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1. Biological Drawing STAMP'D

*1. **Size** : at least $\frac{2}{3}$ of the space

*2. **Title** : explanatory, underlined

*3. **Accuracy** : show all details

*4. **Magnification** : write at the bottom

*5. **Proportion** : accurate relative sizes

*6. **Drawing** : Sharp 2B pencil, clear continuous outline, no shading.

• **Label lines** : straight, ruled, don't cross, don't touch the drawing, ideally all on one side

• **Magnification** = size of drawing $\div$ actual size (x)

• **Actual size** = drawing $\div$ magnification



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2. Tables

- *1. IV in the **left** column → DV in the next column
- *2. units in the **heading only**, not in the body
- *3. Same d.p. throughout [Set by the instrument]
- *4. Group repeats together → then average
- *5. Draw the table **before** starting.

Variable:

- IV = factor you **change**
- DV = factor you **measure** [changes due to the IV]
- Constant = kept the **same** in each test.



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3. Precision

• Balance : $0.1g$ [1d.p.] or $0.01g$ [2d.p.] ;

copy the display completely

• Ruler : $0.1cm$

• Thermometer : $0.5^{\circ}C$

• stopwatch : $1s$ [or $0.1s/0.01s$ if the display shows it]

• measuring cylinder : $0.5cm^3$

• Syringe : $0.2cm^3$

• Burette : $0.05cm^3$

• calculations : the answer has the same s.f. as the least precise raw data

• units : density = $g\ cm^{-3}$ / rate = s^{-1}



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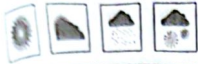
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4. Qualitative observations

- Universal indicator : "turned from green to red"
- Benedict's : "brick-red ppt formed"
- Limewater : "white ppt formed"
- Iodine : "remained brown" or "turned brown to blue-black"
- Leaf test : "originally green parts stained blue-black, originally white parts stained brown".

5. Graphs : ALPS

- *1. **Axes** : labelled with quantity + units
- *2. **Line** : smooth best-fit line or curve [equal points above & below]. No point-to-point joining, no extrapolation.
- *3. **Plotting** : neat crosses [x]
- *4. **Scale** : easy [1, 2, 5, 10 per square]. Never 3, 7, or 11. Covers at least $\frac{2}{3}$ of the grid.
- **IV** → x-axis • **Title** for the graph, if asked.
- **DV** → y-axis



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6. Food tests

• Starch [Iodine]

→ Drop of iodine onto the sample

→ brown → blue-black

• Reducing sugar [Benedict's]

1. 2cm^3 sample + 2cm^3 Benedict's

2. Shake

3. Boiling water bath

→ blue → green [little] → orange [moderate]

Brick-red ppt. [lots]

• Protein [Biuret]

1. 2cm^3 NaOH + 2cm^3 sample, shake

2. Add 1% CuSO_4 drop by drop, shaking each time

→ blue → violet.

• Fat [Ethanol emulsion]

1. 2cm^3 ethanol + sample, shake

2. Add 2cm^3 water, shake

→ white emulsion [absent = clear, colourless]



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7. Indicators

- Universal indicator

- Limewater : clear $\rightarrow$ white ppt [CO_2]

- Hydrogen carbonate indicator :

Highest CO_2 yellow $\rightarrow$ orange $\rightarrow$ red [atmospheric]

Purple [lowest] $\leftarrow$ magenta

- cobalt chloride paper : blue $\rightarrow$ pink [water present]

8. Planning : Checklist

1. **IV** : what you change, with the range of values

2. **DV** : what you measure & how [apparatus, units]

3. **constant** : list them & say how each is kept

constant

4. **Numbered steps** : clear & precise

5. **Reliability** : repeat $\rightarrow$ average

6. **control** : set-up with no IV [e.g. boiled enzyme]

7. **Analysis / conclusion** : say how to read the

results

8. **Safety** : risk $\rightarrow$ precaution



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9. Sources of error

A. General [Any Experience]

1. Time lapse

'Error: There was a time lapse between taking the samples & adding iodine / reading the volume / reading the length

'Effect: The reaction continued for longer than intended, so the readings obtained were different from the expected values.

'Improvement: stagger the start times of the set-ups so that each is tested for the same duration.



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2. Subjective colour judging

- Error: It was difficult to judge the exact colour change
- Effect: The time taken recorded may be longer or shorter than expected.
- Improvement: use a colourimeter connected to a data logger to detect the colour change objectively.

3. Small sample size

- Error: only a small number of samples was used.
- Effect: The results are not representative of the whole population.
- Improvement: Increase the sample size & calculate the average.

4. Instrument not precise

• Error: The instrument was not precise enough to measure small volumes.

• Effect: The measurement recorded may be higher or lower than expected.

• Improvement: Use a more precise instrument, such as burette.

5. Wide range of values

• Error: A wide range of temperature / pH / concentration used.

• Effect: The relationship between the variables cannot be accurately observed.

• Improvement: Use a narrower range & carry out the experiment at more frequent intervals.



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B. Enzymes [catalase / Amylase]

6. Different potato plants

- Error: The potato specimens came from different potato plants.
- Effect: A different amount of catalase was present in the cells, so more or less oxygen was produced & the number of bubbles was higher or lower than expected.
- Improvement: use the same potato tuber for all set-ups

7. Slices stuck together

- Error: The potato slices stuck to each other.
- Effect: The surface area exposed to hydrogen peroxide decreased, so less oxygen was produced & fewer bubbles were counted than expected.
- Improvement: Use one slice of potato, repeat the experiment with a second slice & calculate the average number of bubbles.

8. Slices trapped in froth

- Error: The potato slices were trapped in the froth.
- Effect: The slices took up space, so the height of froth measured was higher than expected.
- Improvement: Use one slice, repeat the experiment & calculate the average height of froth.



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9. Bubbles too fast to count

- Error: The oxygen bubbles were produced too fast to be counted accurately
- Effect: Fewer bubbles than expected were recorded.
- Improvement: Repeat the experiment & calculate the average, or collect the O_2 with a gas syringe.

10. Bubble size varies

- Error: The size of the bubbles produced varied.
- Effect: The height of froth measured may be higher or lower than expected
- Improvement: Repeat the experiment a few times & calculate the average height of froth to increase reliability.



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11. Reaction too fast to time

- Error: The reaction was too fast to determine the end point accurately.

- Effect: The time taken recorded may be shorter or longer than expected.

- Improvement: use less enzyme / substrate to slow the reaction so the time taken to reach the end-point increases.



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C. Osmosis

12. Evaporation of solution

• Error: water evaporated from the salt/sucrose solution.

• Effect: The concentration of the solution increased & its water potential decreased, so more water left the potato by osmosis & the potato became shorter than expected.

• Improvement: cover the petri dish with a lid to prevent evaporation.

13. Water on the surface

- Error: Different volumes of water adhered to the surface of the visking tubing / potato
- Effect: The mass or volume recorded was higher or lower than expected
- Improvement: Blot the surface dry in the same way for every set-up before measuring.

14. Slices from different fruits

- Error: The slices came from different fruits
- Effect: The cell sap had different starting water potentials, so the comparison was not reliable.
- Improvement: cut all the slices from the same fruit.



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D. Respiration / Gas Experiments

15. Gas dissolves in limewater

• Error: Different volumes of gas dissolved in the limewater.

• Effect: A smaller volume of gas was measured than expected.

• Improvement: collect the gas using a gas syringe.

16. Yeast lacks oxygen

• Error: There was insufficient oxygen for the yeast.

• Effect: Anaerobic respiration occurred, so the rate of reaction was slower and the time taken was longer than expected.

• Improvement: stir the mixture to allow aeration.



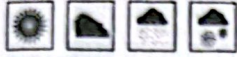
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17. Capillary tube shifts

- Error : The liquid level in the capillary tube changed when the apparatus was moved.
- Effect: The readings obtained were inaccurate
- Improvement: clamp the apparatus more tightly.



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E. Photosynthesis

18. Lamp heats the set-up

• Error: The heat from the lamp causes the

temperature of the set-up to rise.

• Effect: The rate of reaction increased, so the

time taken for decolourisation was

shorter than expected.

• Improvement: Carry out the experiment in a

thermostatically controlled water

bath.



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F. Heat experiments

19. Food not completely burnt

• Error: The food sample was not completely burnt

• Effect: The change in temperature was lower than expected, so the calculated energy value was lower than expected.

• Improvement: Ensure the sample burns completely before measuring the final temperature.

20. Heat loss to surroundings

• Error: Heat was lost to the surrounding

• Effect: The change in temperature was lower than expected, so the calculated energy value was lower than expected.

• Improvement: Use a draught shield / lid to reduce heat loss.



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21. Homeostasis set-up

- Error: Heat was lost to the surrounding
- Effect: The change in temperature was higher or lower than expected.
- Improvement: use polystyrene cups for insulation.

G. Floating Tissue Discs

22. Different tissue lengths

- Error: The potato tissues were of different lengths
- Effect: Longer tissues had a shorter distance to travel, so the time taken to float was shorter than expected.
- Improvement: use a taller container so the difference in length becomes insignificant, or measure the volume of oxygen using a gas syringe.