

THERMODYNAMICS

Lesson Plan (Scenario)

Lesson title: Thermodynamics
Subject: Physics
Level: Secondary School
Suggested time: 3 x 45 minutes

Equipment needed:

- Computers
- Video projector
- Internet connection

Lesson 1 (45 minutes)

Teaching Unit: Introduction to Thermodynamics, Pressure, Temperature, Internal Energy, Heat

Teaching Methods: discussion, instruction, exercises (online), individual work, collaboration

Teaching Methodologies: ex-cathedra learning, directive learning, exploratory learning

Learning Tools: electronic textbook and electronic workbook, slides, forum

Equipment: computer classroom, projector, internet connection

Lesson Objectives:

Functional:

- students develop their ability of logical thinking
- students develop their ability of pragmatic and meaningful reasoning
- students systematically upgrade their knowledge of basic concepts and their characteristics
- students solve problems from e-workbook independently

Educational:

- students acquire basic concepts, i.e. pressure, temperature, energy, heat
- students systematically upgrade their knowledge

Sequence of Lesson Stages:

1. Motivation
2. Introduction to the topic
3. Main activities
4. Exercises (individual)
5. Final activities

Teacher's Activities	Student's Activities
1. Motivation The teacher presents some examples from everyday life to the students (AppliedThermodynamics.pdf). The introduced examples are cases of common use of thermodynamics, or can be explained by principles of thermodynamics.	Students listen and watch the presentation and accompanying video material.
2. Introduction to the topic The topic is announced: <i>Today's topic is thermodynamics. We will learn about</i>	While listening to the initial motivation, students prepare for discussion on the new topic.

<i>temperature, pressure, heat, and internal energy. We will perform some simulations and also solve exercises to consolidate our knowledge.</i>	
3. Main activities The teacher explains the first five topics from the material (electronic textbook). For each topic, the teacher first presents the topic, and then demonstrates the corresponding simulations, which are followed by a short discussion and explanation of results. Afterwards, the students are given short exercises and/or few quizzes on that topic.	Students listen to the explanation, watch simulations, try simulations by themselves, and actively participate in debate on explanation of results. Students do the exercises and answer the questions or solve quizzes. They can compare their answers and results, and further discuss the topic.
4. Exercises (individual) Students are given exercises in the electronic workbook, which they solve individually. The correct answers are discussed together.	Students individually solve exercises. Students participate in discussion, explaining correct/wrong answers.
5. Final activities The teacher uses forum to further discuss the topic, answer the question, counsel students, and give support regarding their homework.	If students do not finish the exercises, they get these exercises as homework. Students use forum to discuss the correct answers and ask the teacher for help.

Lesson 2 (45 minutes)

Teaching Unit: Work, First Law, Entropy, Velocity Distribution, Specific Heat

Teaching Methods: discussion, instruction, exercises (electronic), individual work, collaboration

Teaching Methodologies: ex-cathedra learning, directive learning, exploratory learning

Learning Tools: electronic textbook and electronic workbook, slides, forum

Equipment: computer classroom, projector, internet connection

Lesson Objectives:

Functional:

- students develop their ability of logical thinking
- students develop their ability of pragmatic and meaningful reasoning
- students systematically upgrade their knowledge of basic concepts and their characteristics
- students solve problems from electronic workbook independently

Educational:

- students acquire basic concepts, i.e. work, First law of thermodynamics, velocity distribution, specific heat
- students get to know interdependences
- students systematically upgrade their knowledge

Sequence of Lesson Stages:

1. Motivation
2. Introduction to the topic
3. Main activities
4. Exercises (individual)
5. Final activities

Teacher's Activities	Student's Activities
<p>1. Motivation</p> <p>The teacher presents some interesting examples (HeatWorkEntropy.pdf). The principles of their functioning and other phenomena can be found in thermodynamics.</p>	<p>Students listen and watch the presentation and accompanying video material.</p>
<p>2. Introduction to the topic</p> <p>The topic is announced: <i>Today's topic is thermodynamics. We will learn about work, First law of thermodynamics, velocity distribution, and specific heat. We will perform some simulations and also solve exercises to consolidate our knowledge.</i></p>	<p>While listening to the initial motivation, students prepare for discussion on the new topic.</p>
<p>3. Main activities</p> <p>The teacher explains the last five topics from the material (electronic textbook). For each topic, the teacher first presents the topic, and then demonstrates the corresponding simulations, which are followed by a short discussion and explanation of results. Afterwards, the students are given short exercises and/or few quizzes on that topic.</p>	<p>Students listen to the explanation, watch simulations, try simulations by themselves, and actively participate in debate on explanation of results.</p> <p>Students do the exercises and answer the questions or solve quizzes. They can compare their answers and results, and further discuss the topic.</p>
<p>4. Exercises (individual)</p> <p>Students are given exercises in the electronic workbook, which they solve individually. The correct answers are discussed together.</p>	<p>Students individually solve exercises.</p> <p>Students participate in discussion, explaining correct/wrong answers.</p>
<p>5. Final activities</p> <p>The teacher uses forum to further discuss the topic, answer the question, counsel students, and give support regarding their homework.</p>	<p>If students do not finish the exercises, they get these exercises as homework. Students use forum to discuss the correct answers and ask the teacher for help.</p>

Lesson 3 (45 minutes)

Teaching Unit: A gallery of multimedia examples from thermodynamics

Teaching Methods: discussion, instruction, collaboration work, research collaboration over the Web

Teaching Methodologies: ex-cathedra learning, exploratory learning

Learning Tools: forum, Web Collaboration Tools (e.g. Google Docs), Internet resources

Equipment: computer classroom, projector, internet connection

Lesson Objectives:

Functional:

- students develop their ability of Web-based research
- students develop their ability of cooperation and collaboration work
- students develop their ability of critical thinking and analysis
- students document their work and systematically build a collaborative documents

Educational:

- students upgrade their knowledge in thermodynamics

Sequence of Lesson Stages:

1. Motivation
2. Introduction to the topic
3. Setting up the collaboration tools
4. Researching using Internet
5. Collaborative formation of the final document

Teacher's Activities	Student's Activities
1. Motivation The teacher presents collaboration using forum and collaborating way of documenting (e.g. Google Docs).	Students listen and watch the Web presentation.
2. Introduction to the topic The topic is announced: <i>Today we will create a collaborative document with multimedia elements (pictures, video, animation...) from the field of thermodynamics.</i> The teacher shows an interesting example on the Web. The teacher announces collaborative preparation of a joint document.	While listening to the initial motivation, students prepare for the work.
3. Setting up the collaboration tools The teacher sets up a new topic on the forum. The teacher uses forum to answer the student's questions.	Students collaborate. They use forum to coordinate their work, identify thematic groups and their coordination (group leaders).
4. Researching using Internet The teacher uses forum to answer the question, give consultations and support.	Students individually search for interesting pages on the Web, using search engines (e.g. Google) and browsing interesting and promising Web pages. They use term in thermodynamics (they learned in the previous two hours) as keywords in the search. They can use some additional keywords, such as <i>video, animation, simulation, picture, illustration, lecture, tutorial...</i>
5. Collaborative formation of the final document The teacher uses forum to answer the question, give consultations and support. At the end, the teacher comments on the prepared document and goes through it together with the students.	Students compose a collaborative document (using Google Docs, for example) which includes links to interesting Web pages and the comment on these Web pages and their content. The document has to be well structured and capture all presented topics on thermodynamics.