

MARINE ENVIRONMENT STUDENTS MANUAL

Suitable for syllabus in

Marine Studies and Marine Education (Queensland)

Marine Studies (New South Wales)

Maritime Studies (South Australia)

Environmental Education (Victoria and Northern Territory)

Senior Science Marine Studies and Nautical Studies (Western Australia)

and

companion to the textbook

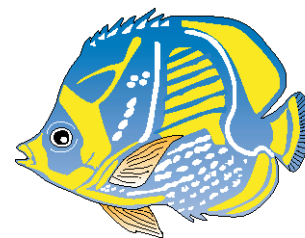
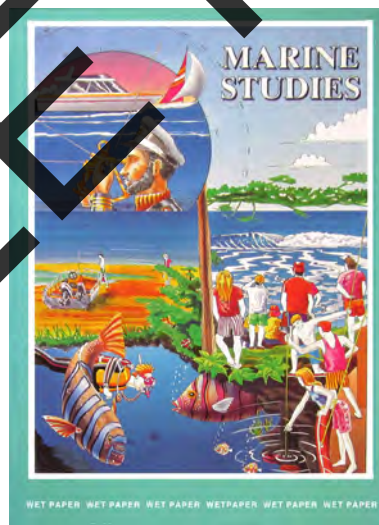
MARINE STUDIES

A course for senior students

by

Bob Moffatt

B Sc, Dip Ed, Grad Dip.Ed Admin, MACE



Wet Paper

QUALITY ASSURANCE

Wet Paper is committed to total quality management and the implementation of a quality system throughout each project undertaken, to ensure the highest standards of professionalism, ethical practice and client and customer satisfaction.

Quality assurance is the responsibility of the manager who has the authority to manage all functions to quality, and is the nominated Quality Assurance Manager as defined in AS 3901/ISO 9001.

To ensure the best possible use of this book for quality education, Wet Paper offers the following services.

1. For schools who purchase single copies, a free telephone support service is available in office hours by simply telephoning Wet Paper on (07) 55 972 806 or by faxing your request or leaving a message on our answering machine on (07) 55 39 4187 any time.
2. For schools who use class sets of the book, an in-service program is available for staff wishing to implement any of the activities. A program can be arranged by contacting the manager.

Wet Paper also has a commitment to actively support teacher associations and conservation groups with an interest in marine studies education.

3. Schools or teachers can write for our complimentary newsletter which outlines conference dates and other seminars where free workshop sessions are held explaining any activities in this book.
4. Equipment used in this book is available for training purposes at our Wet Paper Laboratory and Classroom during office hours. Our address is 14 Milbong Terrace, Ashmore, Queensland, 4214.
5. If we cannot answer your questions, Wet Paper has a team of highly qualified consultants who are willing to assist.
6. As this is the first edition, we welcome comments on any of the activities. In time, workbooks will be written to indicate the time each activity takes, its sequence and core questions relevant to national syllabus. As many exercises could take more than two hours, some selection of questions may be necessary before setting students homework.

BEST ENVIRONMENTAL PRACTICE

Each school should develop a best environmental practice statement for marine studies. To help schools do this, Exercise 141 has been prepared as a 'discussion starter'.

In Sections 1 and 2 it is a requirement of some activities to collect specimens of sand, live animals or plants or travel on an excursion into the marine environment.

It is pointless teaching conservation in Section 4 if practical aspects of it are not demonstrated. The following points are worth considering in your school's conservation code:

1. Can a photograph substitute for the collection of a live specimen?
2. Is all waste collected and taken back to school? Encourage students not to use rubbish bins at the seaside as these are often tipped over or serounged through by animals looking for a feed.
3. Take home bottles and cans that can be recycled at school and if chemicals are used, bring home all waste in slop bottles.
4. Wet Paper encourages students to study live specimens so that a deep love can be generated for life on earth. However the following considerations are recommended:
 - Avoid collecting yourself until trained. Consider buying from a collector who has a permit and is restricted to numbers and can be managed. Most collectors are skilled in the handling of live animals and know about stress and mortality rates. Use an aquarium shop to obtain specimens and find out what conditions would give the specimens the greatest chance of survival.
 - Use hardy freshwater species to illustrate marine examples. Many principles of life in water are the same in both fresh and marine environments.
 - In the activities selected, it is hoped we have chosen the toughest of animals and plants.
 - The aim of students working with live animals and plants is to instil a love of the animals and plants of the sea. Consider buying fish and prawns from a fish shop and avoid any other dissections unless you are specifically researching that animal.



CONSULTANTS

Dave Claridge

Marine Education Consultant, Maryborough

Graham Anderton

South Fremantle Senior High School

Gwen Connolly

St. Augustine's College, Cairns

Sue Cerato

Benowa State High School

Len Couzins

Benowa State High School

Peter Hamlyn

North Mackay State High School

Lindsay Holthouse

Senior Secondary Assessment Board, SA

Tony Isaacson

Hallett Cove High School, SA

Geoff Jensen

Innisfail State High School

Phil King

Coffs Harbour High School

Kym McKaige

Department of Primary Industries

Ken Maclean

Babinda State High School

John Maloney

St. Augustine's College, Cairns

Greg McGarvie

Pioneer SHS College, Mackay

Mick O'Connor

Ballina State High School

Mark Rickard

Benowa State High School

Pamela Rutledge

St. Hilda's School, Perth

Kathy Steggles

Whitsunday Anglican School, Mackay

John Smith

Environmental Education Consultant, SA

Jan Thornton

Sea World

Tim Ryan

Maryborough State High School

Alan Wolfe

South Fremantle Senior High School

SAMPLE PAGE

ACKNOWLEDGEMENTS

Permissions

Thanks to the following for giving permission to Wet Paper to reproduce their works
Australian Maritime Safety Authority, Australian Fisheries Management Authority, Great Barrier Reef Marine Park Authority, Sea World, MESA Gold Coast, Surfrider Foundation, Queensland Transport

Principal photographer

Bob Moffatt

Other photographs

Geoff Jensen, Tim Ryan, Australian Fisheries Management Authority

Principal illustrator

Mark Moffatt

Other illustrations

David Tulip, Bernie Cook, Jack Marsh, Tony Edwardson, Jan Thornton, Sue Oats, Steven Byers, Brady Moffatt, Bob Moffatt, Queensland Transport, Great Barrier Reef Marine Park Authority (Project Reef Ed)

Additional advice and assistance

Thelma Moffatt, John Maloney, Tony Failes, Damian Klarwein, Roger Nicol, Geoff Jensen, Alan Wolfe, Paul Sumpter, Jan Thornton, Kym McKauge, Peter Hamlyn, Tina Redden, Annaliese Easton, John Foss, Greg McGarvie, Phil King, Len Couzins, Ward Nicholas, Malcolm Turner, John Foss, Matt Keys, Michael Leggi Wilkinson, Tom Alletson, Ian Tibbets, Nick McMorro, Bill Fowles, Norman Lopez, Erna Walraven and Derek Spielman

Teachers and lecturers

Jack Marsh, David Tulip, Cam McRobbie, Tom Hailstone, Prof Stephenson, Jack Greenwood, Don Fielder, Don Griffiths, Keith Tronc

Supporters and advisors

Barbara Clem, Carol Fortino, Warren Beezley, Ann Coopersmith, Peter Stannard, Bill Stapp, Alastair Mitchell, Paul Threlfall, Jill Green, Mark Snartt, Derek Foster, Richard Harris, Dawn Couchman, Geoff Mercer, Len Zell, Rob Heaney, Shirley Heaney, Don Alcock, Don Fee, Alan Perry, Angus Jackson, Sam Smith, Dawn Couchman, Bob Critchley, Graham Nash, Dave Olreichs, Phil Bishop, Al Greenfiel, Kathy Steggels, John Maloney, Paul Sumpter, Dave Mitchell, John and Meg Kennedy, Michael Michie, Keith Enchielmier, Malcolm Turner, Neville Coleman, Neil Solomons, Bill Templeman, Jan and Barry Alty, Greg Smith, Noel Gillin, John Brown, Peter Stevens, Ian Neil, James Young, Mel Phillips, Bob Ellis, Martin Tellermans, John Broadfoot, Jan Thornton, Kelvin Rodgers, Tertius DeKluyver, Perry Kaigan, Ian Gibbs, Trevor Long, Terry Balsom, Dennis Bridger, Steven Byers, Carol Clavery, Cyril Connell, Tony Failes, Mark Warne, Rod Waldon, Jan Oliver, Bill Dobbie, Sue Cerato, Ann Summers, David Kopelke, Marg Evans, Ann Kenny, Graham Mitchell, Greg Martin, Steve Hall, Peter Holm, Rod Waldon, Dave Reid, Jim Redfield, John Howard, Vera Weitsz, David Gorwin, Stana Hodge, Meran Kilgour and Carol Clavery, John Quinlan, Judy Zolecki, Ken Gilbert, Bill Dobbie, Sue Oats, Kelvin Rodgers, Carol Clavery, Jill Agnew and Gwen Lane, Ann Summers, Margaret Evans, Len Couzins, Bill Baumann, Peter Stannard, Fabian Fay, Col Reinhardt and Mike Julian

Mentors

Jack Marsh, Cyril Connell, Ken Gilbert, Dave Tulip

Schools equipment and students

Grateful acknowledgement is made of the following schools who assisted with photographic shoots, equipment and advice: Innisfail State High School, Pioneer State High School, Benowa State High School, South Fremantle Senior High School, Mackay North State High School and Sea World Project Neptune

Cover

Merv Smith Studio Designs

CONTENTS

SECTION 1 Non – LIVING ASPECTS OF THE SEA

EXERCISE 1 SEA WATER SALTS	11
EXERCISE 2 SALINITY	12
EXERCISE 3 SEA WATER DENSITY	14
EXERCISE 4 WAVES	16
EXERCISE 5 LONGSHORE DRIFT	20
EXERCISE 6 LONGSHORE DRIFT FIELD WORK	22
EXERCISE 7 FORCES THAT CAUSE OCEAN WATER TO MOVE	24
EXERCISE 8 OCEAN CURRENTS	26
EXERCISE 9 CURRENTS AROUND AUSTRALIA AND NEW ZEALAND	28
EXERCISE 10 LOCAL CURRENTS	30
EXERCISE 11 OCEAN SHAPES	32
EXERCISE 12 HYPOTHETICAL BAY	34
EXERCISE 13 HYPOTHETICAL REEF	36
EXERCISE 14 BEACH FORMATION AND EROSION PROCESSES	38
EXERCISE 15 ORBIT FIELDS	40
EXERCISE 16 SAND PER CENT COMPOSITION	44
EXERCISE 17 BEACH PROFILES	48
EXERCISE 18 THE ACTIVE BEACH SYSTEM	52
EXERCISE 19 BEACH EROSION MIND MAPPING	54
EXERCISE 20 DDT IN THE FOOD CHAIN	56
EXERCISE 21 MANAGEMENT OF LONGSHORE DRIFT	58
EXERCISE 22 ST. VINCENT GULF	60
EXERCISE 23 PRACTICE ESSAY ON BEACH EROSION	63
EXERCISE 24 METHODS USED TO COMBAT OIL POLLUTION	64
EXERCISE 25 MARINE OIL POLLUTION	65
EXERCISE 26 EFFECT OF OIL ON FEATHERS	66
EXERCISE 27 OIL SPILL IN HYPOTHETICAL BAY	68
EXERCISE 28 POINT BREAK	70
EXERCISE 29 MAKING A BEACH WALKWAY	72
EXERCISE 30 SEAWATER TEST	74
EXERCISE 31 BEACHES TEST	78

SECTION 2 LIVING ASPECTS OF THE SEA

EXERCISE 32 KEY TERMS	81
EXERCISE 33 PLANKTON OF YOUR LOCAL AREA	82
EXERCISE 34 PLANKTON THREE LEVEL GUIDE	88
EXERCISE 35 LIFE CYCLES	90
EXERCISE 36 ASSOCIATIONS	92
EXERCISE 37 SPONGES	94
EXERCISE 38 ADAPTATIONS OF PLANKTON	96
EXERCISE 39 ANEMONES AND CORALS	98
EXERCISE 40 FISH DISSECTION	100
EXERCISE 41 SHARKS AND RAYS	104
EXERCISE 42 THE IMPORTANCE OF MANGROVES	106
EXERCISE 43 SEAGRASSES	108
EXERCISE 44 MANGROVE TRANSECT	110
EXERCISE 45 MANGROVE LIFE CYCLES	112
EXERCISE 46 HOW TO BUILD AND USE A PLANKTON NET	114
EXERCISE 47 SAMPLING METHODS	116
EXERCISE 48 OSMOSIS	120
EXERCISE 49 ENVIRONMENTAL EFFECTS OF FRESHWATER	122
EXERCISE 50 ROCKY SHORE HABITATS	124
EXERCISE 51 ROCKY SHORE LIFE	126
EXERCISE 52 LOOKING AT MARINE LIFE	128
EXERCISE 53 BARNACLES	130
EXERCISE 54 GASTROPODS	132
EXERCISE 55 ALGAE	134
EXERCISE 56 CORALS	136
EXERCISE 57 ECHINODERMS	138
EXERCISE 58 CEPHALOPODS	140
EXERCISE 59 CRABS	142
EXERCISE 60 ROCKY SHORE ECOSYSTEM STUDY	144
EXERCISE 61 DRAWING FOOD CHAINS	148
EXERCISE 62 MARINE ECOSYSTEMS	150
EXERCISE 63 ADAPTATIONS	152
EXERCISE 64 PHYTOPLANKTON	154
EXERCISE 65 SEAWEEDS	156
EXERCISE 66 ADAPTATIONS OF FISH	158
EXERCISE 67 STREAMLINING	160
EXERCISE 68 VISCOSITY	162
EXERCISE 69 BUOYANCY	163

EXERCISE 70 DENSITY OF SEA WATER	164
EXERCISE 71 WHAT MAKES ADAPTATIONS NECESSARY?	166
EXERCISE 72 COMPARING AND CONTRASTING MANGROVES AND ESTUARIES	168
EXERCISE 73 SAND DUNE PLANTS	170
EXERCISE 74 PRAWN DISSECTION	172
EXERCISE 75 HOW TO SET UP A MARINE AQUARIUM	176
EXERCISE 76 FOOD CHAINS	178
EXERCISE 77 ARTEMIA LIFE CYCLE	180
EXERCISE 78 FIBREGLASS FISH	184
EXERCISE 79 PRESSING SEAWEEDS	186
EXERCISE 80 TURTLES	188
EXERCISE 81 SEA BIRDS	190
EXERCISE 82 MARINE MAMMALS	192
EXERCISE 83 CLASSIFICATION	194
EXERCISE 84 CLASSIFICATION KEY	196
EXERCISE 85 SEAWEED CLASSIFICATION	198
EXERCISE 86 UNDERWATER SLATE	200
EXERCISE 87 NEKTON TEST	201
EXERCISE 88 BENTHOS TEST	204
EXERCISE 89 RESEARCH QUESTIONS	208

SECTION 3 COMMERCIAL USES

EXERCISE 90 ABALONE STOCK	209
EXERCISE 91 THE AUSTRALIAN HERRING	212
EXERCISE 92 SOUTH EAST FISHERY	214
EXERCISE 93 ECOTOURISM	216
EXERCISE 94 MARICULTURE	218
EXERCISE 95 AQUACULTURE PROJECTS	220
EXERCISE 96 SHIPPING	224
EXERCISE 97 ECOTOURISM SURVEY	226
EXERCISE 98 IS TOURISM GOOD FOR THE COMMUNITY?	228
EXERCISE 99 BALLAST WATER PROBLEMS	230
EXERCISE 100 POSITIVE AND NEGATIVE EFFECTS	233
EXERCISE 101 STARFISH PEST STUDY IN HYPOTHETICAL BAY	234
EXERCISE 102 MARPOL	236
EXERCISE 103 MASTER MARINERS STORY	238
EXERCISE 104 AT THE FISH SHOP	240
EXERCISE 105 PRAWN FISHERY ECONOMICS	242
EXERCISE 106 THE ORANGE ROUGHY	246
EXERCISE 107 ADOPT A SHIP	249
EXERCISE 108 COMMERCIAL FISHING GAME	250
EXERCISE 109 WHAT TYPE OF FARM FOR ME?	252
EXERCISE 110 AQUACULTURE RESEARCH	254
EXERCISE 111 TEST	255

MANAGEMENT AND CONSERVATION

EXERCISE 112 KEY TERMS	257
EXERCISE 113 ATTITUDES AND VALUES	258
EXERCISE 114 ECOLOGICAL SUSTAINABLE DEVELOPMENT	260
EXERCISE 115 SEA RIGHTS - THREE LEVEL GUIDE	262
EXERCISE 116 TERRITORIAL WATERS AND AFZ	264
EXERCISE 117 MULTIPLE USE	266
EXERCISE 118 MANAGEMENT STRATEGIES	268
EXERCISE 119 WHY ARE MEPAS NECESSARY?	270
EXERCISE 120 TRADE WASTE	272
EXERCISE 121 LOCAL MANAGEMENT ISSUES	274
EXERCISE 122 ADOPT AN NGO	276
EXERCISE 123 MESA SEAWEEK AND OCEAN CARE DAY	278
EXERCISE 124 LIVE FISH EXPORTS	280
EXERCISE 125 OIL AND GAS	282
EXERCISE 126 LOCATIONS OF AUSTRALIAN FISHERIES	284
EXERCISE 127 CONSERVATION PRINCIPLES	286
EXERCISE 128 RIPARIAN HABITAT ASSESSMENT	288
EXERCISE 129 WATER VELOCITY IN THE CATCHMENT	290
EXERCISE 130 SOURCING LITTER POLLUTION	292
EXERCISE 131 CONFLICTS	294
EXERCISE 132 DILEMMA EXERCISE	296
EXERCISE 133 WRITING A NEWSPAPER ARTICLE	298
EXERCISE 134 FUTURE PROBLEM SOLVING	300
EXERCISE 135 VENETIAN ISLAND	302
EXERCISE 136 TWEED RIVER WALLS	304
EXERCISE 137 MANAGERS AND USER GROUPS	306
EXERCISE 138 MANAGEMENT PROPOSALS	308
EXERCISE 139 HYPOTHETICAL BAY 2010	310
EXERCISE 140 CONTROVERSY AT HYPOTHETICAL BAY?	314
EXERCISE 141 BEST ENVIRONMENTAL PRACTICES	320
EXERCISE 142 PROBLEM SOLVING	324
EXERCISE 143 IMAGES ESSAY	326
EXERCISE 144 WHALE BAY GAME	327
EXERCISE 145 TRADITIONAL MANAGEMENT METHODS	330
EXERCISE 146 DRAIN STENCILLING	332
EXERCISE 147 AUDIOVISUAL MATERIALS LIST	335
SUBJECT INDEX	336
EQUIPMENT INDEX	336

SECTION 1

NON - LIVING ASPECTS

EXERCISE 1 SEA WATER SALTS

METHOD

1. Measure out half a teaspoon of salt and empty it into the conical flask.
2. Now add enough water to cover and dissolve the salt.
3. Set up the equipment as shown in Figure 1.1. Now light the spirit burner by using the manufacturers instructions and adjust the burner to produce a gentle flame under the flask.
4. Put on the safety goggles and keep them on until all the salt has evaporated (see safety warning).
5. When the water has nearly all evaporated, extinguish the burner and let the flask cool.
6. Take the stirring rod and scrape the salt out and onto a piece of filter paper.

QUESTIONS

1. Describe what happens to the water as it heats up.
2. What happens when salt water evaporates?
3. What happened when almost all the water was gone?
4. Did you get the same amount of salt back?
5. Use your textbook page 352 to define the following terms:
 - a. Solute.
 - b. Solvent.
 - c. Solution.

Research

1. Find out how salt is made commercially.
2. http://seawifs.gsfc.nasa.gov/ocean_planet.html

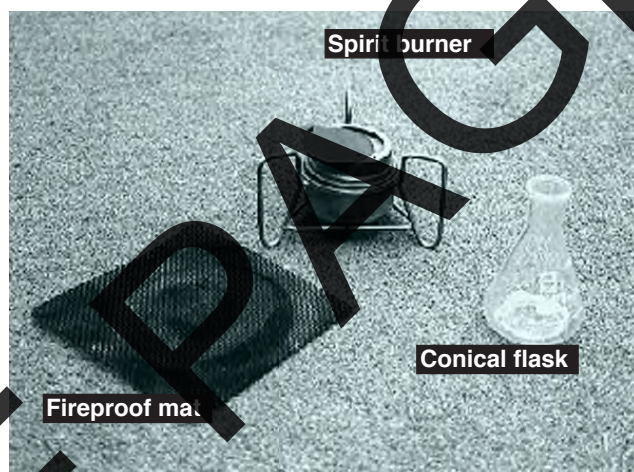


Figure 2.1. Experimental equipment

MATERIALS AND EQUIPMENT (PER GROUP)

- methylated spirits burner
- safety goggles
- table salt
- fireproof mat, matches, oven mitts
- very clean 50 mL conical flask and glass stirring rod
- filter paper
- tap water
- tea spoon

SAFETY WARNING

1. When the sea water solution has nearly all evaporated, it may "spit" up. To stop this remove the flame and let the remainder evaporate under its own heat.
2. All equipment will get very hot after a short time, so make sure you let it cool before touching it.



EXERCISE 2

SALINITY

METHOD

1. Divide up the class into six groups so that each group will work on a different gm/Litre saltwater solutions.
2. Collect 20 drops of your gm/Litre saltwater solution and add this carefully to the 50 mL conical flask.
3. Now add 3 drops of potassium dichromate indicator so as to just turn the sea water yellow as shown in Figure 2.1.

4. Add the silver nitrate drop by drop giving the conical flask a swirl after each drop as shown in Figure 2.2. Make sure someone counts each drop.

5. You will notice that a colour change appears under the drop as it falls into the sea water solution.

When these dark red patches hang around for an increasingly longer time, start swirling after each drop.

6. When one drop turns all the sea water a reddish brown, you have reached what we call the end point.

7. Record the number of drops to end point in data table 1, in Figure 2.4 beside the g/L entry.

8. Now collect the results from the other groups noting the number of drops to end point for each.

9. Use your class results from data table 1 to draw a calibration graph in the space provided in Figure 2.5 for the determination of salinity using the eye dropper technique. Your graph should look something like Figure 2.3. Extrapolate the graph to predict 35 000 and 40 000 mg/L.

10. Now use an unknown sample to determine its salinity and record your results in table 2 Figure 2.4.

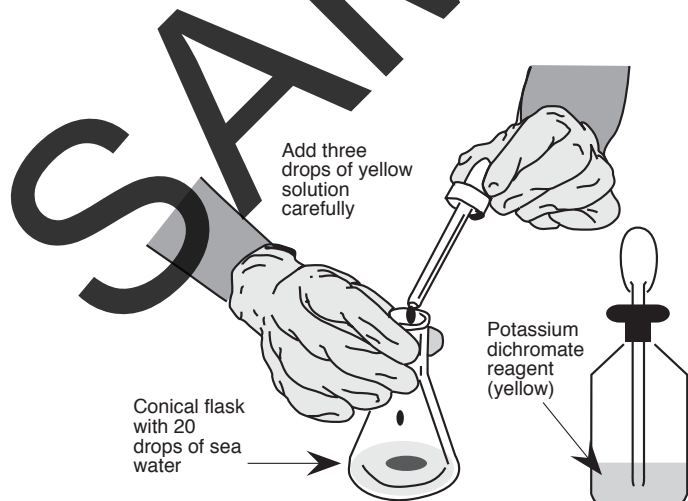


Figure 2.1 Use gloves to add the drops
Wet Paper

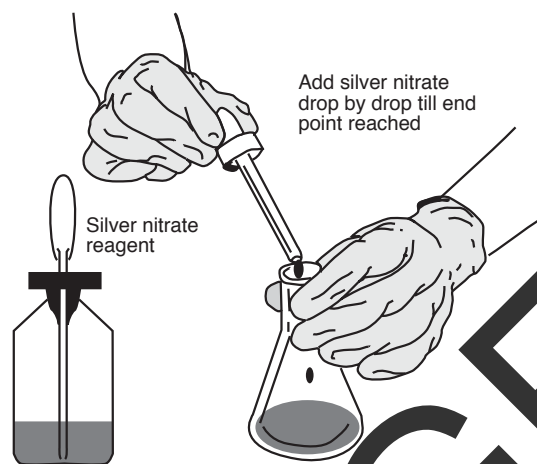


Figure 2.2 Adding silver nitrate solution
Wet Paper

MATERIALS AND EQUIPMENT (PER GROUP)

Note keep the 10, 20, 30 g/L solutions for the next exercise.

Equipment required

- 10 mLs of six saltwater standard solutions 5, 10, 15, 20, 25, 30, grams per litre
- 10 mLs of 0.5M Silver Nitrate solution
- salt water samples (various locations)
- potassium dichromate indicator solution
- 50 mL conical flask
- gloves
- two eye droppers — one marked salt, the other AgNO_3

Notes

1. Because eye droppers vary from manufacturer to manufacturer, you will need to keep the same sized eye droppers for future tests.
2. The eye dropper needs to deliver about .1 mL.
3. Potassium dichromate is poisonous (see safety warning below).

SAFETY WARNING

1. Potassium dichromate is a health risk and should be used carefully and in drops only from a well marked bottle.
2. Silver nitrate is hazardous and causes staining of the hands.
3. **Gloves must be worn during this experiment.**



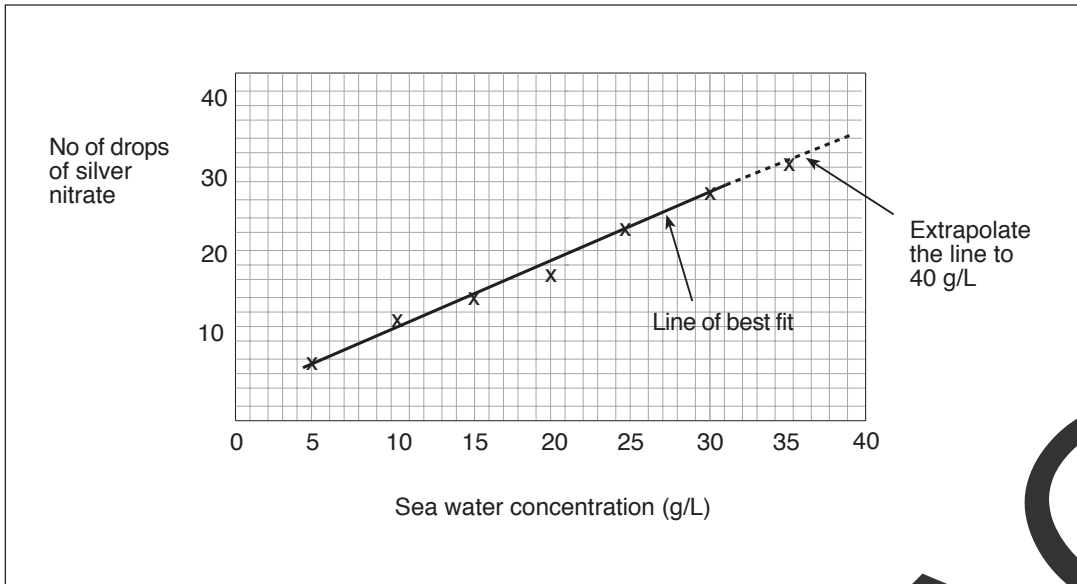


Figure 2.3 Sample calibration graph and safety warning

Data table 1		Data table 2		
Standard solution	Number of drops of silver nitrate to end point	Sample site (e.g. boat harbour near ramp)	Number of drops of silver nitrate to end point	Salinity in mg/L
5 g/L				
10 g/L				
15 g/L				
20 g/L				
25 g/L				
30 /L				

Figure 2.4 Results

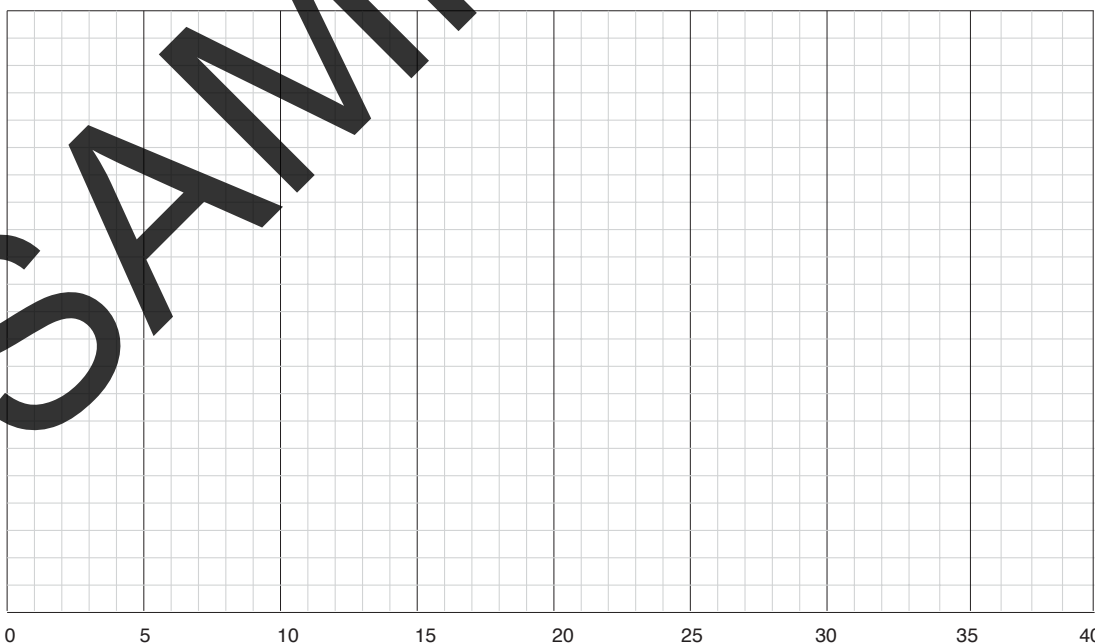


Figure 2.5 Calibration graph drawn from class results.

EXERCISE 3 SEA WATER DENSITY

METHOD

Part A

1. Sharpen two pencils to exactly the same length.
2. Now dissolve a teaspoon of salt in 100 mLs of water.
3. Place the two test tubes in the rack provided and 3/4 fill one with fresh water and the other with salt water.
4. Now place the pencils in each.
 - Can you see a difference? Which is higher? Record your results in Figure 3.1 under Part A.

Part B

5. Now take out one of the pencils and use a pen and ruler to mark down 0.5 cm intervals as shown in Figure 3.1.
 - We will call this your hydrometer.
6. Fill each of the 5 test tubes with the solutions labelled 0, 10, 20, 30, and 40 grams per litre.
7. Now carefully drop the pencil into each test tube as shown in the photograph.
 - Read the scale and record your results in the Table in Figure 3.2.
8. Now repeat the experiment with the other test tubes.
 - Record each of the results in the table as before.

MATERIALS AND EQUIPMENT (PER GROUP)

Part A

- 100 mL beaker
- 5 test tubes (equal size)
- 2 pencils
- test tube rack
- 100 mL beaker
- teaspoon and salt

Part B

- 5 test tubes (equal size)
- pen and ruler
- 10 mLs of 5 saltwater standard solutions labelled 0, 10, 20, 30 and 40 grams per litre

QUESTIONS

1. Now plot a graph of the standard solution (x axis) versus the hydrometer reading (y axis). Describe how the graph changes.
2. What does a hydrometer measure?
3. Which is more dense, salt water or fresh water?
4. If the tide was coming into a river, would the sea water be found on the top of the fresh water or the bottom?
5. What do you think a salt water wedge is in an estuary?

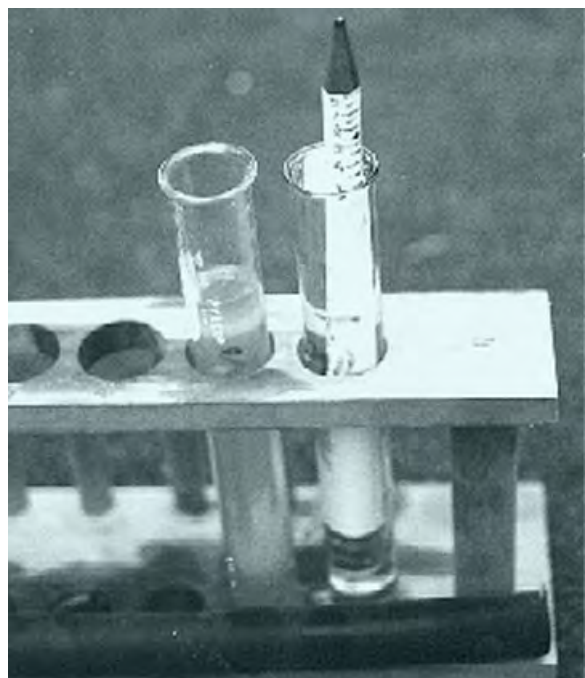


Figure 3.1 Experimental set up for Part B

RESULTS

Part A

Which pencil floated higher? _____

Part B

Data table

Standard solution	Hydrometer reading
0 g/L	
10 g/L	
20 g/L	
30 /L	
35 /L	

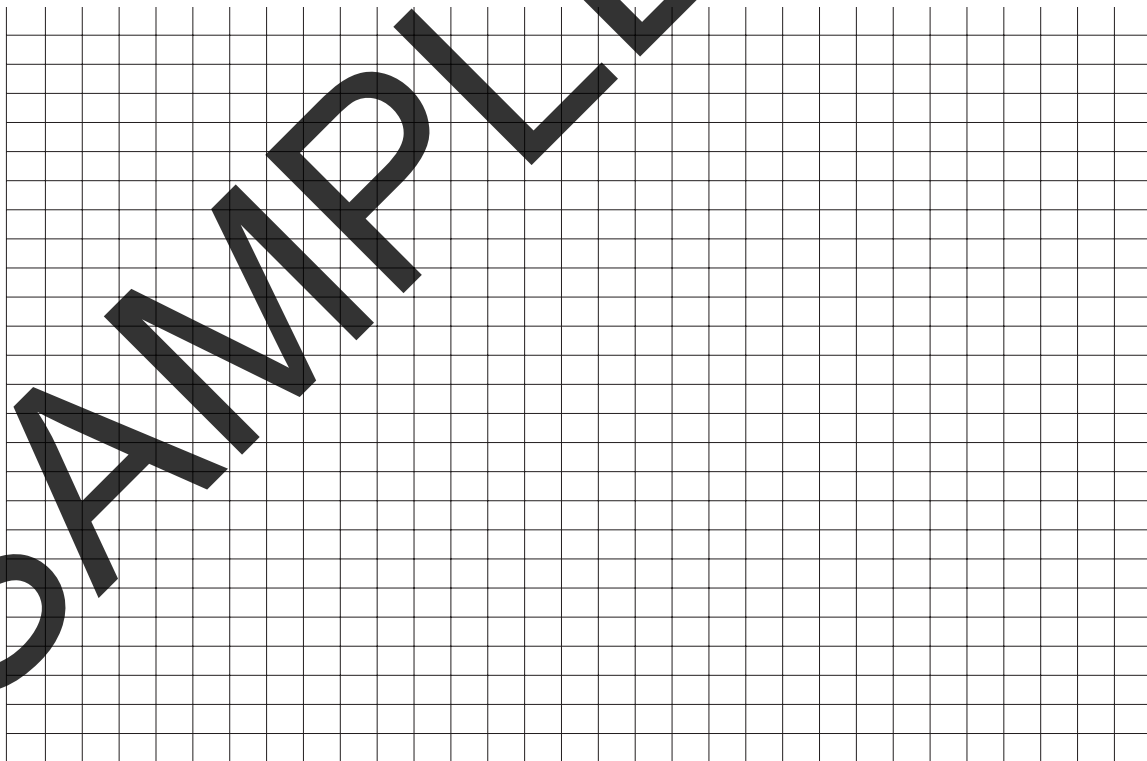


Figure 3.2 Results and questions