What's in the Water? – Year 11 & 12
Program Overview

Program Duration: 45 minute lecture + 1.5 hour water testing program

Minimum Participants: 5 students **Maximum Participants:** 32 students*

Location: Shark Bay

Relevant Subjects: Marine Science, Chemistry, Aquatic Practices, Cert. II in Sampling and Measurement

Program Overview:

During this program, students will investigate how water, with all its unique properties, is an extremely significant abiotic factor affecting the health of ocean life. *What's in the Water?* addresses relevant chemical, oceanographic and environmental concepts from the Queensland Syllabi for Marine Science, Chemistry and Aquatic Practices, the Australian Curriculum for Chemistry and course units from Certificate II in Sampling and Measurement. Students will use technical equipment to identify, measure and compare water quality parameters in a closed aquarium setting and an open, natural system, and will discuss the acceptable ranges of these parameters required for marine life to thrive. Through observations of aquaria, students will become informed as to the processes involved in maintaining water quality in a closed, aquarium system and they will consider the human impacts that can introduce variability in oceanic water quality. Students will learn about the chemical reactions contributing to ocean acidification as a result of climate change and warming oceans and what consequences (and subsequent chemical reactions) may arise for organisms with calcium carbonate skeletons such as coral reefs. This program can provide data for a class project or assessment task or can be utilised for skill development and to discuss experimental design prior to fieldwork in a natural setting.

Additional Information:

- A maximum number of 20 students can participate in the water quality testing component of this program at a time. In the instance of higher numbers (up to 32 students), a second practical session can be scheduled.
- A small additional fee per student will be charged for participation in the water-testing component of the *What's in the Water?* program.
- The water-testing component of this program may involve entering back of house areas and taking photos is not permitted in these areas.
- To be eligible for participation in the water-testing component of the *What's in the Water?* program, students, school staff and any accompanying adults must meet the program's participation criteria and must each have a signed copy (by students' guardians where necessary) of the program waiver form to deliver to the Marine Education Officer upon entry into Sea World.

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Program Schedule

Program Schedule:

Time

9:15am **Arrival**

The school will arrive promptly at 9:15am and will be met by a Marine Education Officer on the lawn next to the flagpoles out the front of Sea World.

9:20am **Park Entry**

The Marine Education Officer will lead the school group through the admissions gate to Shark Bay for the education program.

9:30am **Education Program**

A 45-minute lesson will serve to provide educational content and technical instruction for the practical water-testing component of this program. Please note: selection of this program will prevent the school group from seeing the morning *Seal Guardians Presentation*.

10:15am **Water Quality Testing Program/s**

*For schools with 20 or fewer students, the water quality testing will be completed as one group. For school groups of 20 to 32 students, a second water testing session will be needed and will require approval from Sea World's Marine Education team before the booking is confirmed.

Each water quality testing session will take approximately one to one and a half hours.

Following the 45-minute lesson, the first group of students will be taken to Shark Bay Wharf to conduct water quality tests with Marine Education staff. The water testing component may involve heading into a back of house area to test water from the Broadwater (and photos are not permitted in these areas).

While we will endeavour to begin the water testing immediately following the lesson, due to equipment requirements, we cannot guarantee this. The latest the first water quality testing session may begin is midday.

11.45am **Program Conclusion (approximate)**

If there is only one water quality-testing session, and if it begins immediately after the lesson, this program will conclude at approximately 11:45am and students will be free to enjoy the park for the rest of the day, at the discretion of school staff. In the instance of a second water quality testing session, the program will finalise (at the latest) one and a half hours after final water testing session begins.

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Alignment with Queensland Senior Syllabi:

Science as a Human Endeavour - General
Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility.
Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines.
Advances in science understanding in one field can influence other areas of science, technology and engineering.
The use and acceptance of scientific knowledge is influenced by social, economic, cultural and ethical contexts.
The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences.
Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions.
Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability.
Scientific knowledge can be used to inform the monitoring, assessment and evaluation of risk.
Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question.

MARINE SCIENCE (2019)	
Unit 1: Oceanography	
Unit objectives	1. Describe and explain an ocean planet and the dynamic shore
	2. Apply understanding of an ocean planet and the dynamic shore
	3. Analyse evidence about an ocean planet and the dynamic shore
	4. Interpret evidence about an ocean planet and the dynamic shore
	5. Investigate phenomena associated with an ocean planet and the dynamic shore
	6. Evaluate processes, claims and conclusions about an ocean planet and the dynamic shore
	7. Communicate understandings, findings, arguments and conclusions about an ocean planet and the dynamic shore.
Topic 1: An ocean planet	
Ocean currents	Describe the physical and chemical properties of water, including structure, hydrogen bonding, polarity, action as a solvent, heat capacity and density
	Define thermocline, halocline and pycnocline
Topic 2: The dynamic shore	
Coastal impacts	Recognise that longitudinal studies allow scientists to observe changes occurring in marine environments (e.g. satellite imagery, aerial photography, field research)
Coastal conservation and monitoring impacts	Compare the terms point source and non-point source forms of pollution
	Describe two direct methods of monitoring water pollution levels using an abiotic test (e.g. nitrate, phosphate, heavy metals) or a biotic test (e.g. faecal coliform)

SEA WORLD GOLD COAST AUSTRALIA

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Coastal conservation and monitoring impacts (continued)	Identify and describe land management practices that contribute to the health of marine ecosystems, including siltation, algal blooms and agricultural practices
	Mandatory practical: Conduct water quality tests on a water sample.
Unit 2: Marine biology	
Unit objectives	1. Describe and explain marine ecology and biodiversity, and marine environmental management
	2. Apply understanding of marine ecology and biodiversity, and marine environmental management
Science as a Human Endeavour (unit specific)	Effective marine ecosystem management is informed by the development of complex models requiring a broad range of scientific knowledge in gathering data, identifying indicators and ensuring measurement is valid and reliable.
Topic 2: Marine environmental management	
Marine conservation	Recall the arguments for preserving species and habitats (i.e. ecological, economic, social, aesthetic, ethical)
	Describe the role of stakeholders in the use and management of marine ecosystems
	Recognise the issues affecting a selected marine ecosystem
Unit 3: Marine systems – connections and change	
Unit objectives	1. Describe and explain the reef and beyond, and changes on the reef
	2. Apply understanding of the reef and beyond, and changes on the reef
Science as a Human Endeavour (unit specific)	The majority of scientists accept that anthropogenic atmospheric changes are linked to global temperature increases. Analysis of gas concentrations in the atmosphere and ice cores indicates that greenhouse gas levels have increased as a result of emissions from human activities.
	Scientists agree that global predictions on climate change are accurate; however, at a regional scale, due to localised conditions, predictions are less reliable.
	Decisions about actions to mitigate the effects of climate change depend on the perception of risk by individuals, communities, governments and international agencies and reflect their social, economic and cultural values.
Topic 1: The reef and beyond	
Coral reef development	Recall that the limestone skeleton of a coral is built when calcium ions [Ca^{2+}] combine with carbonate ions [CO_3^{2-}]
Topic 2: Changes on the reef	
Anthropogenic change	Recall the global anthropogenic factors affecting the distribution of coral (i.e. coral mining, pollution: organic and non-organic, fishing practices, dredging, climate change, ocean acidification and shipping)
	Describe the specific pressures affecting coral reefs (i.e. surface run-off, salinity fluctuations, climate change, cyclic crown-of-thorns outbreaks, overfishing, spills and improper ballast)
Ocean equilibria	Explain the reason for differences between ocean pH and freshwater — presence of carbonate buffering system

Ocean equilibria (continued)	Recognise that increases in atmospheric carbon dioxide influences both global temperature and ocean pH
	Describe sources of carbon dioxide in the atmosphere and how this influences ocean chemistry
	Describe the effect of ocean acidification on sea water in terms of increasing the concentration of hydrogen ions decreasing the concentration of carbonate ions
	Understand that the ocean's capacity to absorb carbon dioxide is changing and is linked to temperature (uptake) and changes in primary productivity (storage, e.g. biological pump).
Implications for marine systems	Recognise that the type of carbonate ions and concentration of ions have an implication for the development of shell-forming and skeletal-forming organisms including hard corals (Scleractinia), coralline algae, molluscs, plankton and crustaceans
	Describe the potential consequences of ocean acidification for coral reef ecosystems

CHEMISTRY (2019)	
Unit 2: Molecular interactions and reactions	
Unit objectives	1. Describe and explain intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	2. Apply understanding of intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	3. Analyse evidence about intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	4. Interpret evidence about intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	5. Investigate phenomena associated with intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	6. Evaluate processes, claims and conclusions about intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
	7. Communicate understandings, findings, arguments and conclusions about intermolecular forces and gases, aqueous solutions and acidity, and rates of chemical reactions
Science as a Human Endeavour (unit specific)	Water quality: Knowledge of the composition of water from different sources informs decisions about how that water is treated and used.
Topic 2: Aqueous solutions and acidity	
Solubility	Recognise that changes in temperature can affect solubility and recall that most gases become less soluble as solvent temperature increases while most solutes become more soluble as the solvent temperature increases
pH	Recall that pH is dependent on the concentration of hydrogen ions in solution
	Use the pH scale to compare the levels of acidity or alkalinity of aqueous solutions

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Unit 3: Equilibrium, acids and redox reactions	
Unit objectives	1. Describe and explain chemical equilibrium systems and oxidation and reduction
	2. Apply understanding of chemical equilibrium systems and oxidation and reduction
Science as a Human Endeavour (unit specific)	Carbon dioxide in the atmosphere and hydrosphere: The oceans contribute to the maintenance of steady concentrations of atmospheric carbon dioxide because the gas can dissolve in seawater through a range of reversible processes.
Topic 1: Chemical equilibrium systems	
pH scale	Understand that the pH scale is a logarithmic scale and the pH of a solution can be calculated from the concentration of hydrogen ions using the relationship pH = –log10 [H+]

AQUATIC PRACTICES (2019)	
Environmental	
E2: Ecosystems	E2.1 Aquatic ecosystems include biotic and abiotic components • Abiotic components, e.g. temperature, light, pH, dissolved oxygen, salinity • Relationships between biotic and abiotic components • Different aquatic ecosystems, e.g. coastal, estuarine and riparian
	E2.4 The condition of aquatic ecosystems varies as a result of the biotic and abiotic components • Condition of biotic and abiotic components, e.g. testing for pollutants and taking measurements • Factors that impact on ecosystem condition • Impacts of component condition on their relationship/s, e.g. algal bloom
E3: Conservation and sustainability	E3.1 Marine and freshwater pests and threats, including pollution, impact on aquatic environments • Ways aquatic industries impact on their environment, e.g. overfishing, agricultural runoff and human erosion activities • Sources of aquatic pollution and associated threats, including: – ballast water – oil pollution – fouling organisms
E4: Citizen science	E4.1 The scientific method involves asking questions about the natural world and collecting data systematically to address the question • Dependent and independent variables • Importance of controlling variables in scientific investigations
Commercial	
C1: Employment	C1.2 There are different career opportunities and pathways in aquatic industry and businesses • Roles in aquatic industry and businesses, e.g. marine engineer, eco-tour guide, boat-builder, dive instructor, commercial fisher, aquaculturist

C2: Aquaculture, aquaponics and aquariums	C2.1 Different methods are suited to particular stock/plants, locations, climates, types of water and purposes • Different methods, e.g. cage/pond farming, open/closed systems
	C2.2 Water quality is essential for animal/plant production • Water quality parameters, e.g. pH, dissolved oxygen, nitrates • Testing and adjusting water quality, e.g. temperature
Safety and management practices	
SM4: Management practices	SM4.1 Working with others is essential when working in aquatic environments • Instructions from teachers and trainers • Strategies for working and collaborating effectively in teams • Effective communication strategies
	SM4.2 Completion of aquatic activities requires a range of management skills • Plan and organise aquatic activities • Management of time and resources to complete aquatic activities • Demonstration of initiative

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Alignment with Australian Curriculum:	
CHEMISTRY	
Science Inquiry Skills	
Identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes (ACSCH040; ACSCH074)	
Conduct investigations, including measuring pH and the rate of formation of products, identifying the products of reactions, and testing solubilities, safely, competently and methodically for the collection of valid and reliable data (ACSCH042)	
Represent data in meaningful and useful ways, including using appropriate graphic representations and correct units and symbols; organise and process data to identify trends, patterns and relationships; identify sources of random and systematic error; identify anomalous data; estimate the effect of error on measured results; and select, synthesise and use evidence to make and justify conclusions (ACSCH043)	
Science as a Human Endeavour	
Science is a global enterprise that relies on clear communication, international conventions, peer review, and reproducibility (ACSCH048)	
Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSCH049)	
Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSCH050)	
The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSCH051)	
The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSCH052)	
Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSCH053)	
Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSCH054; ACSCH088)	
Unit 2: Molecular interactions and reactions	
Aqueous Solutions and Acidity	Rainwater is naturally acidic as a result of carbon dioxide dissolved in water and from volcanic emission of sulphur. However scientists have observed an ongoing increase in the acidity of rain and the reduction of the pH of the oceans, which has been explained by an increased release of acidic gases including carbon dioxide, nitrogen oxides and sulphur dioxide into the atmosphere (ACSCH053).
	Water is a key substance in a range of chemical systems because of its unique properties, including its boiling point, density in solid and liquid phases, surface tension, and ability to act as a solvent (ACSCH061)
	The presence of specific ions in solutions can be identified using analytical techniques based on chemical reactions, including precipitation and acid-base reactions (ACSCH064)
	The solubility of substances in water, including ionic and molecular substances, can be explained by the intermolecular forces between species in the substances and water molecules, and is affected by changes in temperature (ACSCH065)

Aqueous Solutions and Acidity (continued)	The pH scale is used to compare the levels of acidity or alkalinity of aqueous solutions; the pH is dependent on the concentration of hydrogen ions in the solution (ACSCH066)
Unit 3: Equilibrium, acids and redox reactions	
Chemical Equilibrium Systems	The pH scale is a logarithmic scale and the pH of a solution can be calculated from the concentration of hydrogen ions; K_w can be used to calculate the concentration of hydrogen ions from the concentration of hydroxide ions in a solution (ACSCH100)
	Acid-base indicators are weak acids or bases where the acidic form is of a different colour to the basic form (ACSCH101)

Alignment with Certificate Courses:	
CERTIFICATE II IN SAMPLING AND MEASUREMENT	
Relevant Course Units	
MSAENV272B	Participate in environmentally sustainable work practices
MSL912001A	Work within a laboratory/field workplace (induction)
MSL922001A	Record and present data
MSL943002A	Participate in laboratory/field workplace safety
MSL952001A	Collect routine site samples
MSL952002A	Handle and transport samples or equipment
MSL913001A	Communicate with other people
MSL913002A	Plan and conduct laboratory/field work
MSL973001A	Perform basic tests