

TRIAL TEACHER RESOURCE UNIT ON ALGAL BLOOMS

Years 10-12

Technology, SOSE, Science and Multi-strand Science
[Possible Links to Legal Studies (Environmental Law) and Sustainable Futures]

Main Idea

In this unit, students will apply their knowledge, experience and resources to investigate products and processes that may help to reduce human related impacts on the growth of Algal Blooms in our Waterways. Cyanobacteria or Algal Blooms were one of the first types of oxygen producing organisms to appear on earth about 35 billion years ago, so they play an important part in our ecosystems. Under certain conditions they can become toxic.

It is important to try and correlate the occurrence of toxic Algal Blooms to nutrients, hydrodynamics and/or turbidity changes to determine if changes are natural or due to human impacts.

Students will examine the range of technologies available for managing the direct and indirect impacts of Algal Blooms.

Key Understandings

Technologies are available to improve the quality of water entering the catchment. These technologies have been developed to address specific problems and deliver outcomes that meet human needs and wants, capitalise on opportunities and extend human capabilities. These technologies may include man-made processes, structures, systems or services and elements of the natural environment. Use of these technologies may impact on and have consequences for individuals, local and global communities, and the environment.

Some actions have been designed and engineered to achieve sustainable use and management of resources. For example, dams, waste treatment plants and wetlands and various filtration and/or chemical methods.

Students will then investigate how these technologies may be applied and look at monitoring methods to help manage our waterways to minimise the occurrence of Algal Blooms. Finally, they will appraise effectiveness of these technologies in achieving desired outcomes.

Focus Questions

Define the problem:

- How and why is the water environment under pressure when algal blooms develop? (*see attachment 1*)
- If cyanobacteria have always been in our water without causing too much trouble, should we really try to get rid of them completely? If not, why not?
- What causes the algae to multiply excessively and form blooms? (*see attachment 2*)
- What can we do and why is it important to get involved? (*see attachment 3*)

- Can we predict when the cyanobacteria will produce toxins and can we do anything to prevent this? (*see attachment 4*)
- Can we conduct experiments to assess the risk factors? (*see attachment 5*)
- What areas or sites need action first?

Address the problem

- What must we consider when selecting an appropriate technology to manage the impact?
- How will this technology affect the surrounding environment?
- What are the anticipated benefits to the environment from the use of this technology?
- Do the benefits outweigh the costs (financial, social and environmental)?
- What is the cost of maintaining the proposed technological devices and who is responsible?

Evaluate the effectiveness of the management action or technology

- How will the effectiveness of design be investigated and evaluated?

Key Terms

Eutrophication, Toxicity, Alternatives, Best Management Practices (BMP's), biodiversity, clients, conflict issue, conflict resolution, conservation, construction, cost-benefit analysis, cultural values, design brief, devising, ecologically sustainable development (ESD), economic values, ecosystem, environmental protection, environmental values, ethics, evaluation criteria, features, function, impacts, implementation, indigenous peoples, information, innovation, integrated management, interest group, investigating, legislation, management plans, materials, methods, model, natural hazards, permits, political values, principles, processes, producing, prototype, recreational, resource, restrictions, rural runoff, urban runoff, safety, stakeholder / user group, solution, technologies, tourism,...

Key Learning Areas

- Technology
- SOSE
- English
- Science
- Mathematics
- Sustainable Futures

Key Competencies

- Collecting, organising and analysing information
- Communicating ideas and information
- Solving problems
- Using technology
- Working in teams to achieve desired outcomes

Learning Objectives

To enable students to broaden their knowledge and understanding of currently available technologies, concepts and strategies for managing the impacts of Algal Blooms on the Waterways both here in Australia and Overseas.

To enable them to develop an understanding of the innovative, workable, environmentally appropriate, socially acceptable and cost effective water and waste management technologies available today.

Outcomes

Students will analyse the impact of human activity on the interaction of water organisms and their environment.

They will evaluate ways to improve accuracy and reliability in their investigations.

Students will assess the validity of conclusions from information/data they have gathered.

Justify positive values about and attitudes towards both living and non-living components of the environment.

On completion of this unit, teachers should be able to make judgements about each student's level of achievement with regard to the following criteria:

- Research the needs/purposes of the water or waste technology
- Research constraints
- Research considerations (eg climate, culture, aesthetics)
- Research construction methods
- Prepare a written design brief detailing the parameters of the design, together with their rationale
- Synthesise the research
- Display concept sketches and plans to convey the design and its aesthetics and highlight creative breakthroughs and key elements
- Make a model or sketch to explain the technology

Activity Ideas

Conduct experiments that demonstrate the effects of Eutrophication.
(See attachments 2 and 3)

Walk their local Waterway for example, the River Torrens to do an audit and assess the likely occurrence of algal blooms and the impact this would have on Tourist activity and other human behaviours for example, sporting events.

Identify and explore the issues

Support students to identify issues by undertaking one or more of the following activities.

- Develop a futures wheel and/or concept map to unearth topics and threats related to the development of algal blooms.
- Brainstorm issues related to the management of water runoff and waste;
- Brainstorm water and waste related threats to their local waterway.
- Determine sources of information students have access to and are realistically likely to need, e.g. volumes of water runoff and waste produced, current methods of disposal or reuse, alternatives available; methods of pumping/recycling water.
- Express ideas, with a Council educator/ school groundsperson/ teacher playing the role of “devil’s advocate” and take different views on issues to expose a range of views and possible starting points.
- Explore the issues of managing water runoff and wastes in the community through class discussion , guest speakers, searching local papers and media for ideas and sketching proposals and notions.
- Search the local papers and media for information about water runoff and waste related threats and issues . Find out how these issues are being handled currently and how they might be managed better.
- Examine the issues, risks and threats from a range of perspectives.

Framing questions and actions

Encourage the students to refine their questions and clarify how their investigations will be conducted. For example:

- Individually or in groups, formulate possible lines of inquiry into water runoff and waste water related threats and issues affecting the occurrence of Algal Blooms in the waterway. Investigate innovative water and waste management technologies used within Australia to improve environmental standards.
- List the threats and/or issues under the headings: water runoff; organic waste; other pollution; actions we can take; possible and probable futures; technologies available today; possible innovations/inventions.
- Prepare a table to collate information relating to the project. Include the names of those responsible for the project and detail where they will seek the information and how it will be gathered.

Collecting information

Valuable information can be gathered by many means and students are encouraged to:

- Search the ‘world wide web’ for relevant sites and explore links to other sites.
- Conduct interviews with staff from the local Councils, consulting firms, and government agencies such as the Environmental Protection Agencies and Natural Resource Management Boards who are involved in issues that affect water quality or pollution.
- Identify people who are knowledgeable in water runoff and waste management techniques, processes and technologies.
- Document known information and explore state of the art technologies.

- Compare and contrast issues and threats facing their local area with those affecting other environments, both nationally and globally. For example, other possible bacterial contamination such as E-coli.
- Cultivate contacts in the broader community for relevant information about water and waste management technologies.
- Write or fax letters to groups involved with the design of innovative technologies. They may be industry groups, government agencies, research institutions and/or organisations.
- Look at environmental protection laws in relation to industry waste output in each of the states and see how they are similar and different.

Interpreting the information

Encourage students to:

- Tabulate the findings from their investigations.
- Consider the motives of the author(s) of the information.
- Check one person's interpretation against another.
- Search for inconsistencies.
- Evaluate information which presents contrasting opinions.
- Make judgements about how to deal with conflicting information.
- Rearrange the information to reflect new patterns.
- Determine the features needed in any technology that might be used in the protection and conservation of the local waterway.
- Examine the appropriateness of processes used in available water and waste management technologies
- Identify the key functional, aesthetic, political and environmental features of technological ideas and practices used to better manage water runoff and waste that enters the local waterway

Making conclusions from the information

Once the investigations have been completed, and any additional information has been evaluated, students could:

- Write a series of generalisations about the water and waste related technologies, based on the information analysed.
- Initiate a question and answer session to discuss conclusions with other classes.
- Investigate the economic, environmental and social costs and benefits of various solutions proposed.
- Consider the consequences of different responses to the conclusions arrived at.
- Present the worst and best case scenarios in a persuasive argument.

Acting on the information

Once the information has been collated and discussed, students might undertake the following activities:

- Develop an action plan using flowcharts, consequence charts, timelines and visual tools to support understanding of how the innovative technologies may help protect the Catchment to the Coast.

- Draft design sketches of some management technologies.
- Identify what is needed to build such technologies.
- Construct a model to demonstrate the workings of the technology.
- Generate detailed reports, multi-media presentations or brochures outlining findings and solutions to the threats, issues and management practices.
- Mount a display inviting others' viewpoints and ideas.
- Write letters to editors of The Local Messenger newspaper expressing views on the use of innovative and environmentally acceptable water and waste management technologies to reduce impacts and threats to the local waterways.

Reflection on outcomes

Encourage students to:

- Assess the effectiveness of the designs, processes and products.
- Examine the benefits and costs of the technologies in functional, social and environmental terms.
- Discuss the main obstacles and opportunities in obtaining information about the innovative water and waste management practices used to protect and conserve our water.
- Write an account of the investigation or develop a flowchart identifying strengths and weaknesses, opportunities and threats of the strategies used by levels of Government and community groups in using innovative technologies to protect and manage the local waterway .
- Reflect on whether the investigation has changed students' individual attitudes to the use of innovative technologies.

After reflection, stimulate group discussions to identify and deal with unresolved questions and to initiate future investigations.

References

Books

Armstrong, P (1998), *The Waste Wise Way: savings, benefits and school operating practices*, Ecorecycle, Victoria.

Dodd, B. & J. Dodd (1994), *Geographical Perspectives of People and their Environment*, SECTRUM, The Jacaranda Press, Milton.

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Great Barrier Reef Marine Park Authority (1999), *Reef Manual*, GBRMPA, Townsville.

Keep Australia Beautiful Council (1998), *School Environmental audit. A guide to best practice environmental management*. Keep Australia Beautiful Council, QLD.

Tyler Miller, G. (1994), *Living in the Environment*, International Thomson Publishing, USA.

Preuss, P., G. Duke & J. Rogers (1998), *A Sustainable Earth*, VAAE, Cambridge University Press, Melbourne

Hamston, Murdoch (1998), *.Integrating Socially, Planning Integrated Units of work for Social Education.*, Eleanor Curtin Publishing. VIC. Australia.

Ribbons of Blue(1998) Water and Rivers Commission of WA - Eutrophication Experiment.

Brochures/Leaflets

Adelaide City Council fact Sheet *Torrens Lake Blue Green Algae*.

Public Health Fact Sheets from Queensland Health Dept. on Nitrates and Phosphates in the Water System.

WEBSITES

www.nrm.gov.au/monitoring/indicators/estuarine/algal.html

www.rbgsyd.nsw.gov.au/information-about-plants/botanical-info/australian-freshwater-algae2(PICTURES)

www.watercare.net/wll/himp-algalblooms.html.

www.dlwc.nsw.gov.au/regions/sydney/water/algae.html

www-cyanosite.bio.purdue.edu/ (PICTURES)

www.science.org.au/nova/017/017key.htm

tas.waterwatch.org.au/manuals.htm

www.murraybluegreenalgae.com/common_questions.htm

[www.tas.waterwatch.org.au/pdf/Part 5 Monitoring Algae.pdf](http://www.tas.waterwatch.org.au/pdf/Part_5_Monitoring_Algae.pdf)

www.nrm.gov.au/monitoring/indicators/estuarine/algal.html

www.epa.nsw.gov.au/soe/97/ch3/8_3.htm

| Title | Topic ID | Category | Year | Publisher Name |
|---|-----------------|------------------|-------------|---|
| Freshwater algae in Australia | algae | book | 1997 | Sainty and Associates |
| What scum is that? Algal blooms and other prolific plant growth | algae | poster | 1995 | Land & Water Conservation |
| Blooming blue green algae: adult study circles (2hrs) | algae | cassette tape | | Murray-Darling Basin Commission |
| Blue-green algae & nutrients in Victoria | algae | folder | 1996 | State Government of Victoria |
| Biomonitoring with diatoms | algae | book | 1998 | Dept of Geographical and Environmental Studies UA |
| A new way to clean our rivers? | algae | magazine | | |
| Cyanobacteria and urban water supplies | algae | magazine | | CRC for Water Quality and Treatment |
| New cure for the blue-green algae blues? | algae | magazine | 1995 | CSIRO Division of Water Resources |
| Toxic algae blooms - a sign of rivers under stress | algae | Internet sourced | | Australian Academy of Sciences |
| Nutrient management strategy for Victorian inland waters | algae | report | 1995 | State Government of Victoria |
| Consumption of cyanobacteria by freshwater | algae | journal | 1994 | |
| Nutrient enrichment, algal blooms and the loss of | algae | brochure | 2000 | Environment Australia/LWRRDC |
| Contributing to the development of the algal management | algae | brochure | | MDBC/LWRRDC |
| Starting on the big picture: session 1 | algae | book | 1995 | AAACE/MDBC |

We would appreciate your constructive feedback on this resource and any suggestions/comments for improvements.