

Wonder
Project

Power Challenge

Rōpū name:

Rōpū members:

Activity 6.2: Wonder Project competition

The challenge:

Create a video or poster that tells the story of your challenge journey. You'll go in the draw to win a prize and be crowned this year's Wonder Project champions.

How to enter

Each school can submit either:

1. A video
2. A poster

To enter, you must have completed:

- Pre and post challenge surveys

Get creative!

Here are some ideas of what you could include in your entry.

1. Introduce your rōpū
2. What did you learn in your challenge?
3. Show off your mahi

Send in your entry

- Get your kaiako or ambassador to upload your entry to the Wonder Project community Facebook group, OR
- Send your entry to hello@wonderproject.nz

Judging

Team Wonder will be judging all entries for the year in October.

Your entry will be up against entries from all challenge participants so make it stand out!

Good luck and may the best rōpū win!

Activity 1.1: Ask

STEM superstars start their projects by asking lots of pātai. This helps them understand the problem they're trying to solve.

The big problem you need to solve is:
I wonder how to power a brighter future?

Let's start by thinking about your goals and how to achieve them.

I wonder what our goals are?

The main goal is to successfully power a hapori (community) with renewable energy using a wind turbine and solar panel. What does success mean to your rōpū?

E.g. Our goal is to power the entire hapori with wind energy alone.

I wonder what pātai to ask?

What do you need to know more about to achieve your goals?

E.g. I wonder how wind is turned into electricity?

I wonder what problems we'll need to overcome?

What potential problems can you think of now to help you find a solution faster?

E.g. I wonder how we could improve our design if it doesn't generate enough power?

Activity 1.2: Exploring energy

Think like a STEM detective to find energy in your kura.

From the sun shining to a school bell ringing, energy is what makes things happen!

In your rōpū, find one example of each energy form. Then write down what it is, and why it fits.

If you find an example that no other rōpū has, you'll get one point. The rōpū with the most points at the end is the winner!

Energy forms	Example	Explanation
Kinetic energy	Running drinking fountain	The water is moving, so it has kinetic energy
Light		
Thermal		
Sound		
Electrical		
Kinetic		
Optional extras	Example	Explanation
Gravitational potential		
Elastic potential		
Points:		

Kōrero

Discuss these pātai with the person next to you.

Which type of energy did you have the most ideas for?

Did you find anything that shows more than one energy form? What was it and what energy forms did it show?

Conclusion

Bright sparks, you've collected heaps of data, learned lots of new things, and powered-up some electrifying turbines. It's now time to use this information to answer our challenge pātai.

I wonder how to power a brighter future?

Because of STEM superheroes like you, the future is bright.

Analysis

The highest number of lights our class achieved was

's turbine performed the best because:

Conjecture comparison

Did your results match your conjecture? Why/why not?

Activity 1.3: Rubber band cars

Energy can't be created or destroyed, but it can be transformed!

Design and construct a small car to explore how energy is transformed from one form to another.

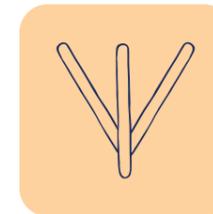
You'll need:

- 4 x popsicle sticks
- 1 x rubber band
- 2 x wooden skewers
- 1 x plastic straw
- 4 x bottle caps or similar for wheels
- Tape, scissors, hot glue
- Ruler or measuring tape

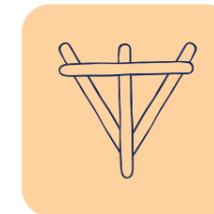
Step 1: Build the car frame



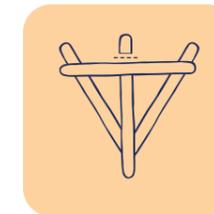
- Glue together two popsicle sticks in a "V" shape



- Glue a third popsicle stick down the middle of the "V", so it sticks out 2cm from the bottom of the "V"



- Glue a final popsicle stick horizontally near the top of the "V" so it crosses all three sticks

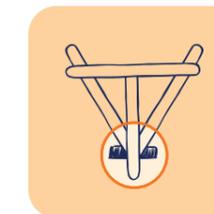


- Cut off the end of the middle stick

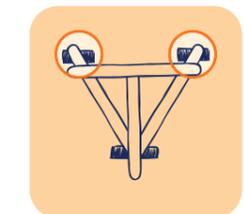


- Let the glue set before continuing

Step 2: Attach the axles



- Cut a 5cm piece of straw and glue it to the bottom of the "V", where the two sides join



- Cut two 2.5 cm pieces of straw, and attach one to each side at the top of the "V"





The great turbine test

Start by seeing how powerful your turbine is on its own.

Hook up your turbine to your printed circuit board (PCB). Then, set it up in front of a fan.

Colour in the lights that you turned on.



Light one:
Light bulb



Light two:
Computer



Light three:
Family home



Light four:
Marae



Light five:
School



Light six:
Museum



Light seven:
Library



Light eight:
Hospital



Light nine:
The entire town



Solar panel solutions

We rely on multiple renewable energy sources to power our hāpori. This helps us keep the lights on, whatever the weather!

Add a solar panel to the mix and see if you can light up the entire town.

Make sure every rōpū in your class uses the same light source and distance to keep the results fair.



Measure how far each car travels with a ruler

Rōpū name	Distance travelled (cm)	Observations

What energy transformations are happening?

Fill in the blanks with the right form of energy.

Sound energy

Kinetic energy

Elastic potential energy

Thermal energy

Stretched rubber band:

 →

Released car:

 + +

What factors made your car go further or faster?

Activity 2.1: Paper circuits

Can you create a simple circuit to turn the lights on?
It's as easy as one, two, three!

Create a path for electricity to **move** from the power source that **generates** electricity, to the load that **uses** the electricity.

Create your circuit

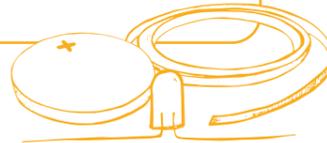
Step 1

Draw a path on the image that starts at point A, connects to the LED icon, and ends at point B.



You only need three basic things:

- Coin battery (the generator)
- Copper tape (the conductive path)
- LED (the load)



Step 2

Use the copper tape to cover the path you've drawn. Make sure you leave a gap where the LED symbol is.



When you create corners on your circuit, don't cut the copper tape! The sticky part on the bottom of the tape is not conductive so it will break your circuit. Instead, bend it into a corner shape.

Step 3

Bend the legs of the LED so they're flat. Attach the LED to your circuit, on top of the LED icon.



Your LED has positive and negative legs. Make sure you connect the positive leg of your LED (the longer leg) to the positive side of your circuit, and the negative leg of the LED (the shorter leg) to the negative side of your circuit.



Did you know?

Materials that let electricity flow through them are called conductors. Materials that do not let electricity flow through them are called insulators.

Step 4

Place the battery on point B, on top of the copper tape.



Your battery also has a positive and negative side – the positive side is labelled with a plus symbol. Make sure the battery is placed on your circuit with the negative side down.

Step 5

Fold the corner of your page so that the copper tape on point A (the positive side of the circuit), touches the positive side of the battery.



Did you manage to turn the lights on?

No light? No worries! Try checking that your LED and battery are the right way around so the circuit flows from positive to negative.



Activity 6.1: Light up our town

Calling all STEM superstars – your town needs you!

Work as a rōpū to light up the entire town using renewable energy solutions.

Ask: How will our design improvements impact our turbine's performance?

Our conjecture:

We think our design improvements will impact our turbine's performance by:

We think this because:

Activity 5.1: Improve

The improve stage is when STEM superstars work together to make their turbine the best it can be.

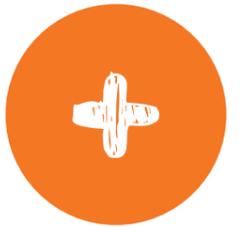
Take another look at everything you've learned across the challenge. Then, write down some things you could improve, and how you could improve them.



What we've learned about energy transformation:	What we've learned about aerodynamics:	What we've learned about torque:	What we've learned about blade design variables:
We can use this information to improve our turbine by:	We can use this information to improve our turbine by:	We can use this information to improve our turbine by:	We can use this information to improve our turbine by:

Now you can create your improved design and finalise your supercharged turbines!

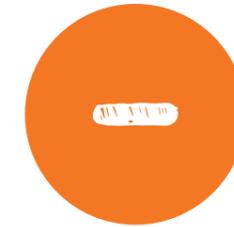
Start here



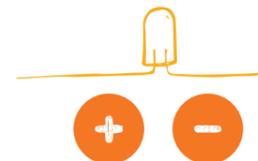
A

Fold

B



End here



Activity 2.2: Energy sources relay

Head outside and test your knowledge on New Zealand's incredible range of energy sources!

Get relay ready!

Step 1

Choose three renewable and three non-renewable energy sources we use in Aotearoa.

Step 2

Fill in the boxes with one of each of your energy sources. Then, cut them out.

Step 3

Each rōpū should now have their own set of six energy sources.

You'll need:

- A big outdoor area
- 2 containers per rōpū – one labelled renewable, one non-renewable
- Scissors

Energy source one:

Energy source two:

Energy source three:

Energy source four:

Energy source five:

Energy source six:

Kua rite koutou?

Step 4

In your rōpū, hand out one energy source per member.

Some members might need to take more than one energy source.

Step 5

Line up at the starting line in your rōpū. Any member with more than one energy source should stand at the front of the line.

Step 6

Choose one rōpū member to place your two labelled containers around 10 metres away from the starting point.

Step 7

When your kaiako says go, each rōpū member should take a turn to:

- Run to their containers
- Put their energy source in the correct container (renewable or non-renewable)
- Run back to the starting line

The rōpū who puts their energy sources in the correct containers, the fastest, are the energy source superstars!

Analysis

What worked well in your tests?

What didn't work well? How could you improve your design?

Does this result match with your conjecture? Why/why not?

Ask: How will our blade design impact our turbine's performance?

Our conjecture:

We think our turbine will light up lights.

Connect each turbine to the PCB by plugging the connector cable from the turbine motor, into the wind input on the PCB.

Keep the fan speed and distance the same for each test so you're only observing the effect of one variable – blade design.

We think this because:

Record your results

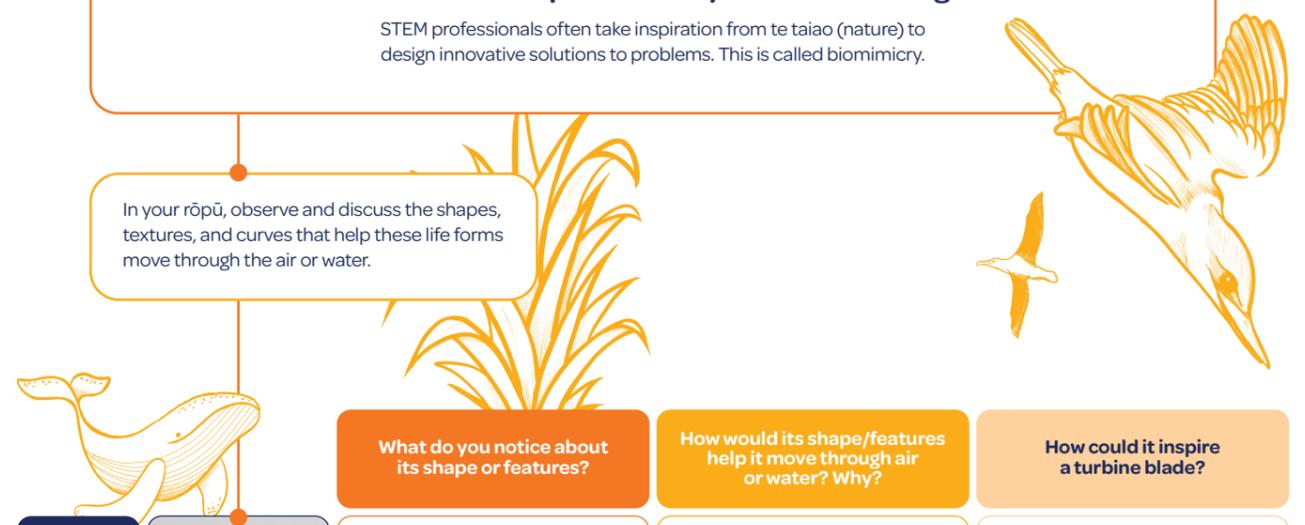
Test Tracker			
Rōpū name	Blade design	Pre-test conjecture	Post-test observation
Turitea	Shape: Koru Size: 15x3cm Number: 4 Materials: Paper	Number of lights: 2 Why: Blade material is too flimsy.	Number of lights: 0 Why: Paper flopped in the wind. The turbine did not spin.
		Number of lights: Why:	Number of lights: Why:
		Number of lights: Why:	Number of lights: Why:
		Number of lights: Why:	Number of lights: Why:
		Number of lights: Why:	Number of lights: Why:
		Number of lights: Why:	Number of lights: Why:

Activity 3.1: Naturally aerodynamic

Discover some of nature's most aerodynamic life forms to find inspiration for your turbine design.

STEM professionals often take inspiration from te taiao (nature) to design innovative solutions to problems. This is called biomimicry.

In your rōpū, observe and discuss the shapes, textures, and curves that help these life forms move through the air or water.



		What do you notice about its shape or features?	How would its shape/features help it move through air or water? Why?	How could it inspire a turbine blade?
Toroa (albatross)				
Kōtare (kingfisher)				
Harakeke (flax)				
Paikea (humpback whale)				

Discussion

Which shapes/features are the most aerodynamic? Why?

Which shapes/features could inspire your turbine blade design?

Activity 4.3: Time to test

Do some tests to see whether your turbine's powerful enough to light up your town.

Perform two tests on your turbine. During each test, observe what is happening, and record the results. This will help you improve your turbine in the next module.

Test 1: Prototype functionality

Engineers carry out functional tests to see if everything is working as it should – it helps detect early bugs!

Give it a whirl!

Give the blades a gentle push.

What do you see?

Are the blades balanced? Do they spin? Wobble?



Nope, it's not spinning yet.

Change one thing at a time and try again. Write the results below.

Yes, it spins.

Ka rawe! Time to power up your prototype.

Test 2: Power up your prototype

Your second test will help you determine how blade designs affect your turbine's performance.

For this test, you'll need:

- A printed circuit board (PCB)
- A fan (a 40cm desk fan will work best)

Activity 4.2: Create

Create your wind turbine prototype!

Watch the 'create' video, then use these instructions as a reminder to bring your design to life.

Create your turbine

Step 1

Make your blades out of your chosen materials using your design from Activity 3.2.

Step 2

Add decorations to the front of your blades.

Step 3

Attach your blades to popsicle sticks using hot glue. Wait for the glue to dry.

What you'll need:

From your power kit

- Base
- Wooden dowel
- 3D printed bracket (the turbine nacelle)
- Motor
- Hub
- Popsicle sticks
- Wingnut and screw

You'll also need recyclable materials to create your turbine blades, and decorations to make it your own.

Tip! Using different materials to make your blades will get different results. Choose carefully.

Step 4

Put the end of your dowel into the hole in your turbine base.

Give it a wiggle to check its stability.

Step 5

Assemble the nacelle. Slide the motor into the nacelle and feed the motor's connector cable through the hole in the bottom of the nacelle.

Step 6

Place the nacelle onto the dowel, slide to your desired height, and screw it tight using the wingnut and screw.

Step 7

Put your blades into the slots in the hub.

Think about how they're spaced out!

Step 8

Attach the hub to the motor pin.

You now have a terrific turbine!
Ka pai te mahi.

Activity 3.2: Blade design

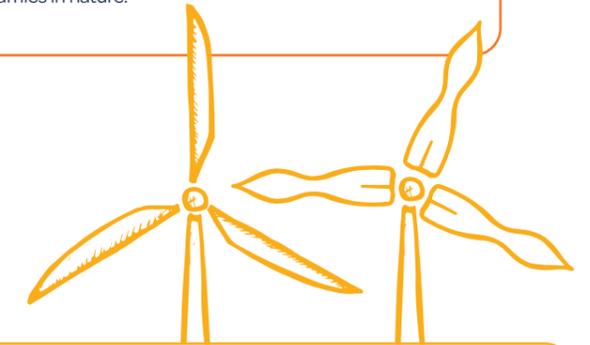
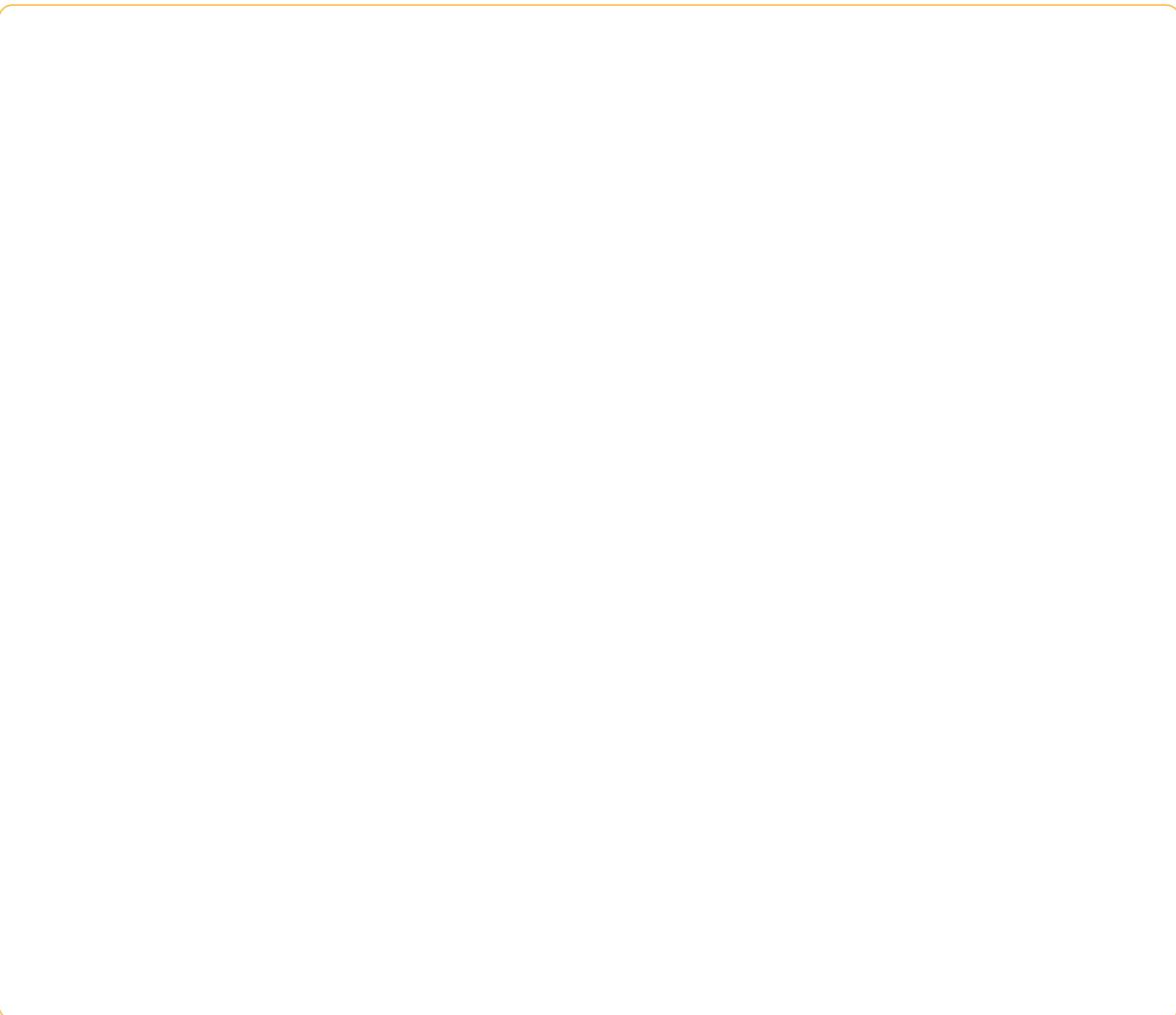
Imagine and plan some aerodynamic blade designs that will help you achieve your challenge goals.

Draw some 2D and 3D blade designs, using what you've learned about aerodynamics in nature.

Tip! Think about what features and shapes will power-up lift and decrease drag.

Imagine

Blade design ideas

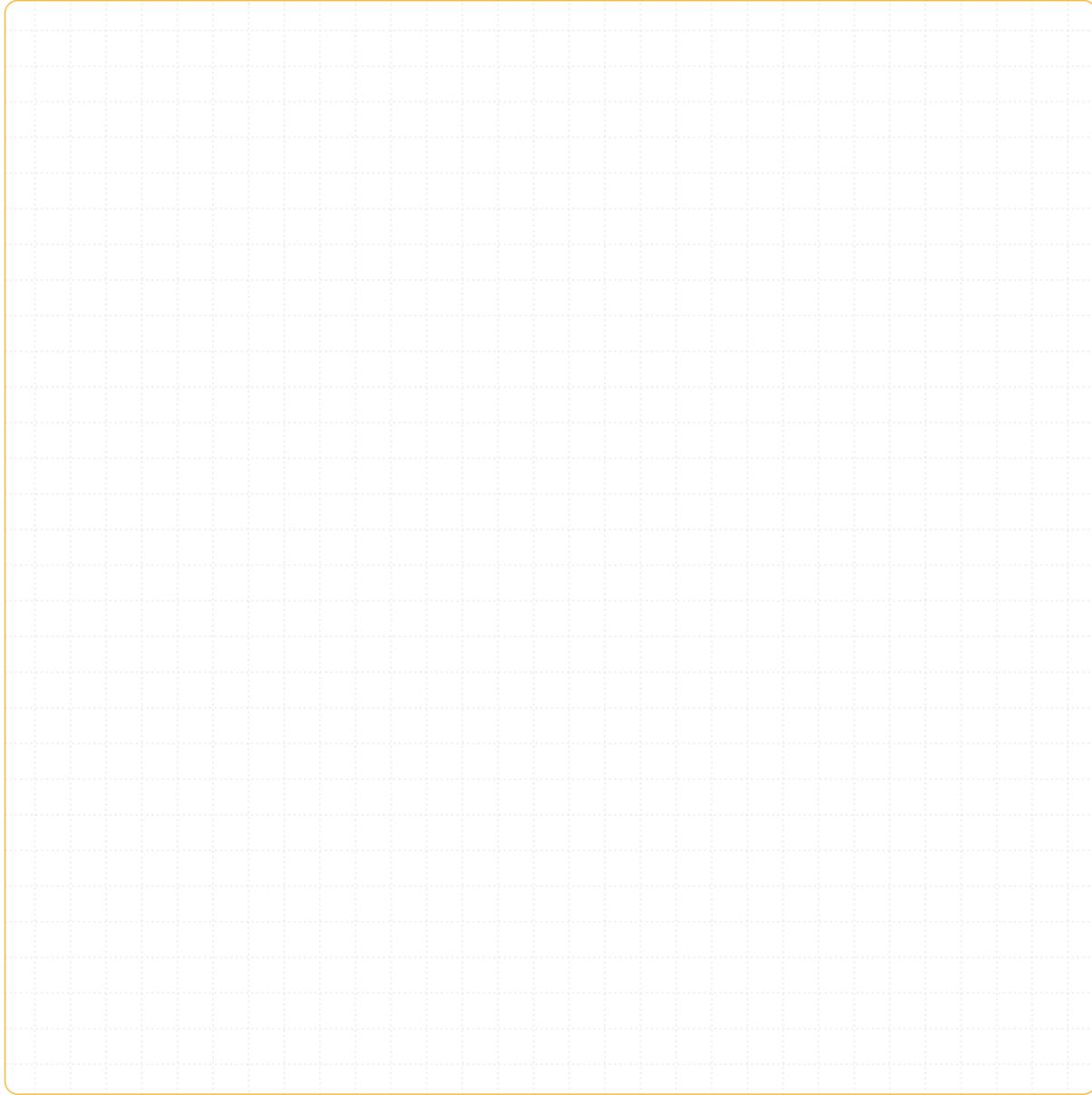


Plan

I wonder which solution is best?

Decide on your final blade design. Then, draw it in the grid, making it the same size and shape you want your actual blades to be. You might like to use a ruler to check measurements.

Our final blade design:



What aerodynamic design features have you used in your blade design?

An empty rectangular box for students to write down the aerodynamic design features used in their blade design.

What materials do you need to create your blades?

An empty rectangular box for students to list the materials needed to create their blades.

Activity 4.1: Great grid race

Race against your classmates to connect the steps in electricity's epic journey through the National Grid!

The National Grid moves electricity hundreds of kilometres across the country so that we have a safe, steady, and reliable electricity supply.

Your challenge is to recreate the journey that electricity travels to get to your home, faster than the other rōpū in your class. Using the cards in your power kit, work with your rōpū to put the steps in the right order as fast as you can.

Ready?
Get set,
charge on!

Step 1

Take a power card.



Step 2

Find classmates with the same colour card to form your rōpū.



Step 3

Talk to your rōpū and discuss what's on their cards.



Step 4

Starting with the 'toaster' card, work backwards to organise your cards in the correct order as fast as you can.

For an extra challenge, try putting them in order without reading the back of the cards!



Step 5

When you think you've got the right order, raise your hand.



May the brightest sparks win!