Turbine tournament

Investigating energy transformations with wind turbines

Year Level:	7-8	**Subject:**	Science (Physical sciences)	**Topic:**	Energy transformations and efficiency
Duration:	2 x 50 minute lessons **Best done over a double lesson to test all design variations without rebuilding models**	**Curriculum:**	**Content description codes:** • **VC2S8U13:** simple machines, including the lever, inclined plane, wedge, pulley, screw, and wheel and axle, alter the direction and magnitude of forces • **VC2S8U15:** strategies and responses to manage and improve the liveability and environmental sustainability of Australia's cities, and to adapt to climate change • **VC2S8U09:** the sustainable use of Earth's resources is influenced by whether the resources are renewable or non-renewable; the processes involved in resource extraction and energy production come with both benefits and risks to sustainability	**Climate Topics:**	• Renewable energy (wind) • Energy transition • Energy efficiency

Brief Overview

Students will become wind engineers for a day, designing and testing model wind turbines to see how blade shape, size and angle affect power output. Working in teams, they'll try out different designs, record their results, and compare which turbine produces the most energy. The activity links their discoveries to how real wind farms fine-tune their turbines for maximum efficiency.

Learning outcomes
Learning Intention Students will investigate how the design of a wind turbine affects its ability to transform wind energy into motion and power. They will explore how simple machines change the direction and magnitude of forces, and how these design choices influence efficiency and performance. **Success Criteria** ● Build and test a simple wind turbine model ● Identify the energy transformations involved in generating power ● Explain how blade design changes affect efficiency and power output ● Describe how turbine design relates to sustainable energy solutions

Introduced climate science concepts	Presumed knowledge
● Renewable energy (wind) ● Energy transition ● Energy efficiency	**VC2S6I03:** equipment can be used to observe, generate, measure and record data with reasonable precision for repeated measurements, using digital tools as appropriate **VC2S4U10:** forces, including frictional, gravitational, electrostatic and magnetic, can be exerted by one object on another through direct contact or from a distance and affect the motion (speed and direction) of objects

Teaching materials and resources					
Tool ID	**Student/ teacher**	**Tool and link**	**Overview**	**Source**	**Approx. price**
R0	Teacher	Glossary of climate terms	This document provides teachers with a glossary of key terms relevant to this lesson plan	Monash Climate Change Communication	n/a

				Research Hub	
R1	Teacher	Lesson powerpoint	PowerPoint slides with lesson content and activity instructions for students to follow, includes speaker notes	Monash Climate Change Communication Research Hub	–
R2	Teacher	Wind turbine experiments guide	Includes the standard turbine model setup and step-by-step testing instructions, plus suggested variations for students' experiments	Monash Climate Change Communication Research Hub	
R3	Student	Stopwatch	To time experiments	School/teacher to provide	
R4	Student	Scale	To weigh the washer	School/teacher to provide	
R5	Student	1-3 gram washers	Part of the wind turbine experiment model	School/teacher to provide	
R6	Student	Twine or string	Part of the wind turbine experiment model	School/teacher to provide	o
R7	Student	Wooden skewers	Part of the wind turbine experiment model	School/teacher to provide	
R8	Student	Paper cups	Part of the wind turbine experiment model	School/teacher to provide	
R9	Student	Straws	Part of the wind turbine experiment model	School/teacher to provide	
R10	Student	Cork (wine-bottle size)	Part of the wind turbine experiment model	School/teacher to provide	
R11	Student	Paper clips	Part of the wind turbine experiment model	School/teacher to	

				provide	
R12	Student	Card	Part of the wind turbine experiment model	School/teacher to provide	
R13	Student	Stationary: scissors, sticky tape, rulers	Part of the wind turbine experiment model	School/teacher to provide	
R14	Student	Desktop fan/s	To create ‘wind’ to power the turbines	School/teacher to provide	
R15	Student	Calculator	For mathematical calculations	Student/school to provide	
R16	Student/ teacher	Video – How does a wind turbine work? (**2:46 mins**)	This video explains how a wind turbine generates power (video is included in the lesson powerpoint for students to watch)	ACCIONA	

Lesson outline				
Stages	**Description**	**Tool ID**	**Slide Number**	**Time**
Before lesson: Material prep	**For this lesson you will need craft/construction materials as listed in the table above. Ensure these have all been sourced before starting this lesson.** **Teacher / student helpers:** Set up the materials station – using items sourced by the teacher, or provided at the school – at the back or side of the room so it doesn’t distract students during presentations or the activity later on.	R3-14	–	–

Part 1: Learning introduction	**Teacher:** Begin the lesson with the PowerPoint (slides 1-5). ● **Slide 1 (*Optional to show to students*):** Learning goals ● **Slide 2:** Title slide ● **Slide 3 (*Discussion question*):** What is a wind turbine? ○ **Slide 4:** Answers/explains ● **Slide 5 (*Discussion question*):** Why are they considered a renewable energy source? ○ **Slide 6:** Answers/explains ● **Slide 7 (*Discussion question*):** How do they generate electricity? ○ **Slide 8 (video – 2:46 mins):** 'How does a wind turbine work?' (**R16**) **Students:** Participate in class discussion, note taking optional. *<u>Differentiation discussion strategy:</u>* *Use the 'popcorn discussion' method and call on hesitant sharers first to name the easier or more obvious words/options. Call on extension students when obvious ones have already been said.*	R1	1-8	20min
Part 2 : Activity introduction + demonstration	**Teacher:** To start the activity, go through **slide 9** that gives a brief overview of the activity:	R1, R2 R3-14	9-11	20min

	Working in groups, students will build a basic turbine model to test how fast it can lift the washer, then experiment with at least **two different blade designs** to see how each affects power and efficiency. Divide the class into groups of around 5, and change to **slide 10**. Using the instructions in the *Wind Turbine Experiments Guide* **(R2)**, have each group follow along as you build the standard model turbine. Once each group has built their basic model, switch to **slide 11** and conduct the first round experiment, following the instructions shown on the slide (also in the *Wind Turbine Experiments Guide* (**R2**)). **Students:** In their groups, students are to: 1. Follow along with the teacher to build the standard model turbine 2. Complete the first experiment, following the instructions on slide 11 3. Record their results			
Part 3: Student experiments	**Teacher:** After each group has completed the first test with the standard model, leave **slide 11** on the screen and have students begin experimenting with alternative blade designs. Each group should test **at least two** different blade variations, exploring factors such as **number, size and angle**. **Students:** In their groups, students should now: 4. Modify their turbine to test **at least two** different blade designs	R1, R2 R3-14	11	10min

	○ Experiment with changes to the number, size or angle of the blades to see how each affects performance ○ Just alter one variable at a time, so it's possible to tell what made the change 5. Repeat the experiment for each blade variation, following the same instructions as before on slide 11 6. Record results for each test in your notebook			
Part 4: Power calculations	**Teacher:** Once each group has tested at least two different blade designs, switch to **slide 12** to begin the next part – calculating power from time. ● **Slide 13:** Convert original units to standard units ● **Slide 14:** Calculate potential energy ● **Slide 15:** Calculate power **Students:** Work through steps 1-3 to calculate the power generated by each of their group's blade variations. *Optional engagement strategy:* *Have students line up in order of the group with the most powerful or efficient turbine to the least.*	R1, R15	12-15	40min
Part 5: Activity learning reflection and discussion	**Teacher:** For the final part, go through **slides 16-18** using what they learnt from the experiment to discuss the effectiveness and pitfalls of each blade variation. ● **Slide 16 (topic holding slide to share class findings):** Number ○ **Slide 17:** Information for discussion	R1	16-21	10min

	• **Slide 18 (topic holding slide to share class findings):** Size
	  ○ **Slide 19:** Information for discussion
	• **Slide 20 (topic holding slide to share class findings):** Angle (Pitch)
	  ○ **Slide 21:** Information for discussion
	
	Students:
	Participate in class discussion, note taking optional.			

Links for further reading
• Wind energy – ARENA (AUS GOV) • What is renewable energy? – UN • How can we address the causes of climate change? – CSIRO