LESSON 1

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. Types and transformations of energy

Methods

Demonstration, use of presentations and / or digital learning objects, observe - think - discuss with a friend, brainstorming, understanding pupils' experience, discussing the filmed material, unfinished sentences, group work, mutual teaching/learning, high-speed inquiry, definition and definition scheme, assessment/ self-assessment, questions for reflection, assessment of group work.

Materials

Presentations, examples of students' engineering creative works, computers with internet access, worksheets, pens, paper.

Objectives of the lesson

Using your experience, after performing experiments, discussing and analyzing film material, completing 2 tasks, you will be able to:

• recognize and name 7-10 types of energy;

• recognize and explain 3-5 energy transformations which are the most common in the environment.

Content

Energy Engineering. The variety of energy types and the analysis of possibilities of using them for human needs. The regularities of energy transformations, the analysis of their application in engineering solutions. Examples and analysis of basic energy engineering problem solving. Analysis of engineering energy production methods, analysis of the operating principles of equipment.

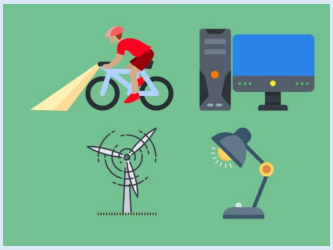
History and Philosophy of Engineering. The analysis of examples of contemporary engineering solutions. Getting familiar with engineering as a discipline for meeting human needs. The description and interpretation of interdisciplinary problem caused by engineering fields. The investigation of engineering thinking and practical interaction.

LESSON 1

Activities

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

1.1. Elucidating the experience (2 min.)
Students are shown the slide *Lesson 1. No.1 Use of energy.*



Lesson No. 1. Appendix No.1. Use of energy

Questions for discussion:

1. What objects do you see in the slide?
2. What do the objects have in common?

/ All of them need energy /

3. Who created all these items / objects?

/ Engineers of various fields /

Summarizing: an engineer is a person who uses scientific and technological knowledge, creativity to solve practical problems.

Tip for the teacher
• Get students interested by the visual material, questions and use the Brainstorming method.

Tip for the teacher
• During the discussion students can be asked specific questions till the right answer is found.

1.2. Announcing the topic of a series of lessons and discussing the aim and the objectives (2 min.)

In order to create the things that are needed for people, we need to know what kind of energy we are surrounded by and to understand how the energy flows.

1st Cycle

ENERGY TRANSFORMATIONS: HOW TO USE / APPLY THEM EFFICIENTLY. Duration of the cycle - 5 lessons

Tips for the teacher
• Discuss the aims and objectives of the topic with students.
• Emphasize the motivation of students - why we aim for these goals, for example, it is necessary in everyday activities, it is interesting, etc.
• The objective of the lesson is not only to be discussed, but also raised together with students.

1.3. Announcing the topic of the lesson and raising the objective (2 min.)

Topic Types of energy
The objectives of the lesson are raised and discussed.
Objective

Using your experience, after performing experiments, discussing and analyzing film material, completing 2 tasks, you will be able to:

•recognize and name 7-10 types of energy;
•recognize and explain 3-5 energy transformations which are the most common in the environment.

LESSON 1

2. ACTIVITY. DISCUSSION AND EXPERIMENTS (12 MIN.)

2.1. Discussion (3 min.)

Questions for discussion:

1. What is energy?

/ Energy is the ability of an object to make a change - that is, to do work, isolate the heat, or other things /

2. Why do we need energy?

/ Energy is needed for various needs: food production, heating of premises, operation of various devices, using vehicles /

3. What energy do we use the most?

/ Light, heat, electricity /

The teacher summarizes: there are three types of energy: light, heat, electricity. There are a lot of energy types around us.

2.2. Experiments (9 min.)

We will find out what types of energy exist around us.
The students are given not inflated balloons (or 2-3 volunteers are invited to perform the experiment). During the experiments, the teacher talks, asks the students what they are experiencing.

Experiments

- Students are asked to stretch the balloons and tell what they are experiencing. Students have to feel the energy of elasticity.

/ Because the balloon pulls back hands /

Summarizing with students: what kind of energy it is and the response is. *See ⓘuseful info*

/ The energy of elasticity /

- Students are asked to inflate the balloons and keep them intact. Then the students suddenly let them go and tell what they are experiencing.

/ There will be a sound, when the balloon is released, it will fly /

Tips for the teacher
- *It is suggested that students write answers on the board / sheet or use the online tools linoit.com, padlet.com and others.*
- *Brainstorming. The answers are not discussed yet.*

Tip for the teacher
- *In the absence of an answer, one can ask questions related to the situation in the classroom, for example, if there were no ..... energy, we could not see each other; if there were not .... energy - we would be cold ...*

Tip for the teacher
- *The named energy types (highlighted) are written on a board (projection / on sheets, etc.) and left until the end of the lesson in a visible place for the students, as in the third ACTIVITY 3.2. task, students will be able to use this information.*

Tip for the teacher
- *If the students do not name the exact type of energy, the teacher can name it himself.*

LESSON 1

Summarizing:

• What is the type of the energy you hear?

/ Sound power /

• When the balloon flies, what kind of energy does it have?

/ Kinetic energy /

Students are asked to inflate their balloons again and knot them. Then rub the balloons into their clothes (wool, synthetics) or hair and tell others what they are experiencing.

Discuss with students what is going on.

/ Hair, clothes are electrified /

Summarizing: the mechanical energy used when rubbing the balloon is converted into electricity.

• The teacher asks all students to carefully connect the electrified balloons or to "tie" the balloons to the ceiling (the balloons must adhere to the ceiling).

Students are asked to explain what is happening.

/ The balloon has acquired a small electric load because of the friction; when the balloons get the same electric charge - they push one another; the ceiling has a different electric load than the balloon - the ceiling pulls the balloon /

Question:

- Where exactly did the students see the phenomena (pulling and pushing) in the environment?

/ Magnets and all electrically powered moving bodies function similarly /

Summarizing: this is **magnetic** energy.

Tip for the teacher

• A magnet and some small metal objects (for example, paper clips) can be placed in the visible place (on the teacher's table). When the magnet is not received / received, the metal objects are collected.

LESSON 1

3. ACTIVITY. TASK – GAME (18 min.)

3.1. Introduction to the task (3 min.)

Students are asked to raise and release the balloons. Discuss what is going on and why.

*/ Until the balloon is raised, it is affected by the **potential (gravitational)** energy, when the balloon is released, the gravitational energy is converted into kinetic energy /*

Summarizing:

- one type of energy is related to movement;
- other types of energy - stored or accumulated energy which is able to become other types of energy under certain conditions.

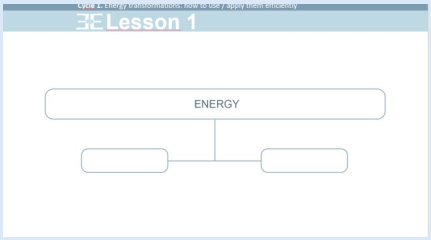
Question:

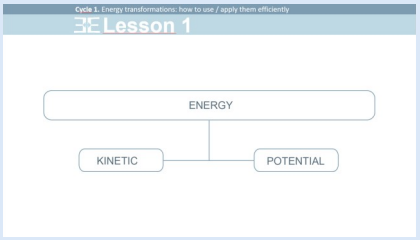
- Do you know how they are called?

/ Kinetic energy and potential energy /

The slide show *Lesson1. Presentation No.2 Types of energy* is displayed in the projector.

Lesson 1. Presentation No.2. Types of energy



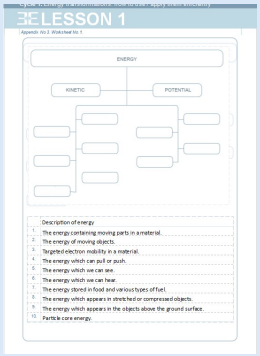


Tip for the teacher
• A slide is presented (this will be required for the next task 3.2) even if the answer is not received .

LESSON 1

3.2. Task– game (10 min.)

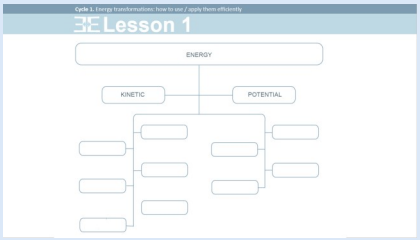
Students are given worksheets *Lesson No 1. Appendix No 1. Types of energy and their descriptions.*



Lesson No 1. Appendix No 3. Types of energy and their descriptions

Students are given colourful sticky notes or they can use *online tools like linoit.com, padlet.com or others.*

Slide show: the scheme *Lesson No. 1. Appendix No. 4. Presentation. Types of energy.*



Lesson No.1. Appendix No. 4. Presentation. Types of energy

Explaining the task.

The description of all types of energy and their layout scheme are found in the appendix *Lesson No.1 Appendix No. 3 Types of energy and their descriptions.* Students are asked to fill in the scheme by writing the names of energy types using the descriptions in the worksheet.

Students are presented (discussed together with students) the task-to-play criteria.

Criteria

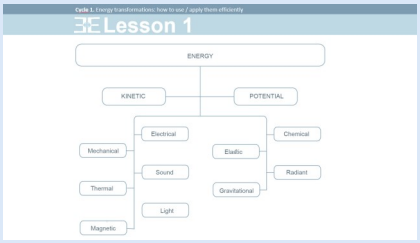
The winner is the pair / team that:
• is the quickest to perform the task ;
• Identifies correctly the biggest number of energy types;
• ..... (students offer their own criteria).

A possible prize for the winner of the game is discussed together with the students (points, sweets or other things).
The beginning of the game is announced. The time is set to complete the task - 2 minutes.
At the end of the task, the work is stopped.
Students can stick their notes with answers onto the board or give their answers online.

Tips for the teacher
• *Students are offered to work in pairs / groups. If students wish, they can work independently.*
• *If we use sticky notes- each group is given those of a different colour.*

LESSON 1

The 2nd slide is demonstrated *Lesson No.1 .Appendix No. 4 Presentation. Types of energy (2nd slide).*



Lesson No.1. Appendix No. 4 Presentation. Types of energy (2nd slide

The results are summarized.

The winning couple is promoted / rated / awarded in a manner agreed between the teacher and the pupils at the beginning of the game.

Tip for the teacher
• *If the names are written incorrectly, students are asked to correct their scheme and present the results then.*

3.3. Summarizing. Interpretation of the law of conservation of energy (5 min.)

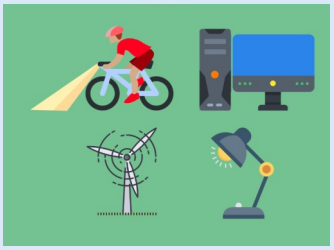
Question:

- How can one energy turn into another kind of energy?

/ E.g. by doing some kind of action / work (stretching, raising, compressing, burning ...) one energy may turn into another energy /

Tip for the teacher
• *During the discussion, ask questions and get the correct answers from the students, if needed.*

Slide Show Lesson 1. Appendix No. 1. Use of Energy.



Slide Show Lesson1. Appendix No. 1. Use of Energy

Questions:

1. What kind of energy do the objects in the pictures use?
2. What other types of energy are converted?

/ Computer: electricity is converted into light and sound energy; cyclist: chemical energy (from food) turns into potential (human muscle) energy that turns into mechanical energy (rotating wheels), mechanical energy is converted into electrical energy (the lamp illuminates), etc. /

The law of conservation of energy. It explains what the law of conservation of energy is. Students are proposed to do an experiment.

Provide students with cold metal objects (spoons, balls, etc.) and ask them to hold them in their hands for 15 seconds.

LESSON 1

Questions:

1. What happened?

/ The thing got warm, the hands got frozen /

2. Why did this happen?

/ We gave the warmth of our hands to the thing and it became warm; the palms lost the same part of the warmth /

Students are asked to rub their hands for a few seconds.

Question:

- What happened?

/ The palms warmed up because mechanical energy turned into heat energy /

Summarizing: energy does not come from anywhere and disappears nowhere. One kind of energy can turn into or be converted into another kind of energy.

The law is called the law of **conservation of energy.**

Tips for the teacher

- *The teacher leads the students' discussion.*
- *Emphasize the possibilities of engineering creativity.*

4. ACTIVITY. REVIEW AND DISCUSSION OF CREATIVE WORKS (6 MIN.)

Engineering projects developed by students are shown.

Lesson No.1. Appendix No. 5. Film No.1 and Appendix No.6. Film No.2

Lesson No.1. Appendix No. 5. Film No.1 and Appendix No.6. Film No.2

Tips for discussion

Discuss what engineering works were developed by students, which energy transformations the students watched and recognized.

5. ACTIVITY. REFLECTION (3 MIN.)

REFLECTION

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

Questions for reflection:

1. What work did I do during this lesson?
2. How (in what way) did I learn?
3. Why do I think so?
4. What did I /we do / the best?
5. What was the most difficult?

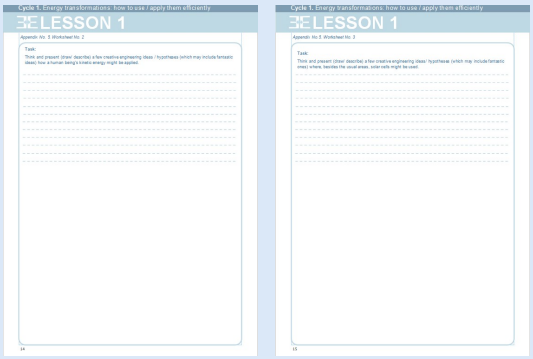
LESSON 1

CREATIVE WORK (45 MIN.)

1. Practical task (30 min.)

Students are proposed to perform a creative task by continuing to work in pairs / groups.

Worksheets are given *Lesson No. 1. Appendix 5. Worksheet No. 2 and Lesson No.1. Appendix No. 5. Worksheet No. 3.*



Lesson No. 1. Appendix 5. Worksheet No. 2 and Lesson No.1. Appendix No. 5. Worksheet No. 3

Students (one from each group) draw one task out of two different ones with the assignment *Lesson No. 1. Appendix 7. Worksheet No. 2 and Lesson No.1. Appendix No. 8. Worksheet No. 3*

Students are asked to come up (show / describe) with a few creative engineering ideas / hypotheses (which may include fantastic ideas). They have 10 min. to complete the task.

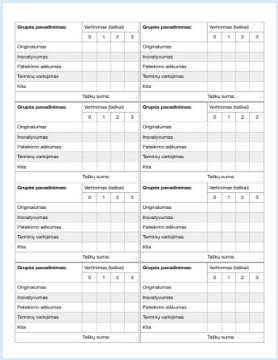
Useful information ⓘ

Task. *Lesson No.1. Appendix No. 5. Worsheet No. 2.*

- How could human kinetic energy be applied?

Task. *Lesson No.1. Appendix No. 5. Worksheet No. 3.*

- Where, besides the usual areas, could solar cells be used?



Evaluation sheets are distributed *Lesson* No. *1. Appendix No.9. Evaluation sheets.*

Lesson No. *1. Appendix No.9. Evaluation sheets*

The evaluation criteria for the results of other groups are discussed.

Tip for the teacher

- *If there is a possibility, organize the creative task during an additional lesson.*

Tips for the teacher

- *The number of tasks must correspond to the number of groups.*
- *The teacher can give some examples, if necessary, see VII Useful information, or other examples.*

Tips for the teacher

- *The management of time necessary for the performance of the task is emphasized to the students.*
- *Consultation and assistance are provided if needed.*

LESSON 1

Suggested evaluation criteria:

• the originality of the idea;
• innovativeness of the engineering project;
• clarity / informative side of the presentation;
• use of terms / concepts;

• other ..... (students offer their own criteria).

When the time is up, students are asked to prepare for presenting their creative works for assessment/self-assessment.

2. Presenting work results, (self) assessment, reflection (15 min.)

Pairs/ groups of students grupės present their creative works.

During the presentations all the other groups carefully listen and assess the works using the evaluation sheets *Lesson 1. Appendix No.9. Evaluation sheets.*

According to the criteria, students evaluate their own and others' works. The results are summarized.

Students (self) evaluate the work of their group, for example, how they succeeded in creating, what was the most successful part of their work, what they failed, what to do differently next time, and / or so on.

REFLECTION

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

Questions for reflection:

1. What did I do during the lesson?
2. How (in what way) did I learn?
3. Why do I think so?
4. What did I/we do / the best?
5. What was the most difficult?

Tip for the teacher

• *You can use the online tools linoit.com, padlet.com, or others.*

Tips for the teacher

• *Positive things in each student's activity should be emphasized and then it should be discussed how to improve the work / activities.*
• *The teacher should encourage a student to think and understand what the learner has learned, how he learned.*

LESSON 1

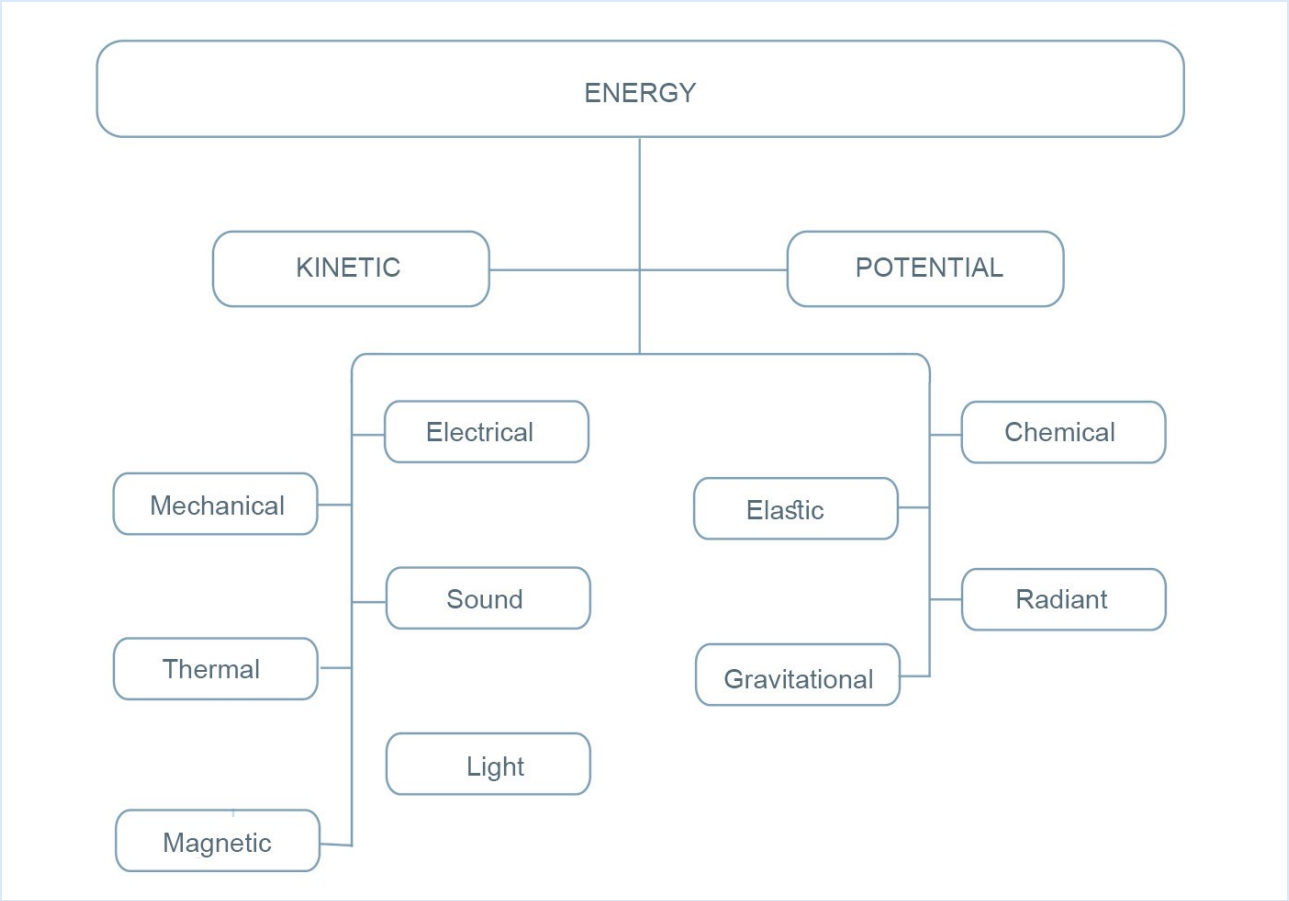
TERMS AND USEFUL INFORMATION

Energy (gr. Energeia - action) - the feature of an object or system determined by nature. A body with energy can perform work or isolate the heat. Energy is needed for various needs: food production, heating of premises, operation of various devices, transportation and vehicles. Energy demand has been increasing in the whole world, thus traditional (fossil fuel) energy sources are being exhausted and its methods of production damage the environment.

The law of conservation of energy states that all energy in the isolated physical system remains constant, but the forms of energy can change. This law is explained more precisely by the first law of thermodynamics. This means that energy does not come from nowhere and it does not disappear anywhere, and one kind of energy can turn into or be converted into another kind of energy.

Solar and kinetic energy adaptation
Nanotechnologists at the Georgia Institute of Technology (USA) are developing a special fiber that can convert both solar and kinetic energy into electricity. Such material technology could be used to create clothing or accessories that would accumulate motion or light-generated electricity.

Answers of the task-game ,,Types of energy and their descriptions": *Lesson 1. Appendix No. 4 Presentation No. 3. Types of energy (2nd slide)*



Lesson 1. Appendix No. 4 Presentation No. 3. Types of energy (2nd slide)

LESSON 1

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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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