THE ST. MICHAEL SCHOOL
FOURTH FORM CSEC
BIOLOGY
PRACTICAL BOOK

Prepared by Tanya Harding
September, 2014

©Tanya Harding, 2004
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Things to Remember</td>
<td>3</td>
</tr>
<tr>
<td>Cells</td>
<td>4</td>
</tr>
<tr>
<td>Plant Tissue Drawing Exercise</td>
<td>5</td>
</tr>
<tr>
<td>Liquid in Liquid Diffusion</td>
<td>6</td>
</tr>
<tr>
<td>Solid in Liquid Diffusion</td>
<td>6</td>
</tr>
<tr>
<td>Osmosis I</td>
<td>7</td>
</tr>
<tr>
<td>Osmosis II</td>
<td>7</td>
</tr>
<tr>
<td>Conditions necessary for photosynthesis – light</td>
<td>8</td>
</tr>
<tr>
<td>Conditions necessary for photosynthesis – chlorophyll</td>
<td>8</td>
</tr>
<tr>
<td>Products of photosynthesis I</td>
<td>9</td>
</tr>
<tr>
<td>Products of photosynthesis II</td>
<td>9</td>
</tr>
<tr>
<td>Leaf Structure</td>
<td>10</td>
</tr>
<tr>
<td>Summary of Food Tests</td>
<td>10</td>
</tr>
<tr>
<td>Food Tests</td>
<td>11</td>
</tr>
<tr>
<td>Enzymes</td>
<td>11</td>
</tr>
<tr>
<td>Respiration Demonstration I</td>
<td>12</td>
</tr>
<tr>
<td>Respiration – Breathing Rate</td>
<td>12</td>
</tr>
<tr>
<td>Transpiration</td>
<td>13</td>
</tr>
<tr>
<td>Storage</td>
<td>14</td>
</tr>
<tr>
<td>Excretion – Testing ‘Urine’</td>
<td>14</td>
</tr>
<tr>
<td>Planning and Design Worksheet 15</td>
<td>15</td>
</tr>
</tbody>
</table>
THINGS TO REMEMBER

- The format of your lab write up is always as follows:
  - Title
  - Aim
  - Materials/Apparatus
  - Method
  - Observations/Results
  - Discussion/Conclusion
- Always underline all of your headings and leave a space between each section.
- Your language should be in third person and in the past tense.
- The aim of the experiment indicates why you are doing the experiment.
- The discussion should contain background information about the practical and explanation of results. Use your notes and textbook to help you with your discussion.
- The conclusion is related to the aim.

DRAWINGS

- Do use a sharp HB pencil.
- Do make your drawings large.
- Draw with a clean continuous lines, not sketchy ones.
- Do not shade or cross hatch areas within the drawing.
- Everything on you drawing should be in pencil.
- Write your title on the bottom of the drawing in capital letters.
- Do not forget to write the view in the title and include the magnification.
- Magnification is calculated as follows:
  \[
  \text{Magnification} = \frac{\text{drawing length}}{\text{real length}}
  \]
- Magnification is written as follows: magnification x This is because magnification is a multiple (i.e. your drawing is usually bigger than the specimen)
- Labelling lines should always be drawn with a ruler and parallel to each other.
- Labels should be written in all capital letters or all lower case letters but not a mixture of the two.
- Never draw specimens from the textbook, your teach is familiar with them and you will get zero for your drawing.
- Try to draw specimens in proportion and as accurately as possible.

DIAGRAMS

- A diagram is not an accurate representation of an object: they are used when drawing apparatus.
- Draw the apparatus using a ruler where it is necessary to draw straight lines.
- Do not draw apparatus with a three quarter view.
- Do draw apparatus as if looking at it straight in front of you.
- The drawing rules apply to diagrams except that a magnification is not required.

TABLES

- Do enclose your tables.
- Titles for tables are written above the table and underlined.
- Do make sure your column headings include the unit used.

GRAPHS

- Do write a meaningful title for your graph.
- Do label both axes and include the units.
- Do use more than half of the graph paper.
- Do use a sharp HB pencil to plot and draw your graph.
- Do include a key if you have more than one line on your graph.
- Do make sure your graph is neat.
Title: Cells

Aim: To determine difference between animal cells and plant cells as observed by a light microscope.

Materials/Apparatus: Onion membrane, microscope slide, cover slip, forceps, scalpel, iodine solution, microscope, prepared slide of animal cells.

Method: Carefully cut a small square of onion tissue. Peel off the thin layer of membrane and place it on a slide. Place one drop of iodine on the membrane, taking care not to let the dropper touch it. Carefully drop the cover slip onto the membrane as indicated in the diagram below. Examine the slide under the microscope at the lowest power. Describe how the cells look under the lowest magnification. Increase the magnification to the next power. Examine the slide again. Draw two cells. Examine the prepared slide. Make a drawing of two cells.

---

**Diagram showing how to place the coverslip onto the slide**

Observations: Compare the structure of the animal cell with that of the plant cell as shown below, include the size and shape of the cells as well as structures that were observed.

Table showing comparison of animal and plant cell

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Cell</td>
<td>Plant Cell</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion:
What are cells? State the functions of all the structures you observed. From your observations what are the main differences between animal and plant cells – refer to your observation table. What other differences would you have expected to see? Explain why these differences were not observed.

Conclusion
In one sentence, summarize the differences you saw between the two types of cells.
TITLE: PLANT TISSUE DRAWING EXERCISE

INTRODUCTION
The aim of this experiment is to develop your drawing skills. Slides showing sections of plant and animal tissue are often very confusing to look at under the microscope. You must be able to examine slides and distinguish between types of tissue in an organ. Roots and stems are plant organs. They are made up of different types of tissues, made up of specialized cells. This is a drawing lab only.

INSTRUCTIONS
1. Choose one of the four slides available for this lab – Helianthus stem, Helianthus root, Zea stem or Zea root.
2. Examine the slide carefully at the lowest magnification. Distinguish the various tissues in the organ. This is done by looking for cells which have a similar size, look and are touching each other. These tissues form layers in the organ – layers that have a characteristic shape or form a pattern.
3. Carefully draw the layers you see in the organ section. Do not draw individual cells. Your aim is to draw the border between groups of similar cells.

An example is shown in figure 1.
The top of drawing shows cells as seen in a slide.
The bottom drawing shows the outline of the tissues.

4. Draw a line through your outline drawing of the organ (see the line in the example).
5. Draw a second drawing, showing one or two cells per tissue, touching the line. Use a higher magnification to see the details of the cells. This is shown in figure 2.
TITLE: LIQUID IN LIQUID DIFFUSION

Aim: To explain the behavior or methylene blue in water.

Materials/Apparatus:
Methylene blue, water, small beaker, dropper

Method:
Fill a small beaker with water. With the dropper, place one drop of methylene blue on the surface of the water. Note the changes observed in five minute intervals for 20 minutes. Record your observations in a table.

Observation:

<table>
<thead>
<tr>
<th>Time/minutes</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Discussion: Define diffusion. State the importance of diffusion to living organisms. Use your knowledge of diffusion to explain your observations. Discuss the limitations of this practical.

Conclusion: What process occurred?

Title: Solid in Liquid Diffusion

Aim: To observe solid in liquid diffusion

Materials and Apparatus:
Beaker, water, potassium permanganate crystals

Method:
Add two crystals of potassium permanganate to a beaker of water. Observe for twenty minutes.

Observations:
Write down what you observed in detail.

Discussion:
Explain what you saw?

Conclusion:
What can you conclude?
Title: Osmosis I

Aim: To observe osmosis in plant tissue

Materials/Apparatus: Potato, two deep Petri dishes, solutions A and B, scalpel

Method: Cut six pieces of plant tissue, 1 cm x 1 cm x 3 cm long. Make a note of the texture of the plant tissue. Place three pieces in a Petri dish containing solution A and three pieces in a Petri dish containing solution B. Leave for 20 minutes. In the mean time, draw a top view of the apparatus. Measure the length of the plant tissue and note any changes in texture.

Observations: Table showing changes in length and texture

Discussion: Define osmosis. Why is osmosis an important process in living organisms. What is a dilute solution? What is a concentrated solution? What is a semi-permeable membrane? Where is a semi-permeable membrane found in the cell. Explain your observations in terms of movement of water.

Conclusion: Which solution was concentrated and which was dilute?

Title: Osmosis II

Aim: To observe osmosis

Materials and Apparatus: Visking tubing, sucrose solution, capillary tube, beaker, clamp and stand, string.

Method: Tie the end of the Visking tubing securely. Fill it, almost to the top, with the sucrose solution. Tie the Visking tubing to the capillary tube so that the end of the tube is in the sucrose solution. Place the Visking tubing into a beaker of water, hold in place using a clamp and stand. Mark the level of the solution in the capillary tube. Measure the level of the liquid from this point every five minutes for twenty-five minutes. In between readings, draw the apparatus. Record your results in a table.

Observations: Table of results

Discussion: Define osmosis. Describe what occurred in the experiment in terms of water movement. Explain why this occurred.

Conclusion: What can you conclude?
**Title: Conditions necessary for photosynthesis - light**

**Aim:** To determine if light is necessary for photosynthesis

**Materials and Apparatus:**
Boiling tube, beaker, tripod, gauze, forceps, spatula, 2 watch glasses, iodine solution, alcohol, two green leaves (from a dicotyledonous plant), foil.

**Method:**
On a plant, cover a leaf with foil. Leave it for two days. Pick the covered leaf and an uncovered leaf. Boil both leaves for about five minutes in the beaker of water. Turn off the Bunsen burner. Remove the leaves and place them into the boiling tube and cover them with alcohol. Put the boiling tube into the beaker of hot water (do not turn back on the Bunsen burner). Allow the leaves to soak until they have lost most of their colour. Carefully remove the leaves from the alcohol and dip them into boiling water. Spread them on the watch glass and cover them with iodine solution.

**Observations:**
Make a large labelled drawing of the apparatus (when the boiling tube is in the water bath with the leaf).

Note the following:
1. the colour of the leaves at the beginning of the experiment;
2. the colour and texture of the leaves after having been immersed in alcohol and
3. the colour of the leaves after being soaked in iodine solution.

**Discussion:**
Define photosynthesis. Write a balanced equation for photosynthesis. What is the purpose of light in photosynthesis? Did both leaves contain starch? Explain how you know this. How does the presence of starch indicate that photosynthesis had occurred? Relate the presence of light to the production of starch using both leaves to explain your answer.

**Conclusion:**
From your results can you say that light is necessary for photosynthesis?

---

**Title: Conditions necessary for photosynthesis**

**Aim:** To determine if chlorophyll is necessary for photosynthesis.

**Materials and Apparatus:**
Boiling tube, beaker, tripod, gauze, forceps, spatula, 1 watch glass, iodine solution, alcohol, variegated leaf

**Method:**
Make a large drawing of the leaf. Indicate the different colours clearly. Boil the leaf for about five minutes in the beaker. Turn off the Bunsen burner. Remove the leaf and place it into the boiling tube, cover it with alcohol. Put the boiling tube into the beaker of hot water. Allow the leaf to soak until it has lost most of its colour. Remove the leaf from the alcohol and dip it into the hot water. Spread the leaf out on the watch glass and cover it with iodine solution. Make a large drawing of the leaf. Indicate the colours clearly.

**Observations:**
The drawing. Note the colours of the leaf before and after the starch test.
Discussion:
Define photosynthesis. Write a balanced equation for photosynthesis. Which part of the leaf contained starch? Explain how this indicates whether or not photosynthesis has taken place. What is the purpose of chlorophyll in the leaf. Relate it’s role to your results.

Conclusion:
From your results can you say that chlorophyll is necessary for photosynthesis?

**Title: Products of photosynthesis I**

**Aim:** To test a chive leaf for carbohydrates.

**Materials and Apparatus:**
Chive leaves, iodine solution, Benedict’s solution, sodium bicarbonate, dilute hydrochloric acid, test tubes, spatula, Bunsen burner, test tube holder, mortar and pestle.

**Method:**
Crush the chive leaves with a little water in the mortar, using a pestle. Carry out a starch test on a small amount of crushed leaves. Carry out a reducing sugar test and if necessary a non-reducing sugar test on fresh samples.

**Observations:**
Note the colour of the suspension before and after each test.

**Discussion/Conclusion:**
What carbohydrates were present in chive leaves? Give reasons for your answer.

**Title: Products of photosynthesis II**

**Aim:** To find out if a water plant gives off oxygen.

**Materials and Apparatus:**
Test tubes, beakers, funnels, pondweed.

**Method:**
Put the pondweed into two separate beakers of water. Cover the weed with an inverted funnel and test tube in each beaker, as shown below. Place one of the beakers in the light and the other in the dark. After a few days compare what has happened in the two cases. Test the gas in both test tubes with a glowing splint.

Diagram showing how apparatus was set up
Observations:
Describe what you saw after a few days. Describe the results of the oxygen test.

Discussion:
What are the products of photosynthesis? What gas was found to be present in the test tube from the plant in the light? Was this gas present in the test tube from the plant in the dark? What process must have occurred in the plant in the light? Why did it not occur in the dark?

Conclusion: What can you conclude?

Title: Leaf Structure

Aim: To compare two leaf specimens

Materials and Apparatus:
Specimens A and B, clear nail polish, microscope slide, cover slip, forceps, dropper.

Method:
Make a large labelled drawing of specimen A. Brush some nail polish on a small section of leaves A and B, on both sides. When it dries carefully peel off the polish and place it on a microscope slide along with a drop of water. Carefully lower a cover slip over it. Examine the slides under the microscope under a medium magnification. Count the number of stomata in view. Record the number of stomata on the upper and lower surfaces of the leaves in a table as well as the following: the size, shape, colour, margin and arrangement of veins.

Observations: Table of features observed in the leaf specimens.

Discussion/Conclusion:
What processes occur in a leaf? From your observations only, describe how the leaf is adapted for its function by stating the function of each part of the leaf you labelled with the general functions of the leaf.

Conclusion:
Are all leaves adapted for their functions in the same way?

SUMMARY OF FOOD TESTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>METHOD</th>
<th>POSITIVE COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td>Add 2 drops of iodine solution to sample</td>
<td>Blue-black</td>
</tr>
<tr>
<td>Reducing Sugar</td>
<td>Add 1 cm³ Benedict’s solution to sample and heat.</td>
<td>Yellow, orange or red</td>
</tr>
<tr>
<td>Non Reducing Sugar</td>
<td>Carry out a reducing sugar test first. If it comes out negative, get a fresh sample. Add 2 drops of hydrochloric acid to sample. Heat mixture, cool. Add small quantities of sodium hydrogen carbonate until the fizzing stops. Add 1 cm³ of Benedict’s solution to sample, heat mixture.</td>
<td>(Blue) Yellow, orange or red</td>
</tr>
<tr>
<td>Grease Spot</td>
<td>Rub sample on a piece of filter paper. Compare to a spot where water has been dropped and allowed to dry.</td>
<td>Translucent spot</td>
</tr>
<tr>
<td>Emulsion</td>
<td>Add 1 cm³ ethanol to sample, shake well. Pour into a test tube containing water.</td>
<td>White emulsion</td>
</tr>
<tr>
<td>Protein</td>
<td>Add 1 cm³ sodium hydroxide solution to sample; add a few drops of copper sulphate and shake.</td>
<td>Purple</td>
</tr>
</tbody>
</table>
Title: Food Tests

Aim: To carry out food tests on a starch test, sugar tests and a protein test on an unknown food sample.

Materials and Apparatus:
Unknown food sample, iodine solution, Benedict’s solution, sodium hydrogen carbonate, sodium hydroxide, copper sulphate solution, test tubes, test tube racks, two spatulas, Bunsen Burner, watch glass.

Method:
If necessary, cut the food sample up into smaller pieces. Test the sample for sugars, proteins and starch.

Observations:
Record your method and observations in a table as shown below.

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducing Sugar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-reducing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sugar (if necessary)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion/Conclusion: What types of food were present in the unknown food sample? What evidence did you have of this?

Title: Enzymes

Introduction
Catalase is an enzyme that occurs in the cells of many living organisms. Certain of the energy-releasing reactions in the cell produce hydrogen peroxide as an end product. This compound, which is toxic to the cell, is split into water and oxygen by the action of Catalase.

\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]
Catalase is found in potato.

Aim: To investigate the effect of temperature on enzyme activity.

Materials and Apparatus:
Potato, beaker of hot water, small beaker of ice, 4 250 ml beakers, 8 test tubes, 2 small measuring cylinders, labels, tripod stand, Bunsen burner, 2 thermometers, long spatula, matches, hydrogen peroxide

Method:
1. Set up water baths at 10 °C, 25 °C, 35 °C, 80 °C using the 4 beakers, ice, boiling water and cold water from the tap. Label the water baths.
2. Place 2 cm³ of accurately measured hydrogen peroxide in each of 4 test tubes.
3. Put one test tube containing a cube of potato and one test tube containing hydrogen peroxide into each water-bath. Leave for 10 minutes.
4. Check the temperature in each water-bath regularly and adjust if necessary.
5. At each temperature add the potato to the hydrogen peroxide and measure the height of the froth.
6. Record your results in your table.
Observations:

<table>
<thead>
<tr>
<th>Temperature/°C</th>
<th>Height of Froth/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

Discussion:
What are enzymes? What is their purpose in living organisms? Explain why temperature (low, optimal and high) affects enzyme reactions. How do you think the height of the foam is related to the rate of the enzyme reaction? What effect does the temperature have on the rate of reactions in the potatoes you used in the experiments? From your observations, at what temperature does catalase in potatoes work at best. Is this the temperature you expected? Explain your answer.

Conclusion:
What was the optimum temperature for this enzyme?

**TITLE: RESPIRATION DEMONSTRATION I**

**AIM:** To show that heat is produced in respiration.

**MATERIAL AND APPARATUS:** Vacuum flask, peas, cotton wool, thermometer

**METHOD:**
Soak some peas in water for a few hours. Boil half of the peas to kill them. Wash both sets of peas in dilute disinfectant to kill any bacteria and fungi on them. Put each set of peas into a vacuum flask. Note the temperature of each flask. Record the temperature of the peas for four more days.

**OBSERVATIONS:**
Record your results in a table. Draw a graph of your results with temperature on the y-axis and time on the x-axis.

**DISCUSSION:**
Define respiration. Write a balanced equation for respiration. Briefly describe the change in temperature (if any) observed in the live peas and dead peas. Explain these observations for both sets of peas. Explain any unexpected observations. Why is it important to kill any bacteria and fungi on the peas?

**CONCLUSION:** What can you conclude?

**TITLE: RESPIRATION – BREATHING RATE**

**AIM:** To investigate how the breathing rate changes with exercise.

**MATERIAL AND APPARATUS:** Stop watch

**METHOD:**
Sit quietly for two minutes. Count how many breaths you take in the next minute. Record it in your table. Wait one minute, in the next minute count the number of breaths again and record. Run in place or around the lab for exactly two minutes. As soon as you stop exercising count the number of breaths you take, that minute and every other minute until your breathing rate returns to normal. Calculate your recovery time by subtracting 6 from the time when your breathing rate returned to normal and add 1.
Example: If your breathing rate returned to normal at minute 8. Your recovery time is calculated as follows: \(8 - 6 + 1 = 3\) minutes.

In a table record the recovery rates of the entire class and the form of exercise of each student (if any). If a student does not exercise in any way write, ‘none’ for that student. Calculate the average recovery time for the class, showing all working.

**OBSERVATIONS:** Graph of breathing rate against time.

**Table showing the change of breathing rate during exercise**

<table>
<thead>
<tr>
<th>Time/minutes</th>
<th>Breathing Rate/Number of breaths per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st}</td>
<td></td>
</tr>
<tr>
<td>3\textsuperscript{rd}</td>
<td></td>
</tr>
<tr>
<td>6\textsuperscript{th}</td>
<td></td>
</tr>
<tr>
<td>8\textsuperscript{th}</td>
<td></td>
</tr>
<tr>
<td>10th</td>
<td></td>
</tr>
</tbody>
</table>

**Table showing the class results of recovery time**

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Recovery Time/minutes</th>
<th>Normal form of Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION:**
Define respiration. Write word equations for aerobic respiration and anaerobic respiration. What is anaerobic respiration used for in humans? What happened to your breathing rate as you began to exercise? Explain why. Why did your breathing rate not return to normal as soon as you stopped exercising? What was your recovery time? From the class results can you say that regular exercise affects the recovery rate? Explain the class results.

**CONCLUSION:** State how breathing rate changes with exercise.

**TITLE: Transpiration**

**Aim:** To compare the transpiration rate between normal lab and windy conditions

**Materials and Apparatus:** Potometer, stop watch, leafy shoot, fan

**Method:** Set up the apparatus under water. Smear Vaseline along the top of the rubber tubing. When the bubble reaches the beginning of the scale, measure the distance it travels every 5 minutes for 25 minutes. (If the speed is quick, the bubble may have to be reset to zero by opening the tap of the water reservoir). Reset the bubble to zero. Place a fan four feet from the leafy shoot. Take readings every 5 minutes for 25 minutes. While you wait for results make a labelled diagram of the apparatus (this should be in the method section). Record your observations in a table.

**Observations:** Table and Graph

<table>
<thead>
<tr>
<th>Time/minutes</th>
<th>Distance bubble travelled/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal Lab</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>
Draw a graph of distance bubble travelled against time, drawing best fit lines for both conditions on the same graph, include a key. Find the gradient of each line to determine the average rate of transpiration for each condition.

Discussion: Define transpiration. What is the importance of transpiration in plant? Describe how the potometer can be used to measure the rate of transpiration? List the factors which affect the rate of transpiration. Identify the factors which affected your observations and discuss how they affected the rates of transpiration you calculated from your observations.

**TITLE: STORAGE**

**AIM:** To examine several storage organs

**MATERIAL AND APPARATUS:** Iris potato, carrot, onion, ginger

**METHOD:** Make a large labelled drawings of the external views of all the storage organs. Draw a longitudinal section of the onion and carrot. In a table note the structures you observed for each storage organ (these would be the labels on your drawings).

**OBSERVATIONS:** Drawings. Table of structures observed for each organ.

**DISCUSSION:** What is translocation? ‘Leaves are considered sources and roots are considered sinks.’ Explain this statement with regards to translocation. Describe how the phloem sieve tubes are adapted for their functions.

Why are foods stored in plant? Why is plant storage important to humans? Include what nutrients are stored in each organ in your answer.

**CONCLUSION:** State what type of storage organ each specimen was.

**TITLE: EXCRETION – TESTING ‘URINE’**

**INTRODUCTION**

Three urine samples were mixed up in a lab. One comes each of the following patients: a patient with a kidney malfunction due to a physical injury; a diabetic and a healthy person. You must determine which sample belongs to which patient.

**AIM:** To test ‘urine’ samples for reducing sugars and proteins.

**MATERIAL AND APPARATUS:** Three samples of mock urine, Benedict’s solution, copper sulphate and sodium hydroxide, five test tubes, test tube holder Bunsen Burner

**METHOD:** Carry out a reducing sugar test and protein test on each sample. Record your results in a table.

**OBSERVATIONS:** Record your observations in a table as shown below.

<table>
<thead>
<tr>
<th>TEST</th>
<th>METHOD</th>
<th>SAMPLE</th>
<th>OBSERVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing Sugar</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION: Define excretion, homeostasis and osmoregulation. What is the function of the kidney. What is a nephron? Explain the terms ultra filtration and reabsorption as it relates to urine formation. Explain which samples belonged to which patient, based on your observations. You must address each test you did and give some back ground to the patient’s problem.

CONCLUSION: State which sample belonged to which patient.

PLANNING AND DESIGN WORKSHEET
In a planning and design experiment, you will use the scientific method to prove or disprove your hypothesis. It is often considered one of the more difficult practical skills because you have to design the method, choose the materials, apparatus, come up with limitations, etc. In the new CXC syllabuses, you will plan your experiment in Fourth Form and actually carry it out in Fifth Form.

TERMS TO LEARN
NB The example practical used was Investigating Photosynthesis - light

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>EXPLANATION</th>
<th>EXAMPLE –</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>An investigation in which one factor or condition is changed to see what effect this has on a particular process.</td>
<td>All other conditions are carefully controlled.</td>
<td>Investigating Photosynthesis – the need for light</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>A suggested explanation or a reason given for an observation</td>
<td>A good hypothesis deals with only one condition or variable, it can be tested, it relates directly to the observations made, it makes common sense.</td>
<td>Plants need light in order to photosynthesize.</td>
</tr>
<tr>
<td>Prediction</td>
<td>A forecast of what will happen if you take a particular course of action.</td>
<td></td>
<td>Leaves that have not been exposed to sunlight will have no starch.</td>
</tr>
<tr>
<td>Aim</td>
<td>A question for which you are seeking an answer, the reason for doing an investigation.</td>
<td>This must be directly related to the hypothesis.</td>
<td>To determine if plants need light to photosynthesize.</td>
</tr>
<tr>
<td>Variable</td>
<td>Any factor or environmental condition which can change during a process of investigation and by doing so affects the results</td>
<td>Only should only be investigating one variable at a time.</td>
<td>Light</td>
</tr>
<tr>
<td>Manipulated Variable</td>
<td>A variable which is changed in a controlled way.</td>
<td>In an experiment, the manipulated variable is the factor being investigated. The effect of changing it is observed.</td>
<td>The leaves covered in foil.</td>
</tr>
<tr>
<td>Control</td>
<td>A set of apparatus, materials and conditions exactly like those in the experimental set-up, except that the variable being investigated is not changed.</td>
<td></td>
<td>The leaves exposed to sunlight.</td>
</tr>
<tr>
<td>Limitation</td>
<td>Any factor or variable which you cannot control which might make your results less reliable.</td>
<td></td>
<td>The days you do the experiment it is overcasts.</td>
</tr>
</tbody>
</table>
The St. Michael School

CSEC Biology
Practicals

Data
- Information resulting from your investigations and are often quantitative – i.e. they can be measured.
- You have to decide what you need to observe or measure and if you need specialized equipment to do so.
- Observing the test for starch

HOW TO APPROACH PLANNING AND DESIGN EXPERIMENTS

1. Your teacher will give you an observation. List all the possible reasons for the observation.
   - Example Observations:
     Students going on a field trip noticed that the boys from the football team were able to walk for a longer time without getting tired while other students got tired more easily.

     Think about all the possible reasons why the football players had more stamina than the other boys. Did it have anything to do with diet, exercise, fitness levels?

2. Write a hypothesis for each of your reasons.
   - Let’s look back at our example and write a hypothesis.
     Football players eat better than other students.
     This statement deals with one condition – diet. It can be tested but it does not relate directly to the observation. Let’s try again.
     The food that football players eat gives them more stamina than students who do not play football.
     This hypothesis is still not good enough, food or diet must be included in talking about the students who do not play football.
     The food that football players eat gives them more stamina than students who do not eat these foods.
     This is testable, deals with only one condition, can be tested and relates back to the observation made.
     The right kind of food increases stamina.
     This statement is simple and fits all the criteria for a good hypothesis.

3. Write your aim for the experiment.
   - Aim: To determine if the right kind of foods increase stamina.

4. Plan your method. A good method includes: a list of materials and apparatus and how it will be used; the readings or observations to be taken; the number of treatments or trials; a control and precautions.
   - Example: Choose 20 sixteen year old boys, all approximately the same size and fitness level. Feed 10 of them a full breakfast and feed the other 10 a light breakfast, at the same time, in the same place. After one hour make students walk on a treadmill, note the time it takes each of the boys to get tired. All the boys should be wearing the same type of foot wear and clothing.
   - The apparatus and materials would include all of the foods in the breakfasts, a stopwatch. The control group would be the boys who eat the light breakfast. The precautions would be the fact that they were all the same age, ate at the same time and wore the same types of clothes.

5. Describe how you plan to display your results.
   - Example: A table showing a list of boys and the time it took for them to tire would work.

6. State what you will expect the results will be.
   - Example: It would be expected that the boys who ate a good breakfast would be able to walk longest without getting tired.

7. Write down any limitations.
   - Example: The temperature of the day, if it was hot boys might tire at similar times because of the heat, not diet or natural differences between the boys, perhaps some boys could walk longer on a light breakfast due to sheer determination.
PLANNING AND DESIGN FORMAT

Observation:

Hypothesis: A simple statement giving a proposed reason for the observation.

Aim: Based on your hypothesis

Materials and Apparatus: All the things required to test the hypothesis, include adequate quantities.

Method: To include the control and precautions, the method is to be written in present tense.

Presentation of Results: Show how the results will be presented but the table will be empty.

Expected Results: State in words what results you would expect if the hypothesis was correct.

Limitations: Any factors that would affected the results which you would have no control over

PLANNING AND DESIGN OBSERVATIONS

1. While digging the soil, a gardener notices that there are lots of earthworms in one pat of the garden but none in another part.
2. A house owner planted a row of poinsettias along his front fence. His house was built on a hillside and next to the fence was a streetlight. He noticed that the plants closer to the streetlight did not turn red at Christmas time, as he expected. The plants further away did turn red.
3. A farmer notices that grass was greener in areas of the field where animals have been tied for grazing.
4. When people want fruit to ripen quickly, the wrap them in paper and put them away in a cupboard.
5. A family which keeps cows, usually collect milk in the kitchen until someone has a chance to boil it and put it away in the fridge. Some days it stays out longer than others and the daily temperatures vary. They usually have not problems with spoiling. Occasionally, the milk goes bad for no apparent reason.
6. Some plants grow back faster than others after the dry season has ended.
7. Students going on a field trip noticed that the boys from the football team were able to walk for a longer time without getting tired while other students got tired more easily.
8. Potatoes in supermarket A have a longer shelf life than potatoes in supermarket B.