Foundations of Energy

Electricity Generation in the Snowy Scheme

Year level	9 & 10	**Duration**	6-8 x 45 minute lessons
Unit outline		**Unit context**	
Students explore the Snowy Hydro scheme as the phenomenon to investigate energy. Students explore particle and wave models to explain energy transfer, relating this to states of matter and phase changes. They revisit the definition of energy, including how it is categorised into kinetic and potential energy. Students play a game which is a representation of the Snowy Hydro system and use this game to draw comparisons between what occurs in the real-world phenomenon and how the Snowy Hydro scheme generates usable electricity for society in a sustainable manner.		*What should learners already know?* Students should already be familiar with the definitions of energy, work and its relationship to power. Students should know there are two types of energy, kinetic and potential. Students should understand what particles and molecules are, what are the states of matter and phase changes. Students should be familiar with electricity and electrical circuits.	

Key Learning Area			**Science**		
Integration & Connection with other Key Learning Areas					
Science	Mathematics	The Arts	Design and Technologies		History
Geography	English	Health	Digital Technologies	Economics	Civics and Citizenship

Key resources			
Resource name	**Resource type**	**Link to access**	**Used for**
Power Peak game	Game hosted by Arludo	The Power Peak game is launching soon! Check back on the Snowy STEM Academy website or subscribe to our e-news to stay up to date with the launch date!	Concepts 2, 3 & 4
Phase Change	PhET Simulation	https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html	Concept 1. Energy transfer
Snowy Scheme overview	YouTube Video	https://www.youtube.com/watch?v=aGJeywOh5vg	Concept 1. Energy transfer
Pumped hydro	YouTube Video	https://www.youtube.com/watch?v=bN2PLXFADtE	Concept 2. System efficiencies
How does pumped hydro work?!	YouTube Video	https://www.youtube.com/shorts/Djbu73NtUf4	Concept 2. System efficiencies
Newton's Laws of Motion	YouTube Video	https://www.youtube.com/watch?v=-w6oW1ut4Dw	Concept 3. Newton's Laws of Motion
Power generation Turbine runner	YouTube Video	https://www.youtube.com/watch?v=R5XSUnTP8XI	Concept 4. Electricity generation

Key vocabulary

Energy, kinetic energy, potential energy, energy transfer, energy transformation, work, gravity, forces, molecule, states of matter, phases changes, generate, electricity, power, Joules, Watts, Watt-hours, kilowatt-hours, megawatt hours, gigawatt-hours, Newton's laws of motion, law of conservation of energy, mass, force, acceleration, input, output, system.
Correct abbreviations of electricity units: J, W, Wh, kWh, MWh and GWh respectively

Key Learning Area curriculum content and achievement standards	
Achievement standards	**Curriculum content descriptions**
Year 9 Understanding	
Students explore simple representations of wave and particle models and determine which model is useful to explain energy transfer in the Snowy Hydro system.	AC9S9U04 use wave and particle models to describe energy transfer through different mediums and examine the usefulness of each model for explaining phenomena
Student analyse the Snowy Hydro system using inputs, outputs, transfers and transformations of energy, applying the Law of Conservation of Energy.	AC9S9U05 apply the law of conservation of energy to analyse system efficiency in terms of energy inputs, outputs, transfers and transformations
Year 10 Understanding	
Students learn about Newton's Laws of Motion and apply them to calculate energy generation in phenomena.	AC9S10U05 investigate Newton's laws of motion and quantitatively analyse the relationship between force, mass and acceleration of objects
Year 9 & 10 Science Inquiry	
Students explore testable questions in the game by investigating the relationship between kinetic and potential energy and develop explanatory models of energy generation in the Snowy Hydro scheme	AC9S9I01 & AC9S10I01 develop investigable questions, reasoned predictions and hypotheses to test relationships and develop explanatory models
Students create models, diagrams and use mathematical formulas to organise and process data and information.	AC9S9I04 & AC9S10I04 select and construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information
Students demonstrate their understanding by creating explanations to communicate their findings about energy generation in the Snowy Hydro scheme.	AC9S9I08 & AC9S10I08 write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content,

	language and text features, using digital tools as appropriate
Achievement standards	**Curriculum content descriptions**
Year 9 & 10 Science as a Human Endeavour	
Students investigate how new developments in technology have enabled the Snowy Hydro scheme to produce energy more efficiently.	AC9S9H02 & AC9S10H02 investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering
	AC9S9H03 & AC9S10H03 analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society

<table>
<tr><th colspan="2">General Capabilities</th></tr>
<tr><th>General Capabilities</th><th>How will students develop or demonstrate the targeted General Capability?</th></tr>
<tr><td colspan="2">Critical and Creative Thinking</td></tr>
<tr><td>Inquiring
Develop questions - This sub-element supports students to narrow or expand the focus of their thinking and explore ideas and concepts critically and creatively. When they develop different kinds of questions, students can further their inquiry. They can find more information about a topic and form a better understanding of how something works or why something is the way it is.

Identify, process and evaluate information - This sub-element supports students to seek information from a range of sources, make decisions about expert or personal opinion and understand which sources are trustworthy, relevant and useful.</td><td>• develop questions to investigate complex issues and topics
○ Students will develop questions to investigate the topic of energy, including how kinetic and potential energy are related, by playing the Power Peak game.
• questions developed assist in forming an understanding of why phenomena or issues arise
○ Answers to students' questions will help them unpack the phenomena of how Snowy Hydro scheme is able to generate electricity through harness the power of kinetic and potential energy of water.</td></tr>
<tr><td>Generating
Create possibilities - This sub-element supports students to explore and combine ideas to create innovative solutions, and adapt and present ideas in new ways, as they engage with learning area content.

Consider alternatives - This sub-element supports students to examine different and creative ways to approach tasks and make recommendations on preferred options and actions.

Put ideas into action - This sub-element supports students to experiment with ideas, modify and adapt approaches, and evaluate options and actions in a range of situations.</td><td>• create possibilities by connecting or adapting complex ideas and proposing innovative and detailed variations or combinations
○ Students investigate how the Power Peak game is a representation of the Snowy Hydro scheme and propose ways to improve the system by making it more efficient.</td></tr>
<tr><td>Analysing
Interpret concepts and problems - This sub-element supports students to interpret concepts, ideas, theories and problems, and deconstruct them into their component parts, to gain a deeper understanding of the context or situation.</td><td>• identify the objective and subjective aspects of a complex concept or problem, with sensitivity to context
○ Students compare the Power Peak game to the real-world phenomenon of the Snowy Hydro scheme, and use the game to explore and understand complex concepts. They consider</td></tr>
</table>

Draw conclusions and provide reasons - This sub-element supports students to reach a conclusion or make a choice for action by connecting to learning area knowledge and understanding. The act of justifying a conclusion also requires the provision of a reason or the development of an argument in support of the conclusion or action. **Evaluate actions and outcomes -** This sub-element supports students to consider the choices made when they solve problems or attempt learning area tasks and evaluate solutions and outcomes to help plan for future action.	how their approaches to the game change energy generation and how this is reflected in the function of the Snowy Hydro system.
Ethical understanding	
Understanding ethical concepts and perspectives **Explore ethical concepts** - This sub-element supports students to identify and examine ethical concepts. They discuss and examine the dimensions of ethical concepts and how they relate to the actions we take in a range of situations. **Examine values, rights and responsibilities and ethical norms** - This sub-element supports students to understand the role that values, rights and responsibilities and norms have in ethical decisions. They consider how a range of values relate to established norms of ethical behaviour.	• **evaluate the consistency in meaning of ethical concepts, such as trust, freedom and rights and responsibilities, in a range of situations and contexts** ○ Students consider ethics in the design of the Snowy Hydro scheme from the perspective of different stakeholders.
Responding to ethical issues **Explore ethical perspectives and frameworks** - This sub-element supports students to develop an understanding of different ethical frameworks and how these inform ethical perspectives and decision-making. Ethical frameworks include approaches that address the role of consequences on ethical actions; approaches that deal with issues of duty, justice and fairness; and approaches that focus on virtues in the ethical decision-making process. **Explore ethical issues** - This sub-element supports students to bring together their understanding of the first 4 sub-elements of the Ethical Understanding learning continuum to investigate ethical issues. They apply their understanding of ethical concepts, values, rights and responsibilities, norms, ethical frameworks and perspectives to curriculum-related ethical contexts.	• **analyse and utilise different ethical frameworks when responding to ethical issues and making ethical decisions** ○ Students have to demonstrate using an ethical framework when presenting an improvement to the Snowy Hydro scheme and analysing it from the perspective of different stakeholders.

Reflecting
Think about thinking (metacognition) - This sub-element supports students to identify, describe and evaluate the thinking and learning strategies that they use to complete activities. They reflect on the ways that their thinking, and the approaches they take, may be influenced by external contributions or viewpoints.
 	
Transfer knowledge - This sub-element supports students to make connections between their current knowledge and skills and new contexts where they can adapt and use what they already know and can do. Both critical and creative thinking are involved, and new contexts can include other learning areas of the curriculum.
	• **reflect on the thinking and processes used when completing activities and drawing conclusions**
	    ○ Students refine their ideas of systems in the game and the real-world phenomenon, by building on their understanding of the relationship between energy, forces, mass and acceleration.
	• **identify possible limitations in their own positions by considering opposing viewpoints, reasonable criticism and feedback**
	    ○ Students reflect on their positions and viewpoints by role playing different stakeholders involved in the Snowy Hydro scheme to consider their viewpoints and provide feedback.

Literacy	

Writing
Creating texts - This sub-element describes how a student becomes increasingly proficient at creating texts for a range of purposes and audiences across learning areas. Students' writing moves from representing basic concepts and simple ideas to conveying abstract concepts and complex ideas, in line with the demands of the learning areas. Creating texts is a holistic sub-element which is supported by the other sub-elements under this element.
 	
Grammar - This sub-element describes how a student becomes increasingly proficient at creating coherent and cohesive, grammatically accurate written texts. Students develop control over grammar at the whole text, sentence and word group level.
 	
Punctuation -This sub-element describes how a student becomes increasingly proficient at using correct punctuation to ensure clarity and ease of reading in the texts they create. As students write more complex and technical texts, they will use increasingly complex punctuation to support meaning.
 	
Spelling - This sub-element describes how a student becomes increasingly proficient in selecting and arranging letters to form accurately spelt words, to ensure written texts are clear and easily
	Crafting ideas
	• **creates sustained, informative texts that precisely explain, analyse and evaluate concepts or abstract entities**
	• **uses structural features flexibly to organise ideas strategically (e.g. includes a defined, cogent conclusion or summation)**
	• **creates texts with forms and features combined strategically for purpose (e.g. describes a historical event from the perspective of a secondary source)**
	• **uses evidence and references**
	• **creates succinct short-answer explanatory texts as well as complex, multi-staged extended texts**
	    ○ Students generate response that explain, analyse and evaluate abstract concepts, using evidence, that organise ideas strategically to describe the Snowy Hydro scheme.
	
	Text form and features
	• **maintains tone appropriate to the audience**
	• **uses extended noun groups/phrases including adjectival phrases (e.g. "a sturdy construction with modern design features") (see Grammar)**
	    ○ Student match the texts they create to the appropriate audience of a presentation or an explanation.

understood. Students develop increasing skill and knowledge in using spelling as a tool to understand and create meaning in texts. At higher levels of the progression, students monitor their own spelling and explain how spelling affects meaning. **Handwriting and keyboarding** - This sub-element describes how a student uses handwriting and keyboarding skills with increasing speed, accuracy and fluency, to compose and edit texts. It describes how a student develops a fluent, legible handwriting style, beginning with unjoined letters and transitioning to joined handwriting.	**Vocabulary** ● **uses complex abstractions (e.g. "economic", "sociocultural")** ○ Students apply their knowledge to complex abstractions, including society and its broader requirements.
Numeracy	
Number sense and algebra Number and place value - This sub-element describes how a student becomes increasingly able to recognise, read, represent, order and interpret numbers within our place value number system, expressed in different ways. It outlines key understandings needed to process, communicate and interpret quantitative information in a variety of contexts. **Counting processes** - This sub-element describes how a student becomes increasingly able to count both verbally, through the stable order of a counting sequence, and perceptually through counting collections. As students make the link between counting 'how many' and the quantities represented by numbers, they begin to understand cardinality and the purpose of counting. **Multiplicative strategies** - This sub-element describes how a student becomes increasingly able to think multiplicatively and use multiplicative strategies in computation to solve problems related to a range of multiplicative situations. Students are introduced to division through equal sharing and equal grouping situations. **Proportional thinking** - This sub-element addresses the proportional relationships between quantities. The ability to reason proportionally requires students to think multiplicatively and work with percentages, rates and ratios and proportions.	Sub elements of numeracy are complex. Please refer to the figures for each sub-element from the Numeracy - Understand this general capability website for relevant levels at each year level. Also useful is the F-10 Curriculum for Numeracy page which is also linked in each element in the left hand column. **Flexible proportional thinking** ● **identifies proportional relationships in formulas and uses proportional thinking flexibly to explore this relationship (e.g. recognises the proportional relationship between concentration and volume of a solution in the formula and uses this relationship to make decisions when diluting solutions)** ○ Student explore proportional thinking by applying Newton's second law of motion (f=ma) to calculate the efficiency of energy generation in systems. Students also understand and apply the use of units to energy (Joules, Watt-hours, etc).

Number patterns and algebraic thinking - This sub-element describes how a student becomes increasingly able to identify and describe repeating and growing patterns in the environment and other everyday contexts. Students develop the capacity to generalise as they learn to recognise, represent, describe and use patterns for prediction and decision making.	
Measurement and geometry **Understanding units of measurement** - This sub-element describes how students becomes increasingly able to identify attributes that can be measured and the units by which they are measured. They initially use direct comparison to recognise and understand what it means to have more or less of a particular attribute, and progress to using informal, and then metric and other formal units. **Measuring time** - This sub-element describes how a student becomes increasingly aware of reading and describing the passage of time and how elapsed time or duration can be measured. They learn to apply units and conventions associated with measuring and recording the sequencing and duration of time.	**Using metric units and formulas** • **identifies appropriate metric units to use according to the level of precision required (e.g. building plans show measurements in millimetres, but to purchase enough carpet you need to measure the length and width of the room and round up to the nearest whole metre)** ○ Students understand and apply the use of units to calculate energy (Joules, Watt-hours, etc) and consider these units in real-world contexts.

Cross Curriculum Priorities	
Cross Curriculum Priorities	**How will students develop or demonstrate the targeted Cross Curriculum Priority?**
Sustainability	
Systems: SS1: All life forms, including human life, are connected through Earth's systems (geosphere, biosphere, hydrosphere and atmosphere) on which they depend for their wellbeing and survival. SS2: Sustainable patterns of living require the responsible use of resources, maintenance of clean air, water and soils, and preservation or restoration of healthy environments.	AC9S9I01 & AC9S10I01 ● **develop investigable questions, reasoned predictions and hypotheses to test relationships and develop explanatory models** ○ Students build testable questions and predict how changes in a system will influence energy generation in the Power Peak game, applying it to the real-world phenomenon of the Snowy Hydro scheme.
World Views SW1:World views that recognise the interdependence of Earth's systems, and value diversity, equity and social justice, are essential for achieving sustainability. SW2: World views are formed by experiences at personal, local, national and global levels, and are linked to individual, community, business and political actions for sustainability.	AC9S9H03 & AC9S10H03 ● **analyse the key factors that contribute to science knowledge and practices being adopted more broadly by society** ○ Students investigate how scientific knowledge and practices are being adopted in the Snowy Hydro scheme to generate electricity for society.
Design: SD1: Sustainably designed products, environments and services aim to minimise the impact on or restore the quality and diversity of environmental, social and economic systems. SD2: Creative and innovative design is integral to the identification of new ways of sustainable living. SD3: Sustainable design requires an awareness of place, past practices, research and technological developments, and balanced judgements based on projected environmental, social and economic impacts.	AC9S9U05 ● **apply the law of conservation of energy to analyse system efficiency in terms of energy inputs, outputs, transfers and transformations** ○ Students investigate how sustainability and design influences the efficiency of the Snowy Hydro scheme to allow it to generate more electricity acknowledging its impact on environmental, social and economic systems.

Futures SF1: Sustainable futures are achieved through informed individual, community, business and political action that values local, national and global equity and fairness across generations into the future. SF2: Sustainable futures require individuals to seek information, identify solutions, reflect on and evaluate past actions, and collaborate with and influence others as they work towards a desired change.	AC9S9I08 & AC9S10I08 ● **write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate** ○ Students present their ideas in appropriate formats for the stakeholder roleplay activity, including considering the unique viewpoints and positions of the stakeholder.

Teaching and Learning Plan

Concept 1. Energy transfer

Learning Intention	Identify wave and particle models to describe energy transfer and create an energy transfer diagram.
Success criteria	I can identify wave and particle models. I can describe how wave and particle models show energy transfer. I can construct an energy transfer diagram to illustrate energy transfer in the Snowy Hydro scheme.

Texts/resources	Learning sequence and Teaching Strategies	Differentiation opportunities	Assessment
Phase Change PhET Simulation https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html ***Snowy Scheme overview* video** https://www.youtube.com/watch?v=aGJeywOh5vg	**Demonstration**: Bring some ice cubes to class and show students how they melt. Ask students to describe what is happening to the solid water to make it become liquid by referencing particle theory. (Answer: Heat energy is causing solid water molecules to vibrate more rapidly until they break apart and form a free flowing liquid.) **Phase Change PhET Simulation** Students use the Phase Change PhET simulation to explore energy transfers. Students should select "Phase Changes" and investigate water molecules. Students should understand **Class activity:** Ask students to stand in a line around the classroom. Students act out energy transfers using the particle model. Each student is a particle and when standing close together and "vibrating" (moving a littleton the spot) they are a solid. Next they get more energy, so begin to move a bit more but close to one another to become a liquid. Finally they get the most energy and move the fastest bouncing off one another carefully and spreading apart to fill the classroom to become a gas. Ask students to reflect on how they needed to use more energy to do each of these energy transfers.	**Opportunities to simplify:** Recall phase changes in states of matter and using physical models of water molecules, have students construct solid, liquid and gas representations of water. Ask students to describe what happens to the molecules to make them change state. Students should relate these phase changes to energy transfer. **Opportunity to extend:** Provide different examples of energy transfer (eg. kinetic energy as sound or light, chemical energy into heat) and ask students to draw a diagram of how the energy is transferred using either the wave or particle model.	Students create a diagram of energy transfer in one aspect of the Snowy Hydro scheme (eg. Particle model to demonstrate how energy transfer occurs when snow melts to form liquid water that moves into rivers and dams as stored energy.)

	Class activity: Give students a long rope and have two students hold either end close to the ground. Ask students to move “energy” along the rope by flicking it up and down. This can also be done as a “Mexican wave” by having students hold hands in a line and “transfer” the energy between them in a wave of each arm. **Explicit teaching:** Explain the significance of the class activities by asking students identify which activity demonstrated particle models and which demonstrated wave models. Ask students to describe how the energy transfer is shown through each model. **Video: *Snowy Scheme overview*** Students watch the video and identify how the particle theory applies to the Snowy Hydro scheme. (Answer: energy is stored in frozen water - snow- and liquid water - in rivers and dams - stored in reservoirs as energy in waiting. The water is then pumped through the generators to generate energy).		

<table>
<tr><th colspan="4">Concept 2. System efficiencies</th></tr>
<tr><td>Learning intention</td><td colspan="3">Identify examples of kinetic and potential energy and apply the law of conservation of energy to summarise the Snowy Hydro scheme as an energy system.</td></tr>
<tr><td>Success criteria</td><td colspan="3">I can distinguish between kinetic energy and potential energy.
I can describe how Snowy Hydro works as an energy system.
I can apply the law of conservation of energy to summarise the inputs, outputs, transfers and transformations in the Snowy Hydro scheme.</td></tr>
<tr><td>Texts/resources</td><td>Learning sequence and Teaching Strategies</td><td>Differentiation opportunities</td><td>Assessment</td></tr>
<tr><td>Power Peak game LAUNCHING SOON!

Pumped hydro video
https://www.youtube.com/watch?v=bN2PLXFADtE

How does pumped hydro work?! Video
https://www.youtube.com/shorts/Djbu73NtUf4</td><td>Game:
Students play the Power Peak game to explore kinetic and potential energy. As students are playing, ask them to consider examples of kinetic and potential energy in the game.

Class discussion:
Ask students what examples they observed and have them consider how the game is a representation of what is occurring in the Snow Hydro scheme as an energy system. Answer: the wombat is a representation of the water generating electricity as it goes down the hill, using kinetic energy from gravitational potential energy. The faster the wombat goes, the more energy it can generate. As the wombat goes up in the chairlift, it represents water being pumped back up the system to the reservoir, ready to be turned back into kinetic energy from gravitational potential energy to generate electricity. The kinetic energy of the wombat turns into electricity when it passes through a power station, which represents the water turning a turbine in the power station to generate electricity.

Videos: Pumped hydro and How does pumped hydro work?!
Students watch the two videos that explain the Snowy Hydro scheme as an energy system.</td><td>Opportunities to simplify:
Students play energy “snap” in pairs to test their knowledge of examples of kinetic and potential energy. Students turn up cards with images representing different kinds of energy (eg. kinetic in the form of water moving, wind, etc; potential in the form of energy stored in food, gravitational potential energy etc). If the cards have a representation of the same type of energy (kinetic or potential but not necessarily the same image) students need to be first to “snap” the card by placing their hand on top of them and calling out the correct energy type. The winner of the game is the one who collects all the cards.</td><td>Assessment:
Based on their diagram, students write a short story of the journey of a water particle in the Snowy Hydro scheme. The story needs to include all the energy transfers or transformations it undergoes in order to generate electricity.</td></tr>
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	Class brainstorm: Brainstorm as a class inputs, outputs, transfers and transformation of the Snow Hydro energy system. **Diagram annotation:** Students create a simple diagram that describes the inputs, inputs, transfer and transformations of energy in the Snowy Hydro scheme.	**Opportunities to extend:** Discuss where the system "loses" energy in different transfers or transformations, ie. where are the energy system's inefficiencies (eg. different types of kinetic energy such as sound energy from water, heat energy when water evaporates or friction/heat/sound from rotating turbines). Ask students to propose ideas in their diagram to make the system more efficient (eg. water falling down any open water systems could be contained so that any water that evaporates and is lost from heat energy is captured and redirected back into the system, turbines could be well lubricated to run more efficiently and "lose" less energy to sound/heat/friction).	

<table>
<tr><th colspan="4">Concept 3. Newton's Laws of Motion</th></tr>
<tr><td>Learning intention</td><td colspan="3">State Newton's law of motion and apply it to explain the relationship between force, mass and acceleration.</td></tr>
<tr><td>Success criteria</td><td colspan="3">I can state Newton's law of motion.
I can apply Newton's law of motion to calculate force, mass and acceleration of objects.
I can explain how Newton's law of motion affects the efficiency of the Snowy Hydro scheme.</td></tr>
<tr><td>Texts/resources</td><td>Learning sequence and Teaching Strategies</td><td>Differentiation opportunities</td><td>Assessment</td></tr>
<tr><td>Power Peak game LAUNCHING SOON!

Newton's Laws of Motion video
https://www.youtube.com/watch?v=-w6oW1ut4Dw</td><td>Game:
Students replay the Power Peak game, this time paying particular attention to the wombat's speed and the amount of energy in Watt-hours (Wh) it generates each round.

Class discussion:
Ask students to describe the relationship between the wombat's speed and the amount of electricity is generated (Answer: the faster the wombat goes, the more electricity it generates.)

Explicit teaching and video:
Explain that the wombat, or water it represents in the Snowy Hydro system, operates on the principals of Newton's laws of motion. Show students the videos to explain

Game:
Ask students to play the game and record the fastest speed the wombat reached on that round.

Explicit teaching:
Introduce students to the formula and units for the equation: force (N) = mass (kg) x acceleration (metre/second).</td><td>Opportunities to simplify:
In pairs, students explore Newton's laws of motion using different simple objects (eg. ball, skateboard etc). Ask them to demonstrate each law of motion using the object. Then, one person in each pair swaps with another group and they have to explain Newton's laws of motion to their new partner by demonstrating using their different objects.

Opportunities to extend:
Students research the capacity of different parts of the Snow Hydro scheme and calculate how much force this amount of water moving through the system (assuming it all moves through at once) would generate using Newton's second law of motion (m=fa).</td><td>Assessment:
Students find an object in their house/classroom (eg. bike, rolling pin, chair etc) and film a short video explaining Newton's laws of motion using that object.</td></tr>
</table>

	Apply learning: Have students calculate the force of the wombat using Newton's second law of motion force = mass x acceleration (f=ma). Note: you will need to give the wombat a particular mass (eg. 50 kg). Assume speed is in metres/second (m/s). **Class discussion:** Ask students to discuss how Newton's laws of motion affect the efficiency of the Snowy Hydro system. (Answer: the more water in the system, the greater the mass. This means it can generate more force and will move with more acceleration, meaning it is more efficient and can ultimately generation more electricity).	Students will practice unit conversions of water from large dams (with 1 L of water = 1 kg) and apply this in their calculations.	

<table>
<tr><th colspan="4">Concept 4. Electricity generation</th></tr>
<tr><td>Learning intention</td><td colspan="3">I can describe the relationship between power and Watt-hours. I can explain how electricity generation can become more efficient.</td></tr>
<tr><td>Success criteria</td><td colspan="3">I can identify the units of energy measurement.
I can summarise the relationship between power and work in energy generation.
I can explain how electricity generation can be more efficient in a system.</td></tr>
<tr><td>Texts/resources</td><td>Learning sequence and Teaching Strategies</td><td>Differentiation opportunities</td><td>Assessment</td></tr>
<tr><td>Power Peak game LAUNCHING SOON!

Power generation Turbine runner video
https://www.youtube.com/watch?v=R5XSUnTP8XI</td><td>Class brainstorm:
Ask students the different ways electricity is generated and create a mind-map as a class. Categorise each method of electricity generation as using renewable or non-renewable resources. Ask students to consider which method of energy generation is preferred and why.

Revision:
Remind students the total amount of energy in something can be measured in units called Joules (J) or units called Watt-hours (Wh). Recall that power is the amount of energy that can be transferred or converted into another form of energy at any. Power is a rate = change in energy/change in time.

Game:
Students play the Power Peak game and notice the amount of energy in Watt-hours (Wh) they generate. The more the wombat “works” (the higher it gets), the more energy it is able to generate. This is then able to meet the demands of the consumer (eg. power lightbulbs, washing machines etc)

Video: Power generation Turbine runner
Watch the video that explains how kinetic energy of water is transferred to kinetic energy of a turbine in the Snowy Hydro system. This then can generate power in the model demonstrated.</td><td>Opportunities to simplify:
Students research another energy generation system that also uses spinning motion to generate electricity (eg. wind). Student draw a simplified diagram of how this system generates electricity. Students should ultimately be able to draw comparisons between this system and the Snowy Hydro scheme.

Opportunities to extend:
Students can build a small electromagnetic motor using some resources, including a battery, paper clips, magnet and copper wires (following these instructions or similar). Students observe how a potential energy stored in the battery can then be turned back into kinetic energy and how this demonstrates potential energy’s ability to do</td><td>Students role play an engineer on the Snowy Hydro scheme and have to propose in a 3 minute presentation the best solution to making the Snowy Hydro system more efficient. Other students can act as industry stakeholders and provide feedback after their presentation on the impact of their proposal (eg. consumers, environmental rangers, financial investors, workers), which the presenting “engineer” needs to justify. Students</td></tr>
</table>

	Explicit teaching: Explain how to generate electricity in this system, kinetic energy of a resource is transferred to spin a turbine. Mechanical energy from the turbine spins a rotor with a magnet within or around a stator of copper coils to generate electricity. Class discussion: Ask students to recall how they got the wombat back up the mountain in the game and what made the wombat go higher (Answer: they pressed "A" and "D" keys on a keyboard and more they pressed then, the higher the wombat travelled). Explain that this is a representation of "work" in the sense that when energy is transformed, it required an investment of energy to start the transformation process. As such, not all energy **Game:** Ask students to play the game again, recording the ways they invest their wombat's "work" to make their energy generation more efficient each round (eg. purchasing more "boosts" to reinvest energy into the system, using some of their accumulated energy to invest in going higher up the mountain). **Apply learning:** Ask students to reflect on their choices in the game and apply this to the Snowy Hydro scheme by describing how their choice in the game makes the Snowy Hydro system more efficient. Students can do further research on how this works in the system to support their answer and preparation for their assessment activity.	"work". This model is a simplified reverse of electricity generation, where the movement or kinetic energy of something actually generates electricity in a turbine, here electricity generates movement or kinetic energy of the wire.	should address aspects such as sustainability and ethics in their presentations and feedback.