

# **BIOLOGY LABORATORY MANUAL**

**LABORATORY EXPERIMENTS  
& MARK SCHEMES APPROPRIATE FOR CSEC**



**COMPILED BY:  
THE BIOLOGY TEACHERS  
AND THE MINISTRY OF  
EDUCATION AND NATIONAL RECONCILIATION OF ST. VINCENT  
AND THE GRENADINES**

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## OVERVIEW OF THE LAB MANUAL DEVELOPMENT PROJECT

Recent CSEC SBA moderation reports revealed that teachers of Biology, Chemistry, Physics and Integrated Science continue to have challenges developing laboratory exercises and designing appropriate mark schemes.

In light of this, the Ministry of Education facilitated the development of moderator-approved lab manuals and mark schemes in each of the four disciplines aforementioned.

This project involved 27 science teachers from schools across St. Vincent and the Grenadines, divided into four panels representative of the four (4) subject areas: Biology, Chemistry, Physics and Integrated Science. Workshops and meetings were held with the science teachers over a period of two weeks to facilitate the development of these resources.

Following the development of these resources, each manual was then vetted by local CSEC moderators to approve the content and validate the resource as one which is suitable for use in CSEC SBA preparations. Use of these manuals is expected to:

1. Improve overall SBA performance in secondary schools.
2. Aid teachers in preparations for the CSEC moderation process.
3. Guarantee more favourable moderation reports in the future.

Teachers are encouraged to make use of this resource as they make preparations for future SBA moderation exercises.

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## INTRODUCING THE BIOLOGY LAB MANUAL

The purpose of this manual is to provide Biology teachers with a resource of reliable laboratory experiments and mark schemes suitable for use in SBA preparation. This manual was prepared by a panel of Vincentian Biology teachers and approved by local CSEC SBA moderators.

The 2019 Biology Panel Members are:

- ❖ Anya St. Jean
- ❖ Cherese Jack
- ❖ Makeisha Bobb
- ❖ Ronnel Rodney-Andrews
- ❖ Rowena King-Dasouza
- ❖ Sean Marshall

Moderator:

- ❖ John Renton

The resource contains forty-five laboratory experiments and sample mark schemes, as well as rules for drawing labs, tips for preserving specimens, and more. It is aligned with the current CSEC Biology syllabus and includes topics and skills as required for CSEC SBAs.

It is the hope of the panel that this resource will improve confidence in preparing for the moderation process, as we work collectively to improve Science education in SVG.

# Ecological Study

Contributed by C. Jack & M. Bobb

## Lab #1

Title: The water-holding capacity of soils

Aim: To investigate the water-holding capacity and drainage rate of clay, sandy and loam soil.

Materials and Apparatus: 4 (100ml) measuring cylinders, 3 beakers, 3 funnels, 3 filter papers, electronic scale, clock, spatula / spoons, water, dry sandy soil, dry clay soil, dry loam soil

Method:

1. Collect 3 -100 ml measuring cylinders and label sand, clay and loam.
2. Using an electronic scale place a beaker labeled sand on the platter and zero the balance.
3. Measure 50g of dry sand into this beaker.
4. Repeat steps 2 and 3 to measure 50g of clay and loam into beakers labeled clay and loam respectively.
5. Prepare the filter paper cone by folding in half, then folding in half again to produce a quarter circle. Separate one outer layer from the other three to create the cone as seen in diagram one below.
6. Place one cone in each funnel.
7. Put a funnel in each of the labeled measuring cylinders and carefully place each soil sample into the correct filter paper.
8. Measure 100 ml of water and slowly pour into each soil sample.
9. Leave to drain for 15 minutes.
10. Observe and note the relative drainage rate
11. Record volume of water collected in each measuring cylinder.
12. Calculate the water - holding capacity of each soil type.

Results:

**Diagram One**

Type of Soil	Volume of water poured into soil- V1 (ml)	Volume of water collected - V2 (ml)	Volume of water retained in soil- V3 (ml)	Water-holding Capacity (%)	Drainage Rate (slow, medium, fast)
Sandy	100				
Clay	100				
Loam	100				

Calculations:

$$V3 = V1 - V2$$

$$\text{Water - Holding Capacity} = V3/V1 \times 100$$

Discussion:

\* Not Assessed \*

Points to Discuss

1. What is water holding capacity?
2. Why is knowledge of the water-holding capacity of soil important?
3. Use the properties of each soil type to explain observations seen in table
  - i. Which soil type had the fastest / slowest drainage rate? Why?
  - ii. Which soil type retained the most water? Why?

**NB: Explain in terms of particle size and air spaces**

4. Based on their water-holding capacity which soil type is best for agriculture?

- Discuss precautions, sources of error or limitations where applicable (E.g. why were dry soil samples used?)

Conclusion:

Logical conclusion related to aim:

- Rank drainage rate of soil types
- What is the water holding capacity of the three soil types?

### SAMPLE MARK SCHEME

**Skill Assessed: MM**

CRITERIA	MARK
<b>Using measuring cylinder</b>	
Readings taken at eye level	1
Readings taken at bottom of meniscus (accurate reading)	2
<input type="checkbox"/> 100ml of water reading accurate	1
<input type="checkbox"/> Volume of water collected in measuring cylinder after draining	1
All liquid poured from cylinder	1
<b>Filter Paper</b>	
Correct folding of filter paper	1
Soil placed below the rim of filter paper	1
<b>Using the Scale</b>	
Clean the platter before weighing	1
Zero scale before adding beaker and before adding soil sample	1
Obtain accurate mass of sample (scale must read 50.0g)	1
Results are reasonable and accurate	1
<b>TOTAL</b>	<b>10</b>

Adapted and edited from: Lab Manual & Workbook for CSEC – Amy Heerman

## Lab #2

**Skill: Drawing**

**Title:** Comparing leaves

**Aim:** To draw and label a dicotyledonous leaf and to compare and contrast a dicotyledonous leaf and a grass leaf.

**Apparatus/Materials:** Dicotyledonous leaf (*name*), monocotyledonous leaf (grass leaf), ruler

**Method:** Draw and label a dicotyledonous leaf and compare and contrast with a grass leaf.

**Results:** List three similarities between the dicotyledonous leaf and the grass leaf, then draw a table to list 3 differences between them.

**Discussion:** What is a monocotyledonous plant? What is a dicotyledonous plant?

**Reflection:** What did I learn by doing this experiment? How can this experiment be improved?

**Conclusion:** Make relevant conclusions

### SAMPLE MARK SCHEME

#### Skill Assessed: DR

- Specified drawing present
- Lines even
- Lines continuous
- Drawing size adequate
- Different parts identified and labelled correctly
- At least 4 labels
- Title in caps
- Title accurate
- Magnification written beside the title
- Magnification calculated correctly

#### Lab #3                      Contributed by Ronnel Rodney-Andrews

TITLE: Classification

AIM:

1. To observe and describe organisms in the environment.
2. To classify organisms in the environment taxonomically up to class.

APPARATUS: Magnifying glass

METHOD:

1. Walk around the school compound for 15 minutes. Observe the different plants and animals.
2. Record the names and visible characteristics of ten living organisms (5 plants and 5 animals) in a table.

3. Construct another table to show the kingdom, phylum and class of each of the ten organisms observed.

Use the following link as a resource [Taxonomical classification of organisms, Taxonomical classification of Plants](#)

### OBSERVATION:

Tabulate observations.

### DISCUSSION:

- What is an organism?
- What is classification?
- What are some of the parameters that can be used when classifying organisms based on observable characteristics?
- What are the different ranks in the taxonomica; hierarchy?
- Analyze the first table and based on the observable characteristics place the animals in different groups (e.g. Colour, presence of wings, antennas, etc.). Do the same for the plants (e.g. Type of leaves, texture of leaves, height, etc.)
- Analyze the second table and identify the animals that belong to the same phylum and state what characteristics allow them to be in that phylum. Do the same for the plants. Repeat the same thing for Class

### CONCLUSION:

Summary of your discussion, mention a few of the main points from the discussion.

## **SAMPLE MARK SCHEME**

### Skill: ORR

1. Correct content under each heading. (1 mark)
2. Appropriate titles written above tables.
  - First table- A table showing the names of the living organisms and their observable characteristics. (1 mark)
  - Second table- A table showing the names of the living organism and the Kingdom, Phylum and Class that they belong to. (1 mark)
3. Titles written in capital letter and underlined (1 mark)
4. Correct headings in table.
  - First table should have Names of living organism and Observable characteristics (1mark)
  - Second table should have Names of living organisms, Kingdom, Phylum/Division and Class. (1 mark)
5. Correct content in tables.
  - First table- Description for 8-10 organisms given (2 marks)
  - Description for 5-7 organisms given (1 mark)

- Description for less than 5 organisms (no mark)
- Second table – 8-10 organisms correctly grouped taxonomically (2 marks)
- 5-7 organisms correctly grouped taxonomically (1 mark)
- Less than 5 organisms grouped taxonomically (no marks)

**Lab #4                      Contributed by Ronnel Rodney-Andrews**

TITLE: INTERDEPENDENCE AMONG ORGANISMS

AIM: To investigate the interdependence among living organisms.

APPARATUS: Magnifying glass

METHOD:

Walk around the school compound. Write down the names of 5 different organisms. Research the food source of each organism observed.. Using the information from the table, construct a food web and from the food web draw two food chains to show the organisms at different trophic levels.

OBSERVATIONS:

Table comes here.

DISCUSSION:

Include food web and food chains here and refer to them in the discussion. Define producers give example from among the list of organisms, do the same for herbivores, carnivores, explain how energy is passed on from each trophic level, use your food and state what can happen if one or more than one of the organisms becomes extinct or its population decreases

CONCLUSION: Relate to aim

**SAMPLE MARK SCHEME**

**Skill Assessed: ORR**

1. Logical sequence of lab report. (1 mark)
2. Correct content under each heading. (1 mark)
3. Table completely bordered. (1 mark)
6. Appropriate title written above table.  
A table showing the names of the living organisms and their food source. (1 mark)
7. Title written in capital letters (1 mark) and underlined. (1 mark)
8. Correct headings in table.  
i.e. "Names of organisms" and "Food Source". (1 mark)
9. Correct observations made and recorded:

- 7-10 organisms observed (2 marks)
- 5-6 organisms observed (1 mark)
- -Less than 5 organisms observed (0)

## Lab #5                      Contributed by Ronnel Rodney-Andrews

INTRODUCTION: In this lab students will be estimating the species density and frequency of plants found on or around the school compound using a quadrat. Teachers may choose any plant species found on or around their school compound. Place the students into small groups according to the number in class. Each group will correspond to a quadrat throw. They may have to do more than one throw, depending on how many groups there are). The different groups will share their information at the end. In doing this it will not take a long time to do ten throws.

TITLE: Estimating species density and species frequency

AIM:

To estimate the species density and species frequency of the Mimosa plant (*Mimosa pudica*) and the Sow thistle (*Sonchus oleraceus*) using a quadrat.

MATERIALS/ APPARATUS:

1m<sup>2</sup> quadrat lawn area where both plants species are located

METHOD:

Select a large area that has the two types of plants growing. Randomly throw the quadrat into the selected area.

Count the number of the different plant species that appear in the quadrat and record the count. Randomly throw the quadrat a total of ten times in the selected area and record the number of grass in each throw.

Calculate the species density and the species frequency of both types of grass. Use the information from your table to plot a bar graph showing the number of nut and bud grass in each quadrat throw.

RESULTS:

Table title comes here

Quadrat throws	Number of Mimosa Plant	Number of Sow thistle
1		
2		
3		
4		
5		
Total		

CALCULATIONS:

DISCUSSION:

Why is it important to sample living organisms, discuss sampling methods and different instruments use to capture organisms during a sampling exercise, why was a quadrat used in this lab, compare the species density and frequency of the two different species

PRECAUTION:

CONCLUSION:

**SAMPLE MARK SCHEME**

**Skill Assessed: ORR**

1. Table completely bordered. (1 mark)
2. Appropriate title written above table. (1 mark)
3. Title written in capital letter and underlined. (1 mark)
4. Correct headings in table. (1 mark)  
i.e. Number of quadrat throws, Number to Sow thistle, Number of Mimosa
5. Relevant changes recorded i.e. number of each species in each quadrat throw.  
- Correct total for Sow thistle (1 mark)  
-Correct total for Mimosa (1 mark)
6. Axes correctly labelled. (2 marks)
7. Correct scale. (1 mark)
8. Correct plotting (16-20 bars -4pts, 12-15- 3pts, 8-11 -2pts, 4-7 -1pt, below 4-0pt)
9. Correct Key (1 mark)

**Lab #6            Contributed by Sean Marshall**

Title: Organisms and their Environment (Field Work)

Aim: To observe organisms which inhabit the Mangrove Swamp at Prospect Salt Pond, in their natural habitat.

Apparatus: Magnifying glasses, Electronic or Simple Light Microscope, Slides, Cover Slips, Test Tubes/specimen jar, Small sweeping fish nets.

Procedure:

1. Using a teat pipette collect approximately 20cm<sup>3</sup> of swamp water, to be viewed under a microscope upon return to the lab.
2. Make general observations around the swamp to detect and name visible organisms. *(Teacher may provide keys, guide books or internet guides to assist students with identification of organisms).*
3. Carefully sweep fishnets through the water, to capture living organisms. Make and record relevant observations about the organisms through gathering samples or photographs. Ensure organisms are not harmed during the process. Take pictures of the results and record relevant information in a suitable table.
4. Observe the mangrove roots and soil directly surrounding them. Record all relevant observations.

Observations: Record in appropriate table

Discussion:

Conclusion: Relate to aim

**SAMPLE MARK SCHEME**

Skill Assessed: MM

Criteria	Mark/s Awarded
<b>Microscope</b>	
<b>Slides prepared properly</b>	1
<b>Started at low power</b>	1
<b>Slide centred</b>	1
<b>Coarse adjustment manipulated</b>	1
<b>Fine adjustment manipulated next</b>	1
<b>Objective lens switched to medium then high if necessary</b>	1
<b>Slides viewed before water sample</b>	

evaporated	1
Sweep net (fish net)	
Net swept randomly with numerous repetitions	1
Organisms observed and handled with utmost care	1
Gilled organisms returned to water within a suitable time frame.	1

## Cells

Contributed by M. Bobb

**Lab #7 (Should be used as practice lab for drawing but should not be submitted for moderation)**

Title: Cells

Aim: To make a slide of leaf cells

Apparatus/materials: microscope, a slide and cover slip, *Rhoeo discolor* leaves, scissors, dropping pipette, beaker, water

Method:

1. Take a single leaf from a piece of *Rhoeo discolor*.
2. Using a sharp scissors, cut off a tiny piece of the lower epidermis of the leaf (about 2mm) and place it onto a clean microscope slide.
3. Add a drop of water and a cover slip.
4. Remove any excess water from the slide with a tissue and place it on the stage of the microscope. Focus on the tissue under low power. Now switch to high power to study the cells in detail.
5. Draw and label a few cells.
6. Explain why the *Rhoeo discolor* cells contain chloroplasts but the onion cells do not.

Observations:

Discussion:

Sources of errors/limitations:

Conclusion:

## SAMPLE MARK SCHEME

### SKILL ASSESSED: DR

#### Clarity

- Clean continuous lines, no unnecessary details, no shading.....(1 mark)
- Reasonable size at least ½ page.....(1 mark)

#### Accuracy

- Faithfulness of reproduction.....(1 mark)
- Structures typical of specimen included.....(1 mark)
- Correct/reasonable proportions.....(1 mark)

#### Labelling

- Neat, straight lines, not crossing, no arrow heads, touching labelled structure.....(1 mark)
- Labels in script.....(1 mark)
- Labels accurate (annotations).....(1mark)
- Acceptable title.....(1mark)
- Magnification.....(1 mark)

TOTAL MARK.....**10 MARKS**

### Lab #8                      Contributed by Ronnel Rodney-Andrews

#### TITLE: PLANT CELL STRUCTURE

AIM: To observe and draw onion (plant) cells.

#### APPARATUS AND REAGENTS:

onion, knife, lamina, cover slip, iodine solution, microscope, forceps , white tile

METHOD: Slice an onion into two lengthwise and remove an inner fleshy leaf. Use forceps to pull away the thin lining from the inner surface of the leaf. Cut a very thin strip about 5mm from the sheath and place it on a lamina. Add a few drops of dilute iodine and cover the sample with a cover slip. Examine the sample under low power (x10) and then under a high power(x40) objective of a microscope. Draw, label and annotate a few onion cells seen under the microscope.

#### DRAWING:

#### DISCUSSION:

#### CONCLUSION

## SAMPLE MARK SCHEME

### Skill Assessed: MM

1. Mount the slide directly over the opening in the stage. (1 mark)
2. Turn the revolving nosepiece to the lower objective lens. Ensure that it clicks in place. Do not touch the lens with fingers. (1mark)
3. Adjust the mirror for adequate lightning. (1 mark)
4. Looking from the side of the microscope gently bring the objective lens to about 5mm above the slide using the coarse adjustment. Do not let the lens touch the slide. Look through the eyepiece and adjust the lens upwards until the specimen comes into clear view. Turn the fine adjustment for clarity. (1 mark)
5. View at a higher magnification by following steps 3-4 for the respective lens. (1 mark)
6. When moving microscope carry with both hands, one hand under the base and other on the arm (1 mark)
7. Make sure that the blank slide, cover slip and dropper that you are going to use are perfectly clean, dry and dust free. (1 mark)
8. Place the glass slide on a clean, dry surface. (1 mark)
9. Place specimen to be analyzed carefully on lamina. (1 mark)
10. Gently squeeze the dropper so that a single drop falls in the center of the microscope glass slide. (1 mark)
11. Accurately lower the cover slip on the drop. First, lower one of its edges and then the rest of it. Do not press down on the cover slip after you have placed it on the glass slide. (1 mark)

## Movement at Molecular Level

Contributed by M. Bobb & R. Dasouza

### Lab #9

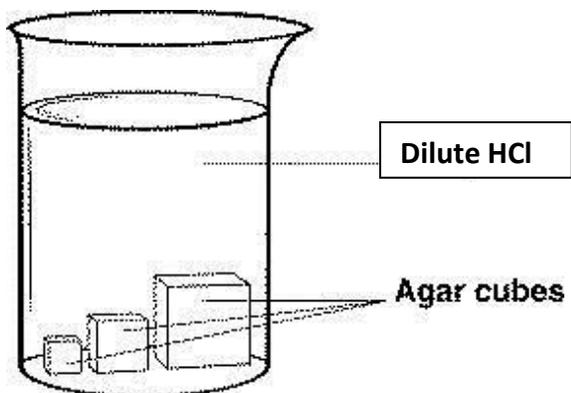
Title: Diffusion

Aim: To demonstrate diffusion in a jelly

Apparatus/materials: Petri dish containing a 2cm depth of agar jelly that has been dyed with potassium permanganate solution, a sharp scalpel and forceps, a tile or board(to use as chopping block), stopwatch/clock, 250cm<sup>3</sup> beaker, ruler, dilute hydrochloric acid.

Method: 1.Cut out some cubes of the agar jelly with the following side lengths: 2cm, 1cm, and 0.5cm.

2. Place about 100 cm<sup>3</sup> of dilute hydrochloric acid in the beaker.
3. At the same time, drop each of the cubes into the acid and note the time.



4. Record the time taken for each cube to turn completely colourless.
5. Write up this investigation. In your conclusion, explain the differences in the time taken for the cubes to turn colourless.
6. If the three cubes represent cells of different sizes, which cell would have the most difficulty obtaining substances by diffusion?

Results:

Comparison of Agar Cubes					
Cube Size	Surface Area (cm <sup>2</sup> )	Volume (cm <sup>3</sup> )	Ratio of Surface Area to Volume	Time (minutes)	Rate of Diffusion (mm/minute)
3 cm <sup>3</sup>					
2 cm <sup>3</sup>					
1 cm <sup>3</sup>					

Discussion:

Sources of errors/limitations:

Conclusion:

### SAMPLE MARK SCHEMES

**SKILLS ASSESSED: ORR & AI**

**ORR:**

- Logical sequence of report ..... (1 mark)
- Naming each section of the report..... (1 mark)

Language and expression:

- Past tense/passive voice..... (1 mark)

- Few/no grammatical errors..... (1 mark)
- Method clearly described with logical sequence..... (1 mark)
- Table title present in all caps and underlined..... (1 mark)
- Units present in the table..... ( 1 mark)

Calculations

- Treatment of results (answer and units)..... (3 marks)
- TOTAL MARK.....**10 MARKS**

**AI:**

- In terms of maximising diffusion, what was the most effective size cube that you tested?.....(1mark)
  - Why was that size most effective at maximising diffusion?...(1 mark)
  - What are the important factors that affect how materials diffuse into cells or tissues?.....(2marks)
  - If a large surface area is helpful to cells, why do cells not grow to be very large?....(1mark)
  - How does your body adapt surface area to volume ratio to help exchange gases?.....(2marks)
  - Why can't certain cells, like bacteria, get to be the size of a small fish?....(1 mark)
  - What are the advantages of large organisms being multicellular?....(2marks)
  - Define diffusion ..... (1 mark)
  - State why KMnO<sub>4</sub> agar cubes turned colourless.....(1 mark)
  - Give equation for the reaction with HCl +KMnO<sub>4</sub>.....(1mark)  

$$2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{KCl} + 2\text{MnCl}_2 + 8\text{H}_2\text{O} + 5\text{Cl}_2$$
  - Conclusions based on data and aim..... (1 mark)
  - Limitations ..... (1 mark)
- TOTAL MARK.....**15 MARKS**

## Lab #10

## Contributed by Ronnel Rodney-Andrews

**INTRODUCTION:** This lab can be used as a practice lab to reinforce different skills such as ORR, MM and AI.

**TITLE:** DIFFUSION

**AIM:** To determine how long it will take potassium permanganate to diffuse across a petri dish.

**APPARATUS:** petri dish, 10cm<sup>3</sup> water, printing paper, pencil and compass, potassium permanganate, stopwatch, measuring cylinder, straw, analytical balance

**METHOD:** Using a pencil and a compass draw four concentric circles, 1cm apart, on a piece of printing paper. Place the paper on a flat even surface and place the petri dish on the paper. Ensure that the centre of the petri dish coincides with the centre of the first circle. Place 0.2g potassium permanganate at the centre of the petri dish using the straw. Start the timer. Record the time taken for the colour of the potassium permanganate to reach each circle. Tabulate data and record all relevant observations.

**OBSERVATIONS:**

Record all relevant before and after observations.

**RESULTS:**

Insert table here.

**DISCUSSION:**

Give relevant background information; explain observations and results, including limitations/sources of error if necessary.

Considerations for the Discussion:

Include a definition of diffusion.

Include an explanation of the observations based on the movement of particles.

Include where the concentration of potassium permanganate was the highest and lowest.

Include the length of time taken for the particles to reach the outermost circle.

Teachers may also consider the following points for discussion in class:

- Predict the observations if the experiment was left for a longer time.
- How is diffusion important to living organisms?
- Discuss how the results of this lab pertain to the movement of substances into and out of the cells of single cell organisms and multicellular organisms.

**SOURCE OF ERROR:**

**CONCLUSION:**

## SAMPLE MARK SCHEME

### Skill Assessed: MM

#### Analytical Balance

1. Ensure that there is no draft near the balance. (1 mark)
2. Ensure that the surface of the balance is clean (1 mark)
3. Tare the balance. (1 mark)
4. Read mass correctly. (1 mark)
5. Pour the potassium permanganate carefully down the straw and remove straw gently from the petri dish. (1 mark)
6. Stop clock (*adjust mark scheme accordingly*)
6. Check for zero error. (1 mark)
7. Correctly operate the stop clock by pressing the appropriate knobs. (1 mark)
8. Read scale at eye level to avoid parallax. (1 mark)
9. Return digital/hands to zero after use. (1 mark)
10. Clean up area after experiment. (1 mark)

### Lab #11

### Contributed by Ronnel Rodney-Andrews

#### TITLE: OSMOSIS

AIM: To observe the effects of osmosis on potato chips.

APPARATUS: potato, ruler, knife, salt solution, tap water or distilled water

METHOD: Cut two potato chips of length 5.0cm, thickness 1.0cm and width 1.0cm. Place one in a liquid labelled A and the other in a liquid labelled B. Remove the chips at 5 minutes intervals for up to 30 minutes and measure their length. Record the measurements in a suitable table. Plot a graph to the length of the chip versus the time for both potato chips in liquid A and B.

RESULTS:

DISCUSSION:

SOURCE OF ERROR:

PRECAUTION:

CONCLUSION:

## SAMPLE MARK SCHEME

### SKILL -ORR

- a. Table completely bordered around drawn in pencil. (1 mark)
- b. Title written in capital letter and underlined. (1 mark)
- c. Correct headings in table with units. (1 mark)
- d. Relevant changes recorded (i.e. the correct lengths of the potato chips in the different solutions at 5 minute intervals for 30 minutes) (2 marks)
  - recording the length of the potato chips in the different solutions at 5 minutes intervals for 15 minutes (1 mark)
  - recording the length of potato chips in the different solutions for less than 15 minutes (no marks)
- e. Axes correctly labelled with correct units. (1 mark)
- f. Correct scales for axes. (1 mark)
- g. Correct plotting of the measurements for each chip in the different solutions. (3 mark)  
(11-14 pts correct-3, 7-11 2pts, 3-6 1pt, below 3 -0pts)
- h. Key to identify the different chips in the different solutions. (1 mark)
- i. Appropriate title of graph underneath of graph (1 mark)

### Lab #12

Title: Osmosis in Potato Cylinders

Aim: To investigate the effect of different concentrations on the mass and length of potato cylinders.

Apparatus: distilled water, sucrose solutions, digital balance, knife, ruler, scalpel, beaker, stopwatch, cork borer, measuring cylinder, potatoes, petri dishes and lids

Diagram:

Method: Peel the potato and use a cork borer to obtain six potato cylinders. Using a ruler and a small knife, trim each potato cylinder to measure 4 cm in length. Ensure the potato cylinders are cut evenly on all sides. Label 3 Petri dishes: distilled water, salt solution and sucrose solution. Place 30 cm<sup>3</sup> of distilled water into the Petri dish labeled "Distilled Water". Repeat this step for the other two conditions. Blot dry two potato cylinders and record observations of the texture. Place these in the Petri dish labelled "Distilled Water". Repeat this procedure with the other cylinders. Cover all Petri dishes and leave them undisturbed for 30 minutes. Remove the

cylinders from the distilled water, blot dry, measure and observe the texture. Repeat with all cylinders in all conditions. Plot a graph showing the length of the potato cylinders before and after the experiment.

Results: Place title in caps.

Condition	Texture and length of potato cylinders			
	Texture before immersion	Average length before immersion (cm)	Texture after 30 mins	Average Length after 30 mins (cm)
Distilled water				
Sucrose solution				
Salt solution				

\*Place graph in this section

Discussion: What is Osmosis?

Give a full explanation for the results of each condition used in the experiment.

In which condition was the greatest change noted? Explain why

Why is it necessary to peel the potato?

Why was the Petri dish covered?

Limitations: State at least two

Precautions: State at least two

Sources of error: State at least two

Reflection: What did you learn performing this experiment? How can you improve this experiment? How is this experiment relevant to you and to society?

Conclusion: Make valid conclusions from your results to answer your aim.

## SAMPLE MARK SCHEMES

### Skill Assessed: ORR

- Report in correct order (1)
- All parts present (1)
- Table neatly constructed (1)
- Table title accurate (1)
- Both length and texture of potato cylinders recorded (2)
  - Only length of potato cylinders recorded (1)
  - Only texture of potato cylinders recorded (1)
- Points plotted correctly (2)
- Scales acceptable (1)
- Graph neatly drawn (1)

Total 10 Marks

### Skill Assessed: AI

- Define Osmosis correctly (2)
- In which solution was the greatest change observed (1)
- Explain the reason for this change (1)
- In which solution was the least amount of changes observed (1)
- Explain the reason for this change(1)
- Explain why potato was peeled (1)
- Precaution/source of error/limitation (1)
- Reflection stated (1)
- Conclusion correctly related to aim (1)

**Total: 10 marks**

## Lab #13

Contributed by M. Bobb

Title: Osmosis

Aim: To investigate the effects of osmosis on potato tuber tissue

Apparatus/materials: potato, chopping board or tile, three boiling tubes, forceps, two small beakers, sharp knife or scalpel, ruler, a balance reading to 0.1 g, filter paper, concentrated (molar) sucrose solution, marker pen or wax pencil.

Method:

1. Half fill one boiling tube with tap water and a second with the sucrose solution. Leave the third empty. Label the tubes.
2. Cut chips of potato measuring 5cm × 1cm × 1cm, make these measurements as accurate as possible so that the three chips are the same size. You should be able to measure to ± 0.1mm. Make sure that no skin is left on the potato tissue.
3. Gently blot each chip to remove excess moisture and find the mass of each by weighing them on balance. Place one chip in each of the boiling tubes. Their masses will be slightly different, so make sure you know which is which- this is best recorded in a table. Leave them for 30 minutes.
4. Remove the chips using forceps and blot them gently, then re-weigh them.
5. Feel each chip in turn to compare how flexible or stiff they are. Note the differences.
6. Calculate the change in mass (+ or -) and the percentage change, from the equation:

$$\% \text{ change} = \text{Change in mass} / \text{Starting mass} \times 100$$

7. Record your results in a table like this:

Tube	Starting mass (g)	Final mass (g)	Change in mass (g)	% change	Condition(flexible/stiff )
Water					
Sucrose solution					
Nothing (air)					

8. Write up your investigation. In your conclusion, explain your results using your knowledge of osmosis. How large were the percentage changes in mass of the chips in the two liquids, compared with the one in air? Can you explain the final 'condition' of the chips, using terms such as 'flaccid' and 'turgid'? Can you think of any criticism of this experiment? For example, does using one chip per tube yield reliable evidence?

Discussion:

Sources of errors/limitations:

Conclusion:

## SAMPLE MARK SCHEMES

### SKILLS ASSESSED: AI & MM

#### AI

- Define osmosis.....(1mark)
- Importance of osmosis in plants.....(1mark)
- Importance of osmosis in animals.....(1mark)
- Correct explanation for changes in:
  - Water.....(1 mark)
  - Sucrose solution.....(1 mark)
  - Air.....(1 mark)
  - Sources of Error.....(2 marks)
  - Conclusions based on data..... (1 mark)
  - Conclusions based on aim.....(1 mark)
- TOTAL MARK..... **10 MARKS**

#### MM: (Ruler)

- All peel removed from strips..... (1mark)
- All three strips of equal dimensions..... (2 marks)
- Edges of strips straight to ensure accurate measurement..... (1 mark)
- Strips completely immersed in solutions..... (1 mark)
- All strips placed in dishes at the same time..... (1 mark)
- Ability to cut strips neatly to given dimensions..... (1 mark)
- Accurate measurement of strips.....(2 marks)
- Handling of apparatus and materials competently..... (1 mark)
- TOTAL MARK..... **10 MARKS**

### Lab #14 Contributed by Sean Marshall

Title: Osmosis in Potato Cups

Aim: To investigate osmosis in plant tissue

Apparatus/Materials: Petri-Dishes, Beakers, Measuring Cylinders, English Potatoes, Concentrated Salt Solution, Paper clips and Knives, Pure water.

Method:

1. Peel an English potato and cut it into halves.

2. Make “potato cups” out of each half by scooping out portions of each.
3. Then measure and add 20ml of pure water to two Petri dishes, labelling one Petri dish A and the other B in the process.
4. 4. To Petri dish A add an empty potato cup. To Petri dish B, add a potato cup half filled with a strong salt solution. Mark the level of the solution with an opened out paper clip.
5. Finally, leave the Petri dishes undisturbed for no less than four hours, before returning to make observations.

Observations: Say whether or not the level of the salt solution in the potato cup in petri dish B, rose above what was marked by the paperclip. Comment also on if the potato cup in petri dish A remained empty or not. **DO NOT MENTION HOW THE POTATO CUPS LOOKED OR FELT.**

Questions to assist with discussion:

1. What is osmosis and diffusion
2. What is the difference between the two processes?
3. In the experiment, what represents:
  - a) The selectively permeable membrane.
  - b) The solution of high water concentration
  - c) The solution of low water concentration
4. Explain your observations.

Sources of error:

Conclusion:

## SAMPLE MARK SCHEMES

### Skill Assessed: ORR

Criteria	Mark(s) Awarded
<b>Correct format (2)</b>  - All sections are included and in correct order (1) - Correct content under headings (1)	2
<b>Observations/ results (4)</b>  Relevant observations of petri-dish A (2): - Cavity remains empty (1) -Water level in petri-dish remains the same (1)  Relevant observations of petri-dish B (2): - Water level in the petri-dish (1) - Salt solution level in the potato cup after osmosis (1)	4
<b>Diagram of potato in petri-dish B set up</b>  - Diagram of apparatus neatly drawn (1) - Diagram of apparatus correctly labelled (1) - Diagram is annotated correctly (1) - Diagram appropriately titled (1)	4
<b>Total</b>	10

### Skill Assessed: AI

Criteria	Mark(s) Awarded
<b>Background Information</b>  - Osmosis Defined (1) - Diffusion Defined (1) - Difference between the two processes highlighted (1)	3
<b>Explanation of results</b>  1. Highlighting the semi-permeable membrane, area of high water concentration and area of low water (1)  2. Explain why there was no change in potato petri-dish A (1)	4

3. Explain why the solution increased above the level marked in petri-dish B (2) <ul style="list-style-type: none"> <li>- State that level of salt solution inside the potato increased (1)</li> <li>- Related this observation to the osmosis theory (1)</li> </ul>	
<b>Sources of error</b> - State one source of error	1
<b>Conclusion</b> - Relate to aim - State results in one sentence	2
Total	10

## Nutrition

### Lab #15

**Contributed by M. Bobb**

Title: Enzymes and Substrate Concentration

Aim: To find out the effect of substrate concentration on the activity of the enzyme catalase

Apparatus/materials: potato/papaya, mortar and pestle, large beaker, chopping board and knife, two 5cm<sup>3</sup> syringes, boiling tube, bung, 5% hydrogen peroxide solution, stopwatch or clock, ruler.

Method:

1. Cut the skin off a medium sized potato. Chop the potato/papaya into small pieces and then homogenise the tissue with an equal volume of distilled water with mortar and pestle.
2. Allow the solid potato/papaya debris to settle and remove the liquid layer above the debris.
3. Place 5cm<sup>3</sup> of the potato/papaya homogenate in a boiling tube.
4. Remove the bung and add 5cm<sup>3</sup> of 5% hydrogen peroxide solution to the potato/papaya homogenate. Quickly replace the bung.
5. Measure the height of froth produced in the first minute after adding the hydrogen peroxide.
6. Repeat the experiment using different concentrations of hydrogen peroxide of between 0.5 and 5%.
7. Plot a graph of the height of froth per minute against concentration of the hydrogen peroxide. Write up your experiment and explain your results.

Observations:

Concentration of hydrogen peroxide solution/%	Height of froth produced per minute/cm
0.5	
1	
2	
3	
5	

Discussion:

Sources of errors/limitations:

Conclusion: relate to aim

### SAMPLE MARK SCHEMES

#### SKILLS ASSESSED: ORR & AI

##### ORR

- Logical sequence of report ..... (1 mark)
- Naming each section of the report..... (1 mark)
- Language and expression:
  - Past tense/passive voice.....(1 mark)
  - Few/no grammatical errors..... (1 mark)
  - Method clearly described with logical sequence..... (1 mark)
  - Table title present in all caps and underlined..... (1 mark)
  - All apparatus/materials listed..... (1 mark)
  - Attention to kinds of data..... (1 mark)
  - Details of data (height of froth, size of bubbles, rate of production of bubbles..... (2 marks)
- TOTAL ..... **10 MARKS**

##### AI:

- Define enzyme.....(1 mark)
- What is the importance of catalase in living tissues?.....(1 mark)
- What is the substrate that catalase reacts with?.....( 1 mark)
- Based on your graph and overall shape what can you conclude about the effect of substrate concentration on reaction rate?.....( 1mark)
- Decomposition reaction equation of hydrogen peroxide?.....( 1mark)
- Explain what is meant by the 'lock and key theory'?.....( 1 mark)
- Deduce increasing substrate concentration after point of saturation does not affect reaction rate.....( 1 mark)
- Conclusions based on data and aim.....( 2 marks)
- Limitations/ precautions.....(1 mark)
- TOTAL ..... **10 MARKS**

**Lab #16      Contributed by M. Bobb**

Title: Food and Nutrition

Aim: To find the energy content of food (peanut)

Apparatus/materials: boiling tube, some peanuts, Bunsen burner and a heat proof mat, small measuring cylinder to measure 20cm<sup>3</sup> of water, thermometer, and mounted needle, balance accurate to at least 0.1g, stand, clamp and boss

Method:

1. Find the mass of the peanut.
2. Place 20cm<sup>3</sup> of water into a boiling tube.
3. Support the boiling tube in a clamp on a stand
4. Measure the temperature of the water
5. Spear a peanut on the end of a mounted needle.
6. Light the Bunsen burner and hold the peanut in the flame until it catches fire (this may take 30 seconds or so)
7. When the peanut is alight, hold it underneath the boiling tube of water so that the flame heats up the water.
8. If the nut stops burning, relight it in the Bunsen flame.
9. Continue until the peanut will no longer burn.
10. Measure the final temperature of the water (use the thermometer to stir the water gently to make sure the heat is evenly distributed).
11. Two facts are needed to allow you to calculate the energy content of the peanut:

- 4.2J of energy raises the temperature of 1g of water by 1<sup>o</sup>C.
- 1cm<sup>3</sup> of water has a mass of 1g.

$$\text{Energy (joules per gram)} = \frac{(\text{final temperature} - \text{temperature at start})}{\text{Mass of peanut (g)}} \quad \times 20 \times 4.2 \text{joules}$$

Discussion:

Sources of errors/limitations:

Conclusion:

**Precautions for peanut lab:** If there is a possibility that the experimenter may be allergic to peanuts alternative food samples may be used such as corn, lima beans or red kidney beans.

**SAMPLE MARK SCHEMES**

**SKILL ASSESSED: ORR & MM**

**ORR:**

- Logical sequencing of report..... ( 1mark)
- Sections named.....(1 mark)

- Any concise form of reporting.....(1 mark)
- Appropriate form of observation.....(1 mark)
- Physical quantities in heading.....(1 mark)
- Calculation of energy content.....(1 mark)
- Units present in heading.....(1 mark)
- Decimal points.....(1 mark)
- All apparatus/materials listed.....(1 mark)
- Table title present in all caps and underlined.....(1 mark)
- TOTAL MARK.....**10 MARKS**

**MM: (Thermometer and Bunsen burner)**

- Thermometer bulb immersed completely in water.....(1 mark)
- Stir thermometer in water before taking reading.....(1 mark)
- Do not let the bulb touch the glass ware .....(1 mark)
- Immerse bulb long enough for thermal equilibrium.....(1 mark)
- Take reading at eye level.....(1 mark)
- Accurately read and interpret scale.....(1 mark)
- Handle equipment and materials to ensure safety.....(1 mark)
- Organize work space/apparatus to ensure safety.....(1 mark)
- Closed airhole before lighting match.....(1 mark)
- Light match immediately before tuning on gas tap.....(1 mark)
- TOTAL MARK..... **10 MARKS**

**Contributed by Anya St. Jean**

**Lab #17**

Title: Enzymes

Aim: To investigate the effect of boiling on the activity of the enzyme catalase in plant and animal tissue.

Apparatus and Materials: 4 test tubes, test tube rack, dropper, 4 spatulas, mortar, pestle, mammalian liver (raw and boiled samples), Irish potato (raw and boiled samples), hydrogen peroxide, small beaker, splint, matches

Method:

1. Label test tubes A, B, C and D.
2. Crush liver samples separately using a mortar and pestle.
3. Add a spatula-full of raw liver to test tube A and a spatula-full of boiled liver to test tube B.

4. Add 6 drops of hydrogen peroxide to test tube A.
5. Carefully insert a glowing splint into test tube A.
6. Repeat steps 4 and 5 using test tube B.
7. Repeat steps 2 – 6 using potato samples and test tubes C and D.

Results: (Table form)

Discussion:

1. Define enzymes, including their characteristics.
2. Explain the results: effervescence/no effervescence and glowing splint/no glowing splint/ including equation.
3. Discuss the effect of boiling on enzyme activity.

Consider the following for in class discussion:

Describe reaction of catalase in the body, including optimum temperature and pH for catalase and equation.

Limitations:

Sources of error:

Precautions:

Conclusion: Give an answer to the aim.

## Sample Mark Scheme

**Skill Assessed: AI**

Definition (1mk)

3 characteristics listed (1mk)

Effect of boiling (1mk)

Effect of un-boiled material (1mk)

Explanation for effervescence/no effervescence (2mks)

Explanation for glowing splint/no glowing splint (2mks)

Limitation/precaution/source of error (1mk)

Conclusion related to aim and data (1mk)

# Photosynthesis

## Lab #18

Title: Photosynthesis

Aim: To find out if chlorophyll is needed for photosynthesis.

Apparatus/materials: suitable potted plants, large beaker, Bunsen burner, tripod and gauze, large beaker, water, iodine solution, forceps, ethanol, boiling tube, white tile or petri dish.

Method:

1. Set up a beaker of water on a tripod and gauze, and heat the water until it boils.
2. Remove a variegated leaf from the plant, and holding it with forceps, kill it by placing it in the boiling water for 30 seconds.
3. Turn off the Bunsen burner, place the leaf in a boiling tube containing ethanol and stand the boiling tube in a hot water bath. *The tube containing ethanol must not be heated directly, since ethanol is highly flammable.*
4. When the leaf has turned colourless or pale yellow, remove and wash with cold water to soften.
5. Spread the leaf out on a white tile or petri dish. Cover the leaf with a few drops of iodine solution and leave for a few minutes, noting any colour change.
6. Write up your experiments.

Observations:

Discussion:

Sources of errors/limitations:

Conclusion

## SAMPLE MARK SCHEMES

### SKILLS ASSESSED: AI & MM

#### AI:

- Definition of photosynthesis ..... (1 mark)
- What is the role of chlorophyll in photosynthesis?..... (2 marks)
- Explain results of tests of variegated .....(1 marks)  
- the variegated plant (2)
- State leaf was boiled to soften it ..... (1 mark)
- State leaf was boiled in alcohol to:  
- remove green colour..... (1mark)  
- to prepare for the Iodine test..... (1 mark)
- State green areas of leaf turned blue/black due to the presence of starch (2 marks)
- Errors/limitations.....(1 mark for any one)
- TOTAL MARK..... **10 MARKS**

**MM :( Bunsen burner)**

- Close air valves..... (1 mark)
- Light match immediately before turning gas on..... (1 mark)
- Slowly open the air hole to get a non-luminous flame..... (1 mark)
- Control flame height to provide a quiet flame..... (1 mark)
- Always attend to flame..... (1 mark)
- Extinguish flame by closing gas tap..... (1 mark)
- Handle equipment and materials correctly to ensure safety..... (1 mark)
- Organize work space/apparatus to ensure safety..... (1 mark)
- TOTAL MARK..... **8 MARKS**

## Respiration

**Contributed by Sean Marshall**

**Lab #19**

Topic: External Respiration

Aim: To determine the effects of exercise on breathing rate.

Apparatus: Stop watch

Method:

1. Allow a student to sit quietly for 2 minutes to ensure complete relaxation.
2. Then, count and record the number of breaths he or she takes for 1 minute.
3. Repeat step two every other minute until a total of four counts are acquired.
4. Then, allow the same student to do some vigorous exercise for 2 minutes.
5. Immediately following, count and record the number of breaths taken for a minute.
6. Repeat step five every other minute until the breath rate returns to normal. (Four counts)
7. Construct a graph of Breath Rate against Time Elapsed.

Results: *(Students should formulate their own title and include the table in the lab report)*

Before Exercise		After Exercise	
Time Elapsed/min	Breath Count/min	Time elapsed/min	Breath Count/min
1		1	
3		3	
5		5	
7		7	

Questions to assist with discussion

1. What is meant by external respiration and breath rate?
2. What is the average breath rate of a healthy human being?
3. What are some of the factors that can affect an individual's breath rate?
4. Explain the changes that occurred in the individual's breath rate during and after exercise.
5. Were there any unexpected results? If so give reasons why they may have been acquired.

Sources of error

Conclusion

### SAMPLE MARK SCHEMES

**Skill Assessed: ORR**

Criteria	Mark/s Awarded
Correct Format	1
<b>Language</b>	
Little or no grammatical errors	1
Method written in correct tense	1
Apparatus listed correctly	1
<b>Table 1</b> (Suitable title)	1
<b>Table 2</b> (Columns appropriately headed)	1
<b>Table 3</b> (Appropriate and accurate content)	1
<b>Graph 1</b> (Suitably titled)	1
<b>Graph 2</b> (Axes labeled correctly)	1
<b>Graph 3</b> (Scale and Key present and acceptable)	1
<b>Graph 4</b> (Accurate plotting of points)	2
<b>TOTAL</b>	_____ X 10 12

**Skill Assessed: A/I**

Criteria	Mark/s Awarded
<b>Background information</b> External Respiration defined Breath rate defined Some of the factors that affect breath rate highlighted	1 1 1
<b>Explanation of results</b> Thorough explanation as to why the breath rate increased during and after exercise. Thorough explanation as to why the breath rate eventually returns to normal with account given for any unexpected result.	2 2
<b>Mention of at least one source of error</b>	1
<b>Conclusion</b> (Based on aim and applicable)	2

**Lab #20**

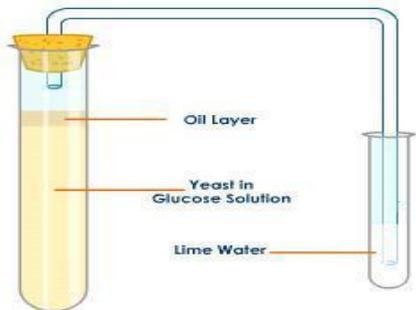
Title: Respiration

Aim: To determine the products of anaerobic respiration in yeast

Apparatus/materials: two boiling tubes, delivery tubes and bungs, some sugar (sucrose), some yeast, Bunsen burner and heat proof mat, some lime water or hydrogen carbonate indicator solution, glass stirring rod, some liquid paraffin, test tube holder, pipette

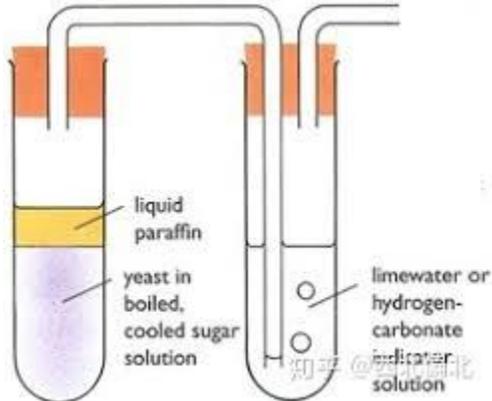
Method:

1. Carefully boil some water in a boiling tube to drive off any air that is dissolved in the water.
2. Dissolve a small amount of sugar in the boiled water and allow it to cool.
3. Add a little yeast and stir.
4. Set up apparatus as shown below. Carefully add a thin layer of liquid to the surface of the yeast/sugar mixture using a pipette.



Picture taken from PMG Biology

5. Set up a control apparatus exactly as shown below, but using boiled yeast.



Picture taken from IGCSE Biology 11 Respiration

6. Leave the apparatus in a warm place for one or two hours. Observe any changes in the indicator solution and record in the observations section.
7. Take the bung out of the tube containing the yeast and use a pipette to remove the layer of liquid paraffin. Gently sniff the contents of the tube. Can you smell alcohol?
8. Write up the experiment and explain the results.
9. Why is the yeast added to boiled water?
10. What is the function of the liquid paraffin?

Observations:

Discussion:

Sources of errors/limitations:

Conclusion:

## SAMPLE MARK SCHEMES

### SKILL ASSESSED: AI

#### AI:

- Definition of respiration..... (1 mark)
- What is anaerobic and aerobic respiration (1 mark each)?..... (2 marks)
- Why was the yeast added to boiled water? ..... (1mark)
- What is the function of the paraffin?.....(1 mark)
- Correct interpretation of results.....(4 marks)
  - Explanation of results in anaerobic respiration (2)
  - Explanation of results in aerobic respiration (2)
- Sources of errors/precautions/limitations.....(1 mark)
- Conclusions based on data.....(1 mark)
- Conclusions related to aim..... (1 mark)
- TOTAL MARK..... **12 MARKS**

### Lab #21      Contributed by Ronnel Rodney-Andrews

TITLE: RESPIRATORY SURFACE OF A FISH (D)

AIM: To observe, draw and annotate a fish gill.

APPARATUS: fish gill, magnifying glass

METHOD:

Use the magnifying glass to observe the features of the gill. Make a fully labelled and annotated drawing of the gill.

DRAWING

DISCUSSION

CONCLUSION

Marking scheme

- a. Large drawing.
  - covers half or more than half of the drawing paper (2 marks)
  - covers less than half of the paper (1 mark)
- b. Smooth, continuous lines. (2marks)
- c. Label lines are straight (1 mark), horizontal (1 mark)
- d. Accurate labels. (2 marks)

- All three labels correctly spelt and correctly placed (2 marks)
  - 2 labels correctly spelt and correctly placed (1 mark)
  - less than 2 labels correctly spelt and correctly placed (no mark)
- e. All labels on the right side, justified. (2 marks)
- f. Correct annotations of labels. (2 marks)
- All three labels correctly annotated (2 marks)
  - 2 labels correctly annotated (1 mark)
  - Less than 2 labels annotated (no mark)
- g. All labels on the right side, justified. (2 marks)
- h. Appropriate title below drawing. (2 marks)
- i. Title capital letters underlined. (2 marks)
- j. Correct view stated. (1 mark)
- k. Correct magnification to one decimal place. (1 mark)
- l. Drawing bears resemblance to original specimen (1 mark)

**Contributed by Anya St. Jean**

**Lab #22**

Title: Breathing

Aim: To investigate the effect of exercise on breathing rate.

Apparatus and Materials: stop clock, notebook, pencil, ruler, student A and student B

Method:

1. Allow student A to rest for 2 minutes to ensure complete relaxation.
2. Count the number of breaths taken by student A in 1 minute.
3. Repeat step 2 every other minute until 4 readings are obtained.
4. Allow student A to do some vigorous exercise for 2 minutes.
5. Immediately after exercise, count the number of breaths taken in 1 minute.
6. Repeat counts every other minute until 4 more readings are obtained.
7. Repeat the entire procedure for student B.
8. Record results in an appropriate table and plot graphs of number of breaths against time for both students.

Results: (table and graph)

Discussion:

1. Define the terms breathing and (internal) respiration.
2. What are the 2 types of respiration? State the difference between the 2.
3. Describe the students breathing rate before exercise? How does it change during exercise? And after exercise?
4. Describe the shape of the graphs for student A and B.
5. How does the breathing rate of student A compare to that of student B?
6. Why does the number of breaths remain the same during the relaxation period?
7. Why does the number of breaths taken increase during exercise?
8. Why does the breathing rate remain high just after exercise then decrease after?
9. State what type of respiration occurred before exercise and during exercise. Write an equation for respiration that occurred before exercise and during exercise.

Source of error:

Limitation:

Precaution:

Conclusion: Give an answer to the aim.

### SAMPLE MARK SCHEMES

**Skill Assessed: ORR**

Correct headings	1
Suitable readings	1
Table title:	1
Graph title:	1
Points plotted correctly <i>16 points plotted correctly = 2</i> <i>8-15 points plotted correctly = 1</i> <i>0-7 points plotted correctly = 0</i>	2
Axes labeled correctly	1
Appropriate scale used	1
Line graph drawn with ruler	1
Key given	1
<b>TOTAL</b>	<b>10 MARKS</b>

**Skill Assessed: AI**

Define breathing and respiration	1
Describe students' breathing before and after exercise	1
Describe graph	1
Compare breathing rate of student A and B	1
Explain why number of breaths remain the same during relaxation period	1
Explain why number of breaths increase during exercise	1
Explain why breathing rate remains high just after exercise then decreases after	1
Equation for anaerobic respiration	1
Limitation, Source of error, Precaution (any 1)	1
Conclusion	1
<b>TOTAL</b>	<b>10 MARKS</b>

## Transport

### Lab #23

Title: Transport in plants

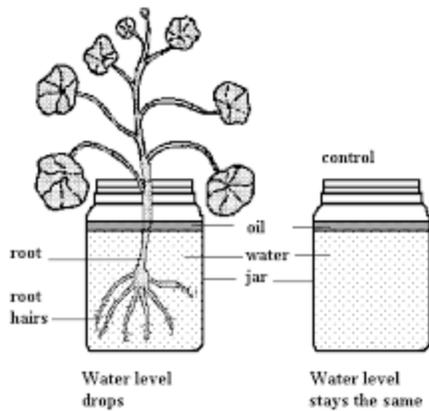
Aim: To determine how wind affects the rate of transpiration.

Apparatus/materials: a plant with roots, a conical flask nearly full of water, some oil, a balance, a fan, a clock.

Method:

1. Assemble the apparatus for a mass potometer as shown below:

9.195 Plants lose water



Picture taken from UN Biology 7

2. Weigh the whole apparatus and enter the mass in a table like this one.

	Mass of apparatus(g)	
	With fan	Without fan
Mass at start		
Mass at end		
Mass lost		

3. Leave the apparatus well away from the fan for 30 minutes.
4. Record the mass again.
5. Just before the apparatus is placed near the fan, weigh the apparatus again and record the mass.
6. Leave the apparatus for 30 minutes near the fan.
7. Record the mass again.
8. Calculate the transpiration rate as water loss in grams per minute.
9. Write up the experiment and explain the difference in transpiration rate under the two conditions.

Discussion:

Sources of errors/limitations:

Conclusion

**SAMPLE MARK SCHEMES**

**SKILL ASSESSED: ORR & MM**

**ORR:**

- Logical sequence of report ..... (1 mark)
- Naming each section of the report..... (1 mark)

Language and expression:

- Past tense/passive voice..... (1 mark)
- Few/no grammatical errors..... (1 mark)
- Method clearly described with logical sequence..... (1 mark)
- Table title present in all caps and underlined..... (1 mark)
- Units present in the table..... (1 mark)

Calculations

- Mass of water loss with fan.....(1 mark)
- Mass of water loss without fan..... (1 mark)
- Treatment of results answers/units..... (1 mark)
- TOTAL MARK..... **10 MARKS**

**MM: (Triple Beam balance)**

- Zero balance..... (1 mark)
- Place the object on the platform..... (1 mark)
- Slide the weight poises until pointer reaches zero again..... (1 mark)
- Start with the 2 heavier weight poises and then use the lightest one to do the tuning (1 mark for each order followed)..... (3 marks)
- Read the weight of the object accurately ..... (2 marks)  
-weight read partially correct (1)
- Handles equipment and materials correctly to ensure safety..... (1 mark)
- Arranges workspace/apparatus to ensure safety..... (1 mark)
- TOTAL MARK..... **10 MARKS**

## Excretion

Contributed by M. Bobb

**Lab #24**

**SUGGESTED SKILL: DR**

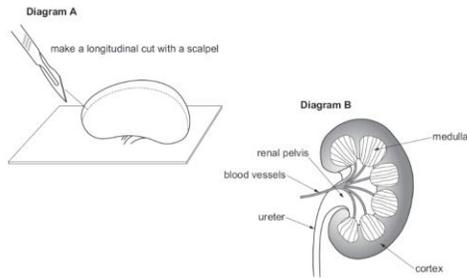
Title: Excretion

Aim: To dissect a kidney

Apparatus/materials: a lamb's or pig's kidney from the butcher, a dissecting board, a scalpel, forceps, seeker

Method:

1. Place the kidney flat on a board and cut through it longitudinally as shown below



Dissection of Mammalian Kidney <http://resource.download.wjec.co.uk.s3.amazonaws.com/vtc/2016-17/Eduqas%20roundup/Biology/teacher%20sheets/Dissection%20of%20mammalian%20kidney.pdf>

2. Remove the top half and examine the parts of the kidney. How many of the structures shown in the figure above that you can see?
3. Make a drawing of the kidney. Add a title, labels and annotations. Don't forget to include the magnification of your drawing.

### SAMPLE MARK SCHEME

#### SKILL ASSESSED: DR

##### Clarity

- Clean continuous lines, no unnecessary details, no shading ( 1 mark)
- Two dimensional (1 mark)

##### Accuracy

- Faithfulness of reproduction (1 mark)
- Structures typical of specimen included ( 1 mark)
- Correct/reasonable proportions (1 mark)
- View correctly stated (1 mark)

##### Labelling

- Neat, straight lines, not crossing, no arrow heads, touching labelled structure ( 1 mark)
- Labels accurate (annotations) (1mark)
- Title adequately stated (1mark)
- Magnification stated correctly (1 mark)
- TOTAL MARK (10 MARKS)

## Movement

Contributed by S. Marshall

Lab #25

Title: Locomotion (Support and Movement)

**Aim:** To draw and label a vertebral bone (Cervical, Thoracic, or Lumbar)

**Lab #26**

**Title:** Locomotion (Support and Movement) 2

**Aim:** To draw and label a long bone (**Femur, Humerus, Tibia or Fibula, etc.**)

**SAMPLE MARK SCHEME**

**Drawing**

<b>Criteria</b>	<b>Mark/s Awarded</b>
<b><u>Clarity</u></b>	
<b>No Shading</b>	1
<b>No unnecessary details</b>	1
<b><u>Accuracy</u></b>	
<b>Faithfulness of representation</b>	1
<b>Well-proportioned</b>	1
<b>No sketching</b>	1
<b>Labeling</b> (No crossing lines, On one side of drawing only, Written in print)	1
<b>Labeling accurate</b> (Transverse process, Centrum, superior articulating surface, etc.) - All ... labelled correctly (2) - More than two labelled correctly (1) - Four or more labelled incorrectly (0)	2
<b>Title</b> (Acceptably stated, in one case, written below the drawing)	1
<b>Magnification</b> (Acceptable, written just after title)	1
<b>TOTAL</b>	10

# Irritability

## Lab #27

Title: Sensitivity and Coordination 1

Aim: To investigate if insulation reduces the loss of heat from a hot 'body'

Apparatus/Materials: two 100cm<sup>3</sup> beakers or cans with lids- the lids must have a hole for a thermometer to fit through, hot water (a temperature of about 60-70 °C is hot enough), two thermometers, elastic bands, some cotton wool

Method:

1. Wrap cotton wool around one of the beakers to act as insulation. Secure it in place with elastic bands.
2. Place hot water in each of the beakers. The water should be at the same starting temperature in each beaker.
3. Place a lid on each beaker and insert thermometers through the holes in the lids.
4. Measure the starting temperature of the water in each beaker.
5. Record the temperature of the water at 1 minute intervals for 20 minutes.
6. Plot a graph of the temperature against time, using the same axes for both sets of results.
7. Write up your experiment and explain your results.
8. Is the apparatus a good 'model' of the effect of insulation in animals? Explain your answer.

Discussion:

Sources of errors/limitations:

Conclusion:

### SAMPLE MARK SCHEME

#### SKILL ASSESSED: ORR

**Title: Sensitivity and Coordination**

- Logical sequence of report ..... (1 mark)
- Naming each section of the report..... (1 mark)

Language and expression:

- Past tense/passive voice..... (1 mark)
- Few/ no grammatical errors..... (1 mark)
- Method clearly described with logical sequence.....: (1 mark)
- Table title present in all caps and underlined..... (1 mark)
- Units present in the table....., ( 1 mark)
- Physical quantities in heading..... (1 mark)
- All apparatus/materials listed.....(1 mark)

### Graph

- Graph title..... (1 mark)
- Labelled axes with units..... (2 marks)
- Scale/size..... (1 mark)
- Plotting points correctly..... (4 marks)
  - All points plotted correctly (4)
  - Only half points plotted correctly (2)
  - Less than half points plotted correctly (1)
  - Two or fewer points plotted correctly (0)
- Connecting points (line)..... (1 mark)
- TOTAL MARK..... **18 MARKS**

### Lab #28

Title: Sensitivity and Coordination 2

Aim: To test the effect of caffeine on the heart rate

Caffeine is present in coffee, tea and many types of cola. Design an investigation to test the hypothesis that drinking caffeine increases the pulse rate. You will need to measure the pulse rate of yourself and other volunteers before and after consuming drinks containing caffeine. Make sure that your plan contains proper controls, and include ways to ensure that your findings are reliable. When you have had your plan checked by your teacher, you may be allowed to carry out the investigation.

### SAMPLE MARK SCHEME

#### SKILL ASSESSED: PD

##### **Title: Sensitivity and coordination**

- Hypothesis acceptable (related to aim and testable)..... (2 marks)
  - Hypothesis related to the aim but not testable (1)
- Aim related to hypothesis..... (1 mark)
- Materials and apparatus listed..... (2 marks)
  - Two or more items missing (1)
- Method suitable..... (2 marks)
  - Method is logical but not correctly sequenced (1)

- Control included..... (1 mark)
- Expected result and interpretation stated..... (1 mark)
- Limitations noted..... (1 mark)
- Suitable format..... (1 mark)
- TOTAL MARK..... **10 MARKS**

## Growth

Contributed by Ronnel Rodney-Andrews

### Lab #29

TITLE: Tropism

AIM: To investigate the effect of gravity on the growth of roots and light on the growth of shoots of a germinating corn seed. (Any plants seed can be used)

APPARATUS: corn seeds, toilet paper, beaker, water

METHOD:

Pour about 2 cm<sup>3</sup> depth of water in a beaker, then line the beaker with the toilet paper. Place the seeds between the glass and the paper, ensuring that the seeds are not placed in the water. Leave the beakers where they will not be disturbed. Add water periodically. When the roots and the shoots of the corn seeds are about 3cm long, change the seedlings so that the roots and shoots are now in horizontal positions. Draw diagrams to show how the seeds are set up. After three days re-examine the seedlings and record your observations.

DRAWINGS

First drawing must be of the seedling in a vertical position

Second drawing will be the same as the first but the seedling will now be in a horizontal position

Third drawing will show what happened after the seedling was left for three days in the horizontal position

DISCUSSION

LIMITATION / SOURCE OF ERROR

CONCLUSION

State again here the trend observed in the lab.

## SAMPLE MARK SCHEME

### SKILL ASSESSED - AI

1. Background information stated (3 marks)
  - Explain geotropism, phototropism.
  - What is auxin-growth hormone in tips of shoots and roots which causes growth just behind the tips of shoots and roots.
2. Identifies patterns and trends- Eventually the roots grow downwards. - Eventually the shoots grow upwards (2 marks)
3. Explain observations: Why do the shoots respond positively to light? (1mark)  
Why do the roots respond positively to gravity? (1mark)
4. Source of error or Limitation (1 mark)
5. Appropriate conclusion- no matter what positions the roots and shoots are in initially they all end up growing towards water (downwards) and towards light source (upwards) respectively (2marks)

## Reproduction

### Lab #30

**Title:** Pride of Barbados Flower (*Caesalpinia pulcherrima*)

**Aim:** To draw and label a Pride of Barbados flower

**Apparatus/material:** Pride of Barbados flower, ruler

**Method:** Draw and annotate a pride of Barbados flower

**Results:** Drawing

**Discussion:** Is the pride of Barbados flower insect or wind pollinated? Give reasons for your answer.

**Reflection:** How is this experiment relevant to me and to society?

**Conclusion:** Summarize the experiment's finding and relate the findings to the aim

## SAMPLE MARK SCHEME

### Skill Assessed: DR

- Specified drawing present
- Lines even
- Lines continuous
- Drawing size adequate
- Labels written correctly
- At least 4 labels

- Title in caps
- Title accurate
- Magnification correctly written
- Magnification calculated correctly

**Lab #31**

**Title:** Fruit dispersal

**Aim:** To determine the method of dispersal of the various fruits in the lab

**Apparatus/ Materials:** 10 varying fruit specimen

**Method** Examine the fruits in the lab and determine the method of dispersal.

**Results:**

Table 1:

Specimen	Method of dispersal	Reason

**Discussion:** What is a fruit?

Why must fruits be dispersed far from the parent plant?

**Reflection:** What did you learn from this experiment? How is this experiment relevant to you and to society?

**Conclusion:** Make any valid conclusion

**SAMPLE MARK SCHEME**

**Skill Assessed: ORR**

- Report in correct order
- All parts present
- Table correctly constructed
- Table title accurate
- Dispersal type identified correctly (2)
  - Types only partially correct (1 only)

- Reasons given (2)  
-partial reasons given (1only)
- Conclusion linked to aim (1)
- Neat work (1)

## Genetics

Contributed by R. Dasouza

### Lab # 32

Title: Variation

Aim: To investigate continuous and discontinuous

Apparatus/ Materials: Measuring tape

Method:

Tongue rolling

Make a list of students in the class.

Students are told to roll their tongues

Make observations, record them in a table, and construct a **bar chart**.

Height

Measure the heights of the heights of the students in the class. Create a class interval-frequency table of the results.

Tabulate the results and plot a **histogram**

Results:

Table 1:

Student's name	Height/cm	Tongue rolling	Student's name	Height/cm	Tongue rolling

Table 2:

Class interval/cm	Frequency

### Discussion

Define variation

Define discontinuous variation. Refer to genes and the effect on the environment

Define continuous variation. Refer to genes and the effect on the environment

What kind of variation is shown by the height and tongue rolling data? Explain your answer.

Explain how variation arises in the population.

Give two precautions and state why they are necessary.

Give two sources of error and state why they would affect the results

Give 2 limitations

State how the experiment can be improved

**Reflection:** How is this experiment relevant to you and to society?

**Conclusion:** summarize results and make a conclusion

### SAMPLE MARK SCHEMES

**Skill Assessed: AI**

- Define variation (1 mk)
- Define discontinuous and continuous variation (2mks)
- Explanation of the type of variation shown by height and by tongue rolling (2mks)

- Discuss how variation may arise (2mks)
- Identify which trait shows continuous variation (1mk)
- Identify which trait showed discontinuous variation (1 mk)
- Explain why a bar graph was used to display the discontinuous trait and why a histogram was used to display the continuous trait. (2 mks)
- From the bar graph state the more abundant characteristic (1 mk)
- Precautions stated/limitation (1mk)
- Reflection stated (1mk)
- Conclusion related to aim and data (1mk)

**Skill Assessed: ORR**

- All tables constructed completely (1)
- Table titles appropriate and written correctly (1)
- Graphs have accurate titles(1)
- All points plotted correctly on graphs (3)
  - Up to 3 plotted incorrectly (2)
  - Up to 6 plotted incorrectly (1)
- Scales appropriate (correct and with units for each axis - 1 mark each) (2)
- Axis labelled for graphs (2)
  - Only one correct / both missing units (1)

**Lab #33**

Title: Genetics

Aim: To discover how the sex of an offspring can be determined

Apparatus/materials: large beakers, 75 Red beads, 25 Gold beads

Method: 1.Place 50 red beads in a container. In another container place, 25 red beads and 25 gold beads and mix thoroughly together. Place beakers side by side with two empty beakers clearly labeled A and B.

2. Close your eyes. Pick one bead from each of the first two beakers. If both beads are red put them into beaker A. If one is red and the other gold, put them into beaker B. Record your results in a table like the one shown, by putting a tick to show the combination of beads produced each time. Do this nine more times, making ten in all.

Observations:

Selection number	Both red	Red and gold
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Discussion:

Sources of errors/limitations:

Conclusion:

### SAMPLE MARK SCHEMES

#### SKILLS ASSESSED: ORR & AI

##### ORR:

- Logical sequencing of report..... ( 1mark)
- Sections named..... (2 marks)
- Any concise form of reporting..... (1 mark)
- Appropriate form of observation..... (1 mark)
- Physical quantities in heading.....(1 mark)
- All apparatus/materials listed.....(1 mark)
- Past tense/passive voice.....(1 mark)
- Few/ no grammatical errors.....(1 mark)
- Table title present in all caps and underlined.....(1 mark)
- TOTAL MARK..... **10 MARKS**

##### AI:

- Define meiosis.....(1 mark)
- state that gametes have a haploid number.....(1 mark)
- state the chromosomes that produce a female-XX and males-XY (2 marks)
- State the probability of having males/females is 50/50.....(1 mark)
- state that the red beads represent the X chromosome.....(1 mark)
- State that the gold bead represents the Y chromosome.....(1 mark)
- Sources of errors.....(1 mark)
- Precautions. ....(1 mark)
- Conclusion related to aim and based on data..... (1 mark)

- TOTAL MARK..... 10 MARKS

**Lab #34**

Title: Genetic variation

Aim: To investigate variation in humans

Apparatus/materials: metre rule, a 30cm rule, weighing scales

Method:

1. Record the height, maximum hand span of the right hand and body mass of all the students in your class and of as many other students in the same year group as possible.
2. Also note whether they are left-handed, right-handed or ambidextrous, their eye colour, and whether or not they can roll their tongue.
3. For the continuously variable features (height, hand span and body mass) divide the ranges into class intervals and record the numbers in each class interval.
4. Plot graphs showing the variation for all six features.

Discussion:

Sources of errors/limitations:

Conclusion:

**SAMPLE MARK SCHEMES**

**SKILL ASSESSED: ORR**

- Logical sequence of report ..... (1 mark)
- Naming each section of the report..... (1 mark)

Language and expression:

- Past tense/passive voice..... (1 mark)
- Few/no grammatical errors..... (1 mark)
- Method clearly described with logical sequence..... (1 mark)
- Table title present in all caps and underlined..... (1 mark)
- Units present in the table..... (1 mark)
- Correct Calculations ..... (1 mark)
- Partially correct (1)

Graph

- Graph title..... (1 mark)
- Equal bar width..... (1 mark)
- Scale/size..... (2 marks)
- Label axes ..... (1 mark)
- Bar height correct..... (1 mark)
- Neatness .....(1 mark)

TOTAL MARK..... 17 MARKS

**Lab #35 Contributed by Ronnel Rodney-Andrews**

TITLE: NATURAL SELECTION

AIM: To model natural selection

APPARATUS: 60 toothpicks (30 green, 30 red), area of green grass

METHOD: Close your eyes and throw the toothpicks onto the grass. Open your eyes and collect as many toothpicks as you can in 15 seconds. Count and record the number of each coloured toothpick that you pick up. Repeat the experiment using all the toothpicks four times. Calculate the average number of each colour toothpick that you collect.

RESULTS:

DISCUSSION:

Students these are some things to consider when writing your discussion. If your discussions sound as if it was prompted because you decide to answer the questions as they are given it will have to be redone. In addition to background information on natural selection the following should help with the explanation of your results.

1. Which colour toothpick was collected the most and why?
2. What does this tell you about the 'survival rate' of the red and green toothpicks?
3. Mention what factor of selection was dealt with in the experiment and what other factors would affect the survival of a population and red and green organisms.
4. If the toothpicks that survived the best bred and produced the same coloured offspring, how would this affect the population in the future?

CONCLUSION:

**Lab #36 Contributed by Ronnel Rodney-Andrews**

TITLE: VARIATION

AIM: To investigate continuous and discontinuous variation

METHOD: Ten students from the class survey ten students including themselves (this represents 10 groups). For each group you must record whether or not the members can roll their tongues. Observe the earlobes of each member to see whether or not they are attached or free. Also measure and record the length of the index finger on the left hand of each member. Gather and tabulate the information from the 10 groups. Draw bar charts for the features that show discontinuous variation and a histogram for the features that show continuous variation.

RESULTS:

Tables and graphs come here

DISCUSSION:

CONCLUSION:

Marking scheme

1. Appropriate titles written above table. (3 marks)
2. Titles written in capital letters and underlined. (3 marks)
3. Correct unit of measurements state in table. (1mark)
4. Correct content in each table. (3 marks)
5. Axes correctly labelled with correct units. (3marks)
6. Correct scales for axes (3 marks)
7. Correct plotting of bars.
8. Appropriate title of graph underneath of graph. (3 marks)
9. Title written in capital letters and underlined. (3marks)

## Planning and Design Labs

Below are samples of Planning and Design labs including a suggested Mark Scheme as stated in the CSEC Biology Syllabus (2015):

### PLANNING AND DESIGN MARK SCHEME

This mark scheme is to be used for the Investigative Project (PD) or modified (if necessary) to assess any other PD lab.

**TOTAL (10)**

**HYPOTHESIS (2)**

- Clearly stated 1
- Testable 1

**AIM (1)**

- Related to hypothesis 1

**MATERIALS AND APPARATUS (1)**

- Appropriate materials and apparatus 1

**METHOD 2**

- Suitable 1
- At least one manipulated or responding variable 1

**CONTROLLED VARIABLE (1)**

-Controlled variable stated 1

**EXPECTED RESULTS (2)**

- Reasonable 1

- Link with method 1

**ASSUMPTIONS/PRECAUTIONS/POSSIBLE SOURCES OF ERRORS (1)**

- Any one stated 1

**Lab #37**

**Title:** Anaerobic respiration of yeast and temperature

**Observation:** Mandy noticed that when her mom bakes using cold water she leaves the dough to rise for a longer time, compared to when she uses warm water.

**Hypothesis:** stated so that it's testable

**Aim:** appropriate to the hypothesis

**Apparatus/ material:** Include replicates

**Method:** Reasonable and logical sequence of activities. Do NOT write in past tense. Include the control variables, manipulated variables and responding variables

**Expected results:** Do NOT include actual results. State what you expect to happen. Include how you want the results to be displayed (e.g. tables, graphs, etc.)

**Limitations:** relevant to the topic

**Precautions:**

**Sources of error**

**Lab #38**

**Title:** Seed size and germination

**Observation:** Gretel noticed that some seeds for different plants are larger than others and told her friend Hansel that the larger seeds grow faster. Hansel did not agree and told her that small seeds grow faster.

**Hypothesis:** stated so that it's testable

**Aim:** appropriate to the hypothesis

**Apparatus/ material:** Include replicates

**Method:** Reasonable and logical sequence of activities. Do NOT write in past tense. Include the control variables, manipulated variables and responding variables

**Expected results:** Do NOT include actual results. State what you expect to happen. Include how you want the results to be displayed (e.g. tables, graphs, etc.)

**Limitations:** relevant to the topic

**Precautions:**

**Sources of error**

### Lab #39

**Title:** Pupil diameter and light intensity

**Observation:** Matthias was playing cricket and lost his sunglasses. Tristan noticed that Matthias' pupils looked very small on the field but in the locker room, the pupils were extremely large.

**Hypothesis:** stated so that it's testable

**Aim:** appropriate to the hypothesis

**Apparatus/ material:** Include replicates

**Method:** Reasonable and logical sequence of activities. Do NOT write in past tense. Include the control variables, manipulated variables and responding variables

**Expected results:** Do NOT include actual results. State what you expect to happen. Include how you want the results to be displayed (e.g. tables, graphs, etc.)

**Limitations:** relevant to the topic

**Precautions:**

## Sources of error

### Lab #40

**Title:** Minerals in water

**Observation:** George noticed that plants located closer to a mineral spring appeared healthier than plants further away from the spring.

**Hypothesis:** stated so that it's testable

**Aim:** appropriate to the hypothesis

**Apparatus/ material:** Include replicates

**Method:** Reasonable and logical sequence of activities. Do NOT write in past tense. Include the control variables, manipulated variables and responding variables

**Expected results:** Do NOT include actual results. State what you expect to happen. Include how you want the results to be displayed (e.g. tables, graphs, etc.)

**Limitations:** relevant to the topic

**Precautions:**

**Sources of error**

### Lab #41

**Title:** Sensitivity and coordination

**Aim:** To use a clinostat to show phototropism in shoots

Plan an investigation using clinostats to find out if the growing shoot of a plant responds to unidirectional light. State the hypothesis you will test, and explain how you will make sure that your experiment is controlled.

**Lab #42****SKILL: PD**

Title: Homeostasis and excretion

Aim: To test urine samples

In this experiment, you are provided with four samples of 'urine':

- The first sample is taken from a person with no medical problems.
- The second is from a patient suffering from diabetes, where glucose is present in the urine.
- The third is from a patient who has a kidney infection. She is excreting urine that contains protein.
- The fourth is from a patient who has an illness that results in the production of large volumes of very dilute urine.

The four samples have lost their original labels. Plan an investigation to find out which sample is from which patient. You should use suitable tests for organic substances (food tests) as well as observations, to decide which urine sample belongs to which patient. If your plan is suitable, you may be allowed to carry it out.

**Lab #43**

**Title: Plant growth**

**SKILL ASSESSED: PD**

Observation: Despite the high rate of growth in rainforests the soil in these forests is poor in nutrients. The nutrients have been washed out of the soil by heavy rainfall. In this project you are going to investigate how different kinds of fertilizer affect the rate of growth of plants.

**Lab #44 Contributed by Ronnel Rodney-Andrews**

Observation: The growth of plants is affected by their environment. Plan and design and experiment based on this observation.

*(List the factors that affect the growth of plants. Divide them into groups based on the number of students in the class and have them choose a factor around which their lab would be based.)*

**Skill Assessed: PD**

**Hypothesis (2 marks)**

- Clear (1 mark)
- Testable (1 mark)

**Aim related to hypothesis (1 mark)**

**Apparatus**

- All essential apparatus (1 mark)
- Essential apparatus missing (0 mark)

**Method**

- Suitable method in logical sequence using appropriate language and tense (3 marks)
- All steps written but no order, correct tense. (2 marks)
- Correct order, correct tense, and ONE step missing (2 marks)
- All steps written, no order, wrong tense (1 mark)
- Essential steps missing (0 marks)

**Variables (2 marks)**

- All essential variable states (2 marks)
- 1 variable missing (1 mark)
- More than one missing (0 mark)

**Expected Results (2 marks)**

- Reasonable (1 mark)
- Linked to method (1 mark)

**Limitation/Source of Error/Precaution (1 mark)**

- Any one stated

**Lab #45      Contributed by Ronnel Rodney-Andrews****OBSERVATION**

Martha's aunt uses white sugar to bake bread while her mother uses brown sugar. Each claims that their type of sugar is the better one to use for making bread light and fluffy. Which of Marth's relatives is correct?

HYPOTHESIS: Clear (1 mark)

Testable (1 mark)

AIM: Related to hypothesis (1 mark)

APPARATUS:

All essential apparatus (1 mark)

Essential apparatus missing (0 mark)

METHOD:

Suitable method in logical sequence using appropriate language and tense (3 marks)

All steps are written, correct tense is used but the order is incorrect. (2 marks)

Correct order, correct tense, and ONE step missing (2 marks)

All steps written, no order, wrong tense (1 mark)

Essential steps missing (0 marks)

VARIABLES:

All essential variable states (2 marks)

1 variable missing (1 mark)

More than one missing (0 mark)

EXPECTED RESULTS: (2 marks)

Reasonable and linked with method

LIMITATION/SOURCE OF ERROR/PRECAUTION (1 mark)

## APPENDIX

### List of Instruments

#### Science Equipment List

A science student has to work with various types of equipment while performing different experiments. This equipment list is the bare-bone basics that you would find in any laboratory:

1. Bunsen burner
2. Wire gauze
3. Tripod stand
4. White tile
5. Beaker
6. Measuring cylinder
7. Test tube/ boiling tube
8. Test tube rack
9. Test tube holder
10. Electronic scale
11. Mortar and pestle
12. Thermometer
13. Wire brush
14. Petri dish and cover
15. Corks
16. Rubber stoppers
17. Wash bottle
18. Funnel
19. Microscope
20. Microscope slides
21. Microscope cover slips
22. Volumetric flask and stopper
23. Stopwatch
24. Erlenmeyer/ conical flask
25. Beaker tongs
26. Scalpel
27. Magnifying glass/ hand lens
28. Dropper
29. Glass stirring rod
30. Retort stand

31. Spatula
32. Forceps
33. Tongs

## **Guidelines**

### **Drawings and Diagrams**

Whether you are doing a drawing or a diagram you have to follow certain basic rules:

- Use mechanical pencil (HB, 2HB, 2H) and a good eraser
- Make a faint outline of what you wish to illustrate
- Fill in the details of your illustration using clear continuous lines of even thickness
- Make your drawing as large as possible within the available space so you can show details accurately. Position your drawing so that you leave enough space for labels, annotations and titles
- Do not shade. To show additional details, you may:
  - leave a blank space
  - streak
  - stipple
  - cross hatch

### **Labels and Annotations**

Whenever you do a drawing or diagram you must label it. A label is simply a name.

Labels must be:

- written neatly in script against the label line and not on top of it
- accurate, specific and spelt correctly
- annotated when necessary to explain points of interest

### **Label lines must:**

- be horizontal where possible
- touch what they are supposed to show
- not cross each other or carry arrowheads or dots

Sometimes a label is not enough, and you must say much more or annotate it. A good annotation must:

- Be brief and informative
- Answer one or more of the following questions:
  - how does it look? (Details not shown in the drawing or diagram, e.g. the colour)
  - what does it do? (Its function or role, e.g. to attract animals for dispersal)
  - how does it work? (E.g. produces a high pressure causing filtration)
- Be written neatly, next to the label

## **Titles and Headings**

All drawings and diagrams must have a title. The title must be self-explanatory; it must say exactly what the illustration is supposed to show. A good title:

- Includes the view of the specimen
- Includes the name of the specimen
- Includes the magnification of the drawing
- Is written in capital letters and underlined and placed below the illustration

## **Magnification**

The magnification is shown below the drawing as 'X' (times) a number. The number indicates how much smaller or larger your drawing is, when compared to the actual specimen. E.g. MAG X4 means the drawing is 4 times bigger than the actual specimen. If your drawing is the same size as the specimen, its magnification is 'X1'

## **How to calculate the magnification**

Before you do your drawing:

1. Measure the maximum length and width of the specimen
2. Decide on a scale which will give a large enough drawing; leave space for your title, labels, and annotations
3. Multiply the measurements of the specimen and the scale. This will be the size of your drawing

For example:

Max. Length of specimen = 14 cm

Max. Width of specimen = 7 cm

Scale = x2 (You want a drawing twice the size of the specimen)

Max. Length of drawing =  $(14 \times 2) = 28$  cm

Max. Width of drawing =  $(7 \times 2) = 14$  cm

The magnification is x2 and your drawing is in proportion

## **Line Graphs**

These are used to show relationships between two factors. To produce a well-drawn line graph, follow these rules:

1. Draw the axes. The x-axis is the independent variable or what you are manipulating, and the y-axis is the dependent variable or what you want to find
2. Label the axes fully, e.g. temperature/, mass/, length/
3. Divide the axes into equal parts, using a proper scale, e.g. 1 cm = 1 unit, 2 units, 5 units, 10 units
4. Plot the points using symbols such as, dots in circles, small triangles, crosses
5. Join the points on the graph with straight lines
6. Give the graph a meaningful title in capital letters. Place the title at the top of the graph.
7. Sometimes you may need to put more than one set of results in the same graph. Using different symbols for each graph, with a key helps

## Tables

1. Give each column of your table a proper heading. If you are recording quantities, the units in which they are measured should be placed as part of the heading
2. Place the independent variable in the first column and the dependent in the second and subsequent columns
3. Do not leave spaces or put dashes in a table for measurements that were not taken. Instead record ND (no data), or if the value is zero, record '0'
4. Give the table a meaningful title in capital letters. Place the title above the table.

## Tips on How to Preserve Specimens

1. **Soft bodied organisms:** e.g. caterpillars and worms can be stored in ethanol in vials.
2. **Organs:**  
Organs must be placed in increasing concentrations of alcohol to dehydrate and prolong shelf-life. Once dehydrated, completely immerse the organ in methylated spirits in a jar for 4 to 5 days. After 4 to 5 days remove the specimen from the methylated spirits and completely immerse in ethanol (e.g. strong rum) for another 4 to 5 days. Then store in a glass jar with fresh ethanol. To prevent deterioration of the organ, replace the ethanol at least once a year.
3. **Insects:**  
Insects must be thawed and then pinned out. To prevent living insects from eating the specimen place moth balls around the pinning board. After one week of drying, store in an insect box.