

CLIMATE CHANGE FOR BEGINNERS



STAGE THREE HSE SCI/TECH

Climate Change for Beginners is a Stage 3 integrated HSIE and Science and Technology sequence of learning experiences. The program is designed to build the core values of sustainability including respect, responsibility, participation and care.

The framework for this unit of work is based on the conceptual model. As outlined in the Transformations workshops held in Northern Sydney Region.

All internet resources listed in this book are in the Links section of the Field of Mars EEC website. www.fieldofmar-e.school@det.nsw.edu.au

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Focus: Climate Change**Key Question:**

How can we live as a responsible global citizen?

Foundation Statements

Science and Technology: Students identify, describe and evaluate interdependent relationships between living things and the environment within ecosystems.

They recognise that the Earth is the source of most materials, and resources must be managed for sustainability.

Human Society and Its Environment:

Students identify environmental issues and problems and they explore ways in which individuals and groups can contribute to solutions for these. They investigate human interactions with environments and recognise ecologically sustainable development.

Rationale

Climate change is regarded as one of the most serious global issues we currently face. Unless we can reduce our reliance on fossil fuels, such as coal, oil and gas, the consequences of dangerous climate change will become irreversible, and its impacts on economies and populations increasingly unpredictable. This unit will provide students with a clear understanding of the causes and effects of climate change and most importantly the changes we need to make as individuals, organisations and as a society to reduce the likelihood that catastrophic climate change will actually take place.

Concept: Sustainability and Responsibility**Key Learning Ideas:**

What are the causes of climate change?

What are the likely effects of climate change?

How can we act responsibly to reduce our contribution to climate change?

Outcomes:**Science/Tec**

LTS3.3 Identifies, describes and evaluates the interactions between living things and their effects on the environment.

ESS3.6 Recognises that the earth is the source of most materials and resources, and describes phenomena and processes, both natural and human, that form and change the earth over time.

HSIE

ENS3.5 Demonstrates an understanding of the interconnectedness between Australia and global environments and how individuals and groups can act in an ecologically responsible manner.

ENS3.6 Explains how various beliefs and practices influence the ways in which people interact with, change and value their environment.

Environmental Education Objectives

Students will develop:

Knowledge and understandings about:

the nature and function of ecosystems and how they are interrelated (K1)
the impact of people on environments (K2).
the role of the community, politics and market forces in environmental decision-making (K3)
the principles of ecologically sustainable development (K4)

Skills in:

applying technical expertise within an environmental context (S1)
identifying and assessing environmental problems (S2)
resolving environmental problems (S4)
adopting behaviours and practices that protect the environment (S5)
evaluating the success of their actions (S6)

Values and attitudes relating to:

a respect for life on Earth (V1)
a commitment to act for the environment (V3)
a commitment to act for the environment by supporting long-term solutions to environmental problems (V3).

Outcomes	Content / Ideas	Teaching Learning Strategies	Resources	Assessment	Quality Teaching
LTS3.3 RS 3.5	Climate Change	Activity 1: Climate Change for Beginners Students watch the <i>Climate Change for Beginners</i> slideshow. There are two versions of the slideshow one self playing with narration, the other is a powerpoint. The latest version of Quicktime is required. Students take notes on key points raised, to be referred to throughout the unit Discuss the key messages contained within the slideshow. These are: <ul style="list-style-type: none"> • It is natural for climate to change slowly. • Human activity is causing the climate to change fast. • We can change to help our planet. 	Background http://www.environment.nsw.gov.au/climateChange/whatis.htm Climate Change for Beginners slideshow (in development) http://www.apple.com/quicktime/download/	Student notes	Background Knowledge
ENS3.6 RS 3.5	Responsibility	Activity 2: Where the Forest Meets the Sea Teacher reads the picture book <i>Where the Forest Meets the Sea</i> to the class. Just like the issue of climate change the book highlights the fact people can make an active choice in what type of future they want. Discuss author's view of the choice we can make to protect the rainforest. Students create cyclic flow chart of events depicted in story using <i>Worksheet 1: Cyclic Flow Chart</i> .	<i>Where the forest meets the sea</i> by Jeannie Baker <i>Worksheet 1: Cyclic flow chart</i>	Flow chart	Knowledge Integration
ENS3.6	Climate Change	Activity 3: Climate Questions On butchers paper teachers record all or some of the following questions: <ul style="list-style-type: none"> • What is climate change? • Why do we need to be concerned about climate change? • How will climate change affect you and your family? • What could you do to help prevent climate change? • What do you think will happen if we don't try to stop climate change? • What should others do to prevent climate change? • Who will be the most effected by climate change? In small groups students spend 5 minutes on each question and record their responses on the butchers paper. Review student responses with the whole class. Use the student	Questions on butchers paper	Brainstorm responses Definitions	Background knowledge Knowledge integration

responses to try and create a class definition of climate change.

At conclusion of unit review responses.

EES3.6	Carbon Cycle	Activity 4: The Carbon Cycle	Carbon Cycle image http://www.windows.uca.r.edu/tour/link=/earth/climate/images/carboncycle.jpg_image.html	Student research and reporting	Deep Knowledge
TS3.2		<p>Living things, including plants and animals, are made of carbon and they depend on carbon for nutrition. Carbon is also an important component in bones, sea shells, and chemical sedimentary rocks like limestone. Carbon can dissolve in water. In the atmosphere, carbon forms a greenhouse gas called carbon dioxide. Currently human activity is directly responsible for a changing climate. Carbon continually moves through these parts of the Earth system. This is called the carbon cycle.</p> <p>In groups, students research key elements of the carbon cycle as allocated by teacher <i>Worksheet 2: Carbon Elements</i>.</p> <p>Groups report back to class and sequence their findings on paper or an IWB creating a sequential flow chart that demonstrates the completed carbon cycle.</p> <p>Extension Activity Students play the carbon cycle game.</p>	<p>Worksheet 2: Carbon Elements</p> <p>The Carbon Cycle game http://www.windows.uca.r.edu/earth/climate/carbon_cycle.html</p>		Deep Understanding
LTS3.3	Carbon emissions	Activity 5: Carbon Emissions	Black Balloons Adds www.savepower.nsw.gov.au	Student responses	Connectedness
RS3.5		<p>An increase in greenhouse gasses in our atmosphere has resulted in the warming of our planet. These gases get their name because they work like a traditional glass greenhouse for plants. The most common greenhouse gases are carbon dioxide, methane and nitrous oxide. They trap heat in the atmosphere and do not let heat escape back into space.</p> <p>Students view NSW Government TV advertisement: www.savepower.nsw.gov.au</p> <p>The 'Black Balloon' is used to represent the invisible carbon emissions from household appliances. Students discuss advertisement with reference to their own households and form generalisations about these.</p> <p>Brainstorm and list all appliances that are used in the classroom or at home that add to the school's or home's carbon emissions.</p>			Substantive Communication

EES3.6	Greenhouse Gases	Activity 6: Greenhouse Gases	Background http://eo.ucar.edu/kids/green/warming4.htm	Student predictions	Problematic Knowledge
INVS3.7		<p>Greenhouse gases are often invisible (though we can smell some!). This activity helps students to visualise what greenhouse gasses actually look like.</p> <p>Open a small bottle of Diet Coke and describe observations, e.g. bubbles, smells, sounds. Draw student attention to the bubbles of carbon dioxide in the liquid.</p> <p>We can see the bubbles of carbon dioxide because they are passing through liquid, however what happens when they pop on the surface.</p> <p>Go outside with the class and drop a few mentos lollies into the diet coke. Observe what happens. Students make predictions about what happened to the bubbles and how this experiment relates to Climate Change.</p> <p>Other greenhouse gasses can't be seen but can be smelled. Students view video of effects of animal produced methane gas on environment at: www.animalssavetheplanet.com</p> <p>As we have seen Greenhouse gases are often invisible. This activity further develops students' deep knowledge of greenhouse gasses by looking at the molecular structure of the gasses.</p> <p>Students use balloons to construct molecular models of the three main greenhouse gases. Coloured balloons to represent each type of gas e.g. black for carbon, white for oxygen, etc: CO_2 Carbon Dioxide (1x carbon, 2 x oxygen) NO_2 Nitrous Oxide (1x nitrogen, 2 x oxygen) CH_4 Methane (1 x carbon, 4 x hydrogen).</p> <p>Students make several of each model and label with the chemical formula to suspend from the ceiling, forming a large colourful layer of balloons (gases) that depicts a visual representation of a heat trapping layer of greenhouse gases. Refer to the pie graph found on Wikipedia.</p>	<p>Diet coke (small bottle)</p> <p>Mentos</p> <p>http://en.wikipedia.org/wiki/Diet_Coke_and_Mentos_eruption</p> <p>http://www.robertprice.co.uk/robblog/archive/2006/6/The_Mentos_And_Diet_Coke_Explosion.shtml</p> <p>www.animalssavetheplanet.com</p> <p>Balloons (4 colours, 1 for each gas)</p> <p>String</p> <p>Sources of Greenhouse gases http://en.wikipedia.org/wiki/Greenhouse_gas</p>	Student demonstration	Deep Knowledge
ESS3.6	Greenhouse effect	Activity 7: Construct a Mini-Greenhouse	Background http://www.epa.gov/climatechange/kids/greenhouse.html	Explanation and conclusions	Deep Understanding
DMS3.8		An increase in greenhouse gasses in our atmosphere has resulted in the warming of our planet. These gases get their name because they work like a traditional glass greenhouse for plants. The most common			
WS3.12			Worksheet 3:		

		<p>greenhouse gases are carbon dioxide, methane and nitrous oxide. They trap heat and do not let heat escape back into space. Construction of a mini greenhouse will demonstrate how heat can be trapped.</p> <p>Students discuss the experiment and record details, observations and results using <i>Worksheet 3: Conducting an Investigation</i>. Background information on conducting scientific investigations can be found in the appendix.</p> <p>Students construct a mini greenhouse using the following procedure:</p> <ul style="list-style-type: none"> • Cut the soft drink bottle in two, separating the top (2/3) from the base (1/3). • Put on gloves and fill the base with soil to represent land. • Place a seedling in the middle of the soil to represent a forest. • Water the plant with a spray bottle. • Place a thermometer into the soil. <p>Half the class students leave their bottle bases uncovered to simulate 'normal' climatic conditions. The other half place the top over the base representing Earth's atmosphere with high concentrations of greenhouse gases. Students predict what will happen to the temperature.</p> <p>Students measure the temperature of the covered and uncovered greenhouses at set intervals e.g. morning, mid-day and afternoon. For best results this should be done over a few days.</p> <p>OR</p>	<p>Conducting an Investigation</p> <p>1.25L soft drink bottle with lid</p> <p>Scissors</p> <p>Textas</p> <p>Potting mix</p> <p>Trowels</p> <p>Gloves</p> <p>Seedlings</p> <p>Sticky tape</p> <p>Thermometer</p> <p>Spray bottle</p>		
ESS3.6	Greenhouse effect	Activity 8: Global Warming Domes	Worksheet 3: Conducting an Investigation	Student graphed results	Deep Understanding
DMS3.7		<p>Students construct a dome-like structure that simulates the effects of global warming. Domes are constructed from items such as fallen sticks, string, tarps, garbage bags, reusable or recyclable items. Students attach balloons from greenhouse gas balloon activity to outside of domes to represent greenhouse gases.</p> <p>Students discuss the experiment and record details, observations and results using <i>Worksheet 3: Conducting an Investigation</i>. Background information on conducting scientific investigations can be found in the appendix.</p> <p>Students use thermometers or hygrometers to record changes to temperature and humidity; make observations about current weather</p>	<p>Thermometers or hygrometers</p> <p>Sticks found in playground</p> <p>String</p> <p>Plastic</p> <p>Tarp</p> <p>Masking tape</p>	Oral explanation	Higher order thinking

conditions and notes on sensation of being inside the dome at hourly intervals throughout the day.

Drop sheets

Students graph results on paper or excel, compare and analyse recordings from all domes and hypothesise about variables including the effects of sunlight and shade on the domes.

Worksheet 4:
Explanation

Students invite Buddy Classes into domes and explain what the domes represent, their function and how they were constructed.

Consider the following:

How does the dome replicate the enhanced greenhouse effect?

How can the dome be used as a model for explaining climate change?

Using *Worksheet 4* and all of the data gathered from observations, experiences and investigations of climate change write an explanation of climate change to accompany either your mini greenhouse or global warming dome. Pitch the text for use with another grade such as Buddy classes or mentors.

INVS3.7	Energy	Activity 9: Energy and Coal	http://www.energyquest.ca.gov/index.html	Prior knowledge
		Think/Pair/Share Activity: What is energy? Who uses it? How is it used? Why do we need to use energy?	http://en.wikipedia.org/wiki/Coal	Substantive communication
		Students explore the energy quest website and develop a group definition of energy	http://www.planete-energies.com/content/coal/formation.html	Connectedness
		The Australian economy is largely based on its mineral wealth. Coal is one of the minerals that is both exported and used domestically to generate electricity. Australia generates most of its energy from coal. The burning of coal and the subsequent release of carbon dioxide is one of the key contributors to greenhouse gasses.	http://www.classzone.com/books/earth_science/terc/content/visualizations/es0701/es0701page01.cfm?chapter_no=visualization	
		Students investigate how coal is formed using the provided links. Research the links between coal and energy production.	http://www.hk-phy.org/energy/power/source_phy/flash/formaton_e.swf	
		In groups students dramatise the process of coal formation and energy production using from coal indicating all the pollutants at various stages of production and use.	http://www.sceyencestudios.com/movies/coalformation.swf	
		Class evaluates each group's performance on depth of representation.	http://www.eia.doe.gov/	

			kids/energyfacts/sources/non-renewable/coal.html		
LTS3.3	Energy Audit	<p>Activity 10: Energy Audit</p> <p>Energy audits are a useful way of investigating energy use in your school or at home. They help to focus student attention on how energy is used, how it is wasted and how it can be saved. Audits can be simple e.g. looking at energy bills or they can be quite detailed e.g. identifying the energy use for a school, classroom or home.</p> <p>The Sustainable Schools Website contains resources and worksheets to help you conduct an energy audit as well as other useful resources.</p> <p>Alternative energy audits are located on the DET asset management website.</p> <p>One simple audit is to examine what electrical items are left on at inappropriate times. This can easily be rectified with modified student and staff behaviour, e.g. switching off at the power point, turning lights off.</p> <p>Review and discuss the results of the energy audit.</p>	<p>http://www.sustainable-schools.nsw.edu.au</p> <p>https://detwww.det.nsw.edu.au/assetmanagement/envisust/index.htm</p>	Student work samples	<p>Knowledge Integration</p> <p>Higher order thinking</p> <p>Problematic Knowledge</p>
WS3.12	Efficiency	<p>Activity 11: Energy efficiency at home and school.</p> <p>Coal and other fossil fuel resources are non-renewable and will potentially run out in our lifetime. Our society needs to find ways to reduce our dependence on coal based energy or to find other non polluting alternatives.</p> <p>Energy efficiency is one of the key methods of reducing energy requirements and can be achieved through behaviour change or via the purchase of appliances that have been rated as energy efficient. Energy also needs to be sourced from non fossil fuel based products such as solar, wind, thermal, hydro etc. These are often referred to as renewable or green energy.</p> <p>Discuss: What are the ways can we reduce our reliance on fossil fuels at home and at school? Why do we need to reduce our fossil fuel use? What are the alternatives to fossil fuels?</p> <p>The Field of Mars EEC offers a Sustainable House program that</p>	<p>Background http://www.technologystudent.com/energy1/engex.htm</p> <p>Field of Mars Sustainable house http://www.fieldofmar-e.schools.nsw.edu.au/</p> <p>Energy Efficient House TaLe Learning object L895 http://www.tale.edu.au</p> <p>Environmental Education Policy</p> <p>http://www.powerhousemuseum.com/education/ecologic/bigfoot/bigfoot2007/</p>	Student responses	<p>Knowledge Integration</p> <p>Higher order thinking</p> <p>Problematic Knowledge</p>

supports this activity. In this program students will discuss how to retrofit a large 2D model of a house to make it more efficient. This includes appliances as well as required behaviour change.

<http://sketchup.google.com/green/>

Alternatively the TaLE website has a number of learning objects relating to energy efficiency. The Energy Efficient House series L895 is particularly useful for this activity.

<http://www.eere.energy.gov/kids/>

To conclude students use the gathered information and the results of the energy audit in Activity 10 to produce a multimedia presentation such as PowerPoint or photostory, to present findings and make recommendations about reducing energy consumption and increasing energy efficiency in the school. This could be presented to school assembly and the parent community at P&C meetings.

http://www.energystar.gov/index.cfm?c=kids.kids_index

<http://www.climatecops.com/>

NB: Audit findings and recommendations should form a part of your School Environmental Management Plan.

TaLe Learning Object
L1142: Energy from the Sun
<http://www.tale.edu.au>

Extension Activities

Design a sustainable house using Google Sketch Up. This 3D design software is free to download and use. The provided link has embedded video showing how architects design green home.

Students calculate their ecological footprint using the Bigfoot Ecological Footprint Calculator on the Powerhouse Museum website.

Design a solar oven. TaLe Learning Object L1142. Use the Sun's energy to cook food. Select design settings for a solar oven: cover, insulation and lining. Choose variables to reach temperatures needed to cook food such as chicken, fish and bread

LTS3.3 DS3.1	Carbon emissions	Activity 12: Carbon, Cars & Trees	Background http://www.abc.net.au/catalyst/stories/s1901661.htm	Calculations Graphs	Problematic Knowledge
		<p>In Australia the average car emits approximately 4 tonnes of CO₂ per year. If an energy saving initiative is undertaken at a given site and reduces CO₂ emissions by 1,000 tonnes of CO₂ a year, this is equivalent to permanently removing 231 cars from the road.</p> <p>Trees are often planted to absorb carbon dioxide. Each mature tree can absorb 250kg of CO₂. It's estimated that a hectare of growing trees (1,000 trees) takes up about 21,000 kg of carbon dioxide each year. Each litre of fuel used by a car releases about 2.36 kg of carbon dioxide.</p>	Background http://www.abc.net.au/news/stories/2008/01/18/2141215.htm	Student suggestions	

Calculate the number of trees you would need to plant in order to absorb the carbon dioxide from a single car over a year.

Task

1. Estimate or record the total distance travelled by your car in one month.
2. Calculate the total litres of fuel consumed by your car in that time.
3. Calculate the amount of carbon dioxide released by your car in one month.
4. Multiply this amount by 12 to calculate how much carbon dioxide your car releases in one year.
5. Calculate how many trees you need to plant in one year to make up for the release of carbon dioxide from your car.

LTS3.3	Carbon offsets	Activity 13: Carbon Garden Students begin to plan, design and construct a carbon garden in the school to offset carbon emissions used by their family car, relating number of trees planted to emissions. A mature tree can absorb 250kg of carbon. The Field of Mars EEC offers a special <i>Bare to Biodiverse</i> videoconference lesson that can be used to help plan and design a carbon garden. You will need to provide a photo of the area that will hold the carbon garden. Using the IWB and VC equipment students examine the digital photo and brainstorm how the area can be improved to help sequester carbon and to provide more appropriate habitats. Using the IWB the students will be able to add the following habitat elements; trees, shrubs, groundcover plants, flowering plants, leaf litter, rocks, logs, tree hollows/nest boxes and water to the digital photo. Once complete the students will have a rough visual plan of their carbon garden. The completed image can be used as a planning, marketing and grant tool.	Field of Mars http://www.fieldofmar-e.schools.nsw.edu.au/ Native Plants Mulch Planting equipment Field of Mars 'Bare to Biodiverse' Connected classroom Digital photo of planting area.	Knowledge Integration	
LTS3.3	Human Impact	Activity 14: The Issue of Cars. Governments are considering legislating the types of cars people can buy based on fuel consumption and emissions. We have already seen the effects of pollution in Beijing at the Olympic Games where the city was covered in a visible blanket of pollution leading up to the games.	Worksheet 5 Issues map Worksheet 6: Banning Cars	Student answers Marking rubric	Problematic Knowledge Knowledge Integration Deep

Limiting the use of private cars in the city dramatically and visibly reduced the amount of pollution during that time. As access to cars, becomes more readily affordable particularly in many developing nations, consider the implications of this on the global environment. Students use the *Worksheet 5: Issues Map* to scaffold this from a variety of perspectives.

Issues map

An issues map can help identify the different dimensions or perspectives that relate to a particular event or topic of concern. It is often helpful to have issues phrased as questions as these can be answered differently depending on the point of view held by those who suggest an answer. The responses can then be categorised as positive or negative.

Discuss: Should car use be reduced in your local area/Northern Beaches? Students complete commons written assessment task *Worksheet 6: Banning Cars*.

DMS3.8	Alternative energy	<p>Activity 15: Design and Make a Renewable Energy Transport</p> <p>With the realisation that traditional fuels like oil are finite, transport companies are very slowly moving towards developing vehicles that rely on less polluting technology. We are seeing the emergence of hybrid cars that utilise electric and petrol motors and it will not be very long before electric cars become common place. Other even greener technology is also being tested, such as hydrogen and solar electric.</p> <p>Design and make a wind or solar powered device or transport vehicle. Explain how it will help to reduce greenhouse gas pollution. The design task is explained in <i>Worksheet 7: Design and Make</i></p> <p>Students conduct an alternative transport exhibition and explain their devices to their visitors.</p>	<p>Background http://en.wikipedia.org/wiki/Solar_vehicle</p> <p>Solar Boat Challenge http://www.solarchallenge.com.au/</p> <p>Worksheet 7: Design and Make</p> <p>World Solar Challenge http://www.wsc.org.au/</p>	Assessment rubric	Connectedness
ESSS3.3	Melting Ice	<p>Activity 16: Floating Ice and Land Ice Experiment.</p> <p>One of the consequences of global warming is the increased melting of ice in the north and south poles. The ice that is at risk of melting comes in two forms, sea ice and land ice. Sea ice floats on top of the ocean and makes up most of the North Pole. Land ice is mainly found on top of the continents of Antarctica and on Greenland.</p>	<p>Documenting Glacial Change interactive http://www.teachersdomain.org/resource/ipy07.sci.ess.earthsys.glaciersphoto/</p> <p>Worksheet 8: Floating Ice</p>	<p>Student worksheet</p> <p>Student discussion</p>	<p>Deep Knowledge</p> <p>Problematic Knowledge</p>
RS3.5					
INVS3.7					

View: 'Documenting Glacial Change' interactive

This introduces the effects of global warming on glaciers. Students observe and examine the changes in glaciers and state causes of these changes?

Worksheet 3:
Conducting an
Investigation

In small groups students conduct the **Floating Ice and land Ice Experiment** as described in *Worksheet 8: Floating Ice*. This experiment demonstrates the effects of global warming on the two forms of ice.

Students discuss the experiment and record details, observations and results using *Worksheet 3: Conducting an Investigation*. Background information on conducting scientific investigations can be found in the appendix.

As the floating ice melts it should not make much difference to the overall level of the water. Sea ice is water that is already in the ocean that has frozen. However as land ice melts it actually adds to the level of the water.

Students discuss the implications for this in their local area, e.g. impacts on houses on the coast, salt water entering rivers, etc

ESS3.3	Displacement	Activity 17: Inuit and Climate Change	Inuit video http://www.teachersdomain.org/resource/ipy07.sci.ess.watcyc.lpmeltingice/	Problematic Knowledge
RS3.5		Watch the 'Inuit Observations of Climate Change' video. Students discuss: What are the effects of melting sea ice and land ice on the Inuit village depicted in the video?		
		Students predict the possible impact of the melting of both forms of ice on the world's coastal communities	Worksheet 1: Cyclic Flow Chart	
		Students use <i>Worksheet 1: Cyclic Flow Chart</i> to identify key effects of melting ice on the Inuit. Students discuss and then predict impact of the melting of both forms of ice on the world's coastal communities.		
LTS3.3	Time	Activity 18: Past, Present and Future	Photos from:	Venn diagram
		Students compare and contrast past and present photos of the local environment noting similarities and differences using a Venn diagram. Photos can be found on the following websites: Picture Australia, PicMan, Discuss the changes in terms of habitats, flora and fauna, habitats, development and people.	Picture Australia http://pictureaustralia.org/	Worksheets
			PicMan http://www2.sl.nsw.gov.au/picman/	Deep knowledge
				Connectedness
				Deep Understanding

Teacher reads the narrative from *Worksheet 10: Past, Present and Future* that takes students on a visual journey of the changes that have occurred to the Narrabeen area over time.

Six Viewer
<http://imagery.maps.nsw.gov.au/>

Either before or after the visioning activity explore a variety of books illustrating aspects of progress/change. Some examples are:
Where The Forest Meets The Sea – Jeannie Baker, *The Window* – Jeannie Baker, *Belonging* – Jeannie Baker, *My Place* – Nadia Wheatly, *Uno's Garden* – Graeme Base, *Cry Me A River* – Steve Posselt, *The Lorax* – Dr Suess and *The Paddock* – Lillith Norman.

Picman webiste
 Historic website

Worksheet 10: Past, Present and Future.

Picture Books

Alternatively watch the *Lorax* video hosted on the Planet Ark website.

Lorax Video
<http://treeday.planetark.org/kids/lorax.cfm>

Silent Conversation

Place the contents of *Worksheet 11: The Lorax* on butchers paper. Students silently examine the questions and write their responses on post it notes and place under the appropriate question. Discuss responses as a class.

Worksheet 11:
 The Lorax

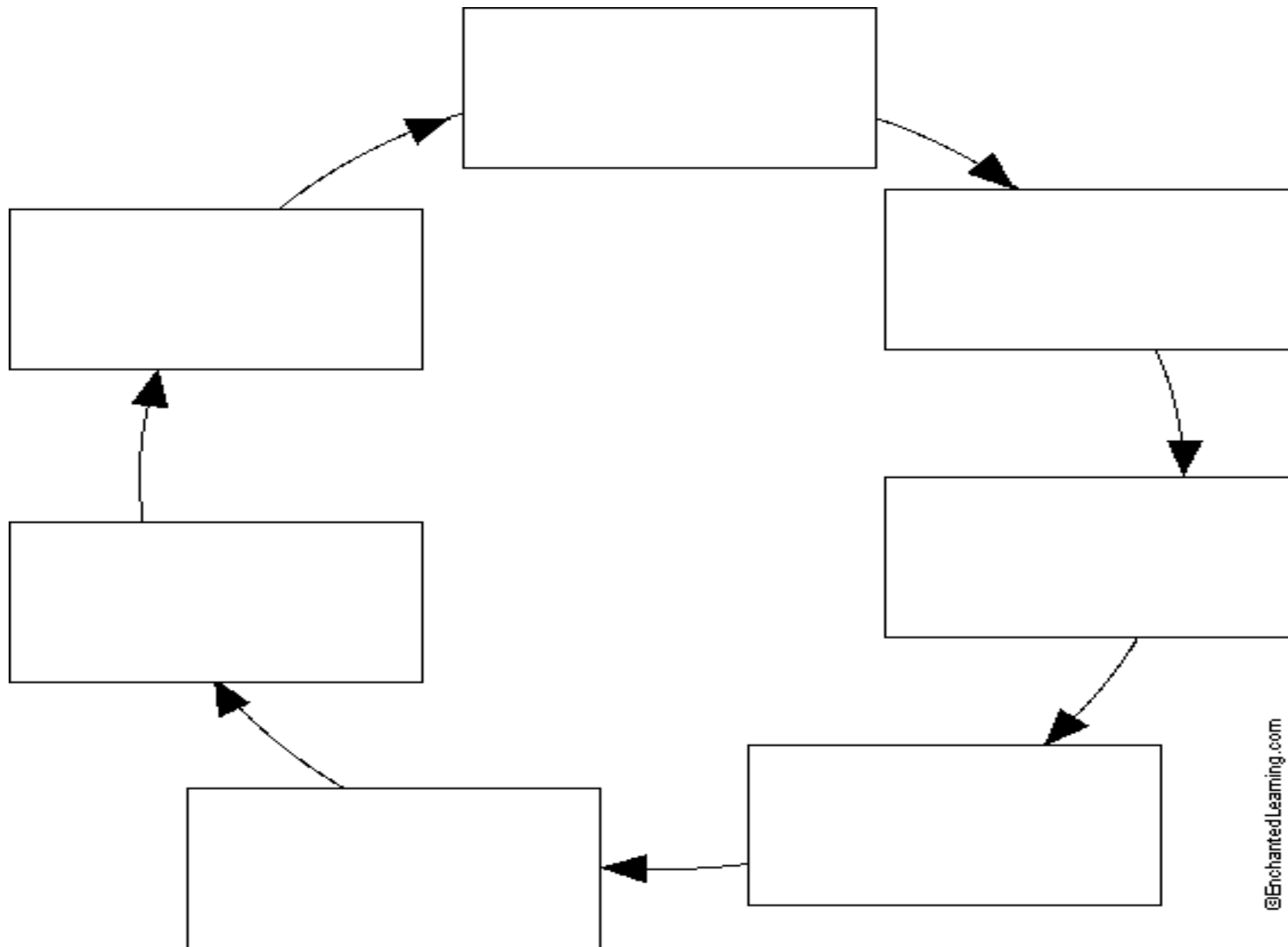
Butchers paper, post it notes

LTS3.3	Impacts	<p>Activity 19: Coastal Environment Centre Excursion</p> <p>Students visit a local beach with a natural intact dune system to investigate the function & importance of natural dune systems. Avalon, Newport, Narrabeen, Long Reef or Mona Vale Beach are suitable beaches or visit a natural sand dune system close to your school.</p> <p>Natural forces shaping the coastal environment</p> <ul style="list-style-type: none"> • Introduction by CEC Educator or Council officer – Our Coast Past, Present and Future (an introductory talk on sea level rise). Students note coastal features and discuss local geology & sea level change from the last ice age. • Field Activity - Students measure and record weather data to understand the effects of weather & climate on the coastal landscape. <p>Student investigate how sand dunes are formed and shaped</p> <ul style="list-style-type: none"> • Field Activity - How dunes are formed and the movement of sand. A profile is created by taking sand samples from different parts of the dune system <p>Plants as protectors of the dune system,</p> <ul style="list-style-type: none"> • Field Activity – Plants of the fore dune, dune crest & hind dune and their adaptations <p>The function of sand dunes as a 'bank of sand' and their importance in the coastal environment – A natural dune system compared to hard</p>	<p>Coastal Environment Centre http://www.pittwater.nsw.gov.au/environment/cec</p>	<p>Deep Knowledge</p> <p>Deep understanding</p> <p>Connectedness</p>
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		<p>surfaces as a buffer to erosion land and development behind the dunes.</p> <ul style="list-style-type: none"> • Activity - Students create a drawing or profile of the dune after a destructive storm with sand samples & plant drawings. Students write about what happens to a dune system in a storm situation & how it recovers afterwards. • Discussion with local residents & other agencies in caring for the dune system. 			
LTS3.3	Conservation	<p>Activity 20: Taronga Zoo Excursion</p> <p>Students visit Taronga Zoo and research one animal of the Southern Oceans.</p> <p>Students investigate the effects of climate change on the habitat and the individual species and how the zoo is playing an important role in modern conservation projects.</p> <p>Students take photos at the zoo and combine these with internet sourced images to create a brief Photostory (no more than 8 images) showing the impact of global warming on this species.</p>	<p>Taronga Zoo http://www.taronga.org.au/taronga-zoo/education/excursion.s.aspx</p>	Rubric	<p>Deep Knowledge</p> <p>Deep understanding</p> <p>Connectedness</p>
ENS3.5	Persuasion	<p>Activity 21: It's Time to Change</p> <p>Students view Severn Suzuki's speech at the Rio Earth Summit as an example of student activism.</p> <p>or</p> <p>Watch the <i>Lost Generation</i> video. This is an amazing example of a simple presentation that is very powerful and motivating.</p> <p>Discuss the ways these videos are designed to persuade the audience via narrative, music, visuals etc. What are some keywords that describe these pervasive videos.</p> <p>Final Assessment Task</p> <p>Students create a presentation approx 2 minutes duration that aims to persuade their family that climate change is happening and the actions their family needs to do to mitigate its effects.</p>	<p>Severn Suzuki http://www.teachertube.com/viewVideo.php?video_id=65060&title=Severn_Suzuki_speaking_at_UN_Earth_Summit_1992</p> <p>Text from Severn Suzuki's speech</p> <p>http://www.sustainablestyle.org/sass/heirbrains/03suzuki.html</p> <p><u>Lost Generations</u> http://www.teachertube.com/viewVideo.php?video_id=109380&title=Lost_Generation&vpkey=</p> <p>Worksheet 12: Assessment Rubric</p>		<p>Connectedness</p> <p>Higher Order Thinking</p> <p>Engagement</p>

Quality Teaching

Intellectual Quality		Quality Learning Environment		Significance	
DK	Deep knowledge	EQC	Explicit quality criteria	BK	Background knowledge
DU	Deep understanding	E	Engagement	CK	Cultural knowledge
PK	Problematic knowledge	HE	High expectations	KI	Knowledge integration
H-OT	Higher-order thinking	SS	Social support	I	Inclusively
M	Metalanguage	SSR	Students' self-regulation	C	Connectedness
SC	Substantive communication	SD	Student direction	N	Narrative

Worksheet 1: Cyclic Flow Chart

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Worksheet 2: The Carbon Cycle

Carbon Cycle	Atmosphere	Limestone
Animals	Decay	Animals
Water	Death	Fossil Fuels
Combustion	Plants	Earth
Respiration	Photosynthesis	Co2

Worksheet 3: Conducting an Investigation

Group members:

Introduction - I am going to investigate

Results - What happened? What did I learn from this investigation?

Prediction - What do I think will happen? Why I think it will happen

Hypothesis

Discussion - Was this what was expected? If not, why not? How can these results be used to improve or change?

What am I going to do?

How will I make it a fair test?

Keep the same

Change

Measure

Worksheet 4: Explanation

TASK: Using all of the data gathered from observations, experiences and investigations of climate change write an explanation of climate change to accompany either your mini greenhouse or global warming dome. Pitch the text at the chosen audience level.

An **explanation** is used to tell how or why something happens or why things are alike or different.

Structure the three parts of an explanation are:

- A **general statement** which describes or identifies the phenomenon
- A **series of statements** that tell how or why the feature or process changes. Words should show cause and effect.
- A **conclusion/application** sums up the explanation and talks about its applications; may also give examples

Language features of an explanation:

- Technical language - *evaporation*
- Action verbs and present tense - *runs, develops, becomes*
- Passive voice - *water is pulled up...*
- Cause and effect terms - *because of.., due to.., therefore, as a result*

Explanation Scaffold

Introduction – identify the phenomenon, giving a summary

Explanation (how and why) sequence

OUTCOMES

WS3.9: Produces a wide range of well structured and well presented factual texts using increasing challenging topics, ideas, issues and written language features.

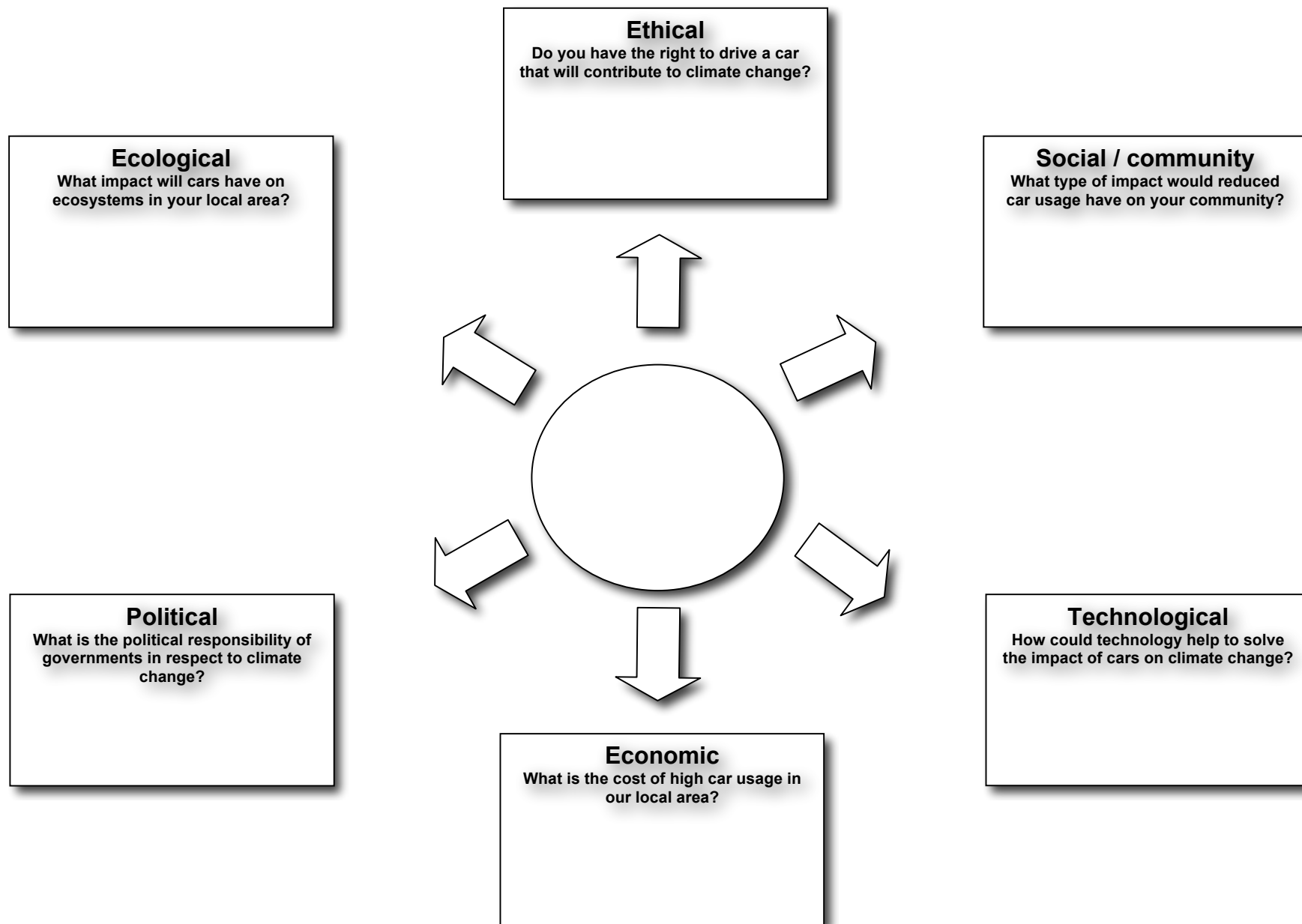
WS3.10 Uses knowledge of sentence structure, grammar and punctuation to edit own writing.

WS3.13 Critically analyses own texts in terms of how well they have been written, how effectively they present the subject matter and how they influence the reader.

Indicators

	Elementary	Basic	Sound	High	Outstanding
Uses correct structure:-					
i. Opening statement of the topic					
ii. Series of arguments for and against					
iii. A conclusion that sums up arguments and recommends in favour of one particular side.					
Uses connectives to link arguments					
Uses paragraphs to introduce new ideas					
Uses evaluative language					
Writes logical arguments with supporting evidence					
Uses correct sentence punctuation in writing					

Conclusion

Worksheet 5: Issues Map

Worksheet 6: Banning Cars

TASK: Plan and write a discussion on the following:

Cars should be banned from the Northern Beaches

Your writing should include:

- Supporting statements for both arguments and then conclude with a summary stating your viewpoint.
- Connectives to link and order arguments
- Correct sentence punctuation
- Use of noun groups
- Persuasive language
- Paragraphs

OUTCOMES

WS3.9: Produces a wide range of well structured and well presented literary texts using increasing challenging topics, ideas, issues and written language features.

WS3.10 Uses knowledge of sentence structure, grammar and punctuation to edit own writing.

WS3.13 Critically analyses own texts in terms of how well they have been written, how effectively they present the subject matter and how they influence the reader.

Indicators

	Elementary	Basic	Sound	High	Outstanding
Uses correct structure:- i. Opening statement of the topic					
ii. Series of arguments for and against					
iii. A conclusion that sums up arguments and recommends in favour of one particular side.					
Uses connectives to link arguments					
Uses paragraphs to introduce new ideas					
Uses evaluative language					
Writes logical arguments with supporting evidence					
Uses correct sentence punctuation in writing					

Worksheet 7: Design and Make

Boat Building Design and Assessment Brief

Outcomes:

Students will

- describe the factors that influence design and justify the decisions made in design and making
- produce a model to meet a specific design brief
- persevere with an activity to its completion

Task: As discussed in accordance with the Pittwater Council 2020 Plan, environmentally effective transport in the Pittwater area is a problem that requires addressing. One possible solution could be the introduction of a ferry system. Your mission, after testing various materials, is to design and make a ferry which will:

- float
- have an enclosed waterproof motor
- use solar energy (the solar panel will be provided for you), if you want additional panels you will need to purchase them yourselves from Dick Smith's – approx \$12.50 each
- carry a 1kg bag of rice

We will be looking at aspects of floating and sinking at school. We will enjoy guest speakers talking about design and we will also conduct tests on waterproof quality of materials, with the help of Narrabeen High School students.

Date:

You are encouraged to collect materials you may like to test or use from home, to talk to family members to gain ideas and to make some preliminary design sketches. (Refer to your boat picture collection)

Please remember you will be required to do the final design sketch with labels and make the boat at school

Date:

High school students will be available to assist with ferry construction.
Initial testing will occur at home

Date:

This is a common assessment task for all Stage 3 students and will be graded. The testing sheet and a marking sheet are included for your reference.

As a culmination, we will be holding a ferry regatta at a local waterway (such as Mullet Creek accessible by North Narrabeen PS) where we will put your ferries to the test.

Ferry Design

Proposed sketch with labels

Draw your ferry boat, including the solar panel and a position for the bag of rice. Label each part for function / feature and material to use.

List your materials/ equipment and give reasons for your choice.

Make your ferry and test it, at home in the bath/ swimming pool, for sea worthiness, ease of movement, ability to carry the weight and speed. Record your results.

	< 30 seconds	31 secs to 1 min	>1 minute to 4 mins	> 4 mins
How well did it float?				
How well did it stay upright?				
Did the ferry maintain its load?				
	Not at all	< 1 metre	1metre to 5 metres	> 5 metres
How far did it move?				
How long did it take for the ferry to travel the distance of the bathtub?				

Look at your results and also at the ferry's waterproof qualities. Are there any improvements you need to make?

My ferry did / did not make it across Mullet Creek carrying its load.

Other solutions that the council could consider to combat the transportation problem are

Next time to improve my ferry's performance I would

It is important to consider alternative means of transport because

A solar powered ferry system would be a good solution to Pittwater's transportation problems because

Solar Powered Ferry Boat Marking Criteria

Name:

Task: Design and make a solar powered ferry boat that can carry a kilogram load.

	Elementary	Basic	Sound	High	Outstanding
Indicators	(2)	(4)	(6)	(8)	(10)
Knowledge and understandings					
Sketch	Limited drawing and 1 label	Attempted drawing and 2 labels	Sketch including hull, solar panel, place for load and 3 labels	Detailed sketch including > 3 labels	Very detailed sketch including parts, features and materials
Skills					
Choice of materials and reason	1-2 materials listed with poorly expressed reasons	3 materials with little detail in reasons	4-5 materials with satisfactory reasons	5-6 materials with clearly stated reasons. May use technical language.	6 or more materials with very clearly stated reasons including technical language
Testing at home	Conditions for test poorly executed	Met most criteria 31 secs to 1 min	Met some criteria 1 to 4 minutes	Met all criteria 1 min to 4 mins	Met all criteria > 4 mins
Evaluation of design	1 negative or positive statement	A positive / negative statement with an attempt to modify design if needed.	3 statements (pos / neg) with a couple of ideas to modify design if needed.	4 statements (pos/neg) with sound ideas to modify design if needed.	Capably suggests 5 or more ideas (pos/neg) with detailed modifications if needed.
Values and Attitudes	(3)	(6)	(9)	(12)	(15)
	Answers one question adequately	Answers two questions adequately	Answers 3 questions adequately	Answers 4 questions adequately	Answers all questions adequately

Science Assessment

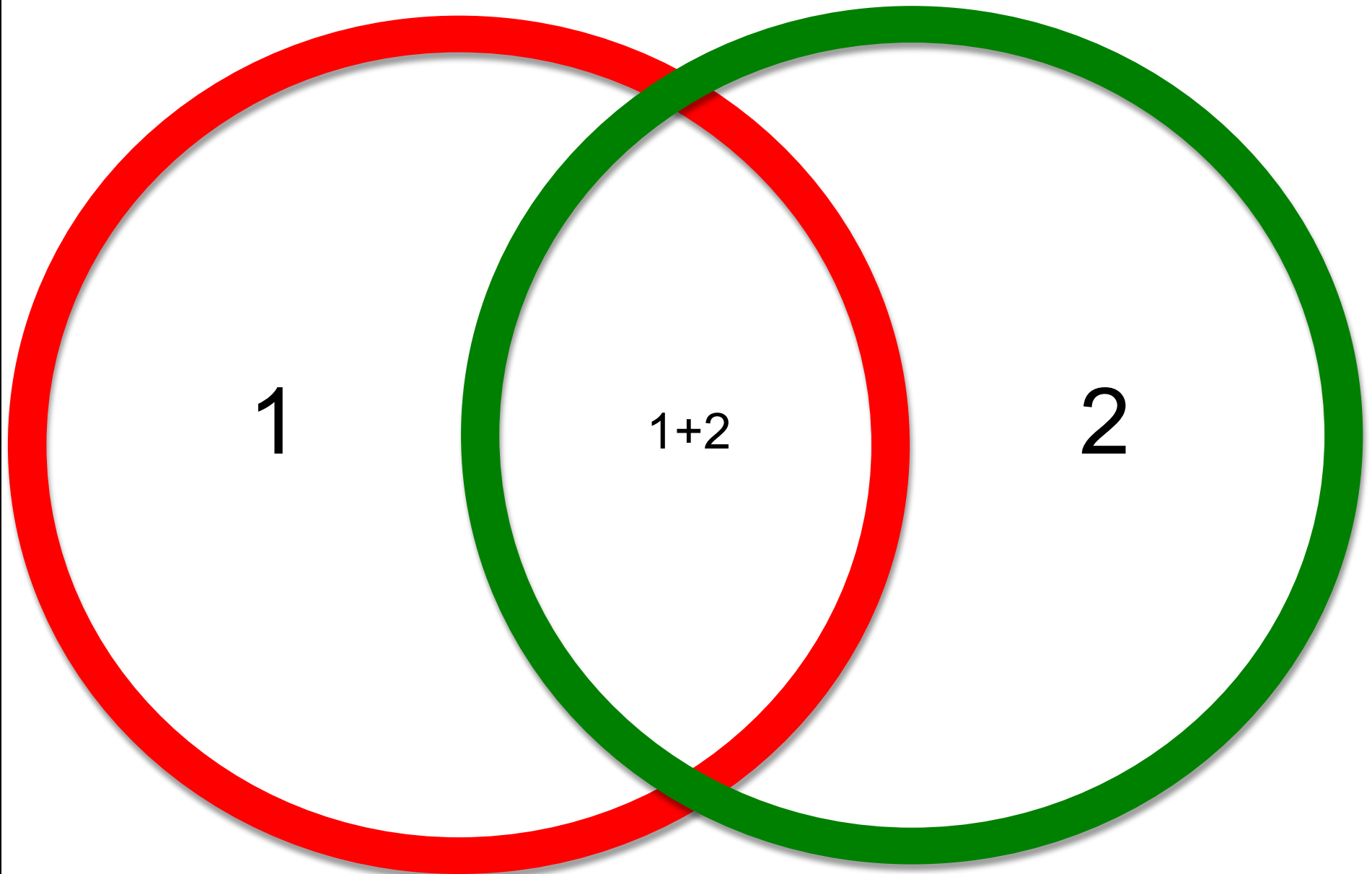
	Elementary	Basic	Sound	High	Outstanding
	(0-10)	(11-20)	(21-30)	(31-40)	(41-50)
Achievement					
Effort					

Worksheet 8: Floating Ice**Equipment:**

- Two glasses or 2 identical measuring cups
- Tote tray
- Ice
- Water (preferably warm)
- Chux wipes
- Elastic band or sticky tape

Procedure:

- Place the two measuring cups or glasses into the tote tray.
- Place 5 ice cubes into a measuring cup.
- Pour water over the ice till the container is about $\frac{3}{4}$ full.
- Mark the level of water on the side of the container with a Texta. This container represents floating sea ice.
- Fill the other measuring cup with water to the same level as the first container.
- Mark the level with a Texta.
- Place Chux over the top of the container and secure with an elastic band or sticky tape.
- Place 5 ice cubes on top of the Chux. This represents ice that is sitting on land.

Worksheet 9: Venn Diagram

Worksheet 10: Past, Present and Future (NEW Version – updated 3/8/09)

Use your imagination to take part in a creative visualisation.

Make yourself comfortable..... close your eyes... and start to breathe in and out to my count... in 1, 2, 3, 4... listen to your own breathing and relax... we are going on a journey to our own special land... back through the portals of time... back to the beginning of Narrabeen... before the first human footprint was captured on our sandy shores... where the only footprints to be found were those of pelicans, seagulls, and perhaps that of the now extinct mega-fauna that once roamed our southern land.... Nothing will hurt you on this journey.... You will be very safe...you are now free falling back through the windows of time...

Keep your eyes closed... and imagine... we are flying through the air... high up in the sky... looking down over our special land... and there it is! ... It is a very big island sitting in the middle of a beautiful blue ocean.... Fly over our big island and have a good look at it.... As you come down closer you notice that the sea level is lower, this is because there is more water held in the icecaps at the North and South poles, you have arrived at the time of the last ice-age, over 600 000 years ago. The sea is so much lower that Australia is connected to other places by bits of land... these land bridges connect Australia to Papua New Guinea and Indonesia above us and to Tasmania in the south... Look closely and you can see animals and groups of Aboriginal people walking on these bridges into and onto our big Australian island...

Zooming in a little closer, breathing in the pure, fresh air around you in a pristine blue sky you look down and you can see there is a lovely coastline... with golden sands... rocky headlands.... and a reef platform which is very long... beautiful clear flowing rivers and creeks flow from hilly forests... through woodland... grasslands and wetlands... before emptying into a crystal clear water lagoon, teeming with fish and abundant flocks of Black Swans... Zooming in closer you suddenly know this place... you realize it is Narrabeen before there has been any modern development... You recognize Mullet Creek flowing into Narrabeen Lagoon which opens out and flows into Narrabeen Beach... you can tell by the shape of the Collaroy/Longreef Headland and the North Narrabeen Headland as well as the stretch of long, golden sand that forms the beach. You can see Narrabeen Creek further north and there are trees everywhere, lots and lots of trees, not single road or footpath in sight.

As you come in to land, like a sea-eagle gliding onto a high, rocky cliff you notice the soothing sound of a quiet, gentle sea breeze, the drone of cicadas in summer and the sweet scent of eucalyptus in the air... you breathe in deep, savouring the delicious tingle the sweet, refreshing, scented air has on your body as it passes through your nose deep into your lungs... you are now journeying on foot, walking further inland and you are incredibly excited to see so many koalas, echidnas, wallabies and kangaroos around you... the bush seems to be crammed with them... they are as common as seeing our brush-tail possums... but you know that back in your time koalas have long since disappeared from the trees in Pittwater.

As you walk along the edge of the lake you can see groups of Aboriginal women collecting pippies, clams and crabs, others cutting reeds and weaving them into baskets while the men are out in long, skinny canoes spearing fish and sea-turtles... there is not a single house in sight, just a few sandstone caves and some crudely made bark shelters where some elderly aboriginals are sheltering from the sun... Across the lake you can see pelicans fishing and black swans gliding effortlessly among the reeds....all around you are the sounds and sights of nature, mixed with the laughter and chatter of busy Aboriginal people.... So many trees, clean, dazzling blue sky and crystal clear waters... it is a living, breathing paradise....

Narrabeen which is an Aboriginal word meaning place of many swans or at this time it was pronounced "Narabang" meaning wild swan is valued by the Guringai People as being a very attractive place to live.

Fish, crustaceans and shellfish were available from the Narrabeen Lagoon and nearby catchment. Possums, koalas, birds and their eggs were a good source of protein. Their teeth, bones, quills and claws were used as tools and for decorations. Neighbouring woodlands provided a good supply of plant foods, nectars, dyes, tools and medicines throughout the year. Caves not only provided protection from the weather conditions, but were a good place for caving painting and rock carvings. It is in these caves that the Guringai People depicted animals, information relating to hunting, water sources, the spirit world stories and unusual events such as the arrival of European settlers.

Whilst you are observing the Guringai People carrying out their daily activities such as hunting, cave painting, gathering food, basket weaving, cooking, fire stick farming and making tools, you fly high above the escarpment and notice a small party of men, dressed in some old fashioned clothes. A man is leading them who appears to look very much like Captain Arthur Phillip, indeed you are correct and you know this to be the time of the arrival of the First Fleet.

Standing on the Narrabeen Headland is a Guringai person who has seen the strange procession gathered at the mouth of Narrabeen Lagoon. You can hear the men discussing where the Lagoon may lead to and if in fact there will be surrounding farming land with drinking water creeks and streams. You know they have come in search of a new place to set up their farms and houses and that this is the beginning of the modern era in the Sydney Basin.

The men are wearing old-fashioned hats, boots, and clothes and carrying crude shooting rifles. They have brought some sacks of flour, tea and a range of camping equipment supplies. Amongst the equipment are some specimen jars and cages for collecting interesting plants and animals to study.

The exploration party found Narrabeen to be a very attractive and productive place to live, a view they shared with the Guringa People. Some years have passed since the first explorers came in search of land and water in this region. Looking out across the catchment area you can see a scattering of wattle and daub houses sitting on cleared patches of land with grazing cows. Nearly all the houses in the area are small dairy farms. All the roads leading to the farms and some simple supply stores are dirt roads. The big main road, which has been named Pittwater Road is a very long, dusty dirt road that winds its way through the entire peninsula.

Many of the Guringai people who were living in and around the Lagoon have since left. Initially the Guringai people were very friendly towards the European explorer/settlers, but misunderstandings and hostility developed. Between the very short period of April 1789 and 1790 many Guringai died of diseases brought to Australia by the European settlers. The Guringai had no immunity to diseases such as smallpox and measles. Most of those who survived moved away from the coast. Milk from the dairy farms is delivered to the people in the area using a horse and cart. The streets are wide enough to fit a horse and buggy built for carrying several milk pails.

We have now moved into the age of the motorcar. Pittwater Road is still a dirt road and many of the buildings are made of brick. The cars are vintage cars and the people who own them are considered to be quite well off. Pittwater Road is becoming a thriving, busy industrial centre. There are a number of specialty shops such as a butcher, baker, blacksmith and timber mill and there is even a public tram. Schools have been built and you can see lots of school children walking to school in bare feet and a few of them are even riding their horses.

After school, children can be seen fishing around the lagoon and playing. No one worries about returning home till it starts getting dark and that's only when they hear their mother's shout of "cooe" which was usually the signal to come home for dinner.

Word has spread about how good it is to live in Narrabeen. Many new immigrants have moved into the area. They have come from far away places such as Italy and Yugoslavia. The migrants have built houses in styles that are similar to the architecture back in their homeland. Many of them have big plots of land and have built several glass houses so that they can grow tomatoes.

Narrabeen has become a farming district with dairy farms, chickens, vegetables and hothouses. Some of the roads are now sealed and other major roads like Powderworks Road are firmly in place.

The beaches and lakes have developed a reputation for being a great holiday spot. People come from many places to enjoy the beaches, sunshine and weather. Holiday shacks made of fibro line the foreshore and inland areas. The tram has since disappeared, as nearly everyone owns a car. Australia has become a rich, developed nation due to the economic gains it has made from selling vast amounts of wheat, wool and minerals.

Worksheet 11: *The Lorax*

What I really like about my local area	What I really dislike about my local area
Natural Resources (our truffula trees needing protection)	Problems that we face
Man Made Resources	Who are the Once-lers of our community?
Who could be The Lorax of our Community	Who has the last truffula seed and who will plant it and start change in our community?

Worksheet 12: Final Assessment Task

Climate Change Presentation

Outcomes:

Students will

- Use a variety of media to develop a presentation on climate change
- Use various forms of persuasion
- persevere with an activity to its completion
- participate in peer and self evaluation of presentations.

WS3.9, WS3.12, WS3.13, EN3.5, EN3.6, LTS3.3, ESS3.6

Task: Your task is to create a two minute presentation on climate change.

In your presentation you should

- Persuade people that climate change is real
- Describe actions that you and your family can do to reduce the threat of climate change.
- Describe the actions that community and government can do to reduce the threat of climate change.

You can create a presentation that is:

A powerpoint or digital slideshow, advertisement, brochure, poster, video, speech, song, poem, narrative, interpretive dance, comic, rap or another of your choice (check with your teacher).

This is a common assessment task for all Stage 3 students and will be graded. The testing sheet and a marking sheet are included for your reference.

As a culmination, we will be holding a ferry regatta at a local waterway (such as Mullet Creek accessible by North Narrabeen PS) where we will put your ferries to the test.

Final Assessment Task Marking Criteria Climate Change Presentation

Name:

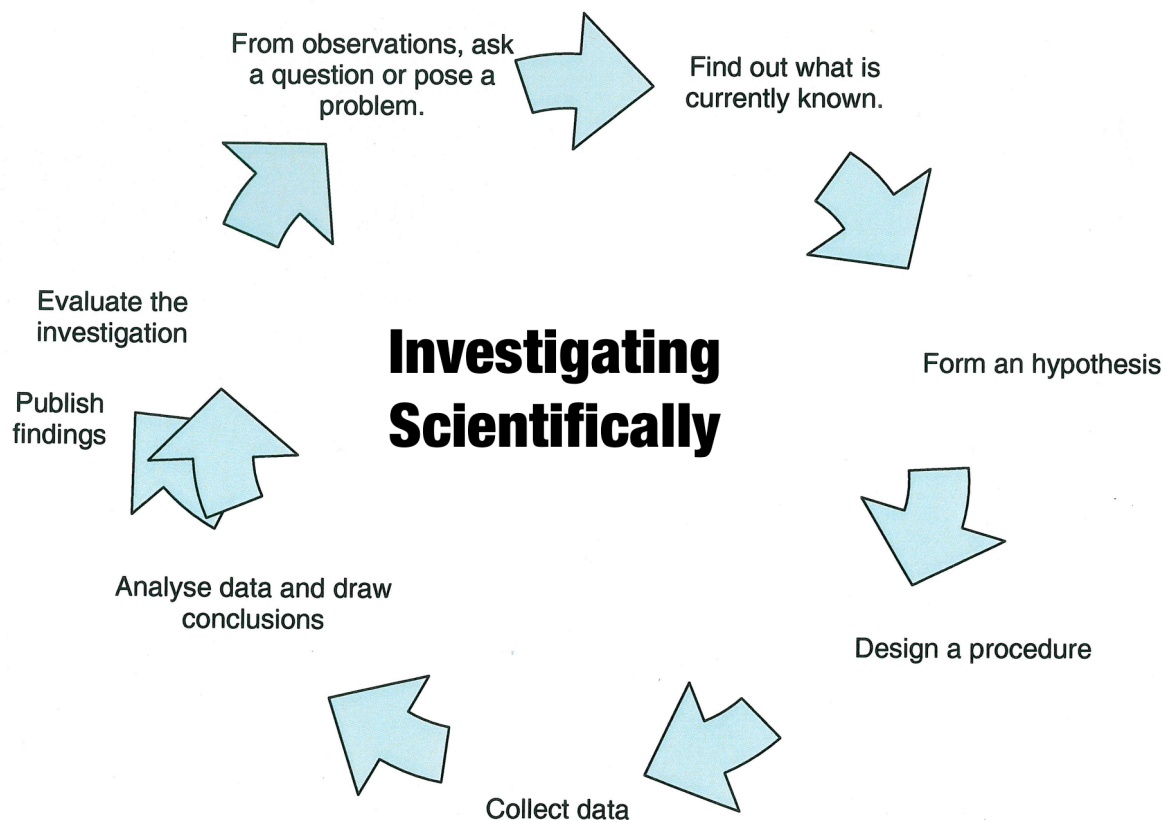
Task: Create a presentation on climate change which convinces your audience that the issue is real and describes actions you, your family and others (schools, councils, community groups, media businesses, governments) can do to reduce the threat of climate change.

	Elementary	Basic	Sound	High	Outstanding
Indicators	(2)	(4)	(6)	(8)	(10)
Knowledge and understandings					
Concept	Displays little understanding of climate change	Displays some understanding of climate change	Displays good understanding of climate change	Displays good understanding of climate change and is persuasive it is real	Displays full understanding of climate change and is very persuasive that it is real
Actions	Only addresses actions the child can take to reduce the threat of climate change	Addresses actions that the child and family can take to reduce the threat of climate change	Addresses actions that the child and family plus one other organisation can take to reduce the threat of climate change	Addresses actions that the child, family plus more than one other organisation can take to reduce the threat of climate change	Addresses actions that the child, family plus more than one other organisation can take to reduce the threat of climate change in a persuasive manner
Skills					
Sequence of information	There is little clear organisation of information / content	Some information / content is logically sequenced and explained	Content / information is logically sequenced for the most part	Content / information is logically sequenced	Content / information is logically and clearly sequenced using headings related to material
Written / multi media Presentation	Little variation in use of colour, graphics, backgrounds, effects diagrams, headings, fonts	Some variation in use of colour, graphics, backgrounds, effects diagrams, headings, fonts	Good variation in use of colour, graphics, backgrounds, effects diagrams, headings, fonts but occasionally these detract from the presentation content	Makes good use of colour, graphics, backgrounds, effects diagrams, headings, fonts to enhance the presentation	Makes outstanding use of colour, graphics, backgrounds, effects diagrams, headings, fonts to enhance the presentation
Oral Presentation	Is not confident in communicating presentation to an audience and does not meet time criteria	Communicates some information and understandings with confidence	Communicates and expresses ideas concerning climate change and actions	Communicates effectively and expresses well developed ideas concerning climate change and actions to persuade the audience	Communicates effectively, engaging the audience and expresses well developed ideas concerning climate change and actions to persuade the audience
Evaluation					
Self and peer	Little analysis of self and peers presentation	Some analysis self and peers presentation	Some analysis self and peers presentations in terms of content and persuasiveness	Thoughtful analyses self and peers presentations in terms of content and persuasiveness	Critically analyses self and peers presentations in terms of content and persuasiveness

Overall Presentation Assessment

	Elementary	Basic	Sound	High	Outstanding
	(0-18)	(19-30)	(31-40)	(41-55)	(55-60)
Achievement					
Effort					

Conducting Scientific Investigations



Reproduced from: Curriculum K-12 Directorate, NSW Department of Education and Training (Dec 2005)
Investigating Scientifically: Support for Stage 3 Teachers - www.curriculumsupport.education.nsw.gov.au/primary/scitech/investigate/docs/invest_st3.pdf

The investigating scientifically process involves students using the processes of observing, questioning, planning, predicting, testing, collecting, recording and analysing data to draw conclusions in order to develop a better understanding of the world around them, relying heavily on first hand information.

Observing and Exploring (Ask questions, pose problems, find out what is currently known)

1. Teacher leads the class in a brainstorming session to help the students define the question that they will investigate, eg How can we keep the hot chocolate warm? What do we know about keeping things warm? What additional information do we need to find?

A mind map could be used in the brainstorming session to help students clarify what they know and what they need to find out. For example, Will insulation keep our coffee from going cold? Does the type of cup affect heat loss? Does the starting temperature of the hot chocolate affect the heat loss? Does the size of the cup affect heat loss? Does the material the cup is made from affect heat loss?

Students may be guided to conduct research from secondary sources such as books, CD ROMs, Internet etc. to find out about concepts such as heat transfer, temperature, and sources of heat...

Once the research is completed students should share their understandings by contributing in a class discussion. Teachers may guide the students during the class discussion to ensure the relevant and correct scientific concepts and language are used. For example, Energy is transferred from a body of high temperature to one of a lower temperature. Energy can be transferred through all materials even through empty space. Convection is a process by which energy is transferred in liquids or gases. Conduction is the process through which energy is transferred through solids.

2. As a class, brainstorm possible investigations that can be constructed to solve the problem or answer the questions. (This can be done by either creating a new mind map or adding the new knowledge to the initial mind map.)

Hypothesising and Predicting

(Define a problem that can be investigated scientifically)

Students with teacher assistance develop a hypothesis related to their chosen investigation. Students should be guided to identify the relationship between the independent and dependent variables.

Example hypotheses:

Foam cups will keep hot chocolate warmer than paper cups.

Smaller mugs will keep hot chocolate warmer than larger mugs.

Insulated mugs will keep hot chocolate warmer than non-insulated mugs.

Tall mugs will keep hot chocolate warmer than short mugs.

Devising and Testing

(Describe a procedure for collecting data, identify appropriate equipment to carry out the procedure)

Discuss with students how they could make their investigation fair.

Students should identify the variables that could affect the results of the investigation, and therefore, need to be kept constant. Students should be able to identify the independent variable and the dependent variable. E.g., The variables would include such items as the size of mug, shape of mug, composition of mug, initial temperature, water impurities, quantity of milk, ambient temperature, and instruments used to measure temperature.

Discuss with students how they could ensure their investigation is reliable. E.g.: Is what I have chosen to measure and the way that I measure it able to be repeated/replicated with consistent results? Can the students repeat their investigation? Would they need to replicate the investigation? How many times should students repeat or replicate their investigation?

Provide the students with a procedure proforma. (E.g., Worksheet 3 Conducting an Investigation)

Explain or discuss with students the experimental procedure and the process for collecting data and the equipment needed to conduct the investigation.

Alert students to possible risks involved in conducting their investigation and ensure appropriate risk management procedures are followed.

Note: Depending on the student's level of development, Stage 3 students should be encouraged to develop the procedure for their investigation independently.

Collecting and Recording Data

(Use the procedure and equipment to collect and record data)

Students conduct their investigation in pairs or small groups with guidance. Teachers should demonstrate/model to students the importance of making accurate and precise measurements.

Note: Depending on the level of development of the students, the teacher may provide a proforma for the students or allow the students to independently develop their own method of recording their observations.

Analysing and Drawing Conclusions

(Reach a conclusion which is communicated to others)

Once all the data is collected, a careful and systematic analysis should be conducted to identify if the evidence gathered supports the hypothesis. Students should analyse the collected data as well as evaluating the procedure and instruments used in their investigation.

Constructing graphs is one method of analysing the student's data. Spreadsheet applications assist in producing effective graphs once the data has been entered.

Teachers should discuss with students the various types of graphs and assist students to choose an appropriate graph to best represent their data, ie, column graphs for discontinuous data, line graphs for continuous data.

Teachers may lead the class in a discussion to describe trends and patterns in the student data. Reference should be made to the hypothesis: Do the trends support the hypothesis? What scientific explanation is there for the results?

Evaluate the investigation by identifying possible sources of error and suggest improvements to the investigation. Students/teachers can suggest further investigations arising from the results.

Teachers and students jointly, or students independently, write a conclusion. The information gained from this investigation may lead to a design and make activity, e.g., designing a more efficient mug.

Publishing and Presentation

Students should be encouraged to present their investigation to an audience.

Presenting their findings provides students with an opportunity to reinforce and showcase their learning. It can also provide the teachers with a valuable assessment opportunity.

Presentations may be made through the construction of a scientific report, scientific poster, or electronic presentation, eg, web page, slide show etc.

A presentation tells a story of an investigation. Students' presentations, regardless of their form, should aim to inform the audience about:

- What they investigated
- Why they were interested in the investigation
- How they did the investigation
- What they observed
- What the observation/results mean
- Why the results are important
- What they have learned
- What they may do next.

The report can be grouped under the following headings: hypothesis, background, materials, procedure, results, discussion and conclusion, bibliography.

Ensure that students are guided through the process of acknowledging sources of information, such as books, web sites and people that contributed to their investigations.