Wonder Project

Power Challenge

Rōpū name:

Rōpū members:

engineering new zealand te ao rangahau

ENERGISED BY TRANSPOWER

SUPPORTED BY EECA Mercury OMEXOM

Activity 4.3: **Power Challenge competition**

The challenge:

Create a video or poster that tells the story of your Power Challenge journey and go in the draw to win a prize.

Be in it to win it

Each school can submit either:

1. A video
2. Or a poster

You could choose to:

- Create your entry together as a school, OR
- Create an entry with your rōpū and get your kaiako or ambassador to select the best one

Schools who want to participate in the Power Challenge competition must have completed:

- All activity sheets
- Pre challenge and post challenge student surveys

Now let's get creative!

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

Introduce your rōpū

- Tell us about yourselves
- What were your roles and responsibilities?
- How did you use teamwork to complete the challenge?

What have you learned in the challenge?

- Can you explain how STEM relates to turbines?
- Show us what you know about renewable energy.
- How did you use the engineering design process?

Showcase your turbines

- Show off your innovative and creative turbine designs.
- How did you think like an engineer to solve problems and optimise your turbines?
- Show us your turbine in action through pictures, drawings, or a video.

Did you light up your entire town?

- Show us how many lights you turned on in your mini town.
- What aerodynamic design variables contributed to your final result?

Send in your entry

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

Good luck and may the brightest sparks win!

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.

Activity 1.1: Transforming energy

Energy transformations happen all around the world, every minute of the day. You can explore some everyday examples right here in the classroom.

Let's transform some energy!

First, you need to understand the energy forms you'll experience in this activity. You'll find them listed in the table below.

Discuss the energy forms in this table as a class to try and figure out what each one is.

Energy forms
Gravitational potential
Elastic potential
Kinetic
Electrical
Light
Thermal
Sound

Ready?

It's time to test out some everyday energy transformations in rōpū of four. Then, see if you can correctly fill in the blanks with the energy form you start with, and the energy form, or forms, you end up with.

Energy transformation tests

Example

A rollercoaster travels down a hill.

Gravitational potential energy (cart at the top of the coaster) → Kinetic energy + sound energy + thermal energy (cart travelling downhill)

Test 1

Hold a ruler at the edge of a table, with half of it hanging off the side. Flick the side that's not on the table.

________ → ________ (flicked ruler)

Test 2

Place your hands together, palm to palm. Then, rub them firmly and quickly against each other.

________ → ________ + ________ (hands rubbing)

Test 3

Turn off the classroom lights. Then, turn them back on.

______ (Lights off) → ______ + ______ + (Lights on)

Test 4

Hold a pencil above the floor. Then, let go.

______ (pencil held above the floor)

→ ______ (pencil dropping)

→ ______ (pencil hitting the floor)

Test 5

Blow up a balloon and hold the end with your fingers. Then, let go.

______ (Blown up balloon)

→ ______ + ______ (Released balloon)

Can you think of any other everyday energy transformations?

Write down your own examples in the box below:

Analysis

The highest number of lights our class achieved was ______

Rōpū name ______ 's turbine performed the best because

Conjecture comparison:

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

Record your data

Rōpū name	Generator 1: Wind turbine	Generator 2: Solar panel		Total lights
	Blade design	**Light distance**	**Light type**	
Turitea	*Shape: Koru Size: 15x3cm Number: 4 Materials: Paper*	*30cm*	*Flashlight*	*7*
	Shape: Size: Number: Materials:			
	Shape: Size: Number: Materials:			
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Activity 1.2: Paper circuits

You only need three basic things:

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

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

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 1

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

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.

Step 4

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

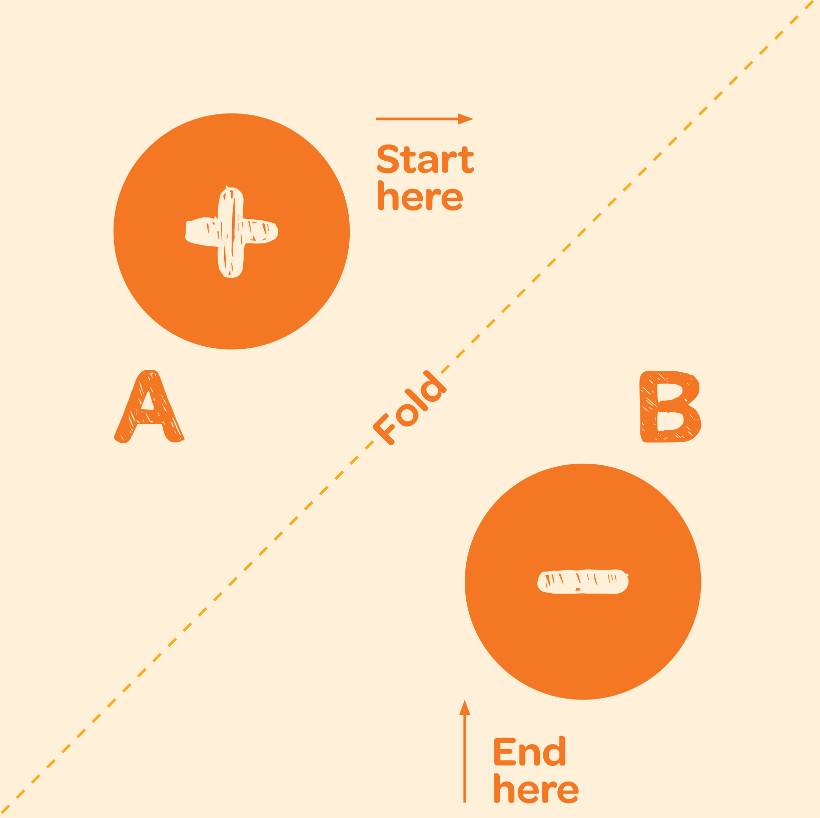
Your battery also has a positive and negative side – the positive side is labelled with a plus symbol. Make sure the battery is placed on your circuit with the negative side down.

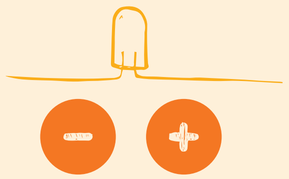
Step 5

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.



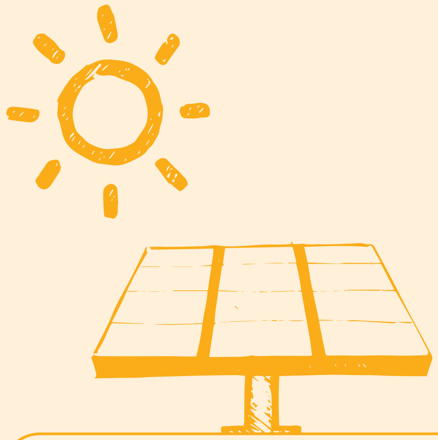


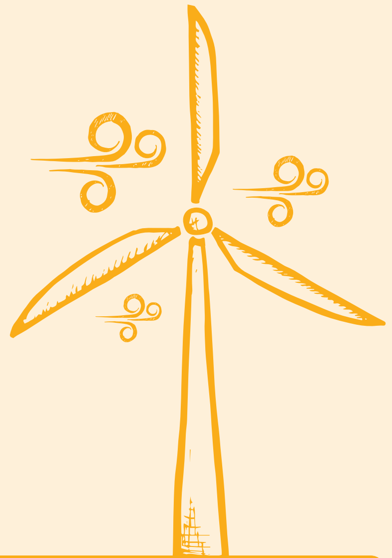
Solar panel solutions

We rely on multiple renewable energy sources to power our hapori. 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.





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 4.2: Light up our town

Calling all STEM superstars – your town needs you!

Your town uses electricity to take care of the hapori. They're relying on your STEM smarts to keep the lights on, the schools open and the hospitals running.

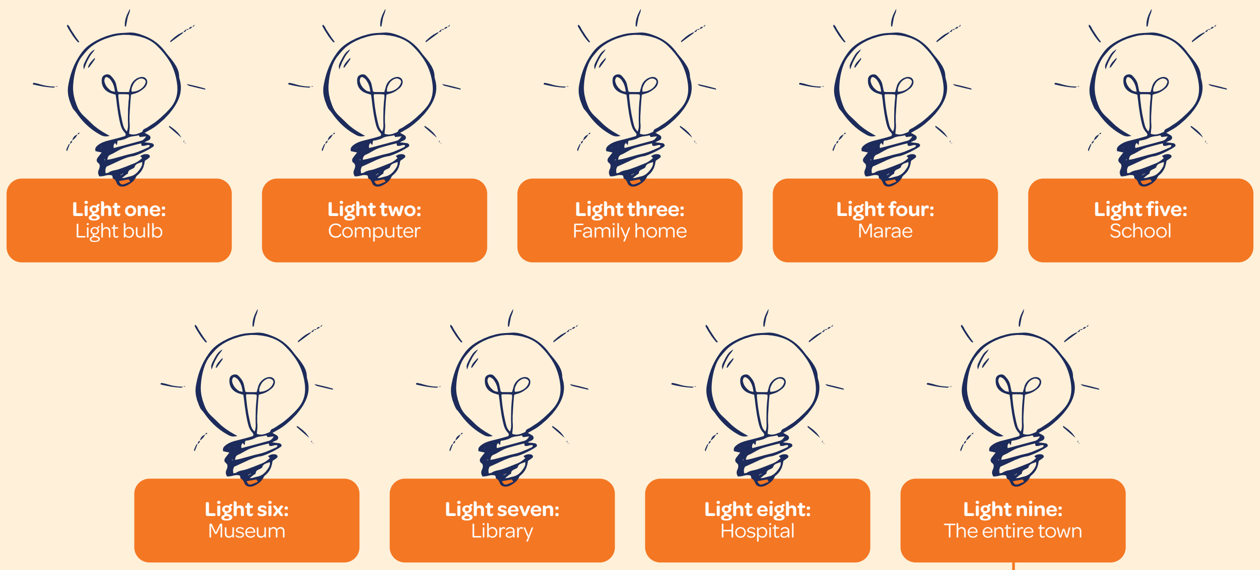
You'll need to problem solve and work as a rōpū to light up the entire town using renewable energy solutions. Good luck!

The great turbine test

Let's 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 with your turbine alone.



Activity 2.1: Energy sources relay

Test your knowledge on New Zealand's incredible range of energy sources the speedy way in the energy sources relay!

Get relay ready!

What you'll need:

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

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.

Energy source one:	Energy source two:	Energy source three:
Energy source four:	Energy source five:	Energy source six:

Kei te 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 line.

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!

Activity 2.2: 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:

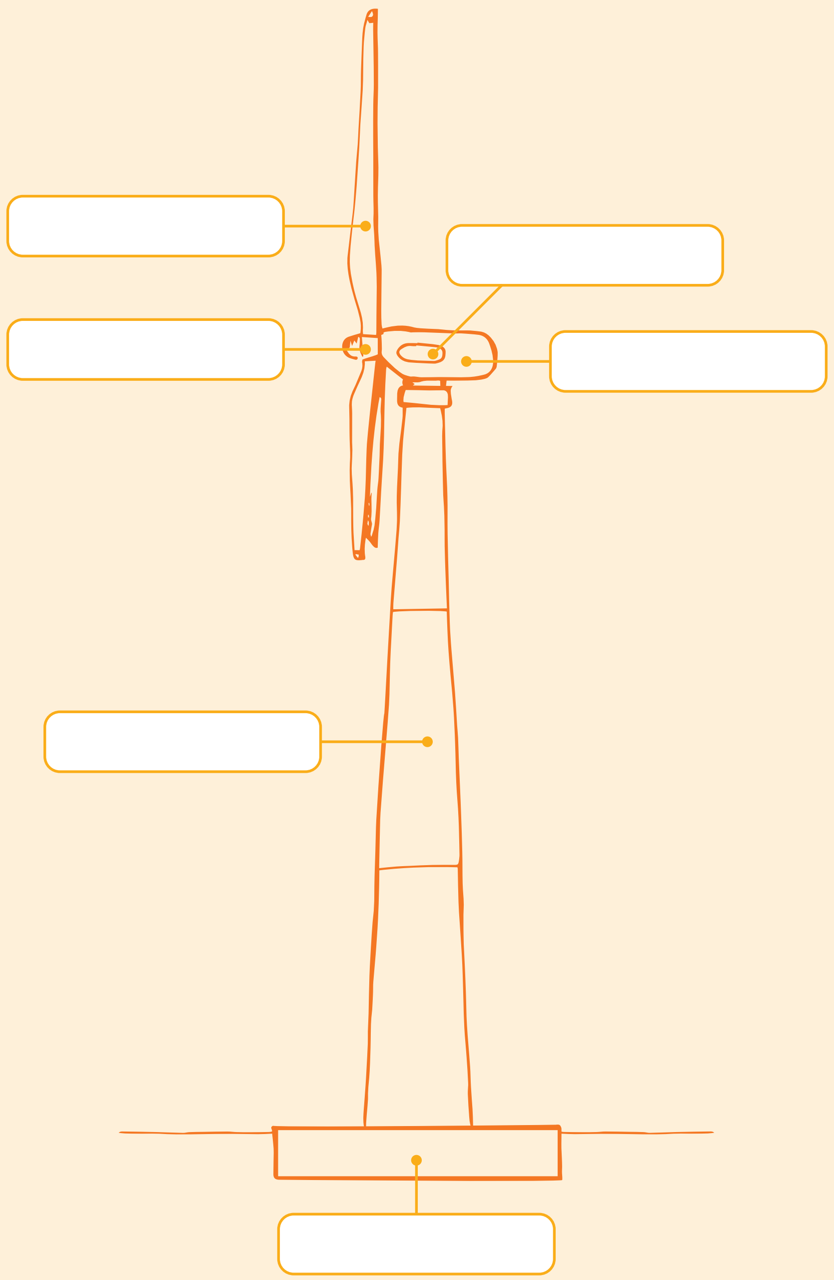
I wonder how to power a brighter future?

You can start to unpack this problem by answering these power-ful pātai.

I wonder what parts a turbine has?

Fill in the gaps with the correct turbine parts.

- Base
- Tower
- Generator
- Nacelle (generator housing)
- Hub
- Blades



Activity 4.1: 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 blade design variables:	What we've learned from testing our turbines:
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!

Analysis

What did you learn from your tests?

Which variables worked well? What didn't work well?

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

I wonder how a turbine generates electricity?

Fill in the gaps with one of these words. Some might be used twice!

Wind energy	Blades	Rotational energy	Generator	Electrical energy

When ____ moves over the turbine ____ ,

it transforms into ____ . This makes the blades spin.

The blades are connected to the turbine's ____ .

So, when the blades spin, the ____ spins.

This transforms the ____ into ____ .

I wonder how aerodynamics affects turbines?

Aerodynamics is:

It affects turbines by:

Some blade design variables that impact aerodynamics are:

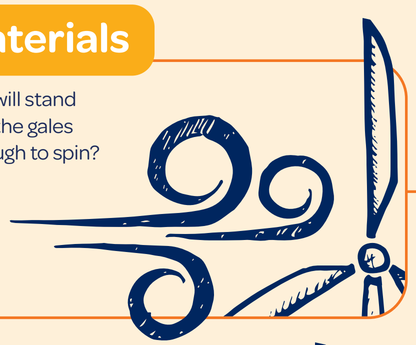
Activity 2.3: Blade design

Power up your imaginations! Imagine and plan some blade ideas that will help you achieve your challenge goal.

Draw some 2D and 3D blade designs, thinking about design variables and their impact on aerodynamics.

Blade materials

What material will stand strong against the gales but is light enough to spin?

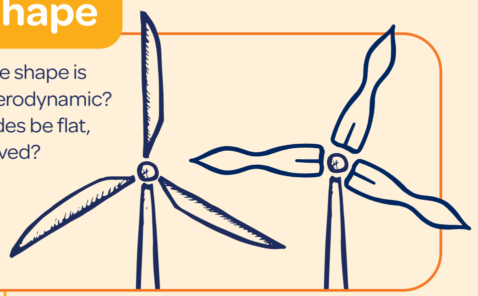


Blade size

Will bigger blades create more electricity or slow the turbine down?

Blade shape

Which blade shape is the most aerodynamic? Should blades be flat, bent or curved?



Blade number

Will a higher number of blades spin faster, or add too much extra weight?

Imagine:
Blade design ideas:

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

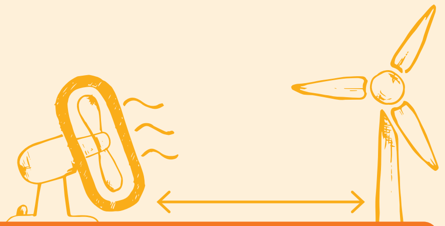
Our conjecture:

We think our turbine will light up ___ lights.

We think this because:

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

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



Record your results in the test tracker.

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.*
	Shape: Size: Number: Materials:	Number of lights: Why:	Number of lights: Why:
	Shape: Size: Number: Materials:	Number of lights: Why:	Number of lights: Why:
	Shape: Size: Number: Materials:	Number of lights: Why:	Number of lights: Why:
	Shape: Size: Number: Materials:	Number of lights: Why:	Number of lights: Why:
	Shape: Size: Number: Materials:	Number of lights: Why:	Number of lights: Why:

Activity 3.3: Time to test

Will your turbine whip through the wind or spin in slow mo? Do some tests to see whether it's fit to power a town.

You're going to 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.

You're almost there. Troubleshoot with your support crew. What **design variables** can you change? Change one variable at a time and try again. Write the results below.

Yes, it spins.

Congratulations! Time to power up your prototype.

Test 2: Power up your prototype

Your second test will help you determine how different variables 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)

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'd like your actual blades to be. You might like to use a ruler to check measurements.

Our final blade design:

How do you think each blade design variable will affect the amount of electricity your turbine generates?

What materials do you need to create your blades?

Activity 3.1: 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.

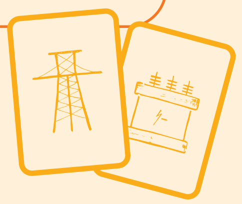
Ready? Get set, charge on!

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.

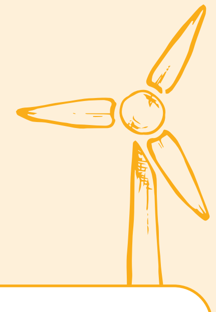
For an extra challenge, try putting them in order without reading the back of the cards!

Step 5

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

May the brightest sparks win!

Activity 3.2: Create



Let's create a turbine prototype.

Watch the 'create' video, then use these instructions as a handy reminder as you construct your masterpiece.

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.

Remember, using different materials to make your blades will get different results. Choose carefully!

Create your turbine!

Step 1

Using your final design from the imagine and plan stages, make your blades out of your chosen recyclable materials.

Step 2

Add decorations to the front of your blades to make them unique.

Step 3

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

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 have a terrific turbine. Ka pai te mahi.