1 2 3 . 9 8 7

Energy Station

Please Note

The OPITEC range of projects is not primarily intended as toys for young children. It is for teaching, designing and making to ensure that pupils experience a range of tools and processes.

A project with information with on energy

Making a model to produce solar energy

Making a model to produce energy from the wind

Making a model to produce thermo energy

plus other projects

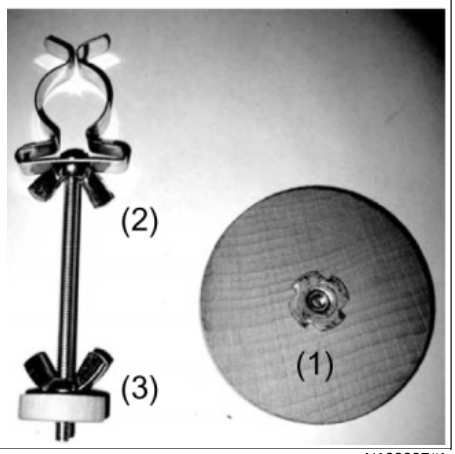
Making the fan:

<Keines>:

- knip de krokodilkabel in stukken van gelijke lengte
- verwijder de isolatie aan de uiteindes van de krokodilkabel m.b.v een schaar; knip hiervoor de plastic mantel ca 1 cm van het uiteinde in en trek deze eraf
- draai het vrijgekomen koperdraad samen tussen de vingers
- verbind nu de beide krokodilkabels met de beide kabels van de motor; draai de beide uiteindes in elkaar en druk ze vervolgens op de krokodilkabel
- omwikkel de in elkaar gedraaide kabels strak met ca 1 cm plakband

De bouw van de motorhouder:

1. sla de slagmoer zo ver mogelijk in het gat van de grote houten schijf (1)
2. draai bout van boven in de motorhouder en bevestig deze met een vleugelmoer; draai de moer zo vast mogelijk (2)
3. schroef de tweede vleugelmoer ca 1 cm op de schroef met de vleugels naar boven (3)
4. schuif het kleine houten schijfje als tussenring op de schroef (3) en draai de motorhouder in de voet
5. leg de stukken waar de kabels in elkaar zijn gedraaid onder de tussenring en draai de vleugelmoer zo vast naar onder dat de kabel zo goed mogelijk door de tussenring wordt vastgeklemd
6. schuif de motor in de motorhouder



Eindmontage van de ventilator:

- zet de propeller zo in elkaar dat de bladen ietwat scuin ten opzichte van elkaar staan
- steek de propeller op de as van de motor
- test de motor met een batterij of een zonnecel in combiantie met zonlicht of fel licht van een lamp

N123987#1

Solar Energy station

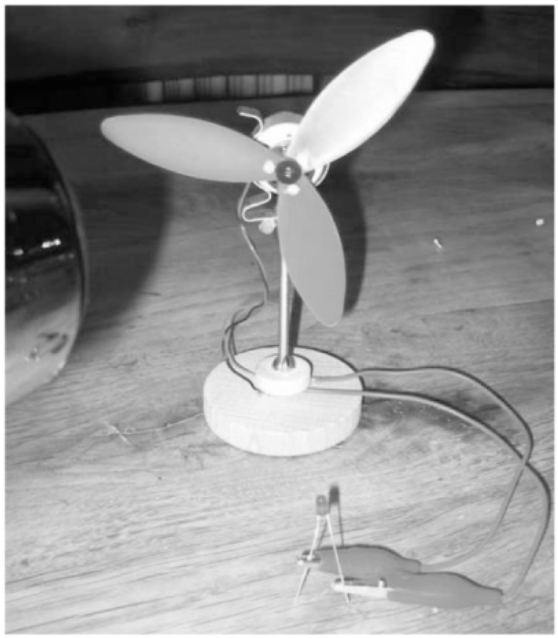
Connect the fan to the solar cell
Place the solar sell in sunlight or by a bright lamp
How much light do you need to activate the propeller fan so that it turns as fast as possible ?

What causes the change in speed of the propeller?

Wind power station I

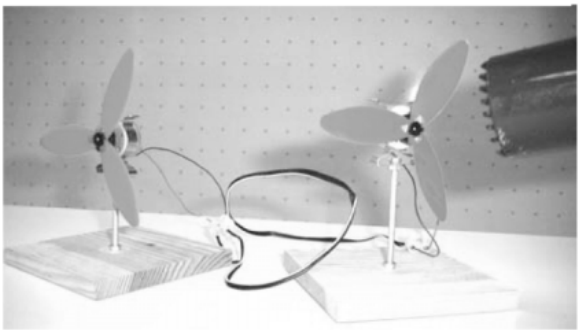
Connect a LED to the ends of the leads. The short leg to the red cable from the motor and the longer leg of the LED to the black cable.
Play a hairdryer fan on the propeller so that it turns and watch the LED

Why can you call this wind energy?



Wind power station II

Join one fan model to another
Drive one of the propellers with a fan.
The first fan will act as a generator (Dynamo) and drive the second
How do think it works- what happens when you make one propeller work and the other follows suit?
See if you can explain the sequence of events.
Try blowing on one fan with your mouth to see if you can generate enough electricity to turn the second propeller.



Thermo power station:

Here you will need a couple of small jam jars, one filed with hot water the other with cold

Both of the glasses must be full so that there are no air bubbles

Connect and place the square thermo element , firstly on the warm glass, and then on the cold glass, and finally in between the two glasses

Under which condition does the propeller turn

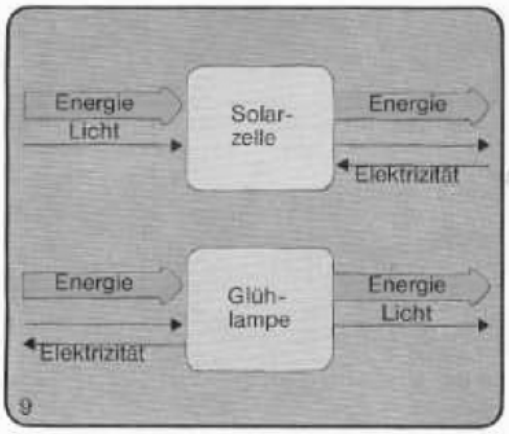
Try holding an ice cube on one side of the element and the palm of your hand against the other

Does the propeller turn only with the cold

An introduction to Energy production

So that the propeller turns, the LED lights, we need a power source, whether from wind, light or heat.. This was known earlier as power and is now more widely known as the word energy. Wind heat and light can all produce energy. In the solar cells and in wind generators the energy is produced as electricity. This can then be relayed in turn to run motor or a light a lamp a long way away. Even when this energy is produced motor and lights produce warmth.

Energy always needs a carrier to take it from place to another all where it can be used to operate a light, a fan or a cleaner etc.



Thermo elements…

The basic law of thermo dynamics states that there are no machines that can change heat fully into mechanical energy without producing a temperature difference

There are no ships that can take all their energy need from the water in the sea

Here you can see these effects with thermo element. Warmth from the water passes through the element and this in turn converts it to electricity. The greater the temperature difference between input and out put of the thermo element the more effective it will be.
.

- thermische energie
- warmtepomp
- Carnotse werking
- 2e hoofdwet van de thermodynamica
- meting van warmtestraling

The thermo element as a heat exchanger:

Connect the thermo element to a 4,5 volt battery. In a short time one side will get warmer the other will become colder. With the battery the thermo element becomes a heat exchanger

Warmth is drawn from one side the temperature sinks on the other side. The other side becomes warmer and so on. Here the energy for the heat exchanger is supplied by the battery.

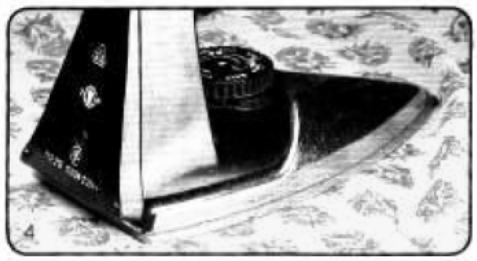
6.2 Energy

Which is more expensive: If you forget to turn off the oven or you forget to turn off a light?
This is easy the oven is dearer because it uses more energy.
An oven needs more energy than a light ? something is not quite right
What if an oven is left on for an hour and as bulb for a month?
The lamp has used more energy
What is meant is that an oven uses more energy than a light bulb when left on for the SAME amount of time
An oven uses 2000j per second a light 100j per second.

In other words the energy flowing to an oven is 200joule per second and that flowing to a lamp is 100 joule per second –therefore the oven needs 20 x as much energy as a lamp when running for the same time amount of time

On many devices the energy (joule pro second) is shown in Watts

This is often printed on the machines



Picture 4 shows a vacuum cleaner with an energy need of 500 J or 50watt per second

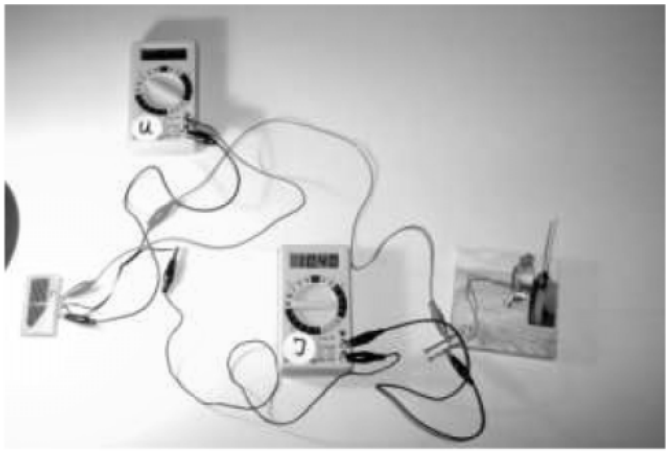
By larger numbers the number changes 1000Watts = 1 Kilo watt, 1Mega watt =1000Kilo watt

1000,000 Watts

Experiments with energy:

Experiment 1.
With help of the formula P=U x I the strength of the energy current can be measured (electrical performance) from an energy source in which electricity is produced. By measuring the voltage U and the Current I the strength of the energy flow can be found.

For example from the solar cell to the motor & propeller, also the influence of the cells position be determined.

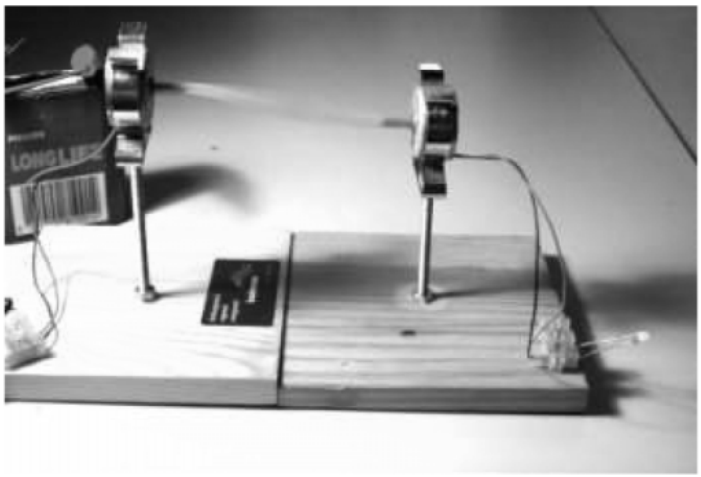


Experiment 2.
Extra material needed is a piece of silicon tube 3mm inner diameter

Join the shafts of two motors together as shown in the photograph

Crocodile clip a battery on to one of the motors and an LED to the other. If the LED is connected the correct way around it should light. From this we can see that the energy flows from the battery to the motor, through the silicon tube into the second motor which in turn acts as a dynamo, lighting the LED

By using a meter as in experiment 1 you should be able to measure the amount of energy that flows from the motor to the dynamo and so to the LED etc



Experiments with the (4)

Goal:

With the help of a thermo element we test the energy from a heat source and see how heat exchanger will work. This will also give you a chance to make precise measurements.

Materials needed:

Thermo elemen	Solar motor and propeller
Crocodile cable	2 x aluminium blocks 3cm x 3 x 5 (3)
Polystyrene boxes	1 Wooden box
Hear paste	2 Multimeters
4.5 volt battery	Stop watch
Matt black paint	Stabilised power supply

•Cut up a 2cm thick polystyrene tile and glue it together so that the aluminium block can be set inside and is level with the top

.

THE THREMO ELEMENT as a heat machine:

First experiment:

* Place one aluminium block in the ice box of a fridge and the other in a hot water bath about 50 centigrade.

*Use crocodile clips to join a solar motor to the thermo element

*Place the warm aluminium block on a table and press one side of the thermo elements on it

*Take the cold aluminium block place it on a table press down with your hand on to the other side of the thermo element.

*Now take your hand away and press the warm block on top

*Describe what happens and how you can produce energy

Zeit in s	Temperatur 1 in °C	Energiezunahme in J	Temperatur 2 in °C	Energieabnahme in J	I in A	P = UI in W

Measuring the results:

We are trying to determine the amount of energy from the thermo element.

* Place the aluminium block back again in the fridge and warm the other to 40 centigrade

* Instead of the motor join a 2.8 Ohm resistors. Using the multimeter you can measure the amount of current and voltage flowing in the circuit ..

* Make up table with following heading

* Cover both sides of the thermo element with a heat conducting paste

* Place the cooled aluminium block with the element into the polystyrene box

* Place the cold aluminium block on one side the heat block on the other covering it with a polystyrene box as a cover to insulate the package

* Take a measurement every 30 seconds until the element to reaches a normal temperature

.

Results:* Fill in the results in the table

* See if you can make a relationship between the energy P and the current U in a graphical form

* Discuss the results

Extra opgaven:

1. stel voor deze proef een energiebalans op (vgl proef 6); de specifieke warmtecapaciteit van aluminium is 0,89 kJ/kg-K
2. bepaal de sterkte van de energiestroom in het midden en bereken de gemiddelde werkingsgraad van het Peltierelement als thermische krachtmachine

The thermo element as a heat pump:

Experiment:

* Connect the thermo element to a 4.5 volt battery for a short time. Then place your hands on the sides of the element

* Describe what you feel

Measuring:

* Make up the same arrangement once again as you did in the last experiment. This time instead of a resistor use a low power supply unit with a constant 9 volts

* Draw up the following table

Zeit in s	Temperatur 1 in °C	Energiezunahme in J	Temperatur 2 in °C	Energieabnahme in J	I in A	P = UI in W

* Carry ou the experiment and take a measurement every 30S. Finish when there is a temperature Difference of 40K between the aluminium blocks

* Work out the missing values in the table. As energy point choose the temperature at the beginning of the experiment

* Work out the middle value of the energy current and how much energy the thermo element has produced

* Work out an energy balance, to see where the energy comes from, that warm block

Produces

See if you can describe the advantages of a heat pump system over a normal heating system

The thermo element as an energy radiation calculator:

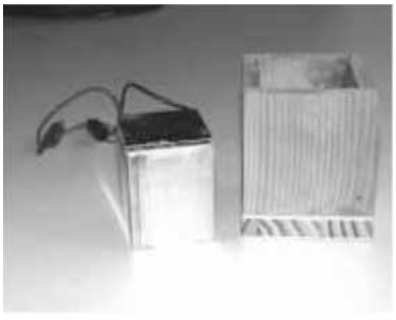
Paint onside of the thermo element in matt black paint

Paint the other side with a heat transfer paste. Place an aluminium block in

the wooden box. Place the thermo element paste side down on top of the aluminium block

This will now serve as a measure of radiated energy. You can also use a solar meter with solar cell. Althougth this is specially for sunlight. Our thermo measure is universal

The energy can with a factor of 9.4 WN measured with the thermo element



Work out with the help of the thermo measure the Solar constant .

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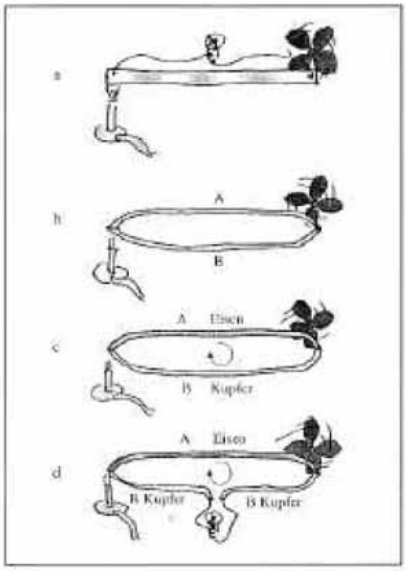


How the thermo element works

The function of a thermo element can be explained without going into the minute detail
The basic principle is when a conductor is heated on one end and cooled on the other a current will flow. This is known as an Entropie current even though it is weak. It tries to carry all the
current along. You can imagine it as if you are sweeping a rough floor with a brush. The brush takes everything with it –but not completely. “Brush current” and “Dirt current” are together but loosely. To remove all the “dirt” the brush must be passed over the ground several times. This is as brush –Entropie and the dirt the Electrical charge
So in our conductor the Entropie takes the electrical charge with it so at the end of the conductor there is a difference in potential. When thermal and electrical drive are equal which happens in a short time, the electrons cease to flow

The Entrophie flows on without the electrons

We are trying this make this with a electrical source You would think that all you need to do is connect a couple of leads and a bulb and it must light

If we take the bulb out of the circuit then we a have a short circuit but that is not the case. What happens is what we talked about at the beginning:

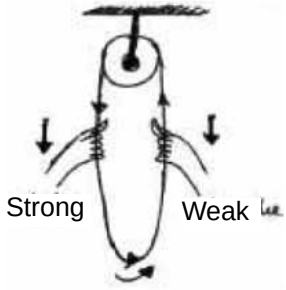
If we think about it as a circle, as we have already seen

What is missing to get the element to function ?. We need to make a connection from different metals eg. A from iron and B from copper. The flow in A and B are no longer the same and the coupling with the Entropie is different. In iron it is 10 times as strong as in copper. The electrons as are pulled stronger in the iron as in the copper. The iron wins over the copper so the electrons make a circuit flow in a clockwise direction .

In short:
The function of a thermo element works due to the different de coupling of the electrical charge

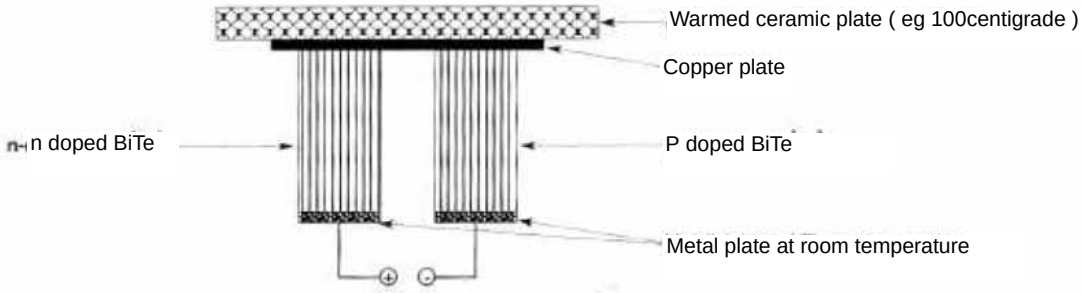
Here is another example. A cord hangs over a pulley. If you pull equally on both sides of the cord at the sides nothing will happen –the pulley will stay still. However if you pull harder on one side the pulley will start to turn. In short the hands are equal to the Entropie and the cord to the electrical charge

The hand pulsl harder on one side than the other and the pulley will turn in a clockwise direction



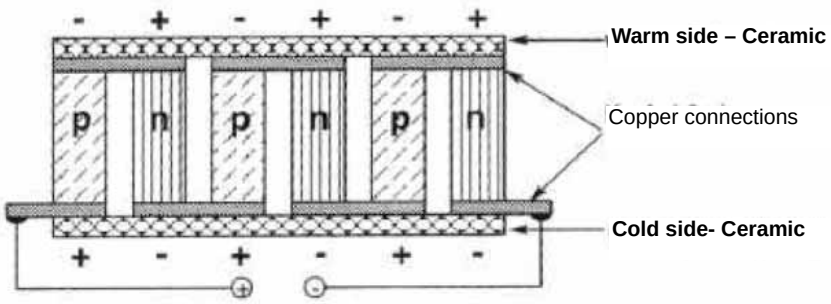
The make up of a Thermo element:

Instead of two different metals fused together semi conductors are used
Eg P and N doped Wismut Tellrit that has a much wider range as normal metal.



Instead of the two semi conductors being soldered together the thermo voltage from the two same materials is used.
The two lower ends of the semi conductor are at different temperatures

In manufactured thermo elements the basic parts are as needs be parallel and series connected.



Thermo voltage

Technical data:

The Opitec elements have the following technical data:

- Maximum cooling 17 W	Maximum temp difference 67 deg. Centigrade
Maximum Working voltage 8 Volt	Maximum current 3.5 A
Resistance 1.8 Ohms	Warm value 140mW/K
Maximum working temperature 70centigrade	Short term: 110 deg.C
Thermo voltage 27mV/K	