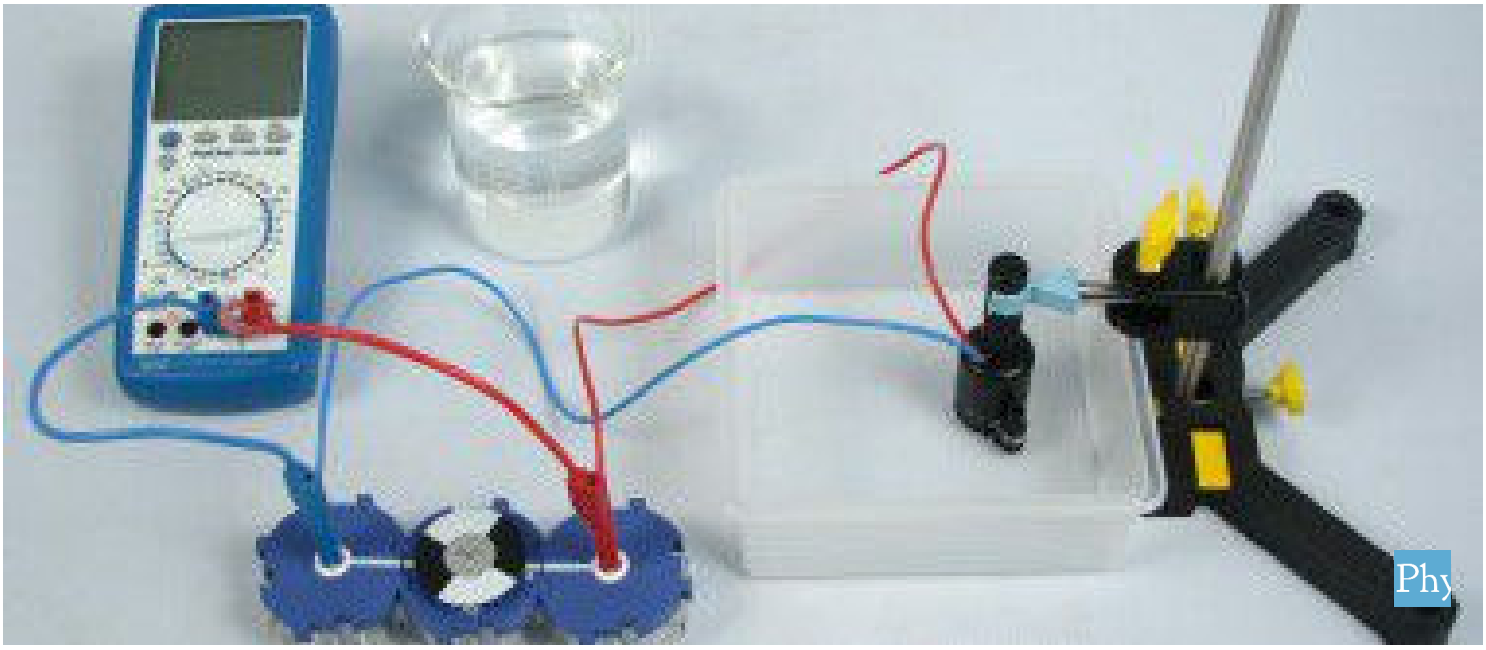
Running water drives a generator



Physics > Energy > Energy forms, conversion & conservation

Physics > Energy > Renewable energies: Water

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

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

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Teacher information

Application

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Experiment setup

Water, like all other objects on earth, is constantly accelerated towards the centre of the earth and therefore naturally moves from the lowest point that can be reached. To do this, it converts potential energy into kinetic energy and accelerates.

When the flow of water hits an object, it causes a force in the direction of flow and accelerates it. This allows people to use the kinetic energy to drive water wheels and turbines.

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Other teacher information (1/3)

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Previous knowledge

Students should be familiar with the basic concepts of energy conversion.

Scientific principle

In this experiment, a generator is driven by the kinetic energy of a stream of water and observed how this can be used to generate electricity.

Other teacher information (2/3)

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Learning objective

Students learn how to convert the kinetic energy of water currents into usable energy.

Tasks

In this experiment, the process of pumping water by electric voltage is to be reversed by attempting to generate voltage by moving water.

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Other teacher information (3/3)

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Notes on structure and implementation

In this experiment, a flow pump is used. It has the advantage that it can also be used as a generator, since with flow pumps the water can flow through the pump in both directions. However, it is possible that air collects in the pump, which then significantly reduces the pumping power and must therefore first be removed.

It is advisable to use distilled water to avoid jamming of the impeller or other problems caused by lime scale.

Notice: This experiment can also be shown more clearly if the silicone hose is used instead of the syringe to connect the pump to a water tap.

Attention: When connecting the pump to a water tap, however, it is essential to ensure that the voltage does not rise above 2.5 V-, otherwise the pump will be damaged.

Safety instructions

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

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Student Information

Motivation

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The Rhine Falls of Schaffhausen in Switzerland

Natural water currents come in many forms: from small streams to raging rivers. These currents are created by the earth's gravitational field and flow at different speeds depending on the terrain and the original energy.

Water wheels have been able to harness the kinetic energy of these waters for a long time, and in modern times hydroelectric power stations and turbines have added more ways of generating usable energy for humans from the movement of water.

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37079 Göttingen
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Fax: 0551 604 - 107
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Tasks

The experimental setup

In this experiment, the process of pumping water by electric voltage is to be reversed by attempting to generate voltage by moving water.

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Equipment

Position	Material	Item No.	Quantity
1	Motor with indicating disc, SB	05660-00	1
2	Junction module, SB	05601-10	2
3	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
4	Support base, variable	02001-00	1
5	Connecting cord, 32 A, 250 mm, red	07360-01	1
6	Connecting cord, 32 A, 250 mm, blue	07360-04	1
7	Dish, plastic, 150x150x65 mm	33928-00	1
8	Water pump/ water turbine/ generator	05753-00	1
9	clamp, d = 16 mm, with mounting rod	05764-00	1
10	Syringe 20ml, Luer, 100 pcs	02591-10	1
11	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
12	Boss head	02043-00	1
13	Digital multimeter, 600V AC/DC, 10A AC/DC, 20 MΩ, 200 µF, 20 kHz, −20°C… 760°C	07122-00	1

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Structure (1/2)

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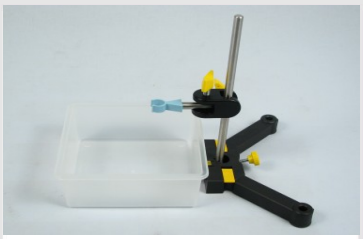

Figure 2

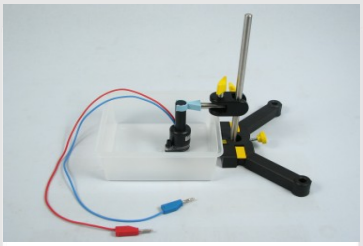

Figure 3

1. Insert the tripod rod into one half of the tripod base (Fig. 1).

2.Attach the clamp holder to the stand rod using the double socket and place the tub under the clamp holder (Fig. 2).

3.Clamp the pump in the clamp holder and move the double sleeve downwards so that the pump stands on the bottom of the tub (Fig. 3).

Figure 1

Structure (2/2)

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4.Connect a voltmeter in parallel with the pump and provide the beaker filled with water and the syringe (Fig. 4).

5.Assemble the motor and the two line modules with connection socket as shown in Fig. 5.

6. Connect the pump to the motor according to the polarity. The red plug corresponds to the positive pole and the blue plug to the negative pole (Fig. 6).

7.Switch the voltmeter parallel to the motor and place the beaker filled with water on the table and place the syringe next to the tub (Fig.7).

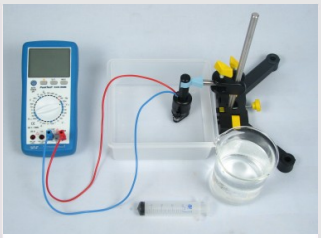

Figure 4

Figure 5

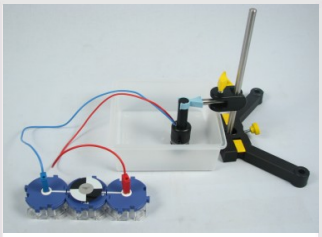

Figure 6

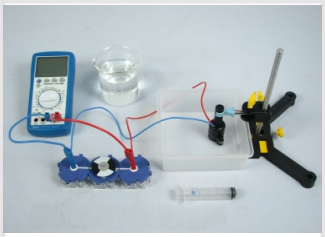

Figure 7

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Procedure (1/2)

Figure 8

1.Set the voltmeter to a measuring range of 2 V-. Check whether the impeller on the underside of the pump can be moved.

Experiment 1

2. Fill the syringe with water from the beaker and insert it as deep as possible into the opening for the hose on the pump (Fig. 8).

3.Press the water of the syringe quickly and evenly into the pump.

Repeat the experiment several times and note down in your experiment protocol what can be observed on the voltmeter during the different runs and what values it displays.

Procedure (2/2)

Experiment 2

1. Carry out the experiment in the same way as in experiment 1 and make a note of what can be observed in the motor.

2. Note whether the values for the voltage are different from those in experiment 1.

Notice:

- Make sure the syringe runs smoothly.
- The water pressure must not be too high, but also not too low. Try to find a suitable medium pressure for ideal results.
- The injection angle is also important for the result. The syringe should be slightly tilted, i.e. not completely parallel to the stand rod, in order to achieve the best possible results.

Robert-Bosch-Breite 10
37079 Göttingen
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Fax: 0551 604 - 107
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Report

Task 1

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Drag the words into the correct gaps

Hydropower turbines, in simplified terms, work similarly to _____ with a denser _____. The _____ of water is nevertheless usually lower than that of air, because water is also significantly more inert and therefore normally does not reach as high _____ as wind. However, with water currents, the _____ is much easier to recognize and by far more consistent, since _____ change only very slowly over millennia.

- direction of flow
- flow velocities
- mass flow
- wind turbines
- current patterns
- flow medium

Check

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Task 2

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What is the equation for kinetic energy E_{kin}?

$$E_{kin} = \square \cdot \square \cdot \left(\square \right)^2$$

h	m
V	g
v	Q
$\frac{1}{2}$	t

h = altitude, m = mass, V = volume, g = acceleration due to gravity

v=speed, Q = charge, t = time

Check

Task 3

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In which of these scenarios does kinetic energy play the main macroscopic role?

- [ ] Glowing lamp
- [ ] Rolling ball
- [ ] Tensioned spring
- [ ] Falling stone
- [ ] Boiling water

Check

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Slide	Score/Total
Slide 16: Hydroelectric turbines	0/6
Slide 17: Kinetic energy	0/3
Slide 18: Macroscopic view	0/2

Total 0/11

Solutions Repeat

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