U6 SUMMARY

General Qs

◇ Describethe effects on the results if (control variable) was not controlled
Results not valid
◇Biotic vs abiotic - biotic are living factors like age sex bmi of participants, abiotic non living factors include temperature
◇Record and analyze Results - draw a table with suitable headings and units, Describe suitable statistical test. Draw bar graph with error bars or line graph with axis labeled
◇ Statistical tests:

Cp 10 PHOTOSYNTHESIS

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

• Find a suitable {mass / length} of plant to use.
• Find a suitable method to change light intensity.
• Find a suitable (temperature / time} to collect (gas/02).
• Find suitable {method / apparatus) to measure volume of gas/02}/ (Ignore number of bubbles).

B) Devise a detailed method, including how you would control and monitor important variables. (9)

- Clear statement of the dependent variable: the volume of {gas / O2} released.
- Description of method of measuring volume of gas (photosynth meter).
- Method of standardizing plants (length/ mass).
  Ignore age / species / size
- Method of producing two different light intensities (moving lamp).
- Use of (sodium) hydrogen carbonate.
- Allow plant time to acclimatize.
- {Standardized/ stated} time for gas collection (5 mins to 24 hrs).
- One variable that needs to be controlled and its method of control.
  E.g. temperature using TC water bath/ heat shield/ LED bulb.
  Ignore AC room/ wavelength of light.
- {Repeats/ repeat the whole experiment} to give mean and SD.
- Method of calculation of rate. E.g. volume/ time

C) Suggest two limitations of your proposed method.

- Difficult to measure (small) {volumes / distances} of {gas / O2}.
- Difficult to control temperature.
- Difficult to control surface area of leaves.
- Idea that actual growing conditions in the river change during the day so
- the results may not be a fair representation.

Cp11 Carry out an experiment using quadrats and transects to determine the distribution and abundance of organisms, and measuring abiotic factors appropriate to the habitat.

The photograph shows a flightless grasshopper, *Brachaspis robustus*.

(Source: © Davide Bonora/Shutterstock)

This endangered species is only found in one small part of New Zealand.

These grasshoppers are approximately 4 cm long.

The grasshoppers are most active between November and March.

The grasshoppers are camouflaged so they can only be seen when they move.

A student decided to compare the population of grasshoppers living on an unused gravel road and a natural gravel area.

The student formed the following hypothesis:

The population of *B.robustus* in the natural gravel area will be larger than the population on an unused gravel road.

A) Describe preliminary practical work that you might undertake to find a suitable method for observing these grasshoppers to provide quantitative results.

- Find a suitable method of identifying this species.
- Find a suitable method to stimulate grasshopper movement (because they are camouflaged).
- Find the time of day/month the grasshoppers are (most) active.
- Find a suitable {sampling/counting} method.
  E.g. suitable methods - transects/ size of quadrat/ nets.
- Find suitable weather conditions.

B) Devise a detailed method, including how you would control and monitor important variables. (8)

- Clear statement of the dependent variable: number of grasshoppers per unit area.
- Method of producing standardized sample sites (of known area on both sites).
- Standardized {method/time} of counting on both sites. E.g. use of nets/quadrats/ cameras.
- Identify two variables to be monitored.
  E.g. temperature, light(intensity), humidity, rainfall, pH, time of day, weather.
- Describe how one variable can be {monitored/controlled}.
  E.g. use similar aspects/ slopes of road and gravel area.
- Repeats for {one/either} sample area.

- Repeat the whole investigation at different times of year (between November and March). (1)
- Method of calculation of population density.

C) Suggest three limitations of your proposed method.

- Difficulty in identifying this species.
- Difficulty in seeing/making grasshopper move/ hard to catch them.
- Difficult to ensure each grasshopper counted is a new individual
- Difficult to {measure/monitor} a named variable.
- Sampled once so population may change over time.

Cp 12 Investigate the effect of temperature on the development of organisms.

Preliminary Practical Work:

• Find a suitable range of temperature.
• Find a suitable growth medium (for mentioned species.)
• Find an appropriate measurement of growth.
• Find the time taken for a measurable change in growth.
• Find the time for the species to grow aka (eggs to hatch or seedlings to germinate)
• Identify an environmental condition to control and to be taken into account {temperature /salinity / pH / oxygen concentration / light intensity}.

Limitations:

• Difficult to control {all variables / or a named variable} affecting the growth of the organism/ affecting the results.
• Idea of difficulty of measuring growth.
• Possible infection of the plants/seedlings/species with {bacteria / fungi / virus}.
• Named environmental factors may fluctuate.
• Suitable reference to difficulty of counting (if asked for counting of certain variable)
• Genetic Variability affects growth of organisms.

Describe an experiment to investigate the effect of calcium ion concentration on the time taken for brine shrimps to hatch.

1. Dependent variable is the number (of eggs) hatched per unit time. (1)
2. Use of five different concentrations of calcium ions. (1)
3. Counting brine shrimps {hatched /swimming} at {same / stated} time intervals. (1)
4. Suitable control of one variable. (1)
5. E.g. temperature / stated temp (up to 45°C) – thermostatically/ controlled water bath, pH – buffer, light intensity – distance of bulb.
6. Repeats (for each treatment) and calculate a mean. (1)

Describe an experiment to investigate the effect of adding zinc sulphate on the growth of maize plants.

1. (Dependent) variable to be measured stated: distance between leaves/

internode length/ number of yellow stripes. (1)
2. Idea of one growth medium with and one without (added)zinc (sulfate).
(1)
3. ACCEPT a range of concentrations that includes 0.
4. Use of {seeds / seedlings}. (1)
5. Method for measuring the dependent variable. (1)
6. {Same / stated} time for measurements to be taken/ at least 5 days. (1)
7. Repeats and calculate a mean. (1)

Cp 13 Investigate the rate of growth of microorganisms in a liquid culture.
A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Find a suitable {concentration/ volume} of pineapple juice. (1)
  Accept find a suitable range of concentrations.
  Accept find a suitable method of making the pineapple juice.
  Accept find storage time (of pineapple juice) which has an effect.
- Find a suitable timescale for growth of bacteria (1)
- Find a suitable {temperature / pH} for {growth of bacteria/ incubation/ activity of enzyme}. (1)
- Find a suitable way to count bacteria/ method for comparing growth (rate). (1)

B) Devise a detailed method, including how you would control and monitor important variables. (8)

- Clear statement of the dependent variable: {number of bacteria / turbidity/ absorbance} with ref to time. (1)
- Method of producing pineapple juice (1)
- (Use of nutrient broth) with and without pineapple juice. (1)
  Accept several concentrations of juice as long one is zero/ heated juice / water / sugar solution as a control.
- Use of aseptic technique. (1) E.g. flaming neck of bottles, work near Bunsen burner.
- Samples taken at suitable intervals. (1)
- Suitable method for counting bacteria. (1)
- Accept {absorbance / transmission} with {colorimeter / datalogger}/ serial dilution and plating.
- Method of calculation of growth rate (1)
- Identify one variable to be controlled and description of how it is controlled. (1)
- Identify second variable to be controlled and description of how it is controlled. (1)
- Accept: temperature, pH, {age / variety / part / tissue} of pineapple,
- {concentration / volume} of juice, {age / volume/ concentration} of bacterial culture.
- Repeats for each set up or repeat the whole investigation. (1)

C) Suggest three limitations of your proposed method.

- {Clumping / uneven distribution} of bacteria makes it difficult to count. Factors related to colorimeter use. Relevant named factors may affect growth (rate) of bacteria. (2)

Cp 14 Investigate the effect of antimicrobial substances on the growth of bacteria.

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Find a suitable mass/age of leaves/concentration of extract/method of extraction. (1)
- Find a suitable temperature/pH/medium/time/species of bacteria. (1)
- Find a suitable method to measure {inhibition/antibacterial effect}. (1)

B) Devise a detailed method, including how you would control and monitor important variables. (9)

- Clear statement of the dependent variable e.g. Zone of inhibition. (1)
- Description of method of preparation of extract. (1)
- Method of preparing bacterial lawn/broth/pour plate (1)
- Method of applying extract. E.g. Wells/discs/drop in broth/ put on agar.
- Detail of measuring dependent variable. E.g. ruler/grid. (1)
- Description of aseptic technique (1)
- Use of a control for comparison. (1)
- Incubate at stated temperature (but not more than 30˚). (1)
- Two variables that need to be controlled. (1) E.g. temperature/pH/incubation time/size of disc/medium/species of bacteria.
- Method of control of one named variable. (1)
- Repeat the whole experiment to calculate (mean) and SD/error bars. (1)

C) Describe two limitations of your proposed method.

- Difficult to measure distances/ diameters/ ZOI with precision. (1)
- Only tested against one species of bacteria. (1)
- Contamination. (1)
- Bacteria cultured in aerobic conditions and gut is anaerobic or not
- cultures at human body temperature. (1)

Cp 15 Using a hydrogen carrier (redox indicator), investigate the effect of temperature on respiration in yeast.

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Find a suitable {mass / concentration / number of cells} of yeast (that will produce carbon dioxide). (1)
- Accept suitable {concentration / mass} of sugar.
- Accept suitable concentration / mass of mineral ions.
- Find a suitable {method for measuring carbon dioxide / method to measure oxygen consumption / redox indicator} .(1)
  E.g. TTC / DCPIP / methylene blue.
- Find a suitable range of temperatures. (1)
- Accept find a suitable timescale to measure the {volume of gas produced / oxygen consumption}.

B) Devise a detailed method, including how you would control and monitor important variables. (8)

- Clear statement of the dependent variable: Volume of carbon dioxide produced per unit time/ volume of oxygen used per unit time / time for (named) redox indicator to change colour. (1)
- Some description of apparatus used. (1)
  E.g. method of collecting (carbon dioxide) gas / respirometer with soda lime/ tubes in a water bath before mixing.
- Control of mass of yeast/ {volume/ concentration} of yeast (suspension)/ number of yeast cells. (1)
- Incubate for a set period of time and record {volume of carbon dioxide produced/ movement of ink drop}/ record time for {colour change of redox indicator}. (1)
- Five stated temperatures in a range of 5-55˚C. (1)
- Two variables that need to be controlled. (1)
- E.g. {concentration / volume} of redox indicator; {mass / concentration} of glucose; {type / strain / species / age} of yeast.
- Description of how one of these variables is controlled. (1)
  pH – buffer; mass of glucose - use of balance.
- Repeats for each temperature or repeat the whole experiment. (1)
- Method of calculating rate of respiration. (1)
  E.g. 1 divided by time taken for colour change/ distance divided by time/ volume divided by time.

C) Give two limitations of your proposed method.

- Difficult to measure (small) values of the dependent variable/ to recognize end point. (1)
- Difficult to prevent contamination of yeast cultures/ hard to maintain aseptic conditions. (1)
- Difficulties related to experimental design. (1)
  E.g. yeast may change from aerobic to anaerobic respiration during
- investigation; build-up of waste products may affect enzymes.

Cp 16 Use a respirometer to determine the rate of respiration and respiratory quotient of a suitable material.

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Suitable way of germinating seeds/checking they are viable. (1)
- Find a suitable temperature for {respiration/germination/seeds to grow}.
- Find a suitable mass of seeds to give a measurable volume of gas. (1)
- Find a suitable method for absorbing carbon dioxide. (1)
- Find a suitable method to measure (change of) gas volume. (1)
  Do no allow oxygen produced

B) Devise a detailed method, including how you would control and monitor important variables. (9)

- Clear statement of the dependent variable: distance moved in unit time/ volume of oxygen in unit time. (1)
  Allow volume of gas using syringe.
- Some description of apparatus used. E.g. respirometer. (1)
- Control mass of seeds. (1)
- (record) time for a measured distance of the meniscus or volume of gas.
- Time to acclimatise. (1)
- Repeat with and without soda lime. (1)
- One variable that needs to be controlled. (1)
- Description of how this variable is controlled. (1)
  AC with suitable stated temperature/incubator.
- Repeat the method with the other seed type. (1)
- Formula for calculating RQ. (1)
  $CO_2 \div O_2$ Or distance with soda lime – distance without ÷ distance
- without soda lime.

C) Suggest two limitations of your proposed method.

- Difficult to measure distances or (collect small) volumes of gas. (1)
- Difficult to prevent contamination of watermelon seeds. (1)
- Difficulty of controlling temperature. (1)

Cp 17 Investigate the effects of exercise on Tidal Volume, Breathing Rate, Respiratory minute ventilation, and oxygen consumption using data from spirometer traces.

Preliminary Practical Work:

• Select the most suitable type of exercises.
• Idea of standardising participants (Age of participants, gender of participants, health, previous experience of exercising, VC training, usual training regime, height, body mass, BMI).
• Idea of determining timescale for measurable effect (on VC/TV/BR..etc).
• Obtaining informed consent from participants.
• Measuring baseline respiratory variables at rest.

Limitations:

• Difficult to control all variables affecting VC.
E.g. genetic variability, previous history of exercising, additional activities outside of excersing sessions, diet.
• Idea that participants will differ in their effort.
• Idea that accurate measurement of VC is reliant on the subject exhaling fully (which may not be the case).
• Idea that the {results / participants} may not be representative (of an individual / the population).

• Spirometry only measures lung function and cannot determine the cause of changes in respiratory parameters.
• Environmental factors such as altitude, temperature, and humidity can also impact respiratory parameters.

Cp 18

Investigate the production of amylase in germinating grains. (jan 21)

(Source: © DR KEITH WHEELER / SCIENCE PHOTO LIBRARY)

Wheat grains store starch in the endosperm.

During germination the embryo releases amylase from the cells surrounding the endosperm.

The starch is digested by the amylase. This allows the embryo to grow.

Abscisic acid inhibits the germination of wheat grains.

A student formed the following hypothesis:

the greater the concentration of abscisic acid (ABA), the smaller the production of amylase by the wheat grain.

Plan an investigation to find evidence to support or reject this hypothesis.

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Find a suitable concentration range for ABA. (1)
  Accept suitable concentrations of ABA.
- Find a suitable method for measuring starch digestion. (1)
  Accept suitable method for measuring amylase production.
- Find a suitable {temperature/pH} (for starch digestion). (1)
  Accept species (of wheat).
- Find a suitable timescale (for starch digestion). (1)
  Accept find a suitable time for soaking endosperm in ABA.

B) Devise a detailed method, including how you would control and monitor important variables. (8)

- Clear statement of the dependent variable: size of clear area/ absorbance /transmission using colourimeter. (1)
- Some description of aseptic technique. (1)
  E.g. rinse endosperm in {sodium hypochlorite/sterile water}.
- Soak the endosperm with ABA and place on starch agar/ place endosperm in tube containing starch solution. (1)
- Stated time for incubation 24 - 72hrs. (1)
- Method of determining clear area. (1)
  E.g. trace for total area or take (several) diameter measurement(s).
  Accept use colorimeter to measure {transmission / absorbance} (if starch in tube method used).
- Identify one variable to be controlled and description of how this variable is controlled.

- Identify second variable to be controlled and description of how this variable is controlled. (1)
  E.g. pH, temperature, humidity, light intensity, species / variety, age of seed.
- Repeats at each ABA concentration or repeat the whole experiment. (1)
- Test at 5 different concentrations of ABA. (1)

C) Suggest two limitations of your proposed method.

- Difficult to measure small clear areas. (1)
  Accept difficulty in using the colorimeter or judging an end point.
- Difficult to maintain aseptic conditions. (1)
  Accept {seeds / agar} may be contaminated with bacteria.
- {Growth regulators / chemicals} in seed may affect amylase production.
  Accept genetic variation in seeds effects {amylase production / size of endosperm}.

Additional practical- Habituation

A) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

- Find the time for animal to start feeding/ accept find time interval between touches. (1)
- Find a suitable conditions for the animal to feed. (1)
- Find a suitable method to for applying a touch/ suitable force. (1)
- Find a suitable method of determining/measuring the extent of fan withdrawal. (1)

B) Devise a detailed method, including how you would control and monitor important variables. (8)

- Clear statement of the dependent variable: record the length /extent of the withdrawal.
- Allow animal to acclimatize. (1)
- Method of touching the animal: use of glass rod/cotton bud / touch with the same force.
- Stated time intervals between touches or stated number of touches in a set time. (1)
- Supply of organic particles to stimulate feeding activity. (1)
- Identify one variable to be controlled and description of how it is controlled (1)
- Identify the second variable to be controlled and description of how it is controlled. (1)
- MP6 and 7 e.g., temperature with thermostat in tank/ water bath.
  Accept same age/sex.
- Repeat with another animal. (1)

C) Suggest three limitations of your proposed method.

- Difficulty in determining extent of withdrawal. (1)
- Difficult to determine same pressure/force of touch. (1)
- Difficult to ensure each organism in the {same age/not already habituated}. (1)
- Difficult to control concentration of organic particles. (1)
  Accept noise/vibration/water currents/light to shade.

Statistical tests

Used for evaluating if 2 or more data sets are significantly different or are correlated
Null hypothesis stated always There is no [Significant difference/ Correlation] between data sets
'any relationship visible is by chance until the test proves otherwise'
Use critical value from table at **0.05**

Studying a difference

☆ Chi squared-used to compare between observed & expected data
Null hypothesis: there is no significant difference between observed & expected data
Example: inheritance crosses vs actual off- spring
If the chi-squared value is greater than, or equal to, the critical value then there is a significant difference between observed and expected results. Null hypothesis REJECTED.

☆ Student t-test- used to see if there is a significant difference between 2 data sets collected in a study
Null hypothesis: No significant difference in the dependent variable between data A & data B
Example: Abundance of certain plant species around building A vs b, data collected, mean calculated to get t value
IF T VALUE GREATER THAN CRITICAL VALUE REJECT NULL HYPOTHESIS

Studying a correlation

☆ Spearman's rank correlation - used to check for correlation between the independent and dependent variable
Null hypothesis: there is no correlation b/w me independent variable & dependent variable

Example. No correlation between light intensity and abundance of organisms