LESSON 5

Aim of the cycle

To help students develop engineering competencies, creatively solve engineering problems in the area of effective use of energy, develop the ability to creatively apply scientific and technological knowledge.

Objectives of the cycle

The objectives for students are:

- to recognize and observe engineering processes, systems, analyze engineering decisions regarding energy engineering, realize the importance of engineering creations and technological innovations, their relations with natural, social and cultural environment;
- to develop a responsible attitude to various problems of real-life environmental science and sustainable development, as well as the importance of their solutions;
- to study the environment, raise questions, formulate hypotheses, perform, summarize, evaluate research, identify errors and correct inaccuracies, formulate conclusions;
- while learning about the development of modern technologies, get acquainted and analyze engineering methods; develop problem solving and assessment, critical thinking skills.

Topic of the lesson. Variety of sensors and their possible uses

Materials

Paper, pens, video projector, worksheets, internet access, the webpage microbit.org. Micro:bit controllers.

Methods

Demonstration; use of presentations and / or digital learning objects, brainstorming; discussion; understanding students' experience; mutual teaching/ learning; (self) assessment; practical tasks; questions for reflection.

Objectives

After getting acquainted with the concept of sensors and their variety, using possibilities (provide 3-5 examples); using the webpage microbit.org, you will learn and program Micro:bit
2 microschemes for using light and warmth sensors.

Content

Energy Engineering. Examples and analysis of basic energy engineering problem solving. The regularities of energy transformations, analysis of their applications in engineering solutions. The importance of heat transfer patterns for solving engineering problems, application of energy measurement methods, knowledge of the principles of operation of devices, analysis, constructional possibilities. Analysis of engineering problems, simulations, possibilities of construction. Engineering: analysis of key examples of energy engineering problems. Analysis of engineering energy production methods, analysis of the principles of equipment operations.

Computer engineering. Computer object management and application. Simulation by computer programs. Sensor usage and sample analysis. Micro: bit microchip usage and programming. Application of principles of programming logic in practical engineering solutions.

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Activities

1. ACTIVITY. PRESENTING THE TOPIC (6 MIN.)

1.1 Elucidating the experience (1 min.)

Questions:

1. Which food products are low in calories but can supply the body with vital nutrients? Do you know what the vital nutrients are?

/ Part of the fruit and most vegetables are low in calories but have many different vitamins, minerals and fiber essential for the body that are needed for the digestive process /

2. What should be the diet for us to be healthy and energetic?

/ Nutrition should be varied and balanced: we need to get enough different nutrients and a sufficient amount of calories /

Summarizing: a human feels good when his/her nutrition is balanced and varied.

Tip for the teacher
- *From the provided answers find out what students know and what should be reminded to them.*

1.2 Reminding of the topic of the cycle

Cycle

ENERGY TRANSFORMATIONS. HOW TO USE / APPLY THEM EFFICIENTLY?

Tip for the teacher
- *If the students have problems remembering the answers, they can search for them online or a teacher might remind the information.*

1.3 Introduction (4 min.)

Questions for discussion:

1. Do you think that people have enough food in all over the world?

/ Nowadays about 800 millions constantly lack food /

2. Do you believe that our planet would be able to provide food for even more people?

/ Students provide their hypotheses /

Summarizing: humanity's food provisions will depend heavily on the ability to grow food even when facing the changing climate or lack of arable land. As in many other areas, new technologies and science can help here.

3. What technologies can help to monitor the condition of plants, growth conditions?

/ Smart technologies which use various types of sensors /

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2. ACTIVITY. GETTING ACQUAINTED WITH SENSORS (6 MIN.)

2.1. Discussion - the use of sensors

Question:

- What is a sensor?

/ Generally speaking, a sensor is a tool which identifies events or changes taking place in its environment and sends this information to other electronic components /

If students are not able to answer the question correctly, the following **questions** are given:

1. How do you know that it is cold in the room even though you do not have a thermometer?
2. How can you tell if the room is light or dark?

/ Using senses which tranfer the information to our brain /

Summarizing: similarly to a human's senses, a sensor reacts to environmental changes and transfer information.

Tip for the teacher

- *To understand the concept of a sensor a teacher might give an example about human organs— ears, eyes, nose or skin. Explain thet they are a human's "sensors".*

2.2. Task - discussion 4 min.)

Students are asked to sit in groups. They might use the internet.

The groups are given blank paper sheets and pens.

Tip for the teacher

- *The suggested size of a group is 3-4 students.*

Task

To name as many using possibilities of sensors as you can think of

Students have 3 minutes to complete the task.

When the time is finished, students are asked to tell the written possibilities of sensors.

Tip for the teacher

- *If during the lesson students do not have internet access, it is suggested to prepare some information about sensors in advance for students to analyze it individually.*

Summarizing: there is a wide variety of sensors and a lot of possibilities where they might be used.

More ⓘ *useful info*

Tip for the teacher

- *Creatively present the task – suggest a possibility to become hydroponics engineers who create automatic illumination control and the system for detecting temperature.*

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3. ACTIVITY. INDIVIDUAL WORK (30 MIN.)

3.1. Presenting the task (1 min.)

Task

Practically test warmth and light sensors using the Micro:bit programming microscheme.

The answers can be found ⓘ *Useful info*. Possible result of the main task

3.2. Practical work (29 min.)

A teacher, regarding the needs and abilities of students, might organize the process, for example:

- students are provided with worksheets containing practical task for their individual work *Lesson 6. Appendix No. 1.Worksheets* .
- a teacher observes the students and help them if it is needed;
- a teacher demonstrates to all students how to complete the task step by step.

More *Useful info* ⓘ

The answers are provided ⓘ Useful info. Possible result of the main task

Recommendation

Students who finish the task earlier, are suggested to test their created programs or complete the additional task *Lesson 6. Appendix No.2.Additional task. Using Microbit buttons* .

Lesson 6. Appendix No.2.Additional task. Using Microbit buttons ⓘ *Useful info*. Possible result of the additional task

Tip for teacher

• Get acquainted with the Micro:bit programming environment before the lesson in case students have technical questions about using it.

Tip for the teacher

• If there is a lack of technical equipment, students might perform the task in groups of 2-3 students. The task might also be performed without real Micro:bit microschemes – it is enought to have computers with internet access – the results will be visible with the virtual Micro:bit microscheme in the webpage.

4. ACTIVITY. SUMMARIZING (3 MIN.)

Questions:

1. What did I learn during the lesson?
2. Did I face any difficulties creating programs which identify warmth and light?
3. What did I succed at?

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TERMS AND USEFUL INFORMATION

Areas of applying sensors.

In the modern seociety sensors are very important. They might be applied in various areas, for example:

1.Smart car parking systems (sensors are used to detect free parking spaces);

2. Automatic illumination, when a person moves, a light is switched on (sensors detect human movements);

3. Earthquake detection (sensors detect early earthquake vibrations);

4.To detect radiation (sensors detect radiation from radioactive substances);

5. Hydroponics for the determination of mineral content in he water, for temperature measurement, light regulation;

And many other areas of application (more :http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/)

Micro:bit programming environment.

Micro:bit programming environment might be accessed via the webpage: https://makecode.microbit.org/

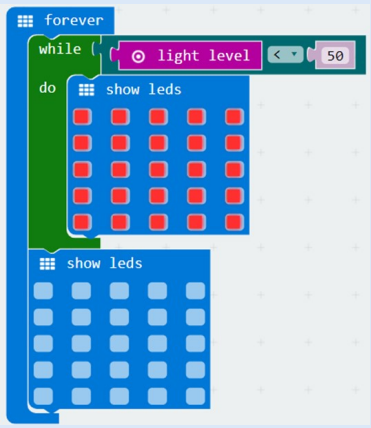
It is enough to enter the webpage one time in order to use the programming environment —later it is not needed to have the internet access, i.e. the webpage might be used even though there is no internet connection.

If the real Micro:bit are used, the questions might be raised how to transfer the created program to the Micro:bit using different internet browsers or operational systems. There are instructions in students' worksheets how to transfer the project via „Windows" operational system using „Google Chrome". Instructions of all possible situations are provided in the Micro:bit webpage: https://makecode.microbit.org/#

POSSIBLE RESULT OF THE MAIN TASK

There are all algorithms which should be created by students.

The complete algorithm using whichMicro:bit reacts to the lower level of light and turns on the light bulbs:



Picture 1. Algorithm created with Micro:bit which reacts to the light

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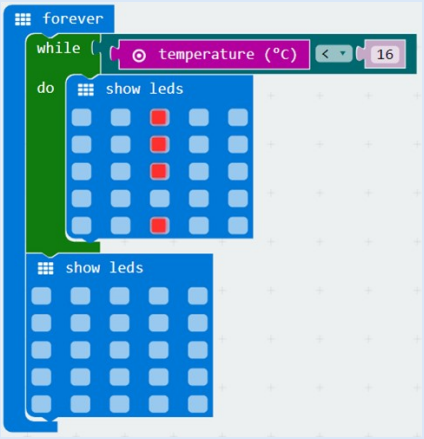
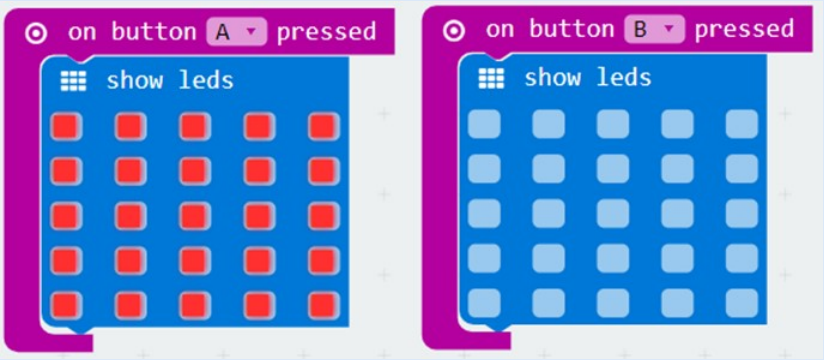
The algorithm which reacts to the temperature changes: Micro:bit will show the exclamation mark when the temperature will be lower than 16 °C.



Picture 2. Algorithm which reacts to the temperature changes

POSSIBLE RESULT OF THE ADDITIONAL TASK (ADDITIONAL TASK. USING MICROBIT BUTTONS)

The additional algorithm: when pressing the button “A” in the Micro:bit microscheme, all Micro:bit light bulbs turn on, when pressing the button “B” – the bulbs turn off.



Picture 3. The last algorithm programmed by students is designed to hand control the light

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SOURCES

50 Sensor Applications for a Smarter World. [accessed on 2018 03 27] Internet link: <http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/ >.

Next-gen urban farms: 10 innovative projects from around the world. Guardian sustainable business < https://www.theguardian.com/sustainable-business/2014/jul/02/next-gen-urban-farms-10-innovative-projects-from-around-the-world >.

BASED ON

Specializuoto ugdymo krypties programa (pradinio, pagrindinio ir vidurinio ugdymo kartu su inžineriniu ugdymu programų) inžinerinio ugdymo dalis, patvirtinta Lietuvos Respublikos švietimo ir mokslo ministro 2014 m. rugpjūčio 8 d. Internet link: <https://www.smm.lt/uploads/documents/svietimas/ugdymoprogramos/isakymas%20del%20inzinerines%20programos1.pdf >.

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