MODEL TEACHING PROGRAM USING EXPERIMENTAL METHODS IN LEARNING OF SCIENCE

„InnoExperiment – Innovative Approach to Teaching through Experiment"
Project Leader: Zespół Szkolno – Przedszkolny w Goniądzu (ZSP)

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A STRUCTURE OF THE MODEL TEACHING KIT:

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1. Introduction to the model teaching set

The modern world is constantly changing. These changes result from progress based on the development of modern technologies and scientific achievements, which means that education must be compatible with these changes. The model teaching set is based on the use of innovative ideas and concepts that will become a signpost for the teacher. On the other hand, as a mentor and professional, he will not only use them in the lesson, but also adapt to changing realities to support and enhance the development of a young person. The model is based on learning by doing and is focused on students. The departure from previously used practices is to show that only innovative methods will activate students to independence, easier learning and understanding of the surrounding world.

1.1 A report summarizing the application and robotics programs in school education in European countries.

Programming is taught in all European countries from early childhood education to higher education. The concept of activities often combined with robotics and teaching the experimental method, using in practice teaching at school, not only theoretical knowledge. It is defined as a process that starts with the specification of the problem and ends with testing the developed solution with a properly selected application or programming language. Programming understood in this way is taught to all school children. The concept of programming classes is combined with robots and experimental learning, which often improves the set goals, science is primarily logical education and precise presentation of thoughts and ideas. Additionally, students develop competences such as creativity, entrepreneurship, and awaken cognitive curiosity. In the programming and information robotics classes, students learn new ways of learning, mainly practical applications. Thanks to this, learning is not boring and sometimes even fascinating.

A very important element of the use of programming and robotics in education is the systematic retrofitting of subject laboratories with equipment and teaching aids that will fully allow the implementation of the program content. Still in some European countries there is a lack of funds for the purchase of appropriate equipment, and above all for the modernization of IT laboratories, because technology is still moving forward, and the lack of funds does not allow for the maximum implementation of the planned program content.
In addition, teachers themselves should make efforts to systematically supplement and expand their skills and qualifications in the field of programming and robotics, because it is they who must guide students and give them the basis for conscious use of new technologies. They have

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to show students the tools to learn programming not only through dry knowledge, but above all through fun (using Arduino, Lego Mindstorms, Scratch elements). Therefore, an important element are robots that develop the ability to cooperate and communicate in small groups, and these are key competences useful for future IT specialists, programmers, and in everyday life.

When analyzing the use of programming and robotics in lessons in European countries, it can be noticed that a lot of emphasis is placed on the variety of working methods, in particular working with activating methods, with particular emphasis on the experiment that teaches by doing. Thanks to the activating methods, the student broadens his knowledge, deepens his interests, develops new ideas, communicates with others, learns to discuss. The student is more involved in work, which allows him to achieve better academic results. These methods also affect the active participation of children in classes, their involvement and a noticeable increase in internal motivation. Thanks to these methods, teachers also notice that it is a very good and effective way of imparting knowledge to explain many phenomena. We all know that it is easier for a student to learn when he can touch something, watch something. Often teachers use experiences and experiments, thanks to which students fully understand the phenomena and problems of the surrounding world. They awaken cognitive curiosity, motivation to explore knowledge and solve problems. Consequently, they acquire the ability to use the acquired knowledge in practice. It is noticeable that the students themselves want to gain knowledge through further experiences and experiments.

The effectiveness of programming and robotics classes in European countries is influenced by many factors. One of them is often the lack of finances to purchase teaching aids needed to experiment, program or teach robotics. Often, even when help is available, their number is too small for the number of students in the class. Classrooms are overcrowded, varied in terms of students' skills and knowledge, which makes it difficult to stimulate students to think and be interested in the topic. Teachers are faced with the problem of attracting and provoking students to mental effort combined with creativity. And yet in every class there are students with learning difficulties or gifted students, where the working time must be adapted to their knowledge and skills. After all, the time of classes is limited. School curricula are also very tight, and the number of hours is often not enough to fully cover a given topic. Therefore, in many European countries, extra-curricular activities are conducted to develop students' interests and abilities. These classes can be used by willing students.

An important element that affects the effectiveness of the above-mentioned classes is also the administrative work of the teacher, i.e. the documentation that is required of him. Extra activities take away the time and energy of teachers that they would be more likely to use to work with students.

By using elements of programming and robotics and experimenting with their participation in lessons, students' interest in this topic in all European countries is enormous. It is not only about science, but also about various other activities. It is a very good and effective way of imparting knowledge and explaining phenomena. Some phenomena and problems are easier to show than to explain in a complicated and sometimes incomprehensible way for young people. The very visualization of a code introduced by programming or a program to be performed

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by a physical element, i.e. a robot, is very rewarding for students and gives them a lot of satisfaction. It also allows them to better understand the mechanism and processes that they read about in textbooks or hear from teachers during lessons.
It should be noted that some European countries are up to date with new taught technologies, such as 3D printing, nanotechnology. They have great potential to popularize technical sciences or to develop mathematical, analytical and logical skills. However, there are very few schools.

To sum up, learning programming and robotics in European countries is introduced in schools from an early age. The development of IT skills and IT thinking is strengthened and extended with new program content with each new year. As a result, schools try to modernize the teaching environment in this direction, purchase teaching aids and equipment for scientific and technological education, if possible. The implementation of such technologies brings positive results and significantly influences the comprehensive development of the student. Consequently, it increases the quality of school work.

2. The main assumptions of the set.

The model teaching set is a response to the need to raise key competences from the point of view of increasing students' opportunities in the future labor market, experimental teaching and shaping the right attitudes (creativity, innovation, entrepreneurship and teamwork). Undoubtedly, they are the foundation for further improvement of qualifications and skills. As a result of the project, a modern programming and robotics learning program was created, which will serve the team of teachers in conducting additional classes throughout the country and in the European arena. There is also a library of educational materials (scenario examples) and other resources useful for teachers (coding files).

The set includes innovative materials and modern methods that are focused on equalizing the educational opportunities of students. The work focuses on students with special educational needs, including disabilities, at risk of premature dropping out of the education system, and extremely gifted to respond to the individual needs of the student as accurately as possible.

At present, modern computer technologies are an indispensable element of the teaching process. They also promote the social inclusion of, for example, a disabled student through e-learning, and access to information via the Internet. Therefore, the model teaching set includes ICT-based learning. The extensive use of information and communication techniques affects the student's development of creative and innovative attitudes, and above all, improves the attractiveness of learning itself.

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An important element of creating a model set will be the use of elements stimulating creativity, initiative as well as key competences (mainly exact sciences), which is a strong basis for education at a higher level.

The last feature characterizing the set is its focus on individual work with gifted students and creation of mechanisms for finding and nurturing talents.

3. Objectives.

The model teaching set is addressed to pupils in grades 5-8 of primary school (9-10 Lithuania?). For its implementation, it is necessary to create such learning conditions by selecting appropriate working methods that will support the development of children while achieving the objectives of the core curriculum.
Which include:
• developing competences such as creativity, innovation and entrepreneurship;
• developing the skills of critical and logical thinking, reasoning,
• arguing and reasoning;
• showing the value of knowledge as a basis for developing skills;
• awakening students' cognitive curiosity and motivation to learn;
• equipping students with such information and shaping such skills that allow them to understand the world in a more mature and orderly way;
• supporting the student in recognizing his / her own predispositions and determining the path of further education;
• encouraging organized and conscious self-education based on the ability to prepare your own workshop.

The general objectives derive from specific objectives related to the acquisition of key competences by students formulated by the Council of Europe and the European Parliament as a framework defining new basic skills acquired in the lifelong learning process.

The key competences of the EU include:
• Communication in the mother tongue and in foreign languages,
• Mathematical competence and basic competences in science and technology,
• IT competences,
• Learning of studying methods
• Social and civic competences,

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• Initiative and entrepreneurship,
• Cultural awareness and expression,
• Media competence

In the light of these goals, a modern student should:

- communicate effectively in Polish and in foreign languages, including performing in front of the audience;
- communicate effectively in various situations, present your own position, taking into account the experiences and views of other people;
- search, organize, critically analyze and use information from various sources;
- demonstrate readiness for creative and scientific activity and interest in the surrounding world;
- creative solving problems in various fields with a conscious use of methods and tools derived from computer science;
- solve problems, also using mediation techniques;
- be able to work in a team and show social activity.

The content included in the basic course is related to the general objectives and the knowledge of the core curriculum of the second educational stage of primary school, much beyond its basic scope, complementing it. Therefore, they can be used during program lessons or in extracurricular activities. Actions taken as part of innovation are intended to develop key competences and focus on science, mainly mathematics, physics and ICT.

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3.1. Physics

Topic	Hours	Detailed requirements from the core curriculum	Implementation stage
Work and power of electric current.	2	Student: - names the forms of energy into which electricity is converted into the indicated devices, e.g. used in the household; -describes the conversion of electricity into mechanical energy (work); - presents the ways of generating electricity and their importance for the protection of the natural environment; - demonstrates the conversion of electricity into mechanical work; - uses the concepts of work and power of electric current, calculates work and power of electric current; - converts electricity given in kilowatt hours into joules and vice versa; - plans and makes the experiment related to determining the power of the receiver; - determines the receiver power using a voltmeter and ammeter; - draws a chama electrical circuit depicting the experimental setup for determining power; -solves simple calculation tasks using the formula for the work and power of electric current, distinguishes between the size of data and searched.	12-14 years
Straight line motion.	2	Student: - indicates examples of movement in the surrounding reality; - uses physical quantities: route, speed, time, to describe uniform linear motion; - calculates the speed units in the SI system; - makes graphs of the dependence of the road and speed on time for uniform linear motion; - plans experience related to determining the speed of movement (e.g. during walking, running, cycling); estimates the order of magnitude of the expected result; - reads data from the table; read the speed and distance traveled from diagrams	12-14 years

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		of the dependence of the road and speed on time in uniform linear motion; -draws graphs of the dependence of the road and speed on time in uniform linear motion; - uses physical quantities: path, speed, time to solve simple computational tasks related to uniform linear motion; - solves problems using the relationship between road, speed and time in straight line traffic.	
Refraction of light.	2	Student: - indicates examples of refraction in the surrounding reality; - designs an experiment illustrating the phenomenon of refraction (changes in the angle of refraction when the angle of incidence changes; - describes the course and result of the experiment carried out, explains the role of the instruments used; - makes a schematic drawing illustrating the experimental system; - describes the course of rays at the transition of light from a thinner medium to an optically thicker medium and vice versa, using the concept of refraction angle.	12-14 years
Light Fission.	2	Student: - shows examples of refraction in the surrounding reality; - designs an experiment illustrating the phenomenon of refraction (changes in the angle of refraction when changing the angle of incidence; - describes the course and result of the experiment carried out, explains the role of the instruments used; - makes a schematic drawing illustrating the experimental system; - describes the course of rays at the transition of light from a thinner medium to an optically thicker medium and vice versa, using the concept of refraction angle; - describes the phenomenon of light splitting using a prism; - describes white light as a mixture of colors, and laser light as one-colored	12-14 years

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		light.	
Ohm's law.	2	Student: - uses the concept of electrical resistance as the value characterizing a conductor; - explains what the electrical resistance depends on; - plan the experience associated with determining the electrical resistance of a resistor using a voltmeter and ammeter; - applies Ohm's law in simple electrical circuits; - reads data from the table and save the data in the form of a table; - makes a graph of the current dependence on the applied voltage based on data from the table; - determines the receiver resistance using an ammeter and voltmeter; - solves accounting tasks regarding electrical resistance.	12-14 years
Light reflection and dispersion.	2	Student: - formulates the rule of reflection; - describes the course and a result of the experiment using the concepts of angle of incidence and reflection angle; - explains the role of used tools and making a diagram of the experimental system; - describes the phenomena of reflection and dispersion of light, giving examples of their occurrence and use.	12-14 years
Receiving images using lenses.	2	Student: - plans the experience related to testing the course of rays passing through the border of two optical centers; - names sand distinguishes types of lenses; - describes the course of rays passing through the focusing or distracting lenses; using the concepts of focus, focal length and focusing ability of the lens; - creates a sharp image of the object on the screen using the focusing lens; - selects experimentally the position of the lens and the object; - makes a schematic drawing illustrating the formation of the image obtained using the focusing lens;	12-14 years

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		- draws structurally images created by the focusing lens; - distinguishes between images: real, apparent, simple, inverted, enlarged, reduced; - describes the creation of images in the human eye, explains the meaning of the concepts of myopia and farsightedness; - explains the role of lenses in correcting these vision defects.	
The principle of conservation of mechanical energy.	2	Students: - names the energies possessed by a given body at a given moment; - explains how the energies of the body change during ascent and descent; - indicates examples from the environment of changes taking place; - analyzes energy transformations occurring in various situations; - determines when energy reaches maximum and when minimum values.	12-14 years

3.2. Mathematics

Topic	Hours	Detailed requirements from the core curriculum	Implementation stage
Perpendicular lines and parallel lines.	2	Student: - recognizes straight or perpendicular sections and straight or parallel sections; - shows perpendicular and parallel streets on the city plan; - draws perpendicular and parallel lines with a ruler and set square; - draws perpendicular and parallel lines on a checked sheet; - uses the characters: T and || to describe perpendicular and parallel lines; - indicates and draws a line segment being the distance of a point from a straight line.	10-12 years
Square. Rectangle.	2	Student: - describes the rectangle, including the square; - draws the diagonals of a rectangle;	10-12 years

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		- draws and recognizes rectangles in drawings; - draws a rectangle with a ruler, set square and compass when it has the given length of two adjacent sides; - draws a square with a ruler, set square and compass when it has a given diagonal of this figure; - lists the properties of the diagonals of a rectangle; - solves tasks using the properties of a rectangle.	
Drawing polygons.	2	- names and draws polygons with the given name; - indicates and counts diagonals in a polygon; - applies the theorem of the sum of the angles of a triangle; - uses the knowledge of the sum of angles in a quadrangle in tasks; - solves tasks using polygon properties; - understands and interprets relevant mathematical concepts, knows the basic terminology; - reads and understands simple text containing numerical information; - distinguishes between figures circle and circle; - uses a compass - draws circles and circles; - distinguishes in the circle and circle the center, radius, diameter and chord; - applies the relationship between the radius and diameter of the circle and the circle; - uses circle and circle messages in tasks.	10-12 years
Square Area.	2	Student: - calculates the area of a rectangle and square when the sides of these figures are expressed by natural numbers and the same units; - uses field units; - converts field units; - solves the tasks for calculating the square and rectangle;	10-12 years
Perimeters of regular polygons.	2	Student: - calculates the perimeter of a rectangle and square when the lengths of the	10-12 years

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		sides of these figures are given; - calculates the side length of a square or rectangle when the perimeter of a figure is given; - text tasks in which you need to calculate the perimeter of a rectangle; - performs auxiliary drawings for text tasks.	
Symmetry in a coordinate system.	2	Student: - recognizes axisymmetric figures; - draws a figure (point, segment, circle) symmetrical to the given relative to the straight; - indicates the axes of symmetry of the axisymmetric figures; - draws a figure (eg triangle, trapezoid) symmetrical to the given relative to the straight; - determines the coordinates of points symmetrical to the data relative to the coordinate system axis.	12-14 years
Pythagorean theorem.	2	Student: - indicates the hypotenuse and hypotenuse of the right triangle; - formulates Pythagoras' theorem; - uses the Pythagorean theorem to calculate the length of sections; - calculates the length of the segment whose ends are given lattice points in the coordinate system; - geometrically justifies the Pythagorean theorem; - solves typical practical tasks using the Pythagorean theorem; - solves complex practical tasks using the Pythagorean theorem; - finds Pythagorean trios.	12-14 years
Describing prisms.	2	Student: - distinguishes between simple prisms and names them; - describes the prisms; - shows the height of the straight and inclined prism on the model;	12-14 years

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		- draws straight prisms and their grids; - classifies prisms; - based on examples of solids, determines the formulas for the number of walls, edges and vertices of a prism	
Symmetry relative to the point (0,0).	2	Student: - recognizes symmetrical shapes; - draws a figure (point, segment, circle) symmetrical to a given one with respect to the point; - indicates the center of symmetry of center-symmetric figures; - draws a figure (eg. a triangle, trapezoid) symmetrical to a given point; - determines the coordinates of points symmetrical to the data in relation to the origin of the coordinate system; - recognizes center-symmetric shapes and indicates their centers of symmetry.	12-14 years
Describing the pyramids.	2	Student: - distinguishes pyramids from various solids and gives their names; - gives examples of pyramids, eg. in architecture and surroundings; - indicates the basic elements of the pyramids (eg. base edges, side edges, solid height, heights side walls); - recognizes and draws pyramid grids; - draws pyramids.	12-14 years

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3.3. ICT

Topic	Hours	Detailed requirements from the core curriculum	Implementation stage
"Killing the witch with a ray reflected from the mirror"	2	Student: - uses appropriate structural instructions; - sends messages and program responses to receiving a message, uses scenes; - introduces a new sprite and compose a script for it in the SCRATCH environment; - creates a game in the SCRATCH environment.	10-12 years
Programming the robot Lego Mindstorms EV3	2	Student: - knows how to start the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like; - knows basic blocks for building algorithms in the program; - knows how to create simple algorithms in the program; - can write instructions to individual blocks; - knows how to run an algorithm built in the program; - can move the robot through the maze; - can build simple scripts; - student understands and knows how to apply loop instructions to repetitive activities.	12-14 years
Robot as a windmill. **Robot in the maze.**	2 2	- knows how to start the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like, - uses basic blocks for building algorithms in the program; - knows how to create simple algorithms in the program; - can write instructions to individual blocks; - knows how to run an algorithm built in the program; - can control the robot using commands; - can build simple scripts; - understands and knows how to apply loop instructions to repetitive	12-14 years

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		activities.	

4. Contents of education, forms and upbringing.

The proposals for actions contained in this set assume the activation of students and teachers. Working with activating methods will play a big role here, with particular emphasis on the experiment and the extensive use of information technology (ICT). Activating methods increase the effectiveness of teaching, make classes more attractive to the student, increase his interest in virtually every subject. They release curiosity and greater commitment. By teaching with activation methods, the teacher acts as a guide organizing didactic situations, controlling the student's discovery of knowledge.
These methods not only allow the student to arouse interest in the subject or test his knowledge. Their main advantage is the improvement of skills useful not only during lessons, but also in everyday life, e.g. the ability to draw conclusions, analytical and critical thinking, combining events and facts into cause-and-effect relationships, the ability to behave properly in a new situation, communication skills, discussing, creativity. Activating methods affect the active participation of children in classes, their involvement and a noticeable increase in internal motivation. It is important to believe that what you have seen with your own eyes, what you have touched, experienced, is easier to understand. In addition, some phenomena are simply easier to show than to translate in a complex and sometimes incomprehensible way for young people. Currently, we can use ready-made tools and programs that allow us to make the connection process more attractive. There are one benefit to different age groups and the results are outcomes. An example of this tool is GeoGebra - free software supporting learning mathematics (http://geogebra.org) or the website Math.edu.pl.
However, if we want to expand the knowledge and skills in physics, it is worth using the tools for learning this subject available on the pages www.algodoo.com or www.darmoweprogramy.org/programy/fizyka.php .

4.1. Experiment

The student's cognitive development consists in the independent construction of knowledge from various sources in their own, subjective way: from a specific experience to organizing the world they are learning. The sense of agency, experience, and the student's independent pursuit of knowledge result in permanent development and openness to learning about the world and oneself. Experiments and experiments fit perfectly

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with these theses. By carrying out experiments, students fully understand the phenomena and problems of the surrounding world, awake cognitive curiosity, motivation to explore knowledge and the problem, and consequently acquire the ability to use this knowledge in practice.

In education, we can distinguish five types of experiments and experiments:

1. performed by a teacher
2. performed by the teacher together with the students
3. performed by students at home - on the students' own initiative or as homework
4. performed in student groups
5. performed by the students themselves.

It has to be assumed that any experiment, even one that doesn't work, is very valuable. The most important thing is to analyze the results together with the students and formulate conclusions, to think about what caused the experiment to fail. The progress of science consists in discovering new phenomena, but also in refuting old hypotheses. Searching for new explanations and causes of phenomena is an indispensable element of the development of science. By working with the experimental method, the students themselves will want to gain knowledge through experience. for the very high involvement of students.

4.2. Programming

Programming, also known as coding, has numerous applications today. The programs control devices which task is to make life easier for all users. Thanks to them our computers, tablets, mobile phones, also the servers of internet and banking portals and a seemingly prosaic fridge, washing machine or a vacuum cleaner work. Programming can be defined as writing instructions for a computer. However, for programming to be beneficial, it was necessary to create programming languages, that is, sets of commands based on words, not numbers, with a specific syntax and capable of being unambiguously translated into machine code. There is no perfect and universal language for everything, and evolving technology forces a constant search for new, more effective coding languages.

Programming effectively develops commutative and logical thinking skills. Commutation thinking is a thought process in which a problem and its solution are formulated in a comprehensible and executable manner by a computer. It develops a whole range of skills that are rarely shaped in any other context, especially school. Programming teaches problem solving, decomposition (dividing large tasks into smaller ones), inference and correcting errors. These are skills that are useful in studying science.

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Computational thinking is directly related to understanding logical constructs. When a computer performs a task, it always executes an algorithm, usually a list of steps that has to be performed step by step in order to achieve the desired effect. Computer operation is always predictable - the same algorithm performed multiple times on the same data will always produce the same results.

Teaching programming has many benefits that have little to do with technology itself. A number of studies suggest that it positively influences both the cognitive abilities and social skills of students. Children taught the basics of computer science with an emphasis on algorithmic thinking and logical constructs develop a whole range of school and social skills. Noticeable progress is being made in areas such as visual memory, cognition and language skills. Metacognitive skills also increase - students know better how to learn, which is related to developing self-control and independent learning.

4.2.1. Scratch

Knowledge of even the basics of programming opens a new field for creative expression. For this reason, properly used, programming gives measurable results in developing creativity in children. The development of creativity is the more likely the easier the programming language is to master, and the wider possibilities it offers. A great example of such a language is Scratch, which structure was inspired by LEGO blocks, where children intuitively begin to combine elements available in the set, combining and creating models that inspire them to continue working. Creativity in this context arises almost organic. It is similar with Scratch, in which children intuitively combine blocks to create simple programs from which they draw inspiration to create new ones. During lessons and during extracurricular activities, students work on the www.scracht.mit.edu platform, which develops the child's creativity.

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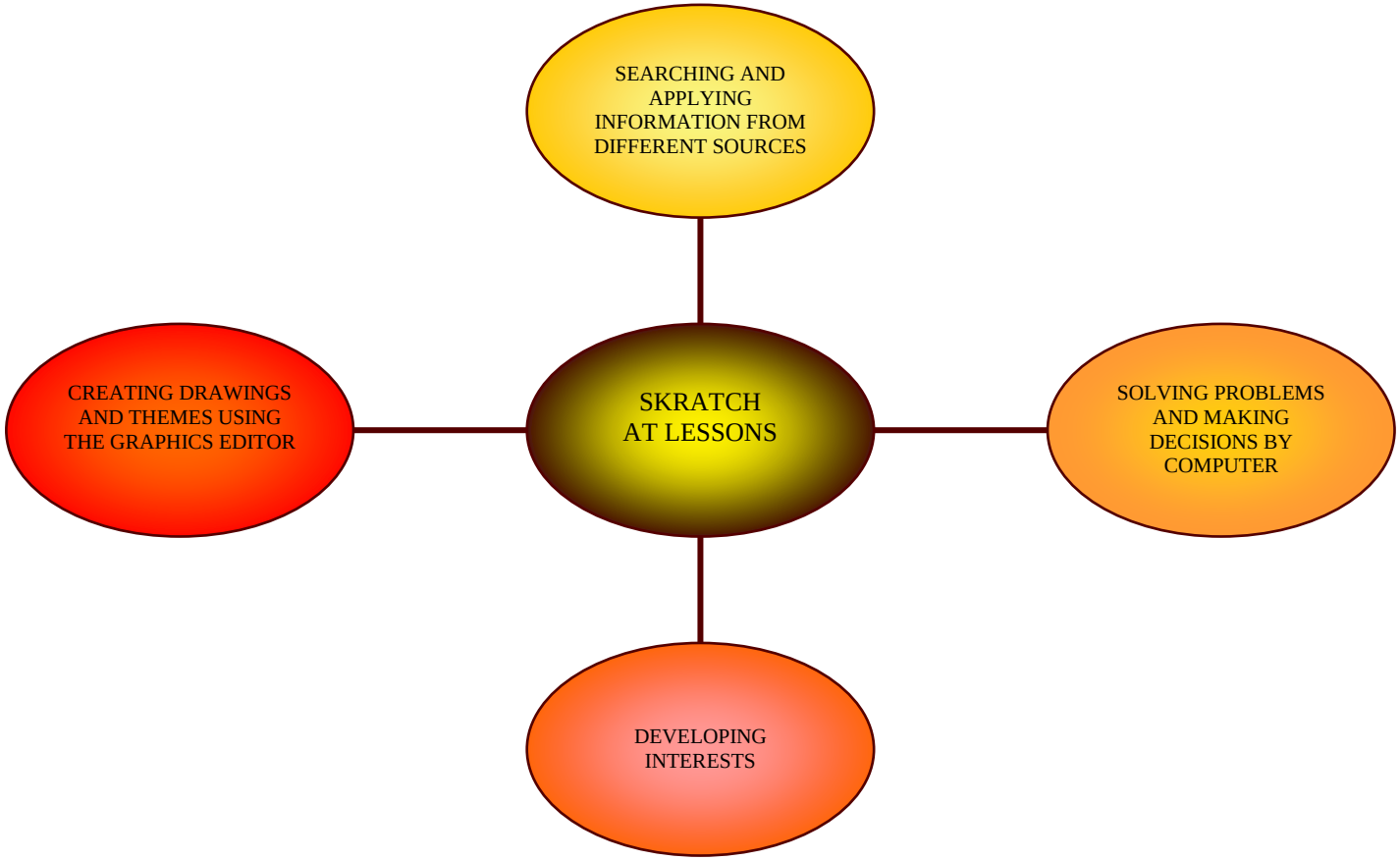

Pic. Scratch at lessons in relation to the core curriculum.

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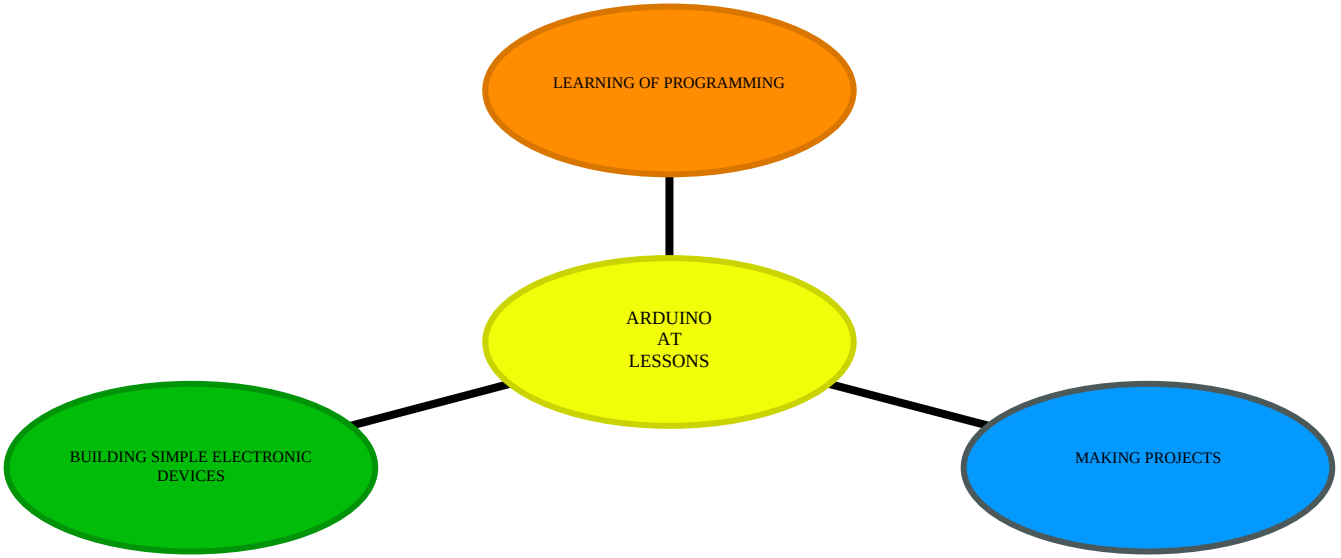
4.2.2. Arduinio

Arduino is a programming platform for embedded systems based on a simple Open Hardware project for microcontrollers mounted in a single printed circuit, with embedded input / output circuits support and a standardized programming language. We can find it on www.arduino.cc .

One of the main goals of the Arduino platform is to enable the creation of embedded systems for people who are not experts in electronics and programming. The simplicity of design is visible both in the hardware layer created by joining the boards "on top of each other", as well as in the software layer implemented by the basic and simple to use elements of the programming language.
Teachers are eager to reach for this platform and use it as part of school classes on the basics of electronics and programming. Arduino introduces students to the world of embedded systems in a friendly way, allowing you to start working with microcontrollers and create first projects.



Pic. Arduino at lessons in relation to the core curriculum.

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5. Summary table of Model teaching program using experimental methods in learning science.

DEPARTMENT	EDUCATIONAL STAGE	DESCRIPTION OF THE PROGRAM	SUBJECT	AGE	CLASS	SCENARIO TITLE	NUMBER OF HOURS	AUTHOR	ATTACHMENT
PHYSICS	**Primary school**	The program will be an opportunity to consolidate basic skills in robotics and programming. Lessons are adapted to the level of development of children and take into account the amount of time needed to master skills or tasks. Each student will have the opportunity to develop their skills in logical thinking, both independence and cooperation in a group, creativity and imagination.	Robotics	14 years	Class VIII	**Work and power of electric current**	*3 hours lesson*	*Jarosław Szczęsny*	**Work and power of electric current.ev3**
			Robotics	14 years	Class VIII	**Straight line motion**	*3 hours lesson*	*Jarosław Szczęsny*	**Uniform robot motion.ev3**
			Robotics	14 years	Class VIII	**Uneven linear motion**	*3 hours lesson*	*Jarosław Szczęsny*	**Uneven linear motion.ev3**
			Scratch	14 years	Class VIII	**Light Fission**	*2 hours lesson*	*Jarosław Szczęsny*	**Light Fission.sb2** **Light Fission2.sb2**
			Scratch	14 years	Class VIII	**Light reflection and dispersion**	*2 hours lesson*	*Jarosław Szczęsny*	**mirror.sb2** **light reflection.sb2** **light reflection2.sb2**
			Scratch	14 years	Class VIII	**Ohm's law**	*2 hours lesson*	*Jarosław Szczęsny*	**Ohm_s law.sb3**
			Scratch	14 years	Class VIII	**Receiving images using lenses**	*2 hours lesson*	*Jarosław Szczęsny*	**Receiving images using lenses.sb2**
			Scratch	14 years	Class VIII	**Refraction of light**	*2 hours lesson*	*Jarosław Szczęsny*	**Refraction of light.sb2**
			Scratch	14 years	Class VIII	**The principle of conservation of**	*2 hours lesson*	*Jarosław Szczęsny*	**The principle of conservation of**

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						mechanical energy			**mechanical energy.sb2**
			Scratch	14 years	Class VIII	**Straight line motion**	*2 hours lesson*	*Jarosław Szczęsny*	**Uniform movement.sb2** **Accelerated movement.sb2**
		Students will be able to acquire knowledge, understanding, develop abilities and form values that would allow each student to understand the essential regularities, processes and phenomena of the surrounding world, their interrelationships, will be able to apply scientific ideas in explaining the surrounding environment. During the study of the program there is a close integration with information technologies - ICT is used for searching, summarizing and providing information, processing research, testing and observation data, studying or modeling natural phenomena; showing the	Mechanics	13 years	Class VII	**Calculation of average movement speed**	*4 hour lesson*	*Kristina Višnevskienė*	**1**
			Electrical circuits	13 years	Class VII	**Single LED control using digital output**	*4 hour lesson*	*Kristina Višnevskienė*	**2**
			Electrical circuits	13 years	Class VII	**Three light LEDs- directional indicator**	*4 hour lesson*	*Kristina Višnevskienė*	**3**, **4**
			Energy	14 years	Class VIII	**The law of conservation of energy**	*4 hour lesson*	*Kristina Višnevskienė*	**5**
			Simple mechanisms	14 years	Class VIII	**The principle of two-arm lever**	*4 hour lesson*	*Kristina Višnevskienė*	**6**

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		close connection between physics and technology is examined the latest technological achievements, their practical application, theories based on practical examples, learning to evaluate scientific discoveries and technologies from the point of view of sustainable development, taking care of safety.	Electrical circuits	13 years	Class VII	**Control of two LEDs using digital outputs**	*4 hour lesson*	*Kristina Višnevskienė*	**7**
			Electrical circuits	13 years	Class VII	**Photoresistor - an alternative light switch**	*4 hour lesson*	*Kristina Višnevskienė*	**8**
		Using scratch, makerblock and Arduino to program videogames tu calculate mathematics issues. We also use assets provided by software	Object acceleration calculation based on speed and distance (coding and robotics)	12 years	Class V	**Car Acceleration**	*3h*	*Alfonso López (AIJU)*	**3**
			Speed Light Calculation (coding and robotics)	12 years	Class V	**Speed Light**	*3h*	*Alfonso López (AIJU)*	**6**
			Calculating ball bounce on wall	12-14 years	Class V	**Angle refraction**	*4h*	*Alfonso López (AIJU)*	**14**
MATHS	**Primary school**	The program will be an opportunity to consolidate basic skills in geometry. It is also an opportunity to fill in	Properties of flat figures	12 years	Class V	**Perpendicular lines and parallel lines**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Perpendicular straight 1.sb3** **Straight parallel**

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		and compensate for deficiencies in the field of elementary geometry. Lessons are adapted to the level of development of children and take into account the amount of time needed to master skills or tasks. Each student will have the opportunity to develop their skills in logical thinking, both independence and cooperation in a group, creativity and imagination.							**1.sb3**
			Properties of flat figures	12 years	Class V	**Square. Rectangle.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Square.sb3** **Rectangle.sb3**
			Properties of flat figures	12 years	Class V	**Drawing polygons.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Parallelogram.sb3** **Drawing polygons.sb3** **Trapeze.sb3**
			Area of plane figures	12 years	Class V	**Square area.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Area and perimeter.sb3**
			Properties of flat figures	12 years	Class V	**Perimeters of regular polygons.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Perimeter of a polygon 1.sb3**
			Symmetries	14 years	Class VIII	**Symmetry in a coordinate system.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Ox symmetry.sb3**
			Pythagorean theorem	14 years	Class VII	**Pythagorean theorem**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Prism.sb3**
			Spatial solids	14 years	Class VIII	**Describing prisms.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Describing prisms.sb3**
			Symmetries	14 years	Class VIII	**Symmetry relative to the**	*2 hours lesson*	*Renata Jasińska,*	**Symmetry about 00.sb3**

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						point (0,0).		*Alicja Radziwon*	
			Spatial solids	14 years	Class VIII	**Describing pyramids.**	*2 hours lesson*	*Renata Jasińska, Alicja Radziwon*	**Triangles.sb3**
		Some math problems may appear to be harder as the students can't visualize and comprehend what they're supposed to do. Examples would be the problems with time, speed, and distance or calculating the coin value. The program will help to visualize the problems and solve them multiple times with immediate feedback.	Finance management	10-12 years	Class V-VI	**Finance management**	*2 hours lesson*	*Valerijus Jaglinski*	**12**
			Speed time route	10-12 years	Class V-VI	**Speed time route**	*3 hours lesson*	*Valerijus Jaglinski*	**13**
		Using scratch, makerblock and Arduino to program videogames to calculate mathematics issues. We also use assets provided by software	uniform line movement (coding and robotics)	12 years	Class V	**Bikes Encounter**	*3h*	*Jose Carlos Sola (AIJU)*	**1**
			Vector Axis (coding and robotics)	12 years	Class V	**Cat vs Mices**	*4h*	*Jose Carlos Sola (AIJU)*	**2**
			First Degree Equation - Problem 1 (coding and robotics)	12-14 years	Class V	**First Degree Equation - Problem 1**	*3h*	*Alfonso López (AIJU)*	**4**

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			First Degree Equation - Problem 2 (coding and robotics)	12-14 years	Class V	**First Degree Equation - Problem 2**	*3h*	*Alfonso López* *(AIJU)*	**5**
			First Degree Equation - Problem 2 (coding and robotics)	12-14 years	Class V	**Arithmetic Means**	*3h*	*Jose Carlos Sola* *(AIJU)*	**8**
		Students will build an algorithm that is a calculator	Algorithms & mathematical operations	12-14 years	Class IV-VI	**Improving math skills in Scratch**	*3 hour lesson*	*Edyta Michaluk*	**20 21**
		Students create a script that will assign individual geometric shapes to groups.	Geometric figures	12-14 years	Class IV-VI	**Division of geometric figures**	*4 hour lesson*	*Edyta Michaluk*	**22 23 24**
		Students will recall geometric figures and their properties. In addition, they get acquainted with the creation of animations in the environment.	Geometric figures & calculations	12-14 years	Class IV-VI	**Geometric shapes and animations in Scratch**	*4 hour lesson*	*Edyta Michaluk*	**25 26 27 28** **29 30 31 32**

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6. Examples of lesson plans using innovative methods.

6.1. Physics

SCENARIO		
Title	**Work and power of electric current.**	
Summary	Students in class will learn the concept of work and power output. They become familiar with the formulas on their calculation. In practical operation, they will determine the power of the receiver. When determining power, use an ammeter and a voltmeter.	
Author/s	Jarosław Szczęsny	Date: 27/09/2019

Didactic objectives
General objectives: - Introduction of the concepts of work and power of electric current and formulas for their calculation. - Plan and carry out the experiment of determining the power of the receiver using an ammeter and voltmeter. **Specific lesson objectives:** Students will be able to: - name the forms of energy into which electricity is converted into the indicated devices, e.g. used in the household, -describe the conversion of electricity into mechanical energy (work), - present the ways of generating electricity and their importance for the protection of the natural environment, - demonstrate the conversion of electricity into mechanical work, - using the concepts of work and power of electric current, calculate work and power of electric current, - convert electricity given in kilowatt hours into joules and vice versa, - plan and carry out the experiment related to determining the power of the receiver, - determine the receiver power using a voltmeter and ammeter,

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- draw a chama electrical circuit depicting the experimental setup for determining power,
-solve simple calculation tasks using the formula for the work and power of electric current,
distinguishes between the size of data and searched.

Physics☐ Mathematics☐ Information Technology☐ Robotics ☒
Programming☐

Education Level: 10-12 years☐ 12-14 years ☒

Problem Statement

-What are the formulas for calculating the work and power of an electric current?
- How to determine power?
- What instruments are needed to determine the receiver power?

BOM (Bill Of Materials needed)

- computer station
- LEGO MINDSTORMS EV3 robot
- instruments for experience: light bulb, 4.5 V battery, ammeter, voltmeter, wires.

Activity description

1. Organizational and organizational activities
2. Introduction to the topic - discussion of ways to generate electricity.
3. Discussion of examples of the conversion of electricity into other forms of energy.
4. Discussion of work performed by electric current.
5. Discussion of the power of electric current.
6. Performing by the students the experiment of determining the receiver power using an ammeter and voltmeter - work in groups.
7. A reminder of a kilowatt hour as a unit of energy and work.
8. Reading information from nameplates of electrical devices.
   Calculation of electricity costs
9. Practical exercises - working with the LEGO MINDSTORMS EV3 robot.
   - measurement of voltage prevailing in the robot circuit
   - reading current while the robot is working,
   - calculating the robot's power and electricity consumed during its work.
10. Problem solving.

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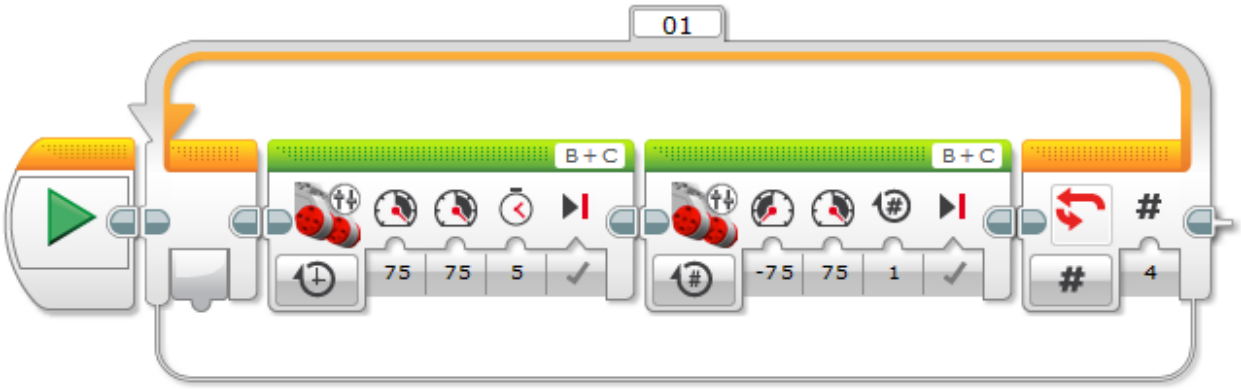
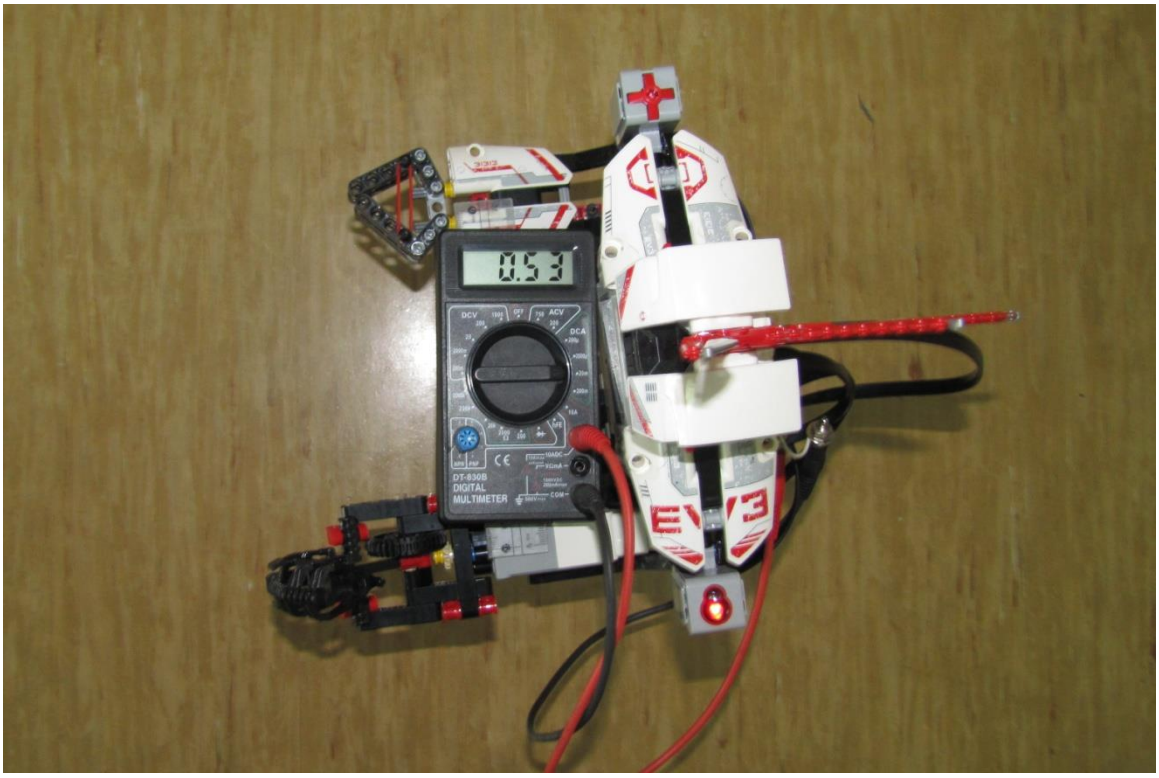
11. Summary and end of the lesson.

Resources

light bulb, 4.5 V battery, ammeter, voltmeter, cables.





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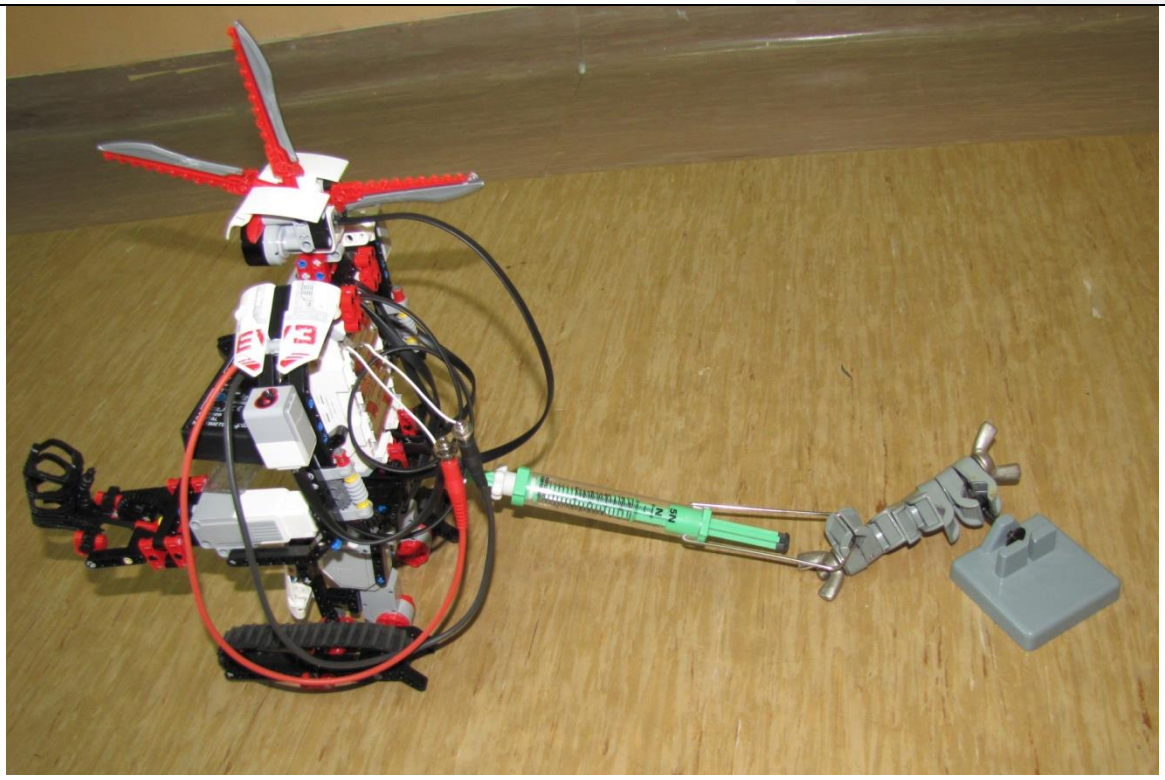

Students' Evaluation
The student will be assessed in writing for his commitment and correct conclusions from experience.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy siódmej szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://www.robocamp.pl/pl/lego-mindstorms-ev3-wersja-domowa-edukacyjna/
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Straight line motion.**	
Summary	Students will learn the concept of uniform uniform motion, the concept of speed and its units in the SI system. They will learn to plan tasks to determine the speed. Based on their experience, they will learn to read and make graphs of the speed versus time versus distance.	
Author/s	Jarosław Szczęsny	Date: 06/01/2020

Didactic objectives
General objectives: - Introduction of the concept of uniform linear motion. - Introduction of the concept of speed and its units in the SI system. -Planning, conducting and analyzing experiments related to determining speed. - Reading and plotting speed versus time versus time graphs. Specific lesson objectives: Students will be able to: - indicate examples of movement in the surrounding reality, - use physical quantities: route, speed, time, to describe uniform linear motion; - calculate the speed units in the SI system, - make graphs of the dependence of the road and speed on time for uniform linear motion - plan experience related to determining the speed of movement (e.g. during walking, running, cycling); estimates the order of magnitude of the expected result; - read data from the table; read the speed and distance traveled from diagrams of the dependence of the road and speed on time in uniform linear motion, -draw graphs of the dependence of the road and speed on time in uniform linear motion, - use physical quantities: path, speed, time to solve simple computational tasks related to uniform linear motion, - solve problems using the relationship between road, speed and time in straight line traffic.
Physics☒ Mathematics☐ Information Technology☐ Robotics☐ Programming☐

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Education Level:	10-12 years☐ 12-14 years ☒
Problem Statement	
- What is straight line motion? - What is speed and what is its unit in the SI system? - How to determine the speed?	
BOM (Bill Of Materials needed)	
Tube with water and air bubble, stopwatches, highlighters.	
Activity description	
Lesson flow: 1. Organizational and organizational activities 2. Introduction to the topic - a reminder of the basic concepts describing movement. 3. Performance demonstration examining uniform motion. 4. Introduction of the concept of speed and its unit and formula. 5. Exercise in reading and drawing graphs of speed versus time and road versus time 6. Planning and conducting by the students an experiment on determining the speed of movement, e.g. during walking, running (group work) 7. Simulation in the SCRATCH environment of creating graphs for uniform linear motion.	

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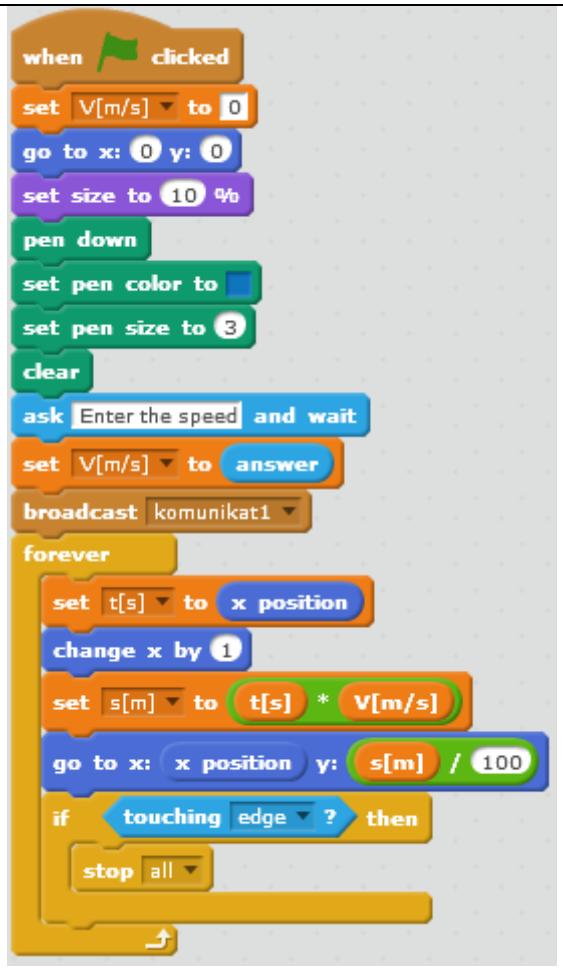

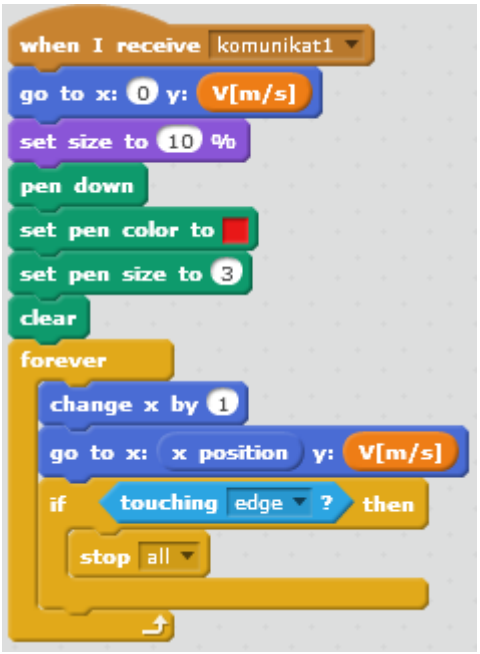

8. Summary and end of the lesson.

Resources
- computer stadion - SCRATCH environment installed or Internet Access - instruments for experiments: tube with water and air bubble, stopwatches, markers.

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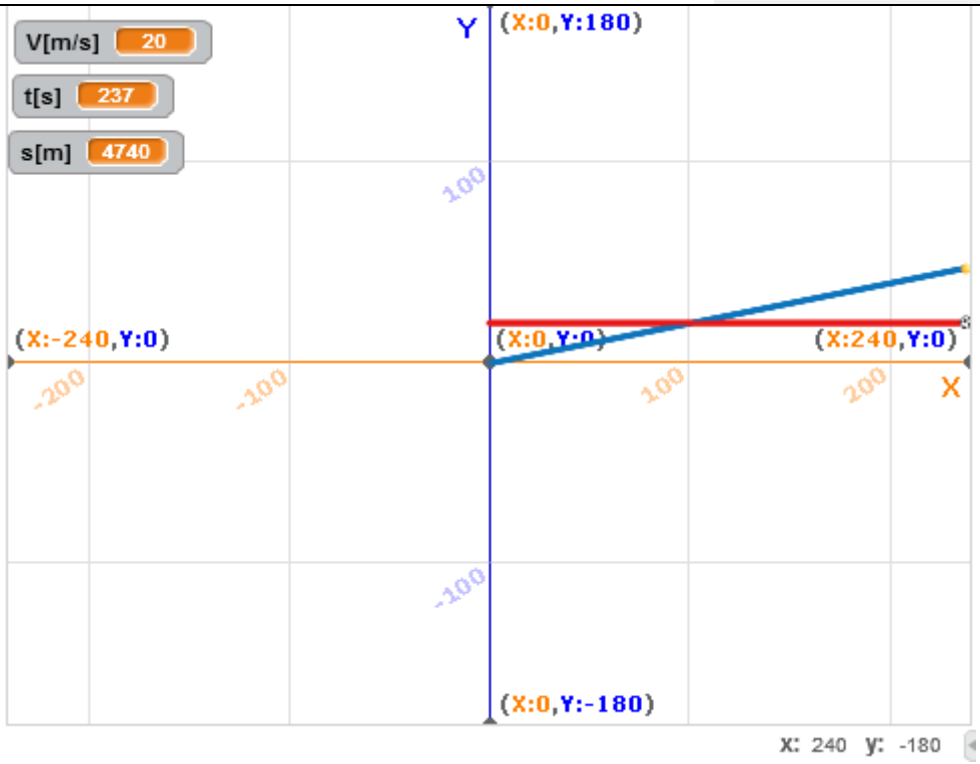

Students' Evaluation
The student is assessed for active work, involvement in classes.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy siódmej szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://scratch.mit.edu
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Uneven linear motion**	
Summary	Students learn the concept of nonuniform motion, the concept of average and instantaneous speed. They will learn to plan tasks to determine the average speed. On the basis of experience, they will learn to read and make graphs of speed versus time versus time.	
Authors	Jarosław Szczęsny	Data: 18/11/2019

Didactic objectives
General objectives: - introduction of the concepts of average speed and instantaneous speed in non-uniform motion, - exercise in drawing and analyzing charts. **Specific lesson objectives:** - Students will be able to: - use physical quantities: path, speed, time, to describe uneven straight line motion; point out examples of this movement in the surrounding reality, - distinguish between average and instantaneous speeds in non-uniform traffic, - use the concept of average speed to solve simple calculation tasks, - prepare a graph of speed versus time, analyze a graph and make conclusions.
Physics Mathematics☐ Computer science☐ Robotics☒ Programming☐
Educational level: 10-12 years old ☐ 12-14 years old ☒
Problem Statement
- What is rectilinear motion? - What is the average and instantaneous speed and what are their units in the SI system? - How to determine the average speed?
BOM (Bill Of Materials needed)
- computer station

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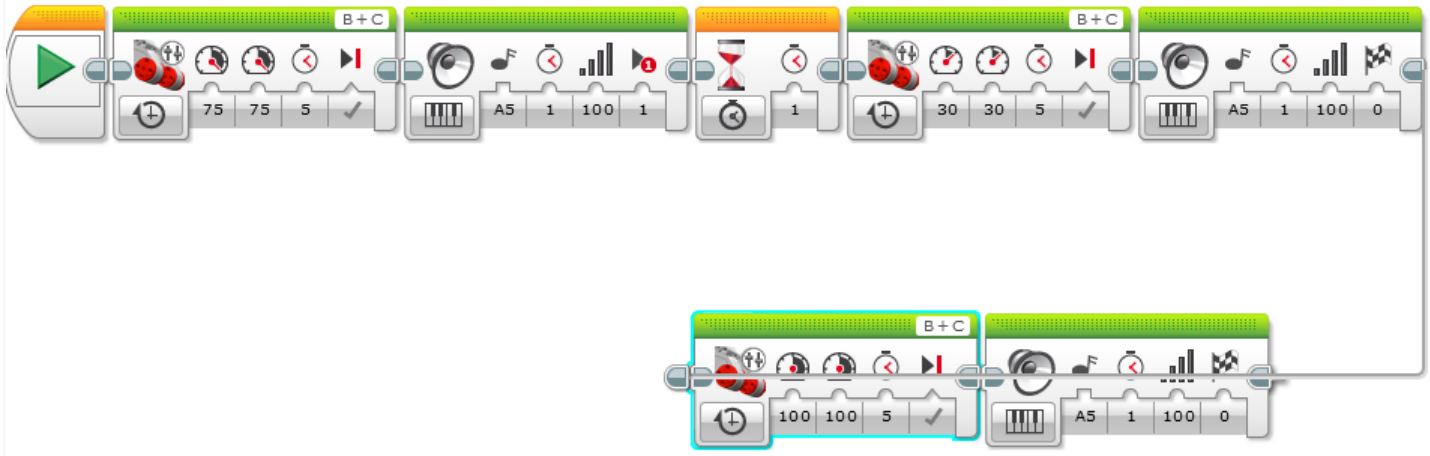
- LEGO MINDSTORMS EV3 robot.

Activity description

1. Organizational and organizational activities
2. Introduction to the topic - a reminder of the basic concepts describing movement.
3. Performance demonstration examining uniform motion.
4. Introduction of the concepts of average speed and instantaneous speed and formulas for calculating these quantities.
5. Discussion of the differences between these two quantities.
6. Exercise in reading and drawing graphs of speed versus time and distance versus time
7. Planning and conducting by the students an experiment on determining the speed of movement, e.g. during walking, running (working in groups)
8. Practical exercises - working with the LEGO MINDSTORMS EV3 robot.
   - measuring the path the robot will take at the same time when its speed changes,
   - creating a table of the length of road sections traveled by the robot at equal intervals.
9. Summary and end of the lesson.

Resources



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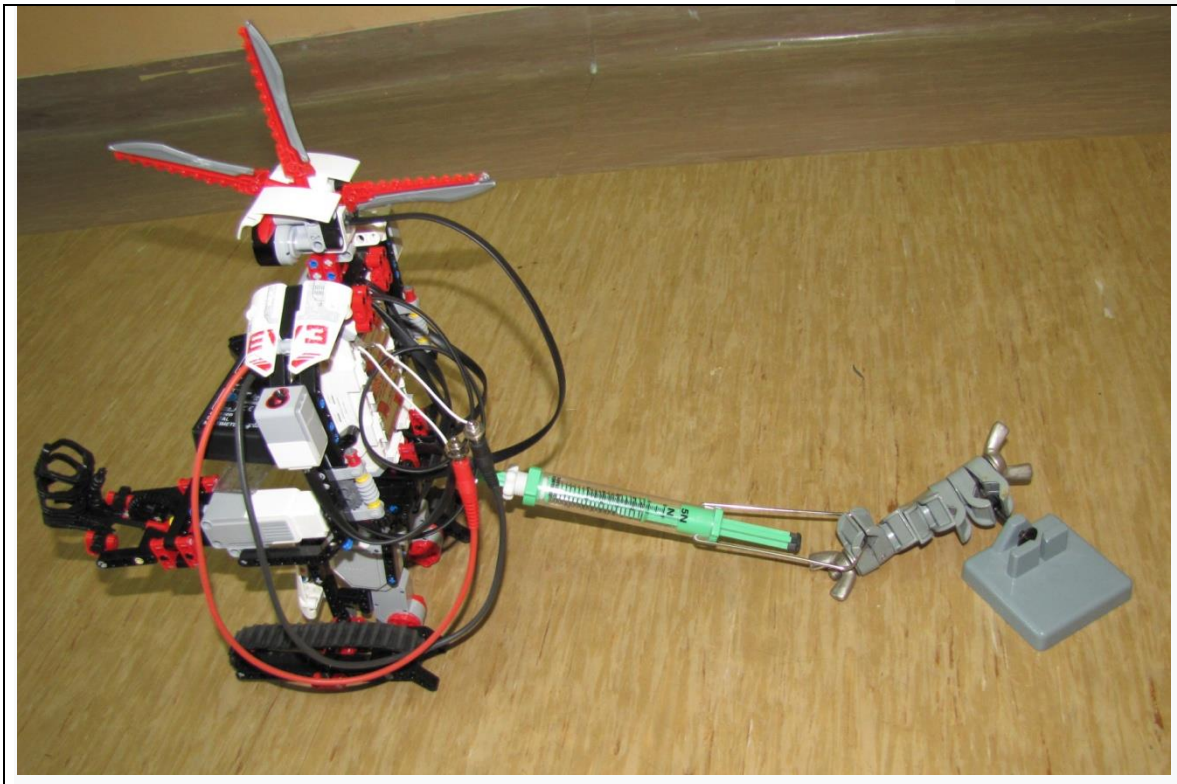

Students' Evaluation
The student will be assessed for commitment and proper performance of tasks.
Bibliography
Meetings with physics - Physics textbook for the seventh grade of primary school Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://www.robocamp.pl/pl/lego-mindstorms-ev3-wersja-domowa-edukacyjna/
Scalability
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More information
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SCENARIO		
Title	**Light Fission**	
Summary	Students will become familiar with the concept of "refraction of light". They know the relationship between the angle of incidence and the angle of refraction. They will know what the phenomenon of refraction and fission of white light in the prism is.	
Author/s	Jarosław Szczęsny	Date: 10/12/2019

Didactic objectives
General objectives: -Introduction of the concept of refraction. -Experimental demonstration of the relationship between the angle of incidence and the angle of refraction. -Discussion of the phenomenon of refraction and fission of white light in a prism. Specific lesson objectives: -Students will be able to: -Show examples of refraction in the surrounding reality, -Design an experiment illustrating the phenomenon of refraction (changes in the angle of refraction when changing the angle of incidence -describe the course and result of the experiment carried out, explain the role of the instruments used -make a schematic drawing illustrating the experimental system, -describe the course of rays at the transition of light from a thinner medium to an optically thicker medium and vice versa, using the concept of refraction angle, -describe the phenomenon of light splitting using a prism, -describe white light as a mixture of colors, and laser light as one-colored light
Physics☒ Mathematics☐ Information Technology☐ Robotics☐ Programming
Education Level: 10-12 years☐ 12-14 years ☒
Problem Statement
- What is a refraction of light? - What are the relationships between the angle of incidence and the angle of refraction?

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- What is the phenomenon of refraction?

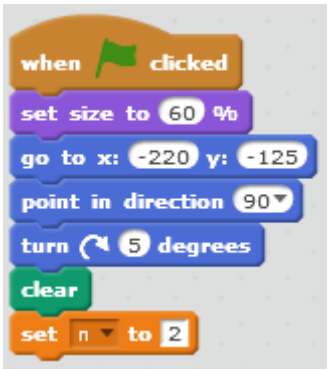
BOM (Bill Of Materials needed)

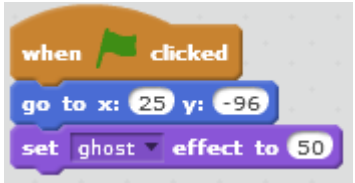
- computer station
- SCRATCH environment or Internet access installed
- instruments for optics experiments.

Activity description

Lesson flow:

1. Organizational and organizational activities
2. Introduction to the topic - a reminder of messages regarding the propagation of light in homogeneous media
3. Demonstration of an experiment showing refraction of light.
4. Demonstration of an experiment showing refraction at the border of two centers.
5. Explanation of the phenomenon of refraction based on observation of experiments.
6. Demonstration of the difference in refraction of light depending on the centers on which the light falls.
7. Explanation of the dependence angle of refraction on the type of medium.
8. Explanation of the relationship between the angle of incidence and the angle of refraction.
9. Experience demonstration - the passage of laser light through the prism
10. Simulation in SCRATCH environment of white light splitting after passing through the prism.





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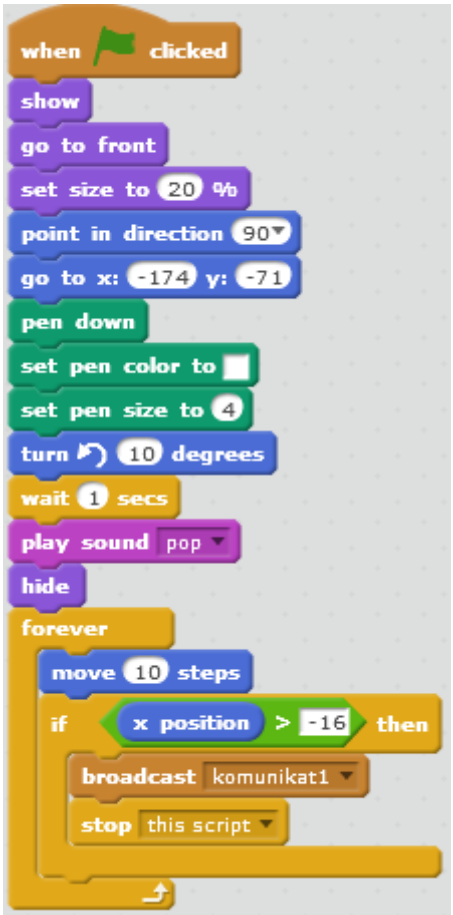

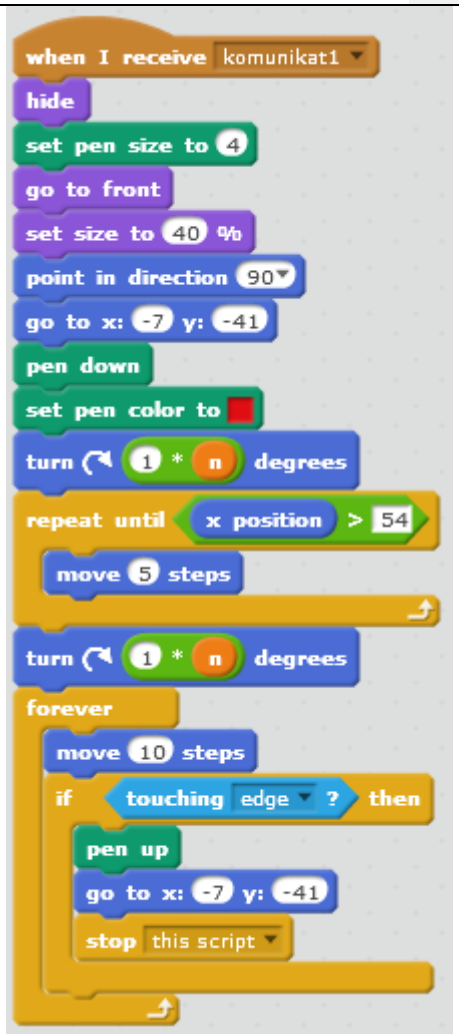

11. Summary and end of the lesson.

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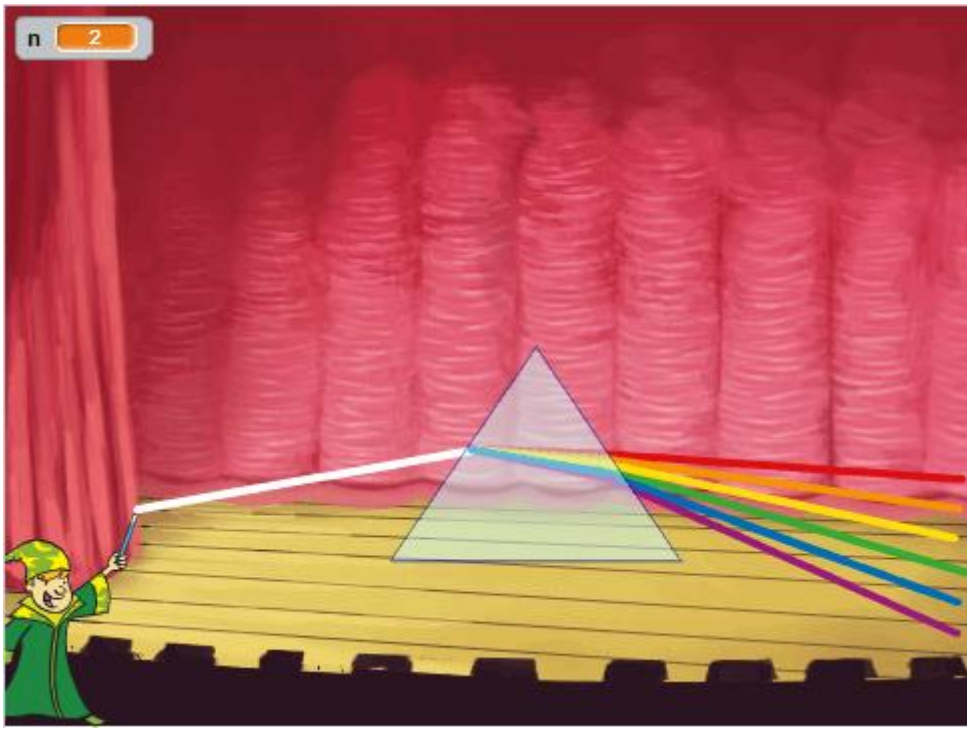
Resources
- computer stadion - SCRATCH environment installed or Internet Access 
Students' Evaluation
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SCENARIO		
Title	**Light reflection and dispersion**	
Summary	During the course, students will be introduced with information on the phenomenon of light reflection and scattering. They will know the rule of reflection.	
Author/s	Jarosław Szczęsny	Date: 15/12/2019

Didactic objectives
General goals: - introducing the concepts of reflection and dispersion of light. - indication of reflection and dispersion of light in everyday life. **Specific lesson goals:** - formulating the rule of reflection, - describing the course and a result of the experiment using the concepts of angle of incidence and reflection angle, explaining the role of used tools and making a diagram of the experimental system, -describing the phenomena of reflection and dispersion of light, giveing examples of their occurrence and use.
Physics ☒ Mathematics☐ Information Technology☐ Robotics☐ Programming☐
Education Level: 10-12 years☐ 12-14 years ☒
Problem Statement
What effect does the reflection surface have? What is the relationship between the angle of incidence and reflection?
BOM (Bill Of Materials needed)
- laser pointer, - mirror, - Screen, - protractor, - computer - SCRATCH environment installed or internet access
Activity description

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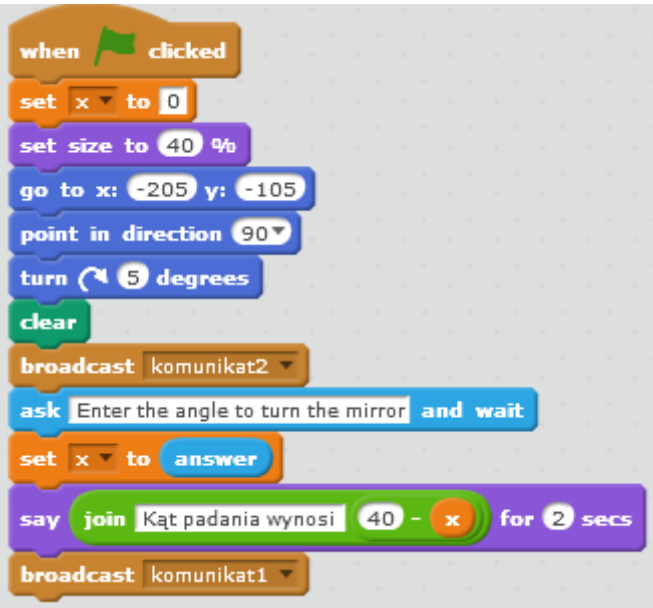
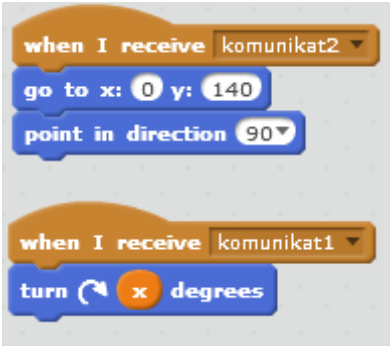
Lesson course:

1. Organizational activities
2. Introduction to the topic - a reminder of the light news.
    - The lecture about when and where to observe the reflection of light.
3. Discussion: What does it mean that we see through the Ligot
4. A demonstration of experience checking how light is reflected.
    - Students will formulate a conclusion about the experience.
    - Slideshow "Reflection and dispersion of light"
5. Introduction of concepts describing the phenomenon of light reflection
    - Introduction of reflection rule.
6. Performing an experiment showing the difference between reflection and light scattering.
    - Introduction of the concept of light scattering.
    - Explain the difference between reflection and light scattering.
7. Brainstorming - students give examples of reflection and dispersion of light from everyday life
8. Simulation in the SCRATCH environment of the reflection phenomenon from the mirror





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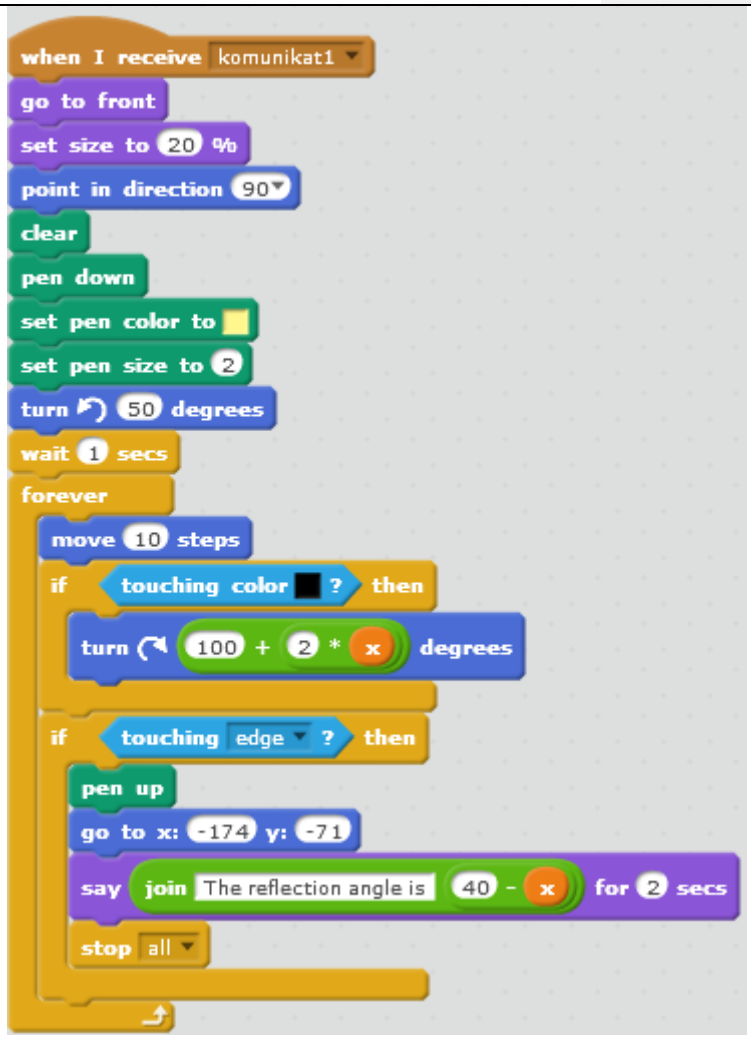

9. Solving tasks.

10. Summary of the lesson.

Resources

- computer stadion
- SCRATCH environment installed or Internet Access

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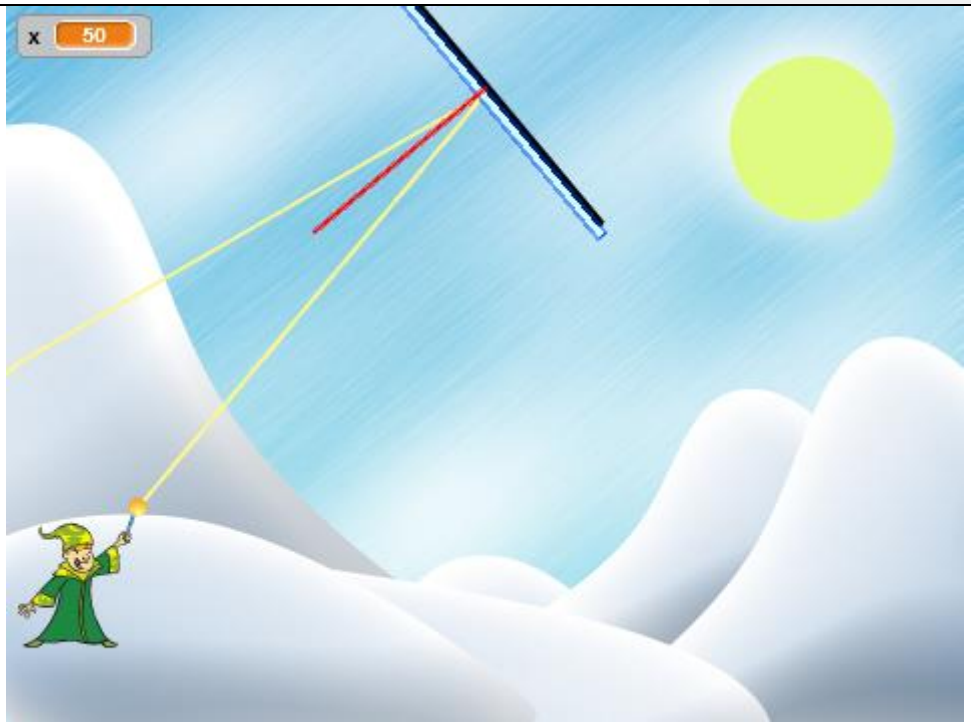

Students' Evaluation
The student will be maeked for his commitment and the proper performance of the experiments.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy ósmej szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://scratch.mit.edu
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

SCENARIO	
Title	**Ohm's law.**

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Summary	During the course, students will become familiar with the concept of electrical resistance. The definition of electrical resistance and its unit will be introduced. They will know Ohm's law. In practical activities, they will determine the electrical resistance of a resistor using a voltmeter and ammeter. In order to consolidate knowledge, they will solve tasks regarding electrical resistance and Ohm's law.	
Author/s	Jarosław Szczęsny	Date: 25/01/2019

Didactic objectives
General objectives: Introduction of the concept of electrical resistance. Introduction of the definition of electrical resistance and its unit. Experimental determination of the electrical resistance of a resistor using a voltmeter and ammeter. Knowing Ohm's law. Solving problems related to electrical resistance and Ohm's law. Specific lesson objectives: Students will be able to: use the concept of electrical resistance as the value characterizing a conductor, explain what the electrical resistance depends on, plan the experience associated with determining the electrical resistance of a resistor using a voltmeter and ammeter, apply Ohm's law in simple electrical circuits, read data from the table and save the data in the form of a table, make a graph of the current dependence on the applied voltage based on data from the table, determine the receiver resistance using an ammeter and voltmeter, solve accounting tasks regarding electrical resistance.
Physics ☒ Mathematics☐ Information Technology☐ Robotics☐ Programming☐
Education Level: 10-12 years☐ 12-14 years ☒
Problem Statement

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- What is electrical resistance?
- How to determine electrical resistance using a voltmeter and ammeter?
- What is Ohm's law?

BOM (Bill Of Materials needed)

- computer station
- SCRATCH environment installed or Internet access
- instruments for experiments: elements for the construction of electrical circuits, including resistors of different resistance, light bulbs.

Activity description

Lesson flow:

1. Organizational and cleaning activities
2. Introduction to the topic - an attempt to answer the question whether there is a relationship between voltage and current in an electrical circuit
3. Performing the experiment using a circuit with varying voltage.
4. Measurement of voltage and current of various electrical components and drawing conclusions
5. Introduction and discussion of the concept of electrical resistance - based on the results of the experiment
6. Introduction of the unit of electrical resistance and the formula: R = U / I
7. Discussion: What determines the electrical resistance.
8. Experimental study on what the electrical resistance of a conductor depends on.
9. Discussion of Ohm's law based on the results of experiments
10. Simulation of Ohm's law using the SCRATCH

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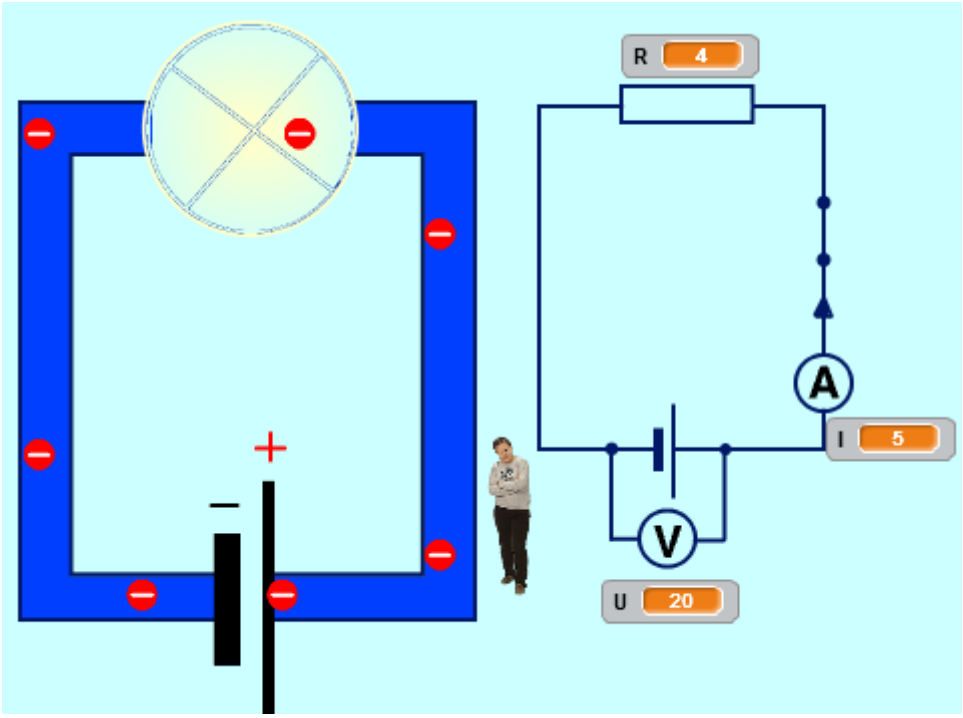
Resources
- computer stadion - SCRATCH environment installed or Internet Access 

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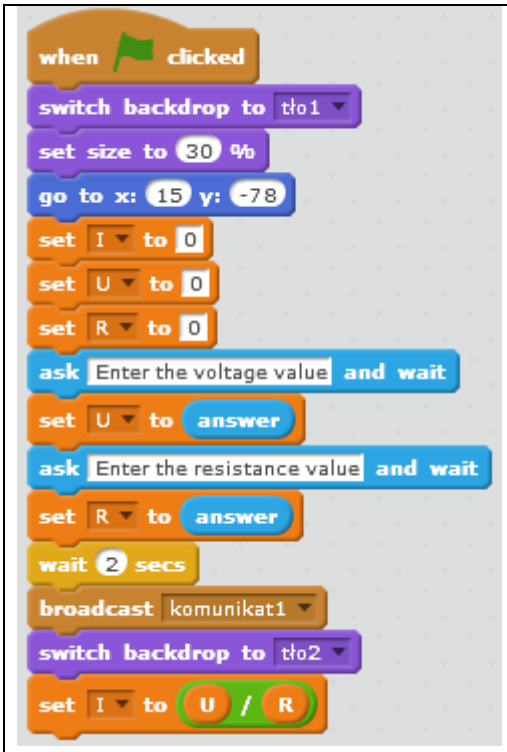

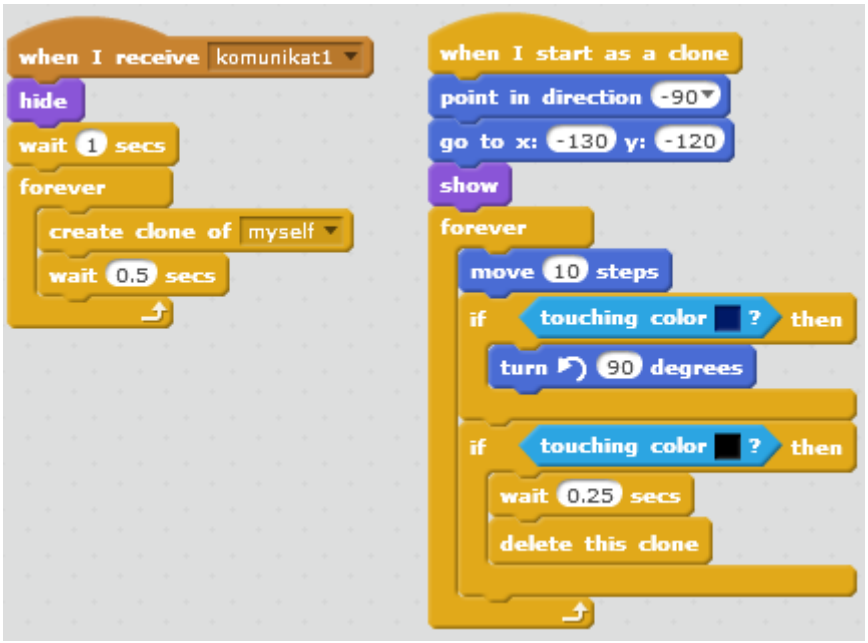

11. Solving problems related to Ohm's law.

Drawing graphs of the dependence of electric current on voltage; reading information from graphs for cases in

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which Ohm's law is fulfilled 12. Summary and end of the lesson.
Students' Evaluation
The student will be assessed in writing for his commitment and proper performance of the experiments.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy ósmejj szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://scratch.mit.edu
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Receiving images using lenses.**	
Summary	During the course, students will be able to recall basic information about the phenomenon of light refraction. They will be acquainted with the types of lenses and the experimental obtaining of images created with the help of a focusing lens. They will learn the equation of the lens and use it to determine the position of the image.	
Author/s	Jarosław Szczęsny	Date: 07/01/2020

Didactic objectives
General objectives: -To familiarize students with the types of lenses. -Experimental receiving images using lenses. - Discussion of the structure of the human eye and the most common vision defects and ways of correcting them. **Specific lesson objectives:** Students will be able to: -plan the experience related to testing the course of rays passing through the border of two optical centers, -replace and distinguish types of lenses, -describe the course of rays passing through the focusing or distracting lenses, using the concepts of focus, focal length and focusing ability of the lens, - create a sharp image of the object on the screen using the focusing lens, - select experimentally the position of the lens and the object, -make a schematic drawing illustrating the formation of the image obtained using the focusing lens, -draw structurally images created by the focusing lens, -distinguish between images: real, apparent, simple, inverted, enlarged, reduced, -describe the creation of images in the human eye, explain the meaning of the concepts of myopia and farsightedness, -explain the role of lenses in correcting these vision defects.
Physics ☒ Mathematics ☐ Information Technology ☐ Robotics ☐ Programming ☐

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Education Level:	10-12 years ☐	12-14 years ☒

Problem Statement

How can you construct images created with concave and convex lenses?

What are the features of the images formed in the lenses?

How and where can be the lenses used?

BOM (Bill Of Materials needed)

- a computer
- SCRATCH environment installed or Internet Access
- instruments for experiments: focusing and diffusing lenses, with different focal lengths, laser pointers, candle, cardboard.

Activity description

Lesson course:

1. Organizational activities
2. Introduction to the topic - a reminder of news about the phenomenon of refraction.
   - What are the lenses for?
   - An explanation of what a lens is.
   - Overview of lens types.
3. Experiment demonstration - the passage of a parallel light beam through focusing and diffusing lenses.
   - Discussion of the phenomena of beam focusing and scattering as it passes through the lens.
   - Introduction of the concepts: focuses - for the focusing lens, virtual focus - for the diffusing lens.
4. Demonstration of an experiment showing the passage of parallel rays through the lenses with different focusing abilities.
   - Introduction of the concepts of focal length and focusing ability.
5. Plan and demonstrate by students the experience of studying the course of rays passing through the focusing lens and determining its focal length.
   - Implementation by students (in groups) of an experiment: creating a sharp image of an object on the screen using a focusing lens.
6. Introduction of concepts related to the construction of images.
   - Creating the structure of images obtained with the help of focusing lenses, discussing the

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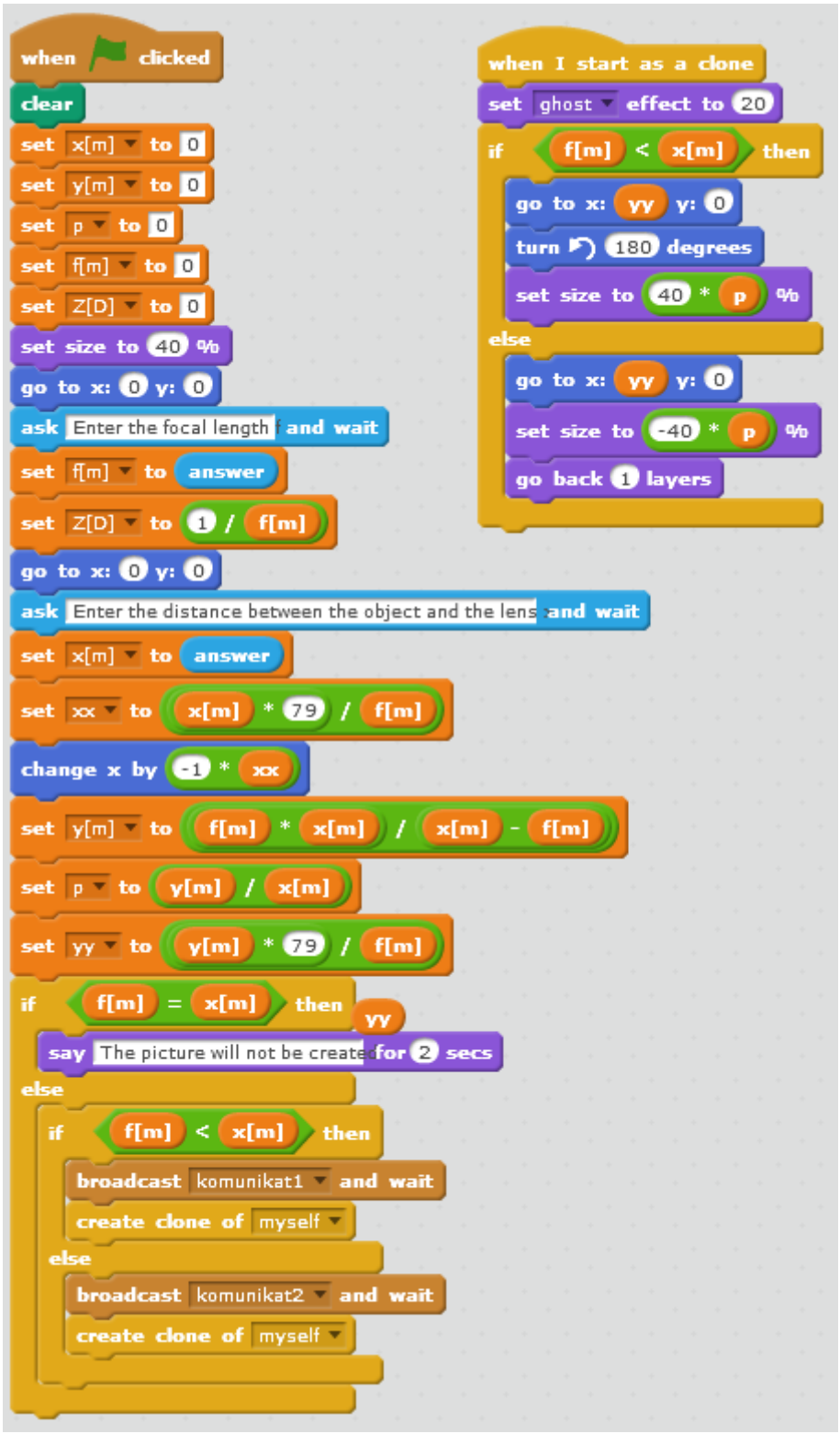
features of these images.

7. Simulation in the SCRATCH environment of the formation of images obtained using the focusing lens.



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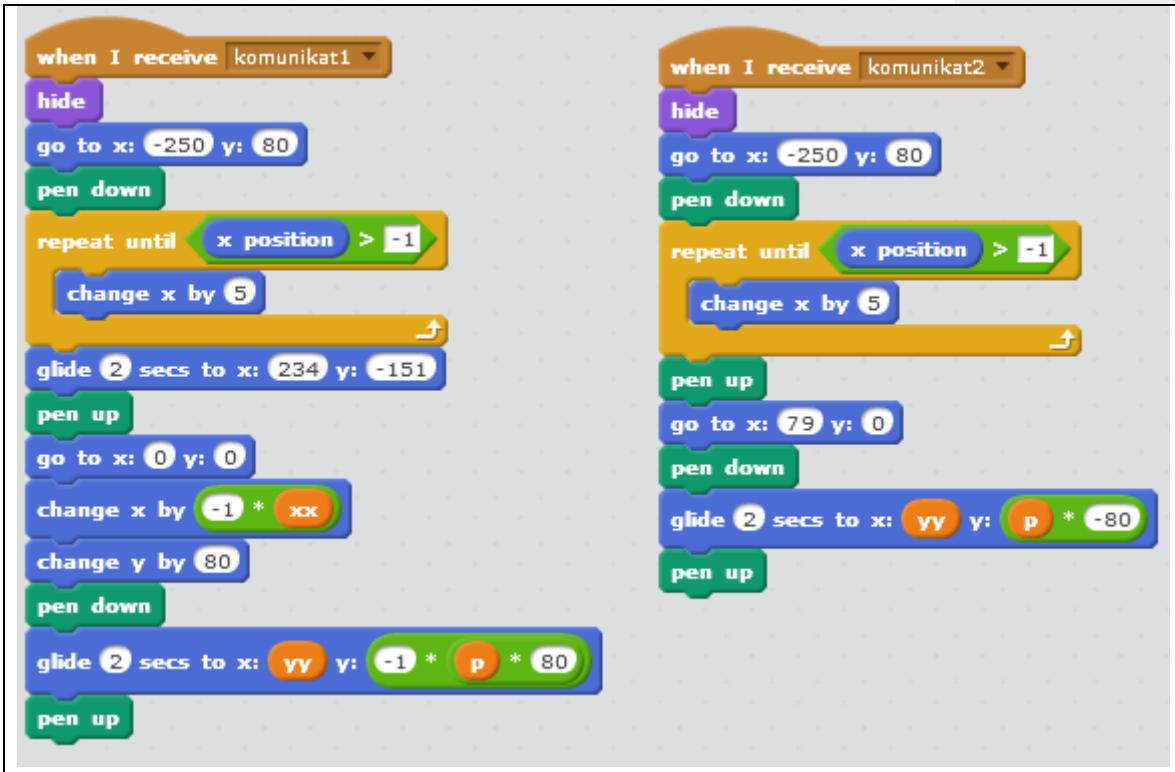

8. Discussion of the structure and operation of the human eye.
9. Discussion of ways to correct vision defects.
10. Solving problems related to lenses.
11. Summary and end of the lesson.

Resources

- computer stadion
- SCRATCH environment installed or Internet Access

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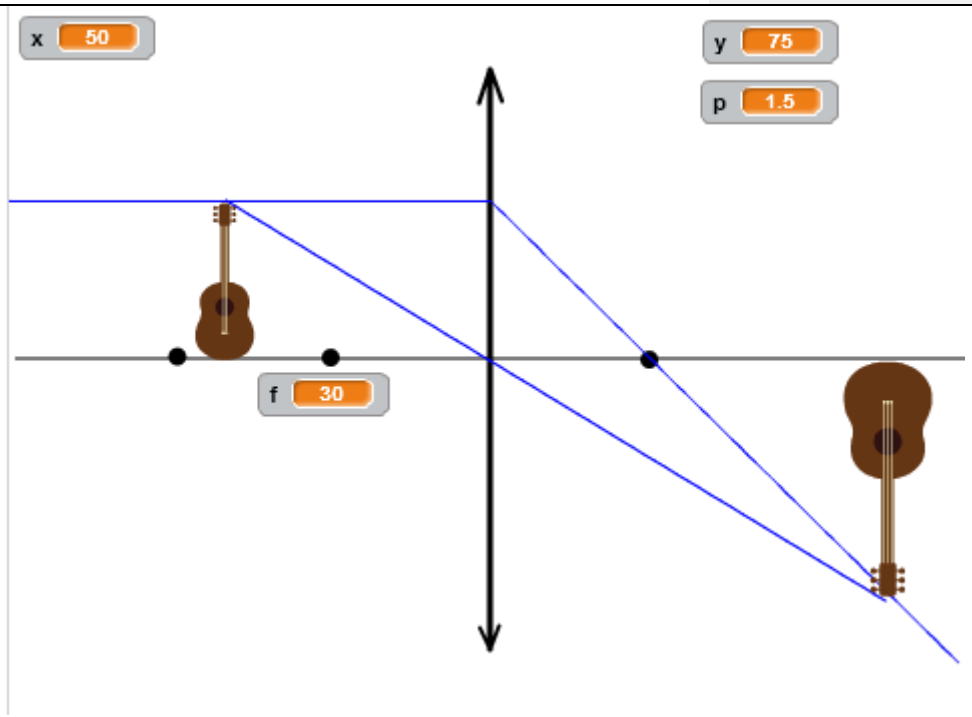

Students' Evaluation
The student will be marked for commitment and a proper performance of experiments.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy siódmej szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://scratch.mit.edu
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Refraction of light.**	
Summary	The student will become familiar with the concept of refraction. Thanks to practical action (experience) he will be able to indicate the relationship between the angle of incidence and the angle of refraction. He will make a schematic drawing for the experiment.	
Author/s	Jarosław Szczęsny	Date: 19/01/2020

Didactic objectives
General objectives: - Introduction of the concept of refraction. - Experimental demonstration of the relationship between the angle of incidence and the angle of refraction. Specific lesson objectives: Students will be able to: - Indicate examples of refraction in the surrounding reality, - Design an experiment illustrating the phenomenon of refraction (changes in the angle of refraction when the angle of incidence changes - describe the course and result of the experiment carried out, explain the role of the instruments used - make a schematic drawing illustrating the experimental system, - describe the course of rays at the transition of light from a thinner medium to an optically thicker medium and vice versa, using the concept of refraction angle.
Physics☒ Mathematics☐ Information Technology☐ Robotics☐ Programming☐
Education Level: 10-12 years☐ 12-14 years ☒
Problem Statement
-What is the phenomenon of refraction? -When does the phenomenon of refraction occur?
BOM (Bill Of Materials needed)
- computer station

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- SCRATCH environment or Internet access installed

- instruments for optics experiments.

Activity description

Lesson flow:

1. Organizational and organizational activities
2. Introduction to the topic - a reminder of messages regarding the propagation of light in homogeneous media
3. Demonstration of an experiment showing refraction of light.
4. Demonstration of an experiment showing refraction at the border of two centers.
    - Explanation of the phenomenon of refraction based on observation of experiments.
5. Demonstration of the difference in refraction of light depending on the centers on which the light falls.
    - Explanation of the dependence angle of refraction on the type of medium.
    - Explanation of the relationship between the angle of incidence and the angle of refraction.
6. Experience demonstration - the passage of laser light through the prism
7. Simulation in the SCRATCH environment of refraction at the border of two centers.

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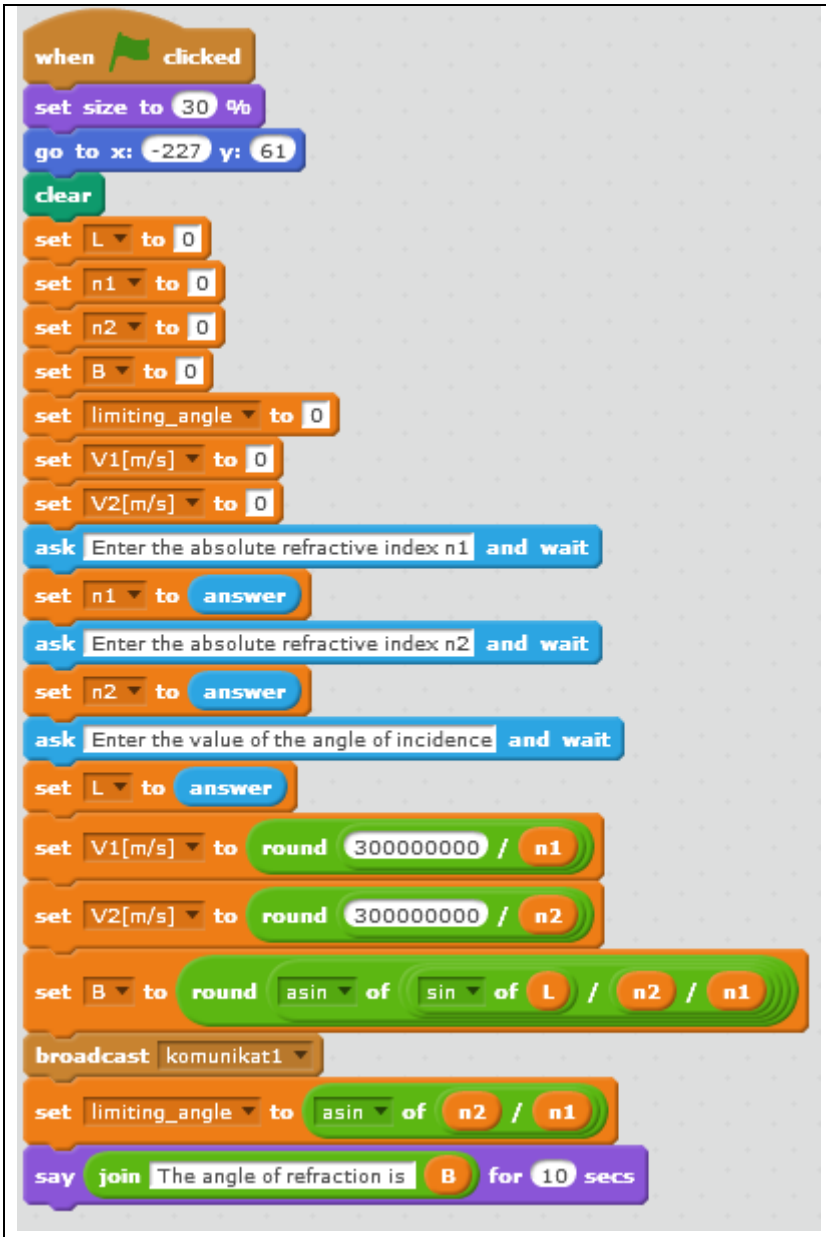

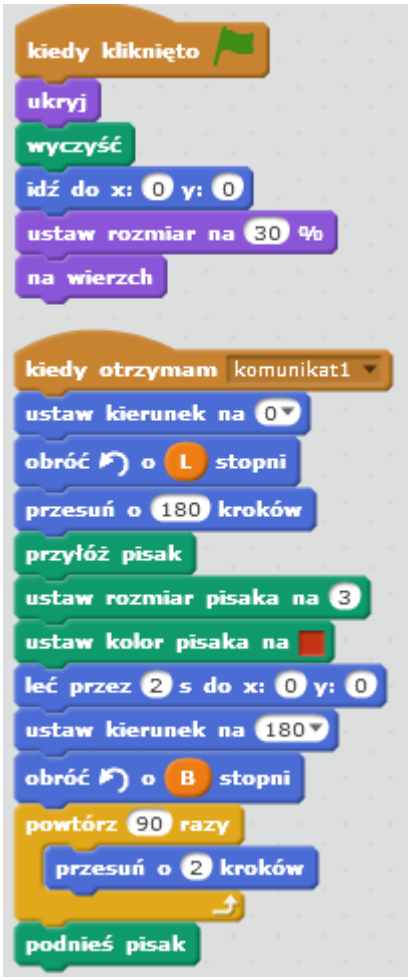

8. Summary and end of the lesson.

Resources
- computer stadion - SCRATCH environment installed or Internet Access

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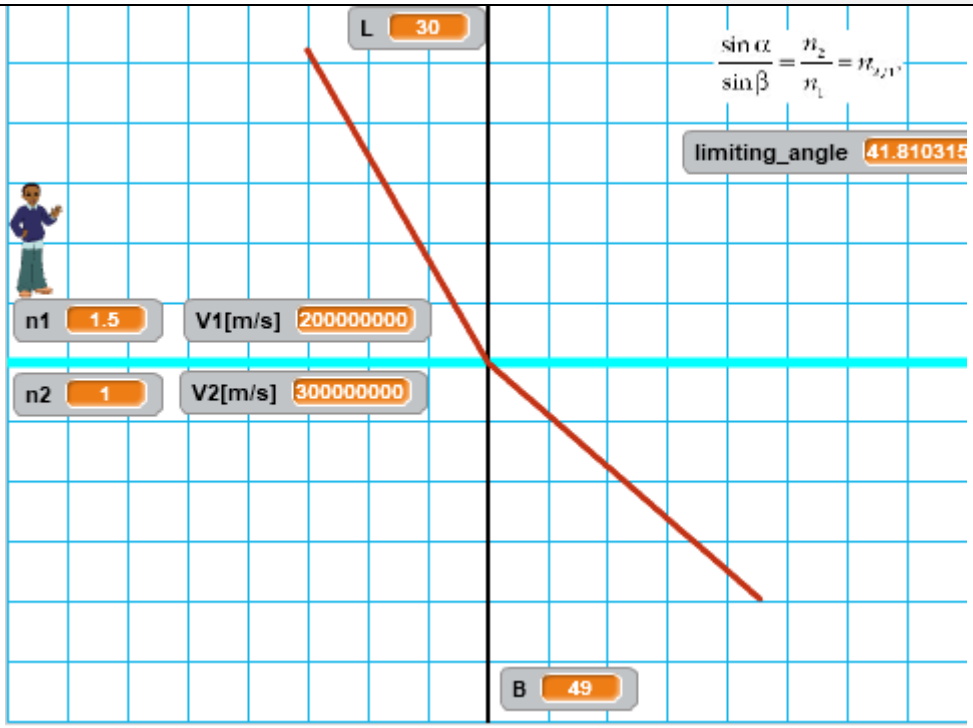

Students' Evaluation
The student will be assessed for commitment and proper performance of experiments.
Bibliography
Spotkania z fizyką - Podręcznik do fizyki dla klasy ósmej szkoły podstawowej Authors: Grażyna Francuz-Ornat, Teresa Kulawik, Maria Nowotny-Różańska https://scratch.mit.edu
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**The principle of conservation of mechanical energy**.	
Summary	The goal is to familiarize students with the principle of conservation of mechanical energy.	
Author/s	Jarosław Szczęsny	Date: 02/12/2019

Didactic objectives
General objectives: - familiarizing students with the content of the principle of conservation of mechanical energy, - analyzing energy changes in everyday situations. Specific lesson objectives: Students will be able to: - name the energies possessed by a given body at a given moment, - explain how the energies of the body change during ascent and descent, - indicate examples from the environment of changes taking place, - analyze energy transformations occurring in various situations, - Determine when energy reaches maximum and when minimum values.
Physics ☒ Mathematics☐ Information Technology☐ Robotics☐ Programming☐
Education Level: 10-12 years☐ 12-14 years ☒
Problem Statement
When is mechanical energy saved? How does mechanical energy change during free fall? What energy losses will occur?
BOM (Bill Of Materials needed)
- Computer position - SCRATCH environment or Internet access installed - mathematical pendulum - rubber ball, - screw toy - toy car.
Activity description

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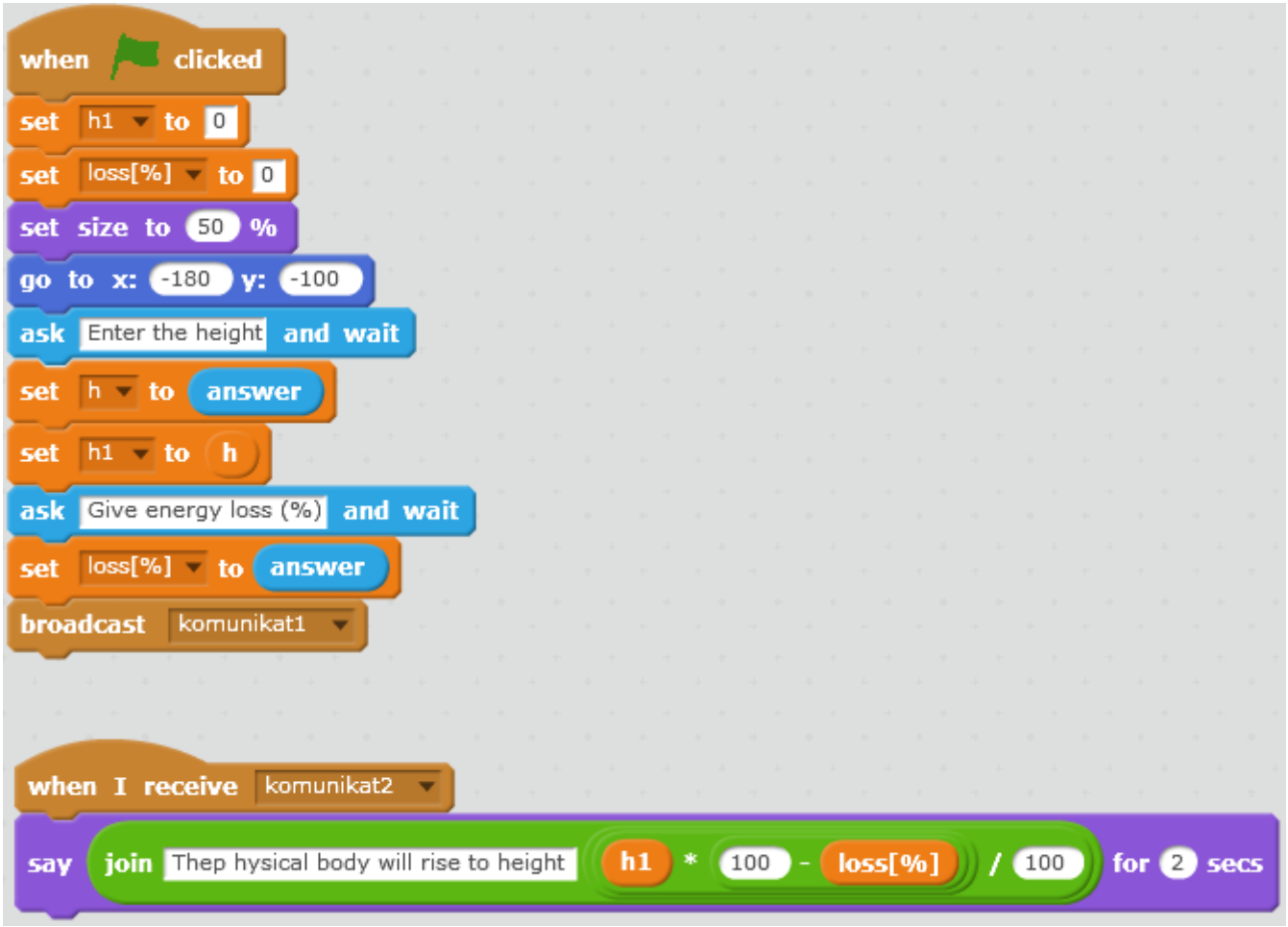
Lesson flow:

11. Organizational and organizational activities
12. Introduction to the topic - a reminder of news on energy and various forms of energy.
13. Introduction and explanation of the concept of isolated body system.
14. Discussion of free fall,
15. Introduction of the principle of conservation of mechanical energy
16. Discussion of other possibilities of energy transformation.
17. Performing an experiment showing the transformation of potential energy of a falling body into other forms of energy.
18. Discussion of energy losses occurring during the decline.
19. Simulation in free fall SCRATCH environment.



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10. Problem solving.

11. Summary and end of the lesson.

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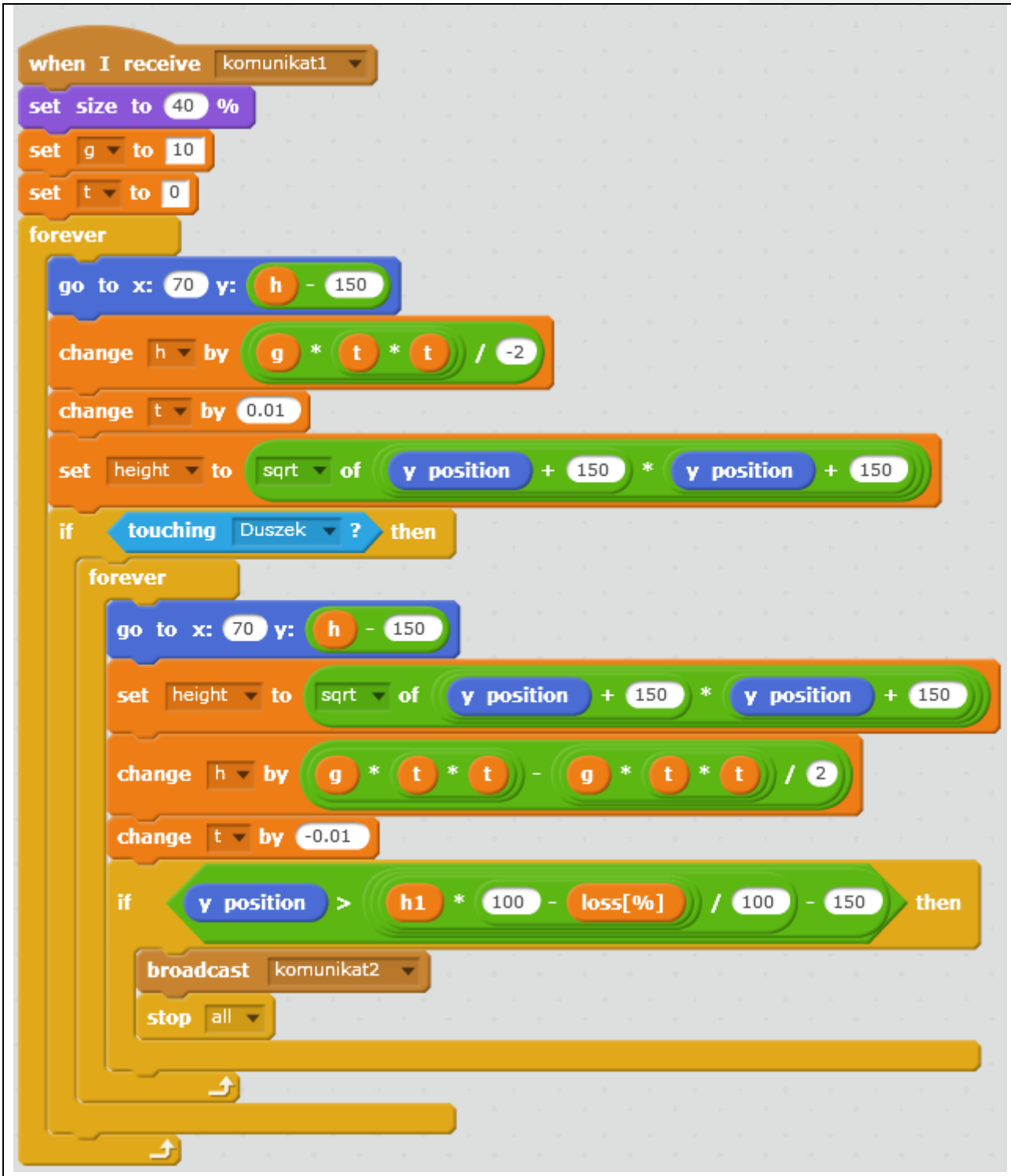

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Resources
- computer stadion - SCRATCH environment installed or Internet Access 
Students' Evaluation
The student will be assessed for commitment and proper performance of experiments.
Bibliography
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Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Straight line motion.**	
Summary	Students will learn the concept of uniform uniform motion, the concept of speed and its units in the SI system. They will learn to plan tasks to determine the speed. Based on their experience, they will learn to read and make graphs of the speed versus time versus distance.	
Author/s	Jarosław Szczęsny	Date: 06/01/2020

Didactic objectives
General objectives: - Introduction of the concept of uniform linear motion. - Introduction of the concept of speed and its units in the SI system. -Planning, conducting and analyzing experiments related to determining speed. - Reading and plotting speed versus time versus time graphs. Specific lesson objectives: Students will be able to: - indicate examples of movement in the surrounding reality, - use physical quantities: route, speed, time, to describe uniform linear motion; - calculate the speed units in the SI system, - make graphs of the dependence of the road and speed on time for uniform linear motion - plan experience related to determining the speed of movement (e.g. during walking, running, cycling); estimates the order of magnitude of the expected result; - read data from the table; read the speed and distance traveled from diagrams of the dependence of the road and speed on time in uniform linear motion, -draw graphs of the dependence of the road and speed on time in uniform linear motion, - use physical quantities: path, speed, time to solve simple computational tasks related to uniform linear motion, - solve problems using the relationship between road, speed and time in straight line traffic.

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Physics☒	Mathematics☐	Information Technology☐	Robotics☐	Programming☐
Education Level:	10-12 years☐	12-14 years ☒		

Problem Statement

- What is straight line motion?
- What is speed and what is its unit in the SI system?
- How to determine the speed?

BOM (Bill Of Materials needed)

tube with water and air bubble, stopwatches, highlighters.

Activity description

Lesson flow:

1. Organizational and organizational activities
2. Introduction to the topic - a reminder of the basic concepts describing movement.
3. Performance demonstration examining uniform motion.
4. Introduction of the concept of speed and its unit and formula.
5. Exercise in reading and drawing graphs of speed versus time and road versus time
6. Planning and conducting by the students an experiment on determining the speed of movement, e.g. during walking, running (group work)
7. Simulation in the SCRATCH environment of creating graphs for uniform linear motion.

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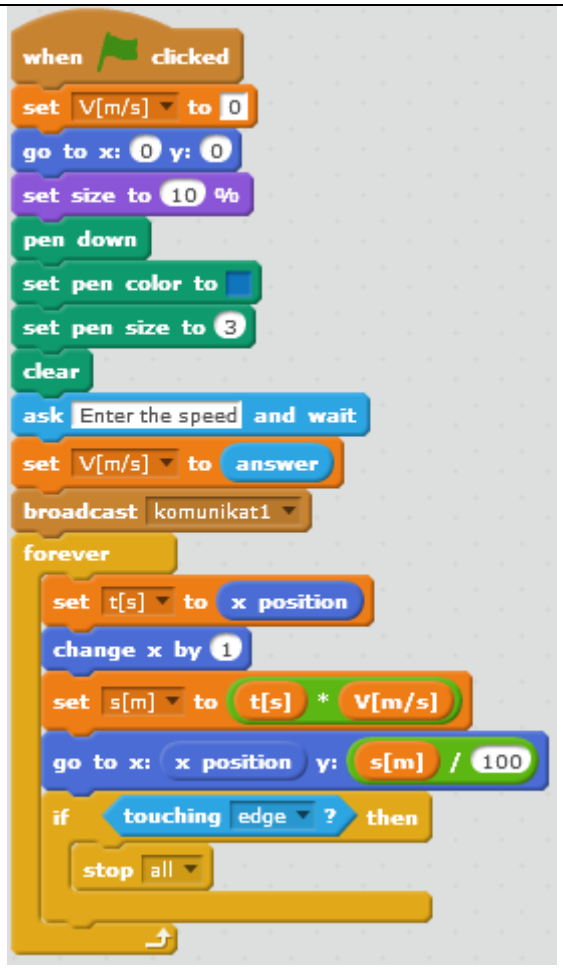

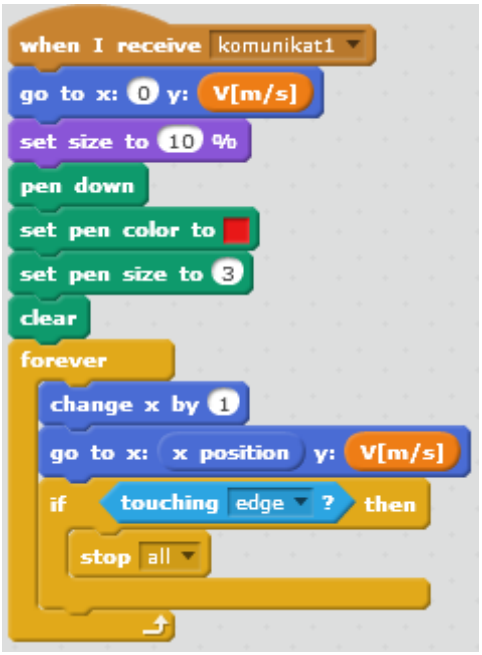

8. Summary and end of the lesson.

Resources
- computer stadion - SCRATCH environment installed or Internet Access - instruments for experiments: tube with water and air bubble, stopwatches, markers.

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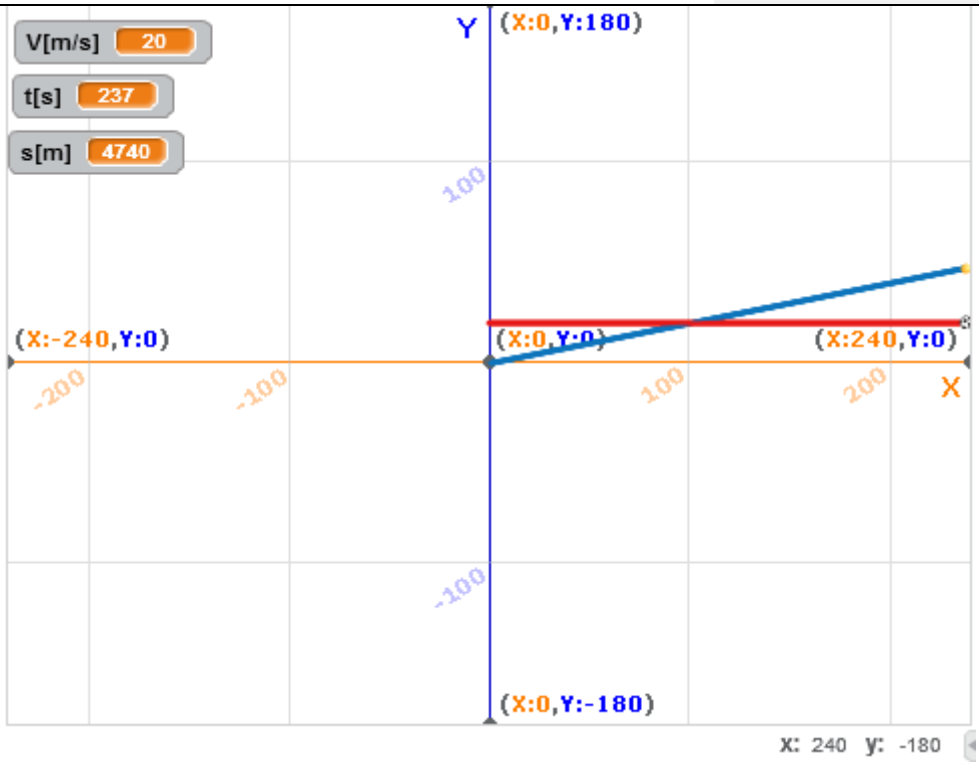

Students' Evaluation
The student is assessed for active work, involvement in classes.
Bibliography
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Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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6.2. Mathematics

SCENARIO		
Title	Perpendicular lines and parallel lines.	
Summary	Representation of perpendicular and parallel lines Viewing boards with such simple ones Attempts to use a ruler and a set square when drawing searching for straight (parallel) sections in a child's environment, e.g. parallel sections as elements of objects in the classroom, outside the window, etc. It is worth placing sticks, pencils or crayons on the bench in such a way that they are models of perpendicular or parallel sections. In one of two lessons you can use your own city, district and village plan. The child learns to use the plan, gets to know the area. An educative exercise is to search the map of perpendicular and parallel streets, as well as search for perpendicular (parallel) streets to the indicated street. The child may use the instruments to justify perpendicularity or parallelism of the streets. Work with the scratch program	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 01/12/2019

Didactic objectives
Lesson aims Student: recognizes straight or perpendicular sections and straight or parallel sections; indicates perpendicular and parallel streets on the city plan; draws perpendicular lines and parallel lines with a ruler and set square; draws perpendicular and parallel lines on a squared paper; uses the characters T and || to describe perpendicular lines and parallel lines; indicates and draws a segment being the distance of a point from a straight line.
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☒ 12-14years☐
Problem Statement
How to draw a parallel and perpendicular straight with a ruler? How to draw a segment being the distance of a point from a straight line?
BOM (Bill Of Materials needed)
Computer workstations
Activity description

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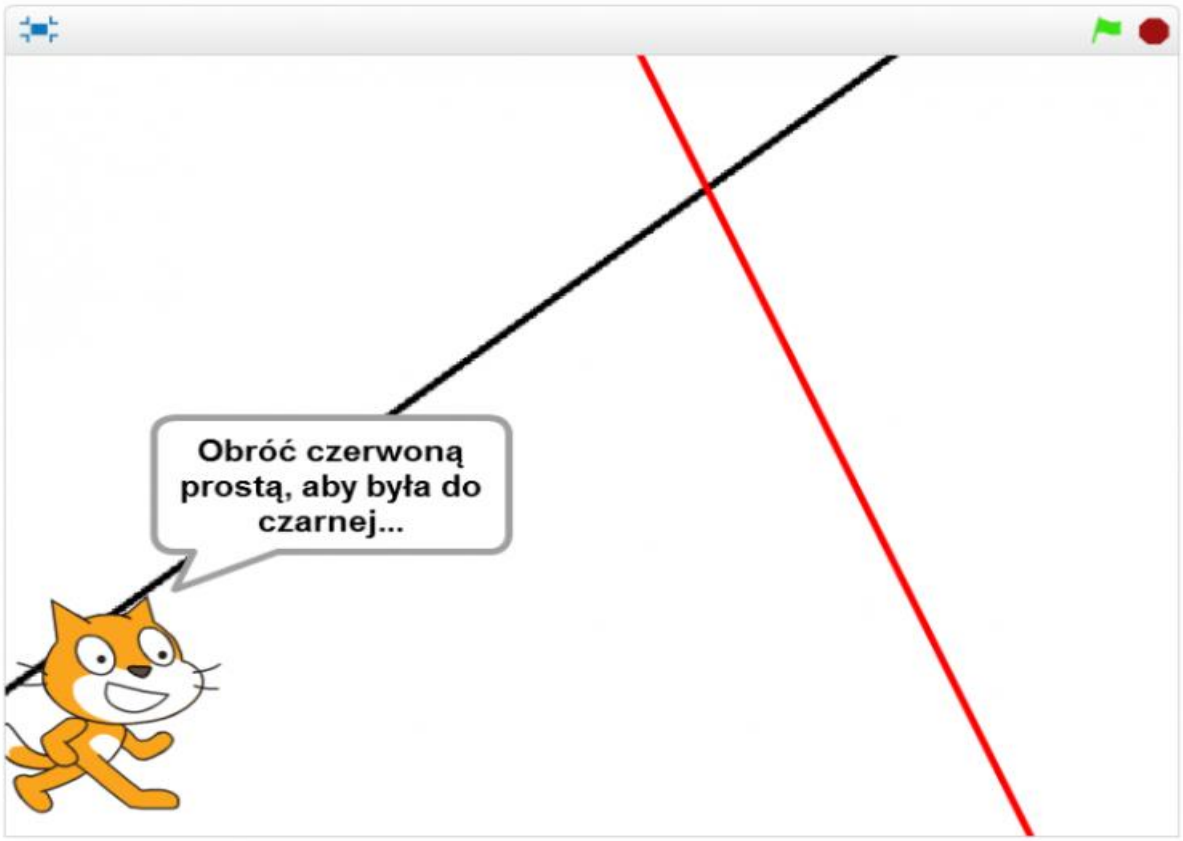
Familiarization with the topic of classes
2. Presentation of perpendicular and parallel lines on boards.
3. Search for straight (parallel) sections in a child's environment.
4. Search for perpendicular straight sections of the child's environment.
5.Drawing with a straight ruler and set square perpendicular and parallel.
6. Practical exercises with arranging sticks, pencils, crayons - perpendicular and parallel sections.
7. Practical exercises with city plan - marking perpendicular and parallel streets.
8. Work with the scratch program - perpendicular and parallel lines –

Sample script and the appearance of the scene

"Straight perpendicular and parallel straight" is a project in which there are 2 sprites:
• Guide cat, which gives instructions and commands and assesses the correctness of the task
• straight - a line that appears in two places on the stage at different angles. One of them doesn't move (it's a stamp) and the other one is rotated by the player.
The cat will decide whether to set the lines parallel or perpendicular. We leave the background white for better readability.



Let's start with the preparation of sprites. The cat appeared automatically, and we draw a straight line ourselves (by clicking the brush next to the inscription "New sprite"). Remember to click the line icon, not the pencil. After drawing the line, we duplicate it to have 2 costumes that look identical, differing only in colors (e.g. the first black and the second red). To make our lines reach from edge to edge, it's worth setting the size to e.g.

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150% at the beginning. Since we have prepared sprites, we have to put them somewhere. The cat can be in any corner, and straight: stationary will be hooked e.g. at (-100.0) and movable at (100.0). So after starting the program, we should clear the stage, set our sprite in the selected place, set a random direction and remember it (k = the direction of the black line), make a stamp, jump to the second place.

It is worth considering with what accuracy (jump) we will rotate the straight line. If we rotated it 90 degrees, the task would be very simple; if it were 1 degree - it would be very difficult to see if the lines are perpendicular or whether there is an angle of 89 or 91 degrees between them. Therefore, it is worth choosing experimentally. Let's assume it will be 15 degrees. If we would like to change the direction of the red line at the beginning (for difficulty), we must rotate it by a random multiple of our jump (15). What limits to draw? If we do not want them to be parallel, we must add to this direction an angle greater than zero, but less than 180, so we are interested in multiples of 15 greater than 0 and less than 12. If we want to avoid perpendicularity, then the rotation angle must be in the range (-90.90), i.e. we are interested in multiples from -5 to 5. How to decide whether we will set the lines perpendicular or parallel? At the beginning let's introduce a variable (p / y) that will randomize the value from 2 numbers: if we draw 1, then we will set perpendicular, and 2 - parallel.

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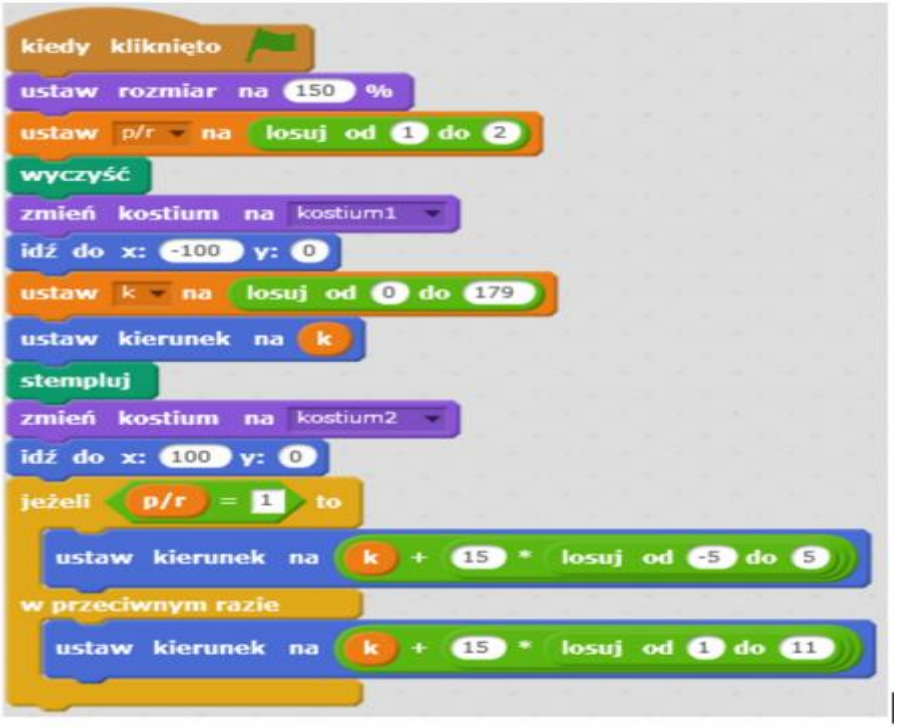
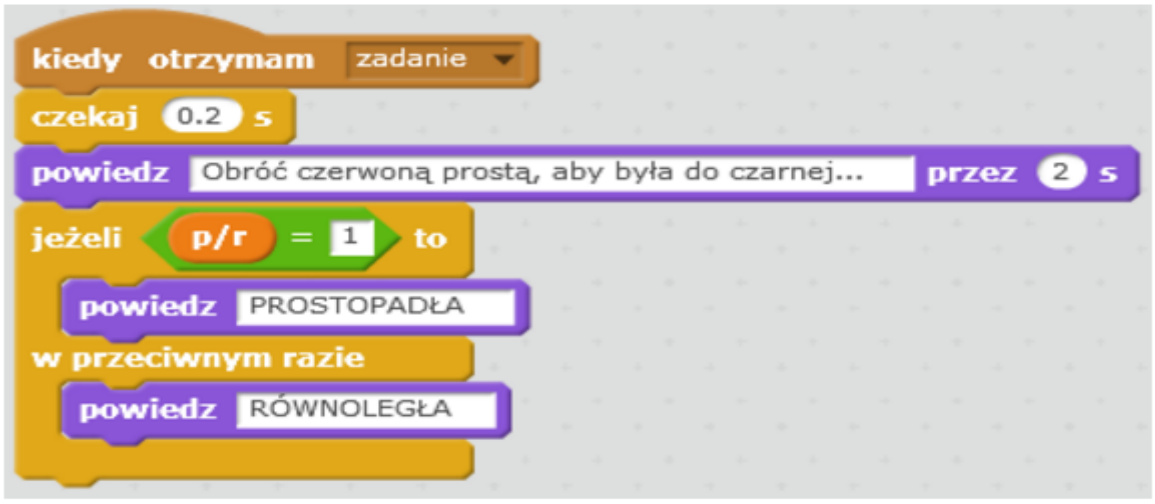


The red line can be rotated using the keyboard: right arrow - turn 15 degrees to the right (clockwise), left arrow - opposite. So that we know what task awaits us, this can be communicated to us by a Cat. He, in turn, will learn that he is to say something by means of a message. So after setting the simple ones, they should send a message such as "task". When the Cat receives it, he will say "Turn the red straight so that it is black ..." and after a while it will add depending on the value of the variable "p / r" - "RECTANGULAR" or "PARALLEL"



Now we will need time to set the straight line. A signal for the computer to complete the task will be pressing space. Then the Cat will assess the correctness of the task. How? The direction of the black line is in the range <0.179> and the red - <-179.180>. So the lines will be parallel if they have the same direction or if the red one is 180 degrees smaller and perpendicular if the difference in directions is +/- 90 or +/- 270. We can save these conditions in various ways. The simplest seems to be the use of the remainder of division - modulo. It is worth noting that in the case of parallelism after dividing by 180, e.g. from the angle -110 we get the remainder 70,

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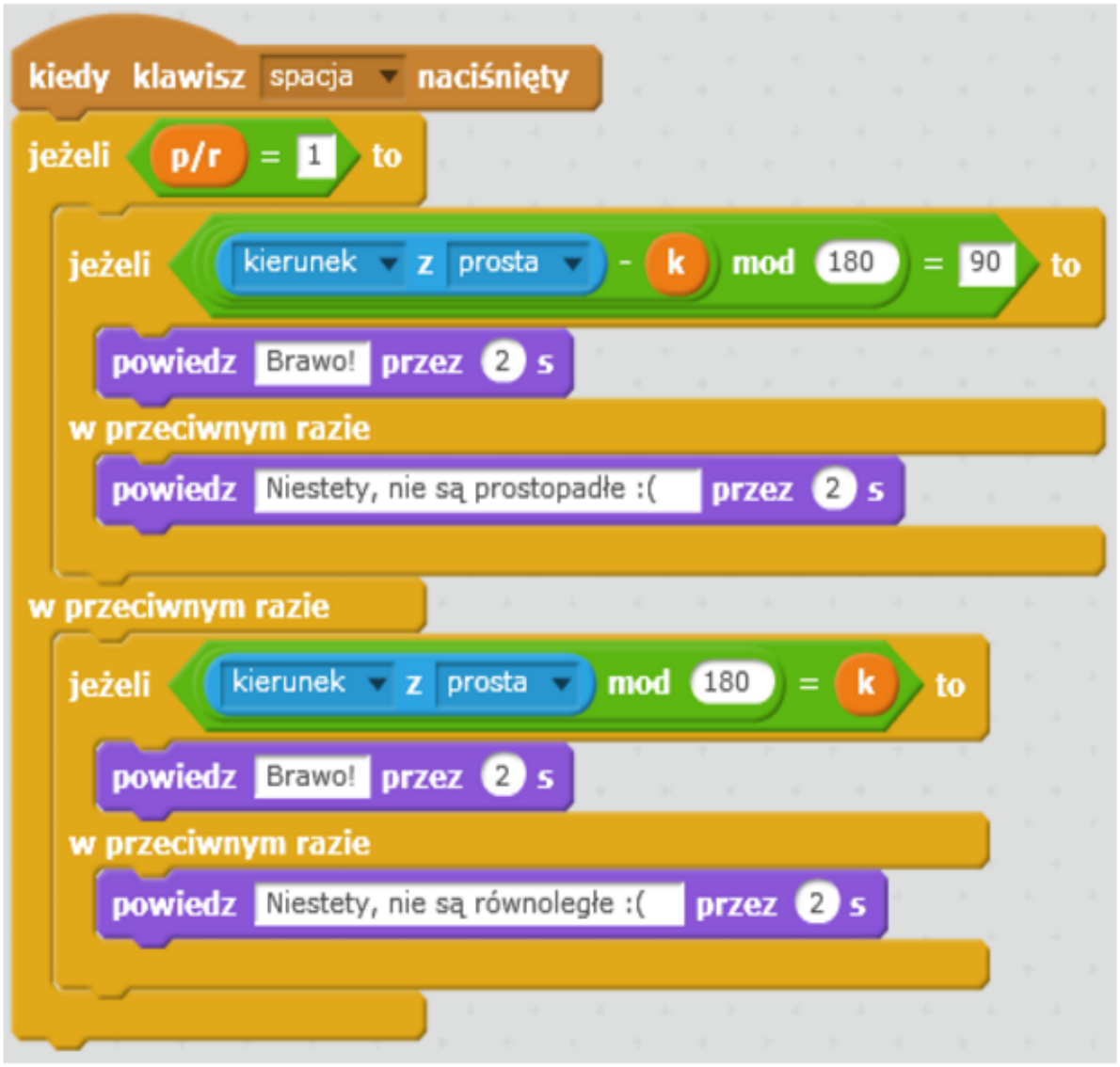
and in the case of perpendicularity all numbers: +/- 90, +/- 270 mod 180 = 90. Hence the way of checking could look like this:



To prevent the program from terminating at this point, you can force a subsequent start with the message "task" after evaluation. However, this message should also cause a new simple setting. Therefore, you must also modify the Simple sprite script, which will eventually look like this:

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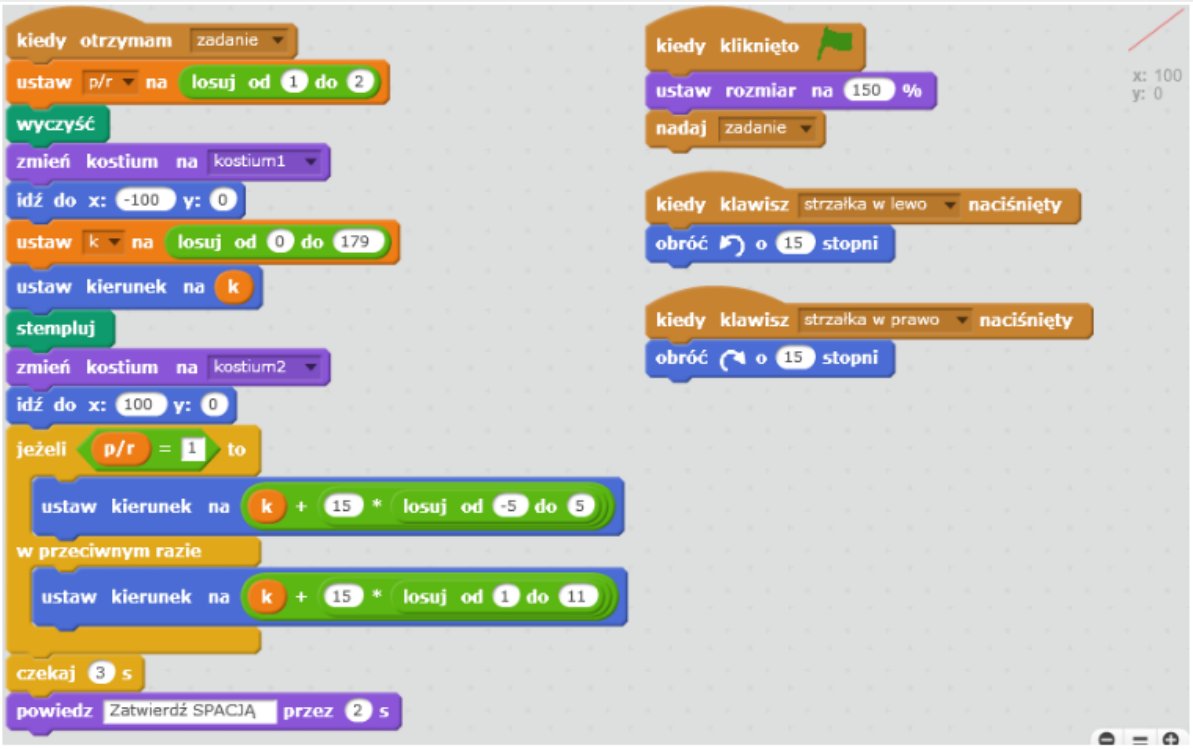

Summary
Or a very simple script

Perpendicular lines

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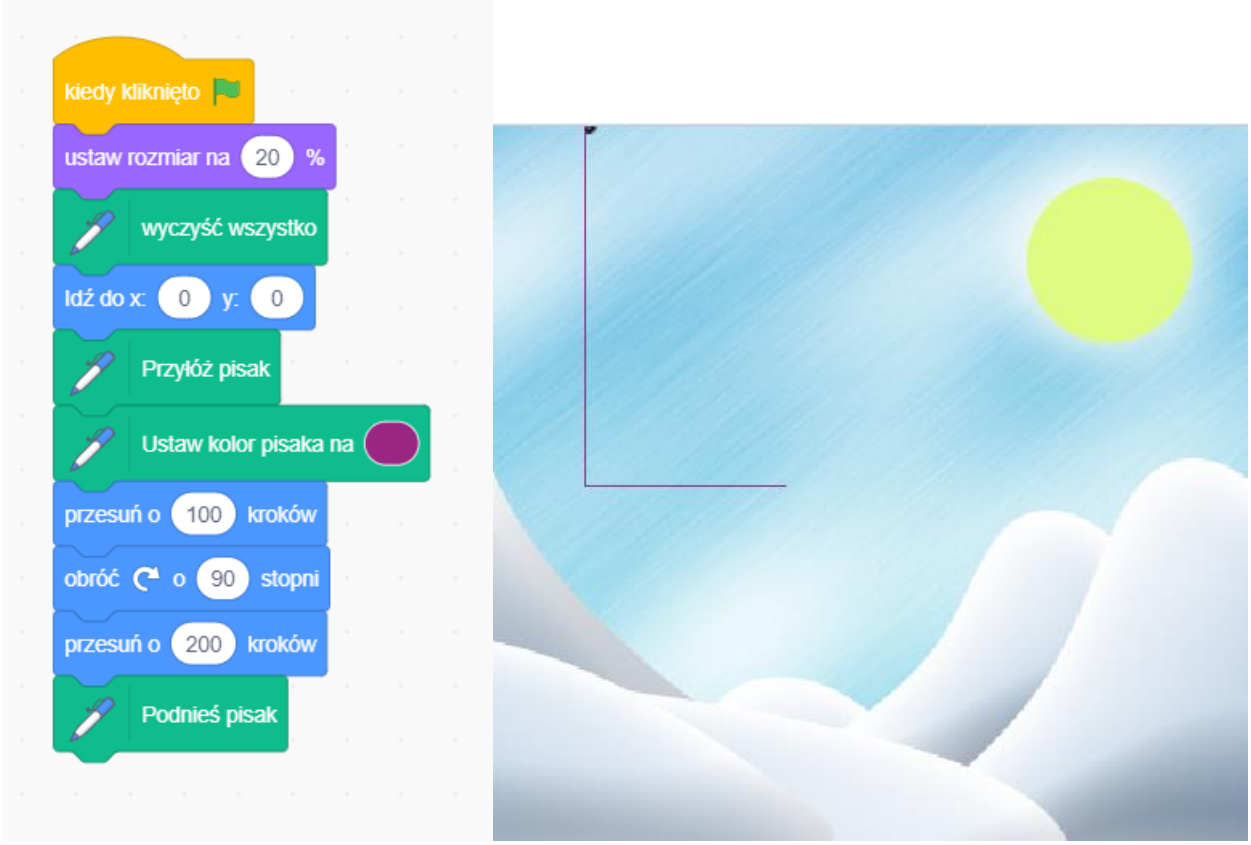

Simple paralel

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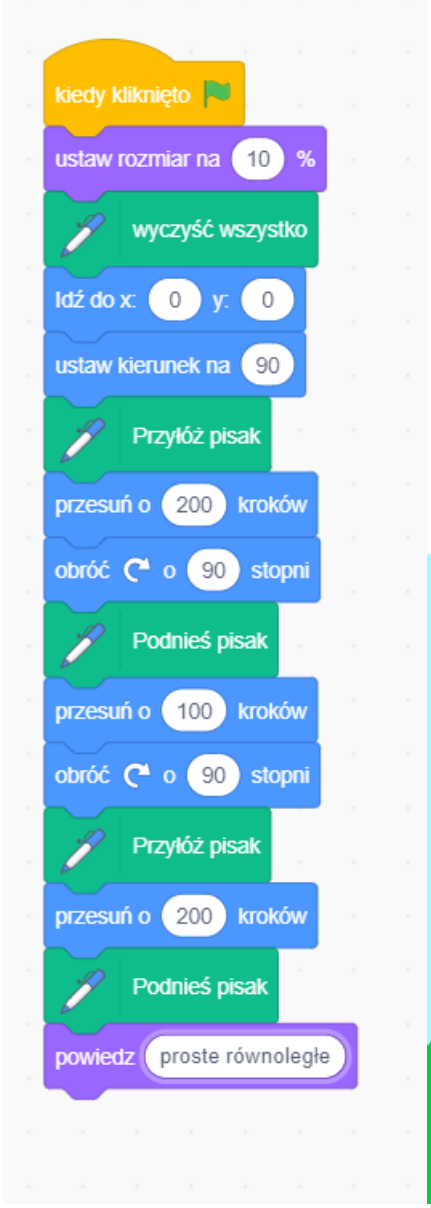

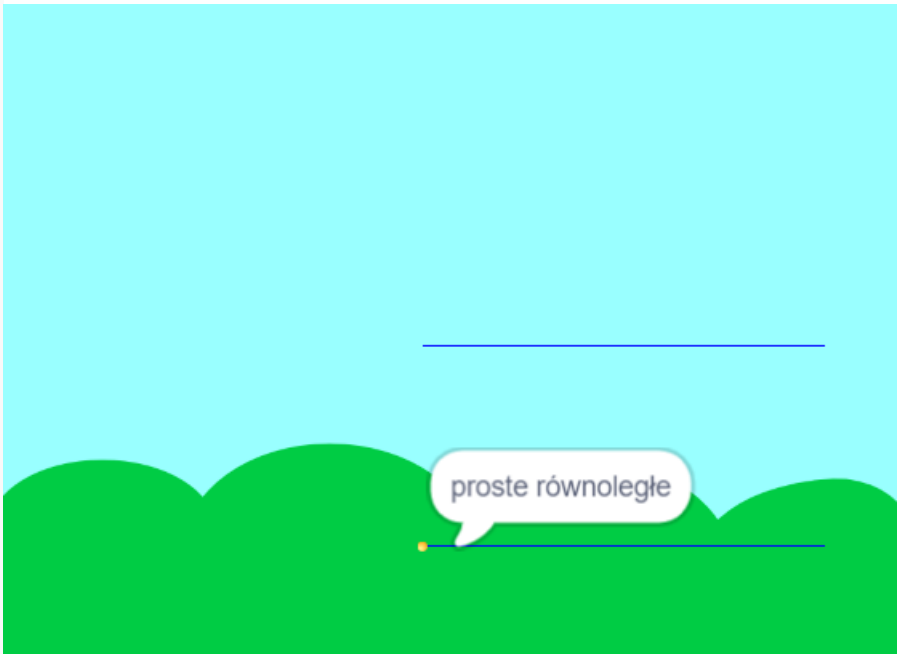

Resources

Charts showing the arrangement of perpendicular and parallel lines
Plates with an effect that we want to receive (stairs, spirals, mazes).

Rulers, squares, pencils, sticks, crayons.

Students' Evaluation

Grade for involvement, active participation in classes - written grade.

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Bibliography
Mistrzowiekodowania.pl Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works
Scalability
We can program so that stairs and spirals are created.
More information
We can program so that stairs, spirals from sections of a certain length or from a specified number of sections are created.

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SCENARIO		
Title	Square rectangle.	
Summary	The student will remind the shapes of rectangles and square. He will learn the properties of these figures. He learns to draw figures of given lengths.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 02/12/2019

Didactic objectives

Lesson objectives
Pupil:
describes the rectangle, including the square;
draws the diagonals of a rectangle;
draws and recognizes rectangles in drawings;
draws a rectangle with a ruler, set square and compass when it has the given length of two adjacent sides;
draws a square with a ruler, set square and compass when it has a given diagonal of this figure;
lists the properties of the diagonals of a rectangle;
solves tasks using the properties of a rectangle.

Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐

Education Level: 10-12years☒ 12-14years☐

Problem Statement

What is the difference between a square and a rectangle? How to use instruments for drawing figures? How to use the properties of these figures when drawing them?

BOM (Bill Of Materials needed)

Computer workstations, scratch software

Activity description

1. Organizational activities
2. Reminder of rectangle and square shapes
3. exercises in drawing rectangles.
4. Exercises in drawing squares. Drawing a rectangle can be practiced first on a clean sheet without grids, and then on a grid sheet, but not on existing lines. In turn, drawing a square, when its diagonals are given, you need to practice on a checkered piece of paper - this is a very important skill ...
5. Exercises in drawing a diamond with diagonals.
6. Folding rectangular pages for testing, the properties of the rectangle, for example, put the short side of the rectangle to the long side and show how you can create a square from the rectangle. You can then cut the

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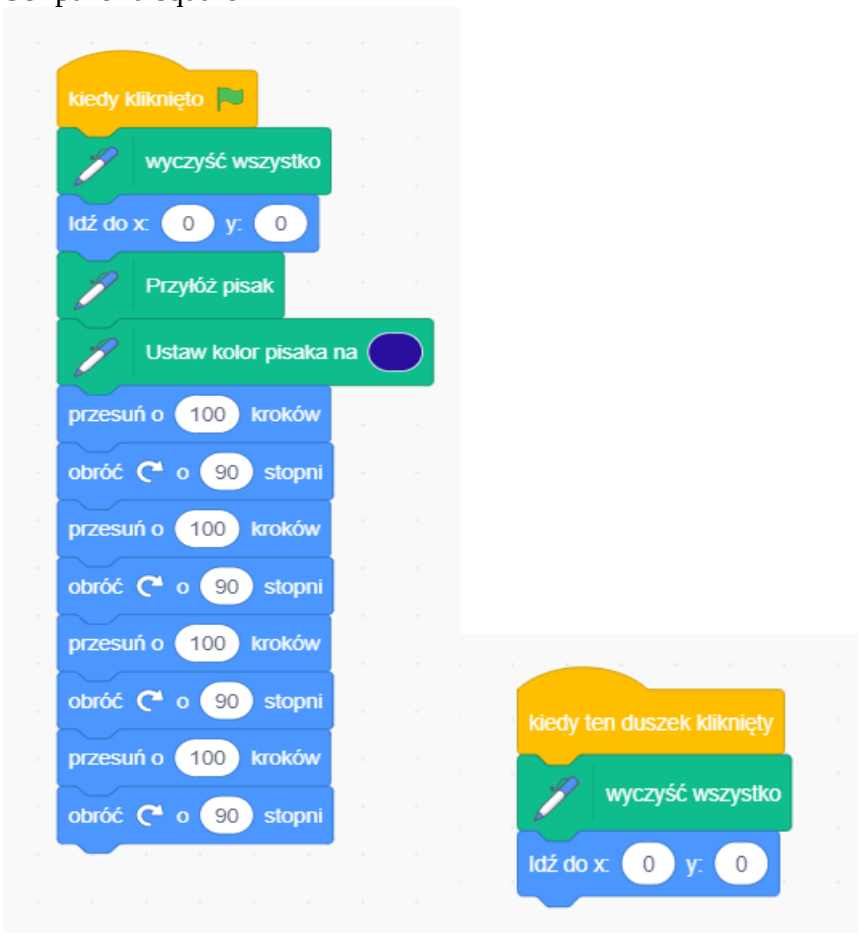
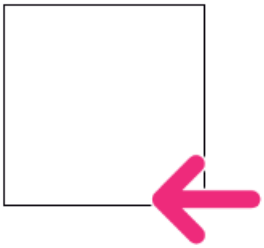
unnecessary piece of paper and bend the rest to properly test the properties of the square.
7. Sticking the completed figures to the notebook, describing their properties, marking the appropriate parts with color.
8. Work with the scratch program - (developing a list of steps to draw a square and drawing it on the board
Joint preparation of the list of steps to draw a rectangle
Work in the scratch program - drawing rectangles with different side lengths and squares with different side lengths)
Summary
Script for a square





Rectangle script

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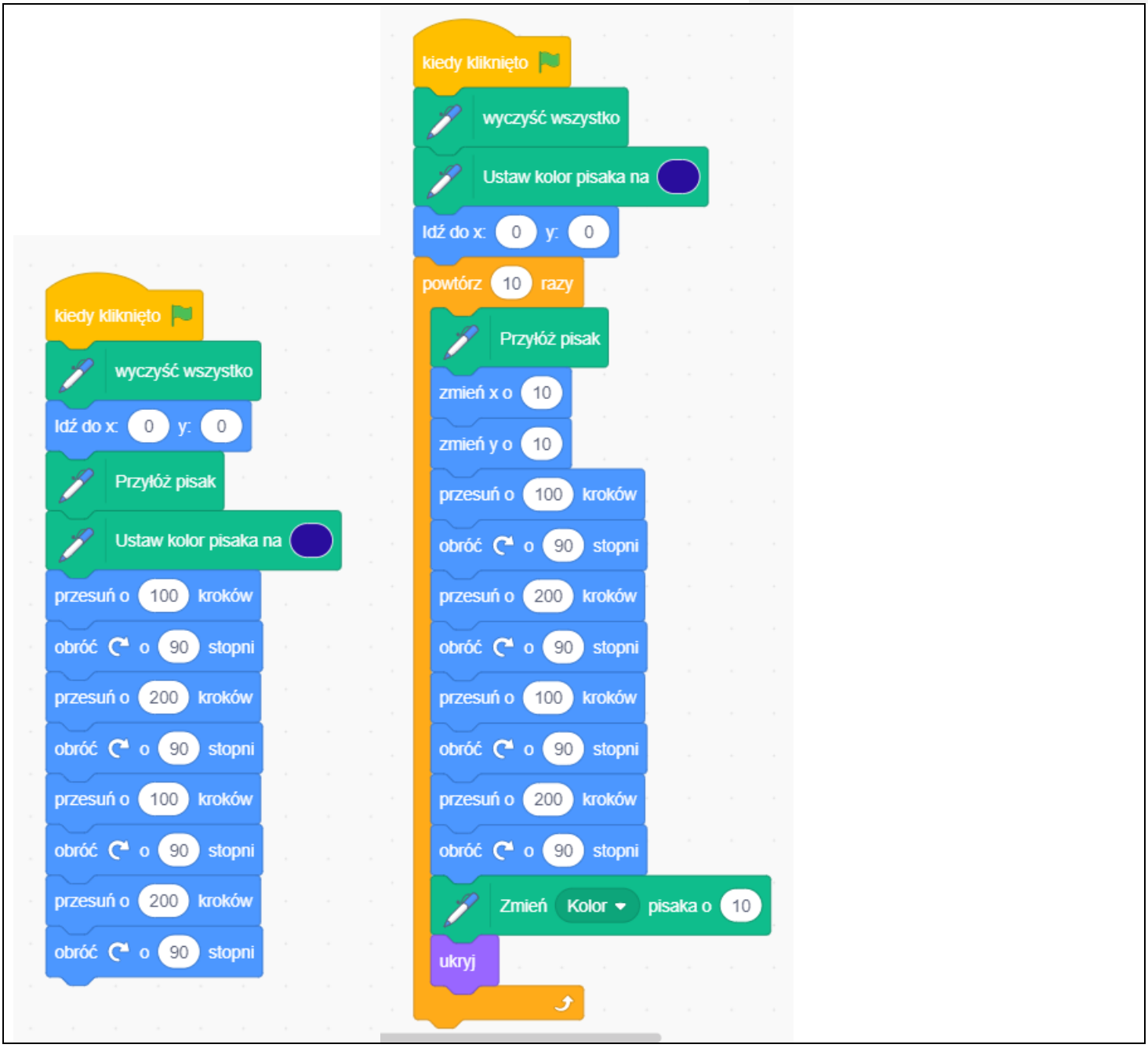

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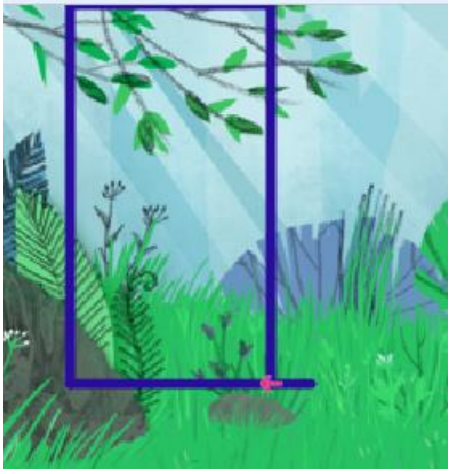

Resources
Rectangular sheets of paper, pencils, rulers with figures.
Students' Evaluation
Fit on the planned stage, special effects. Involvement. Student activity
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works
Scalability
We can program so that stairs and spirals are created.
More information
We can program so that stairs, spirals from sections of a certain length or from a specified number of sections are created.

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SCENARIO		
Title	Drawing polygons.	
Summary	The student will be able to recognize and name polygons. Familiar with the statements about the sum of the polygon's internal angles. Learn to draw these polygons.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 03/12/2019

Didactic objectives
Lesson aims Student: names and draws polygons with the given name; indicates and counts diagonals in a polygon; applies the theorem of the sum of the angles of a triangle; uses the knowledge of the sum of angles in a quadrangle in tasks; solves tasks using polygon properties; understands and interprets relevant mathematical concepts, knows the basic terminology; reads and understands simple text containing numerical information. distinguishes between figures circle and circle; uses a compass - draws circles and circles; distinguishes in the circle and circle the center, radius, diameter and chord; applies the relationship between the radius and diameter of the circle and the circle; uses circle and circle messages in tasks.
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☒ 12-14years☐
Problem Statement
What characterizes a polygon? What polygon is a regular polygon? What is the wheel? What is the difference between a polygon and a circle?
BOM (Bill Of Materials needed)
Computer workstations, scratch software
Activity description
1. Organizational activities 2. Reminder of shapes of various geometric figures. 3. We introduce new important concepts: the internal angle of the polygon, names of polygons and their diagonals, the sum of measures of the internal angles of the triangle and quadrangle. 4. Calculation of the internal angle measure of a regular polygon.

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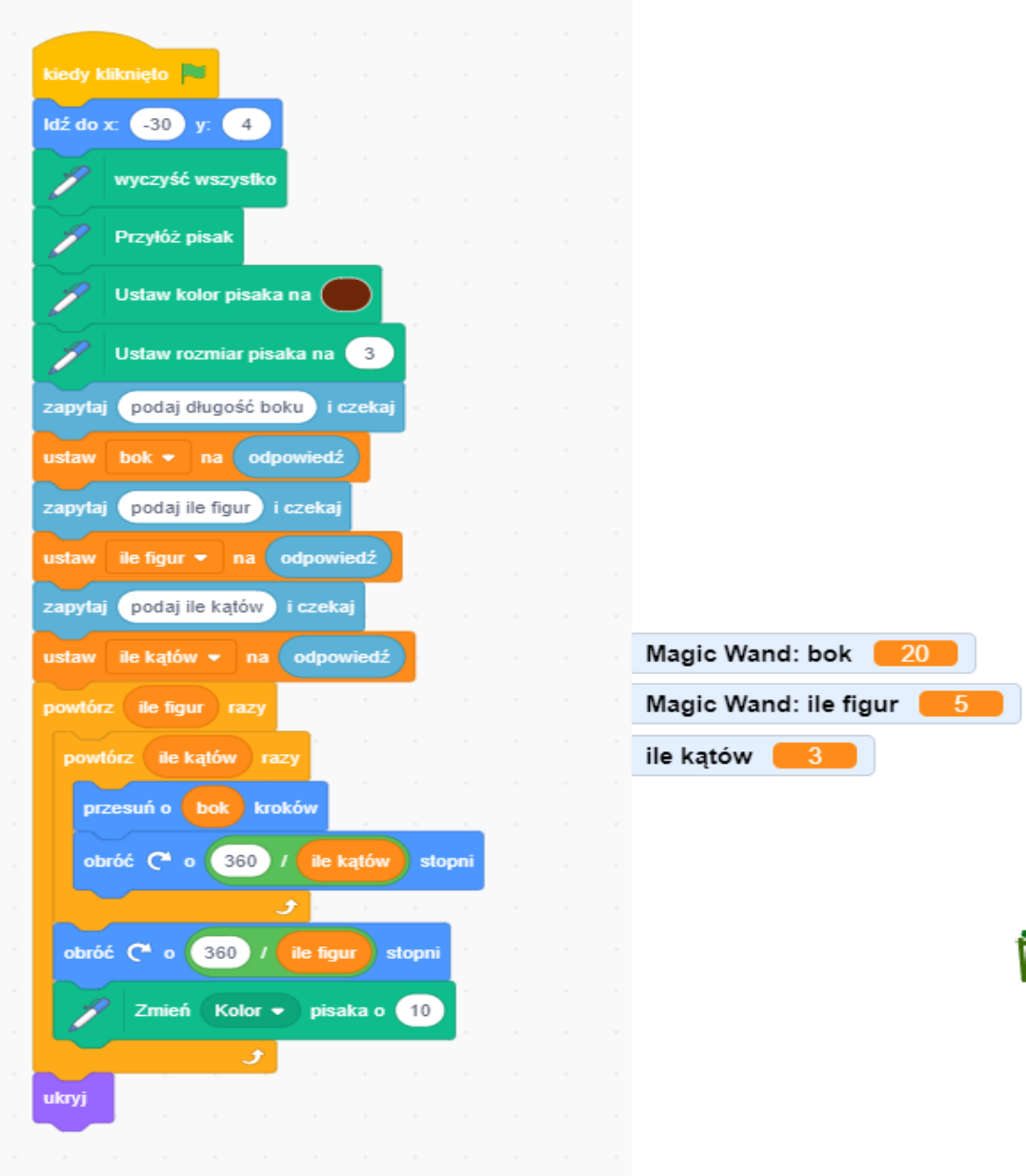
5. Work with the scratch program
6. Summary

Sample script and the appearance of the scene

Script for a polygon



Or

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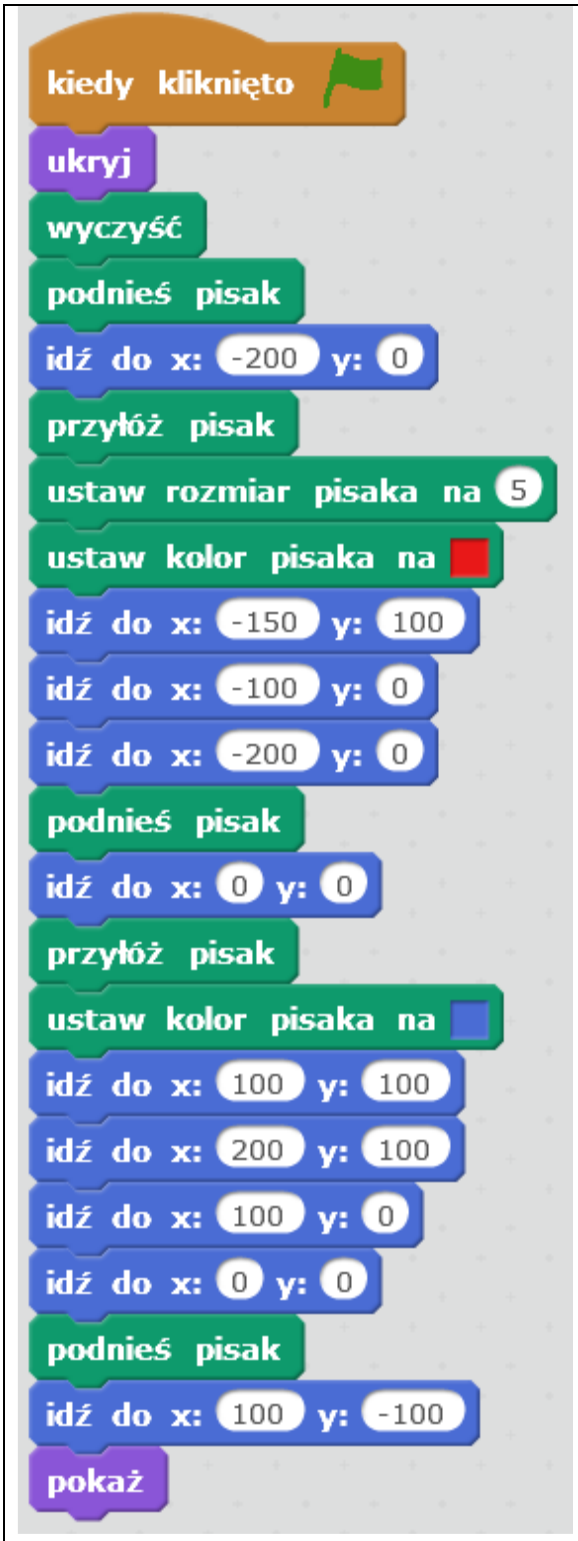

Or

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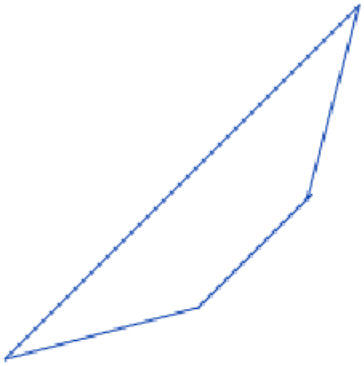

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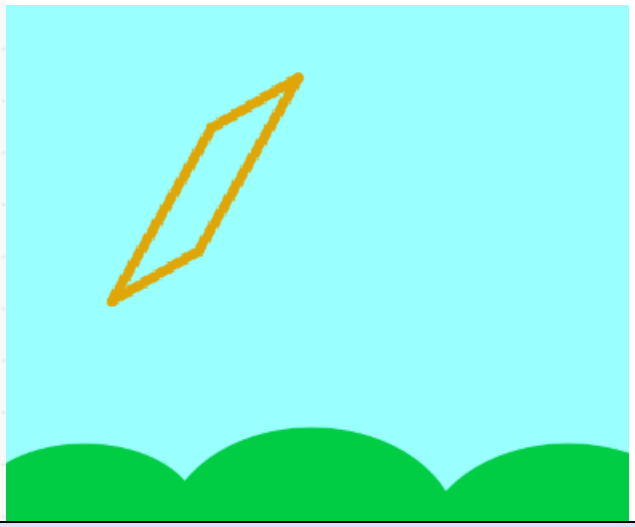

Resources
Drawings of polygons, circles, charts dividing the polygon into triangles.
Students' Evaluation
Commitment, correct, executing commands, activity
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works.
Scalability
Increasing the number of sides in a polygon
More information
Drawing wheels.

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SCENARIO		
Title	Square Area	
Summery	Students will record messages about rectangles and squares. They will acquire the ability to calculate the area of a rectangle and square. They will learn to swap field units.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 04/12/2019

Didactic objectives
Lesson objectives Pupil: calculates the area of a rectangle and square when the sides of these figures are expressed by natural numbers and the same units; uses field units; converts field units; solves the tasks for calculating the square and rectangle;
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☒ 12-14years☐
Problem Statement
How do you calculate the area of a rectangle and square? What are the surface area units? How to swap units?
BOM (Bill Of Materials needed)
Computer workstations, scratch software
Activity description
1. Organizational activities 2. We remind you about the square and the rectangle 3. What rectangle is a square 4.We repeat or introduce the concept of a square field and a rectangle field (When discussing field units, students draw a 1 dm^2 square on a piece of paper and distinguish 1 row of squares with 1 cm side in it. Then, e.g. in the corner of the class, you need to draw a square side 1 m. Students try to fill it with squares of 1 dm^2 prepared by them (cut out of paper). In this exercise the students notice that the squares they prepared do not fill the drawn square. The relationship between the units of the easy field will be remembered in this way) 5. Going out with the students to the field, drawing a square of 1 a square and filling it with 1 sq m square. 6. Work with the scratch program - a game where students set the length of the sides and calculate the area of rectangles.

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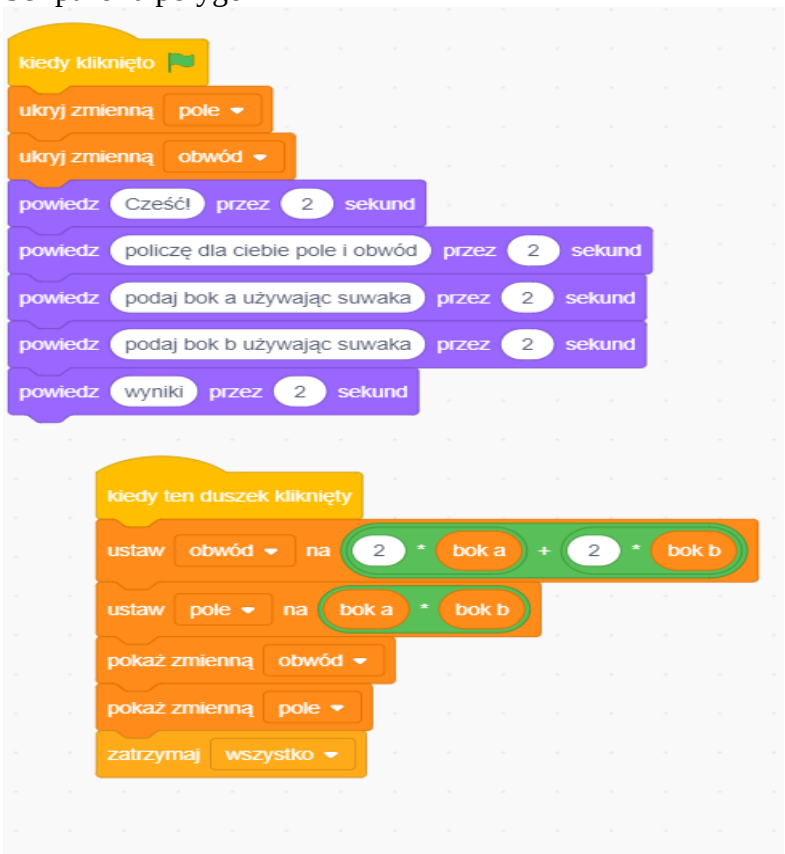
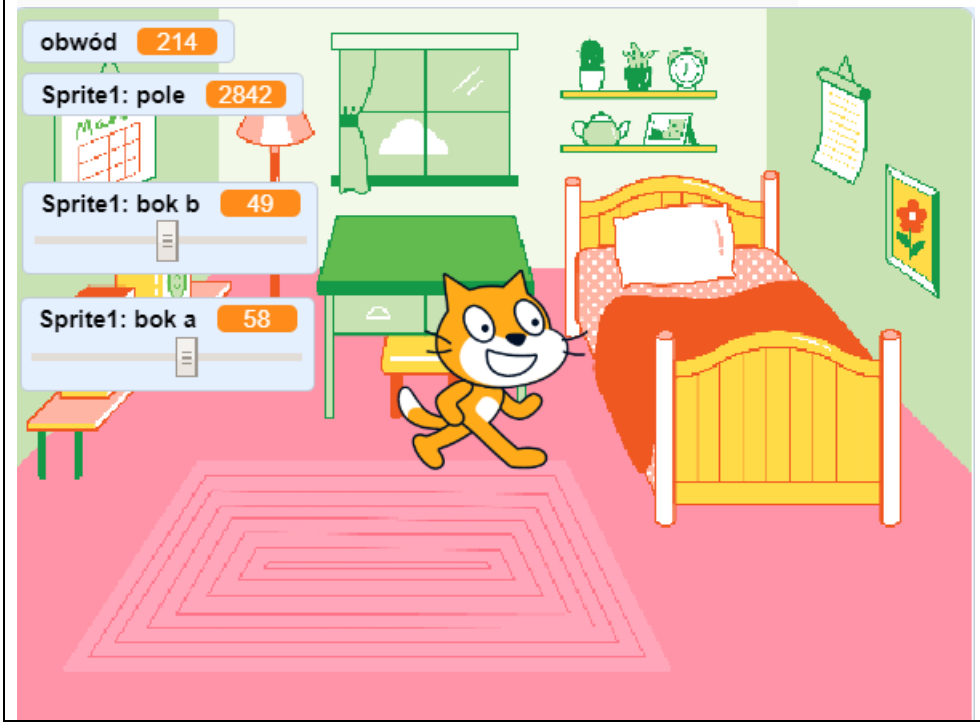
7. On the basis of the above program, students try to arrange similar for other figures.
8. Summary.

Sample script and the appearance of the scene

Script for a polygon





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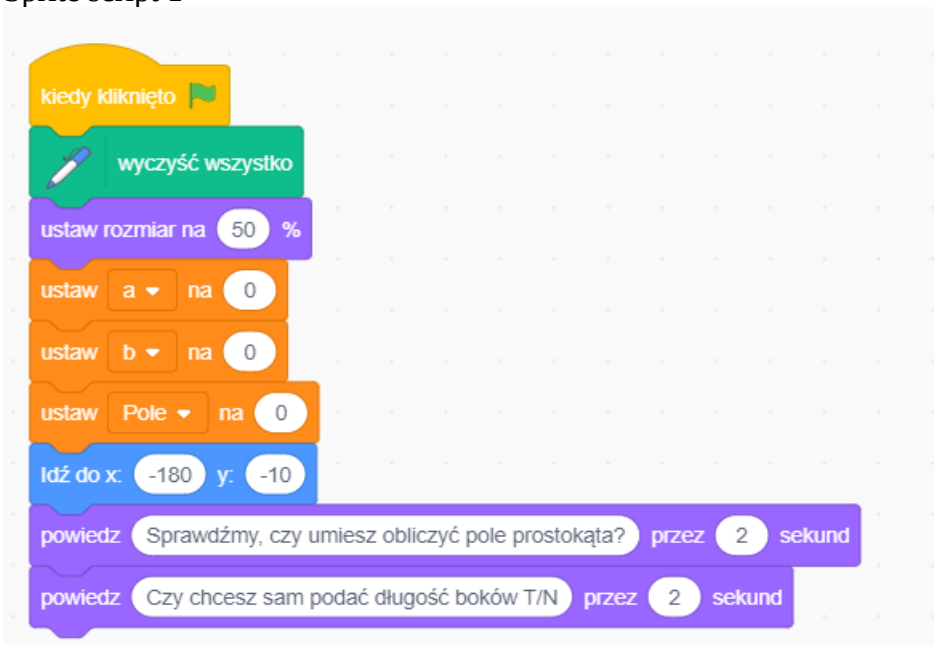
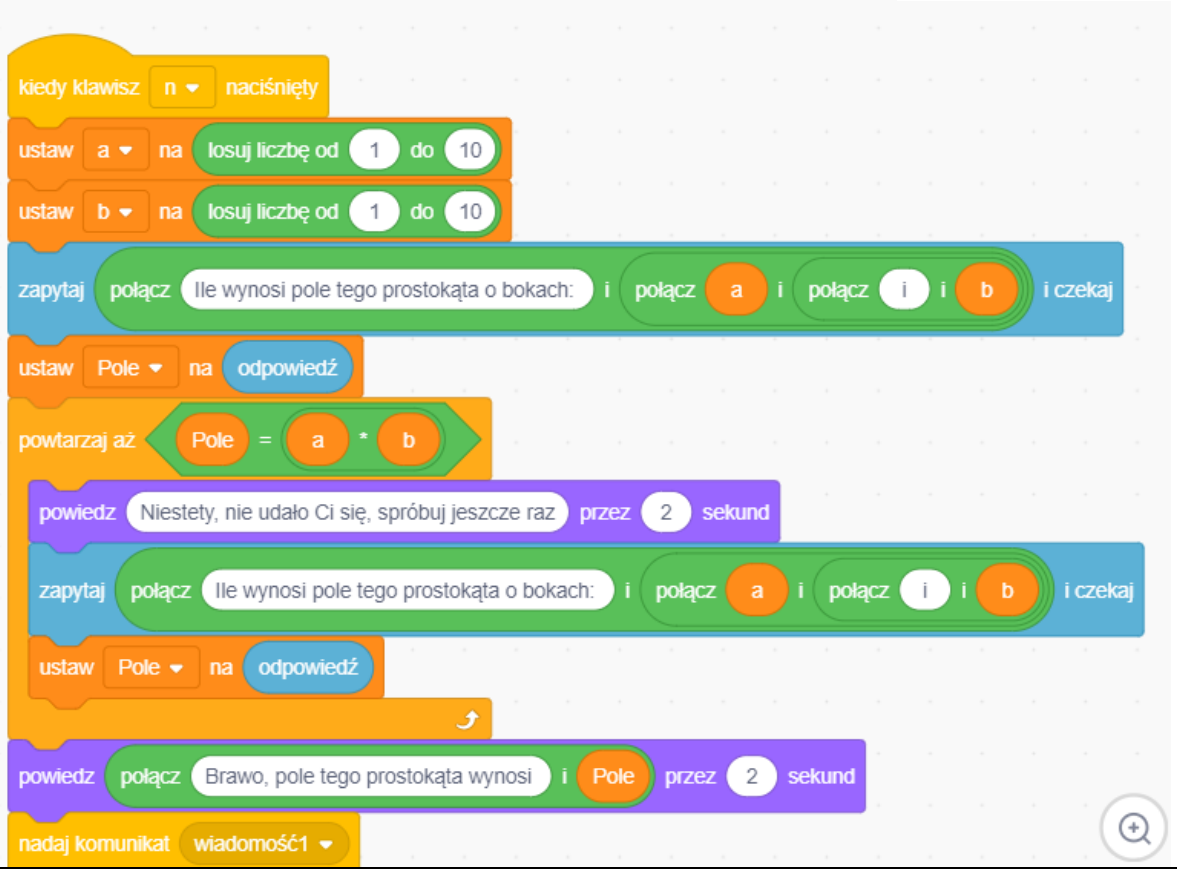
Or
Sprite script 1





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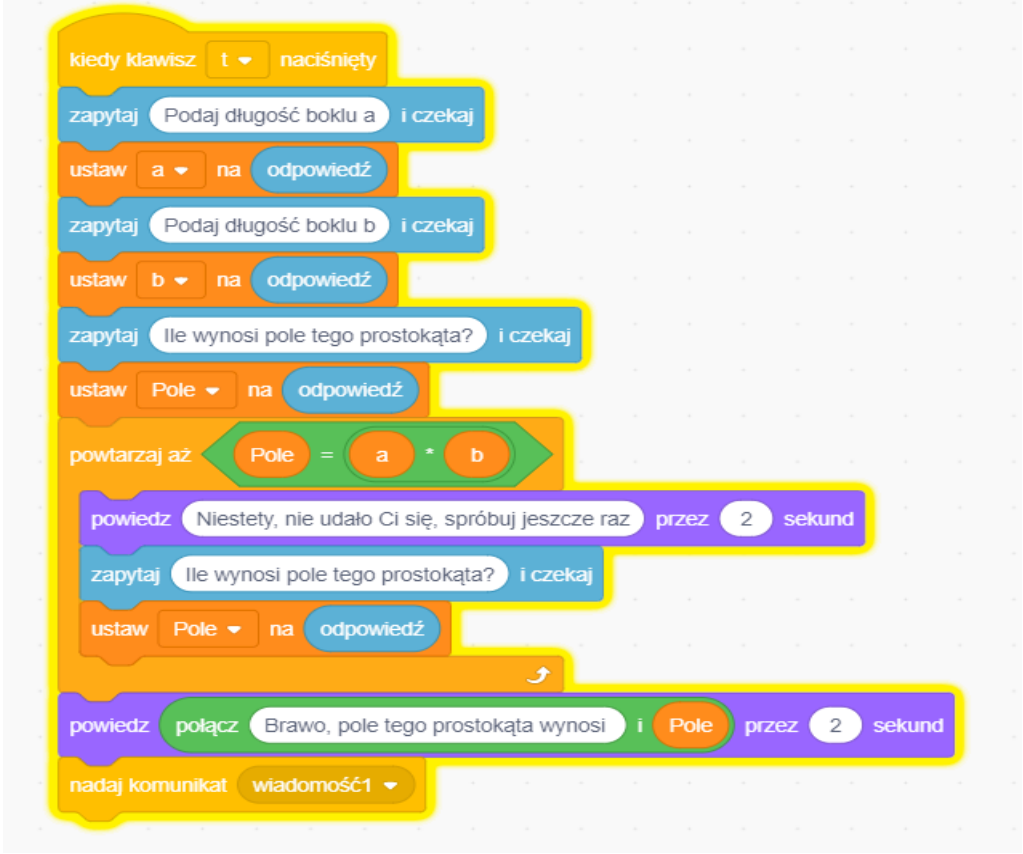

Sprite script 2

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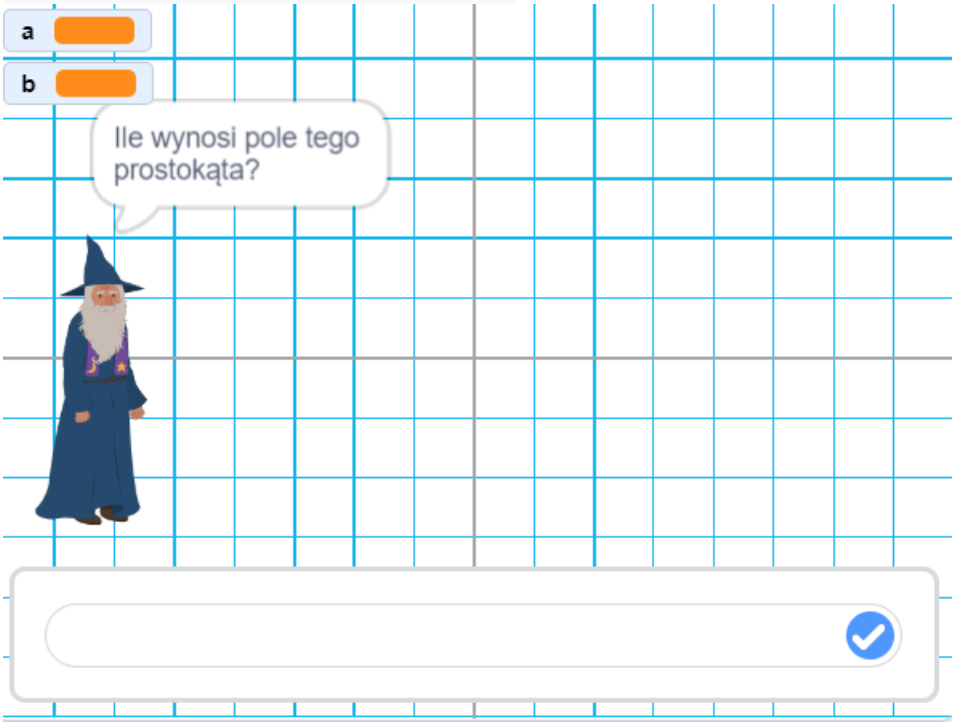

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Resources
Charts of rectangles and squares divided into unit squares.
Students' Evaluation
The student is assessed for the correct performance of the teacher's tasks.
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works.
Scalability
Depending on the level, students can use the program or create the program themselves, put the commands in the correct order.
More information
Students can be asked to choose numbers in such a way to get a specific result. Compare the number of solutions.

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SCENARIO		
Title	Perimeters of regular polygons.	
Summary	The student will learn to calculate the perimeter of a rectangle and square. He can solve text tasks With the use of known patterns. Learn to make drawings for tasks with content.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 04/12/2019

Didactic objectives
Lesson objectives Pupil: calculates the perimeter of a rectangle and square when the lengths of the sides of these figures are given; calculates the side length of a square or rectangle when the perimeter of a figure is given; solves text tasks in which you need to calculate the perimeter of a rectangle; performs auxiliary drawings for text tasks.
Physics☐ Mathematics☒ information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☒ 12-14years☐
Problem Statement
How to calculate the perimeter of a square, rectangle and other figures? In what units do we express the circumference? How to make an auxiliary drawing for a task
BOM (Bill Of Materials needed)
Computer workstations, scratch software
Activity description
1. Organizational activities 2. Reminder of the perimeter of the figure 3. Reminder of how to calculate the perimeter of a square, rectangle 3. Calculation of circuits 4.Work with the scratch program: Laying blocks in the appropriate scheme 5.Each student must calculate the circumference and check the correctness of the result 6. We modify the program so that it counts the circumferences of other quadrangles and polygons 7. Summary **Sample script and the appearance of the scene** Script

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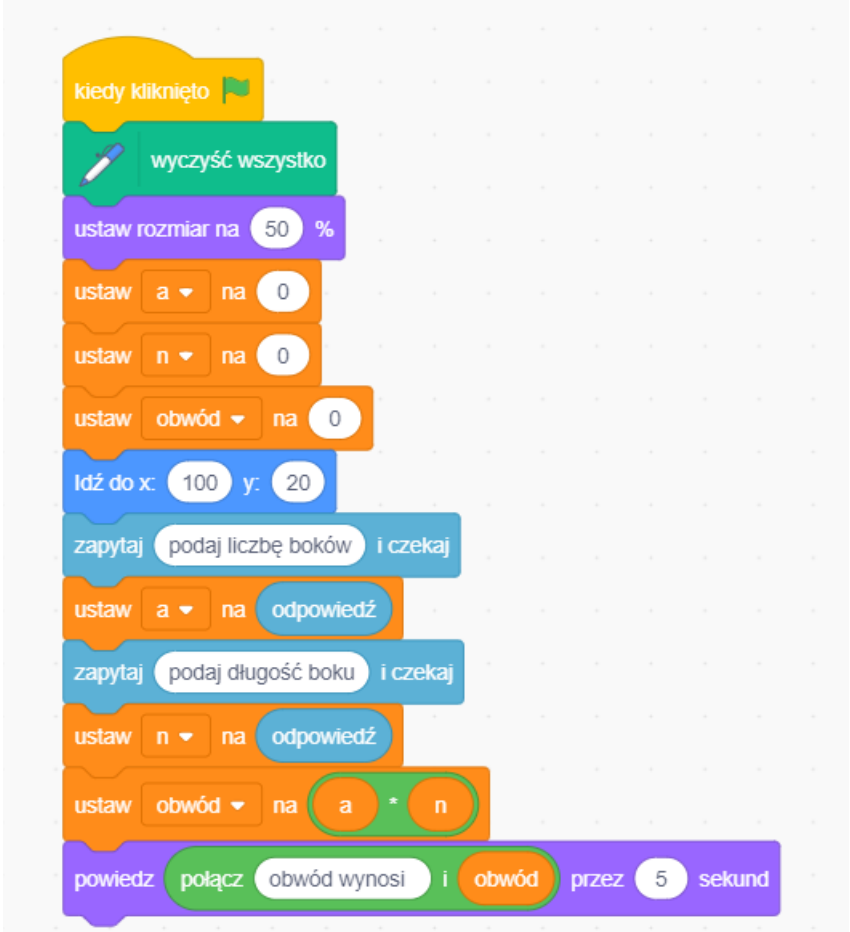

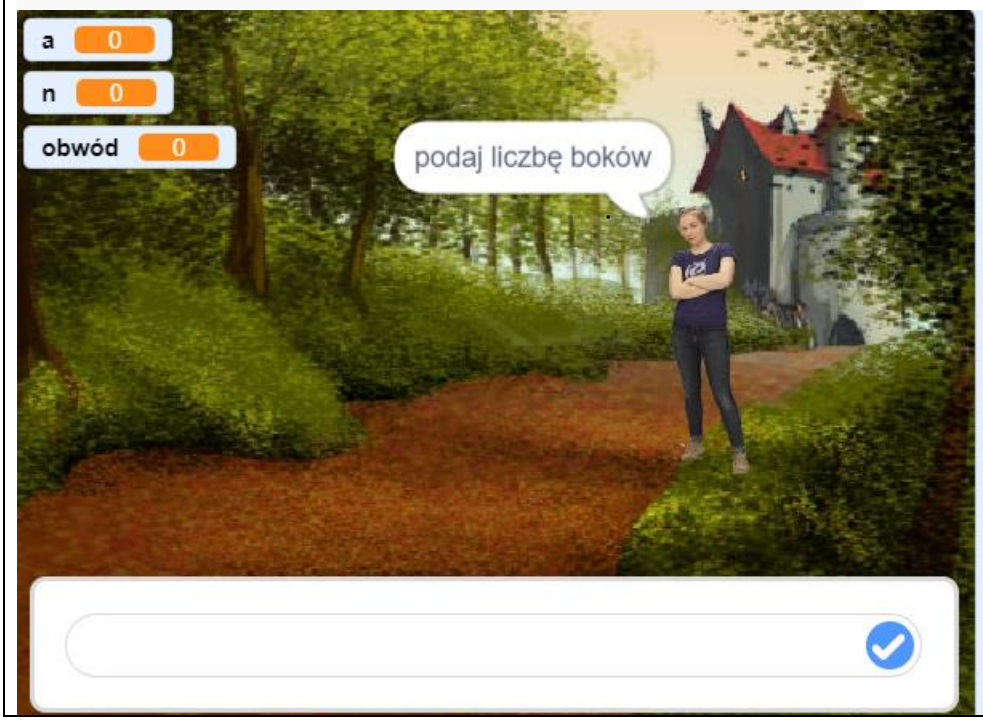

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Resources
Geometric figures.
Students' Evaluation
Commitment to work, activity, accuracy of work performed.
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works.
Scalability
The task can be hindered by selecting numbers, converting units of length.
More information
The task can be differentiated by working in the scratch program from checking and calculating circuits, by stacking ready-made blocks for writing the program yourself.

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SCENARIO		
Title	Symmetry in a coordinate system	
Summary	Students recognize the properties of symmetrical points relative to a straight line and can mark such points and figures, determine the coordinates of symmetrical points to data relative to the axis of the coordinate system.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 06/12/2019

Didactic objectives
Lesson objectives Pupil: • recognizes axisymmetric figures; • draws a figure (point, segment, circle) symmetrical to the given relative to the straight; • indicates the axes of symmetry of the axisymmetric figures; • draws a figure (eg triangle, trapezoid) symmetrical to the given relative to the straight; • determines the coordinates of points symmetrical to the data relative to the coordinate system axis.
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☐ 12-14years☒
Problem Statement
Where is the point, the figure symmetrical in relation to the straight line? What is the relationship of symmetrical points with respect to the axis of the coordinate system?
BOM (Bill Of Materials needed)
Computer workstations, scratch software
Activity description
1. Organizational activities 2. Shaping the concept of symmetrical figures: we organize classes so that students notice the properties of symmetrical points relative to a straight line and can mark such points (we show relevant boards, photos) 3. Drawing figures symmetrical in relation to the straight line - independent work 4. Work in the scratch program - inserting different sprites - observing their transformations. 5.Summary **Sample script and the appearance of the scene** First sprite script

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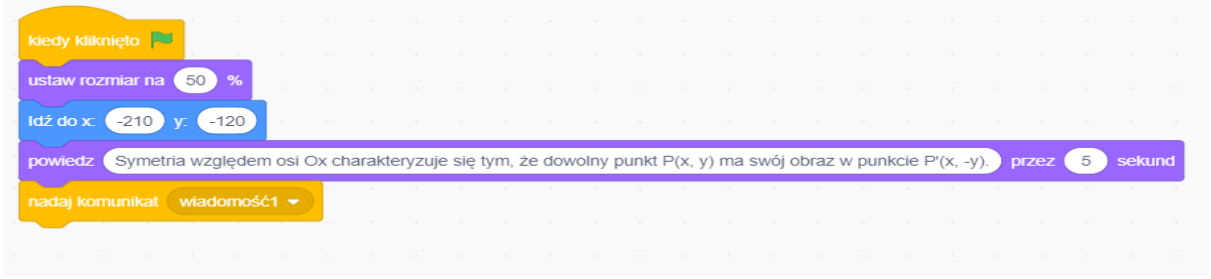
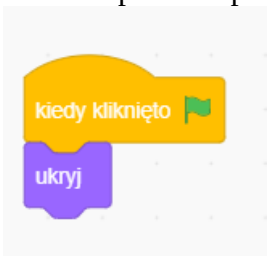
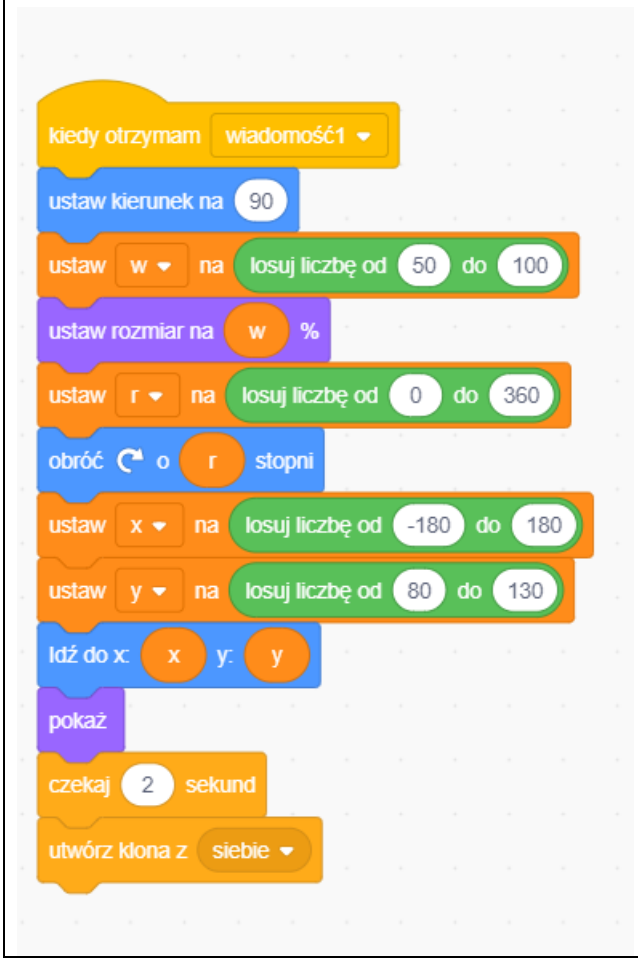


Second sprite script





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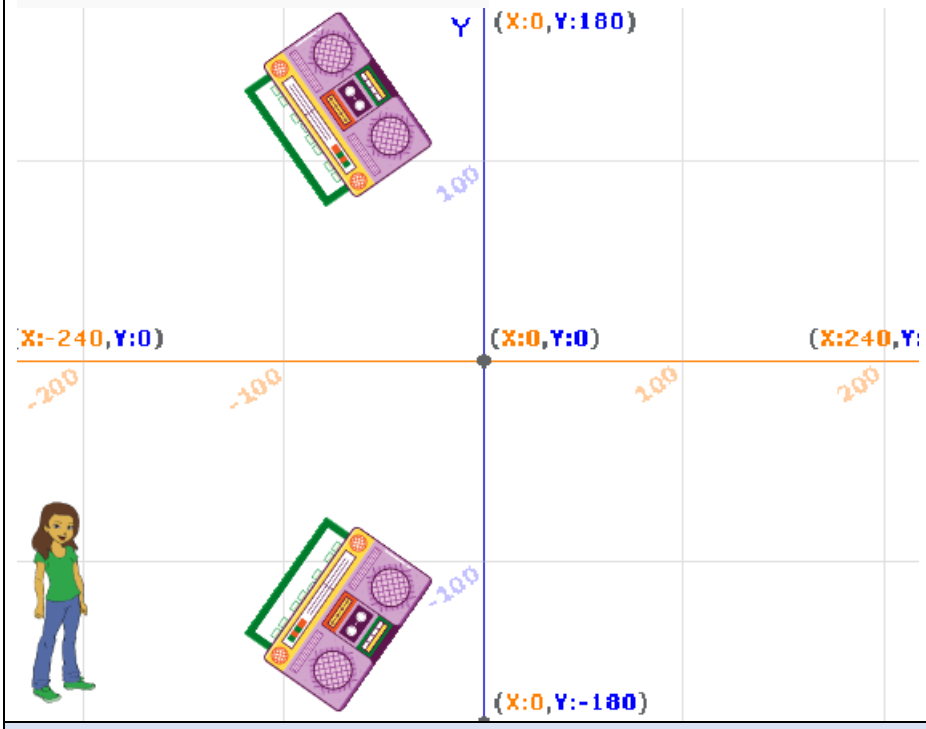

Resources

Coordinate system, cards, ruler, pencil, compass, pictures of symmetrical figures in relation to the straight line.

Students' Evaluation

Correct task performance, drawing accuracy. activity during classes

Bibliography

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Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works.
Scalability
Describing the position of objects relative to each other. Reading point coordinates.
More information
Extending the scratch program by adding more sprites. Extension of the scratch program with other polygons. Writing program symmetry about the Y axis.

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SCENARIO		
Title	Pythagorean theorem.	
Summary	The student learns Pythagorean theorem, can use it to calculate the length of sections, solves text tasks	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 06/12/2019

Didactic objectives
Lesson objectives Pupil: • indicates the hypotenuse and hypotenuse of the right triangle; • formulates Pythagoras' theorem; • uses the Pythagorean theorem to calculate the length of sections; • calculates the length of the segment whose ends are given lattice points in the coordinate system; • geometrically justifies the Pythagorean theorem. • solves typical practical tasks using the Pythagorean theorem; • solves complex practical tasks using the Pythagorean theorem; • finds Pythagorean trios.
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☐ 12-14years☒
Problem Statement
What triangle do we call rectangular? Which sides are shorter and which are the longest? What are their names? What is the relationship between them?
BOM (Bill Of Materials needed)
Computer workstations, scratch software
Activity description
1. Organizational activities. 2. Rectangular triangle - nomenclature. 3. Drawing squares on the sides of the triangles and calculating their areas. 4. Searching for the relationship between the results obtained. 5. Work with the scratch program - counting the length of the sides and determining the type of triangle.

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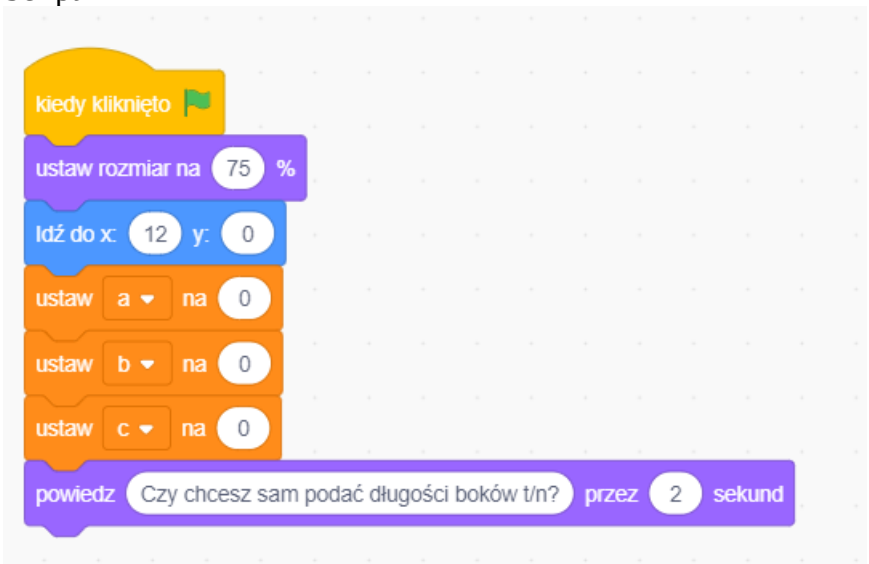
6. Summary of classes.

Sample script and the appearance of the scene

Script



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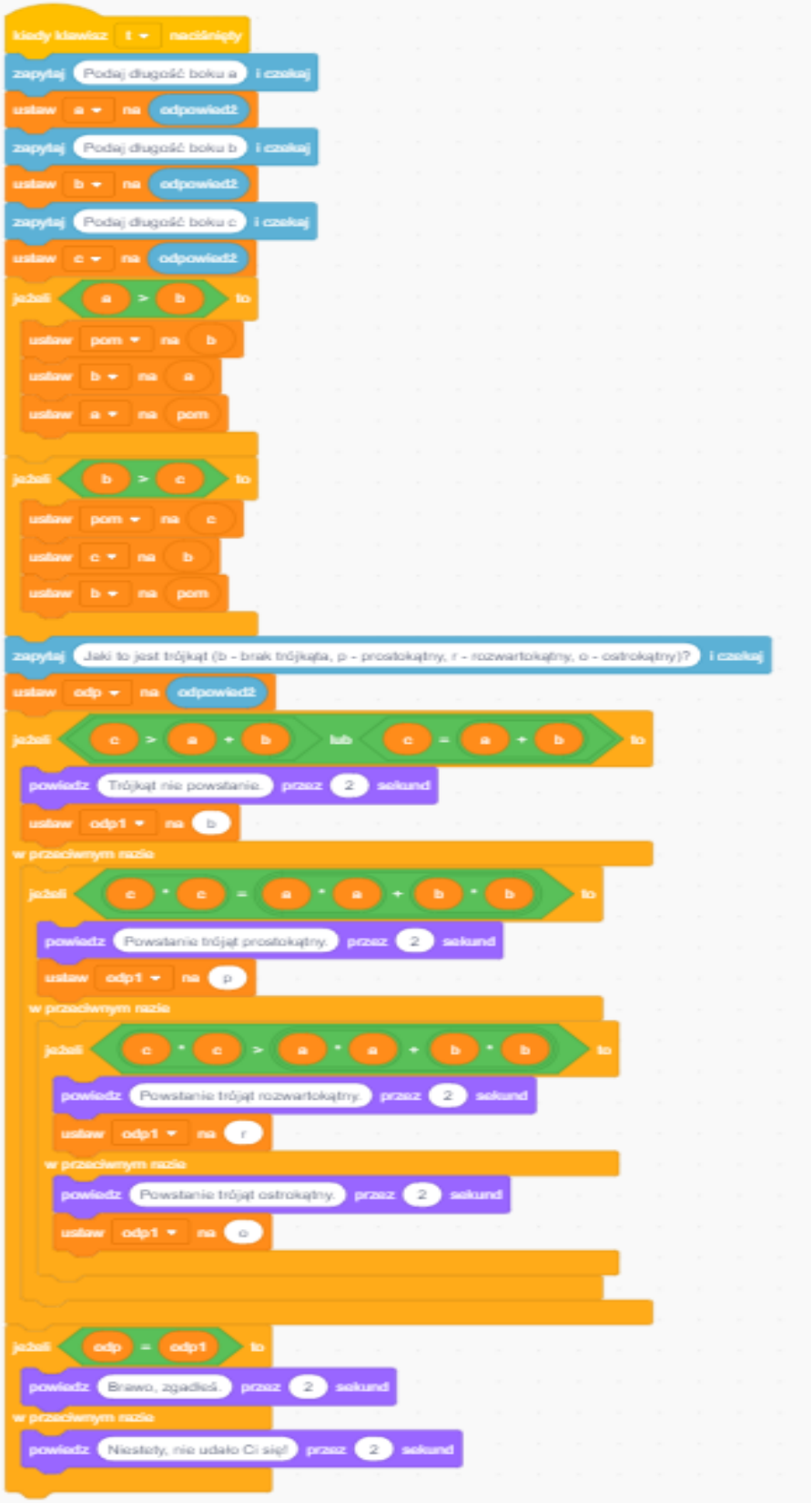

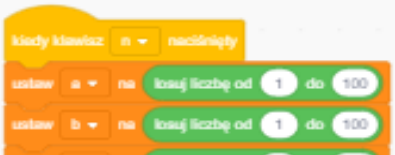

mission. The design or publication reflects only
onsible for the substantive content contained

Resources
Charts with right-angled triangles. Cards, pencils, rulers
Students' Evaluation
Activity, correct task performance,
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works.
Scalability
In the scratch program, try to draw such triangles.
More information
Draw each of the triangles that appears on the board. Calculation of their fields, circumferences.

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SCENARIO		
Title	Describing prisms	
Summary	The student distinguishes between prisms among solids, He names them, indicates height, side walls, edges Can draw polyhedrons and indicated elements	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 07/12/2019

Didactic objectives
Pupil • distinguishes between simple prisms and names them; • describes the prisms; • shows the height of the straight and inclined prism on the model; • draws straight prisms and their grids; • classifies prisms; • based on examples of solids, determines the formulas for the number of walls, edges and vertices of a prism.
Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐
Education Level: 10-12years☐ 12-14years☒
Problem Statement
What distinguishes a prism from other solids? How many faces, edges, vertices?
BOM (Bill Of Materials needed)
Computer workstations, projector, scratch software
Activity description
1. Organizational activities 2. We describe straight prisms, with cuboid and cube distinction. 3. We introduce the concept of the correct prism. We can display on the screen instructions for drawing straight prisms. Students draw on their own, based on the instructions. 4. We indicate the height of the prism in the illustrations or models. 5. We mention that there are also inclined prisms (we show photos or models), whose side walls are parallelograms. 6. We count walls, vertices, edges and look for the relationship between the polygon in the base and their number. 7. Working with the scratch program - we choose the model, give the number of sides in the base,

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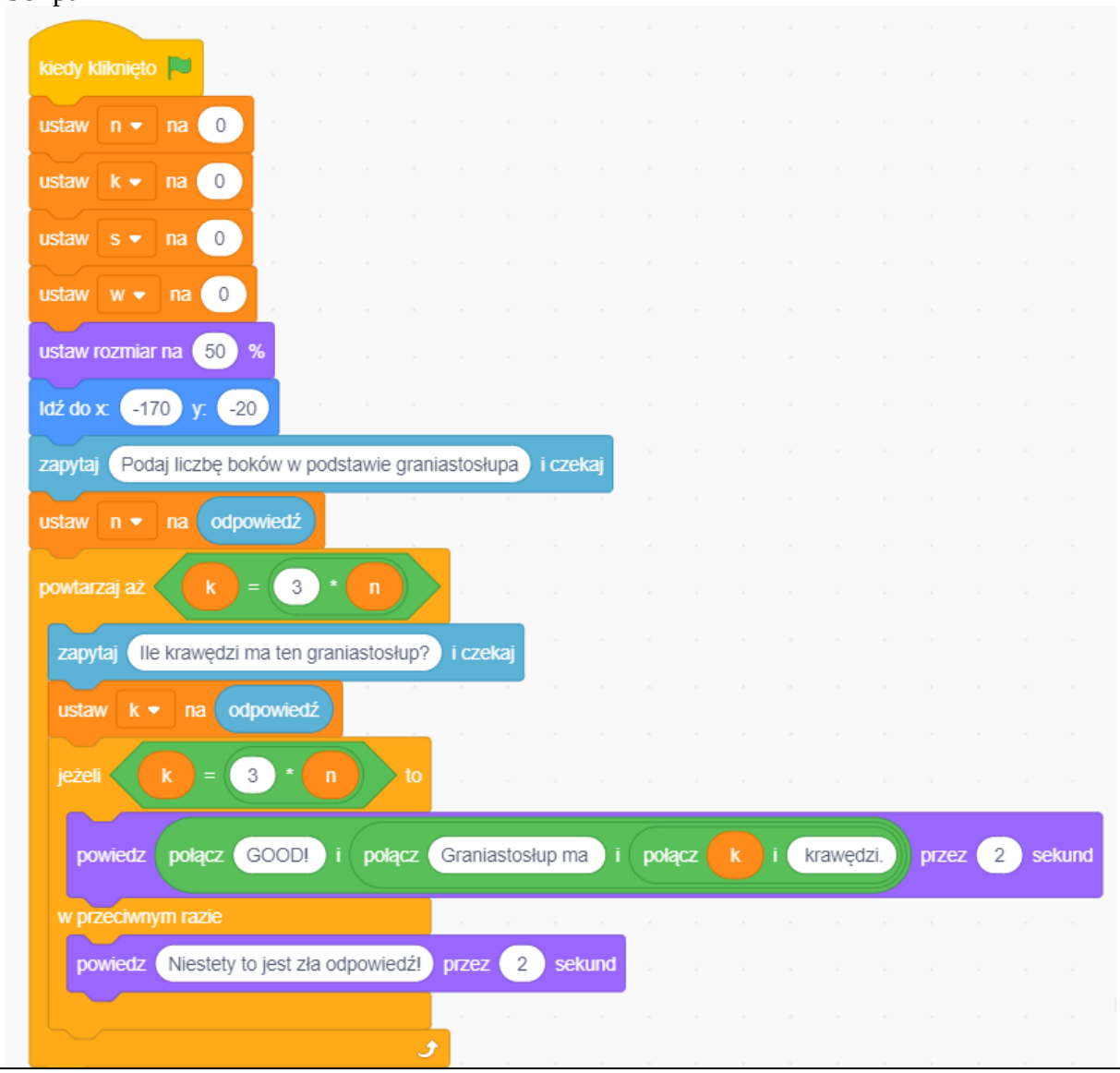
check whether we can correctly enter the number of walls, edges and vertices.

8. Summary.

Sample script and the appearance of the scene

Script



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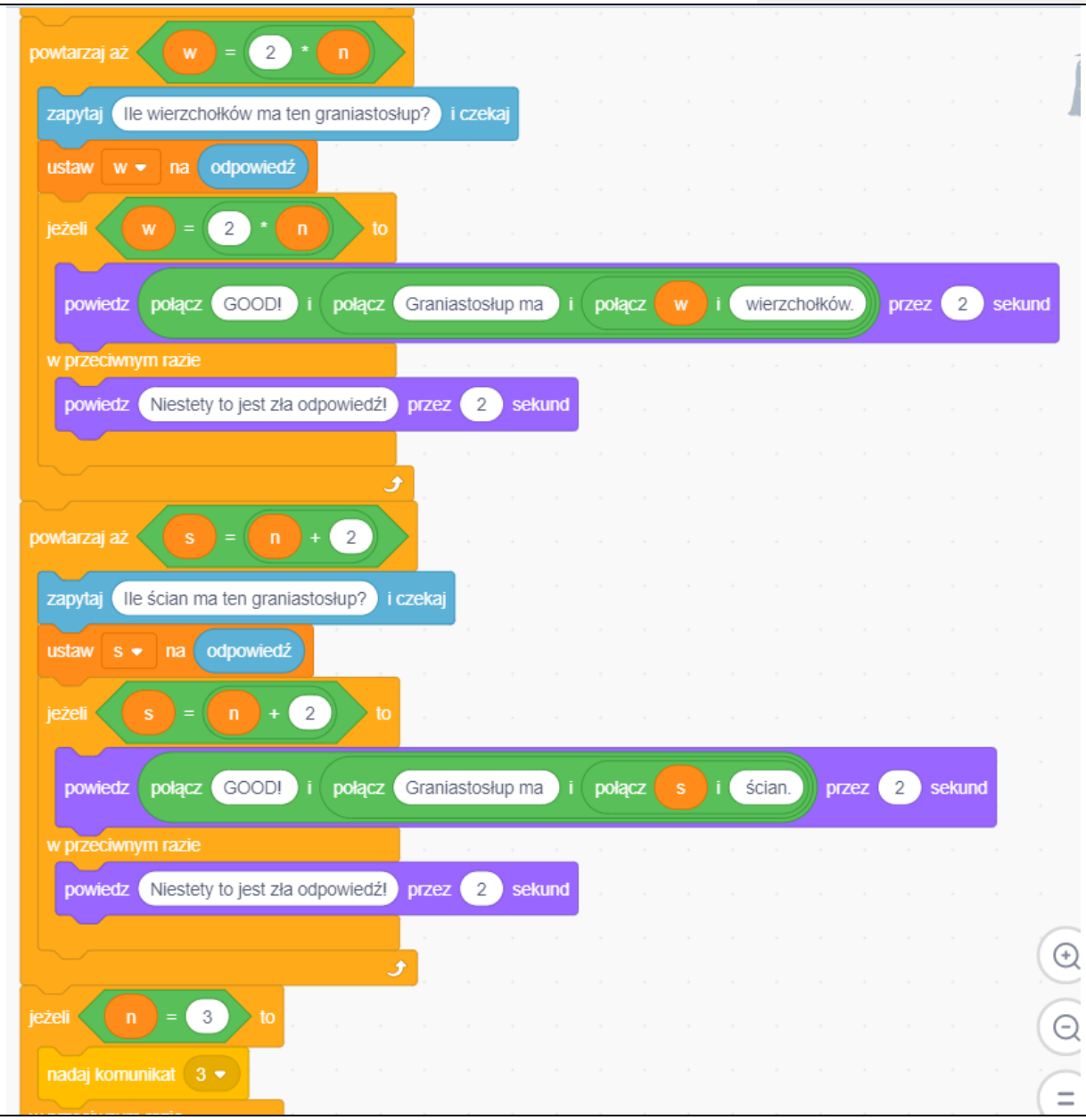

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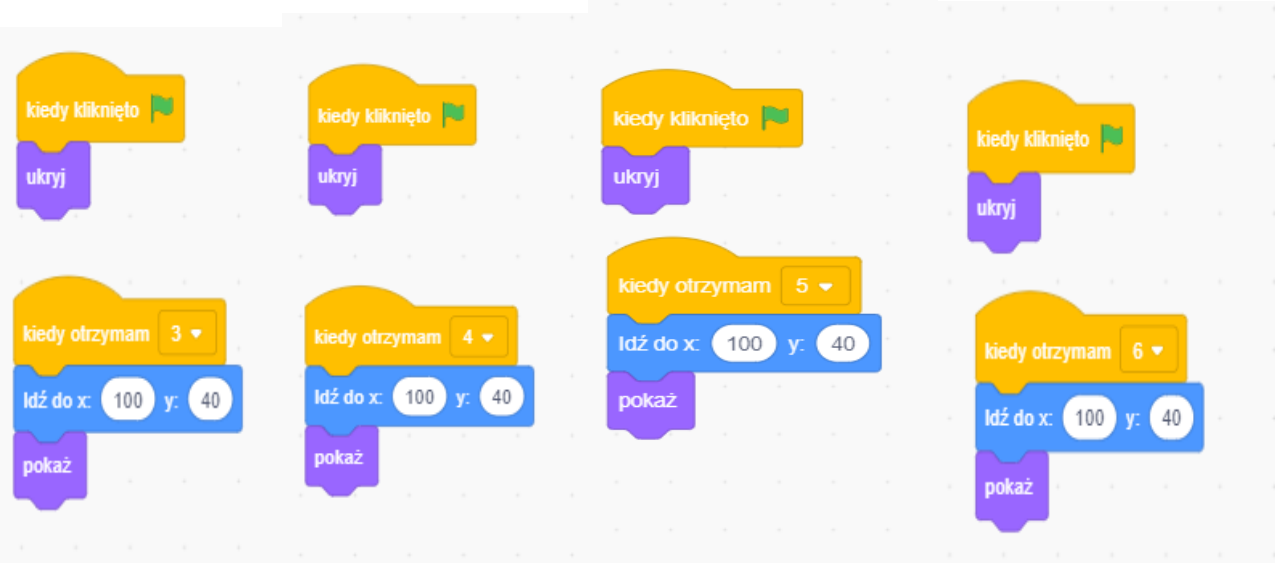
Scripts for n = 3, n = 4, n = 5, etc. As sprites we insert prisms with triangular, quadrilateral, pentagonal bases, etc….



Resources

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Models of solids - prisms, charts with appropriate prisms, sheets of paper, pencil.
Students' Evaluation
The correctness of drawing, commitment, activity during the lesson.
Bibliography
Mathematics textbooks, workbooks, task sets are available. Only those with whom the class works.
Scalability
Depending on the educational level, you can change the polygon in the base of the solid (increase the number of its sides),
More information
You can extend the scratch program by determining the surface area of the solid or counting the volume.

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SCENARIO		
Title	Symmetry relative to the point (0,0)	
Summary	Recognition of symmetrical figures relative to point (00) Recognition of mid-symmetric figures	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 07/12/2019

Didactic objectives

Pupil:
• recognizes symmetrical shapes;
• draws a figure (point, segment, circle) symmetrical to a given one with respect to the point;
• indicates the center of symmetry of center-symmetric figures;
• draws a figure (eg a triangle, trapezoid) symmetrical to a given point;
• determines the coordinates of points symmetrical to the data in relation to the origin of the coordinate system.
recognizes center-symmetric shapes and indicates their centers of symmetry.

Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐

Education Level: 10-12years☐ 12-14years☒

Problem Statement

What is the center of symmetry?
Where is?
Which figures have a center of symmetry?
How are the figures symmetrical about the point?

BOM (Bill Of Materials needed)

Computer workstations, scratch software
Posters with figures symmetrical about point (0,0)

Activity description

1. Organizational activities
2. We shape the concept of figures symmetrical in relation to a point and organize classes so that students notice the properties of points symmetrical in relation to a point.
3. we discuss examples of symmetrical figures relative to a point - various examples can be used
4. We develop the ability to recognize figures symmetrical about a point and draw such figures.
5. We try to guide students to discover the relationship between the coordinates of symmetrical points relative to the origin of the coordinate system and to apply this relationship in tasks
6. Work with the scratch program - figures symmetrical to the point (0,0) and kaleidoscope.
7. Summary

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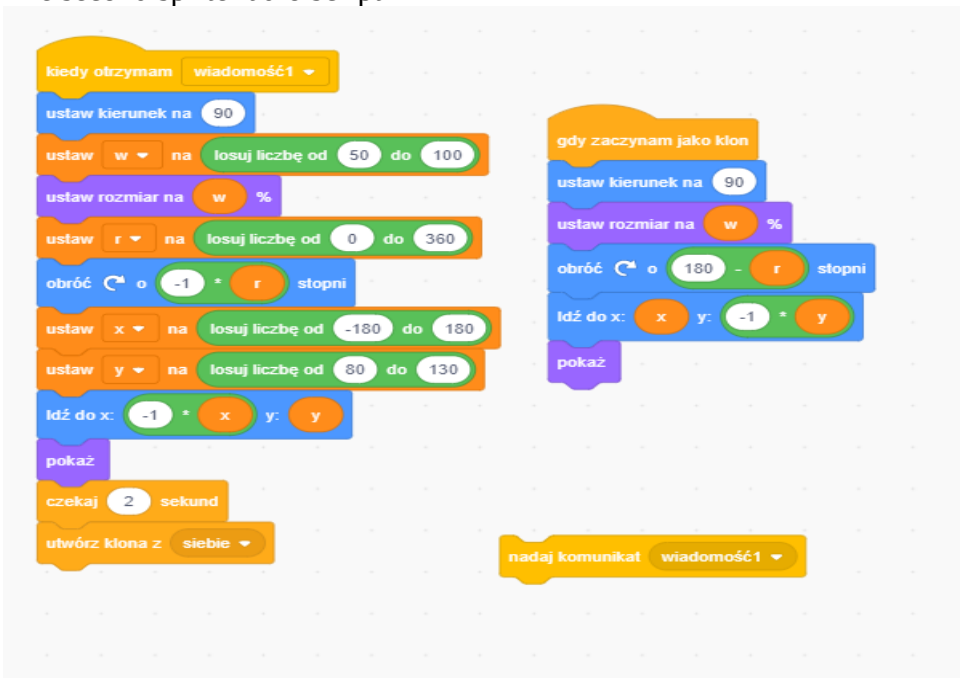
Sample script and the appearance of the scene

ABBY Script- the first sprite

The second sprite radio script



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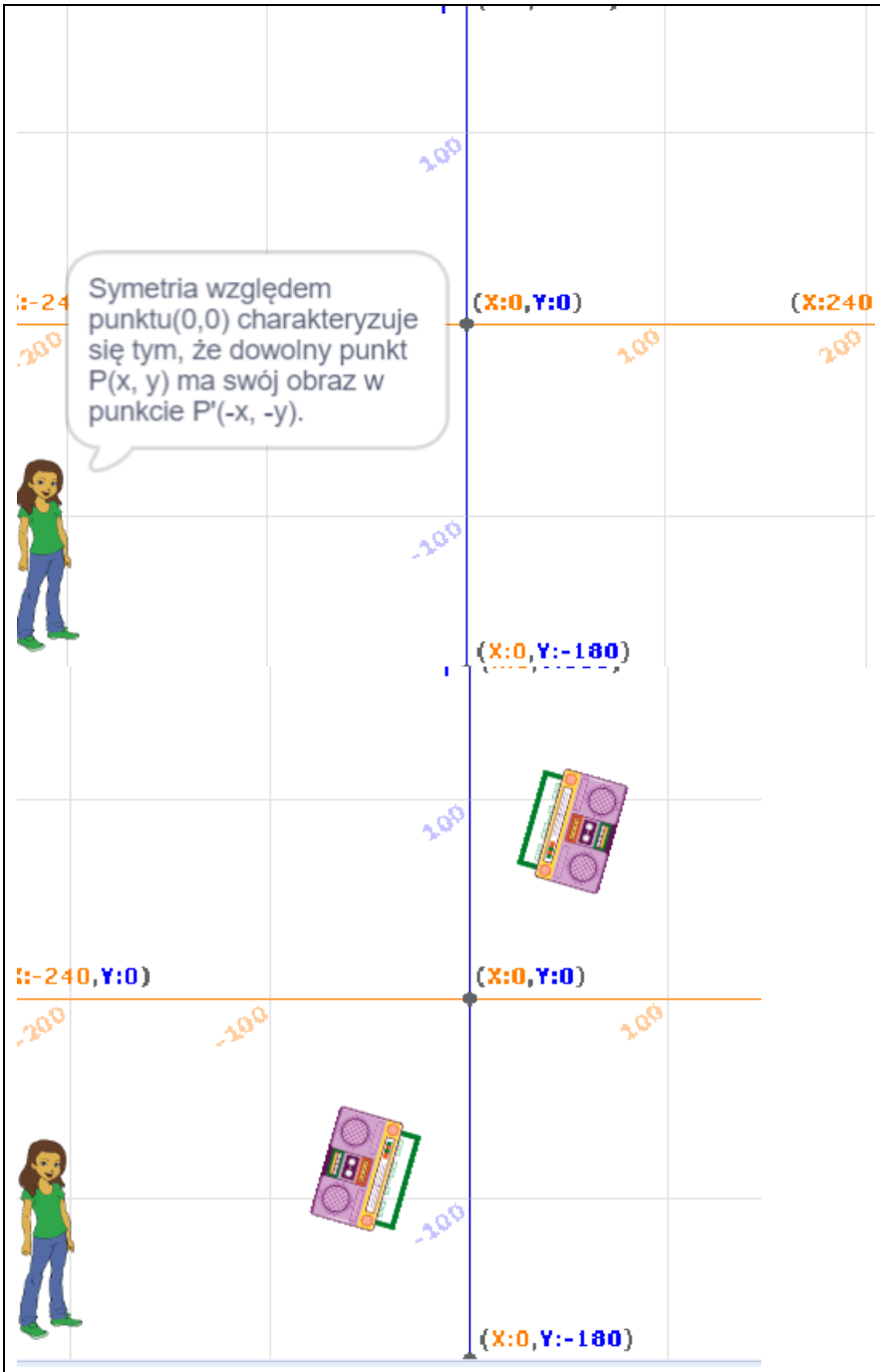

or some other script

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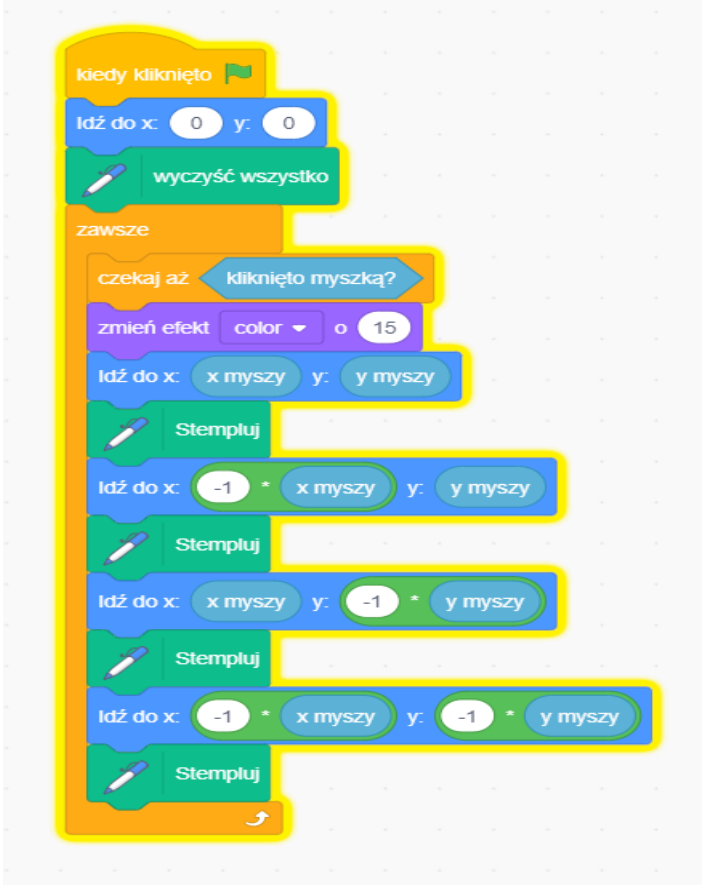

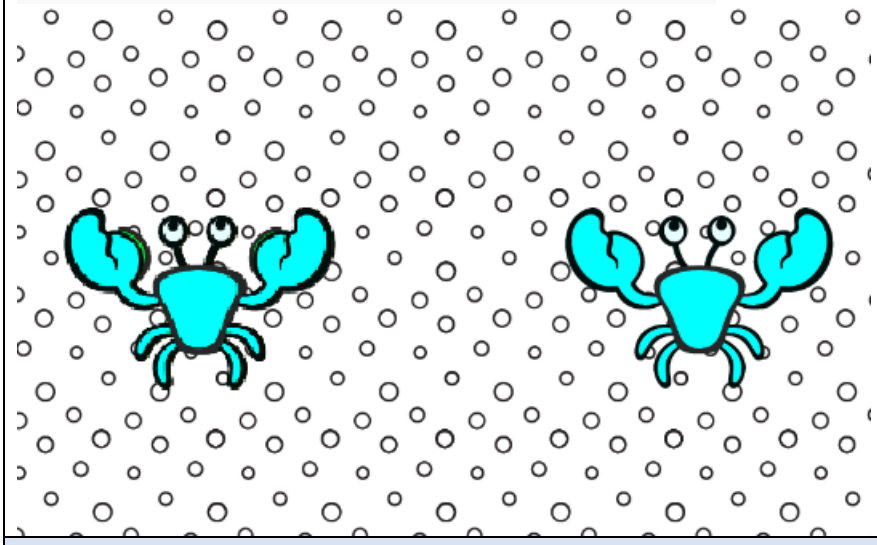

Resources

Posters, photos, various paintings, patterns - nature, architecture, art

Students' Evaluation

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Commitment to work, activity, accuracy of work performed.
Bibliography
Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works
Scalability
Describing the position of objects in relation to each other. Reading the coordinates of points.
More information
You can extend the scratch program by determining the surface area of the solid or counting the volume.

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SCENARIO		
Title	Describing the pyramids.	
Summary	The student will learn about the concept of a pyramid, learn to distinguish it from other solids, Will indicate the basic elements of these solids.	
Author/s	Renata Jasińska, Alicja Radziwon	Date: 08/12/2019

Didactic objectives

• distinguishes pyramids from various solids and gives their names;
• gives examples of pyramids, eg in architecture and surroundings;
• indicates the basic elements of the pyramids (eg base edges, side edges, solid height, heights side walls);
• recognizes and draws pyramid grids;
• draws pyramids.

Physics☐ Mathematics☒ Information☐ Technology☐ Robotics☐ Programming☐

Education Level: 10-12years☐ 12-14years☒

Problem Statement

What distinguishes pyramids from other solids?
How many walls do they have, how many edges? How many vertices?
How does their number depend on the polygon in the base?
Where is the height of the pyramid?

BOM (Bill Of Materials needed)

Computer workstations, projector, scratch software

Activity description

1. Organizational and organizational activities
2. Introduction to the subject reminder of prisms
3. We introduce the concept of a pyramid.
4. We describe it and teach how to draw pyramids and their grids - you can on the basis of instructions.
5. We organize cooperation in small groups. Students will learn about the pyramid, its elements and types, including about the normal pyramid and regular tetrahedron (in textbooks, the Internet).
6. Students create a crossword puzzle taking into account the concepts appearing in the lesson. They prepare the crossword in two versions: to be solved and solved. After completing this task, each group passes its crossword to the neighboring group with a request to solve it. Verification of the correctness of the crossword solution is based on the solution of the group that arranged the crossword.
7. Solving various tasks regarding the ownership of pyramids.
8. Working with the scratch program, we calculate the number of faces, edges and vertices in selected models. We check the correctness of the calculations.

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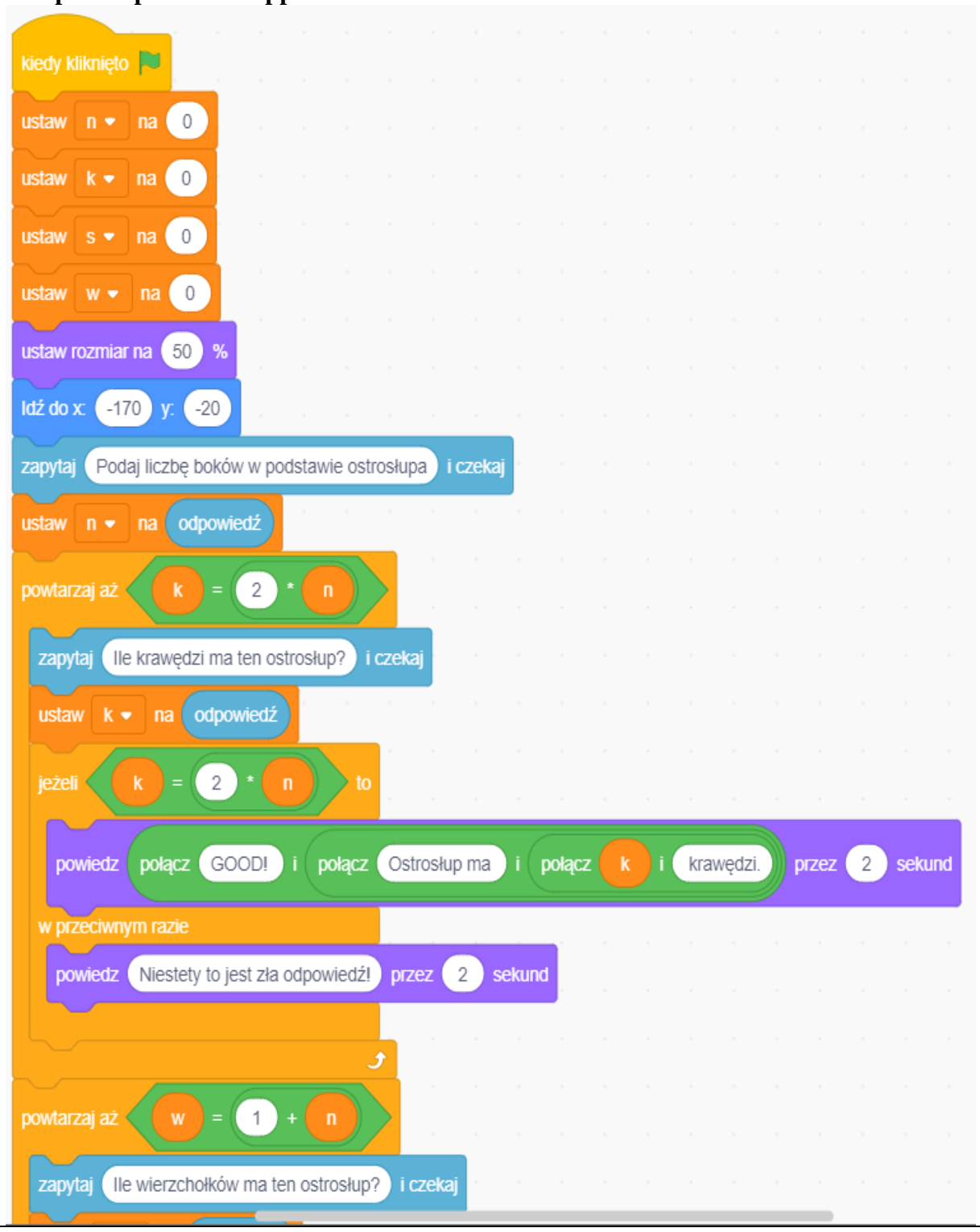
9. Summary.

Sample script and the appearance of the scene



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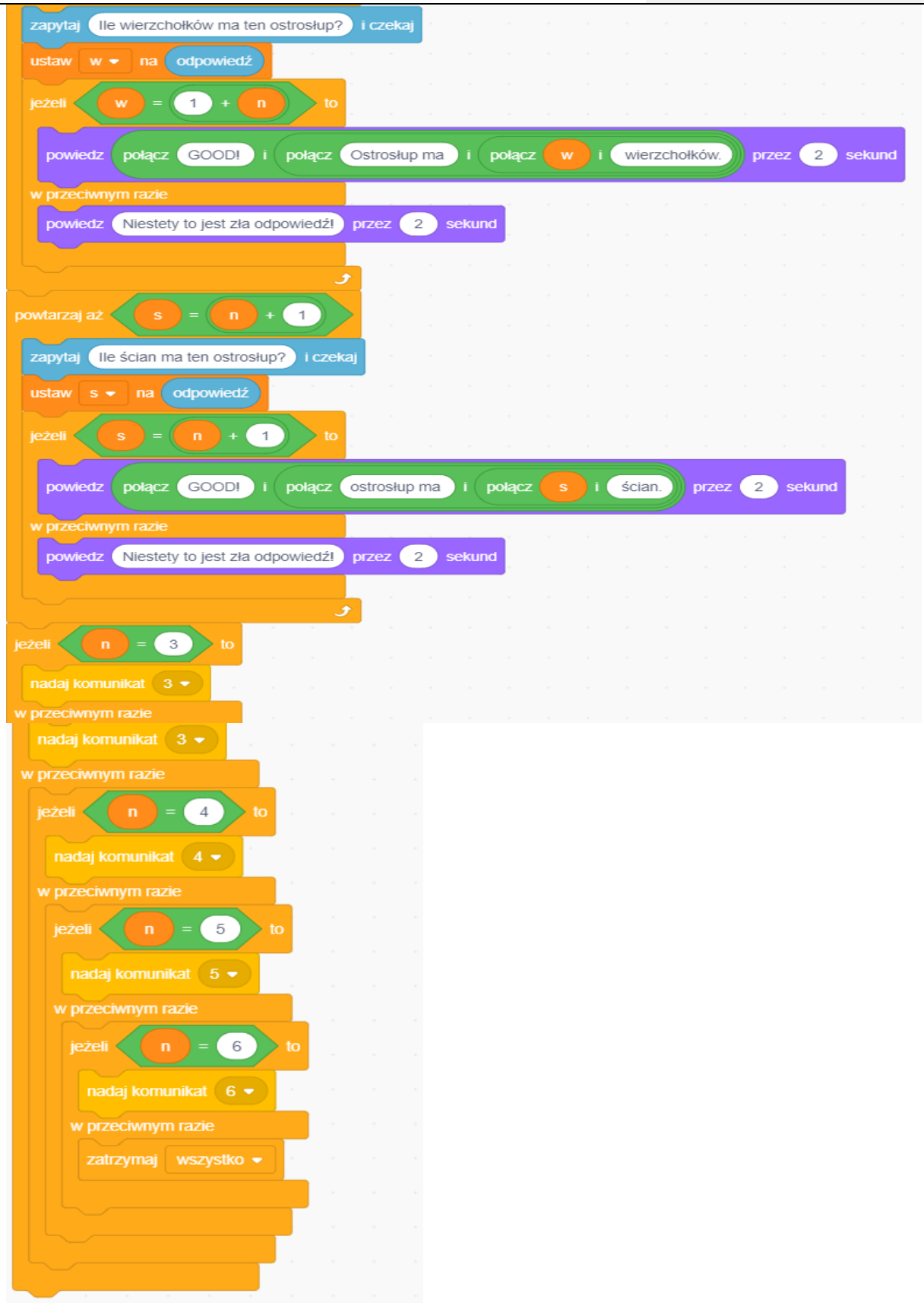

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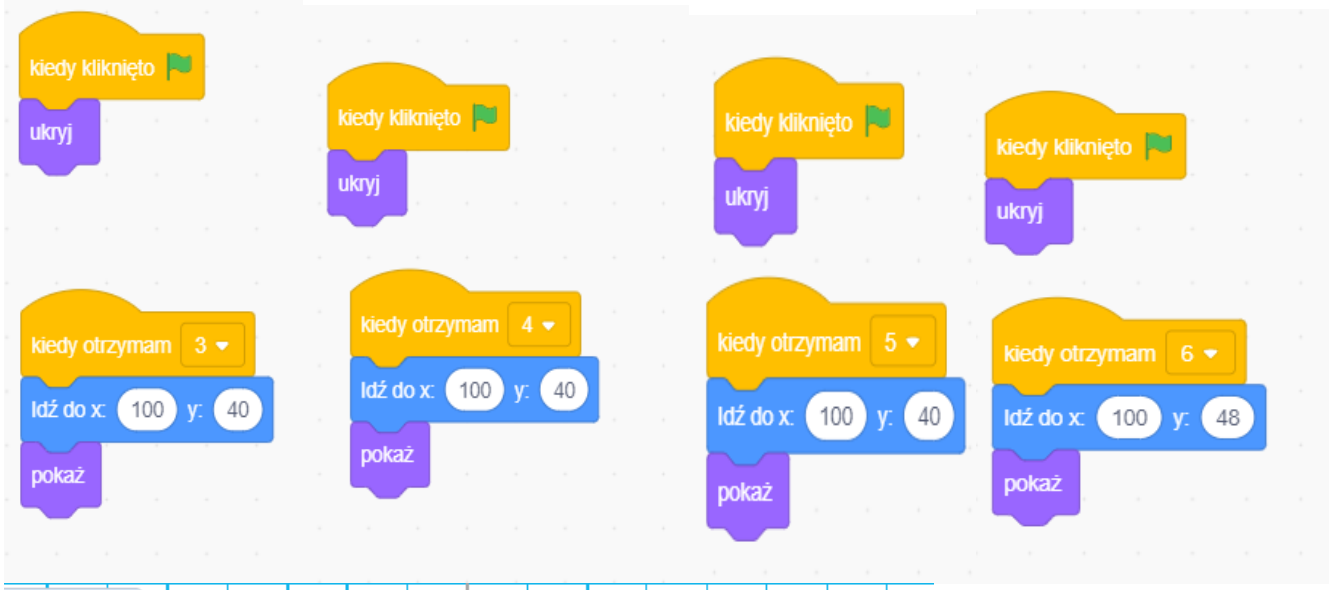
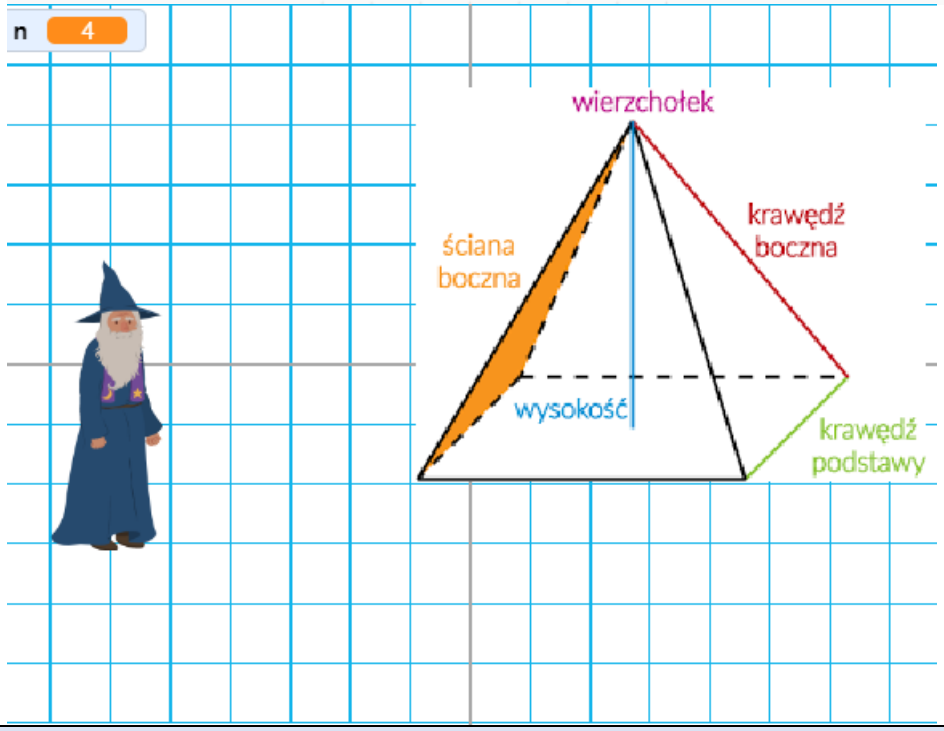
Scripts for n = 3, n = 4, n = 5, etc., where sprites are solids





Resources

Pyramid models, drawings, photos - available on the internet.

Students' Evaluation

Commitment to work, activity, accuracy of work performed.

Bibliography

Available mathematics school textbooks, workbooks, task sets. Just those with whom the class works

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Scalability
Depending on the educational level, you can change the polygon in the base of the solid (increase the number of its sides).
More information
You can extend the scratch program by determining the surface area of the solid or counting the volume.

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6.3. ICT

SCENARIO		
Title	**Robot in a maze.**	
Summary	Students are to write a program for the robot that is to go through the maze.	
Authors	Jarosław Szczęsny	Data: 05/11/2019

General objectives:

the student knows the concepts: algorithm, instruction, turning activities into instructions, reminder and consolidation of the LEGO MINDSTORMS EV3 Home Edition program, developing a solution project and its implementation using the program.

Specific objectives:

knows how to run the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like, knows the basic blocks for building algorithms in the program, knows how to create simple algorithms in the program, can write instructions to individual blocks, knows how to run an algorithm built in the program, the student can move the robot around the maze, student is able to build simple scripts, the student understands and knows how to apply loop instructions to repetitive activities.

Physics☐ Mathematics☐ Computer science☐ Robotics☐ Programming ☒

Educational level: 10-12 years ☐ old 12-14 years old ☒

Problem Statement

Arrange a program with which the robot can overcome the maze?

BOM (Bill Of Materials needed)

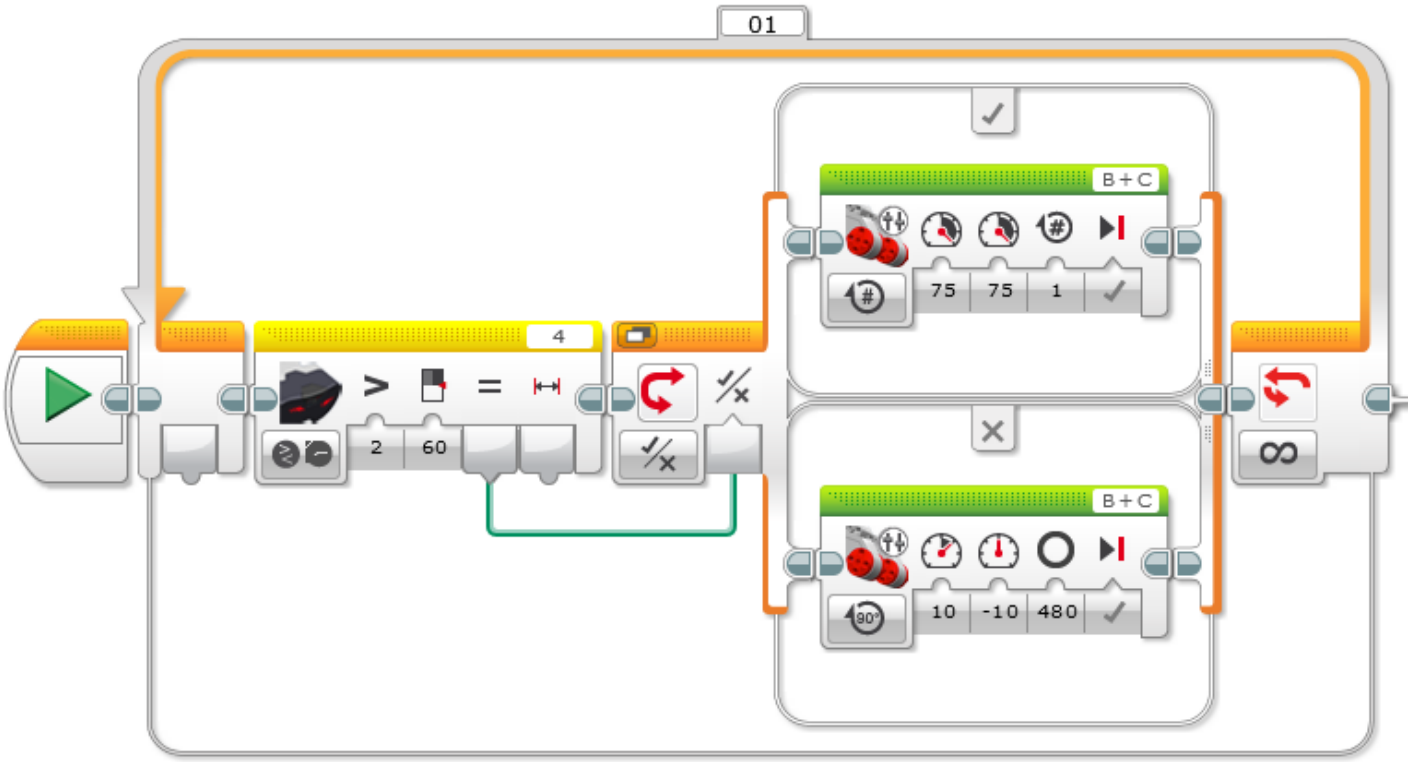
- computer station
- LEGO MINDSTORMS EV3 robot

Activity description

This project has been funded with support from the European Commission. The design or publication reflects only the views of the author, and the European Commission is not responsible for the substantive content contained therein

1. Organizational and organizational activities
2. Group work (groups of 4) - voluntary selection of the group composition
3. Choosing the team's captain who will present the group
4. Introduction to the topic - discussion of ways to overcome the maze
5. Reminder of conditional instructions
6. Robot control using conditional expressions.
7. Task specification: writing a program for the robot that will pass the maze
8. Detailed discussion of the selected problem and division into smaller sub-problems
9. Exchange of experiences and ideas
10. Practical exercises - writing the program and working with the LEGO MINDSTORMS EV3 robot.
11. Presentation of programs
12. Summary and end of the lesson.

Resources



Students' Evaluation

The student will be assessed for commitment and proper performance of experiments.

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Bibliography
I like this! - Computer science textbook for the seventh grade of primary school Authors: Grażyna Koba https://www.robocamp.pl/pl/lego-mindstorms-ev3-wersja-domowa-edukacyjna/
Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Robot as a windmill.**	
Summary	Students are to write a program for a robot that cleans up a confined space.	
Authors	Jarosław Szczęsny	Data: 15/11/2019

Didacticobjectives
General objectives: - the student knows the concepts: algorithm, instruction, - turning activities into instructions, - reminding and consolidation of the LEGO MINDSTORMS EV3 Home Edition program, - developing the solution project and its implementation using the program. **Specific objectives:** - how to start the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like, - basic blocks for building algorithms in the program, - they know how to create simple algorithms in the program, -can write instructions to individual blocks, - how to run an algorithm built in the program, - the student can control the robot using commands, - the student can build simple scripts, - the student understands and knows how to apply loop instructions to repetitive activities
Physics☐ Mathematics☐ Computer science☐ Robotics☐ Programming ☒
Educational level: 10-12 years old☐ 12-14 years old ☒
Problem Statement
Creation of an algorithm controlling the robot in a closed space, operating non-stop, with a working propeller.
BOM (Bill Of Materials needed)

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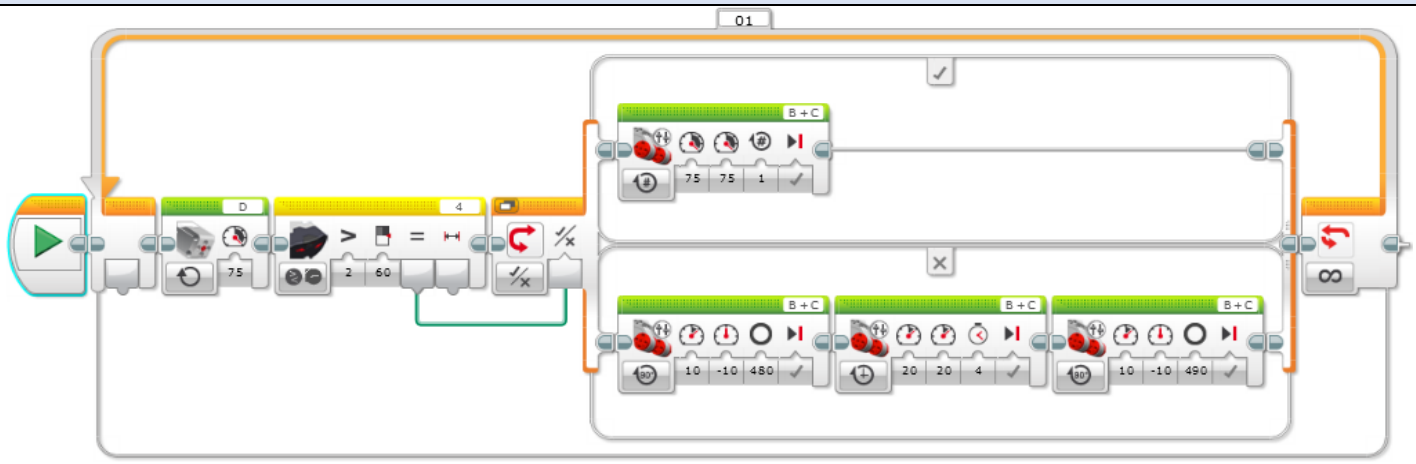
- computer station

- LEGO MINDSTORMS EV3 robot

Activity description

1. Organizational and organizational activities
2. Group work (groups of 4) - voluntary selection of the group composition
3. Choosing the team's captain who will present the group
4. Introduction to the topic - discussion of the ways in which the robot moves in a closed space, controlled by a specific condition
5. Reminder of conditional instructions
6. Robot control using conditional expressions.
7. Task specification: writing a program for a robot that will move in a closed space
8. Detailed discussion of the selected problem and division into smaller sub-problems
9. Exchange of experiences and ideas
10. Practical exercises - writing the program and working with the LEGO MINDSTORMS EV3 robot.
11. Presentation of programs
12. Summary and end of the lesson.

Resources



Students' Evaluation

The student will be assessed for commitment and proper performance of experiments.

Bibliography

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Scalability
Script modification and improvement.
Moreinformation
Solving tasks using the program.

SCENARIO		
Title	**Programming the robot Lego Mindstorms EV3**	
Summary	Students are to write a robot program that will perform a specific task.	
authors	Jarosław Szczęsny	Data: 10/11/2019

Didactic objectives
General objectives: - the student knows the concepts: algorithm, instruction, - turning activities into instructions, - reminding and consolidation of the LEGO MINDSTORMS EV3 Home Edition program, - developing the solution project and its implementation using the program. Specific objectives: - how to start the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like, - basic blocks for building algorithms in the program, - they know how to create simple algorithms in the program, -can write instructions to individual blocks,

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- how to run an algorithm built in the program,
-the student can move the robot through the maze,
-the student can build simple scripts,
- student understands and knows how to apply loop instructions to repetitive activities.

Physics☐ Mathematics☐ Computer science☐ Robotics ☒ Programming ☒

Educational level: 10-12 years old☐ 12-14 years old ☒

Problem Statement

Arrange the program with which the robot will move forward and backward. When it encounters an obstacle, it has to stop and make a sound.

BOM (Bill Of Materials needed)

- computer station
- LEGO MINDSTORMS EV3 robot

Activity description

1. Organizational and organizational activities
2. Group work (groups of 4) - voluntary selection of the group composition
3. Choosing the team's captain who will present the group
4. Introduction to the topic - discussion of ways to overcome the maze
5. Reminder of conditional instructions
6. Robot control using conditional expressions.
7. Task specification: writing a program for the robot that will perform specific activities.
8. Detailed discussion of the selected problem and division into smaller sub-problems
9. Exchange of experiences and ideas
10. Practical exercises - writing the program and working with the LEGO MINDSTORMS EV3 robot.
11. Presentation of programs
12. Summary and end of the lesson.

Resources

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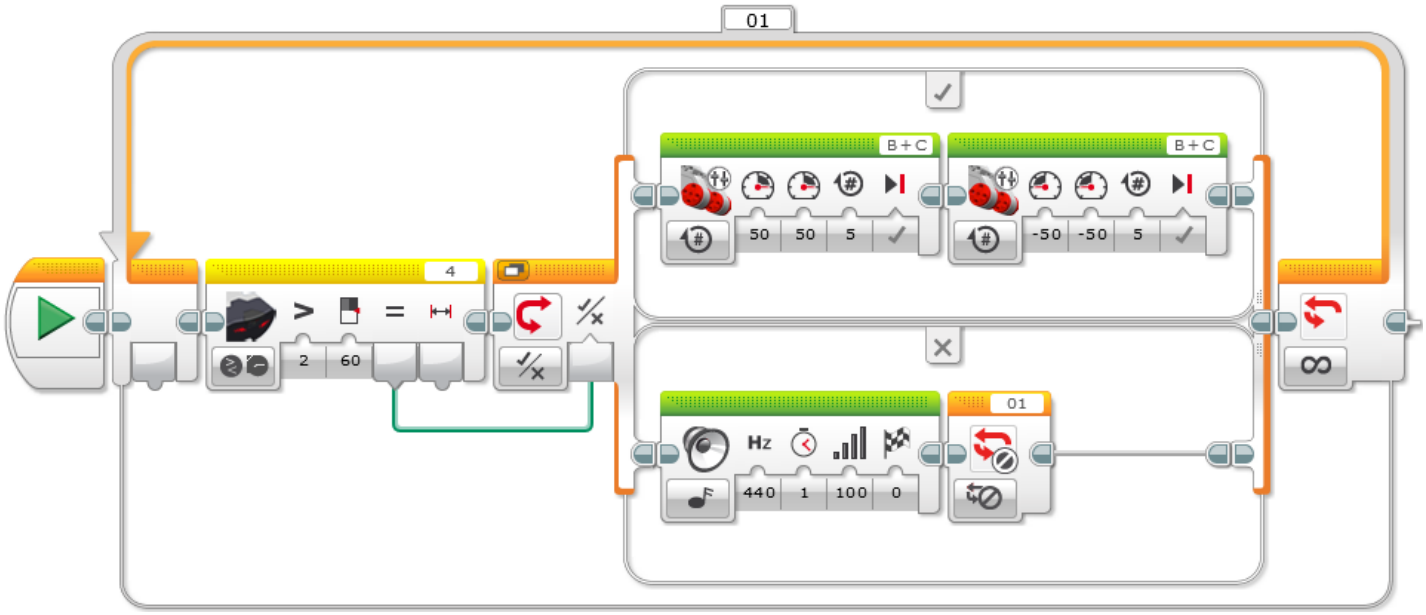

Students' Evaluation
The student will be assessed for commitment and proper performance of experiments.
Bibliography
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Scalability
Script modification and improvement.
More information
Solving tasks using the program.

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SCENARIO		
Title	**Creating algorithms in LEGO MINDSTORMS. Geometric figures.**	
Summary	Students are to write a program for the robot, which after drawing a number specifying the number of sides will draw this figure.	
Authors	Jarosław Szczęsny	Data: 02/11/2019

Didacticobjectives
General objectives: the student knows the concepts: algorithm, instruction, turning activities into instructions, reminder and consolidation of the LEGO MINDSTORMS EV3 Home Edition program, developing a solution project and its implementation using the program. Specific objectives: knows how to run the program and what the LEGO MINDSTORMS EV3 Home Edition window looks like, knows the basic blocks for building algorithms in the program, knows how to create simple algorithms in the program, can write instructions to individual blocks, knows how to run an algorithm built in the program, the student can move the robot along a given path, student is able to build simple scripts, the student understands and knows how to apply loop instructions to repetitive activities.
Physics☐ Mathematics☐ Computer science☐ Robotics ☒ Programming ☐
Educational level: 10-12 years old ☐ 12-14 years old ☒
Problem Statement
What are the types of flat geometric figures? What will the algorithm in the form of a list of steps look like showing the robot's movement on the sides of the figures? How to convert an algorithm into a program?
BOM (Bill Of Materials needed)
- computer station

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- LEGO MINDSTORMS EV3 robot

Activity description

1. Organizational and organizational activities
2. Group work (groups of 4) - voluntary selection of the group composition
3. Choosing the team's captain who will present the group
4. Introduction to the topic - a reminder of the basic concepts describing flat figures.
5. Introduction to conditional instructions
6. Robot control using conditional expressions.
7. Task specification: writing a program for a robot which after drawing a number determining the number of sides will draw this figure
8. Detailed discussion of the selected problem and division into smaller sub-problems
9. Exchange of experiences and ideas
10. Practical exercises - writing the program and working with the LEGO MINDSTORMS EV3 robot.
11. Presentation of programs
12. Summary and end of the lesson.

Resources

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Students' Evaluation
The student will be assessed for commitment and proper performance of experiments.

Bibliography
I like this! - Computer science textbook for the seventh grade of primary school Authors: Grażyna Koba https://www.robocamp.pl/pl/lego-mindstorms-ev3-wersja-domowa-edukacyjna/

Scale / Scope
Script modification and improvement.

More information
Solving tasks using the program.

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SCENARIO		
Title	**Killing the witch with a ray reflected from the mirror.**	
Summary	During the course, students will be able to recall and consolidate previously learned commands and constructions of the SCRATCH language, recall the tools needed to work in the SCRATCH environment. They will remind you of the concept of a variable. They will create a game according to a developed script.	
Author/s	Jarosław Szczęsny	Date: 14/01/2020

Didactic objectives
General objectives: reminding and consolidating previously learned commands and the construction of the SCRATCH language, tool guide in the SCRATCH environment a reminder of the concept of a variable, creating a game according to a developed scenario. training the competence to create a program in the SCRATCH environment. Specific lesson objectives: 1. Students will be able to: - use appropriate structural instructions, - send messages and program responses to receiving a message, use scenes, - introduce a new sprite and compose a script for it in the SCRATCH environment create a game in the SCRATCH environment 2. Students will understand: the concept of a variable and will be able to use it in the program, the event and knew how to use it in the program
Physics☐ Mathematics☐ Information Technology ☒ Robotics☐ Programming☐

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Education Level:	10-12 years☐	12-14 year ☒

Problem Statement

How are the tools used in the SCRATCH environment to create games?

What is the variable?

How is the program created in the SCRATCH environment?

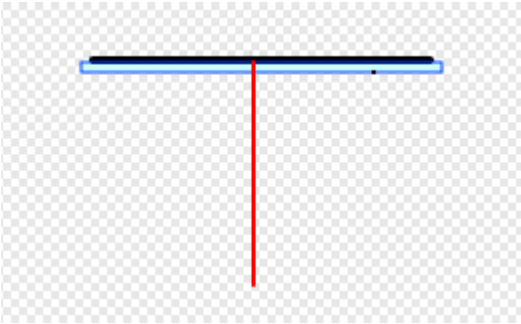
BOM (Bill Of Materials needed)

- computer station.
- SCRATCH environment installed or internet access

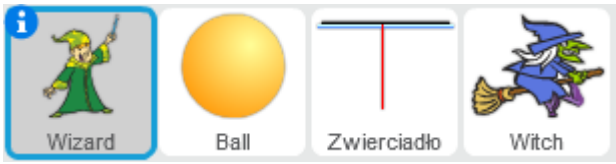
Activity description

Lesson flow:

1. Organizational and organizational activities
2. Introduction
3. Starting computers
4. Provide information to students about tasks to create the game:
    - game scenario - discussing the various stages of the game with students and discussing the strategy for completing the task,
    - creating a new sprite - a mirror with normal one marked,



- creating algorithms for individual sprites.



5. Exercise (completing the task)
    - Reminding participants of tools and building SCRATCH windows.
    - The instructor suggests that the sending beam is at the bottom of the screen and shoots at an

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angle of 50º towards the mirror.

- Introducing a new one from the sprite library.

5. Dividing the task into smaller problems (Divide and Winner method)

a) Checking coordinates: wizard, mirrors, balls, after starting the program.

b) Checking the ball's direction of movement.

c) Ball angle control. Determining its speed of movement and direction of movement in the parameters.

d) Defining the END GAME criterion when the ball touches the witch or the edge of the screen.

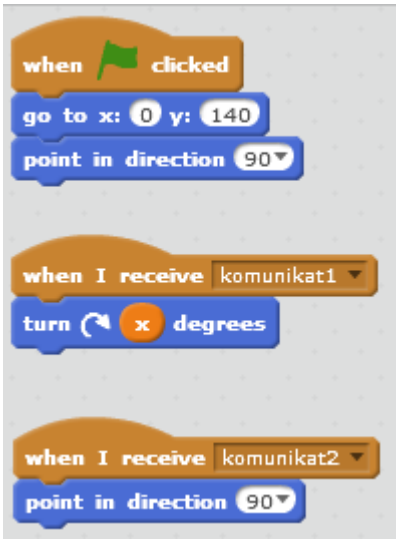
e) Determining the angle of the ball reflected from the mirror.

f) Creating variables: how many (mirror rotation angle) and x (number of shots)

g) Writing scripts for sprites.

Resources

- computer stadion
- script for mirror



Script for the WITCHER

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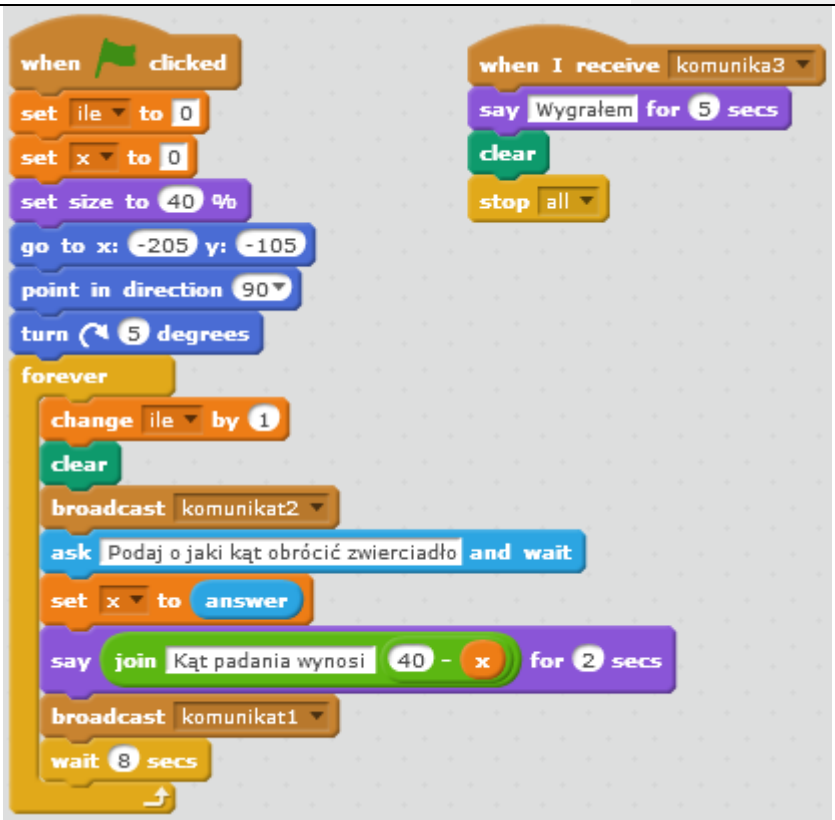

Ball script

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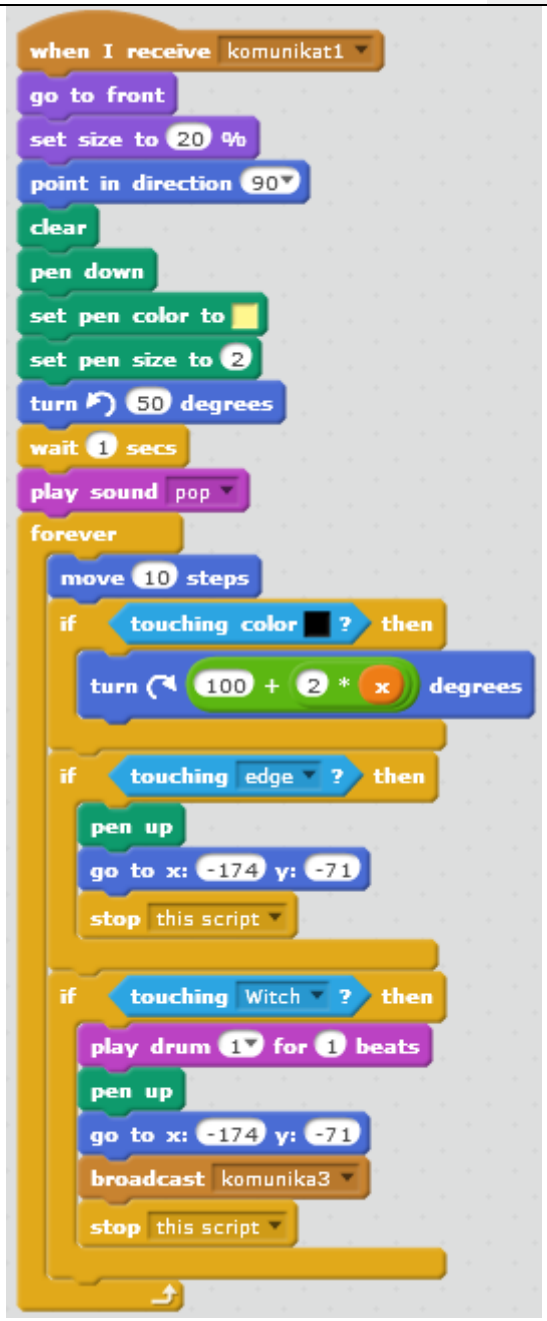

The final result

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Students' Evaluation
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Bibliography
Lubię to! - Podręcznik do informatyki dla klasy siódmej szkoły podstawowej Authors: Grażyna Koba https://scratch.mit.edu
Scalability
Script modification and improvement.
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