MYP MAY 2016
BIOLOGY ON-SCREEN EXAMINATION

Exemplar Marked Candidate Responses

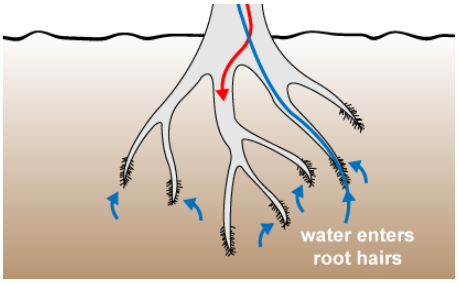
This document contains exemplar material which demonstrates how the markscheme was applied to two student responses for the May 2016 session. Teachers should consider the application of the marksheme and in particular the assessment of longer, open ended responses. Teachers may wish to mark the student response themselves using the published markscheme and then compare their marking to the standard demonstrated in this document.

Question 1 (10 marks)

Living cells and organisms exchange materials with their environment.

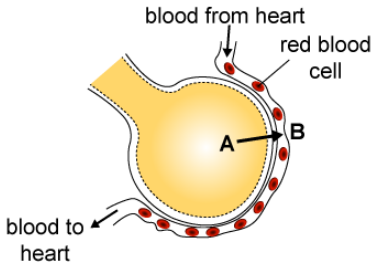
Question 1a (2 marks)

Select the option describing the transport mechanism in the diagrams below.



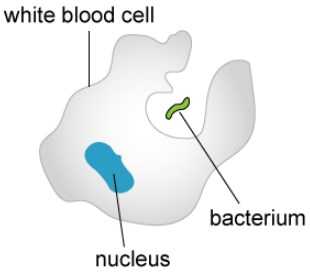
Water is taken up by root hair cells.

Osmosis



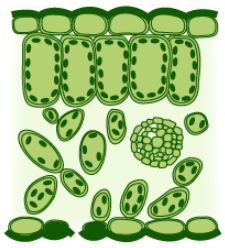
In the lungs oxygen is taken up into the bloodstream.

Diffusion



A white blood cell taking in bacteria.

Neither



Oxygen is given out by the leaf cells.

Neither

1/2

Question 1b (1 mark)

Oxygen is carried by red blood cells. **State** the name of the organ system which carries blood through the human body.

cardiovascular system

1/1

Question 1c (2 marks)

Using scientific terms, **outline** why the uptake of oxygen from the lungs into the bloodstream does not require energy.

This process is going because of differences of concentrations of gases such as oxygen and carbon dioxide. This difference causes t he diffusion to occur there.

0/2

Question 1d (1 mark)

Besides oxygen, the blood in the circulatory system also carries messenger substances called hormones. **State** the name of another system that transmits signals in the human body.

nervous system

1/1

Question 1e (4 marks)

Select one of the senses.

- sight
- hearing
- taste
- smell
- touch

Explain how this sense and the transmission of signals inside the human body leads to responses which help us to survive. You should refer to an example of a survival situation in your answer.

It can help you to survive when, for example you are walking in the dark place and you have to touch everything and if you touch som ething sharp you will understand it and will avoid of going there.

2/4 Touching something sharp is stimulus linked to touch. Avoid going there is a response to the stimulus.

Question 2 (12 marks)

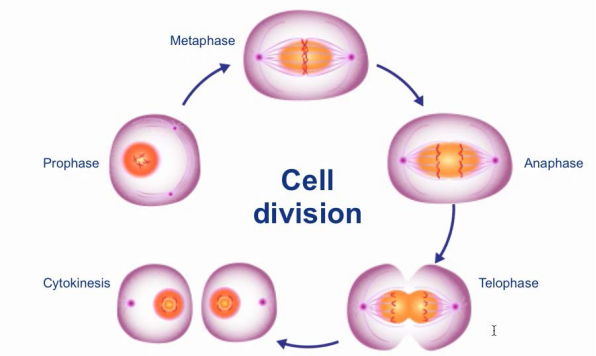
Question 2a (1 mark)

State the name of the molecule that stores genetic information in living organisms.

DNA deoxyribonucleic acid

1/1

The following diagram shows the phases of mitosis.



Question 2b (3 marks)

Outline how the events in anaphase are crucial for the formation of two identical cells.

The events that happen in anaphase are crucial for the formatino of two identical cells as the spindle fibres are attached to the centro meres of the chromosomes. When the centrioles are on opposite sides of the cell, spindle fibres contact and separate the sister chro matids, they have to be pulled in opposite directions to separate them. This is crucial for the formation of two identical cells.

3/3

Question 2c (3 marks)

Mitosis is the process that leads to growth and repair whereas meiosis is required for sexual reproduction.

Outline three differences between the products of mitosis and meiosis.

The products of mitosis are identical to the mother cell there is no genetic variation as a-sexual reproduction is taking place and the p roduct is identical, and mitosis only occurs in somatic body cells, also, the cells produced have a diploid set of chromosomes. Where as, meiosis has genetic variation, it takes place in the gametes, and the product only has a haploid set of chromosomes.

2/3 The answer should focus on the products of cell division not the process. The location of the division is part of the process.

Question 2d (2 marks)

Describe one problem that can occur to the genetic molecule during meiosis.

Mutation might be a problem that occurs during meiosis, it can create a problem or a faulty gene. A mutation might occur and this pro blem will show in the offspring. The mutation can either be insertion, deletion or the substitution of a gene. All of these might lead to a problem/diseases.

1/2

Question 2e (3 marks)

Explain how **one** process that occurs in meiosis can lead to genetic differences in children.

In meiosis, the product is that in every cell there is a haploid set of chromosomes, so when the egg and sperm combine, there will be a diploid set of chromosomes. During meiosis, the process that leads to genetic variation is the fact after the replication of the DNA, e ach 23 pairs of chromosomes is placed into a cell. So the product is 4 cells egg cells or 4 sperm cells, where each has 23 chromoso mes. This creates genetic variation as any of the 4 cells can combine with any of the other 4 cells, meaning that the 23 pairs of the fe male can combine with any 23 pairs of the males, so there will always be genetic variation.

0/3 This answer addresses fertilisation, not meiosis.

Question 3 (7 marks)

Identical twins have the same genes so they are genetically identical.

Question 3a (1 mark)

Select one pair of twins.

Pair 1 ◉

Pair 2 ○

Pair 3 ○

Pair 1: Martin Schoeller/ AUGUST
Pair 2: University Hospitals Case Medical Center, www.healthyandhandsome.nl
Pair 3: © Tommy Kono

Identify a feature in which this pair of twins differ.

The hair colour

1/1

The twins in the images are genetically identical.

Question 3b (1 mark)

Suggest a factor which could account for the difference in the feature you identified in part (a).

The phenotype of the twins is different

0/1 This is not a reason.

Question 3c (2 marks)

Outline a reason why the difference seen in the twins may not be seen in the children of each twin.

Because the difference might be a recessive gene, meaining it could easily be overtaken by any dominant gene

0/2

The table shows four people, identified by the letters A, B, C, and D.

Trait	A	B	C	D
Have a sun tan	yes	yes	no	no
Sex	male	male	male	female
Tongue roll	yes	no	yes	no
Natural hair colour	brown	brown	brown	brown
Have coloured or dyed white hair	no	no	yes	yes
Eye colour	brown	brown	brown	blue

Tongue roll:

Question 3d (3 marks)

Use the information in the table to **identify** which two people are identical twins. **Justify** your answer using examples from the table.

A and C are identical twins

This is because sun tan, sex and dyed hair colour do not determine if two people are identical twins. However, eye colour, natural hai r colour and tongue roll are attributes which determine if two people are twins. Since A and C have same eye colour, natural hair colo ur and can both do the tongue roll, it means they are identical twins.

2/3 The response does not indicate that the traits are genetic.

Question 4 (18 marks)

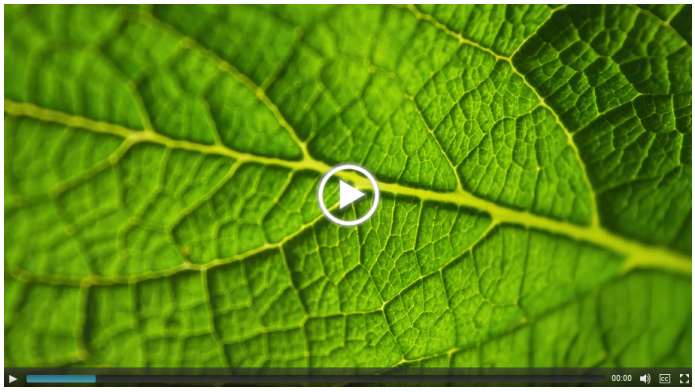
Question 4a (1 mark)

Organize the following molecules into the correct positions to show the word equation for photosynthesis.

carbon dioxide + water → (Sunlight) glucose + oxygen

1/1

In this question you will investigate how the rate of photosynthesis is related to the environmental conditions of a plant.



Question 4b (1 mark)

State the problem being tested by this

Rate of photosynthesis depending on the temperature and solution.

1/1

Question 4c (4 marks)

Formulate a testable hypothesis for this experiment. Use scientific reasoning to **explain** your answer**.**

If the solution temperature changes then leaf discs will produce bubbles and photosynthesis because the air enters into the leaf discs and take out solution.

0/4 Does not indicate how temperature is changing and how that will impact time of disc floating.

Question 4d (10 marks)

State the variables and **outline** how to manipulate those stated.

Independent variable

temperature

How to manipulate this variable

Photosynthesis depends on time and temperature because it helps taking out the solution from the discs and to produce photosynthesis, so the time spent for developing photosynthesis for the disc depends on temperature.

Dependent variable

Rate of photosynthesis of the leaf discs

How to manipulate this variable

Looking at the time that a leaf disc spends to produce photosynthesis with solution into the discs.

Control variables

-Solution
-Type of plant
-Sunlight
-Time

How to manipulate these variables

The solution have to be always the same (sodium bicarbonate)
The type of plant where the leaf discs are token must be always the same because photosynthesis also depends on the type of plant .
Sunlight must be always the same because it´s crucial for plants to develop photosynthesis.
The time determinate how much time do the disc spend for developing photosynthesis depending on the temperature.

5/10

Question 4e (2 marks)

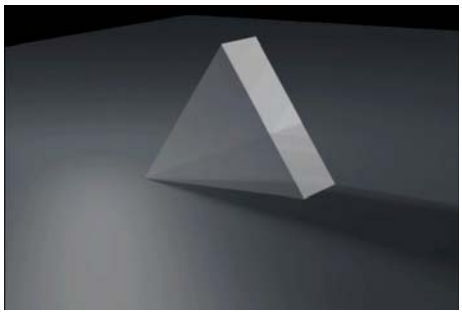
State how many trials should be conducted for this experiment in order to collect sufficient data. **Justify** your answer.

There should be 3 trials minimum because it´s the minimum number of trials to have estable data and this experiment can also depend on the amount of sodium dropped in the solution or in the exact temerature of the solution as the size of the leaf discs.

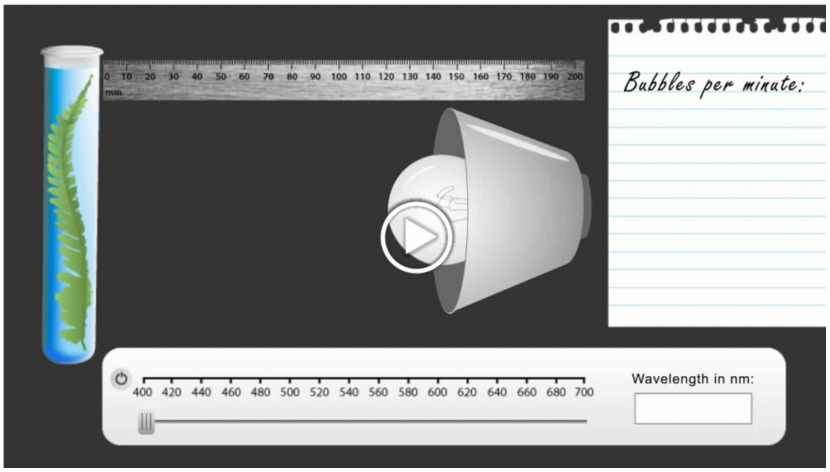
1/2

Question 5 (10 marks)

Photosynthesis is a light dependent process. Sunlight is made up of light of different wavelengths. Wavelength is related to the colour of light.



A group of students were interested in testing the effect of wavelength of light on photosynthesis so they designed the apparatus shown below to measure the change in gas production of a plant due to photosynthesis. The animation shows what the experiment looked like.



Question 5a (4 marks)

Suggest a design for a data table to collect a sufficient amount of data from the investigation. You need to state the number of rows and columns and state appropriate labels to your table.

Number of rows:

5

Labels for rows:

1. 10
2. 20
3. 30
4. 40
5. 50

Number of columns:

2

Labels for columns:

1. Distance from light source
2. Trial number

1/4

Question 5b (3 marks)

After doing this first experiment the students found that the maximum rate of photosynthesis occurred at a wavelength of 650 nm and they decided to study this further. The students now investigated the effect of distance from the light source on photosynthesis. Their data is presented in the table below. Use the calculator tool to **calculate** the mean average of the data. You should give your values to an appropriate number of significant figures.

Distance from the light source / cm	Bubbles of gas / min				
	Trial number				
	1	2	3	4	5
10	118	89	109	102	119
20	109	99	101	112	119
30	59	63	58	67	70
40	19	24	31	27	33
50	8	15	4	11	8

Distance from the light source / cm	Mean average number of bubbles / min
10	107.4
20	108
30	63.4
40	26.8
50	9.2

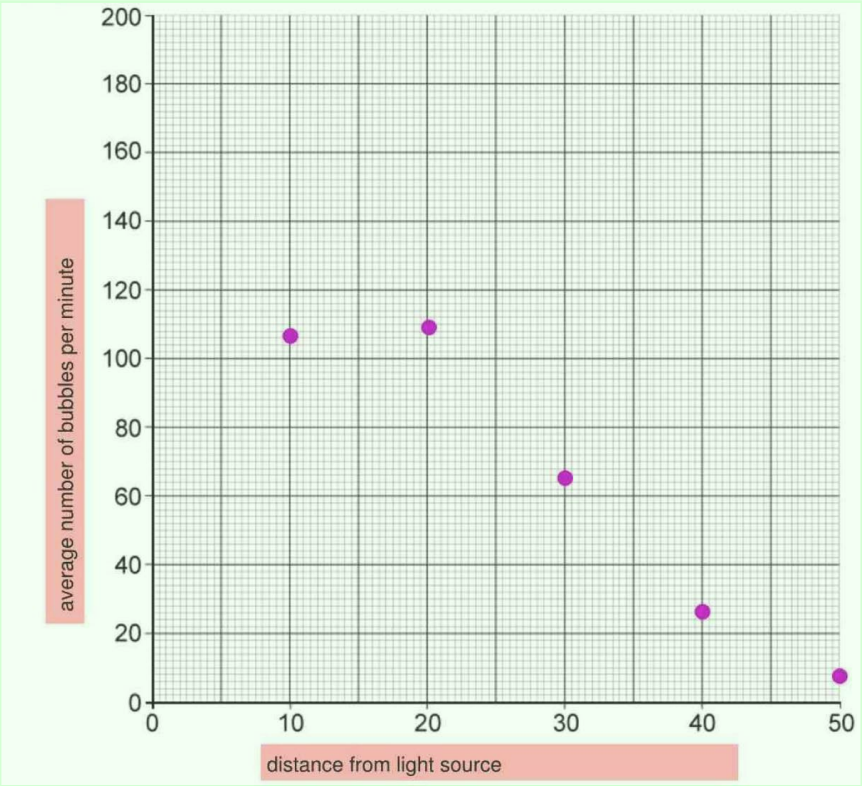
2/3 Not given as whole number.

Question 5c (3 marks)

Present the transformed data in a graph using the graphing tool. You need to add appropriate labels to the axes and give your graph an appropriate title.

Graph title

Bubbles of gas produced per minute



2/3

Question 6 (14 marks)

Biomass is the mass remaining when all water has been removed from an organism.

A different group of students wanted to determine how other factors might affect photosynthesis. They found details of the following investigation into biomass.

Hypothesis:

If one group of plants receives more water then the biomass of those plants will increase more than the plants with less water added.

Overview of Method:

Step 1: Collect 20 plants of the same species and similar size.

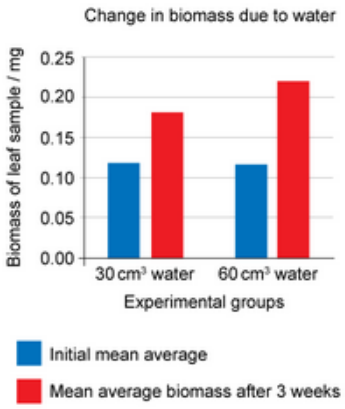
Step 2: Pull one leaf from each plant, cut a square 2 cm × 2 cm, dehydrate the square, and then weigh the leaf samples.

Step 3: Place all of the plants in an environment with similar soil, light, and temperature.

Step 4: Add 30 cm^3 of water to 10 of the plants every other day and add 60 cm^3 of water to the other 10 plants every other day.

Step 5: After 3 weeks, remove 1 leaf from each plant and follow step 2.

The results from the investigation are shown in the graph.



Question 6a (1 mark)

State one trend in the data.

The Mean average biomass after 3 weeks is always more than the initial.

1/1

Question 6b (3 marks)

Explain one scientific reason for the difference in final and initial mean average biomass for the two groups.

The initial is as not be given any water, therefore when it is dehidrated it doesn't have a lot of water to be removed. While after three weeks the leaf has been given water regularly (group 2 more than group 1) therefore when it's dehidrated it had more means to produce more food via photosynthesis and increase biomass.

1/3

Question 6c (1 mark)

Comment on the validity of the hypothesis based on the data.

The hypothesis is correct since the data shown in the graph shows the exact same trend.

1/1

Question 6d (4 marks)

Based on the method and apparatus presented, **describe one** strength and one weakness related to the method's design.

It doesn't specify the exact equipement needed to preform the experiment.
It has a very specific numbers we should follow.

0/4

Question 6e (4 marks)

Outline two improvements to this investigation. **Justify** your answers.

There should be specification of the amount of time the plants used in the experiment had been living. This is because maybe not all of them have had the same amount of time to completly develop themselfs which could cause outliers.

There should be more species to compare their performance to this experiment. This would give a broader aproach to the experiment and perhaps a different result.

0/4

Question 6f (1 mark)

Other than changing the temperature or light, **state one** extension to this method that would benefit this scientific investigation.

There could be used different kinds of soil.

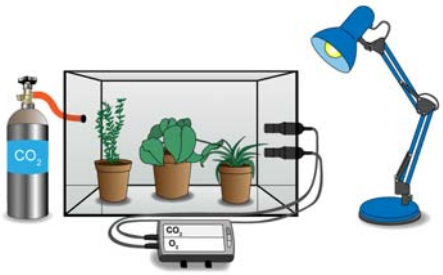
1/1

Question 7 (16 marks)

After the students had completed all of these investigations they wanted to conduct one final investigation. In the back of the science room they found an apparatus that had been donated to the school that looked like the image below.

Design an investigation that would use this apparatus to study photosynthesis. Your plan should:

- state a problem to be studied
- formulate and explain a testable hypothesis
- identify relevant variables
- describe how to measure and manipulate the variables
- describe the method
- list any safety considerations.



Does photosynthesis work with the absence of CO_2?

Hypothesis: If we stop the entering of carobon dioxide on the apparatus with the plants, then photosynthesis will not fucntion correctly and no oxygen will be produce, because carbon dioxide is essential for the photosynthesis.

Dependent variable: Carbon dioxide

Independent variable: Oxygen created

Control varible:

-Same plants, same soil, same conditions, same amount of water and soil.

Method:

-We will stop the carbon dioxide from entering the apparatus.

-Then, we will add water to the plants and conect the apparatus for measuring the quantities of oxygen adn carbondioxide.

-We will write the results on a table.

-The next step will be repeat the same process but with carbon dioxide entering the apparatus.

-We will then mesure the quantities of carbon dioxide and oxygen and write them in the table.

Finally, we will compare both results and find the conclusions.

Caution: It will be important to use carefully the apparatus that contains the carbon dioxide, if not the experiment will not result as ima gined.

7/16 Problem is stated, formulates a vague hypothesis using unconnected scientific reasoning, variables partly wrongly identified, describes a method for collecting some data.

Question 8 (7 marks)

Human activities are leading to the loss of biodiversity in the world's ecosystem. The human activities listed below are the main causes of the loss of biodiversity.

Alteration and loss of habitats

Before: Rich woodland

Alteration and loss of habitats

After: Deforestation

Introduction of invasive species

Before: Native species present

Introduction of invasive species

After: Non-native species colonize the habitat

Pollution

Before: Clean river

Pollution

After: Polluted river

Overexploitation of resources

Before: Healthy fish stocks

Overexploitation of resources

After: Overfishing

Climate change

Before: Extensive ice caps

Climate change

After: Melting ice caps

Question 8a (1 mark)

State the meaning of the term *biodiversity*.

Biodiversity refers to the term used to describe multiple ecosystem present in one another.

0/1

Question 8b (2 marks)

Outline how **one** specific human action could reduce biodiversity.

Cutting trees

0/2

Question 8c (4 marks)

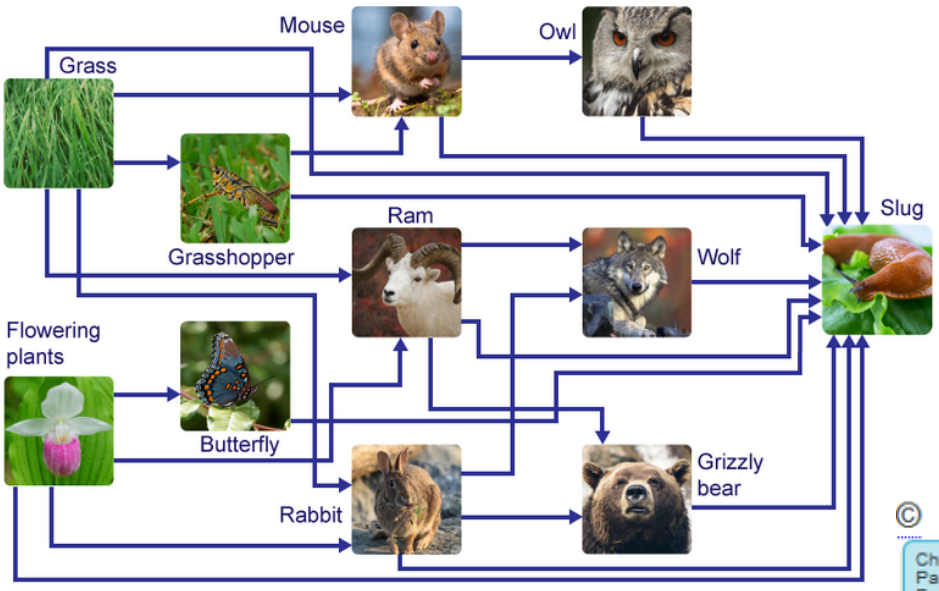
Explain, using scientific language, how the loss of one species might affect other organisms in the ecosystem.

The loss of one species might affect other organisms in the ecosystem as they all rely on one another for source of energy, also kno wn as food chain.

1/4

Question 9 (5 marks)

This diagram uses pictures of organisms to show connections within an ecosystem.



Question 9a (1 mark)

State the name of this type of diagram.

food chain

1/1

Question 9b (2 marks)

Use the diagram to **state** the roles of the flowering plant and the slug in this ecosystem.

flowering plant are the source of food for the secondary consumer which is eaten for the primary consumer. and the slug eats the de ad body of the animal decomposing them.

1/2

The term *charismatic megafauna* has recently been used to describe endangered animals that have popular appeal. The media have used animals such as gorillas, pandas and tigers tohighlight conservation issues. These species, however, do not always have a key role within an ecosystem; if the organisms were removed from the ecosystem, the ecosystem would not collapse. Aesthetic considerations may mean that people might be more interested in protecting an endangered flower but not an endangered slug. Biologists, however, place value on an organism's role within an ecosystem rather than on its appearance.

Question 9c (2 marks)

Justify using scientific reasoning why each of these organisms are equally important to protect. You must refer to the diagram above in your answer.

flowering plant

this is the source of food for the butterfly and grasshopper in which if the flower dissapear the rabbit will have a reduce in population which could affect the bear.

slug

the slug is important for the decomposition of dead animal corpses.

0/2

Question 10 (21 marks)

Scientists are preserving the diversity of plants by creating seed banks. Seed banks store seeds from as many plants as possible.

Photograph courtesy Argonne National Laboratory
© Gane Kumaraswamy
Alfredo Caliz/Panos

Question 10a (1 mark)

State one reason why seed banks are important.

Seens banks are important in order to have lots of different samples of seeds from every plant on Earth collected and stored in a saf e place for future needs.

This is important to be done in order to be able to have a vareity of plant in the futures.

1/1

Question 10b (3 marks)

Outline the process used to create a seed bank.

Firstly, scientists collect the seeds from their ecosystem at the right time when the plants produce their seeds.Then the seend must b e safly transportted from their ecosystem to the seed bank.

Then, when the seeds are erivved to the seed bank, the scientists must make sure that the seeds are dormant, in order that they will not start growing.

Then the dormant seed must be stored for a long period of time. The stored seed must be stored in an environment where the temer ature and light is right in order to make sure that the seeds do not start to germinate or to become rotten.

3/3

Question 10c (17 marks)

Discuss and **evaluate** the implications of creating and maintaining seed banks. In this extended piece of writing you should consider:

- the value of seed banks for the conservation of an individual species and whole ecosystems
- the responsibility for creating and maintaining seed banks
- an economic consideration **or** a political consideration.

The impllication of creating and maintaining a seed bank are very valueable and important. This is because plants all over the world should be safe and well treated in order to keep being alive in their ecosystem. The seed bank makes sure that this happens. Thank s to the seed bank, different species of different plants are being kept and not distroyed.

In addition, there is a sagnificant responsibility for creating and having a seed bank. This is because all of the dormnt seeds must still be well treated and kept safetly enough in order to become a plant one day.

This responsibility might also affect the economic situation of the seed bank's owner. This is becasue it cost a lot to travel over the w orld and collect those seeds. In addition all the different machines that are used for checking the seeds and keeping them dormant a nd safe are wuite expenssive. Therefore, the seed bank might affect you economic consideration.

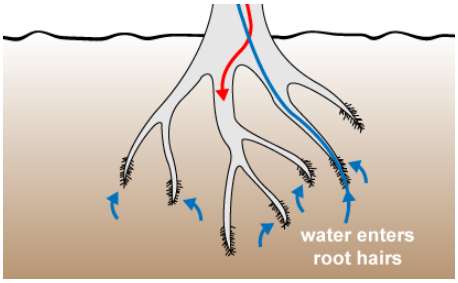
4/17 Incomplete statement, some vague comment about individual species or ecosystem, issue for maintaining stated, consideration vague.

Question 1 (10 marks)

Living cells and organisms exchange materials with their environment.

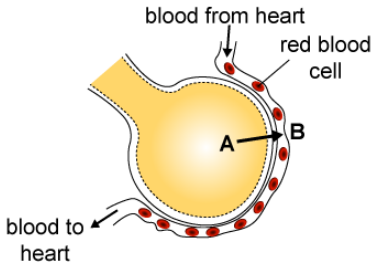
Question 1a (2 marks)

Select the option describing the transport mechanism in the diagrams below.



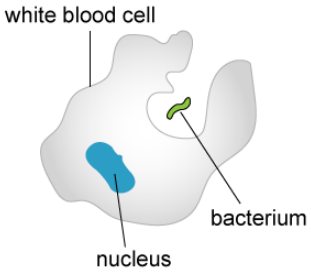
Water is taken up by root hair cells.

Diffusion



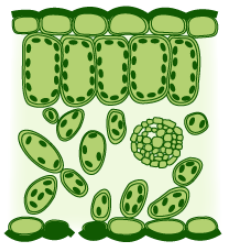
In the lungs oxygen is taken up into the bloodstream.

Osmosis



A white blood cell taking in bacteria.

Neither



Oxygen is given out by the leaf cells.

Osmosis

0/2

Question 1b (1 mark)

Oxygen is carried by red blood cells. **State** the name of the organ system which carries blood through the human body.

Circulatory system

1/1

Question 1c (2 marks)

Using scientific terms, **outline** why the uptake of oxygen from the lungs into the bloodstream does not require energy.

0/2

Question 1d (1 mark)

Besides oxygen, the blood in the circulatory system also carries messenger substances called hormones. **State** the name of another system that transmits signals in the human body.

nervous system

1/1

Question 1e (4 marks)

Select one of the senses.

- sight
- hearing
- taste
- smell
- touch

Explain how this sense and the transmission of signals inside the human body leads to responses which help us to survive. You should refer to an example of a survival situation in your answer.

When a human skin comes into contact with an object that is pressing on it, the skin sends electric signals, containing information ab out feeling that is pressing on our skin. Once the signals are transported into the brain, it sends signals, telling the muscles to get aw ay from the source of the pressure. Thanks to this sense, human species has a better way of analyzing the danger of the world.

4/4

Question 2 (12 marks)

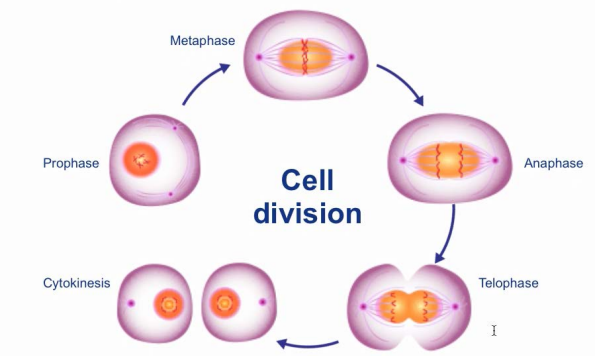
Question 2a (1 mark)

State the name of the molecule that stores genetic information in living organisms.

DNA

1/1

The following diagram shows the phases of mitosis.



Question 2b (3 marks)

Outline how the events in anaphase are crucial for the formation of two identical cells.

Only when the chromosomes in the anaphase are able to divide properly, with each side having the same number of chromosomes, would the daughter cells be able to divide to form genetically identical cells to the parents. If the separation did not happen properly i n the anaphase, we know that the daughter cells would not be identical to the parents, and therefore must be part of a different type of cells.

3/3

Question 2c (3 marks)

Mitosis is the process that leads to growth and repair whereas meiosis is required for sexual reproduction.

Outline three differences between the products of mitosis and meiosis.

Mitosis and meiosis are different because:

Meiosis divides to form two haploid cells called gametes that only have half the number of chromosomes of normal cells , while mitosis divides to form two daughter cells that are diploid.

In meiosis, the chromosome number does not double, only divides, while in mitosis, the chromosome number doubles a nd then divides.

Meiosis results in genetically different cells, while mitosis results in genetically similar cells.

2/3

Question 2d (2 marks)

Describe one problem that can occur to the genetic molecule during meiosis.

The number of chromosomes would not divide properly, resulting in one cell having more chromosomes than the other.

0/2

Question 2e (3 marks)

Explain how **one** process that occurs in meiosis can lead to genetic differences in children.

The division process separates the chromosomes in a random order, but each gamete should receive same number of chromosomes . The random order in which the chromosomes have been divided is unkown, thus any characteristic of the parent could be there for t heir children. This random separation also ensures that no two children have the same gene sequence.

2/3 used chromosome correctly. Correctly described independent separation of chromosomes.

Question 3 (7 marks)

Identical twins have the same genes so they are genetically identical.

Question 3a (1 mark)

Select one pair of twins.

Pair 1 ○

Pair 2 ◉

Pair 3 ○

Pair 1: Martin Schoeller/ AUGUST
Pair 2: University Hospitals Case Medical Center, www.healthyandhandsome.nl
Pair 3: © Tommy Kono

Identify a feature in which this pair of twins differ.

The freckles. The second twin has way more freckles than the other.

1/1

The twins in the images are genetically identical.

Question 3b (1 mark)

Suggest a factor which could account for the difference in the feature you identified in part (a).

The cells may not have been equally divided.

0/2

Question 3c (2 marks)

Outline a reason why the difference seen in the twins may not be seen in the children of each twin.

Because some genes disappear.

0/2

The table shows four people, identified by the letters A, B, C, and D.

Trait	A	B	C	D
Have a sun tan	yes	yes	no	no
Sex	male	male	male	female
Tongue roll	yes	no	yes	no
Natural hair colour	brown	brown	brown	brown
Have coloured or dyed white hair	no	no	yes	yes
Eye colour	brown	brown	brown	blue

Tongue roll:

Question 3d (3 marks)

Use the information in the table to **identify** which two people are identical twins. **Justify** your answer using examples from the table.

A and C are identical twins, becuase the traits related to the genes are the same, for example: the tongue roll, the natural hair colour and the eyes coloured.

3/3

Question 4 (18 marks)

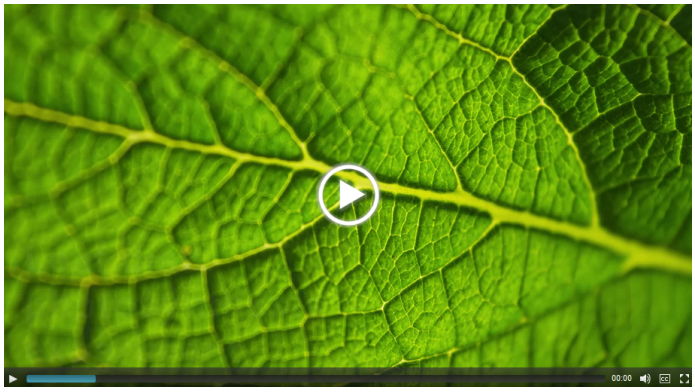
Question 4a (1 mark)

Organize the following molecules into the correct positions to show the word equation for photosynthesis.

glucose + oxygen → (Sunlight) carbon dioxide + water

0/1

In this question you will investigate how the rate of photosynthesis is related to the environmental conditions of a plant.



Question 4b (1 mark)

State the problem being tested by this

An indirect method that can be used to measure the rate of photosynthesis.

0/1

Question 4c (4 marks)

Formulate a testable hypothesis for this experiment. Use scientific reasoning to **explain** your answer**.**

If the temperature of the leaf increases than the rate of photosynthesis increases along with time it takes for the leaf discs to rise to th e top. For example, the leaf discs float at first because there are air spaces inside the leaf. Then the sodium hyrdogen solution fills th e spaces inside the leaf allowing the density of the leaf to increase. Furthermore, bubbles form as photosynthesis occurs due to the h ot temperatures of the solution. However, the bubbles force the solution out of the leaf, which decreases the density of the leaf. This l eads to the decrease of the density of the leaf disc and begins to float again.

1/4

Question 4d (10 marks)

State the variables and **outline** how to manipulate those stated.

Independent variable

Temperature of sodium hydrogen carbonate (5, 20, 40, 60, 80) (celcius)

How to manipulate this variable

The independent variable can be manipulated by putting the solution of sodium hydrogen carbonate in water baths of the given temp erature as the 'input' of the experiment. This is to achieve th exact tempreature (degrees celcius) required to control this experiment. I n addition, to keep track of the temperature of the water bath, a thermometer can be utilized.

Dependent variable

The time it takes for the leaf discs to rise to the top again

How to manipulate this variable

This variable can be manipulated by recording the time it takes for the leaf dics to rise to the top again and float. The time can be rec orded by using a stopwatch or timer, this way, it is efficient and quick.

Control variables

1. The number of leaf discs
2. Amount of solution (sodium hydrogen carbonate) in the beaker and syringe
3. Size of the leaf discs
4. Amount of light on the solution

How to manipulate these variables

The number of leaf discs can be manipulated by simply counting the number of leaves used in the solution at the same time. It is sug gested to use around six leaf discs. This is because there will be enough space to in the solution for the leaf discs. Furthermore, the amount of soultion in the beaker or the syringe can be controlled by using the appropriate measurements (mL). This should be controlled as there should be the same amount of solution in for eacht temperature. If each temperature does not have the same am ount of solution, then the results of the lab experiment will be completely different and would be no use in finding the rate of photosyn thesis. Moreover, the size of the leaf dics must be the same because otherwise it would take more time for solution to sink in if the di sc was larger. It must be controlled since the temperature is changing. In addition, the amount of light on the beaker whill have a hug e effect on the rate of photosynthesis as it is a key component of the process. Therefore, the light will manipulated by shining only a c ertain amount of light on the beaker.

8/10 Described why the last control variables are important but not how they are manipulated

Question 4e (2 marks)

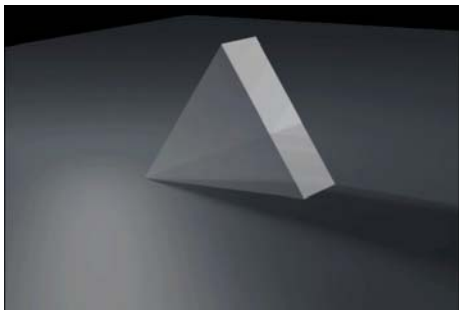
State how many trials should be conducted for this experiment in order to collect sufficient data. **Justify** your answer.

The more trials in an experiment is always more accurate in researching any scientific fact. This is ebcause the more trials you have, the stronger your data is. Therefore, in this specific lab experiment the trial number should be at least five trials due to the fact that it i s an experiment where the temperature must be controlled.

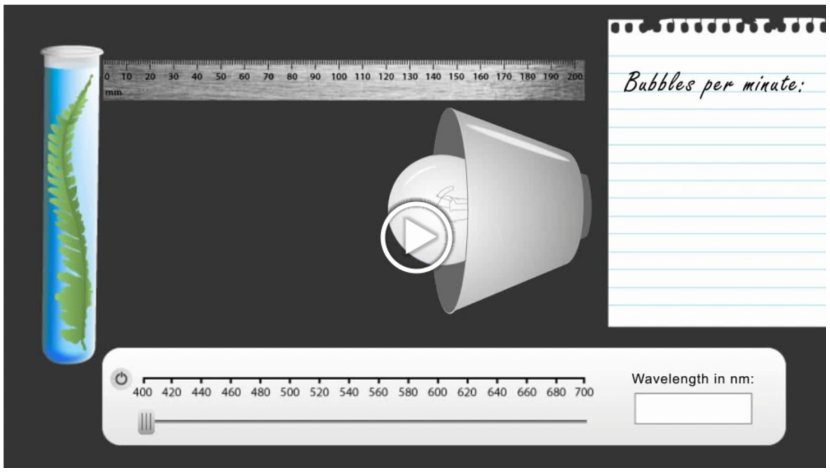
1/2

Question 5 (10 marks)

Photosynthesis is a light dependent process. Sunlight is made up of light of different wavelengths. Wavelength is related to the colour of light.



A group of students were interested in testing the effect of wavelength of light on photosynthesis so they designed the apparatus shown below to measure the change in gas production of a plant due to photosynthesis. The animation shows what the experiment looked like.



Question 5a (4 marks)

Suggest a design for a data table to collect a sufficient amount of data from the investigation. You need to state the number of rows and columns and state appropriate labels to your table.

Number of rows:

7 with infc

Labels for rows:

label the rows ´wavelength

Number of columns:

7

Labels for columns:

´number of bubbles per minute´

2/4 no label for data or values. No label for bubbles.

Question 5b (3 marks)

After doing this first experiment the students found that the maximum rate of photosynthesis occurred at a wavelength of 650 nm and they decided to study this further. The students now investigated the effect of distance from the light source on photosynthesis. Their data is presented in the table below. Use the calculator tool to **calculate** the mean average of the data. You should give your values to an appropriate number of significant figures.

Distance from the light source / cm	Bubbles of gas / min				
	Trial number				
	1	2	3	4	5
10	118	89	109	102	119
20	109	99	101	112	119
30	59	63	58	67	70
40	19	24	31	27	33
50	8	15	4	11	8

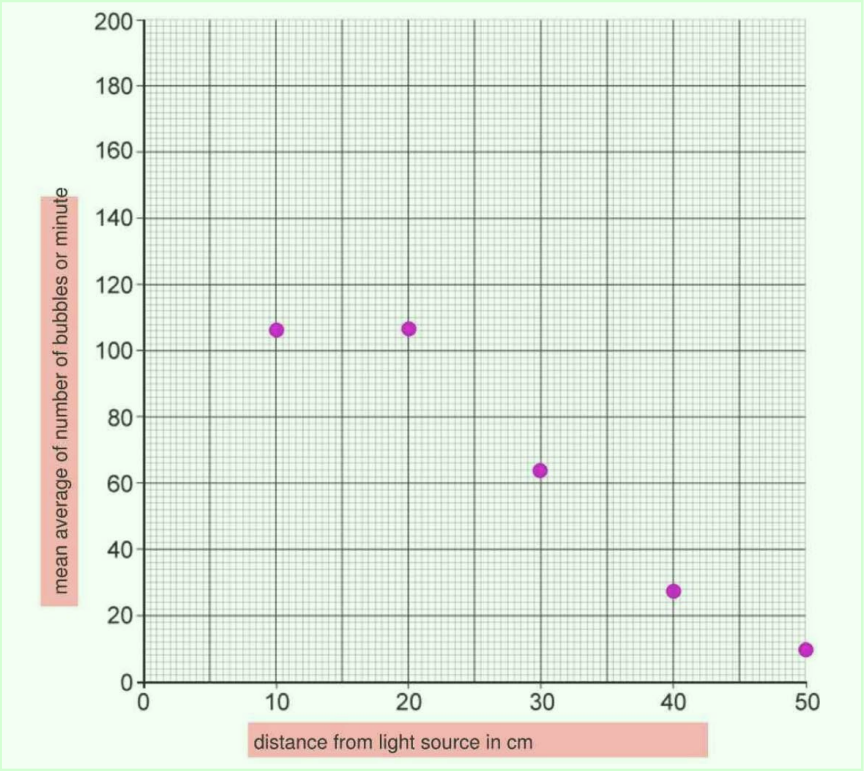
Distance from the light source / cm	Mean average number of bubbles / min
10	107.4
20	108
30	63.4
40	26.8
50	9.2

2/3

Question 5c (3 marks)

Present the transformed data in a graph using the graphing tool. You need to add appropriate labels to the axes and give your graph an appropriate title.

Graph title



3/3

Question 6 (14 marks)

Biomass is the mass remaining when all water has been removed from an organism.

A different group of students wanted to determine how other factors might affect photosynthesis. They found details of the following investigation into biomass.

Hypothesis:

If one group of plants receives more water then the biomass of those plants will increase more than the plants with less water added.

Overview of Method:

Step 1: Collect 20 plants of the same species and similar size.

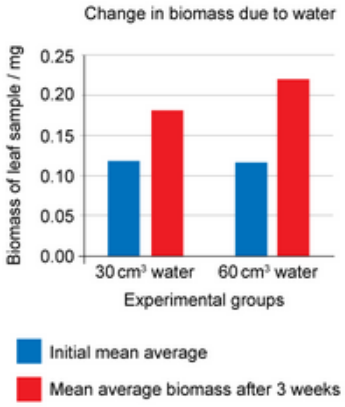
Step 2: Pull one leaf from each plant, cut a square 2 cm × 2 cm, dehydrate the square, and then weigh the leaf samples.

Step 3: Place all of the plants in an environment with similar soil, light, and temperature.

Step 4: Add 30 cm^3 of water to 10 of the plants every other day and add 60 cm^3 of water to the other 10 plants every other day.

Step 5: After 3 weeks, remove 1 leaf from each plant and follow step 2.

The results from the investigation are shown in the graph.



Question 6a (1 mark)

State one trend in the data.

The biomass of the plants that recieved more water is higher than the plant that has added less.

0/1

Question 6b (3 marks)

Explain one scientific reason for the difference in final and initial mean average biomass for the two groups.

It is because when the plant t=get more water, they photosynthesize more. Whne they photosynthesis, they will create energy and th at energy will be contained inside the plant even after the water has gone. So the biomass of the plant that water has been added mo re has more energy (eg mg) so it is heavier than the one that has less water added.

1/3 Energy is not specific enough.

Question 6c (1 mark)

Comment on the validity of the hypothesis based on the data.

HEr hypothesis is correct, and we can know that from seeing the data that plant with 60cm cube water added has about 0.05mg mor e than the plant with 30 cm cube water added.

1/1

Question 6d (4 marks)

Based on the method and apparatus presented, **describe one** strength and one weakness related to the method's design.

One strength is that the student used 20 plants. By using 20 plants, student can have many data (10) so the data will be reliable.

One weakness is that the student didn't decide which part of the plant does he/she take the leaf. It is weakness because the rate of p hotosynthesis changes with the place of the plant, and for example, the place that sunlight can be attracted will have higher rate of p hotosynthesis, and bottom less.

4/4

Question 6e (4 marks)

Outline two improvements to this investigation. **Justify** your answers.

First improvement is that to choose which part of the place the sudent take the leaves for measurement. It is because the rate of pho tosynthesis changes with the place of the plant, and for example, the place that sunlight can be attracted will have higher rate of phot osynthesis, and bottom less. So it will be better if they choose which part of the plant they take the leaves.

Second improvement is to write more detailed hypothesis. It is because if they write hypothesis using scientific knowledge, it will bec ome easier to understand for the people who do the same experiment after.

2/4

Question 6f (1 mark)

Other than changing the temperature or light, **state one** extension to this method that would benefit this scientific investigation.

Changing the distanse between the light and the plant.

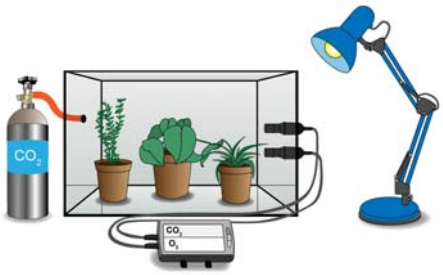
1/1

Question 7 (16 marks)

After the students had completed all of these investigations they wanted to conduct one final investigation. In the back of the science room they found an apparatus that had been donated to the school that looked like the image below.

Design an investigation that would use this apparatus to study photosynthesis. Your plan should:

- state a problem to be studied
- formulate and explain a testable hypothesis
- identify relevant variables
- describe how to measure and manipulate the variables
- describe the method
- list any safety considerations.

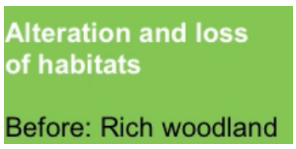


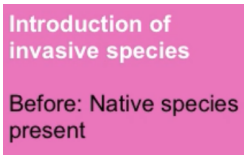
A problem that could be studied is how carbon dioxide (CO2) affects the photosynthesis of the plants. In this experiment, oxygen is a product as a result of photosynthesis so the affects of phtosynthesis will be determined by the amount of oxygen. If the amount of car bon dioxide (CO2) increases, then the rate of photosynthesis of the plants will decrease due to less oxgen, which is a product of phot osynthesis. The independent variable will be the amount of carbon dioxide. It will be measured in a monitor and it would be possible t o increase carbon dioxide by releasing more CO2 from the CO2 tank. The dependent variable will be the amount of oxygen produced due to photosyntehesis of the plants. This also will be measured through a monitor and could be manipulated through sensors conne cted into the glass. The controlled variables will be the size and type of plants, amount of sunlight (light source) acted upon the plants , and the same internal conditions (temperature, humidity, etc.) inside the glass. This will be kept controlled by making sure to specifi cally decide on all these controlled varaibles before starting the environment. The method will be to first place all materials, plants, lig ht source, montitor, CO2 tank in position. Then to wear all safety measures. I will first turn on the lights into 5 brightness. I will first rel ease 20g of CO2 into the glass and then measure the amount of oxygen inside the glass. Then, I will repeat my steps for 40, 60, 80, and 100g of CO2. You need to make sure you wear safety glasses, glowns, and masks due to exposure of CO2 will result in dizzyne ss and other harm.

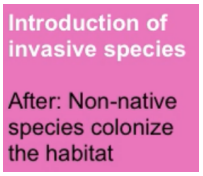
9/16 Valid or focused problem is stated. Formulates and only attempts explains a testable hypothesis using scientific reasoning (error made). Four variables identified. Method for manipulation SOME variables described. Outlines a method for collecting SOME relevant data linked to hypothesis. Valid comment about safety.

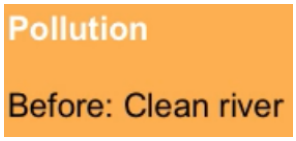
Question 8 (7 marks)

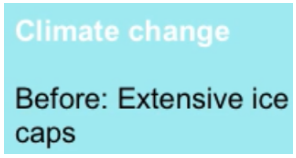
Human activities are leading to the loss of biodiversity in the world's ecosystem. The human activities listed below are the main causes of the loss of biodiversity.











Question 8a (1 mark)

State the meaning of the term *biodiversity*.

The term, "biodiversity" is a term used to describe the amount of different animals and species within an ecosystem.

1/1

Question 8b (2 marks)

Outline how **one** specific human action could reduce biodiversity.

One human action could reduce biodiversity because one action can affect the whole ecosystem. This is because the animals have adapted to living in the same environment together. Taking out one species of animals can have a massive effect on the survival of o ther animals.

0/2 Did not give an example of human activity. Did not link any specific description to activity.

Question 8c (4 marks)

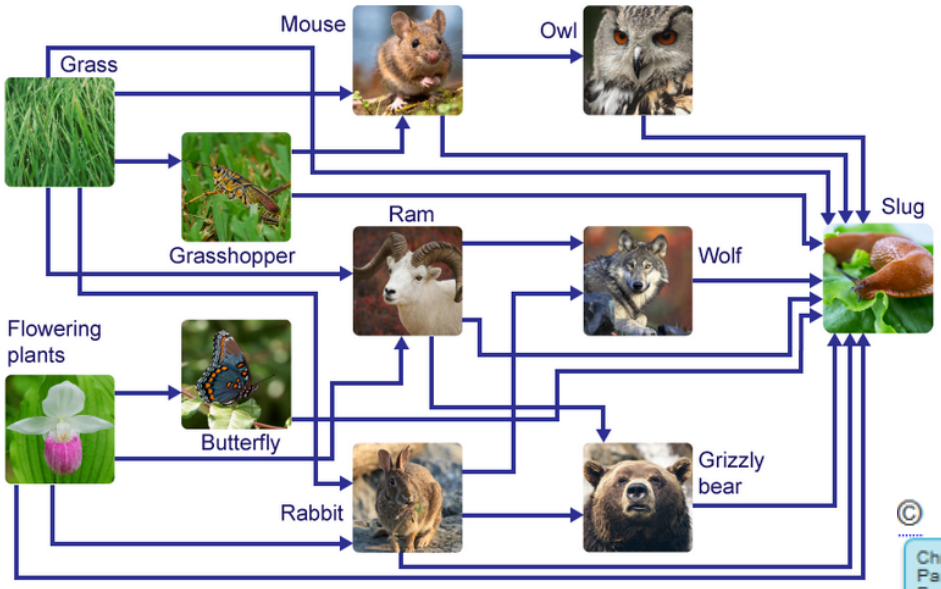
Explain, using scientific language, how the loss of one species might affect other organisms in the ecosystem.

The loss of one species might affect other organisms in the ecosystem because these organisms may rely on each other as a source of energy. For example, if a population on foxes rely on a population of mice to hunt and eat, but the mice go extinct due to a human action, then the foxes have no source of food anymore. This can escalate even further. For example, the foxes go extinct in the area because there are no more mice, then the wolves can't hunt foxes anymore and can't rely on them as a source of energy.

3/4 No scientific term used = 0 marks. Identifies a species lost (mice) = 1 mark. Identifies relationship (fox hunt mice) = 1 mark. Describe effect on affected organism (fox go extinct) = 1 mark

Question 9 (5 marks)

This diagram uses pictures of organisms to show connections within an ecosystem.



Question 9a (1 mark)

State the name of this type of diagram.

Trophic food web

1/1

Question 9b (2 marks)

Use the diagram to **state** the roles of the flowering plant and the slug in this ecosystem.

The flower feeds the butterflies, rams, and rabbits. And the slug feeds off of the remains and carcasses of the animals, and turns the m into waiste products. They are the beginning and the end of the food web, therefore if one of them is removed, the whole web will c ollapse.

2/2 The response goes beyond the slug eating dead organisms.

The term *charismatic megafauna* has recently been used to describe endangered animals that have popular appeal. The media have used animals such as gorillas, pandas and tigers tohighlight conservation issues. These species, however, do not always have a key role within an ecosystem; if the organisms were removed from the ecosystem, the ecosystem would not collapse. Aesthetic considerations may mean that people might be more interested in protecting an endangered flower but not an endangered slug. Biologists, however, place value on an organism's role within an ecosystem rather than on its appearance.

Question 9c (2 marks)

Justify using scientific reasoning why each of these organisms are equally important to protect. You must refer to the diagram above in your answer.

flowering plant

The flower feeds the butterflies, rams, and rabbits. Therefore it is the beginning of the food chain. And if the flower is removed from th e chain, the predators that feed off of it will begin to deminish. Which will have a chain reaction and affect the other animals that feed offf of the butterflies rams and rabbits. Only after a long period of time, will the ecosystem be stable again.

slug

A slug is equally as important as a flower in an ecosystem, because the slug is the decomposer. The slug feeds off of the remains an d carcasses of the animals, and turns them into waiste products. Which is then beneficial to the soil. Which feeds the flowers.

1/2 Does not refer to "only" decomposer.

Question 10 (21 marks)

Scientists are preserving the diversity of plants by creating seed banks. Seed banks store seeds from as many plants as possible.

Photograph courtesy Argonne National Laboratory
© Gane Kumaraswamy
Alfredo Caliz/Panos

Question 10a (1 mark)

State one reason why seed banks are important.

In order to collect seeds of every plant in case it is endangered or needed for medication and it goes extinct.

1/1

Question 10b (3 marks)

Outline the process used to create a seed bank.

1- scientists must first travel to the ecosystem at a time when plant will be producing seed.
2- coollects them in manner that prepares them for shipment
3- carefully transported to seed bank .
4- scientists make sure they are dormant
5- dormant seed stored in right temperatiure, humidity and light for a long period of time.

3/3

Question 10c (17 marks)

Discuss and **evaluate** the implications of creating and maintaining seed banks. In this extended piece of writing you should consider:

- the value of seed banks for the conservation of an individual species and whole ecosystems
- the responsibility for creating and maintaining seed banks
- an economic consideration **or** a political consideration.

Seed banks ensure that we have every single seed of all the plants known to man stored in one place, in order to use them for future needs in case they go extinct. Seed banks are useful for when a plant is extinct and it played a major role in an ecosytem, thats whe n the plant is then planted in the needed ecosystem and grown again in order for it reporoduce and is there for the needed ecosystem. Plants are sometimes needed by spesific individual species to grow, and they might be needed for that species's feeding process.

seed banks have a huge responsibility when they vreate and maintaina seed bank, as a seed bank should have the right envionrme nt, the responsibility is big on those scientits to make sure that the environment is appopriate or the seeds will be lost, and wont be a vailable for future needs.

seed banks are going to help the economy on the long run, as many plants produce medications that are needed for patients, the co nstant rate of medication production is goign to keep the economy stable and keep producing money from plants.

6/17 Complete of limited relevance statement and attempted justification. Relevant comment about individual species. Issue for maintaining stated. Economic described in general terms.