their sources of inspiration?
   - Do you think they enjoyed the work they did? Why?
6. From the research, guide students through how to develop a poster or infographic to display what they have learned in this session. This poster can be developed online, using Canva for example, or if there is insufficient access to IT resources, students can draw their poster or infographic using paper, colouring pencils and markers.
7. Once all of the poster and infographics are completed, the teacher should take the work of each group, and mount the posters on the walls of the classroom, or of the school hallways, so as to encourage other classes and students to learn about STEAM Females**.**

Reference list (include if needed)

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- European Commission (2019) EU "Digital Competence Framework" EU Science Hub retrieved from {https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework}
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- Smith, Marash, Claire, Happy Ada Lovelace day (2020) retrieved from {https://www.worldsciencefestival.com/2013/10/happy_ada_lovelace_day/ }
- Sullivan, Crystal, (2018) Biographics "Ada Lovelace The First Computer Programmer" https://www.youtube.com/watch?v=IZptxisyVqQ

Handout:

THEME ALLOCATED:	STEAM females of the Past
TITLE OF THE WEBQUEST:	A Journey to meet the First Computer Programmer
INTRODUCTION	

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What do we mean by computer programming? Do you have any ideas that you would like to share with the class? Computer programming is what we use to tell computers, iPads, tablets and other devices what is it that we want them to do. It is a set of instructions and commands that we give to our computers. A computer programmer is someone who writes these instructions for the computer. In order to do this, they need to learn how to think like and communicate with the computer.

Looking around your classroom, can you identify IT devices that may have some 'programming'? Discuss this with your teacher!

TASK

Today you are going to travel back in time to research who the first computer programmer was. Imagine this person was the beginning of the computer technology you have in your hands! Without this person, you might not have computers, mobile phones, televisions and more!

You are using this persons' invention and so begin by searching for them.

Once you have found out who they are, you need to undertake a journey to bring their memory into the present day! For this, you will need to research all about their lives, find out what led them to be the first computer programmer, and then you will design a flyer (either online if you can, or on pen and paper) to show what you have learned about the first computer programmer!

This is your way of honouring their memory and celebrating the gift that they gave to the world – technology! Bring back as much relevant information as you can!

PROCESS

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Step 1: The Mystery Programmer:

The first step is to find out who we are talking about! In teams of 2-3, you will search online for the person considered "the first computer programmer".

Once you have found this person, investigate their life!

Research their background, education, career path and achievements. You might find some of the following links useful:

- Ada Lovelace Biography, Britannica (2020) - https://www.britannica.com/biography/Ada-Lovelace
- World Science Festival (2013) https://www.worldsciencefestival.com/2013/10/happy_ada_lovelace_day/
- Ada Lovelace The Original Woman in Tech, TedX Bucharest, (2017): https://www.youtube.com/watch?v=1QQ3gWmd20s
- Evans, Claire, The Story Behind the World's First Computer Programmer, https://www.youtube.com/watch?v=Tkg8FdwfvlU
- Sullivan, Crystal, (2018) Biographics "Ada Lovelace The First Computer Programmer" - https://www.youtube.com/watch?v=IZptxisyVqQ
- Editors (2020) Computer history museum, Ada Lovelace retrieved from https://www.computerhistory.org/babbage/adalovelace

Step 2: Meeting a Hero!

Great, now you know that Ada Lovelace is the first computer programmer. Now that you have a name, next you and your team should get to know a little about this STEAM hero. Imagine what she was like as a person! From the research you have conducted, find and list her characteristics. Try and answer the following questions in your group:

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- What was she good at?
- What special knowledge and skills did she have?
- How did she learn everything she needed to know to be the first computer programmer?
- Do you think she enjoyed what she was doing?
- Can you find a significant life event that may have led her to this career?

Step 3: Create a flyer or infographic

Ada Lovelace was very inventive; she lived her life as an innovator. Can you suggest creative ways in which you can present your findings about Ada?

For example, you could create a poster with a timeline of her greatest achievements. Or an infographic that presents her 'curriculum vitae'. Or you could write a short report on her life. Whatever you decide, the following links might be useful to help you get started:

- [VIDEO] Make an Infographic In Canva for Kids: https://youtu.be/PiCflxcWasc
- Canva – Kids Poster Templates: https://www.canva.com/templates/search/kids-posters/
- Design Cap – Kids Poster Maker: https://www.designcap.com/poster/kids.html

EVALUATION

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Quiz - Answer the following questions in your group:

1. From what you have learned; why is Ada Lovelace considered the first computer programmer?
2. Name as many devices as you can that you think use some form of computer programming.
3. Who were Ada's role models?
4. Was Ada's work respected in her lifetime, give your opinion and explain your viewpoint.
5. Has Ada's contribution to science been marked in any way?
6. If Ada Lovelace were around today, what global challenge would you like to ask her about and why?
7. If you could invent something what would it be?

CONCLUSION

Congratulations! You have completed your first STEAM WebQuest! Had you heard of Ada Lovelace before? On reflection do you think she has had an influence on technology?

If the world's first computer programmer were alive today what do you think she might say about the digital world? About science? About women in science?

Do you think there are people like her in the world today?

What other people can you think made contributions to the STEAM world.

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Lesson Plan 6

Course: STEAM Concepts	
Lesson: STEAM Concepts -Programmed	
Area: Pre-Robotics Lesson Plan	
Grade Level: 3rd-4th Class (8-10 years)	Timeframe: 60 minutes

Lesson Overview:

Children will learn the simple concept of coding and robotics, programming simple steps through role play and creative thinking. They will also look at references to simple code from past to present. Children will also discuss the implications of robotics for the future.

Objectives:

Upon completion of this Lesson students will be able to:

- Describe the simple concept of programming, coding and robotics-commands.
- Identify and define basic algorithm through simple tasks
- Use role play to illustrate how movement can be programmed
- Break down steps of programming and explore very simple concepts of programming.
- Analyse the human body as a structure that fulfils complex commands consistently.
- Consider robotics and the future

Material/ resources

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1. Laptop and interactive white board or computer lab.
2. Record the evidence in an online format.
3. Web sources of interest:

- Scratch (2013): http://www.scratch.ie/sites/all/themes/scratch_theme/resources/WorkBook2.0/SeperatedModules/Solutions/ALLsolutions2013_2.0.pdf
- Hackster.io Anavnet Community (2020) Projects Mindstorms: https://www.hackster.io/mindstorms/projects
- National geographic 2020: https://www.nationalgeographic.org/activity/how-train-your-robot/
- Crickit Flippy Robot: https://learn.adafruit.com/crickit-flippy-robot (adafruit 2020)

Lesson Activities

Children will learn the simple concept of coding and robotics, programming simple steps through role play and creative thinking. They will also look at references to simple code from past to present. Children will also discuss the implications of robotics for the future.

- Setting Classroom with interactive white board.
- Authentic learning, project-based learning using role play, creativity and web sources
- Engagement and active participation through hands-on practices
- Standard elementary class group 25-27 children.
- Ages 8-10 years.
- Monitor prior knowledge
- Wooden human mannequin, robotics, Lego.
- Link with the relevant digital competences

The project-based and enquiry-based learning brings all the learning styles together in the group task as the learners are introduced to Scratch through a simple lesson. It is envisaged students will use the weblinks provided to

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undertake some research into Scratch and come up with a project idea as a result of the initial lesson.

It is important for the teacher to demonstrate what is required, using a search engine for a specific idea/article prior to issuing the challenge.

1. Read aloud the project and introduce the topic of robotics and programming.
2. Display example of robotics and coding and simple projects on the interactive board.
3. If delivering the session in the computer lab, teachers need to demonstrate where the students can go online and make notes on their research.
4. The use of role play and an initial demonstration will be very important for illustrating the core concept of the lesson.

Assessment:

Students will be assessed based on how they carry out the investigation into robotics and simple coding specifically commands as they work in teams and as part of the group. They will be assessed on teamwork, their use of the role play and discussion skills to reflect on in conclusion about robotics and the future. Throughout the lesson they will be observed at certain points in the investigation, planning, identifying alternatives, breaking the steps and commands down, practical role play and evaluating as well as in the context of the digital competences when they research coding digital clips and media files on robotics.

The students' learning will be **assessed** using **the digital competence framework** and using their response to the learning objectives.

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Information and data literacy; observe and assess how students locate and retrieve data, the decisions they make on storing, managing and organizing the content one of the most critical aspects; *evaluating its relevance.*

Communication and collaboration, problem solving and creating the commands for digital content.

Instructions for teachers

1. Read aloud the project and introduce the topic of robotics and programming.
2. Display example of robotics and coding and simple projects on the interactive board.
3. Arrange the children into groups or pairs, introduce the topic of robotics and coding using the physical props in your room, robotics kits, wooden mannequin and the online clips.
4. Explain that for the robot to learn how to move or respond to any commands it needs clear definite appropriate direction delivered in a step by step fashion. Use the example of learning to dance. The dancer needs to know the steps.
5. Introduce a diagram of the body and compare it to the robot, explain that very simply the brain interacts with all the many systems of the body and provides the commands and signals to the body which in turn responds. The body is an amazing system and engages many systems and commands at the same time.
6. However, the body has learned to do this over time and just as a baby learns to do everything in stages, the robot will need to learn step by step.
7. Simple commands are the goal of today's task.
8. Ask the class to try to "floss", show the dance on screen, they are engaging two different parts of their body in opposite movements at the same time. Ask them to test the floss movement with their wooden mannequin and compare the results?

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9. The wooden mannequin does not have the flexibility and dexterity of the human body.
10. Ask the class if they would like a robot to assist them with any tasks. Limit the tasks to physical tasks like carrying a book. Ask for volunteers in the groups, one student role plays the scenario and the remaining student(s) call out commands to test instructing them to carry the book.
11. The volunteers cannot move without being given clear direction, they must imagine themselves as robots who cannot move, the other person is the brain or control centre telling each limb to move. Insist that there are no movements without clearly defined steps. They must imagine they are using their body to process and make these movements for the first time.
12. Refer to examples online of robot commands and act this out.
13. Ask the class to come up with a variety of tasks that they can role play.
14. Introduce the word “algorithm”, a set of tasks/steps in a sequence, explain that they have just role-played what an “algorithm” looks like. Ask them to look up this term. Remember to refer them to early computer programmers like Ada Lovelace, who they will learn about in the other lesson.
15. Ask them if they know any other words linked to computer programming?
16. Ask them to put these words into a search engine and discuss what these terms mean.
17. IF the robot had fallen, what might have been the problem? Following this, ask them to think about bugs and debugging if this has not arisen.
18. Ask them to look at simple examples of robotics online and share the links provided.
19. Ask the groups to come up with their own role play and their own list of steps-algorithm to accompany the task.
20. Ask the class to search for scratch coding online and find an example of simple scratch that you would like to investigate. Use the links suggested if useful.
21. Ask them to compare and contrast the language they have used in their scenarios with the language of the coding cited here.

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22. Ask them to make any modifications or adjustments based on what they are looking at. They will be taking a simple task and preparing it for Lego Mindstorms.

Reference list (include if needed)

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2. edX 2020 Robotics overview and courses {https://www.edx.org/learn/robotics}
3. Flipped Classroom Tutorials (2018) Scratch Coding a complete overview for beginners {https://www.youtube.com/watch?v=K0T7zuxEIgw}
4. Lego Discover (2015) How to program tutorial (learn to program tutorial) Lego Mindstorms 1 https://www.youtube.com/watch?v=81hctQt6Cp8
5. Lego Discover (2018) How to make your robot react (learn to program tutorial Lego Mindstorms -3 {https://www.youtube.com/watch?v=QYHYA-_d-8M}
6. Lego Education (2020) {https://education.lego.com/en-us/support/mindstorms-ev3}
7. Lego Education (2020) {https://education.lego.com/en-us/support/mindstorms-ev3/getting-started}
8. Lego Fantube (2018) {https://www.youtube.com/watch?v=gbLv0k40wrs}
9. MIT (2019) Scratch Overview {https://www.media.mit.edu/projects/scratch/overview/}
10. MIT (2020) Scratch community {https://scratch.mit.edu/}
11. MIT media lab (2017) {https://www.youtube.com/watch?v=_q2RgQMc96k}
12. MITK12 Videos (2016)How to make a video game {https://www.youtube.com/watch?v=Ex1ktxOxVgI}
13. National Geographic 2020 {https://www.nationalgeographic.org/activity/how-train-your-robot/}

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14. Out-school (2020) https://outschool.com/classes/introduction-to-robotics-build-and-program-a-real-robot-with-microbit-sUNQmOFw?sectionUid=ef066277-ad3e-4a7b-97b9-e931974b6953#abkc1zlb7w
15. Projects Mindstorms https://www.hackster.io/mindstorms/projects (National geographic 2020
16. Scratch (20213) Scratch Workbook Solutions http://www.scratch.ie/sites/all/themes/scratch_theme/resources/WorkBook2.0/SeperatedModules/Solutions/ALLsolutions2013_2.0.pdf
17. Scratch Ed (2011) intro to scratch https://www.youtube.com/watch?v=ywG6lv9mFLI
18. Scratch Ed Learn Share Connect (2020) (http://scratched.gse.harvard.edu/
19. Scratch Team (2017) getting started with scratch https://www.youtube.com/watch?v=ssoRNCtmhVM

Lesson Plan 7

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Course: STEAM	
Lesson 1: Build your own Salt Sculpture	
Area: Chemistry and Art	
Grade Level: Primary school (age 9 -11)	Timeframe: 30-40 min

Lesson Overview

In this lesson you will build an artwork on which you will grow salt crystals. You will keep a log over during the time the salt crystals are forming.

Objectives:

Upon completion of this Lesson students will be able to:

- Grow salt crystals and know how they are formed
- Understand what atoms are
- Keep a log of their experiment

Material/ resources

Please number all the instructional tools/resources material you will use in your lesson with a short title and source for copyright issues (include references were needed in the relevant section).

- Pan/kettle
- Kitchen Salt (400 gram)

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- Water (1 liter)
- Wire/Thread/Yarn
- Toothpicks/skewers
- Bowl
- Wisk
- Optional: colour pigment or dye

Lesson Activities

1. Growing Salt Crystals (40 min)

The salt crystals can be grown in the classroom or at home.

Building of the artwork:
Start with making artwork from wire/thread/yarn which should fit inside the bowl/container you are using. You can also use toothpicks or small wooden skewers or sticks to build your frame for the salt crystals to grow on!

Instructions salt solution:
- Bring water to a boil
- Add the salt and mix well till all the salt is dissolved (be patient, it might take a bit of time! Keep stirring)
- When all the salt is dissolved, pour the water in a transparent container/bowl
- Place your creation of wire/thread/yarn in the water so it is partly submerged or touches the water enough so it can suck up the water
- Place the container on a warm spot (in the sun or near a radiator)

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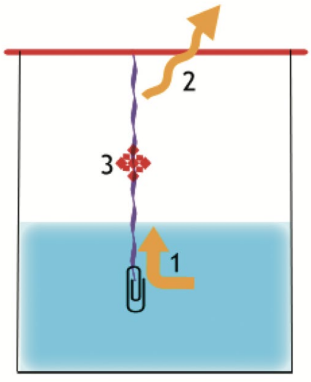
It can take a very long time before you see crystals forming: sometimes two or three weeks. That's why you need a little patience. But you usually see the first crystals appear after a few days. On a warm spot your crystals will grow faster since the water will evaporate faster.



How do salt crystals form?

1. The saline solution is drawn into the thread
2. The water evaporates due to the heat.
3. The salt remains, and these become salt crystals

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2. Keeping a log (2-3 weeks)

Scientists write very precisely how they conducted their experiments, often referred to as 'keeping a log'. Keeping such a log is very useful: you will know exactly what you did later on. Now that you are going to build a salt crystal yourself as a scientist, you should of course also make a log! For example, write a piece every day or take pictures of your crystals. You also write down everything that goes wrong in your logbook.

Instructions for teachers

Background information

The story behind your salt crystal

You now know how to make salt crystals, but what actually happens when you do that? Below you can read exactly what happens in your saline solution.

Water and salt are not alike. Salt consists of grains and water is a liquid at normal temperature. When we dissolve the salt in the water, we have a mixture. In that case, the salt particles float in the water.
As long as you use a little bit of salt, salt dissolves well in water. But if you dissolve a lot of salt in water, the water will be "full" at some point - no more salt can be dissolved. We call this a saturated solution. If you add more salt, the extra salt will simply remain in the bottom of your cup as granules.
You can compare it to a classroom where there are chairs, but where there are no children. If the teacher lets a few children into the room, they can all sit on a chair. But when the teacher puts a lot of children in the classroom, at some point all the seats are taken. The children who then remain must stand, just like the salt grains at the bottom of the cup.
After you make the saturated solution, put the solution on a warm one spot, causing the water to evaporate little by little. But because water evaporates, there is also less room for the salt to dissolve! The more water evaporates, the more salt becomes solid salt again. Think of the example of the

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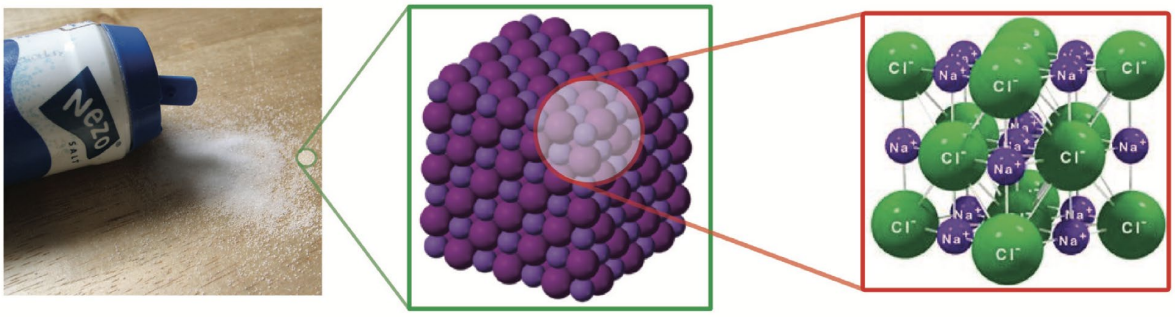
classroom; if the classroom is full and the teacher removes the chairs one by one, more and more children have to stand.

Maybe the children are not happy that they have to stand. But when salt can no longer dissolve, it forms salt crystals. And that's not bad, that's fun! A crystal is a solid that has a very regular structure. Below you see a picture of a salt crystal. Just look: all the balls are neatly attached to each other in the same way. We call these balls 'atoms'.



But what exactly are atoms? Atoms are the building blocks of everything you see: the whole world around you is made up of atoms. Atoms are enormously small, so small that you can no longer see them even with a microscope. Well, except with the very best microscopes. There are over a hundred different atoms and everything around you is made up of them. There are two different types of atoms in a salt crystal. We call these sodium atoms and chlorine atoms. They are always sitting next to each other, and also above and below each other, layer after layer after layer. In the picture of the salt crystal, the small spheres are the sodium atoms and the large spheres are the chlorine atoms.

If you make salt crystals by evaporating water, that crystal builds up slowly. One by one the sodium and chlorine atoms join together: atom after atom, layer after layer. The piece of crystal that you see in the picture is just a very small piece of a grain of salt: it contains many more atoms.

In real life, atoms have no color: not purple, not pink, not yellow, not green. We often draw them with a color, but that is because then you can clearly see the difference between the atoms.

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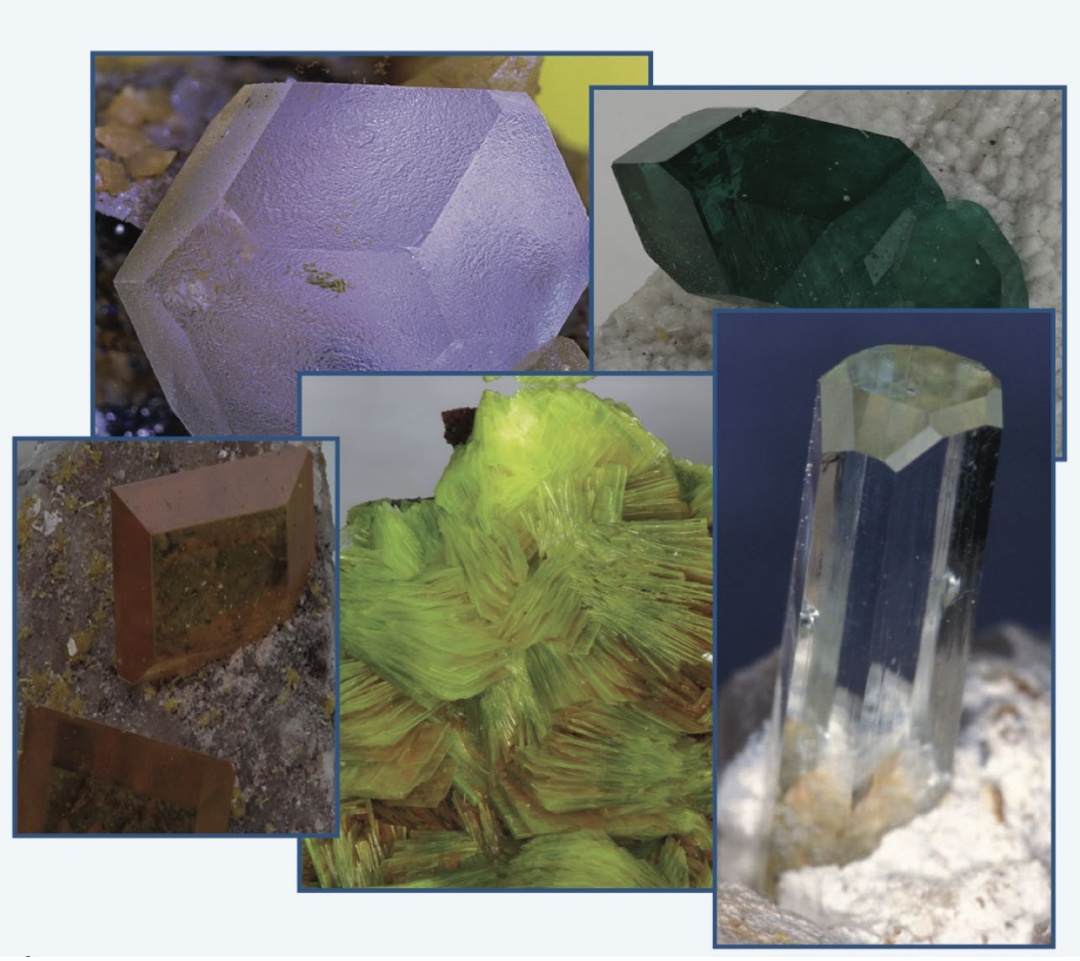
Back to the crystals: Crystals are also found in nature. Snowflakes are examples of crystals, but also gemstones such as diamonds are crystals that you can find in nature. In the pictures below you can see a number of beautiful crystals from nature. As you can see, crystals come in different shapes!



Crystals in science

Some scientists find it fun and exciting to look at crystals. But they don't look at the color or the shape, but how the atoms in the crystal are connected. And that

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differs from substance to substance: the atoms in a salt crystal are attached to each other very differently than the atoms in diamond.

Reference list (include if needed)

So, you now know what happens when you make salt crystals. Moreover, you know that crystals are not only beautiful, but also very useful. Do you want to know more? More information can be found at www.zoutkristallen.nl (in Dutch). Here you can find fun facts and stories about salt, such as where salt comes from and how it ends up on the table. Also here are the logs of other children and you can leave messages in each other's guestbook.

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Lesson Plan 8

Course: Acids and Bases	
Lesson: Colourful kitchen chemistry	
Area: Chemistry	
Grade Level: Primary School (from year 1)	Timeframe: 30-40 min.

Lesson Overview (Please edit accordingly):

- DIY kitchen science, to do at school or at home. Almost everything you need can be at home or at the supermarket. Anyone can do it, enjoy!
- two colourful experiments: 1. rainbow skittles and 2. colourful cabbage

Objectives:

Upon completion of this Lesson students will be able to:

- be curious to find out how things work, and see science is everywhere around them
- understand some chemistry behind colour changes
- know the difference between acids and bases

Material/ resources

Experiment 1, rainbow skittles:

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- Skittles
- plate
- boiling water

Experiment 2, colourful cabbage:

- a red cabbage (fresh or in a jar)
- a tablespoon
- a small bowl
- a pan
- a knife
- liquids you want to test for their acidity
- a glass

Please add the description of each Activity (150 – 200 words) including:

- Setting: the activities can take place either in a classroom, an outdoors place, or in the kitchen. They were in fact designed as experiments to be carried out at home but they could be implemented in various contexts.
- The activities are hands-on are designed based on a problem-based approach and experimentation that requires active engagement by the learners
- The activities are designed to be carried out in small groups (3-4 students) to maximize active engagement. They could be implemented in a classroom with a typical size of 20-25 students, and not more than 6 groups of students per one teacher.
- There is no prior knowledge that is required but observation and simple experiment skills are essential.
- The only materials required are the following for each group of students
  - a red cabbage (fresh or in a jar)
  - a tablespoon
  - a small bowl
  - a pan

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Lesson Activities

1. Make a drawing of a rainbow: what are the colours and in which order?
2. Place the Skittles in rainbow order at the edge of the plate (10 mins)
3. The teacher pours boiling water in the middle of the plate, until the Skittles are in water up to half-way. (5 min.)
4. Describe what is happening and ask how it works. Explanation: The heat of the water causes the dyes on the Skittles to become liquid and mix with the water.The dyes move most easily to places where there is no other dye, which is why the dyes move towards the centre.
5. When the water has cooled down you can eat the Skittels :)

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4

RAINBOW

HOW DOES IT WORK?

The heat of the water causes the dyes on the Skittles to become liquid and mix with the water.

The dyes move most easily to places where there is no other dye, which is why the dyes move towards the centre. This is similar to the way in which the black ink was pushed up by the water into the coffee filter.

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4

RAINBOW

WHAT DO YOU NEED?

plate

boiling water

Skittles

Did you know that red, orange, yellow, green, blue, indigo and violet are the colours of the rainbow? Make one yourself!

Step-by-step plan

1. Place the Skittles in rainbow order at the edge of the plate.
2. Ask an adult to pour the boiling water into the middle of the plate until the Skittles are in water up to half-way.

TIP! When the water has cooled down you can eat the Skittles!

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Colourful Cabbage (fresh)

1. Cut up part of the red cabbage into small pieces (teacher)
2. Put the pieces into a pan and add some water
3. Cook the cabbage (teacher)
4. Turn off the hob and let it cool down
5. When everything has cooled down, drain the red cabbage juice through a sieve into a bowl.

Colourful Cabbage (from a jar)

6. Skip step 1-5. Drain the red cabbage juice into a bowl or glass.

Now the real experimenting can begin!

Pour a little purple water into a glass and add a liquid that you want to test. For example, water, vinegar, lemon juice, soapy water or baking soda in water. The liquids change from purple to a different colour. They turn green/blue, purple or red.

7. Also fun: Mixing different colours. What happens now?
This is the most important step in assessing the students learning: what do they observe? Is this what they expected, and why? If not, why is it different?

Insert Assessment Activity Title (Timeframe)

Summative assessment at end of the lesson
Summative assessment is done through an online science quiz at the end of the lesson where students are asked to respond to various questions around the science concepts introduced in the activities. Below there are 4 indicative questions.

1. What causes the color changes? (Peha or acid base)
2. An acid can neutralize the base (true or false)

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3. A base can neutralize an acid (true or false)

4. What can the color of an indicator tell you about the substances added to it?

Formative assessment throughout the lesson:

Formative assessment will take place throughout the activities through two ways:

a) observations of the ways in which students engage with the activities (e.g., active role with experimentation, enthusiasm, interaction and collaboration with other students)

b) whole-group discussion around questions related to the process of experimentation as well as transfer of scientific knowledge to everyday life settings:

i) what did you observe?
ii) why did this happen?
iii) what would happen if we added more soap or baking soda?
iv) what happens when people have stomach-pain?
v) how is the water in swimming pools tests for its acidity?
vi) What are some things acids and bases are used to make?
vii) What makes a weak base?
viii) What makes a weak acid?
ix) Why is water important to acids and bases?
x) What are strong acids?
xi) What are weak acids

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2

COLOURFUL CABBAGE JUICE

WHAT DO YOU NEED?

All kinds of different substances can magically change the colour of red cabbage juice. Try it yourself.

- a red cabbage (fresh or in a jar)
- a pan
- a tablespoon
- a small bowl
- a knife
- liquids that you want to test
- a glass

Step-by-step plan
(fresh red cabbage)

1. Ask an adult to cut up part of the red cabbage into small pieces.
2. Put the pieces into a pan and add some water.
3. Ask an adult to cook the cabbage.
4. Turn off the hob and let it cool down.
5. When everything has cooled down, drain the red cabbage juice through a sieve into a bowl.

Step-by-step plan
(red cabbage from a jar)

1. Drain the red cabbage juice into a bowl or glass.

Now the real experimenting can begin!

6. Pour a little purple water into a glass and add a liquid that you want to test. For example, water, vinegar, lemon juice, soapy water or baking soda in water. The liquids change from purple to a different colour. They turn green/blue, purple or red.

Also fun: Mixing different colours. What happens now?

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2

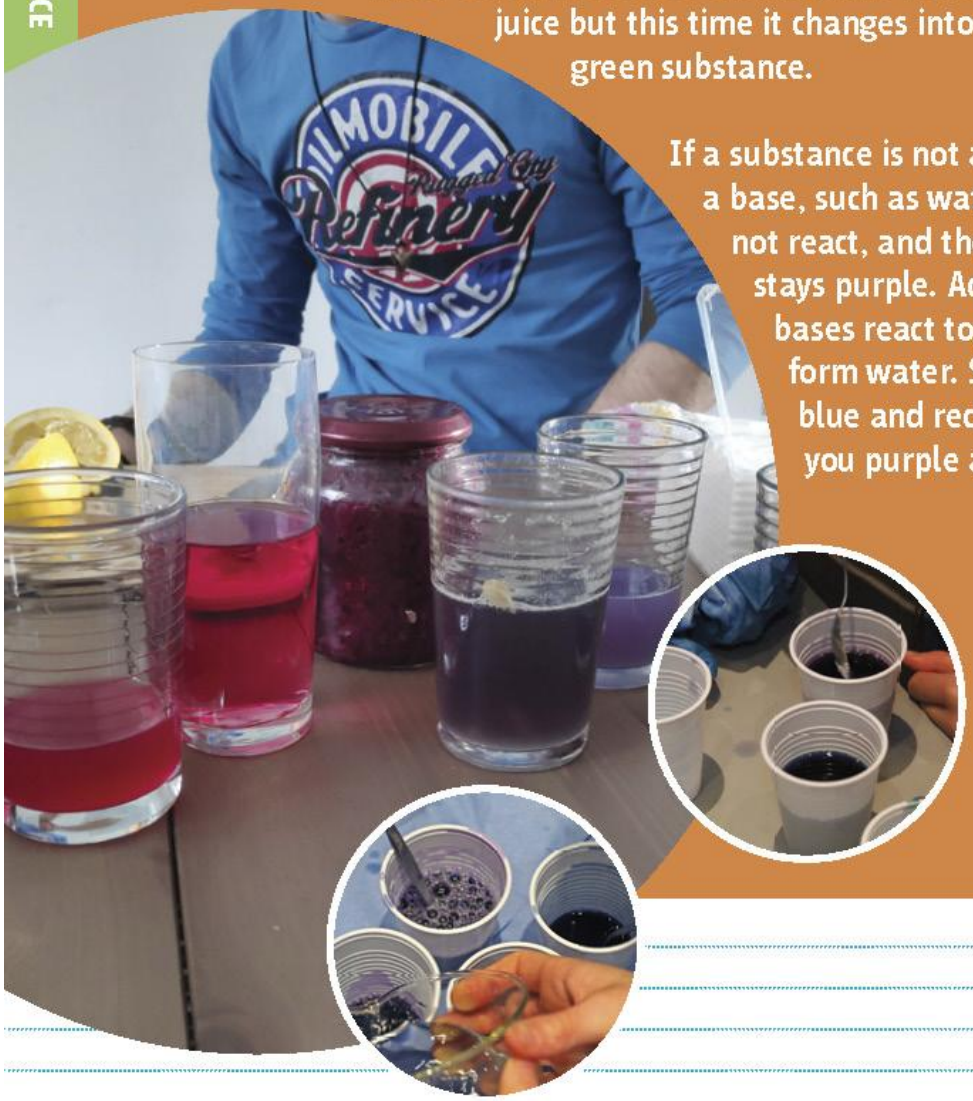
COLOURFUL CABBAGE JUICE

HOW DOES IT WORK?

The red cabbage juice is what we call an indicator. If you add acids such as citric acid or vinegar, the colour of the juice changes from purple to red because the substances in the red cabbage juice change into other substances with a red colour.

Baking soda and soapy water are the opposite of acids: bases. These substances also react with the red cabbage juice but this time it changes into a blue/ green substance.

If a substance is not an acid or a base, such as water, it does not react, and the juice stays purple. Acids and bases react together to form water. So mixing blue and red will give you purple again.



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Please describe (100-150 words) how teachers can:

The teacher acts as a facilitator walking from group to group checking for understanding through questioning with the group. Important decisions to make include the formation of the groups to ensure balanced interactions and power dynamics and assigning equally agentic roles to the students.

The teacher also provides feedback on the work-in-progress alongside positive reinforcement to each group.

Student scaffolding can be achieved through a series of questioning and assigning of mentoring roles within the group.

Student learning can be examined during this process through questioning as a form of a summative assessment.

Instructions for teachers:

Colourful Cabbage explained

The red cabbage juice is what we call an indicator. If you add acids such as citric acid or vinegar, the colour of the juice changes from purple to red because the substances in the red cabbage juice change into other substances with a red colour.

Baking soda and soapy water are the opposite of acids: bases. These substances also react with the red **cabbage juice but this time it changes into a blue/ green substance.**

If a substance is not an acid or a base, such as water, it does not react, and the juice stays purple. Acids and bases react together to form water. So mixing blue and red will give you purple again.

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Want to explore more?

Use this method to measure the acidity of the soil in your neighbourhood: http://smartkidslab.nl/content/english/1-ph-meter-maken/SmartKidsLab-Measure-acitidy.pdf

Reference list (include if needed)

https://www.rug.nl/sciencelinx/zpannendzernike/proefjes-om-thuis-te-doen

Measure acidity of red cabbage (in Dutch only):

Video and overview: https://www.skillsdojo.nl/smartkidslab/zuur-meten-met-rodekoolsap/

LP: http://smartkidslab.nl/content/1-maak-een-meter/1-ph-meter-maken/SmartKidsLab_Zuurmeter.pdf

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Lesson Plan 9

Course: HTML Language	
Lesson: Basic HTML	
Area: Technology	
Grade Level: Secondary school	Timeframe: 40’

Lesson Overview (Please edit accordingly):

Using Codecademy lessons about HTML language (https://www.codecademy.com/learn/learn-html), students will acquire basic knowledge about this language. After that, they’ll learn how to create a basic webpage following a series of requirements.

Objectives:

Upon completion of this Lesson students will be able to:

- Acquire the basic knowledge related to HTML
- Create a simple webpage using HTML language
- Add embedded content to your website using HTML (videos, images, tables)

Material/ resources

- https://www.codecademy.com/learn/learn-html
- Electronic devices (laptops, tablets…) for students
- Electronic device for the instructor
- A digital blackboard

Lesson Activities

1. **Codecademy lessons (At home)**

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Students will view the HTML course at home to acquire the basic knowledge about this language. This course, *Learn HTML*, can be found at Codecademy web page: https://www.codecademy.com/learn/learn-html. This involves a flipped classroom approach. Students will need to have an electronic device to follow the lessons.

2. **Creating a webpage (25')**

Students, in groups of 4, will create a webpage using HTML language. Each webpage must include these concepts:

- Insert a table
- Insert an image
- Insert a YouTube video
- Insert a minimum of 3 different types of titles.

This activity will be done in class using one computer per group.

3. **Presenting the webpages (15')**

Each group will present the webpage they created using HTML language to the rest of their classmates. It must be a short presentation, the duration of each one will depend on the number of groups there are.

Instructions for teachers

- The inclusion of a video that students should watch previously, following the Flip classroom methodology, will enable each student to follow their own pace and pause the video whenever need it.
- Then, in the classroom, the teacher will be able to check if students fulfill all the requirements and include all the compulsory elements. If there is a recurrent doubt or mistake, it could be explained to the whole class by the teacher, using a projector or a digital blackboard. Feedback will be given simultaneously.
- The cooperative and collaborative aspect of the lesson will enable students to participate and acquire teamwork skills while acquire HTML knowledge. Moreover, the topic of the different webpages created will be totally free, thus encouraging the involvement and motivation of students.

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- If needed, the teacher will include more elements for those groups that finish early.

Reference list (include if needed)

https://www.codecademy.com/learn/learn-html

Lesson Plan 10

Course: Programming with Scratch	
Lesson: Basic knowledge about Scratch	
Area: Technology	
Grade Level: Primary	Timeframe: 40’

Lesson Overview (Please edit accordingly):

This lesson will provide students with basic knowledge about how to basically program through Scratch, an online easy-to-use tool for that purpose. For example, they will learn some of the basic commands and put them into practice. They will later be able to try it in one experiential workshop, using Makey Makey.

Objectives:

Upon completion of this Lesson students will be able to:

- List the commands needed for basic programming
- Acquire a basic knowledge of the proposed online tool
- Use the different commands learned

Material/ resources

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- Scratch (https://scratch.mit.edu/)
- Digital devices (computers, tablets, etc.) for students
- 5 templates or educational boards to carry out different tasks in different levels

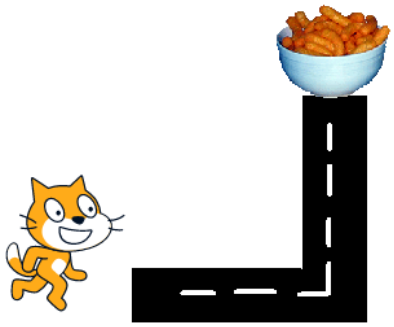
Lesson Activities

1. **How to use Scratch (20 minutes)**

The activity will take place in the classroom and will consist of an explanation by the tutor of the main commands and uses of the Scratch tool.
The whole class will attend this first activity.
The materials needed are an electronic device for the teacher and a screen on which he can show his students the basic concepts of the lesson.
Link to the Scratch tool for programming: https://scratch.mit.edu/

2. **Using Scratch (20 minutes)**

To put into practice what has been learned, an activity will be carried out in which students, in groups of 4, will have to face different challenges. Different templates will be used, with progressive difficulty, which they will have to complete in order to solve all of them. The templates will present different challenges, such as including sounds or executing the directions. This activity will be done in the classroom using on computer or digital device per group.



3. **Creating Scratch routes (if there is time left)**

If students complete the 5 templates before time ends, they can create their own templates, so they can continue with the programming activity.

Instructions for teachers

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The progressive difficulty of the different templates will enable every student to follow their own pace. In order to start working on the next template, the teacher must check that all requirements have been fulfilled. The number of templates finished by each group will give the teacher a clear insight on the students' knowledge acquisition. Therefore, if one group finishes all the given tasks, it will be a great indicator of this knowledge acquisition. When doubts and mistakes are recurrent, the teacher could explain one specific aspect to the whole class. Explanations will be shown on the projector or digital blackboard, being it of great usefulness for students. The playful characteristic of the activity will encourage the motivation and involvement of students. The templates will progressively increase their difficulty, which will allow students purchase greater skills and abilities progressively. As it is mentioned before, it is necessary to provide students with extra activities in order to give them the chance to continue with the lesson if they have finished the second activity before the end of the class. This way, teacher give students the opportunity to create their own template using their creativity.

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Lesson Plan 11

Course: Multidisciplinary Lesson	
Lesson: The Great Fire of London	
Area: History, Design Technology (DT) and Math	
Grade Level: Lower primary level	Timeframe: 45 minutes – 1 hour

Lesson Overview:

- Hands on fun DT activity which will engage children in applying what they already know about the Great Fire of London into a moving scene. During this activity children use fine motor skills to draw and colour buildings from 1666, cut, fold and hole punch card and insert fasteners. This activity invites DT and history questions from children. These scenes can be played with and used as a writing prompt.

Objectives:

Upon completion of this lesson students will be able to:

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- **Design Technology:** fold and cut paper and card, cut along lines, straight and curved, use a hole punch, insert paper fasteners for card
- **History:** use secondary source material to find out about an event
- **Math:** use measurements for materials

Material / resources:

This lesson works with a full class (20-30 children) inside a classroom. It is a hands on practical activity.

1. 1. **Pencil** (1 per child)
2. Coloured pencils / crayons (to share)
3. A5 white card (1 per child and extra for lever)
4. Scissors (to share)
5. Split pins (1 per child)
6. Hole punch (to share)
7. Images depicting the Great Fire of London (either to show to the whole class or a selection to pass around the individual groups)
8. Interactive White Board (IWB) or printed copies of images
9. Red, yellow, orange tissue paper or coloured paper (several sheets per group)

Lesson Activities:

1. **Introduction to the scenario and activity** (15 minutes)
   - Start by showing an image or short video (provided) about the Great Fire of London and explain the basic story of the event.
     http://www.fireoflondon.org.uk/collection-type/artworks/
     https://www.bbc.co.uk/newsround/37253904
     https://www.bbc.co.uk/newsround/37253903

   - With the images of the fire on display discuss what we know happened during the Great Fire of London. You can prompt the discussion with questions such as:
     What material are the houses made of?
     What colour might the houses have been?
     Describe how the houses have been built?
     Are the houses close together or far apart?

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How do you think this contributed to the spread of the fire?
How do we know all this?

- If necessary, show some more images until the children have built up a clear understanding of the buildings appearance and layout (tall, close together, wooden).

2. **Create a simple diorama of a scene from the Fire of London** (20 – 30 minutes)
   - Each student will make their own diorama provide the necessary materials for the activity.
   - Model how children are to draw a row of houses themselves on cardboard (you may have pre-prepared examples ready to show each group)

Step-by-step instructions for learners:

1. Students should use the houses in the pictures as inspiration for drawing a row of houses on their piece of cardboard.

2. Colour the buildings.

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3. Cut along the rooftop skyline.

4. The students should now use a new piece of cardboard and fold a strip of cardboard (approx. 2cm wide) and cut along the fold. Students

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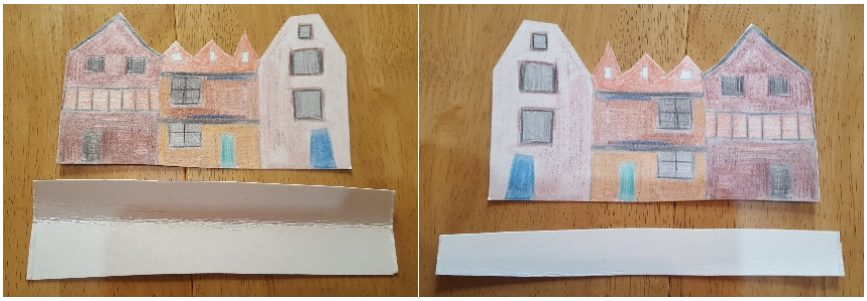
should use a ruler (or compare length) to ensure their strip of cardboard is longer than the line of houses.



5. Create a flame effect at one end of the cardboard strip with the coloured paper/tissue paper and crayons.

6. Use a hole punch to put a hole at any point of the image.

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6. The flames need to pivot up above the houses from the hole punch point and another hole put into the cardboard strip. This may take some experimentation to ensure the hole is punched in the best location for the flames to appear above the houses.

3. Final assessment and discussion (10 minutes)

- Once all of the groups have completed their dioramas then each group should go around the class and look at the other group's dioramas.
- After this, a full class discussion should take place about the activity and the Great Fire of London, you may ask them about how modern-day cities are built differently to reduce the chances of such an event happening again.

Instructions for teachers:

Prior knowledge of the Great Fire of London:

This lesson works best if the students have some prior knowledge of the Great Fire of London. The children can gain an understanding of the Great Fire of London by watching the videos provided.

Differentiation:

This activity can be differentiated by outcome.

Additional assessment of knowledge:

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You may add an element of assessment of historic understanding through open and closed questioning and application of knowledge i.e.

- *What material are the houses made of?*
- *How do we know this?*
- *What colour might you colour your houses?*
- *Describe how the houses have been built?*
- *Are the house close together or far apart?*
- *How do you think this contributed to the fire?*

Assessment of DT skills through observation of children completing the activity, the amount of support required, and their understanding of instructions given:

- Student feedback during activity
- Guidance provided verbally throughout the lesson.

Other Comments:

You may wish to provide preprinted houses for the children to colour, cut out and stick onto the cardboard. Such as;

https://www.sparklebox.co.uk/topic/past/fire-of-london.html

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Lesson Plan 12

Course: Multidisciplinary Lesson	
Lesson: Solar Snacks	
Area: Math, Physics and Design Technology (DT)	
Grade Level: Any secondary level	Timeframe: 45 minutes – 1 hour

Lesson Overview:

- Students investigate how parabolas can focus light to heat marshmallows in a simple solar oven. This is one way that people could cook in the powerless world or if they have limited access to cooking fuels. This activity can be done in small groups of 3 or more individuals.

Objectives:

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Upon completion of this lesson students will be able to;

- **Math:** understand the geometry and potential real world uses of parabolas
- **Physics:** understand how solar energy can be used and how light energy can be converted into heat energy
- Design and Technology: use basic resources to engineer a simple solar oven

Material / resources:

This activity works best outside on a sunny day. On a cloudy day, perform the experiment inside the classroom with a halogen desk lamp. This could perhaps also be used as a demonstration on a sunny day before going outside.

1. printed copies of the parabola (template provided)
2. A4 corrugated cardboard (four sheets per group)
3. A3 thin card (one sheet per group)
4. aluminium foil
5. glue sticks, tape
6. long bamboo or wood skewers
7. marshmallows
8. probe or infra-red thermometer
9. protective gloves
10. transparent acrylic sheet (optional)
11. halogen desk lamps for use on a cloudy day (caution: can be hot)

Lesson Activities:

1. **Introduction to the scenario and activity** (10 minutes)
   - Imagine a world where there is no electricity or access to fuels for cooking.
   - What potential ways could you use to cook food or to heat water?
   - One solution that could be used is solar cooking, in this case we will focus on the concept of a *parabolic solar oven*.

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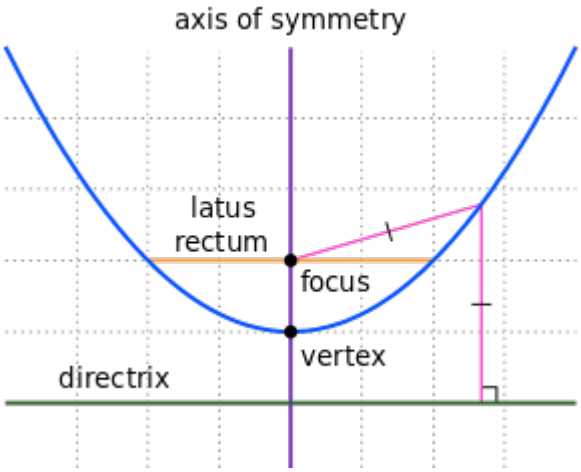
- Discuss which STEAM roles might help in this situation: e.g. optical engineer, thermodynamics scientist, energy engineer, food scientist etc. *Students can take on these roles if they wish*.
- Briefly introduce parabolas and their properties.
- A parabola is a curve where any point is at an equal distance from a fixed point (the focus), and a fixed straight line (the directrix).
- Use the link for a more detailed explanation and diagrams https://www.mathsisfun.com/geometry/parabola.html



- Explain that parabolas are found everywhere in the world including;

In nature

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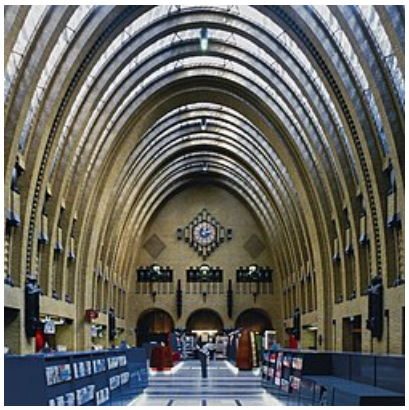
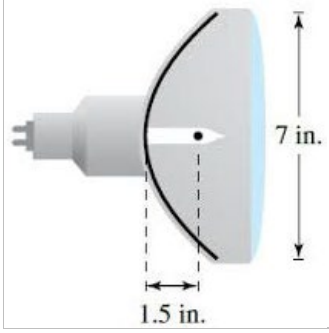


Architecture

And.....

- In everyday life they are especially useful for reflecting and focusing light in torches, vehicles headlights and household light bulbs.



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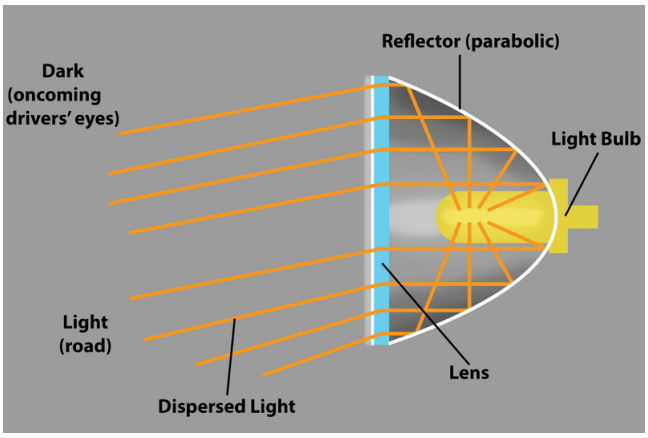

2. **Build your parabolic solar oven** (20 – 25 minutes)
   - Guide teams as they carefully follow the step-by-step instructions to build a small reflective parabolic solar oven.
   - If undertaking this outside, students can optionally use transparent acrylic sheets as a top cover, which helps trap heat. *<u>*Do NOT try this if using halogen lamps**</u>*.

   - *Step-by-step instructions for learners*
     1. Cut out a parabola using the template page provided
     2. Use this parabola as a template to draw a parabola shape onto each of the 4 sheets of A4 corrugated cardboard and then cut the shapes out (leaving each group with 4 individual parabolas made of corrugated cardboard)
     3. Glue two of the parabolas together to create one of double thickness, then do the same with the other two parabolas as well
     4. Use a skewer to accurately create a hole through the focus points on each of the 2 parabolas (again using the parabola template with the focus point marked as a red spot)
     5. Use the glue stick to carefully cover one side of the A3 thin card, and one side of each parabola, with aluminum foil. Make sure the shiny side

Erasmus+

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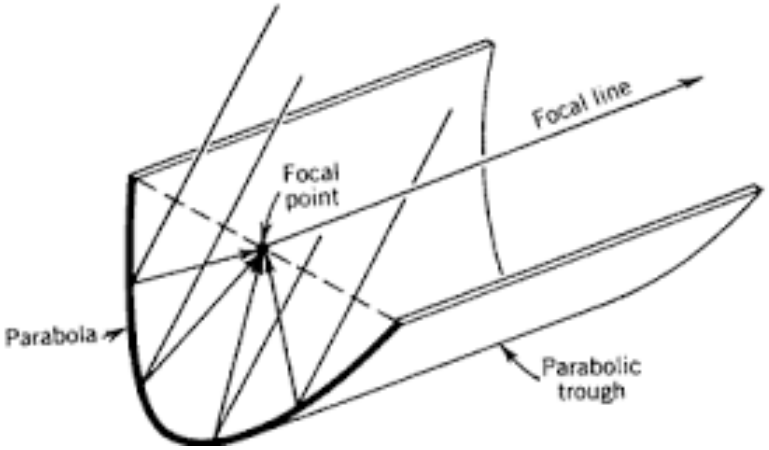
faces out and try not to create wrinkles as this will reduce the effectiveness of the reflective surfaces

6. Wrap the thin card around the curved edges of the parabolas and tape it in place to create your solar oven, this should be wrapped all-round the parabola at each end to form a kind of a parabolic trough.

Ensure the foil is on the inside of the oven.



7. Slide a skewer through the pre-pierced focus points of each parabola and make sure the skewer passes straight through the oven and out each side.
8. Now they have engineered a simple reflective parabolic solar oven with a cooking skewer

3. **Test your parabolic ovens** (10 – 20 minutes)
   - Test the parabolic solar ovens with marshmallows and thermometers. See how fast the marshmallows melt, and / or what final temperature the ovens reach.
   - *Step-by-step instructions for learners*
     1. It's time to cook! Load one or two marshmallows onto your skewer. Make sure they don't touch the foil, so light can reflect onto them
     2. Angle your oven to face the sun, or if inside, the halogen lamp

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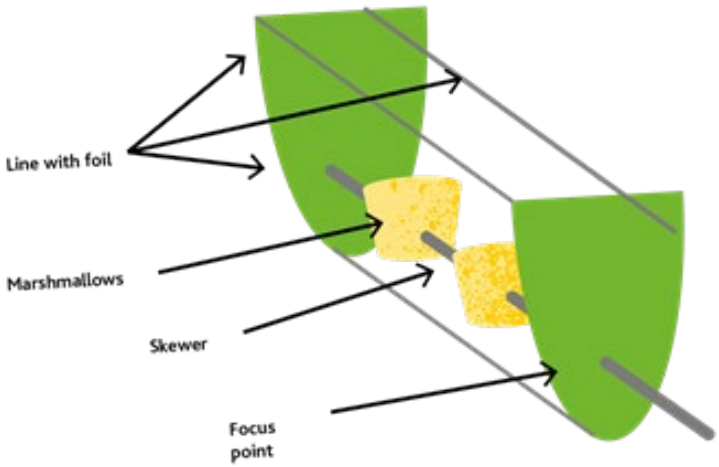
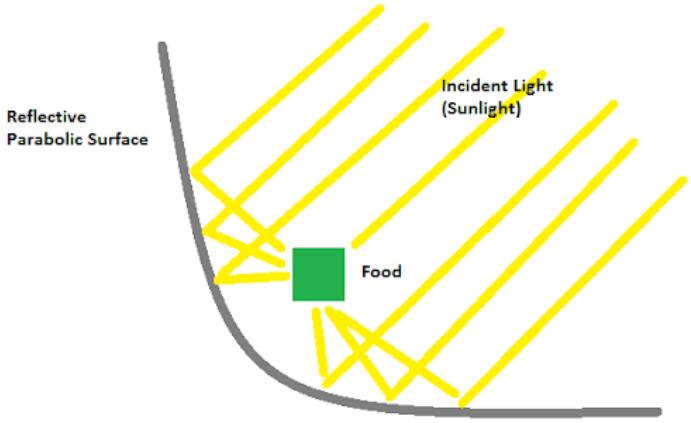
- **NOTE: Take extra care if using a halogen lamp as they can generate a lot of heat and you could burn yourself. Use protective gloves and wear protective eyewear*.*

The following image below omits one side of the card/foil reflector





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- It is important to explain the process that is happening, solar energy, in the form of sunlight is being converted into heat energy to heat and 'cook' the marshmallows.
- The principles of the process are;
    1. **Concentrating sunlight**: the reflective metal surface is reflecting the sunlight so that it is concentrated and the energy is stronger at the focus point where the skewer and marshmallows are located
    2. **Converting light energy to heat energy**: the interaction between the light energy and the receiver materials converts light to heat and this is called conduction
    3. **Trapping heat energy:** this heat energy is now being 'trapped' within the parabolic trough and as more light energy enters it will continue to be converted into heat energy, this process can be increased by covering the top of the parabolic oven with the transparent acrylic sheet.

- The parabolic solar oven lets the UV light rays in and then converts them to longer infrared light rays. Infrared radiation has the right energy to make water, fat and protein molecules in food vibrate vigorously and heat up.
- It is not the sun's heat that cooks the food, nor is it the outside ambient temperature (though this can affect the rate or time required to cook) but rather it is the sun's rays that are converted to heat energy that cook the food.

4. **Final assessment activity** (5 minutes)

- Once all the groups have completed the task and tested their ovens the teacher will decide which group's oven worked the best based on the temperature it achieved and / or the level in which their marshmallows were cooked.

Instructions for teachers:

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Interesting facts about parabolas:

1. A parabola is plane curve which is mirror-symmetrical and is approximately U-shaped, the mathematical equation is y2 = 2px or x2 = 2py
2. If you throw a ball, the trajectory it follows through the air is a parabola
3 Any ray of light that's parallel to the parabola's axis of symmetry will be reflected onto the focus point. That's why parabolas are used to focus torch or headlight beams and are also used in satellite dishes.

Differentiation Ideas:

Support: Make one model for students to copy prior to the session.

Challenge: Ask teams to also make ovens based around hemispheric end formers and compare their performance. Discuss why the parabola works better: the shape focuses the light onto the axis, where the marshmallows are positioned. A hemisphere can't focus the light in the same way.

Additional prompts for participating students:

- Use the foil shiny side out and take care not to wrinkle it when gluing to the card.
- Don't forget to coat the two end former parabolas in foil as well.
- It's important that as much light as possible can get below the marshmallows, which should be in small enough pieces so that they don't touch the foil trough.
- Angle the ovens so that they point at the sun or the lamp being used.
- The red dot on the parabola template is the focus point – the axis on which the skewer will go and on which the marshmallows will need to be.
- Light needs to reflect off the parabola and trough lining onto the marshmallows and that's vital for an efficient cooking process.

Other Comments:

Extension Ideas:

- Students could research and build other forms of solar ovens.

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- Students can research ‘rocket’ stoves, which drastically reduce the smoke produced by burning wood. Why are rocket stoves important for people's health in less economically developed countries?

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