Soil Analysis

Soil forms the basis of the world we live in. It is the top layer of the Earth's surface, consisting of rock and mineral particles mixed with organic matter. There are many varieties of soil around the world from Clay to Sand and from Rainforest to Mud. Different types of soil have their own individual characteristics that in turn affect the suitability of growth. This is due to different nutrient levels, water holding capability, pH etc.
Many species of plants have adapted to better suit their soil environment. These adaptations have allowed certain plant species to thrive in an area in which other plants would never survive.
Mangroves are highly admired for the way they have adapted to live in a saline environment. Flora naturally need freshwater to survive just as we do. Then how can mangroves survive growing in salt water? Mangroves have adapted to filter out the salt when it is absorbed along with the nutrient filled water. This salt is excreted through roots, leaves and bark. What is left is freshwater that can be used by the mangrove. This may seem like a big deal when you could just grow in fresh water however this adaptation allows mangroves to have less competition from other flora.
The following experiments are to observe the individual characteristics of 3 different Zones of Mangrove Mud and also Beach, Rainforest and Clay Soil.
The purpose of these experiments is to carry out various experiments and thus observe the different characteristics of soils. These characteristics can be compared to see how differences in soil might determine the type of vegetation that grows there.

Safety Precautions:
Make sure gloves are worn at all times as there are some harmful bacteria and diseases in dirt.

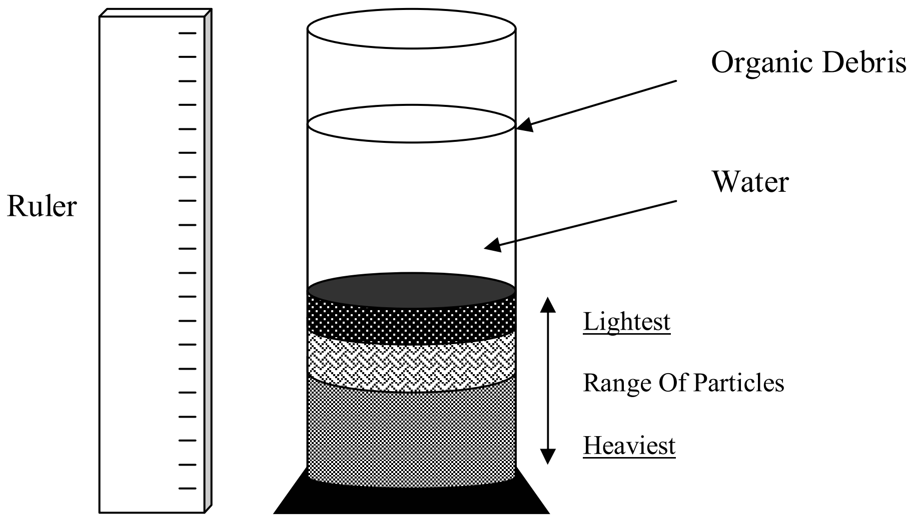
Experiment 1 Soil Texture:

Aim: To find the percentage of sand, clay and silt in different soil samples.

Prediction: I predict that the soil with the highest percentage of sand will be the Trinity Beach sample. The soil with the highest percentage of clay will be the Clay sample. The soil with the highest percentage of silt will be the Outer Zone Mangrove Sample.

Materials:
* 6 x 200mL measuring cylinders
* 3 x Mud samples from different areas of the mangroves (Inner, Middle and Outer Zones)
* Ruler with mm measurements
* Disposable Gloves
* 3 x Samples of various areas (Beach, Rainforest and Clay Soil)
* Spoons
* Sieve

Diagram: (For Step 4 and 5)



Procedure:

1. Sift all of the samples to remove insoluble lumps of dirt, plant debris etc.
2. Measure 40mL of the first dried sample (for example Inner Zone Mud) into a measuring cylinder and label it accordingly.
3. Fill the cylinder with 200mL of water and shake until all the dirt particles are mixed throughout the water.
4. Put the cylinder down on a level bench and measure the depth of the sediment after the following time intervals: 30 seconds, 30 minutes, and 12 hours.
5. Repeat for each dirt sample. Record results on the table.

Results:

Mangrove Mud:

	Inner Zone Mud	Middle Zone Mud	Outer Zone Mud	Stoney Creek Rainforest	Trinity Beach Soil	Clay Soil
30s depth (sand)	17 mm	11 mm	5 mm	Minimal	28 mm	12 mm
30 min depth	30 mm	20 mm	34 mm	29 mm	32 mm	25 mm
12 hour depth (total depth)	41 mm	37 mm	51 mm	38 mm	33 mm	54 mm
Sand layer (30s depth)	17 mm	11 mm	5 mm	Minimal	28 mm	12 mm
Silt layer (30 min – 30s depth)	13 mm	9 mm	29 mm	≈ 29 mm	4 mm	13 mm
Clay layer (12h – 30min depth)	11 mm	17 mm	17 mm	9 mm	1 mm	29 mm
% Sand = $\frac{\text{Sand depth}}{\text{Total depth}}$ X100	41.46 %	29.73 %	9.80 %	Minimal	84.85 %	22.22 %
% Silt = $\frac{\text{Silt depth}}{\text{Total depth}}$ X100	31.71 %	24.32 %	56.86 %	≈ 76.32 %	12.12 %	24.07 %
% Clay = $\frac{\text{Clay depth}}{\text{Total depth}}$ X100	26.83 %	45.95 %	33.34 %	23.68 %	3.03 %	53.70 %

Discussion:

There are many different kinds of soil and they all have there own individual characteristics that affect the flora growth in that type of soil. These characteristics are things like:

- The capacity of soil to hold minerals and water
- The movement (capillary action) of water into soil
- The drainage ability of water through the soil

These are just a few of the characteristics affected by the amounts of clay, sand and silt present in the soil. These three sediment types were determined through the experiment above.

It was determined that the soil sample with the highest percentage of sand was Trinity Beach with 84.95% of the sample being made up of sand. This is obviously no surprise but note how it is still made up of other types of sediment. On average sand is made of silica which is a mineral similar to quartz and opal. This is a hard substance that resists erosion. This insoluble mineral does not offer the best conditions for flora growth as nutrient and water trapping in the "soil" is difficult. The sand in the Trinity Beach area upholds the characteristics outlined for silica however due to the results above it is evident that the soil also contains 12.12% of silt and 3.03% of clay. These other sediments may help to trap the necessary nutrients for plant growth in the soil. The flora that grows on the beach is hardy (casuarinas and Spinifex). This is due to the limited amount of water and nutrients available.

The highest percentage of Silt in the soil samples was Stoney Creek rainforest (76.32%). Rainforest is a nutrient high area where flora growth is prominent. This nutrient level is due to the way silt (and also clay) traps the nutrient rich water needed for the extensive growth. Silt is made up of finely eroded rock (this rock is largely made up of quartz and feldspar). This sedimentary silt is washed down with the rain and is trapped amongst the roots of trees. In relation to the mangroves, this silt is washed downstream in the annual floods and trapped in the particular roots (stilt, prop etc). This root network holds the nutrient laden silt to be used when needed. Without these roots (if the mangroves are cut down) the silt will wash through along with the nutrients. This silt collects at river mouths, causing shallower water and in the case of the nearby Great Barrier Reef in the Cairns area silt deposits that destroys the original habitat.

Obviously the clay soil sample contained the highest percentage of clay (53.70%). Clay, when wet, is a flexible substance that can be moulded at will. When dry it becomes rock like and perfect for holding soil together. This characteristic is highly beneficial to the environment in the way it helps to prevent erosion. Clay is not necessarily highly nutrient filled sediment but, like clay, it is finer grained and holds a lot of water. Soil with high clay percentages is not a preferable flora environment because it is not well draining. Some plants still live in clay soil and many Australian plants have adapted to this especially wattles. Mangrove Mud contains its fair share of clay (ranging from 36% to 46%). This clay is responsible for the sticky characteristic of mud when it is wet. Clay helps to hold the mud together to avoid it being washed into the river or wetland. Clay is not well draining and could be responsible for the way mangrove mud appears to be wet even when the tide has long since gone out.

It was often difficult to take readings of the amount of soil that had settled at different time periods. In the case of the mud samples they are rich in silt and clay and this clouded the water. It was difficult to determine what was actually settled from what was still suspended in the water above. A reading was taken and this was compared to readings taken when the water had cleared and all particles had settled. At this stage it was quite easy to see the different sediments that had settled. This difficulty in recording the levels could give reason for an amount of "percentage error".

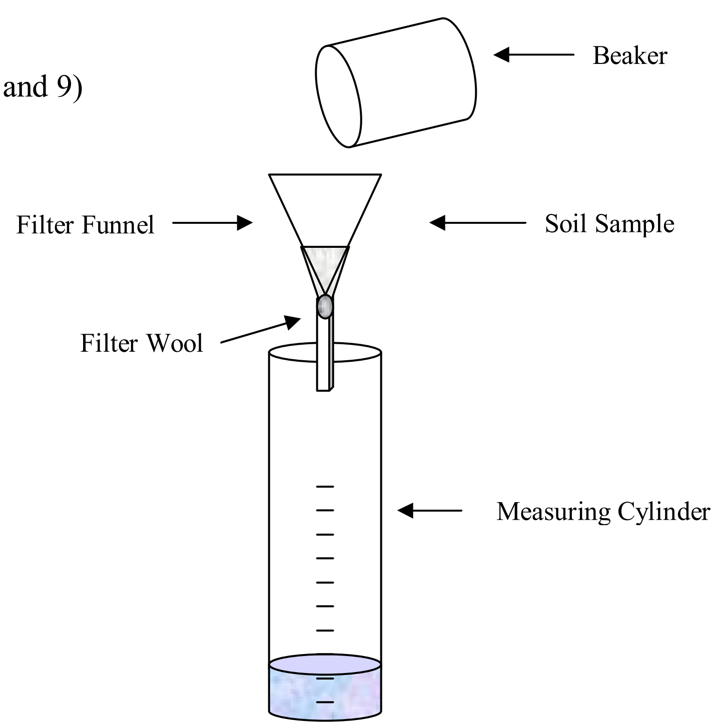
Conclusion:
The different sedimentary percentages analysed in this experiment are responsible for the individual flora species that grow in some areas but not in others. This variation in plant types is important to provide different habitats and food sources for Australian wildlife and marine species.

Experiment 2 Soil Permeability:
Aim: To observe the rate at which 50mL of water passes through different samples of saturated soil and mud.

Prediction: I predict that it will take the longest amount of time for 50mL of water to pass through the Outer Zone Mud. I predict that it will take the shortest amount of time for 50mL of water to pass through the Trinity Beach Soil Sample.

Materials:
* 6 x 100mL measuring cylinders
* 3 x Mud samples from different areas of the mangroves (Inner, Middle and Outer Zones)
* 1 x 100mL beaker
* Disposable Gloves
* 3 x Samples of various areas (Beach, Rainforest and Clay Soil)
* Filter Wool
* 6 x 75mm filter funnels
* 6 x Timers

Diagram: (For Steps 8 and 9)



Procedure:

1. Loosely plug the necks of all the filter funnels with filter wool and place a 100mL measuring cylinder beneath each of them.
2. Take up the first funnel. Fill the funnel about one third with the first sample of dry dirt.
3. Repeat this for each individual funnel and dirt sample.
4. Place each funnel in a 100mL measuring cylinder.
5. Pour approximately 50mL of water in each funnel.
6. Allow the water to filter through the dirt until it stops dripping. This is the point at which the dirt is fully saturated.
7. When this point is reached empty the cylinders and replace back under the saturated soil funnels.
8. Pair each funnel and measuring cylinder set up with a Timer. Add 50mL of water to each funnel and start their timers as you do so.
9. Time how long it takes for the 50mL to pass through each sample that is until the drip rate is less than one drip per minute.
10. Do NOT discard the saturated soil sample as it will be used in Experiment 3.

Results:

Sample Type	Time It Takes For 50mL To Pass Through Saturated Sample
Inner Zone	13.56 minutes
Middle Zone	17.32 minutes
Outer Zone	23.14 minutes
Clay Soil	No Dripping At All
Trinity Beach Soil (Sand)	17.32 minutes
Rainforest Soil	7.54 minutes

Discussion:

Soil naturally traps water and this can be determined by testing it for Soil Permeability. It took the longest for the 50mL of water to drip through the clay because it didn’t drip at all. Clay is a highly water absorbing substance and when wet the particles cling together creating a thick goop. This thick clay settled in the bottom of the funnel. There were no more gaps to allow water to flow through so it accumulated in the funnel. In the environment clay soil also absorbs this water and when it reaches a certain point of water absorbency it can no longer absorb any more water. This non-absorbed water runs off the clay soil and floods nearby rivers and creeks. This not only becomes damaging floodwater but it limits the clay to how much nutrients they can absorb through the water. The drainage of soil is also important. Soil that either drains to fast or drains to slow can

affect the flora's growth. The clay could not drain and this would lead to root rot and lack of oxygen available to the plants roots.
Mangrove mud can absorb a lot of water and therefore trap a lot of nutrients. However they also contain a lot of clay (26% to 46%) and this along with the increase in water due to tidal activity makes it difficult for mangroves to absorb oxygen through underground root systems. This is the reason that mangroves have evolved to have roots like stilt roots, aerial roots and knee roots.
The rainforest soil drained the fastest of all the soil samples. Rainforest soil is full of flora debris that creates well draining holes in the soil. The soil is also well aerated which allows gaps for the water to run through. This is not a problem for the flora as it is well known that a lot of rain falls in rainforest areas.

Conclusion:
It is necessary to have a good balance of absorbency and drainage to make conditions for flora growth as good as possible. Mangroves live in a less suited environment and this has been the reason for the evolution of above ground roots to breath and help with stability.

Experiment 3 Field Capacity:
Aim: To measure the water-holding ability of a soil. This is to get an idea of the maximum amount of soil moisture available to plants, since the water which drains off due to gravity is in the root zone too briefly to be absorbed.

Prediction: I predict that the Rainforest Soil will have the best water-holding ability however the Inner Zone Mud will hold the least amount of water..

Equipment:
* The 6 Saturated Soil samples left over from the last experiment
* 6 x 100mL beakers
* 6 x plastic spoons or spatulas
* Balance accurate to 0.01g
* Permanent marker
* Drying oven set at no more than 105°C

Procedure:
1. Label each evaporating dish so that later when the saturated soil sample is added it is not confused with the other ones.
2. Weigh each evaporating and record its weight under its appropriate name on the results table.
3. Transfer each soil sample to its appropriately labeled evaporating dish (do not include the filter wool used in the last experiment).
4. Weigh each evaporating dish along with its soil sample. Subtract the weight of the evaporating dish from this weight to find the weight of the Soil + Water.
5. Place the dishes in a drying oven at 100°C and allow the dish to dry for 24 hours.
6. Allow the evaporating dishes to cool then weigh them. Subtract the weight of the dish from this weight to find the weight of dry soil.
7. Subtract the weight of dry soil away from the weight of the original soil + water to find the weight of water lost.

Results:

	Trinity Beach	Stoney Creek Rainforest	Clay	Outer Zone Mud	Middle Zone Mud	Inner Zone Mud
1. Mass of Evaporating Dish	49.62	41.62	48.09	43.51	48.22	45.31
2. Mass of Evaporating Dish and Saturated Soil	97.71	78.78	90.31	83.88	82.00	85.29
3. Mass of Saturated Soil (2 – 1)	48.09	37.16	42.22	40.37	33.78	39.98
4. Mass of Evaporating Dish and Dry Soil (Final Mass)	87.22	63.07	79.09	68.25	70.81	70.87
5. Mass of Dry Soil (4 – 1)	37.60	21.45	31.00	24.74	22.59	25.56
6. Mass of Water in Soil (3 – 5)	10.49	15.71	11.22	15.63	11.19	14.42
7. Percent of Water in Soil $\frac{\text{Mass Of Water (6)}}{\text{Mass Of Saturated Soil (3)}} \times 100$	21.81 %	42.28 %	26.58 %	38.72 %	33.13 %	36.07 %

Discussion:
Field capacity is a measurement of the water-holding ability of individual soils. Soil can only hold so much water and then the rest becomes drain off. This in turn is the maximum amount of water available to the flora growing in that soil.
The Stoney Creek Rainforest soil sample contained the most amount of water held in the sample (42.28%). This high percentage means that this particular soil sample holds the most amount of nutrient rich water for flora use. This is highly beneficial for the use of the plant at that time and also for storage of water and nutrients for later. The increased holding ability of the soil means that less water is wasted.
The soil with the least holding ability is the Trinity Beach sand (21.81%). The Trinity Beach sand sample is obviously from the beach and this is by a tidal mass of water. These tidal tendencies soak the soil say once a day. The tide is always going to be there so the soil does not need to store as much water. Also it is not capable of storing a lot of water because of its grainy structure instead of finer particles (silt and clay) that can absorb water (Experiment 1).
Mangroves need to absorb a lot of water to obtain as much nutrients as possible. Mangrove mud is able to hold a lot of water (33% to 39%) however this water is predominantly saline. The mangroves have evolved to use this nutrient rich water by filtering out the salt. This leaves the plant with fresh water filled with the nutrients.

Conclusion:
It is necessary for some soils to absorb a lot of water but it is also important to have a certain level of drainage ability. If the soil absorbed ALL of the water then root rot would occur. Also if all of this water was absorbed then the ground beneath our feet would become a sloppy mess unsuitable for walking on.

Experiment 4 Capillary Action Of Soil:

Aim: To observe the rate at which water is absorbed into different soil samples using a Capillary Action setup (see Diagram). Water is absorbed by soil as the soil contains small spaces where water can be held.

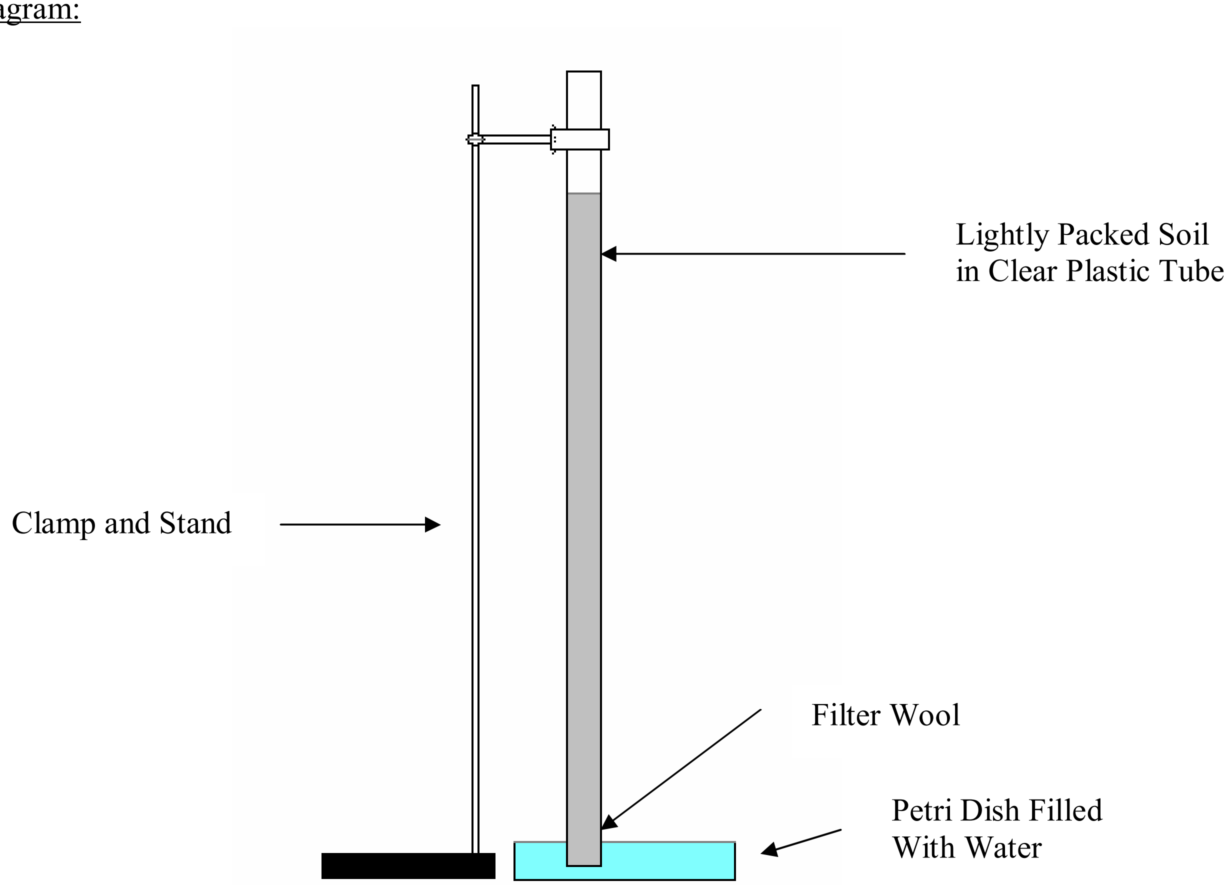
Prediction: I predict that the Stoney Creek rainforest will absorb the most amount of water over the designated days and the Inner Mud Zone will absorb the least.

Materials;

* 2 x Mud samples from different areas of the mangroves (Inner & Middle Zones)
* 3 x Samples of various areas (Beach, Rainforest and Clay Soil)
* 5 x 50cm Clear Plastic Tube, approximately 2cm in diameter.
* 5 x Clamps and Stands
* 5 x bottom half of Petri Dishes
* Permanent marker
* Filter Wool
* Beaker to top up Petri Dishes
* Ruler marked with millimeters

Note: The Outer Zone mud sample was too hard to insert and pack into a tube so it was not tested.

Diagram:



Procedure:

1. Loosely plug one end of each plastic tube with filter wool and trim the excess ends.
2. Label each tube and three quarters fill the named tube with the appropriate dried soil.
3. Tap the tubes to settle the soil.
4. Clamp the tubes above a Petri dish so that it is held just off the bottom of the dish.
5. Fill the Petri dish with water and refill it when necessary during the experiment.
6. Measure the height of the water absorbed up the tube at the time intervals shown in Table 4.

Results:

	Monday 21 May					Tuesday 22 May	Wednesday 23 May	Rate of Absorbency (average mm per day)
	30 mins 10:00 am	1 hour 10:30 am	2 hours 11:30 am	3 hours 12:30 am	4 hours 1:30 pm	24 hours 9:30 am	48 hours 9:30 am	
Inner Zone Mud	34 mm	40 mm	52 mm	53 mm	55 mm	105 mm	146 mm	48.7 mm per day
Middle Zone Mud	32 mm	33 mm	41 mm	44 mm	45 mm	71 mm	93 mm	31 mm per day
Trinity Beach	94 mm	99 mm	114 mm	124 mm	133 mm	184 mm	243 mm	81 mm per day
Clay	36 mm	39 mm	52 mm	53 mm	64 mm	107 mm	219 mm	73 mm per day
Stoney Creek Rainforest	44 mm	47 mm	54 mm	55 mm	56 mm	120 mm	121 mm	40.3 mm per day

Discussion:

All soil samples have small gaps between the particles where water is absorbed and stored. All soil samples have their own characteristics and this could account for the individual rates at which they are able to absorb water.

The Trinity Beach Soil sample absorbed the most amount of water in 3 days (243mm). This sample has a high percentage of sand grains in its soil. These grains are quite large and because of their irregular shape when packed together they are not completely fitting. This leaves small gaps between the grains where water can be absorbed.

The Middle Zone Mud sample absorbed the least amount of water in 3 days (93mm). I do not believe this is an accurate reading because when it came time to fill the plastic tube with the sample it was extremely difficult as the Middle Zone Mud had bonded together. This was due to the clay percentage in the soil. When the soil dried so had the clay and this formed an almost rock like substance.

This was also the reason why the Outer Zone Mud sample was not tested. It had also become a solid mass that could not be sieved to obtain the finer particles needed for this experiment.

In previous experiments mangrove mud was quite high in the amount of water present in its soil. Also in experiment 2 Soil Permeability the Outer Zone and also the Middle Zone mud drained the fastest and this was due to the fact that they had gaps in between their particles to allow water to flow through. This is similar to the principle used in this experiment so I would assume that had this experiment been done accurately that these two zones would have absorbed close to the highest amounts absorbed over 3 days. Mangroves thrive in these muddy environments and have learnt to avoid the drowning affect that extensive amounts of water often have on plants. Some species of mangrove have evolved to have above ground roots such as stilt roots and aerial roots. When the tide begins to rise in the areas where mud is present (around the coastline) it is quickly absorbed into the mud and held there. This provides nutrients for the mangroves but without the above ground roots they would be dead. This strategy that the mangroves have helps to support my theory that the Outer and Middle Zone mud must be able to absorb water at quite a fast rate even though the reading for Middle Zone mud says otherwise.

Conclusion:
The ability to absorb a lot of water at a relatively fast rate is important to trap nutrients in the soil. However it is important to balance the soil to water ratio because flooded soil is not what the plants need.

Experiment 5 Soil pH:
Aim: To observe the individual pH levels of soils.

Prediction: I predict that the Middle Zone Mud sample will have the highest acidity (below 7). Trinity Beach on the other hand will have the lowest acidity (higher than 7).

Materials:
* 3 x Mud samples from different areas of the mangroves (Inner, Middle and Outer Zones)
* 3 x Samples of various areas (Beach, Rainforest and Clay Soil)
* pH kit
* Distilled water
* 6 x small beakers
* 6 x stirring rods
* Permanent marker

Procedure:
1. Label each beaker and add the appropriate dried soil to each beaker. Make sure each soil sample is approximately the same.
2. Add approximately the same amount of distilled water to each beaker.
3. Thoroughly stir the beakers to dissolve as much soil as possible.
4. Test each beaker of soil sample with the pH tester and remember to wash the tester with distilled water after every beaker.

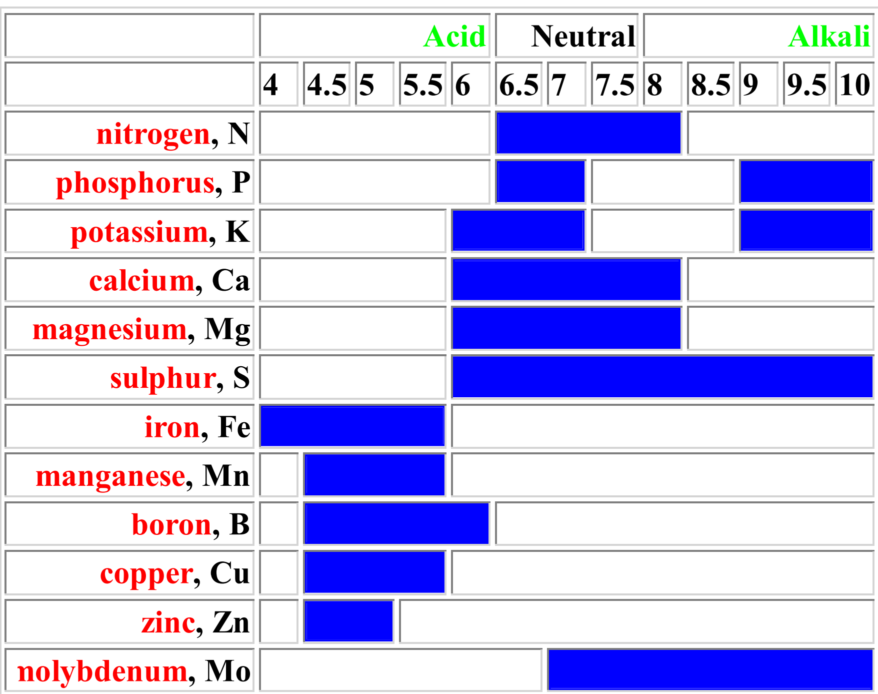
Results:

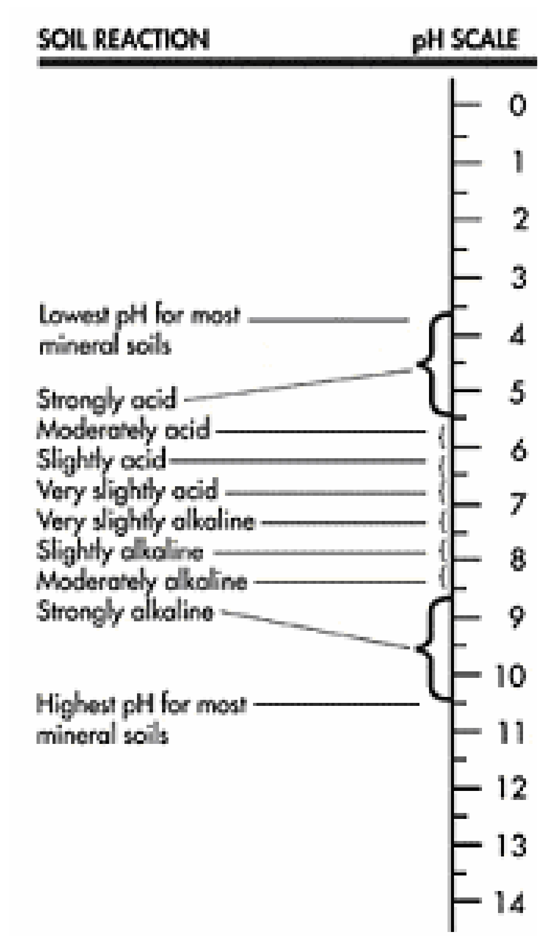
Soil Sample	Ph level
Trinity Beach	6.1
Stoney Creek Rainforest	6.7
Clay	5.9
Outer Zone Mud	7.0
Middle Zone Mud	7.2
Inner Zone Mud	8.4

Discussion:

Soil pH is an indication of the alkalinity or acidity of soil. A pH meter ranges from 0 to 14 and 7 is the point at which soil is deemed neutral. Some plants tend to thrive in one condition but placed in another death is inevitable. They prefer either one or the other along with many soil organisms that live alongside the flora. The pH of the soil can also affect the availability of nutrients.

The table below left shows the different types of nutrients available to flora depending on the pH of the soil. The table at the right shows the scale of pH and how to read this scale.





The pH of soil can be affected by decomposing matter, rainfall, fertilisers, and the original materials that the soil was formed from. Soil that is mixed with rocks that have a low pH reading generally have a higher acidity level. The soil that has been mixed with rocks that have a high pH will have a lower acidity level (a basic pH level). When it rains nutrients are leached from the soil by the passing water. This is a good thing as it makes the nutrients available for the plants however it does change the acidity level as these nutrients are being replaced by acidic elements such as aluminium and iron.

This is asumed to be the reason why soil formed in rainy conditions is more acidic than that formed in dryer conditions.
The decomposition of matter also makes the soil more acidic.
The Inner Zone Mud sample had the highest pH reading (8.4). This reading, using the pH scale rates the soil as Moderatly Alkine. The other mud samples are closer to 7 and nutural and this could be due to the fact that the Inner Zone is not as flushed with floodwater and tide as the other Zones and therefore the soil is not subject to changes in acidity in the ways stated above.
The soil with the lowest pH reading was the Clay sample (5.9). Using the pH scale this means that the soil is Moderatly acid.
I am not too sure of the accuracy of this reading as it does not agree with the facts on pH examined above. A search on the internet comes up with the following results. "More often than not, clay soil is alkaline (has a high pH)."[1]

Conclusion:
The acidity of the soil is affected by elements of nature such as rainfall, decomposing of matter and rock matter present in the soil. It is also STRONGLY affected by fertilisers washed into the soil from farms and gardens.

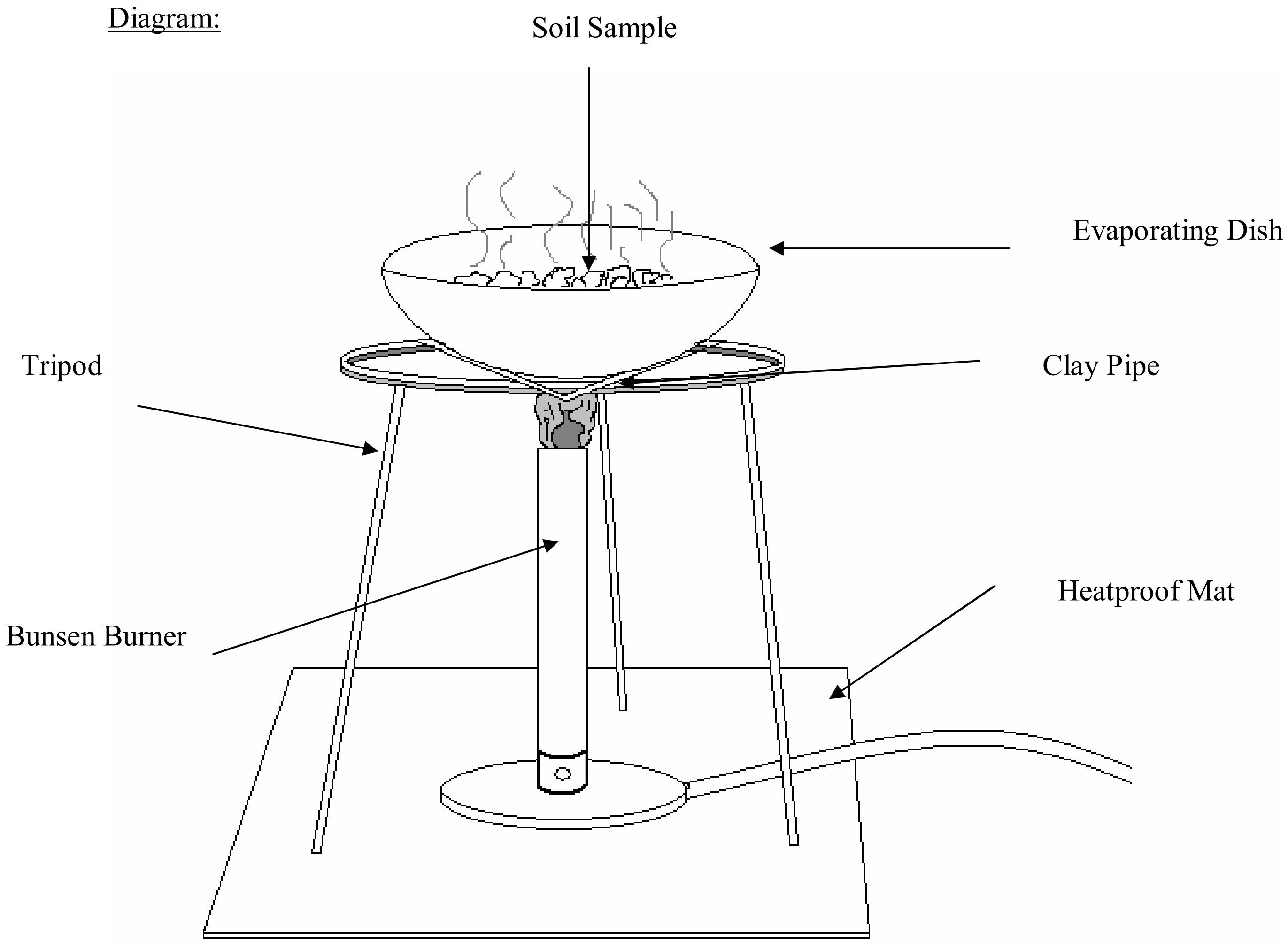
Experiment 6 Soil Organic Matter (Humus):
Aim: To determine the percentage of soil organic matter (Humus) in each soil sample through heating.

Prediction: I predict that the rainforest will contain the most amount of Humus and that the clay will contain the least amount of Humus.

Materials:
* The six dry soil samples form experiment 3 Field Capacity.
* 6 x evaporating dishes
* 6 x heat mats, tripod, pipe clay triangle and wire gauze
* 6 x Bunsen burner
* Metal Spatula
* Tongs
* Balance accurate to 0.01g

[1] www.bachmans.com/tipssheets/Soils/WorkingWithClay.cfm

Diagram:



Procedure:

1. Label each evaporating dish and weigh it. Record each weight at its appropriate name on the results table.
2. Add the dry soil samples from experiment 3 to their appropriately labeled dish.
3. Find the Mass of the dry soil present (N^o 3 on the results table) by subtracting the mass of the Evaporating dish from the mass of the evaporating dish PLUS the dry soil.
4. Set up the 6 sets of Bunsen burner, heat mat, tripod, pipe clay triangle and wire gauze as shown in the diagram.
5. Heat the soil strongly for 15 minutes remembering to turn it often with the spatula during heating.
6. Remove the dishes from the heat and allow them to cool on a heat mat.
7. Weigh them all again and record the weights in the N^o 4 column.
8. Work out the other weights using (N^o 5 and N^o 6) the results table.
9. Work out the Percentages using the formula shown.

Results:

	Trinity Beach	Stoney Creek Rainforest	Clay	Outer Zone Mud	Middle Zone Mud	Inner Zone Mud
1. Mass of Evaporating Dish	49.62	41.62	48.09	43.51	48.22	45.31
2. Mass of Evaporating Dish and Air-Dry Soil	87.22	63.07	79.09	68.25	70.81	70.87
3. Mass of Air Dry Soil (2 – 1)	37.60	21.45	31.00	24.74	22.59	25.56
4. Mass of Evaporating Dish and Soil After Strong Heating	86.14	60.83	77.94	66.34	69.67	70.53
5. Mass of Heated Soil (4 – 1)	36.52	19.21	29.85	22.83	21.45	25.22
6. Mass of Organic Matter (3 – 5)	1.08	2.24	1.15	1.91	1.14	0.34
7. Percent Of Organic Matter $\frac{\text{Mass of Organic Matter (6)}}{\text{Mass of Air-Dry Soil (3)}} \times 100$	2.87 %	10.44 %	3.71 %	7.72 %	5.07 %	1.33 %

Discussion:

Organic matter in the soil is debris that has been discarded by other flora and this acts like mulch. It releases nutrients into the soil as the bacteria and fungi decompose it.

In soil such as Stoney Creek Rainforest the percentage of Humus is relatively high in comparison to the actual soil (10.44%). This is due to the fact that Rainforests contain a huge number of plants which are constantly depositing dead leaf litter and branches. These are in turn decomposed to form smaller particles that become part of the soil below. These smaller particles also help to create gaps in the soil that can be used to absorb water/nutrients and also to aerate the soil.

The Inner Zone Mud sample contained the least amount of Humus (1.33%). This is because not very much can grow in its soil. Some of the smaller species of mangroves do grow their but they do not exceed about 2.5m in height. The Inner Zone is too far away from the tidal area to be able to absorb much water. This leaves this area with limited nutrient supply and also limited water supply. When the soil was collected from this area it was dry and hard to dig up however the mud collected from the Outer Zone was goopy and sticky. These differences are due to the fact that one area gets more water than the other. In the Outer Zone much more flora grows and this in turn creates more leaf litter and debris to be absorbed into the soil.

Conclusion:

Not only does Humus provide gaps for water to be absorbed into but it also provides extra nutrients for plants. The percentage of Humus depends on the amount of vegetation growing in the soil and also the tendencies for those plants to deposit leaves and other debris.

Experiment 7 Identifying Bacteria Growth in Soil

Aim: To determine the amount of Bacteria and Fungi growth in different soil samples. To compare the growth against each other to determine which area has the greatest amount of decomposers.

Prediction: I predict that the Rainforest sample will have the most amounts of Bacteria and Fungi and that the Inner Zone Mud sample will have the least amount of Bacteria and Fungi.

Materials:
* Enough Molten Agars to fill 6 Petri Dishes
* Distilled water
* Permanent Marker
* 6 Beakers
* Stirring Rods
* 6 pipettes
* Sticky Tape
* 3 x Mud samples from different areas of the mangroves (Inner, Middle and Outer Zones)
* 3 x Samples of various areas (Beach, Rainforest and Clay Soil)
* Camera
* Incubator

Diagrams:

Diagram 1:

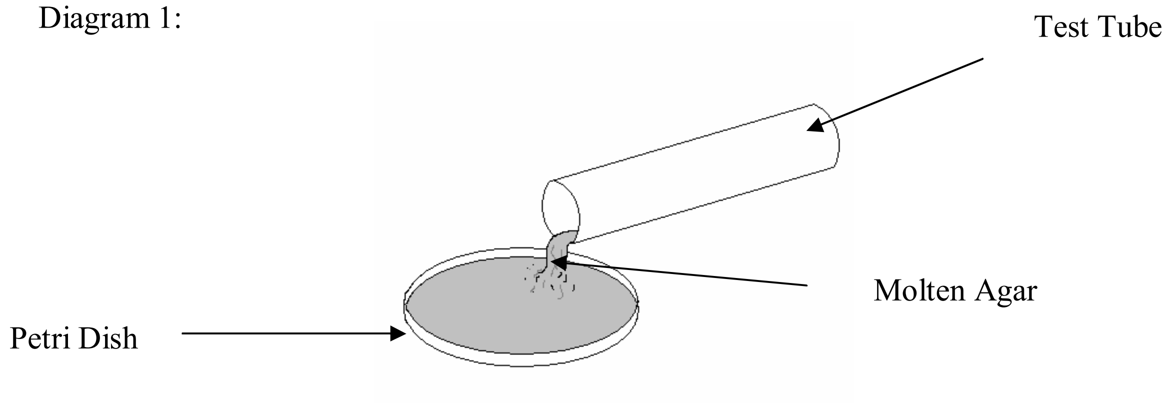


Diagram 2:

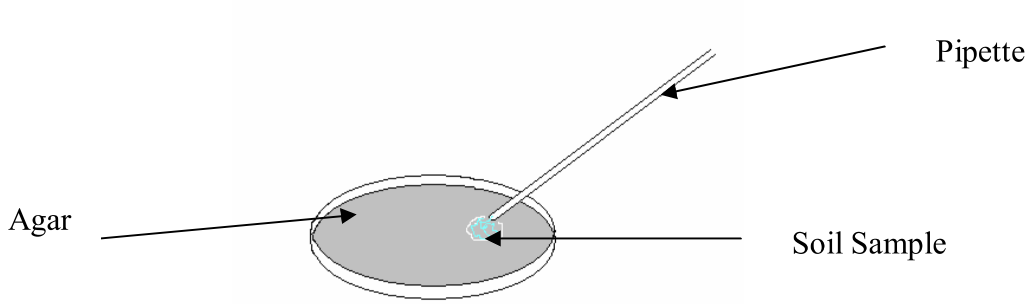
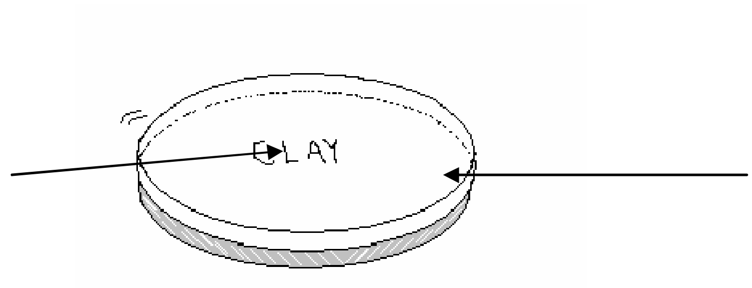


Diagram 3:

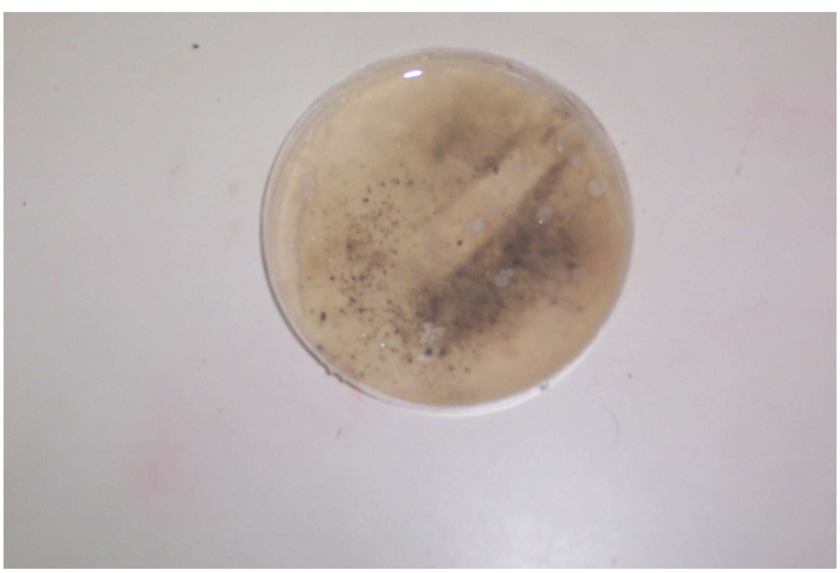


<u>Procedure:</u>

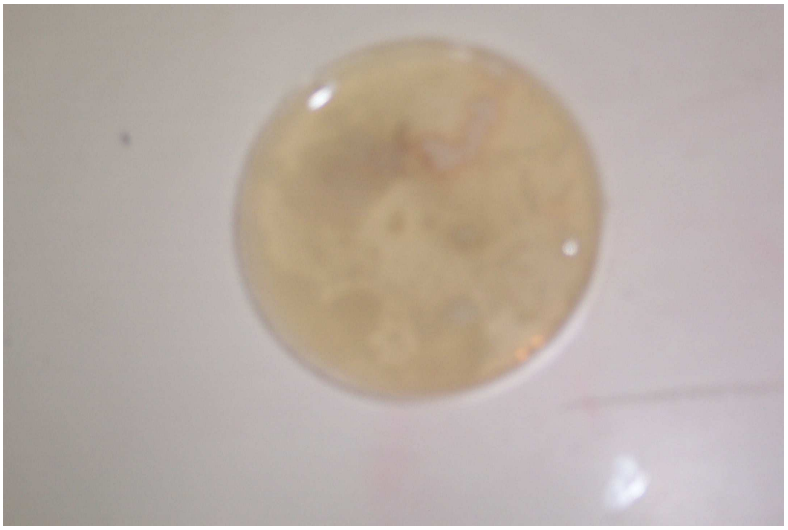
1. Warm up pre prepared agar until it becomes molten.
2. Whilst the agar is warming take the 6 small beakers and label them.
3. Add 1 teaspoon of dirt to the appropriately named beaker and add 50mL of water to each beaker.
4. Thoroughly mix the dirt in the beaker until as much of it has dissolved as possible.
5. Label 6 sets of Agar plates.
6. For each plate half fill it with agar then add a sample of the appropriate soil sample using a pipette. Put the lid on and firmly sticky tape it shut.
7. Repeat this with the other 5 agar plates.
8. Place all the agar plates in an incubator at 20°C.

<u>Results:</u>

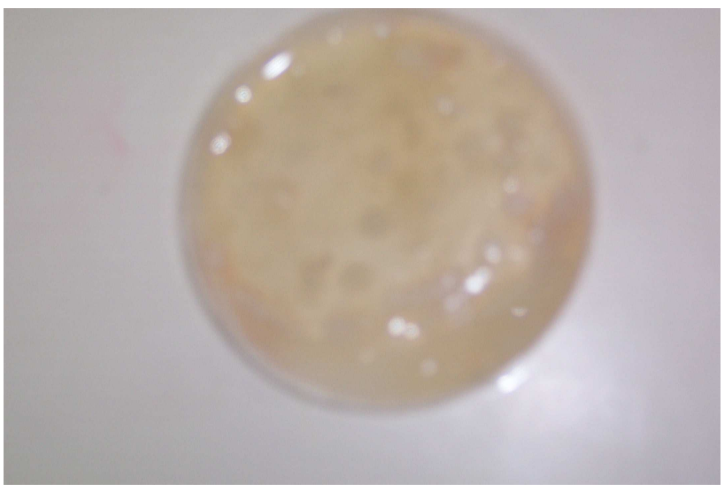
Inner Zone Mud sample



Middle Zone Mud sample

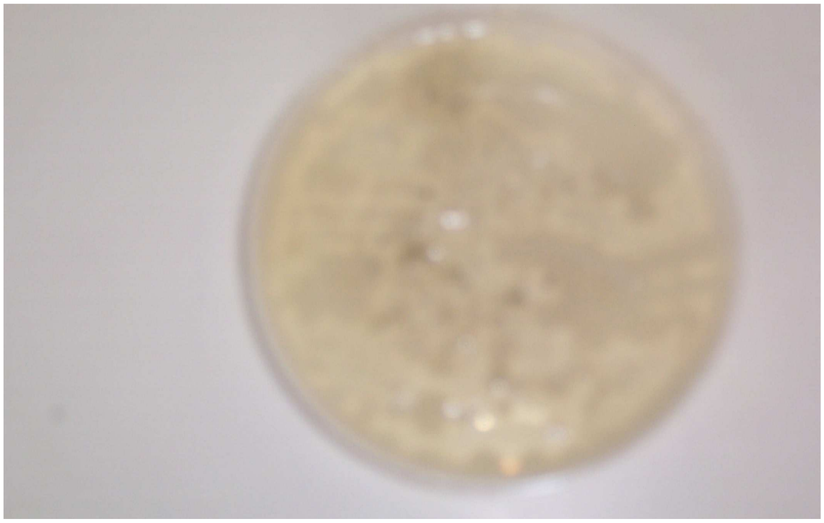


Outer Zone Mud sample

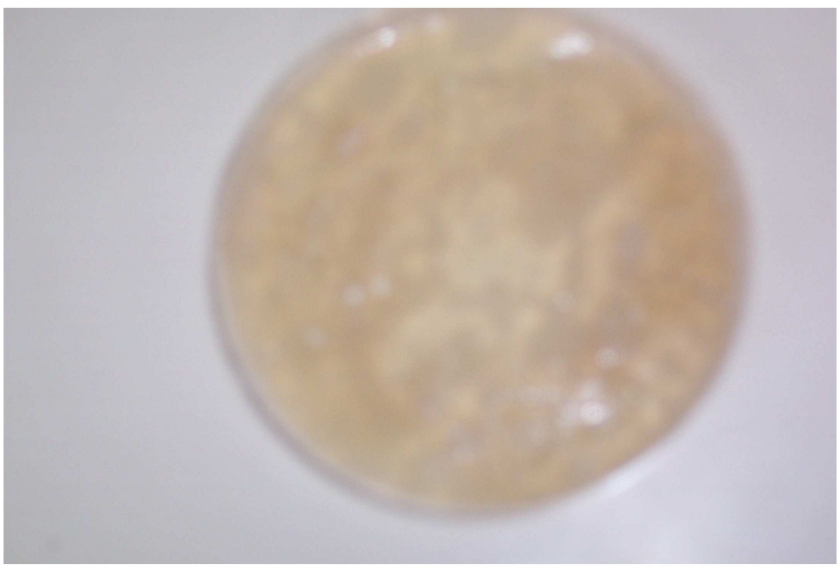


Trinity Beach sample

Stoney Creek Rainforest sample



Clay sample



Discussion:

It is difficult to see the details in the pictures above but when viewing them naturally it was possible to see that the Beach grew the most Fungi and Bacteria. This was the amount visible in the agar not by separating the colonies into either Fungi or Bacteria. Soil pH affects the suitability for fungi and bacteria growth. The pH of the beach was moderately acidic and this is only slightly below the pH level preferred by most soil bacteria. Fungi, moulds and anaerobic bacteria and tend to multiply in higher numbers the lower the pH level is. This is in accordance with the low pH of the Trinity Beach Sample.

Conclusion:

Bacteria and fungi growth is predominatly determined by the pH levels of the soil.

Summary:

Different soil types have individual characteristics which in turn affect the vegetation growth in that particular soil. Below are the results of all of the experiments (excluding Experiment 7).

	Inner Zone Mud	Middle Zone Mud	Outer Zone Mud	Stoney Creek Rainforest	Trinity Beach Sand	Clay Soil
% Sand	41.46 %	29.73 %	9.80 %	Minimal	84.85 %	22.22 %
% Silt	31.71 %	24.32 %	56.86 %	≈ 76.32 %	12.12 %	24.07 %
% Clay	26.83 %	45.95 %	33.34 %	23.68 %	3.03 %	53.70 %
Time It Takes For 50mL Of Water To Pass Through Saturated Soil Sample	13.56 mins	17.2 mins	23.14 mins	7.54 mins	17.32 mins	No Dripping
Percent of Water in Soil	36.07 %	33.13 %	38.72 %	42.28 %	21.81 %	26.58 %
Average Rate Of Absorbency Per Day Over 3 Days	48.7 mm	31 mm	N/A	40.3 mm	81 mm	73 mm
pH Of Soil	8.4	7.2	7.0	6.7	6.1	5.9
Percent Of Organic Matter In Soil	1.33 %	5.07 %	7.72 %	10.44 %	2.87 %	3.71 %

The Stoney Creek Rainforest is overall the best soil sample. The soil sample has good drainage which avoids root rot and oxygen deprival because of too much water flooding the soil. However the soil sample can also hold a lot of water which is necessary for trapping nutrients in the soil. The pH of the soil is close to neutral which is good for promoting Bacteria and Fungal growth. These Bacteria and Fungi help to decompose the high percentage of Organic Matter present in this soil type. The vegetation in the Stoney Creek Rainforest area where this sample was collected is thriving with lush, tropical plants. This type of vegetation needs a lot of water and the soil provides necessary water holding abilities and absorbency rates to hold this water. The flora growing in this area is prone to shedding leaves and this is accountable for the high percentage of Organic Matter. Rainforest soil is appropriate for most flora growth as it contains high nutrient levels. However the soil drains really fast and if clearing occurs the topsoil is easily washed away.

The soil which is least suitable for soil growth is Clay. It does not drain easily however it also absorbs water at a relatively strong rate. This is not a good combination as it leaves the soil open to over saturation and also oxygen depletion. This over saturation causes the soil to become unsuitable for most vegetation growth. Most plants prefer well drained soil. Mangroves have evolved to live in saline environments whose soil is flooded half the day at least. They have evolved to have above ground roots that help the plant to breath. These roots also provide stability for the plants in mud that is soft and often unstable due to the high percentage in water. The Outer Zone Mud sample and the Middle Zone Mud Sample both had relatively neutral pH and this preferable pH level was backed up by the higher percentage in vegetation compared to the Inner Zone Mud sample where less vegetation grew along with less water content.

All vegetation growth is affected by the soil environment they are in however some plants have adapted to better suit this difference.