Teacher Toolkit

Written within the ERASMUS+ project

"LEGO® MINDSTORMS® EV3 IN STEM EDUCATION"
2019-1-PL01-KA229-065800

Participating organisations

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THE SITE OF THE PROJECT
https://erasmus-lego-stem.weebly.com/

The Teacher Toolkit contains different ICT exercises and activities designed by the teachers from each partner school within the "LEGO® MINDSTORMS® EV3 IN STEM EDUCATION", 2019-1-PL01-KA229-065800 project. The lessons have been taught during the period of implementation of the project. They are examples of good practices.

Each exercise is about the use of ICT tools while teaching different subjects in school such as Mathematics, Geography, Biology, Chemistry, IT, Art, Music and English. It is for STEAM education.

The Teacher Toolkit gives its users the opportunity to incorporate modern technology into lessons to enhance students' learning and prepare them for a successful future in our tech-driven world. Its aim is to support teachers across the world with resources for using modern technology, i.e. VR glasses, Photons, Bee-Bot, 3D pens, Lego Education Apps, Lego Mindstorms robots, Coding Apps, in their everyday schoolwork. It helps teachers make their classes engaging for students and teach them the 21st century technical skills.

THE USE OF 3D PENS IN SCHOOL

Goals

- the student creates projects, 3D models with pens;

- the student develops imagination;

- the student learns the use of modern technologies;

Working methods

Activating methods - learning through experience;

Forms of work

Individual, group;

Teaching aids

Patterns to be copied, filament in various colors, a set of 3D pens;

The activity - procedure

1. Each student receives a pen with a filament, a pattern to be copied and a transparent overlay.
2. Worksheets with patterns to be copied, used by the student, are included in the Banach 3D pens package.
3. Students, using 3D pens, create their own three-dimensional models of objects (e.g. solids or tree leaves found in Poland).
4. This activity might be used while teaching Maths (printing solids), art (leaves), etc. Teachers should review the worksheets included in the Banach 3D pens package and use these ones which might be connected with their subjects.

Author: teacher Tomasz Suleja

BEE-BOT CODING OF THE EUROPEAN CAPITAL CITIES

Goals
- the student learns the use of modern technologies and teaching aids for learning and programming;
- the students revises directions (right/left, up/down);
- the student revises the names of European capitals and national flags;
- the student is encouraged to speak, share their experiences, express emotions and ideas, present them to a group of peers;
- the student develops the coding skills;
- the student improves logical thinking;

Working methods
Activating methods - learning through experience;

Forms of work
Individual, group;

Teaching aids
Bee-Bot (kod produktu: 356002) www.mojebambino.pl
The set of the questions to be answered;
The mat with the answers to the questions where the Bee-Bot operates;

The activity - procedure
Task: program the Bee-Bot in order to get to the correct answer.
1. The student chooses one piece of paper with the question on it.
   There are following pieces of paper with questions:

The capital of Poland is…
The capital of Spain is…
The capital of Germany is…
The capital of Romania is…
The capital of France is…

2. The student reads the question, answers it and program the Bee-Bot to get to the correct answer on the Bee-Bot mat.
3. There is no one right solution to get to the correct answer so different students might program the robot differently.
4. The end result is that the bee reaches the right solution.

The idea derived from:
https://mojebambino.pl/blog/wp-content/uploads/2020/08/Scenariusz-zajęć-Bee-bot.pdf

Author: teacher Ilona Wojtczak

MULTIPLICATION TABLE WITH THE PHOTON ROBOT

Goals
- the student consolidates the multiplication table in the range of 100;
- the student revises directions (right/left, up/down);
- the student develops the coding skills with the Photon Blocks application;
- the student improves logical thinking and cooperation skills;

Working methods
Activating methods - learning through experience;

Forms of work
Individual, group;

Teaching aids
- Photon educational robot;
- tablet;
- Educational mat where the teacher puts the cards with the numbers (the result of the multiplication);
- printed cards with multiplication activities in the range of 100;

The activity - procedure
Task: program the Photon to get to the correct answer.

1. The teacher prepares an educational mat, Photon robot and a tablet. He informs the students that they will learn programming. He explains what programming is.
2. The cards with the numbers: 64, 35, 55, 40, 77, 49, 18, 50, 99 are laid out on the mat. The teacher starts the robot and the tablet and uses the Photon Blocks programming interface to design the robot's route. The students get to know the main screen of the programming interface, the traffic directions, color and sound functions.
3. The student chooses one of the cards with the multiplication activities in the range of 100, i.e. 8x8, 7x5, 8x5. Then, he gives the correct answer and indicates that answer on the mat. Final part is to program the Photon's rout to the correct answer.
4. There is no one right solution to get to the correct answer so different students might program the robot differently. However, the students should be aware that the shortest route is the best one. Using the tablet, the student selects the appropriate blocks, e.g.: Start, Drive forward, Turn right, Turn left, Sound, Change color. The programmed robot moves in the indicated directions, stops in the field with the correct result, makes a sound and changes color.
5. The end result is that the Photon reaches the field with the correct result, makes a sound and changes colour.

Author: teacher Renata Wotalska

THE USE OF VR GLASSES WHILE TEACHING AND LEARNING ENGLISH

Goals

- the student uses the vocabulary connected with the travelling,;
- the student revises Present Continuous Tense structures;
- the student develops the speaking skills and cooperation skills;

Working methods
Activating methods – role plays;

Forms of work
Pairs;

Teaching aids
        A set of Class Premium VRP64/4 which works best for the class with no more than 8 students. One VR set is for a pair. If there are more than 8 students, they might be divided into groups of three or four. The thing is there must be a VR glasses set for a group.

The activity - procedure

1. The teacher divides the class into pairs. Each pair receives the Class VR Glasses set. One of the students puts the set on his head and he chooses a place to visit from the range of ones which are recorded in the Class VR glasses memory. The students might virtually go to, i.e.: New York, London, Dubai, Mars, China.
2. The student without the set on his head asks his friend some questions, i.e.:
   Where are you?
   How are you feeling?
   What are you doing?
   What can you see?
   What are other people doing?

3. After 5 minutes of talking, the students change their roles.

Author: teacher Urszula Kaniewska

USING GEOGEBRA IN MATH CHALLENGES

Goals
- the student visualizes segments lines, polygons and other geometric objects that seem sometimes abstract;
- the student builds hexagons from equilateral triangles;
- the student deepens in the concept on angle ;
- the student knows different types of symmetry by rotating and translating lines and polygons;

Working methods
Challenge-based learning;
Flipped Classroom;

Forms of work
Work in pairs;
Small groups;
Whole class discussions;

Teaching aids
    Each student watches a GeoGebra video tutorial that demonstrates the basic functions and commands for drawing geometric objects the days before classroom practice. A group of students will review each pair of students the work done so that no one is left behind.

The activity - procedure
1. The teacher divides the class into pairs. Each pair works with a laptop. Students draw with commands and functions different simple geometric elements (points, lines, rays and polygons).
2. The students observe if there are coordinates, labels, name of each object and learn to name and hide them.
3. Students measure the distance between points, angles that form polygonal lines, and sides of polygons.
4. Students learn to draw regular and irregular polygons with n<7 sides.

CHALLENGE 2

SECOND CHALLENGE (STEM original activity)
Part 1 Creating a circuit (Engineering + Mathematics)
First, students from each country build a circuit with black duct tape on white paper. This circuit is a regular six-sided polygon, whose side measures 1 meter.
1) Given that any regular polygon can be inscribed in a circle. Students make an initial drawing as a draft, in which they find the value of the diameter of the circle where our polygon is inscribed.
2) Students reflect on building a hexagon from equilateral triangles. How many equilateral triangles can be formed in a regular hexagon? How many degrees does each angle of an equilateral triangle measure? What is the measure of each angle of a regular hexagon?
Part 2 Following lines (Technology + IT Coding)
Second, place the robot on any point on the perimeter of the hexagon.
Create a program so that the robot circulates along the black adhesive line of the perimeter of the hexagonal circuit.
1) Calculate the circumference of the circumscribed circle (length of the circle that circumscribes the hexagon).
2) Is the perimeter of the hexagon greater than the length of the circumference that circumscribes it? Explain your reasoning to your answer.

Authors: teachers Adela Cascales, Miguel Morell

USING QR CODES AS A TEACHING AID

Goals
- reduce difficulty in coding to facilitate learning;
- display block sequence in programming;
- focus the task on the adjustment and variations of certain commands;
- facilitate learning in the introductory phases of programming by blocks;

Working methods
Use of tablets;
Use of mobile devices;

Forms of work
Small groups;
Whole class discussions;

Teaching aids
QR code reading application. Using the cell phone scanner to read the content of the QR codes;

The activity - procedure
1. Divide students into small groups of 3-4 students. Provide a tablet for each group and make sure you have the QR code reader app or phone per group that can do it.

2. From the image of the QR code, the students reproduce the sequence of the programming code in the tablet application.

3. The students analyze the movements of the robot as a result of the application of the code of the sequence in the resolution of the proposed challenge.

4. The students adjust the distance, angle, turn or other commands so that the robot solves the challenge favorably.

Authors: teachers Vicent Ángel, Chelo Hoyuelos and Sole Flores

GEOMETRY AND OPEN ROBERTA LAB

Goals

- the students use knowledge from the field of Geometry to program the Lego Mindstorm EV3 robot;
- the students create projects in Open Roberta Lab;
- the students develop imagination;
- the students learn the use of modern technologies;

Working methods

Activating methods - learning through experience;

Forms of work

Individual, group;

Teaching aids

Open Roberta Lab Platform
https://lab.open-roberta.org/
NEPO Language;

The activity - procedure

1. Work in pairs to find the proprieties of a square.

2. Tell the difference between different types of quadrilaterals.

3 Make an algorithm for moving the Lego Ev3 Robot on the trajectory of a square.

4 Make an algorithm for moving the Lego Ev3 Robot on following trajectory:
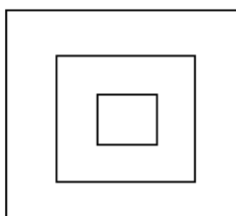
5. Use the Simulator to try the program.
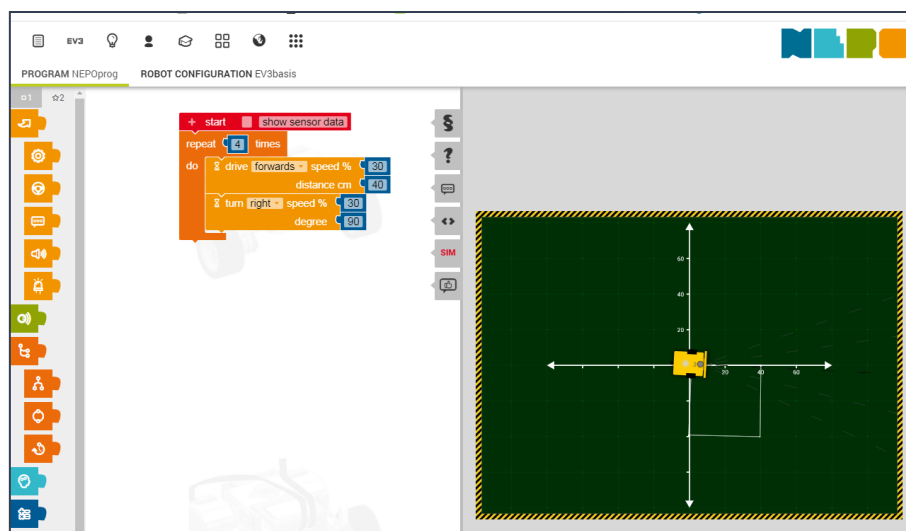
Authors: teachers Sorina Cojocaru, Marian Vlad

MICRO:BIT programming

Goals
- students will read the temperature using the Micro: bit, will display in degrees Celsius on the LED matrix and will display a message based on the recorded temperature value;
- students will compose a song using the specific blocks;
- students will generate the string of natural numbers, even numbers and the odd numbers;

Working methods
Activating methods - learning through experience;

Forms of work
Group of students;

Teaching aids
Micro: Bit (1 pc), USB cable (1 pc), 1.5 v AAA batteries (2 pc), Battery box (1 pc), Code editor;

The activity - procedure
1. Each group of student (3 students/group) will receives a Micro: bit
2. Using the coding platform https://makecode.microbit.org and the notions of algorithms and programming, they will create short programs to solve each task:
- Micro: Bit programming to show us the temperature (thermometer)
Indication: Micro: Bit does not have a special temperature sensor for temperature reading. The temperature we will read is actually the temperature of the silicon mold on the main processor.
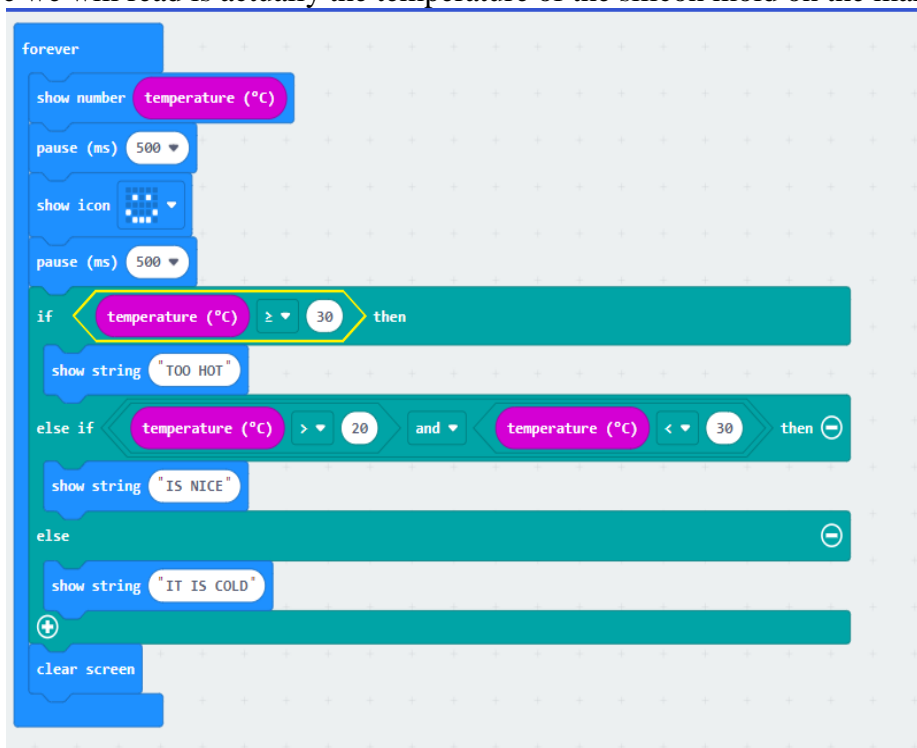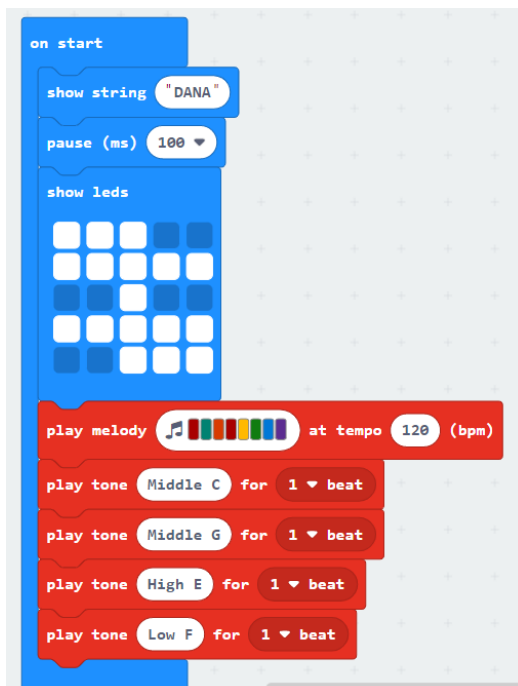

- Micro: Bit programming to make various sounds and music
Indication: Micro: Bit has a built-in speaker on the board, which allows us to easily add sound to
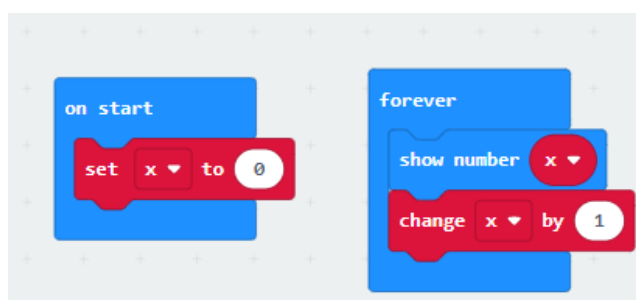
our projects

- Micro: Bit programming to show us strings of numbers
Indication: We will create a variable x that we will initialize with 0 (or with 1), then forever, we will increase the value of this variable and we will display it on the LEDs of the Micro: bit.

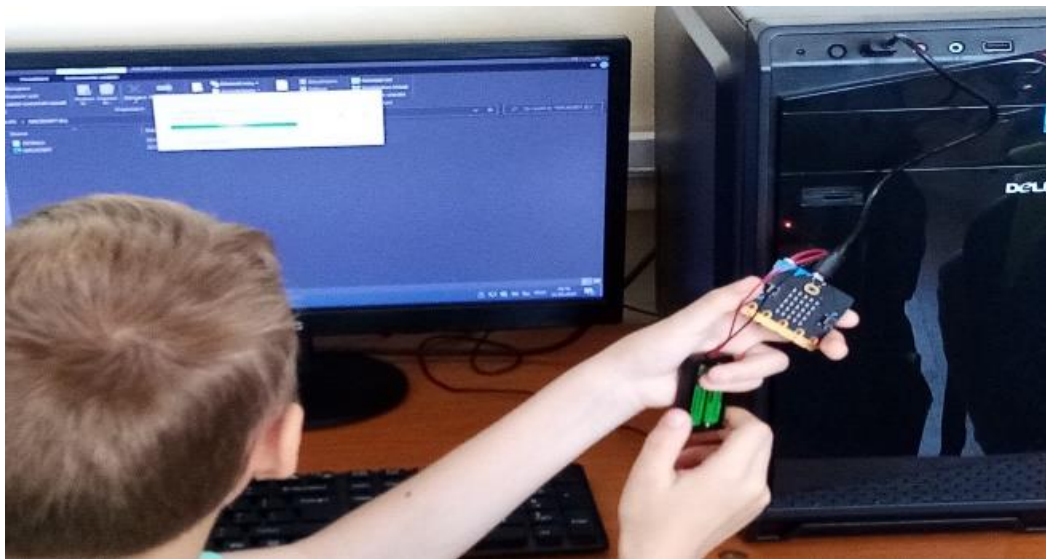a) string of natural numbers

b) even numbers

c) odd numbers

3. This activities might be used while teaching Mathematics, Physics or Music lessons.

Author: teacher Grecu Daniela

USING code.org TO LEARN CODING AND ENGLISH

Goals
- tho have the students learn the language in an attractive context;
- to develop the students' creativity;
- to have the students use the vocabulary for coding;
- to revises Present Tense Simple;
- to develop speaking skills and cooperation skills;

Working methods
Challenge-based learning;

Forms of work
Work in pairs;
Small groups;
Whole class discussions;

Teaching aids
Computer, the internet, video projector, https://code.org/minecraft

The activity - procedure
1. The teacher divides the class into pairs. Each pair works with a laptop. Students access the site https://code.org and collaborate in creating stories with their favorite game characters using code; they have to use Present Tense Simple as often as they can;

2. Taking turns, the students present their project to the class.

Author: teacher Ana Iulia Chiva

FIRST STEPS IN CODING

Goals

- to heighten language skills;
- to have some fun while learning;
- to get a sense of confidence and accomplishment;
- to develop problem-solving skills;
- to adapt to changes in the landscape of the jobs market;

Working methods

Engaging and intuitive methods – computational thinking, collaboration, reasoning and logic;

Forms of work

Individual, group;

Teaching aids

Computers, internet, the site studio.code.org, patterns to follow;

The activity - procedure

1. In groups of three, students access the site studio.code.org
2. The students are introduced and given secret words.
3. They are asked to access the following link https://studio.code.org/users/sign_in
4. They have to introduce a code.
5. Every student chose his/ her name and introduced the secret word and start coding.

6. The students have to use coding blocks to make patterns in the ice.
7. The result of coding is to join Anna and Elsa, two well-known cartoon characters as they explore the magic and beauty of ice. The students create snowflakes and patterns as they ice-skate and make a winter wonderland.

   This is a simple and fun way to introduce students to computer science, sometimes for the very first time, and it fits perfectly for both in-class and after-school settings.

Author: teacher Ancuța Lorina

DECODING IMAGES IS FUN

Goals
- to develop students' creativity;
- to develop students' analytical thinking;
- to develop the student's cooperation skills;
- to raise interest in robots and Robotics;
- to make the first steps towards coding;

Working methods
Activating methods - learning through experience;

Forms of work
Individual, group;

Teaching aids
Printer, patterns to be copied and colored, papers, crayons, the internet https://www.pixilart.com/draw, https://www.kodable.com/videos/492, http://resources.kodable.com/public/activities/2020HOC_UnpluggedWorksheets_k-1.pdf?utm_campaign=q42020content%20&utm_medium=blog&utm_source=unpluggedactivities&utm_content=k-1activities

The activity - procedure

The students watch a film about coding. Then they use applications in which they decode messages and perform different tasks using the technology. Thus, they understand with coding means. They create a code that results in drawing an image, letters and numbers, robots.

Author: teacher Monica Vlad

USING ROBOTS TO TEACH SPECIAL NEEDS STUDENTS

Goals
- to learn how to draw a rectangle assisted by a robot;
- to observe basic characteristics specific to the rectangle;
- to use of modern technologies for learning;
- to enhance cooperation skills;
- to involve students in the special needs classmates' learning process;
- to ensure the recuperative learning processes through sensory-motor education;
- to have fun while learning;

Working methods
Activating methods - learning through experience, explaining, demonstration, and game;

Forms of work
Individual, assisted;

Teaching aids
Robot, duct tape for the 4 sides for a rectangle, the computer, the internet, the LEGO Mindstorms App;

The activity - procedure

Some students, as a team previously make a program for the robot to follow a trajectory in the shape of a rectangle. Then, they use duct tape to design the shape of the rectangle on a mat or on the floor. The robot, using the color sensor, will have to follow the 4 sides of the rectangle, signaling through sounds and images on the screen of the brick, the change of direction on the trajectory of the geometric figure.

The special needs child will learn in three stages. First, he follows the route at the same time with the robot, then does it following the directions given by the teacher and then all on his own.

The core of the recuperative learning processes is the sensory-motor education and the acquisition of personal and social autonomy, these ensuring the field of cognitive education and of the integration in the community of the children with special needs.

Through this lesson, the special needs child learns in a safe environment assisted by a teacher and a robot and the students from the school where the child is integrated help, learning both ICT skills and how to get involved actively in the learning process of their school mates with special needs.

Authors: teachers Gabriela Velica, Iulia Chiva
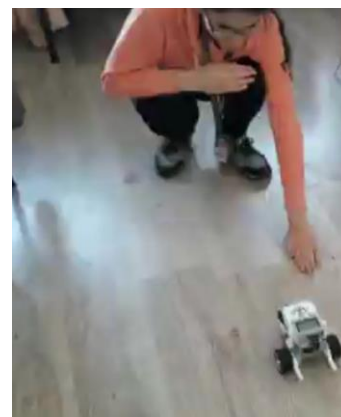
TEACHING FOREIGN LANGUAGES USING ROBOTS - THE ROBOT PARADE

Goals

- to learn the language within an attractive context;
- to encourage the students to speak, present projects to a group;
- to develop students' creativity;
- to have students uses the vocabulary for describing people;
- to revises Present Simple and Continuous Tenses;
- to develop the student's speaking skills and cooperation skills;
- to raise interest in robots and Robotics (it can be a prelude to a lesson that also involves coding);

Working methods

Activating methods - learning through experience
Creating stories,
Role play;

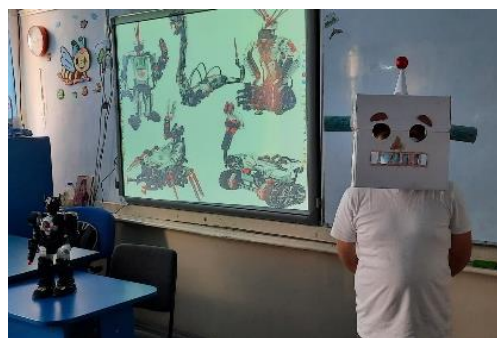### Forms of work

Individual, group, pears;

Teaching aids

Computer, the internet, video projector,
Recyclable materials;

The activity - procedure

Task: The student have to bring to class either a robot made by them using recyclable materials or a toy robot / a LEGO robot. Another option is for some students to dress up as robots.

1. The students assume roles, either of presenters of the show, a journalists, or robots
2. The students take turns coming on stage and presenting themselves as robots or presenting the robot they have brought/made.
3. The students interact in role plays
4. The best presentations are chosen by vote and rewarded
5. Some students teach the others a Robot dance to make things even funnier.

Author: teacher Ana Iulia Chiva

TEACHING MUSIC AND MOVEMENT USING ROBOTS - THE ROBOT DANCE

Goals

- to learn some songs and dances in an attractive context, using robots` clothes, dances and voices;
- to encourage the students to sing, dance and use robot dances and songs;
- to develop students' creativity and talent;
- to develop the student's singing, dancing skills and cooperation skills;
- to raise interest in robots and Robotics;

Working methods

Activating methods - learning through experience;

Role play;

Forms of work

Individual, group, pears;

Teaching aids

Computer, the internet, video projector, YouTube channel
Recyclable materials, toy robots

The activity - procedure

Task: The student have to bring to class a robot made by them using recyclable materials or a toy robot. Everybody dances robots` dances.

1. The students take turns coming on stage, dancing, and singing like robots with the robot they have brought or made.
2. The students interact in role plays
3. The best dance is chosen by vote and learned by all the students as the chosen student teaches the others his/her Robot dance.

Author: teacher Aurelia Gulian

GEOGRAPHY, MAP READING, ROGAINING and ROBOT treasure hunt

Goals
- to correctly use the terminology specific to Geography;
- to integrate knowledge of Geography and computer science in order to build robots and use them;
- to be able to read maps;
- to build robots using a picture;
- to develop creativity and technical thinking;
- to increase intrinsic motivation;
- to develop cooperation skills;
- to develop teamwork skills;

Working methods
Challenge-based learning, outdoors activity;

Forms of work
Small groups;

Teaching aids
Maps, LEGO robots, papers, bags;

The activity - procedure

   The activity has to take place outdoors and it is a treasure hunt. The students are divided into groups. The stake of the game is for each team to find and put together a Lego robot, in the shortest time possible, using a picture of the robot, the map of the itinerary and instructions that the participants get the moment they start the treasure hunt. The pieces of the robot they have to put together are in different check points on the itinerary on the map. The first team to hand over the robot in one piece will be the WINNER. You need some volunteers to wait for the students at checkpoints.

INSTRUCTIONS
-   follow the route indicated on the map;
-   find the 2 stops on the map;
-   at each stop you will be met by a person who will give you a package containing pieces of your robot ;
-   identify the person and take the package! PAY ATTENTION! DO NOT OPEN the packages on the route!
-   You will put the robot together by using the picture given to you, after you finish the route and you get back to the starting point;
-   Hand the assembled robot over.

Authors: teachers Mirela Orban, Ionica Buteică, Cristina Dracea

CHEMICAL BONDS, KIDS AND ROBOTS

<u>Goals</u>

-to define the notion of chemical bond in English;
- to list the types of chemical bonds;
- to explain the cause of the formation of chemical bonds;
- to correctly use the terminology specific to Chemistry;
- to develop cooperation skills;

<u>Working methods</u>
Challenge-based learning;

<u>Forms of work</u>

Work in pairs,
Small groups,
Whole class discussions;

<u>Teaching aids</u>

Computer, the internet, video projector
Balloons, LEGO MINDSTORMS EV3 robot;

<u>The activity - procedure</u>

Teacher presents the theoretical part about ionic bonding and covalent bonding, accompanied by representative videos. This presentation is made in the English, for a better understanding of the language related to chemical concepts.

(A chemical element is STABLE if the valence layer (last layer occupied by electrons) has a stable configuration of doublet (2 electrons on layer 1) or byte (8 electrons on starting with layer 2). The stable chemical elements are He (doublet) and group VIII A (byte).
All other chemicals are unstable; they can become stable by forming chemical bonds:
IONIC BONDING is made between metals (gives up electrons) and non-metals (accepts electrons).
https://www.youtube.com/watch?v=ygeC3xHuvmg&t=209s

COVALENT BOND is made by sharing electrons between identical or different non-metals.

https://www.youtube.com/watch?v=LkAykOv1foc

Let's learn with the puppies!

https://www.youtube.com/watch?v=_M9khs87xQ8)

With the help of a robot, teacher has students demonstrate that the atom can give, accept or share electrons. Basically, they program the robot to transport electrons from one atom to another.

To make the class attractive and engaging, the students are placed in concentric circles representing the electronic layers. The students replace the electrons of the atoms.

To begin with, they dance slowly to the music. When the teacher's makes a certain noise, after the electrons have migrated and the chemical bond have formed, to the faster beat of the song, they all jump, dancing faster.
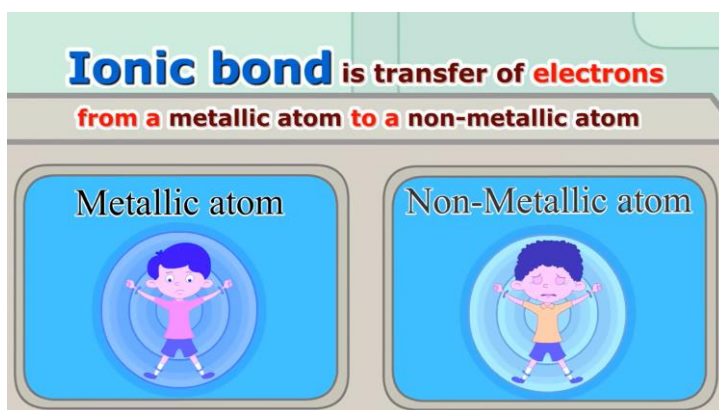
Authors: teachers Luiza Stroe, Sorina Cojocaru

The Science of SYMETRY and ROBOTS

Goals
- to correctly use the terminology specific to biology;
-to define the notion of symmetry;
- to develop cooperation skills;
- to integrate knowledge in biology, physics and computer science in order to build robots and use them;
-to use simulated working environments for working with the robot models;
- develop fine motor skills and abilities, attention, precision, spatial imagination;
- developing creativity and technical thinking;
- developing skills for building, programming and efficient use of cyber systems;
- increasing the motivation for studying real life fields;
- developing teamwork skills,

Working methods
Challenge-based learning,
Debate;

Forms of work
Work in pairs,
Small groups;
Whole class discussions;

Teaching aids
Computer, the internet, video projector,
Board, LEGO MINDSTORMS EV3 robot;

The activity - procedure

To demonstrate symmetry in Biology, the teacher posts on the board some pictures of various symmetrically different organisms and the students will have to notice the differences between them and discover what bilateral symmetry means. Then, for this type of symmetry, they will make a program for the LEGO MINDSTORMS EV3 ROBOT and thus show how the robot performs symmetrical movements on a butterfly made of adhesive tape, on a certain plastic board.
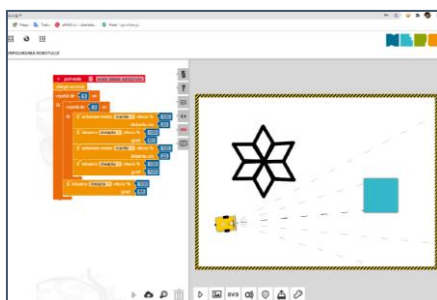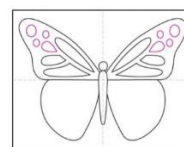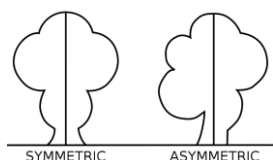
Authors: teachers Nicoleta Sima, Sorina Cojocaru

THE BLOOD FLOW, the CARDIOVASCULAR SYSTEM and LEGO MINDSTORMS EV3 ROBOTS

Goals
- to correctly use the terminology specific to anatomy;
-to define the notion of blood flow;
- to develop cooperation skills;
- to integrate knowledge in biology and computer science in order to build robots and use them;
- developing creativity and technical thinking;
- developing skills for building, programming and efficient use of cyber systems;
- increasing the motivation for studying real life fields;
- developing teamwork skills;

Working methods
Challenge-based learning,
Debate, role play;

Forms of work
Work in pairs,
Small groups,
Whole class discussions;

Teaching aids
Computer, the internet, video projector,
Board, LEGO MINDSTORMS EV3 robot;

The activity - procedure

To demonstrate the blood flow in the cardiovascular system the teacher makes a model on a duplex sheet. The heart and the two types of circulation are drawn. She presents the cardiovascular system and then asks the students to design a program for the robot to follow the lines that represent the paths of the blood flow. To make things more interesting she brings a mannequin to class and teaches them cardiopulmonary resuscitation (CPR) and has them imagine an accident and act out roles of victims and doctors.

Authors: teachers Nicoleta Sima, Sorina Cojocaru

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