New marine science syllabus resources

MTAQ conference 2018

Bob Moffatt

MTAQ life member

Acknowledgements

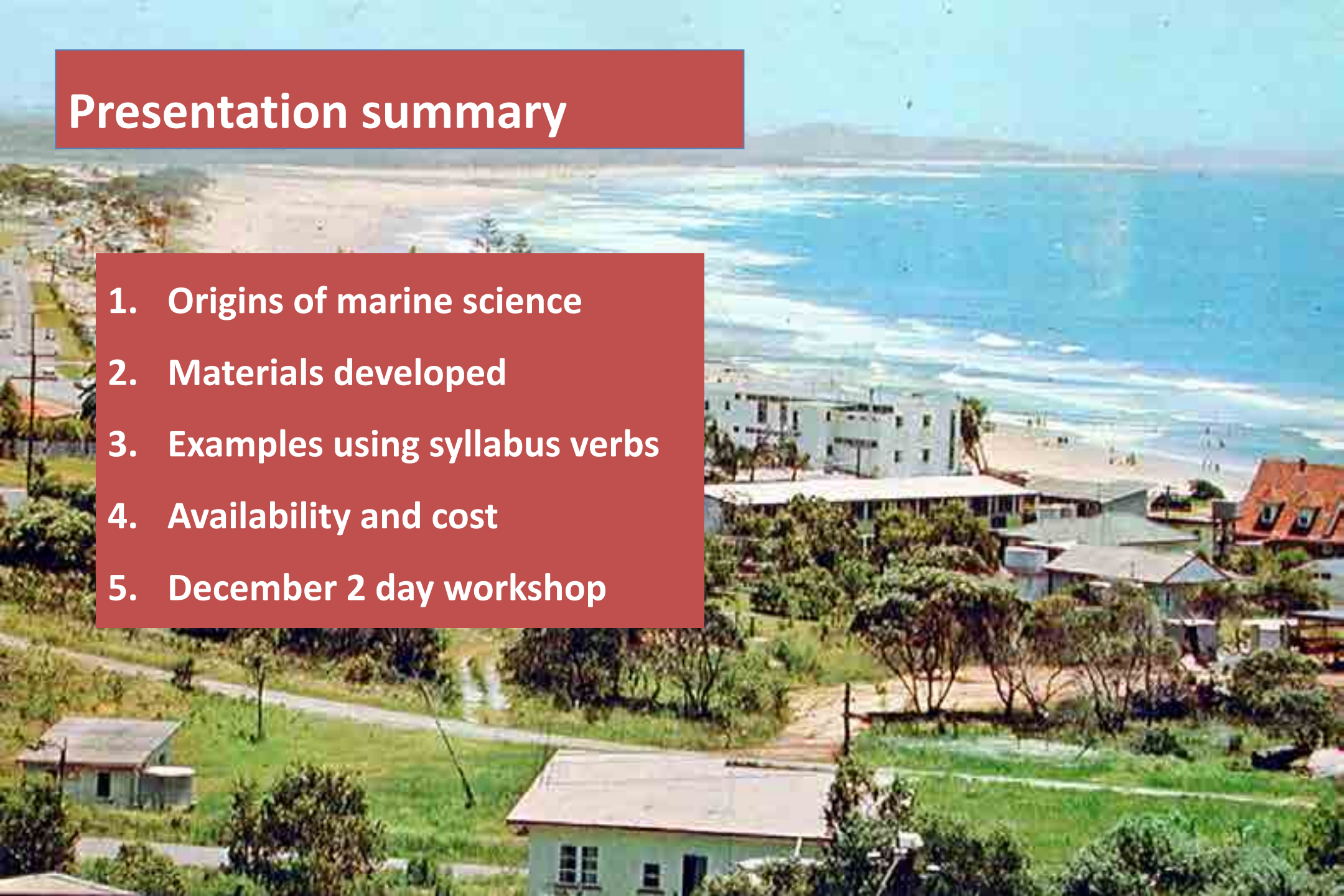
Traditional owners

Marine teachers past and present

Conference organisers and volunteers

Presentation summary

1. Origins of marine science
2. Materials developed
3. Examples using syllabus verbs
4. Availability and cost
5. December 2 day workshop



One university

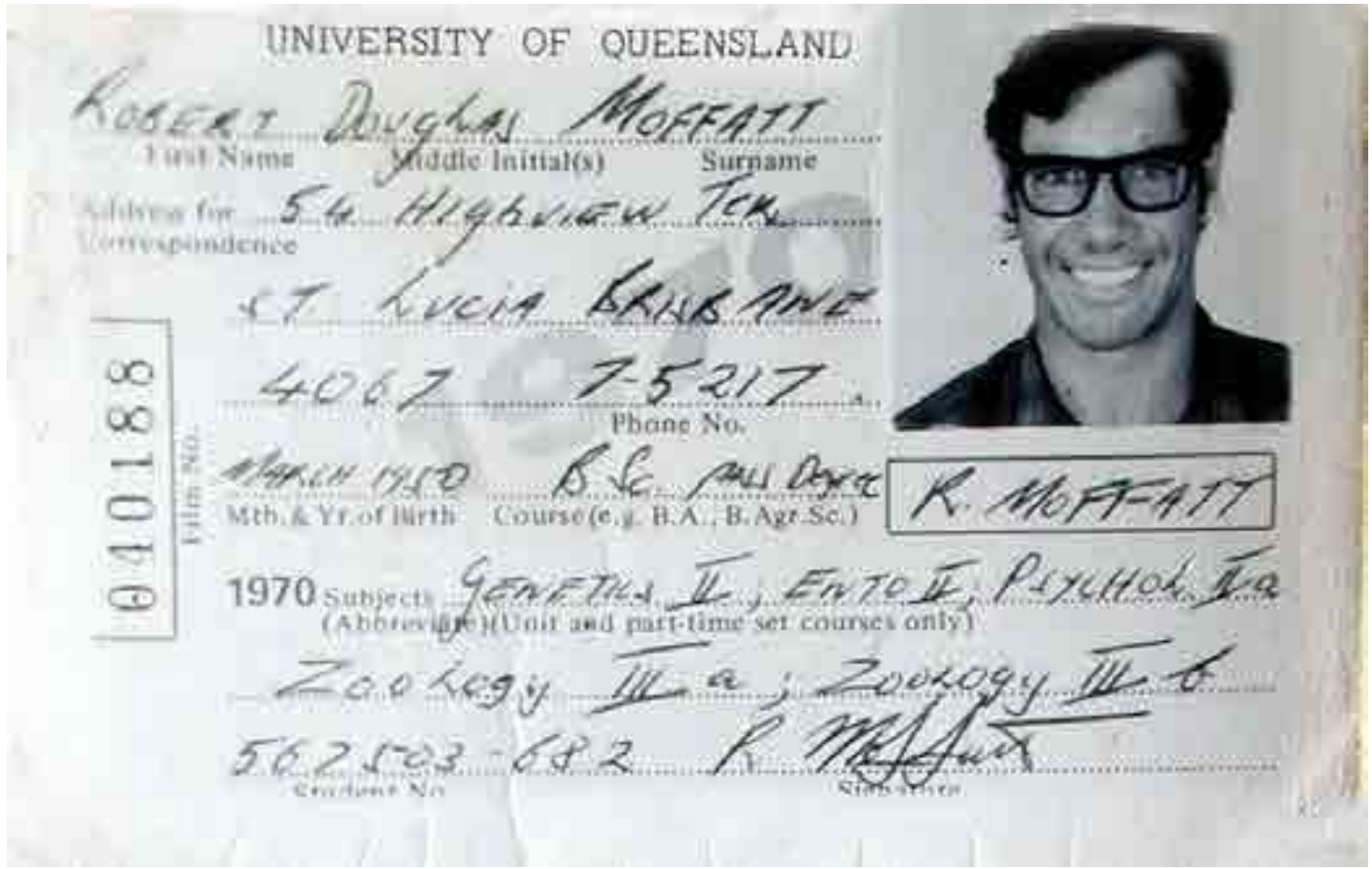
There was only one was university in Qld

Entry was by an external exam which was abandoned by the government in 1970.

I did a 3 year Zoology degree with the aim of sailing the world chasing plankton.

14 of us graduated

None of us got a job.


UNIVERSITY OF QUEENSLAND

ROBERT Douglas MOFFATT

First Name Middle Initial(s) Surname

Address for Correspondence 54 Highview Tce

ST LUCIA BRISBANE

4067 7-5217

Phone No.

0401188

March 1950 B.Sc. Pass Degree

Mth. & Yr. of Birth Course (e.g. B.A., B.Agr.Sc.)

R. MOFFATT

1970 Subjects (Abbreviate) (Unit and part-time set courses only)

GENETICS II, ENTO II, PSYCHOL I

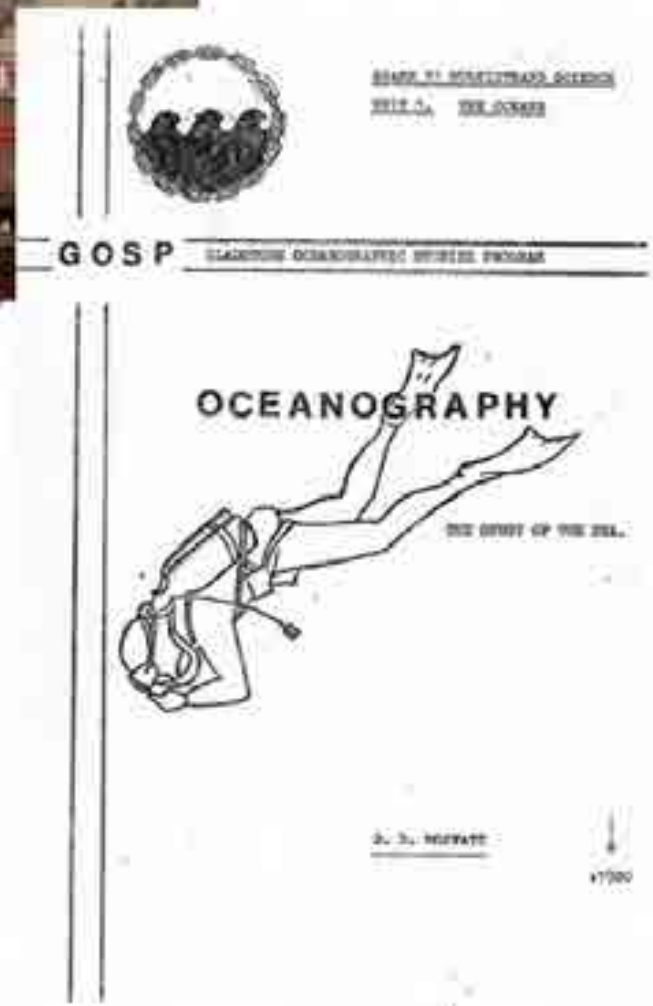
ZOOLOGY III a; ZOOLOGY III b

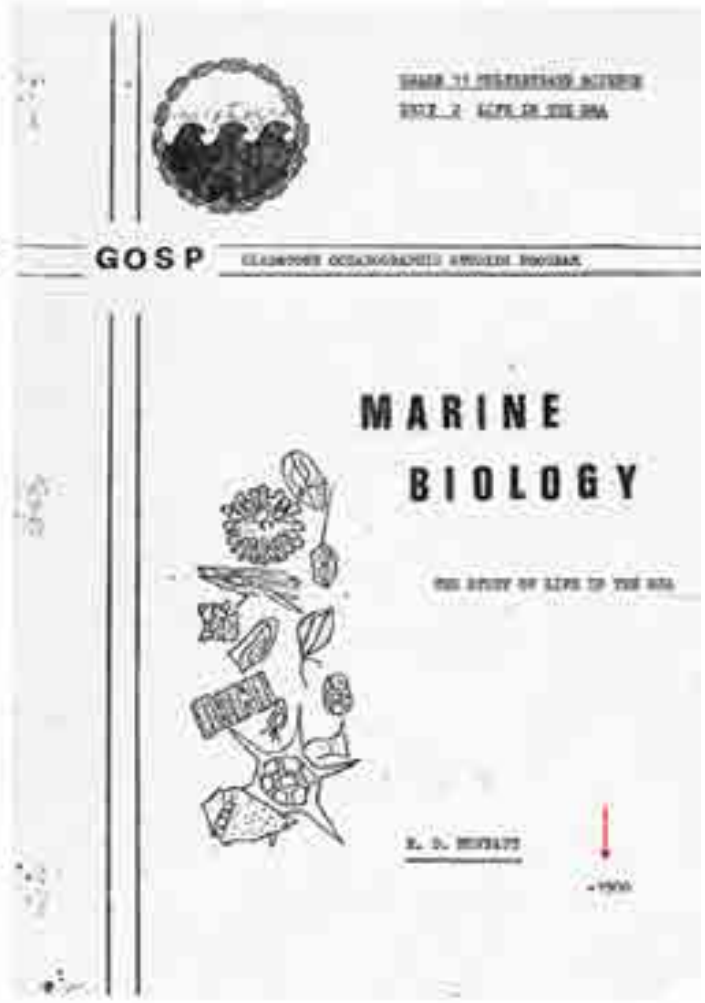
5625203-682

Enrolment No.

Signature

So I went teaching to Kingaroy – then Gladstone





Then Benowa State High

Department of Education

Marine Studies Syllabus

and

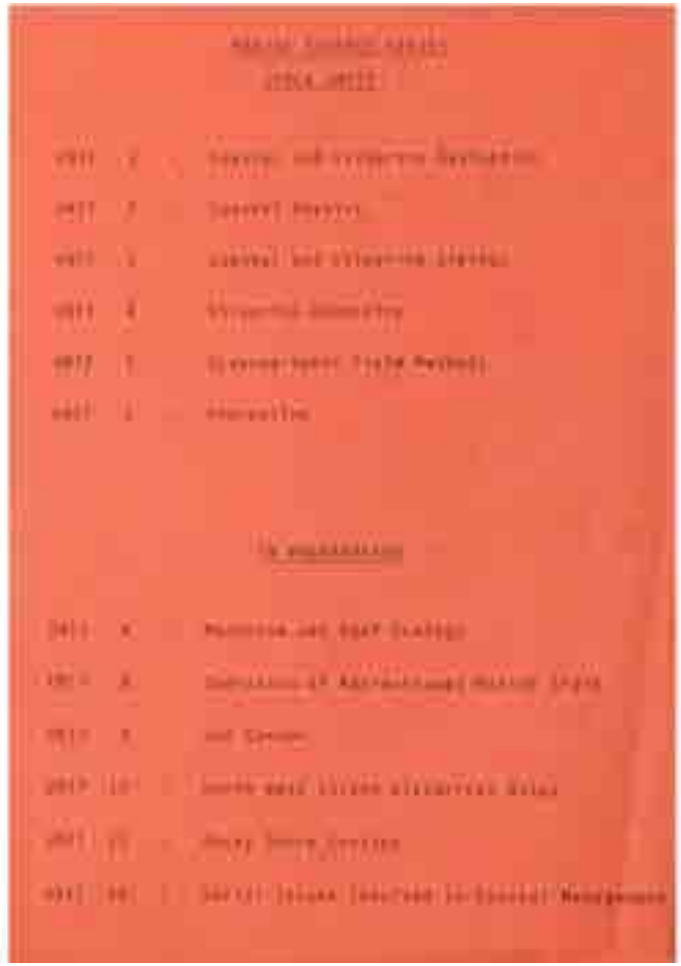
Sample Workprogram

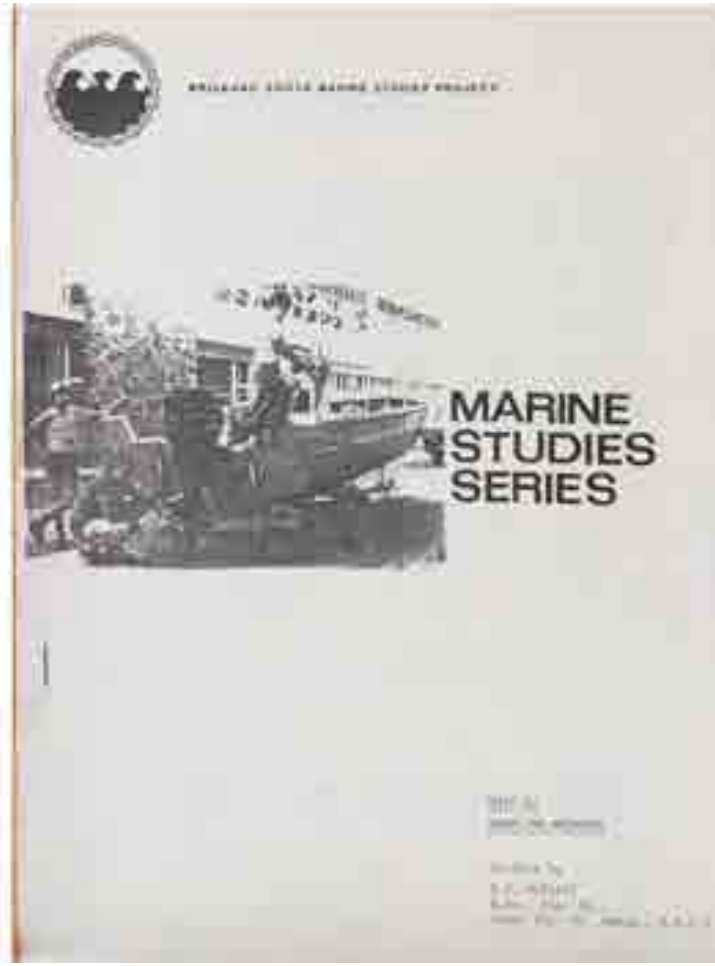
1984

BSSS Marine Studies Syllabus

1989

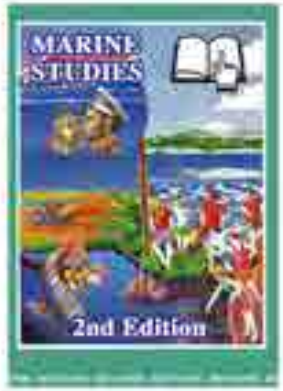
Brisbane South and Marine Science publications

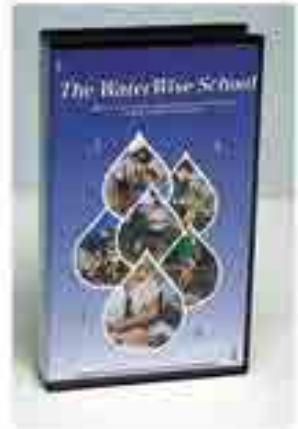




Volunteering, consulting, publishing

1990 - 2000





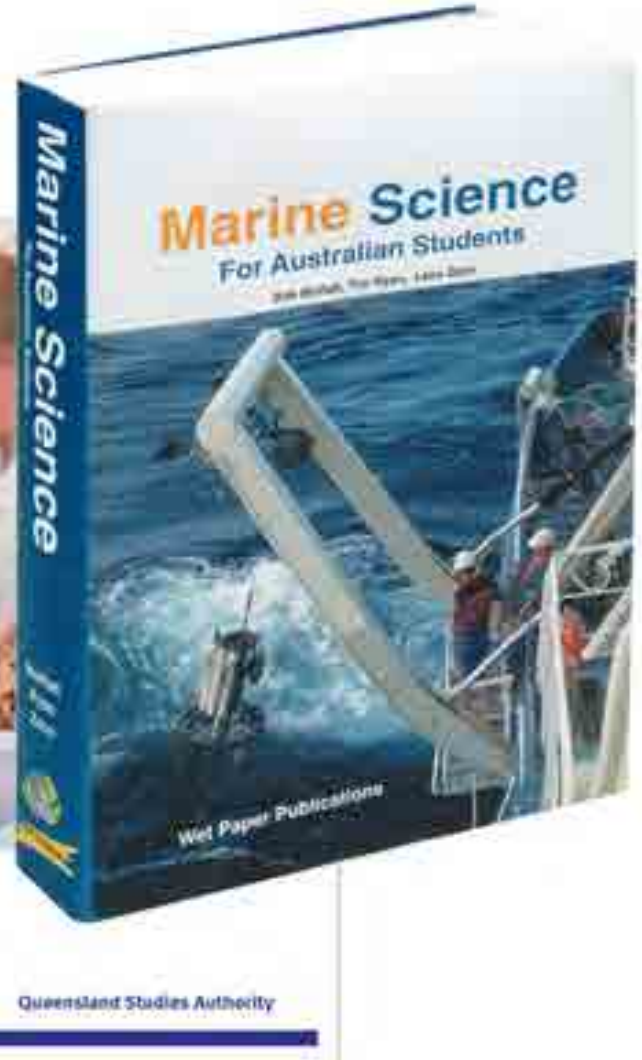
KIDS IN THE WATER

Worked with QSA

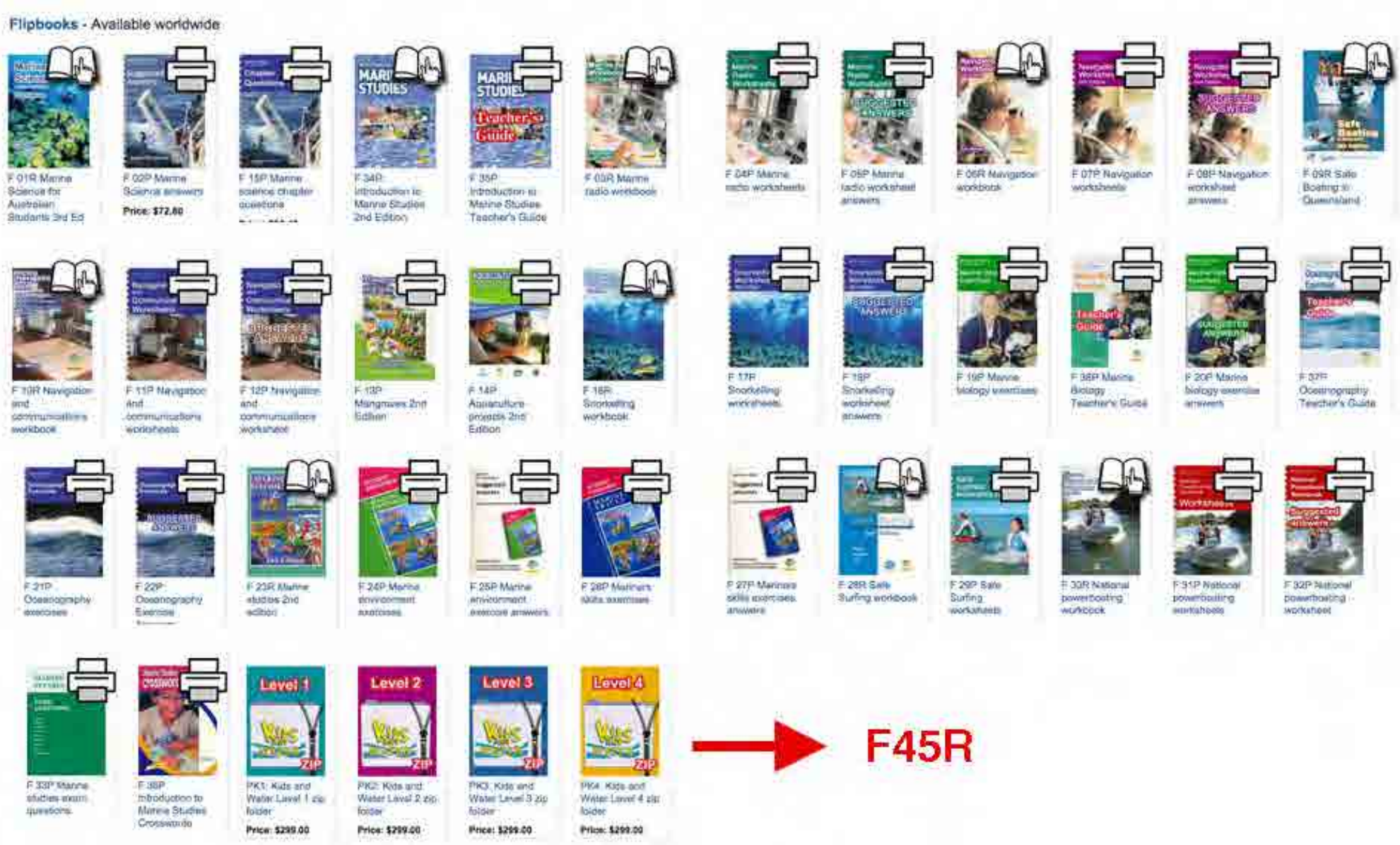
2000 - 2015

Marine Science

Senior Syllabus



Digital publishing … then retirement!!!



So am back with some trial materials in a new project

PUBLICATIONS

Qld New Syllabus Resources

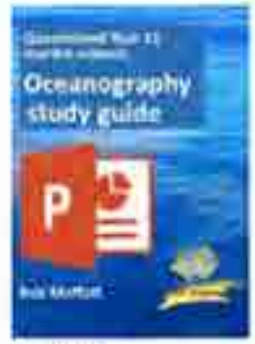
Student Flipbook - read on line

F45R Pilot Oceanography study guide

Price:$90.00

On Sale: $3.00

This is a Pilot edition. $3 for 30 users



Teacher's power point downloaded and used in school under a licence agreement

F47PP Oceanography powerpoints

Price:

- based on your initial enrolment X $30. Min $360

Oceanography approx 1020 slide power point with school agreement

F48R Marine biology study guide

Price:$90.00

Available October 2018 - 95% available MTAQ Sept conference 2018

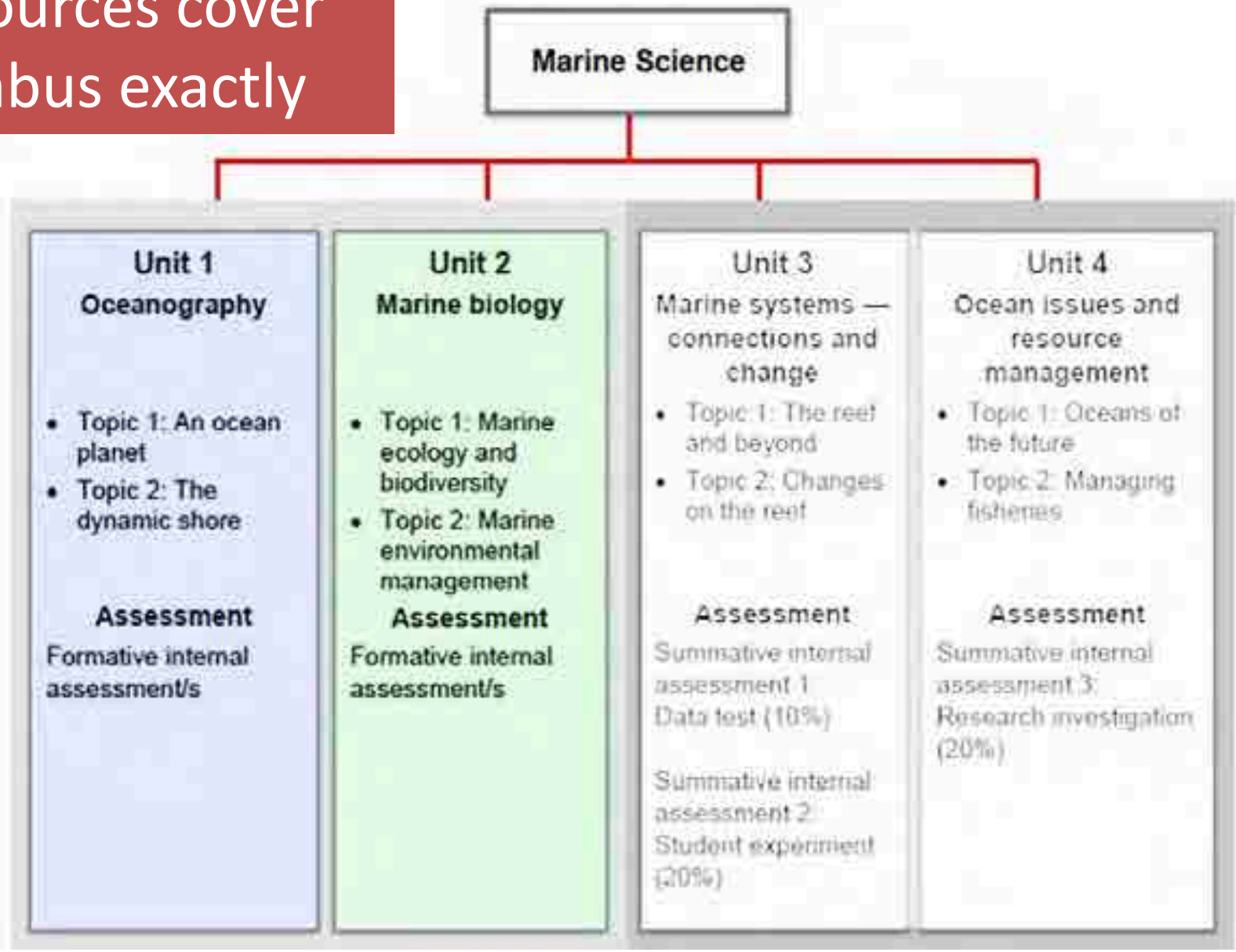
F50PP Marine biology powerpoints

Price:

- based on your initial enrolment X $30. Min $360

Available October 2018

The resources cover the syllabus exactly



Based on the syllabus statement

1.2.5 Subject matter

Subject matter is the body of information, mental procedures and psychomotor procedures (see Marzano & Kendall 2007, 2008) that are necessary for students' learning and engagement with Marine Science. It is particular to each unit in the course of study and provides the basis for student learning experiences.

Subject matter has a direct relationship to the unit objectives, but is of a finer granularity and is more specific. These statements of learning are constructed in a similar way to objectives. Each statement:

- describes an action (or combination of actions) — what the student is expected to do
- describes the element — expressed as information, mental procedures and/or psychomotor procedures
- is contextualised for the topic or circumstance particular to the unit.

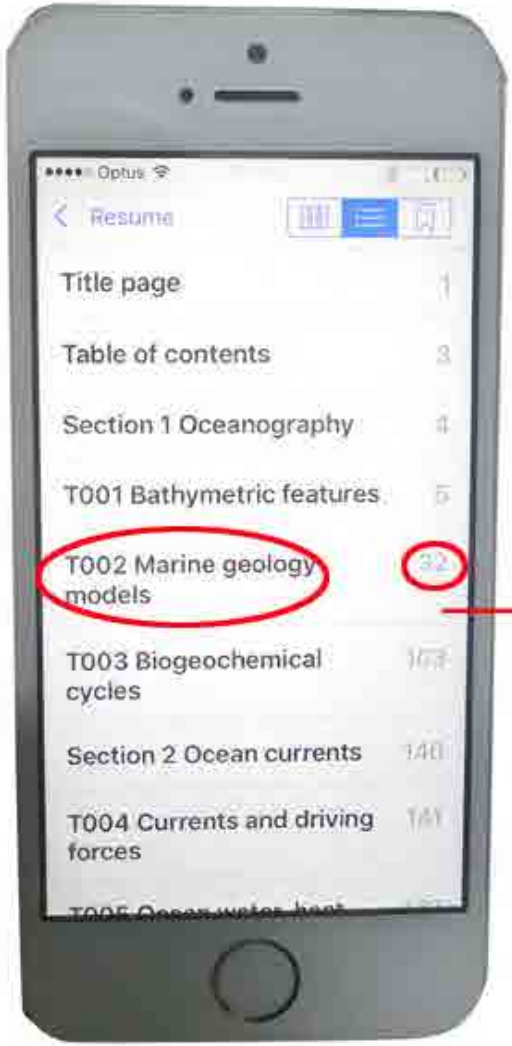
Organisation of subject matter

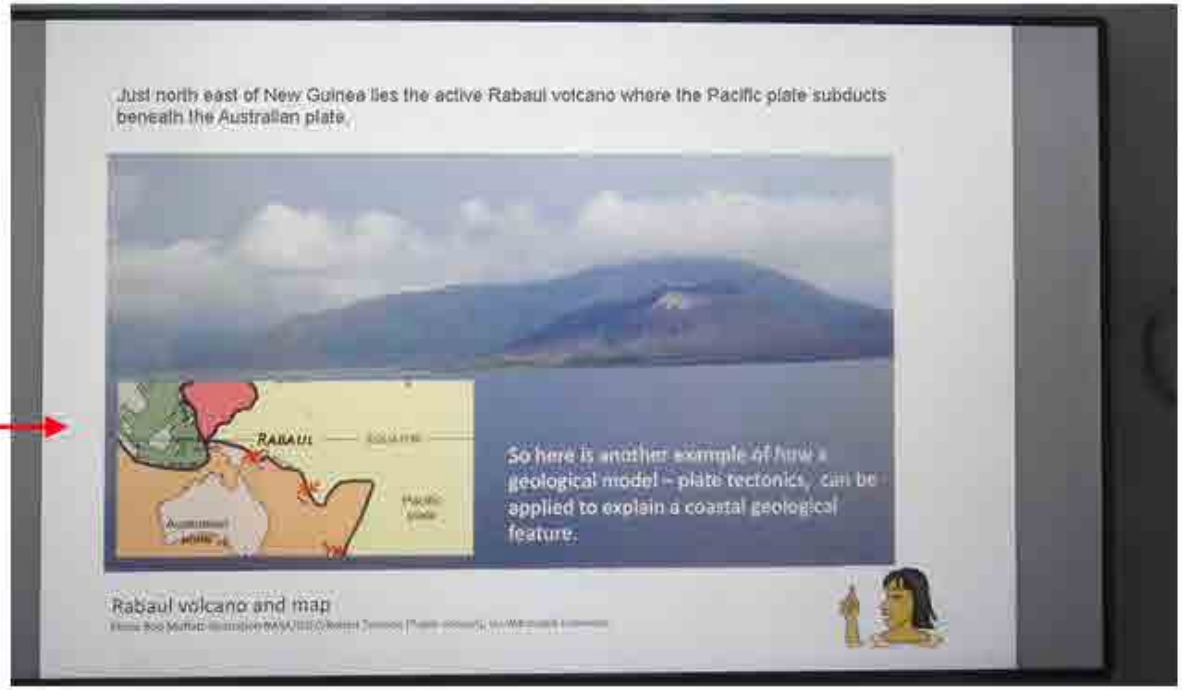
The subject matter is organised as topics within each unit.

The subject matter indicates the required knowledge and skills that students must acquire. Students should experience the mandatory practicals. It is expected that approximately five hours will be required to complete the mandatory practicals that involve fieldwork.

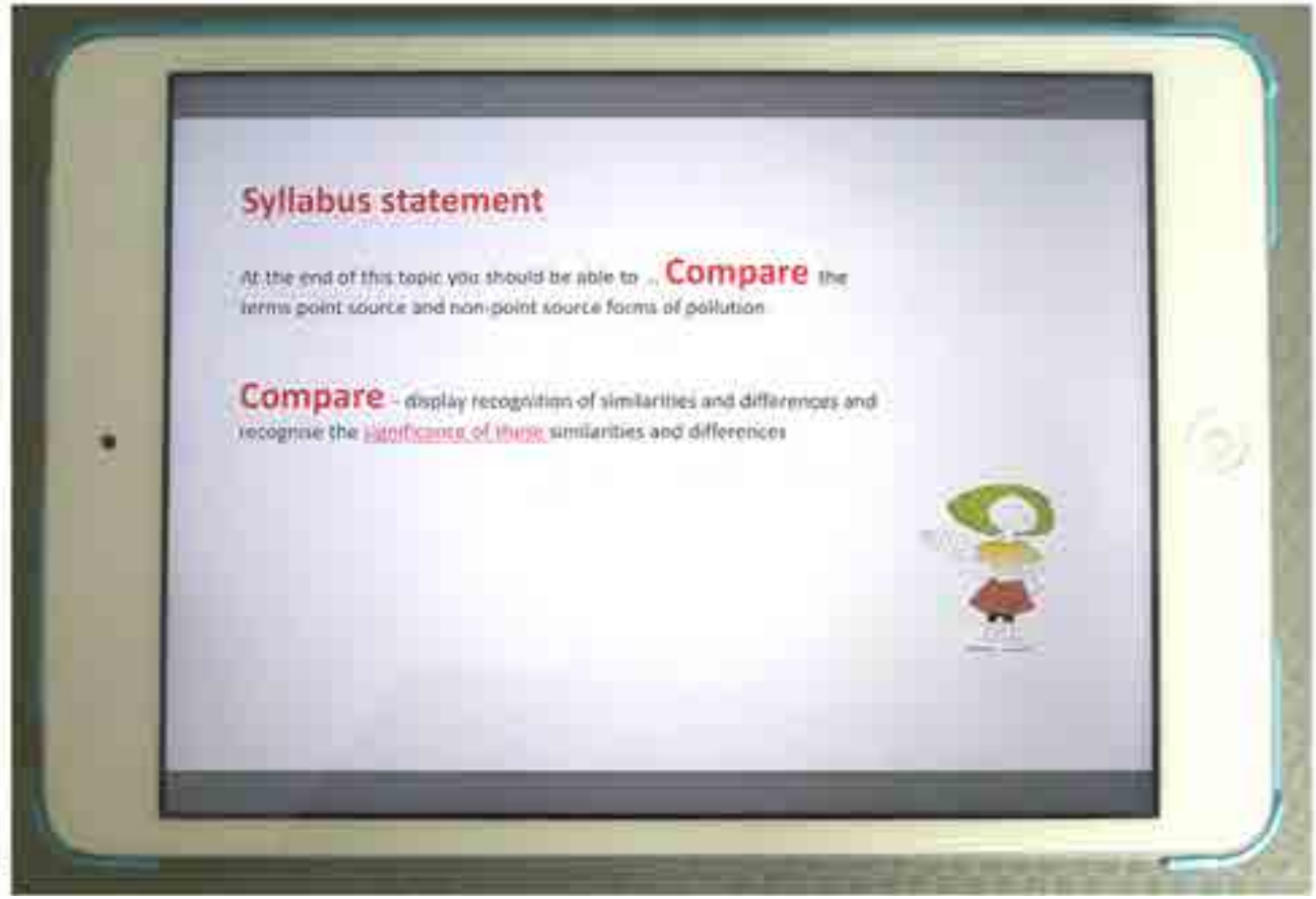
The subject matter from Units 3 and 4 will be assessed by the external examination.

Designed for new generation phones





Navigation by a table of contents based on the syllabus subject matter statements

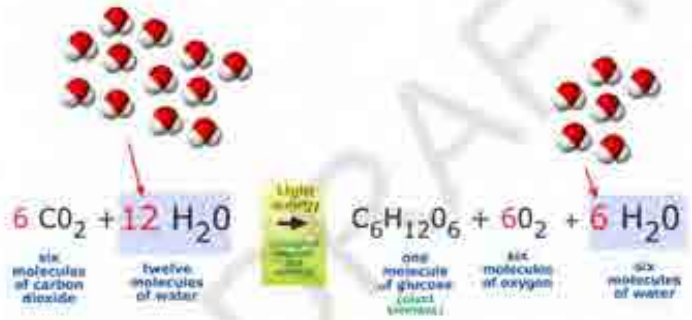


The pages flip as they are read on a phone.
Students then answer questions on a “second device”

Water also cycles through storm water pipes that can greatly affect water quality

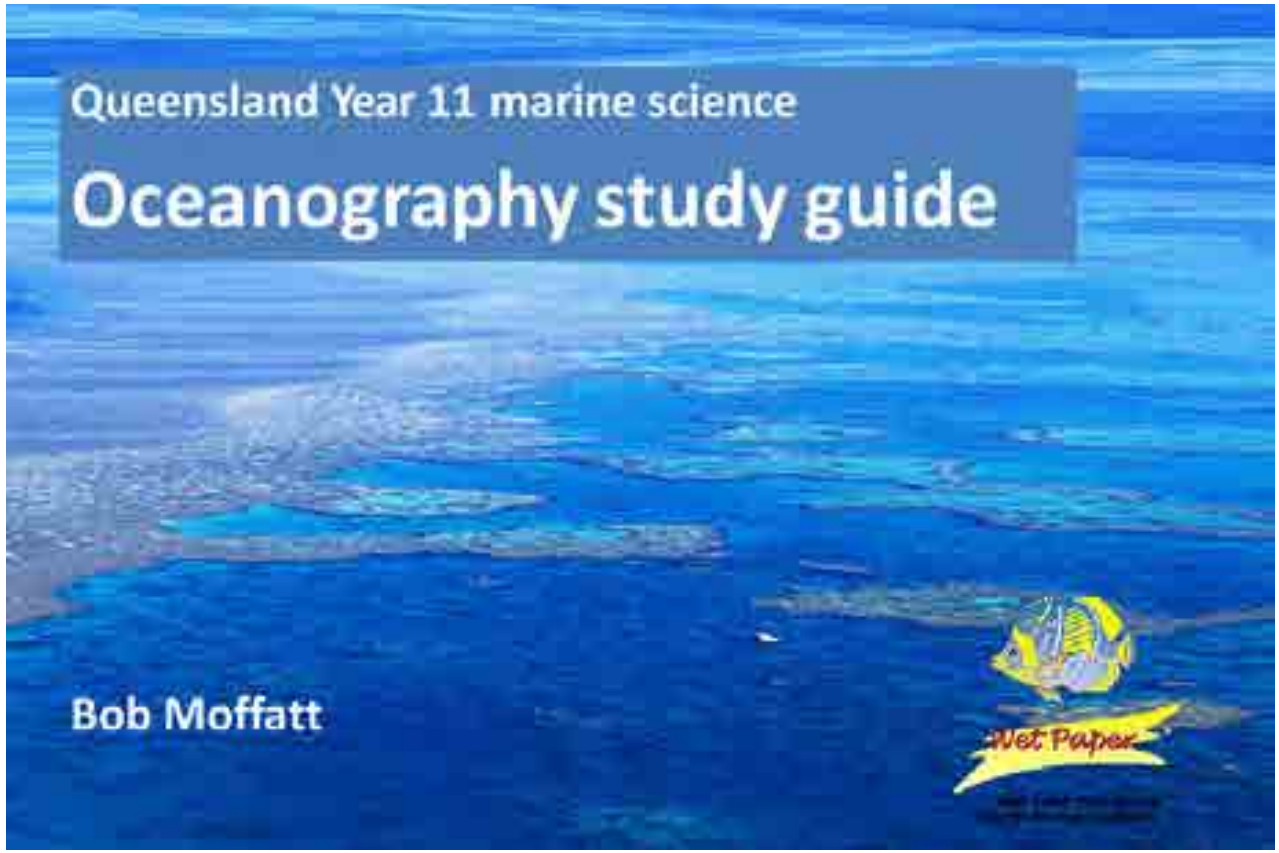
Storm water drain

Water molecules are an essential part of the process for plants to grow by photosynthesis



Photosynthesis equation involves water

The teacher’s resource is one long power point supplied in its original format.



Oceanography
has 1028 slides
and
file size 132mB.

Unit 1: Oceanography

Chapter 1 Oceanography

Chapter 2 Ocean currents

Chapter 3 Ocean conservation

Chapter 4 Coastlines

Subject matter statements have been numbered

1 - 36

Chapter 5 Coastal impacts

Chapter 6 Coastal conservation and impacts

Marine biology
has 1036 slides
and
file size 140 mB.

Unit 2: Marine biology

Subject matter statements have been numbered 37 - 69

Chapter 7 Biodiversity

Chapter 8 Biotic components of marine ecosystems

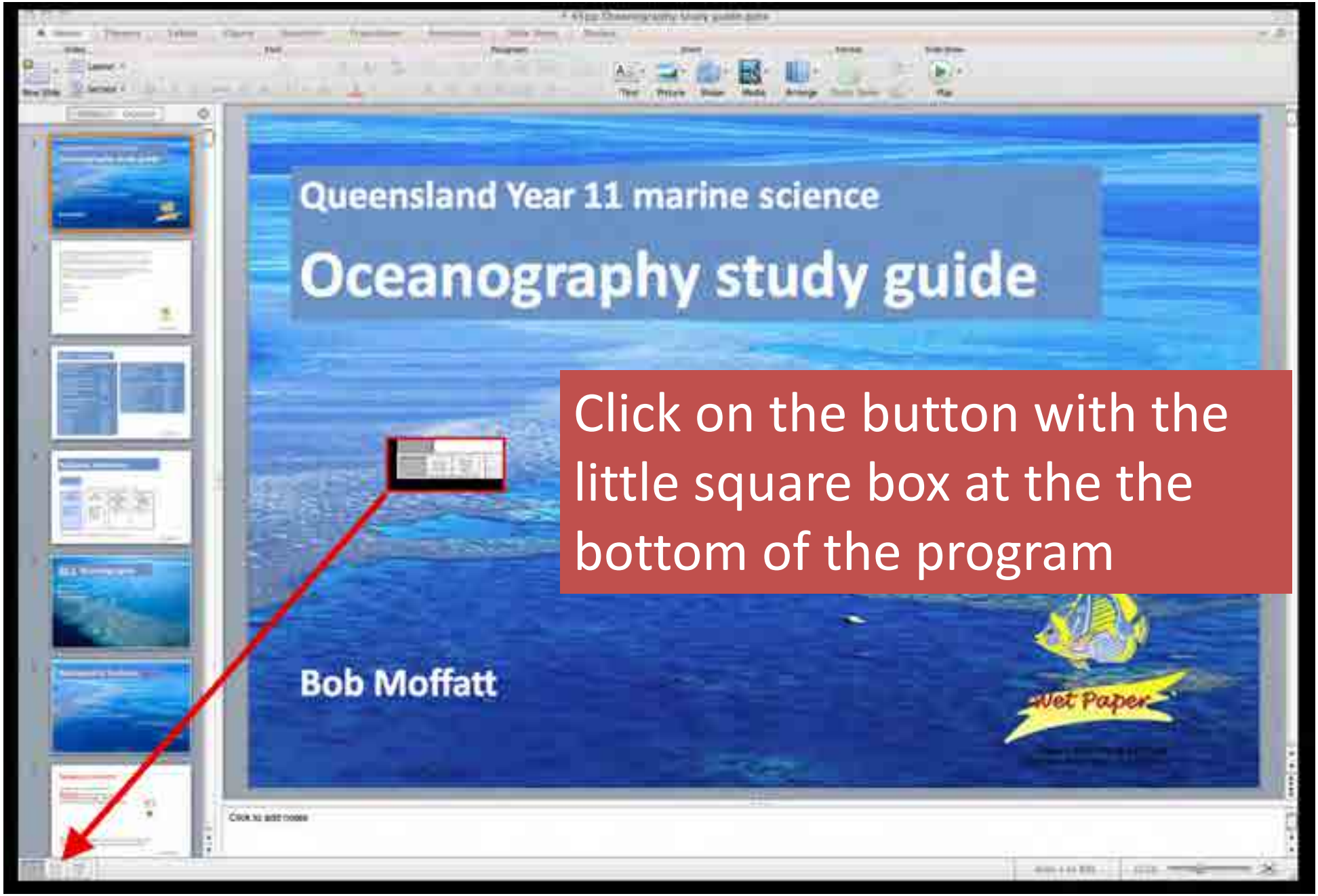
Chapter 9 Abiotic components of marine ecosystems

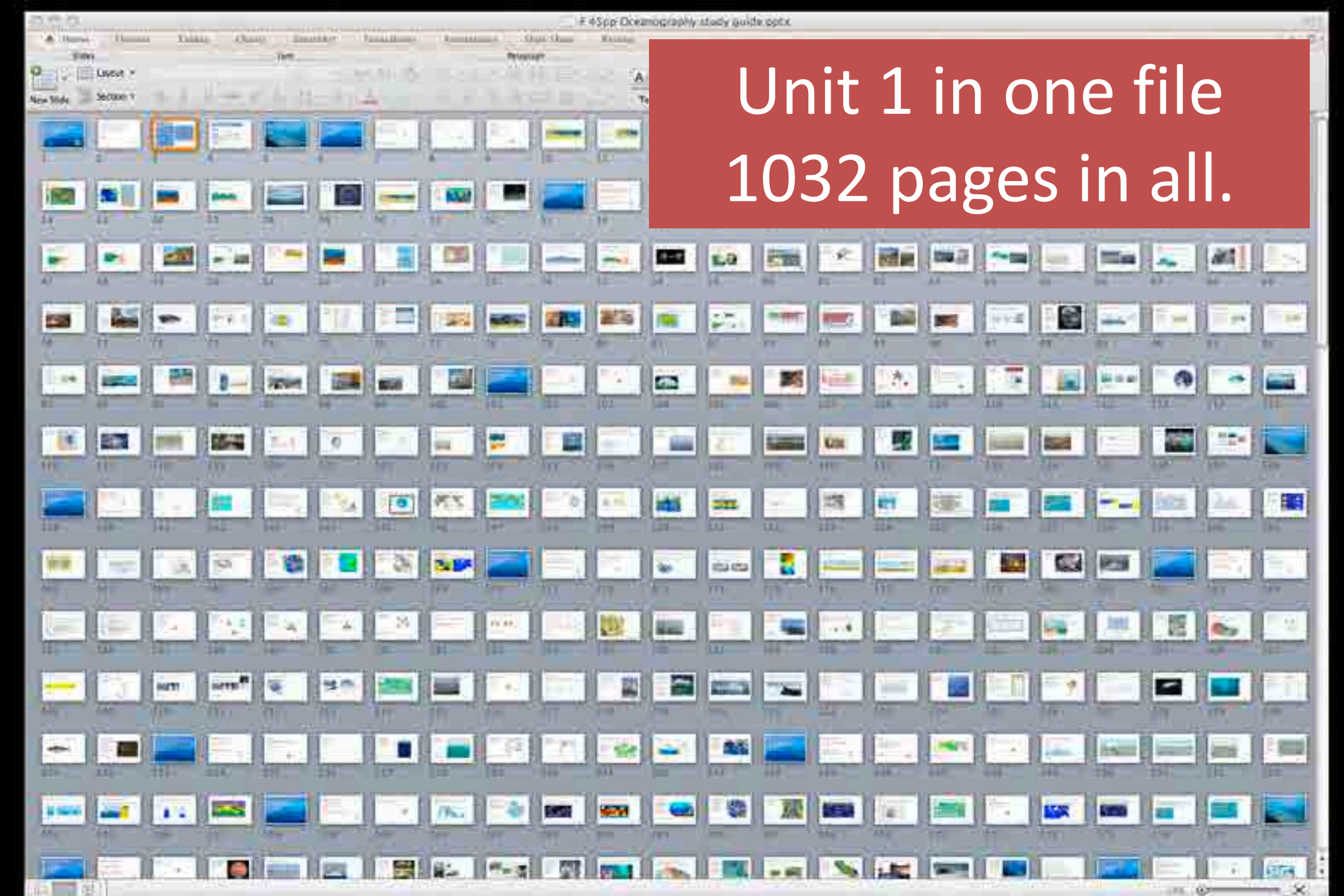
Chapter 10 Adaptations and classification

Chapter 11 Marine conservation

Chapter 12 Resources and sustainable use

All are designed so the original files can be changed so you can make your own set of school notes.


Queensland Year 11 marine science
Oceanography study guide
Click on the button with the little square box at the the bottom of the program
Bob Moffatt
Wet Paper

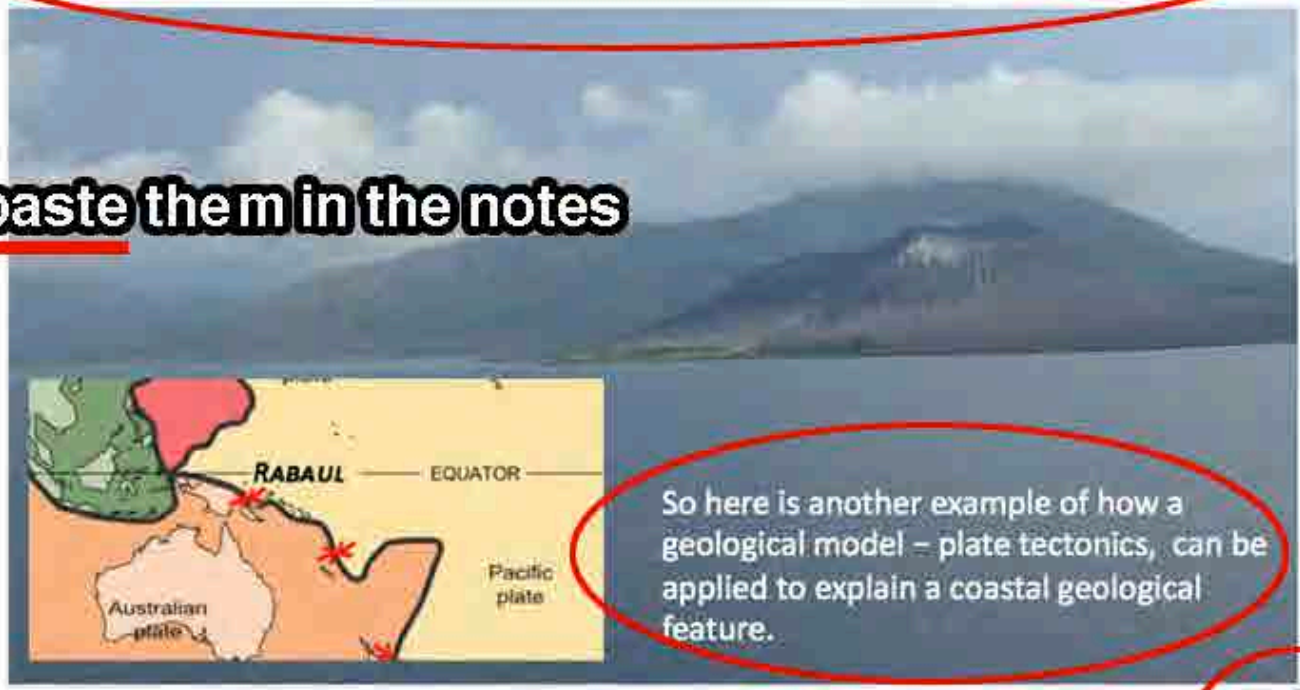

Unit 1 in one file
1032 pages in all.

So here is the original power point

T002 Marine geology models.pptx

Just north east of New Guinea lies the active Rabaul volcano where the Pacific plate subjects beneath the Australian plate.

Cut these out and paste them in the notes



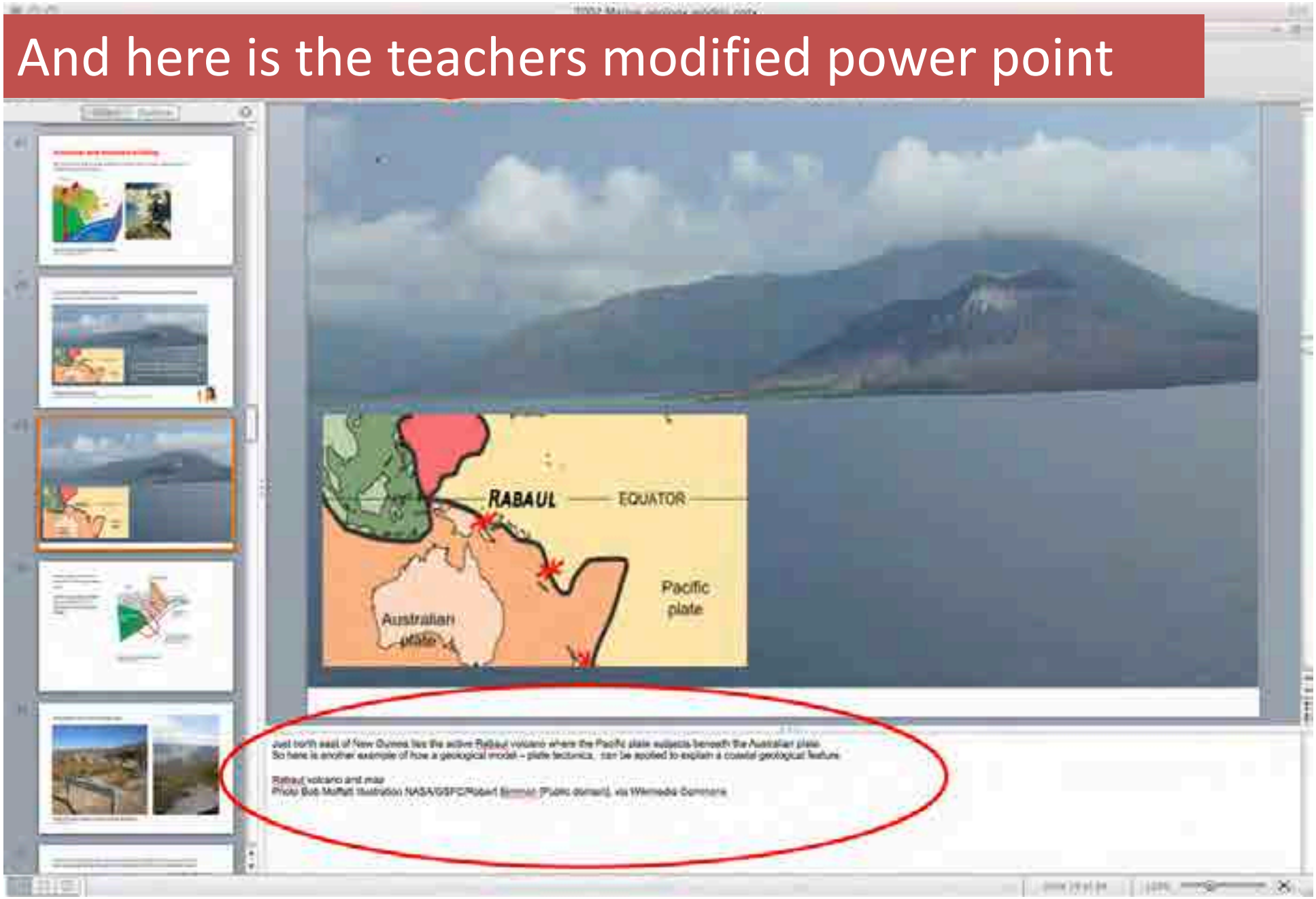
So here is another example of how a geological model – plate tectonics, can be applied to explain a coastal geological feature.

Rabaul volcano and map

Photo Bob Moffatt Illustration NASA/GSFC/Robert Simmon [Public domain], via Wikimedia Commons

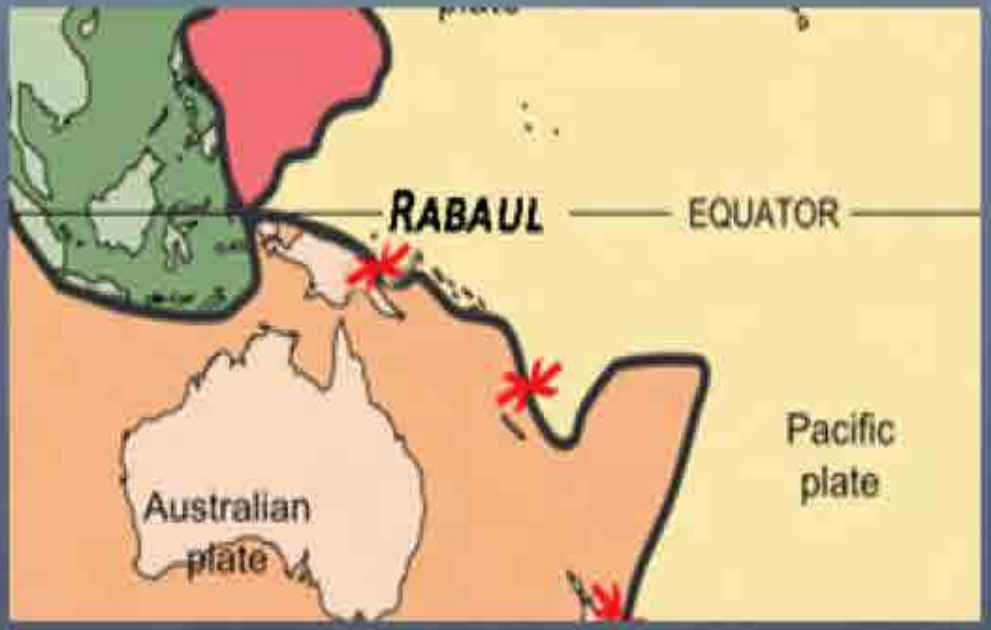
Click to add notes

And here is the teachers modified power point



Finished slide

How a model explains a volcano



If you don’t like what I’ve written, you can cut it out OR fix up my grammar.

Eg: My slant on history

The original zoning plan by the Queensland Government of the day was to mine the reef for minerals and drill for oil.

The stakeholders in the main were senior politicians, mining and oil companies.

Zoning plan for the Great Barrier Reef 1971

Zoning plan for reef 1971

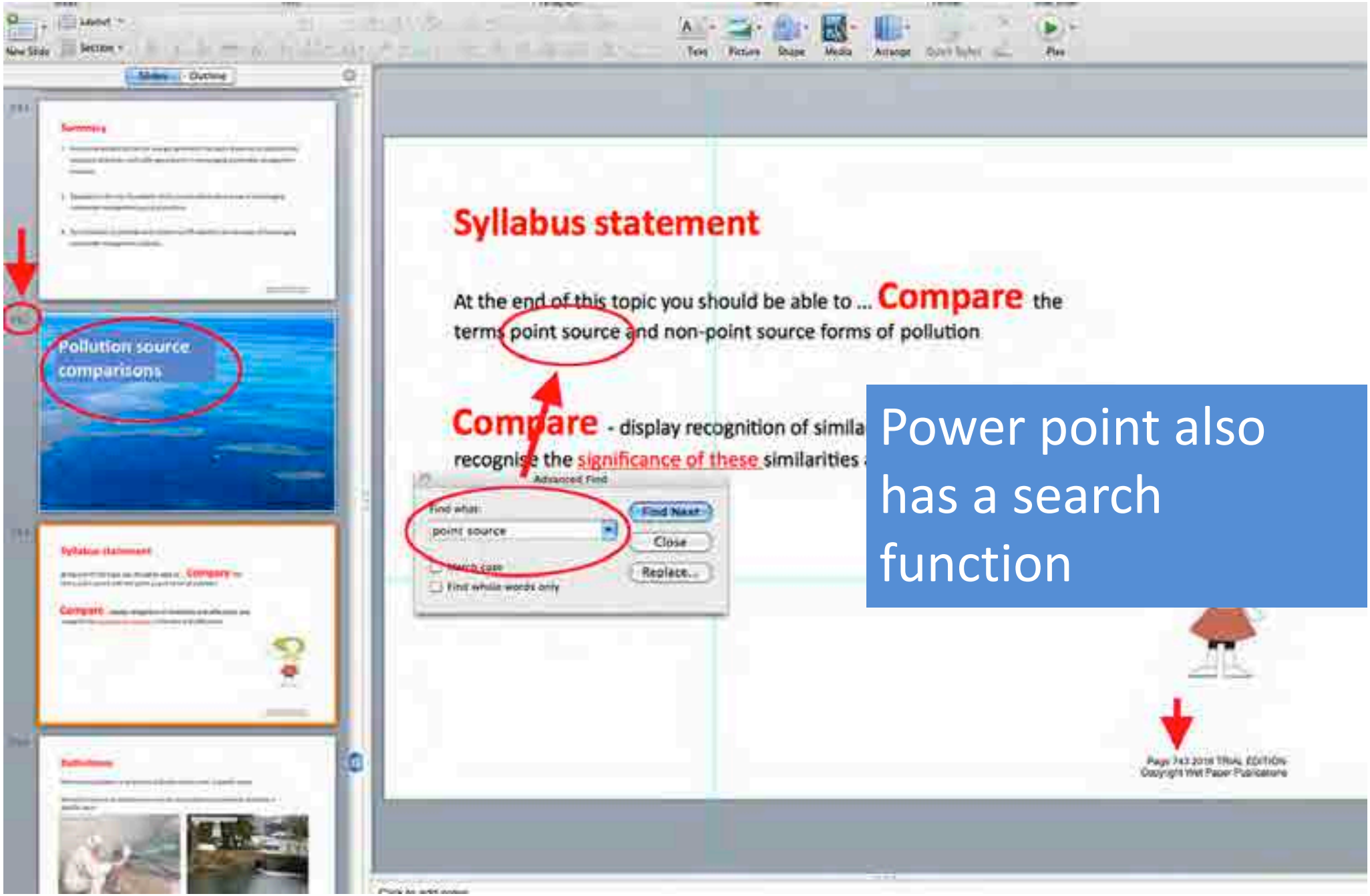
Illustration Bob Moffatt

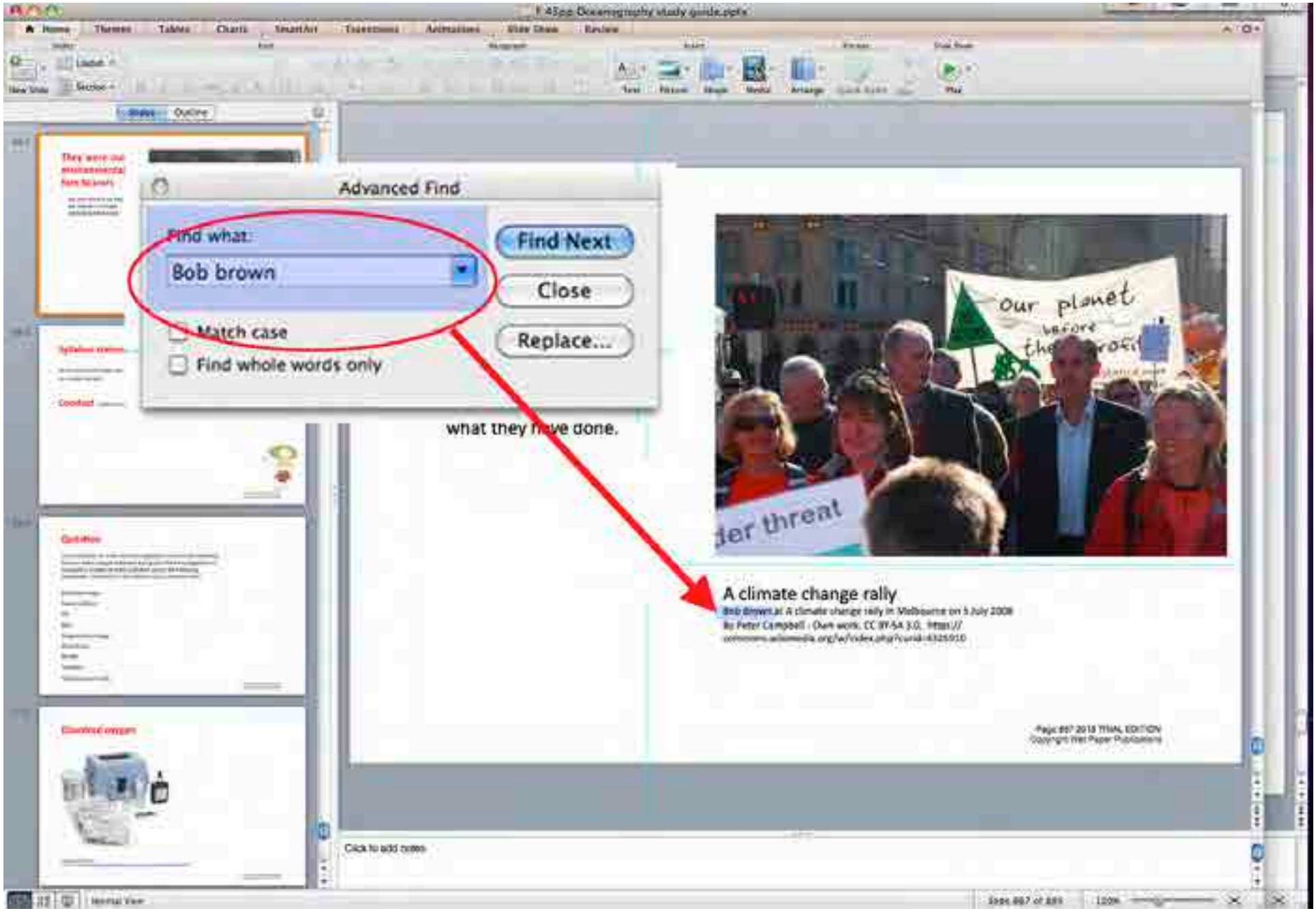
Again a group of activists from the University of Queensland formed a Save the Barrier Reef Campaign and with a groundswell of support for the reef, lead to the creation of the Great Barrier Reef Marine Park Authority - a political decision made by the Australian Government. In the main, the activists were junior members of organisations.

If you don't like what I've written, you can cut it out OR fix up my grammar.

GBRMPA formation

Littoral society (now www.marineconservation.org.au), old and present GBRMPA logos


Summary
Pollution source comparisons
Syllabus statement
Compare
Syllabus statement
At the end of this topic you should be able to ... Compare the terms point source and non-point source forms of pollution
Compare - display recognition of simila
recognise the significance of these similarities
Advanced Find
Find what:
point source
Find Next
Close
Replace...
Match case
Find whole words only
Power point also has a search function


Advanced Find
Find what:
Bob brown
Find Next
Close
Replace...
Match case
Find whole words only
what they have done.
our planet
A climate change rally
Click to add notes

And when finished, save it as a pdf and put it on the school server

Microsoft

Office Products Resources Temp

Apps Install Account Training

Save your presentation file

Applies to: PowerPoint for Office 365, PowerPoint 2016, PowerPoint 2013, More...

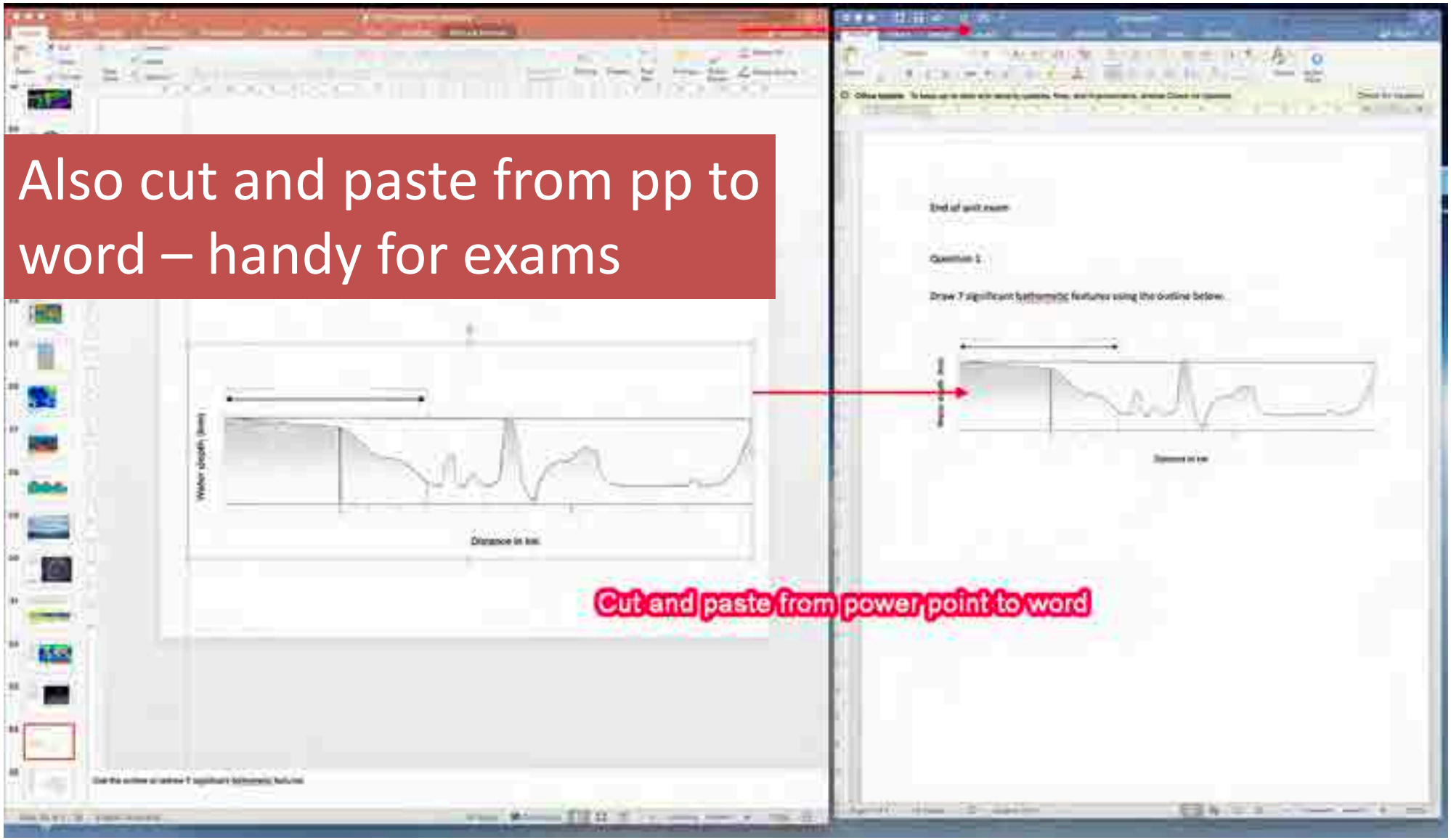
As with any software program, it is a good idea to name and save your presentation immediately, and save your changes frequently while you work.

Newer versions Office 2010 Office 2007

1. On the **File** tab, select **Save**.

You can then make your own book, set of notes under a licence from Wet Paper

Also cut and paste from pp to word – handy for exams



So lets have a look at 6 verbs

1. Describe (from T16)
2. Calculate (from T16 data test)
3. Compare (from T28)
4. Apply (from T43)
5. Evaluate (from T69)
6. Conduct (from T36)

The verbs have been classified into three stars

★	★★	★★★
calculate (e.g. numerical answer; mathematical processes)	analyse	appraise
clarify	apply	appreciate
comprehend (meaning)	categorise	argue
construct (e.g. a diagram)	classify	assess
define	compare	comment (make a judgment)
demonstrate	consider	conduct (e.g. investigations)
describe	contrast	construct (e.g. an argument)
document	critique	create (e.g. a unique product/ artefact; language texts; meaning)
execute	deduce	decide/determine
explain	derive	discuss/explore
identify	determine	evaluate
implement (e.g. a plan, proposal)	discriminate	experiment/test (e.g. ideas, methods)
recall	distinguish	generate/test (e.g. hypotheses)
recognise (e.g. features)	identify	investigate/examine
select	infer/extrapolate	justify/prove (e.g. an argument, statement or conclusion)
understand	interpret (e.g. meaning)	modify
use		predict (e.g. a result)

T016 Material movements

Syllabus statement

At the end of this topic you should be able to ...

Describe

the factors of wave action, wind and longshore drift

in

the management of the movement of water, nutrients, sand, sediment and pollutants (e.g. oil spills, debris)

Describe

- give an account (**written** or spoken) of a situation, event, pattern or process, or of the characteristics or features of something.

Question

Describe the factors of wave action, longshore drift, wind and tides in the management of the movement of water, nutrients, sand, sediment and pollutants (e.g. oil spills, debris) in a summary table.

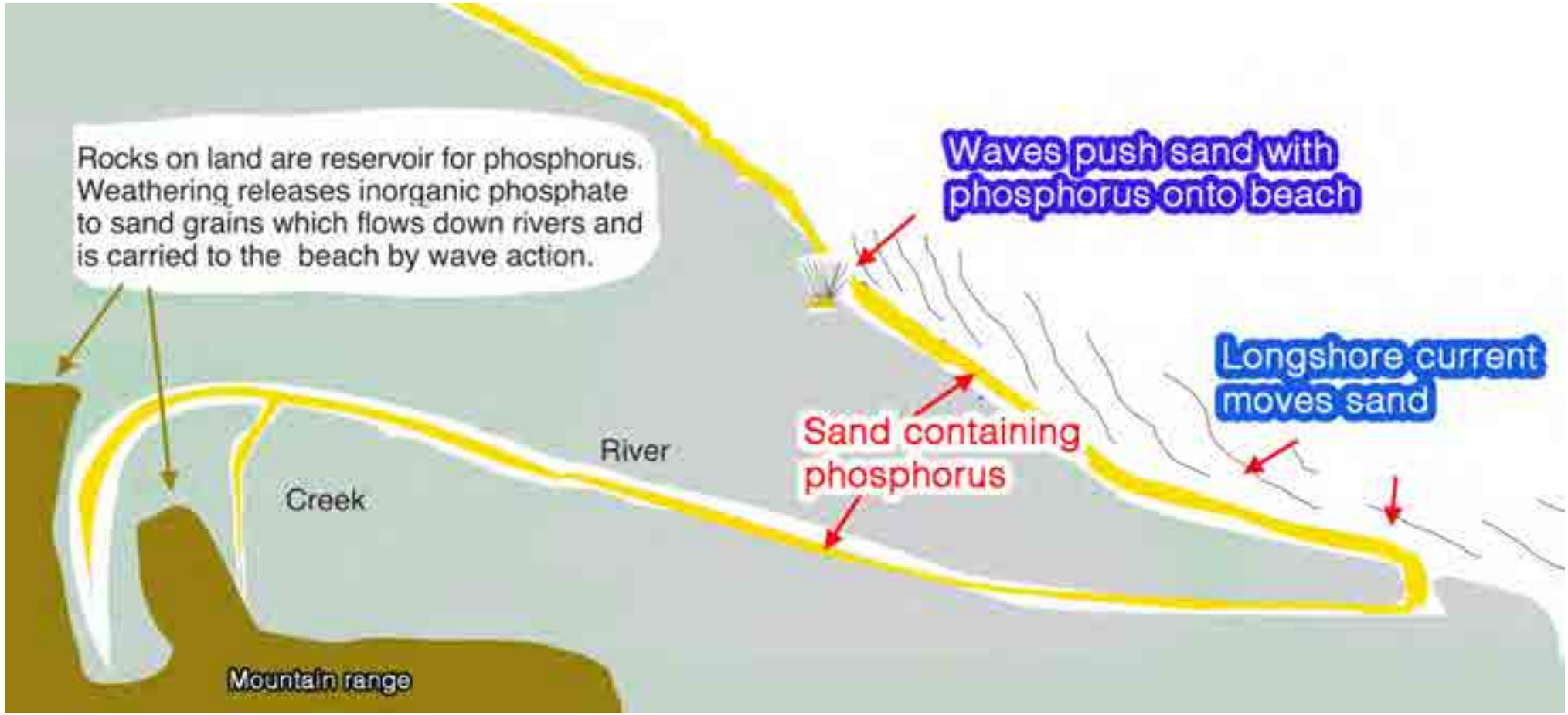
Factor	Management of water movement	Management of nutrient movement	Management of sand movement	Management of sediment movement	Management of pollution movement
Wave action					
Longshore drift					
Wind					
Tides **Optional**					


Waves move water into
an estuary

Waves move water into rock pools


Waves move water into
a reef lagoon

Waves move nutrients along the coastline



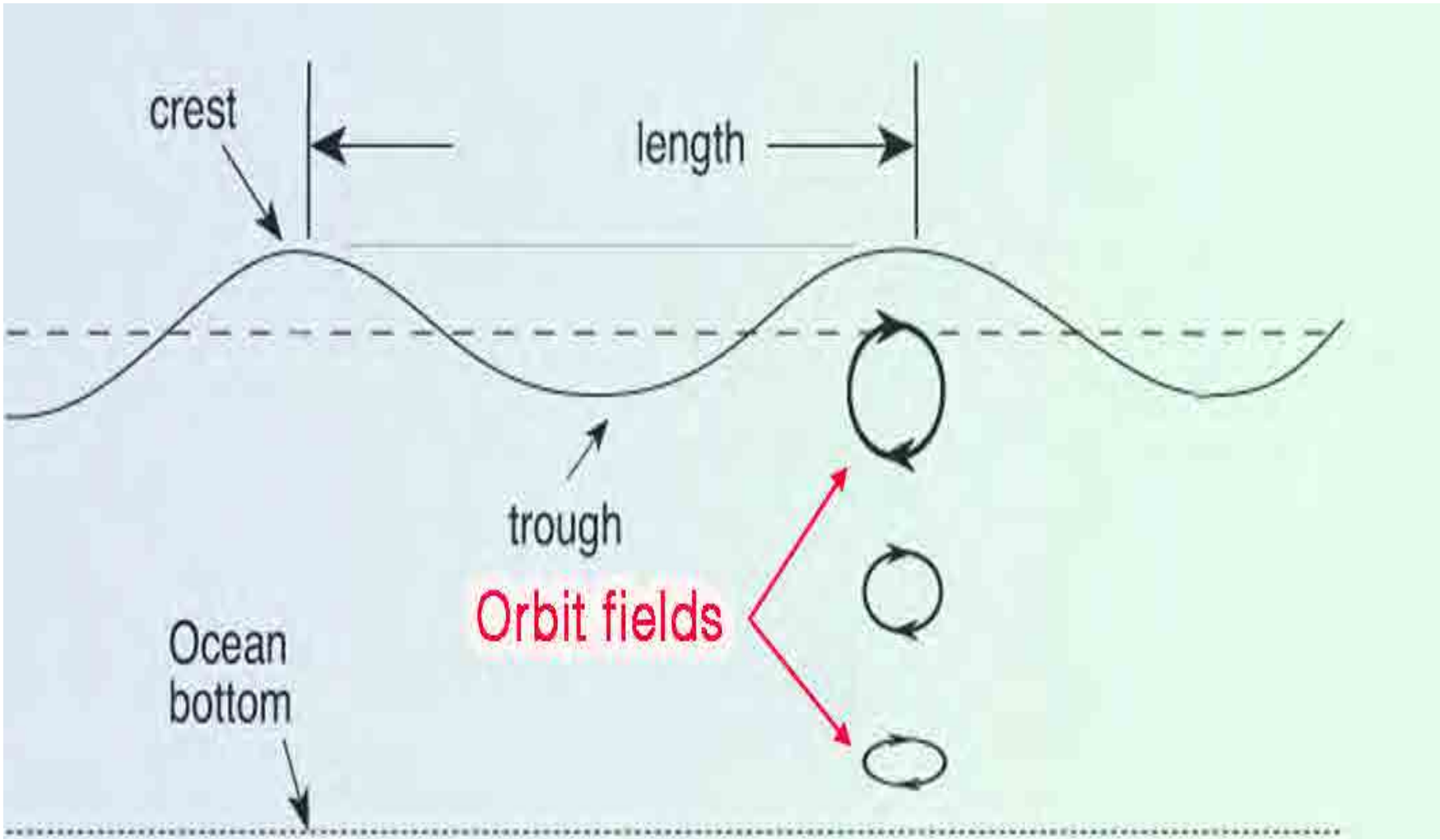
Phosphorus and sand enters a beach system

Illustration Bob Moffatt

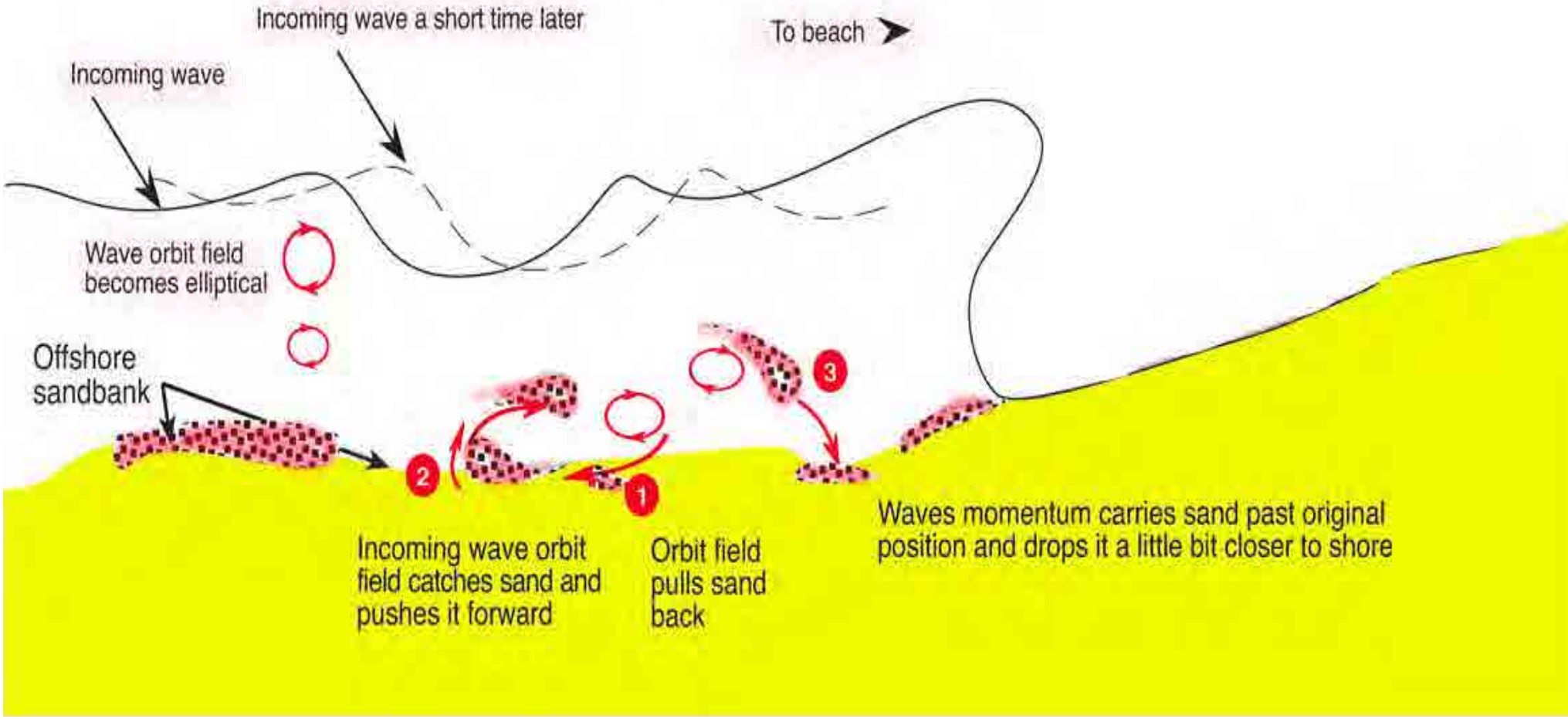
Waves move nutrients onto beaches

Photo Bob Moffatt

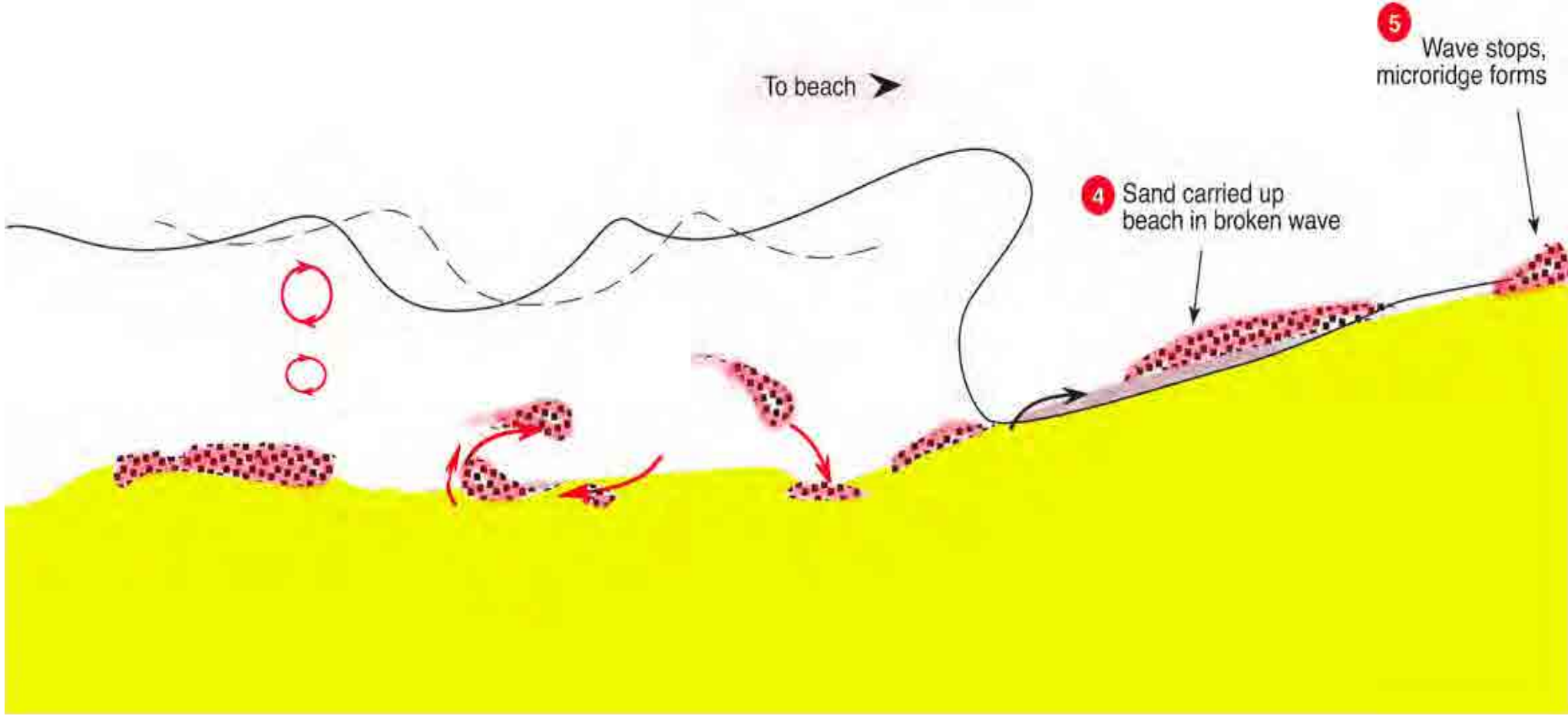
Waves move water in orbit fields



The orbit field pulls the sand back

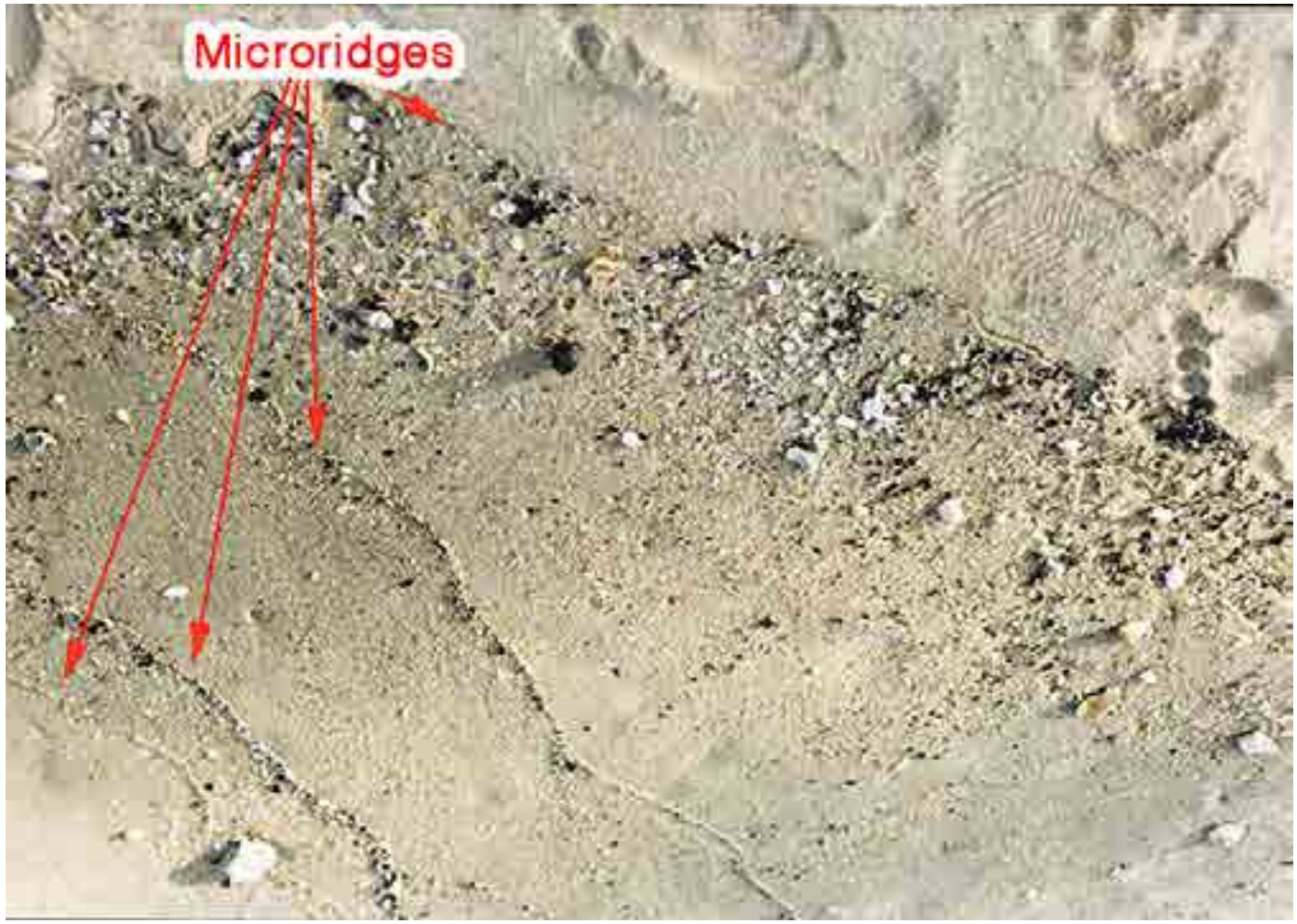


And then throws it towards the beach in calm weather.




Wave bore under wave near beach
Microridge
Wave bore in swash zone on beach
Microridge

Where it forms a microridge and then wind blows it up into the dunes.



Waves can also move pollution onto a beach

Or break up ships causing oil spills

And so on

Factor	Management of water movement	Management of nutrient movement	Management of sand movement	Management of sediment movement	Management of pollution movement
Wave action	Waves can move water up and down the beach in the swash zone, into rock pools, into a lagoon, into an estuary or along the coastline or in rip currents	Waves break over rocks bringing plankton for filter feeding barnacles	Waves move sand onto the beach	Waves move sediment in wave bores into microridges	Waves break up containers, ships grounded
Longshore drift	Longshore drift moves water along the coastline	Longshore drift moves planktonic larvae from one ecosystem to another	Longshore drift moves sand into spits and into estuaries	Longshore move sediment along the coastline	Longshore drift moves debris along the coast and into river entrances
Wind	Wind over tide backs up water, creates on and offshore surf.	Wind blows plant seeds from place to place	Wind blows sand into sand dunes	Wind dries sand on beach in microridges	Wind blows plastic bags into the sea
Tides	Move water in and out of estuaries	Deposit nutrients at high tide	Exposed sand from spring tides with strong winds creates dunes	High tidal range causes greater movement	Tides into and out of a river can slow pollution dispersal

So students save the table as a study guide for their end of year exam.

Topic 2: The dynamic shore 28 hrs (14 weeks)									
Week	Subject matter	Pre-reading	Class time (hrs)	Lesson title	Class activity Eg: Worksheets, class discussion, activity	Assessment	Learning experiences	Code	Experiments and or activities and notes
Coastlines 17 hrs (4 weeks)				Working title					
Week 7	Identify that coastlines are shap	T012	0.5	Shaping coastlines	Power point lesson/show video	Ans Q's P406	Field trip preparati	L	File answers for end of year test,
11 - 15 Mar	Recognise tidal movement in ter	T013	0.25	Tidal movements	Power point lesson/show video	Ans Q's P426	Class discussion	L, 21C, N	File answers for end of year test
	Define sand budget and longsho	T014	1	Sand movements	Wave tank longshore drift exp	Ans Q's P430	Class discussion	21C	Discuss page 450 re Tweed River
	Discussion/activity		1		Discuss experiment results			L	See marine environment manual
	Sub total		2.75						
Week 8	Define refraction, reflection and	T015	0.5	Wave definitions	Power point lesson/show video	Ans Q's P470/471	Class discussion	L	File answers for end of year test,
18 - 22 Mar	Describe the factors of wave act	T016	0.5	Material movements	Power point lesson/show video	Copy table PP476	Class discussion	L	Relate these to up coming excurs
	Discussion/activity	T016	1	Material movements	Discuss tables on page 476 and 513				Relate these to up coming excurs
	Discussion/activity		0.75						

Peer reviewed in 2018 and 2019 and upgraded to incorporate improvements.

Cleveland
Redlands College

T016E Sand grain experiment

With data test

T16E Student experiment and data test

From Marine Science for Australian students

See page 100

Made from

Weathering aprons (Bunnings) and 300 micron mesh (Swiss screens)

Exercise 4.2 Sand per cent composition

In this experiment you are going to work out where the big sand grains are on the beach that you collected in Exercise 4.1

Materials and equipment (per group)

- Sieves — None:
  - *For beaches with fine sand grains*
    - sieves of sizes, 300 μ metres, 250 μ metres, 200μ metres (See Figure 100.1A)
  - *For beaches with larger grain sizes*
    - sieves of sizes, 600 μ metres, 400 μ metres, 200μ metres
    - or larger sieves as shown in Figure 100.1B
- aluminium pie dishes labelled as follows
  - subsample...>300 μm, 250 μm, 200 μm, < 200 μm
- 2 ice cream containers
- completely dry sand samples from top, middle and bottom of beach in plastic zip top bags
- lab balance
- 4 aluminium pie dishes or plastic jars as shown in Figure 100.2

A. For beaches with fine sand grains

B. For beaches with larger grain sizes

Figure 100.1 Materials necessary to make sieves

Field work hints

1. Often it is impractical to take a balance into the field. In this case the use of small plastic containers as shown in Figure 100.2A may be of assistance.
2. You will need a labelled container for each sieve as shown and use a rough estimation as shown in Figure 100.2B to work out the percent.
3. Use zip-top plastic bags to collect other sand samples that can be taken back to the lab and analysed if time permits.

To make sieves

1. Mesh of very fine mesh sizes is available from Swiss Screens, Randall St, Slacks Creek, QLD, 4127. Plastic sieves as shown are available from Bunnings, in a multi pack of 10, and are called a weathering apron, 50mm product code is VG 7430. The silk screen in widths ranging from 900 - 1200mm and a 125mm long strip will make 9 sieves of the sizes mentioned above. If you use the 50mm weathering apron, then cut the 125mm strip into nine equal squares.
2. Use a rubber band to hold down the mesh and then add bonderite glue around the rubber band. Take the all weathering tape and bind the mesh to the sieve. Pull down the tape as you bind to make a strong seal. Allow to dry for 24 hours. Make sure you mark the sieve with the correct size.

Figure 100.2 Field analysis

Study site

Sample sites

Bob Moffatt

Sun dried samples

Bob Moffatt

With statistics added

Top and bottom comparisons for the basis of the hypothesis

12 samples are taken

I'm getting a better method

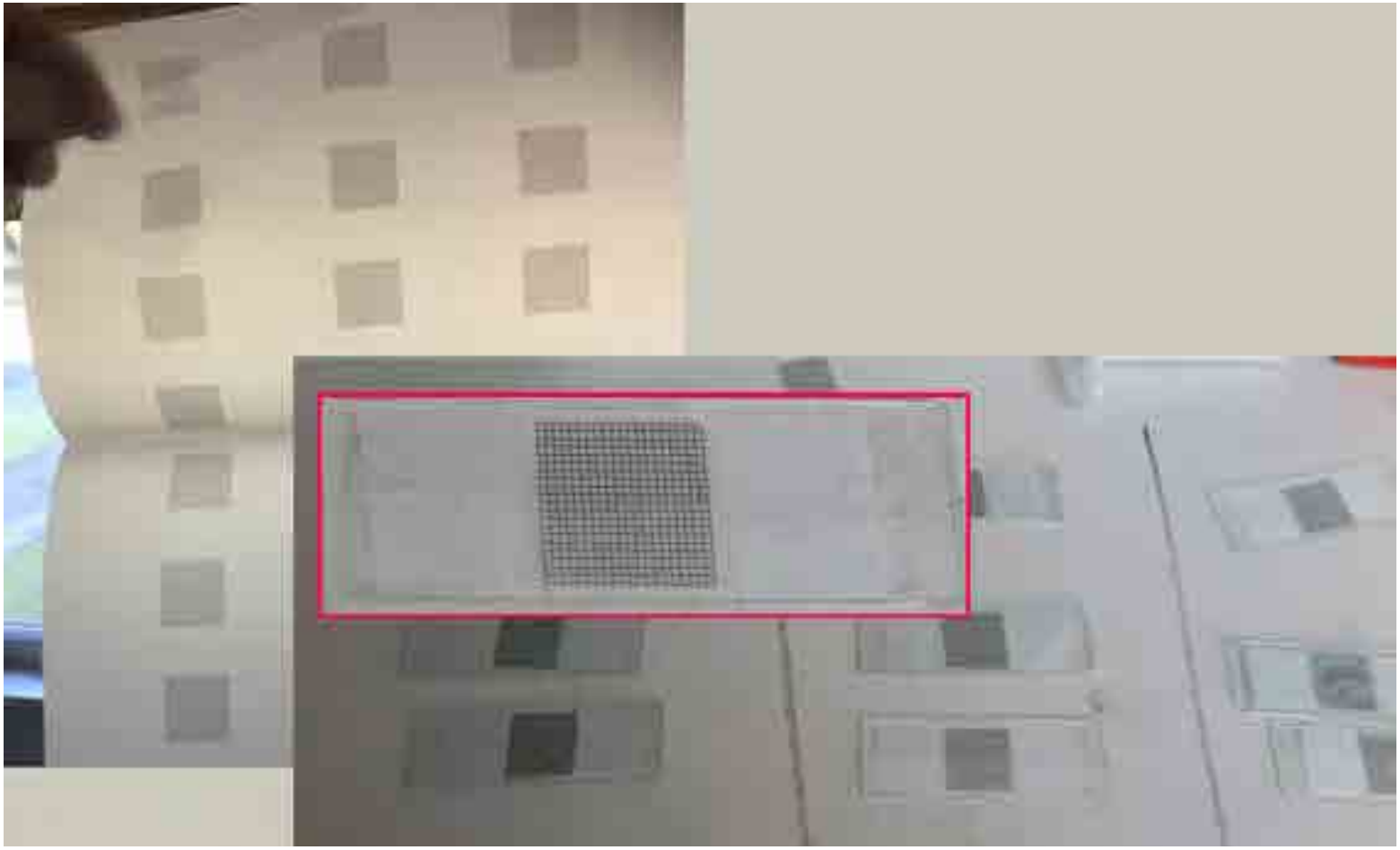
Sand grain percent data calculated.xlsx

	A	B	C	D	E	F	G	H
1	Oceanography Year 11 Sand grain student experiment							
2	Research hypothesis	There is a significant difference between 300 micron percent grain size at the top and bottom of a beach						
3	Null hypothesis	There is no difference between 300 micron percent grain size at the top and bottom of a beach						
4								
5	Selve	% top	% bottom	t-Test: Paired Two Sample for Means				
6	sample #	>300 microns	>300 microns					
7	1	25	75		Variable 1	Variable 2		
8	2	20	80	Mean	27.5	72.5		
9	3	35	65	Variance	84.09090909	84.09090909		
10	4	40	60	Observations	12	12		
11	5	40	60	Pearson Correlation	-1			
12	6	30	70	Hypothesized Mean Difference	0			
13	7	25	75	df	11			
14	8	20	80	t Stat	-8.499602534			
15	9	10	90	P(T<=t) one-tail	1.82771E-06		Probability	Result
16	10	30	70	t Critical one-tail	1.795884819		(ie x.000001)	Hypothesis
17	11	35	65	P(T<=t) two-tail	3.65541E-06		0.000003655	accepted
18	12	20	80	t Critical two-tail	2.20098516		ie <.05	
19								
20								
21	Remember:							
22	Paired is used when two sets of data are related somehow eg sand grains collected on same beach but 2 positions.							
23	Two tail is used when you are interested in whether the P value is < or > 0.05							
24	If P is < 0.05 then significant difference							

Two tailed paired T test done to accept hypothesis

Alternative method

Equipment – home made slides from Danny Stevens (PBC) office works wedding invitation paper



Bob Moffatt


OLYMPUS
2X

Use your mobile phone to get pics and count on the squares

Count the numbers of sand grains in the squares (if a sand grain was partly in a square it was counted).

Bottom

Bob Moffatt

Top

Bob Moffatt

To be peer reviewed end of the year

	A	B	C	D	E	F	G	H	I
1	Null Hypothesis		There is no difference between grain sizes at the top and bottom of the beach						
2	Research hypothesis		There is a significant difference between sand grain sizes at the top of the beach compared to the bottom						
3	Paired test	Because we are comparing two places on the beach							
4	Two tailed	If P is < 0.05 then significant difference							
5									
6	Slide	No of grains		t-Test: Paired Two Sample for Means					
7	Square	per sq mm							
8	No	Top	Bottom		Variable 1	Variable 2			
9	1	10	7	Mean	9.833333333	5.416666667			
10	2	12	8	Variance	1.424242424	1.71969697			
11	3	9	7	Observations	12	12			
12	4	11	6	Pearson Correlation	0.106495395				
13	5	9	4	Hypothesised Mean Difference	0				
14	6	8	5	df	11				
15	7	8	7	t Stat	9.126100716				
16	8	11	4	P(T<=t) one-tail	9.14493E-07		Probability	Result	
17	9	9	5	t Critical one-tail	1.795884819		(ie x.000001)	Hypothesis	
18	10	10	6	P(T<=t) two-tail	1.82899E-06		0.000001828	accepted	
19	11	9	3	t Critical two-tail	2.200985316		ie < 0.05		
20	12	11	5						
21									
22									
23	Remember:								
24	Paired is used when two sets of data are related somehow eg sand grains collected on same beach but 2 positions.								
25	Two tail is used when you are interested in whether the P value is < or > 0.05								
26	If P is < 0.05 then significant difference								
27	if P is > 0.05 then not significantly different								
28									
29	The Pearson correlation is a measure of the linear correlation between two variables X and Y.								
30									
31	Values								
32	1 is total positive linear correlation,								
33	0 is no linear correlation, and								
34	−1 is total negative linear correlation.								
35									
36									
37									
38									
39									
40									
41									

And so on

T028 Pollution source comparisons

Syllabus statement

At the end of this topic you should be able to ...

Compare the terms point source and non-point source forms of pollution

Compare

display recognition of similarities and differences

and

recognise the significance of these similarities and differences.

Objective

Give examples to show similarities and differences between point source and non-point source forms of pollution recognising the significance of the differences.

Rubbish comparisons mangroves supermarket - which is easier to control?

Photos Dave Claridge, Bob Moffatt

Question

Complete the table . (You could use a VEN diagram)

Factor	Similarities - Point source and non point source pollution	Significance
Cleanup expenses Environmental damage Legislation		

Differences	Point source	Non point
Definite single source vs no definite single source		
Local vs widely diffused		
Ease of preventing and controlling the pollution		
Levels of dilution		
Scale of measures needed to address the pollution		

Similarities

Cleanup expenses

Environmental damage

Legislation

Clean up expenses

Both involve money (Similarity).

Seal Penguin and oil AMSA Oil pics

Significance – its expensive in many cases

NEWS

Just In | Politics | World | Business | Sport | Science | Health

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Taxpayers face multi-million-dollar bill to clean up Nickel site

Environmental destruction

Death to mangroves, diseases in fish (Similarity)

Significance – the damage is huge

Both kill marine life

And both decrease biodiversity.

You can legislate

(Similarity)

and then prosecute law breakers

(Significance)

Australian Government
Great Barrier Reef Marine Park Authority

Site map a A

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Media Room

Home › Media Room › Latest news › Illegal recreational fishing fine increased to $2100

Illegal recreational fishing fine increased to $2100

Published: 30/06/2017

Recreational fishers caught poaching from no-take areas in the Great Barrier Reef will face higher penalties from this weekend, with fines increasing from $1800 to $2100.

The increase in the Commonwealth penalty units from tomorrow (July 1) supports the tough stance the Great Barrier Reef Marine Park Authority is taking to protect the Reef, adopting a no-tolerance approach to green zone poaching.

Great Barrier Reef Marine Park Authority director Richard Quincey said it was important Marine Park users knew the rules before heading out on the water.

"People who choose to fish in a no-take green zone could receive a $2100 fine or a prosecution," Mr Quincey said.

"The effects of green zone poaching are cumulative — every fisher who takes fish from a green zone has an impact on the health of the Reef.

Differences between point and non point pollution

1.Definite single source vs no definite single source

2.Local vs widely diffused

3.Ease of preventing and controlling the pollution

4.Levels of dilution

5.Scale of measures needed to address the pollution

But some are more easy to prosecute that others

Non point is also difficult to locate

Local vs widely diffused

- Point source is more localised

And so on

Peer reviewed next year

T043 Apply biodiversity data

Syllabus statement

At the end of this topic you should be able to ...

Apply data to determine the biodiversity of a marine ecosystem using diversity indices

Apply

-use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

-[formula will be given]

-You need excel

Questions

Q1: Using data and Simpsons index below to determine if plants from one sand dune area on a beach are more diverse than another.

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

Q2. Using the same data apply Shannon diversity index (H) to account for abundance and evenness to see if this index put a different interpretation on diversity.

$$H = -\sum (n/N) \ln(n/N)$$

Q1. Comparison of two beaches

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

Where

n = the total number of organisms of a particular species

N = the total number of organisms of all species

$\sum$ = the sum of

D = is Simpsons index


Beach A
Beach B
D = 0.7

Beach A

Species	Number (n)
Spinifex	12
Goats foot	2
Sea oak	0
Pig face	0
Pandanas	1
	N=15

Species	Number (n)
Spinifex	12
Goats foot	2
Sea oak	0
Pig face	0
Pandanas	1
	N=15

Beach A

Beach B

Species	Number (n)
Spinifex	2
Goats foot	8
Sea oak	1
Pig face	1
Pandanas	3
	N=15

Beach A

Species	Number (n)
Spinifex	12
Goats foot	2
Sea oak	0
Pig face	0
Pandanas	1
	N=15

Beach B

Species	Number (n)
Spinifex	2
Goats foot	8
Sea oak	1
Pig face	1
Pandanas	3
	N=15

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

Beach A

Species	Number (n)	n(n-1)
Spinifex	12	132
Goats foot	2	2
Sea oak	0	0
Pig face	0	0
Pandanas	1	0
	N=15	$\sum$ n(n-1) 134

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

$$= 1 - \left(\frac{134}{210} \right)$$

$$= 1 - 0.6$$

$$= 0.4$$

Beach B

Species	Number (n)	n(n-1)
Spinifex	2	2
Goats foot	8	56
Sea oak	1	0
Pig face	1	0
Pandanas	3	6
	N=15	$\sum$ n(n-1) 64

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

$$= 1 - \left(\frac{64}{210} \right)$$

$$= 1 - 0.3$$

$$= 0.7$$

marine reserve

Rezoning application marine reserve edge

$$H = -\sum(n/N)\ \ln(n/N)$$

H	Shannon's diversity index
N	total number of species in the community (richness)
n/N	proportion of N made up of the number of n species
ln	is the natural log of the product of n/N

Species evenness refers to how close in numbers each species in an environment is.

So if there are 4 Goat's feet, and 100 Spinifex plants per 10 square metres, the community is not very even.

But if there are 4 Goat's feet and 6 Spinifex plants per 10 square metres, the community is quite even.

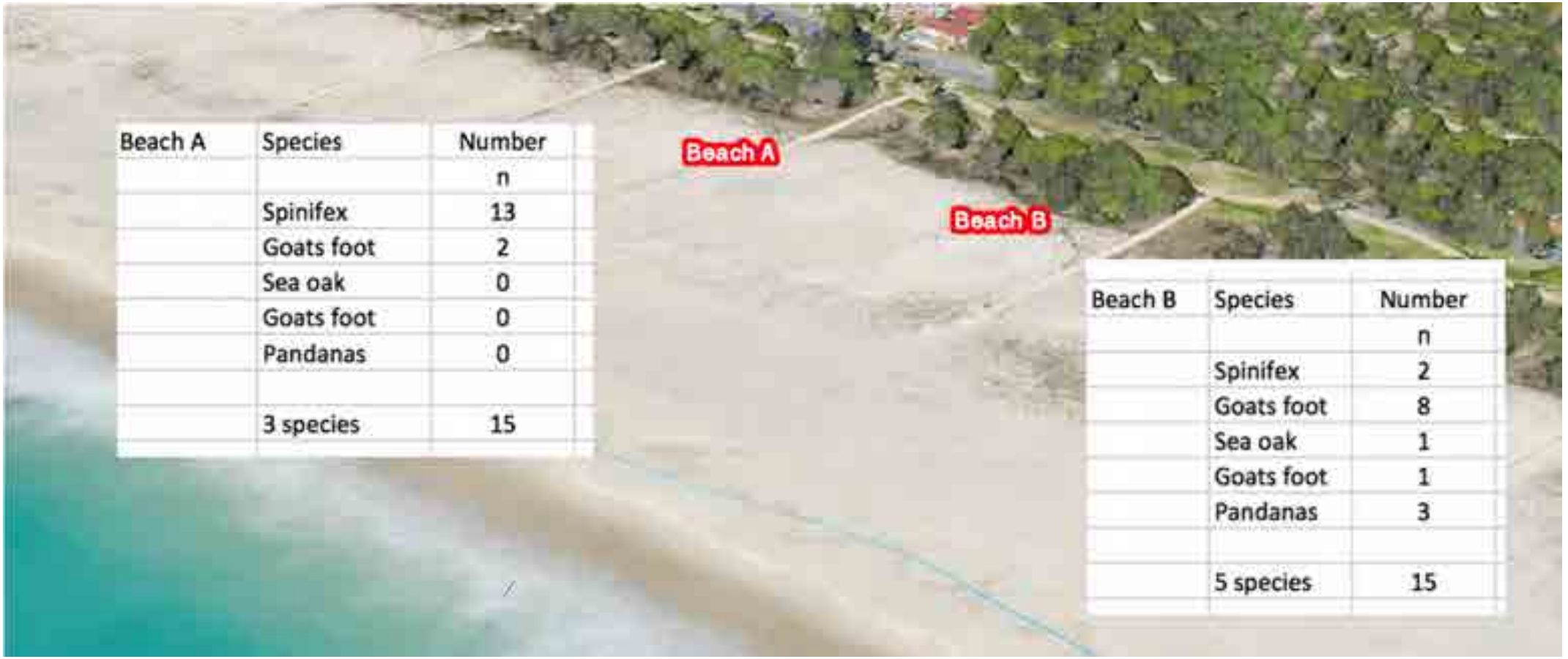
The higher the number the higher the evenness.

This index provides information about

Rarity and commonness

Video

https://www.youtube.com/watch?v=0fsZr5U07aw



Beach A	Species	Number
		n
	Spinifex	13
	Goats foot	2
	Sea oak	0
	Goats foot	0
	Pandanas	0
	3 species	15

Beach B	Species	Number
		n
	Spinifex	2
	Goats foot	8
	Sea oak	1
	Goats foot	1
	Pandanas	3
	5 species	15

61						
62	Beach	Species	Number	Proportion	Natural log of n/N	Product of proportion * natural log
63	B	name	n	n/N	ln(n/N)	n/N x ln(n/N)
64		Spinifex	2			
65		Goats foot	8			
66		Sea oak	1			
67		Goats foot	1			
68		Pandanas	3			
69						
70	5 species	Total (N)	15			

Step 1

	A	B	C
1	**Shannon-Weiner Dive**		
2			
3			
4			
5	Example		Number
6	Beach B	Species	n
7		Spinifex	2
8		Goats foot	8
9		Sea oak	1
10		Goats foot	1
11		Pandanas	3
12			
13	5 species	Total (N)	=SUM(C7:C11)
14			
15	Shannon index H	equals - Sum(n/N x ln(n/N)	
16			

Step 1

	A	B	C	D
1	**Shannon-Weiner Diversity Index**			
2				
3				
4				
5	Example		Number	
6	Beach B	Species	n	
7		Spinifex	2	
8		Goats foot	8	
9		Sea oak	1	
10		Goats foot	1	
11		Pandanas	3	
12				
13	5 species	Total (N)	15	
14				

Step 1

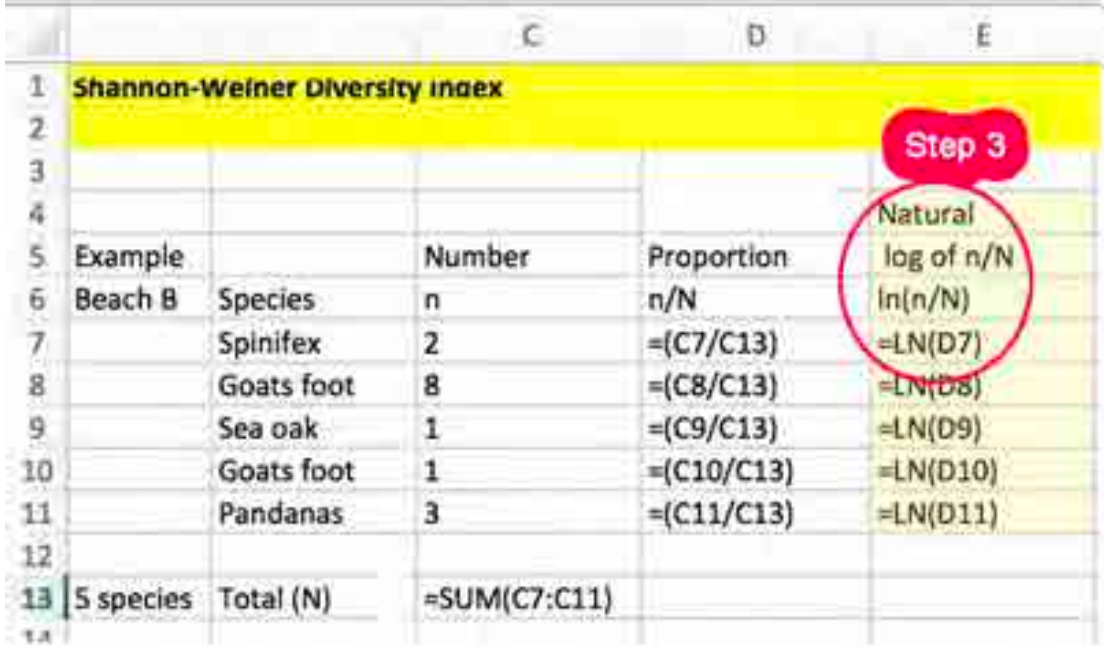
N = 15

Step 2

	A	B	C	D
1	**Shannon-Weiner Dive**			
2				Step 2
3				
4				
5	Example		Number	Proportion
6	Beach B	Species	n	n/N
7		Spinifex	2	=(C7/C13)
8		Goats foot	8	=(C8/C13)
9		Sea oak	1	=(C9/C13)
10		Goats foot	1	=(C10/C13)
11		Pandanas	3	=(C11/C13)
12				
13	5 species	Total (N)	=SUM(C7:C11)	

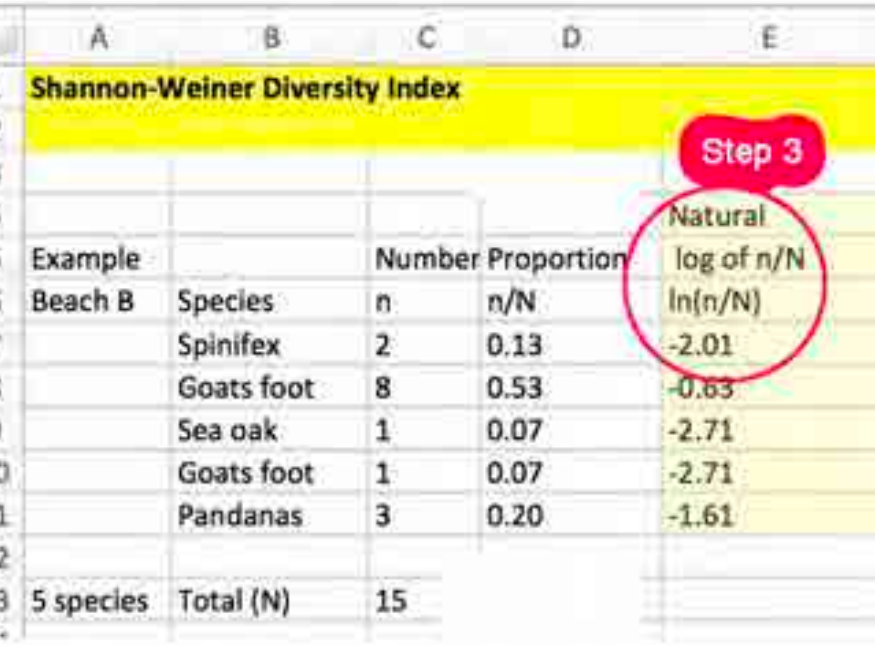
	A	B	C	D
1	**Shannon-Weiner Diversity Index**			
2				Step 2
3				
4				
5	Example		Number	Proportion
6	Beach B	Species	n	n/N
7		Spinifex	2	0.13
8		Goats foot	8	0.53
9		Sea oak	1	0.07
10		Goats foot	1	0.07
11		Pandanas	3	0.20
12				
13	5 species	Total (N)	15	
14				

Step 3



	C	D	E
1	**Shannon-Weiner Diversity Index**		
2			
3			
4			Natural
5	Number	Proportion	log of n/N
6	n	n/N	ln(n/N)
7	2	=(C7/C13)	=LN(D7)
8	8	=(C8/C13)	=LN(D8)
9	1	=(C9/C13)	=LN(D9)
10	1	=(C10/C13)	=LN(D10)
11	3	=(C11/C13)	=LN(D11)
12			
13	=SUM(C7:C11)		

Step 3



	A	B	C	D	E
1	**Shannon-Weiner Diversity Index**				
2					
3					
4					Natural
5	Example		Number	Proportion	log of n/N
6	Beach B	Species	n	n/N	ln(n/N)
7		Spinifex	2	0.13	-2.01
8		Goats foot	8	0.53	-0.63
9		Sea oak	1	0.07	-2.71
10		Goats foot	1	0.07	-2.71
11		Pandanas	3	0.20	-1.61
12					
13	5 species	Total (N)	15		

Step 3

Step 4

	C	D	E	F
1	**Shannon-Weiner Diversity Index**			
2				Step 4
3				
4			Natural	Product of
5	Example	Number	Proportion	log of n/N	proportion * natural log
6	Beach B	Species	n	n/N	ln(n/N)	n/N x ln(n/N)
7		Spinifex	2	=(C7/C13)	=LN(D7)	=SUM(D7*E7)
8		Goats foot	8	=(C8/C13)	=LN(D8)	=SUM(D8*E8)
9		Sea oak	1	=(C9/C13)	=LN(D9)	=SUM(D9*E9)
10		Goats foot	1	=(C10/C13)	=LN(D10)	=SUM(D10*E10)
11		Pandanas	3	=(C11/C13)	=LN(D11)	=SUM(D11*E11)

	A	B	C	D	E	F
1	**Shannon-Weiner Diversity Index**					
2						Step 4
3						
4					Natural	Product of
5	Example		Number	Proportion	log of n/N	proportion * n
6	Beach B	Species	n	n/N	ln(n/N)	n/N x ln(n/N)
7		Spinifex	2	0.13	-2.01	-0.27
8		Goats foot	8	0.53	-0.63	-0.34
9		Sea oak	1	0.07	-2.71	-0.18
10		Goats foot	1	0.07	-2.71	-0.18
11		Pandanas	3	0.20	-1.61	-0.32

Step 5

	A	B	C	D	E	F
1	**Shannon-Weiner Dive**					
2						
3						
4					Natural	Product of
5	Example		Number	Proportion	log of n/N	proportion * natural log
6	Beach B	Species	n	n/N	ln(n/N)	n/N x ln(n/N)
7		Spinifex	2	=(C7/C13)	=LN(D7)	=SUM(D7*E7)
8		Goats foot	8	=(C8/C13)	=LN(D8)	=SUM(D8*E8)
9		Sea oak	1	=(C9/C13)	=LN(D9)	=SUM(D9*E9)
10		Goats foot	1	=(C10/C13)	=LN(D10)	=SUM(D10*E10)
11		Pandanas	3	=(C11/C13)	=LN(D11)	=SUM(D11*E11)
12						
13	5 species	Total (N)	=SUM(C7:C11)			
14						
15	Shannon Index H	equals - Sum(n/N x ln(n/N)			Step 5	=-SUM(F7:F11)
16						

$$H = -\sum(n/N)\ \ln(n/N)$$

	A	B	C	D	E	F
1	**Shannon-Weiner Diversity Index**					
2						
3						
4					Natural	Product of
5	Example		Number	Proportion	log of n/N	proportion * natural log
6	Beach B	Species	n	n/N	ln(n/N)	n/N x ln(n/N)
7		Spinifex	2	0.13	-2.01	-0.27
8		Goats foot	8	0.53	-0.63	-0.34
9		Sea oak	1	0.07	-2.71	-0.18
10		Goats foot	1	0.07	-2.71	-0.18
11		Pandanas	3	0.20	-1.61	-0.32
12						
13	5 species	Total (N)	15			
14						
15	Shannon ir	equals - Sum(n/N x ln(n/N)			Step 5	1.29

$= H$

So what about Beach A

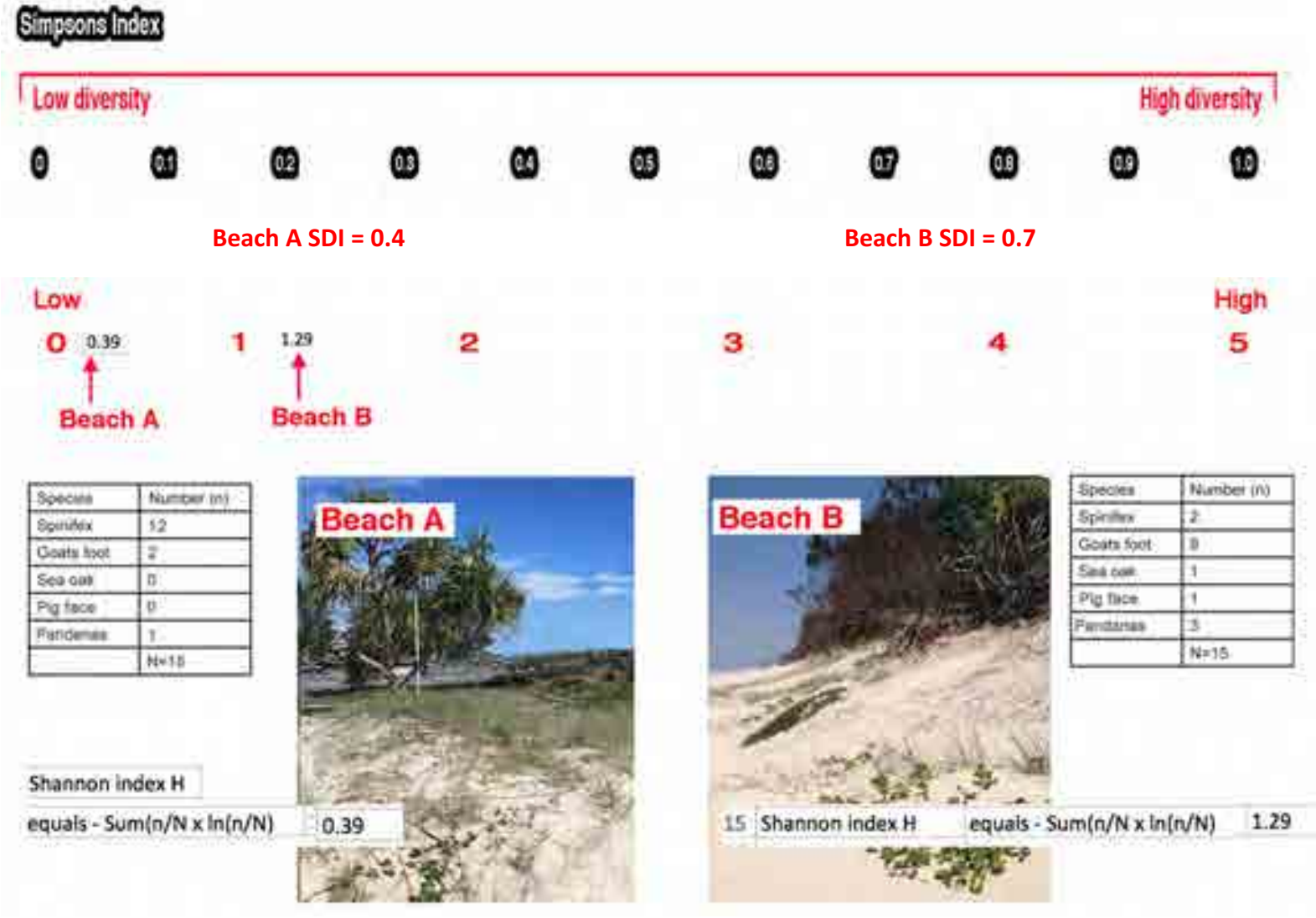
	A	B	C	D	E	F
1	**Shannon-Weiner Dive**					
2						
3						
33	Example			Proportion	log of Pi	proportion * natural log
34	Beach A	Species	Number	Pi	lnPi	Pi*lnPi
35		Spinifex	13	=(C35/C41)	=LN(D35)	=SUM(D35*E35)
36		Goats foot	2	=(C36/C41)	=LN(D36)	=SUM(D36*E36)
37		Sea oak	0	=(C37/C41)	0	=SUM(D37*E37)
38		Goats foot	0	=(C38/C41)	0	=SUM(D38*E38)
39		Pandanas	0	=(C39/C41)	0	=SUM(D39*E39)
40						
41		3 species	=SUM(C35:C39)			
42						
43	Shannon index H	equals - Sum of Pi*lnPi		=-SUM(F35:F39)		

	A	B	C	D	E	F
33	Example			Proportion	log of Pi	proportion * natural log
34	Beach A	Species	Number	Pi	lnPi	Pi*lnPi
35		Spinifex	13	0.87	-0.14	-0.12
36		Goats foot	2	0.13	-2.01	-0.27
37		Sea oak	0	0.00	0.00	0.00
38		Goats foot	0	0.00	0.00	0.00
39		Pandanas	0	0.00	0.00	0.00
40						
41		3 species	15			
42						
43	Shannon ir	equals - Sum of Pi*lnPi		0.39		

$-\sum(n/N)\ \ln(n/N)$

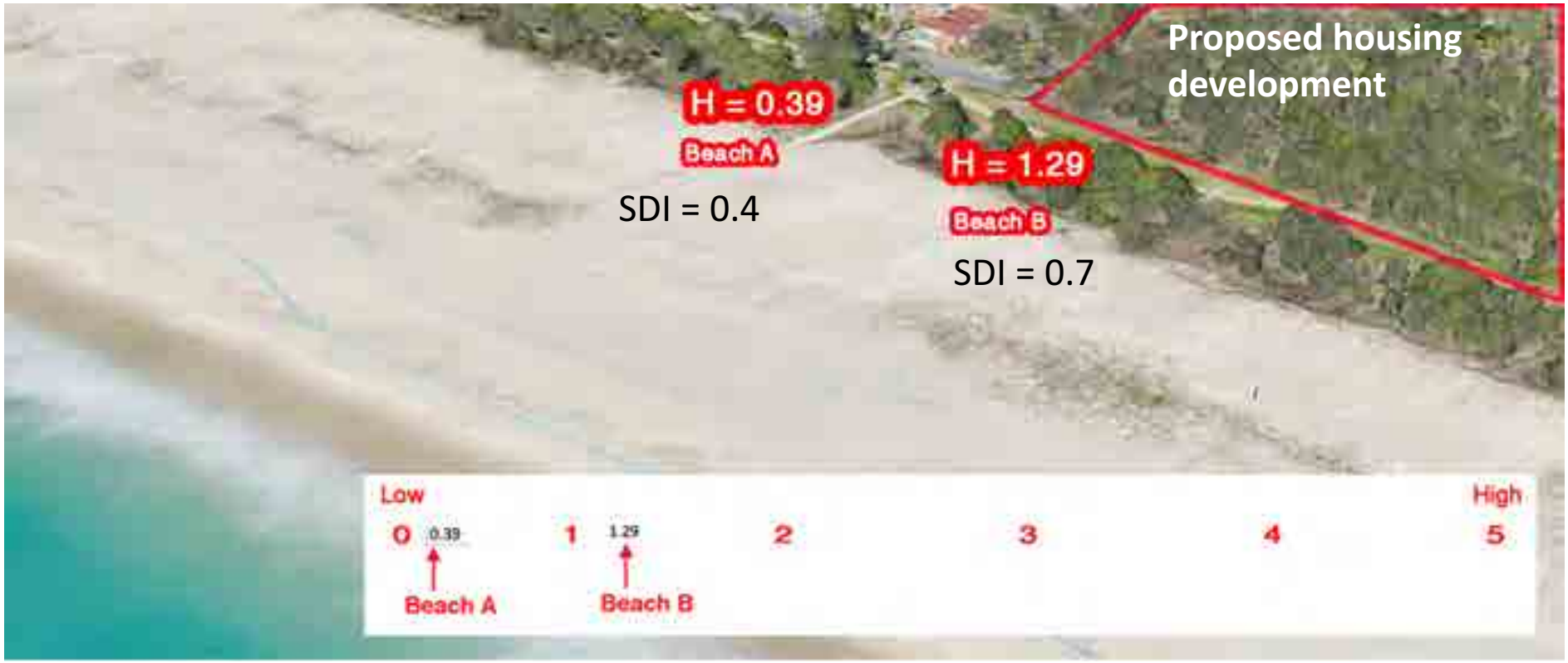
$= H$

Interpretation



Recommendation to council

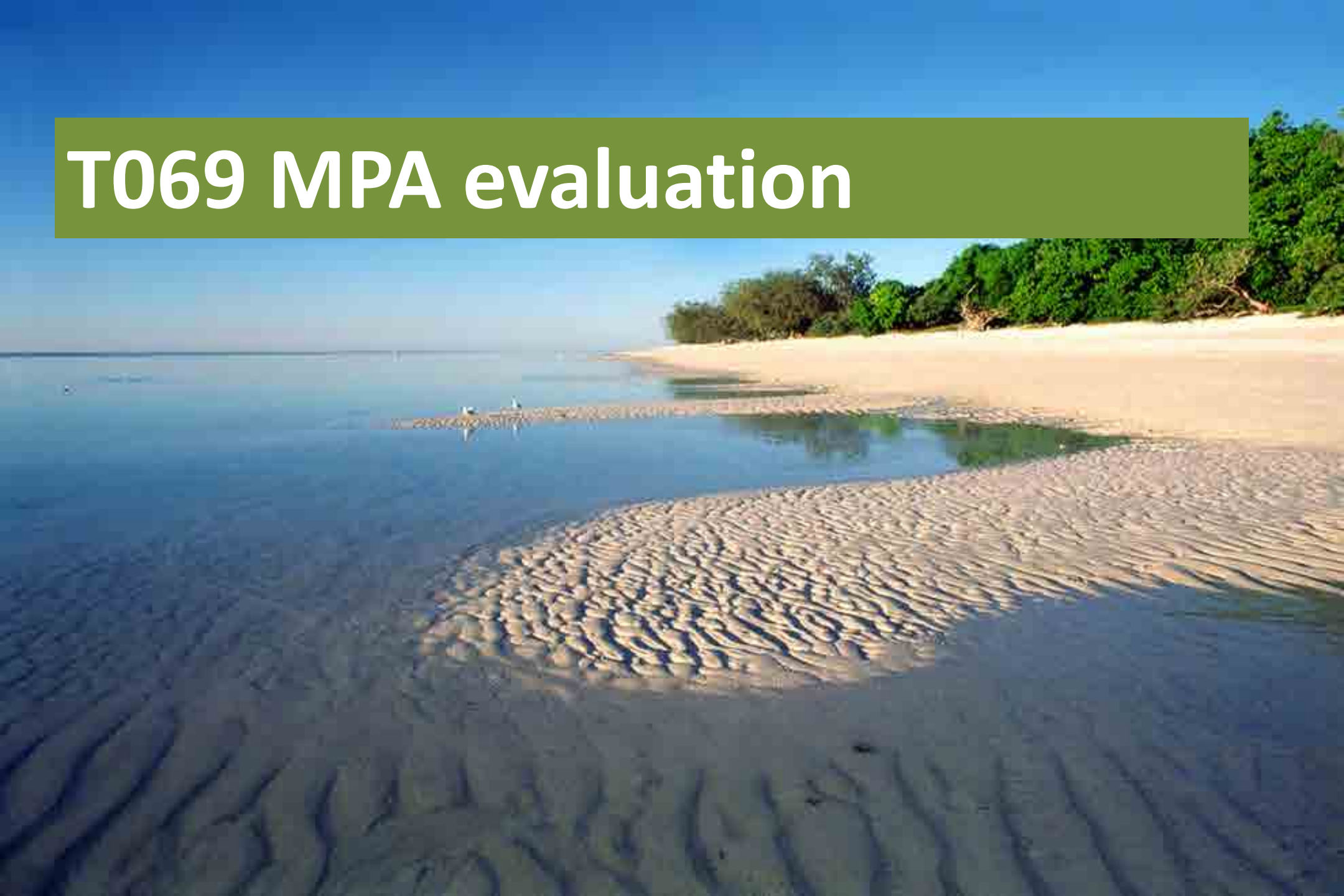
So if Shannon's index is a measure of abundance and evenness of the species present, we can say that the abundance and evenness of dune plants is low and needs to be PROTECTED.



Application of data

And so on

T069 MPA evaluation



Syllabus statement

At the end of this topic you should be able to ...

Evaluate

the marine environmental planning and management process using primary or secondary data of a specific case study (this may be linked to fieldwork).

Question

Using data, show how the use of no take zones protect coral reefs from crown of thorns outbreaks.

Data from

https://www.aims.gov.au/docs/data/data.html

Acknowledgement
Hugh Sweatman
Australian Institute of Marine Science

Research paper from
http://epubs.aims.gov.au/handle/11068/7783

Pdf version from
https://core.ac.uk/download/pdf/82736474.pdf

Current Biology Vol 18 No 14
R598

No-take reserves protect coral reefs from predatory starfish

Hugh Sweatman

The crown-of-thorns starfish, *Acanthaster planci*, is a predator of corals that is a major management issue on coral reefs [1]. It occurs throughout the Indo–Pacific and shows boom–bust population dynamics with low background densities and intermittent outbreaks.

Three waves of population outbreaks have affected Australia's Great Barrier Reef (GBR) since the 1960s.

The waves of outbreaks appear to start ~15°S [2] and progress southward through the central GBR (Figure 1A), causing major losses of living coral on many reefs across a large area and dwarfing losses from other disturbances such as storms or coral bleaching over the same period [3].

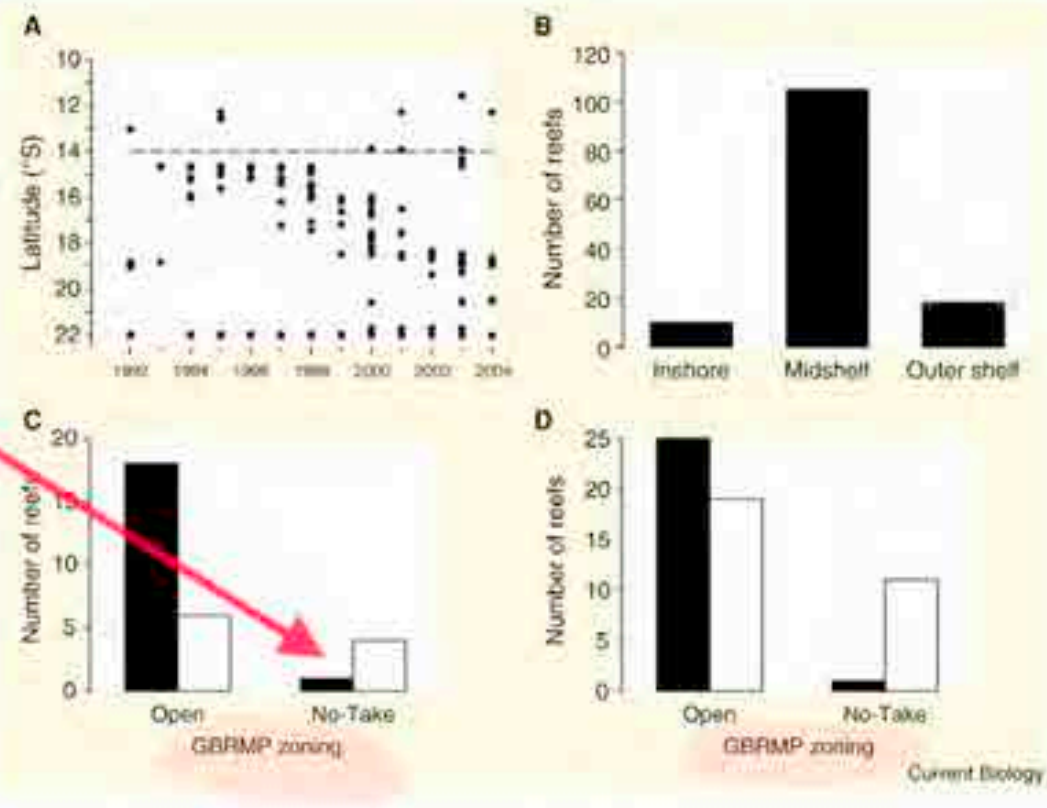


Figure 1. Crown-of-thorns starfish outbreaks on Australia's GBR.

(A) Location of reefs with outbreaks of *A. planci* 1992–2004 by latitude, showing southerly drift in the central GBR (14–21°S) and the consistent presence of outbreaks in the Swain Reefs (~22°S). (B) Number of records of outbreaks 1985–2004 on all GBR reefs grouped by position on the continental shelf. (C) Occurrence of outbreaks 1994–2004 on open and no-take reefs in the mid-shelf region of the GBR where most outbreaks occur; number of reefs with outbreaks (black bars) and without outbreaks (white bars) ($n = 29$, one-tailed Fisher's exact test $p = 0.036$). (D) As (C), but including inshore, mid-shelf and outer shelf reefs ($n = 56$, one-tailed Fisher's exact test $p < 0.003$).

https://core.ac.uk/download/pdf/82736474.pdf

Figure 1. Crown-of-thorns starfish outbreaks on Australia's GBR.

(A) Location of reefs with outbreaks of *A. planci* 1992–2004 by latitude, showing southerly drift in the central GBR (14–21°S) and the consistent presence of outbreaks in the Swain Reefs (~22°S).

(B) Number of records of outbreaks 1985–2004 on all GBR reefs grouped by position on the continental shelf.

(C) Occurrence of outbreaks 1994–2004 on open and no-take reefs in the mid-shelf region of the GBR where most outbreaks occur; number of reefs with outbreaks (black bars) and without outbreaks (white bars) (n = 29, one-tailed Fisher's exact test p = 0.036).

(D) As (C), but including inshore, mid-shelf and outer shelf reefs (n = 56, one-tailed Fisher's exact test $p < 0.003$).

Reference

https://en.wikipedia.org/wiki/Fisher%27s_exact_test

We all need to learn a LOT MORE help.

The power points will be reviewed in 2019.

WHEN the syllabus changes.

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Facilitator
Jennifer Evans

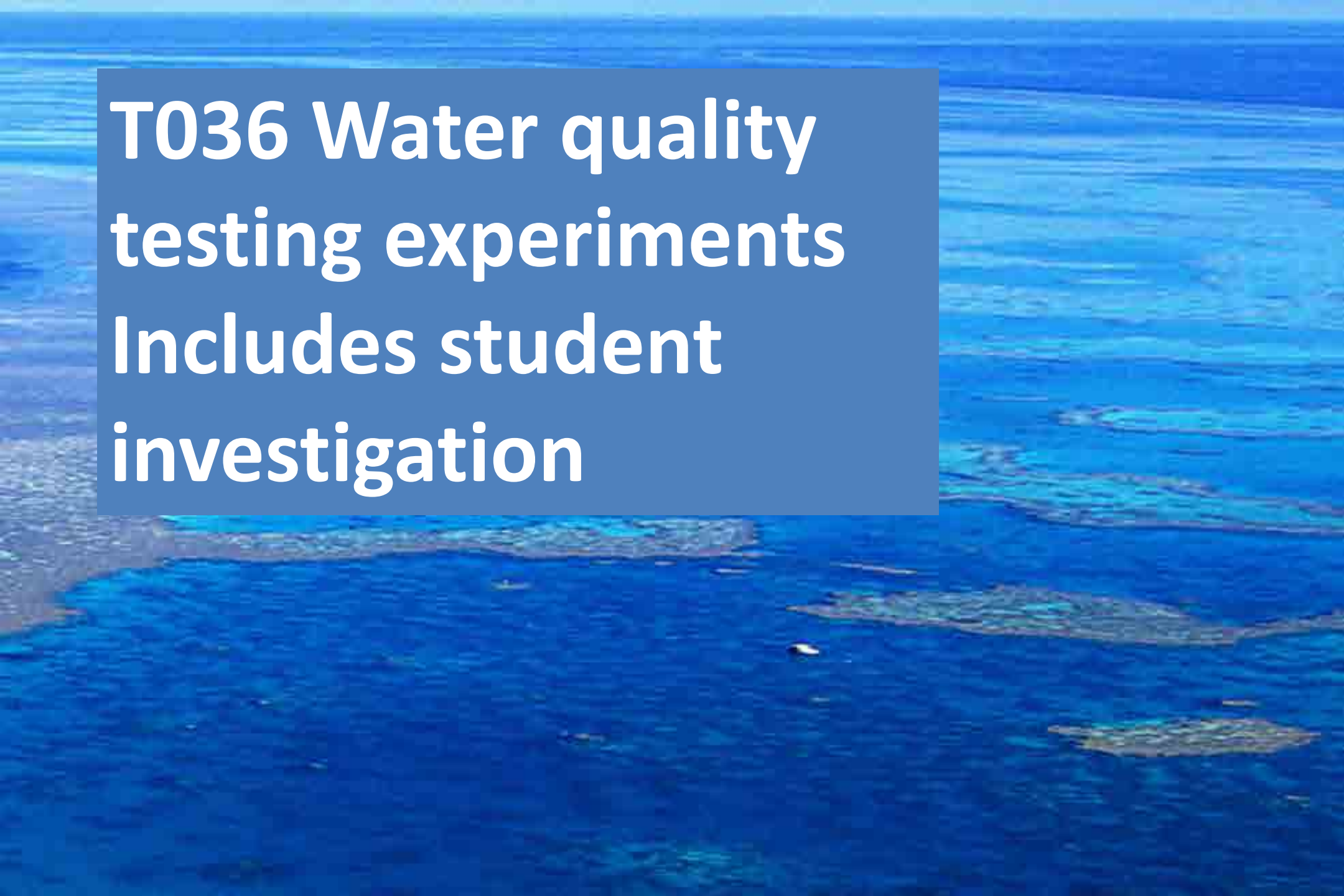
Tuesday 11 September 2018
4pm – 6.30pm

Albany Creek State High School, Building L (Library)

Across the new suite of science General Senior Syllabuses for implementation in 2019, there is greater emphasis for students to improve their scientific numeracy through proficiency in basic data analysis and data interpretation. These skills are fundamental to enhancing creative and critical thinking in our next generation of STEM practitioners.

In this workshop, we will demonstrate the appropriate approaches to statistical analyses and interpretation on data collected in experimental investigations. These methods of statistical analyses are applicable to data collected in the Biology, Agricultural Science, and Marine Science syllabuses.

You will need access to a (Windows or Mac) computer/laptop with an updated version of Microsoft Excel 2013 or more recent.


T036 Water quality testing experiments Includes student investigation

Syllabus statement

At the end of this topic you should be able to ...

Conduct water quality tests on a water sample.

Oceanography investigation

– how healthy is our local water in .. (estuary, waterway, reef, mangroves, river etc)

Water quality tests

WQI values and their significance are summarised below:

Example

Variable	Results (Column A)	Column B (From Q tables)	Factor (Column C)	Column D
1. Dissolved oxygen	130%	91	0.17	15.47
2. Faecal coliform	colonies 130/100ml	41	0.16	6.56
3. pH	8.8 units	58	0.11	6.38
4. B.O.D.	6.5 p.p.m.	48	0.11	4.28
5. Temperature	+0.5 Δ°C	90	0.10	9.00
6. Total Phosphorous	0.3 mg/l	82	0.10	8.20
7. Nitrates	0.62 mg/l	98	0.10	9.80
8. Turbidity	90 cm	30	0.08	2.40
9. Total solids (-salinity)	430 mg/l	42	0.07	2.94
	Overall water quality index			**65.03**

Water quality measurement table After Mitchell and Stapp (Reproduced with permission)

From

Chapter 13 Water quality – the old green bible

Variable	Results (Column A)	Column B	Factor (Column C)	Column D
1. Dissolved oxygen	%		0.17	
2. Faecal coliform	colonies /100ml		0.16	
3. pH	units		0.11	
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6. Total Phosphorous	mg/l		0.10	
7. Nitrates	mg/l		0.10	
8. Turbidity	cm		0.08	
9. Total solids (-salinity)	mg/l		0.07	
Overall water quality index				

After Mitchell and Stapp 1988

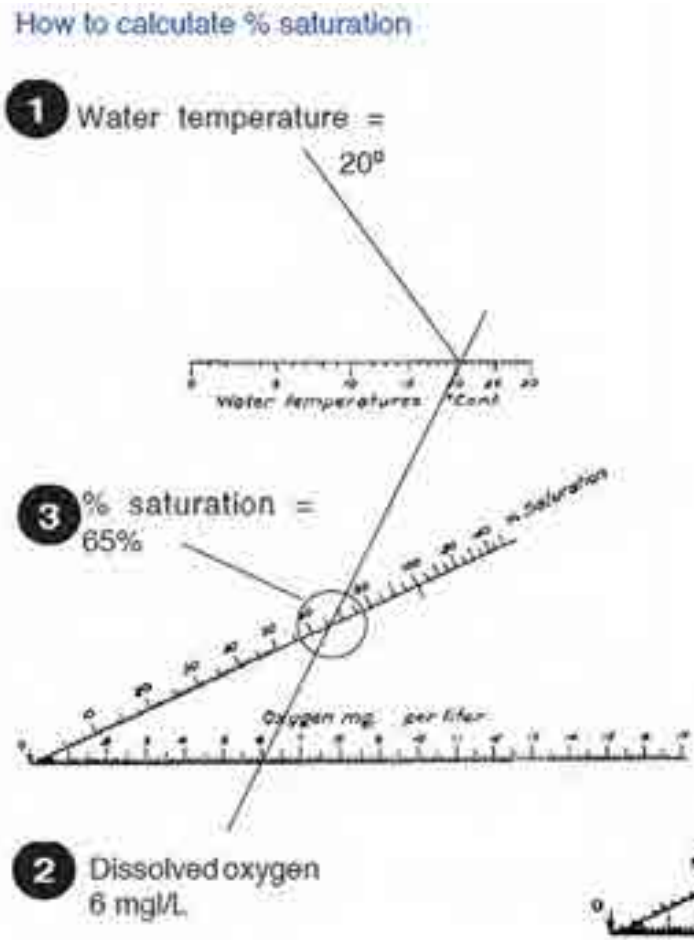
Fig. 22 Water quality data table (After Mitchell and Stapp 1988)

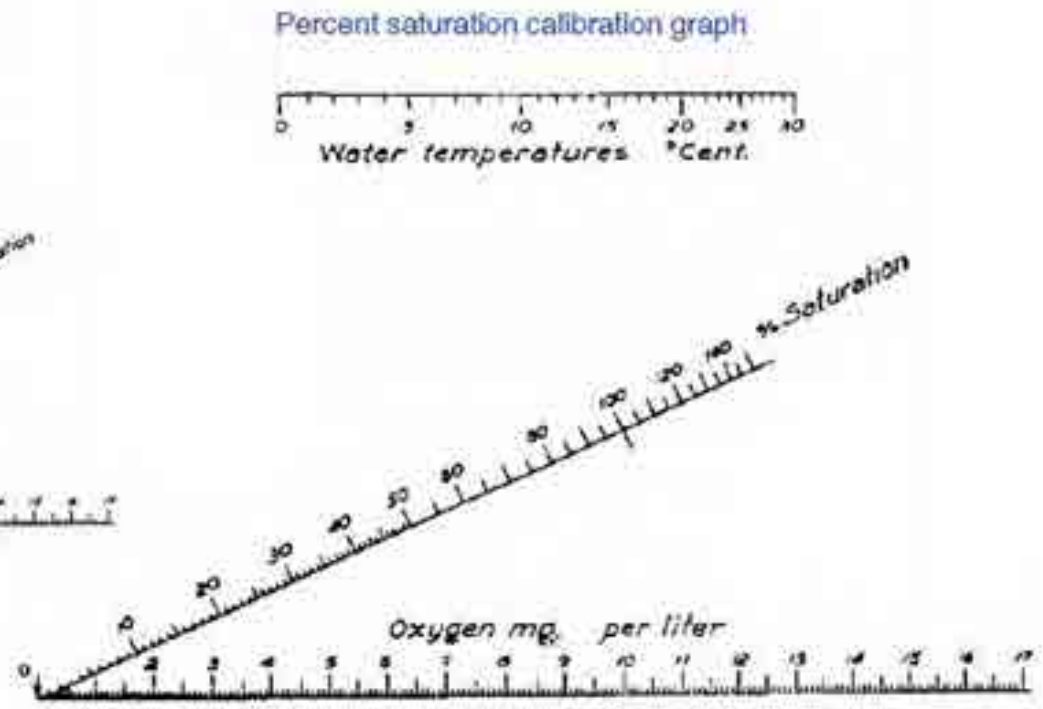
A parameter is taken

Eg: Dissolved oxygen

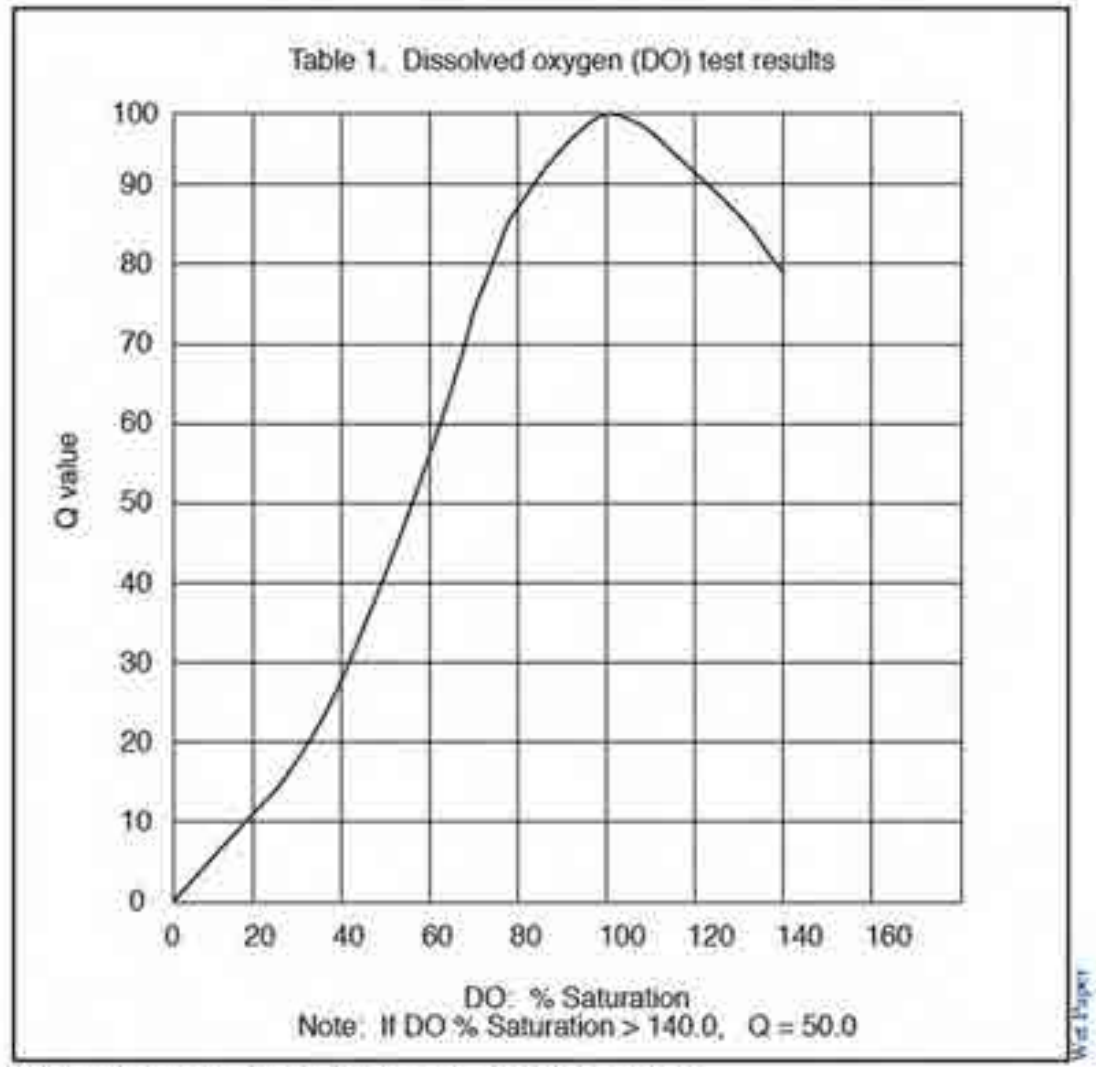
Hatch DO kit instructions
Credit https://www.hach.com/dissolved-oxygen-test-kit-model-ox-2p/product?id=7640219538#

Data collected and analysed





A high Q value meant the water is healthy.



After Mitchell and Stapp (1988) Page 66. Reproduced with permission.

Results discussed

Water quality tests

WQI values and their significance are summarised below:

- 90 - 100 excellent
- 70 - 90 good
- 50 - 70 medium
- 25 - 50 bad
- 0 - 25 very bad

Example

Variable	Results (Column A)	Column B (From Q tables)	Factor (Column C)	Column D
1. Dissolved oxygen	130%	91	0.17	15.47
2. Faecal coliform	colonies 130/100ml	41	0.16	6.56
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	Overall water quality index			65.03

Water quality measurement table After Mitchell and Stapp (Reproduced with permission)

Research claim, other data and research presented etc etc

Water quality tests

WQI values and their significance are summarised below:

- 90 - 100 excellent
- 70 - 90 good
- 50 - 70 medium
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Example

Variable	Results (Column A)	Column B (From Q tables)	Factor (Column C)	Column D
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	Overall water quality index			**65.03**

Water quality measurement table After Mitchell and Stapp (Reproduced with permission)

Note:

This has passed peer review in QCAA Sunshine Coast panels for the past 10 years and is a historic method but easy to understand.

There are other ways to interpret the data.

AVAILABILITY and cost

Wet Paper Year 11 Marine science
PO Box 540 Coolangatta 4225
0418 769 790
bmoffatt@wetpaper.com.au

A Year 11 Study guides

Read as a flipbook from the internet

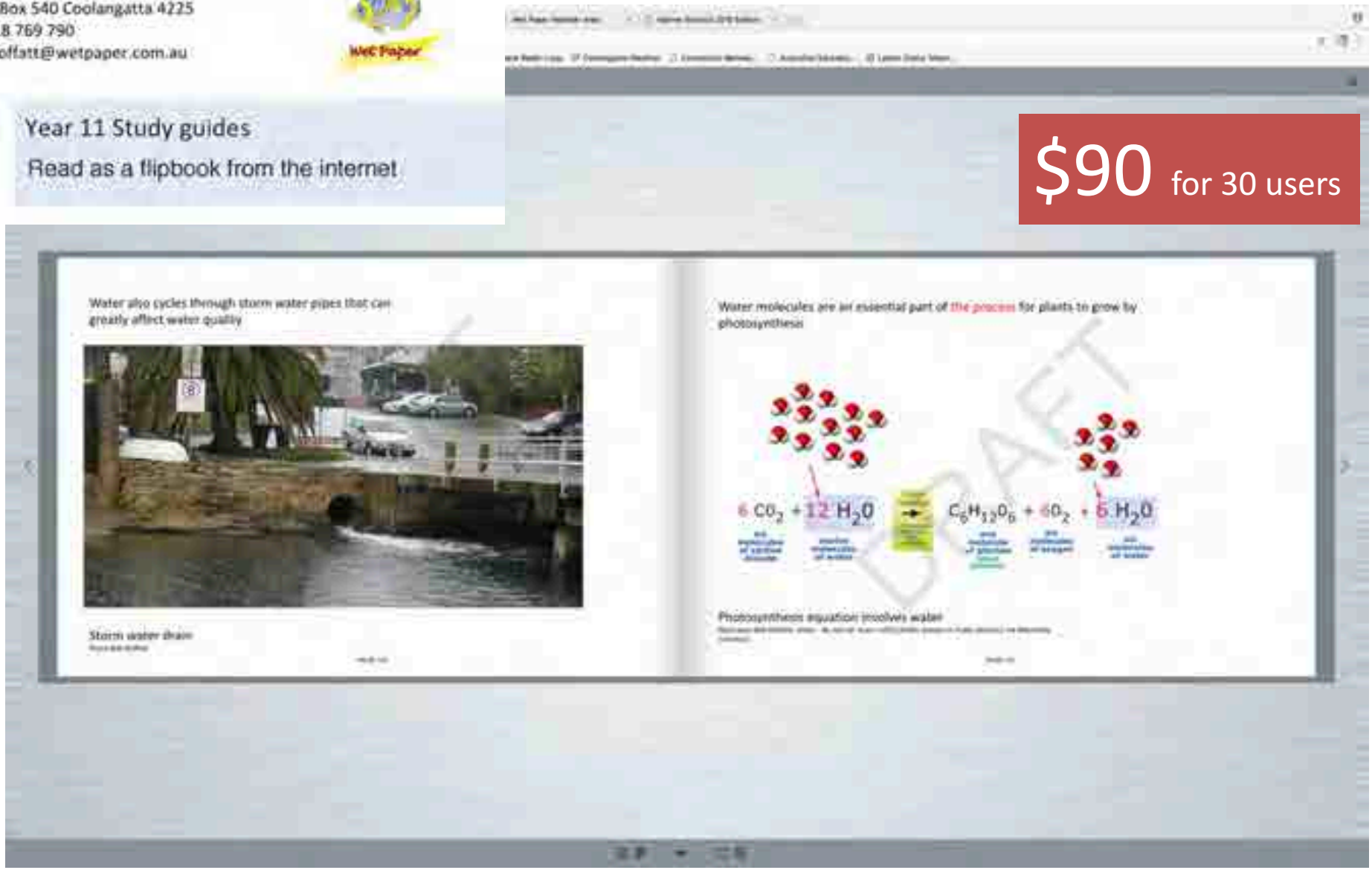
B Year 11 Study guide and power points package

Wet Paper Year 11 Marine science
PO Box 540 Coolangatta 4225
0418 769 790
bmoffatt@wetpaper.com.au

A Year 11 Study guides

Read as a flipbook from the internet

$90 for 30 users



Option A

Study guides is by web ordering

1. Web site send you tax invoice and key

2. Paste key into your account

3. Book in cloud account

FOR Oceanography flipbook

- **USE CHROME**

- **Available now for $3 for 30 users**

Option B
The power point package

You are buying a licence with some rights reserved

By [mapu] - originally posted to Flickr as Moreton Island, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=6283138

These are
- Give credit to the creator
- Don’t sell it to others
- Don’t give it to other schools

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The licence is between a school and the publisher (T/A) Wet Paper, 32 Michel Drive, Currumbin QLD 4224 continuously from 1 January 2019.
The publisher grants to the school a revocable, non-exclusive, non-transferable right and licence to modify for classroom use the power points listed at www.wetpaper.com.au for the sole purpose of creating further power point presentations, exercises, lab and field work lesson notes. The title to, and intellectual property in these online resources rests with the publisher's author, illustrators, photographers and design consultants and nothing in the Agreement should be construed as transferring those rights to the school.
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So once you sign I give you a link to download the power points.

Power point licence agreement

Between

_____

School name , hereby called "the school"

And

Bob Moffatt – hereby called "the author" Wet Paper Publications – hereby called "the publisher" 32 Michel Drive, Currumbin QLD 4224

Background

A. _____ is a marine science teacher at _____ State High School / College.

B. Wet Paper is the creator and author/supplier of printable and non-printable online resources and books and is seeking to source funds to sustain the web based resources listed in Schedule 1.

C. The publisher has agreed to give the school, a revocable, non-exclusive, non-transferable licence to modify the powerpoints in Schedule 1, for use by the school community as well as three years complimentary matching flipbook keys.

It is agreed

1. Licence period

1 January 2019 – continuous

2. Grant of licence

2.1 The publisher grants to the school a revocable, non-exclusive, non-transferable right and licence to modify for classroom use the power points listed in Schedule 1 for the sole purpose of creating further power point presentations, exercises, lab and field work lesson notes within the school.

2.2 The publisher also grants to the school three years of complimentary web page access keys to the flipbooks detailed in Schedule 1.

2.3 The title to, and intellectual property in these online resources rests with the publisher's author, illustrators, photographers and design consultants and nothing in the Agreement should be construed as transferring those rights to the school.

2.4 Payment for this licence shall not constitute ownership.

2.5 This agreement is conditional on the school purchasing power points at the rates as outlined in Section 4 below, for the term of this agreement for use exclusively within the school community based on the number of students enrolled in Marine Science.

3.Warranty

3.1 The publisher warrants to the school that the author will supply all the files that he has been capable of producing as listed in Schedule 1 from a zip file on a nominated server.

3.2 The school warrants to the author and the publisher that they will not distribute, provide or on-sell either image or text metadata or any reproductions of the author's resources listed in Schedule 1 to any other school or any other person or organisation outside the school community.

4. Payment

4.1 To secure this agreement EFT payment shall be for a minimum of 12 students on the initial enrolment supplied by the school x $60. Payment shall be by EFT from a tax invoice generated by the publisher.

Schedule 1: As per www.wetpaper.com.au

F47 PP	Oceanography power point file modifiable by your school, approximately 900 slides and notes
F50 PP	Marine biology power point file modifiable by your school, approximately 900 slides and notes
F01 B	Marine Science for Australian Students 3rd Edition
F13 P	Mangroves in focus 2nd Edition

Schedule 2: Nominated teacher to detail number of enrolled students

School/college nominated person details (e. details of person to supply numbers of students 2019. (Invoice will be based on this number x $60

Name: _____ Email _____ Initial enrolment estimate _____ X $60 = _____

EXECUTED as an Agreement

Execution by the author Execution by the teacher Witness by the headmaster/mistress/principal

Cost

It will cost you $60 x your estimated 2019 enrolment.
Example Est. enrolment 20 , invoice = $1200

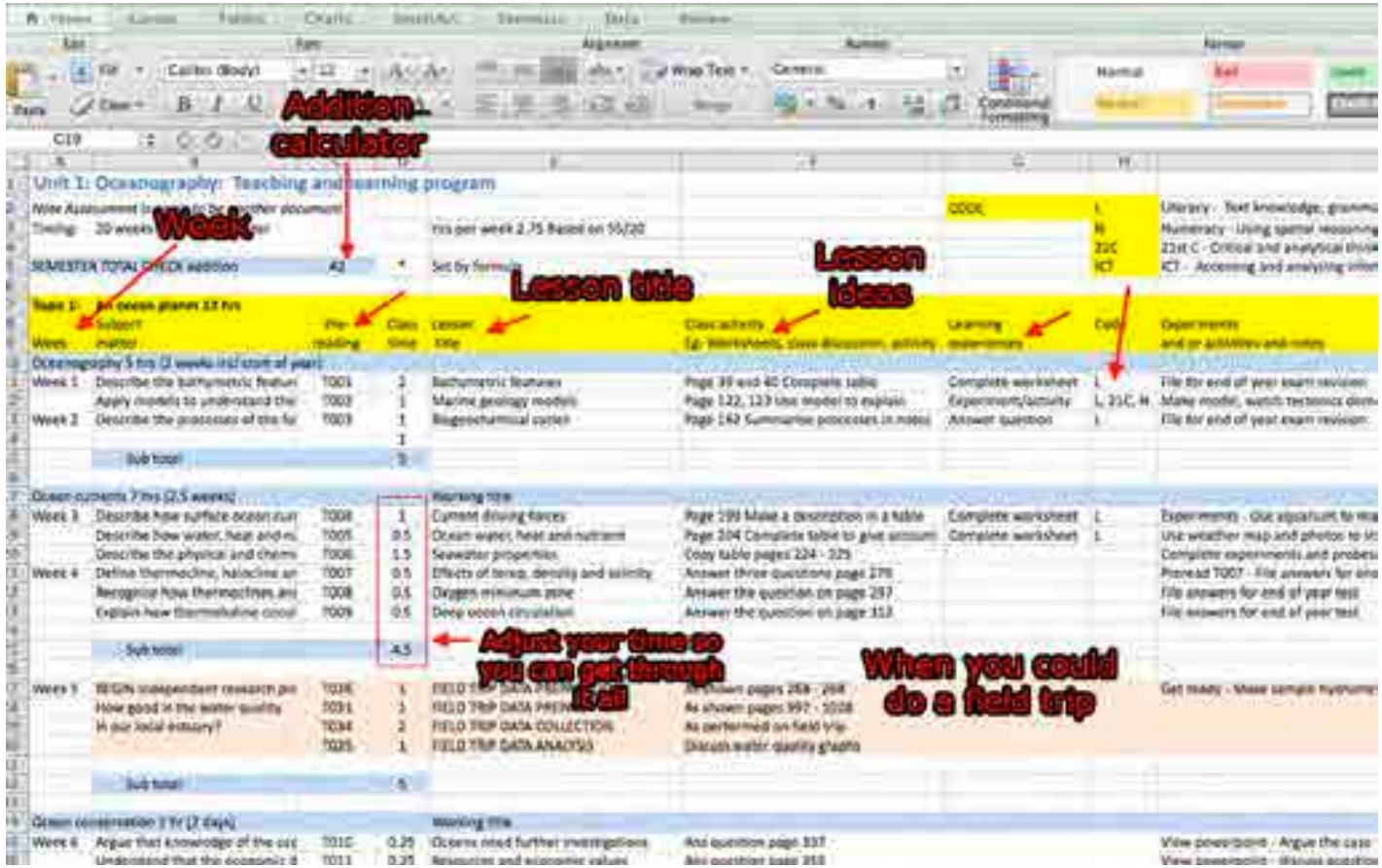
If you like the year 11 power points, it will cost you another $60 x the number who come back and do year 12 in 2020.

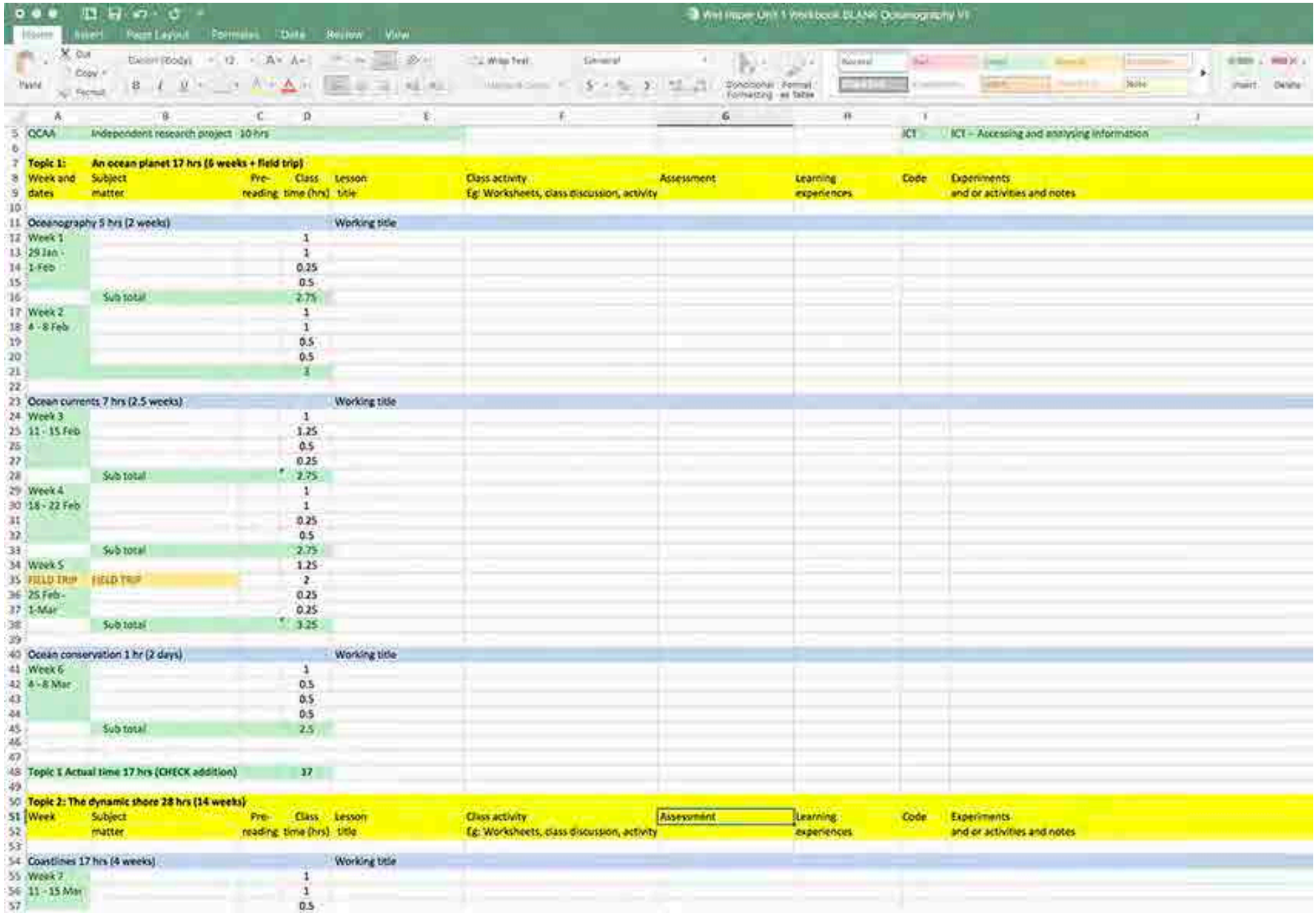
If you want the power points now – sign up and
I'll invoice you in November payable February 14th 2019

(Min 12)

All money raised goes to employing a teacher to do the year 12 power points.

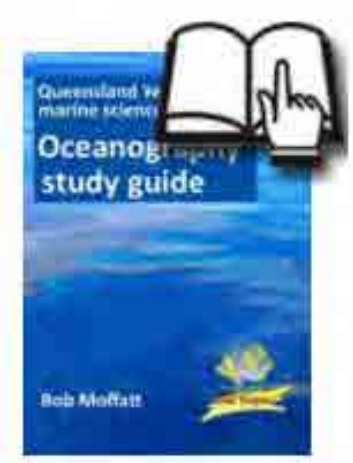
You also get a 2019 workbook time calculator and sample workbook

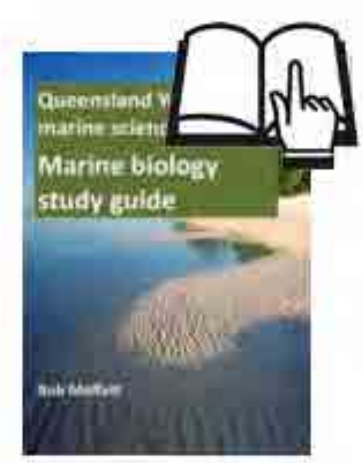




QCAA	Independent research project	10 hrs							ICT	ICT – Accessing and analysing information	
Topic 1:	**An ocean planet 17 hrs (6 weeks + field trip)**										
Week and dates	Subject matter	Pre-reading	Class time (hrs)	Lesson title	Class activity Eg: Worksheets, class discussion, activity		Assessment	Learning experiences	Code	Experiments and or activities and notes	
Oceanography 5 hrs (2 weeks)				Working title							
Week 1			1								
29 Jan -			1								
1 Feb			0.25								
			0.5								
	Sub total		2.75								
Week 2			1								
4 - 8 Feb			1								
			0.5								
			0.5								
			3								
Ocean currents 7 hrs (2.5 weeks)				Working title							
Week 3			1								
11 - 15 Feb			1.25								
			0.5								
			0.25								
	Sub total		2.75								
Week 4			1								
18 - 22 Feb			1								
			0.25								
			0.5								
	Sub total		2.75								
Week 5			1.25								
FIELD TRIP	FIELD TRIP		2								
25 Feb -			0.25								
1 Mar			0.25								
	Sub total		3.25								
Ocean conservation 1 hr (2 days)				Working title							
Week 6			1								
4 - 8 Mar			0.5								
			0.5								
			0.5								
	Sub total		2.5								
Topic 1 Actual time 17 hrs (CHECK addition)			17								
Topic 2: The dynamic shore 28 hrs (14 weeks)											
Week	Subject matter	Pre-reading	Class time (hrs)	Lesson title	Class activity Eg: Worksheets, class discussion, activity		Assessment	Learning experiences	Code	Experiments and or activities and notes	
Coastlines 17 hrs (4 weeks)				Working title							
Week 7			1								
11 - 15 Mar			1								
			0.5								

And other stuff





3 years free rent

Pdf printable
file

And an end of the year a 2 day workshop
- limit is 30
- preference given to practicing teachers

South Coast Marine Science Workshop

Syllabus content as it relates to field trips and lab experiments

DRAFT – depends on funding sources

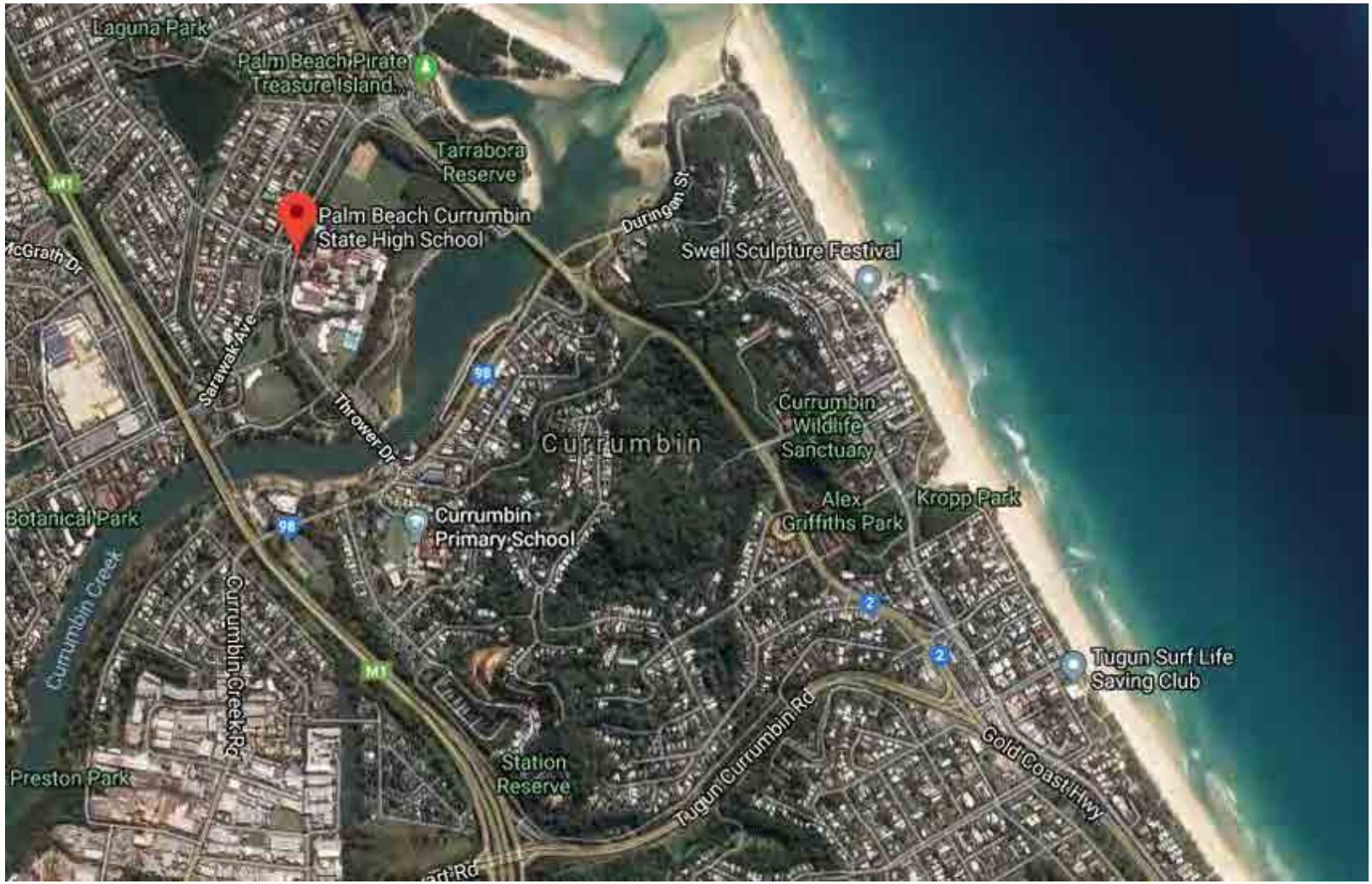
Monday 3rd / Tuesday 4th December

Palm Beach SHS Science Department
Thrower Drive, Currumbin 4223 - Gold Coast, Queensland

Cost

Free to Wet Paper Power Point licence holders (BYO food or buy it, accommodation up to you)
Sponsored by Wet Paper, Palm Beach SHS, have approached MTAQ and local scientific supply company
Accommodation up to you – Local Caravan Park (Burleigh council park twin share for $70 Monday 3rd, motels, air B&B
Breakfasts at local Subway. Lunch you pay, dinner Monday night bring a plate and what you want to drink.

Estuary, high energy coast, fractured ecosystem, mangroves, environmental stakeholders, purpose built aquaculture room, caravan park up the road.



A chance to see and do the activities from the power points

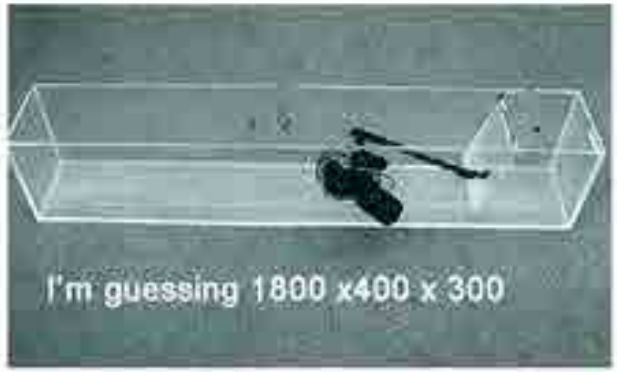
- Set up Artemia for a two-day hatching experiment







- Building a wave tank



- Make a simple salinity hydrometer, secchi disc and water collection bottles
- Convection current apparatus experiment
- Biscuit and syrup plate tectonics experiment
- Sand grain and micro-plastics analysis
- Sand sieving experiment
- Making oceanographic models
- Using excel for Students t test data and Shannon's index
- Using a mobile phone for microscope photos
- Two hour field trip dynamic shore
- Two hour field trip mangroves
- One hour water testing
- Open session using digital techno in the classroom
- Visit Geko House meet Surfrider foundation environmental stakeholders
- View 2000 powerpoint slides
- Networking BBQ

- Setting up for class experiments
- Building aquarium racks for water testing experiments

So it’s a long term project in partnership with schools who like teaching from power points

AND as I said

Funds go to employing someone to write year 12 and improve the power points developed this year.

There are 90 year 12 power point to do

Unit 3: Marine systems — connections and change

List 13 Coral reef distribution

T70 Identify reefs globally
T71 Coral geographic distribution
T72 Coral geologic appearance
T73 GBR geology shaping
T74 Difference reef structures
T75 Recognise reef zonation

List 14 Coral reef development

T76 Three coral groups
T77 Classify to genus
T78 Coral anatomy
T79 Coral limestone skeleton
T80 How corals feed
T81 Coral symbiosis
T82 Coral life cycle
T83 Laval dispersion
T84 How corals grow
T85 Assess reef data

List 15 Reef habitats and connectivity

T86 Corals as engineers
T87 Reef mosaic
T88 Explain connectivity
T89 Fish life cycles
T90 Fish reef benefits
T91 Ecological tipping points
T92 Reef hysteresis
T93 Assess reef diversity
T94 Analyse reef diversity
T95 Interpret reef changes
T96 Water quality on reefs
T97 Water quality overall effects
T98 Conduct connectivity experiment

List 16 Anthropogenic change

T99 Determine reef futures
T100 Global anthropogenic factors
T101 Specific reef pressures
T102 Holocene no bleaching
T103 Shelford's law bleaching
T104 GBR thermal data
T105 After bleaching effects
T106 Bleaching recovery conditions
T107 Compare regional bleaching
T108 Coral core data

List 17 Ocean equilibria

T109 pH and carbonates
T110 Geology and carbonates
T111 C02 and ph
T112 C02 and oceans
T113 Ocean acidification
T114 Carbonate compensation depth
T115 Oceans C02 capacity

List 18 Implications for marine systems

T116 Carbonates and shells
T117 Carbonate systems data
T118 Ocean acidification experiments
T119 Ocean acidification consequences
T120 Acidification and resilience
T121 Altered pH practical

Unit 4: Ocean issues and resource management

List 19 Management and conservation

T122 Use conservation arguments
T123 Explain MPA design criteria
T124 Marine ecosystem health
T125 Evaluate MPA success
T126 Compare management roles

List 20 Future scenarios

T127 Evaluate marine systems
T128 Historical geological data
T129 Ocean acidification consequences
T130 Climate driving factors
T131 Global temperature impacts

List 21 Fisheries and population dynamics

T132 Define fishery types
T133 Wild catch significance
T134 World fisheries declines
T135 Fish population distribution
T136 Assess necosity data
T137 Assess bioaccumulation effects
T138 Thermal regime effects
T139 Compare fish populations
T140 Use Lincoln index
T141 Assess fish pop data
T142 Recognise international agreements
T143 Appraise sustainable yields
T144 Fisheries management shifts
T145 MPAs and sustainability
T146 Apply Lincoln index

List 22 Australia's fisheries management

T147 Identify AFZ
T148 Infer Fisheries status
T149 Identify seafood export
T150 Assess seafood imports
T151 Recall fisheries values
T152 Total allowable catch
T153 Spatial fish management
T154 Fish precautionary principles

Chapter 23 Aquaculture

T155 World aquaculture state
T156 Analyse ABARES reports
T157 Identify marketing attributes
T158 Predict carrying capacity
T159 Contrast aquaculture systems
T160 Understand aquaculture issues

So if you like what I'm doing sign up – I need the money.

It's my Wet Paper legacy project.