

Climate Change

Year 10 Australian Science Curriculum Focus

Explaining phenomena involving science and its applications.

Students investigate how human activity is affecting the carbon cycle and the impact of some of those effects on biodiversity.

Students develop an understanding of:

- The carbon cycle
- The biosphere, lithosphere, hydrosphere and atmosphere
- Human impacts on the carbon cycle and the flow on effects on biodiversity
- Climate change
- How scientific knowledge can be used to understand climate change
- What behaviours can change to reduce the impacts of climate change.

Inquiry questions for the unit:

- What is the carbon cycle?
- What are the four subsystems that interact to make up the carbon cycle?
- How have humans impacted the carbon cycle?
- What is climate change?
- How has biodiversity been affected by climate change?
- What behaviours can we change to reduce the impacts of climate change?



Year 10 Science Unit Overview — Climate Change

School name	Unit title	Duration of unit
	Climate Change	Approximately five weeks
Unit outline <p>Year 10 Australian Science Curriculum Focus – Explaining phenomena involving science and its applications.</p> <p>Students investigate how human activity is affecting the carbon cycle and the impact of some of those effects on biodiversity.</p> <p>Students develop an understanding of:</p> <ul style="list-style-type: none"> • The carbon cycle • The biosphere, lithosphere, hydrosphere, and atmosphere • Human impacts on the carbon cycle and the flow on effects on biodiversity • Climate change • How scientific knowledge can be used to understand climate change • What behaviours can change to reduce the impacts of climate change. <p>Inquiry questions for the unit:</p> <ul style="list-style-type: none"> • What is the carbon cycle? • What are the four subsystems that interact to make up the carbon cycle? • How have humans impacted the carbon cycle? • What is climate change? • How has biodiversity been affected by climate change? • What behaviours can we change to reduce the impacts of climate change? 		

Year 10 Level Description – In the Year 10 curriculum students explore systems at different scales and connect microscopic and macroscopic properties to explain phenomena. Students explore the biological, chemical, geological and physical evidence for different theories, such as theories of natural selection and the Big Bang. Atomic theory is developed to understand relationships within the periodic table. Understanding motion and forces are related by applying physical laws. Relationships between aspects of the living, physical and chemical world are applied to systems on a local and global scale and this enables students to predict how changes will affect equilibrium within these systems.

Year 10 Achievement Standard - By the end of Year 10, students develop questions and hypotheses and independently design and carry out appropriate methods of investigation. When designing and undertaking investigations they take into account the need for accuracy, safety, fairness, ethical actions and collaboration. They identify where digital technologies can be used to enhance the quality of investigations and they communicate using scientific language and representations appropriate to the content.

Students demonstrate an understanding of the scientific theories that explain the origin of the universe and the evolution of life on Earth. They use relationships between force, mass and acceleration to predict changes in the motion of objects. They explain the basis of the periodic table and use this organiser to distinguish between elements, and use knowledge of chemical change to predict the products of chemical reactions. They explain and predict how change, including that caused by human activity, affects the sustainability of systems at a local and global level. They describe factors that have guided scientific developments, predict how future applications of science and technology may affect people's lives and evaluate information from a scientific perspective.

Teacher Notes

- **Unit overview**

The Great Barrier Reef Marine Park Authority (GBRMPA) Climate Change Teaching Unit is a science based Year 10 unit of work. The content descriptors for this unit are from the 2011 Australian Science Curriculum (www.australiancurriculum.edu.au). Following the inquiry based 5Es approach to teaching science, the unit is based on the Australian Curriculum Assessment and Reporting Authority (ACARA) expectations of a minimum of two hours per week of science lessons for Year 10 students. Each lesson is of approximately one hour duration, with some lessons requiring more time to allow further depth of study or time for excursions. The nature of science investigations is to follow the line of student inquiry to promote and encourage students to think like scientists. Teachers may find that students will need or want to complete investigations other than those suggested in the teaching strategies outlined in this unit. Students are to be encouraged to follow their own line of inquiry and in the case where students do this, the teaching strategies and resources outlined in this unit may be used as a guide to supplement the student directed investigations. The overall unit or the individual lessons could be extended or shortened to cater for individual classes as deemed necessary by the class teacher. Teachers will need to allow time to prepare for the lessons prior to teaching each lesson.

- **Aim of the unit**

The lessons are structured to build students' knowledge of climate change. Investigating the global systems that rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere, students will develop an understanding of how human activities have impacted these global systems which has led to climate change. Students will also investigate and build their knowledge of the impacts of climate change on sea levels and biodiversity. Climate change is affecting the Great Barrier Reef (for more information on climate change and the Great Barrier Reef see below in 'climate change background information' and also www.gbrmpa.gov.au). Understanding these effects – what has caused them and what the future effects will be – will build students' environmental knowledge and encourage their understanding of sustainability and stewardship. The main premise of this unit is climate change, which is one of the Key Focus Areas of the *Great Barrier Reef Outlook Report 2009* (see www.gbrmpa.gov.au for more information on the *Outlook Report 2009*). GBRMPA encourages teachers to follow the main aim of Reef Guardianship – to be stewards of the environment.

Climate change background information

What is climate change?

Gases in the earth's atmosphere trap some of the sun's energy that would otherwise be radiated back into space. This is called the greenhouse effect. This process keeps the earth at a temperature suitable for life. Climate change results from an enhanced greenhouse effect. Increased levels of greenhouse gases (mostly carbon dioxide) in the atmosphere mean that more heat is being trapped and the earth's temperature is increasing. There is now consensus that emissions from human activities are largely responsible for enhanced levels of greenhouse gasses. We have already seen evidence of climate change resulting from elevated greenhouse gas concentrations. Since the beginning of last century, air temperature has increased by 0.6°C on average worldwide. In Australia, 2005 was the hottest year ever recorded. The temperature was 1.1°C higher than the average from the previous 30 years.

How has climate change affected the Great Barrier Reef ecosystem?

The Great Barrier Reef is internationally renowned for its biodiversity. Its reefs (about 2900 in total) are home to thousands of species. Extensive areas of seagrass meadows, mangrove forests, saltmarsh, sand and mud areas also provide a diverse range of habitats for many species. The diversity of the Great Barrier Reef's natural values makes it a particularly unique and valued ecosystem. Understanding the vulnerability of such a large and intricate system to climate change is a challenge. We must first understand how climate change will affect an individual species or a community of different species. Identifying how these predictions will influence the entire Great Barrier Reef is a much larger challenge. However we do know, while few systems are likely to benefit from climate change, coral reefs are particularly vulnerable.

The vulnerability of corals to future climate change has received considerable attention, as impacts on them have already been observed. Coral bleaching has begun to increase in frequency and severity due to rising sea temperatures. These events have led some experts to claim that coral reefs around the world are 'in crisis'. Mass coral bleaching has occurred

worldwide, devastating reefs in some regions including the Maldives, Seychelles and Palau. Approximately five per cent of reefs in the Great Barrier Reef were severely damaged in each of the 1998 and 2002 mass coral bleaching events. Projections of future water temperatures suggest coral bleaching could become more extreme in the course of this century.

Many other species including microbes, fish, marine turtles and seabirds are also temperature sensitive. Scientists predict impacts on these species under future climate change projections. For example, the gender of turtle hatchlings is temperature determined; higher temperatures lead to an increased proportion of females. However, increased temperature is just one of the many effects of climate change on the Reef. The other environmental changes predicted suggest there will be additional impacts. Some may have severe consequences. The implications of ocean acidification for animals and plants that produce calcium carbonate skeletons for example, could be profound. Rising sea levels could lead to large redistributions of benthic (bottom-dwelling) habitats and the animals that depend on them. In fact, all animals will be impacted by climate change in the future. Scientists are still working on solving some of these mysteries, as it is the interactions between the varied effects that are most uncertain.

What you can do

As our awareness of climate change has increased, so too has our need to understand the threat it poses. Knowledge of the vulnerability of the Great Barrier Reef to climate change is essential to meaningfully respond to this challenge. This has prompted experts to assess the vulnerability of all species groups and habitats of the Great Barrier Reef to climate change and to highlight its social and cultural implications. ***Climate Change and the Great Barrier Reef: A Vulnerability Assessment*** (www.gbrmpa.gov.au) is a collaboration between the Great Barrier Reef Marine Park Authority and over 80 leading climate and tropical marine scientists. This publication provides a comprehensive assessment of how future climate changes are likely to affect Great Barrier Reef species, ecosystems, industries and communities. Climate change cannot be fully averted and we must understand, prepare and adapt to the inevitable effects of climate change. GBRMPA's Climate Change Response Program is taking important steps towards reducing the negative impacts of climate change on the Great Barrier Reef.






Climate change is a global issue but there are many things that individuals, businesses and governments can do to help minimise its impact on the Great Barrier Reef. There are two main steps that you can take to help the Reef in the face of climate change. The first is to reduce greenhouse gas emissions, as increases in their concentrations are responsible for climate change. The greenhouse gas emissions that we produce come from using electricity, burning fuel in our cars and using products that require fuel and electricity to produce. Some things you can do at home or at school to reduce greenhouse gas emissions are:

- Switch to 'green' electricity produced from renewable sources by contacting your energy provider
- Use energy efficient lights
- Choose energy efficient products
- Turn off electrical devices such as televisions at the power point
- Turn off lights around the house
- Refuse, reduce, re-use and recycle
- Use less hot water
- Dry your clothes the natural way, not in the dryer
- Plant trees which take up carbon dioxide as they grow
- Heat and cool your house efficiently
- Drive less: car pool, use public transport, walk or cycle
- Spread the word to others
- Offset or neutralise your greenhouse gas emissions.

The second step is to reduce the impact that you have on the Reef. A healthy Reef is more resilient and can recover quickly from the impacts of climate change, such as coral bleaching. See **The Great Barrier Reef: Doing your bit to look after it** (www.gbrmpa.gov.au) for more information on what you can do to look after the health of our Great Barrier Reef.

Unit Lessons

Engage	Lesson 1: Global systems – what do we know, what do we want to know?
Explore	Lesson 2: Creating a greenhouse Lesson 3: Making carbon dioxide
Explain	Lesson 4: Four systems – biosphere, lithosphere, hydrosphere, atmosphere Lesson 5: Carbon cycle
Elaborate	Lesson 6: Investigating how water absorbs carbon dioxide Lesson 7: Rate of coral growth Investigation Lesson 8: What if.... and what can we do?
Evaluate	Lesson 9: Assessment preparation Lesson 10: Assessment preparation Lesson 11: Assessment preparation Lesson 12: Assessment preparation

Identify curriculum			
Content descriptions to be taught			General capabilities and cross-curriculum priorities
Science Understandings	Science as a Human Endeavour	Science Inquiry Skills	
Earth and Space Sciences <ul style="list-style-type: none"> Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere, and atmosphere <ul style="list-style-type: none"> Investigating how human activity affects global systems Modelling a cycle, such as the water, carbon, nitrogen or phosphorus cycle within the biosphere Explaining the causes and effects of the greenhouse effect Investigating the effect of climate change on sea levels and biodiversity Considering the long-term effects of loss of biodiversity 	Nature and Development of Science <ul style="list-style-type: none"> Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community Use and Influence of Science <ul style="list-style-type: none"> People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions The values and needs of contemporary society can influence the focus of scientific research 	Questioning and Predicting <ul style="list-style-type: none"> Formulate questions or hypotheses that can be investigated scientifically Planning and Conducting <ul style="list-style-type: none"> Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data. Assess risks and address ethical issues associated with these methods Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data Processing and Analysing Data and Information <ul style="list-style-type: none"> Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies Use knowledge of scientific concepts to draw conclusions that are consistent with evidence Evaluating <ul style="list-style-type: none"> Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems Communicating <ul style="list-style-type: none"> Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations 	 Literacy <ul style="list-style-type: none"> Communicate confidently in listening, reading and viewing, writing, speaking and creating print and visual materials  Critical and Creative Thinking <ul style="list-style-type: none"> Observe, question, make predictions and think creatively to solve problems during investigations  Ethical Behaviour <ul style="list-style-type: none"> Consider human impacts on the environment and other living organisms and evaluate their own and other people's actions  Personal and Social Competence <ul style="list-style-type: none"> Follow procedures and work both within a group and independently to share and discuss ideas  Sustainability <ul style="list-style-type: none"> Investigate and evaluate human impacts on the climate and the role we all play in creating a more sustainable future for the planet

Relevant prior curriculum	Curriculum working towards
<p>Year 9 of the Australian Science Curriculum outlines that by the end of Year 9, students use their knowledge to pose different types of questions that can be investigated using a range of inquiry skills. They apply their knowledge of science to explain phenomena in the environment and their own lives and describe how knowledge has developed through the work of scientists. They plan experimental procedures which include the accurate control and measurement of variables. They identify inconsistencies in results and suggest reasons for uncertainty in data. They use scientific language and representations when communicating their results and ideas.</p> <p>Students use knowledge of body systems to explain how complex organisms respond to external change. They use knowledge of interrelationships to describe how changes affect ecosystems. They explain geological features and events in terms of geological processes and timescales. They describe the structure of atoms and explain chemical changes in terms of the behaviour of atoms. They describe a range of chemical reactions and explain their importance. They compare, in qualitative terms, how two different forms of energy can be transferred. They describe interrelationships between science and technology and give examples in developments in science that have affected society.</p>	<p>Relevant Senior Science subject content.</p>
Links to other learning areas	
<p>QSA Year 10 Literacy Indicators (2012)</p> <p><i>Viewing and Reading</i></p> <ul style="list-style-type: none"> VR 10 i. View, read, navigate and select texts to suit learning purposes, content and context. VR 10 iv. Independently view, read and demonstrate understanding of learning area texts, including academic texts by combining, connecting, comparing and synthesising ideas and concepts. <p><i>Writing and Creating</i></p> <ul style="list-style-type: none"> WC 10 iii. Plan, draft, edit for meaning and publish learning area texts in print and digital environments, using strategies to: <ul style="list-style-type: none"> Construct representations of people and events Incorporate research. WC 10 iv. Maintain cohesion to support a particular point of view or position across texts, by selecting and controlling: <ul style="list-style-type: none"> Language features that compact and generalise text, e.g. nominalisation Language to analyse, evaluate and express higher order concepts. 	

School Specific Links to Other Learning Areas (schools should insert their own links to other learning areas as necessary)

Assessment		Make judgements
Describe the assessment	Assessment date	Student task sheet, links to QSA Literacy Indicators (2012) and guide to making judgements can be found in the resource section of the unit.
<p>Summative Assessment</p> <p>Students will write a persuasive text about climate change in the form of a magazine article, a newspaper editorial, an essay or a journal article. The persuasive text should include several aspects of climate change:</p> <ul style="list-style-type: none"> • What is climate change? • How has it affected biodiversity on the Great Barrier Reef • What are predictions for future effects of climate change and how will this impact biodiversity on a larger scale? • What are local and global considerations to reduce the impact of climate change? <p>Students will need to identify other aspects of climate change that they deem appropriate for their persuasive text.</p> <p>Students could choose to extend the assessment piece into an Extended Response Task as is suited to the assessment needs of the subject.</p>	<p>The summative assessment piece is designed to be produced and presented during the Evaluate stage of the unit when students will have gathered all the knowledge required to successfully address the criteria. This date is to be determined by the class teacher.</p>	

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>ENGAGE - To capture interest and discover what we think we know</p> <p>Lesson 1 – Global Systems</p> <p>Suggested Time – one hour</p> <p>Introduction – Carbon Cycle</p> <ul style="list-style-type: none"> View carbon cycle images or footage of the carbon cycle. Many images are available online and on YouTube (see links in Resources column). The school may also have video footage the students could view. Discuss and ask students to draw their own labelled diagram of the carbon cycle in pairs or individually. <p>Investigation – four global systems</p> <ul style="list-style-type: none"> Provide a diagram of four global systems – biosphere, lithosphere, atmosphere and hydrosphere. Briefly discuss and explain these four systems, record inquiry questions for later research. Students will be provided with the opportunity to research these topics later in the unit. Ask students to divide a piece of paper into four to represent each of the four global systems and in pairs or groups, write how the carbon cycle relies on interaction in each of the four global systems. Students may want to watch the YouTube clips again as they explain how the carbon cycle is related to the four global systems. Students keep this as a reference for a future activity in the unit. Share and discuss ideas with others in class. Start a science journal for students to record their learning and reflection as they progress through the unit. The science journal could be done in a simple ruled exercise book or a scrap book, or done on a computer in a format suitable to the class. How much time students are given to write in their science journal each lesson will need to be determined by the teacher according to the needs of the students. A science journal is a record of observations, experiences and reflections. It contains a series of dated, chronological entries. It may include written text, drawings, labelled diagrams, photographs, tables and graphs. Teachers could also use the science journal as a part of the students' overall assessment. 	<p>Lesson 1</p> <p>Diagnostic assessment opportunities:</p> <ul style="list-style-type: none"> observe students' responses during the lesson to determine students' awareness of the topic. 	<p>Section 6 of the <i>Disability Standards for Education</i> (The Standards for Curriculum Development, Accreditation and Delivery) state that education providers, including class teachers, must take reasonable steps to ensure a course/program is designed to allow any student to participate and experience success in learning.</p> <p>The <i>Disability Standards for Education 2005</i> (Cwlth) is available from: www.ag.gov.au select Human rights and anti-discrimination > Disability standards for education.</p> <p>ESL Considerations</p> <p>Teachers should refer to the Learning Place (www.learningplace.com.au), 'ESL in the Classroom' for 'Break it Down, Build it Up' resources to help restructure the unit according to the ESL needs of the class.</p> <p>Risk Management</p> <p>Refer to Department of Education and Training www.education.qld.gov.au for advice and forms relating to risk management during curriculum activities and excursions.</p>	<p>Lesson 1</p> <p>Images and/or footage of the carbon cycle.</p> <p>Some YouTube clips are:</p> <p>www.youtube.com/watch?v=U3SZKJVKRxQ</p> <p>www.youtube.com/watch?v=HrIr3xDhQ0E&feature=related</p> <p>www.youtube.com/watch?v=c40jebr9jbg&feature=related</p> <p>Diagram of the four global systems – hydrosphere, biosphere, lithosphere, atmosphere.</p>

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>EXPLORE – To have shared, hands-on experiences</p> <p>Lesson 2 – Creating a greenhouse</p> <p>Suggested Time – one hour</p> <p>Introduction – Preparation</p> <ul style="list-style-type: none"> Read Resource 2 – Greenhouse Investigations. Discuss the investigation with students. There are two investigations to show two different ways of demonstrating the impacts of increasing greenhouse gases. Students could do one or both. The first investigation allows time in between reading temperatures to set up the second investigation (ongoing investigation). This time could be used to refer back throughout the unit about the correlation between CO₂ and temperature. Ask students what they already know about the greenhouse gases and how they relate to climate change. Fill out the investigation planner (Resource 1) and set up the investigation. <p>Investigation – Greenhouse investigation</p> <ul style="list-style-type: none"> Complete the investigations, record results. If the second investigation was also set up, ask students to discuss what they think will happen and why. How will it affect the growth of the plants? As a class, discuss the results and link how this relates back to the carbon cycle. Students record their learning and reflections in their science journal. <p>Lesson 3 – Making carbon dioxide</p> <p>Suggested Time – one hour</p> <p>Introduction – Preparation</p> <ul style="list-style-type: none"> Read Resource 3 together – Making Carbon Dioxide. Discuss what the students know about the properties of carbon dioxide. Fill in the investigation planner (Resource 1) and set up the investigation. <p>Investigation – Making carbon dioxide</p> <ul style="list-style-type: none"> Complete the Making Carbon Dioxide experiment and record results. Discuss the students' results and answers to the questions to define the properties of carbon dioxide. Students record their learning and reflections in their science journal. 	<p>Lesson 2</p> <p>Formative assessment opportunities:</p> <ul style="list-style-type: none"> use students' investigation planners to assess their science inquiry skills <p>Lesson 3</p> <p>Formative assessment opportunities:</p> <ul style="list-style-type: none"> use students' investigation planners to assess their science inquiry skills. 		<p>Lesson 2</p> <p>Resource 1 – Investigation Planner.</p> <p>Resource 2 – Greenhouse Investigations.</p> <p>Materials list for the investigations is provided in Resource 2.</p> <p>Lesson 3</p> <p>Resource 3 – Making Carbon Dioxide.</p> <p>Materials list for the investigation is provided in Resource 3.</p> <p>Resource 1 – Investigation Planner</p>

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>EXPLAIN – To demonstrate what we have learned by exploring</p> <p>Lesson 4 – four systems – biosphere, lithosphere, hydrosphere, atmosphere</p> <p>Suggested Time – one hour</p> <p>Introduction – Discuss</p> <ul style="list-style-type: none"> Discuss the four global systems with students; ask them to share what they know about each system. Students may refer back to some of their notes and reflections from Lesson 1. On a board or large piece of paper divided into four to represent each of the four global systems, record students' responses. <p>Investigation – Research</p> <ul style="list-style-type: none"> Divide students into pairs or groups, each is to choose one of the four systems to research. Provide books and access to the Internet for students to research their chosen system. Students might also want to refer back to the questions about the four global systems they wrote down in Lesson 1. Students create small reports on facts of their chosen system. Students then share with the class their findings and add the information to the original class responses from the beginning of the lesson. Students record their learning and reflections in their science journal. <p>Lesson 5 – Carbon Cycle</p> <p>Suggested Time – one hour</p> <p>Introduction – YouTube Clip</p> <ul style="list-style-type: none"> Watch the carbon cycle YouTube clip – The Carbon Cycle and Global Warming Discuss how the carbon cycle relates to the four global systems. Refer back to Lesson 1 notes to discuss if the students' understanding of the carbon cycle and the four global systems has changed. <p>Investigation – Answering questions</p> <ul style="list-style-type: none"> Watch the clip again. Students use Resource 4 to answer questions as they watch the clip. Discuss and clarify students understanding of the carbon cycle and how it all relates to climate change. Create a definition of what climate change is using the students' knowledge of the carbon cycle and the four global systems. Students record their learning and reflections in their science journal. 	<p>Lesson 4</p> <p>Formative assessment opportunities:</p> <ul style="list-style-type: none"> use students responses and reports to assess their developing knowledge of the four global systems. <p>Lesson 5</p> <p>Formative assessment opportunities:</p> <ul style="list-style-type: none"> use students' responses to the question sheet to assess their developing biological science understandings. 		<p>Lesson 4</p> <p>Books and internet access for students to research the four global systems.</p> <p>Lesson 5</p> <p>YouTube Clip – The Carbon Cycle and Global Warming www.youtube.com/watch?v=1o4ODWMZq5U&feature=related</p> <p>Resource 4 – Carbon Cycle Question Sheet.</p>

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>ELABORATE – To build understanding through an investigation</p> <p>Lesson 6 – Investigating how water absorbs carbon dioxide</p> <p>Suggested Time – one hour</p> <p>Introduction – Ocean acidification in a jar</p> <ul style="list-style-type: none"> Read Resource 5 and complete the investigation (teachers may choose to set this up using the investigation planner or do as a simple experiment without the investigation planner). Discuss the results and the questions. Ask and discuss with students how increasing carbon dioxide levels and therefore increasing acid levels, might affect animals in the ocean, specifically animals with shells. <p>Investigation – Rubber Egg Experiment</p> <ul style="list-style-type: none"> Read Resource 6 – Rubber Egg Experiment. Discuss how the experiment relates to investigating the impacts of increasing carbon dioxide levels in the ocean. Fill in the investigation planner and set up the experiment. Students record their learning and reflections in their science journal. <p>OPTIONAL HIGHER ORDER THINKING ACTIVITY</p> <p>Warmer water absorbs less carbon dioxide thus disrupting the carbon cycle even further. Ask students to create their own experiment to demonstrate the fact that warm water absorbs less carbon dioxide than cool normal ocean temperatures.</p> <p>Lesson 7 – Rate of coral growth investigation</p> <p>Suggested Time – one hour</p> <p>Introduction – Rising sea levels</p> <ul style="list-style-type: none"> Examine results from the Rubber Egg Experiment, record results and discuss what it means for animals on the Great Barrier Reef. Read Reef Beat 2009 - Climate Change and the Reef, Poster 3, Climate Change Impacts on the Great Barrier Reef. Discuss all the different impacts climate change will have on the Reef. Explain to students they are going to investigate how increasing sea levels might impact the reef. Ask students for their ideas and discuss. <p>Investigation – Coral growth</p> <ul style="list-style-type: none"> Show students the Coral Growth Table (Resource 7). Read the data table together and ask students to graph the data onto 	<p>Lesson 6</p> <p>Summative assessment opportunities:</p> <ul style="list-style-type: none"> use students' investigation planners and discussion responses to assess their science inquiry skills and science understandings and human endeavours. <p>Lesson 7</p> <p>Summative assessment opportunities:</p> <ul style="list-style-type: none"> use students' graph and responses to questions to assess students' science understandings and inquiry skills. 		<p>Lesson 6</p> <p>Resource 5 – Ocean acidification in a jar.</p> <p>Materials list for the ocean acidification investigation is provided in Resource 5.</p> <p>Resource 6 – Rubber Egg Experiment.</p> <p>Materials list for Rubber Egg Experiment is provided in Resource 6.</p> <p>Lesson 7</p> <p>Reef Beat Climate Change and the Reef 2009, Poster 3, Climate Change Impacts on the Great Barrier Reef www.gbrmpa.gov.au</p> <p>Or on the Reef Beat 2009 Climate Change DVD available from GBRMPA.</p> <p>Resource 7 – Coral Growth Chart.</p>

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>graph paper (depth on the horizontal axis, growth on the vertical axis).</p> <ul style="list-style-type: none"> Ask students to answer the questions below the data table. Discuss the questions and draw conclusions about how this will affect coral biodiversity on the reef. Depending on time and class needs, teachers could lead students into providing an analysis of how destruction of coral on the reef will lead to lack of biodiversity within the entire reef ecosystem. Students record their learning and reflections in their science journal. <p>Lesson 8 – What if...? What can we do?</p> <p>Suggested Time – one hour</p> <p>Introduction – What if...?</p> <ul style="list-style-type: none"> Discuss with students how climate change may affect other ecosystems and their biodiversity. Refer back to Lesson 7 and all the climate change impacts discussed on the Reef Beat Poster. In groups or pairs, ask students to choose a specific ecosystem. This might be a local place, or another place students are familiar with. Ask each group to spend 15-20 minutes briefly brainstorming how climate change is impacting their chosen ecosystems, how this can affect the biodiversity of those ecosystems, and explain why the loss of biodiversity in an ecosystem is something to be concerned about. Students could do this in dot point form or might do a cause-and-effect chart in the form of a futures circle (see example in Resource 8). <p>Investigation – What can we do?</p> <ul style="list-style-type: none"> Watch Climate Change Animations from GBRMPA - What is Climate Change? What are the Impacts of Climate Change? Discuss the information presented in the animations. Do a Hot Potato Activity to generate a discussion about the following topics. Teachers could also add in their own questions. <ul style="list-style-type: none"> What does it really mean to be sustainable? How can our actions impact the Reef? What does climate change mean for the Great Barrier Reef? Where does our fuel come from and can this change? What simple things can everyone realistically do every day? As a class, read through the answers and make decisions about how students can learn more about climate change and live more sustainably. 	<p>Lesson 8</p> <p>Summative assessment opportunities:</p> <ul style="list-style-type: none"> use students' brainstorming and Hot Potato Activity responses to assess their science understandings and human endeavours. 		<p>Graphing paper</p> <p>Lesson 8</p> <p>Resource 8 – Futures Circle.</p> <p>Climate Change Animations available from www.gbrmpa.gov.au or available on Reef Beat 2009 DVD from GBRMPA.</p> <p>Large paper and pens for Hot Potato Activity.</p>

Teaching and learning		Supportive learning environment	
Teaching strategies and learning experiences	Assessment opportunities	Adjustments for needs of learners	Resources
<p>EVALUATE – To review and reflect on learning</p> <p>Lesson 9 – Assessment preparation</p> <p>Suggested time – one hour</p> <p>Introduction – Reflection and begin task</p> <ul style="list-style-type: none"> As a class, reflect on what has been learned throughout the lessons. Explain to the students that they are going to begin their final assessment project. Present them with a task sheet (Resource 9). Read through the task sheet together and identify all the requirements of the task. Discuss available resources. Identify all the work done throughout the unit that will help the students complete the task. Set out a plan for time management and resource management. <p>Investigation – Start preparing projects</p> <ul style="list-style-type: none"> Allow students time to research and prepare their projects. Students may need scaffolding for different parts of the project; this will depend on the need of the class. <p>Lesson 10 – 12 – Continue assessment preparation</p>	<p>Lesson 9</p> <p>Summative assessment opportunities:</p> <ul style="list-style-type: none"> - use students' final assessment piece to assess their science understandings, human endeavours and inquiry skills. 		<p>Lesson 9</p> <p>Resource 9 – Student Task Sheet.</p> <p>Assistance with writing an Extended Response Tasks http://seniorbiology.com/ert.html.</p>

Use feedback (these are some suggestions, teachers will need to vary this according to the needs of their class)	
Ways to monitor learning and assessment	<p>Year 10 teacher:</p> <ul style="list-style-type: none"> Initially plan the teaching, learning and assessment needs of all learners and make adjustments to the unit plan as necessary Use diagnostic, formative and summative assessment opportunities throughout the unit to plan for students learning and assess student knowledge development Mark presentations and moderate with colleagues to achieve consensus and consistency of teacher judgment
Feedback to students	<p>Teachers:</p> <ul style="list-style-type: none"> Plan opportunities for conversations to provide ongoing feedback (spoken and written) and encouragement to students on their strengths and areas for improvement Reflect on and review learning opportunities to individualise learning experiences required Provide multiple opportunities for students to experience, practise and improve knowledge, processes and skills <p>Students:</p> <ul style="list-style-type: none"> Identify what they can do well and what they need to improve Provide feedback to a peer on interaction skills and suggest some strategies for improvement (written and spoken feedback)
Reflection on the unit plan	<p>At the conclusion of the unit teachers can reflect on the unit for future planning by answering the following questions:</p> <ul style="list-style-type: none"> What worked well in this unit? What was a stumbling block? How would you refine it? What trends and gaps in learning have you identified? How will you build on these learning experiences next term and beyond?

Resource 1 – Investigation Planner

Investigation Planner

Name: **Date:**

Investigation Question	Hypothesis. What do you think will happen? Explain why.
-------------------------------	--

To make the test fair what are you going to:

Independent Variable	Dependant Variable	Control Variable
Change?	Measure?	Keep the same?
Labelled Diagram	Equipment	Procedure
Illustrate how you will set up your investigation.	What equipment will you need?	How will you complete the investigation? Use dot points.

Resource 2 – Investigation Planner (cont.)

Explaining Results

Explain what happened.	
Why did this happen?	Was your hypothesis accurate?
What challenges did you have in doing this investigation?	How could you improve this investigation? What would you investigate next? Fairness? Accuracy?

Teacher Comments:
.....
.....

Resource 2 – Greenhouse Investigation

Investigation 1 – Jar Temperature Investigation

Aim	
	To discover the impact of greenhouse gases on the temperature of the atmosphere.
Materials	
	<ul style="list-style-type: none">• A sunny day• Two small thermometers• One large clear glass jar
Procedure	
	<ol style="list-style-type: none">1. Put two thermometers side by side on the same surface outdoors in the direct sunlight.2. Cover one of the thermometers with the glass jar, the jar will need to be put upside down over the thermometer.3. Record the readings from each thermometer straight away in the table below.4. Record the readings from each thermometer again after 30 minutes in the table below.5. Record the readings from each thermometer again after one hour in the table below.6. Answer the following questions:<ol style="list-style-type: none">a. Is there a difference in temperature inside and outside the jar that was not there at the start?b. Use your own words or pictures to explain why there was a difference if there was one.

Time	Temperature - no glass jar	Temperature - with glass jar
Start		
After 30 minutes		
After 60 minutes		

Carbon dioxide and other greenhouse gasses have a similar effect on the atmosphere as the glass jar did on the air inside the jar. This is similar to what happens in a greenhouse and so is called the 'greenhouse effect'. The greenhouse effect is important for us as it has made the Earth warm enough to support life. However, human activity is now adding more 'greenhouse gases' to the atmosphere, putting the carbon cycle out of balance and causing the earth to get hotter.

Resource 2 – Greenhouse Investigation (cont.)

Investigation 2 – Building a Greenhouse

Aim	
	To find out if the amount of CO ₂ in a closed environment will cause the temperature to rise within that environment
Materials	
	<ul style="list-style-type: none"> Two terrarium containers (could be glass jars, plastic bottles or takeaway containers. They need to be clear and have lids that fit securely). Soil Worm castings or mulch if available Seeds – flowers or vegetables Two thermometers
Procedure	
	<ol style="list-style-type: none"> Fill the bottom half of each container with soil. Add worm castings or mulch if available. Add seeds to both containers. Water the seeds in each container. Put a thermometer into each terrarium. Record the temperature of each terrarium as the starting temperature in the table below. Put the lid on one of the terrariums; leave the other one without a lid. Put the terrariums in a sunny spot where they will be safe but will not be exposed to rain (to keep it a fair test). Two or three times a week, record the temperature of each terrarium until the seedlings become too big and need to be planted out into the garden. Graph your results and record in your investigation planner.

Date	Temperature - no lid	Temperature - with lid
Start		

Resource 3 – Making Carbon Dioxide

Aim	
	To make carbon dioxide and learn about its properties
Materials	
	<ul style="list-style-type: none">• One large orange juice or similar bottle with large plastic cap. A big bottle is better.• One flexible drinking straw• Blu-tac or similar to seal around the straw• Baking soda (sodium bicarbonate)• Vinegar (a dilute acid)• One short candle• One glass jar at least twice the height of the candle• One small glass
Procedure	
	<ol style="list-style-type: none">1. Make a hole the same size as the straw in the juice bottle cap.2. From the top of the cap, push the straw about 1cm through the cap into the bottle. If you put it in too far, the froth from the reaction will come out the straw.3. Seal around the straw with blu-tac.4. Stand the candle up in the glass jar and light it. It should stay alight. If it goes out, the jar is too narrow and you will need a wider jar.5. Put two teaspoons of baking soda into the juice bottle. Add two to three drops of vinegar. You should see some fizzing and frothing as the two chemicals react to make carbon dioxide. Quickly replace the lid onto the juice bottle.6. Pour about 1cm of vinegar into the small glass.7. When everything is ready, take the cap off the juice bottle and quickly pour the vinegar from the small glass into the juice bottle and then quickly put the cap back on.8. Put the tip of the straw over the edge of the jar with the candle and watch what happens.9. Answer the following questions:<ol style="list-style-type: none">a. What made the carbon dioxide?b. Why did the carbon dioxide go into the jar?c. Why did the candle go out?

Resource 4 – Carbon Cycle Question Sheet

1. Carbon is found in many places. Name three.

2. What is the Terrestrial Biosphere?

3. What is the Atmosphere?

4. What is the Geosphere, also called the Lithosphere?

5. What would happen to Kate the Cow if there was nothing to absorb the carbon dioxide she breathes out?

6. What would happen to plants if the things that eat them did not breathe out carbon dioxide?

7. Kate makes carbon dioxide by breathing and in other ways. What is one other way Kate makes carbon dioxide?

8. Put yourself in the picture of Pat the Plant and Kate the Cow. Draw yourself as a stick person and use arrows to show where you might get carbon from for your body and how you give it back.



9. What fuels can be made from dead plants and animals when they have been buried for a very long time?

10. What natural processes or things use up the carbon dioxide in the atmosphere?

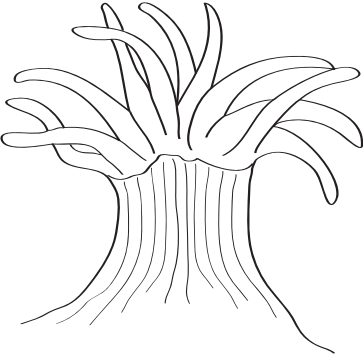
11. What happens to the carbon dioxide in plants if they are burnt?

12. Algae in the ocean is like grass and plants on land. What eats the algae in the oceans carbon cycle?

13. Put a sea creature in the picture (see question 8). Draw arrows to show where it gets carbon from for its body and how it gives it back.



Resource 5 – Ocean Acidification in a Jar

Aim	
	To find out how water absorbs carbon dioxide.
Materials	
	<ul style="list-style-type: none">• One glass jar• Water• Bromothymol blue• One straw
Procedure	
	<ol style="list-style-type: none">1. Fill the glass jar with water.2. Add some bromothymol blue to the water until you get a blue colour (a few millilitres of bromothymol blue should be enough for one cup of water). The water will turn blue if it is basic, green if it is neutral and yellow if it is acidic. You want your water to be basic to start the investigation.3. Blow gently into the water using a straw.4. What happens to the colour of the water? _____ _____ _____5. Blow gently into the water some more.6. What happens to the colour of the water? _____ _____ _____7. Explain why the water changes colour. _____ _____ _____8. Explain what this means for our oceans given the increase in carbon dioxide being released into the atmosphere by the burning of fossil fuels. _____ _____ _____

Resource 6 – The Rubber Egg Experiment

Aim

To find out what could happen to shells and corals in more acidic waters.

Materials

- Two hard boiled eggs (you could use raw eggs but it will end up messy)
- Vinegar
- Tap water
- Two beakers (big enough to put the an egg into and easily cover with liquid)
- Litmus paper or a PH test kit

Procedure



1. Fill one of the beakers with vinegar and one with water.
2. Measure the PH level of the vinegar and water to determine the acid level of each liquid.
3. Carefully place an egg into each beaker.
4. Leave three to four days (observing daily if possible).
5. Remove the eggs from the beakers and record your findings.
6. Answer the following questions:
 - a. What happened to the egg shells in each beaker? Why?

- b. Was there a difference depending on the PH of the substance used?

- c. How is PH related to ocean acidity?

- d. What does a lower PH mean for marine organisms?

- e. How are the atmosphere and the ocean connected?

Resource 7 – Coral Growth Data Table

Table 1: The table shows the rate of growth (in mm per year) of coral patch reefs in different depths of water along the Great Barrier Reef.

Depth (m)	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5
Growth (mm in 1 year)	8.9	10.3	16.2	9.2	12.1	10.6	9.9	7.8
Depth (m)	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5
Growth (mm in 1 year)	5.8	8.4	7.8	8.7	9.3	9.4	9.4	9.3

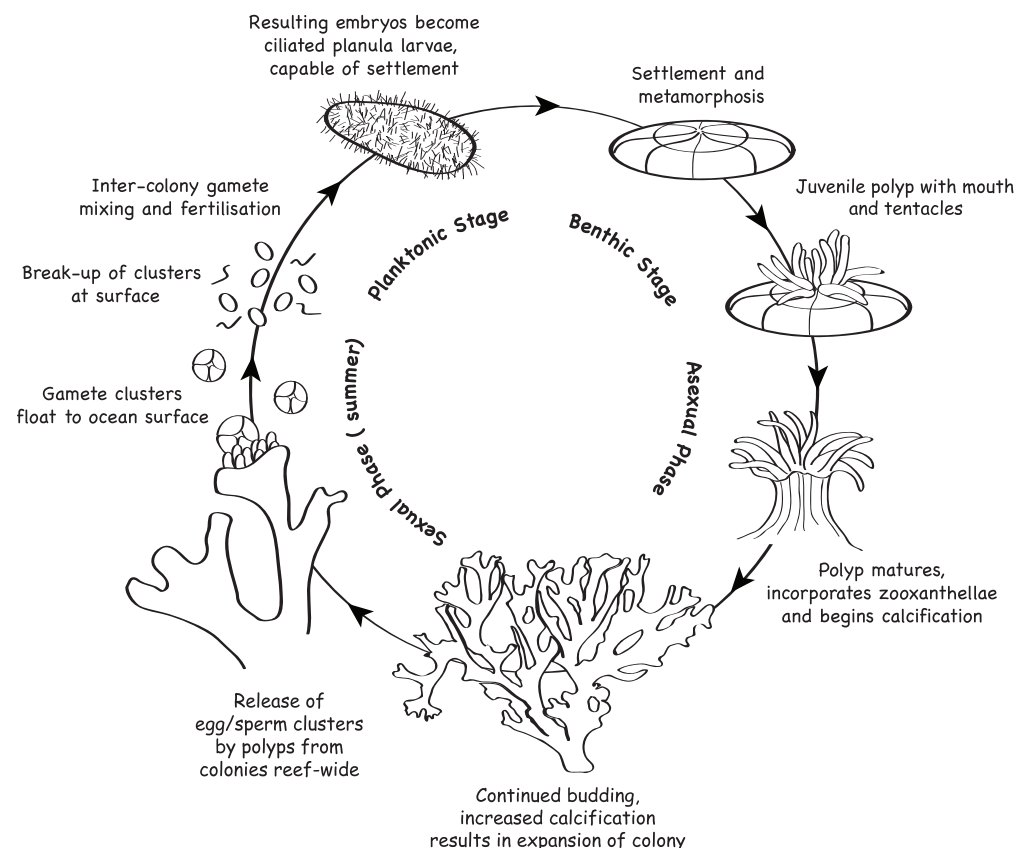
1. At what depth do these coral grow fastest?

2. At what depth do these coral grow slowest?

3. What happens to coral growth as the water gets deeper and deeper?

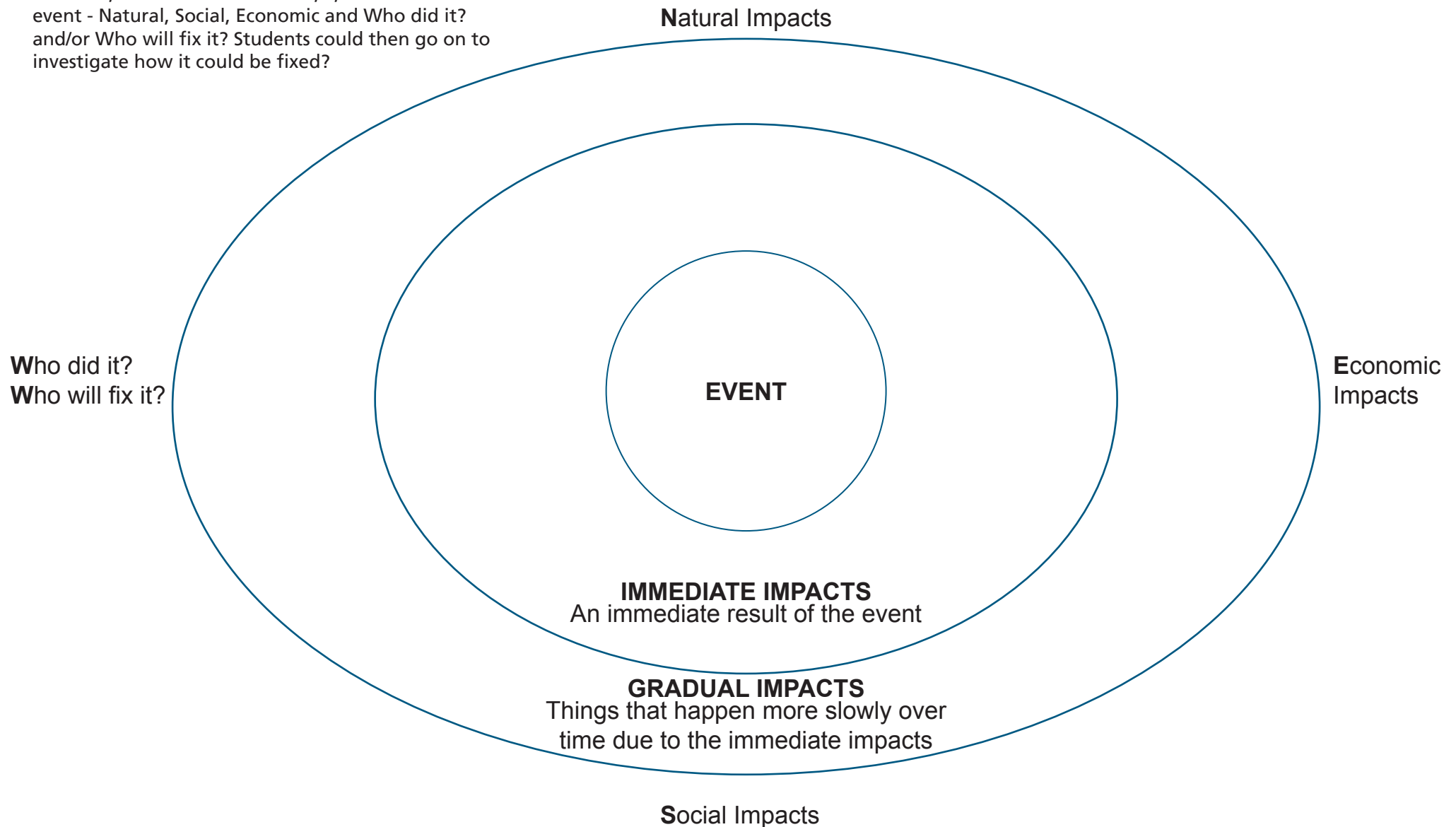
4. How might these coral be affected by sea level rise?

5. What other factors might influence coral growth?



Resource 8 – Futures Circle

Students identify a certain event. As they move out of the circle, they define what gradually happens due to the event. For more advanced analysis of an event, students look at the N, S, E and W of an event - Natural, Social, Economic and Who did it? and/or Who will fix it? Students could then go on to investigate how it could be fixed?



Resource 9 – Student Task Sheet

Climate Change – Year 10 Science Reporting

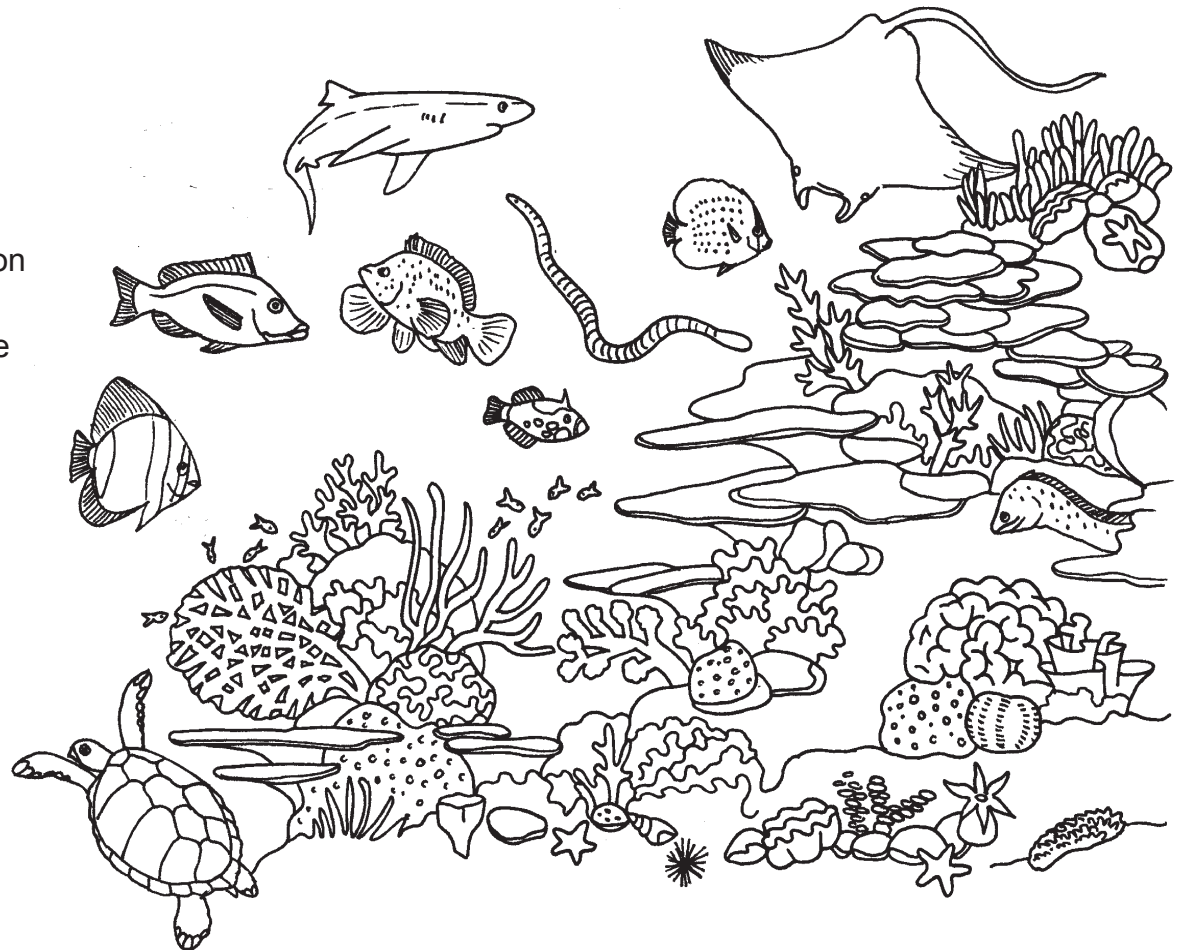
Your Task:

You will write a persuasive text about climate change in the form of a magazine article, a newspaper editorial, an essay or a journal article.

The persuasive text should include several aspects of climate change:

- What is climate change?
- Give examples to show how it has affected biodiversity on the Great Barrier Reef
- What are predictions for future effects of climate change and how will this impact biodiversity both on the Great Barrier Reef and in other ecosystems?
- What are local and global considerations to reduce the impact of climate change?

You will need to identify other aspects of climate change that you deem appropriate for your persuasive text.



Year 10 Climate Change – Science Report

Name: _____

Purpose of assessment: Create a persuasive text describing climate change, its current and future impacts on the Great Barrier Reef and strategies to reduce the impact of climate change. All descriptions of reducing climate change should consider a local and global scale.

Knowledge and Understanding		Skills		
Science Understanding	Science as a Human Endeavour	Science Inquiry Skills		
Earth and Space Sciences - Define, describe and explain climate change in relation to: <ul style="list-style-type: none">Interactions between the biosphere, lithosphere, hydrosphere and atmosphere, with specific focus on the Great Barrier Reef.How human activity affects global systems, especially in relation to the cause and effects of the 'Greenhouse effect'.Investigating the effect of climate change on the Great Barrier Reef, especially in relation to sea levels and biodiversity.The long-term effects of loss of biodiversity on the Great Barrier Reef.	Nature & Development of Science - Explanation of climate change makes reference to a theory refined over time through a process of review by the scientific community. Use and Influence of Science - Using scientific knowledge, considers and explains the effects of climate change on the Great Barrier Reef on both a local and global scale. - Investigates and proposes strategies to reduce the impact of climate change that are both scientifically sound and socially plausible.	Questioning and Predicting - Define, describes and explains climate change using the Great Barrier Reef as a context. Planning and Conducting - Plans and conducts an investigation into climate change using the Great Barrier Reef as a context. Processing and Analysing Data and Information - Uses information gathered to: <ul style="list-style-type: none">Interpret patterns and scientific projections between current impacts of climate change on the Great Barrier Reef on both a local and global scaleDraw conclusions about the effects of climate change on the Great Barrier Reef that are consistent with evidence.	Evaluating - Reflects upon learning to identify key current and future impacts of climate change on the Great Barrier Reef. Proposes strategies to reduce the impact of climate change on the Great Barrier Reef. Communicating - Arguments made are used using scientifically-sound arguments and appropriate scientific language, conventions and representations - Chooses the most appropriate method for displaying information and communicating to audience. -Diagrams and pictures used are relevant, labelled and referenced.	
<p>▶ The student comprehensively and accurately defines, describes and explains climate change with a specific focus on the Great Barrier Reef. The students' text explores the effects of climate change on the Great Barrier Reef, with a focus on sea levels and long-term biodiversity loss in a detailed and scientifically sound manner.</p> <p>▶ The student accurately defines, describes and explains climate change with a specific focus on the Great Barrier Reef. The students' text explores the effects of climate change on the Great Barrier Reef, with a focus on sea levels and long-term biodiversity loss in a generally scientifically sound manner.</p> <p>▶ The student describes, with teacher prompting, climate change with a specific focus on the Great Barrier Reef. The students' text states an effect of climate change on the Great Barrier Reef, with mention of issues relating to sea levels and long-term biodiversity loss.</p>	<p>▶ Scientific knowledge is used to comprehensively explain the effects of climate change on the Great Barrier Reef on both a local and global scale. The student provides a scientifically robust strategies, as well as plausible social and economic considerations to reduce the impact of climate change on the Great Barrier Reef.</p> <p>▶ Scientific knowledge is used to adequately explain the effects of climate change on the Great Barrier Reef on both a local and global scale. The student provides at least one scientifically robust strategy, as well as a plausible social and economic consideration to reduce the impact of climate change on the Great Barrier Reef.</p> <p>▶ Some scientific knowledge is used to explain the effects of climate change on the Great Barrier Reef on both a local and global scale. The student proposes a strategy to reduce the impact of climate change on the Great Barrier Reef that is based on science and mentions social and economic impacts.</p>	<p>▶ A very high level of detailed, scientific information is gathered and recorded during investigation to explain climate change and its impact on the Great Barrier Reef. Information and data collected is used to interpret patterns and explicitly link climate change, specifically the impacts of sea level rise and biodiversity loss, on a local and global scale.</p> <p>▶ Scientific information is gathered and recorded during investigation to explain climate change and its impact on the Great Barrier Reef. Information and data collected is used to interpret patterns between climate change, specifically, the impacts of sea level rise and biodiversity loss, on a local and global scale</p> <p>▶ Some scientific information is gathered and recorded during investigations to partially explain climate change and its impact on the Great Barrier Reef. Information and data collected is used to describe a pattern between climate change and the change in sea levels and biodiversity on a local and global scale.</p>	<p>▶ The student accurately and reasonably reflects upon learning to provide the most scientifically sound and effective strategies to reduce the impacts of climate change on the Great Barrier Reef. Scientific language, conventions and representations are consistently used and displayed in a clear and concise manner in an appropriately chosen format.</p> <p>▶ The student accurately reflects upon learning to provide strategies to reduce the impacts of climate change on the Great Barrier Reef. Scientific language, conventions and representations are regularly used and displayed in a clear and concise manner in an appropriately chosen format.</p> <p>▶ The student uses learning to provide strategies to reduce the impacts of climate change on the Great Barrier Reef. Some scientific language, conventions and representations are used and information and ideas are displayed in a generally clear and concise manner and appropriate format.</p>	<p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>

QSA Literacy Indicators (2012)		✓
Viewing and Reading		
VR 10 i.	View, read, navigate and select texts to suit learning purposes, content and context.	
VR 10 iv.	Independently view, read and demonstrate understanding of learning area texts, including academic texts by combining, connecting, comparing and synthesising ideas and concepts.	
Writing and Creating		
WC10 iii.	Plan, draft, edit for meaning and publish learning area texts in print and digital environments, using strategies to: <ul style="list-style-type: none"> • Construct representations of people and events • Incorporate research. 	
WC10 iv.	Maintain cohesion to support a particular point of view or position across texts, by selecting and controlling: <ul style="list-style-type: none"> • Language features that compact and generalise text, e.g. nominalisation • Language to analyse, evaluate and express higher order concepts. 	

Feedback:.....