Grave Concerns

Students will investigate, observe, gather evidence, generate and test ideas, communicate and debate scientific ideas about the building of and breaking down of the Earth’s natural materials. This unit adds to the current Earth science curriculum. The context for student investigations and study is the local cemetery.

Curriculum links

Principles

• High expectations
• Cultural diversity
• Learning to learn
• Community engagement
• Coherence

Key Competencies

• Thinking
• Using language symbols and text
• Managing self
• Relating to others

Values students will

• Explore with empathy the values of others
• Learn to accept different kinds of values – social & cultural
• Learn about the values on which NZs cultural & institutional traditions are based.

Levels 3, 4 & 5 Learning Area

In science, students explore how both the natural physical world and science itself work so that they can participate as critical, informed, and responsible citizens in a society in which science plays a significant role.

Historic Cemeteries Conservation Trust of New Zealand
Learning Areas - Science

Levels Three and Four

Level 3: Strand - Material World
Level 3 students will gain knowledge, skills and experience in

Properties and changes of matter
- Group materials in different ways, based on the observations and measurements of the characteristic chemical and physical properties of a range of different materials.

Chemistry and Society
- Relate the observed characteristic chemical and physical properties of a range of different materials to technological uses and natural processes

Level 3: Strand - The nature of Science

Investigations in Science
Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.

Participating and contributing
Students will use their growing science knowledge when exploring issues of concern to them. Explore various aspects of an issue and make decisions about possible actions.

Level 4: Strand - Material World
Level 4 students will gain knowledge, skills and experience in

Properties and changes of matter
- Group materials in different ways, based on the observations and measurements of the characteristic chemical and physical properties of a range of different materials.
- Compare physical and chemical changes.

The structure of matter
- Begin to develop an understanding of the particle nature of matter ad use this to explain observed changes.

Chemistry and society
- Relate the observed characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.

Level 4: Strand - The nature of Science

Investigations in Science
Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.

Participating and contributing
Students will use their growing science knowledge when exploring issues of concern to them. Explore various aspects of an issue and make decisions about possible actions.
Strand: Material World
Level 5 students will gain knowledge, skills and experience in

Properties and changes of matter
- Investigate the chemical and physical properties of different groups of substances

Chemistry and Society
- Link the properties of different groups of substances to the way they are used in society.

Level 5: Strand - The nature of Science

Investigations in Science
- Develop and carry out more complex investigations.
- Show an increasing awareness of the complexity of working scientifically including recognition of multiple variables.
- Begin to evaluate the suitability of the investigative methods chosen.

Participating and contributing
- Develop an understanding of socio scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate.
Prior teaching required:
For Years 7 & 8 and Years 9 & 10 students it is recommended that students undertake an earth science study so they develop a good basic understanding of the ways sedimentary, igneous and metamorphic rocks are formed.

This unit is designed as a set of extension activities and ideas where students develop knowledge and skills in earth science in the context of the cemetery. Students are encouraged to look at socio scientific issues and to think about possible appropriate action.

Note:
While the resources for unit have been designed for Years 9, 10, and Year 11 students, teachers at Years 5 & 6, and 7 & 8 will be able to use these materials with some care and adjustments in the experimental activities that have been included. For use at Years 5 & 6 and Years 7 & 8 teachers will need to remove several of the scientific investigations or demonstrate the outcomes of these experiments.

Some of the work presented here may also contain some ideas for students looking for a science fair investigation or for students looking to undertake a science based inquiry for NCEA.

Many of the resources have been put together in PowerPoint format so that teachers can use the resources as teaching presentations. Equipment needed and methods to be used for experiments can be displayed in the laboratory. Where teachers need they can add in additional information or delete information from the presentation where this may be too difficult for younger students or where teachers do not have access to appropriate equipment.

Materials needed for the unit

For this unit teachers need to collect together a range of rock samples that students can use for experimentation. The rocks samples needed include those most commonly used in the cemetery.

- limestone,
- sandstone,
- granite,
- slate, and
- marble.
- conglomerate

If possible have a variety of examples of the types of rock listed above. Also samples of other rock types should also be included for identification and comparison tests eg coal, basalt, greywacke etc.
Section 1: Characteristics of rocks used in the cemetery

Introducing the unit - Identifying rocks

Materials needed

- Rock samples. Have a set of rocks available for each group of three or four students.
- Download the PowerPoint presentation called “Materials”
- Magnifying lens
- Pens
- Paper

Ask students to organise the rocks into groups. At this stage they can organise groups according to whatever categories they like. They need to be able to justify why they have grouped them the way they have. Ask them to regroup in a different way and explain why they have grouped that way.

Ask students if they know the names of any of the rocks in front of them.

Show students slides 1-15 of the PowerPoint presentation called Materials. This resource introduces students to the kinds of rocks that have most commonly been used in our cemeteries. If you have enough material, have students try to identify examples of the rocks in front of them as they are shown on screen.

Student Inquiry “What is the best rock type for a monument?”

Tell students that they are about to start an inquiry. Their task is as follows…

Your task is to choose the best rock type for a monument of your own design that will last for many, many years. Your decision will be based on appearance, hardness, ability to withstand chemical attack, porosity or water absorbency of the material, and density. You need to judge or test each rock to see how these meet your design needs.

Experiment 1: Appearance

Think about your monument. Decide

- What it is for?
  and
- What will it look like?

Make a quick draft sketch of your monument. It may be to commemorate a famous person, it may be a cemetery memorial for a family member or friend, it may be a plaque commemorating a past event or it may be an artistic piece for the centre of town or a park or garden ornament.

Decide on which of the rocks you think would look nice and say why you would like to make a monument out of your choice.
Section 1: Characteristics of rocks used in the cemetery

Experiment 2– Testing for hardness

Softer rocks are easier to carve and shape but are prone to weathering. In this experiment you will be testing a variety of rocks for their hardness.

What equipment will you need?

- Samples of different kinds of rocks labeled.
- A sample of wood can also be included
- A piece of copper or copper sample. An older copper coin will do.
- Steel knife
- Your own fingernails
- Eye protection.

Have students think about ways they could compare rock samples for hardness. There are several ways they could do this. One way would be for the students to rub one stone against another and see if one stone left a mark on another. Students need to be systematic in checking the stones.

- How will you compare the rock samples?
- How will you make it a fair test?
- How will you make sure your tests are safe?
- How will you record your results?

<table>
<thead>
<tr>
<th>Pairs of rocks compared</th>
<th>Which rock scratched or left marks on the other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A second way is to use the items listed in the equipment list to try and make a mark on the rocks. I.e. fingernail, copper, steel knife blade again checking and comparing for hardness. [Display Slide 18]

- How will you make it a fair test?
- How will you make sure your tests are safe?
- How will you record your results?

<table>
<thead>
<tr>
<th>Name of rock</th>
<th>Can be scratched by a fingernail</th>
<th>Can be scratched by a copper coin</th>
<th>Can be scratched by a steel knife blade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Introduce students to Mohs’ Test for hardness of rocks. [Display PowerPoint Slide 19].
Section 1: Characteristics of rocks used in the cemetery

Experiment 3: Erosion

Softer rocks are easier to carve and shape but are prone to weathering. In this experiment you will be testing a variety of rocks for erosion. [Display Powerpoint slide 20]

What equipment will you need?
- Samples of different kinds of rocks labeled.
- Metal file
- Newsprint
- Accurate balance
- Eye protection

Have students think about ways they could compare rock samples for hardness. There are several ways they could do this. One way would be for the students to rub one stone against another and see if one stone left a mark on another. Students need to be systematic in checking the stones.

• How will you judge how much rock you have worn away?
• How will you make it a fair test?
• How will you make sure your tests are safe?
• How will you record your results?

<table>
<thead>
<tr>
<th>Name of rock</th>
<th>Mass of rock worn away in ____ minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Experiment 4: Chemical reaction

Which rocks are subject to chemical reaction? This is important where you are placing your monument in a location with a high rainfall or where there may be acid rain. [Display Powerpoint slide 21]

What equipment will you need?
- Samples of different kinds of rocks labeled.
- Dilute sulphuric acid
- Bowl for used rock samples
- Beakers
- Eye protection

• How will you compare the affect of acid on the rock samples?
• How will you make it a reliable test?
• How will you make sure your tests are safe?
• How will you record your results?

<table>
<thead>
<tr>
<th>Name of rock</th>
<th>Reaction with dilute acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Experiment 5: Porosity

Do rocks absorb water? Do some rocks absorb more water than others? [Display Powerpoint slide 20]

What equipment will you need?
- Samples of different kinds of rocks labeled.
- Plastic Beakers
- Paper towels
- Balance

- How will you judge how much water the rock samples have absorbed?
- How will you make it a reliable test?
- How will you make sure your tests are safe?
- How will you record your results?

<table>
<thead>
<tr>
<th>Name of rock</th>
<th>Mass before immersion</th>
<th>Mass after immersion for 10 minutes</th>
<th>Mass after immersion for 30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Experiment 6: Density (For Year 9 and 10 students)

Generally those rocks which are more densely constructed will last longer. You can calculate the density of materials by dividing its mass by its volume. mass (g) ÷ volume cm$^3$ = density (g/cm$^3$) [Display Powerpoint slide 23 and 24]

What equipment will you need?
- Samples of different kinds of rocks labeled.
- Plastic beakers & Displacement can
- Water
- Measuring cylinder
- Accurate balance

- How will you measure the mass of the rock samples?
- How will you measure the volume of the rock samples?
- How will you make it a reliable test?
- How will you make sure your tests are safe?
- How will you record your results?

<table>
<thead>
<tr>
<th>Name of rock</th>
<th>Recorded Mass</th>
<th>Recorded Volume</th>
<th>Calculated Density</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the purpose your monument? ____________________________________________

Draw up your design.

<table>
<thead>
<tr>
<th>Name of Rocks</th>
<th>Appearance</th>
<th>Hardness</th>
<th>Erosion</th>
<th>Reaction with acid</th>
<th>Porosity</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is your choice of material for building your monument? ____________________________

Why have you made this choice - give your reasons ____________________________

_________________________________________________________________________
Section 2: Weathering, rusting and rotting

Download the Powerpoint presentation called “Processes.” This presentation examines some of the processes that students will observe on a visit to the cemetery.

Two types of weathering of cemetery stones can be observed and are covered in this presentation.
1. Chemical weathering of limestone and marble.
2. Physical weathering of all types of stone.

Other types of weathering that can be found include rusting of metals and rotting of wood.

Present slides 1-8 and discuss. This is an introduction to the concept of weathering and takes a closer look at evidence of chemical weathering using the cemetery as a case study.

Section 2: Experiment – Rates of chemical reactions (Year 9 & 10)

What affects how quickly rocks are attacked by acid? Display Powerpoint Slide 8

What equipment will you need?
- Limestone/or marble chips (size of chips might be a factor to investigate?)
- Dilute hydrochloric acid
- Bunsen burner, tripod, gauze & heatproof mat
- Thermometer
- Balance
- Timer
- Conical flask with bung and delivery tube
- Trough
- Measuring cylinders

Choose a factor to investigate?
There are various options students might choose to test. One option might be the temperature of the acid. Does warm acid attack limestone and marble more quickly than cold acid? Another option is the concentration of the acid.

How will you measure the rate of reaction?
How will you make it a reliable test?
How will you make sure your tests are safe?
How will you record your results?

<table>
<thead>
<tr>
<th>Temperature of acid (°C)</th>
<th>Time to collect 20cm³ of gas</th>
<th>Concentration of acid (M)</th>
<th>Time to collect 20cm³ of gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 2: Weathering, rusting and rotting

The role of Heating & Cooling / Freezing & Thawing

Present slides 10 - 14 and discuss. These slides take a closer look at evidence of physical weathering using the cemetery as a case study.

Section 2: Experiment – Homework Activity

What happens to water when it freezes?

What equipment will you need?

- Small plastic or glass bottle with tight fitting lid
- Water
- Freezer
- Ice cream container with fitting lid.

Fill the bottle with water right to the top. Screw on the lid tightly. Place the filled bottle in the ice cream container and fit the lid. Place in the freezer over night.

Describe how the bottle and water look next morning.

The role of Plants and Vandals

Present the remaining slides (Slides 15 - 23) in the presentation.

Ask students…

Do you think there are a fix-it solutions to these problems? If so speculate what those solutions could it be.

You may need to revisit some of the slides. Note: There may be some problems featured which do not have ready solutions.

Cemetery trails

Have students visit your local cemetery to find and highlight some of the features of weathering discussed in the Processes PowerPoint. You may like to have students search out their own examples especially if the cemetery is small to medium in size. Provide each group with a digital camera. Students photograph the evidence and prepare a quick 4 or 5 slide PowerPoint for presentation.

Alternatively you may wish to set up trails for the students where they find and look at specific types of weathering. You need to provide students with a cemetery map as well as Block and Plot numbers for specific headstones that they are expected to visit on the trail. There are examples of this type of trail provided with this unit that apply to the Northern and Southern cemeteries in Dunedin.
Encourage students to start thinking about what is happening to our local cemeteries. Have students undertake a Block Survey during their visit to the cemetery. If you are close enough to the cemetery, have them return to do the survey another day.

Assign a block or manageable area of the cemetery to each group and provide a map of the area for students. Try and obtain cemetery maps with areas that show individual plots marked if possible. Students draw up a recording sheet for recording the data gathered or use the survey sheet provided over the page. Students investigate the percentage of plots within the area they are surveying that have complete headstones in good order, damaged or degraded headstones, or do not have any evidence of a headstone or grave development on the plot.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Complete Headstone</th>
<th>Broken/disassembled Headstone</th>
<th>Some evidence of fence or plot surround/plinth etc</th>
<th>Plot is bare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot #</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot #</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot #</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Activity Two**

Have students graph and work out the percentages of complete headstones, broken and disassembled headstones, some evidence of plot development and bare plots that currently exist in the cemetery and compare.

**Activity Three**

Contact your local museum, historical society, genealogy group or friends of the cemetery group to see if there are any old photographs of the cemetery available. Compare the look of the cemetery in the photographs with the overall look of the cemetery today. Have your students come to some conclusions about the amount of degradation of the local cemetery that has occurred between the time of the photograph and today.
Participating and contributing in Socio-Scientific issues

Activity 4: What is happening to Historic Cemeteries?

Show students the following 5-minute video story screened on TV3 News Campbell Live. The story called “Historic cemeteries falling into a state of neglect” screened on Friday 20th June 2008. You can video stream from the following link, [http://www.3news.co.nz/Video/CampbellLive/tabid/367/articleID/60200/Default.aspx#video](http://www.3news.co.nz/Video/CampbellLive/tabid/367/articleID/60200/Default.aspx#video)

“When you drive into Whangarei, you could be excused for not noticing the historic cemetery that sits on the right of the main road into the city.” This story starter is available at [http://www.3news.co.nz/TVShows/CampbellLive/Stories/tabid/817/articleID/60200/Default.aspx](http://www.3news.co.nz/TVShows/CampbellLive/Stories/tabid/817/articleID/60200/Default.aspx) (Unfortunately the whole story is not available in text version but the essence of it is if you are unable to stream the video story.)

After watching the video have students work through this opinion proof activity. This activity is helpful when there are multiple viewpoints on particular issues involved. Students have to find support for the opinion is culled from the text of the video.

One opinion in this story…

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Proof</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Whangarei City Council was justified in resorting to clearing away the old settlers headstones and the overgrown weeds.</td>
<td></td>
</tr>
</tbody>
</table>

An alternative opinion in this story …

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Proof</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Whangarei City Council’s action in clearing away the old settlers headstones and the overgrown weeds is not justifiable.</td>
<td></td>
</tr>
</tbody>
</table>

And another….

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Proof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merv Rusk was justified in lobbying the Whangarei City Council to erect a memorial and reinstate the old Kioreroa Settlers Cemetery.</td>
<td></td>
</tr>
</tbody>
</table>

Students can use their Opinion-Proof charts to write a persuasive essay, compose an editorial suitable for a newspaper, or to prepare themselves for a classroom debate.
Participating and contributing in Socio-Scientific issues

Activity 5: Are there alternatives?

Have students consider the pros and cons of the solution arrived at by the current Whangerei City council. Use the following organiser as a basis for student brainstorming. This could be a group activity or an individual homework activity.

<table>
<thead>
<tr>
<th>Solution</th>
<th>Why is this a suitable solution?</th>
<th>Why is this not a suitable solution?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erecting a new memorial is a suitable way of reinstating the Kioreroa Cemetery.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A useful resource for this activity is the Historic Cemeteries Conservation Trust Website at [http://www.cemeteries.org.nz/](http://www.cemeteries.org.nz/) and click on the left hand link to Heritage Values of Historic Cemeteries. The site will assist students to think about alternatives to the Kioreroa Cemetery situation in Whangarei.

Activity 6: Maintaining heritage in the face of natural decay

Download the PowerPoint slideshow called “Cemetery Maintenance.” This resource shows a variety of before and after scenarios and illustrates a range of headstone and plot repairs that have been completed or are being undertaken by monumental masons.

Have students revisit their trail data gathered on their cemetery visit. Have students go through the written information and photographs they have gathered and decide on the following…

a) What kind of weathering has been involved in the problem – chemical or physical weathering and what may be the possible cause of the problem? (Encourage students to consider that there may be more than one cause for a problem. Eg a headstone leaning due roots undermining the foundation may also be a tempting target for vandals.)

b) Consider what solutions that may be applied to the problem.


Participating and contributing in Socio-Scientific issues

Activity 7: Becoming involved

- Discuss - Who should take care of cemeteries? Why are they important in a community? Have someone from your local history group or museum talk to the students about heritage cemeteries and its value to the community.

- Discuss with students possible ways they could become involved in heritage care of a local cemetery. Who would they need to contact? Who would they need to work with? Have students form action groups for caring for a local cemetery.

This might include adopting a plot or several plots that they will keep tidy

- Weeding plots and grave surrounds.
- Growing and planting out of plots with bulbs and small plants that are easily divided.
- Cleaning of some headstones with soft brushes and water.

This might include greater action such as

- attempting to increase community interest in the cemetery.
- fundraising for repair of the local headstones of importance.
- organising for interpretive boards etc for visitors.

Resources
