

**STEMkey**  
Module IO8



**Electricity**

## Activity 1 - Reverse Engineering

This Worksheet document is based on the work within the project “Teaching standard STEM topics with a key competence approach (STEMkey)”. Coordination: Prof. Dr. Katja Maaß, International Centre for STEM Education (ICSE) at the University of Education Freiburg, Germany. Partners: Charles University, Constantine the Philosopher University, Hacettepe University, Institute of Education of the University of Lisbon, Norwegian University of Science and Technology, University of Innsbruck, University of Maribor, University of Nicosia, Faculty of Science of the University of Zagreb, Utrecht University, Vilnius University.

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## I. Reverse Engineering

### Activity 1. Reverse Engineering



Work in pairs



60 min

### Learning Outcomes

**Knowledge:** Connect electricity to daily life phenomena, construct simple electric circuits (i.e., series and parallel circuits), connect different components and draw the scientific representation of circuits.

**Skills:** Observe, discuss and apply the principle of reverse engineering to investigate how things work. Think about how a circuit should be constructed to provide a specific application.

**Attitudes:** Foster a creative mindset through brainstorming new applications and innovations in electric circuits.

This activity aims to introduce the basics of electricity; however, it should be noted that abstract thinking is necessary to conceptualize different circuits. Pre-service and in-service teachers should be able to identify how electric energy is stored and transferred.

### Session description

In this activity, pre-service and in-service teachers will apply the concept of reverse engineering, which can be described as the process of discovering the technological principles involved in the design of a device, object or system, through the analysis of its structure, function and operation. This technique is widely used in software architecture but also in hardware design. Objectively, reverse engineering consists, for example, in disassembling a machine to find out how it works; evaluate its functionality and improve its design. Pre-service and in-service teachers are placed in a scenario of a team of engineers from a technology company, challenged to evaluate the product (the box) of a competing company. This box contains some type of device or function that allows the pre-service and in-service teachers to manipulate and predict their function and internal structure (the circuit). Pre-service and in-service teachers are asked to make predictions on the circuits that are hidden inside. Afterward, pre-service and in-service teachers design their own box with the same features as the mystery box. At this stage, pre-service and in-service teachers explain the functionality of each of the circuit components (battery, wires, light bulb, resistors, switches). The final challenge involves the comparison between the two boxes: the mystery box and their own box. Pre-service and in-service share their constructions and explain how they work.

### Brief description of one example (Mystery Box)

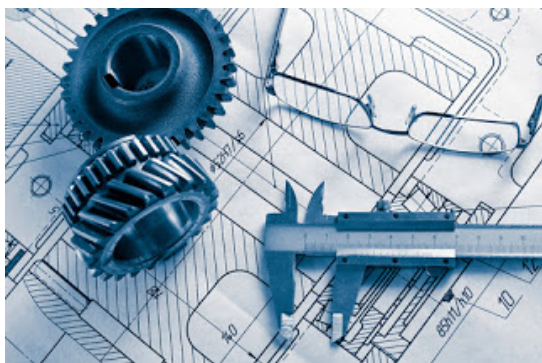
Please consider the following example. This box contains a series connection of three lamps and two switches (a button and a lever). Although the connections are hidden, students can manipulate the switches and identify the pattern observed in the lights. For example, when you turn on one of the switches, a light bulb lights up, however, when you turn the lever, we now have two more light bulbs on. The first one decreases its luminous intensity. It is possible to discuss various aspects such as the luminous intensity of each lamp, what would happen if a lamp were disconnected from the circuit and also the prediction of the circuit itself.



## Activity 1: Reverse Engineering



### Worksheet



**Reverse engineering** is the process of discovering the technological principles and the design of a device, object or system, through the analysis of its structure, function and operation. Objectively, **reverse engineering** consists of, for example, disassembling a machine to find out how it works. In this way, we can admit that technological evolution is not always marked by innovation, but by the constant improvement of

existing products. There are many examples of technological companies that compete with each other in the same business segment, applying this technique to remain competitive in the market.

(Adapted from <https://engenharia360.com/engenharia-reversa>)

Imagine that you are a group of engineers, technicians and electricians who work in an electrical equipment company and your boss asked you to analyse and find out how a new product works, from a competing company, which is being a sales success, for then develop a similar one.



**Pay attention to the mystery box. Apply the reverse engineering technique to understand its operation and then design another one with the same principle.**

1. Observe and explore the mystery box without opening it.
2. Describe your observations.
3. Design your own box with the same features as the mystery box.
4. Draw a picture or take a photo of your box.
5. Open the mystery box and look inside.