

Support for the Environmental Education Policy: Mathematics



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Introduction

This document complements the *Environmental Education Policy for Schools* and should be read in conjunction with the support document, *Implementing Environmental Education in your school*. It has been specially prepared for secondary Mathematics teachers.

The policy requires schools to draw on those areas of the formal and informal curriculum which support an ecologically sustainable world.

Each faculty in your school is asked to:

- identify and address those outcomes in Board of Studies Syllabuses K-12 which are specific to environmental education
- integrate the teaching of environmental education topics and issues to support outcomes in other Board of Studies syllabuses
- use the opportunities provided by special events and actions of the school community to enhance those student learning outcomes related to environmental education
- contribute to the development and implementation of the school environmental management plan.

The policy has three focus areas, each of which can be supported by the activities, projects and curriculum programs developed by teachers in all key learning areas in your school. The focus areas are:

- curriculum
- management of resources
- management of school grounds.

This document makes specific references to the Mathematics KLA and provides ideas and examples of how your faculty can contribute to each of these focus areas.



OBJECTIVES OF ENVIRONMENTAL EDUCATION

The objectives of environmental education are summarised below. Wherever possible, you are encouraged to link the appropriate objectives to the achievement of outcomes in the syllabuses you teach.

Curriculum objectives

Students will develop:

- knowledge and understandings about:
 - ❖ the nature and function of ecosystems and how they are interrelated (K1)
 - ❖ the impact of people on environments (K2)
 - ❖ the role of the community, politics and market forces in environmental decision-making (K3)
 - ❖ the principles of ecologically sustainable development (K4), and
 - ❖ career opportunities associated with the environment (K5)
- skills in:
 - ❖ applying technical skills within an environmental context (S1)
 - ❖ identifying and assessing environmental problems (S2)
 - ❖ communicating environmental problems to others (S3)
 - ❖ resolving environmental problems (S4)
 - ❖ adopting behaviours and practices that protect the environment (S5)
 - ❖ evaluating the success of their actions (S6)
- a respect for all life on Earth (V1)
- an appreciation of their cultural heritage (V2), and
- a commitment to act for the environment by supporting long-term solutions to environmental problems (V3).

MATHEMATICS AND ENVIRONMENTAL EDUCATION

Stage 4

By engaging in a variety of measurement and statistics activities, as outlined in the Years 7-8 Syllabus, students will understand better a range of local and global environmental issues, including life expectancy, populations, traffic, growth rates of plants, temperature and farming. Specific issues that relate directly to the students' environment should be examined.

Activities that students could engage in include:

- identifying the location and number of taps on a map of the school. Taps can be surveyed to determine whether they are dripping. Students then consider the implications of dripping taps in the school and develop strategies to measure the volume of water lost from individual taps and all the taps as an aggregate
- estimating the surface area of each type of land surface in the school and calculating the total volume of stormwater run-off as a result of a storm. Students could then consider the impact of stormwater on the different types of land surfaces
- completing an audit of water, energy, waste, products and materials. Students could then graph the results to determine consumption levels and strategies to reduce use.

A number of outcomes in the Stage 4 Mathematics Syllabus relate very closely to the objectives of the Environmental Education Policy for Schools. The following examples are taken from the values area.

VA12: A student appreciates that a mathematical model is a simplified image of some aspect of the social or physical environment.

VA14: A student appreciates how mathematics is used in a range of aspects of society.

VA15: A student appreciates the contribution of mathematics to our society.

Stage 5

The *Mathematics Stage 5 Syllabus* contains core and option topics that are pertinent to the integration of environmental education. Examples are in the following courses:

- The **Advanced course**, where students have opportunities to construct a model and formulate a mathematical description of a real situation in the option topic: Modelling
- The **Intermediate course**, where students collect, organise, analyse and interpret data in a range of investigations; and
- The **Standard course**, where the core content includes instruction on *Mathematics of our environment*. This topic examines issues relating to populations, the school environment and the general environment.

SOME USEFUL ACTIVITIES

In the Stage 5 Standard course, students are required to investigate a problem by posing suitable questions and planning data collection.

Mathematics of our environment

In the topic, *Mathematics of our environment* there are a number of possible activities:

- calculating and predicting populations (e.g. using number patterns, describing populations, populations and graphs)
- investigating mathematical patterns related to the number of petals on flowers, the breeding of such animals as rabbits and other facets of nature. Students evaluate the use of Fibonacci numbers in studying the environment
- carrying out a formulae and nature (e.g. students use formulae to determine volumes of trees)
- carrying out a school survey: Students plan and implement a survey of the school grounds. They collect data and report their findings to determine actions to minimise or rectify any environmental problems.

Note: The above ideas could be integrated into an environmental project or study of a local environmental issue. Suggestions include:

- construction of a school learnscape
- study of a specific local environmental problem (e.g. water quality in a local creek)
- survey attitudes towards environmental issues and actions
- study of stormwater, with an examination of what a catchment is
- public versus private transport.

Intermediate course

In the intermediate course, relevant outcomes include the following:

- A student uses and interprets graphs representing physical phenomena.
- A student designs and performs simple chance experiments and uses these experiments to estimate probabilities.

Some possible activities with an environmental focus to support the achievement of these outcomes include:

- conducting an audit of electricity, water, waste products and materials at school and home
- designing, collecting data, displaying data (graphs, tables), developing and making conclusions on a report an investigation (e.g. a school environment audit)
- examining everyday graphs, including looking at media graphs and interpreting information
- finding examples of fractals in nature (e.g. coastline, ferns, leaves)
- researching or reporting on taxes for business (e.g. pollution taxes)
- reading a topographic map to identify the catchment limits of a local creek.

Advanced course

In the advanced course, relevant outcomes include the following:

- A student constructs, solves, interprets and reports on mathematical models of real situations.
- A student investigates a problem by determining its focus and using appropriate statistical processes and techniques.

Some possible activities with an environmental focus to support the achievement of these outcomes include:

- M1: **Measuring:** Uses and interprets practical scales (e.g. acidity levels)
- M2: **Area:** What is a catchment?
Volume: How much water falls on the school?
- CD1: **Collecting data,** including an audit of electricity, water, waste, products and materials.

Organising, displaying and interpreting data:

Activities include:

- Critically reviews surveys, polls and reports and uses published information to assist in the development of informed opinions and arguments (e.g. environmental issues such as logging forests)
- Investigates population growth in a certain area or country
- Taxes on pollution: compare costs of different forms of transport (e.g. private car versus public transport)
- Vegetation survey
- Navigation on land (e.g. reading and interpreting topographical maps)
- Consider a range of graphs that represent practical situations (e.g. populations of plants/animals)
- Efficient use of land
- Traffic flow problems.

Stage 6

The Stage 6 General Mathematics syllabus highlights applications and contains suggested activities and sample questions that would support student learning in environmental education.

Through the completion of **DA2: Data collection and sampling**, and **DA5: Interpreting sets of data**, students will acquire skills, knowledge and understandings relevant to many local environmental situations. This will help students to contribute towards the school environmental management plan and implement strategies that support the management of the school and local environments.

Activities which students could include:

- collecting, analysing and reporting on data pertaining to an area of interest
- displaying and interpreting data which are presented in a range of forms
- determining how statistics can be used to sway an audience
- understanding a lunch bin audit
- carrying out a Water Bug Survey (Streamwatch).

Outcomes

Activities relating to environmental education can assist students to demonstrate the following outcomes:

- P9: A student determines an appropriate form of organisation and representation of collected data.
- P11: A student justifies his or her response to a given problem, using appropriate mathematical terminology.
- H3: A student develops and tests a general mathematical relationship from observed patterns.
- H4: A student analyses representations of data in order to make inferences, predictions and conclusions.
- H5: A student makes predictions about the behaviour of situations based on simple models.

INNOVATIVE ACTIVITIES

Waste Less: A joint publication of the Environment Protection Authority and the Curriculum Support Directorate of the NSW Department of Education and Training, developed to assist in the teaching of mathematics and to support the integration of environmental education across the curriculum.

Schools Environmental Audit (SEA): This is a series of activities designed to engage the whole school community in accepting responsibility for waste minimisation, and was developed by the Keep Australia Beautiful Council.

The Environment School Project: This is a publication of the Curriculum Support Directorate that lists activities, resources and contacts for a holistic approach to environmental management.

National Water Week (School Kit): A series of activities which encourage people to minimise their impact on water quality, avoiding water wastage and get involved in water issues.

Mathematics Curriculum Teaching Program (MCTP): This is a series of short video clips with worksheets and activities on a whole range of topics, including the environment.

Streamwatch (Water Bug Survey): Environmental program of Sydney Water. Many publications with a range of activities and exercises. *The Bug Book. Your guide to a successful survey* is one useful publication with excellent activities.

Water Watch and your Catchment: A publication reproduced by Water Watch (Queensland) and consisting of a series of activities and exercises on water issues.