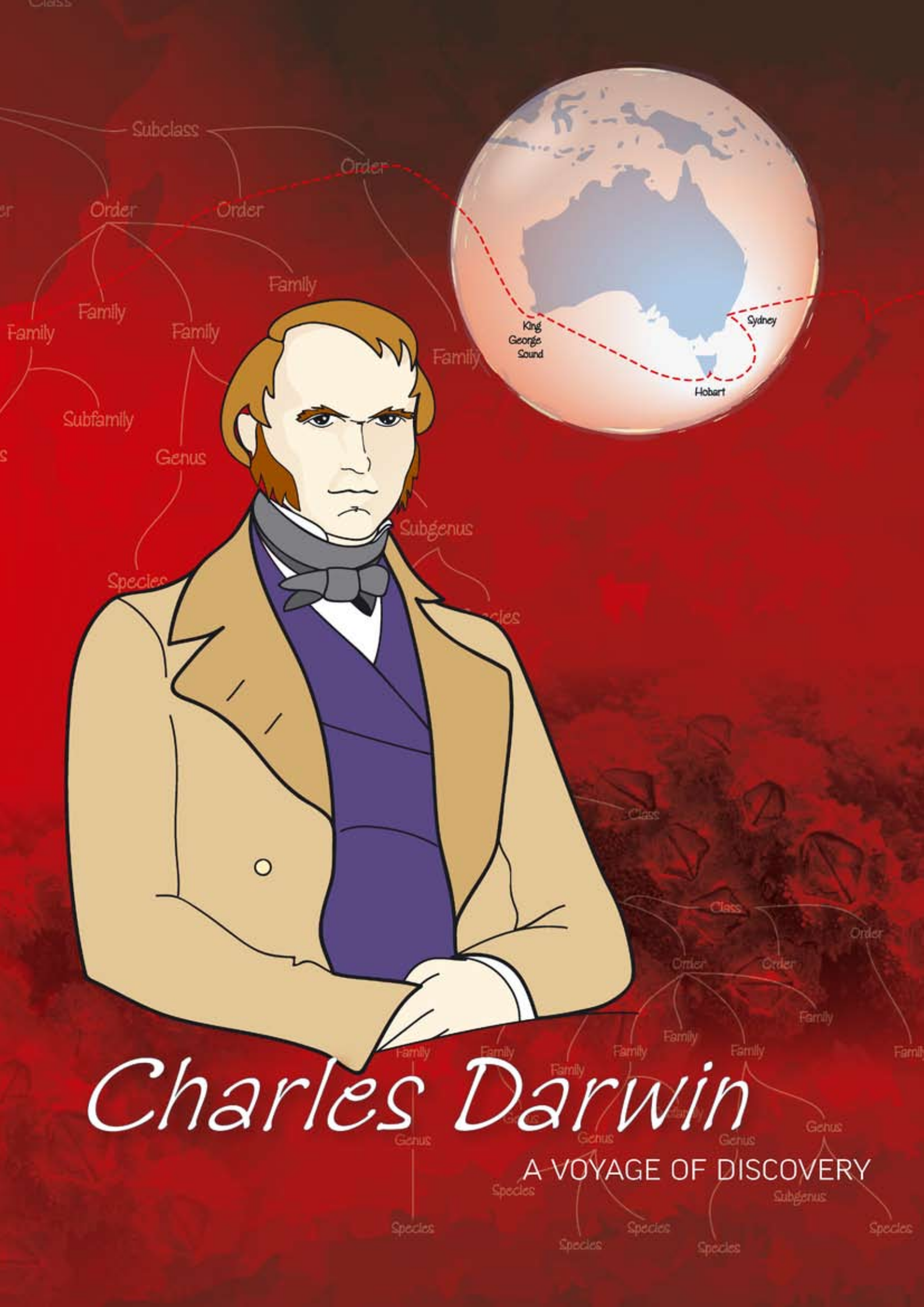
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King George Sound
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Hobart
Charles Darwin
A VOYAGE OF DISCOVERY

Australian Government

A message from Peter Garrett

This year, the world celebrates the 200th anniversary of Charles Darwin's birth and the 150th anniversary of his work, *On the Origin of Species*. Australia is also commemorating the five-year, round-the-world voyage that brought a youthful Darwin to Australia and saw him discover an abundance of new species.

The Australian Biological Resources Study and the Australian Science Teachers Association have made an outstanding contribution to this anniversary year by producing this resource book on Darwin's experiences in Australia. There is much still to be discovered about Australia's plants and animals and I encourage teachers to use this book to inspire the next generation of species discoverers.

Peter Garrett
Minister for the Environment, Heritage and the Arts
March 2009

Australian Government
Department of the Environment, Water, Heritage and the Arts

ABRS

Australian Science Teachers Association

Acknowledgements

The author would like to thank the following people and organizations for their help with the research for and reviewing of this book:

- Science Teachers' Association of Queensland (STAQ) and Ms Sue Monteath, STAQ President
- Education panel members
  - David Fittell
  - Di Nichols
  - Susan Peaty
- Members of the scientific community who agreed to being quoted and/or provided advice
  - Ms Ailsa Holland, Queensland Herbarium Brisbane, Botanic Gardens Mt Coot-tha, Qld
  - Dr David Lovell, Redlands Veterinary Clinic, Thornlands, Qld
  - Dr Bill McDonald, Queensland Herbarium, Botanic Gardens Mt Coot-tha, Qld
  - Dr Kerryn Parry-Jones, School of Biological Sciences, University of Sydney, NSW
  - Ms Louise Saunders, Bat Care Brisbane, Qld
  - Dr Linfa Wang, Australian Animal Health Laboratory, CSIRO, Geelong, Vic

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Editor: A Jarrott
Designer: B Kuchlmayr
Printer: Blue Star Print
Publisher: Australian Biological Resources Study

ISBN: 978 0 642 56859 5

Introduction

This booklet of activities has been funded by the Australian Biological Resources Study (ABRS) to commemorate two important events occurring in 2009 — the bi-centenary of the birth of Charles Darwin and the 150th anniversary of the publication of his book, *On the Origin of Species*. Although ***Charles Darwin: A Voyage of Discovery*** has been created specifically for this year of celebrations, the activities have been designed so they can continue to be used in the future.

A *Background information* section has been included to provide teachers with an outline of Darwin's interests and ways of working, his historic theory of natural selection, how he came to visit Australia on the *Beagle* and his connections to well-known early residents of Australia.

The diverse range of activities included is designed for students in the middle years of schooling (Years 6–9) throughout Australia and will acquaint them with Darwin's Australian connections, his greatest contribution to science — his theory of natural selection, his methods of obtaining evidence and the relevance of his theory today.

The activities are grouped into Introductory, Developmental and Culminating sections. Teachers are invited to select some or all activities from each section for their unit of work.

How to Use Activities

The Introductory activities are intended to engage students in the unit of work. *Let's begin* allows teachers to assess students' prior understandings and misunderstandings about Darwin and his contributions to science. *Darwin's large island* introduces students to his visit to Australia and provides links to history and geography.

The Developmental activities include:

- field studies – *What's in your schoolyard?* and *Collecting and preserving*
- controlled experiments – *Variation and survival* and *How on earth did they get there?*, and
- a critical thinking exercise – *A most extraordinary animal*.

A further activity, a contemporary case study involving the emergence of viruses in fruit bats – *Change and evolution*, is available on the ASTA website (**www.asta.edu.au**).

The Culminating activities, *Summing up, Party time* and *The exhibition*, allow students to revisit what they have learnt from the other activities.

Some activities have appendices which can be found on the ASTA website (**www.asta.edu.au**). If an activity has an appendix, this is indicated, along with its online location.

Teachers should perform their own safety audit before each activity.

Teachers who would like to offer students more support for scaffolding their controlled experiments and designing their reports will find *Working Scientifically* by Mark Hackling very useful. It can be downloaded from the Western Australian Department of Education and Training website: **www.det.wa.edu.au/education/science/Teach/workingscientificallyrevised.pdf**.

We hope that you and your students find these activities stimulating and enjoyable.

Contents

Teacher Feedback Questionnaire

Charles Darwin: A Voyage of Discovery

Charles Darwin: A Voyage of Discovery is an ASTA & ABRS resource book for teachers.
The information you provide will assist in making improvements to future publications.

Your name	Year level you teach (please circle all that apply)
	K 1 2 3 4 5 6 7 8 9 10 11 12
School's name	Year levels catered for at your school (please circle all that apply)
	K 1 2 3 4 5 6 7 8 9 10 11 12
School's email	

School's mailing address	ASTA member (please tick the appropriate box)
	☐ YES (Please state which science teachers association)
	☐ NO

Please indicate your ratings

Feedback Criteria						
1. Overall response to the book	2	1	0	-1	-2	
A valuable resource ←						→ Of little value
Well presented ←						→ Poorly presented
Information sections were helpful ←						→ Not helpful
Supports an inquiry approach to student learning ←						→ Does not support an inquiry approach
2. Resource Book Content	2	1	0	-1	-2	
Good balance of activities — years 6–9 ←						→ Too targeted
Includes activities relevant to the class level I teach ←						→ Irrelevant to my students
Created student interest ←						→ Little interest created
Provided springboard to other ideas and activities ←						→ No scope for creativity
Additional resource links were useful ←						→ Not useful
Appropriate methodology ←						→ Inappropriate methodology

3. What did you find most valuable about the book?.....

.....

Why? .....

.....

4. What did you find least valuable about the book?.....

.....

Why? .....

.....

FAX/POST this evaluation form to ABRS by 30 September 2009 to
WIN one of 8 x ***Charles Darwin in Australia***
200th Anniversary edition books (one per state and territory)

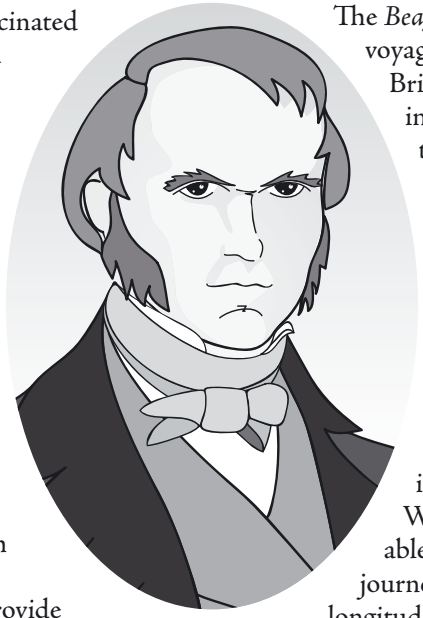
Fax: 02 6250 9448
Mail to: Australian Biological Resources Study, GPO Box 787, Canberra ACT 2601

Background information

Charles Darwin the scientist and his Australian connections

Darwin the naturalist and taxonomist

Even as a young child, Darwin was fascinated by the **biodiversity*** around him and employed his skills in **taxonomy*** to make collections, identify and group things. As an adult his powers of observation, rigorous testing, analysis and ability to ask questions led him to write his famous **theory*** of evolution by natural selection.



Whilst employed on the survey ship the HMS *Beagle*, Darwin observed and collected plants, animals and geological specimens, including fossils. With the assistance of his cabin boy, he kept meticulous records about each one — the date and place where it was collected and information about the environment in which it was found. These specimens and records, together with the Captain's notes, were to provide much of the evidence for what was to become his theory of natural selection, a theory that has stood the test of time and that has had an overwhelming influence on the science we call biology.

In Darwin's time, identification of a living thing involved the careful observation of internal and external appearance and, in the case of animals, other detectable features such as body temperature and behaviour. Nowadays, in addition to these observations, identification can include chemical analysis, including **DNA*** composition. Modern techniques can lead to a revision of the group in which an organism is placed, thus showing evolutionary relationships more accurately.

Chance appointment of a lifetime

Darwin was very fortunate to end up on board the *Beagle* for its 1831–1836 voyage around the world. Its Captain, Robert FitzRoy, wanted a companion to accompany him on the voyage. He requested, and was granted, a naturalist companion.

Darwin obtained that appointment as the result of a chain of events. The first person recommended for the position declined the offer. Darwin had recently graduated from Cambridge University with an Arts degree but in his spare time indulged his interest in natural history. This brought him to the notice of professors in this area. Via this Cambridge link and a number of other 'old boys' connections, Charles was offered the position on the *Beagle*. Darwin's father was horrified, however, and only allowed him to take it after Charles had persuaded his uncle Jos Wedgewood to speak to his father on his behalf. This is how Darwin came to embark on the most important journey in his life — a journey that would take him to many islands, small and large, including Australia, and would go down in the annals of the history of science.

The *Beagle*'s real purpose

The *Beagle* was actually a survey ship and the voyage was funded to make maps for the British Royal Navy. Captain FitzRoy was instructed to measure the depth of the sea, to survey the South American coastline and the Falkland Islands and record a series of longitudes around the world using chronometers (nautical clocks). Readings were recorded across the Pacific to Port Jackson, Australia. In Australia, FitzRoy was instructed to record longitude observations at the internationally important reference points of Sydney in New South Wales, Hobart in Tasmania and King George Sound in Western Australia. This is why Darwin was able to visit these parts of Australia. On the journey home, FitzRoy was to continue recording longitude at other specified ports of call — the Keeling Islands, Mauritius, the Cape of Good Hope and Atlantic islands.

Some notable australians

The *Beagle's* voyage and its two-month visit to Australia brought Darwin into contact with a number of people who are still remembered today. Captain Robert FitzRoy became Governor of New Zealand and is also recognised as the father of weather forecasting.

By the time Darwin arrived in Sydney, the well-known landscape artist Conrad Martens was a resident. He had earlier been on the *Beagle* with Darwin, where he replaced another Australian artist, Augustus Earle. Whilst in New South Wales, Darwin met Major Thomas Mitchell, explorer and Surveyor-General of NSW.

Darwin's cabin boy, Syms Coverington, who meticulously collected, labelled and recorded many of the specimens that were to form the basis of Darwin's explanation of the process of evolution, was to settle in Australia. Coverington continued to correspond with Darwin and collect specimens for him, in particular barnacles, which were to be important for Darwin's writings.

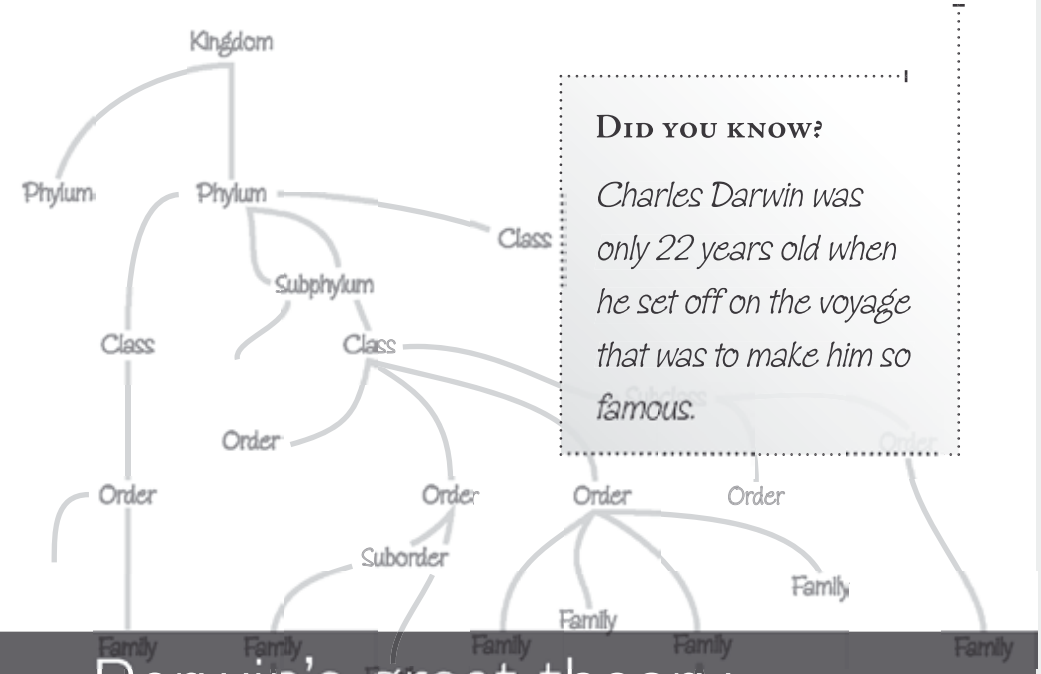
Darwin's Australian visit

Darwin arrived at Sydney Cove in the colony of New South Wales on 12 January 1836 in the middle of an Australian summer and a severe drought. Whilst in New South Wales, he explored westwards to Bathurst, in Tasmania he explored along the Derwent as far as New Norfolk and in Western Australia he explored the area around King George Sound from whence he departed on 14 March 1836.

HMS Beagle by Owen Stanley, 1841. National Maritime Museum, Greenwich, London. Source: www.wikipedia.org

Record keeping and collecting

Whenever he was ashore, Darwin would explore the area, always with a notebook in hand. In this notebook, he made brief observations about the geology, plants and animals of the area and the people and their living conditions. He was always comparing his observations to previous ones. Typically, an hour or two in the field each day would provide him with enough material to occupy the rest of the day, preserving and recording his specimens and using his personal, geological and zoological diaries to expand on his field notes. Once back in England, Darwin used these diaries to write up his voyages.



Did you know?

Charles Darwin was only 22 years old when he set off on the voyage that was to make him so famous.

Darwin's great theory

The idea that living things had evolved was put forward in Darwin's time, but no satisfactory mechanism by which this had occurred had been described. Darwin indicated the mechanism and provided an enormous body of evidence in its support.

Darwin explained that plants and animals change over time through a process of Natural Selection and that this occurs because:

1. Not all plants and animals in a population are alike.
2. More young are born than can hope to survive for long enough to reproduce.
3. Those plants and animals with features best suited to their environment ('the fittest') are more likely to survive and reproduce.
4. These survivors pass their desirable features on to their offspring.
5. Gradually these features become more common and the population changes over time.
6. If the changes are great enough they could produce a completely new species of plant or animal altogether.

Note: Bacteria and viruses had not been identified in Darwin's time, but his theory holds true for all organisms.

Reference

Charles Darwin in Australia, F.W. Nicholas & J M Nicholas, Cambridge University Press, 2002.

Some terms

Biodiversity is the variety of life on earth. It includes micro-organisims, plants, animals, their genes and the ecosystems of which they are a part. For more information see – *Exploring Biodiversity: a resource book of ideas for National Science Week 2001* (available at **www.asta.edu.au**).

Taxonomy is the process of sorting and naming the different kinds of living things (organisms). It involves identifying and classifying (grouping) them to show their similarities. This system existed in Darwin's time but Darwin offered the explanation and evidence for the way in which organisms had come into existence over time. He proposed that through the process of natural selection species adapt to their different environments and change over time. Taxonomy is still a very important field of science, e.g. the identification and naming of a particular human flu virus or species of human disease-carrying mosquito is a crucial step in undertaking prevention, control and eradication measures.

A **theory** in everyday life might simply be a possible explanation for why something happened, but in science, a theory only becomes a theory as a result of an immense body of evidence to support it. Furthermore, it is testable. Scientific theories are as important as scientific facts and laws and they have important predictive powers. Darwin's theory of evolution by natural selection is one of science's most important theories as it can be applied to all organisms, e.g. it enables scientists to begin to understand how strains of bird flu can change and reproduce in humans and it explains why insects become resistant to pesticides over time. Some other scientific theories are: the cell theory, atomic theory, kinetic theory of gases, plate tectonics, big bang, quantum theory, theory of relativity, giant impact theory.

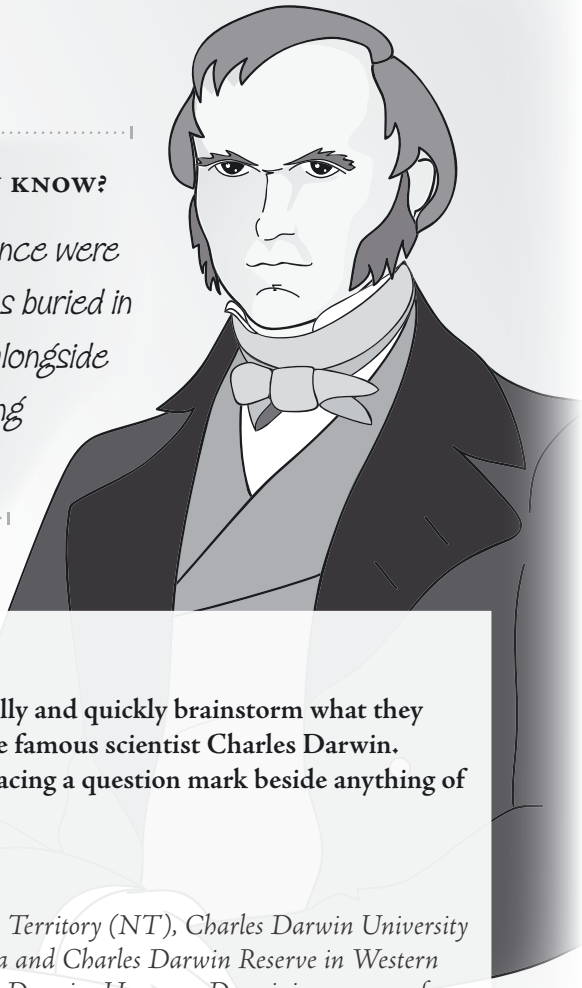
DNA (**D**eoxyribose **N**ucleic **A**cid) is the name given to chemicals found in cells that contain the hereditary (genetic) information. DNA determines how an organism will grow, develop and function.

Let's begin...

No doubt some of your students will have heard about Charles Darwin and his great contribution to biology. Some of you even will have 'Darwin tales' to tell. For example, a teacher friend of the author learnt in the course of researching her family history that Darwin had cited her 'great-great-great grandfather' in one of his articles!

Did you know?

Darwin's contributions to science were so well recognised that he was buried in Westminster Abbey, London, alongside other famous scientists including Sir Isaac Newton.



Purpose of activity

This is a short activity designed to ascertain student conceptions and misconceptions about Charles Darwin. Students and the class will have the opportunity to revisit their 'understandings' throughout the module.

Introduce aspects from the *Background Information* (p4) section of this booklet as you deem appropriate, particularly details of his Australian visit, if students are not doing the *Darwin's large island* (p7) activity.

These activities use the **think-pair-share** technique. Students begin with a personal brainstorm and record their ideas, then work in pairs to share and compile their contributions. Two pairs then share and compile their contributions, then four pairs share and compile their contributions. Finally, each group shares their contributions with the class and a class list is compiled.

Materials required

(For individual students)

- Notebooks and pens

(For the class)

- Butchers paper to compile the class list
- Thick felt-tipped marker

Student activity

1. **'Think' Students work individually and quickly brainstorm what they know about or associate with the famous scientist Charles Darwin. Later, they record their ideas, placing a question mark beside anything of which they are not quite sure.**

Notes

- *Darwin, the capital of the Northern Territory (NT), Charles Darwin University (NT), Mount Darwin in Tasmania and Charles Darwin Reserve in Western Australia were named after Charles Darwin. However, Darwinia, a genus of Australian plants, is named after Charles' grandfather Erasmus, who was a botanist and physician.*
- *Some students will be aware of some aspect of Darwin's theory, but others may have incorrect information such as 'Darwin said we are descended from monkeys'. Accept all information, as students will have the opportunity to review their lists throughout this activity and in later activities.*

2. **'Pair' Students then work in pairs to share and discuss their records and create a list for the pair.**

3. **'Share' Students now combine two pairs into groups of four. They share and discuss their records and collate information for the group.**

4. **'Share' Two groups of four then come together to share and discuss their records and collate a list for the larger group.**

5. **'Share' The groups of eight share their lists with the whole class and a class list is compiled.**

Notes

- *A question mark should be placed beside any point of which students are not sure or points where there is disagreement between students.*
- *Tell the students they will be referring to this list throughout the unit of work to see what they can add or remove from it. Remind them they could also go online (or to the library) to resolve any queries.*

6. **Conclude this activity by introducing students to the kinds of investigations they will be doing in this unit of work.**

Darwin's large island

'The voyage of the Beagle has been by far the most important event of my life and has determined my whole career....'
Charles Darwin, in Neve, M. and Messenger, S., eds. (2002)
Charles Darwin: autobiographies.
Penguin Books: London, UK, p42.

Purpose of activity

This activity engages students with Darwin's Australian experiences. It introduces them to the places Darwin visited and the kinds of observations he made about the extent of European settlement, contact with the first Australians and Australia's unique plants and animals. Students use extracts from Darwin's diary and access teacher-supplied images and/or the Internet to create illustrated posters of his Australian visit. Consider leaving these posters on display throughout the unit of work.

You might need to inform students that Darwin travelled to Australia on the *Beagle*. Introduce aspects from the *Background information* (p4) section of this booklet as you deem appropriate and if students have not done the *Let's begin* (p6) activity, discuss why he is so famous.

This is not a plain language task — students might have difficulty understanding Darwin's language and writing style and the diary genre. Teachers are advised to assist students to decode the entries. The task also provides an opportunity to illustrate to students how written language changes over time. Consider asking students to re-write selected entries in their own words to aid their understanding of them.

Materials required

(FOR EACH GROUP OF STUDENTS)

- Extracts from Darwin's diary entries from his time in Australia (can be downloaded from **www.asta.edu.au**. Darwin's full diaries are available at **http://darwin-online.org.uk**)
- Maps of Australia, New South Wales, Tasmania and Western Australia showing the *Beagle's* Australian voyage (can be downloaded from **www.asta.edu.au**)
- One or two pieces of butchers paper or chart paper for each state being researched
- Black felt-tipped markers, glue
- Access to relevant library books, the Internet, or previously downloaded or collected images so students can illustrate Darwin's diary entries for each date and location (the illustrations are to include the places, landscapes, plants and animals described and each is to be accompanied by the relevant title captions, artist and source details). Picture Australia has many useful images. The link to this site is **www.pictureaustralia.org**. Download tips on how to source these images are available from **www.asta.edu.au**.

Student activity

1. **Students work in small groups to complete an illustrated large class chart or poster for each of the states that Darwin visited. Each chart or poster should include a small map of Australia that shows the Beagle's Australian route, as well as a map of the particular state, with the places Darwin visited marked on it. Students should find illustrations for extracts from Darwin's diary to paste onto the poster/chart and then paste/print the relevant sentence or phrase from the diary near the illustration, with an acknowledgment of the artist and source.**

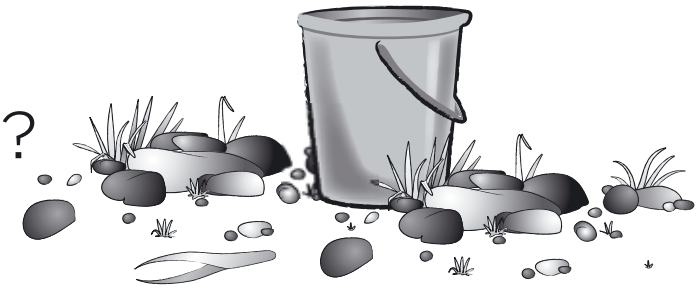
Notes

- *As many things are often described for one day it could save time if part of the entry for a particular day or state is allocated to each group.*
- *It is recommended that students access the Internet for this activity, as there are excellent illustrations available. If possible, print out these in colour.*

2. **When the illustrated maps are completed they should be displayed around the classroom so students can peruse them and visualise where Darwin went in Australia and the observations he made.**

3. **Students conclude this activity by recording their own notes about Darwin's visit to Australia — the places he visited and the observations he made.**

What's in your schoolyard?



Darwin was fascinated by the biodiversity around him and employed his skills in taxonomy to make collections and group things.

Purpose of activity

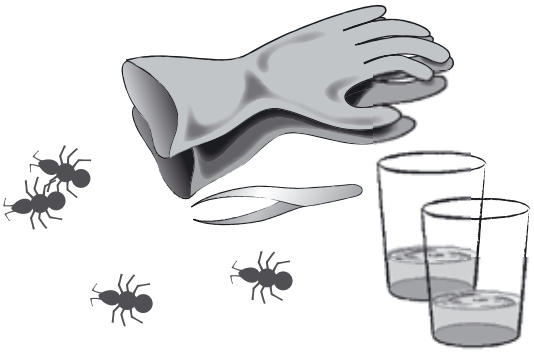
In this activity, students have the opportunity to investigate the fascinating and often-overlooked world of mini-beasts. They begin with a field exercise, collecting organisms that fall into simple pit traps placed in 'lawn' and 'leaf litter' areas. Back in the classroom, students explore biodiversity and taxonomy (classification and naming) by observing their 'catch' to identify similarities and differences. Students will draw bar graphs of their results and draw conclusions about their findings.

NB: This activity is better done in the warmer months of the year.

An Animal Care and Ethics licence is not required for collecting mini-beasts (invertebrates).

Prior to this activity, teachers should go to **www.amonline.net.au/pdf/pack.pdf** for a PDF titled *Australian Museum Backyard Biodiversity Study*. Invertebrate information sheets (pages 6–12) enable students to identify the organisms they 'catch'. If students are to do the **optional** Step 6 in this activity, pages 4 and 5 should also be provided to enable them to identify arthropods and group them in the Classes in which they belong — Insecta, Arachnida, Crustacea and Myriapoda.

Students work in small groups of two or three for this activity and later pool their data.



Student activity

1 Students select a grassed (lawn) area and a leaf litter area and dig their pit traps. They place a cup containing detergent water into each pit and arrange overhead shelters.

Notes

- *Each cup should be a quarter full of water plus contain one drop of detergent.*
- *The hole should be large enough to allow the rim of a plastic cup to sit flush with the ground.*
- *After the cup is placed in the hole, the sides should be carefully back-filled.*
- *The cup should be covered by placing four small pebbles or sticks around its rim to hold the piece of cardboard or firm plastic about 1 cm above its rim. Anchor the plastic or cardboard so that it will not blow off. This arrangement will allow things to only crawl into the cup, not fall in from above.*

Safety points

For this experiment students should choose an area that other students are not likely to walk over/through. The student who is doing the digging and back-filling may need to wear gloves.

---

2 Approximately twenty-four hours later, students collect their cups and begin identifying each type of organism they have collected. They also note the number of organisms of each type they have found at both sites.

Notes

- *Students should make sure each cup, when retrieved, is labelled, e.g. G for grassy, L for leaf litter.*
- *In the classroom, students should place the contents of one cup into a white saucer or on a white tile and use an artist's brush, forceps, hand lens, slide, cover slip, microscope and the supplied Invertebrate information sheets to identify each organism and to record on the 'Schoolyard biodiversity' table the number of each type they have found.*

Sample table

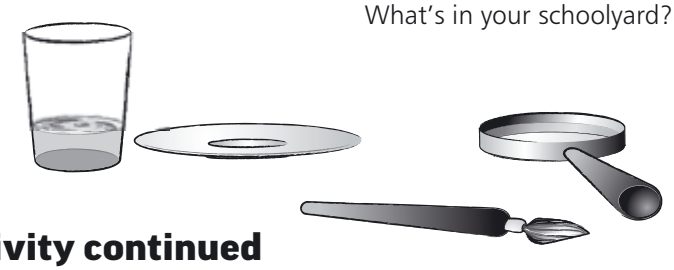
Schoolyard biodiversity				
Animal type	Found in grassy area		Found in leaf litter area	
	Tally	Total	Tally	Total
Amphipods				
Springtails				
Beetles				
Unidentified type 1 etc				

(A full table can be downloaded from **www.asta.edu.au**)

3 Students design and draw a bar graph of their results to show the numbers of each kind of organism found in the grassy area and the leaf litter area.

Notes

- *Students should place similar organisms found at both sites side by side to make comparisons easier.*



Materials required
(FOR EACH GROUP)

- two plastic drinking cups, each one quarter-filled with water plus one drop of detergent
- two pieces of cardboard or firm plastic large enough to extend beyond the top of the cup
- four small pebbles or sticks to rest the cardboard on
- small garden trowel
- gardening gloves (optional)
- small artist's brush
- forceps or tweezers
- white saucer or tile
- cavity slide
- cover slips
- hand lens
- microscope (optional)
- Invertebrate information sheets (see *Step 2*)
- Sample 'Schoolyard biodiversity' table on which students can record their findings (downloaded from **www.asta.edu.au**)

Student activity continued

4 **Students then examine their graphs to see what conclusions they can draw about the types and numbers of organisms found at each site and record their observations.**

Notes

Guide students with questions such as:

- *Did one site seem to have more different kinds of organisms? Which one?*
- *Did one site seem to have more organisms of a particular kind? Which one?*
- *Did one site seem to be better, overall, for collecting organisms? Which one? Suggest why this might be.*

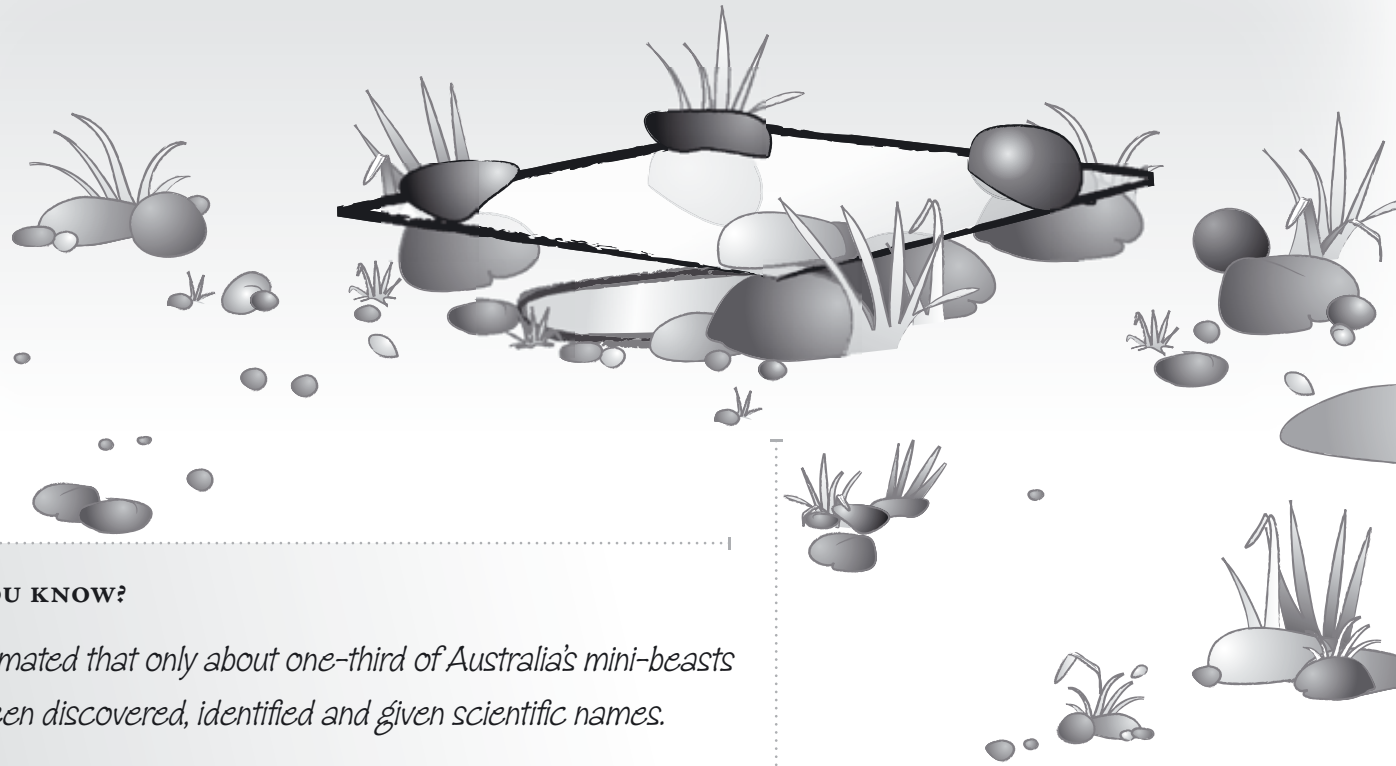
5 **Students compare their graphs with others in the class to look for similarities and differences. They record their observations.**

6 **(Optional) Students use 1b Classification pages 4 and 5 of Invertebrate information sheets to see if they can further identify the invertebrates they have collected into one of the following taxonomic Classes – Insects, Arachnids, Crustaceans and Myriapods. They record their deliberations.**

7 **Students conclude their activity by recording what they have found out about the biodiversity of organisms in the schoolyard and comment on the similarities and differences between the results obtained by the various groups.**

Acknowledgement

Adapted from the Australian Museum's Backyard Biodiversity Study.



DID YOU KNOW?

It is estimated that only about one-third of Australia's mini-beasts have been discovered, identified and given scientific names.

Collecting and preserving

During the five-year *Beagle* expedition, Darwin shipped back to England 1,529 species preserved in spirit and 3,907 labelled skins, bones and other dried specimens. Upon returning to England, Darwin arranged for his specimens to be sent to other naturalists who could classify them.

Today, just as in Darwin's time, the collection and preservation of plant specimens is important. It facilitates identification of species, recording of their geographical distribution and further study of the species. Collections of preserved plant specimens are stored in herbaria.

Purpose of activity

In this activity students will learn how to collect, preserve, display and label a plant specimen and what identifying details to record. Students' specimens will form a class herbarium. If students' specimens are kept long-term, the activity could be designed to show changes in plant patterns from year to year, or season to season, if students choose plants that are numerous or in flower. Over time, previous class herbaria could serve as useful reference points.

It is envisaged that students will collect their specimens from the school grounds.

Prior to this activity, teachers should outline safety instructions to students regarding equipment use and behaviour expectations. Teachers should also be aware of the possibility of allergic reactions e.g. from bee stings, plant sap.

NB: It takes 2–4 weeks to dry the specimens.

Student activity

1 Students learn the importance of collecting and preserving plant specimens and appreciate that Darwin amassed a large collection of specimens during his voyage.

Notes

- *Elicit from students their understandings as to why and how plant scientists (botanists) collect and preserve specimens. Use students' ideas to bring out points mentioned in the 'Purpose of activity' section and to prepare students for their own plant collection activity.*
- *Emphasise that students should not collect plants from National Parks or State Forests.*
- *Emphasise that students should not collect rare plants. (Weeds are good to collect, but care should be taken not to disperse them or their seeds.)*

2 Students discuss safe and sustainable plant collecting.

Notes

This discussion should clarify additional points such as:

- *Collect only part of the plant, in a way that causes minimal damage.*
- *If the plant is small and students wish to collect the whole plant, they should do so only if there are plenty of others nearby.*
- *Be wary of thorns, spines, sap and resident insects or other creatures.*
- *Wash your hands after collecting samples.*

3 Students learn how to collect a small plant sample in the field and how to handle and prepare it.

Notes

- *Elicit from students what kinds of samples would be useful to identify a flowering plant, fern or conifer e.g. small twig with leaves or leaf-like structures, flowers, seeds, loose bark. Roots are not necessary.*
- *Demonstrate how to cut a small sample from a plant so that the bark of the plant is not ripped. Put the specimen into a sealed plastic bag. (The sample should be typical of the plant.) Stress the need to collect good specimens.*
- *Tell students they need to collect a specimen that will fit onto a piece of A4 paper.*
- *Show the students how to record details such as the date and place of collection, (including street, suburb/nearest town), type of area where the plant was found, name of collector/s, name of plant (if known), size, shape, flower colour, bark characteristics if a tree.*

4 Students go into the playground and select their specimen. They place it in the plastic bag, seal it and record collection details in their notebook.

5 Back in the classroom, students preserve their specimens as per the *Specimen preparation* instructions (see box p11).

Notes

Work through the instructions step by step, asking the students to suggest a reason for each of the steps in the procedure:

Plant speicmen sheets: Carl Davies © CPBR

Materials required

(FOR EACH PAIR OF STUDENTS)

- plastic bag for field specimen
- rubber band or plastic twist tie
- scissors or secateurs
- sheet of A4 mounting paper (white cardboard, art paper or blotting paper)
- old tabloid newspaper
- sheet of paper towel a little larger than A4 size
- notebook and pencil
- wood glue or glue stick
- small piece of paper to make plant fixing strips
- paper towel to dry plant

(FOR EVERY 4–5 PAIRS OF STUDENTS)

- two sheets of firm cardboard (preferably corrugated) each larger than A4 size
- a heavy book

(FOR THE CLASS HERBARIUM BOOK)

- three-ring binder
- clear plastic protector sheets to fit binder (one for each specimen collected, plus one to hold a contents page)

(FOR THE TEACHER)

- a plant with which to demonstrate how a sample is taken
- one or more digital cameras for students to take photos of the plant they are sampling

References

Teacher's Plant Collection Guide, New Mexico State University, **http://ddl.nmsu.edu/kids/explore/pltcollguide.html**

Collecting and Preserving Plant Specimens, A Manual, Version 3. Queensland Herbarium, January 2007, **www.epa.qld.gov.au**
Under '*Quick Links*' click on '*Publications*' and then type in '*Collecting and preserving plant specimens*'.

Student activity continued

- *Drying the plant prevents mould.*
- *Glued strips of paper last longer than sticky tape.*
- *The paper towel is absorbent and prevents the plant sticking to the newspaper.*
- *Regular replacement of the newspaper allows all moisture to be removed from the plant.*
- *A carefully-dried specimen, if appropriately stored, can last hundreds of years.*
- *The heavy book acts as a press to flatten the specimen and help it to adhere to the mounting paper.*

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6 Students attempt to identify the common and/or scientific names of their specimens using their own knowledge, family and community knowledge, the Internet and school resource books. They add this information to the specimen page.

Notes

- *Any photos they have taken could be useful in assisting identification.*
- *It is not essential that identification occurs. This can be quite difficult.*

---

7 After students have observed, discussed (and suggested additions/changes to) each other's work, the specimens are placed into the class herbarium book and a contents page is compiled.

Notes

- *Regular freezing of the herbarium book in a sealed plastic bag will help prevent psocids (book lice) from attacking the specimens.*

Specimen preparation

1. Dry the specimen if necessary.
2. Display the specimen on an A4 sheet of paper (preferably absorbent). (All the plant parts should be spread out.)
3. Use several tiny glued strips of paper to attach the plant to the A4 sheet.
4. Add a neat, pencilled copy of all data collection details to the bottom, right-hand side of the page.
5. Place a double sheet of newspaper underneath the specimen page.
6. Put a sheet of paper towel on top of the specimen.
7. Place two doubled sheets of newspaper on top of the paper towel.
8. Carefully transfer the papers containing the specimens to the flat storage area that has the sheet of cardboard.
   (Up to five pairs of students can store their specimens on top of each other, separated by sheets of cardboard.)
9. Place the second sheet of cardboard on top of the last pair's specimen.
10. Place a heavy book on top.
11. Daily for a week and every two or three days thereafter, carefully remove the specimens and replace the newspaper.
12. Return each pair's work to the 'plant press'.
13. Continue for three or four weeks until all the specimens are completely dry.

Ornithorhynchus anatinus (Platypus) by John Gould. Source: www.wikipedia.org

Did you know?

An Aboriginal dreaming story describes the platypus as the offspring of a duck and an amorous water rat.

A most extraordinary animal

'In the dusk of the evening I took a stroll along a chain of ponds, which in this dry country represent the course of a river, & had the good fortune to see several of the famous Platypus or Ornithorhyncus paradoxicus. *They were diving & playing about the surface of the water; but showed very little of their bodies so that they might easily have been mistaken for many water rats.'*

Charles Darwin, 19 Jan 1836, *Beagle* Notes

Since its discovery by colonists in the late nineteenth century, the platypus has been a focus of fascination to scientists. The first specimens to arrive in London were thought to be a hoax — parts of different animals carefully sewn together. In 1800, a German anatomist named the 'duck-bill' *Ornithorhynchus paradoxus*. At the same time, an English naturalist named it *Platypus anatinus* (fr. Greek *platypous* — 'flat-footed' and *anatinus* — 'duck-like'). The two names were used at the same time, but the name 'platypus' had been used previously for a genus of beetles! A combination of the two names, *Ornithorhynchus anatinus*, was placed on the zoological register but 'platypus' has remained the popular name.

Purpose of activity

Students take on the role of a taxonomist as they consider the **anatomical*** (structural) and **physiological*** (functional) features of the platypus (*Ornithorhynchus anatinus*) in order to decide to which taxonomic group (Class) it belongs. The remarkable nature of the platypus is highlighted as students contemplate whether those features are typically seen in mammals, reptiles or birds. As well, recent DNA evidence is considered. Students conclude by deliberating on the evolutionary origins of the platypus.

Students will learn that some features of the platypus support Darwin's idea that intermediate organisms exist/have existed that show features typical of more than one group of animals.

Did You Know?

Many thousands of platypus were killed, pickled in barrels of brandy and sent to England for scientists who were arguing about the creature's classification.

A Moyal (2001)

Materials required

- Reference materials (Australian wildlife books, platypus pictures or posters, a specimen from your regional Museum's schools loans service, web access)

To get you started:

- **www.wildwatch.com.au/platypus.htm**
- **www.platypus.asn.au**

Further information

For information about the sequencing of the platypus genome go to **www.nsf.gov** and type 'platypus' in the search box. The ABC's Catalyst program on 28 August featured a segment *Decoding the Platypus*. This can be downloaded from the web.

Some terms

Anatomical (structural) features – are the body parts of which an organism, plant or animal is made. Anatomical features of an animal include structures such as the digestive, reproductive, nervous, circulatory, immune, muscular and skeletal systems and the parts of which those systems are made. Anatomical features of a flowering plant include structures such as leaves, roots, stems, flowers and transport systems and the parts of which those systems are made.

Physiological (functional) features – are the jobs each body part does, e.g. mammary glands produce milk for the young and the job of a heart is to pump blood around the body. In flowering plants the job of the leaf is to take in sun to provide energy to make the organic chemicals the plant needs to grow and develop.

Platypus research

On 8 May 2008, *Nature* magazine reported that teams of scientists from around the world including Australian scientists had analysed platypus DNA to map its genetic make-up. They found the platypus has a mix of genes that cross different classifications of animals with more bird and reptile-like genes than mammalian. They reported:

1 the genes that determine sex are similar to those of a bird, not a mammal
2 the genes for egg-laying, venom production and vision link them to reptiles
3 their immune systems are similar to those of other mammals but, like the echidna, the platypus produces some unique immune effects which may protect its young, and
4 the genes for milk production are largely similar to those of mammals.

Student activity

1 **In groups, students compile a comprehensive list of platypus features. Students might need prompting. e.g. How do they reproduce? How do they feed their young?**

Notes

- *Students will come up with features such as mammary glands (anatomical), produces milk (physiological), warm-blooded (physiological), fur (anatomical), lays eggs, backbone, four-chambered heart, circulatory system, respiratory system, digestive system, internal bony skeleton, poison gland on hind leg of male, soft duck-like bill, webbed feet, claws.*

Note: Students do not need to state whether a feature is anatomical or physiological.

2 **Using the table provided students list each feature as typical of a reptile, bird or mammal, of all three, or as uncertain.**

Notes

- *Provide each group with the following table.*

'The Platypus': a most extraordinary animal

The feature is typically present in (Yes/No)			
Feature	Reptiles	Birds	Mammals
e.g. fur			Yes
e.g. lays eggs	Yes	Yes	
e.g. produces milk			Yes

(A full table can be downloaded from **www.asta.edu.au**)

3 **Students look at their table and decide in which group of vertebrate (backboned) animals, Reptile, Bird or Mammal (taxonomists call each of these groups a *Class*), the platypus best fits. They should state any problems they encountered in allocating the platypus to this group.**

4 **Present students with the latest platypus research (see Platypus research) that shows how modern techniques inform how evolution has occurred. Students add information from this activity to their table.**

5 **Students suggest the evolutionary relationships of the platypus.**

Notes

- *A branching tree diagram may be useful.*

  The reasoning that students employ to decide the relationships is more important than scientific accuracy.

6 **Students conclude the activity by recording:**

a. why the platypus is 'a most extraordinary animal'
b. the ways in which the evolutionary relationships of an organism are determined, and
c. their ideas about whether modern research such as DNA mapping supports or refutes Darwin's theory of evolution.

Variation and survival

Purpose of activity

In this activity, students are introduced to Darwin's theory of evolution. They use the tomato (*Solanum lycopersicum*) to observe the variations between seeds. They select the smallest and largest seeds for germination and use a fair test to see if seed size affects plant survival.

Materials required (FOR EACH GROUP OF STUDENTS)

- 1–2 rotting tomatoes* of the same variety e.g. Roma
- paper towel
- forceps or toothpicks
- white saucer or tile
- water
- two 13 cm diameter plant pots and saucers
- seedling mix
- trowel
- a sample table for this activity downloaded from **www.asta.edu.au**

* Seeds must ferment in rotting fruit to promote germination. For fresh tomatoes, students should scrape out the seed mixture and place it into a glass jar. If necessary, add a little water so the seeds just float. Cover jar with a paper towel and leave in a warm place for 4–5 days.

Extension ideas

1 Students could repeat the same experiment testing different variables such as shape and colour.

2 Students could undertake internet research to find out about:
- the different species of wild tomatoes in the northern Andes and on the Galapagos Islands and use Darwin's theory to suggest how these species came about, or
- the various edible varieties of tomato. Use Darwin's theory to suggest how humans have assisted the development of these varieties from wild types.

Student activity

1 Students are introduced to Darwin's theory.

Notes

Guide students to give examples that illustrate the points below:

- *Differences in individuals of the same kind of species — e.g. humans, cats, tomatoes, cattle, sheep*
- *Cases where there are more offspring than can possibly survive to maturity (garden weeds provide useful examples)*
- *Kinds of offspring that have the poorest chance of survival and the greatest e.g. Which cobbler's peg seedlings in a garden patch would have the best chance for surviving long enough to produce seeds?*
- *Changes in a population over many generations, due to the above factors e.g. Which features would tend to become more common? Which would tend to become more rare?*

---

2 Students investigate variations in the tomato seeds and whether a particular feature might increase a seedling's chance of survival.

a Students use toothpicks or forceps and a white surface to separate out the seeds. They should record the differences they observe.

b Students sort out the five smallest and five largest seeds from one fruit and place them into separately labelled pots containing thoroughly moistened potting mix. The seeds should be spaced out and about 5mm underneath the surface.

c Students should place the pots in a well- illuminated area and keep them moist throughout the experiment.

d Students should record their observations of the plants as they grow.

Notes

a Guide students to look for differences in, for example, pigmentation, shape and size of the seeds. In recording differences, simple, labelled pencil drawings would be appropriate.

b Students could be asked to predict what results they might expect and to give reasons for their predictions. NB: A sample size of five is very unreliable. A class with eight groups, each working with one tomato, should have data from 40 of the smallest seeds and 40 of the largest seeds to compare.

c In warm weather the seeds should germinate in 6–14 days. The experiment could be terminated after this time, when the plants need transplanting, or, if a suitable school garden exists, it could continue until fruiting (about 12–14 weeks).

d Provide each group with the following table to record their observations of the plants.

Sample table

My group's tomato experiment

	Observations	
Day and date of observation	Smallest seeds	Largest seeds
M T W T F S S: / /20		
M T W T F S S: / /20		
M T W T F S S: / /20		

(A full table can be downloaded from **www.asta.edu.au**)

Student activity continued

3 At the end of the experiment, student groups pool their data into a class table.

- **Students construct bar graphs for the class data.**
- **Students look for similarities and differences between the two groups of seedlings.**
- **Students record their conclusions.**

Notes

- *Use selective questions to guide students to make comparisons between the two groups of seeds. e.g. For the smaller seeds that were planted, what was the total number of seeds that germinated? For the larger seeds that were planted, what was the total number of seeds that germinated? Are there any differences between the two? Are these differences significant enough to be important?*
- *Guide students toward suggesting other differences and similarities in their data, e.g. height, number and size of leaves, overall size of the plants, tallest plant, healthiest-looking plants.*
- *Ask students what conclusions they can make about how seed size affects the growth and survival of tomato seedlings. Ask them how reliable they think their findings are and how they could make them more reliable.*

4 Students refer back to points in Darwin's theory to see how their findings might support any of the points.

Notes

- *This is an opportunity to draw out that an enormous amount of experimentation must be undertaken before a theory is accepted by science.*
- *Tell the students the purpose of this experiment was to enable them to see differences in a population, how particular features might affect the chance of survival and how changes can occur in a population over time.*

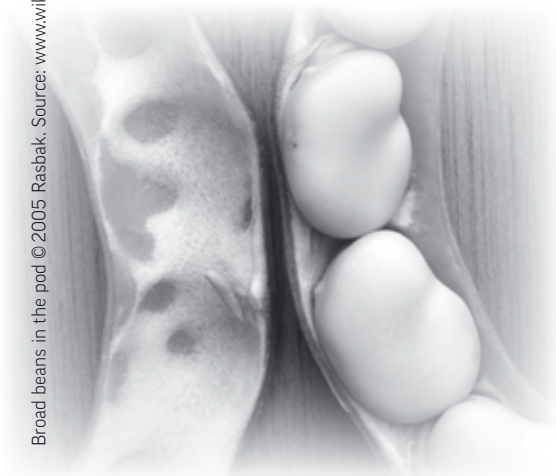
Did you know?

Tomatoes originated from the South American continent. Darwin was the first to collect species of tomatoes found only on the Galapagos Islands.

How on earth did they get there?

'I have begun making some few experiments on the effects of immersion in sea-water on the germinating powers of seeds, in the hope of being able to throw a very little light on the distribution of plants, more especially in regard to the same species being found in many cases in far outlying islands and on the mainland.'

Charles Darwin, *Gardeners' Chronicle and Agricultural Gazette* no. 21 (26 May 1855), p356.



Broad beans in the pod © 2005 Rasbak. Source: www.wikipedia.org

With his test, Darwin investigated the effect of salt water immersion on about 85g–110g of each of 87 kinds of seeds and found that 64 kinds germinated after 28 days of immersion and a few survived an immersion of 137 days. Darwin called his experiment ***Does salt water kill seeds?***

He did not change the water at all.

In commenting on his experiment he noted:

- for convenience, most of the seeds tested were small
- most seed types tested sank and could not be transported
- water itself, rather than the salt in the water, might kill the seeds
- seeds would most likely end up in the sea as part of a whole or nearly whole plant or its fruit
- these plant parts were likely to have dried at land's edge before being swept into the sea, and
- dried plant parts would be more buoyant than the seeds alone.

(These points might be useful to refer to during this activity.)

Purpose of activity

Students perform an activity similar to Darwin's ***Does salt water kill seeds?*** experiment. They use cress (*Lepidium sativum*), radish (*Raphanus sativus*) and broad bean (*Vicia faba*) seeds that have been immersed in salt water for various periods of time to see whether the seeds could survive time in the sea and germinate in a new place.

This experiment takes 6–9 weeks.

Materials required

(for each class)

- 1 packet each of cress and radish seeds
- 6 packets of broad bean seeds

(for each group of students)

- 10 seeds of each type of plant for immersion and later 10 of each that have not been immersed
- 3 jars filled with a rock salt water solution of 35g/l (this is the concentration of sea water)
- 6 plant pots
- good quality potting mix
- labels

Student activity

1 **Introduce students to the idea that Darwin was constantly asking questions such as 'how' or 'why' something occurred. Tell them one question he asked was 'How did plants become distributed over the Earth's surface?'**

Notes

- *Elicit students' ideas for the ways in which plants might naturally be transported across a body of salt water, e.g. birds, wind, currents and tides.*
- *For each suggestion ask students what kinds of features might assist a plant seed to be transported in that way. Students might be able to give examples of how some seeds are transported, e.g. how the fruit of a coconut assists its transport across water.*

2 **Tell students one experiment Darwin did was to test how plant seeds would survive immersion in seawater. Students will replicate this experiment using fewer types of seeds — cress, radish and broad bean seeds.**

Notes

- *After students have seen the seeds ask them to predict which type might best survive the salt water and to give a reason for their prediction.*
- *Ask them how they will set up a control.*

3 **Students fill three identical jars with salt water. They label jar 1 Cress, jar 2 Radish and jar 3 Broad Beans. They add ten seeds of the respective type to the labelled container. Each group leaves their set-up for an agreed number of days. Students use a table to record their observations.**

Notes

- *Encourage students to use the scientific names of the plants (see* Purpose of activity **p15** *for this information).*
- *As this experiment can get very smelly, a porous cover could be placed over each jar.*
- *It is suggested that each group performs its experiment for a different length of time, e.g. for eight groups — one day, one week, two weeks, three weeks, four weeks, five weeks, six weeks or seven weeks.*

Sample table

Table 1 Immersion of Seeds in Salt Water

Day of observation	Observation		
	Cress	Radish	Broad Beans
0			
1			
2			
7 etc			

(A full table can be downloaded from **www.asta.edu.au**)

4 **After the agreed length of time has passed, students remove the seeds and allow them to dry for one week.**

Notes

- *Ask students why the seeds are dried before being planted. If necessary, refer students back to the controlled experiment or fair testing method — change one thing and take measurements while keeping everything else the same.*

5 **Students then place each kind of seed into a labelled plant pot containing potting mix, according to each seed packet's instructions. At the same time a control set of seeds, which have not been soaked, should be planted.**

Notes

- *Ask the students the purpose of planting non-immersed seeds.*
- *Students need to keep the pots moist and in good light.*
- *Refer to the seed packets for an indication of when to expect germination to occur.*

6 **Students use the data table below to record when germination occurs, how many seeds germinate and if there seem to be any differences in the health of the plants.**

Notes

Sample table

Table 2 Effects of Salt Water Immersion on Seed Germination

	Observations					
	Cress		Radish		Broad Beans	
	Immersed x days	Not immersed	Immersed x days	Not immersed	Immersed x days	Not immersed
No. seeds used	10	10	10	10	10	10
	Number Germinating					
Day						
Total germinating						
Healthiness of plants						

(A full table can be downloaded from **www.asta.edu.au**)

Raphanus sativus subsp. *sativus* © 2007 Radijs voos. Source: www.wikipedia.org

Student activity continued

7 **Students transfer their data into the class data table. Discuss the definition of 'healthiness' and some possible indicators of this.**

Notes

Sample table

Table 3 Class Data for Effects of Salt Water Immersion on Seed Germination and Healthiness of Plants

	Observations					
	Cress		Radish		Broad Beans	
	Im-mersed	Not immersed	Im-mersed	Not immersed	Im-mersed	Not immersed
No. seeds used	10	10	10	10	10	10
Total Number Germinating						
1 day						
7 days						
14 days etc						
Healthiness of Plants						
1 day						
7 days						
14 days etc						

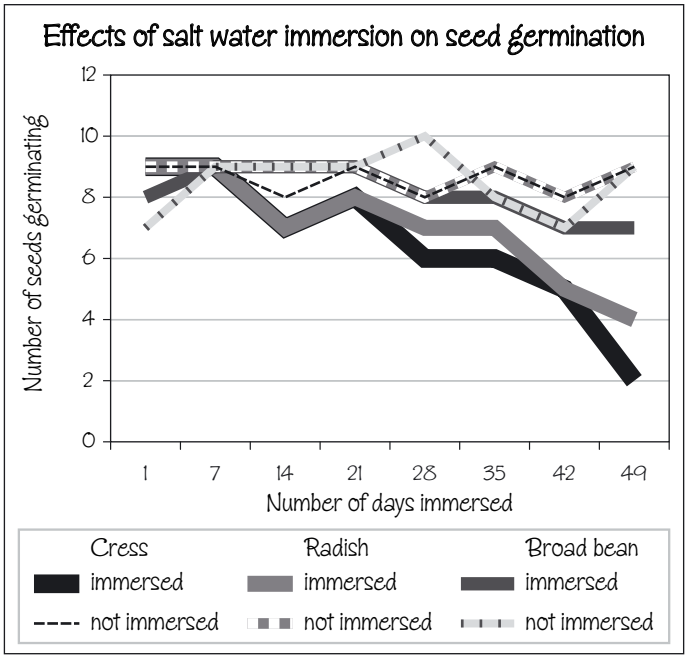
(A full table can be downloaded from **www.asta.edu.au**)

8 **Students use the data from Table 3 to construct a line graph.**

Notes

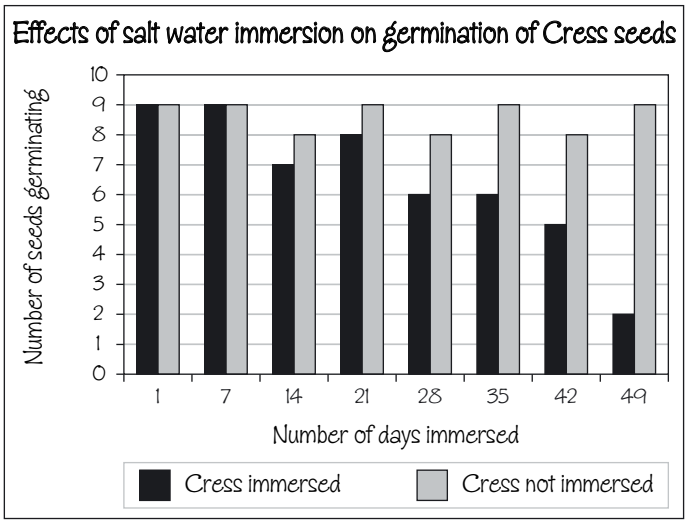
- *Make sure students: use the correct axes, use the same scale along an axis, label their axes, identify each line graph and give their graph a title.*

Sample graph (fictitious)



- *Students who have difficulty in constructing line graphs could construct separate bar graphs for each plant type.*

Sample bar graph (fictitious)



9 **Students use their graphs, along with their observations of the healthiness of the germinating plants, to draw conclusions about the effects of the length of immersion in salt water on the germination and healthiness of seedlings for the three seed types. They record their conclusions.**

Notes

- *For each type of seed, use selective questions to guide students to look for any differences in the number of seeds germinating and decide whether any differences seem significant.*

10 **Students use all their data to draw and record conclusions about which seed type/s is/are more likely to survive being transported across the sea.**

Notes

- *Guide students to consider the effects of submerging seeds on the germination and the healthiness of the seedlings.*

11 **Students discuss whether their data supports or refutes their prediction/s and record their deliberations.**

12 **Students consider ways in which the experiment could be improved and record their ideas.**

Notes

- *Use selective questions to guide students to consider factors such as: the number of seeds used; the number of types of seeds used; the duration of the experiment; seed size; using the same salt water throughout the experiment; and the effect of water alone.*

Summing up

Purpose of activity

This activity provides students with an opportunity to revisit and consolidate their understandings about Charles Darwin's contribution to science (his theory and methods of gathering evidence) and his visit to Australia.

It uses the **think-pair-share** technique. Students begin work in pairs to compile their answer to each question, then two pairs share and combine their answers and then four pairs share and consolidate their answers. Finally, each group shares its answers with the class and a class list is created.

Teachers should use the class compilation time to 'prompt' or 'add' additional information as appropriate.

Note: Classes that undertook the activity *Let's begin* (p6) should revisit the class posters and for each point on them indicate whether it has been confirmed or not. Students could access the Internet to see whether any unconfirmed points can be substantiated.

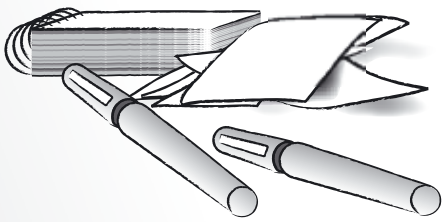
Materials required

(FOR EACH GROUP OF FOUR STUDENTS)

- students' notebooks
- pens
- A4 paper

(FOR THE CLASS)

- any class posters from previous activities
- butchers paper
- thick felt-tipped pens



Student activity

1 **Students work in pairs to peruse the records they have for this unit of work and record the following in their notebooks:**

- **What is Darwin's most important contribution to science?**
- **In what ways are their investigations similar to those carried out by Darwin?**
- **What is the Australian link to Darwin's important contribution?**

Notes

- What's in your schoolyard? (p8) *and* Collecting and preserving (p10) *employ the skills of collecting and identifying specimens for further study, just as Darwin did during his voyage on the* Beagle.
- Variation and survival (p14) *and* How on earth did they get there? (p15) *use similar methods of experimental investigation to those Darwin used. The latter experiment is a scaled-down replica of one performed by Darwin.*
- *Darwin's most important contribution to science is his theory of natural selection. See the* Background information (p4) *section for a brief outline of the theory.*
- Change and evolution **(this bonus activity is available on the ASTA website www.asta.edu.au)** *provides examples of how Darwin's theory can be applied to natural systems today.*
- *Darwin's five-year voyage on the* Beagle, *including a visit to Australia, enabled him to collect the specimens he used as evidence for his theory. See the* Background information (p4) *section and* Darwin's large island (p7) *for more information.*
- *Students who did the* Let's begin (p6) *activity should be asked if they wish to change anything they recorded during that activity, and, if so, why. This will give the teacher an opportunity to see if student misconceptions have been altered during the course of the unit.*

2 **Students form groups of four by two pairs assembling. They share and discuss their records for each question and collate a list for the group.**

3 **Two groups of four students then come together to share and discuss their records and collate a list for the new group.**

4 **The groups of eight students share their lists with the whole class and a class list is compiled.**

5 **Students conclude this activity by collaborating to create a shared computer document. They are each given a copy of the final document to place in their notebook.**

DID YOU KNOW?

Charles Darwin corresponded with almost 2,000 people around the world during his lifetime.

Party time!

Purpose of activity

In this activity, students hold a 200th birthday party for Charles Darwin. They display their activities and class posters around the room and each prepare a short (one-paragraph) birthday toast to Darwin.

This is an opportunity for students to be creative e.g. make party decorations or compile music and sounds, with Charles Darwin, his experiments and his contributions to science as the theme.

Preparation is needed for any good party. Students should prepare for this activity by negotiating which students' work will be displayed and planning and preparing appropriate decorations, food and drinks. Invitations should be created and sent to special guests. By prior arrangement, students from another class, or selected staff members, could be invited to the party.

Materials required (FOR THE CLASS)

- students' work
- class posters
- themed party decorations
- party food and drinks (take allergies into account, so food is safe for all students)
- small pieces of paper

Student activity

1 **Students decide which food, drinks and party decorations they will supply, and what invitations, if any, need to be sent, and prepare individual toasts to Darwin. They also decide on the room layout.**

NOTES

- *Some suggested party decorations are: plant and animal mobiles, hats and masks.*
- *Discuss the points that are included in a toast to a person and hold a brief discussion on things students know about Darwin that are worthy of a toast. Tell students that each one of them should prepare a brief toast to be proposed on party day.*
- *Students should review their work from this unit, including class posters and maps, to provide inspiration for the toast they will be making.*

2 **On party day, each class member writes his or her name on a piece of paper that is put into a container for a draw. The student whose name is picked proposes his or her toast.**

NOTES

- *Continue with the draw for as long as interest remains.*

3 **The teacher concludes the party by proposing the final toast.**

NOTES

- *The teacher's toast should include important aspects of Darwin's life and work to which students have not previously referred.*

DID YOU KNOW?

Charles Darwin was born on 12 February 1809.

The exhibition

Purpose of activity

In this activity, students plan and design an exhibition that showcases Charles Darwin and his contribution to science. They select objects from the work they have undertaken in this unit to use as exhibits, design labels for them and create promotional material to encourage visitors. The exhibition could be displayed in the school library or foyer, or in the local council library.

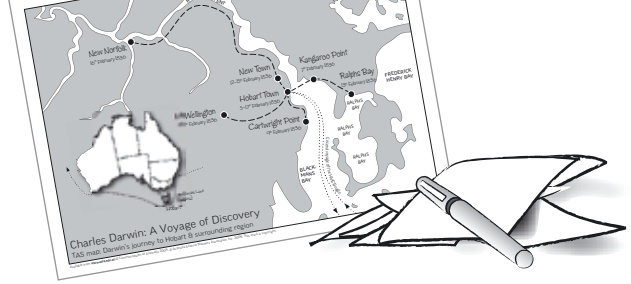
Student activity

1 **Students are informed that because of their research about Charles Darwin and public interest in the topic they have been allocated space at (*state where*) for an exhibition entitled *Charles Darwin and his Contribution to Science*. If necessary, they are then introduced to the concept of an exhibition.**

NOTES

- *Inform students of the dimensions of the display cabinets, poster boards, space available etc.*
- *If possible, students should visit the display area before they begin designing and creating the exhibition.*
- *Via discussion about exhibitions or promotional material students have seen, highlight the main features of an exhibition: it displays objects relating to a theme; there are explanatory labels for the objects; the exhibition is designed to be interesting; any text should be succinct, informative and readable; and the layout is mindful of the way a viewer approaches the exhibition.*

The exhibition continued

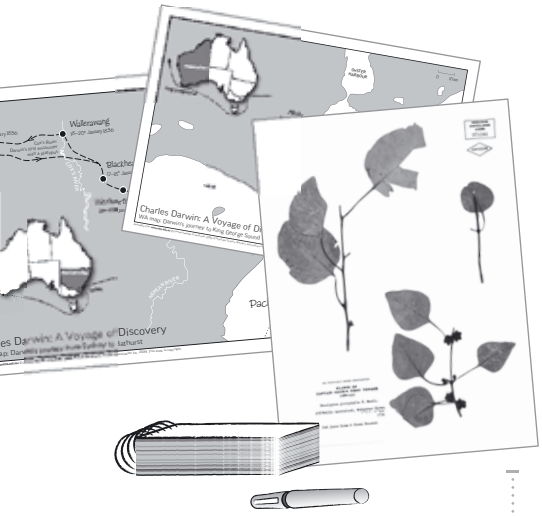


The teacher will need to:

- obtain prior permission to house the students' exhibition in the selected place
- ascertain the details of the space where the exhibition will be housed and the dates on which it can be displayed, and
- check if the school requires parental/carer permission before students' work is displayed at an off-school site.

Materials required (FOR THE CLASS)

- students' work from this unit, including posters and illustrated maps
- pens and good quality paper for creating publicity materials and writing display labels, or, access to computers and printers.



DID YOU KNOW?

Charles Darwin's family home and gardens, Down House, Kent, UK, house exhibitions of his life and work.

Student activity

2 **Via a class discussion about aspects of the Charles Darwin unit students have just completed, students compile a list of things they found interesting about Darwin and his work. They then use this list to highlight which points the intended audience might find interesting. Any posters, maps, objects or student records that relate to these are noted.**

NOTES

- *Darwin's theory of natural selection, his visit to Australia on the* Beagle*, the many specimens he collected, the experiments he performed and the relevance of his theory today could all be considered potential material.*

3 **Students work in groups of four to eight to decide how to illustrate the points in the class list, using items from this unit of work, and then report their ideas to the class. Class members then finalise the content of the exhibition and select students' work for inclusion.**

NOTES

- *The illustrated maps from* Darwin's large island *could provide interesting graphics, and a sample of student work for each activity, with an appropriate label, would illustrate particular points.*

4 **Students work in groups of three to four to compose draft materials for the exhibition. Each group is given a particular writing/labelling task.**

NOTES

- *These tasks include: the main title for the exhibit; labels for particular exhibits; promotional material such as a brief article in the school newsletter; promotional A4 posters for display around the school; a short notice for the school assembly; and flyers or brochures.*

5 **Students display drafts around the room so other class members can evaluate them. After feedback, students prepare their final exhibits.**

NOTES

- *Some statements will be too wordy while others will be too small to read. A uniform lettering style and size might be of benefit.*
- *General guidelines for an engaging exhibit include:*
  - *Minimise the amount of text and maximise the use of images and objects.*
  - *Where possible, utilise more than one sense — use sound sources, manipulatives (e.g. 'lift the flap to see the answer'), tactile materials and 'feely boxes'.*
  - *Limit the text on descriptive signs to thirty words. (This word limit applies to labels and signage, not to the work students did during the unit.)*
  - *Use minimum 30-point font size.*

6 **Students plan the release of the promotional material and do a 'mock-up' of the final exhibition so final adjustments can be made.**

7 **Students set up the exhibition by the due date.**

8 **Students conclude the activity by evaluating the effectiveness of the exhibition.**

NOTES

- *Ask students to come up with some ideas to assess and rate 'effectiveness'.*

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ABRS

Australian Government

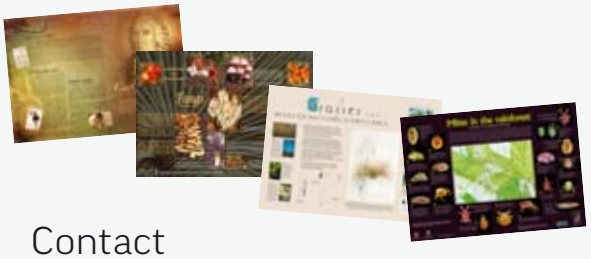
Department of the Environment, Water, Heritage and the Arts

Australian Biological Resources Study (ABRS)

Australia's plants and animals are unique and among the most diverse of any country in the world. However, only about 25 per cent of Australian plants and animals have been named and almost half the continent has never been visited by biological scientists. There is much still to be discovered…

The Australian Biological Resources Study (ABRS) is the Australian Government focal point for species discovery — the discovery, description and naming of new species. ABRS funds research and early career scholarships through the National Taxonomy Research Grant Program. It also produces national lists of correct scientific plant and animal names that are used by scientists, conservation and biosecurity agencies and industry.

ABRS has a range of posters on Australia's plants and animals available for classroom use:



Contact

abrs@environment.gov.au

Australian Biological Resources Study
GPO Box 787
Canberra ACT 2601
Australia

www.environment.gov.au/biodiversity/abrs/

1809

12 February Charles Darwin
born Shropshire England

200th Birthday

1831–1936

The voyage of the *HMS Beagle*

1859

On the Origin of Species
is published

150th Anniversary

Australian Government
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ABRS

Australian Science Teachers Association