**SACE Stage 2 Earth and Environmental Science**

**Assessment Type 3 — Earth Systems Study**

This Study will be externally assessed. It represents 30% of the final marks in this subject.

# Purpose

This assessment allows you to develop and demonstrate your field observation skills and to communicate your knowledge through an Earth Systems Study report.



Brukunga Mine waste heap pollutes its surroundings

# About Brukuga Mine

The Brukunga mine is in the Adelaide Hills, near Nairne. It was originally opened after World War II to mine pyrite ore, which was turned into super-phosphate fertiliser. However, a cheaper source of sulphuric acid was found, and the mine was closed in 1972. The crushers and metallurgic plant were dismantled and removed. The company left behind 2 piles of waste rock, which consisted of 8 million tons of rock removed to access the pyrite underneath. Soon after the mine closure, it was found that a pile of tailings, which contain pyrite ore, was leaking sulphuric acid into a small lake next to the pile of tailings. The acid had formed through the natural oxidation of the pyrite minerals in air and water to form the sulphuric acid, this effect is known as Acid and Metalliferous Drainage or Acid Mine Drainage (AMD).

One of the solutions for AMD at Brukunga involves using lime to neutralise the acid. Lime is dispersed as sludge into a tank containing contaminated water. At the mine site they input lime to dilute sulphuric acid, and contaminated water. Oxygen, which is provided by air blowers, ensures the chemical reactions are completed before the mix leaves the plant. The output substance is gypsum and water.

# Your task

You will participate in an excursion to the Brukunga Mine Site, during which you will investigate the impact on the local environment of acid metalliferous drainage (AMD), as well as the procedures being undertaken to counteract this damage. You will then undertake an investigation into one aspect of the problem and/or the remediation work being carried out.

Before the excursion you must research the literature on the Brukunga mine to gain an understanding of the location and its problems. A good introduction to this topic can be found om the site called Rehabiliitation of Brukunga Mine / Brukunga Mine AMD.

You will then develop your proposed research question. However, you may decide to modify it after the excursion.

If you are planning a practical hands-on investigation, you must decide what equipment you will need. You may need to collect samples at the site. Whatever investigation topic you select, you will certainly need to take some photos.

After the excursion you will design, plan, undertake, and report on a field- or literature-based extended investigation to answer your question. The investigation must include collection and analysis of both primary and secondary data. You must be able to analyse the information gathered in terms of the interactions of two or more Earth Systems.

Some possible investigation questions for the BRUKUNGA MINE project, (examples only)

* What features of the local environment exacerbated the problems caused by the mining activities?
* how should the mine waste have been controlled to prevent the problems from arising?
* what other uses could have been found for the ore mineral when it was no longer needed to produce sulphuric acid?
* develop a detailed description of what today's conditions in the area below the mine might have been if no efforts had been made to remediate the problems.
* analyse the sediments at different areas of the site in terms of the minerals present, the pH values etc.

You may choose any other appropriate investigation question, beyond the examples above.

# Description of assessment

## Proposal (IAE1) – Individually

You will design an investigation proposal then trial your methods to assist the design of your procedure. You should collect a considerable proportion of your data during the excursion to Brukunga.

One draft of the proposal should be submitted for teacher feedback and approval. You may modify your proposal in response to this feedback before you undertake your investigation.

Your modified proposal must be submitted with your report for assessment.

### The proposal should include:

* • a statement of an investigable question or hypothesis
* • a rationale for and an outline of the proposed research approach and method
* • a list of equipment required
* • the procedure to be followed
* • the type of data that will be collected
* • a risk assessment that addresses safety, ethical, and legal considerations.

### Report – Individually

The report should use scientific terminology and include:

* • an introduction to identify the purpose, and relevant background or previous research into the topic (KA1, 4)
* • appropriate representation of data, e.g. tables, graphs, maps, charts, photographs, or other illustrations (IAE2)
* • analysis of the information gathered in terms of the interactions of two or more Earth systems (IAE3)
* • evaluation of procedures and results to identify limitations of, and improvements to, the investigation (IAE4)
* • a conclusion, which includes predictions or advice based on findings (IAE3)
* • citations and referencing (KA4)

## Assessment conditions

The combined word count for the proposal and the report should be a maximum of 2000 words, if written, or the equivalent in multimodal form.

Your work will be assessed using the performance standards for Stage 2 Earth and Environmental Science. These are given below:

Performance Standards for Stage 2 Earth and Environmental Science

### Investigation, Analysis, and Evaluation

### Knowledge and Application

A

Designs a logical, coherent, and detailed earth and environmental science investigation.

Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.

Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.

Critically and logically evaluates procedures and their effect on data.

Demonstrates deep and broad knowledge and understanding of a range of earth and environmental science concepts.

Develops and applies earth and environmental science concepts highly effectively in new and familiar contexts.

Critically explores and understands in depth the interaction between science and society.

Communicates knowledge and understanding of earth and environmental science coherently, with highly effective use of appropriate terms, conventions, and representations.

B

Designs a well-considered and clear earth and environmental science investigation.

Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.

Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.

Logically evaluates procedures and their effect on data.

Demonstrates some depth and breadth of knowledge and understanding of a range of earth and environmental science concepts.

Develops and applies earth and environmental science concepts mostly effectively in new and familiar contexts.

Logically explores and understands in some depth the interaction between science and society.

Communicates knowledge and understanding of earth and environmental science mostly coherently, with effective use of appropriate terms, conventions, and representations.

C

Designs a considered and generally clear earth and environmental science investigation.

Obtains, records, and represents data, using generally appropriate conventions and formats with some errors, but generally accurately and effectively.

Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.

Evaluates procedures and some of their effect on data.

Demonstrates knowledge and understanding of a general range of earth and environmental science concepts.

Develops and applies earth and environmental science concepts generally effectively in new or familiar contexts.

Explores and understands aspects of the interaction between science and society.

Communicates knowledge and understanding of earth and environmental science generally effectively, using some appropriate terms, conventions, and representations.

D

Prepares the outline of an earth and environmental science investigation.

Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.

Describes data and undertakes some basic interpretation to formulate a basic conclusion.

Attempts to evaluate procedures or suggest an effect on data.

Demonstrates some basic knowledge and partial understanding of earth and environmental science concepts.

Develops and applies some earth and environmental science concepts in familiar contexts.

Partially explores and recognises aspects of the interaction between science and society.

Communicates basic earth and environmental science information, using some appropriate terms, conventions, and/or representations.

E

Identifies a simple procedure for an earth and environmental science investigation.

Attempts to record and represent some data, with limited accuracy or effectiveness.

Attempts to describe results and/or interpret data to formulate a basic conclusion.

Acknowledges that procedures affect data.

Demonstrates limited recognition and awareness of earth and environmental science concepts.

Attempts to develop and apply earth and environmental science concepts in familiar contexts.

Attempts to explore and identify an aspect of the interaction between science and society.

Attempts to communicate information about earth and environmental science.

**Note for Teachers**

Contact John Mignone at [John.Mignone@sa.gov.au](mailto:John.Mignone@sa.gov.au). He will be very happy to arrange an excursion for your class.