Specimen answer 1

June 14 BIOL5 10b

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

10. b)

BIOL 1	BIOL 2	Themes
cardiac cycle	mitosis - G1/S phase	Light
↳ contraction		electrical
		chemical
BIOL 4	BIOL 5	
light → photosynthesis	thermoregulation	
electrical ← respiration	ATP in muscle	
trophic levels	contraction	
	eyes, rods and cones	
	impulses	

Energy can take many different forms, and is an essential component in the maintenance and continuity of life. One form that energy can take is light energy. In this example we will consider the process of photosynthesis, which relies heavily upon light energy in order to work. Without photosynthesis, hexose sugars such as glucose, are not produced and so growth is not promoted. Thus the plant uses in photosynthesis, light energy in the form of photons of light hit the chlorophyll molecules, cause the chlorophyll to become excited. They then emit high energy electrons, which pass down a chain of electron carriers. The energy generated from this transfer is used to combine ADP and Pi to form ATP, a molecule that when split also releases energy.

Electron transport chains also occur in respiration. As before again energy transferred between carriers is used to combine ADP and Pi to form ATP. However, the energy is also used to pump protons from the matrix of the mitochondria and into the inter-

membrane space. Here, proton concentration builds up, establishing a proton gradient across the mitochondrial membrane. This brings me on to the next another form of energy that energy can take – electrical ~~chemical~~ energy. As a result of the established proton gradient, the protons can diffuse back into the matrix through stalked panels in the membrane – the ATP synthase enzyme. As they diffuse down, they generate electrical potential energy, which is ~~equally~~ enough to also combine ADP and Pi to form ATP. ATP is an example of an energy source. It is a molecule that many metabolic processes rely on in order to occur. ATP can be hydrolysed to release energy in a single step reaction. ATP features in the mechanism of muscle contraction. When myosin heads are bound to the actin filaments during contraction, ATP molecules bind to the myosin heads. The energy released from the hydrolysis of ATP causes the head to detach from actin. The head returns to its original position, and then

reattaches to acon but further along. This may not seem significant if we consider an individual unit, but on a large scale where this action is produced simultaneously, it enables the muscle to contract with great force. One example being the heart. ~~Muscles are important. However in order~~ The heart uses impulses, originating from the Sino atrial node (SAN), to cause atrial contraction. In turn, this stimulates the atrioventricular node (AVN) to produce an impulse that travels to the ventricular wall via the bundle of His and Purkinje fibres - leading to ventricular contraction. However, in order for the stimulation and contractions to occur they require impulses. Impulses are in itself electrical energy, passing through nerves at such a pace. The generation of the electrical energy requires the use of ions and chemical gradients. Ions carry charges that enable them to change the membrane potential of axons. The electrically positive charge of Na^+ ions when they diffuse into the axon via sodium channels causes depolarisation. When the threshold

intensity is met, an action potential can occur. It is thus an action potential that is transferred across the axon in the form of an electrical impulses.

Energy in itself cannot be created nor destroyed, but it can be transferred, changing into different forms of energy. ~~One example of energy transfer is seen in the ecosystem. Animals do not~~ However, not all of this energy is actually used, most of it is particularly wasted. An example would be energy transfer in the ecosystem. If we start at the very top of a food chain, we finding that energy ~~is also wasted~~ transfer is inefficient even at the first step. When producers that photosynthesise, not all the light energy ~~the~~ reaches their leaves is used ~~to make~~. Some of the light energy may come in the form of the wrong wavelength, ~~other~~ some simply passes through the leaf due to a lack of photosynthetic pigment in that area. When the producers are consumed by the consumers, energy transfer is also inefficient with the

percentage of energy transfer approximately 2%. This is as a result of factors such as that not all the food is digestible, some of the energy gained is used in respiration and lost as heat, some energy is lost in the form of egestion of faeces. However bacteria, such as saprotrophic bacteria, can fix this energy to form useful products.

If we consider a generic aspects and how energy is involved, we find that mitosis plays an example. Most of the cells are in the interphase stage for most of time, and during the G1 phase the rate of respiration by the cell has increased in order to synthesise and replicate organelles.

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	2	0	Little introduction, no penalty.
2	10	2	0	Good comment.
3	10	2	0	Ignore energy generated.
4	10	2	0	Shows movement and use of energy, addresses title.
5	10	3	0	References to energy change here.
6	10	3	0	A - Not quite enough on ATP.
7	10	3	0	M starts.
8	10	4	0	M - Good theory but not enough energy change.
9	10	4	0	Not related to energy, therefore irrelevant.
10	10	4	0	N - Nerves not linked to theme, needs link to ATP.
11	10	5	0	Ecology, only basic spec knowledge.
12	10	5	0	Ec - Some element of why energy not transferred. Needs ref to food as substrate for respiration.
13	10	6	0	Ignore short concluding paragraph.
14	10	6	20	A-level content in number of topics (4/5) and links to theme. One irrelevant topic. Relational - awarded 20 marks.

Specimen answer 2

June 14 BIOL5 10a

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

10 (a) PLANTS — ANIMALS

- CO_2 stomata — O_2 respiration
- water xylem — CO_2 chemoreceptors
- ions phloem — urea in urine
- O_2 stomata
- mutualistic nitrogen bacteria — CELLS:
- how? diffusion, active transport
- insects - holes in body — glucose levels
- fish - lamellae, counter current system — water levels

homeostasis is very important for cell and organisms. Many exchanges are carried out between the external environment of cells and organisms and their internal environment to maintain their internal environment this may include getting rid of harmful substances to keep a constant internal environment, or it may include taking in necessary substances.

cells are able to make several exchanges ~~that~~ to their external environment via their membranes, the most common being the semi-permeable membrane consisting of phospholipids with hydrophilic heads and hydrophobic tails this allows only certain substances to be exchanged. By containing of intrinsic proteins, protein channels can be used to transport substances such as sodium ~~that~~ from the inside of

the cell to the outside other methods of exchange include diffusion which is the movement from a high concentration to a low concentration such as in the lungs, the movement of O_2 and CO_2 &, osmosis which is to stop cells from bursting or shrinking, water molecules move down a concentration gradient due to such as in fish through the ~~lamellae, the counter current system~~ means a gradient is during cholera where a release of cuende ions lowers the water potential and finally active transport which requires energy, mainly in the form ATP, to pump molecules from a low concentration to a high concentration such as in the axon membrane where sodium ions are, na the sodium-potassium pump, are pumped out of the axon membrane to maintain a negative charge on the inside

Plants also have lots of exchanges
0 with their ~~outside~~ external
environment to maintain their
internal environment. For example,
in photosynthesis plants need
CO_2 to combine with RuBP in
the calvin cycle (in the light independent reaction)
to eventually
produce useful substances such
as glucose which is needed for
respiration. The plants have
stomata which are controlled
0 by guard cells and these
control the opening of closing
the stomata so not too much
water is lost. The CO_2 diffuses in
to the stomata whilst O_2 is
diffused out. The maintains their
internal environment as they
need to keep a photosynthesing to
grow so need to keep exchanging
gases ~~Plants~~

Plants are need to exchange
with the soil for water, and
nutrients the water is moved into
needed for photosynthesis in the light dependent reaction
0

the roots via osmosis and then transported up the plant by the xylem, this movement is helped by the root pressure and cohesive properties of water plants also need mineral ions from the soil which are carried around the plant by the phloem. these ions are needed to produce proteins and amino acids.

insects also make exchanges to their external environment as gas exchange occurs through tiny holes on the outer surface of their bodies. this keeps a constant concentration gradient

Animals ~~oft~~ are constantly carrying out exchanges with their external environment as respiration is a continuous process to keep us alive. we require O_2 the constant gas exchange of O_2 and CO_2 to

keep a diffusion gradient in the ~~to~~ capillaries in the lungs we need the O_2 ~~to me~~ as the final acceptor of the electron transport chain on the membrane of the mitochondria this aerobic respiration ~~causes~~ produces lots of ATP needed in our internal environment for active transport and muscle contraction, these internal environments are very important to keep.

~~Ma~~ Endotherms ~~are~~ ~~Are~~ need to maintain a constant body temperature, when they're too hot, they sweat so the heat from the water is evaporated away. This exchange cools down the mammal so they do not overheat which could possibly cause the positive feedback ~~of~~ of hyperthermia

To conclude, cells and organisms

create many exchanges with their external environment, mainly consisting of gas exchange for respiration or photosynthesis, which are very important for the cells and organisms to stay alive and function effectively

1 5

Senior examiner annotations				
#	Item	Page	Mark/ symbol	Annotation
1	10	2	0	H – Concept only.
2	10	2	0	Re-stating title only.
3	10	2	0	C – Some knowledge but very low level and not addressing title. Not quite enough detail.
4	10	2	0	Significant error. Sodium – not ions. Channels let sodium ions in but they are actively transported out.
5	10	3	0	Lungs mentioned. Not enough to credit L yet.
6	10	3	0	No mention of water potential. Water concentration is poor terminology.
7	10	3	0	Cholera = D. Very little detail so not enough.
8	10	3	0	Chloride ions released but no indication of where to.
9	10	3	0	Reference to Nerves = N.
10	10	4	0	Entire paragraph about photosynthesis is irrelevant.
11	10	4	0	G – But superficial.
12	10	4	0	W – Passage of water through a plant. Mention only, very superficial.
13	10	5	0	Continuation of W but no additional relevant detail.
14	10	5	0	Continuation of W but no additional relevant detail. Combined with earlier G now just about A-level content.
15	10	5	0	G – Superficial.
16	10	6	0	L – Mention only not enough.
17	10	6	0	Could be irrelevant but candidate is trying to link to title so ignore.
18	10	6	0	T – A bit superficial but just enough.
19	10	7	15	A-level content in some topics but no real attempt to relate to theme. Lacking detail in some topics. One irrelevant topic area. Multistructural - awarded 15 marks.

Specimen answer 3

June 14 BIOL5 10b

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

10 b) How energy is transferred within and between organisms

Plan:

- ecosystems energy loss
- nitrogen cycle
- carbon cycle
- ATP
- digestion
- Pacinian corpuscle
- photosynthesis
  - light chemical
- rod cells, cone cells

Energy is transferred between organisms in a number of different ways. Energy transfers is vital for the survival of organisms and for them to carry out specialised processes such as active transport, muscle contration etc and regulation of body temperature. Energy cannot be created or destroyed it is transformed from one form to another.

The sun is vital for survival on Earth for many organisms. The sun provides energy in the form of both heat and light. Photosynthetic organisms such as plants contain leaves with lots of chloroplasts which and a high are full of pigments such as chlorophyll A, B. Light energy strikes ~~other~~ chlorophyll molecules where it excites electrons to a higher energy level. They pass down a series of electron carriers in redox reaction and the energy is used combine ADP with P_i to form ATP. The Thus is called photophosphorylation. Photolysis of water by light splits water into protons, electron and oxygen, this produces reduced NADP. CO_2 enter though stomata and the enzyme Rubisco catalyses the formation of 2 molecules of GSP from CO_2 and RUBP.

TP GP is GAP reduced TP to TP by reduced NADP and energy from ATP. TP can be regenerated to form RUBP and can also be converted to useful organic substances such as glucose. In photosynthesis, light energy from sun is converted to chemical energy in the form of glucose which then passes along food chain.

At each trophic level, there is a loss of energy between organisms and their environment. Firstly, not all light energy that strikes chlorophyll molecule is of the right wavelength and not all light energy strikes chlorophyll molecule, so energy is lost between the sun and producer. Energy is also lost between consumers as not all of the organism is eaten, for example the roots in plants or bones of animal. Not all of organism can be digested, for example cellulose in plants, and is excreted, lost in faeces. Energy is also lost between an organism and its environment due to respiration and maintenance of body temperature but also during movement. Energy is transferred between consumers, producer and their

environment in many ways, and energy is converted into a number of different forms.

In carbon cycle, when organisms die, saprobionts release enzymes that break down organic matter. They absorb products of digestion by diffusion, then when they respire, they release CO_2 into the atmosphere. Energy is also transferred when fossil fuels are burnt as they release CO_2 and methane.

In Nitrogen cycle, nitrogen fixing bacteria convert nitrogen gas from atmosphere into nitrogen. In process of ammonification, saprobionts release enzymes that break down nitrogen containing compounds such as urea into ammonium ions, this is an example of energy transfer. Nitrifying bacteria can then oxidise ammonium ions to nitrite ions then nitrate ions, which can be absorbed by plants, and nitrate nitrogen used by plants for protein synthesis.

In living organisms, there are receptors on cell surface membranes such as the Pacinian corpuscle. The pacinian corpuscle converts mechanical energy into electrical energy. In a Pacinian corpuscle pressure

& causes sodium ion channels to stretch and change shape. This causes sodium ions to enter causing depolarisation and creation of an action potential, which is then transpated along sensory neurones to the CNS. Other receptors include rod cells and cone cells which also act as transducers. They Rod cells display when light is detect. in black white, while cone cells display in full colour. Rod cells Several rod cells are connected to one bipolar neurone, therefore they have poor visual acuity compared to cone cells where each cone cell is connected to one neurone. Rod and cone cells are sensitive to light and are photoreceptor that convert light energy into nerous, electrical impulses, which then pass to optic nerve.

ATP, adenosine triosphosphate, is produced in both the stroma and cristae by oxidative phosphorylation and photophosphorylation. ATP is an immediate energy source, that cannot be stored and is broken down by a single one step reaction. The energy transfer when an ATP molecule is hydrolysed, is used in many processes

including active transport and muscle contraction. Hydrolysis of ATP transfers energy which is vital in muscle contraction for the 'power stroke' movement and the crossing over of actin, myosin filaments but is also very important in the detachment of actin myosin cross bridges.

There is a transfer of energy in digestion as polymers in food which are insoluble and cannot be directly absorbed into the blood and assimilated, are broken down into monosaccharides. Proteases break down proteins into amino acids, carbohydrases break down ~~glycogen~~ polysaccharides into monosaccharides such as glucose. These can products can then be absorbed into to the blood where they can be used by body. Chemical energy in glucose can be converted into to heat energy or other forms of energy during respiration, this can be used by the ~~food~~ body to maintain regular body temperature and constant internal environment (homeostasis).

In conclusion, the transfer of energy from one ~~one~~ form to another is vital

for the survival of organisms

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	1	0	Plan viewed, no creditable material.
2	10	2	0	Introduction. Do not view as irrelevant material.
3	10	2	0	P - Idea of light energy to chemical energy.
4	10	2	0	P - Correct reference to photolysis and using energy from ATP and reduced NADP to form glucose in light-independent reaction.
5	10	3	0	Et - Correct references to loss of energy between trophic levels and the different ways in which this occurs.
6	10	4	0	Irrelevant material about nutrient cycles.
7	10	4	0	Sr - Pacinian corpuscle converting mechanical energy into electrical energy.
8	10	5	0	Sr - Correct reference to the functioning of light receptors transferring light energy into electrical energy.
9	10	6	0	Correct material about chemical energy from ATP being converted into movement energy and used in active transport. The error in referring to both the stroma and the cristae as the site of ATP production is not a significant error so does not negate.
10	10	6	0	Mc - Noted as a topic however insufficient material.
11	10	6	0	D - Glucose produced as a result of digestion can then be converted into other energy forms eg heat to maintain body temp.
12	10	7	0	Following theme using examples (holistic) - directly addressing theme. One irrelevant passage but, on balance, offset by content. Nothing detailed beyond specification. Extended abstract - awarded 22 marks.

Specimen answer 4

June 14 BIOL5 10a

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

plan.

respiration ✓

photosynthesis ✓

homeostasis – endotherms exotherms ✓

tissue fluid ✓

diabetics – glucose conc.

Homeostasis is defined as maintaining a constant internal environment, this includes heat regulation. In an endotherm (organisms capable of producing their own heat) this is fairly simple, if the core temperature rises the hypothalamus (heat centre) in the brain stimulates the capillaries nearest the skin to allow more blood to pass through them, this is known as vaso-dilation causing the skin to heat up, the sweat glands also sweat and this evaporates, reducing the core temperature. Exotherms cannot do this, they are entirely dependent upon their environment ~~heating their body~~ for their temperature, to do this they will be more active and during [illegible] to cool themselves will be in the shade, many lizards and other reptiles are [illegible] which is why many are found in warm countries.

Respiration is another exchange organisms and cells do to maintain their internal environment. a bi-product of respiration is heat, respiration produces ATP which is vital in maintaining a constant internal environment as it is used for movement and growth. Respiration has a number of processes, the first of which is glycolysis which involves turning glucose ~~and~~ into pyruvate, each molecule of pyruvate produces one molecule of ATP and one molecule of NADH, pyruvate is then used in the link reaction to produce acetylcoA and then the

Turn over ▶

Krebs cycle uses this to generate a 4 carbon molecule this cycle also produces ATP. The last stage of respiration is the electron transport chain which relies on gaseous exchange between the lungs and the external environment as respiration requires oxygen and produces CO_2 and through gaseous exchange CO_2 is expelled and O_2 diffuses into the blood.

In plants, which can also respire, there is another way of producing useful organic substances and this is photosynthesis the equation of which is entirely opposite to that of respiration.

$$CO_2 + H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + O_2$$

Through pores in the epidermis of the leaf (known as stomata) CO_2 diffuses into the leaf and it diffuses out of the leaves in the first stage of photosynthesis (the light dependent reaction) light is required and is absorbed by the leaves, this is under control of leaf cells and organisms are adapted in their natural environment as plants need light in order to carry out photosynthesis.

Cells within organisms (mostly animal cells) are surrounded in tissue fluid, through diffusion the cell exchanges all needs from the tissue fluid i.e. minerals and O_2

and is able to get rid of waste i.e CO2, without tissue fluid the cells would quickly die they could not respire. tissue fluid is formed using the products absorbed via ~~co~~ digestion, this is another way that organisms and cells are coping out working with their ~~ext~~ external environment in order to maintain their internal environment. food comes from the external environment i.e crops, animals and the eating and digestion of these helps to maintain the blood-glucose concentration. To stress the importance of exchanges with the external environment it is vital to look and be cautious of when this does not occur. Diabetics, who cannot produce insulin or have become almost immune to insulin, because of this the glucose from digestion cannot be stored and therefore is not absorbed, ~~and so is excreted in the urine~~ (because it does not diffuse into the epithelial cells, as there is a high concentration of glucose in the blood) and so the glucose is excreted in the urine. This can result in loss of limbs and even death.

in conclusion the exchange of between external and internal environment can be seen in almost all living organisms, without which life would not be possible

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	1	0	Pan noted.
2	10	2	0	Homeostasis topic noted, no detail.
3	10	2	0	T - Temperature topic noted, heat loss via sweating but no mention of heat energy being required for evaporation. Possible significant error – capillaries do not control blood flow to skin.
4	10	2	0	Respiration irrelevant.
5	10	3	0	G - Gas exchange noted.
6	10	3	0	Photosynthesis is irrelevant.
7	10	3	0	G - Gas exchange again, still not enough detail.
8	10	4	0	Tf - Tissue fluid topic noted and some weak A-level content.
9	10	4	0	D – Digestion topic noted but no detail.
10	10	4	0	B - Control of blood glucose concentration topic noted, insufficient detail.
11	10	4	11	Some superficial A-level content. Irrelevant topics. Does try to deal with number of topics - so elements of multistructural. Borderline between unistructural and multistructural - awarded 11 marks.

Specimen answer 5

June 14 BIOL5 10b

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

predator prey food
trophic level
respiration
photosynthesis
digestion of carbs
muscle contraction
Active transport - ATP
ATP - anaerobic
aerobic
mitochondria
light

ATP (adenosine triphosphate) is the human body's main source of energy. This is because it is readily available in muscle cells.

ATP can be used in aerobic and anaerobic respiration. ATP is resynthesised from ADP + Pi + energy. ATP is used in the glycolysis stage of respiration. 2 ATP molecules are ~~made~~ used and 4 molecules are produced. This is then transferred out of the muscle sarcoplasm by diffusion.

ATP is used in active transport to move ions from areas of high concentration to areas of lower concentrations. The ATP diffuses across and binds to the receptor on certain proteins such as the sodium-potassium pump. This provides the pump with energy to move sodium and potassium ions in and out of the cell.

The digestion of carbohydrates and other food transfers energy throughout the body. The food is broken down to release glucose which is a sugar energy source. This glucose is used in respiration and is transferred ~~through~~ by the blood to respiring

tissues. If the glucose is not needed it is transported back to the liver or muscle cells and converted into glycogen where it remains, readily available to be broken down back into glucose. The energy is transferred from the food into the respiring cell.

* This is called glycogenesis

Producers, such as plants, use sunlight as their main source of energy. They make the light into glucose, via photosynthesis, which can be used by other animals/organisms. The light independent reaction uses CO_2 and ATP and reduced NADP from the light dependent reaction to produce glucose. The CO_2 combines with Ribulose biphosphate (RuBp) to form GP. The ATP and reduced NADP are used to convert GP to TP. One phosphate from the TP is used to make useful organic substances, such as glucose. The TP is then converted to RuBp. This is the Calvin cycle and must occur 6 times to make 1 glucose $6(C_6H_{12}O_6)$.

This glucose is then eaten by other organisms which are primary consumers.

The primary consumers are then eaten by secondary consumers and so on until there is a top predator, such as the humans, which are not hunted by any predators. These levels are called trophic levels. During each trophic level energy is transferred in the form of glucose in muscles and other soluble compounds. The energy transfer between each level is not very efficient as there are areas that cannot be eaten, such as bones, and not all the energy is stored. Some of the energy is excreted as not all of it can be digested. The transfer between the sun and producers is the least efficient as some of the waves are of the wrong wavelength, or don't not strike the chlorophyll or are reflected back into the atmosphere.

In humans energy is transferred back to the atmosphere as heat. When a person sweats, their capillaries dilate, known as vasodilation. This causes them to come to the surface of the skin so heat is radiated off out. Energy is also lost

a) sweat when a person becomes

too hot

10

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	2	0	A – ATP included but not in context of energy transfer.
2	10	2	0	Significant error – high to low.
3	10	2	0	No – No reference to nerves but the only place in the spec where sodium potassium pumps are mentioned, so accept.
4	10	2	0	D – Digestion – not enough detail.
5	10	2	0	Ab – Absorption – idea of glucose transferred into cells but weak content.
6	10	3	0	P – Photosynthesis – A-level content.
7	10	3	0	Significant error here relating to GP and TP. Phosphate from TP is not used to make glucose.
8	10	4	0	Ec energy transfer – some A-level content.
9	10	4	0	P – superficial photosynthesis.
10	10	4	0	Not relevant – energy transfer to atmosphere, not within/between organisms.
11	10	4	0	Significant error.
12	10	5	10	Number of significant errors and an irrelevant passage. Only a couple of topics with any real A-level content - linked to generally poor terminology. Unistructural - awarded 10 marks.

Specimen answer 6

June 14 BIOL5 10b

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment. **[25 marks]**

OR

10 (b) How energy is transferred within and between organisms. **[25 marks]**

If you want to make a plan write it here.

Trophic levels – consumption

Sun →

loss energy

ATP produced during

respiration → energy for muscle contraction

via coenzymes

chemical energy

Nitrogen cycle

death of cells → saprobiotic

many fossil fuels → energy-warm

photosynthesis via

coenzymes release

Energy transfer is the movement of energy. Energy can be in multiple form such as mechanical energy, food energy, light energy.

Energy from the sun / light energy is absorbed by the chloroplasts in the process of photosynthesis. Energy is therefore transferred from light energy to chemical energy. Food chains and food webs result in energy transfer between different trophic levels. For example energy transfer can take place between producer (plants) and primary consumers. The consumption of energy via eating means energy is transferred from 1 trophic level to the next however it is the process of digestion and enzymes such as salivary amylase that break down the energy within our body so it can be transferred around the body as glucose in the blood stream to provide energy. Energy transfer can also be transferred between trophic levels primary consumer to secondary consumer and secondary consumer to tertiary consumer. all of this energy transfer takes place due to digestion.

The carbon cycle and other cycles in biology transfer energy. death of organisms eg plants consumed by saprotrophic microorganism therefore result in energy being transferred to the microorganism. Moreover

energy can also be transferred due to an absence of saprobiotic microorganisms and damp conditions dead plants and animals become fossil fuels the process of combustion releases the energy stored in fossil fuels. This can be used as energy for vehicles or warmth be transferred to heat energy which would then be transferred to humans to keep them warm

ATP produced during respiration is a way energy is transferred in the body. The breaking of a phosphate bond by ATPase from ATP provides energy such as for muscle contraction However this energy is produced due to respiration during the final stage of respiration the electron transport chain due to the movement of H+ ions down the concentration gradient ADP and Pi combine near ATP synthase. ATP is then transferred around the body and used as an immediate energy source for cells to carry out metabolic processes To produce ATP energy transfer occurs from the respiratory substrate glucose and oxygen. Photosynthesis also transfers energy however in photosynthesis energy is transferred originally from light to coenzymes such as NADP and then form organic substances ~~such as glucose~~ Glucose is used for energy transfer and also for

originally from light energy

photosynthesis requires light energy to make glucose

respiration the consumption of plants by humans provides them with glucose which provides them with chemical energy. When the body coenzymes marker energy eg reduced NAD produces 3 ATP molecules compared to FAD which produces 2 ATP molecules during respiration

One organism can stimulate each other for example if a dog was to bite a human stretch pressure receptors on the skin would detect pressure Pacinian corpuscles detect mechanical energy therefore another organism stimulates an action potential to be generated and thus increase the conversion of the mechanical energy stimulus to chemical energy in the body

As previously mentioned with the body energy is transferred to the cells via ATP. However after consumption of human food and its breakdown energy is transferred in the blood as glucose molecules. Glucose enables respiration to take place however the rate of transfer with the body of glucose is dependent on its rate eg. insulin decreases the rate of glucose available for transfer around the body As it has detected a high level of glucose hence glucose is converted to glycogen limiting the availability

and between proteins such as myosin the matrix of mitochondria to the cytoplasm

of energy for transfer.

Overall there are multiple methods of energy transfer and are similar in plants and animals and microorganisms such as ATP and the process of respiration 0 the transfer of energy also results in conversion of energy from one form to another between organisms to a more 1 2 useful form for the receiver of energy eg. light to chemical energy in the process of photosynthesis.

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	2	0	Idea of energy transfer through ecosystems just about enough, but would look for more detail.
2	10	3	0	Idea of carbon cycle and fossil fuels here considered relevant.
3	10	3	0	Use of ATP in energy transfer just about enough.
4	10	3	0	Idea of respiration energy transfer just about enough.
5	10	3	0	Significant error – idea that ATP is transferred around the body.
6	10	3	0	Idea of energy transfer light to chemical in Photosynthesis.
7	10	4	0	Idea of mechanical energy transferred to chemical energy noted under stimulus response for breadth, but not enough detail.
8	10	4	0	Significant error again energy transferred into cells as ATP.
9	10	5	0	Nothing irrelevant in this section, but nothing to credit either.
10	10	5	12	A-level detail and mostly suitable topics. However, significant errors and one irrelevant passage. Multistructural - awarded 12 marks.

Specimen answer 7

June 14 BIOL5 10a

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

Transpiration

Respiration

Gas exchange in lungs

Homeostasis

Carbon/nitrogen cycle

~~Energy is transferred between organisms in many ways~~

In order to ~~prevent~~ maintain their internal environment, and ~~the~~ allow the organism to maintain homeostasis, they must maintain a relationship with their external environment which will provide energy, food sources, gases and many other substances to do this. One example of how this works is homeostasis involving blood temperature. When the blood temperature is too high, the hypothalamus in the thermoregulatory centre of the brain is notified. The hypothalamus responds by informing the heat loss centre. This then reduces the heat of the blood by ~~increasing~~ widening the arterioles near the surface of the skin, which allows blood to flow closer to the surface. This allows ~~more~~ heat to be lost through convection to the external environment, which is cooler than the internal temperature. Temperature is also reduced by sweating, which reduces skin temperature by water droplets on the skin evaporating, which further reduces temperature. ~~En~~ Ectotherms

cannot self regulate their body temperature, instead relying solely on the external environment to aid them. Their body temperature is reduced or increased by behaviors such as basking, moving in and out of water and skin color (black absorbs most heat).

Another way in which internal environment is maintained is through the transpiration stream in plants. The transpiration stream is a stream of water which leaves the plant through the stomata, found on the underside of the leaf. This transpiration stream drags water up through the xylem vessels of the plant, which is dead and hollow. The loss of water allows the pressure to drop, more water through the roots, containing numerous essential to plant growth. This happens through the xylem.

Another main factor in maintaining homeostasis is using the external environment is the taking in of oxygen and breathing out of carbon dioxide in respiration. Respiration helps maintain the internal environment by providing an

energy source, ATP, to achieve homeostasis and muscle contraction, among other things. Respiration occurs in the mitochondria of the cells, ~~[illegible]~~. Oxygen, which is taken in through the lungs is used as a final acceptor in the electron transport chain, so that electrons can be returned to the protons to regain. The carbon dioxide produced by respiration is also returned to the air as it must be removed by the body to maintain internal environment, as it is poisonous ~~[illegible]~~ large quantities.

Another way in which internal environment is maintained is again based on CO_2. In order to ~~maintain~~ maintain internal environment the CO_2 created as goes into the carbon cycle. The carbon cycle is also a way in which plants get the carbon dioxide they need to photosynthesise, which again provides energy for maintaining homeostasis.

~~[illegible]~~ The nitrogen cycle is another important way in which organisms ~~[illegible]~~ maintain homeostasis. Nitrogen

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	2	0	T – Temperature control. A-level detail but not enough explanation of how evaporation reduces blood temperature.
2	10	3	0	Relevant but not A-level detail.
3	10	3	0	W – Passage of water through plant. Ignore dead and hollow centre of the tree as this probably refers to xylem. Not enough detail.
4	10	3	0	L – lung function – No A-level detail here.
5	10	4	0	This is irrelevant. Goes too far beyond the scope of the title.
6	10	4	0	Nc – Nutrient cycles – Relevant selection but not enough detail.
7	10	4	9	Some A-level material but only in one/maybe two topics and a lot that is superficial. Some irrelevant material. Unistructural - awarded 9 marks.

Specimen answer 8

June 14 BIOL5 10b

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

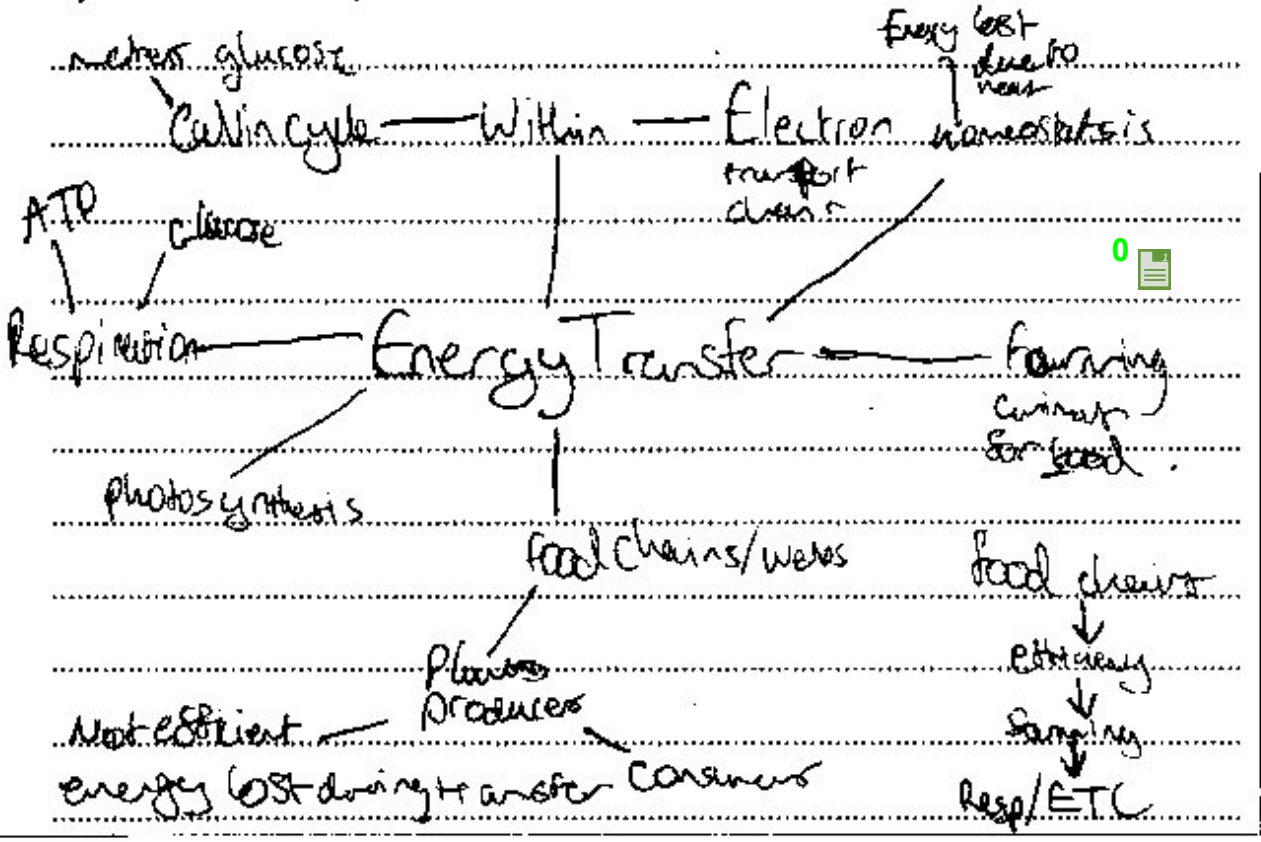
[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.



Energy transfer occur all the time between organisms, one of the ways in which energy is transferred between organisms is through food webs and chains. The first part of a food chain is the sun, the sun provides light energy so that plants can photosynthesise and produce convert energy into growth. This is relatively inefficient process as much light does not even reach the chloroplasts. Just under 2% of the light energy from the sun is converted into growth by plants. Plants convert this light energy into growth, when light hits the chlorophyll, electrons get excited and are emitted, there they undergo a series of oxidation and reduction reactions, the energy lost by ~~these reactions~~ the electrons is ~~converted into ATP~~ used to combine ADP + Pi to form ATP, which is an energy source. Following this the light-independent reaction occurs which uses ATP from the light-dependent reaction to form Triose Phosphate. This is formed when Ribulose bisphosphate and CO_2 react to form Glycerate-3-phosphate, ATP and reduced NAD ~~reduced NAD~~ are used to convert this into Triose phosphate, this is used to make glucose, which is used in respiration as a source of energy.

During respiration glucose is broken down into ~~pyruvate~~ pyruvate, using NAD, also energy from this reaction ~~is~~ combines ADP+Pi to form ATP. Energy is also transferred during the electron transport chain where ATP is formed at various stages using the energy ~~transferred~~ transferred. During respiration some energy is also transferred into heat energy.

After the producers in the food chain there are consumers, they eat the plants, so that they can transfer the energy into growth. Consumers eat the plants which contain proteins and carbohydrates. Starch and other carbohydrates are broken down in the ~~saliva~~ mouth, by enzymes in the saliva such as amylase. Starch is broken down into maltose, which can be broken down into glucose for use in respiration.

Endotherms that maintain their own body temperature often ~~have~~ require more energy as more energy is transferred into maintaining body temperature. This is one of the reasons why to increase the efficiency of energy transfer in agriculture, intensive farming is used.

animals are ~~reared~~ reared in cramped and warm conditions, to reduce muscle contraction and to keep environment temperature close to the optimum body temperature. Muscle contraction is one way in which energy is transferred as ATP is required to form crossbridges between myosin and actin and detach them, so reduced muscle contraction leads to increased efficiency.

Energy is also required by active processes such as active transport, which requires ATP to be broken down to release energy, so that ions can be taken up. Such as in an action potential when the sodium-potassium pump ~~takes~~ takes over, pumping sodium out and potassium ions in.

Overall energy is required for a variety of processes and is ~~transfe~~ transferred in many different ways between organisms and within them.

1 8

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	1	0	Plan noted.
2	10	2	0	Ec – Energy transfer through ecosystems noted but not enough detail.
3	10	2	0	Photosynthesis LDR detail.
4	10	2	0	P – Photosynthesis LIR.
5	10	3	0	R – Respiration noted and ETC.
6	10	3	0	Ec again – combined with first paragraph now sufficient detail.
7	10	3	0	D – Digestion noted but not enough detail.
8	10	4	0	F- Food production noted but not sufficient detail.
9	10	4	0	Mc – Muscle contraction and along with food production above is given credit.
10	10	4	0	N – Nerve impulses noted but no real detail.
11	10	4	18	Several topics linked to title/theme. A-level detail in some and no significant errors - or irrelevant material. Relational - awarded 18 marks.

Specimen answer 9

June 14 BIOL5 10a

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

~~Energy transfer – Nitrogen cycle~~

Cell exchange with environment. Transpiration → Ventilation

Respiration

Photosynthesis

Breakdown of food

Cellular exchange – diffusion

– Active transport

Homeostasis

Plan

10a) How cells and organisms keep in exchange with their external environment to maintain their internal environment.

It is important that organisms can regulate their internal environment in order to provide optimum conditions for internal reactions. The maintenance of a constant internal environment is known as homeostasis. Regulating internal conditions increases organism's chance of survival as it means that the organism can grow and reproduce at the optimum level.

One way in which plants maintain their internal environment is through transpiration. Water is absorbed through the roots of the plant via the root hair cells and travels up the xylem via a series of hydrogen bonds. Water evaporates from the leaves and as the water molecules inside the xylem are bonded together in a chain, the evaporation causes more water molecules to be dragged up the plant to replace those lost from the leaves.

Transpiration ensures that water is available for photosynthesis and for maintaining the turgidity of cells. By balancing the amount of water that evaporates from the leaves with the amount of water that is absorbed through the roots it ensures that the plant does not become dehydrated.

This brings us on to cell turgidity. It is important that plant cells remain turgid (or firm) in order to maintain the structure of the plant. The water potential inside

the cells must remain steady. If the water potential
falls, the cell may shrink. If the water potential
when the cell was placed in the water potential inside
the cell were too high it could burst. In this case water
would leave the cell via osmosis.

Another way in which plants interact with
their external environment is through photosynthesis.
When light hits a plant leaf it is absorbed by a chlorophyll
molecule. ~~Then~~ A pair of electrons within the molecule
become excited and are raised to a higher energy level.
They enter the electron transport chain, where each electron
causes an ATP to lose energy level from the process
Once, the energy is released as the electrons travel across the
chain. This energy combines ADP and Pi to form ATP.
The final electron carrier is NAD. The electrons along with
hydrogen from the splitting of water (by daylight) reduce
~~NADP~~ to NAD to ~~&~~ NADH. ~~This is then used to reduce~~
This is then used to reduce CO2 to TP in the next stage
of photosynthesis, the light independent reaction, which
requires CO2. Photosynthesis is important because it
provides glucose which is an energy source for the plant.
It involves gaseous exchange with the environment as
CO2 is taken in and O2 is given out as a waste product of
the light independent reaction.

Animals gain energy through the breakdown

Do not write outside the box

of food into glucose which is then used for respiration. The Food is broken down by ~~enzymes first by~~ enzymes - first by amylase in the saliva and then by digestive enzymes in the gut. Glucose is absorbed into the blood through the lining of the small intestine by diffusion and active transport proteins. Glucose can then be used as immediate energy source for respiration or converted into glycogen and stored as glycogen. Glycogen is a long-term energy store in the liver.

One aspect of the internal environment that needs to be maintained is temperature. ~~If temperature rises~~ At high temperatures provide kinetic energy for enzymes, increasing the frequency of their collisions with substrates and therefore increasing the number of enzyme-substrate complexes that are formed. This means that reactions happen faster. However, if the temperature is too high enzymes become denatured as are the bonds that fold them. The tertiary structure is broken and the active site changes shape. ~~Enzymes~~ Therefore an organism must exchange heat with the external environment of temperature. [illegible] which is detected by thermoreceptors in the hypothalamus, which measures blood temperature. Signals are sent to effectors in the skin to cause vasodilation, which [illegible] to increase heat loss through radiation, and sweating. Sweating involves the loss of water to the external

Turn over ▶

environment. The water evaporates from the stomata leaving
sodium chloride behind.

Red blood cells exchange oxygen with the
external environment. The pigment haemoglobin combines
with O_2 in the blood to form oxyhaemoglobin. The 0
is carried around the body by the red blood cells.
Every blood cell has the oxygen released for
cellular respiration.

Respiration is probably the most important
example of exchange between organisms and the environment,
because it provides the energy needed for growth, repair,
internal reactions and cell division. Glucose is converted
into pyruvate during glycolysis which forms a net
product of 2 ATP molecules. Pyruvate then goes 0
through the Krebs cycle ~~where it is converted~~
~~to acetyl coA~~ in the Krebs cycle NAD and
FAD are reduced and finally ATP is produced. The
NADH and FADH continue to the electron transport
chain where the hydrogen that they carry provides
electrons and protons that travel from one electron
carrier to the next. Energy is released from each
electron carrier and is then used from the
last. This is the chemiosmosis process 14

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	1	0	Plan noted.
2	10	2	0	H - Homeostasis noted but no detail.
3	10	2	0	W - Passage of water through a plant noted and transpiration idea.
4	10	3	0	C – Cells noted, idea of turgidity.
5	10	3	0	Respiration irrelevant.
6	10	3	0	G – Gas exchange noted but not enough detail.
7	10	4	0	D – Digestion noted and idea of glucose release from food to be absorbed.
8	10	4	0	T – Temperature control noted and detail on temperature regulation. Section above about enzymes not creditworthy, but not regarded as irrelevant as it is linked to the following passage.
9	10	5	0	C- Cells noted, but no detail given (could also be credited under Tf – tissue fluid).
10	10	5	0	Respiration irrelevant.
11	10	5	14	A-level detail in some topics but not really addressing the theme of the essay, or interrelated. One irrelevant topic area but no significant errors. Multistructural - awarded 14 marks.

Specimen answer 10

June 14 BIOL5 10a

10 Write an essay on **one** of the following topics.

EITHER

10 (a) How cells and organisms carry out exchanges with their external environment to maintain their internal environment.

[25 marks]

OR

10 (b) How energy is transferred within and between organisms.

[25 marks]

If you want to make a plan write it here.

Plan

1 → diffusion

→ osmosis

→ active transport

→ lungs

→ plant exchange

→ fish

→ insects

→ plants →

10a. Most organisms have to exchange gases in order to produce energy for processes in the body by respiration and/or photosynthesis.

Mammals have lungs which are the exchange surface for gases. Air is taken in by the lungs due to a decreased pressure in the thorax created by the movement of the diaphragm which moves down and out. The air then travels through the structure of the lungs to the alveoli where oxygen diffuses into the blood in the capillaries of the alveoli and CO_2 diffuses out of the blood and is removed during exhalation.

Fish have gills which is their gaseous exchange surface. Fish take in water through their mouth which then passes over the gills. Lamellae on the gills contain lots of capillaries to produce a rich blood supply. The water passes over the lamellae in the opposite direction to the flow of blood. This countercurrent system means that more oxygen is removed from the water as diffuses into the blood. This is because a high concentration

gradient is constantly be maintained over the whole surface of the ~~fish~~ lamellae. ~~It~~ In this way 80% of the available Oxygen is removed from the water. ~~It~~ Water has high ~~content~~ Concentration as it passes over the gill and the blood has a very low concentration of oxygen as Oxygen diffuses into the blood it is carried away into the opposite direction to the water So the water is always at - high concentration of oxygen compared to the concentration of oxygen in the blood. CO_2 also diffuses out of the blood into the water and is carried away from the fish and transport it.

Insects take in air through tracheoles which go in throughout the insects body to all cells so oxygen diffuses directly into the cells that need it. as insects don't have blood to carry oxygen round their bodies.

Plants taken in ~~Co~~ and give out O_2 and CO_2 through stomata which are gaps in the leaves of the plant. Guard cells on either side of the stomal pore control the amount of gases

that enter and leave the leaf. They also control how much water is lost through transpiration.

Plants require lots of CO_2 to photosynthesis so when it is light plants take in lots of CO_2 from their external environment. In photosynthesis O_2 is produced as well as energy which is then given out to the surroundings as it diffuses out of the leaves or it is taken up and used for respiration.

Plants require water, ions and minerals from the soil for for processes in the plant: ions are actively transported into the root hair cells of plants and water diffuses by osmosis into these cells due to these having a lower water potential inside the cell than outside of it.

The active transport of ions requires ATP as it is going against a concentration gradient. ATP is produced in respiration and photosynthesis.

0

0

15

Senior examiner annotations				
#	**Item**	**Page**	**Mark/ symbol**	**Annotation**
1	10	2	0	
2	10	2	0	L – Lung function but there is limited A-level detail of pressure changes.
3	10	2	0	G – Gas exchange. Includes detailed explanation of fish, insect and plant gas exchange.
4	10	4	0	W – Passage of water through plant. Good detail of absorption of water by osmosis into root hair cells.
5	10	4	0	C - Cells. Relevant selection but not enough detail for further credit.
6	10	4	15	A bit limited in scope with 4 topics but A-level content - if often limited in detail. Not really interrelated, or addressing the theme of the essay in a coherent fashion. Multistructural - awarded 15 marks.