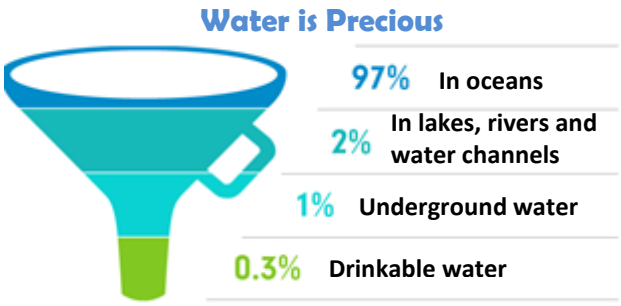
Campus Fieldwork Course

Water Sample Analysis & Plankton Observation

School Name		**Class**	
Student Name		**Date**	

Water is a precious natural resource. Only around 2.5% of the world's water is fresh water while the rest is seawater. Water bodies may have different levels of pollution due to the development of city. This can be reflected from various measurements. In the following experiment, can you tell how clean is your water samples by analyzing the data you have collected?



A glass of water might contain thousands of microorganisms called plankton. Plankton are the diverse collection of organisms found in water that are unable to propel themselves against a current. They can be classified into phytoplankton and zooplankton. Although most of them are tiny, they play a critical role in maintaining the health and balance in the water life and its complex food webs, and some of them are also biological indicators to determine the water quality. Let's try to find them.

Objectives

- To learn about features of freshwater flora and fauna as well as the environment;
- To familiarize with the testing techniques of various parameters of water quality;
- To compare and analyze the situation of different water samples;
- To appreciate the wonders of the living world.

Water Sample Testing

Equipment & Apparatus（For Each Group）

Fieldwork

☐	Compass	x 1	☐	Brush	x 1
☐	Light meter toolkit	Share	☐	Tray	x 1
☐	Large plastic vial	x 1	☐	Bucket with string	Share
☐	Sampling bottle	x 1	☐	DO meter	x 1
☐	Aquarium net	x 1	☐	pH cum thermometer	x 1
☐	Forceps	x 1	☐	Identification kit	x 1

Experiment

☐	Dried & weighted filter paper	x 2	☐	Dropper	x 1
			☐	Cuvettes	x 2
☐	Filter funnel setup	x 1	☐	Spectrophotometer	Share
☐	Evaporating dish	x 1	☐	Solution A (Ammonium molybdate / H_2SO_4)	Share
☐	Oven	Share			
☐	Refractometer	x 1	☐	Solution B (5% Stannous chloride)	Share
☐	Wash bottle toolkit (Deionized water)	x 1	☐	Solution C (Nessler's reagent)	Share
			☐	Chemical Oxygen Demand detection kit	x 1
☐	Cloth	x 1	☐	*E. coli* detection dishes	Share

Fieldwork Procedure

1. Site Observation

Draw a sketch map top view of the field site and the surrounding area below, indicating:

- your study site and direction (with a compass);
- main structure of the water body;
- direction of stream flow;
- vegetation;
- Things inside the water body (e.g. boulders, fallen log, etc.);
- other particulars of interest.

1. **Water Depth & Light Transmittance Measurements**
   1) Measure the water depth using the scale on the light meter toolkit.
   2) Measure the light intensity on the water surface and 10cm under the surface. Calculate the light transmittance using the formula below:

$$Light\ transmittance = \frac{Light\ intensity\ at\ the\ water\ depth\ of\ 10cm}{Light\ intensity\ on\ the\ water\ surface}\ \%$$

2. **Water Sampling**
   Collect water samples using a plastic vial and a sampling bottle. And then complete **Table 1** by observing the water samples.
   - *Use the bucket if necessary.*
   - *Collect your samples from the water bottom, or water containing impurities (if applicable).*

3. **Dissolved Oxygen (DO) Measurement**
   Measure the dissolved oxygen content by immersing the probe of the DO meter into the water.
   - *Wash the probe with deionized water and dry it with cloth or tissue beforehand.*
   - *Avoid making bubbles and record the average reading within a 30-second period.*

4. **pH & Temperature Measurements**
   Immerse the probe of the pH cum thermometer to measure the pH and temperature of water.
   - *Wash the probe with deionized water and dry it with cloth or tissue beforehand.*
   - *Avoid making bubbles and record the average reading within a 30-second period.*

5. **Searching for Living Organisms**
   Search around the field site, identify the living organisms by their structures and record their abundance in **Table 4.** You can try to observe their adaptive features.
   - *Use the net or brush to place organisms on the tray for easier identification, and then put them into the water samples.*
   - *Use forceps to take some algae and put into water sample, if any.*
   - *Pay attention to the organisms under rock or on plants.*

Experiment Procedures

1. **Total Suspended Solids (TSS)**
   Weigh a pre-dried filter paper and filter 50ml water sample into a beaker. Use forceps to put the filter paper into an evaporating dish, dry in a 105℃ oven for 1 hour and reweigh.

   TSS (mg/L or ppm) = Increase in mass of filter paper (mg) × 20

2. **Salinity**
   1) Calibrate the refractometer by using deionized water and dry it with glass cleaning cloth.
   2) Fully fill the glass chamber with water sample.
   3) Take the reading.

3. Chemical Oxygen Demand (COD)

1) Fully fill the bottle with the filtrate.
2) Remove the yellow plastic string to clear the aperture from the top of the tube. Squeeze the tube to expel the air inside.
3) Immerse the tube opening in the water sample, then release your hand to fill the tube up to the 2/3 to 3/4 full.
4) Repeat step 2) & 3) if the water inside the tube is not enough.
5) Shake the tube a few times. Put the tube on the color chart as shown and compare with the standard colors immediately after 5 minutes.

4. Ammonia (NH_3) Content

1) Add 5ml filtrate into the cuvette (up to the white mark).
2) Add 1 drop of Solution C.
3) Cover the cuvette with a stopper and turn the cuvette upside down for a few times to mix well.
4) Hold the upper part of the cuvette and clean the surface of the cuvette.
5) Measure the ammonia content by spectrophotometer (425nm).

5. Phosphate (PO_4^{3-}) Content

1) Add 5ml filtrate into the cuvette (up to the white mark).
2) Add 1 drop of Solution A.
3) Cover the cuvette with a stopper and turn the cuvette upside down for a few times to mix well.
4) Add 1 drop of Solution B and mix well.
5) Hold the upper part of the cuvette and clean the surface of the cuvette.
6) Measure the phosphate content by spectrophotometer (506nm).

6. *Escherichia coli* (*E. coli*) Content

1) Use a syringe to spread 1ml water sample onto the *E. coli* detection dish.
2) Incubate overnight at 37℃.
3) Count the colony number of *E. coli*.

Discussion

- Compare and analyze the quality of each water sample.
- What factor(s) do you think will affect the water quality most? Why?
- What kind of sewage causes high level of ammonium/ phosphate content? Why?
- What factors may affect the level of dissolved oxygen?
- Why does algal bloom occur? How does it affect the ecosystem? Please explain.
- Do you think any other measurements should be made? Why?

Data Record Sheets

Table 1: Physical Factors

(You can make references to **Table 5**)

Physical Factors	Sample 1	Sample 2	Sample 3	Sample 4
Water colour				
Odour				
Floating matters				
Water depth (m)				
Light intensity on water surface (lux)				
Light intensity at 10cm depth (lux)				
Light transmittance (%)				
Water temperature (℃)				
TSS (mg/L or ppm)				

Table 2: Chemical Factors

Chemical Factors	Sample 1	Sample 2	Sample 3	Sample 4
DO (mg/L or ppm)				
pH				
Salinity (ppt or g/100g)				
COD (mg/L)				
NH_4^+ (ppm or mg/L)				
PO_4^{3-} (ppm or mg/L)				

Table 3: Microorganisms

Microorganisms	Sample 1	Sample 2	Sample 3	Sample 4
E. coli content (CFU/100ml)				

Table 3: Biotic Factors

Species Name	Sample 1	Sample 2	Sample 3	Sample 4
Animals				
Turtles				
Frogs / Tadpoles				
Dragonflies/ Dragonfly nymphs				
Damselflies/ Damselfly nymphs				
Bloodworms				
Mosquito larvae				
Leeches				
Snails				
Fish				
Plants				
Umbrella Plant				
Water Lily				
Water Snowflake				
Water Lettuce				
Lesser Duck-weed				
Parrot Feather Watermilfoil				
Water Hyacinth				
Fishwort				
Common Rush				
Whorled Pennywort				

Pollution Index

Table 5: Physical Factor Analysis (4-point Scale)

Physical Factors	0	1	2	3
Water colour	Clear	Less Clear	Brown	Black
Smell	None	Some	Moderate	Strong
Floating matters	None	Some	Plentiful	Abundant
Mean light transmittance	> 70%	41% - 70%	10% - 40%	< 10%
Temperature difference from other groups (°C)	< 1	1 - 1.5	1.5 - 2	> 2
TSS (mg/L or ppm)	< 20	20 - 35	– 50	> 50

Mean Assessment Score (A) on Physical Factor Analysis	

Table 6: Chemical Factor Analysis (4-point Scale)

Chemical Factors	0	1	2	3
DO (mg/L or ppm)	> 7.0	5.1 - 7.0	3.0 - 5.0	< 3.0
pH	6.0 - 7.0	5.0 - 5.9 / 7.1 - 8.0	4.0 - 4.9 / 8.1 - 9.0	< 4.0 / > 9.0
Salinity (%)	< 3	3 - 6	7 - 10	> 10
COD	< 5	5 - 13	14 - 50	> 50
NH_4^+ (ppm or mg/L)	< 2.1	2.1 - 5.0	5.1 - 7.0	> 7.0
PO_4^{3-} (ppm or mg/L)	< 3.0	3.0 - 6.0	6.1 - 9.0	> 9.0

Mean Assessment Score (B) on Chemical Factor Analysis	

Table 7: Microorganism Analysis (4-point Scale)

	0	1	2	3
E. coli content (CFU/100ml)	< 180	181 - 400	401 - 610	> 610

Mean Assessment Score (C) on Microorganism Analysis	

Table 8: Biological Indicators

Organism Group	Indicator Species		
i	Dragonfly/damselfly nymphs Snails with operculum	Mayfly nymphs Water Penny	Stonefly nymphs Microscopic algae
ii	Caddisfly larvae Snails without operculum	Mosquito larvae Green algae	Freshwater shrimps
iii	Leeches Protozoa (*Paramecium*, etc)	Blood worms Green algae (*Spirogyra*, etc)	Water louse (*Asellus*)
iv	Sludge worm (*Tubifex*)	Sewage fungi	

Table 9: Biotic Factor Analysis (4-point Scale)

Biotic Factor	0	1	2	3
Indicator Organisms	Group i dominants + ii, iii, iv	Group ii dominants + iii, iv	Group iii dominants + iv	Group iv OR no organism found

Mean Assessment Score (D) on Biotic Factor Analysis	

Table 10: Degree of Pollution

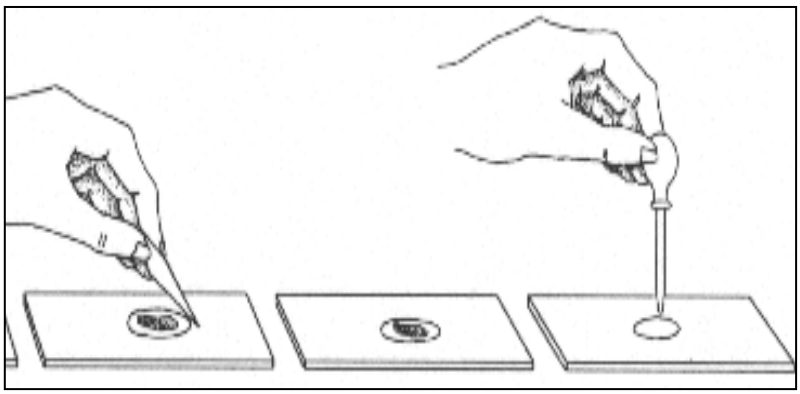
Average Score of (A)、(B)、(C) 、(D)	Pollution Magnitude
0.00 - 0.75	Clean
0.76 - 1.50	Slightly polluted
1.51 - 2.25	Moderately polluted
2.26 - 3.00	Severely polluted

Note: Assumed the above factors are equally important

Plankton Observation

Equipment & Apparatus (For Each Group)

		Fieldwork			
☐	Plankton net	Share	☐	Wash bottle	Share
		Experiment			
☐	Plastic vial	x 1	☐	Cover slips	x 10
☐	Light microscopes	x 2	☐	Droppers	x 2
☐	Slides	x 10	☐	Identification kit	x 1



1. Collecting plankton

Submerge the plankton net into the water body, and drag it vertically or horizontally. Wash the net by using wash bottle after dragging the net at least 10 times. Finally, collect the bottle which contains water together with the plankton.

2. Observing plankton

Search the plankton (including phytoplankton and zooplankton) in the water sample by using light microscopes. Take photos of them and identify them. Think about the meaning of the presence of plankton on water quality while appreciating the wonders of the drop of water.

1. Transfer a drop of water to a slide and cover it with a cover slip.
2. Observe the plankton under a light microscope.
3. Determine whether they are phytoplankton or zooplankton and identify them using the identification kit.
4. Take a photo of each plankton you found and circle it on the photo.
5. Write down the corresponding names of the planktons on **Table 11**.

Table 11: Plankton Records

Photo Number	Type	Species Name

Discuss and answer the following questions related to plankton.

(1) Where can phytoplankton be normally found? Why?

Near the water surface / middle part of water bodies / bottom part of water bodies

_____

_____

(2) Using a light microscope to observe one of the phytoplankton you found and write down the features which enable them to maintain such a level.

_____

_____

(3) Where can phytoplankton be normally found? Why?

Near the water surface / middle part of water bodies / bottom part of water bodies

_____

_____