

LINKS TO THE AUSTRALIAN SCIENCE CURRICULUM

Middle School Focus

KEY TERMS	ASPECTS OF THIS RESOURCE RELEVANT TO THE AUSTRALIAN SCIENCE CURRICULUM
Contemporary Science	Climate Change and adaptations; biodiversity and ecological sustainability.
Unifying ideas	Patterns, systems, order and organisation; exploration, questioning and speculating; cause and effect; evidence, models, explanation and theories; sustainability of systems; form and function.
CONTENT STRANDS	Understand facts, concepts, principles, laws, theories and models.
Science Understanding	BIOLOGY: Biological classification and the diversity of living things; function is related to structure; ecosystems; natural selection; theories for the extinction of the dinosaurs. EARTH and SPACE SCIENCES: geological processes and history; the fossil record; past environmental conditions and changes over time; theory of plate tectonics; geological phenomena; asteroids and meteorites.
Science Inquiry Skills	Pose questions; design fair tests; control variables; conduct investigations; organise data using tables, graphs and ICTs; analyse and interpret evidence; communicate findings using scientific language; make valid conclusions; explain patterns in data using scientific concepts.
Science as a Human Endeavour	Be aware of contemporary issues such as climate change and sustainability, the research of Australian scientists, and rewarding careers in science; apply scientific understandings to make responsible and informed decisions about issues.
UNIFYING IDEAS	Be aware of renewable and non-renewable resources and sustainable practices which reduce CO ₂ emissions; note the effects of this on global warming and climate change.
Sustainability	
Form and Function	Be aware of the link between form and function; how the shape and size of fossil teeth relates to their function; how dinosaur re-constructions can be done using an understanding of present-day organisms.
Evidence, models, explanations and theories.	Examine evidence that provides the basis of explanations; refine explanations to form models and theories which provide a detailed but tentative basis for understanding a range of evidence - dinosaur extinction theories.

Relevant content descriptors in the Australian Science Curriculum that relate to this resource are outlined below. They can be developed by using the following: online content in this resource; activities in Section 4 *Related QM Resources - Sustainable Living Resources*; and the activities in Section 6 *For Teachers and Glossary*.

While this resource has been designed with a middle school focus, many of the worksheets can be adapted to cover a broader range of age levels.

YEAR 4 SCIENCE UNDERSTANDING

Grouping living things: Grouping living things on the basis of observable characteristics. Elaborations: group living things including humans according to observable similarities and differences. (For example, this could be extended to look at differences between dinosaurs and the ways that scientists classify them into different groups. See also aspects of the *Dinosaur Details* worksheet in Section 6.)

Interactions of living things: Interactions between living things in a habitat, including simple food chains in local environments. Elaborations: explore ways that living things interact with their environment and each other; explore the ways that living things can cause changes (beneficial and detrimental) to the environments in which they live. (For example, see the *Pests and Threats Teacher Resource* booklet in Section 6.)

YEAR 4 SCIENCE INQUIRY SKILLS

Communicating: Represent and communicate ideas and explanations using methods such as diagrams, physical representations and simple reports. **Elaborations:** work in groups to present results and findings using constructed models, presentations and digital technologies where available; use simple explanations, arguments and descriptive text types such as information reports to communicate science ideas. (For example, a modified version of the Middle School Project could be developed.)

YEAR 5 SCIENCE INQUIRY SKILLS

Investigation methods: Contribute to decisions about the investigation method to use, including using fair tests, models, information research, surveys and data from secondary sources. **Elaborations:** experience a range of ways of discovering a range of information and ideas relating to science, including the internet and text-based research. (For example, use the internet to investigate some of the following: the environmental conditions at the time of the extinction of the dinosaurs; theories for the extinction of the dinosaurs; causes for extinctions today; and research into one endangered species.)

YEAR 5 SCIENCE AS A HUMAN ENDEAVOUR

Nature of science: Science ideas and understanding change as new evidence becomes available. **Elaborations:** understand that conclusions are drawn based on evidence presented and that the addition of new evidence may change the conclusions drawn. (For example, the reconstruction of some dinosaur skeletons has changed over the years. The 'horn' of *Iguanodon* was later discovered to be a thumb after a complete *Iguanodon* skeleton was unearthed. Findings of the iridium layer in special rock layers dated at 65 million years ago, presented evidence for the Alvarez hypothesis.)

Influence of science: Science has led to changes in the way people live and its applications both influence and can be influenced by personal and community choices. e.g. electricity usage. **Elaborations:** investigate the way electricity and electrical appliances have changed the way we live and how we make choices about the use of electricity, personally and as a community. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources and Energy Usage in Section 6.)

YEAR 6 SCIENCE UNDERSTANDING

Relationships of living things: Relationships between living things, including food webs and suitability of particular habitats. **Elaborations:** investigate the characteristics of living things, including their body structure and behaviour, and recognise that these characteristics help them to survive in their particular environment. (For example, investigate the structural adaptations of specific dinosaurs; why species changed at the Mt Etna site over time; how these new species were better adapted to the changed environment.)

Using Earth's resources: Human activity, such as the use and management of water, energy sources, and mineral resources, can have consequences for the environment and other living things. **Elaborations:** understand that energy resources have associated environmental costs when humans use them and that their use can be managed to minimise the environmental impact; use food webs to explain and predict how human changes to habitats can lead to endangered species or extinctions. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources, and the Pests and Threats Teacher Resource booklet in Section 6.)

Major events at the Earth's surface: The causes and effects of major natural events at the Earth's surface such as earthquakes, tsunamis and volcanic eruptions. **Elaborations:** compile a list of examples of major natural events; identify and investigate the causes of some major natural events such as earthquakes, volcanic eruptions, and tsunamis. (For example, see the Natural Disasters Teacher booklet and the Middle School Project in Section 6.)

Sustainable energy transformations: Sustainable sources of energy, including water, solar and wind, and how they can be transformed into useful forms of energy. **Elaborations:** investigate how moving air and water can be used to provide power to turn turbines and create electricity; understand that electricity can be generated from sunlight through the use of solar panels; investigate other sustainable sources of energy and how they can be transformed into useful forms. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources and the Energy Usage and Energy-related activities in Section 6.)

YEAR 6 SCIENCE INQUIRY SKILLS

Communicating: Use a range of forms to represent and communicate evidence, ideas and explanations including using models and reports. **Elaborations:** use labelled diagrams to communicate ideas and knowledge; use a variety of written and spoken text types, including information reports, explanations, arguments, debates and procedural recounts to communicate science ideas. (For example, see the Middle School Project in Section 6.)

YEAR 6 SCIENCE AS A HUMAN ENDEAVOUR

Influence of Science: Science has led to changes in the way people live and its applications both influence, and can be influenced, by personal and community choices e.g. in relation to sustainable practices. Elaborations: compare how personal and community choices about preferred futures influence our application of science for energy sustainability. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources and the Energy Usage and Energy-related activities in Section 6.)

Contribution of scientists: Australian scientists have made a significant contribution to scientific understanding in various fields of human endeavour. Elaborations: explore institutions and locations where contemporary Australian scientists conduct scientific research relating to catastrophic natural events. (For example, investigate the research done by Dr Scott Hocknull into past climate change in Australia; Dr Alex Cook into meteorite impact zones in Australia; and see the Natural Disasters Teacher booklet in Section 6.)

YEAR 7 SCIENCE UNDERSTANDING

Shaping the Earth: The processes which shape geological features and landforms. Elaborations: compare the contribution of volcanoes and earthquakes to producing distinctive landforms. (For example, investigate the theory of plate tectonics; investigate the formation of the Deccan Traps in India; and see the Meteorite Matters sheet in Section 6, etcetera.)

Renewable energy sources: The difference between renewable and non-renewable sources of energy. Elaborations: establish a definition of renewable and non-renewable energy; classify energy sources found or used in Australia as renewable or non-renewable e.g. coal, oil, natural gas, HEP, uranium, geothermal, solar, wind, tidal and biofuels. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources and the Energy Usage and Energy-related activities in Section 6.)

YEAR 7 SCIENCE INQUIRY SKILLS

Communicating: Communicate using scientific language, representations and evidence-based arguments. Elaborations: use correct scientific terms for organisms, objects, events and materials; construct an extended response to a scientific question that contains a range of representations such as text, diagrams and charts. (For example, see the Middle School Project in Section 6.)

Evaluating evidence: Evaluate claims from a scientific perspective. Elaborations: describe how science is used to support claims and decide whether the science mentioned is relevant to the situation described. (For example, investigate the claims linking global climate change to the threatened status of some species. See the Middle School Project and the Pests and Threats Teacher booklet in Section 6.)

YEAR 7 SCIENCE AS A HUMAN ENDEAVOUR

Nature of Science: Science helps individuals and communities to make choices about issues in life and evaluate claims made in a range of media and advertising. Elaborations: compare the advantages and disadvantages of energy resources such as wind, solar, tidal, geothermal and hydroelectric; debate the use of non-renewable energy resources including coal, oil, gas and uranium. (For example, see the worksheets in Section 4 *Related QM Resources* - Sustainable Living Resources and the Energy Usage and Energy-related activities in Section 6.)

Contributions of Scientists: Scientists from Australia and elsewhere make major contributions to scientific knowledge, engineering and technology. Elaborations: identify the way in which scientists from Australia continue to make major contributions to scientific knowledge about the El Nino Effect and other weather patterns. (For example, study the fossil evidence in Section 3 that suggests changes to Australia's weather patterns in the past have led to changes in the evolution of Australian fauna; investigate weather patterns and changes today; predict the effects of this on the survival of specific Australian fauna.)

YEAR 8 SCIENCE UNDERSTANDING

Biological classification: Biological classification systems based on observable characteristics of living things. Elaborations: group organisms on the basis of structural features and record these groupings in tables or diagrams to identify similarities and relationships. (For example, see the Dinosaur Details worksheet in Section 6.)

Ecosystems: The interrelationships between organisms, energy and matter in ecosystems, and the effects of human activity on the sustainability of ecosystems. Elaborations: predict and investigate the effects from the introduction or removal of a species in a community. (For example, see the Middle School Project and the Pests and Threats Teacher booklet in Section 6.)

Geological evidence of change: The role of geological evidence, including the fossil record, in investigating ancient events, past environmental conditions and changes over time. Elaborations: investigate the formation of both plant and animal fossils; simulate the formation of plant, animal and trace fossils; use fossils to make inferences about the environmental conditions at the time of their formation; research a significant fossil site e.g. Winton in Qld. (For example, read through Section 3 of the resource and use the following worksheets and activities found in Section 6: Palaeological Pursuits; Interpreting fossils evidence; A Fossil Community; and Let's Investigate.)

YEAR 8 SCIENCE INQUIRY SKILLS

Questioning and predicting: Formulate scientific questions to investigate and make predictions based on prior observations and scientific knowledge. Elaborations: use information and knowledge from previous investigations to predict the expected results from an investigation. (For example: see the Let's Investigate activity in Section 6. Depending on the ability level of the students, teachers may need to modify this and/or model the investigation and suggest equipment to be used. Teachers may decide to examine just one of the suggested test variables.)

Fair testing: Design fair tests, identifying variables to be changed, measured and controlled, and the need for repeat trials. Elaborations: recognise the differences between controlled, dependent and independent variables; consider the number of trials required to be carried out in order to obtain the required degree of accuracy. (For example, see the Let's Investigate activity in Section 6.)

Using equipment: Use some specialised equipment and materials safely and identify and minimise risks to self and others. Elaborations: learn and apply specific skills and rules relating to the safe use of scientific equipment. (For example, see the Let's Investigate activity in Section 6.)

Observing and Measuring: Collect and record data, making observations and measurements with accuracy appropriate to the task, using ICT where appropriate. (For example, see the Let's Investigate activity in Section 6.)

Analysing results: construct and use tables and graphs to represent and analyse data, including using ICT. Elaborations: design appropriate tables to record data; use graphical methods and apply conventions used in plotting graphs. (For example, see the Let's Investigate activity in Section 6.)

Developing explanations: Summarise and explain data, using scientific understanding to draw conclusions. Elaborations: use tables, graphs and charts to summarise and present information in a clear and engaging way; select major ideas, issues or information from a range of sources such as experimental results, internet research, texts and audiovisual material. (For example, see the Middle School Project in Section 6.)

Communicating: Communicate using scientific language, representations and evidence-based arguments. Elaborations: construct an extended response to a scientific question that contains a range of representations such as text, diagrams and charts. (For example, see the Middle School Project in Section 6.)

Evaluating evidence: Evaluate claims from a scientific perspective, including using real findings. Elaborations: describe how science is used to support claims and decide whether the science mentioned is relevant to the situation described. (For example, investigate the claims linking global climate change to the threatened status of some species. See the Middle School Project and the Pests and Threats Teacher booklet in Section 6.)

YEAR 8 SCIENCE AS A HUMAN ENDEAVOUR

Science careers: There are careers and industries that involve knowledge, understanding and applications of science. Elaborations: recognise that palaeontologists have distinct ways of working and representing their specialised knowledge. (For example, investigate some of the research areas of geoscientists at the Queensland Museum such as Dr Scott Hocknull and Dr Alex Cook.)

Contribution of scientists: Scientists from Australia and elsewhere make major contributions to scientific knowledge, engineering and technology. Elaborations: research the contributions of Australian palaeontologists to our understanding of ancient life. (For example, read and investigate the effect of past climate change on the evolution of rainforest species in the Mt Etna region of Queensland. This is shown in Section 3.)

YEAR 9 SCIENCE UNDERSTANDING

Earth systems: Interactions between the Earth's spheres, such as carbon and nitrogen cycles, and the impact of humans and natural events on these interactions. Elaborations: discuss global warming as a result of the enhanced greenhouse effect and its potential impact on ecosystems. (For example, see the Middle School Project and the Pests and Threats Teacher booklet in Section 6.)

YEAR 9 SCIENCE INQUIRY SKILLS

Questions and predicting: Research information from a variety of sources to formulate scientific questions and develop testable hypotheses. Elaborations: develop ideas from students' own or others' investigations and experiences to investigate further. (For example, see the Let's Investigate activity in Section 6.)

Investigation Methods: Choose the most appropriate investigation type for the question including experimental investigations involving repeat trials and replicates and multiple variables. Elaborations: combine research using secondary sources with experimental investigation; explain the choice of variables to be controlled, changed and measured in an investigation. (For example, see the Let's Investigate activity in Section 6.)

Using equipment: Select and use specialised equipment and materials that are suitable for the investigations. Elaborations: learn specific skills for the use of scientific instruments. (For example, see the Let's Investigate activity in Section 6.)

Managing risk: Carry out a risk assessment of a practical activity. Elaborations: consider the potential hazards of chemicals or biological materials used in experimental investigations. (For example, see the Let's Investigate activity in Section 6.)

Analysing results: Represent and analyse data appropriately including using simple statistical methods and ICT. Elaborations: calculate means and ranges from data and consider the distribution of sets of quantitative data. (For example, see the Let's Investigate activity in Section 6.)

Developing explanations: Draw conclusions that are consistent with the evidence and critique these conclusions with reference to scientific concepts. Elaborations: suggest more than one possible explanation of the data presented. (For example, see the Middle School Project in Section 6.)

Communicating: Communicate scientific ideas and information for a particular audience and purpose, including making evidence-based arguments. Elaborations: present results and ideas using oral presentations, slide shows, poster presentations and contribute to group discussions. (For example, see the Middle School Project in Section 6.)

YEAR 9 SCIENCE AS A HUMAN ENDEAVOUR

Contribution of scientists: Scientists are recognised by society in various ways for their contribution to human understanding. Elaborations: research Australian scientists who have won significant national and international recognition for their work. (For example, Dr. Scott Hocknull who has won the following awards: 2009 Riversleigh Medal; 2009 Queensland's 50 Best and Brightest, Queensland Courier Mail; 2005 Neville Stephens Medal, Geological Society of Australia; 2002 Young Australian of the Year.)

UNIT THEME: WHY DID THE DINOSAURS DIE OUT?

This theme is one that catches the interest of Middle School students. It allows them to suggest and explore theories about the extinction of the dinosaurs. Initial discussion with students and assessing their prior knowledge on the topic may lead to a contextual unit incorporating some of the following topics.

Earth and Space Sciences; Biology

1. **Volcanism** – Structure of the Earth; Earth's crust and tectonic plates; continental drift; volcanoes; earthquakes; tsunamis.
2. **Palaeontology** – Geological time; History of Life on Earth; fossils; how fossils form; fossils and DNA; extinction; causes of extinction; threats to species today.
3. **Climate and Weather** – Water cycle; Weather maps; extreme weather events (cyclones, floods, bushfires and drought); climate change – causes and effects, and effects on rates of extinction.
4. **Space** – Earth's position in space; asteroids, meteorites and comets.
5. **Classification & Adaptation** – different types of dinosaurs; structure is related to function.
6. **Ecology** – interactions between organisms and their surroundings.
7. **Evolution** – evolution by natural selection; changes in ecosystems have causes and consequences.

Initial Brainstorming Session

1. In groups, allow students to brainstorm answers to the question:

Why did the dinosaurs die out?

2. Then get them to share their responses with the rest of the class. Write these on the board.

Some possible responses by students may include the following:

- An asteroid hit the Earth
- Comets bombarded the Earth
- Dust clouds blocked out light from the Sun
- Another planet affected the Earth
- There was an Ice Age and temperatures dropped
- A volcano erupted
- There was a rise in the Earth's temperature and it got drier
- There was a shortage of food
- The land masses drifted apart and so food and weather changed
- A disease spread through the dinosaurs
- A flood covered the area where the dinosaurs lived
- There were never any dinosaurs
- They evolved into something else
- No new offspring were produced
- A tsunamis wiped them out after the asteroid hit



Artist: J. T. Bauer. Image: Queensland Museum, Creative Commons licence BY-NC-ND.

3. Now group the students' responses into the following headings:

Catastrophe on Earth	Something from Outer Space	Natural Changes

Students can explore the concept of hypotheses and theories. e.g. Impact theories versus Gradualistic theories; the extraterrestrial impact hypothesis (catastrophic) and the habitat loss hypothesis (gradualistic); Volcano theory; etcetera.

After the initial brainstorming session, students may then come up with further questions such as: If dinosaurs ruled the Earth 65 million years ago, then the Earth must be a lot older than this. When was the Earth formed? What is its structure? What was the climate like then? Could the dinosaurs move to other areas? For example, were there land bridges or were oceans covering these? When were the Ice Ages? When did humans first appear?

These questions may lead to a study of the topics listed at the bottom of the previous page. A unit of work can then be devised around this theme.

Additional worksheets and activities can be found in Sections 4 and 6 of this resource.