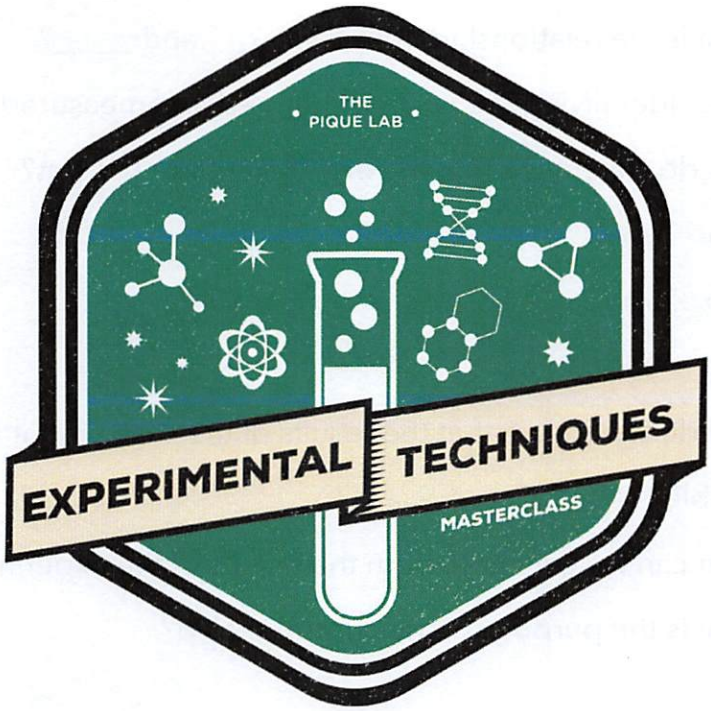
ThePiqueLab
learning centre



The Pique Lab Learning Centre

Primary School Science

Experimental Techniques Masterclass

Guide Booklet

Name: Teacher's Copy

Date: _____

COURSE COVERAGE

PART I: ENHANCING YOUR TOOLBOX

Question Trends For Experimental Type Questions

1. What is the aim of the experiment?
    a. Differentiating between "if" and "how"
2. What is the relationship between _____ and _____?
    a. Identifying the correct changed and measured variables
3. How do we ensure that the experiment is a fair test?
    a. Type 1
    b. Type 2
    c. Type 3
4. How do we ensure that the results of the experiment are reliable?
5. What can we conclude from the results of the experiment?
6. What is the purpose of the control set-up?

#1: AIM OF THE EXPERIMENT

TEMPLATE STRUCTURE

To find out [if / how] _____ [affects] _____.
(changed variable) (measured variable)

QUESTION #1

Sam carried out an experiment with fruit flies and three different brands of insecticides, S, T and U.

He carried out the following steps:

1. He sprayed an equal amount of insecticide into 3 similar glass tanks, one for each brand of insecticide.
2. Next, he put a batch of 30 adult fruit flies into each of the tanks.
3. Then, he covered the tanks for 20 minutes.
4. At the end of the 20 minutes, he counted the number of fruit flies that were still alive.

The table below shows the number of fruit flies alive at the end of each experiment.

Tank with Insecticide	Number of fruit flies still alive after 20 minutes
S	0
T	0
U	0

What was Sam trying to find out from his experiment?

ANSWER

Sam was trying to find out [how] the brand of insecticide [affects] the number of fruit flies still alive after 20 minutes.

#2: RELATIONSHIP TYPE QUESTION

IMPORTANT KEYWORDS

BETWEEN	AND

between ____ and ____

Variable 1 Variable 2

(V1) Changed / Independent Variable

(V2) Measured / Dependent Variable

METHOD 1

As the _____ increases / decreases,
(changed variable)

the _____ increases / decreases.
(measured variable)

METHOD 2

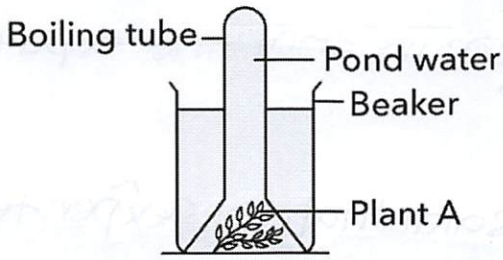
The CT1 the _____,
(changed variable)

the CT2 the _____.
(measured variable)

C.T. = Comparison Term E.g. Faster, slower

QUESTION #2

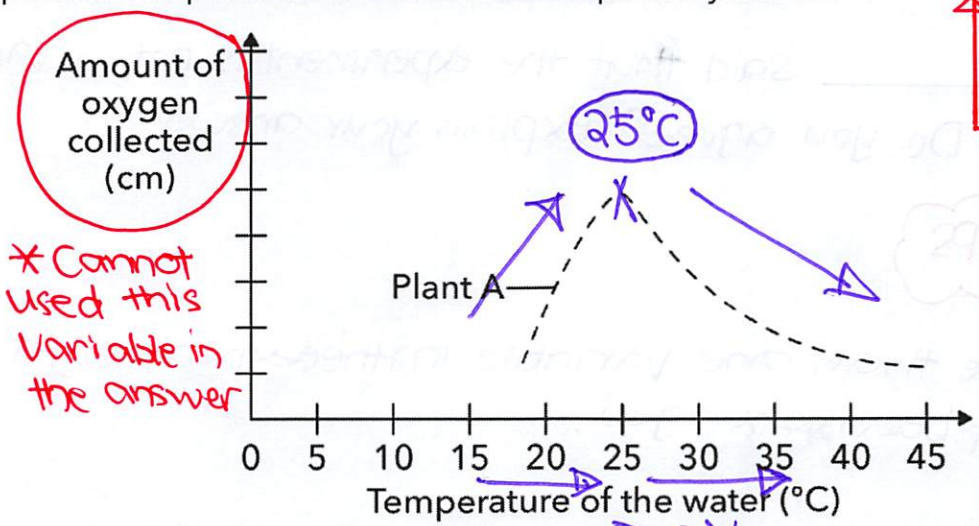
Cheryl carried out an experiment to find out **how** the temperature of water **affects** the rate at which plant A carried out photosynthesis.



She prepared similar set-ups as above by varying the temperature of pond water at 5°C intervals from 20°C to 40°C. She recorded the amount of oxygen collected in the boiling tube after 2 hours and plotted a graph to show the effect of the temperature of pond water on the rate of photosynthesis.

M.V.

C.V.



Describe the relationship between the temperature of the water and the rate of photosynthesis in plant A.

M.V.

ANSWER

As the increases until 25°C, the increases.

As the increases beyond 25°C, the decreases.

#3: HOW DO WE ENSURE A FAIR TEST?

TEMPLATE STRUCTURE

Type #1

Q: How do we ensure that the experiment is a fair test?

A: For an experiment to be a fair test, there can only be one changed variable, which is the _____ (changed variable). → "SHOW OFF"

Type #2

Q: _____ said that the experiment is not a fair test. Do you agree? Explain your answer.

3 STEPS

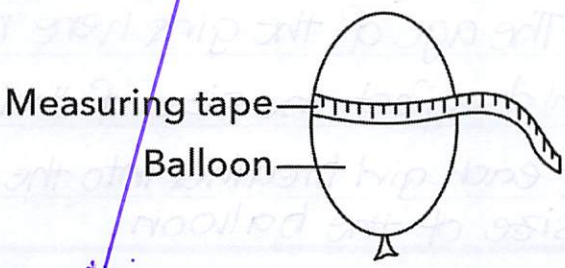
① More than one variable has been changed in the experiment.

② _____ (Extra Variable) was/were not kept the same

③ and this would _____ (Explain how the extra variable affects the results/measured V.)

QUESTION #3

Four girls wanted to find out if the mass of a person affects the amount of air she breathes out. Each of them then took a deep breath and blew into a balloon. Then, the balloon was secured with a rubber band to ensure that no air could escape. Next, the balloon was measured around its widest part to determine its size as shown in the diagram below.



Name	Age (years)	Mass (kg)	Number of breaths blown into the balloon	Size of balloon (cm)
Alicia	7	34	1	11
Brenda	9	52	1	9
Candice	11	45	1	12
Deborah	13	60	1	8

Their teacher said that the investigation is not a fair one. Why did she say that?

ANALYSIS

1. Identify the "Extra Variable" - Age of the girls
2. How does the "Extra Variable" mentioned above affect the "results of the experiment"?

(1) Age of the girls → affects → (2) size/capacity of the lungs → affects → (3) Amount of air each girl breathes out into the balloon

(4) Size of the balloon → affects

ANSWER

Their teacher said that the investigation is not a fair one. Why did she say that?

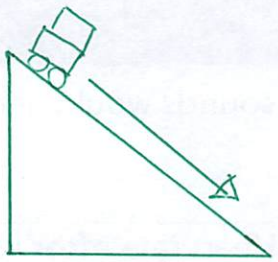
APPLYING THE FAIR TEST TYPE (2)

(1) More than one variable has been changed in the experiment. (2) The age of the girls were not kept the same (3) and this would affect the size of their lungs, affecting the amount of air each girl breathes into the balloon, affecting the size of the balloon.

TEMPLATE STRUCTURE

Type #3

Q: How does keeping the toy car (Variable A) the same ensure that the experiment is a fair test?



Changed Variable = Type of surface of the ramp.

measured Variable = Time taken for the toy car to reach the bottom of the ramp.

2 STEPS

① Keeping the toy car (Variable A) the same ensures that the mass of the toy car (Variable B) is also kept the same and would not affect the time taken for the toy car to reach the bottom of the ramp (measured variable / Results).

② Thus, there would only be one changed variable, which is the type of surface of the ramp (changed variable) that affects the results.

#4: HOW DO WE ENSURE THAT THE RESULTS ARE RELIABLE?

TEMPLATE STRUCTURE

For each _____ (changed variable), carry out the experiment 3 times and take the average _____ (measured variable) for a more reliable result.

QUESTION #4

James conducted an experiment to find out how loud sounds would affect his heart rate. He recorded his results as shown below.

	Normal heart rate **before** listening to loud sound (beats/min)	Heart rate **after** listening to loud sound (beats/min)
1st attempt	94	104
2nd attempt	96	108
3rd attempt	96	107

Why did James conduct the same experiment for three attempts?

ANSWER

For each loudness of the sound, carry out the experiment 3 times and take the average change in James's heart rate for a more reliable result.

#5: MAKING A CONCLUSION FROM THE RESULTS OF THE EXPERIMENT

TEMPLATE STRUCTURE

Method #1: Relationship

Changed Variable

As the [V1] ↑/↓,
the [V2] ↑/↓.

Measured Variable

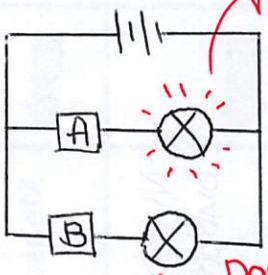
Changed Variable

The CT1 the [V1],
the CT2 the [V2].

Measured Variable

CT = Comparison Term

Method #2: State the property

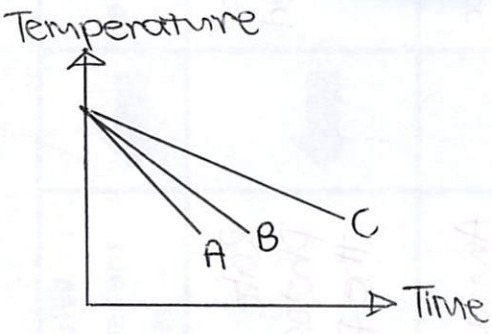


lights up.

Does not light up.

Material A is a conductor of electricity while material B is an insulator of electricity.

Method #3: Compare the property



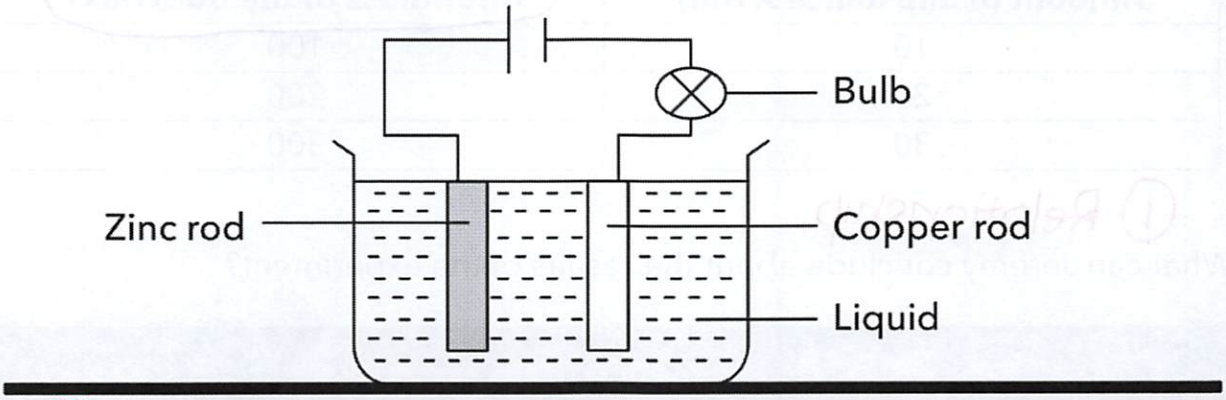
Material A is the best conductor of heat, followed by material B and then material C.

Changed variable	→	What does the changed variable represent?	→	Measured variable	→	What does the measured variable represent?
Distance between the light source and the submerged plant	→	Amount of light received by the plant.	→	Number of air bubbles produced	→	Rate of photosynthesis of the plant
Size of the wing-like structure of the seed.	→	Exposed surface area of the seed	→	Time taken for the seed to land.	→	Amount of air resistance acting on the seed.
Number of batteries used in the circuit	→	Amount of electric current flowing through the circuit.	→	Number of paper clips attracted to the electromagnet.	→	Magnetic strength of the electromagnet.

DIFFERENCE BETWEEN WHAT WE CAN OBSERVE VS WHAT WE CAN CONCLUDE	
Observation	**Conclusion**
~~SEE~~ 👀	Interpret from your observation

QUESTION #5A

Jeremy wanted to investigate the electrical conductivity of different types of liquids. He prepared 5 beakers containing different liquids and used a new set of copper and zinc rods for each liquid tested.



② State the property.

Conductor / Insulator

He then recorded his findings in the table below.

Liquids	Did the bulb light up?
Detergent	No
Copper Sulfate Solution	Yes
Salt Solution	Yes
Limewater	Yes
Milk	No

What conclusion can Jeremy make about the five liquids?

ANSWER

Detergent and milk are insulators of electricity while copper sulfate solution, salt solution and limewater are conductors of electricity.

QUESTION #5B

Jeremy conducted the similar experiment using the same set-up. He used detergent as the only liquid in the beaker. He added substance X in small amounts and recorded his observations in the table below.

electrical conductivity.

Amount of Substance X (ml)	Brightness of the Bulb (lux)
10	100
20	200
30	300

① Relationship.

What can Jeremy conclude about the results of the experiment?

ANSWER

As the amount of substance X added to the detergent increases, the electrical conductivity of the mixture increases.

#6: WHAT IS THE PURPOSE OF THE CONTROL SET-UP?

TEMPLATE STRUCTURE

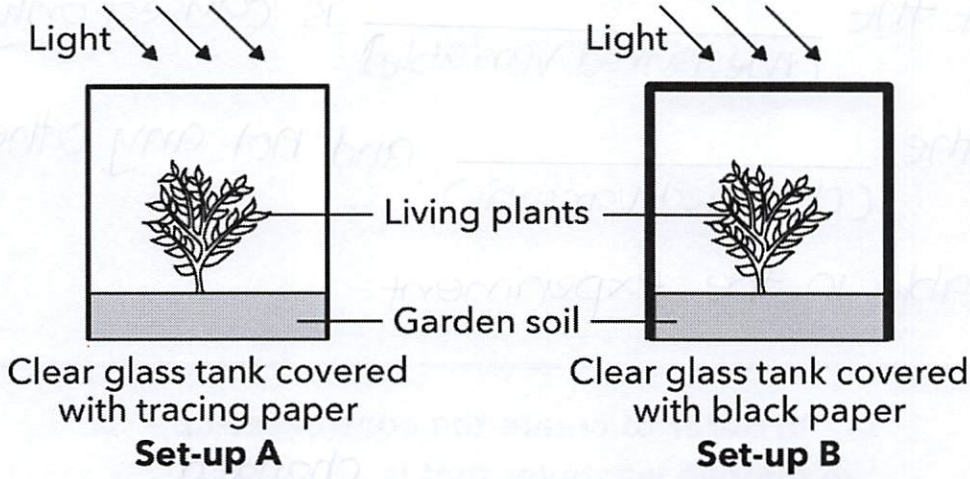
Set-up ? acts as a control set-up to ensure / compare / confirm / prove / show that the _____ (measured variable) is caused only by the _____ (changed variable) and not any other variable in the experiment.

***In order to create the control set-up, we remove whatever that is changed.**

QUESTION #6A

Cheryl wanted to investigate how the amount of light affects the rate of photosynthesis in plants and prepares three set-ups, A, B and C.

The diagram below shows set-ups A and B in a clear glass tank after the plants have been de-starched for 48 hours.



She has also prepared set-up C for the same experiment.

Tick (√) in the appropriate boxes below to show what Cheryl should use in Set-up C.

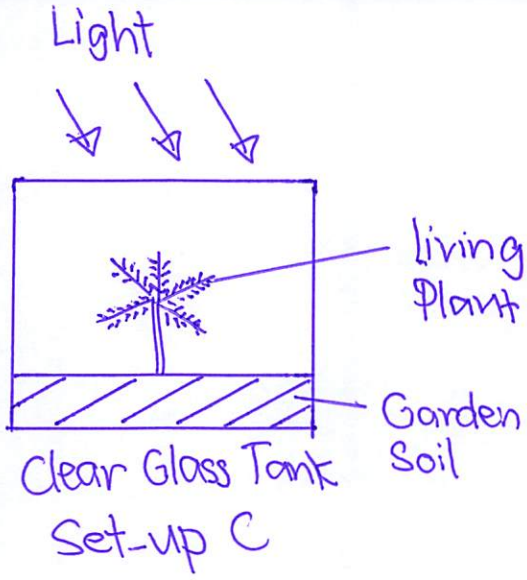
ANSWER

Items for Set-up C	Tick
Clear glass tank	✓
Tracing paper	
Black paper	
Living plants	✓
Garden soil	✓
Light	✓

QUESTION #6B

Draw Set-up C in the box provided below.

ANSWER



QUESTION #6C

What is the purpose for Set-up C in the experiment?

ANSWER

Set-up C acts as a control set-up to ensure that the rate of photosynthesis in plants is caused only by the amount of light received by the plants and not any other variable in the experiment.