GROUP 4 PROJECT PHYSICS REPORT
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Background information
We have read some article on the internet regarding the 'relationship between electrical conductivity and ions present'. Here is some abstract from the internet article: '……however the difference in times of occurrence of the maxima of the polar conductivity and various ions concentrations indicate that all ions of different categories may contribute to polar conductivity in varying degrees'(source from the internet www.agn.org/pubs/crossref/1992/92JD01915.shtml) hence our project is aimed at relating the ions present with the environment using a physics approach.

Purpose
To find the conductivity of pond water and its relationship with the presence of ion.

Hypothesis
The higher the potential difference of the pond water the more ions present.

Variable

DEPENDANT	INDEPENDENT	CONTROLLED
The potential difference of pond water	Pond water from different parts of Singapore	Volume of sampled water used
		Resistivity of wires used (in multi-meter)

Equipment and apparatus

1)Multimeter	8) Water samples from different parts of Singapore
2) Cables	9) Distilled water
3) 4 x 200mlbeakers	
4) Glass flask	
5) Measuring cylinder	
6) Pipette	
7) Mass balance	

Procedure

Procedures

1) Use the measuring cylinder to collect 150 ml of the pond water and put it separate glass beaker
2) Label the glass beaker respectively
3) Take the multimeter and adjust it to 2V DC mode
4) Immerse the electrodes into the pond water and record the readings
5) Repeat step 4 and take several readings
6) Ensure that the depth and the distance between the electrodes remain constant every time reading is taken
7) Use pipette to take 20.0 ml of the pond water sample
8) Measure the mass of the conical flask
9) Measure the mass of the conical flask after the addition of sample pond water
10) Record the data obtained
11) Show relationship between density and conductivity

Data collection

Table of potential difference of collected sample of pond water

Location of water sample	1st reading ± **0.001**/V	2nd reading ± **0.001**/V	3rd reading± **0.001**/V	Average potential difference ± **0.001**/V
De-ionized water	0.006	0.004	0.003	0.004
NUS Prince George Park pond	0.025	0.023	0.025	0.025
ACS(I) pond	0.022	0.023	0.025	0.023
Bukit Timah nature reserve	0.014	0.017	0.018	0.016
Botanical Garden swan lake	0.015	0.016	0.017	0.017

Table of mass of pond water

Location of water sample	Volume of pond water ± 0.06/cm3	Mass of conical flask ± 0.01/ g	Mass of conical flask + pond water ± 0.01/ g	Mass of pond water ± 0.01/ g
ACS(I) pond water	20.0	119.23	139.46	20.23
Botanical Garden pond water	20.0	119.33	139.51	20.18
NUS pond water	20.0	119.44	139.65	20.21
Bukit Timah nature reserve	20.0	119.56	139.72	20.16
De-ionized water	20.0	119.42	139.44	20.02

Calculation

Calculation

Density of ACS (I) water= mass/volume
= 20.23/20.0
= 1.012 g/cm3

Density of NUS pond water= mass/volume
= 20.21/20.0
= 1.011 g/cm3

Density of Botanical garden pond water= mass/volume
= 20.18/20.0
= 1.009 g/cm3

Density of Bukit Timah pond water= mass/volume
= 20.16/20.0
= 1.008g/cm3

Density of de-ionized water= mass/volume
= 20.02/20.0
= 1.001 g/cm3

Uncertainty – sample calculation

$\Delta\rho = (\Delta m/m + \Delta V/V) \times \rho$
$= (0.01/20.23 + 0.06/20.0) \times 1.0115$
$= 0.003$

Table indicating relationship between density and potential difference

Location of water sample	Density ρ ± 0.003 / gcm-3	Potential difference ± 0.001/ V
NUS pond water	1.011	0.025
ACS(I) pond water	1.012	0.023
Botanical Garden pond water	1.009	0.017
Bukit Timah pond water	1.008	0.016
De-ionized water	1.001	0.004

Conclusion and evaluation

- Percentage uncertainty=$0.003/1.0115 \times 100\% \times$
  $=0.3\%$
- Negligible uncertainty suggests that the experimental method is accurate. Since the presence of ions contributes to he conductivity of electricity, moreover based on the data and calculation, the higher the potential difference the higher the concentration of the ions present. The more ions present the denser the water is. Our group's biology student carried out another experiment, using Ervatamia leaf, with the help of hold punch, syringe, 18 watt lamp, and stopwatch; they found out that ACS (I) pond water has the fastest rate of photosynthesis. This can be linked to our physics part: the higher potential difference the faster the rate of photosynthesis. But this is not the case because ACS (I) pond water only has the second highest potential difference.
  This shows that there are limitations and inaccuracy in the experimental method, though the percentage uncertainty suggests accurate method.
  This may be due to the imprecise and uncertainty involved when the water and getting potential difference weigh.
  1. Water in the pipette may not be transferred completely into conical flask. However the volume used in calculation are all 20.0ml.
  2. When reading multimter the readings fluctuate a lot hence an average reading was taken for every set of reading. This is inaccurate since the potential difference changes though the variables are controlled.

Furthermore, the readings of potential difference are directly compared with the density of the water; hence if the readings are inaccurate, the conclusion may not be correct either.

Improvement

UV-VIS spectrometer could be used t test/measure what are the concentrations of ions present in the pond water so that a more accurate conclusion can be derived.

Reflection

To be honest, including a portion of physics component was something which I did not even think about before the experiment was carried out; neither did I expect it to happen. The reason why we measure the density and potential difference of the sampled water was merely because we could not think of nay physics terms which we can measure for this experiment! Ironically these random trying became the inspiration which drove us to think further and out of the box. That was how we linked rate of photosynthesis to potential difference of sampled water.

However I am sure that there are uncertainties in our results and conclusion. Especially the potential difference of sampled water, (even the way we measured the potential difference was doubtful) which fluctuated a lot: the reading was decreasing and increasing all the time and for a very few seconds, it stayed constant. Hence the readings we recorded were actually the average value.

There are many things to learn apart from the physics component. Normally we can hardly find someone taking a biology and physics combination; however we almost successfully related physics to biology. I realize that design an experiment is so important that it really prove' well begun half done'. It was really a memorable experience.