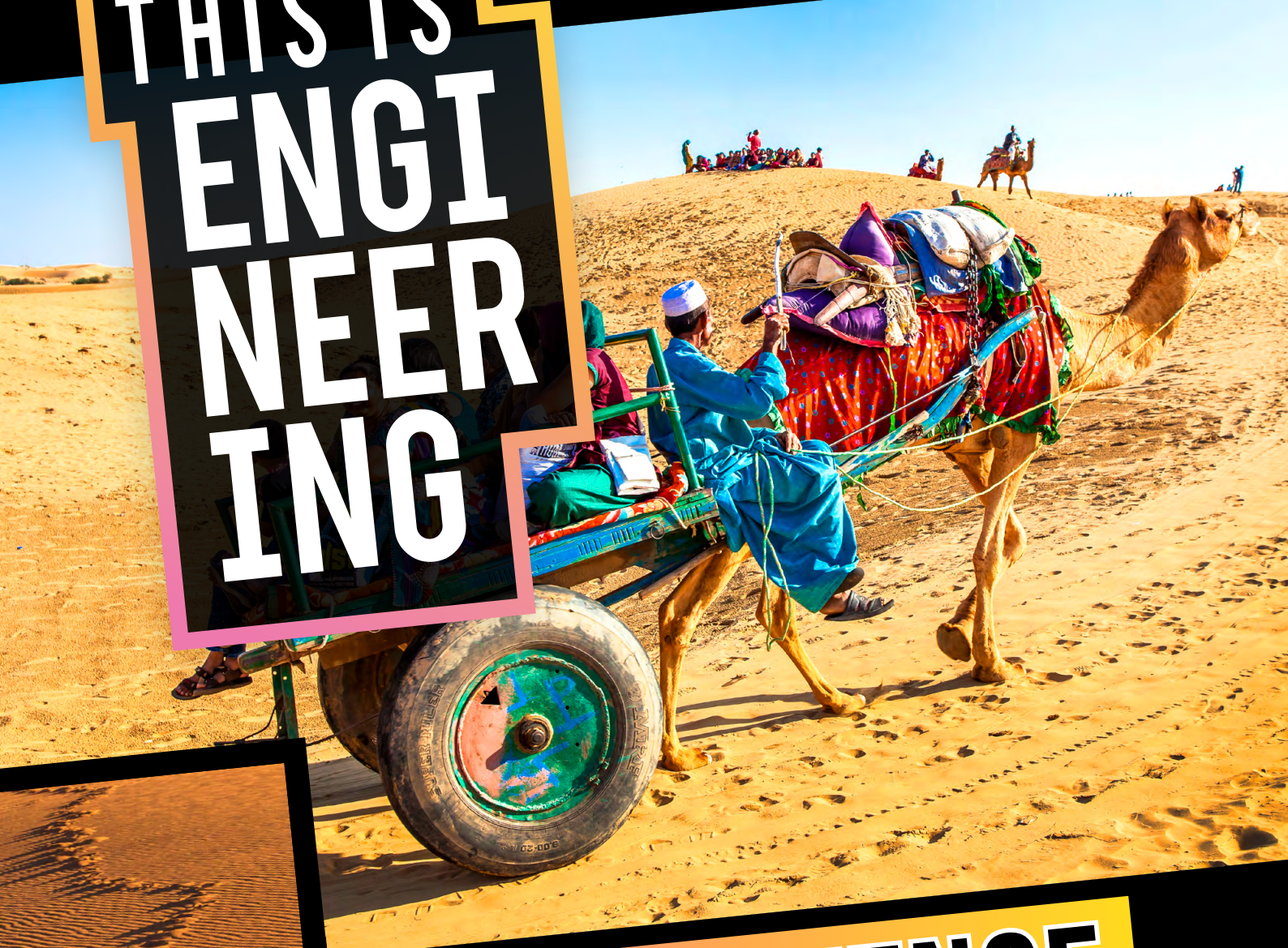
Royal Academy of Engineering

THIS IS ENGINEERING



OUR EXISTENCE

Desert

This resource explains how an indigenous population has created an engineering solution to the problems they encounter in extreme heat, including solar power and traditional desert dress.

DESERT

Most people think of deserts as vast areas of heat and sand, but, the largest desert is in fact Antarctica. Deserts cover one-fifth of the Earth's surface, and gets less than 10 inches of rain a year. The largest hot desert on Earth is the Sahara, which covers 3.5 million square miles and can reach temperatures of above 50°C.

KEEPING COOL

Exposure to such high temperatures can affect the body in adverse ways.

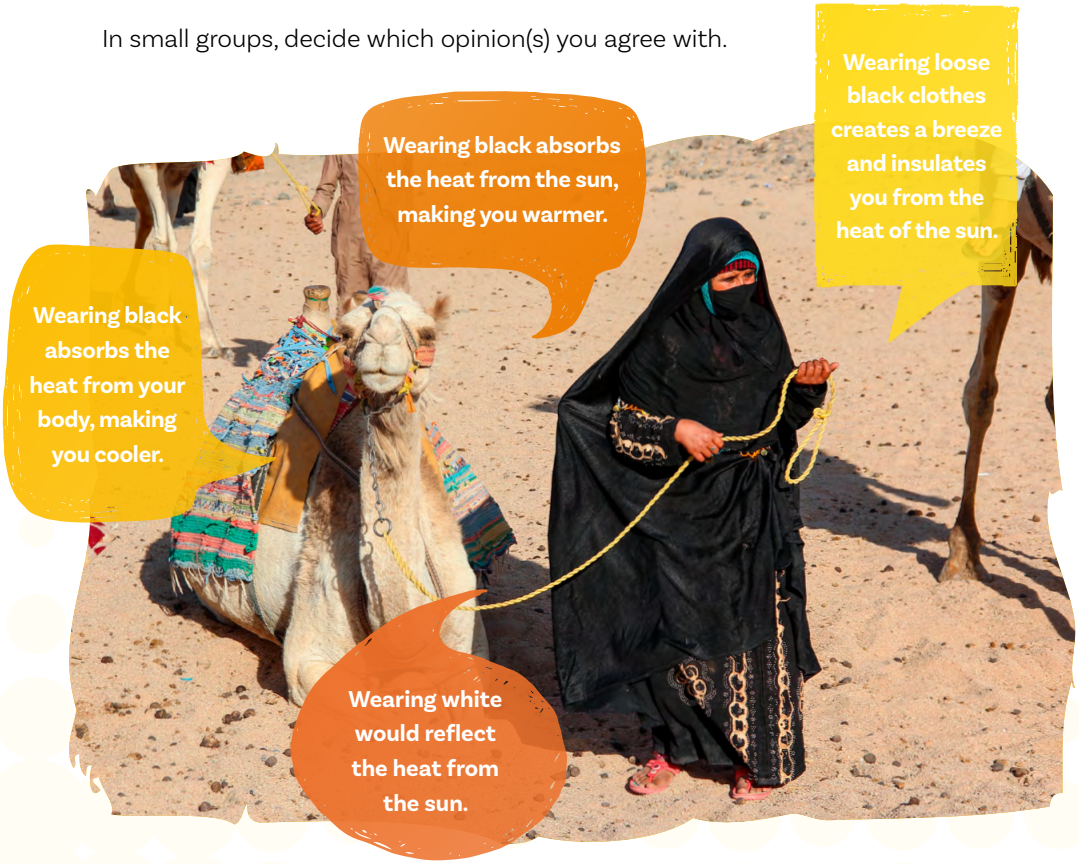
Heat exhaustion is where a person becomes very hot and starts to lose water or salt from the body. Heatstroke can occur when the body's core temperature is above 40°C. At this point the body is no longer able to cool itself. If left untreated heatstroke can put strain on the vital organs.

Traditionally, Bedouin women wear black dresses and head covers to keep themselves cool in the hot desert.

Activity 1

Discuss why the Bedouin women would wear loose black clothing in the desert.

In small groups, decide which opinion(s) you agree with.



Bedouin woman wearing traditional black clothing

Massimo Vernicesole / Shutterstock.com

- Why do you agree with that opinion?
- What evidence do you have to support your ideas?

WATER IN THE DESERT

The desert also has the added danger of a lack of available water.

Dehydration is caused by not taking in as much fluid as the body loses. Dehydration can cause dizziness and headaches. If dehydration is ongoing or untreated it can lead to kidney stones, or in severe cases, seizures or loss of consciousness.

The fogstand beetle (**Stenocara gracilipes**) is a species of beetle native to the Namib Desert in southern Africa. The beetle collects much needed water on its bumpy back surface from early morning fogs. To see the fogstand beetle in action, watch this clip: **http://tinyurl.com/fogstand**

Shutterstock.com

Activity 2

Use the fogstand beetle to design a way to collect water from morning dew or fog.

In pairs, you will need to design a fog catcher. To create your fog catcher you can use string, mesh or any other materials you have available. Remember, you will need to deliver the water to a storage container so that the water can be used.

Once you are happy with your design, make and test your fog catcher.

Are there any improvements you can make to your fog catcher?

Using ideas from nature in engineering solutions is called biomimicry.

ENERGY IN THE DESERT

The Sahara desert contains large deposits of oil and natural gas.

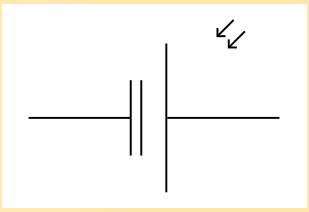
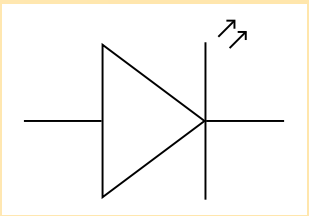
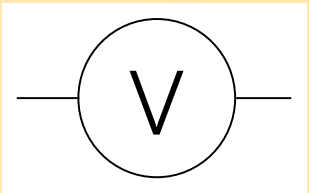
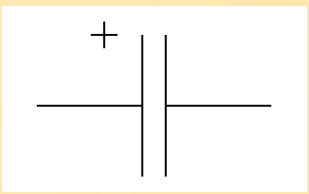
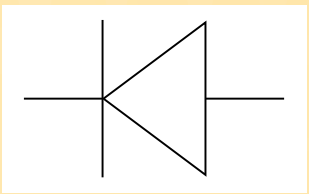
Oil and gas are non-renewable resources, which release harmful chemicals when burnt to generate electricity.

Solar power is an emerging industry in Morocco where the Noor I power plant opened in 2015. The solar power plant is situated on the edge of the Sahara desert near the town of Ouarzazate and is capable of generating up to 160 megawatts of electricity. This power plant uses the thermal energy from the sun to heat water into steam. However, another way to harness power from the sun is to use solar panels that convert light energy directly into electrical energy.

Activity 3

In small groups, design a solar-powered light that families can use in the desert.

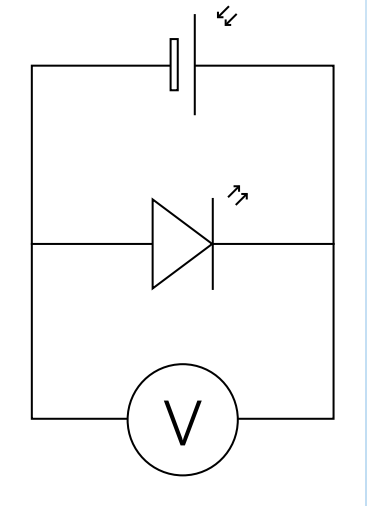
Here are the symbols of components you will be using, some of them you might be familiar with.

Component	Symbol
Solar cell	
LED (light-emitting diode)	
Voltmeter	
Capacitor	
Diode	

Part 1

Investigate the output of solar cells

First set up the following circuit to investigate the output of a single solar cell. Test the output in different conditions.



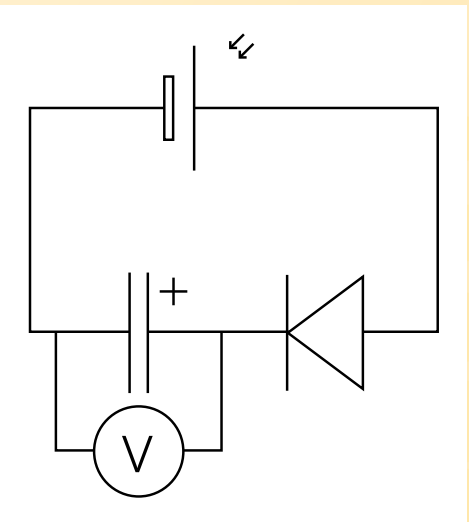
Light conditions	Output voltage (V)
Bright sunlight	
Overcast daylight	
Indoor electric light	
Torch	

Part 2

Investigate how you can store electrical energy with a capacitor.

A capacitor can be used to temporarily store electrical energy. When connected to a charging circuit the capacitor will charge, storing the electrical energy. The capacitor will discharge this energy when disconnected from its charging circuit, so it can be used like a temporary battery. Capacitors are commonly used in electronic devices to maintain power supply while batteries are being changed.

First, set up this circuit with a capacitor, solar panel and a diode. Take extra care to make sure the positive and negative connections are the right way around.

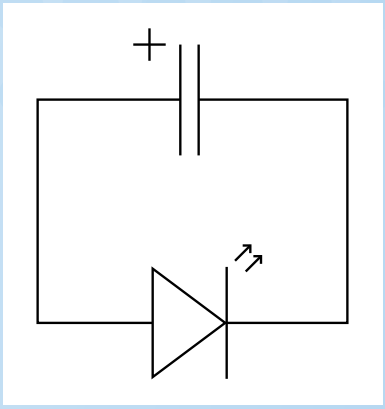


How long does the capacitor take to charge to 2.5V?

Do not charge the capacitor beyond 3V.

Now that your capacitor is charged, it can be used to power your LED. Set up the following circuit:

How long can the capacitor power the LED?



Part 3

Using what you have learnt from your investigations, design and make a prototype of a light that families in deserts could use to be able to see at night.

You should think about the following when designing your product:

Part 4

Create a presentation for your product to pitch your idea to potential investors.

STRETCH AND CHALLENGE

Design a circuit for your product so that the light will turn on when it gets dark.

NOTES FOR TEACHERS

ACTIVITY 1

Black, matte objects are good absorbers and white, shiny objects are good reflectors.

Wearing loose fitted, black clothing means that air is able to circulate and heat radiated by the body can be absorbed by the clothing and radiated away. Wearing long loose clothing can also protect against UV rays.

You could extend this activity by experimenting on heat transfer though different coloured fabric.

ACTIVITY 2

The prototype fog catchers could be tested in the school playing fields if left overnight for the collection of dew, or in a classroom that has been humidified.

To humidify a classroom, you would use a humidifier, or if that is not available, place beakers of water on a Bunsen burner or radiator.

ACTIVITY 3

Conduct a full risk assessment before this activity. This activity works best in the summer term or sunny months.

Part 1

You could extend this to investigate how having more than one solar panel in series and parallel affects, the output voltage.

Part 2

The time it takes for the capacitor to charge depends on the power the solar panel provides.

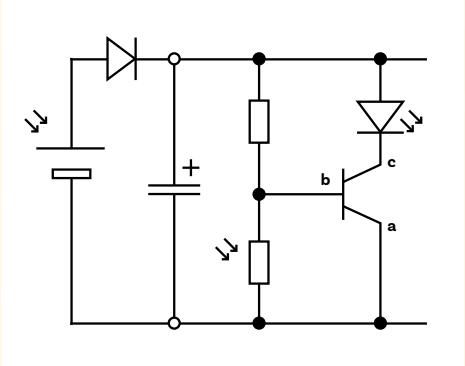
If the solar panel is not charging the capacitor, then a battery can be used to charge the capacitor in seconds.

Part 3

A fully charged 10F super capacitor will power a small LED for several hours.

STRETCH AND CHALLENGE

Students should research ways to make this circuit themselves. However, here is an example circuit diagram for an automatic switch:



Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

Royal Academy of Engineering
Prince Philip House
3 Carlton House Terrace
London SW1Y 5DG

Tel: +44 (0)20 7766 0600
www.raeng.org.uk
Registered charity number 293074