ЭE LESSON 4

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. Calculating energy and the energy balance

Materials

Video projector, worksheets, internet access, the Scratch program.

Methods

Discussion; demonstration; brainstorming; understanding pupils' experience; using digital learning objects; individual work; questions for reflection; characteristic curve; (self) assessment; discussion; reflection.

Objectives

Using the „Scratch" programming language, you will learn how to create the program to calculate the amount of used energy; using this program you will count your energy balance; explain the importance of balanced energy to human health.

Content

Energy Engineering. Analysis of examples of solving basic energy engineering problems. The regularities of energy transformations, analysis of their applications in engineering solutions. Application of energy calculation methods. Analysis of engineering problems, simulations, possibilities of construction. Investigation of engineering energy usage.

Computer engineering. Computer object creation, management and application. Simulation computer programs. Program testing. Visual programming language options. Scratch programming language, Programming and testing. Application of principles of programming logic in practical engineering solutions.

History and philosophy of engineering. Influence of measuring methods and instrumentation on engineering achievements.

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Activities

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

1.1. Revision (2 min)

Question:

• What did you learn during the previous lesson?

/ *How to calculate the energy obtained from food; feeling of fullness depends not only on calories but also on the volume of food* /

1.2. Revision of the topic of the cycle of lessons

Cycle: ENERGY TRANSFORMATIONS. HOW TO USE / APPLY THEM EFFICIENTLY?

1.3. Introduction (3 min.)

Questions for discussion:

1. Do you think that you consume enough food?

2. Is this amount of energy enough for activities which you perform during a day?

/ *The recommended amount of calories for teenagers is approximately 2000 kcal* /

3. On what depends your consumed amount of energy?

/ *Type of activity, human body mass, duration of activity/*

1.4. Announcing the topic of the lesson and discussing the aim and the objectives (1 min.)

Topic: Calculating energy and the energy balance

Objective

Using the „Scratch" programming language, you will learn how to create the program to calculate the amount of used energy; using this program you will count your energy balance; explain the importance of balanced energy to human health.

2. ACITIVTY. PERFORMING THE TASK (36 MIN.)

2.1. Presenting the task (1 min.)

Task

To create the calculator in order to count the amount of calories consumed during a day using the „Scratch" programming language.

Tip for the teacher
• *Get acquainted with the "Scratch" programming language before the lesson in case students have technical questions about using it.*

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

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

Tips for the teacher
• The aim and objectives are discussed with students;
• The students' motivation is emphasized – why we concentrate on these objectives; e.g. it is useful in everyday activities, it is interesting, etc.
• The aim and objectives should be not only discussed but it also be attempted to raise them together with students.

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2.2. Practical task (28 min.)

Students are given worksheets *Lesson No. 4. Appendix No.1. Creating the calorie calculator.*

Lesson No. 4. Appendix No.1. Creating the calorie calculator.

Students are explained the structure of the performance chart and the formula to calculate calories:

Lesson 4. Appendix No.1.Worksheet, 1st p.

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 4. Appendix No.1.Worksheets.*

- a teacher observes the students and help them if it is needed;

Students are given more complicated worksheets containing practical task for their individual work *Lesson 4. Appendix No. 2. Challenge.*

Lesson 4. Appendix No. 2. Challenge

- a teacher demonstrates to all students how to complete the task step by step.

Students, using the provided information, complete the practical task.

Students are reminded that they have 25 min. to complete the task.

The answers can be found ⓘ Useful info. Possible results/

Tip for the teacher
•*If there are not enough computers for each student, it is suggested for students to work in pairs.*

Tips for the teacher
• *Students who finish creating the program earlier, might dedicate more time for testing it;*

• *It is recommended to give additional time for students who did not manage to complete the task in time.*

Tip for the teacher
• *A teacher helps students to perform the task if needed.*

Tip for the teacher
• *If a student did not manage to perform the task, a teacher or or other students might offer their help.*

How to raise an inventor

2.3. Presenting the task and discussion (2 min.)

When the time is over, students present their works, discuss and comment on the answers.

Summarizing: the calorie calculator is created. If data is typed in, the result indicating amount of used calories is received.

2.4. Task – calculating energy balance using the created program (5 min.)

Task

Calculate the amount of energy used during the day and compare with the amount of energy calculated during the last day (the amount of energy received per day from food).

Questions:

1. What results have you got when comparing the calories you have received and consumed? Do you think that your energy is balanced?

2. What does it mean if the amount of calorie intake per day is significantly higher than the amount of calories burned?

/ *It means that there is a risk to gain weight and become obese in the future* /

3. What does it mean if the amount of calories burned is significantly higher than the amount of calorie intake?

/ *It means that you might lack energy to perform all tasks and might feel tired* /

Summarizing: the lesser difference between received and used calories, the better balanced human energy exchange is.

3 ACTVITY. REFLECTION (3 MIN.)

Questions:

1. What did I learn during the lesson?

2. How can the acquired knowledge help me to maintain good health in the future?

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TERMS AND USEFUL INFORMATION

Activity coefficients table.

The table is divided into three parts – activity, intensity of activity and MET coefficient (MET – liet. Metabolinis ekvivalentas) metabolic equivalent which means 1 kcal/kg/hour.

Activity	Additional information	MET ratio
Sleeping	-	0.93
Lying down	-	1.1
Sitting	-	1.43
Walking	Slow ≈4km/h	3.0
Walking	Vigorous effort ≈6.5km/h	4.0
Reading	-	1.5
School activities	-	1.56
Ball games	-	3.57
Football	-	7.1
Bicycling	Slow (≈16km/h)	4.0
Bicycling	Moderate (≈22km/h)	9.0
Bicycling	Vigorous effort (25-30km/h)	14.0
Dancing	Slow dancing, aerobics	6.0
Dancing	Vigorous effort	7.0
Jogging	Slow ≈8.3km/h	9.0
Jogging	Moderate ≈11km/h	11.5
Jogging	Vigorous effort ≈16km/h	16.0
Swimming	Slow	6.0
Swimming	Vigorous effort	10.5

Table 1. Summary of activity coefficients according to hss.edu

The main formula of calculating calories.

The formula is used to calculate the burned calories:

Used energy (kcal) = 0.0175 x MET (taken from the chart) x mass (kg) x time (min)

The formula is constructed regarding the human body mass, duration of activity and activity itself. Each part is equally important. The constant (0.0175) is for unifying dimensional mismatches (for example, time is in minutes, while the MET factor is obtained using hours).

Summary of activity coefficients taken from:

Women's Sports Medicine Center, Hospital for Special Surgery „Burning Calories with Exercise: Calculating Estimated Energy Expenditure" 2009. URL: < **https://www.verywellfit.com/how-many-calories-you-burn-during-exercise-4111064** >

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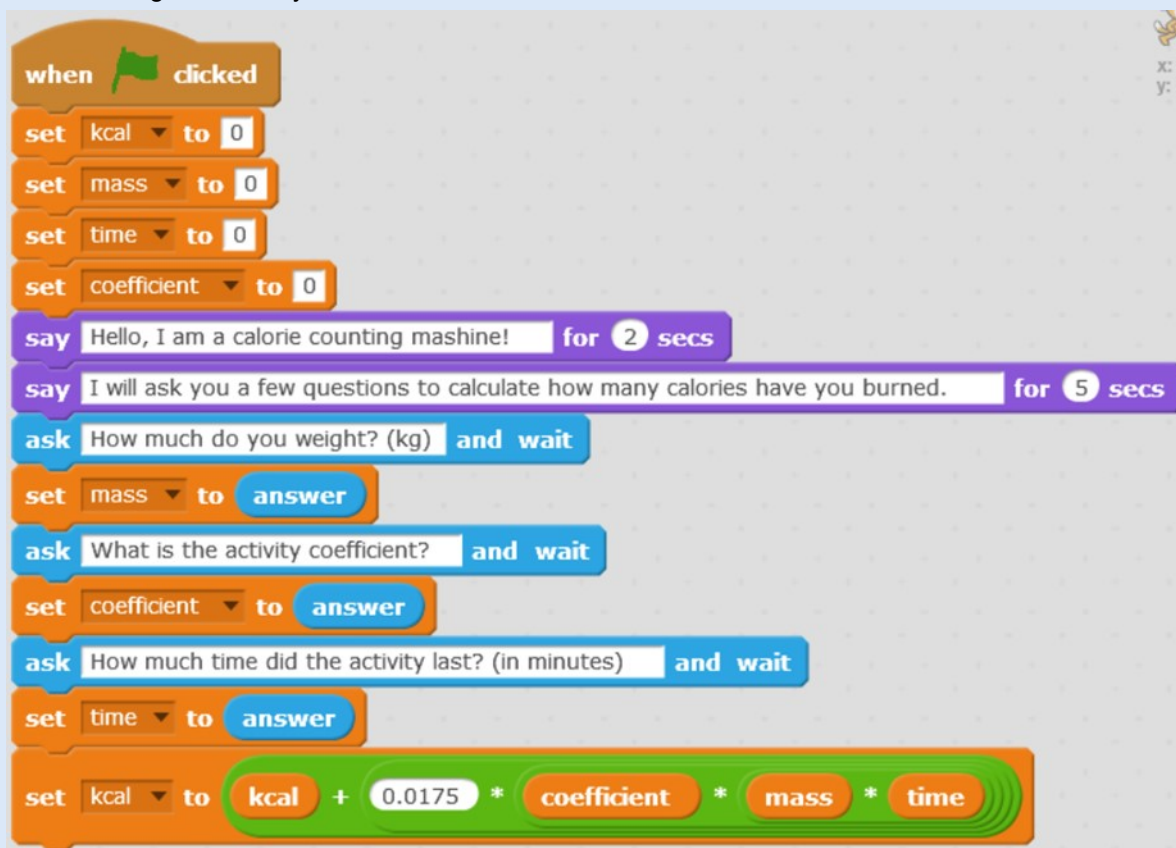
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POSSIBLE RESULTS

The task might be completed in several ways. Two different programs are given here, the first is created in the main task, the second is created in the more challenging task.

Using the „Scratch" programming language the calculator is being created which counts the amount of calories used during one activity:
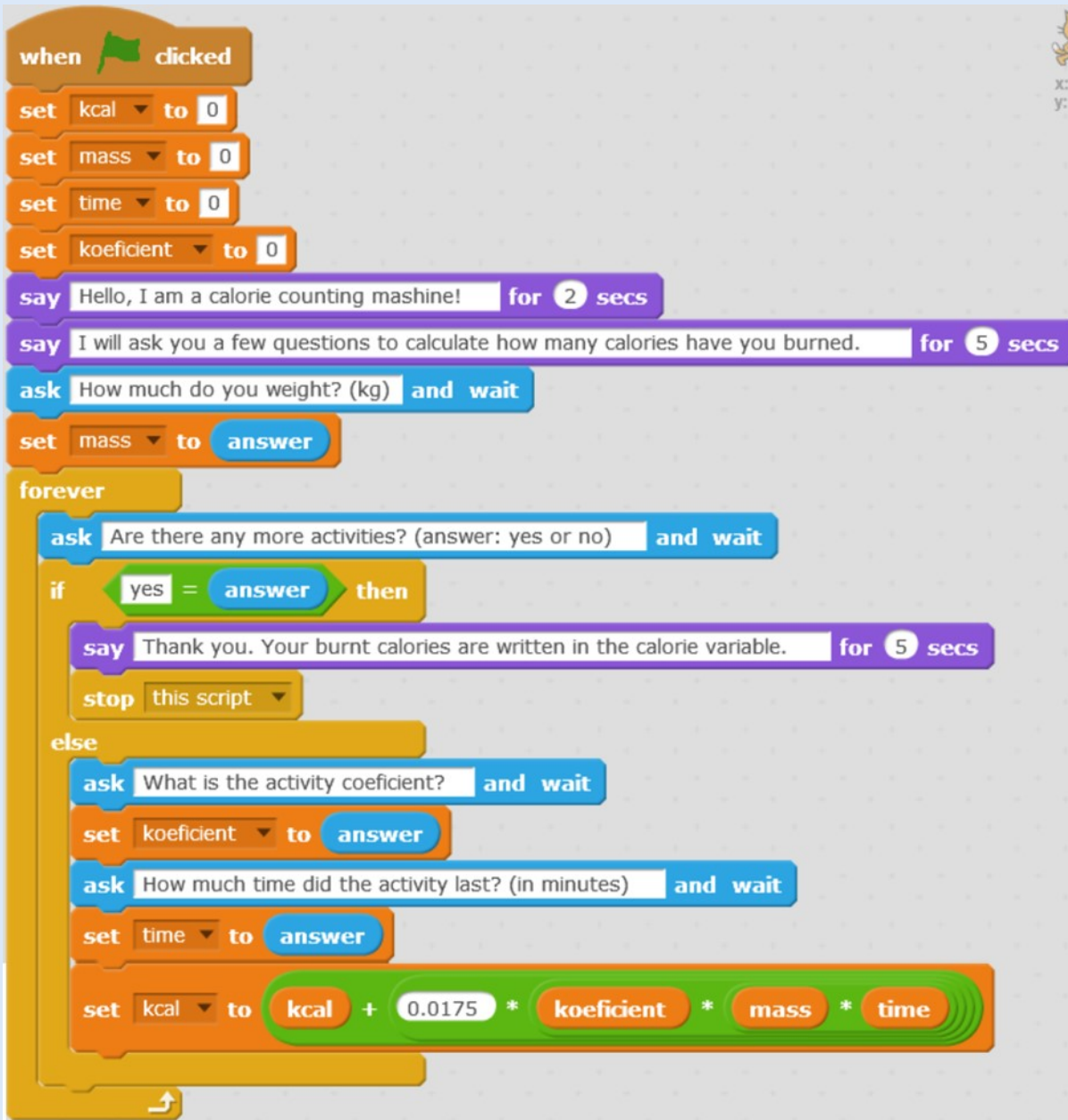

Picture 1. Simple calorie calculator

Using the „Scratch" programming language a more complicated calculator is created which use the cycle and adds the calories used during the all mentioned activities:

TERMS AND USEFUL INFORMATION

Using the „Scratch" programming language a more advanced calculator is created which use the cycle and adds the calories used during the all mentioned activities:

```
when [flag] clicked
set kcal ▾ to 0
set mass ▾ to 0
set time ▾ to 0
set koeficient ▾ to 0
say Hello, I am a calorie counting mashine! for 2 secs
say I will ask you a few questions to calculate how many calories have you burned. for 5 secs
ask How much do you weight? (kg) and wait
set mass ▾ to answer
forever
    ask Are there any more activities? (answer: yes or no) and wait
    if yes = answer then
        say Thank you. Your burnt calories are written in the calorie variable. for 5 secs
        stop this script ▾
    else
        ask What is the activity coeficient? and wait
        set koeficient ▾ to answer
        ask How much time did the activity last? (in minutes) and wait
        set time ▾ to answer
        set kcal ▾ to kcal + 0.0175 * koeficient * mass * time
```

Picture 2. Advanced calorie calculator

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TERMS AND USEFUL INFORMATION

Eduational video about Energy Balance/ Energy from Food- Intake and How to Read a Nutritional label. [accessed on 2018 02 23]. Internet link: < https://www.youtube.com/watch?v=yqt8aaeHB5k >.

What is a calorie? - Emma Bryce. [accessed on 2018 02 23]. Internet link:

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How the food you eat affects your brain?– Mia Nacamulli. [accessed on 2018 02 24]. Internet link: < https://www.youtube.com/watch?v=xyQY8a-ng6g >.

How the food you eat affects your gut - Shilpa Ravella. [accessed on 2018 02 24]. Internet link: < https://www.youtube.com/watch?v=1sISguPDlhY >.

This Is 200 Calories. [žiūrėta 2018 02 24]. Internet link: < https://www.youtube.com/watch?v=KMGUmcveQeg >.

Eat well for a healthy planet - Angela Colli. [accessed on 2018 02 27]. Internet link: <http://moodle.scientix.eu/course/index.php?categoryid=141>.

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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. rugpjū-čio 8 d. Internet link: <https://www.smm.lt/uploads/documents/svietimas/ugdymoprogramos/isakymas%20del%20inzinerines%20programos1.pdf >.

Kaip skaičiuojamos kalorijos. Žurnalas „Ar žinai kad?" Nr.9, 2015 /pagal „How it works" licenciją.

Energijos eikvojimas įvairiose sporto šakose. Kalorijų skaičiavimas ir poreikis, Sveikata ir subalansuota mityba <https://www.kalorijos.lt/kaloriju-eikvojimas-sporto-sakose/ >.