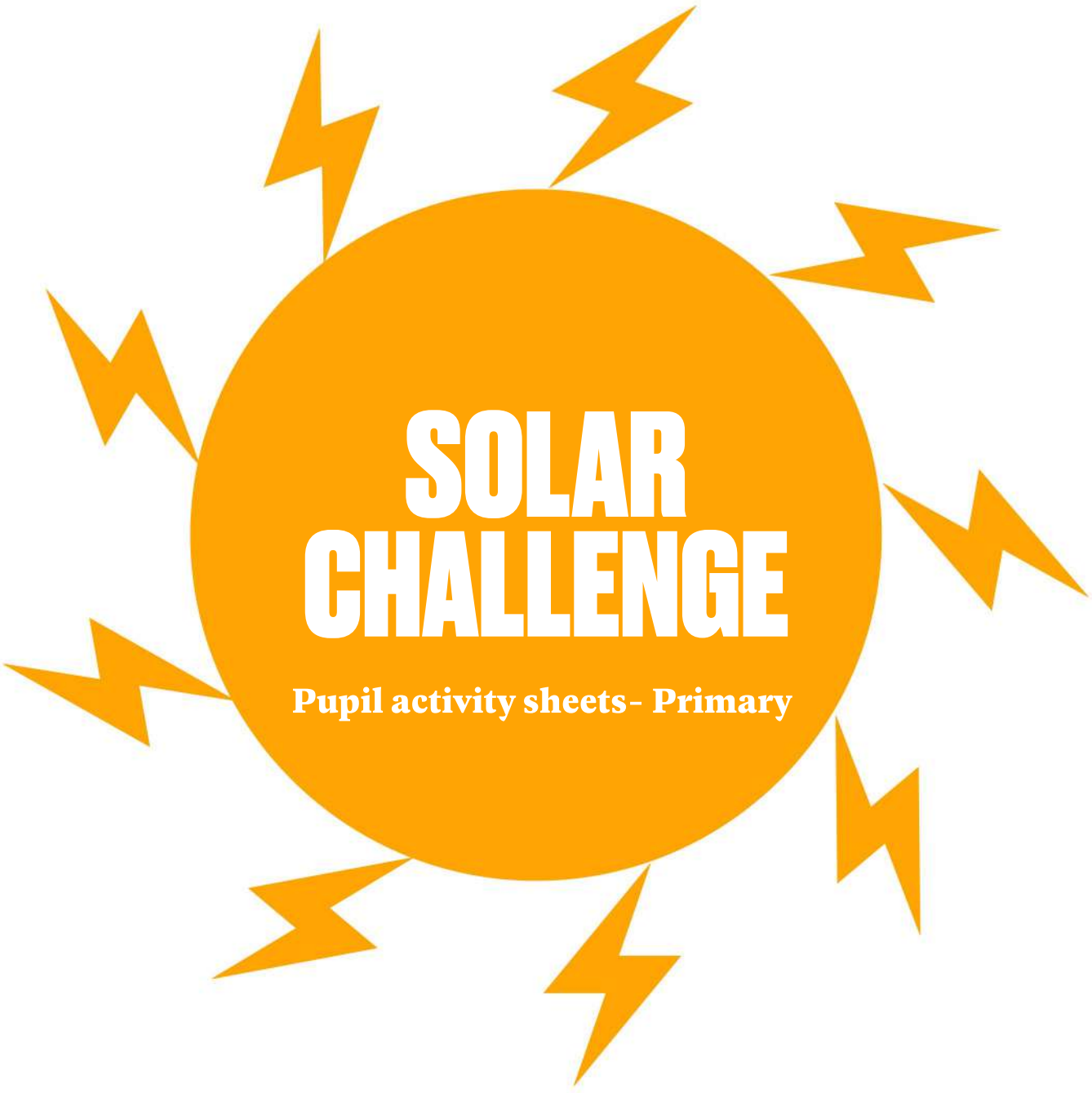


SOLAR CHALLENGE

Pupil activity sheets- Primary

Making a National Grid – place cards

LONDON

Population

8 million

LEEDS

Population

800,000

Making a National Grid - power stations

TRURO

Population

19,000

CARDIFF

Population

350,000

NORWICH

Population

145,000

GLASGOW

Population

600,000

RUGBY

Population

105,000

ST. IVES

Population

11,000

The Sustainable Development Goals

No poverty	End poverty in all its forms everywhere.
Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
Good Health & Well-being for People	Ensure healthy lives and promote well-being for all at all ages.
Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Gender Equality	Achieve gender equality and empower all women and girls.
Clean Water & Sanitation	Ensure availability and sustainable management of water and sanitation for all.
Affordable & Clean Energy	Ensure access to affordable, reliable, sustainable modern energy for all.
Decent Work & Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Industry, Innovation & Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
Reducing Inequalities	Reduce income inequality within and among countries.
Sustainable Cities & Communities	Make cities and human settlements inclusive, safe, resilient, and sustainable.
Responsible Consumption & Production	Ensure sustainable consumption and production patterns.
Climate Action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss.
Peace, Justice & Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Building circuits to explore the use of solar cells

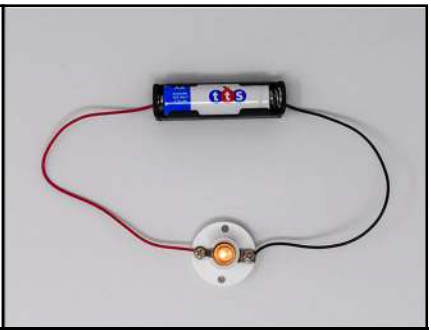
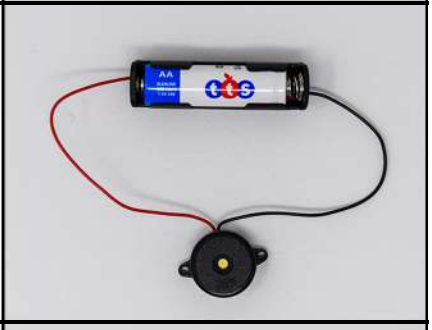
Name:

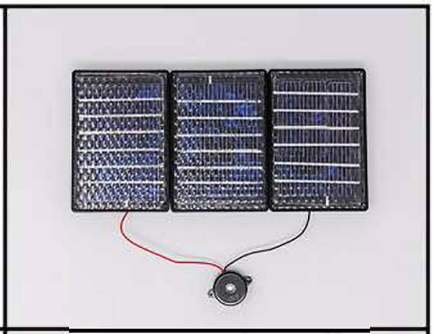
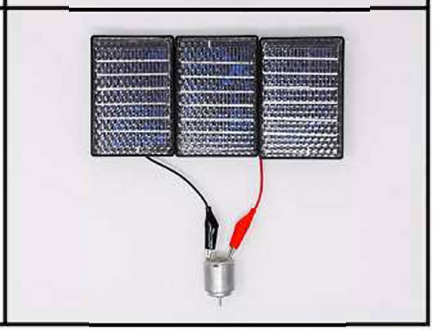
Class:

In these activities you are going to be finding out how solar cells can be used to provide power for circuits.

1. Getting the power

The first thing to do is to think about how to use a battery in a circuit.
Try setting up these circuits:

a. Connect a battery to a bulb – find out what happens and write it down here.	
b. Now connect the battery to a buzzer – see what happens and write it down.	
c. Now try connecting the battery to a motor – make a note of what happens.	
The battery can be replaced with a solar cell. (You may need more than one to do the same job as a battery.)	
d. Find out if the bulb can be powered by solar cells and write down what happens.	

e. Now see if the buzzer can be powered by solar cells and make a note of what you see.	
f. Now connect the solar cells to a motor– see what happens and write it down.	

The first of these experiments might seem a bit odd – why use light to get the solar cell to produce electricity, and then power the bulb to make light? There are good reasons though. The solar cell is likely to be on the roof of a building, and the bulbs in a room that has little or no natural light.

What does a solar cell do?

In what way is a solar cell like a battery?

In what way is a solar cell different to a battery?

2. How much light?

A solar cell needs light to work. In this experiment we're going to find out how much.

How could you set up an experiment to see how the amount of light affects the amount of electricity the solar cell produces? Here are some questions that might help you to plan the experiment.

a. How are you going to vary the amount of light that reaches the solar cell?

b. How will you know how much electricity the solar cell is producing?

c. What will you need to measure or describe how much electricity is being produced?

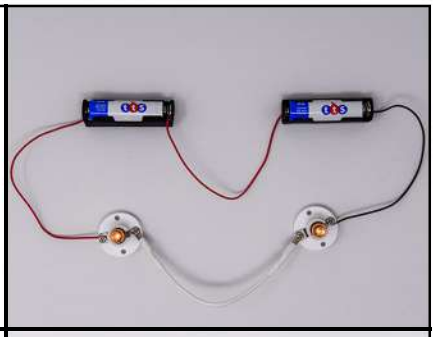
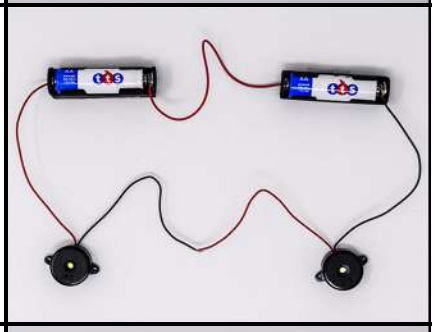
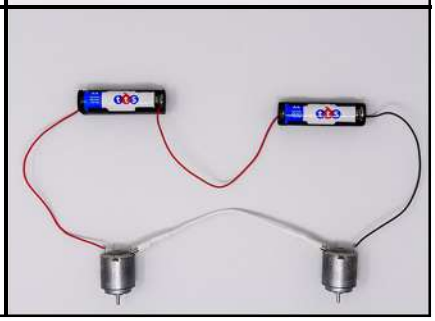
d. How will you record your evidence?

Now try setting up your experiment and finding out how the amount of light affects the amount of electricity produced.

e. What did your experiment show?

3. Turning up the power

If more power was needed in a circuit, more solar cells could be used. Solar cells can be connected together in the same way that batteries can. As with batteries, it matters which way round they go.

a. Let's revisit how batteries work. Set up a circuit with two bulbs. Put one battery in the circuit and see what happens. Now try three. What was the effect?	
b. Now try this with a battery and a buzzer. Increase the number of batteries and the number of buzzers to two. What happens?	
c. See if the same thing is true with motors as well. What happens?	

Note: care has to be taken with this. Too many batteries mean too much power and this can blow bulbs and burn out buzzers and motors.

d. Set up a circuit with three bulbs. Try to power these using a solar cell. Now try two cells. What difference did it make? Now try three. What happens?

e. Try using the solar cells to power a set of buzzers. Does the same thing happen?

f. Try your ideas out now with motors. What happens?

Let's think about what we've learned here.

What happens if we connect several solar cells together?

What have we got to be careful about when connecting them together?

Why might it be useful to connect a large number of solar cells together?

Your Solar challenge

Name:

Class:

Many villages in Gwanda do not have access to mains electricity. Combined with drought this has led to families going hungry as they cannot grow enough food to eat and sell.

A village of 40 households has had some great news...they have received funding for ten solar cells.

"I see myself living a happier life. My children will be able to live healthily, eat more often and able to focus in school."

Your challenge is to work as a team to explore how best to use the ten solar cells to bring the greatest benefit to the community.

Solar Challenge Activity	Useful worksheets	Who will lead?
Teamwork – assign team roles. You have a lot to do, so decide who in your team will do what to make the best use of your skills and time.		
Research – carry out research to make sure you have the knowledge to make the best recommendations for the use of solar cells.	- *Community case studies* - *What does the community in Gwanda need electricity for?* - *Village map*	
Developing and finalising your ideas – work out the best use of the ten solar cells.	- *Power to the people!* - *How much electricity do appliances use?* - *Appliance energy cards* - *Ten squares = 10 units* - *Village map*	
Modelling your ideas – use the community map and/or your model to show your recommendations for the positioning of the solar cells.	- *Village map*	
Presenting your ideas – plan a three-minute presentation to capture how your research helped you make your recommendations. **Reflection** – think about how you worked as a team and what you have learnt through doing the solar challenge.	- *Team feedback*	

Community case studies

Before you make decisions about the best use of electricity for the community, it is important to find out more about the lives of people living there and the village layout.

In your groups look at the photographs and read the different *Community case studies*. Record any ideas you have for how electricity could be used to help the different people on the sheet *What does the community in Gwanda want electricity for?.*

Primary School

This primary school has 827 children.

When the primary school has funding they have school feeding schemes to try and attract students to come to school. At the moment the school has little funding so a lot of children are missing classes.

Many children have to help their families to fetch water, which involves walking long distances. This makes them late for school.

"The biggest challenge we have is our children come to school on empty stomachs."
Deputy Head teacher.

Community health clinic

The clinic supports six villages with a combined population of nearly 6,000 people.

The nurses offer a range of services including vaccinating children and handing out food for families in need, especially for families with children under two years old.

They are also trying to reduce the number of teenage pregnancies by offering advice to young people.

"We have recorded cases of malnutrition especially amongst children under five who suffer a lot from insufficient feeding due to a lack of food."

Small-scale farmer

Mrs Mube grows and sells vegetables and clothes to support her three children and herself.

A shortage of water is a big challenge for her. The nearest borehole is about 7 kilometres away. She walks there every day to collect at least 100 litres of water.

"There is no water and as a result we are producing very little in our garden. It's not enough to feed my family."

She hopes the solar-powered systems will help the community access water and also that she will ***"be able to put up lights to help keep chickens."***

She wants to be able to earn enough income to take care of her household.

Small-scale farmer

My Moyo is married with four children. He grows maize,potatoes, tomatoes and onions for a living. As rain fall has decreased in the region the fields are not producing enough.

"Water is a big problem for us. We spend our time thinking of ways we can get more of it."

To increase the family income he often goes in search of other work such as making bricks and wooden chairs.

Given access to water, Mr Moyo said,

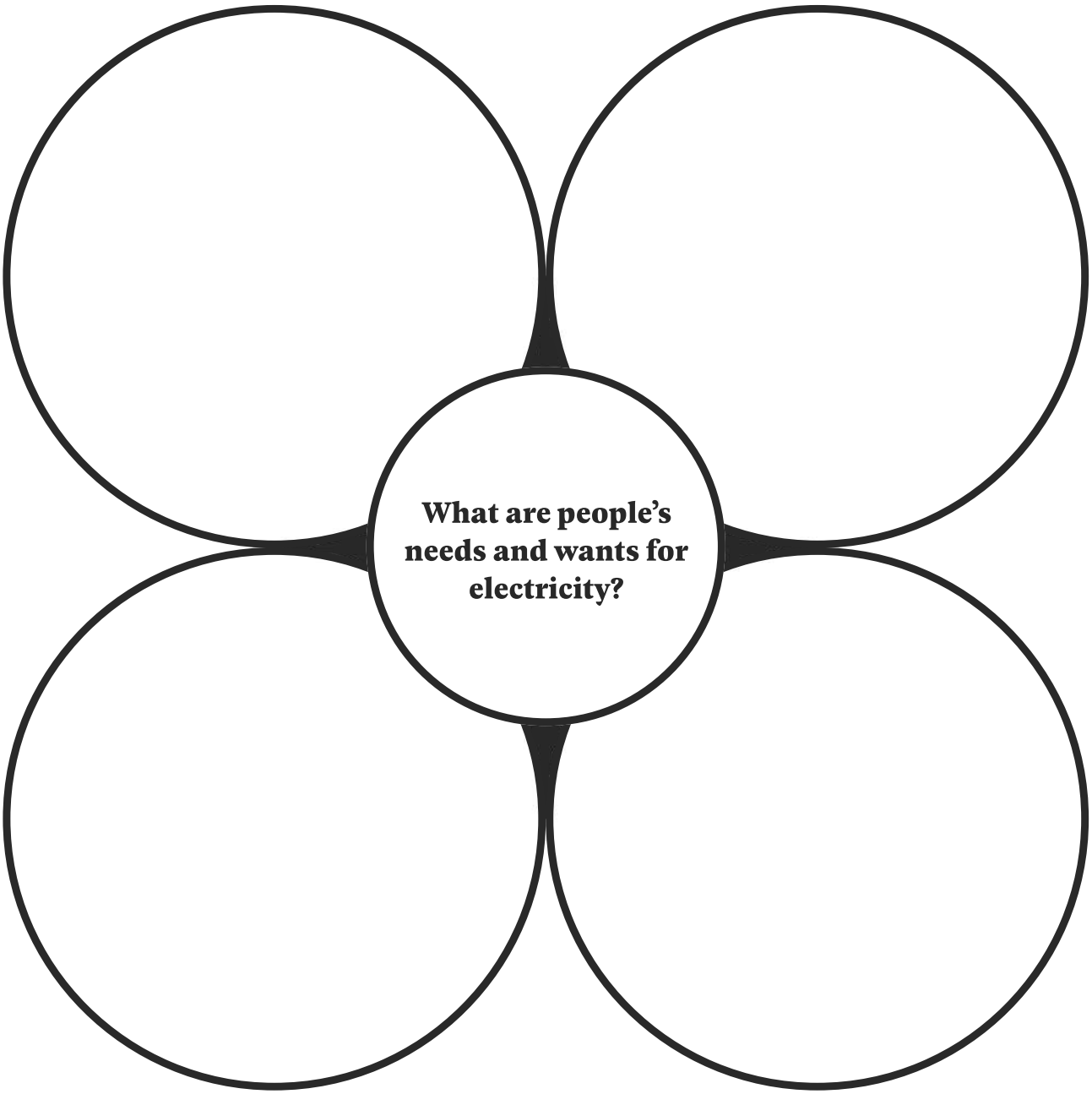
"I hope to grow and produce the kinds of crops that allow me to sell so that I can take care of my family and be able to provide for their needs such as schools supplies."

What does the community in Gwanda want electricity for?

Name:

Class:

Record details of people, their roles and their possible needs for electricity.



How much energy do electrical appliances use?

Name:

Class:

Electrical energy is measured in units. This is how you pay for electricity at home – and how your school pays for it too. The electricity meter shows how many units you have used. The more units used – the more you have to pay!

The first one has been done for you. Complete the rest of the table.

Application	Number of hours used in the day	Amount of energy used in one day	Amount of energy used in one day shown graphically
 100W filament bulb	5	0.5	
 Colour TV	5	0.8	
 Space heater	5	10	
 Electric kettle	0.5	1	
 Fridge/freezer	24	6	
 LED bulb	5	0.1	
 Phone charger	1	0.01	
 Water pump to irrigate crops	6	6	

Appliance energy cards

100W filament bulb

5 hours a day = 0.5 units

Colour TV

5 hours a day = 0.8 units

Space heater

5 hours a day = 10 units

Phone charger

1hr a day = 0.01 units

Electric kettle

0.5 hours = 1 unit

LED bulb

5 hours = 0.1 units

Fridge/freezer

24 hours = 6 units

Irrigation pump

6 hours = 6 units

Computer

8 hours = 0.3 units

Radio

4 hours = 0.1 units

Use these cards showing typical uses of electricity in a day to help plan your daily use for the village.

Electricity at night time

Some electrical appliances are likely to be used more in the evening or throughout the whole day. The solar cells do not produce as much electricity then. But you don't need to worry about this – the solar system can have a device called an accumulator. It stores energy during the day so it can be used at night time.

Power to the people!

Some tips to help you plan the use of solar cells for the village

Each solar cell produces one unit of electricity a day. The community has up to 10 units of electricity to use each day.

Use your research on the community and look at the *Appliance energy cards* to help you decide how many of the different appliances you want your village to have on each day.

Record your decisions

Use the table below or the excel sheet – old.practicalaction.org/power-primary

Application	Number of hours used in the day	Amount of energy used in one day	Amount of energy used in one day shown graphically
Total amount of energy used in the village in one day. ***Note: This cannot be more than 10 units.***			

Ten squares = 10 units of energy

Each team should have a strip of 10 squares for them to work out their use of energy for the village.

Shade in the squares to show how you plan to use the energy in the village. Using different colours or types of shading might help.

Add notes underneath to remind you what the uses are.

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Add notes underneath to remind you what the uses are.


Village Map
Next village 5km
Sleeping room
House
Toilet
Grain store
Chicken shed
Communal gardens
Communal area
School
Market area
Garden
Toilets
Cattle enclosure
Health clinic
Water hole 2km
N
W
E
S

Team Feedback

Name:

Listening to other people's ideas and feeding back to them in a positive way is really helpful for them.

Listen to the presentations from each group. Think about how well they did in terms of the criteria in the table below. Make notes and give them a mark out of 5 for each area, where 5 is the best.

Practical ACTION

Team name	Teamwork Did they work well as a team?	Research How well did they carry out their research?	Developing and finalising ideas Did they develop some good, innovative ideas, and improve on them?	Plan How good is the plan?	Presentation How well did the team communicate their work?	Final score