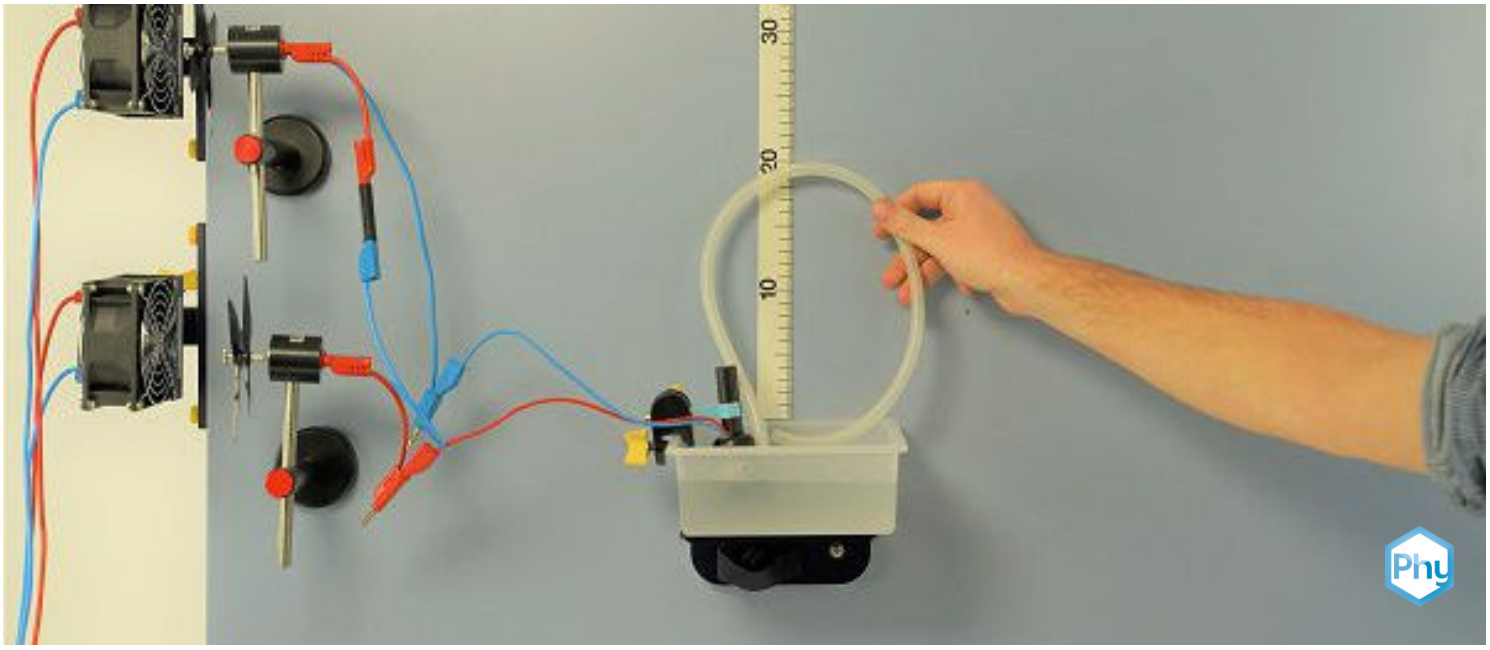
Pumping water with wind energy



Pumping water with wind energy

Physics > Energy > Renewable energies: Wind

Difficulty level	Group size	Preparation time	Execution time
medium	-	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/64a7d45c896cc40002f801b0

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General information

Application

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Pumping water with wind energy

If water is to be transported over long distances, hills and mountains can be a hindrance.

Wind-powered pumps offer good alternatives, especially considering the good wind conditions on elevated areas.

Using the siphon effect, this experiment shows how water can be pumped over a high point using wind energy.

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Other information (1/2)

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Prior knowledge

According to the law of conservation of energy, the water cannot receive any additional potential energy if there are no external forces acting.

Principle

With the help of a pump, water can be pumped up to a certain height depending on its performance. However, if the cohesive forces of water are exploited, it is possible to overcome even greater heights than the pump can make possible.

In this experiment, the cohesive forces ensure that the water remains cohesive and the water jet does not tear apart.

Other information (2/2)

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Learning

Students recognise the siphon effect and know why cohesive forces are crucial.

Note

There must be no air in the pump as this will reduce the pumping capacity. To remove air, the power source should be switched on and off several times and, if necessary, the pump should be tilted. Lightly tapping the pump on the bottom of the tub can also help.

It is advisable to use distilled water to avoid limescale residues.

The blower may be operated with a maximum voltage of 12 V.

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Safety instructions

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

For H and P phrases, please refer to the safety data sheet of the respective chemical.

Theory

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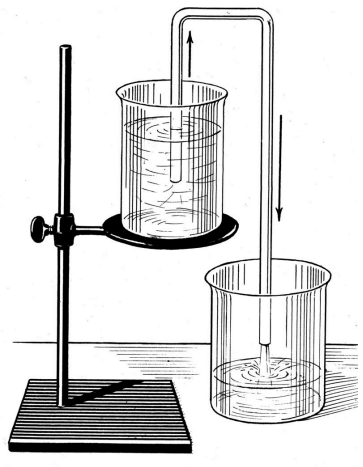

The siphon

A siphon is a construction that can be used to transfer a liquid from a container into a lowered container. The container can remain untouched and does not have to be tilted.

The cohesive forces

Cohesive forces are attractive forces in matching molecules that hold a substance (e.g. water) together.

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	1
3	Blower, 12V	05750-00	2
4	Generator with metrical thread axis and nut	05751-01	2
5	Rotor, 2 pieces	05752-01	2
6	Clamping holder with 2 clamping possibilit, 0-13 mm,fixing magnet	02151-08	2
7	Scale for demonstration board	02153-00	1
8	Clamp on holder	02164-00	2
9	Apparatus carrier w. fix. magnet	45525-00	1
10	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
11	Silicone tubing, ID 6 mm	47530-00	1
12	Boss head	02043-00	1
13	Double sockets,1 pair,red a.black	07264-00	1
14	clamp, d = 16 mm, with mounting rod	05764-00	1
15	Water pump/ water turbine/ generator	05753-00	1
16	Dish, plastic, 150x150x65 mm	33928-00	1
17	snap-fastener, flexible	170863	1
18	Connecting cord, 32 A, 250 mm, red	07360-01	1
19	Connecting cord, 32 A, 250 mm, blue	07360-04	1
20	Connecting cord, 32 A, 500 mm, red	07361-01	1
21	Connecting cord, 32 A, 500 mm, blue	07361-04	1
22	Connecting cord, 32 A, 750 mm, red	07362-01	1
23	Connecting cord, 32 A, 750 mm, blue	07362-04	1
24	G-clamp	02014-01	2

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Setup and procedure

Structure (1/2)

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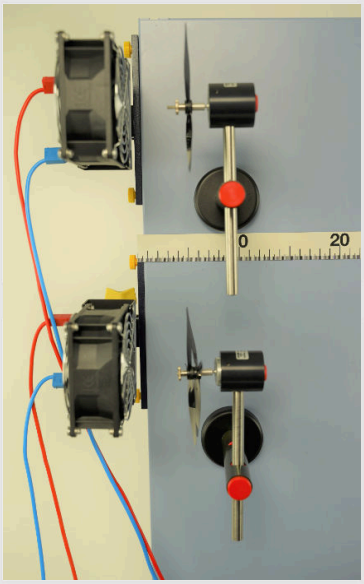

- On the left side of the demo panel, carefully screw the two clamps onto the support and hold the blowers in them.
- Connect the lower blower to the DC output of the power supply unit and connect the upper blower in parallel to the lower blower.
- The power supply unit is switched off.
- Attach 6 rotor blades to each of the wind generators. For a good result, the matte side of the rotors must be facing away from the blowers.
- Place the wind generators each with a magnetic clamp in front of the blower so that the distance is about 5 cm.

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Structure (2/2)

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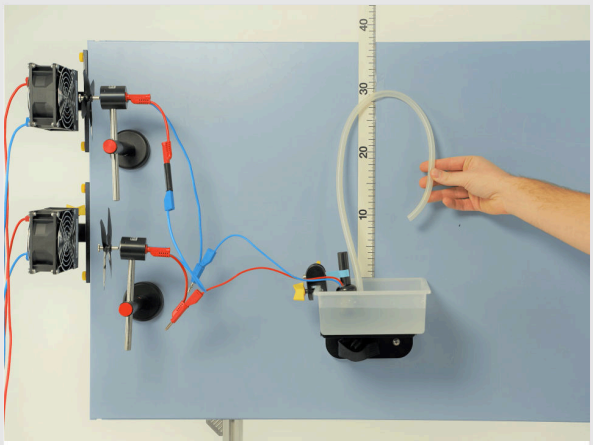

Experimental setup

- Set up the circuit according to the illustration. Pay attention to the polarity of the pump.
- Align the blowers so that they create a horizontal wind jet along the board.
- Fill the tub about halfway with water.
- Attach the silicone hose to the pump.
- Place the pump in the tub with the help of a clamp.
- Place the scale perpendicular to the water surface.

Procedure (1/2)

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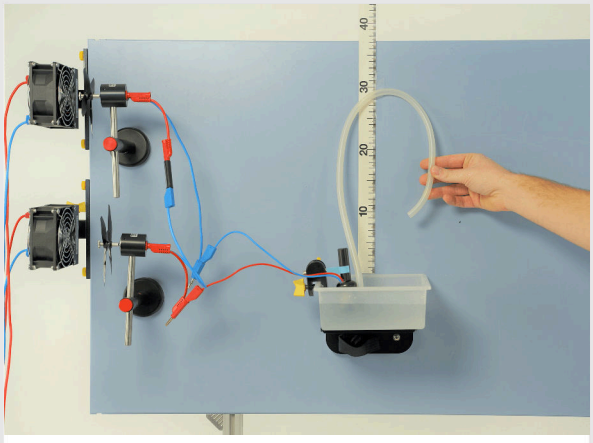

Hose height from 30cm

- Hold the hose so that the water has to overcome a height of at least 30 cm.
- Make sure that the free end of the hose is above the tub and the end is not in the water. (This would lower the pump height because of the back pressure).
- Switch on the power supply unit and set a voltage of 12 V.
- Observe the pump and the hose.

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Procedure (2/2)

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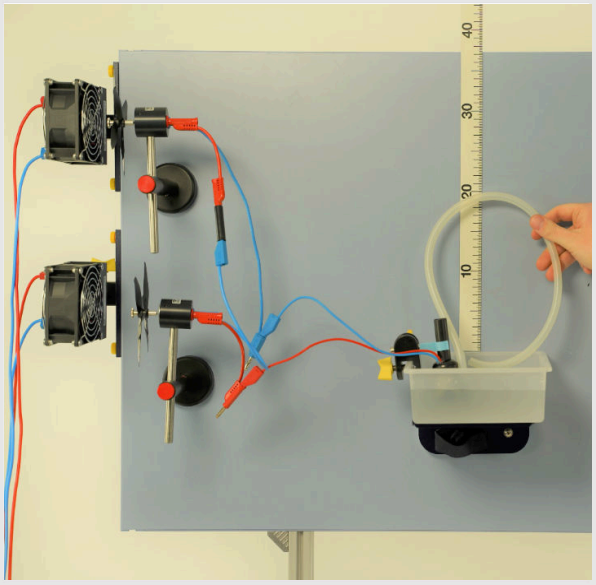

- Measure the height of the water column in the silicone hose.
- Slowly push the high point of the hose down until the water comes out of the hose. Wait about 10 seconds.
- Slowly raise the high point of the hose again to at least 30 cm, making sure that the hose opening is not higher than 20 cm.
- Observe the pump and the hose.
- Switch off the mains unit.

Evaluation

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Observation

The water rises to a height of about 20 cm. If you lower the high point of the hose below 20 cm, the water flows back through the hose into the tub.

If you raise the high point of the hose again, the water continues to flow, although it overcomes a height of considerably more than 20 cm.

With the help of the pump, a height of about 20 cm is reached. The additional height is only possible if the water subsequently flows back at least to the height of 20 cm or even lower. In this case, the water behind the high point pulls the water in front with it because of the cohesive force, as this ensures that the water remains coherent and the water jet does not tear apart.

Fill in the missing words.

This effect is also called _____.

Check

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Slide	Score / Total
Slide 13: Suction lift effect	0/1

Total score 0 / 1

Show solutions Repeat

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