Water: our most precious resource
<table>
<thead>
<tr>
<th>INVESTIGATION 1</th>
<th>INVESTIGATION 9</th>
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<tr>
<td>Tjilbruke Springs</td>
<td>Groundwater pollution</td>
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<tr>
<th>INVESTIGATION 2</th>
<th>INVESTIGATION 10</th>
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<tr>
<td>Density of water and ice</td>
<td>Estimating storm run-off</td>
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<tr>
<th>INVESTIGATION 3</th>
<th>INVESTIGATION 11</th>
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<tbody>
<tr>
<td>Seawater and fresh water</td>
<td>ASR poster design</td>
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<th>INVESTIGATION 4</th>
<th>INVESTIGATION 12</th>
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<tr>
<td>Floating icebergs</td>
<td>ASR model building</td>
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<tr>
<th>INVESTIGATION 5</th>
<th>INVESTIGATION 13</th>
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<tr>
<td>The Water Cycle</td>
<td>Water re-cycling poster</td>
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<th>INVESTIGATION 6</th>
<th>INVESTIGATION 14</th>
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<tbody>
<tr>
<td>Melting ice at both ends</td>
<td>Measuring shower water</td>
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<th>INVESTIGATION 7</th>
<th>INVESTIGATION 15</th>
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<tbody>
<tr>
<td>Designing a dam</td>
<td>Water divining evaluation</td>
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<th>INVESTIGATION 8</th>
<th>INVESTIGATION 16</th>
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<tbody>
<tr>
<td>Porosity and Permeability</td>
<td>Down-hole geophysics</td>
</tr>
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Kaurna Heritage

Tjilbruke Springs
Learn about Kaurna heritage

INVESTIGATION 1:

Visit the **Tjilbruke Springs**, listen to the story and then design a poster or short video.

Communicate ideas, findings and representations using digital technologies as appropriate

Cross-curriculum priorities

*Aboriginal and Torres Strait Islander histories and cultures will allow all young Australians the opportunity to gain a deeper understanding and appreciation of Aboriginal and Torres Strait Islander histories and cultures, their significance for Australia and the impact these have had, and continue to have, on our world.*
What is water?
$H_2O$
Why does ice float?
INVESTIGATION 2:

Design and carry out an experiment to:

measure the density of cold water and the density of ice and find the answer.

Collaboratively and individually plan and conduct
HINT:

Density = Mass / Volume

You will need to accurately measure both the mass and volume of a piece of ice, divide one measure by the other, and then repeat for a sample of water.
Volume of a cube

Volume of a Cube

Volume = L x W x h

Like a rectangular solid, multiply the length, times the width times the height.
Volume of any solid
Volume of any solid

Overflow Can
Volume of any solid

measuring cylinder
Using a measuring cylinder
INVESTIGATION 3:

Design and carry out an experiment to:

compare the densities of seawater and freshwater

Collaboratively and individually plan and conduct
INVESTIGATION 4:

Design and carry out an experiment to:

find out if an iceberg of sea-ice floats in seawater any higher or lower than an iceberg of freshwater ice?

Collaboratively and individually plan and conduct
3. Seawater & fresh water
4. Floating Icebergs
7. Designing a dam
11. ASR Poster
12. ASR model building
10. Estimating storm flow
16. Downhole gas
13. Water recycling
14. Measuring
15. Water quality
How much water is there on planet Earth?
diameter = 1426 km
What is the water cycle?
INVESTIGATION 5:

Research all of the processes involved in the *water cycle* and design a poster to show how it works.

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.
Work sample 2: Poster – Water cycle

Students analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems.

They communicate their ideas, methods and findings using scientific language and appropriate representations.
Work sample 2: Poster – Water cycle

Annotations

- Uses scientific terminology (freezes, melts, vapour, cools, precipitation) to describe the water cycle and changes of state involved.

- Shows movement of water using arrows.

- Indicates role played by ice reservoirs in the water cycle.

- Indicates some water catchments on land.

- Describes how sustainable use of water relates to the water cycle.

Annotation (Overview)

In this work sample the student communicates ideas and findings using scientific language and appropriate representations.
Where is most of the water?
Where did all the water come from?
Why are glaciers melting?

- [http://www.windows2universe.org/earth/changing_planet/melting_glaciers_intro.htm](http://www.windows2universe.org/earth/changing_planet/melting_glaciers_intro.htm)
Will sea level rise if the ice melts?
Will sea level rise if the ice melts?

INVESTIGATION 6:

Design and carry out a laboratory experiment to find out if there are the same (or different) effects of melting sea-ice, (e.g. in the Arctic), and melting ice-sheets, (e.g. in the Antarctic or Greenland).

Collaboratively and individually plan and conduct

Science and technology contribute to finding solutions to a range of contemporary issues
Where did the Earth’s water come from?

Scientific knowledge changes as new evidence becomes available

Some scientific discoveries have significantly changed people’s understanding of the world.
Science knowledge can develop through collaboration and connecting ideas across the disciplines of science.
Distribution of Earth's Water

- Earth's water: 97%
  - Saline (oceans): 97%
- Freshwater: 3%
  - Groundwater: 30.1%
  - Icecaps and Glaciers: 68.7%
  - Surface water: 0.3%
- Fresh surface water (liquid): 87%
- Swamps: 11%
- Rivers: 2%
Where does this water come from?
What’s involved in designing a dam?

INVESTIGATION 7:

Visit the Kangaroo Creek dam.

Sketch the dam’s structure and compare it with an “Arch Dam”.

Suggest reasons for the choice of design.

What kinds of scientists or engineers would have been involved?

Describe ethical issues that might arise when considering building a dam.

Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical consideration.
What sort of ethical issues?
What sort of ethical issues?
What sort of ethical issues?
Where does this water come from?
IN MEMORY OF
WILLIAM PACKER
BORN 22. 8. 1863 DOYNTON, ENGLAND
DIED 19. 7. 1914 PAYNEHAM, SOUTH AUSTRALIA
HIS WIFE HARRIET (nee HUTCHINSON)
AND THEIR CHILDREN - JOHN, MATTHEW,
MARTHA, ELLEN, WILLIAM ALFRED, THOMAS,
JOSEPH, FRANK, FREDERICK AND EDWIN
AND
TO COMMENDATE THEIR CONTRIBUTION,
WHICH BEGAN IN 1896, TO THE SOUTH AUSTRALIAN
CELERY INDUSTRY AND MARKET GARDENING IN
THE ATHELSTONE AND PARADISE AREAS.
THE PACKER FAMILY WAS NOTED FOR THE
QUALITY CELERY GROWN FOR LOCAL AND
INTERSTATE MARKETS. THE LAST CELERY GROWN
BY THE FAMILY WAS ON THIS SITE IN 1976
BY DESCENDANTS OF MATTHEW.
ERECTED BY THEIR DESCENDANTS 1995.
THE GRAY FAMILY

FIRST ACQUIRED LAND IN THE CAMPBELLTOWN AREA IN FEBRUARY 1876 WHEN SAMUEL GRAY PURCHASED A SIX ACRE BLOCK, AT THIS SITE, FOR ONE HUNDRED AND FIFTY POUNDS.

HIS SON ISAAC, AND SUBSEQUENTLY ISAAC’S SONS SIDNEY AND GEORGE, ALSO OWNED MARKET GARDENING PROPERTY IN CAMPBELLTOWN.

SIDNEY’S SON ARNOLD CONTINUED THE MARKET GARDENING TRADITION UNTIL 1987, A PERIOD OF MORE THAN ONE HUNDRED YEARS.
Where is this water coming from?
What is an aquifer?
Why is there water in some rocks but not others?
Sediments and Sedimentary Rocks
Porosity is defined by the ratio:

$$\phi = \frac{V_V}{V_T}$$

Where $V_V$ is the volume of void space and $V_T$ is the total volume of the sample.
Permeability is a measure of the ability of a material, (such as a rock), to allow fluids, (such as water), to pass through.
INVESTIGATION 8:

Carry out laboratory experiments to measure the porosity and compare the permeability of different sediments.

In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task.
INVESTIGATION 8:

Carry out laboratory experiments to measure the *porosity* and compare the *permeability* of different sediments.

Design a method of measuring the porosity and permeability of *rocks* (rather than *sediments*).

In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task.
EQUIPMENT

- 2 paper cups (1 with a hole and 1 without)
- Measuring cylinder
- Large jar or beaker
- Sediment samples
- Spoon/scraper
- Stopwatch
METHOD

A. Measuring **porosity**

1. Pour 100 mL of water into your cup and draw a line where the water comes up to. Write 100 mL in the total volume column on your data sheet. Pour out the water.

2. Fill the cup with sediment (1) sample, up to the line you drew. Label it (1).

3. Using your measuring cylinder, slowly and carefully pour water into the cup until the water reaches the top of your sample. **Record the volume of water remaining.**

4. Subtract the volume remaining from the total volume. This is the amount of water you added to your sample. **Record this volume** – it is the total pore space.

5. To determine the porosity of the sample, divide the total pore space volume by the total volume, and multiply the result by 100. **Write the porosity on your data sheet.**

   (Note: % pore space = pore space / total volume x 100)

6. Repeat the above procedure using each of the other sediment samples, (2) and (3).
B. Measuring *permeability*

1. Hold the empty cup with a hole over a large beaker. Carefully add a measured quantity of sediment sample (1), into this cup with a hole.

2. Pour 100 mL of water into the cup with your sample. Time how long it takes from when you begin pouring until when the water completely drains out of the sample.

   **Record the time on your data sheet.**

3. Repeat the above procedure for samples (2) and (3)
## Data Table

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Total Volume (mL)</th>
<th>Volume remaining in cylinder</th>
<th>Total pore space (mL)</th>
<th>Porosity (% pore space)</th>
<th>Time for 100 mL to pass through</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
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<tr>
<td>(3)</td>
<td></td>
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</tbody>
</table>
PREDICTION
PREDICTION

- Which sediment do you think will have the greatest porosity?
PREDICTION

- Which sediment do you think will have the greatest porosity?
- Which sediment do you think will have the greatest permeability?
RESULTS

1. Which sample had the greatest porosity?
RESULTS

1. Which sample had the greatest porosity?
2. Which sample had the greatest permeability?
CONCLUSIONS
CONCLUSIONS

1. Suggest one way in which the method used and the accuracy of your results could have been improved.
CONCLUSIONS

1. Suggest one way in which the method used and the accuracy of your results could have been improved.

2. Describe a method you might be able to use to measure the porosity and permeability of *rocks* rather than *sediments*. 
CONCLUSIONS

1. Suggest one way in which the method used and the accuracy of your results could have been improved.

2. Describe a method you might be able to use to measure the porosity and permeability of rocks rather than sediments.

3. As an environmental engineer, which sediment would have the greatest risk of transferring harmful chemicals into a drinking water aquifer?

   Explain your answer.
Rain

Mound Spring
minerals left by evaporating water make a mound

Bore

water can't get through these rocks

cracked rock

water can't get through these rocks
How can groundwater become polluted?
Mounting evidence suggests that high levels of arsenic in water used to grow crops could degrade soils, reduce yields – and find its way into food...
Arsenic contamination of groundwater in Bangladesh threatens the health of up to 30 million people.
The problem originates in arsenic-rich bedrock of the Brahmaputra river basin that filters drinking water pumped to the surface through millions of tubewells.
Police have asked about 140 residents and visitors to leave a Northern Territory cattle station and tourist park after elevated levels of arsenic were found in long-term residents.

The NT coroner has declared Mt Bundy Station, on the banks of the Adelaide River, a restricted area and has asked people to leave.
Where does the waste water go?
Wells and bores may become polluted by seepage of surface water.
Where does this water come from?
How does pollution move through an aquifer?

INVESTIGATION 9:

Carry out an experiment to find out how groundwater pollution can spread, using the models at Flinders University.

Science and technology contributes to finding solutions to a range of contemporary issues.
How does pollution move through an aquifer?

INVESTIGATION 9:

Carry out an experiment to find out how groundwater pollution can spread, using the models at Flinders University.

Science and technology contribute to finding solutions to a range of contemporary issues.

Make a 2-minute documentary film to explain how pollution can move, using colored dyes in the groundwater model.

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.
How does pollution move through an aquifer?

INVESTIGATION 9:

Carry out and an experiment to find out how groundwater pollution can spread, using the models at Flinders University.

Science and technology contribute to finding solutions to a range of contemporary issues.

Make a 2-minute documentary film to explain how pollution can move, using colored dyes in the groundwater model.

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.

What does a hydro-geologist do?

People use understanding and skills from across the disciplines of science in their occupations……
National Centre for Groundwater Research and Training
Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships.
What can be done to save water?
storm water
How much storm-water runs off from our local area?

INVESTIGATION 10:

Use satellite images on Google Earth to estimate the proportion of land covered by asphalt, concrete and other impervious cover in our local area.

Use your result to estimate the storm-water runoff of each local square Km, in the course of 1 year with an average local rainfall.

Make a 1-minute documentary film to explain your calculations and results.

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.
In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task.
Adelaide Rainfall

- The annual estimated average rainfall for Adelaide is 585 millimetres.

Annual rainfall totals for Adelaide have ranged from a high of 882.4 millimetres to the lowest fall of 257 millimetres.

http://www.abs.gov.au
Local Rainfall Volume?

Volume of a Cube

\[ \text{Volume} = L \times W \times h \]

Like a rectangular solid, multiply the length, times the width times the height.
Calculating Rainfall Volume

Use $L \times W$ = your estimated local area of “run-off”, per square km

$h$ = depth of average annual rainfall in Adelaide (0.6 m)

Use metres (m) for all data: $1 \text{ m}^3 = 1 \text{ kl (kilolitre)}$
Aquifer Storage and Recovery (ASR)

- Storm/Waste-water to aquifer in wet season
- Recovery from aquifer in dry season
Aquifer Storage and Recovery (ASR)

Groundwater quality affecting crops

NATIVE GROUNDWATER FOR IRRIGATION

Groundwater salinity increasing through continued pumping
ASR BORE

EXTERNAL WATER SOURCE RECHARGE COMPLETE

Ground Surface

Injected Water Level

INJECTED WATER

Mixed Zone

Higher water level and greatly improved groundwater salinity
ASR Bore

Maximum pumping levels water for irrigation

Ground Surface

Irrigation drainage return

Maximum drawdown water level

Mixed Zone

Maximum drawdown still pumping mixed groundwater and no increasing salinity
What can be done to save water?

INVESTIGATION 11:

Visit the *Aquifer Storage and Recovery* (ASR) facility of the City of Salisbury Council, and design a poster illustrating how it works.

Science understanding influences the development of practices in areas of human activity such as ............ terrestrial resource management.

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.
What can be done to save water?

INVESTIGATION 12:

Design and build your own groundwater model, using the equipment provided. Include one unconfined and one confined aquifer, an ASR system with pumping and injection wells and reed-beds for storm-water catchment and purification.

Collaboratively and individually plan and conduct

Make a 2-minute documentary film to explain how ASR works, using your groundwater model

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate
What can be done to save water?

INVESTIGATION 13:

Visit the City of Tea Tree Gully and make a poster showing Council’s initiatives that help clean and conserve water in the district.

Science and technology contribute to finding solutions to a range of contemporary issues.

Science understanding influences the development of practices in areas of human activity such as industry and terrestrial resource management.
What can I do to save water?

Identify questions and problems that can be investigated scientifically and make prediction based on scientific knowledge
What can I do to save water?

INVESTIGATION 14:

Design and carry out an experiment to find out how much water you use in the shower in one year.

In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task.

Summarize data from students’ own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions.

Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method.
How can you find a good source of groundwater?
Does water divining really work?

Watch the video  http://www.youtube.com/watch?v=q_mWZWdcqK4

INVESTIGATION 15:

Describe the conclusions reached in the video.

Was it a “fair test”?

Suggest some possible improvements to the experimental method used in the video

**Reflect on the method** used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method

Use scientific knowledge and findings from investigations to evaluate claims
What is a more scientifically credible way to find viable groundwater supplies?
Drilling
What kinds of data is collected down bore-holes?
Science understanding influences the development of practices in areas of human activity such as industry, agriculture and terrestrial resource management.
INVESTIGATION 16:

During your visit to the PIRSA groundwater unit at Glenside, make a list of all of some different measurements that can be made by wire-line logging down bore-holes.

What kinds of work do geophysics technicians do?

People use understanding and skills from across the disciplines of science in their occupations......
Teacher Earth Science Education Programme

PARTNERS

PRINCIPAL

Australian Government
National Water Commission

PLATINUM

GOLD

AWE
BEACH PETROLEUM
CSIRO
GEODYNAMICS LIMITED

KAROON Gas Australia Ltd
nexus
THE UNIVERSITY OF MELBOURNE
The Geoscience Pathways Project aims to change attitudes towards the Geosciences by demonstrating their essential contribution to modern society.

Through Geoscience, schools can raise student awareness of the vital importance of the resources industry and the wide variety of career opportunities in mining, energy and exploration, many of which are in current and projected skills shortage.

Geoscience can also provide the necessary scientific background for students to understand and engage in informed debate about contemporary issues.
The Geoscience Pathways Project aims to change attitudes towards the Geosciences by demonstrating their essential contribution to modern society.

Through Geoscience, schools can raise student awareness of the vital importance of the resources industry and the wide variety of career opportunities.
Latest News

Select Year: 2009

- **Mining Jobs Joins our Website**
  04 JUN 2009

- **SA - Careers Night 24th June 2009**
  25 MAY 2009

- **Mining People International Joins our Website**
  14 MAY 2009

- **Free Trial - Science Education Review**
  21 APR 2009

- **Geoscience Pathways has joined facebook**
  30 MAR 2009

- **Video - "Take AIM at Climate Change"**
  03 FEB 2009

On the left are links to the latest news within our project, our schools and partners. If you have any exciting news please email our administration to get your article posted on our website.

Contact Us
Teacher's Resources, Aids and Links

As most science teachers will be aware, the context of studying the planet Earth well suits introduction to most of the fundamentals of science and the scientific method. For example, introductions to Physics, Chemistry and Biology can well follow from first learning about the earth's magnetic field, its motions, gravitation, minerals and history of life.

By becoming part of the Geoscience Pathways project teachers can freely share their best units, lesson plans, student notes and exercises, just as they have used them in their classrooms. Click on the links below to learn how colleagues have successfully engaged students of all ages in geoscience topics or projects, either as discrete units or across the curriculum.

Gold Pans free to loan

As part of the Geoscience Pathways Project, 10 Plastic Gold pans (shown below) were bought as resources. These gold pans are available to borrow for excursions, at no charge. They are currently located at East Marden Primary School. If you would like more details about the gold pans, please contact [contact information].
Other Educators

Below are a list of other educators in the Earth and Environmental Sciences.

If you wish to be added to this list OR have your own free page to advertise your courses and training. Please contact the Webmaster.

ACT

- The Australian National University - Research School of Earth Sciences

New South Wales

- The University of New South Wales - Department of Biological, Earth and Environmental Sciences
- The University of New South Wales - School of Petroleum Engineering
- The University of New South Wales - School of Mining Engineering
- The University of Newcastle - School of Environmental & Life Sciences
PESA

The Petroleum Exploration Society of Australia proudly sponsors the Geoscience Pathways Website.

The Petroleum Exploration Society of Australia is a non-profit association of individuals involved in the exploration for oil and gas. The purpose and objectives of PESA are:

- To promote professional and technical aspects of the upstream petroleum industry throughout Australia by providing a medium for gathering individuals interested in oil and gas exploration
- To present views and discuss technical and professional matters relating to the upstream petroleum industry
- To foster and provide continuing education for the benefit of members;
  and
- To maintain a high standard of professional conduct on the part of its members.

The Geoscience Pathways Project

You may wish to join us, and thereby:

Collaborate in our Australian Curriculum
   Earth & Space Science implementation
   Share our website (create your own school page)
   • Share our unit/lesson plans and outcomes
   • Participate in our PD activities
   • Participate in our longitudinal study
   • Share our funding support