

## LESSON 3

### 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. Energy in the human body

#### Methods

Demonstration, use of presentations and / or digital learning objects, observe - think - discuss with a friend, brainstorming, understanding pupils' experience, group work, inquiry-based learning, practical research, self-assessment, reflection.

#### Materials

Presentations, films, worksheets, computers, labels for various foods, plasticine / modelling clay, mobile phones, tablets or others.

#### Objectives

After using calorie counters (online), having analyzed the working principle of calorimeter, performed an experiment in pairs, discussing and completing practical tasks, you will be able to explain:

- what is measured in calories and what this unit means;
- which food products groups contain most and least number of kilocalories (3-5 examples);
- how to calculate an amount of calories in food (2 ways).

### Content

**Chemistry and Bioengineering.** Practical application of methods and measuring devices applied in chemistry and bioengineering research, their structure and principles of operation. Food research and food analysis.

**Energy Engineering.** Analysis of examples of solving basic energy engineering problems. 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 and devices, analysis, constructional possibilities. Analysis of mathematical concepts, models, methods and relationships applied to solving energy engineering problems, calculations.

**History and Philosophy of Engineering.** Influence of measuring methods and instrumentation on engineering achievements.

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## Activities

### 1. ACTIVITY. PRESENTING THE TOPIC ( 7 MIN.)

#### 1.1. Revision (2 min)

**Question:**

- How do living organisms obtain energy?

*/ Living organisms obtain energy using nutrients /*

#### 1.2. Revision of the topic of the cycle of lessons

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

#### 1.3. Introduction ( 4 min.)

**Questions for discussion:**

1. How do people obtain energy?

*/by eating /*

2. How does food become energy?

*/The chemical energy of the food is liberated and converted into other forms of energy, such as motion, sound, heat, etc. by breathing (in the form of oxygen) /*

3. On what the energy content of foods depend/ how much energy will we absorb from food?

*/ It depends on the composition of the product, how much the product contains energy nutrients (proteins, fats, carbohydrates, minerals) /*

4. How do we acquire the information about the composition of the product?

*/ We can find it on a label /*

Students are given labels of products.

**Question:**

- What kind of information can we find on products' labels?

*/ The answer should be - the labels indicate the composition and energy value of the product, expressed in kcal (kilocalories) /*

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

**Topic:** Energy in the human body.

Announcing and discussing the aim and objectives of the lesson.

**Objective:**

After using calorie counters (online), having analyzed the working principle of calorimeter, performed an experiment in pairs, discussing and completing practical tasks, you will be able to explain:

**Tip for the teacher**

- Students can be asked specific questions in order to get the right answers.

**Tips for the teacher**

- During the questions/ answers time, students can be asked specific questions in order to get the right answers.
- If the 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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- what is measured in calories and what this unit means;
- which food products groups contain most and least number of kilocalories (3-5 examples);
- how to calculate an amount of calories in food (2 ways).

## 2. ACTIVITY. PRESENTING NEW MATERIAL ( 5 MIN.)

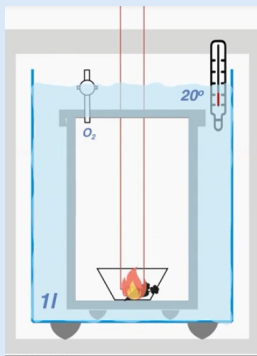
### 2.1. Analysis of the concept of calorie and how a calorimeter works (3 min)

#### Question:

- Do you know how to measure calories in food?

/ The tool is called a *calorimeter* /

Slide show *Lesson No. 3. Appendix No. 1. Calorimeter working principle*



Lesson No. 3. Appendix No. 1. Calorimeter working principle

When a pause **⏸** appears, a film is stopped and the following questions are given:

Questions for analysis:

1. What should be done in order to raise the temperature of water in a calorimeter?

*/To warm it /*

2. How can the water be warmed?

*/To burn the carrots /*

When the right answer is given, students continue watching the film. – *the carrots are burned.*

When a pause **⏸** appears, the film is stopped and the following questions are given:

3. What happens when the food is burnt?

*/The heat dissipates which warms the water /*

When the right answer is given, students continue watching the film - *the temperature of the thermometer rises.*

**Pause.** **⏸**

#### Tips for the teacher

- It is suggested to show the film with pausing it when the black screen appears. Then students might be given questions — *specific and direct questions should help students to find out by themselves how a calorimeter works;*
- *a teacher does not provide answers — students are allowed to guess/ answer the questions; if a right answer is not given, students continue watching the film silently. Then the question about what is happening in the film, is posed again.*

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**Question:**

4. What is a kilocalorie?

The last part of the presentation is shown - *1 kilocalorie is the amount of energy that needs to be increased by one degree to 1 kilogram of water.*

**Question:**

5. How much does 1 liter of water weigh?

*/1l=1kg/*

**2.2. Summarizing (2 min)**

The last part of the slide is shown – „**61°- 20°**”.

It is explained that **kilocalories** indicate a certain amount of heat (which can be provided by the food).

*/The difference between final and initial temperatures indicates the amount of heat released during the burning food /*

**Question:**

- Which transformation of energy happen?

*/ Chemical energy was turned into the thermal energy /*

**3. ACTIVITY. PERFORMING THE TASK (18 MIN.)**

**3.1. Announcing the task (2 min.)**

- Write down the products / dishes you have eaten today;
- Calculate how much energy was received from the consumed food using free calorie counters.

A teacher announces that students might use mobile phones, tablets, computers or other means with internet access.

**3.2. Performing the task (12 min.)**

Students are suggested to calculate the calories using a free calorie counter, e.g.:

<https://caloriecontrol.org/healthy-weight-tool-kit/food-calorie-calculator/>

<https://www.calculator.net/calorie-calculator.html>

**3.3. Discussing the task in groups (2 min.)**

A teacher suggests students to discuss and compare the received results in pairs.

**3.4. Presenting and discussing the task (2 min.)**

When the task is finished, students present their works and discuss/ comment on the answers.

**Tips for the teacher**

- Students work individually using gadgets with internet access;
- It is recommended to find a calorie counter in your native language;
- A teacher is recommended to get acquainted with calorie counters which are going to be used during the lesson in advance.

**Tips for the teacher**

- Estimated time for performing the task is emphasized. Students keep track of time by themselves.
- Students have a possibility to use the Internet.

**Tips for the teacher**

- A teacher asks for students' pairs (2-3) to present answers. Other students might add more information to the answers,
- A teacher asks if all students understand the task. If there is a need, the task should be explained once again.

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## 4. ACTIVITY. EXPERIMENT (13 MIN.)

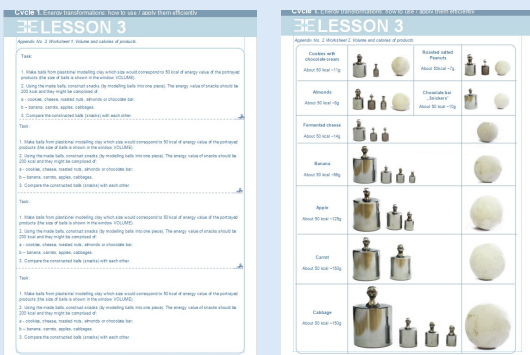
Students are suggested to conduct an experiment in pairs.

Students are given the task *Lesson No. 3. Appendix No. 2. Volume and calories of products and tools -plasticine/modelling clay.*

A teacher explains how to perform the task. In the chart there are pictures of products, their names, the metric amount (the number of grams which is equal to 50 kilocalories) and a product's volume indicated by a circle/ ball.

### Tip for the teacher

- *Students are suggested to work in pairs. However, they can also work individually if they wish.*



*Lesson No 3. Appendix No. 2. Volume and calories of products*

### Task:

1. Make balls from plasticine/ modelling clay which size would correspond to 50 kcal of energy value of the portrayed products (the size of balls is shown in the window VOLUME).

2. Using the made balls, construct snacks (by modelling balls into one piece). The energy value of snacks should be 200 kcal and they might be comprised of:

**a** - cookies, cheese, roasted nuts, almonds or chocolate bar;

**b** – banana, carrots, apples, cabbages.

3. Compare the constructed balls (snacks) with each other.

- Which snack is bigger?
- Which is more nourishing and why?

Students complete the task considering the given information (10 min.).

When the task is finished, results are summarized and discussed.

### Possible questions:

1. What happens when we eat products from the line **a**? Will the stomach be full? Why?

*/ It might appear that a snack of 200 kilocalories should be enough to satisfy the stomach, however, it is believed that a body decides when*

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2. What will happen if we eat enough products from the group **a** to make the stomach full? How many calories are we going to consume after eating the same amount of products from the group **a** as compared to the products from the group **b**?

*/ We will consume much more calories than after eating the same a-*

## 5. ACITIVITY. REFLECTION (2 min.)

*mount (volume) of products from the group **b** (fruit, vegetables) /*

Students' assessment and self-assessment, how they succeeded to achieve the objective of the lesson, what the personal progress of each student is.

### Questions:

1. What did I do during the lesson?
2. How (in what way) did I learn?
3. What did I do the best?
4. What did I manage to learn during the lesson?
5. What was the most difficult?

## POSSIBLE DIFFICULTIES

There might be too many activities or too much information for the classroom of younger students. A teacher should decide which and how many activities will be carried on, depending on the age and working pace of the students.

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## TERMS AND USEFUL INFORMATION:

**Calorie (cal)** – is a non-systemic unit of labor and energy, equal to 4.184 J (Joule). One calorie is the amount of energy needed to increase the temperature of one gram of water to one degree in Celsius. On food labels, energy is usually expressed in kilocalories (kcal), because there is so much energy in the diet that it is easier to group in 1000 calories.

The number of calories for any food is indicated by counting how much energy is released by burning a particular substance (food). Traditionally calories are calculated by adding food and burning it in a special device - a calorimeter. The amount of calories in the diet indicates how much energy is present in that product.

### How the human body transforms food into energy.

The food particles are carried to all body cells through the bloodstream . Some of them are used for the construction of new cells, and from others, such as glucose, - energy is generated.

Cells need oxygen in the air to release energy in the food. We get oxygen from the air by breathing. When you breathe from food, glucose reacts with oxygen. When energy is released, glucose and oxygen are converted to water and carbon dioxide. A person's inspiration is about 20,000 times a day.

### Energy Foods.

**Fat** is a diet rich in calories. Each gram contains 9 kilocalories. **Carbohydrates and proteins** have less than half calories than fat. **The dietary fiber** contains about 2 kilocalories in each gram. And **water** does not have calories at all.

**Nutrient fibers** are substances of plant origin, whose function in our body is quite simple, to help the digestive system. Fibers help move food throughout the intestine, whose length, if we stand, can reach 10 meters. The use of fibers helps to remove toxins from the body.

**200 kilocalories** can be obtained by eating a small handful of salted nuts, half a cupcake, a small bowl of flakes, three eggs, four apples, six slices of melon or two broccoli heads.

Consuming a lot of water and healthy fiber can make one eat a lot more, although getting fewer calories, one will feel full.

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## SOURCES

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