Content package for interactive whiteboards – Energy conversion

This guideline provides an overview of the content and didactic context of the media in the content package for interactive whiteboards entitled “Energy Conversion.”
General information on the use and teaching concept of the content packages for interactive whiteboards is provided in the teaching method “Working with a content package for interactive whiteboards,” which is also included in the media package.

1 Introduction to teaching this topic

1.1 Motivation for the topic

Energy conversion plays a role in many different areas of life. For instance, when we run, our stimulated muscles convert chemical energy to mechanical energy. The sun produces heat and light by converting nuclear energy to radiant energy. A solar cell, on the other hand, absorbs the radiant energy given off by the sun and converts it to electrical energy.
Energy conversion is a highly important subject in physics class, taught starting from grade 7 to the highest grades. The topics covered range from mechanics to thermodynamics. It also overlaps with biology (photosynthesis, cellular respiration) and chemistry (conversion of substances).
The media in the content package provide a suitable way of acquainting students with the principle of energy conversion. Most of the 29 individual media can be used in physics class starting from grade 7. The content package is designed for a period of about two lessons.

1.2 Media selection

The content package for interactive whiteboards entitled “Energy conversion” contains 25 individual media.

- **Ten photos:** Various examples of typical energy conversion processes and energy converters in nature and technology
- **Two interactive graphics** on the energy conversion processes and the efficiency of energy conversion
- **Three simulations:** Photovoltaics – basic principle, Fuel cell – operating principle, Photosynthesis – principle
- **Two text documents:** Energy conversion (guideline) and Energy conversion processes in everyday life
- **One interactive exercise** on energy converters
- **One set of experimentation instructions:** Converting mechanical energy into thermal energy (with teacher information and answer sheet)
- **Two worksheets (with answer sheet)** – one with calculation tasks related to efficiency and one with work assignments for a poetic analysis of the subject of energy conversion
- **One link list:** Energy conversion (link list)
- **One guideline** for the interactive whiteboard content for teachers

1.3 Background information for teachers

The media can be combined in various ways in terms of content and teaching method, depending on the focus of the class.
It is recommended that teachers work through the topic in the following steps:

- Introduction
- Energy can be converted

- What can convert energy?
  Energy converters – group work
- Energy is lost during conversion
- Interdisciplinary lessons
  Energy conversion in chemistry – energy conversion in biology
- Further study phase
  Theory – exercises – worksheets
- Case study: Energy conversion in a solar cell

2 Introduction: Photos

The content package for interactive whiteboards provides numerous photos illustrating different energy conversion processes. Depending on the type of energy conversion being discussed, teachers can show the appropriate photos.

Energy conversion	Energy converters
Chemical to electrical energy	 “Alkaline battery”
Chemical to thermal energy	 “Burning Candle”
Chemical to mechanical energy	 “Muscle power”
Mechanical to electrical energy	 “Bicycle dynamo”
Thermal to mechanical energy	 “Steam turbine”
Radiant energy to electrical energy	 “Solar electric power plant on open space (“solar field,” “solar park”)”
Radiant energy to thermal energy	 “Solar collectors”
Radiant energy to chemical energy	 “Tree”
Electrical energy to radiant energy	 “Incandescent lamp”  “Xenon auto light bulb”

The information sheet can be used to make the students aware that energy conversion takes place everywhere in everyday life.

Medium  “Energy conversion processes in everyday life”

3 Energy can be converted

Teachers can explain the various forms of energy and the possible ways they can be converted into each other using an interactive graphic. The graphic first presents an overview of the energy forms chemical energy, electrical energy, nuclear energy, mechanical energy, radiant energy, and thermal energy.
By clicking an energy form, you can see a display of possible conversions into other energy forms.

Medium  “Energy conversion”

4 What can convert energy?

4.1 Energy converters

If you click the button for each energy form, you can provide the students with an understanding of the possible ways to convert a particular energy form. The possible conversions of the energy form to other forms are shown. In addition, a typical energy converter can be shown and hidden (by clicking the blue dot) for each possible way to convert energy. The graphic also provides space for handwritten notes.

Medium  “Energy conversion”

4.2 Group work

The following topics can be worked through in stages or as group work, based on selected examples. As an introduction to a particular topic, each group of students can use the media files and compile their associations with the media files. They can find additional information via the link list. Finally, the students will attempt to describe the energy conversion process. The group will then present its results to the other students. The following groups are possible:

Group 1: Environmentally friendly energy converters

Media  “Photovoltaics – principle”

 “Solar power system”

Group 2: Energy converters in everyday life

Medium  “Bicycle dynamo”

5 Energy is lost during conversion

In the second interactive graphic, clicking an energy form displays the efficiency and energy loss of selected examples. In addition, the physics formula for determining efficiency can be displayed by clicking “Formula”.

Medium “Efficiency of energy conversion”

6 Interdisciplinary lessons

Energy conversion processes are not just a physics topic; they are also important for understanding certain facts in other scientific subjects. The following media can be used to make excursions into chemistry and biology.

6.1 Chemistry

The two photos show examples of conversion from chemical energy to electrical or radiant energy.

Media “Alkaline battery”
“Burning candle”

The operating principle of a fuel cell is shown in the simulation, which teachers can stop at any point by clicking “Pause.” They can then add their own notes, for example, with the interactive pen.

Medium “Fuel cell – operating principle”

6.2 Biology

Photosynthesis is the most important metabolic process in nature. During this process, plants convert radiant energy to chemical energy. The animation shows the entire principle of photosynthesis. It can be played similar to the simulation of the fuel cell.

Media “Photosynthesis – principle”
“Tree”

The photo for muscle power shows an example of an energy conversion process in the human body. When muscles are stimulated, chemical energy is converted to mechanical energy.

Medium “Muscle power”

7 Further study phase

7.1 Theory

The guideline and link list are suitable for further study on the topic, and can be distributed to students as the basis for a presentation or given to them to work through as homework.

Media
- “Energy conversion” (guideline)
- “Link list: Energy conversion”

7.2 Exercises

The interactive exercise is used to test students’ level of knowledge. It can be used at the end of the lesson as an aid to memorization of the material that has just been learned, or for review at the beginning of the next lesson. Students can work through the exercise by themselves on the interactive whiteboard, and the answers can be displayed.
Eight energy converters are given in the exercise. The students should determine the forms of energy that the energy converter converts to and from.

Medium
- “Energy converters”

In the “Content package for interactive whiteboards – Energy conversion,” you will also find a simulation that visualizes the conversion of potential energy to kinetic energy and thermal energy by means of a skateboarder riding on a track. The students can have fun experimenting with it. A number of related tasks can be generated; some examples are provided in the teacher information.

Medium
- “Energy skate park” (with teacher information)

7.3 Worksheets

The students can complete the worksheet as homework or together in class. The worksheet can also be used as a test.
The worksheet includes questions and calculation tasks on the subject of efficiency. It is good for further study and for practicing simple physics calculations. In addition, students can further research the efficiencies of heat engines, power plants, and other energy sources and compile the results as a table of values.

Medium
- “Assignments related to efficiency” (with answer sheet)

7.4 Experiments

The experimentation instructions provide a simple experiment on converting mechanical energy to thermal energy. The corresponding teacher information and the answer sheet help teachers prepare and carry out the experiment.

Medium — “Determining the efficiency of a hand-held mixer” (with teacher information and answer sheet)

Note: The media in the content package for interactive whiteboards entitled “Energy conversion” also exist as individual media in the media package of the same name on the Siemens Stiftung Media Portal.

8 Case study: Energy conversion in a solar cell

The following teaching idea is intended to illustrate the wide variety of possible uses for the media available in the content package for interactive whiteboards, based on a concrete example. This case study includes those media that provide a suitable way of teaching students about solar cells and how they convert energy (radiant energy to electrical energy), along with information on efficiency.
Case studies on other energy conversion processes, such as the conversion from mechanical to thermal energy, could be carried out in a way similar to this example.

Lesson step	Explanations and notes
Introduction	The photo can be used as an introduction. → “Solar electric power plant on open space (“solar field,” “solar park”)” Teachers can ascertain the students’ previous knowledge of solar cells in a brainstorming session. They can write notes or keywords directly on the photo with the interactive pen, for example.
Teaching phase	The next step is to explain the energy conversion process based on an interactive graphic. → “Energy conversion” After opening the graphic, the teacher clicks the “Radiant energy” button. This opens a new page showing the possible energy conversion processes. Teachers can then focus on the conversion of radiant energy to electrical energy by tracing this path using the pen function. If the teacher clicks the blue dot on the connecting arrow, the solar cell is shown as the energy converter. This page also provides space for adding handwritten notes, such as a formula.

Lesson step	Explanations and notes
Practical work phase	The class then works through the operating principle of a solar cell based on the simulation. →  “Photovoltaics – basic principle”
For further study	Another interactive graphic can be used to teach that energy is always lost during conversion: →  “Efficiency of energy conversion” The starting page shows the energy forms and the formula for efficiency. If teachers click the icon for radiant energy or the button below it with the same name, the conversion from “radiant energy to electrical energy” and the conversion from “radiant energy to thermal energy” are shown. If they decide to look more closely at the conversion from radiant energy to electrical energy, they can click the blue dot on the connecting arrow to display details on the efficiency and energy losses for this type of conversion. There is also space here for adding handwritten notes.
Homework	Task 2 from the following worksheet is assigned as homework. The students’ task is to calculate the efficiency of a solar cell. →  “Assignments related to efficiency” Note: During class, teachers can also complete the task directly on the whiteboard. To do so, they must call up a new page in the content package. The solution can be written by hand, either by the teacher or a student.