Lesson activity: GCSE to A-level progression (Biology) answer booklet

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Contents	Page
Transition activities 1-3 Scientific vocabulary	3-4
Transition activity 4 SI units and prefixes	5
Transition activity 5 Units	5
Transition activity 6 Converting units	5
Transition activity 7 Investigating enzymes	6-7
Transition activity 8 Mean, media, mode and scatter graphs	8
Transition activity 9 Data in tables	9
Transition activity 10 Analysing complex graphs	10
Transition activity 11 Extended writing	10
Transition activity 12 Cell structure and magnification	11
Transition activity 13 Cell division	11
Transition activity 14 Transport across cell membranes	12
Transition activity 15 Digestion and food tests	12
Transition activity 16 Circulatory system and gas exchange	13
Transition activity 17 DNA and genetics	14
Transition activity 18 monoclonal antibodies	14

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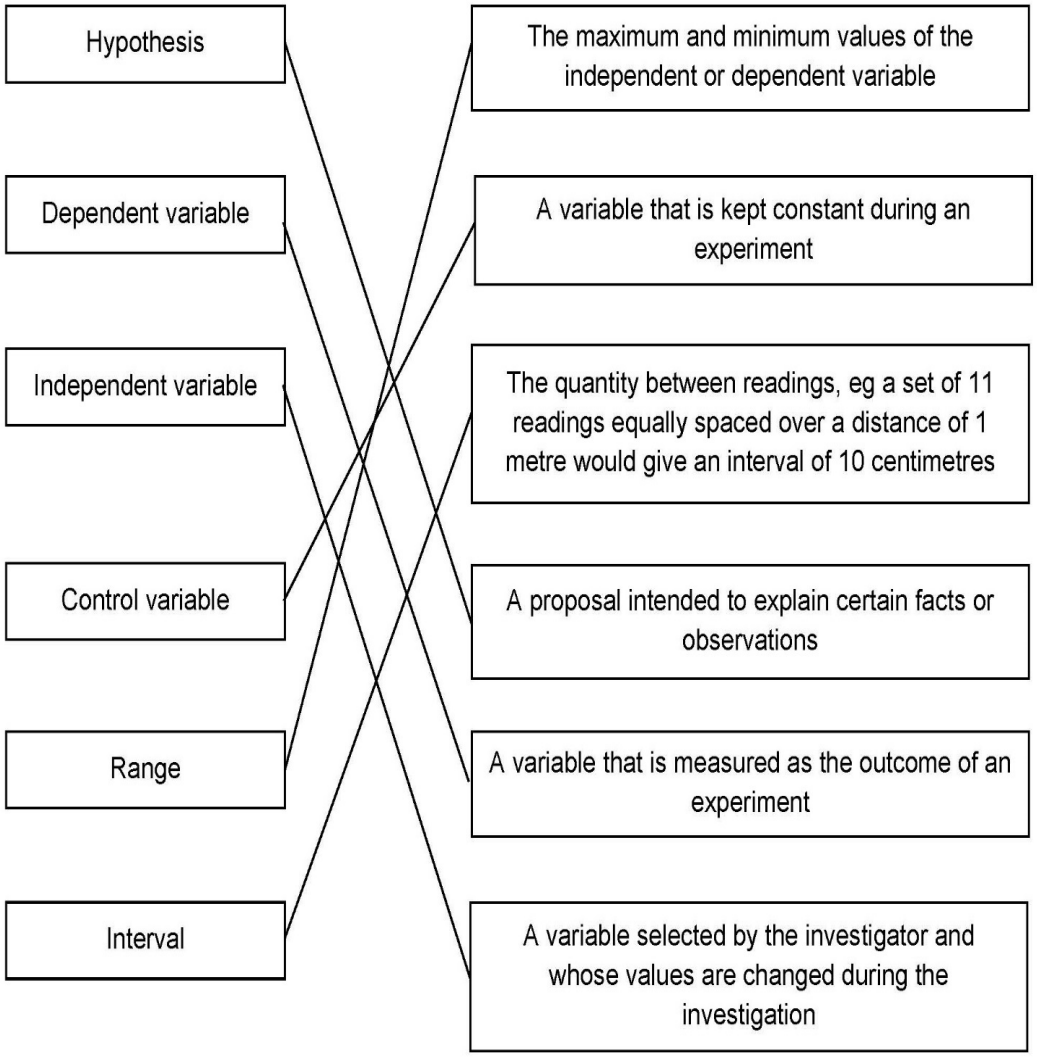
Activity 1 Scientific vocabulary: Designing an investigation



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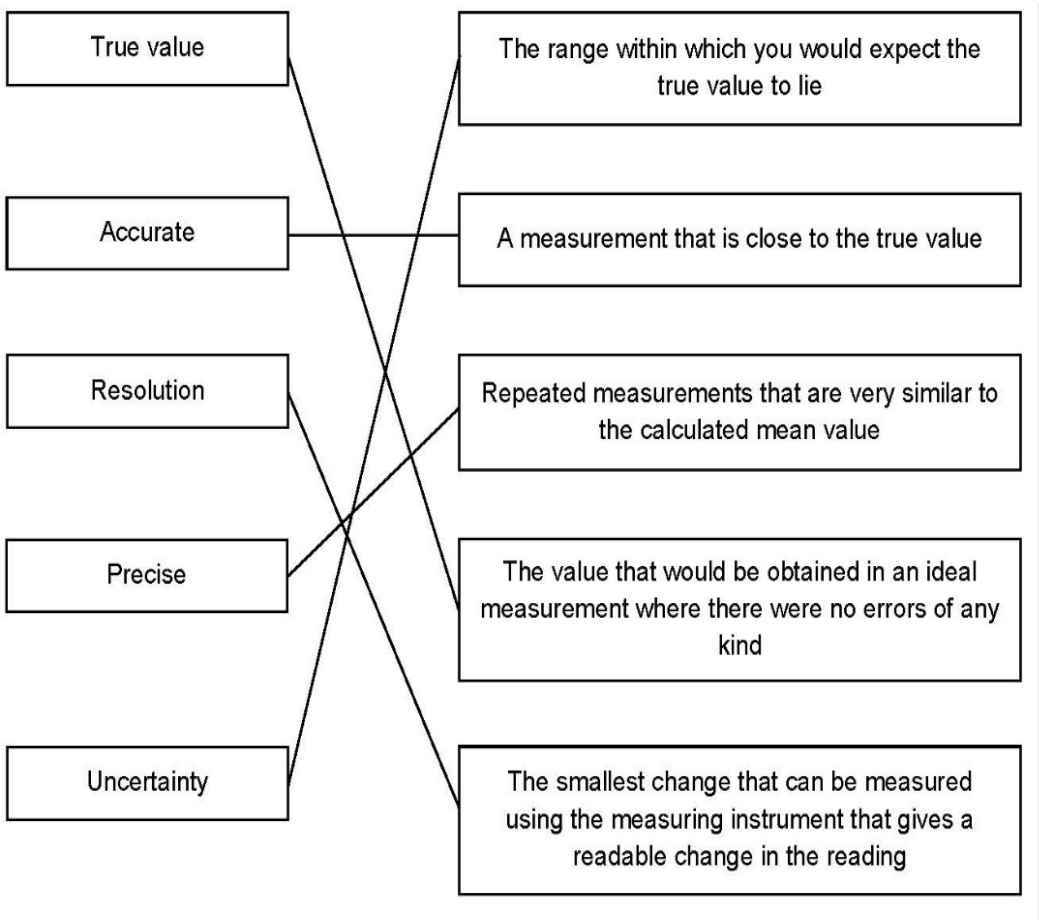
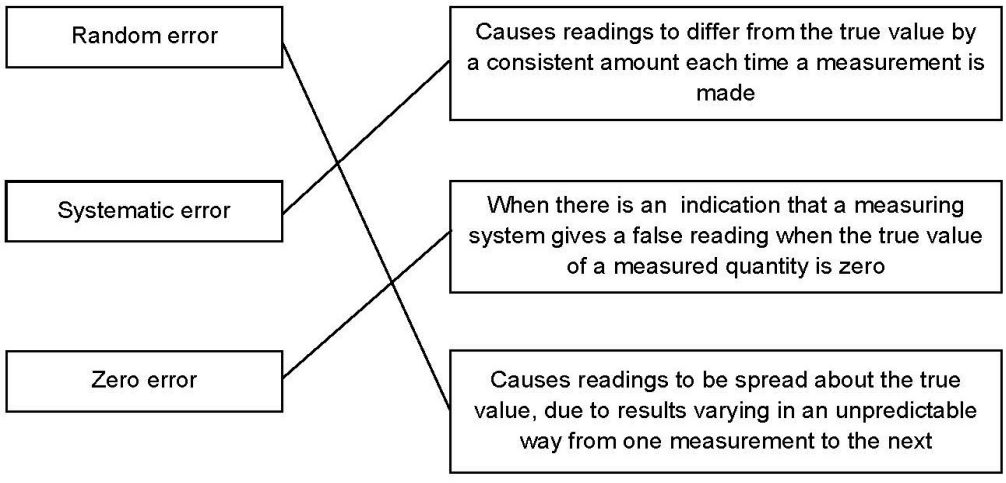
Activity 2 Scientific vocabulary: Making measurements



Activity 3 Scientific vocabulary: Errors



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Activity 4 SI units and prefixes
1. ms (milliseconds)
2. µm
3. km
4. nm
5. g or kg
6. g
7. pm (picometres)

Activity 5 Units
1. 4 g
2. 0.05 ml, 50 µl
3. 1.5 m^3
4. 120 days
5. 2 °C
6. 100 µm
7. 0.1 mm
8. 2 m

Activity 6 Converting units
1. 2.24 mm
2. 0.104 g
3. 6200 m
4. 10 000 nanograms
5. 7 l
6. 0.01l

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Activity 7 Investigating enzymes
1. The hypothesis is that length of egg white in each tube will decrease. This is expected to happen because protein in the egg white will be digested by the protease enzyme. The magnitude of the decrease will depend on the pH and temperature in which the enzyme and protein are incubated as enzyme activity is affected by both pH and temperature. Remember: a hypothesis requires some scientific explanation as to why it is thought to be true.
2. The prediction was correct as the biggest decrease in length of egg white occurred at both pH7 and at 35°C. This suggests that the enzyme is most effective at this pH and temperature of those tested. (A prediction also requires some explanation. These results tell us that the optimum conditions for the enzyme of the three pH and temperature values tested. However, we cannot conclude that these are the best conditions for the enzyme, that would require further tests.)
3. Independent – pH or temperature; dependent- length of egg white.
4. Control variables include length of incubation time, concentration of protease enzyme used.
5. Repeatable – same person using same method and equipment gives same outcome. It is not enough to say ‘keep everything the same’. Reproducible – different person or different method and equipment gives same outcome
6. 1 mm
7. Repeating the investigation allows you to identify and then ignore anomalous results. Ideally, you would repeat an experiment such as these three times to see how close together the results are and ignore those that appear anomalous when calculating a mean change at each pH/ temperature. Repeated results that are close to the mean are said to be precise. When suggesting repeating an experiment as an improvement, you must state why this would help. It is not enough to identify an anomaly, you must be clear how to deal with (eg ignore when calculating a mean).

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Activity 7 Investigating enzymes

8. To calculate % change : calculate the change in length and then express it as a percentage of the total starting length

   For example: pH 4
   change in length 6.0 - 5.6 = 0.4 cm
   0.4 as a % of 6 $= \frac{0.4}{6} \times 100 = 6.66666$
   to 3 sig fig. = 6.67

   pH 4 = 6.67 15°C = 5.00
   pH 7 = 36.7 35°C = 36.7
   pH 9 = 3.33 55°C = 11.7

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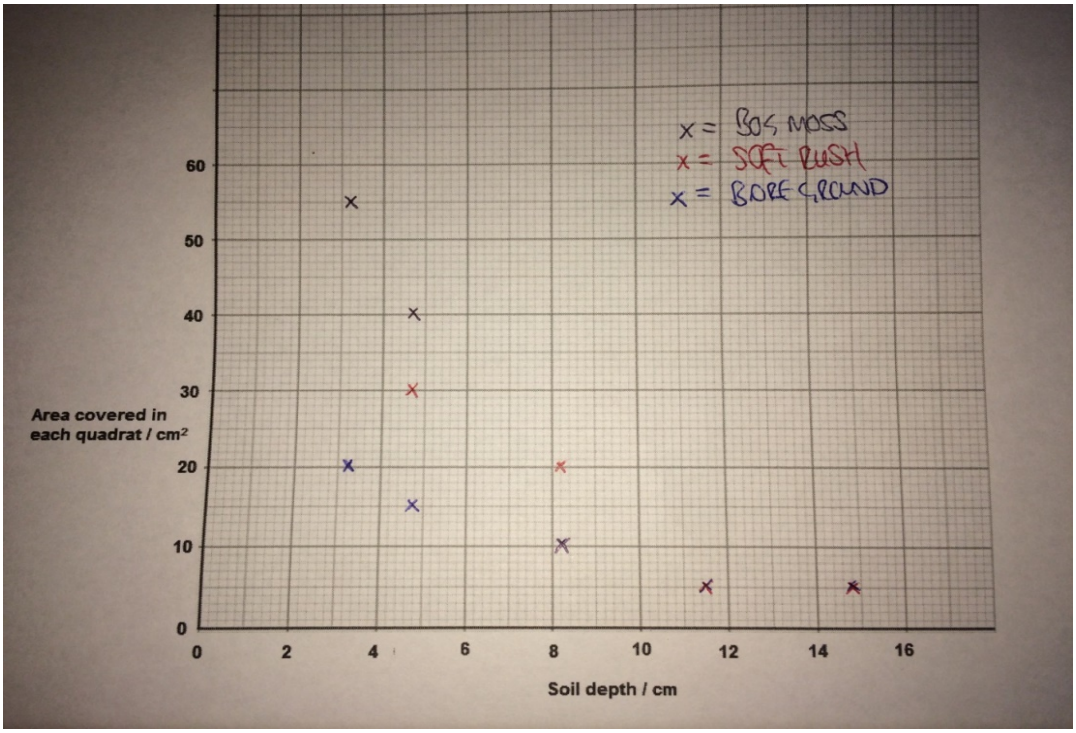
Activity 8 Mean, media, mode and scatter graphs

1. 5 cm^2

2. 8.5 cm^2

3. 10 cm^2

4.



5. Bog moss and soft rush favour shallow soils as the deeper the soil, the lower the area covered by each of these.

   The deeper the soil, the better vegetation grows as the deeper the soil the less area covered by bare ground.

   In your answer mention both factors that you were asked to plot on the graph in your conclusion.

6. Repeat the investigation in similar positions to increase the sample size. This will allow to check for precision of results and to identify and ignore anomalous results when calculating mean values. This increases accuracy and validity of conclusions.

   Only stating that you would repeat the investigation is insufficient. The reasons why this is an improvement are needed. Use the correct scientific language such as validity, accuracy and precision.

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Activity 9 Data in tables

1. % of deaths following mechanical valve = $\frac{180}{2852}$ x 100 = 6%

   % of deaths following biological valve = $\frac{178}{1754}$ x 100 = 10%

   Therefore a higher percentage of patients die with biological valve than mechanical valve.

2. Evaluate means to use the information (and your own knowledge) to consider the evidence on both sides. It is essential that you include a judgement based on the evidence, for example say which type of valve you would recommend.

   Content could include the following as comparison of both valves.

   Mechanical valves

- longer lasting or more durable or don't wear out as easily or less likely to need replacing (within 6 years)
- blood clots on the brain are more likely after surgery
- patient has to take anti-clotting medication for the rest of their lives
- if medication not taken correctly, clots can lead to blood clots on brain / heart attack
- medication can lead to excessive bleeding (after injury)
- some patients say they can hear the valves opening and closing
- survival rate at 5 years is slightly higher for mechanical valve
- lower percentage of deaths due to heart-related problems

Biological valves

- more likely to need further operation or another new valve
- valve may harden
- more likely to be rejected
- no additional medication required
- ethical issues surrounding use of animal tissue
- more likely to need (immuno-suppressant) medication

Both valves

- both are readily available • little wait time

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Activity 10 Analysing complex graphs

1. 2.5 dm^3

2. 13.5 breaths per minute

3. Increased from 15.0 to 19.5 breaths per minute = an increase of 4.5 breaths per minute.
   4.5 x 100 = 30%
   15

4. 5.5 km h–1

5. Tidal volume increases from 0.6 dm3 to 2.0 dm3 from 0–10 km h–1

   Average change per increase of 1.0 km h–1 $\frac{1.4}{10}$ = 0.14 dm3 km h–1

Activity 11 Extended answers

A good description requires scientifically relevant facts, events or processes to be identified and given in detail to form an accurate account. Your description should include the following points:

1. Isolation of different populations

   habitat variation between lemur populations

   genetic variation or mutation (in each population)

   better adapted survive (reproduce) **and** pass on (favourable) allele(s) to offspring

   (eventually) cannot produce fertile offspring with other populations

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Activity 12 Cells and cell division

1. Controls the activities of the cell

2. Red blood cell or bacteria / prokaryote or xylem cell

3. Any **three** features correctly identified and labelled:

- cell membrane
- nucleus
- cytoplasm
- mitochondria
- ribosomes

4. Cell wall, chloroplast, vacuole

5. Magnification = $\frac{\text{size of image}}{\text{size of real object}}$

6. Higher magnification and higher resolution

Activity 13 Cells and cell division

	statement is true for		
	mitosis only	**meiosis only**	**both mitosis and meiosis**
all cells produced are genetically identical	✓		
in humans, at the end of cell division each cell contains 23 chromosomes		✓	
involves DNA replication			✓

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Activity 14 Transport across cell membranes
1. Yes, because the mass change of egg 4 is much lower than the others.
2. $\frac{75.7 - 72.4}{72.4} \times 100 = 4.6\%$
3. Mass increased because water entered the egg by osmosis from a dilute solution in the beaker to a more concentrated solution in the egg through a partially permeable membrane.
4. Use five or more different concentrations of salt / sugar solution in beakers plot the percentage change (in mass / volume) on a graph determine the concentration where the curve / line crosses the zero percentage change (in mass / volume).
5. Ions are moved from an area of low concentration to high concentration by **active transport** which requires using energy.

Activity 15 Digestion and food tests
1. The method could include the following steps: 1. Biuret reagent tests for protein 2. add Biuret reagent to milk 3. solution will turn (from blue) to lilac if positive 4. iodine solution tests for starch (ignore iodine unqualified) 5. add iodine solution to milk 6. solution will turn (from orange / brown) to blue / black if positive 7. Benedict's reagent tests for sugars 8. add Benedict's reagent to milk and heat 9. solution will turn (from blue) to (brick) red / brown / orange / yellow / green if positive.
2. Lipase breaks down fat into fatty acids, the fatty acids lower the pH. when the fatty acids cause the pH to be below 10 the indicator becomes colourless.
3. Bile emulsifies fats which creates a larger surface area of fat. The lipase can then break down the fat to produce fatty acids more quickly or effectively.

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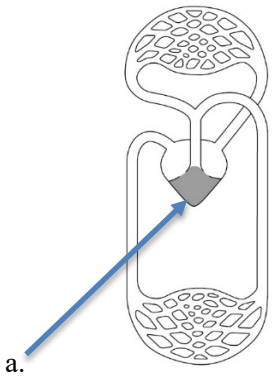
Activity 16 Circulatory system and gas exchange

1. Blood is pumped to the lungs by one side of the heart **and** blood is pumped to the body by the other side of the heart.

2. Ventricle labeled as gray area as below



3. Oxygenated and deoxygenated blood mixes so less oxygen reaches the body cells.

4. The concentration gradient of oxygen is less steep in water where there is a low concentration of oxygen, so less oxygen diffuses into blood / cells / gills.
   Less aerobic respiration occurs so less energy is released / available so less metabolism
   or
   More anaerobic respiration occurs so less energy is released / available so less metabolism.

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Activity 17 DNA and genetics
1. Chromosome(s)
2. X = sugar Y = nucleotide Z= base
3. Double helix
4. 3

Activity 18 Monoclonal antibodies
• Inject the protein into a mouse • Combine lymphocytes with tumour or cancer cells to make hybridoma (cells) • Find a hybridoma which makes a monoclonal antibody specific to PVY • Clones (the hybridoma) to produce many cells (to make the antibody)

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