Learning Unit	
Subject	Physics
Title	Electromagnetic phenomena and their role in production and usage of electrical power
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Description of the unit	At these lessons students will investigate practically electromagnet characteristics of the electrical driver and electrical current generator. At the end of every practical task a student should demonstrate the equipment manufactured by him in action. Then these students will be able to explain dependence of physical values and phenomena on changing outside variable factors. At these units of the lessons students will work in groups to fulfill practical tasks and during investigations. At the end of every study step students demonstrate work of active equipment (electromagnet, the working model of electrical motor, frame with current in the magnetic field) and patterns in physical phenomena that he has discovered. At the end of the lesson students will prepare a computer presentation and write a short essay for the theme, which will be proposed by the teacher. .

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Contents	Theory: 1. Magnetic field around the moving charges 2. Basic features of magnetic field 3. Presentation of magnetic fields with help of power lines. Basic features of power magnetic lines. 4. Magnetic field, which is created by electrical current conductors. Dependence of magnetic field on the conductor form and electrical current direction there. 5. Interaction of constant magnetic and electrical current conductor. 6. Electrical magnetics and their usage in technology and household. 7. Rotation of electrical current frame in constant magnetic field. 8. Electric motor. 9. Electromagnetic induction. How induction current is arisen in the conductor, what crosses power lines of magnetic field. 10. Electrical current generator and its usage in electrical power production. Different power sources that provide work of generators and their influence to the environment. 11. Comparison of generators with other types of current sources (for example, chemical sources, solar power panels and so on) Practical work: 1. Electromagnetic manufacturing and investigation of its features. It should be determined how the lifting force of an electromagnet depends on current strength and also how magnetic field direction depends on the current direction. 2. Interaction investigation of the constant magnet and the current frame. Dependence of force direction that acts to the frame from magnetic poles and current direction in the frame. 3. Study of construction and assembly of an active model of electric motor.. Dependence investigation of motor rotation direction on current direction in its windings. 4. Study of electrical current generator (with usage of an electric motor model)
***Learning Outcomes / Skills ***	- At the end of this study lesson students can explain reasons for an arisen magnetic field, to present this one with help of magnetic force lines. They can explain the interaction of current conductors and constant magnetic. Students can manufacture an electromagnet and know some fields of electromagnet usage. They have basic knowledge about construction of electric motors and generators. Students know the principle of their work and how power transformations happen in this equipment.. They know about the main methods of power production and transmission. Students understand priority and risks of influence to the environment during power production with usage of different power sources. They can find needed information and give reports about this one in view of presentations or essays. . . -

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Learning Unit	
Target students/class	Students of 15-16 years old
Prerequisites	A students can answer and do to the following: What is electric current? How this electric current is created, which features are specific for electric current?. What is power and its types? How to draw an electric circuit diagram and how to assemble this on? What is the constant magnet, magnet pole and their interaction? How to use a magnet needle?
Time expected/	5 hours
Interdisciplinary links/	economic geography, chemistry, biology, social subjects, informatics.
Methodology	Group work during conduction of the test and preparation of result conclusions. Creative approach to achieve purposes of practical work and ability to make a right solution. Ability verbally and in written way (assembly of the equipment or electrical circuit) and digitally to present the received knowledge and skills. Individual work.
Human Resources (internal and/or external)	Physics teacher
Resources /	Equipment for demonstration and laboratory test (current sources, magnets, conductors, measuring equipment, active models and other auxiliary means) Proper computer equipment and means. Working notebook.
Lesson Plan/	The unit No 1 (theory) At the beginning of this unit the teacher sets purposes for study of the theme as follows “Electromagnetic phenomena and its role in production and usage of electric power” and introduces the students, how to achieve these purposes step by step. The teacher makes clear the theme of the first unit. He explains how a magnetic field is created around the moving charges, what features it has, how to draw this one, in order it will be seen. The teacher includes the students into active common work. He conducts a comparison between magnetic field and electric field and at the same time he puts their attention to the common and different features of these fields. All actions are done with demonstration of tests and shown on the screen with the help of a digital camera. . The students do individual work in the working notebook during all this unit. The teacher controls and checks these working Home tasks - to find 3-5 examples for usage of electromagnets in technology and household. To be prepared for practical work on manufacturing of electromagnet.

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The unit No 2 (practice)

At the beginning of the unit the teacher gives back working notebooks, which are checked by him and asks questions concerning the planned practical task. Then students are organized into groups of 4-6 persons and start group work on manufacturing of electromagnet and investigation of its features. For these purposes five tables are prepared the following equipment and materials: iron nail (10 sm), copper wire with varnish coating (5 m), rheostat, tube for cocktail, scissors, batarei (4,5 V), lamp on state, switcher, magnetic needle, paper clips,
The students prepare the work results in their notebooks, the teacher controls the work process and if necessary helps, answers students questions and asks them himself. Work fulfillment takes around 30-35 min. Anyone who completes this work earlier, does additional tasks about the influence of the core in the electromagnet. At the end of this unit the students discuss the question, how electromagnets are used (the hometask). The working notebooks, inc the reports, are submitted to the teacher to check these ones. Hometask with a deadline by the fifth unit of this lesson. It is needed to write a short essay or to prepare a presentation and send this work to the teacher by electronic way. The students chose one of the following themes

1. Ecological advantages of electric motors before internal combustion engine
2. Comparison between generators, chemical sources, solar panels as different from the current source and how these ones are different for influence to the environment..
3. Influence of different methods of electric power production to climate the planet.
4. Electric power production in Estonia, what types of sources are used at present.

The unit No 3 (theory + practice)

At the beginning of this unit the teacher gives back students the working notebooks, which are checked by him. At the same time the teacher comments on the work results. Then the teacher declares the unit theme ”Interaction of conductors and constant magnets”. The teacher talks about the interaction of the constant magnet and the current frame. It is proposed that the students are organized into groups in such a way, in order to be four students in which. They should see the dependence of force direction that acts to the current frame on values of the magnetic poles and current direction in the frame. Force direction is determined according to the view, how the current frame is pulled in and out. (batteries, lines magnets and wire frames are prepared beforehand at seven school tables), electric current in the inductor during moving of constant magnet in this one (electromagnetic induction). One of the students shows this fenomena with the help of a demonstration galvanometer.. The students should prepare conclusions, current direction and induction current strength depending on what conditions. As A result of this unit the teacher proposes to solve some tasks

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	that are connected with determination of current directions, magnetic field and strength. Hometask - to find at home electrical devices, in which an electric motor is used. . Unit No 4 (практика) At the beginning of this unit the teacher again talks about strength, that acts to the current frame in the magnetic field and about electromagnetic induction fenomena. The students are working in the groups on disassembled and acted models. At first they disassemble the model. study its composition and purpose for every separate element. Then the students assemble and connect this model to the battery with the usage of wires and switcher and try to see that the motor works as a result. Then the students investigate how the motor reacts to the change of current direction.. In the next investigation instead of the battery it is connected to a galvanometer and the rotor is coming to the movement manually at first to one side and then to the other side. At the same time to see how current arises. The proper conclusions should be made as a result. At the end of this unit the students compare an electric motors and an electric current generator. Hometask - to prepare the presentation or small essay and submit to the teacher by electronic way (in format pdf if possible). Unit No 5 (general unit) At the beginning of this unit the teacher does comments about the presentations and essays received. After this the teacher together with students analyze results of this theme study during 15-20 min at the same time the students do the proper tasks in their working notebooks. Then the students present their work, which is chosen by the teacher (3.4 min). Then students discuss with each other in free form the lesson theme. At the end of the unit the working notebooks are submitted to the teacher to control the student work.

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21st Century Skills

- Critical thinking
- Communication skills
- Creativity
- Problem solving
- Perseverance
- Collaboration
- Information literacy
- Technology skills and digital literacy
- Media literacy
- Global awareness
- Self-direction
- Social skills
- Literacy skills
- Civic literacy
- Social responsibility
- Innovation skills
- Thinking skills

During this lesson the students definitely receive the following:

Critical thinking: they will analyze- the data collected during the experiments made by them

Creativity: they will write essays about electric phenomena, methods of electric power production, influence on the environment and so on.

Collaboration: they will collaborate between groups at the lesson and in each group to realize the final presentation of the group work.

Individual work - is such a useful skill. This is used during this lesson. A student can express his own opinion and things.

Communication: They will communicate and discuss the study theme, to prepare common results and conclusions. To work together at practical units.

Information literacy: the students are asked to investigate the tasks and find proper information at home..

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	Media literacy and technology literacy: They will create personal presentations according to the given theme and with the usage of proper online tools. Technology literacy. The students are familiar with general questions concerning electric power production. They receive definite skills in theory and in practice.
Assessment	Summative assessment is used at the end of this lesson. Formative assessment is used during this lesson.
Remarks	

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