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How do physical characteristics determine the distribution of organisms in a fresh water enviroment?

There are many abiotic factors which affect ponds, and pond life. These factors could have a significant effect on the pond life, specifically diversity and distribution of plants and animals.
Factors such as temperature, wind speed, humidity, altitude/climate, photoperiod, salinity, water flow, turbidity, substrate, light intensity, dissolved gases and pollution have a significant impact on the pond, and inhabitant organisms of the pond.
Due to time limitations of this experiment, only three factors are going to be studied in the experiment. These factors are; temperature, pH and turbidity, which may determine the distribution of organisms in a pond.

When talking about the temperature of water, the meaning is basically whether the water is hot or cold. However, it is not as simple as that; towards the surface, the water is warm because of the heat from the sun. The further below the surface, the cooler the water gets because the heat radiating from the sun would not reach so far down. This would in itself affect organisms living in the pond. For example, on the surface, organisms that would need heat to survive would live further at the top. The organisms which would not need so much heat to survive would be able to live further at the bottom of the pond.

The pH of the water would basically mean whether the water is more acidic or alkaline, or even whether it is neutral. The calibration of the of the pH meter proved to be rather difficult, as the meters were quite old. There would be many ways to measure the pH of the water samples provided. One way would be to use litmus paper; this would be by taking a few drops of the specific water sample and placing them onto a sheet of litmus paper. The paper would then change colour and this would therefore indicate what pH the water was at. Another way would be to use a universal indicator such methanol orange. This would change the colour of the sample of water and as a result this would therefore indicate what pH the sample was at.

Turbidity is the measure of to which extent light passing through water is reduced due to suspended materials in the water. This is literally the optical property of water, based on the amount of light reflected by suspended particles. The cloudy appearance of water caused by the presence of suspended and colloidal matter, measured by how deeply light can penetrate into the water from the surface would significantly affect certain organisms; especially plants towards the bottom of the pond would need light to photosynthesis. The scattering and absorption of light that makes the water look murky, caused by the content and shape of matter suspended in the water. Turbidity could also be the state of having sediment or foreign particles suspended or stirred up in water.

Three samples of pond water taken from independent fresh water environments made the basis of the experiment. The temperature, pH and the turbidity were measured from the following samples, a shallow pond, a water butt and an aquarium.

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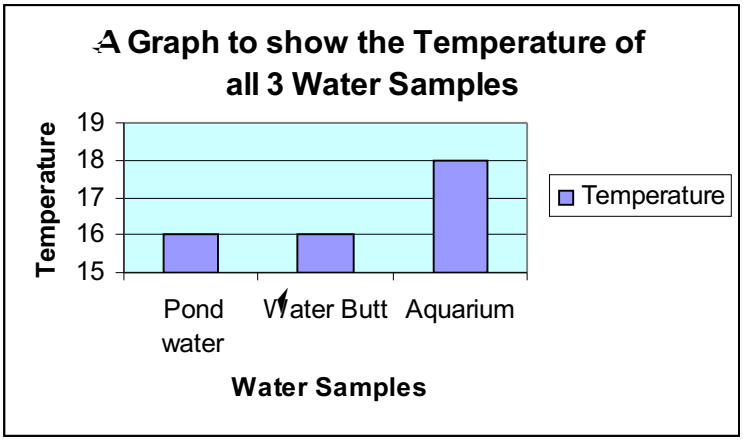
Results: -

The following results were accumulated: -

Water sample	Temperature	pH	Turbidity
Pond water	16	7	34
Water Butt	16	6.6	19
Aquarium	18	7.9	50

I have created a bar chart for the results gathered from the temperature experiment to make the information easier to comprehend and analyse.



Data analysis:
It is apparent that the temperature of the pond water and the water butt are both the same, but the temperature of the Aquarium is slightly, but significantly higher than the other two samples. This result is odd due to the fact that all of the samples were placed in separate containers, and stored in the laboratory – resulting in the temperature of the water samples coming down to room temperature. One reason as to why the temperature of the aquarium was slightly higher than the rest could have been put down to the fact that there were two fishes in the water when the experiment was carried out. This would almost certainly result in a higher temperature because the organisms present in the aquarium would be respiring and creating body heat, therefore increasing the temperature.

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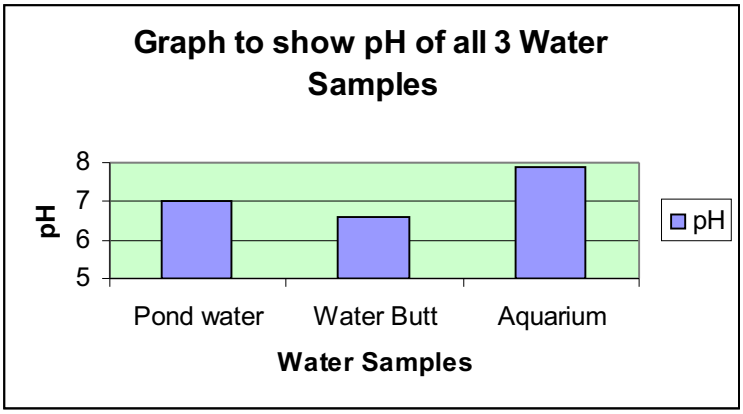
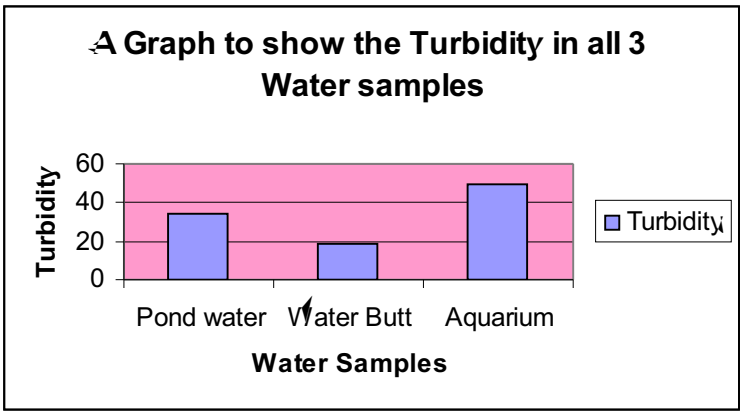
I have created a bar chart for the results gathered from the pH experiment to make the information easier to comprehend and analyse.



Data analysis:
The sample with the highest acidity content is in the aquarium. The lowest bar is that of the water butt, it has the lowest acidity content, but shows a considerable alkaline content. The pond water has a neutral pH, meaning it has neither high acid nor alkaline contents.

I have created a bar chart for the results gathered from the turbidity experiment to make the information easier to comprehend and analyse.



Data Analysis: -
The turbidity is the optical property of a water sample that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample.[1] The turbidity of the aquarium is almost obviously the highest meaning that this was the murkiest. This could have been due to the fact that there were plants and other decorations in the tank, decreasing the amount of light able to penetrate the water.

[1] www.state.ma.us/dfwele/River/rivLow_Flow_Inventory/glossary.html

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Organisms found in ponds

I have chosen 10 organisms to study, and I shall proceed to create a food web of these specific organisms.

Mayfly Nymph (*Centroptilum species*):

The first animal that was chosen was the Mayfly Nymph. These insects are found in very clean water containing lots of oxygen. They absorb oxygen from the water through their gills. They are primary consumers and eat plants and algae.

Water Spider (*Argyroneta aquatica*):

This spider builds a silken retreat under water among plants which it fills with air. It is a good swimmer and will catch its aquatic prey and subdue it with its venomous jaws. Water spiders live for about two years. They live on a diet of insects. This spider builds a silken retreat under water among plants which it fills with air so that it does not have to keep swimming up to breathe.

Water flea (*Daphnia*):

Daphnia are called fleas, but this is not technically true. They are found in large numbers in lakes and ponds. Daphnia give birth to live young, but the eggs are incubated in a brood pouch. Daphnia are herbivores; they eat small green algae and are eaten by carnivores such as the Phantom Midge Larva.

Water Hoglouse (*Asellus species*):

These animals are rather closely related to wood lice. Fourteen legs show that they are different from spiders and insects. They belong to the Crustacean family. The water louse is about 8mm long. They are found in fresh water such as ponds, lakes or slow moving rivers. The water louse eats detritus (dead plant and animal material) and has four pairs of jaws. They are eaten by: water mites and other carnivores.

Algae:

Microscopic plant-like organisms that contain chlorophyll. Algae are nourished by carbon dioxide (CO2) and use sunlight to carry out photosynthesis. There are 21,000 known species of algae. The most common pond types are black, blue-green, green and mustard. They are producers, and are consumed by primary consumers.

Common duckweed:

Duckweed is found statewide but most commonly in the piedmont, midlands and coastal plain. It thrives in quiescent ponds and backwaters where little water movement is present. The rapid rate at which duckweed can reproduce may result in total coverage of the pond's surface in a short period of time. It is often associated with ponds having high levels of organic nutrients such as those found in livestock or swine feed lots or waste treatment facilities. Duckweed is a very small floating aquatic plant, usually light green in color.

Blood worm – midges:

Midges are a large group of insects that resemble the mosquito. Males have feathery antennae. Females have just slightly hairy antennae like that of mosquitoes. Most do not

bite. Most larvae are round-bodied and can be yellow, red or whitish in colour. The red larvae are called 'blood worms' and like to live in water in both ponds and streams that has a slight current. The freshwater larvae of certain midges are red as a result of the high hemoglobin content of their blood.

Whirligig Beetle:
Whirligig beetles are the only beetles that can swim on the surface film of the water. They are oval, black beetles 3 mm to 15 mm long, and are found gliding or skating across the surface of pond, lakes or quiet streams in late summer or fall. Whirligig beetles gather in large numbers on the surface of the water and swim rapidly in small whirling circles within the group. That is how they received their name. They seem to dance or 'gig' on the surface of the water.

Ramshorn snail:
These are very common and are found on plants at the pond margin. Most are less than 1 cm across, but can be larger. They are herbivores and graze on the algae that coat the water plants. The shell is a simple flat coil with no spire or point. Small Ram's Horn snails are eaten by fish.

Cyclops (*Cyclops species*):
The mythical creature Cyclops had only one eye, so does this microscopic animal. It carries two sacks of eggs close to its tail. It is often seen with hundreds of rotifers. They are secondary consumers, and eat algae, small animals and detritus. They are eaten by certain animals; these are Phantom Midge Larvae and water mites.

Food Web: -

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Biological Indicators

Environmental scientists have determined that the presence, condition, and numbers of the types of fish, insects, algae, and plants can provide accurate information about the health of a specific river, lake or pond. These types of plants and animals are called biological indicators.

An indicator has the ability to reflect biological, chemical or physical attributes of a specific ecological condition. The primary uses of an indicator are to characterise current status and to track or predict significant change.

Biological indicator species are unique environmental indicators as they offer a signal of the biological condition in a watershed. Using 'bioindicators' as an early warning of pollution or degradation in an ecosystem can help sustain critical resources, as signs of pollution or any disease that may affect the whole population of the wetland can be found early.
Indicators are actually groups or types of biological resources that can be used to assess environmental condition. Within each group, individual species can be used to calculate metrics such as percent 'Achnanthes minutissima' (a diatom species) or groups of species (e.g., EPT taxa) or individual orders (e.g., Caddisfly larvae - Order Trichoptera) in an effort to assess water quality conditions.

Evaluation: -

For the duration of the experiment, not many major problems were encountered. The calibration of the of the pH meter proved to be rather difficult, as the meters were quite old. There would be many ways to measure the pH of the water samples provided. One way would be to use litmus paper; this would be by taking a few drops of the specific water sample and placing them onto a sheet of litmus paper. The paper would then change colour and this would therefore indicate what pH the water was at. Another way would be to use a universal indicator such methanol orange. This would change the colour of the sample of water and as a result this would therefore indicate what pH the sample was at.

A factor which could have affected the results of the experiment was that all of the water samples were placed into containers and stored in the laboratory. This meant that the samples would have adjusted to the room temperature, therefore making the results incorrect. An improvement to the original method would have been to take the temperature of the samples in their natural environment e.g. the pond.

Another factor which did mostly affect the results was that of the aquarium sample. The aquarium temperature was slightly higher than the rest even though it was stored with the rest. This could have because of the fact that there were two fishes in the water when the experiment was carried out. This would almost certainly result in a higher temperature because the organisms present in the aquarium would be respiring and creating body heat, therefore increasing the temperature.

A problem encountered was that when the experiment for the turbidity was being carried out, the light sensor kept fluctuating. It did not really settle on just one figure, as a result of this, a value in the middle of the fluctuating results had to be recorded.

An improvement to the method could have been to use more scientific equipment, making the results more accurate and fair. This would have been, to use a data logger instead of a thermometer. This is because; the data logger would have more precise information. Also if the experiment was carried out over several days, then an average could have been taken – making the information accurate.

Conclusion: -

After extensively analysis the results accumulated using graph, the following information was extracted. It was evident that the aquarium sample had a distinctively higher temperature than the rest of the samples. This was put down to the fact that there were large organisms – fishes, present in the aquarium that the results were being derived from, increasing the temperature slightly due to their body heat.

The pHs of all three of the water samples were all extremely similar. The sample with the highest acidity content is in the aquarium. The lowest was that of water butt, it has the lowest acidity content, but shows a considerable alkaline content. The pond water has a neutral pH, meaning it has neither high acid nor alkaline contents.

The turbidity of the aquarium was the highest, meaning that this was the murkiest. This could have been due to the fact that there were plants and other decorations in the tank,

decreasing the amount of light able to penetrate the water.

Sources of Information

- http://wow.nrri.umn.edu/wow/under/parameters/turbidity.html
- http://www.naturegrid.org.uk/pondexplorer/pond3.html
- www.alienexplorer.com/ecology/Ecology.html
- www.bartleby.com/61/63/B0336300.html
- www.dnr.state.sc.us/wild/freshfish/img/duckweed.pdf
- www.cybersleuth-kids.com/sleuth/Science/Animals/Arachnids/Spiders/Water_Spiders/
- www.bbc.co.uk/nature/wildfacts/factfiles/429.shtml
- http://www.epa.gov/bioindicators/
- http://www.suite101.com/article.cfm/ecology/57858