

IB Diploma

BIOLOGY

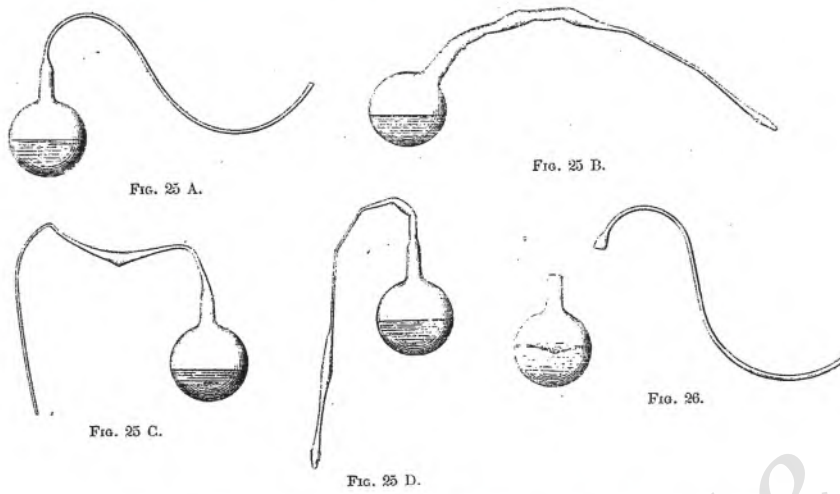
SL P2

2017 — 2024

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1 - (BIOLO/21_SL_Summer_2017_Q2) - Cell Biology, Ecology

Pictured below are Louis Pasteur's original drawings of swan-necked flasks.



[Source: L Pasteur and L Pasteur Vallery-Radot, (1922), *Œuvres de Pasteur*, Vol II Fermentations et générations dites spontanées, pages 260–261]

(a) Describe how Pasteur's experiments provided convincing evidence to falsify the concept of spontaneous generation.

[3]

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(b) State the function of life in *Paramecium* that is carried out by:

(i) cilia.

[1]

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(ii) the contractile vacuole.

[1]

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(c) Discuss the advantages and disadvantages of the use of adult stem cells.

[3]

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(d) Explain the role of decomposers in an ecosystem.

[2]

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2 - (BIOLO/22_SL_Summer_2017_Q2) - *Cell Biology, Human Physiology*

- (a) Glands are organs that secrete and release particular chemical substances. Melatonin is an important hormone secreted in the pineal gland in the brain. Describe its role in mammals.

[2]

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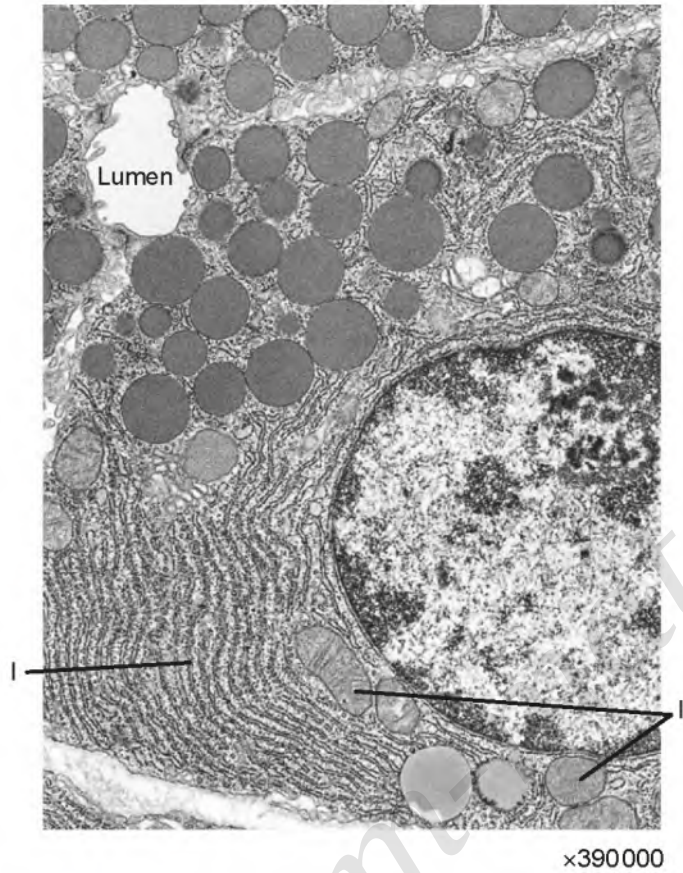
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(b) The electron micrograph shows the structures in an exocrine gland cell of the pancreas.



[Source: Meschner AL, *Junqueira's Basic Histology: Text and Atlas*, 12th edition. Copyright McGrawHill Education.]

(i) State the principal product of this cell. [1]

.....

(ii) Using the table, identify the organelles labelled I and II on the electron micrograph with their principal role. [2]

Organelle	Name	Principal role
I		
II		

3 - (BIOLO/22_SL_Summer_2017_Q3) - Cell Biology

(a) Outline the use of human embryonic stem cells (hESC) to treat Stargardt's disease. [2]

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(b) The most common form of Stargardt's disease is known to be autosomal recessive. Using a Punnett grid, deduce the probability of a child inheriting Stargardt's disease, if both of the parents are carriers of the disease but do not have the disease themselves. [3]

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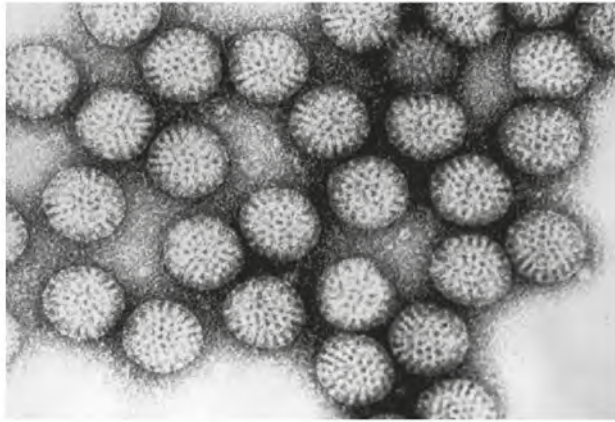
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4 - (BIOLO/20_SL_Winter_2017_Q2) - Cell Biology, Genetics, Human Physiology

The figure shows a transmission electron micrograph of rotavirus particles. Each rotavirus is about 70 nanometres in diameter.



[Source: CDC / Dr. Erskine L. Palmer]

(a) State a reason for using an electron microscope to view this virus rather than a light microscope. [1]

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(b) Rotavirus causes diarrhea and vomiting. Explain why viral diseases cannot be treated using antibiotics. [2]

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(c) State an application of plasmids in biotechnology. [1]

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5 - (BIOLO/20_SL_Winter_2017_Q6) - *Cell Biology, Human Physiology, Genetics*

Reproduction in eukaryotes can be sexual or asexual.

- (a) Describe the origin of eukaryotic cells according to the endosymbiotic theory. [4]
- (b) Explain how hormones are used to control the human menstrual cycle. [8]
- (c) Outline natural methods of cloning in some eukaryotes. [3]

6 - (BIOLO/20_SL_Winter_2017_Q7) - *Cell Biology, Molecular Biology, Ecology*

Plants have widespread influences, from food chains to climate change.

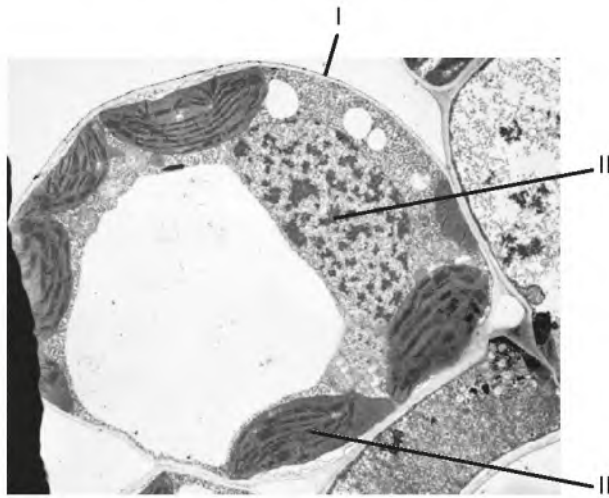
- (a) Draw a diagram of a palisade mesophyll cell labelling only the structures that would not be present in a pancreatic cell. [3]
- (b) Explain the process of photosynthesis. [8]
- (c) Describe the process of peat formation. [4]

7 - (BIOLO/21_SL_Summer_2018_Q5) - *Cell Biology, Ecology*

- (a) Draw a labelled diagram to show the fluid mosaic model of the plasma membrane. [4]
- (b) Unicellular and multicellular organisms share the same functions of life. Outline four functions of life. [4]
- (c) The structure of organisms is based on organic molecules containing carbon. Explain the cycling of carbon in an ecosystem. [7]

8 - (BIOLO/22_SL_Summer_2018_Q3) - Cell Biology, Ecology

(a) The electron micrograph shows a palisade mesophyll cell.



[Source: BIOPHOTO ASSOCIATES/Getty Images]

(i) State the name of the structures labelled I and II. [1]

I.
II.

(ii) Outline the function of the structure labelled III. [2]

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(iii) The plant from which this cell was taken is in the group angiospermophyta. State one characteristic that is unique to this group of plants. [1]

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(b) Distinguish between autotrophic nutrition and heterotrophic nutrition.

[2]

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(c) Explain how energy and nutrients are transferred in ecosystems.

[3]

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9 - (BIOLO/22_SL_Summer_2018_Q5) - *Cell Biology, Human Physiology*

Every cell is surrounded by a cell surface membrane which regulates the movement of materials into and out of the cell.

(a) Draw an annotated diagram of the fluid mosaic model of membrane structure.

[4]

(b) Describe the processes involved in absorbing different nutrients across the cell membrane of villus epithelium cells lining the small intestine.

[4]

(c) Explain the events that occur during a nerve impulse and how the impulse is propagated along an axon.

[7]

10 - (BIOLO/20_SL_Winter_2018_Q5) - *Cell Biology*

(a) The structure of prokaryotic cells has been investigated using electron microscopy. Draw a labelled diagram to show prokaryotic cell structure.

[4]

(b) Outline the reasons for differences between the proteomes of cells within a multicellular organism.

[4]

(c) Discuss the cell theory and its limitations.

[7]

ANSWERS

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1 - (BIOL0/21_SL_Summer_2017_Q2) - Cell Biology, Ecology

a	<p>a. spontaneous generation is life appearing from nothing / from non-living / cells only come from pre-existing cells/life ✓</p> <p>b. broth/culture medium (for bacteria) (used/placed) in flasks ✓</p> <p>c. broth boiled/sterilized «in some flasks» to kill microbes ✓</p> <p>d. no clouding/signs of bacterial growth/reproduction / microbes did not appear «in flasks of boiled broth» ✓</p> <p>e. after necks of flasks were snapped boiled broth became cloudy/growth of microbes ✓</p> <p>f. because microbes from the air contaminated the «boiled» broth ✓</p> <p>g. curved necks allowed indirect exposure to air but prevented entry of microbes ✓</p>	<p>Allow bacteria or organisms instead of microbes.</p>	3 max
b	<p>i movement / locomotion OR feeding/nutrition ✓</p>		1
	<p>ii homeostasis OR maintain osmotic balance / expels «excess» water / maintains «cell» water content ✓</p>		1
c	<p><i>Advantages:</i></p> <p>a. «adult stem cells» can divide «endlessly» / can differentiate ✓</p> <p>b. «adult stem cells» can be used to repair/regenerate «tissues» ✓</p> <p>c. fewer ethical objections «than with embryonic stem cells» ✓</p> <p>d. adults can give «informed» consent for use of their stem cells ✓</p> <p>e. adult source is not killed / «source» would not have grown into new human / no death of embryos used to provide stem cells ✓</p> <p>f. no rejection problems / patient's own cells used ✓</p> <p>g. less chance of cancer/«malignant» tumor development «than from embryonic stem cells» ✓</p> <p>h. most tissues in adults contain some stem cells ✓</p> <p><i>Disadvantages:</i></p> <p>i. difficult to obtain/collect/find in adult body/very few available ✓</p> <p>j. some «adult» tissues contain few/no stem cells ✓</p> <p>k. «adult stem cells» differentiate into fewer cell types «than embryonic cells» / OWTTE ✓</p>		3 max
d	<p>a. saprotrophs/decomposers feed on/break down dead «organic» matter ✓</p> <p>b. saprotrophs/decomposers release energy «heat» accelerating decomposition/warming soil ✓</p> <p>c. saprotrophs/decomposers recycle nutrients / make nutrients available (to producers) OR improves soil fertility / returns nutrients (minerals/nitrates/phosphates/carbon) to soil/water/environment ✓</p> <p>d. saprotrophs/decomposers detoxify waste ✓</p>		2 max

2 - (BIOLO/22_SL_Summer_2017_Q2) - Cell Biology, Human Physiology

a		<p>a. controls circadian rhythms/biological clocks «in mammals» ✓ b. production is controlled by amount of light detected by the retina ✓ c. high production/secretion in the dark OR no production/secretion in the day OR production/secretion is directly proportional to night time duration ✓ d. affects «seasonal» reproduction/sleep-wake cycles/jet lag ✓</p>		2 max									
b	i	«digestive» enzymes ✓		1									
	ii	<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 15%;">organelle</th> <th style="width: 35%;">name</th> <th style="width: 50%;">principal role</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">I</td> <td>rough endoplasmic reticulum OR ribosome</td> <td>protein production/synthesis «for excretion» ✓</td> </tr> <tr> <td style="text-align: center;">II</td> <td>mitochondrion/mitochondria</td> <td><u>aerobic</u> «cell» respiration OR ATP/energy production ✓</td> </tr> </tbody> </table>	organelle	name	principal role	I	rough endoplasmic reticulum OR ribosome	protein production/synthesis «for excretion» ✓	II	mitochondrion/mitochondria	<u>aerobic</u> «cell» respiration OR ATP/energy production ✓		2
organelle	name	principal role											
I	rough endoplasmic reticulum OR ribosome	protein production/synthesis «for excretion» ✓											
II	mitochondrion/mitochondria	<u>aerobic</u> «cell» respiration OR ATP/energy production ✓											

3 - (BIOLO/22_SL_Summer_2017_Q3) - Cell Biology

a		<p>a. «an inherited form of» degeneration of retinal layer/photoreceptor cells/blindness OR eye genetic disorder ✓ b. «hESC/stem cells» can provide/differentiate into healthy <u>retinal</u> cells ✓ c. injecting «hESC/stem cells» into the retina/eye can restore vision in animal/human trials ✓</p>	OWTTE	2 max									
b		<p>a. correct allele identification ✓ «eg: S = dominant/normal; s = recessive/disease»</p> <p>b. correct Punnett grid ✓</p> <p>c. correct phenotypic ratio/outcome ✓</p>	<p>example: s =recessive, disease-causing form of gene, S =dominant, normal form parents =Ss. Any letter can be used as capital and lower case but a legend/key is not required if correct notation is used.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">S</td> <td style="text-align: center;">s</td> </tr> <tr> <td style="text-align: center;">S</td> <td style="text-align: center;">SS</td> <td style="text-align: center;">Ss</td> </tr> <tr> <td style="text-align: center;">s</td> <td style="text-align: center;">Ss</td> <td style="text-align: center;">ss</td> </tr> </table> <p>Do not award mp b if the gametes do not show heterozygous organisms</p> <p>phenotypic ratio: $\frac{3}{4}$ normal : $\frac{1}{4}$ with disease OR 3 normal : 1 with disease OR «75 % normal :» 25 % disease</p>		S	s	S	SS	Ss	s	Ss	ss	3
	S	s											
S	SS	Ss											
s	Ss	ss											

4 - (BIOLO/20_SL_Winter_2017_Q2) - Cell Biology, Genetics, Human Physiology

a	electron microscope has greater resolution/magnification OR 70 nm is too small/viruses are too small to be viewed by a light microscope ✓		1
b	a. viruses are not living ✓ b. viruses lack metabolism/lack enzymes «for metabolism»/lack cell walls ✓ c. antibiotics target metabolic «pathways»/cell wall production ✓		2 max
c	transfer/vector of genetic material/genes/DNA fragments OR to produce insulin/useful protein ✓		1

5 - (BIOLO/20_SL_Winter_2017_Q6) - Cell Biology, Human Physiology, Genetics

a	a. mitochondria and chloroplasts are similar to prokaryotes ✓ b. «host» cell took in another cell by endocytosis/by engulfing «in a vesicle» ✓ c. but did not digest the cell/kept the «ingested» cell alive OR symbiotic/mutualistic relationship «between engulfed and host cell» ✓ d. chloroplasts and mitochondria were once independent/free-living «organisms» ✓ e. DNA «loop» in chloroplast/mitochondrion ✓ f. division/binary fission of chloroplast/mitochondrion ✓ g. double membrane around chloroplast/mitochondrion ✓ h. 70s ribosomes «in chloroplast/mitochondrion» ✓	Allow "taking in" in place of "engulfing" Award up to [2] for evidence from mpe to mph	4 max
b	a. FSH stimulates the development of follicles ✓ b. follicles produce estrogen ✓ c. estrogen stimulates the repair of the uterus lining ✓ d. estrogen stimulates LH secretion ✓ e. LH causes/stimulates ovulation ✓ f. LH causes/stimulates the development of the corpus luteum ✓ g. corpus luteum secretes progesterone ✓ h. progesterone causes/stimulates thickening of the uterus lining OR prepares uterine lining for implantation OR maintains the endometrium ✓ i. progesterone/estrogen inhibits the secretion of LH/FSH ✓ j. falling progesterone levels at the end of the cycle allow FSH production/menstruation ✓ k. negative/positive feedback «control» described correctly ✓ l. LH/FSH are pituitary hormones ✓		8 max
c	a. clones are genetically identical organisms OR group of cells derived from a single parent cell ✓ b. asexual reproduction in plants such as tubers/runners/bulbs ✓ c. common in non-vertebrates such as budding in hydra ✓ d. budding in yeast/fungi ✓ e. identical twins «in humans» are clones because they originate from the same cell ✓	Allow other verifiable examples of plants Allow other verifiable examples of invertebrates Allow other verifiable examples of fungi	3 max

6 - (BIOLO/20_SL_Winter_2017_Q7) - Cell Biology, Molecular Biology, Ecology

a		<p>Allow [2 max] if any features common to both plant cells and animal cells are labelled</p> <p>Must be shown as a double line Labelled either inside or on the membrane</p>	3 max
	<ul style="list-style-type: none"> a. cell wall ✓ b. large vacuole ✓ c. chloroplast/plastid ✓ d. starch grain ✓ e. tonoplast ✓ 		

b		<p>Award only [1] for correct display of equation unless further annotated or explained</p>	8 max
	<ul style="list-style-type: none"> a. <u>autotrophs</u> perform photosynthesis ✓ b. carbon dioxide and water are the reactants/raw materials required for «photosynthesis» ✓ c. light splits water molecules/causes photolysis ✓ d. «photolysis» releases oxygen as a «waste» product ✓ e. light energy is converted into chemical energy ✓ f. «photosynthesis» produces organic compounds/glucose/carbohydrates ✓ g. photosynthesis occurs in chloroplasts ✓ h. chlorophyll «photosynthetic pigment» absorbs light ✓ i. different pigments absorb different wavelengths «of light» ✓ j. chlorophyll absorbs red and blue light/ends of the spectrum ✓ k. carbon dioxide concentration/temperature/light intensity are limiting factors ✓ 	<p>Allow up to [2] for correct use of understandings specified as AHL topic 8</p>	
c	<ul style="list-style-type: none"> a. formed from dead plant material/leaves/mosses/<i>Sphagnum</i> ✓ b. formed in waterlogged sites/bogs/mires/swamps ✓ c. where bacteria/fungi/saprotrophs are not active/are inhibited ✓ d. organic matter not fully decomposed ✓ e. «occurs» in acidic conditions ✓ f. «occurs» in anaerobic conditions ✓ g. «very» slow process/takes a long time ✓ 	<p>Reject anaerobic respiration</p>	4 max

7 - (BIOLO/21_SL_Summer_2018_Q5) - Cell Biology, Ecology

a	<p>Draw a labelled diagram to show the fluid mosaic model of the plasma membrane.</p> <ul style="list-style-type: none"> a. two correctly oriented layers of <u>phospholipids/phospholipid bilayer</u> shown with heads facing in opposite directions ✓ b. phospholipids shown with two parts labelled <u>hydrophilic/phosphate</u> head AND <u>hydrophobic/hydrocarbon</u> tail c. <u>protein</u> (any) shown as a globular structure embedded in one/both layers of phospholipid ✓ d. <u>peripheral protein</u> shown as globular structure at the surface of the membrane AND <u>integral protein</u> shown as embedded globular structures ✓ e. <u>glycoprotein</u> shown as embedded globular structure with antenna-like carbohydrate protruding / <u>carbohydrate</u> shown as a branched/antenna-like structure either on a protein or on a phospholipid OR <u>channel</u> protein(s) shown with a pore passing through it OR <u>pump</u> protein shown as a transmembrane globular structure ✓ f. <u>cholesterol</u> shown in between adjacent phospholipids ✓ 	<p>Do not award the mark unless the structure is labelled with the underlined name.</p>	4 max
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	b	<p>a. nutrition: process by which organisms take in and make use of food//nutrients OWTTE ✓</p> <p>b. metabolism: conversion of organic molecules/chemical reactions in an organism ✓</p> <p>c. growth: increase in size/mass/number of cells within an organism ✓</p> <p>d. response/irritability/sensitivity: reactions/responsiveness to stimuli/factors ✓</p> <p>e. homeostasis: regulating/maintaining constant/stable interior environment ✓</p> <p>f. reproduction: production of similar cells/organisms from existing ones/offspring ✓</p> <p>g. excretion: elimination of (metabolic) wastes ✓</p>		4 max
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	c	<p>a. autotrophs/producers absorb carbon (dioxide) from atmosphere/air/water ✓</p> <p>b. autotrophs make carbohydrates/organic compounds / perform photosynthesis ✓</p> <p>c. carbon (compounds) pass along food chains/trophic levels (as consumers feed) ✓</p> <p>d. respiration releases carbon (dioxide) into atmosphere/water ✓</p> <p>e. carbon (dioxide) is released from dead matter /by decomposition/respiration ✓</p> <p>f. methane is produced during anaerobic respiration of organic matter / by methanogens in cattle/herbivores ✓</p> <p>g. methane is oxidized into carbon dioxide in the atmosphere ✓</p> <p>h. fossil fuels/peat were made from partially decomposed organic matter ✓</p> <p>i. combustion of fossil fuels/forest fires/biomass releases carbon (dioxide) into the atmosphere ✓</p> <p>j. volcanic eruptions may add large quantities of carbon (dioxide) into the atmosphere ✓</p> <p>k. limestone (from shells/reefs)/trees/permafrost are <u>sinks</u> of carbon ✓</p>		7 max
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8 - (BIOLO/22_SL_Summer_2018_Q3) - Cell Biology, Ecology

	a	i	<p>I. cell wall ✓</p> <p>II. nucleus/chromatin ✓</p>	<i>Both needed.</i>	1												
	a	ii	<p>a. necessary for photosynthesis/converts light energy into chemical energy ✓</p> <p>b. contains chlorophyll to absorb light ✓</p> <p>c. (contains enzymes) for production of carbohydrate/glucose/starch ✓</p>		2 max												
	a	iii	<p>a. produce flowers ✓</p> <p>b. enclosed seeds/have fruit ✓</p>		1 max												
	b		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 45%; text-align: center;">autotroph</th> <th style="width: 50%; text-align: center;">heterotroph</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">a.</td> <td style="padding: 2px;">inorganic source of carbon</td> <td style="padding: 2px;">organic source of carbon compounds ✓</td> </tr> <tr> <td style="text-align: center;">b.</td> <td style="padding: 2px;">synthesizes organic molecules from inorganic sources ✓</td> <td style="padding: 2px;">obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓</td> </tr> <tr> <td style="text-align: center;">c.</td> <td style="padding: 2px;">autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓</td> <td style="padding: 2px;">heterotrophs require chemical energy from ingested nutrients ✓</td> </tr> </tbody> </table>		autotroph	heterotroph	a.	inorganic source of carbon	organic source of carbon compounds ✓	b.	synthesizes organic molecules from inorganic sources ✓	obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓	c.	autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓	heterotrophs require chemical energy from ingested nutrients ✓	<i>Table format not required. Must be paired statements.</i>	2
	autotroph	heterotroph															
a.	inorganic source of carbon	organic source of carbon compounds ✓															
b.	synthesizes organic molecules from inorganic sources ✓	obtains organic molecules from other organisms/cannot make organic molecules from inorganic ✓															
c.	autotrophs photosynthesise/require light (or chemicals) for building its own nutrients ✓	heterotrophs require chemical energy from ingested nutrients ✓															

c	<p>a. energy enters ecosystems from the <u>Sun</u> / continuous supply from the <u>Sun</u> ✓</p> <p>b. light energy is converted into chemical energy and lost with movement along food chains OR energy needs to be «constantly» added «to ecosystem» as lost with movement along food chains / energy lost as <u>heat</u> with movement along food chains ✓</p> <p>c. nutrients are recycled within ecosystems / nutrients in an ecosystem are finite and limited ✓</p> <p>d. nutrients not lost but transformed into different compounds ✓</p> <p>e. nutrients «carbon compounds»/energy flow through food chains by means of feeding ✓</p>	3 max
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9 - (BIOLO/22_SL_Summer_2018_Q5) - Cell Biology, Human Physiology

a	<p>a. <u>phospholipid bilayer</u> – with head and tails ✓</p> <p>b. hydrophilic/phosphate/polar heads AND hydrophobic/hydrocarbon/fatty acid/non-polar tails labelled ✓</p> <p>c. <u>integral/intrinsic protein</u> – embedded in the phospholipid bilayer ✓</p> <p>d. <u>protein channel</u> – integral protein showing clear channel/pore ✓</p> <p>e. <u>peripheral/extrinsic protein</u> – on the surface ✓</p> <p>f. <u>glycoprotein</u> with carbohydrate attached ✓</p> <p>g. <u>cholesterol</u> – shown embedded in bilayer ✓</p>	<p><i>Award [1] for each structure clearly drawn and correctly labelled.</i></p> <p><i>Both needed.</i></p>	4 max
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b	<p>a. «simple» diffusion of nutrients along/down a concentration gradient ✓</p> <p>b. example of simple diffusion, eg: fatty acids ✓</p> <p>c. facilitated diffusion of nutrients involves movement through <u>channel proteins</u> ✓</p> <p>d. example of nutrient for facilitated diffusion eg: fructose ✓</p> <p>e. active transport of nutrients against a concentration gradient / involving <u>protein pumps</u> ✓</p> <p>f. example of active transport, eg: (iron) ions/glucose/amino acids ✓</p> <p>g. endocytosis / by means of vesicles ✓</p> <p>h. example of nutrient for endocytosis, eg: cholesterol in lipoprotein particles ✓</p>	4 max
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