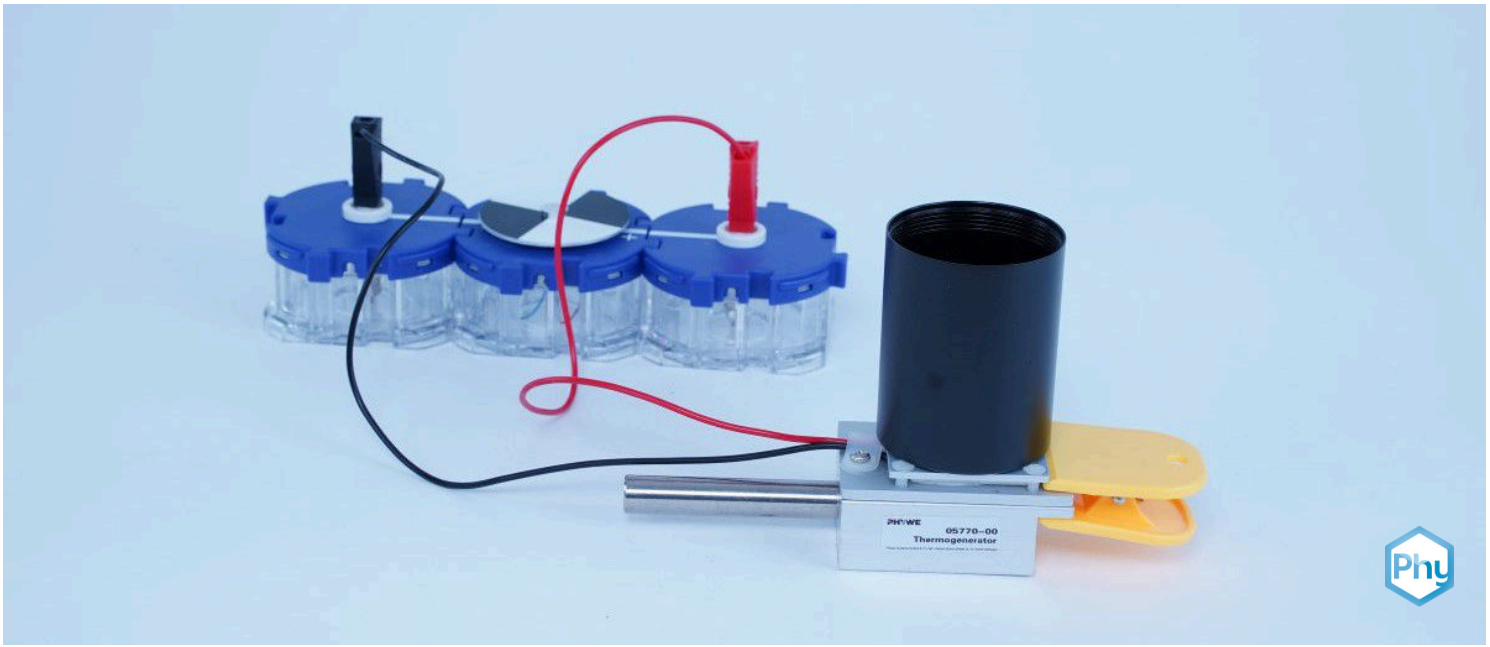
Conversion of thermal energy into motion



Physics | Energy | Energy forms, conversion & conservation

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

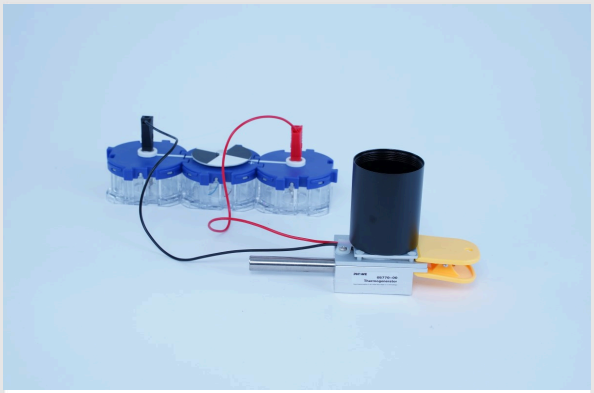
http://localhost:1337/c/6167debd2d1cf30003518c1d

PHYWE

Teacher information

Application

PHYWE



The experimental setup

Energy exists in various forms and can neither be created nor destroyed.

One of the greatest challenges of science is to discover ways to convert energy from natural sources into energy that can be used by humans.

The Peltier element is a physical component that can convert thermal energy (in the form of a temperature difference) into electrical energy.

The electric current is versatile and can be used, for example, to cause movements of mechanical components.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/3)

PHYWE

Previous

Students should be familiar with the basic forms of energy and the concept that energy can be converted from one form to another.

Principle

The students are introduced to a way of converting energy from heat to kinetic energy by observing the Peltier element. To do this, they provide the Peltier element with a warm object and connect it to an electrically operated, mechanical component (turntable).

By observing the turntable and the structure, the process of energy conversion can now be understood.

Other teacher information (2/3)

PHYWE

Learning

Students learn that a thermogenerator can generate mechanical energy using cold and heat.

Tasks

Create a temperature difference across the Peltier element using various methods and then observe the behavior of the motorized turntable.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (3/3)

PHYWE

Notes on structure and implementation

- Sufficient time must be allowed between the two experiments for the two sides of the thermogenerator to cool back to room temperature and for the thermoelectric voltage to return to zero.
- Hot water (approx. 60°C), as well as crushed ice should be provided at the teacher's desk.

Safety instructions

PHYWE

The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

PHYWE

Student Information

Motivation

PHYWE

A moving train

Kinetic energy is one of the most important everyday forms of energy that enables us to move and travel. However, cars, trains and other means of transport require a lot of energy to be set in motion.

Since energy cannot be created, humans must convert other forms of energy into kinetic energy in order to use all these useful vehicles.

This experiment presents an interesting example that demonstrates the conversion of heat energy into kinetic energy.

PHYWE

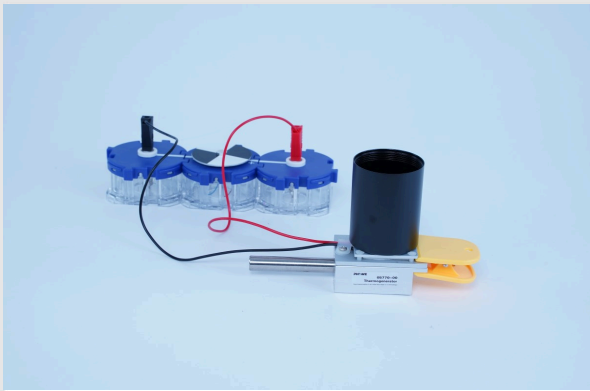
Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Tasks

PHYWE



The experimental setup

Can heat or cold be used to drive a motor?

In this experiment, the thermocouple is connected to a motor.

You try to drive the motor by placing a cup of hot water, or ice cubes, on the thermocouple.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Equipment

Position	Material	Item No.	Quantity
1	Motor with indicating disc, SB	05660-00	1
2	Junction module, SB	05601-10	2
3	Thermal generator for student experiments	05770-00	1
4	Beaker, aluminum, polished	05903-00	1
5	Beaker, black	05904-00	1
6	Beaker, 100 ml, plastic (PP)	36011-01	1
7	Beaker, Borosilicate, low-form, 400 ml	46055-00	1

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Additional material

PHYWE

- Water
- Ice cream

Structure (1/2)

PHYWE

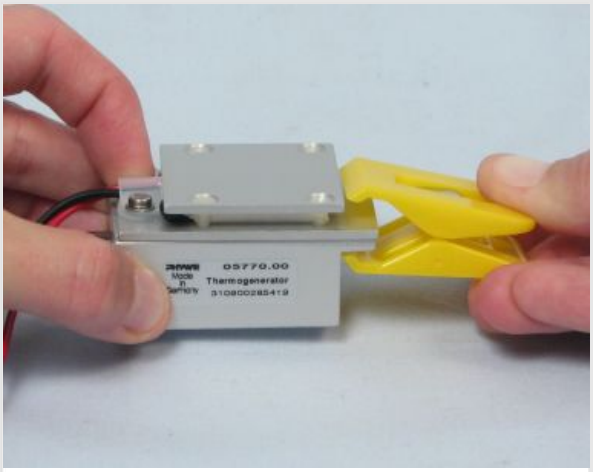


Figure 1

1. The thermogenerator consists of an aluminium block, a yellow clamp and the "Peltier element" (located between two thin aluminum plates).

2. Place the aluminum block on the table with the smaller side facing down. Attach the Peltier element to the aluminum block with the clamp so that its larger side is facing down (Fig. 1).

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

Structure (2/2)

PHYWE

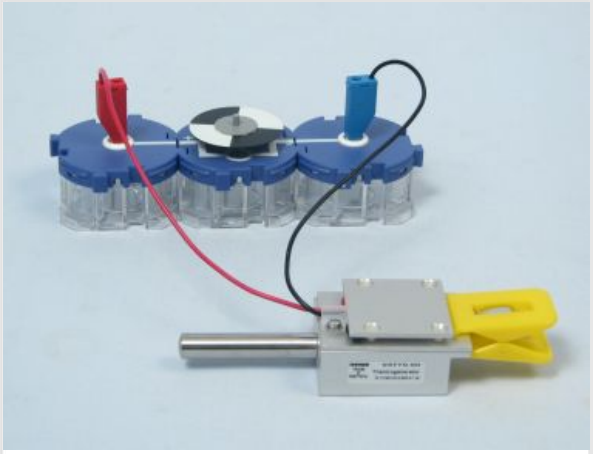


Figure 2

3. Connect the element to the motor (Fig. 2).

4. Make sure that the red wire is connected to the positive terminal and the black wire with the blue head is connected to the negative terminal of the motor.

Procedure (1/2)

PHYWE

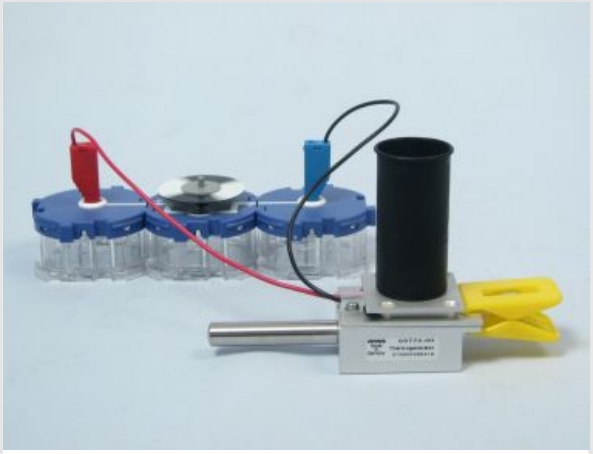


Figure 3

Experiment 1

1. Fill the beaker (400 ml) halfway with hot water.

2. Tip some of the water into the black beaker and place it on the thermocouple (Fig. 3).

3. You may have to push the motor to get it to run. Observe in which direction it turns and note your observations in the log.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Procedure (2/2)

PHYWE

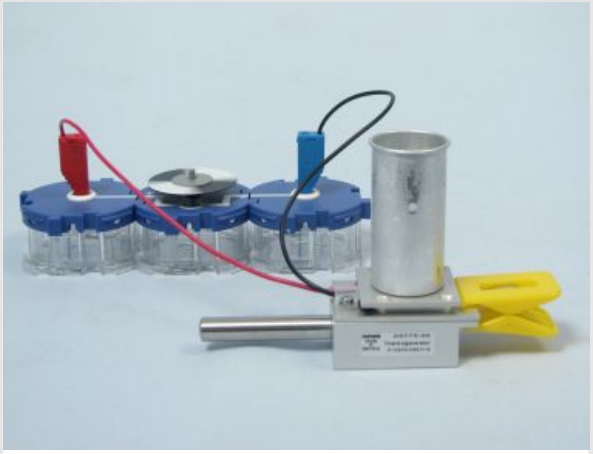


Figure 4

Experiment 2

1. Fill the beaker (100 ml) with crushed ice pieces.

2. Tip this into the blank cup and add some melted water or cold water (the cup should be half full of water).

3. Place the blank beaker with ice on the thermogenerator (Fig. 4).

4. Note the direction of rotation of the motor in the log.

PHYWE

Report

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 1

PHYWE

Note your observations, especially in relation to the direction of rotation.

Experimen

Experimen

Task 2

PHYWE

Which of these forms of energy play a role in this experiment?

- ☐ Electrical energy
- ☐ Thermal energy
- ☐ Height energy
- ☐ Kinetic energy (energy of motion)
- ☐ Light energy

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 3

PHYWE

Which statement about the direction of rotation of the turntable is true?

The direction of rotation appears arbitrary and independent of the temperature difference generated. When repeating the experiment with the same temperature difference, different directions of rotation may occur.

The direction of rotation of the disc depends on the temperature difference generated, since the direction of flow of the electrical energy generated depends on whether the Peltier element is heated or cooled. The direction of rotation of experiment 1 should reverse accordingly in experiment 2.

Task 4

PHYWE

In which order does the energy conversion take place?

⇒ ⇒

Thermal energy	electrical energy	chemical energy
Height energy	kinetic energy	Light energy

Check

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Slide	Score / Total
Slide 18: Forms of energy	0/3
Slide 19: Direction of rotation	0/1
Slide 20: In which order does the energy conversion take place?	0/3

Total 0 / 7

Solutions Repeat Export text

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de