Applied Science BTEC

Transition booklet

Name:_____

Task	Page numbers	Tick when completed
1. Cell Biology	2-6	
2. Atomic structure	7-10	
3. Waves	11-15	
4. Scientific skills	16-18	

You should use your GCSE knowledge along with additional research to complete the tasks in this booklet. When doing additional research remember to reference your sources of information.

1. Cell Biology

Draw and label diagrams of the following cells:

Animal cell

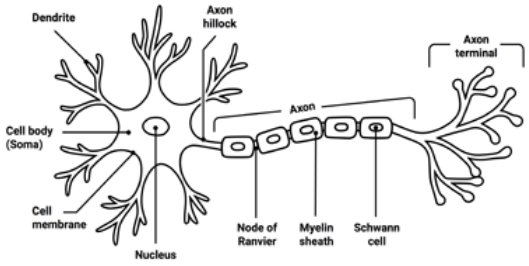
Plant cell

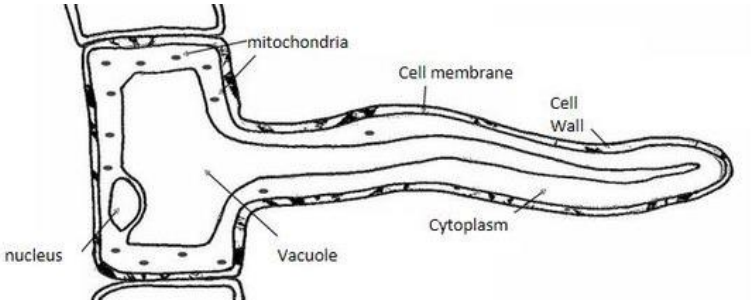
Bacterial cell

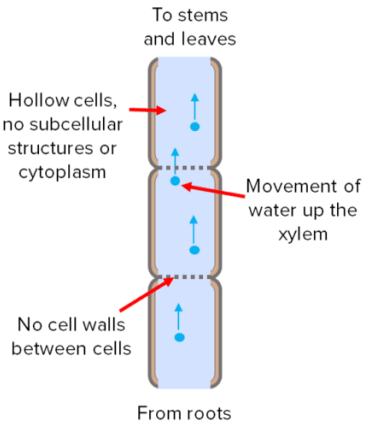
Complete the table outlining the function of each organelle:

Organelle	Function
Nucleus	
Cytoplasm	
Cell wall	
Cell membrane	
Ribosome	
Mitochondria	
Chloroplast	
Vacuole	
Capsule	
Flagella	
Vesicle	

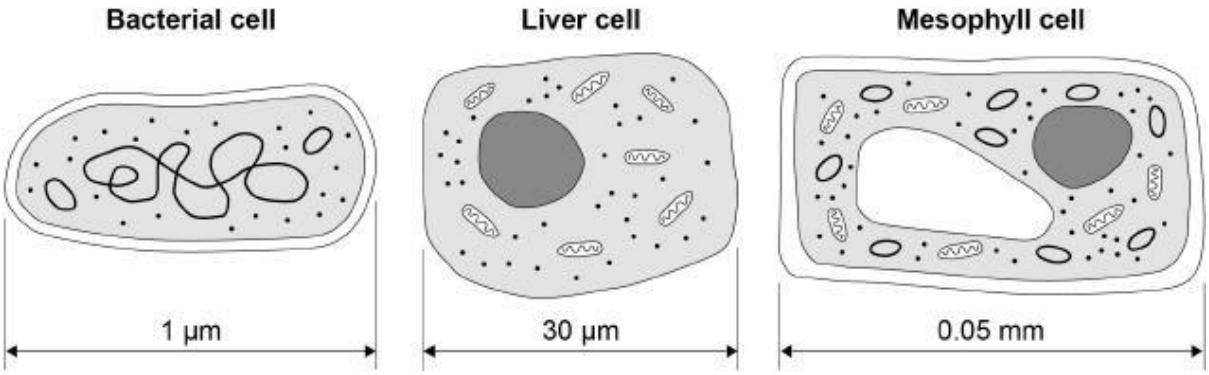
Identify each of the specialised cells below. Explain how each is adapted for its function:







Q1. The diagram below shows three types of cell.



(a) Give **two** similarities between the prokaryotic cell and the eukaryotic cells in the diagram above.

1 _____

2 _____

(2)

(b) Give **three** differences between the prokaryotic cell and the eukaryotic cells in the diagram above.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(c) Calculate the ratio of the size of the bacterial cell to the size of the mesophyll cell.

_____

_____

_____

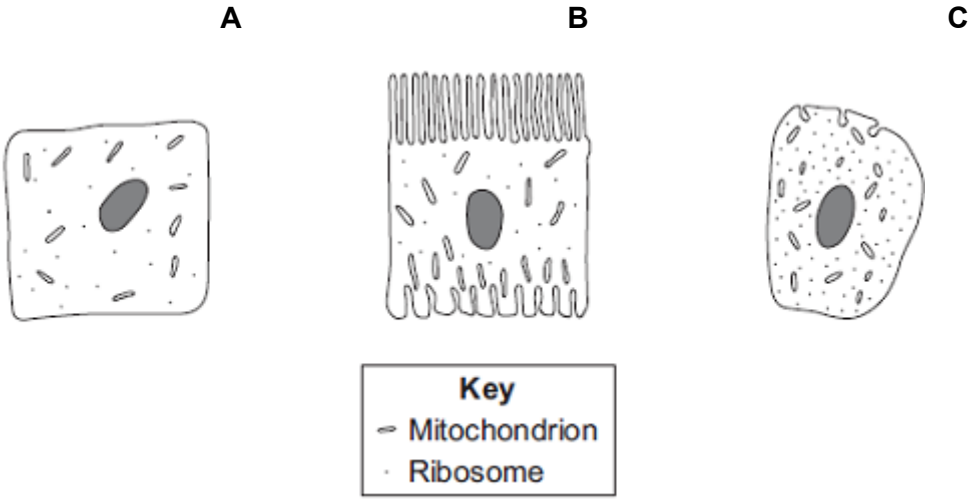
_____

Ratio = 1 : _____

(2)

Q2.

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or

out of the cell? ☐

Give **one** reason for your choice.

_____

_____

(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

_____

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

_____

_____

_____

_____

(2)

2. Atomic structure

Draw and label an atom

Complete the tables:

Subatomic particle	Relative charge	Relative mass
Proton		
Neutron		
Electron		

	Mass number	Atomic number	Number of protons	Number of neutrons	Number of electrons
$^{1}_{1}H$					
$^{3}_{1}H$					
H^{+}					
$^{35}_{17}Cl$					
$^{37}_{17}Cl$					
Al	27	13			

Calculate the relative formula mass of the following compounds:

1. NaCl
2. H_2S

3. MgO
4. HNO_3
5. H_2SO_4
6. C_2H_5OH
7. $Mg(OH)_2$
8. $NaOH$
9. $BeCl_2$
10. $Al(OH)_3$

Q1. This question is about atoms.

(a) What does the number 19 represent in $^{19}_{9}F$?

_____ **(1)**

(b) How many atoms are present in one mole of fluorine atoms?

_____ **(1)**

(c) The plum pudding model of the atom was replaced by the nuclear model.

The nuclear model was developed after the alpha particle scattering experiment.

Compare the plum pudding model with the nuclear model of the atom.

_____

_____

_____

_____

_____

_____

_____ **(4)**

(d) An element has three isotopes.

The table shows the mass numbers and percentage of each isotope.

	Isotope 1	**Isotope 2**	**Isotope 3**
Mass number	24	25	26
Percentage (%)	78.6	10.1	11.3

Calculate the relative atomic mass (A_r) of the element.

Give your answer to 3 significant figures.

Relative atomic mass = _____ **(2)**

Q2. This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

(a) Rubidium and potassium are added to water.

Predict **one** observation you would see that shows that rubidium is more reactive than potassium.

_____ **(1)**

(b) Explain why rubidium is more reactive than potassium.

_____ **(3)**

(c) Complete the equation for the reaction of rubidium with water.

You should balance the equation.

$$Rb + H_2O \rightarrow \quad +$$

(3)

The noble gases are in Group 0.

(d) Which is a correct statement about the noble gases?

Tick (✓) **one** box.

The noble gases all have atoms with eight electrons in the outer shell.	☐
The noble gases have boiling points that increase going down the group.	☐
The noble gases have molecules with two atoms.	☐
The noble gases react with metals to form ionic compounds.	☐

(1)

(e) The table below shows information about the three isotopes of neon.

Mass number	**Percentage abundance (%)**
20	90.48
21	0.27
22	9.25

Calculate the relative atomic mass (A_r) of neon.

Give your answer to 3 significant figures.

Relative atomic mass (3 significant figures) = _____ **(3)**

3. Waves

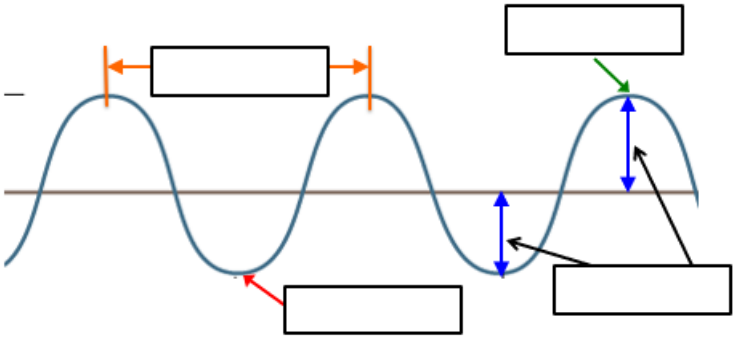
1. What do waves transfer?

2. What are the two types of wave?

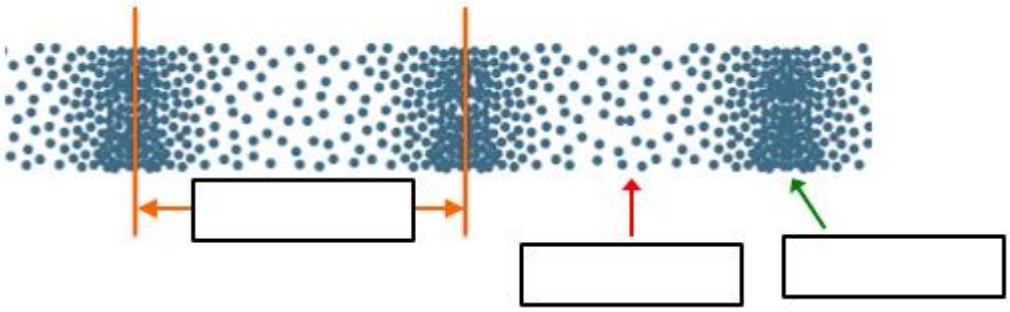
3. Transverse waves vibrate _____ to the direction of energy transfer.

Longitudinal waves vibrate _____ to the direction of energy transfer.

4. Label the transverse wave.



5. Label the longitudinal wave.



6. Match the key term to the correct definition.

Height of a wave	Wavelength
Bottom of a wave	Amplitude
Top of a wave	Crest
Distance between two waves	Trough
Where particles are closest together	Compression
Where particles are furthest apart	Rarefaction

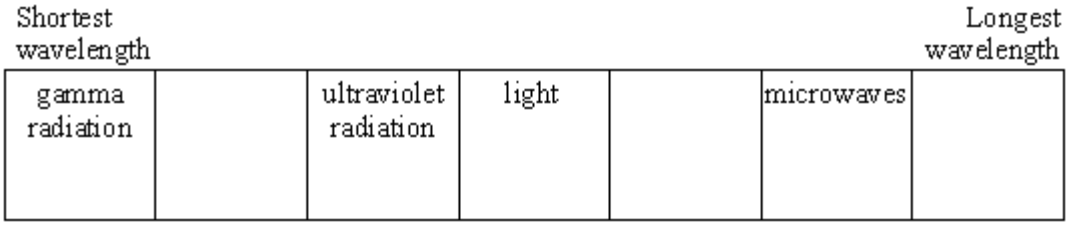
7. For each wave described below, identify the wave as a transverse or longitudinal wave:

a. The wave created by moving the end of a spring toy up and down.
b. The wave created by moving the end of a spring toy back and forth parallel to the length of the spring.
c. A sound wave.
d. An ocean wave.
e. An electromagnetic wave.

8. Describe the differences between longitudinal waves and transverse waves (3).

9. Radio waves are electromagnetic waves. Describe how radio waves are different from sound waves. (4)

10. Complete the waves on the electromagnetic spectrum:



11. Write down the equation linking wave speed, frequency and wavelength.

12. What is the wave speed if:
a. f = 5 Hz, λ = 1 m b) f = 6 Hz, λ = 0.25 m c) f = 10 Hz, λ = 0.2 m

13. What is the wave frequency if:
a. v = 5 m/s, λ = 1 m b) v = 330 m/s, λ = 0.01 m c) v = 1,500 m/s, λ = 0.5 m

14. What is the wavelength if:
a. f = 25 Hz, v = 2 m/s b) f = 15 Hz, v = 0.1 m/s c) f = 1,800 Hz, v = 0.2 m/s

15. An instrument produces a frequency of 6.86 kHz and a wavelength of 0.05 m. Calculate the speed.

16. A wave has a speed of 550 m/s and a frequency of 11 kHz. Calculate the wavelength.

17. The speed of any EM wave is 300,000,000 m/s. Calculate the frequency of a radio wave with wavelength of 10 cm.

18. Microwaves are a transverse wave of wavelength 0.05 cm. Calculate the frequency of a microwave.

Q1. Different parts of the electromagnetic spectrum have different uses.

(a) The diagram shows the electromagnetic spectrum.

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

(i) Use the correct answers from the box to complete the sentence.

amplitude	**frequency**	**speed**	**wavelength**

The arrow in the diagram is in the direction of increasing _____ and decreasing _____ .

(2)

(ii) Draw a ring around the correct answer to complete the sentence.

The range of wavelengths for waves in the electromagnetic spectrum is approximately

10^{-15} to 10^{4}
10^{-4} to 10^{4}
10^{4} to 10^{15}

metres.

(1)

(b) The wavelength of a radio wave is 1500 m.
The speed of radio waves is 3.0×10^{8} m / s.

Calculate the frequency of the radio wave.

Give the unit.

_____

_____

_____

Frequency = _____ **(3)**

(c) (i) State **one** hazard of exposure to infrared radiation.

_____ **(1)**

(ii) State **one** hazard of exposure to ultraviolet radiation.

_____ **(1)**

(d) X-rays are used in hospitals for computed tomography (CT) scans.

(i) State **one** other medical use for X-rays.

_____

_____ **(1)**

(ii) State a property of X-rays that makes them suitable for your answer in part **(d)(i)**.

_____

_____ **(1)**

(iii) The scientific unit of measurement used to measure the dose received from radiations, such as X-rays or background radiation, is the millisievert (mSv).

The table shows the X-ray dose resulting from CT scans of various parts of the body.

The table also shows the time it would take to get the same dose from background radiation.

Part of the body	X-ray dose in mSv	Time it would take to get the same dose from background radiation
Abdomen	9.0	3 years
Sinuses	0.5	2 months
Spine	4.0	16 months

A student suggests that the X-ray dose and the time it would take to get the same dose from background radiation are directly proportional.

Use calculations to test this suggestion and state your conclusion.

_____

_____

_____

_____

_____

_____

_____

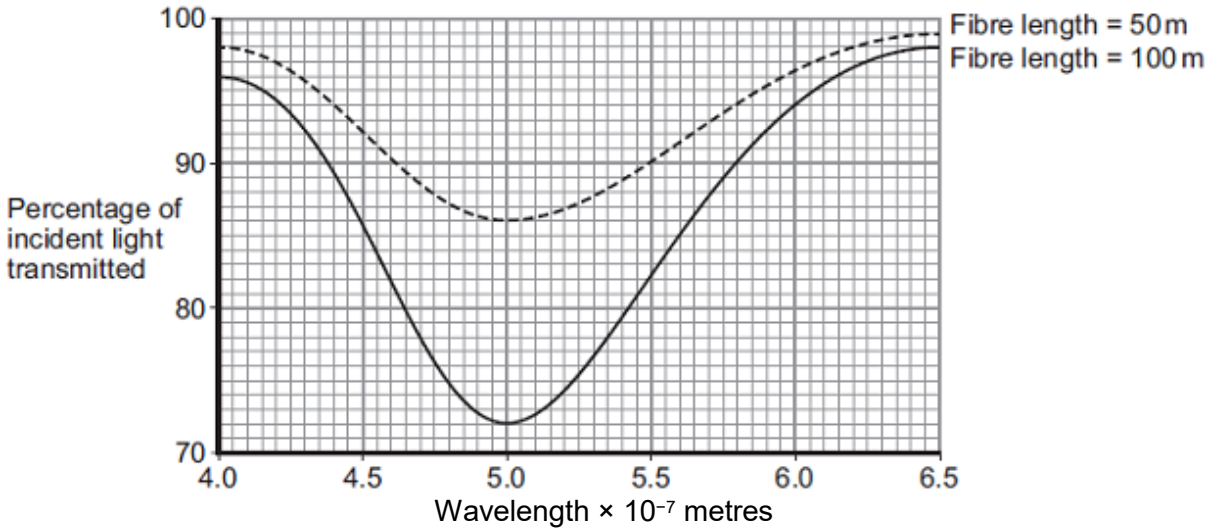
_____

_____

_____ **(3)**

Q2. Different wavelengths of light can be used to transmit information along optical fibres.

The graph below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

_____

_____

_____

_____

_____

_____

_____

_____ (3)

4. Scientific skills

Write definitions for the following scientific key terms:

Key term	**Definition**
Accuracy	
Calibration	
Random error	
Systematic error	
Zero error	
Hypothesis	
Interval	
Precision	
Range	
Repeatable	
Reproducible	
Resolution	
Independent variable	
Dependent variable	
Control variable	

Plants use carbon dioxide and water to produce glucose and oxygen.

This process is called photosynthesis.

The rate of photosynthesis is affected by many factors, such as light intensity.

Aquatic plants release visible bubbles of oxygen gas into the surrounding water when they photosynthesise.

Pond weed is an example of an aquatic plant.

You have been asked to write a plan to investigate the effect of light intensity on the rate of photosynthesis in pond weed.

Your plan should include the following details:

- a hypothesis
- selection and justification of equipment, techniques or standard procedures
- health and safety associated with the investigation
- methods for data collection and analysis to test the hypothesis including:
  - quantities to be measured
  - number and range of measurements to be taken
  - how equipment may be used
  - control variables
  - brief method for data collection analysis.

(12)

Mark schemes: Use these to mark and make corrections to your answers to the exam style questions (use a different colour pen!).

1. Cell Biology

Q1. (a) any **two** from: (both have)

- cytoplasm
- (cell) membrane
- DNA / genetic material
- ribosomes

2

(b) any **three** from:

- prokaryotic cell is smaller
- prokaryotic cell has no mitochondria
- prokaryotic cell has no nucleus
  or DNA is free in the cytoplasm
  or genetic material is free in the cytoplasm
- prokaryotic cell has a single loop of DNA
  or prokaryotic cell has a single loop of genetic material
- prokaryotic cell has plasmids

3

(c) 1 µm = 0.001 mm
or 1 mm = 1000 µm
or 0.05 mm = 50 µm
or 0.05 × 1000

1

(1:) 50

*do **not** accept if a unit is given*

1

Q2. (a) **B :** large(r) surface / area **or** large(r) membrane

1

(b) (i) • (salivary) amylase • carbohydrase

1

(ii) many ribosomes
ribosomes produce protein

or

many mitochondria (1) mitochondria provide energy to build / make protein (1)

1

2. Atomic structure

Q1. (a) mass number

(b) 6.02×10^{23}

(c) **similarities**

- both have positive charges
- both have (negative) electrons
- neither has neutrons

differences

plum pudding model	nuclear model
ball of positive charge (spread throughout)	positive charge concentrated at the centre
electrons spread throughout (embedded in the ball of positive charge)	electrons outside the nucleus
no empty space in the atom	most of the atom is empty space
mass spread throughout	mass concentrated at the centre

4

(d) $\frac{(24 \times 78.6) + (25 \times 0.1) + (26 \times 11.3)}{100}$

= 24.3

Q2.

(a) any **one** from:

- more vigorous bubbling (for rubidium)
- bigger / brighter flame (for rubidium)

1

(b) (rubidium's) outer shell / electron is further from the nucleus (so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium) (so) the outer electron (in rubidium) is more easily lost

(c) $2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$

(d) the noble gases have boiling points that increase going down the group

(e) (relative atomic mass =) $\frac{(90.48 \times 20) + (0.27 \times 21) + (9.25 \times 22)}{100}$

allow (relative atomic mass =) $\frac{1809.6 + 5.67 + 203.5}{100}$

allow (relative atomic mass =) 18.096 + 0.0567 + 2.035

1

= 20.1877 = 20.2

3. Waves

Q1. (a) (i) frequency
wavelength

(ii) 10^{-15} to 10^{4}

(b) 2.0×10^{5}

Hz

(c) (i) (skin) burns

(ii) skin cancer / blindness

(d) (i) any **one** from:

- (detecting) bone fractures
- (detecting) dental problems
- treating cancer

(ii) any **one** from:

- affect photographic film
- absorbed by bone
- transmitted by soft tissue
- kill (cancer) cells

(iii) 9 / 36 = 0.25
0.5 / 2 = 0.25
4 / 16 = 0.25

accept:
36 / 9 = 4
2 / 0.5 = 4
16 / 4 = 4

conclusion based on calculation

Q2. (for both fibres) increasing the <u>wavelength</u> of light decreases and then increases the percentage / amount of light transmitted

(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres)
or
maximum transmission occurs at 6.5 (x 10^{-7} metres)

the shorter fibre transmits a greater percentage of light (at the same wavelength)

[3]

4. Scientific skills

Answers will be credited according to the learner's demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content but learners should be rewarded for other relevant answers.

A plan that makes reference to:

- a hypothesis/prediction
  - *e.g. As light intensity increases more oxygen bubbles are released indicating that the rate of photosynthesis has increased.*
- equipment, techniques and/or procedures
  - *e.g. equipment*
    - *pond weed*
    - *boiling tube*
    - *water*
    - *light source/ lamp*
    - *ruler*
    - *timer*
    - *heat shield*
  - *e.g. Method*
    - *Leave for five minutes for the pondweed to acclimatise/equilibrate/reach to the new light intensity.*
    - *Count the number of bubbles given off in one minute.*
    - *Move the light 10 cm further back.*
    - *Leave for five minutes for the pondweed to acclimatise/equilibrate/reach again.*
    - *Count the number of bubbles given off in one minute/ collect oxygen in a gas syringe.*
    - *Repeat by moving the lamp away by 10 cm intervals until 50 cm is reached.*
    - *Repeat experiment so that 3 full sets of results have been collected.*

Allow any other valid method
e.g. depth of water as changing light intensity

- risks and hazards
  - *e.g. care with glass ware*
  - *e.g. light source can get hot*
- control variables
  - *e.g. species and size of pondweed, volume of water, temperature*

- dependant variable- how it will be measured, units and the precision of measurements to be taken
  - *e.g. the number of bubbles of oxygen given off in one minute, count with no unit, speed of bubbles could cause issue with precision, bubbles not all of same size/volume, not all bubbles are pure oxygen – some may also contain carbon dioxide (from respiration)*
- independent variable- the range of measurements/ categories to be used and how they will be measured, the intervals to take measurements,
  - *e.g. the light intensity/ distance of light source from the pond weed, distances in cm 10, 20, 30, 40, 50 (5 measurements) measured with a ruler*
  - *e.g. relationship between distance and light intensity (e.g. inverse square law/ reciprocal) or use of light meter*
- data analysis
  - *e.g. collect results in a table*
  - *highlight anomalous results and repeat if possible*
  - *calculate means, excluding anomalous results*
  - *produce graph*
  - *draw conclusion against hypothesis.*