

Teachers' Guide

Objectives of the lesson

Cognitive objectives:

- Students explain that the evolution of electrical energy and its applications needed many years of research, many scientists/engineers, and many failing attempts. Also, it was developed relatively recently
- Students know how the electric motor is connected to the rest of the construction and mention its advantages
- Students can control the variables

Emotional objectives:

- Students are willing to experiment and make hypotheses
- Students are willing to observe and make hypotheses

Psychomotor objectives:

- Students collaborate with each other to achieve the objectives of the activity
- Students can communicate effectively with their groups and in the plenary discussion, develop their critical thinking skills and be creative when they are asked to solve a problem
- Students develop fine motor skills and handle the measurement instruments

Introduction to the activity

This is the first time your students will use the motor and the battery case. The activity starts with a short introduction to the history and evolution of electricity, the scientific research, the technological inventions, and their evolution. The objective of these information is not students to learn by heart the names of the scientists, even though there are movies for most of them (ask them if they know them), but to understand that the evolution of science and technology is not easy, but needs long efforts, many of which failed, and improvements over improvements. Also, they need to understand that electric phenomena and their applications are something very recent. You can mention that most probably many houses in Greece during the 1950s did not have electricity. Their grandparents lived at that time.

Next, you will refer that when we are working with electricity circuits, we need to connect all the devices we want to the power source (explain in brief what a power source is). Show your students the motor and the battery case from the set and explain how to use them.

Simple Machine

To transmit motion, you use gears. Remember the gear ratio, here the gear are similar, so the ratio is 1:1. Highlight how the motor is connected to the wheels and the car moves.

Building

The building is simple and easy, each group will have their own.

Beware! Each time you use the motor and the battery case, remember when you disassemble the building to remove at least one battery from the battery case, so that even the switch is turned on by mistake your batteries will not empty.

You will also need to have AA battery supply. Check that the motors and the battery cases work before your lesson.

Answers to the worksheet

1. The motor need to be connected to the battery case to move. Also, in the battery case you need 6 batteries, in the correct polarity

The motor is connected to a gear, which is meshed with another gear. The second gear is on the wheel axl, so motion is transmitted.

2. The switch is turned off in the middle point. In the other two possible points, the vehicle moves towards one direction or the other.

3. Without a motor the vehicle stops after a while (due to friction), whereas with the motor it doesn't stop until it finds an obstacle. Also, the speed before depended on the force applied to the car and gradually it stopped, when the force was not applied. With the motor, the speed is greater and remains the same.

4. Get organized on how to make the measurement. A suggestion is one member of the group to let the car, and the other to wait to catch it after 5 seconds. Set a starting point and let students note the point it reached. Another suggestion is to set the starting and finishing point and measure the time between the two. Do the time measurement yourself. Students of that age don't have cell phones or the fine mobility skills to do so.

5. Move on to step 11. Repeat the measurements, as you consider best. The result is that the vehicle moves further (*due to the greater diameter of the wheel and the greater circumference, at the same time it covers more distance).

6. Move on to step 12. Compare the speed of the initial vehicle because the change is on the meshing gears. BEWARE! Highlight to your students that since you put the middle wheels again, you have to compare the speed with when you had the middle wheels again, because each time we only change one variable.

The relation between the gears is 1:3, the driver gear is the smallest one, so the driven gear will move slower (for 3 rotations of the small gear, the bigger rotates once). The power of the car is stable, so the speed is smaller.

7. The speed is increased, however it is significantly lower than before, when we used the similar gears. So, the speed depends on the gear ratio, as well as the wheels used.