PENRITH LAKES
ENVIRONMENTAL EDUCATION CENTRE
EDUCATION FOR A SUSTAINABLE FUTURE

Year 11 Investigating Science
Cause and Effect - Inferences and Generalisations
(Depth Study modelling)
A collaborative practical investigation @ Penrith Lakes

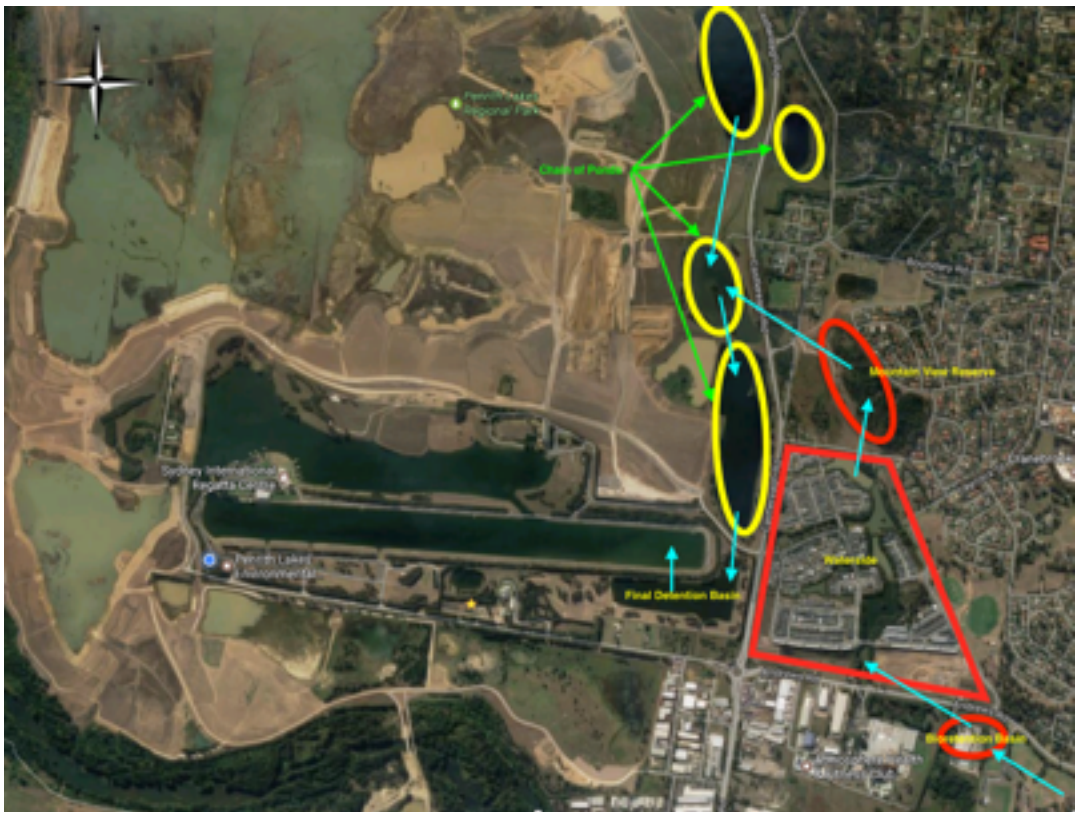
Key Inquiry Question:
What inferences can be drawn from observations?

Students:

- conduct a collaborative practical investigation
- collect a range of qualitative and quantitative primary water quality data of a pond/lake
- make inferences and conclusions derived from the primary data collected in this collaborative practical investigation

Name _____

Inquiry Question: How healthy is the Ecosystem at Penrith Lakes?



STATION 1 Abiotic Factors

Use water testing kit to collect abiotic data for this site.

Site: ***Final Detention Basin***	**Conditions:**	**Date:**	**Time:**

Factor	**Equipment Used / Units**	**Your small group results**	**Average results for your group**
1. Phosphate (Nutrient) - *Half fill tube. Dissolve tablet. Wait 5 mins. Compare water to chart.*	***Test tablet kit - ppm (Parts per million)***		
2. Water pH - (Blue box) *Fill tube. 3cm of paper in tube. Wait 1 min. Compare paper to chart.*	***Universal Indicator Paper - a number***		
3. Turbidity	***Turbidity Tube - NTU's (Nephelometric Turbidity Units)***		
4. Water Temperature	***Digital Thermometer - ^{o}C (Degrees Celsius)***		
5. Dissolved Oxygen - *mg/l is the reading on DO meter.*	***Dissolved Oxygen Meter (Milligrams per Litre)***	mg/L	mg/L
Use conversion chart to get % sat.	***Conversion Chart - Temp, mg/L and % (% saturation)***	% saturation	% saturation
6. Conductivity or Total Dissolved Solids (Salts)	***Total Dissolved Solids (TDS) Scan- ppm (Parts per million)***		
7. Light	***Light / Lux Meter - Lux***		
8. Slope	***Clinometer - Degrees (^{o})***		
9. Wind exposure (speed)	***Anemometer - kph***		
10. Water Depth	***General knowledge of lakes.***	4m	
11. Visual Pollution	***Visual Assessment. Use your eyes.***	Circle the appropriate result: **LOW MEDIUM HIGH**	
12. Water Source		***Groundwater and run-off***	

STATION 2 Dipnetting

- **Invertebrate population sampling - (Results given in wrap up)**

STATION 3 Waterbird Observation

1. *On your walk - Look at the bird pictures.*
2. *Keep a tally of the number of birds sighted for each species.*
3. *Using column 5, fill in the bird numbers seen today. The teacher will guide you. Use this to work out abundance/distribution and then a habitat/food supply point score.*

Pelican Tally :

Little Pied Cormorant Tally :

Eurasian Coot Tally :

Australian Wood Duck Tally :

DIVERS

Little Black Cormorant Tally :

Australian Grebe Tally :

SWIMMERS

Pacific Black Duck Tally :

Dusky Moorhen Tally :

Great Egret Tally :

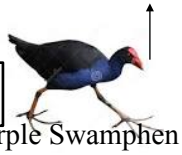
White-faced Heron Tally :

Royal Spoonbill Tally :

Black Swan Tally :

WADERS

Purple Swamphen Tally :



Black winged Stilt Tally :

Waterbird Counts at 5 survey sites (Teacher will help you fill this out)

Bird Species / Site No.	1	2	3	4	5*	Abundance	Distribution
1. Australian Grebe			1				
2. Australian Wood Duck	3	4	6	12			
3. Black Swan							
4. Blackwinged Stilt				2			
5. Dusky Moorhen							
6..Eurasian Coot			4				
7. Great Egret							
8. Little Black Cormorant							
9. Little Pied Cormorant		6		2			
10 Pacific Black Duck				8			
11.Pelican		1	1				
12 Purple Swamphen	4						
13. Royal Spoonbill							
14.White-faced Heron			1				
15. Other:_____							
Total Abundance per Site		*11*	*13*	*24*			
Total Species per Site		*3*	*5*	*4*			

Bird Species	Circle points for birds seen today
1. Grebe	4
2. Wood Duck	2
3. Black Swan	5
4. Stilt	5
5. Dusky Moorhen	3
6. Eurasian Coot	3
7. Great Egret	5
8. Black Cormorant	4
9. Pied Cormorant	4
10.Black Duck	3
11.Pelican	5
12.Purple Swamphen	4
13.Royal Spoonbill	5
14.Heron	5
15.Other	5
Total point score *TODAY*	

Habitat total bird score?	
0-10	Poor
11-18	Fair
19 - 25	Good
>25	Excellent

Wrap Up

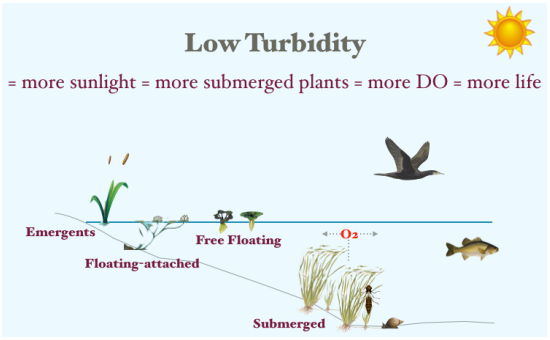
Analysis of abiotic and biotic key relationships

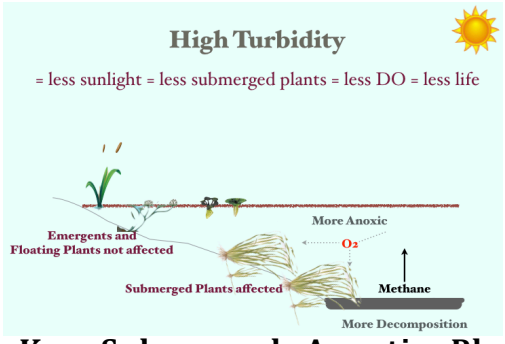
Turbidity, Light and Dissolved Oxygen

- The final basin has low turbidity (abiotic factor).
- An ↑ sunlight (abiotic factor) → ↑ aquatic plants (biotic factor) → ↑ D.O.(abiotic factor) → ↑ invertebrates/aquatic life (biotic factor).

Note: a minimum of 60% D.O is essential for gill breathers such as dragonfly nymphs.

- Farming past : ↑ turbidity →↓ sunlight →↓ aquatic plants →↓ D.O. →↓ invertebrates.





Phosphate and Water Source

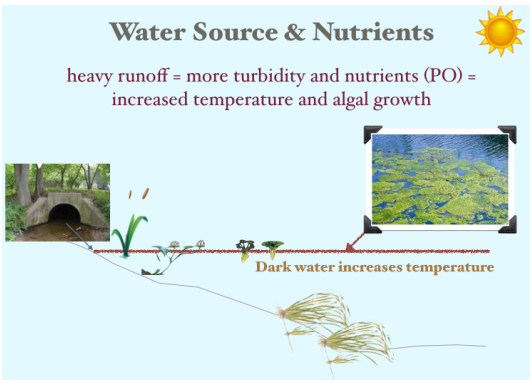
- Phosphate is an essential nutrient for plant growth. It is a plant food. Too much food can cause problems.
- ↑ urban runoff (main water source for the lakes) → ↑ phosphate levels (>2) → ↑ risk of blue green algae outbreaks.

Note: A series of large detention basins/lakes has been constructed upstream so that the plants in those can remove excess phosphate (and other impurities) from the water prior to it being allowed into the main lakes.

- Farming past : ↑ phosphate levels (>2)→↑ algae → ↓ aquatic plants →↓ D.O. →↓ invertebrates.

A Key Submerged Aquatic Plant Species - Ribbonweed

- ↑ sunlight + low turbidity → Ribbonweed ↑ dissolved oxygen →↑ aquatic animals.
- Long strands provide shelter for fish and food for snails and other invertebrates.
- Roots take up nutrients, such as phosphate.
- The presence of ribbonweed indicates the waterbody is in good condition.



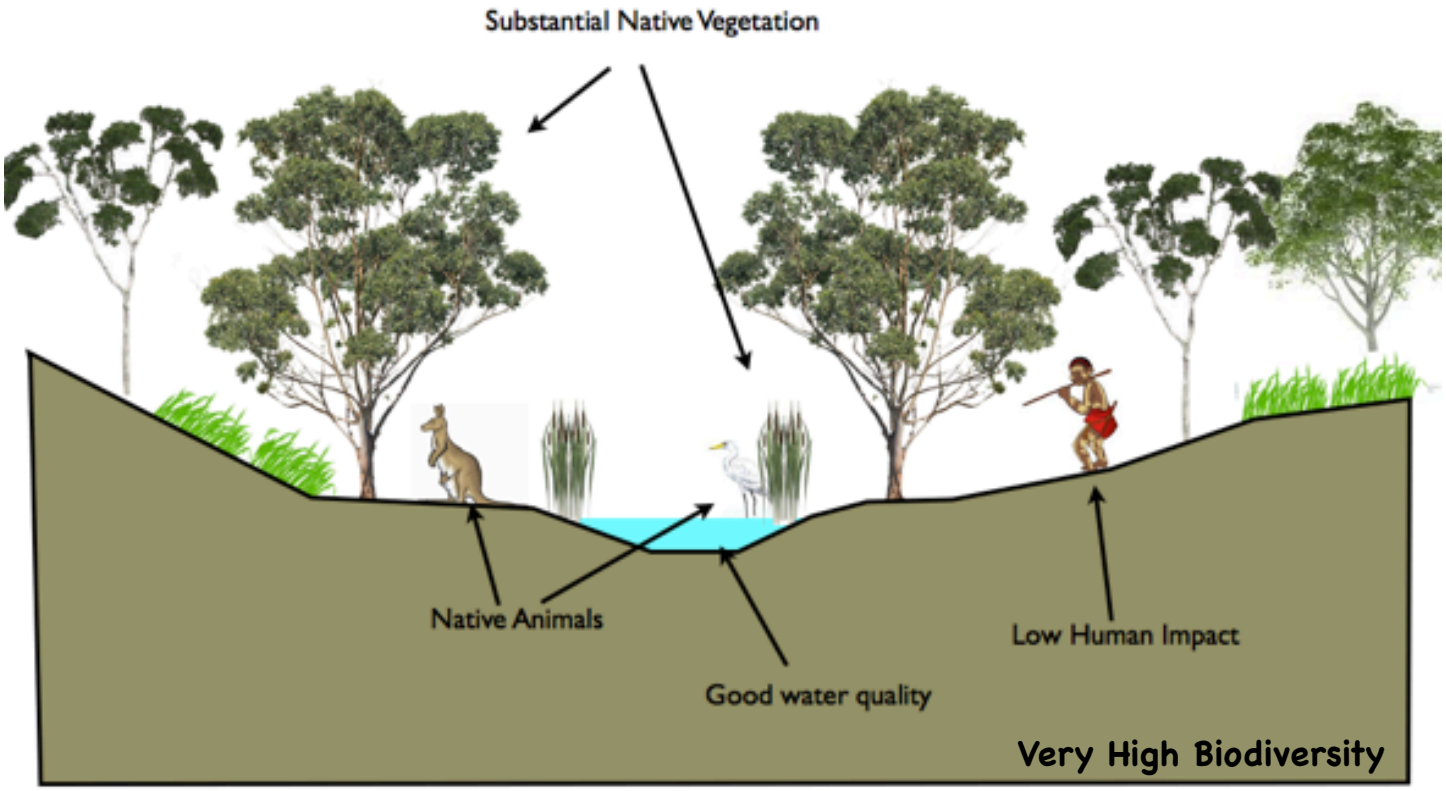
pH and Conductivity/Salinity

- pH is a measure of the hydrogen ion concentration in water. Most aquatic organisms can only survive in the 6-9 pH range. Low pH values are acidic and kill aquatic life.
- Conductivity/Salinity is the amount of dissolved salts present in the water. Higher salt levels → ↑ dehydration of freshwater organisms.

Temperature and Light

- Water temperature is directly dependent on sunlight availability, air temperature and turbidity.
- Temperature affects vital biochemical processes within aquatic organisms and ultimately their survival.
- Most organisms can only tolerate a narrow temperature range.
  - 10 - 30°C = optimal range for macro invertebrates.
  - In warmer water (20 to 30°C), the rate of photosynthesis and plant growth increases. Animal activity also increases .
- Farming past : ↑ turbidity →↑ heat absorption → ↑ water temps →↓ aquatic organisms.

Before White Settlement

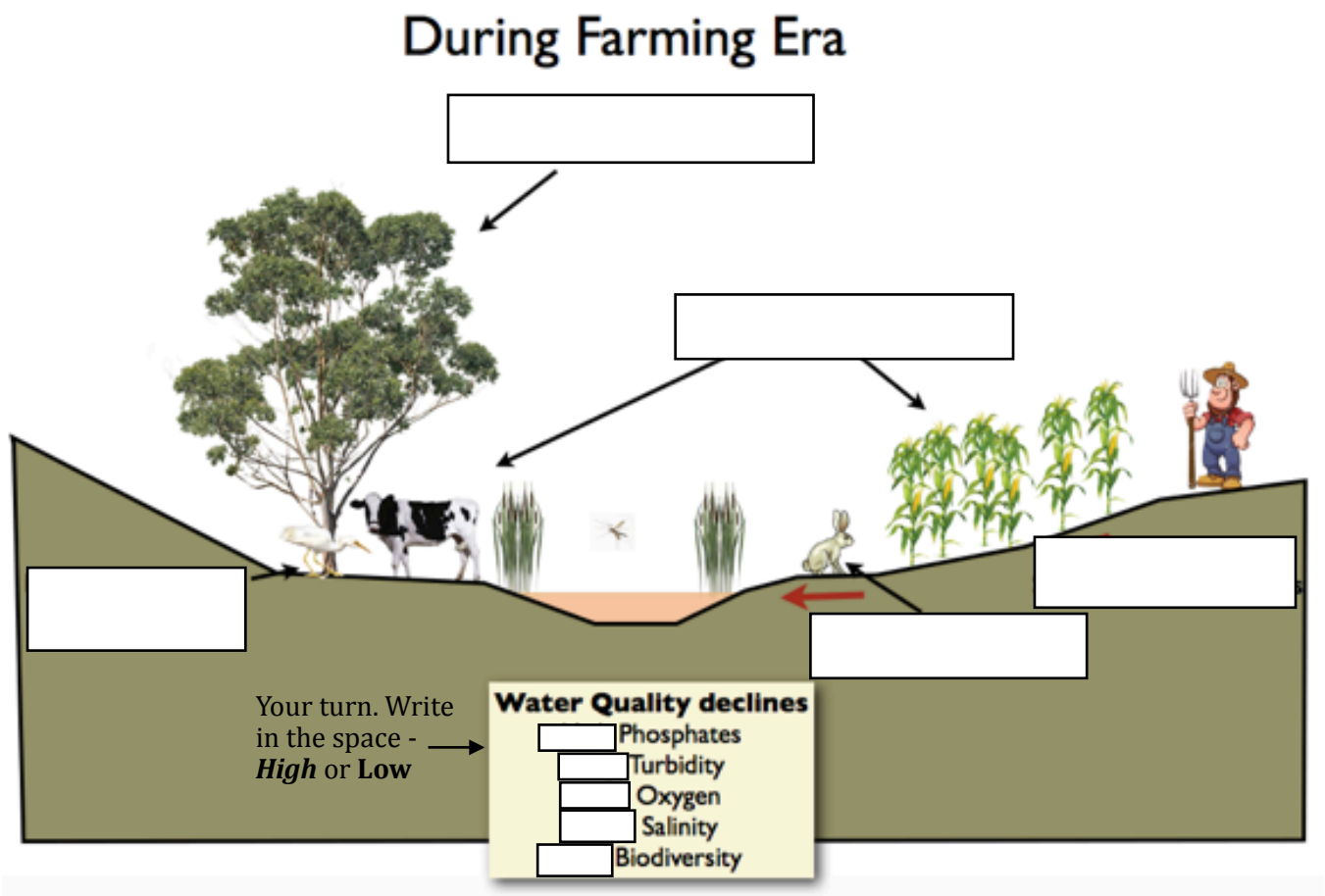


Before White Settlement - Pristine ecosystem (hypothetical measurements)

Turbidity (clarity): **<10 ntu**				pH : **7**			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: **25,000 lux**				Conductivity (salts):**80 ppm**			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: **90%**				Phosphate (nutrients): **0.5 ppm**			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0

Overall Rating	Excellent	Good	Fair	Poor
Score : 48	40+	32 - 39	31 - 20	less than 20

Summary - Low turbidity High oxygen Low salinity
Low phosphates High native biodiversity

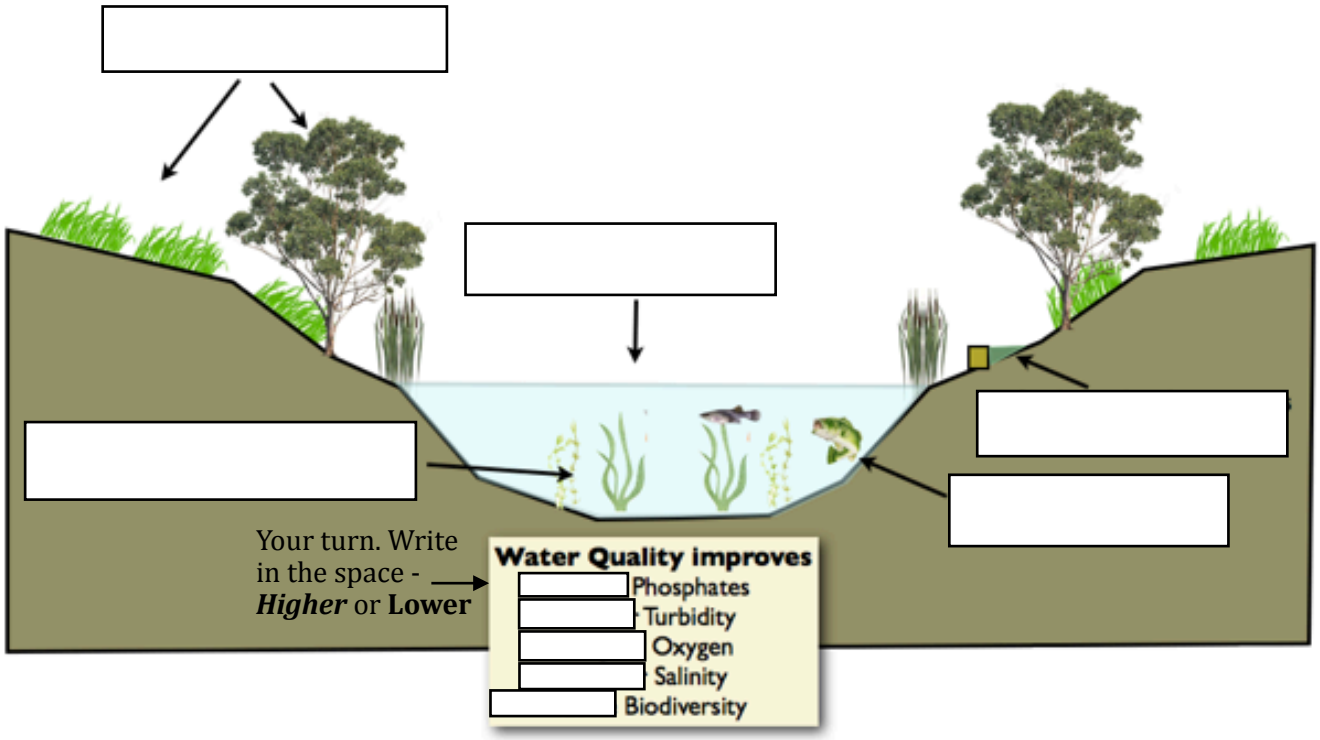


During the Farming Era

Turbidity (clarity): **250 ntu**				pH : **8.6**			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: **3,800 lux**				Conductivity (salts): **950 ppm**			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: **25%**				Phosphate (nutrients): **2.5 ppm**			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0

Overall Rating	Excellent	Good	Fair	Poor
Score : 12	40+	32 - 39	31 - 20	less than 20

After Quarrying - Now & Future



After Quarrying - Now and the Future

Todays results

Turbidity (clarity): _____ ntu				pH : _____			
<10 ntu	10 - 20 ntu	20 - 50 ntu	>50 ntu	6.5 - 8.5	8.6 - 9.0	6.0 - 6.4	<6 or >9.0
8	4	2	0	8	6	4	0
Light: _____ **lux**				Conductivity (salts): _____ **ppm**			
> 15,000	10k - 15k	5k - 9,999	< 5,000	<250 ppm	251-650 ppm	651-1000 ppm	>1000 ppm
8	4	2	0	8	6	4	0
Dissolved Oxygen: _____ **%**				Phosphate (nutrients): _____ **ppm**			
>60%	50% - 60%	40% - 49%	<40 %	0 - 1 ppm	>1 - 2 ppm	>2 - 3 ppm	>3 - 4 ppm
8	6	2	0	8	6	2	0

Overall Rating	Excellent	Good	Fair	Poor
Score :	40+	32 - 39	31 - 20	less than 20

Conclusions from waterbug sampling

Step 1 - With the **help of the instructing teacher**-fill out the table of the total waterbug survey results.

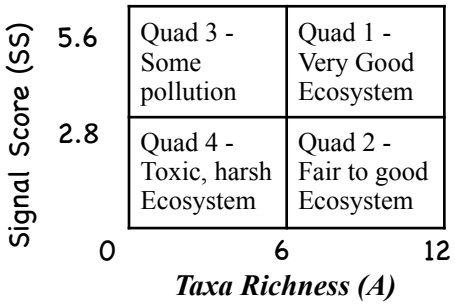
Name, picture & Sensitivity Rating	No. Bugs	*Circle* S.R.	Name, picture & Sensitivity Rating	No. Bugs	*Circle* S.R.
Back Swimmer 		4	Water Beetle 		3
Caddisfly Larvae 		6	Water Boatman 		4
Damselfly Nymph 		6	Water Mite 		5
Dragonfly Nymph 		6	Water Scorpion 		3
Freshwater Shrimp 		6	Water Spider 		4
Giant Water Bug 		4	Water Treader 		4
Leech 		3	Worm 		2
Mayfly Nymph 		7	Mosquito Fish (vertebrate) 		1
Pond Snail 		3	Other		
Total Bug SPECIES caught = (This is a TAXA RICHNESS)		**A**	**Total Sensitivity Rating (S.R.) = This is a POLLUTION INDEX**		**B**
Calculate a **SIGNAL SCORE (S.S.).** **Signal Score = Pollution Index (B) ÷ Taxa Richness (A)**					**S.S. =**

Interpreting your results using an **UNWEIGHTED** Signal Score.

Step 2
Using your signal score, determine a pollution rating. Use the table below.

Signal Score	Pollution Rating
> 3.5	Healthy Habitat
2.8 to 3.5	Mild
2.1 to 2.7	Moderate
< 2.1	Severe

Step 3
A pollution indicator graph. Use your Signal Score and Taxa Richness to plot a point on the graph below.



	Summary from Farming to Now	
	Past farming	**Now and Future**
BIOTIC	***Edge*** plants dominate	
	Low oxygen waterbugs	
	Wading birds dominate	
	Few Mosquito Fish	(In warmer months)
	Low biodiversity	
ABIOTIC	***High*** phosphates	
	High turbidity	
	Low dissolved oxygen	
	High salinity	

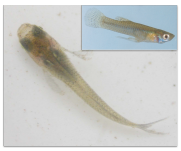
Keystone Species

- Submerged aquatic plants
  - E.g. Ribbonweed

These plants take nutrients out of the water. When they carry out photosynthesis the oxygen goes directly into the water. The plants are a source of food (a producer) and oxygen.

A local extinction event - due to predation

Mosquito Fish



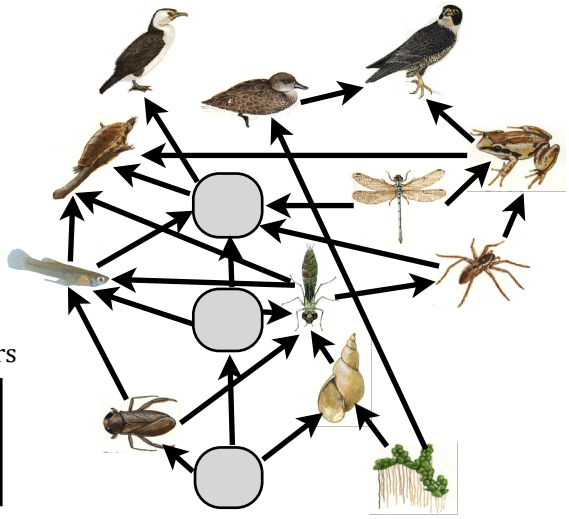
Vs

Green and Gold Bell Frog

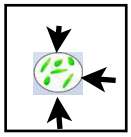
Mosquito Fish

* Brought in to control _____.
* Eats a range of _____
* Responsible for _____ loss (frogs).
* Tolerates _____ water quality.
* _____ quickly.
* Difficult to _____.

Food Web - Place the letter of the 3 missing species



Decomposers



A - Shrimp **B -Bass** **C - Ribbonweed**

General note taking on the day