



Year 6

Science Outline

Chemical Sciences

Early innovators

In this unit, students focus on how the process of evaporation was used in the invention of the Coolgardie safe by Arthur Patrick McCormick which enabled settlers and prospectors to keep their food and vegetables from spoiling during the gold rush era. Such was the success of the safe it was used as the household fridge of Australia from the 1890s until the mid-twentieth century. Through a process of discovery, students develop an understanding how evaporation occurs when a liquid absorbs enough heat energy to turn into a gas. They carry out investigations to show how the process of evaporation can have a cooling effect and build a model of a Coolgardie safe to test out evaporation in action.

EAR 6, CHEMICAL SCIENCE
EARLY INNOVATORS
NOTIONAL HOURS:
7 HRS

Curriculum	Learning activities	Assessment	Resources
<p><i>This content description is applicable to the unit as a whole.</i></p> <p>Science Understanding Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting</p> <p>Science as a Human Endeavour Use and influence of science Scientific understandings, discoveries and inventions are used to solve problems that directly affect peoples' lives</p> <p>Science Inquiry Skills Questioning and predicting With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be</p> <p>With guidance, plan appropriate investigation methods to answer questions or solve problems</p> <p>Decide which variable should be changed and measured in fair tests and accurately observe, measure and record data</p> <p>Processing and analysing data and</p>	<p>Lesson One (1 hour)</p> <p>Celebrating early innovations</p> <p>Keeping yours cool</p> <p>Source an early historical picture of the Swan River Settlement using a keyword search: Swan River settlement or colony, early settlers WA.</p> <p>Have students sit outside and imagine what it would be like to be transported to a newly discovered island. How would they meet their basic needs to survive? What resources would they need?</p> <p>Conduct a think-pair-share as a whole group and come up with three things needed for survival, i.e. food, water, shelter.</p> <p>Share with students a picture of the Swan River Settlement and note what resources a new settler to WA had to meet their basic needs for food and shelter. Note the use of tents for shelter.</p> <p>Pose the question as to how new settlers would have kept their food and drink cool. Is it important to keep food cool? Why? Why not?</p> <p>Think of foods that melt easily like butter. What changes</p>	<p>Journal entries</p> <p>Conducting of investigation</p> <p>Labelled diagram</p> <p>Drawings / pictures of evaporation in action with arrows showing the how heat turn a liquid into a gas</p> <p>Student investigations</p> <p>Investigation planner</p>	<p>Provided</p> <p><i>Investigation planner</i></p> <p><i>Variable grid example</i></p> <p>Teacher provided</p> <p>washed milk carton rubber bands scissors hessian material strips of cloth stapler sticky tape thermometers electric fan (optional) water paper towel small wrapped parcels of butter eucalyptus or tea tree oil glass jar</p>

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<p>information Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate</p> <p>Compare data with predictions and use as evidence in developing explanations</p> <p>Evaluating Suggest improvements to the methods used to investigate a question or solve a problem</p>	<p>would occur to it on a hot day? Can the changes be reversed? If so, how?</p> <p>Provide students with three processed materials: hessian, cotton, and can, which may have been brought from the ship. They may wish to use or come up with an alternative method of keeping the butter the coolest.</p> <p>Pose the question as to how families would have kept a pat of butter cool in the summer heat in the Goldfields of Western Australia. Provide students with two individually wrapped pieces of butter, one piece which is to be left in a cool classroom.</p> <p>In groups of three, students make predictions as to whether the processed and/or natural resources would reduce the rate at which heat is transferred to the butter.</p> <p>Students leave the butter outside for 20 minutes, taking before and after photos.</p> <p>Students then compare the consistency of the butter with the one left in a cool container in the classroom. Ask students why they think their method was more effective than the other.</p> <p>Share with students that what they have achieved in some way is to reduce the transfer of heat through insulation. Insulation is a material or technique used to reduce the rate at which heat is transferred.</p>		

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	<p>Ask students if they know how food was kept cool in the 1800s before the availability of electricity. Do they think they would have used some of the methods they used to insulate their food?</p> <p>Ask students:</p> <ul style="list-style-type: none"> • how their school lunch is kept cool. • do they use a frozen container in their lunch box? • where did the ice come from? • did early settlers have access to ice? <p>Pin up the following scenarios in the room and ask students to stand next to the one they believe to be true.</p> <p><i>The ice will become warmer and melt and the sandwich will get cooler.</i></p> <p><i>The ice will eventually melt and become the same temperature as the water in the drink bottle.</i></p> <p><i>Ice is made from water and will melt and over time will return to its original state of water.</i></p> <p>Inform students that all of the statements are true.</p> <p>Ask students to draw the inside of their lunch box and indicate, using arrows, the effect heat or temperature will have inside the lunch box.</p>		

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	<p>Lesson Two (1 hour)</p> <p>Keeping it cool</p> <p>Inform students how <i>early settlers had to be innovative and use what resources they had at hand because in the early days of settlement they did not have access to electricity to run a fridge or have access to ice. Some settlers built cellars or buried their food underground to keep it cool, while others may have submerged containers in water to keep it cool until the water became heated in the sun.</i></p> <p>Ask students if they know what the word 'evaporation' means. Ask them to think about the wisps of steam that start to appear as water is being boiled. Share as the liquid begins to boil; some of it may start to turn into gas. We call this process evaporation.</p> <p>Take students outside where there is a bit of a draft. Provide them with a cup of water. Ask them to dip their index finger in the water and hold it up to the breeze. Ask them what they see and feel.</p> <p>Add a drop of natural oils, tea tree or eucalyptus oil to the cup of water and ask them to tip their water onto a flat pavement in the sun and step back until they can no longer smell the vapour. Ask them to draw around the puddle with chalk and return 15 minutes or so later and observe what happens. Depending on the weather the</p>		

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	<p>puddle should shrink in size. If weather does not suit, the process can be simulated by using an electric frying pan on low.</p> <p>Explain that water needs energy to change from a liquid to a gas. Heat energizes the molecules in liquid and the molecules start to vibrate and escape the liquid and become a gas.</p> <p>Ask students to draw examples of evaporation they have experienced and draw arrows to show how the molecules of the liquid escape and become a gas.</p> <p>Create an evaporation word wall and draw the three examples of evaporation discussed so far.</p> <p>Suggested words: <i>Liquid, gas, change, heat escape, steam, vibrate, molecules, transfer, energy, evaporate, cool.</i></p> <p>Lesson Three (1- 2 hours)</p> <p>Thinking Cool</p> <p>Ask students to share what they think makes a liquid evaporate the fastest and describe what is happening when a liquid evaporates.</p> <p>Ask students to think back to the puddle they created and think about how washing dries on the clothesline.</p>		

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	<p>Spray a little diluted natural oil in the room as students enter and if you have access to a black board invite a student up the front to spray enough water on their hand to create a handprint and watch what occurs.</p> <p>Conduct a think-pair-share about what students believe happened.</p> <p>Have students draw a diagram in their journal to describe the process of evaporation in action using the words from the word wall.</p> <p>Explain to students that an innovative early settler in WA used the science of evaporation to help people keep their limited fresh food cool.</p> <p>Teacher's information</p> <p>Conduct a keyword search: National Trust Coolgardie Safe and Cellar, using heat to cool valuing heritage.</p> <p>Share with students:</p> <p><i>McCormick adopted the same general idea early explorers of the outback used to cool their canvas water bags, an idea probably inspired by observing Aboriginal people use an animal skin water carrier using the principle of heat transfer to keep water cool. He observed how a wet bag around a bottle cooled its contents. If the bottle was in a draft the bag would dry out</i></p>		

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	<p><i>more quickly but the contents would be cooler. To keep his food cool in the extreme heat in Coolgardie back in the gold rush days of the 1800s, McCormick placed his food in a box and covered it with a wet hessian sack.</i></p> <p><i>McCormick further refined his original idea to include capillary action where water molecules climb up material and drag other water molecule with it. The same process is what a plant does to draw moisture up through its stem. As the water evaporated from the wet hessian, it absorbed heat from its surroundings and kept the contents of the safe cool. The drier the air, the greater the rate of evaporation and the cooler the safe.</i></p> <p><i>The Coolgardie Safe became a household fridge of Australia from the 1890s until the mid-twentieth century.</i></p> <p>Teacher notes</p> <p><i>The principles of evaporation can be highlighted with Aboriginal people's use of animal skins in the creation of a water bag however further mention of Aboriginal people's innovation in choosing the properties of natural materials to make containers, tools, hunting and fishing gear can be further explored. The Australian Museum website provides a great starting point to explore such innovation.</i></p> <p>Share with students that we can see evaporation in action keeping things cool in the following investigations.</p>		

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	<p>Ask students to think back to what happened to their wet finger when held up in the wind. The finger became cool. Could chocolate be kept cool using a similar method? What about butter?</p> <p>How effective would it be in slowing the movement of particles in the chocolate?</p> <p>Evaporation in Action</p> <p>Provide students with the following materials and an explanation on how to conduct the investigation.</p> <ul style="list-style-type: none"> • Materials • Paper towel • Spray mist of water • Pats of butter (wrapped) • Hair dryer • Glass or glass jar <p>Procedure</p> <ol style="list-style-type: none"> 1. Cut the paper towel sheet into strips that are about 6 cm wide. 2. Take one paper towel strip and wet it by dripping water on it. It should feel wet, but not dripping. 		

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	<ol style="list-style-type: none"> 3. Keeping the butter pats in their original wrappers, tightly wrap one of the butters in the wet paper towel strip and tightly wrap another one in a dry paper towel strip. 4. The dry paper towel strip might have a tendency to unwrap. Keep it in place with a small piece of tape. 5. Place the butters side-by-side on a heatproof surface. Place a glass upside down on the edges of the paper strips to keep the butters in place. <p>Have students write a prediction in their journals as to which pat of butter will melt the quickest - the one wrapped in the dry paper towel or the wet paper towel when subjected to wind created from a hair dryer.</p> <p>Ask students to provide a reason for their prediction based on what they have learnt so far.</p> <ol style="list-style-type: none"> 6. Hold dryer so the air will blow down over the butter. The hair dryer should be 15 cm above the butter. 7. Using your timer, blow hot air (with the hair dryer on high) for 5 minutes. 8. After 5 minutes, stop the hair dryer. Observe how the paper towel strips have changed. 9. Remove the paper towel strips and open the wrappers. 		

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	<p>Ask students to describe what happened to the butter wrapped in the wet paper towel compared with the butter wrapped in the dry paper towel?</p> <p>Ask students:</p> <ul style="list-style-type: none"> • Was your prediction supported? Did the evidence support your reasoning? For example the butter wrapped in wet towel will stay cool because as the water evaporated from the wet towel, it absorbed heat from its surroundings and kept the button cool. • Was the test fair? Did all groups have a similar result? • What would they need to change to make the investigation fair? For example, the distance of the heat from the butter, the angle of the heat, the temperature, the force..... <p>Lesson Four (1 hour)</p> <p>Coolgardie Safe</p> <p>Share with students that Coolgardie safes could keep food up to 8 degrees cooler than the outside temperature. They were usually kept on the verandah as this was the coolest place of most outback houses.</p>		

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	<p>In pairs, students construct a model safe from a milk carton using instructions found online using keyword search: making a Coolgardie safe from milk cartons.</p> <p>Carry out the investigation and record the temperature outside the safe and inside the safe five minutes after using a fan and record the results.</p> <p>Determine whether the temperature is eight degrees cooler than the outside temperature?</p> <p>Lesson Five (1 hour)</p> <p>Changes in innovation: a summary</p> <p>In groups, students draw and label a diagram of the process of evaporation for their model Coolgardie safe. Have students make a presentation addressing these points:</p> <ul style="list-style-type: none"> • Describe what happens to the temperature inside the safe when air flows around it. • Describe the process that causes the temperature to do this. • Where does the energy needed to change water from a liquid into a gas come from? • What evidence can they provide to show the water 		

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	<p>was able to reach the hessian?</p> <ul style="list-style-type: none"> • What improvements could you make next time to the design of your safe? • If there was one thing you could change, what would it be? <p>Complete the <i>Investigation planner</i> using ice or butter and a fan, to determine wind makes to cooling. Reinforce that for a test to be fair it is necessary to ensure that only one thing is changed and everything else is kept the same. Refer to the <i>Variable grid example</i>.</p>		