St Ninian's High School

Biology Department

National 5 Biology

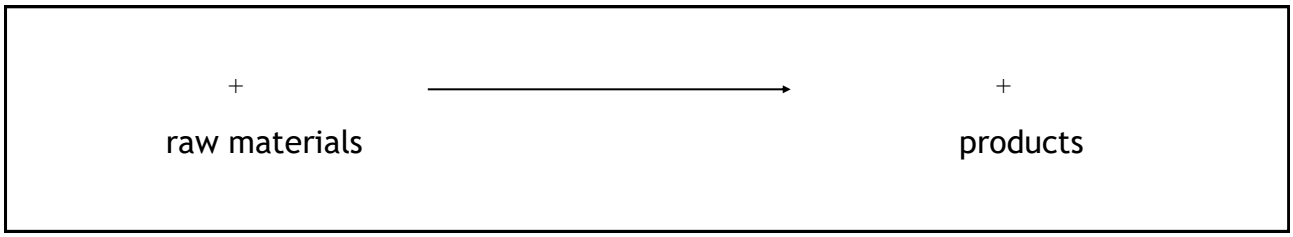
Life on Earth Booklet

Name _____

Photosynthesis

Word Equation

Photosynthesis is a two-stage process:



1. _____ 2. _____

Stage 1: Light Reaction

_____energy from the sun is trapped by _____ in

the _____of green plants for the production of:

1. Production of _____

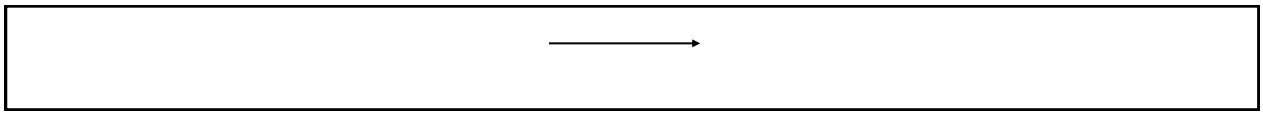
The **light energy** from the sun is converted into _____ energy

which is used to generate _____.

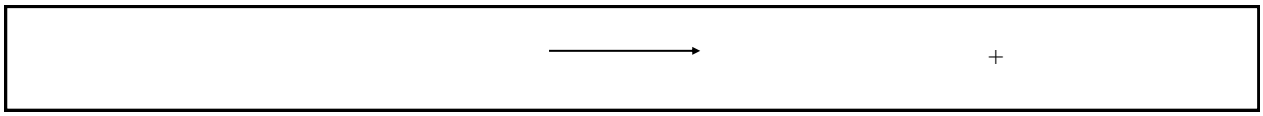
2. Production of _____

Light energy is also used to _____water into _____ and _____

in a process called _____



_____diffuses from the cell and is termed a _____.



Photosynthesis

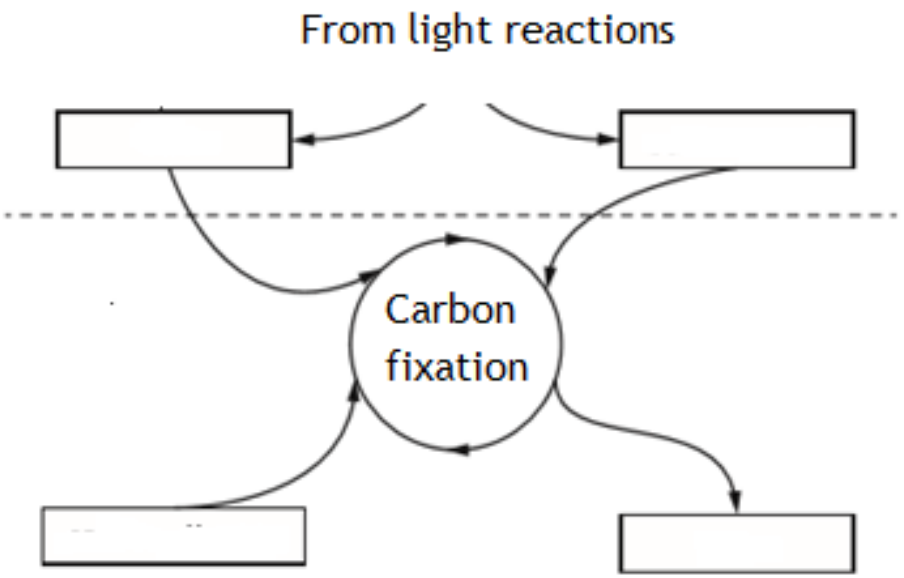
Stage 2: Carbon fixation

A series of _____controlled reactions which converts _____

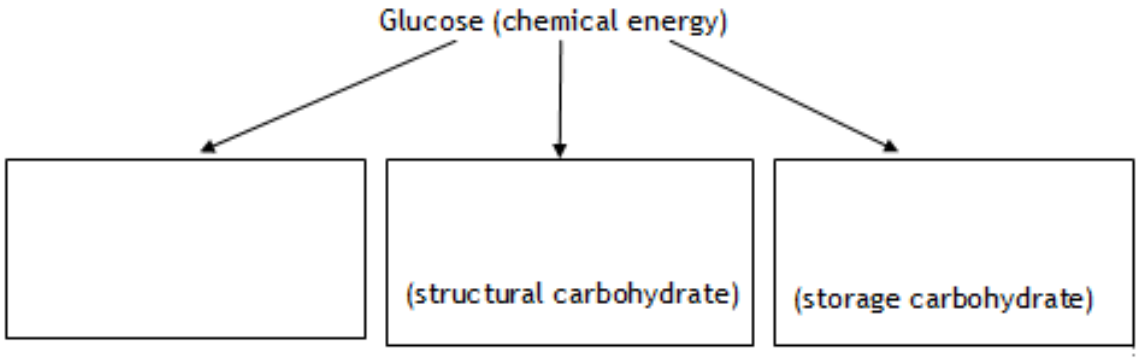
into _____ using _____ and _____ produced in the

_____reactions.

Carbon Fixation Diagram



Fates of Sugar



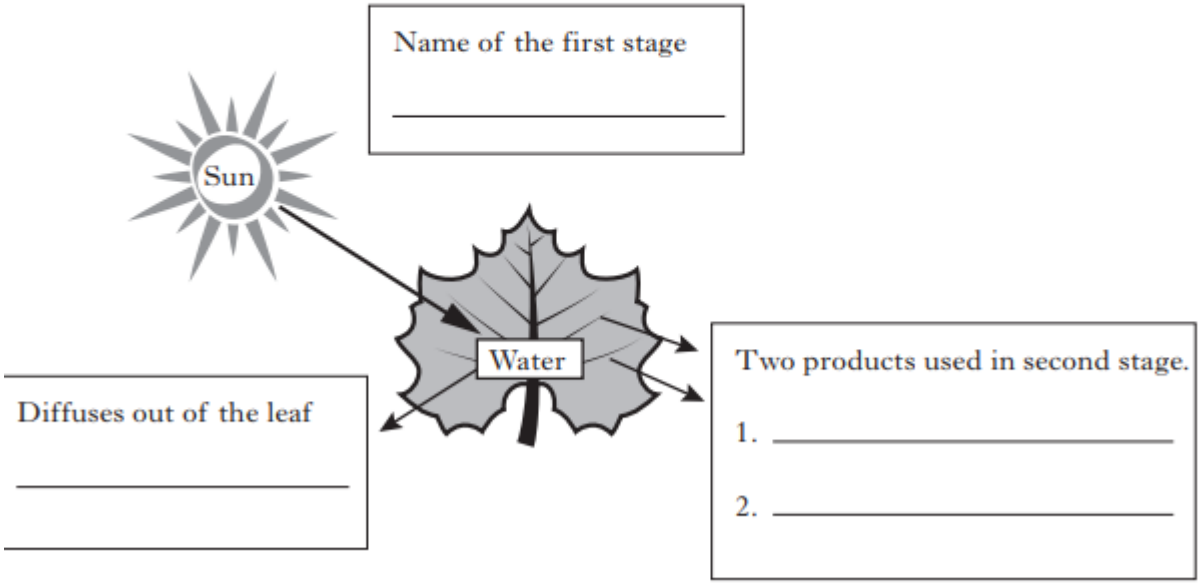
Overall Photosynthesis Diagram

Photosynthesis Quick Quiz

1. Photosynthesis is a two stage process used by green plants to produce food.

a) The diagram below represents a summary of the first stage of photosynthesis. Complete the diagram by filling in the three boxes.

ATP	**carbon dioxide**		**carbon fixation**
glucose	**hydrogen**	**oxygen**	**photolysis**



3

b) Describe the second stage of photosynthesis.

_____

_____

_____

_____ 3

Photosynthesis Quick Quiz

2. Photosynthesis is a two stage process.

Stage 1 — Light reactions

Stage 2 — Carbon fixation

(a) The table below shows some statements about photosynthesis.

Complete the table to show which stage each statement refers to by placing a tick (✓) in the Stage 1 or Stage 2 box.

The first two statements have been completed for you. **2**

Statement	*Stage 1*	*Stage 2*
Carbon dioxide required		✓
Light energy required	✓	
Water required		
Sugar produced		
ATP + Hydrogen required		
Oxygen produced		

(b) Explain why high temperatures (above 50°C) would prevent the photosynthesis reactions from taking place. **2**

Energy Conversion Diagram

Energy Conversion 1

The _____ energy from the _____ is trapped by

_____ in chloroplasts and turned into _____

energy in the form of _____ during the _____ reaction.

Energy conversion 2

The _____ energy found in ATP is then used to produce a store

Of _____ energy called _____ during

_____.

Energy Conversion Summary

_____ energy from the _____

_____ energy in form of _____

Light reaction
(trapped by chlorophyll)

_____ energy in form of _____

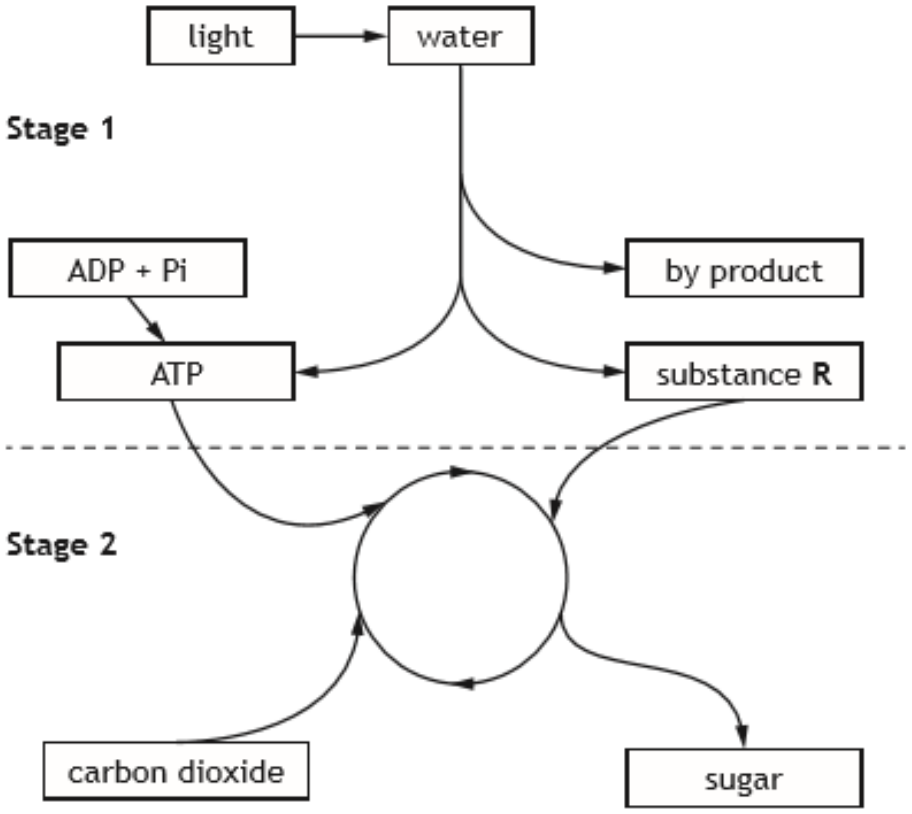
Carbon fixation

_____ energy

Photosynthesis Quick Quiz

1. Photosynthesis is the process by which plants produce sugar using light.

The flow diagram represents stages of photosynthesis in a leaf.



(i) Identify substance **R**. **1**

(ii) Describe the transfer of energy from light arriving at the leaf to the formation of sugar. **3**

Limiting Factors on Photosynthesis

Three Limiting factors

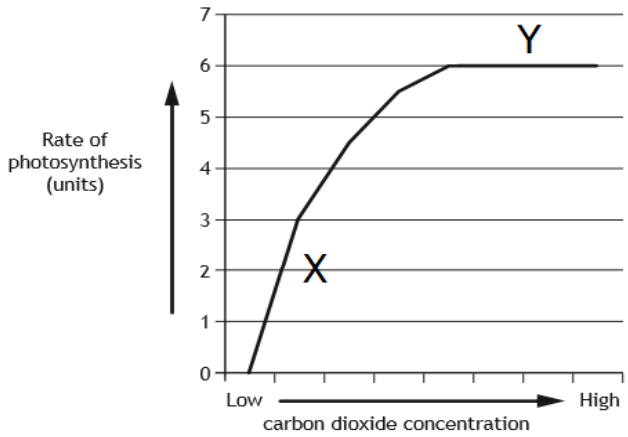
A factor which if increased can _____ the rate of photosynthesis.

1. _____

2. _____

3. _____

Limiting Factor graphs

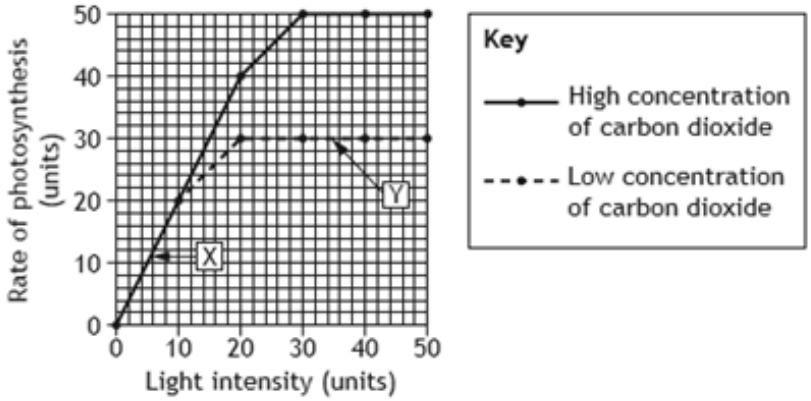


Point X _____

Point Y _____

Photosynthesis Quick Quiz

1. The graph shows the effect of light intensity and carbon dioxide concentration on the rate of photosynthesis.

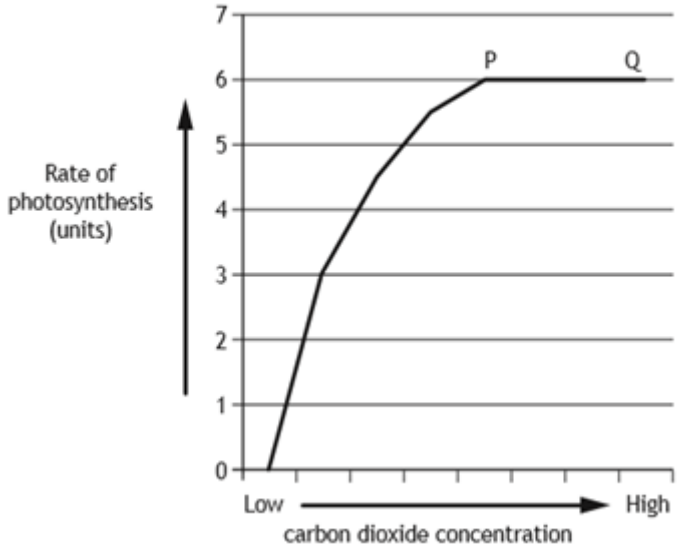


Identify the limiting factor at each of the points X and Y.

X _____

Y _____ 1

2. The graph below shows how the rate of photosynthesis is affected by the concentration of carbon dioxide.



Sate two environmental factors which could limit the rate of photosynthesis between points P and Q.

1. _____

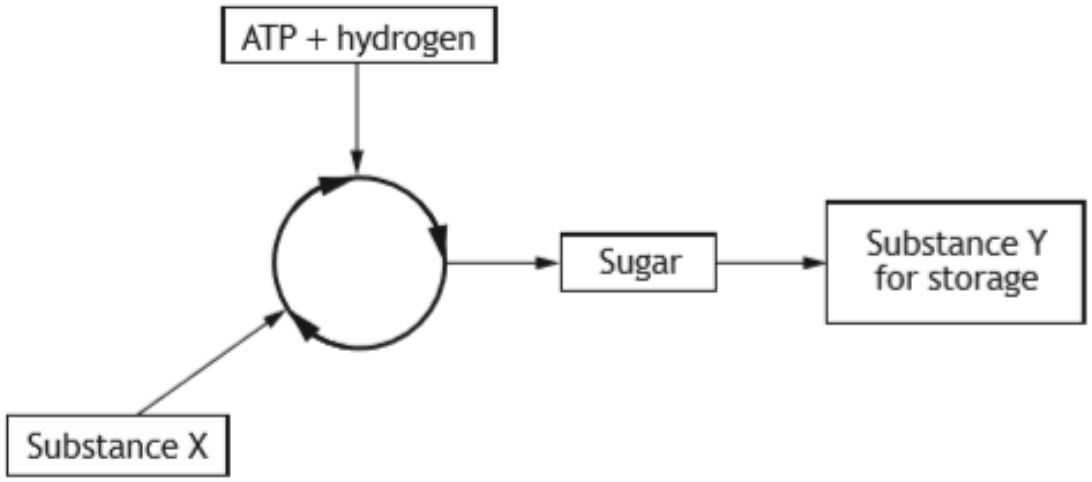
2. _____ 1

Limiting Factor Plant Experiment

3. State one factor, other than temperature, which can limit the rate of photosynthesis. **1**

_____

The diagram represents the second stage of photosynthesis.



Name substances X and Y. **2**

X _____

Y _____

b) Describe the first stage of photosynthesis.

_____

_____

_____

_____

_____

_____

_____ **3**

Measuring Photosynthesis

The rate of photosynthesis can be measured by using a _____weed (elodea) by measuring the number of _____bubbles per minute.

Experimental Set up

The beaker contains _____ and sodium hydrogen carbonate which provides the plant with_____

A _____ is used to provide but a _____shield is used to control the _____.

<u>Labelled Diagram</u>

Water/sodium hydrogen carbonate pond weed O_2 bubbles lamp heat shield

Measuring Photosynthesis

1. An experiment was set up to investigate the effect of light intensity on the rate of photosynthesis in elodea as shown in the diagram below.

The number of bubbles produced in one minute was measured and the light intensity was altered by moving the lamp further from the beaker to lower the light intensity.

Temperature was controlled by placing the beaker of water in a water bath.

Distance of lamp from beaker (cm)	Number of bubbles produced in one minute
10	80
20	80
30	65
40	40
50	20
60	5

a) State the aim of the investigation

_____

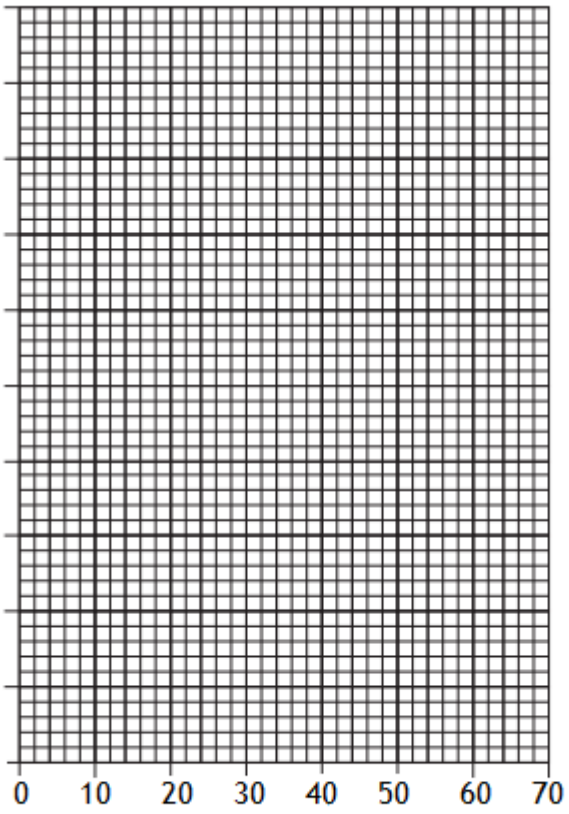
_____

b) State the following variables based on the information above.

Independent variable _____

Dependent variable _____

c) On the grid below, complete the vertical axis and plot a line graph to show the effect of the distance of lamp from beaker on the number of bubbles produced per minute.



(i) Predict the number of oxygen bubbles produced in one minute at 70cm from the beaker

_____ bubbles per minute

(i) Describe the conclusion that can be drawn from the results of the experiment in terms of the effect of light intensity on the rate of photosynthesis.

_____

_____

d) State two variables that have to be kept constant for VALID results apart from controlling the temperature.

1. _____

2._____

e) State how temperature was controlled in this experiment from the information in the passage.

_____

f) A control was not carried out in this experiment but is also important for VALID results.

(i) Describe how to set up a control in this experiment.

_____

_____

(ii) Explain why a control is necessary for VALID results.

_____

_____

g) The student only took one reading at each distance from the lamp. Explain how to improve the reliability of the results.

_____

_____

Starch Test: Limiting factors

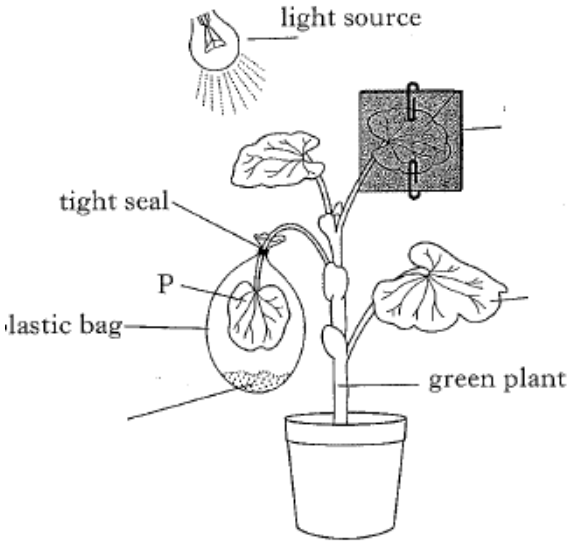
Plants can be checked to see if they are photosynthesising in the presence/ absence of the 3 limiting factors by performing a _____ test.

Leaves are boiled to remove _____ and then _____ is added to test for starch.

If starch is present the leaf will turn _____.

Limiting Factor Experiment

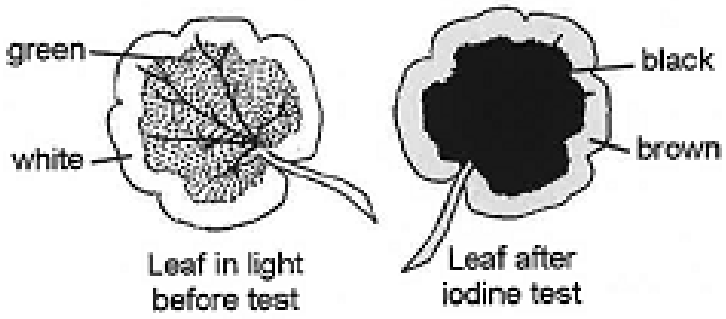
1. Black paper is used to remove the limiting factor of _____
2. Plastic bag with chemical to remove the limiting factor of _____
3. Variegated leaves contain _____ and _____ parts.
   The white parts remove _____.



Limiting Factor Plant Experiment

1. In a variegated leaf the white areas lack photosynthetic pigments.

The diagram shows the appearance of a variegated leaf before and after having been boiled in water, boiled in alcohol to remove any pigment and then bathed in iodine solution.



The result of the iodine test shows the presence in the leaf of

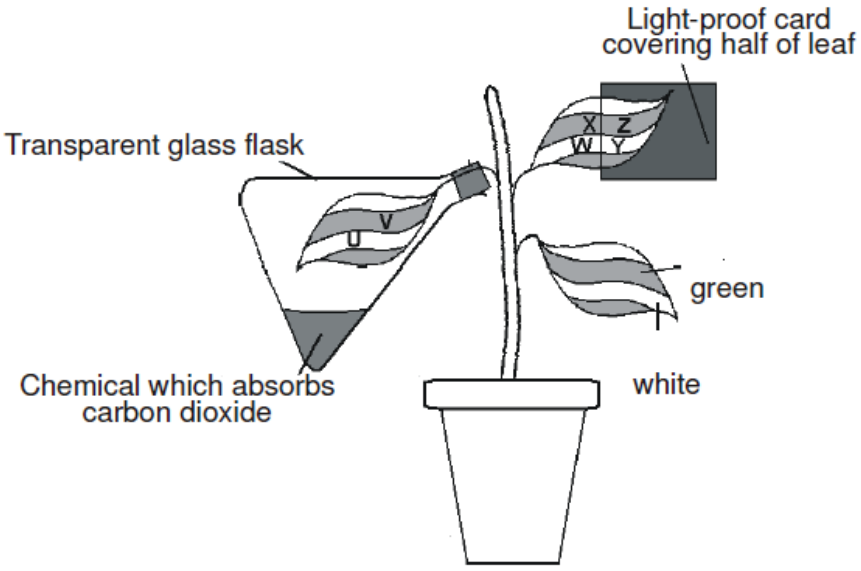
A chlorophyll

B cellulose

C sugar

D starch.

2. The diagram below shows an investigation into photosynthesis using a plant with variegated (green and white) leaves.



In which areas of the leaves would photosynthesis take place?

A X only
B V and X
C W and X
D U, Y and Z

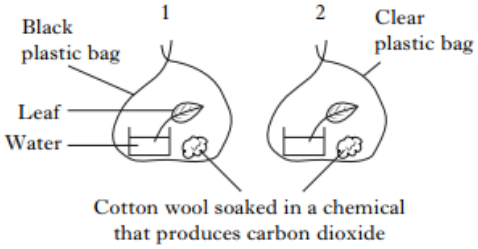
Photosynthesis Mindmap

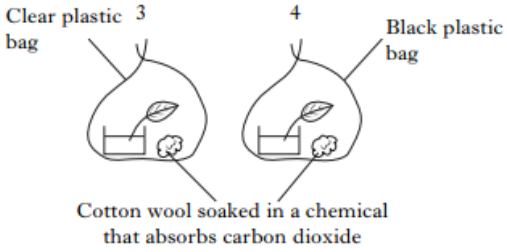
Photosynthesis Quick Quiz

1.The light energy for photosynthesis is captured by

A water
B hydrogen
C chlorophyll
D oxygen.

2. The diagrams below show four experiments used to investigate the conditions needed for photosynthesis.





After two days, the four leaves were tested for the presence of starch. The results from which two experiments should be compared to show that carbon dioxide is needed for photosynthesis?

A 1 and 2
B 2 and 4
C 2 and 3
D 3 and 4

3. The role of chlorophyll in photosynthesis is to trap

A light energy for ATP production
B chemical energy for ATP production
C light energy for ADP production
D chemical energy for ADP production

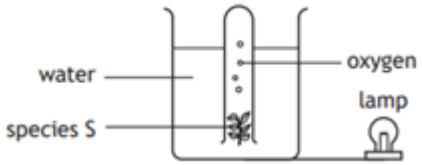
4. The table below shows the rate of photosynthesis in a plant, at 10 °C and 15 °C, in different light intensities.

Light Intensity (units)	*Rate of Photosynthesis*	
	10 °C	15 °C
2	4	5
4	10	15
6	15	30
8	22	45

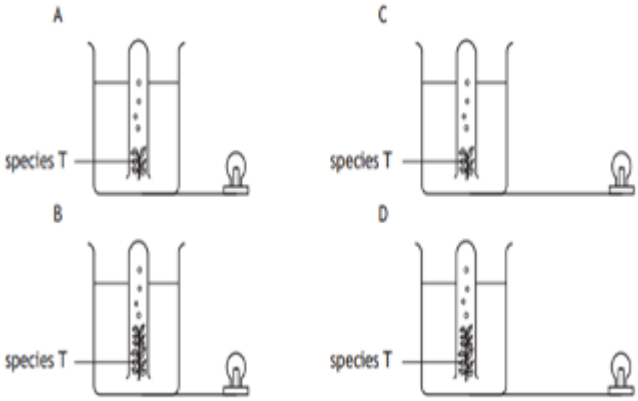
At which light intensity was the rate of photosynthesis at 15 °C found to be 50% greater than the rate at 10 °C?

A 2 units
B 4 units
C 6 units
D 8 units

5. An investigation was carried out to compare the rate of oxygen gas production by two different species o water plant S and T.

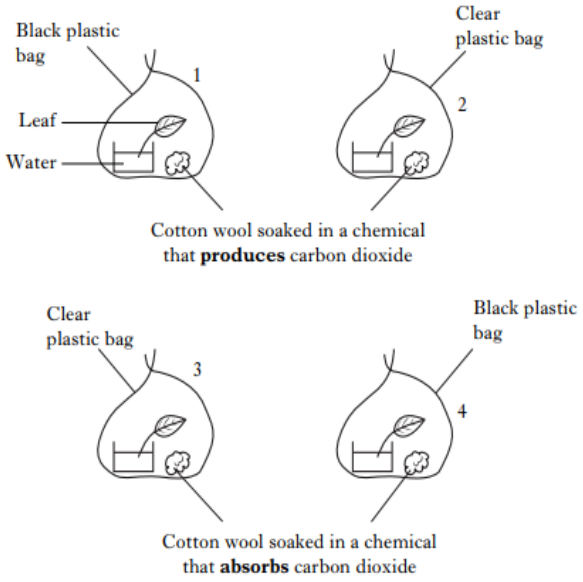


Which diagram below shows the set-up for species T that would allow a valid comparison in the rate of oxygen production of the two species?



Photosynthesis Quick Quiz

6. The diagrams below show four experiments used in an investigation into the conditions needed for photosynthesis. The results from which two experiments should be compared to show that light is needed for photosynthesis?



A 1 and 2
B 1 and 4
C 2 and 3
D 3 and 4

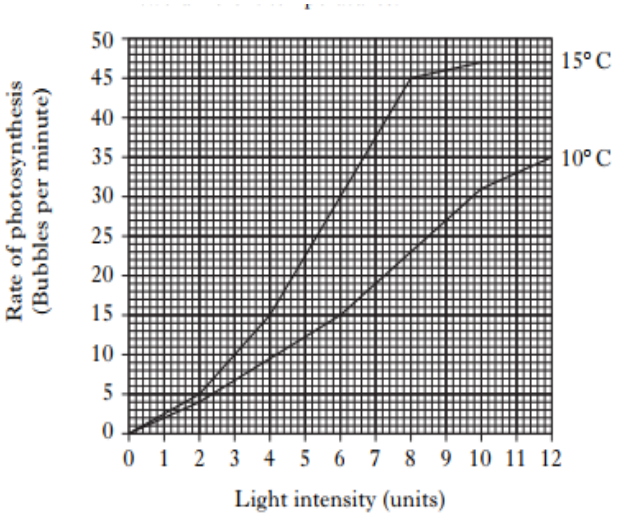
7. The raw materials for photosynthesis are

A carbon dioxide and water
B oxygen and water
C carbon dioxide and glucose
D oxygen and glucose

8. ATP synthesised during photolysis provides the carbon fixation stage of photosynthesis with

A glucose
B carbon dioxide
C energy
D hydrogen

9. The graph below shows the rate of photosynthesis, as light intensity increases, at two different temperatures.
At a light intensity of 6 units, what is the simplest whole number ratio of the rate of photosynthesis at 10°C compared to 15°C?



A 15 : 30
B 10 : 15
C 3: 6
D 1: 2

10. The following stages occur during photosynthesis.

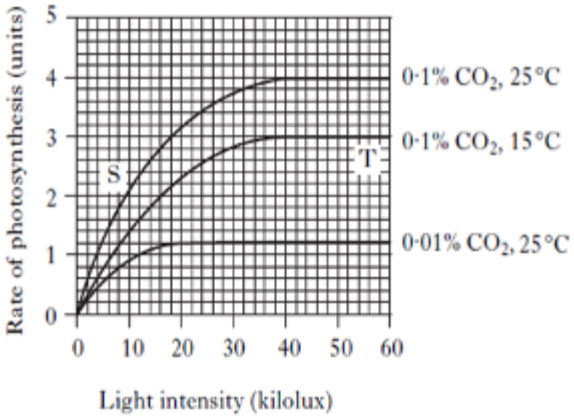
W glucose is formed
X water is broken down to produce H
Y glucose is converted to starch
Z H is combined with CO_2

The correct order for these stages is

A W Z X Y
B Z Y X W
C X Z W Y
D Y X Z W

Photosynthesis Quick Quiz

11. The graph shows the effect of varying the light intensity, temperature and carbon dioxide concentration on the rate of photosynthesis.



The rate of photosynthesis is being limited by

	S	T
A	Temperature	Light intensity
B	Light intensity	Temperature
C	Carbon dioxide	Temperature
D	Light intensity	Carbon dioxide

12. Photolysis is the

A combining of water with CO_2

B use of water by chlorophyll to split light

C release of energy from water using light energy

D splitting of water using light energy

13. The word equation for photosynthesis is

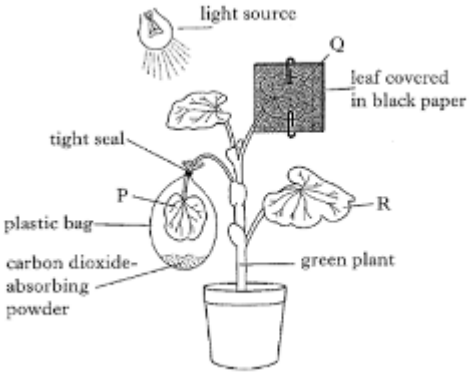
A CO_2 + water ⟶ glucose + O_2

B O_2 + water ⟶ glucose + CO_2

C glucose + O_2 ⟶ CO_2 + water

D CO_2 + O_2 ⟶ glucose + water

14. The diagram below shows an investigation into photosynthesis.



Which of the following statements is correct?

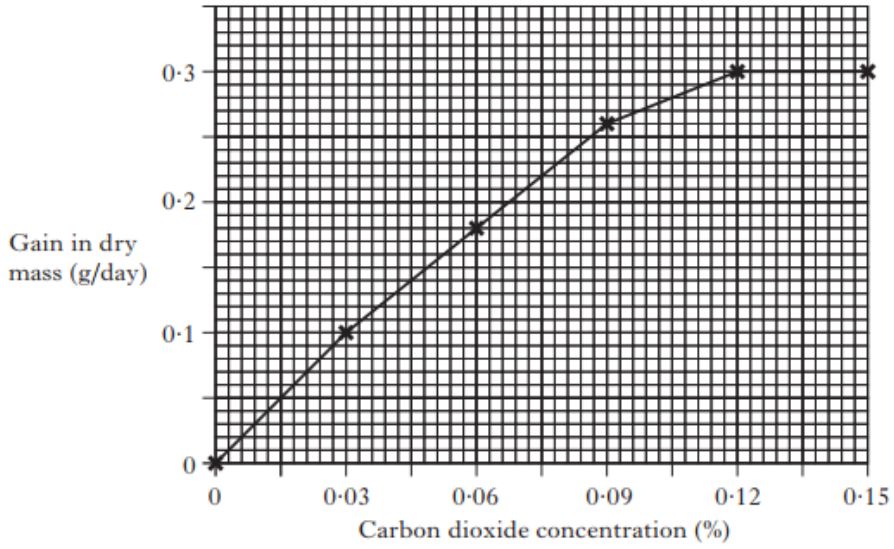
A P, Q and R make food
B Only P and Q make food
C Only P makes food
D Only R makes food

15. Which of the following rows in the table correctly describes the type of carbohydrate with its use?

	Type of carbohydrate	
	Starch	Cellulose
A	Structural	Structural
B	Structural	Storage
C	Storage	Structural
D	Storage	Storage

Photosynthesis Quick Quiz

1. The graph below shows the effect of carbon dioxide concentration on the growth of plants.



(i) State how the growth of plants was measured in this investigation?

_____ 1

(ii) Use data from the graph to describe the relationship between carbon dioxide concentration and the gain in dry mass.

_____

_____ 1

(b) Carbon dioxide concentration is a limiting factor in photosynthesis. Name one other limiting factor.

_____ 1

(c) Photosynthesis uses carbon dioxide for the growth of plants.

(i) Name the stage of photosynthesis which uses carbon dioxide.

_____ 1

(ii) Name one other substance used in this stage.

_____ 1

Producers & Consumers

All the organisms in an ecosystem can be divided into one of two groups

1. **_____**

_____plants that make their own _____.

They do this in a process called _____.

2. **_____**

_____another organism in order to get _____.

Types of Consumers

1. **Primary consumers**

Primary consumers eat _____ and are termed

_____.

Primary consumers are _____**hunted** by secondary consumers &

are termed _____.

2. **Secondary consumers**

Secondary consumers are _____that **hunt** and are termed

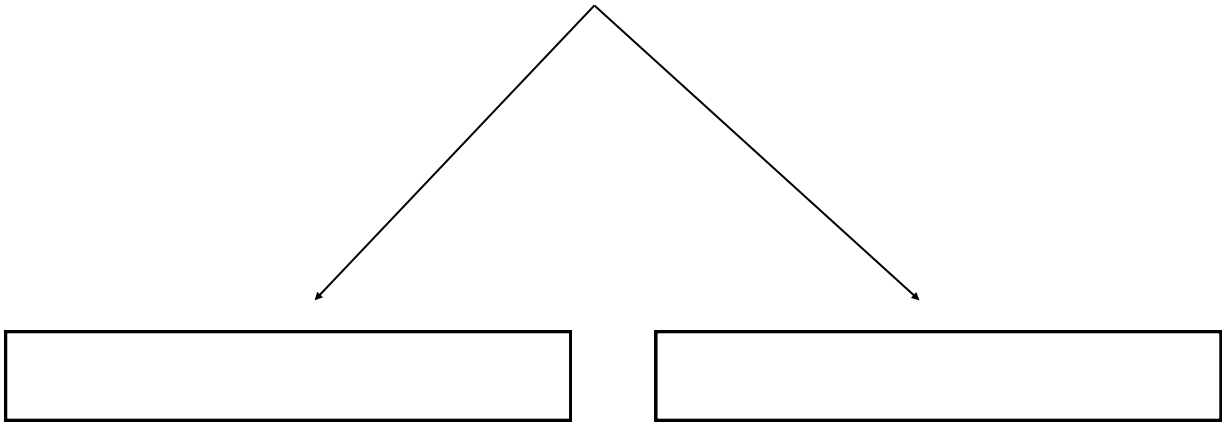
_____. They eat _____ consumers

and are also termed _____.

Consumer diets	Definition
	Consumers that feed on ONLY plants
	Consumers that ONLY feed on other animals
	Consumers that feed on both plants and animals

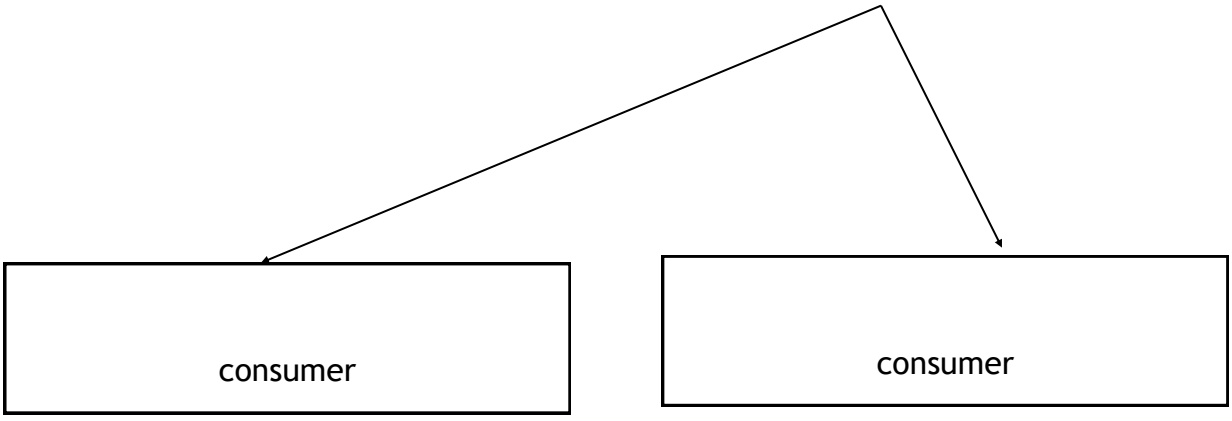
Producers & Consumers Flow Chart

Type of organism in food chain



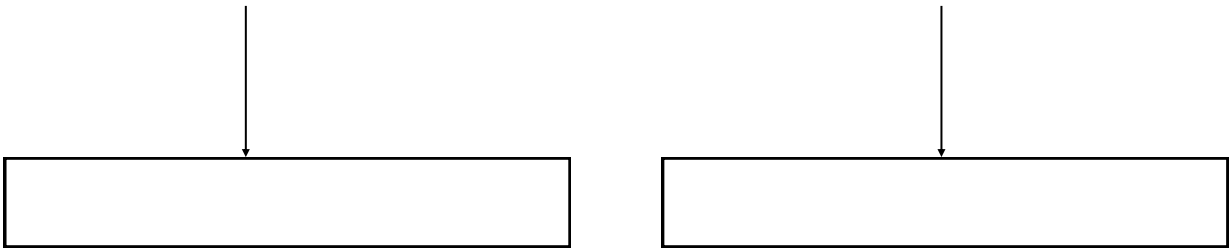
Make their own food by photosynthesis

Eats other organisms to gain food



Only eat producers to gain food

Eat primary consumers to gain food



Animal HUNTED by secondary consumer

Animal that **HUNTS** primary consumer

Food Chains

Food chains

Food chains are arranged as follows and always start with a _____

(green plant):

_____ _____

The arrows in a food chain show the _____of _____

flow as one organism eats another organism.

Energy Conversions

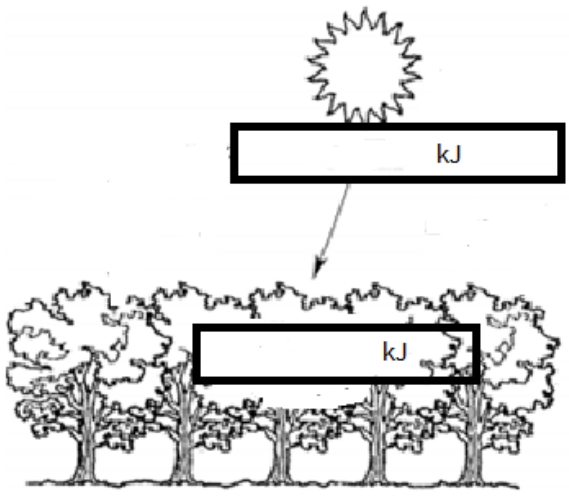
Only a _____ percentage of the light energy from the sun is absorbed

by plants through the green pigment _____ stored in the

chloroplasts.

Question

If 4,000 000 KJ of light energy are given out by the sun and chlorophyll is able to absorb 5% of this energy, calculate the number of units of energy available for new plant Material.



Energy conversions in a food chain

Transferring Energy

When transferring energy from one level to the next in a food chain

1. The **majority** of the energy is lost/gained (approximately _____%) as

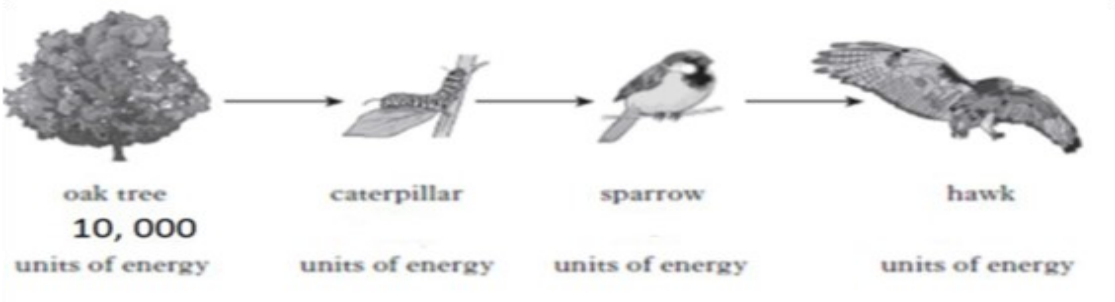
a) _____

b) _____

c) _____

2. Only a **very small quantity of energy** is available at the next level in a food chain for _____ (approximately ____%).

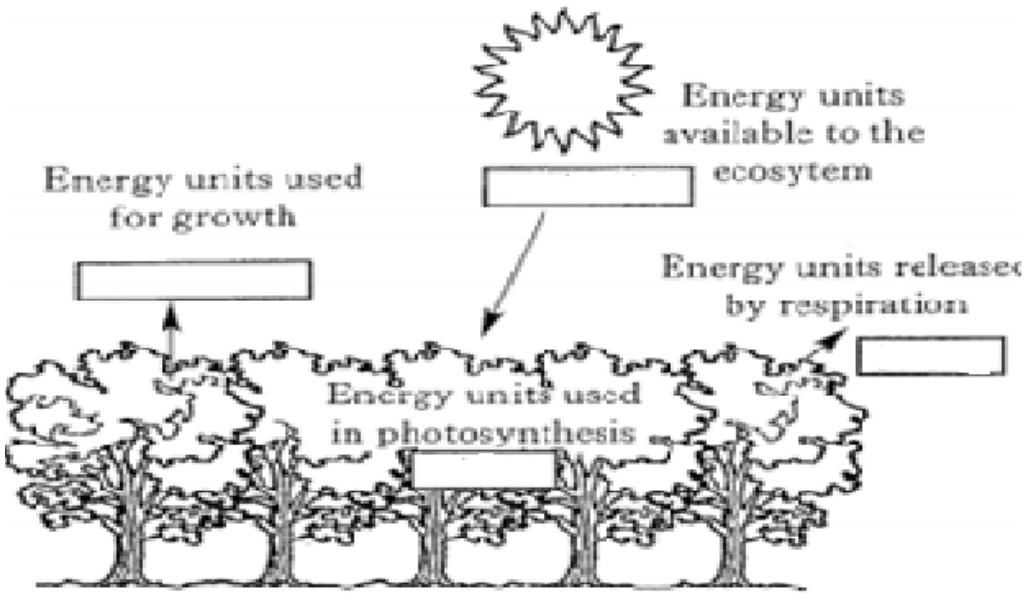
Example



Energy conversions in a food chain

If 4 million units of energy are available to the ecosystem from the sun and chlorophyll is able to absorb 40,000 kJ for photosynthesis . Of this 28,000 kJ are released by respiration leaving 12,000 kJ for growth.

a) Use the information above to complete the flow chart.



b) Calculate the percentage of the energy from sunlight absorbed by trees used for photosynthesis.

_____%

c) The trees are eaten by primary consumers. State the units of energy available to The primary consumers after eating the trees.

_____kJ

d) State one way the energy is lost between the trees and the primary consumers.

_____-

Energy Calculations

1. Plants convert 1% of the light energy they receive from the sun into new plant material.

In the food chain below, plant plankton receive 100,000 units of light energy from the sun.

plant plankton → animal plankton → sprats → mackerel

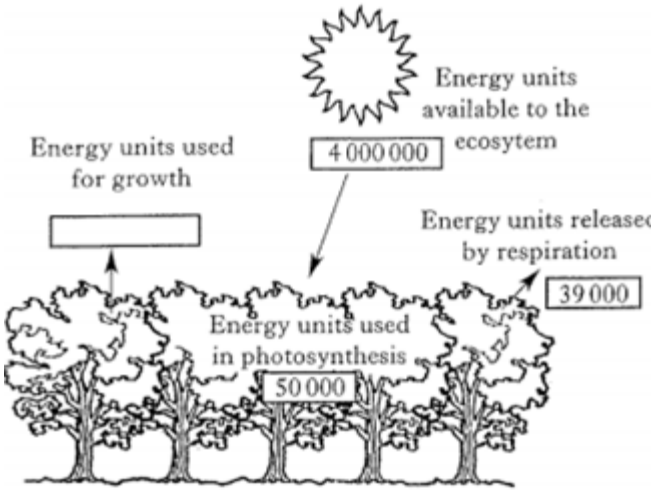
How much of this energy from the sun is converted into new plant material?

A 10 000 units
B 1000 units
C 100 units
D 10 units

2. The diagram represents energy flow in a woodland ecosystem.

The number of energy units for growth is

A 11,000
B 89,000
C 3, 950 000
D 3, 961 000



3. The percentage of the energy from sunlight absorbed by trees and used for photosynthesis is

A 1.25%
B 12.5%
C 98.75%
D 8000%

4. An ecosystem receives 6000 000 units of energy from the sun.

Of this energy, 95% is **NOT** used in Photosynthesis.

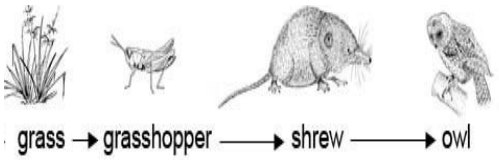
The amount of energy captured by the producers in this ecosystem is

A 30,000 units
B 300,000 units
C 570,000 units
D 5700,000 units

5. The following diagram shows a food chain in a forest ecosystem, and the energy received by each organism in the food chain.

15,500kJ

Which of the following shows the quantity of energy received by the grasshopper?



A 15,550kJ
B 1500kJ
C 1550kJ
D 150kJ

Food Chains & Pyramids

Food chains can be converted into pyramids as follows.

Food Chain

Pyramid

Types of pyramid

1. Pyramids of Numbers
   Show the total _____ of organisms at each _____ of a food chain.

2. Pyramids of Energy
   Show the total _____ contained within organisms at each _____ of a food chain.

   Remember only approximately _____% is passed on for _____ at each stage of a food chain.

Problems with Pyramids of Numbers

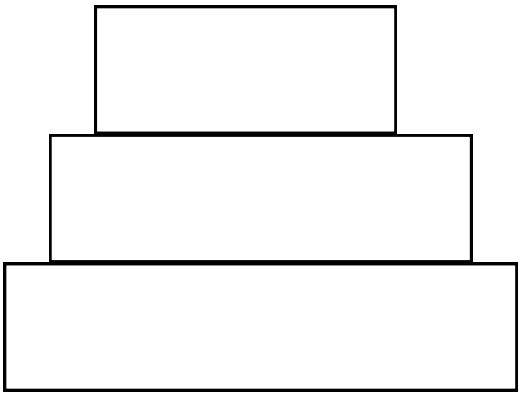
A pyramid of _____ is less _____ as it does not always represent a pyramid shape.

Example 1

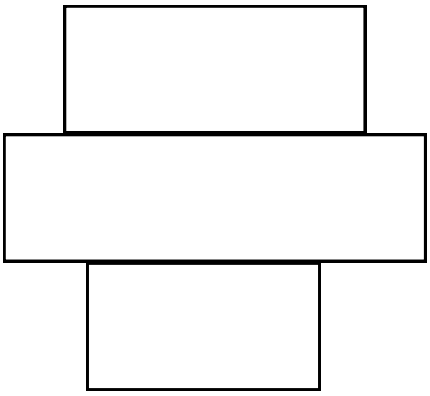
A producer always has the largest quantity of _____ but not always the largest _____ of organisms when _____ are the producer.

Oak tree → squirrel → fox

Pyramid of energy



Pyramid of numbers

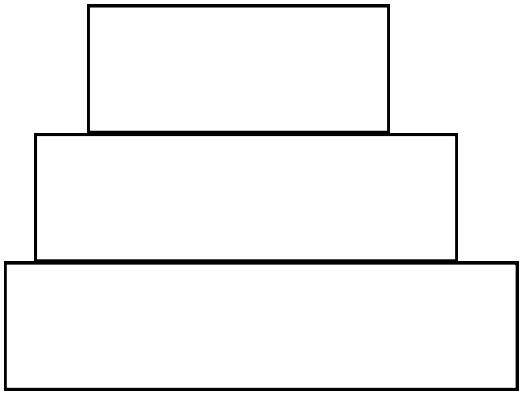


Example 2

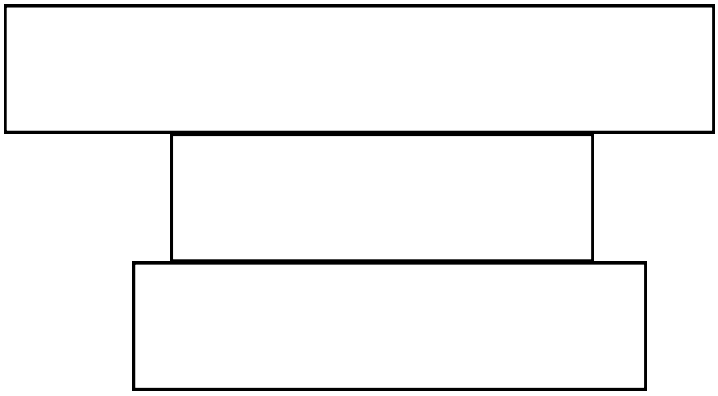
A secondary consumer always has the least _____ but not always the _____numbers of organism when _____ are the top consumer

Grass → sheep → flea

Pyramid of energy



Pyramid of numbers



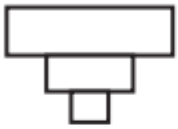
Food Chain & Pyramids Mindmap

Food Chain & Pyramids Quick Quiz

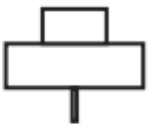
1. Which of the following diagrams represents the pyramid of numbers for the food chain below?

Beech tree ⟶ greenfly ⟶ ladybirds

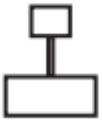
A



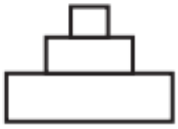
B



C



D



The Treecreeper is a bird which feeds on small insects on the bark of trees during the day. What is the correct description of the Treecreeper's niche?

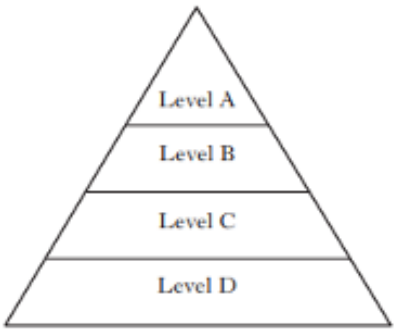
A The place where it lives

B The insects on which it feeds

C The plants and animals in the woodland

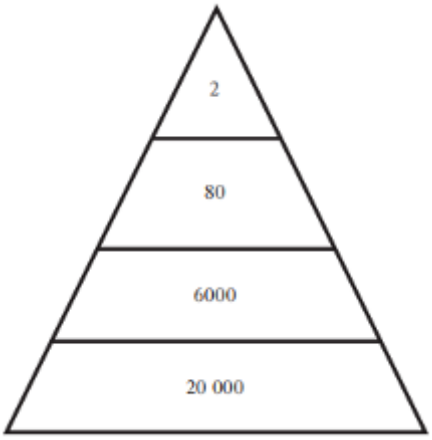
D Its role within the woodland ecosystem

3. The diagram below shows the levels in a pyramid of numbers.



Which level in the pyramid contains primary consumers?

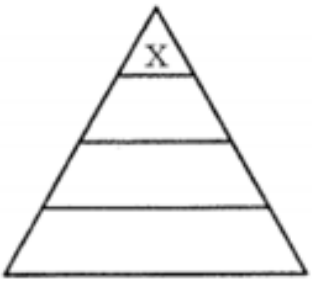
4. The diagram below shows the number of organisms at each level in a pyramid of numbers.



How many organisms are consumers?

A 2
B 82
C 6000
D 6082

5. The diagram below shows the pyramid of energy for a food chain.

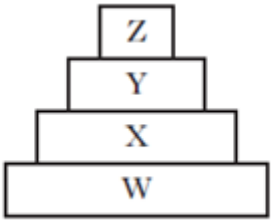


There is less energy at Level X in the pyramid because

A energy is stored in each level and not passed on
B energy is lost at each level in a food chain
C the energy is concentrated in fewer organisms
D organisms in level X are very small

Food Chain & Pyramids Quick Quiz

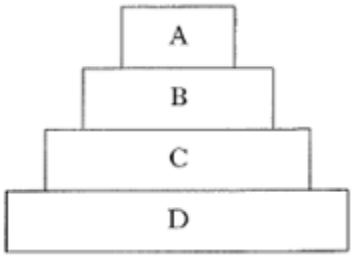
6. The diagram below shows a pyramid of energy.



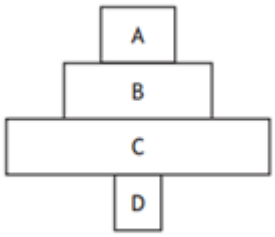
Z represents the total mass of

A producers
B primary consumers
C predators
D secondary consumers

7. The following diagram shows a pyramid of energy. Which level is the results of the energy from the sun being converted into chemical energy?



8. The diagram below shows a pyramid of numbers.



Which letter represents the producer?

9. On average, 90% of energy is lost at each energy transfer in a food chain.

Which of the following is a cause of this energy loss?

A digested material
B movement
C growth
D cell repair

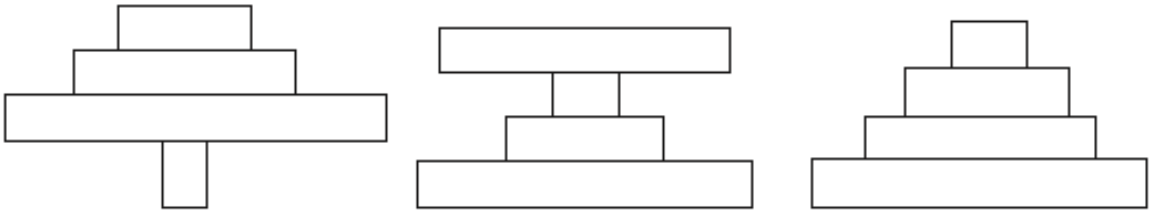
10. Which of the following describes a primary consumer?

A It eats the secondary consumer.
B It is preyed upon by the secondary consumer.
C It is always at the beginning of the food chain.
D It can make its own food.

Food Chains & pyramid Questions

1. (a) A food chain is shown below along with three pyramids of numbers.

grass ⟶ zebra ⟶ lion ⟶ flea



Pyramid K Pyramid L Pyramid M

Identify the pyramid which represents the food chain shown. **1**

Pyramid _____

(b) This food chain can also be represented by a pyramid of biomass.

State the meaning of the term " Pyramid of energy. **1**

_____

_____

(c) (i) Calculations were made to estimate the energy content of a food chain involving three species.

heather ⟶ hare ⟶ golden eagle

Two of these values are given in the table below. Complete the table by calculating the missing energy value. **1**

Space for calculation

Organism	*Energy* (kJ)
heather	97,000
hare	
golden eagle	970

(ii) State one way in which energy may be lost between stages in a food chain. **1**

_____

2. Calculations were made to estimate the energy content of a food chain involving three species.

heather ⟶ hare ⟶ golden eagle

a) Two of these values are given in the table below. Compete the table by calculating the missing energy values.

Space for calculation

Organism	Energy (kJ)
Heather	25,000
Hare	
Golden eagle	250

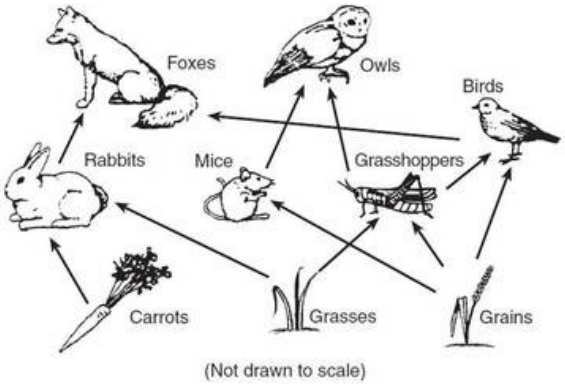
1

b) State two ways in which energy can be lost between stages in a food chain?

1. _____

2. _____ 2

3. The diagram below shows a food web in a woodland ecosystem.



a) Name all the carnivores in the food web above. 1

_____

b) Describe what the arrow in the food web represent? 1

_____

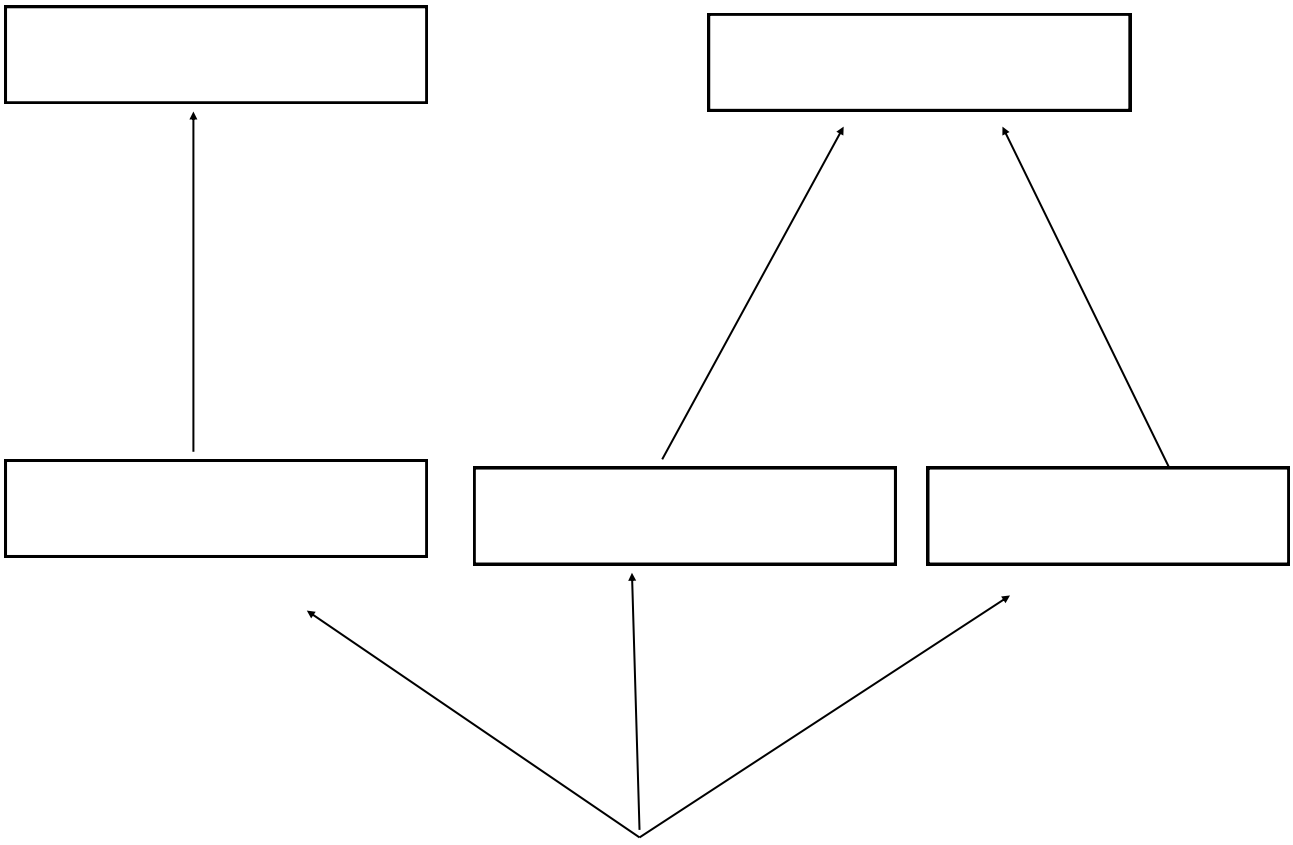
_____

Food Webs

_____ food chains make up food _____

Food web example

Grass is eaten by rabbits which are eaten by foxes. Grass is also eaten by buffalo which are hunted by lions. Lastly zebras which are also hunted by lions also eat grass.



Grass

Quick Questions

1. Name the producer(s) in the food web. _____ 1

2. Name all the primary consumers in the food web.

_____ 1

3. State an example of a predator and a prey from the food web.

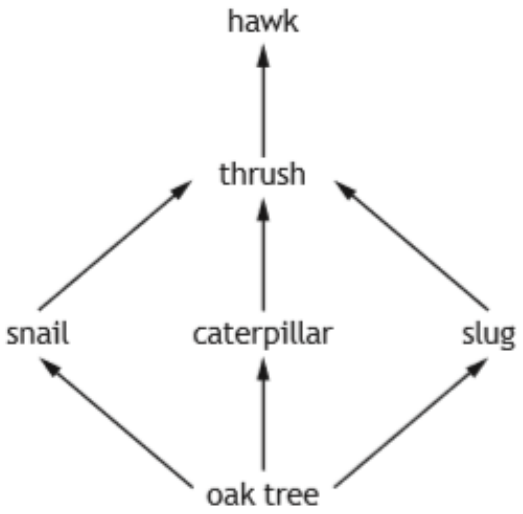
Predator _____ prey _____ 1

4. Give an example of a herbivore from the diagram above.

_____ 1

Food Webs

The diagram shows part of a food web.



a) Name all the primary consumers

_____ 1

b) Name the producer (s)

_____ 1

c) Name two species in competition with each other

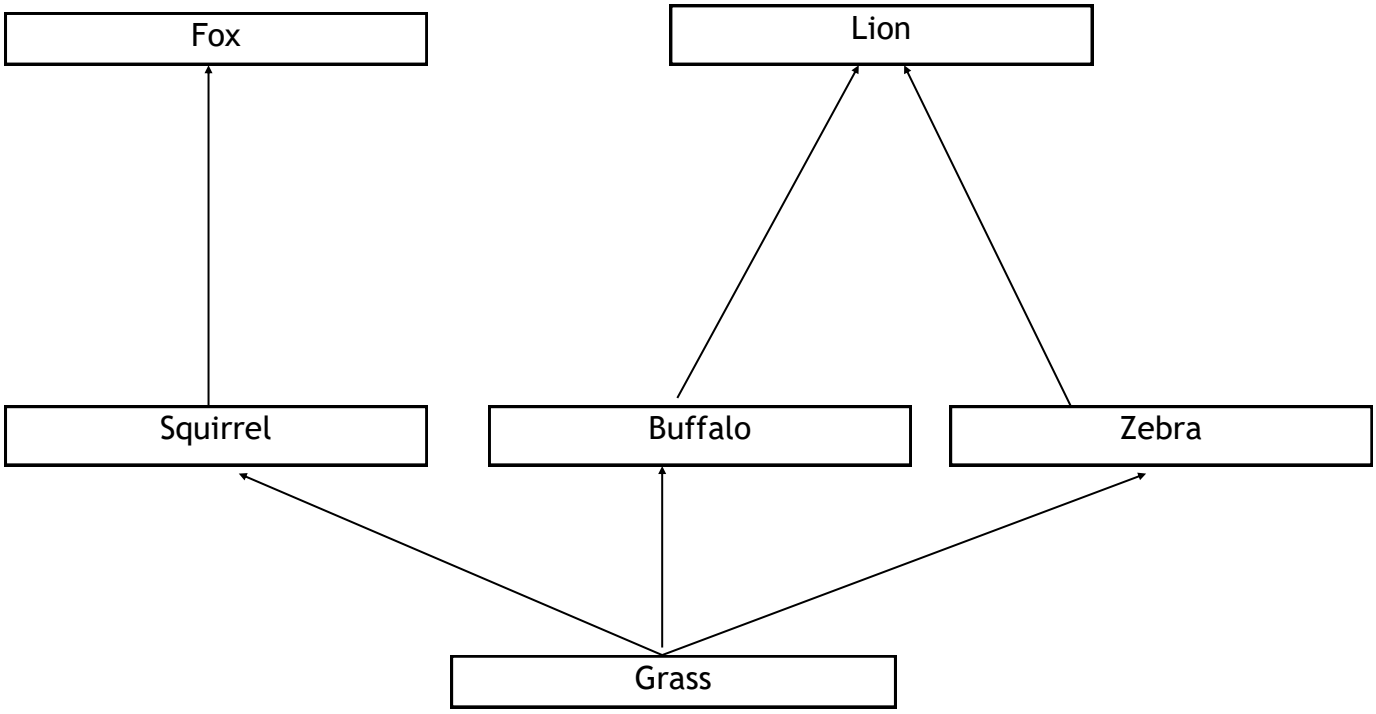
_____ 1

D) A chemical was used to control the number of slugs. Which of the following could be a result of a large decrease in slug numbers?

A An increase in snails.
B An increase in hawks.
C A decrease in caterpillars.
D A decrease in oak trees.

Food Webs

When one organism is removed this will affect ALL other organisms by increasing/ decreasing their numbers



When grass is removed buffalo numbers would **increase** **decrease**

Explanation_____

_____

When foxes are removed, squirrel numbers would **increase** **decrease**

Explanation_____

_____

When zebra are removed, lion numbers would **increase** **decrease**

Explanation_____

_____

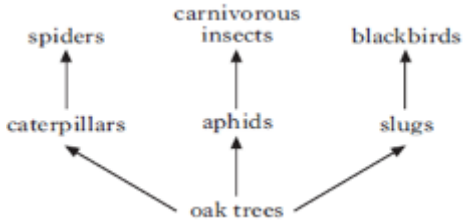
When buffalos are removed, zebra numbers would **increase** **decrease**

Explanation_____

_____

Food Web Questions

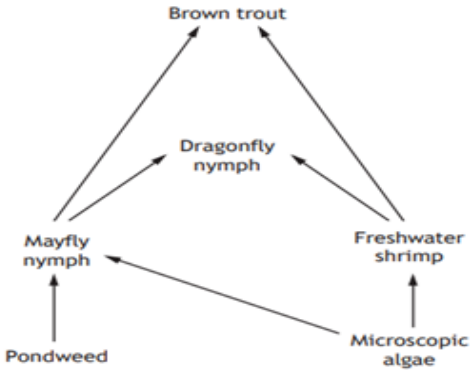
1. The diagram below shows part of a food web in an oak woodland.



The use of insecticide in a nearby field results in the death of most aphids and caterpillars. Which line in the table correctly identifies the effect of the number of slugs and carnivorous insects.

	Number of slugs	*Number of carnivorous insects*
A	increases	decreases
B	decreases	stays the same
C	decreases	increases
D	increases	stays the same

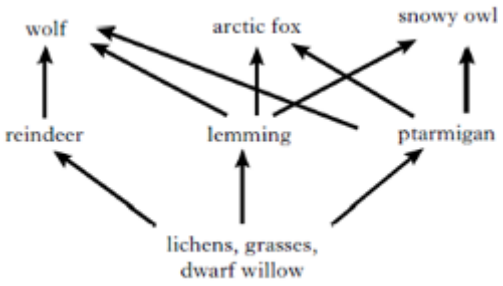
2.The diagram below represents a freshwater food web.



The number of freshwater shrimps was found to have dramatically decreased. Predict the effect of the numbers of dragonfly and microscopic algae.

	Dragonfly	Microscopic algae
A	decrease	decrease
B	increase	increase
C	Increase	decrease
D	decrease	increase

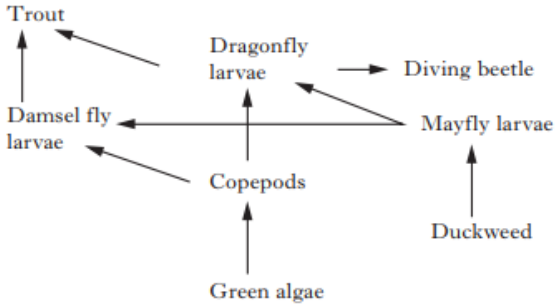
3. The diagram below shows part of a food chain in the Arctic tundra.



A reduction in the lemmings will cause

A an increase in reindeer and a decrease in lichen
B an increase in ptoarmigan and reindeer
C a decrease in dwarf willow and a decrease in reindeer
D a decrease in reindeer and wolves

4. The diagram below shows part of a food web in a freshwater ecosystem.



A reduction in the population of Dragonfly larvae will cause

A an increase in the populations of both the trout and diving beetle

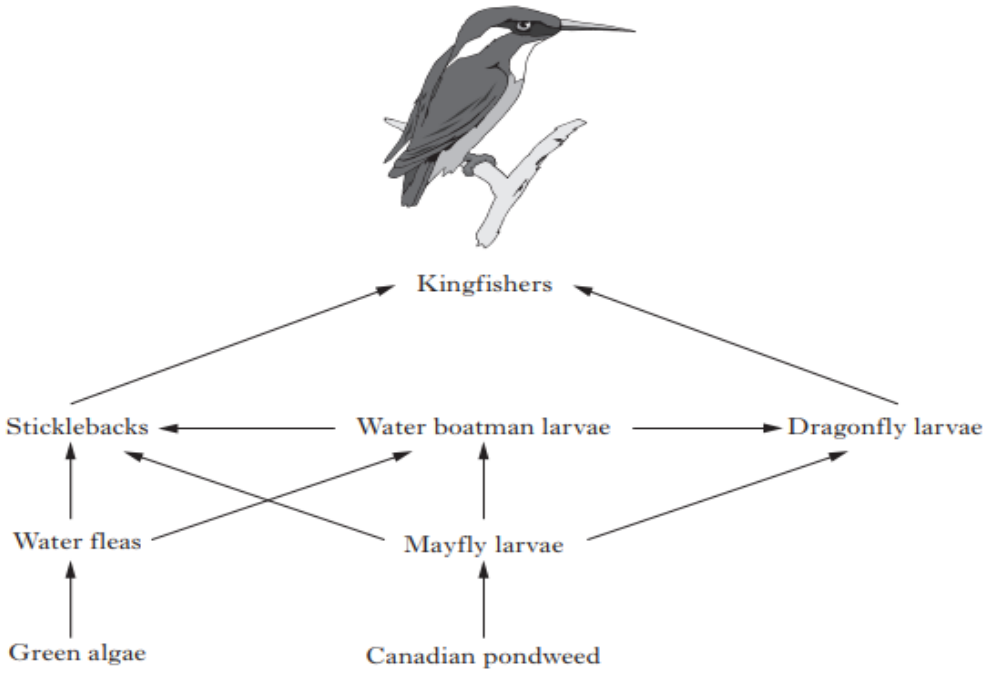
B an increase in the populations of both the trout and copepods

C a decrease in the populations of both green algae and damsel fly larvae

D an increase in the population of copepods and a decrease in the population of mayfly larvae.

Food Chain & Pyramids Quick Quiz

1. The diagram below represents a food web in a freshwater ecosystem



Select organisms from the food web to complete the food chain below.

a) Name all the secondary consumers in this food web.

_____ 1

b) (i) Explain why the dragonfly larvae and the sticklebacks are in competition with each other.

_____

_____ 1

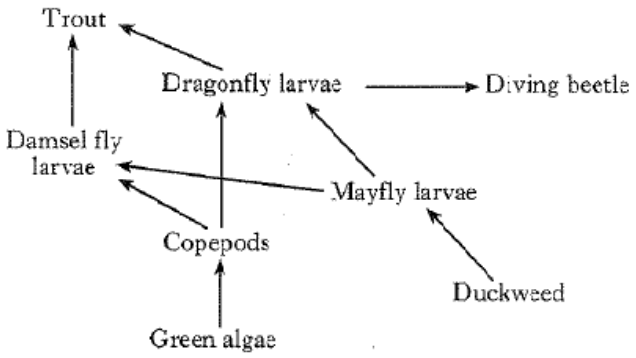
(ii) With reference to this food web, explain why sticklebacks are likely to be more successful than dragonfly larvae if water boatman larvae are removed

_____

_____ 1

Food Chain & Pyramids Quick Quiz

2. Below is a diagram representing a food web in a fresh water ecosystem



a) Create a food chain containing 4 organisms. 1

⟶ ⟶ ⟶

b) Identify **all** primary consumers in the food web. 1

_____

c) i. If Damsel fly larvae were to die out what would happen to the number of copepods. Justify your answer.
Copepods numbers— **increase/decrease/stay the same** 1

Justification _____

_____

ii. If more Diving beetles were introduced to the forest what would happen to the number of dragon fly larvae. Justify your answer.
Dragon fly numbers— **increase/decrease/stay the same** 2

Justification

_____

_____

Competition

Competition occurs when resources are in _____ supply in ecosystems.

Resources animals compete for	Resources plants compete for

Types of competition

1. **Inter specific competition**

   Competition between _____ species for _____
   Resources they require.

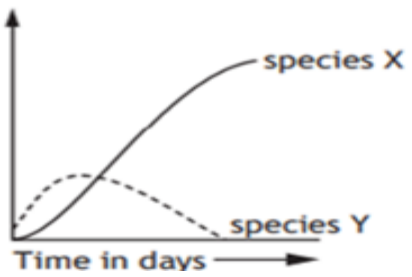
   Example _____ & _____ squirrels

2. **Intra specific competition**

   Competition between the _____ species for _____
   resources they require.

   Intra/Inter specific competition is _____intense and will lead to
   Survival of the fittest aka _____.

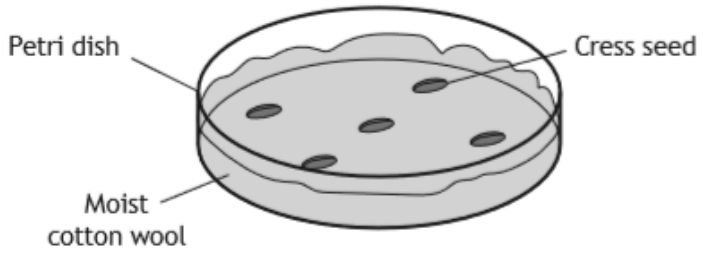
   One organism will _____ One organism will _____



Inter specific Competition in Seeds Experiment

To investigate the effect of competition on the growth of cress seeds, five Petri dishes, labelled A – E, were set up and left for six days.

Each dish contained a layer of moist cotton wool with different numbers of cress seeds sown evenly across its surface. Dish A is shown in the diagram



The results are shown in the table.

Dish	*Number of seeds sown*	*Number of seedlings surviving after six days*	*Percentage of seedlings surviving after six days*
A	5	5	100
B	10	10	100
C	20		95
D	40	34	85
E	80	60	75

a) (i) Complete the table by calculating the number of seedlings surviving in Dish C. 1

(ii) Name the independent variable.

_____ 1

(iii) Describe the relationship between the number of seeds sown and the percentage of seedlings surviving after six days.

_____

_____ 1

b) Explain why the type of competition shown in this investigation is described as being intraspecific.

_____

_____ 1

c) The diagram represents positions of organisms in a food chain. Tick one of the boxes to show the position cress would occupy in the food chain.

d) Name one resource, other than water, for which plants may be in competition.

_____ 1

e) Controls are important for valid results. Describe the control that could be set up in this experiment.

_____

_____ 1

f) Decide whether this research would be described as reliable or not and tick the appropriate box. Give a reason for your choice.

Reliable ☐ Not reliable ☐

Reason_____

_____ 1

Niche and Competition

The_____that an organism plays within a _____.

An organism's niche includes:

1. _____ it requires

   e.g. _____

2. _____ with other organisms in the community

   e.g. _____ & _____-

3. _____ it can tolerate

   e.g. _____-3

To reduce competition, organisms occupy _____niches.

Bird Example

Different _____of beaks meant birds

could eat _____ food reducing

_____competition.

Fish Example

Different _____ of mouth meant

Fish could eat _____ food

reducing _____

competition.

Niche Examples Research

Organism	Resources required in ecosystem	Interactions with other organisms		Conditions it tolerates
		Competition	Predators/prey	
Wildcat				
Red squirrel				
Brown trout				
Bracken				
Scottish Cross bill				
Red Grouse				

Food web, Niche and Competition Mindmap

Competition and Niche

1. Which of the following best describes a niche?

A a living factor which affects biodiversity in an ecosystem
B all the organisms in an area and their habitat
C the role that an organism plays within a community
D one particular species

2. Plants mainly compete for

A water, light and soil nutrients
B water, food and soil nutrients
C light, water and food
D light, food and soil nutrients

3. Which statement describes a type of competition and a matching example.

A Interspecific competition when two birch trees growing close together in a wood.

B Interspecific competition when lions and hyenas feed on zebra

C Intraspecific competition when seals and dolphins feed on small fish

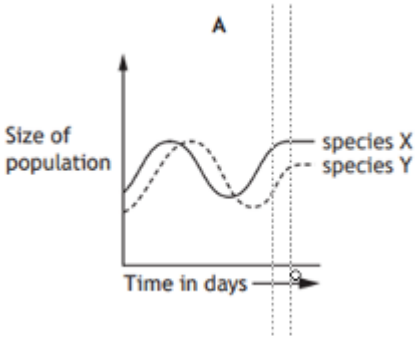
D Intraspecific competition when buttercups and daisies growing in the same field

4. A rabbit feeds on grass, is eaten by foxes and is a habitat for fleas. The statement above describes the rabbit's

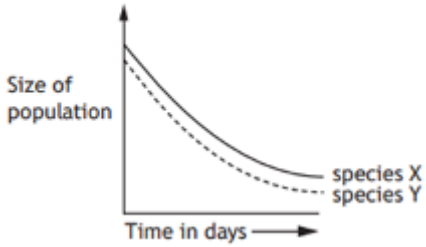
A ecosystem
B community
C niche
D prey

5. Which of the following graphs show the effects of competition for the same food between a successful and unsuccessful species?

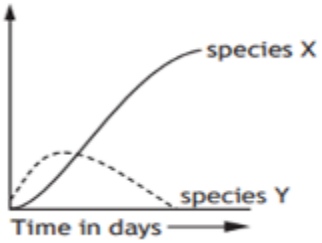
A



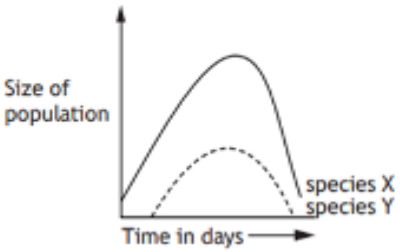
B



C



D

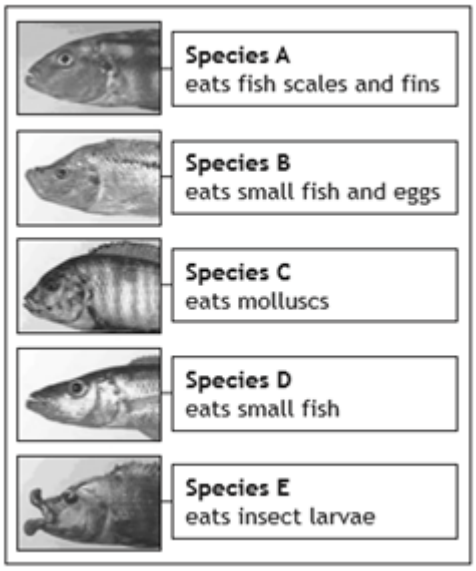


6. In which of the following would competition not occur?

A Rabbits grazing in a field
B Owls and foxes hunting for mice
C Daisies and dandelions growing in a lawn
D Algae and fish in a loch

Competition & Niche Questions

1. The cichlid fish below are all found in Lake Malawi in Africa.



a) (i) Using the information above, identify the feature which enables the fish to have different diets.

_____ 1

(ii) Predict which two species of Cichlipd would be in competition with each other if there was a shortage of fish eggs. Give a reason for your answer.

Species _____ and _____

Reason _____

_____ 1

b) State the term which describes the role that an organism such as the Cichlid plays within its community.

_____ 1

2. During the investigation the students found four different species of periwinkles at different positions on the rocky shore.

The highest position that the sea water reaches on the shore is called the high tide level.

The bars in the table below represent the positions on the shore where each species of periwinkle was found.

	Species of periwinkle			
Position on shore	*Small*	*Edible*	*Rough*	*Flat*
High tide level ↓ Low tide level				

(i) State which species of periwinkle is least likely to compete with the small periwinkle.

Explain your answer. **1**

Species _____

Explanation _____

_____

(ii) Using the information given, explain why the competition between these periwinkles is described as interspecific. **1**

_____

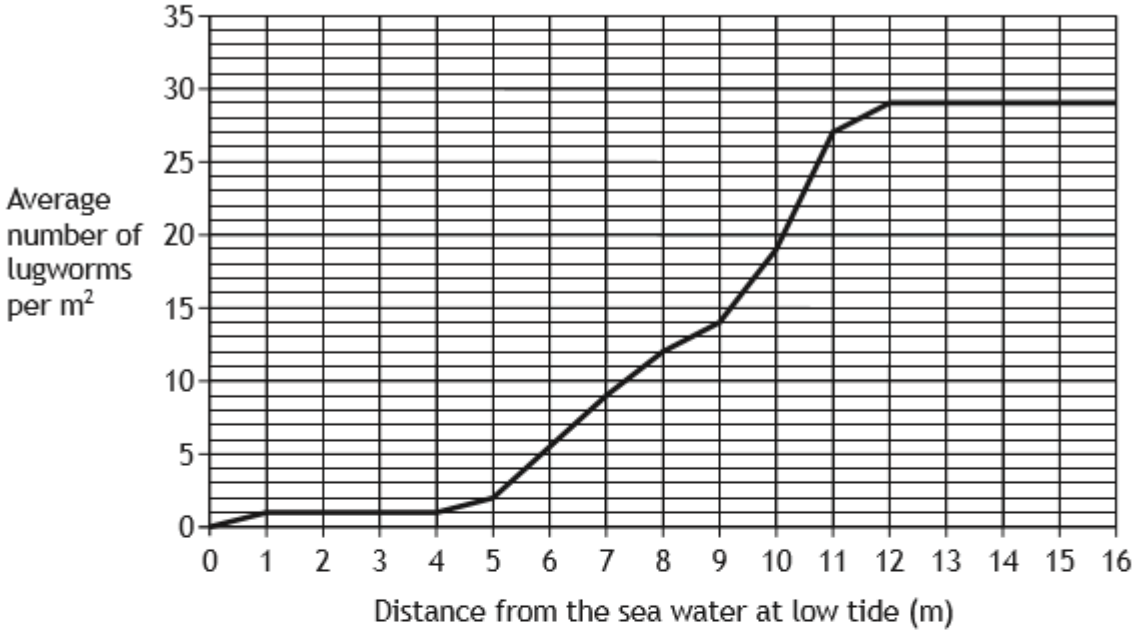
_____

Competition & Niche

MARKS

3. (a) Lugworms live on the seashore in dark moist burrows under the sand.

The graph below shows the average number of lugworms at different distances from the seawater at low tide.



(i) Describe the relationship between the distance from the seawater at low tide and the average number of lugworms per m^2. **2**

(ii) Calculate how many times greater the average number of lugworms at 11 metres is compared to 7 metres from the seawater at low tide. **1**

Space for calculation

_____ times greater

(b) Dover sole and rex sole are different species of flatfish and are predators of lugworms. Curlews, which are a species of wading bird, also feed on lugworms.

(i) Complete the table below by placing a tick (✓) in the correct box to show the type of competition that would occur between the different predators. **1**

Predator	*Type of Competition*	
	Intraspecific	*Interspecific*
rex sole and curlew		
curlew and curlew		
rex sole and dover sole		

(ii) A curlew gains an average of 165 kilojoules (kJ) of energy daily, by feeding on lugworms.

Select, from the following list, the value of the energy which is used for growth each day by the curlew.

Tick (✓) the correct box. **1**

165 kJ ☐

148·5 kJ ☐

16·5 kJ ☐

0 kJ ☐

Competition & Niche

4. (a) In an investigation, students estimated the population and biomass of some organisms found on part of a rocky shore.

The table below shows the results.

Organism	*Population*	*Average mass of one organism* (g)	*Biomass of population* (g)
Seaweed	220	500	110 000
Limpet	1 100		33 000
Crab	100	90	9 000
Gull	5	700	3 500

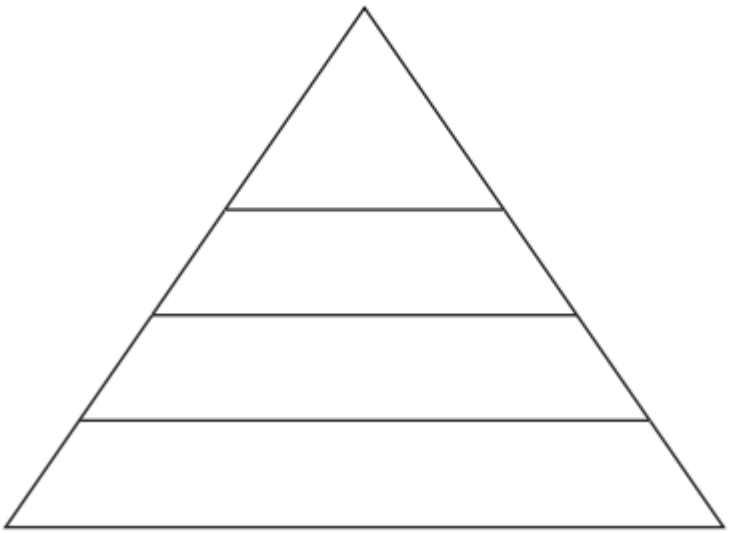
(i) Complete the table to show the average mass of one limpet. **1**

Space for calculation

(ii) The total mass of living material decreases at each level in the food chain. This can be shown as a pyramid of biomass.

Complete the diagram below by entering the names of the organisms from the table into the appropriate section. **1**

(An additional diagram, if required, can be found on *page 26*)



Ecosystem & Biodiversity Terms

An ecosystem consists of all the **living** organisms (the community) in a particular habitat and the **non-living** components with which the organisms interact.

Four key terms

1. habitat
2. community
3. population
4. ecosystem

Biodiversity

Ecosystem Terms	Definition	Example
	Where an organism lives	
	One particular species	
	All the organisms living in one area	
	Living and non living parts with which the organisms interact	

_____and relative _____(number)

of living organisms.

Importance of Maintaining Biodiversity

Variation within a population makes it possible for a population to _____

over time in response to _____environmental conditions.

Biotic and Abiotic Factors

Factors affecting the distribution of organisms which can cause an increase or a

decrease in _____

1. _____ factors
   Living/Non living factor
2. _____ factors
   Living/Non living factor

Examples of Biotic factors

1. _____
2. _____
3. _____
4. _____

Examples of Abiotic factors

1. _____
2. _____
3. _____
4. _____

Competition for resources, disease, food availability, grazing and predation are biotic factors. Light intensity, moisture, pH and temperature are abiotic factors. b Measuring abiotic factors such as light intensity, soil moisture, pH and temperature. Possible sources of error and how to minimise them.

Sampling Biotic Factors

Sampling techniques for abiotic factors

Abiotic factor	Sampling Technique	Description
pH		Place _____ into soil and take _____ from meter. Error Forgetting to _____ probe between readings
Moisture		
Light intensity		Meter held at _____ light intensity Error Casting a _____ over meter
Temperature		Holding thermometer at top and read _____. Error Avoid holding the _____

Sampling Biotic Factors

Sampling techniques for biotic factors

Name of Technique	Description	Sources of Error
Pitfall trap (animals)	Hole dug _____ ground to ensure insects fall in. Covered in _____to ensure nothing eats the insects.	
Quadrats (animals & plants)	Throw quadrat at _____ to make sure sampling is _____(valid) Number of squares that have _____counted (abundance score).	Only throwing quadrat _____ as results would not be _____

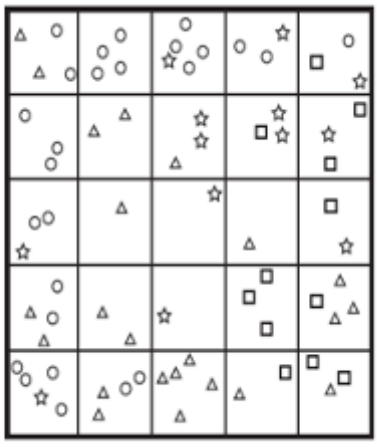
Abundance Score

Daisy abundance _____

Dandelion abundance _____

Plantain abundance _____

Buttercup abundance _____



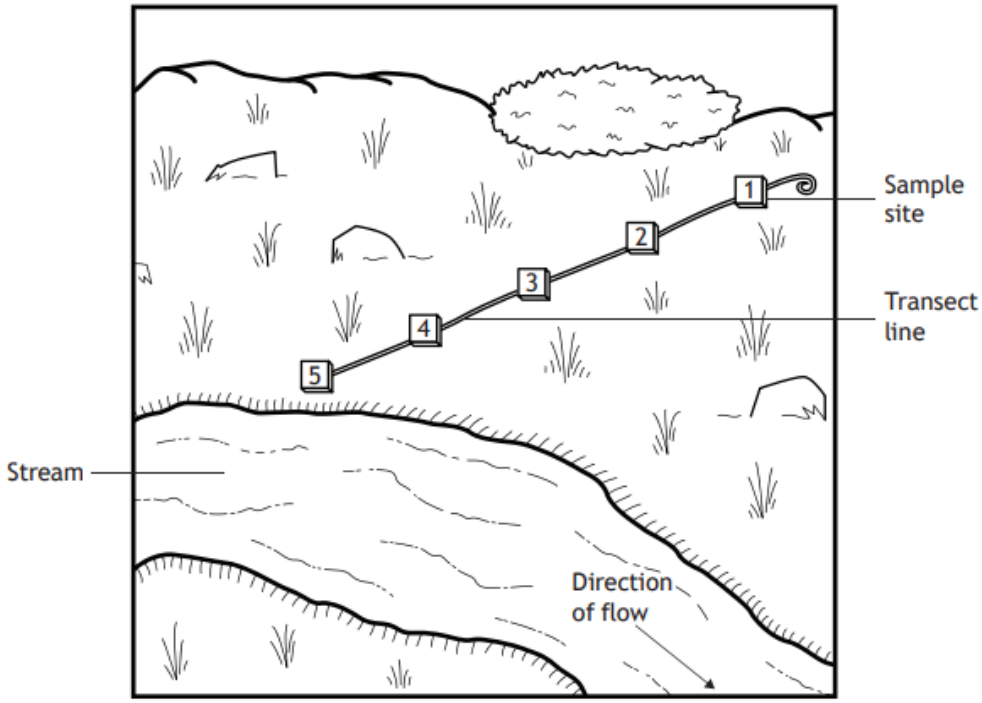
Line Transect

Measuring the abundance score at _____ intervals

Not _____ whilst measuring an abiotic factor.

This allows the effect of an _____factor on the distribution of a plant

to be worked out.



Sample Site	Abundance Score of daisies	Light intensity	Moisture	pH
1				
2				
3				
4				
5				

Influence of Abiotic Factors

1. The distribution of organisms may be affected by abiotic factors.

The table shows the results of a study into the effect of soil moisture levels on the distribution of three species of plant.

		Number of plants		
Sample site	*Soil moisture* (units)	*Species E*	*Species F*	*Species G*
1	20·2	11	15	12
2	23·4	13	14	11
3	22·1	12	16	10
4	24·5	15	17	15
5	26·6	18	13	12
6	28·4	19	15	14

(i) State which species has its distribution most affected by the soil moisture levels. **1**

Species _____

(ii) Calculate the average number of plants per sample site for species F. **1**

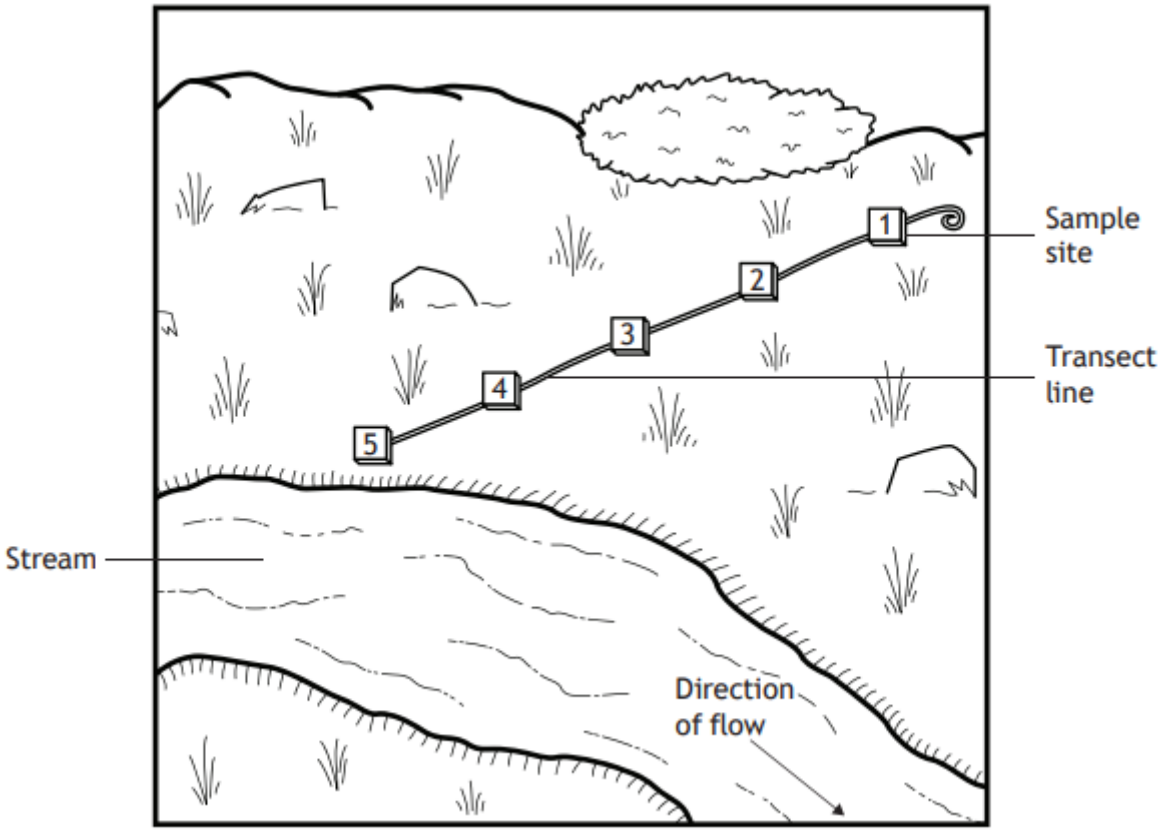
Space for calculation

_____ plants

Questions

2. A group of students wanted to investigate the effect of various factors on the distribution of the plant Yellow Iris.

They set up a line transect and marked out five evenly spaced sample sites. The abundance of Yellow Iris was recorded, and values for soil temperature, pH and moisture were measured at the same sample sites.



Questions

2. The results are shown in the table.

Sample site	*Soil temperature* (°C)	*Soil moisture* (% saturation)	*Soil pH*	*Yellow Iris abundance*
1	12	15	5·4	0
2	13	39	5·5	3
3	11	56	5·6	9
4	12	78	5·5	21
5	11	90	5·4	25

(a) Describe the distribution of Yellow Iris along the transect line from sample site 1 to 5. **1**

_____

(b) Identify which abiotic factor had the greatest effect on the distribution of Yellow Iris. **1**

_____

(c) Probes were used to measure the soil moisture and soil pH.

Describe a precaution that should be taken when using a probe to make sure that the measurements are valid. **1**

_____

_____

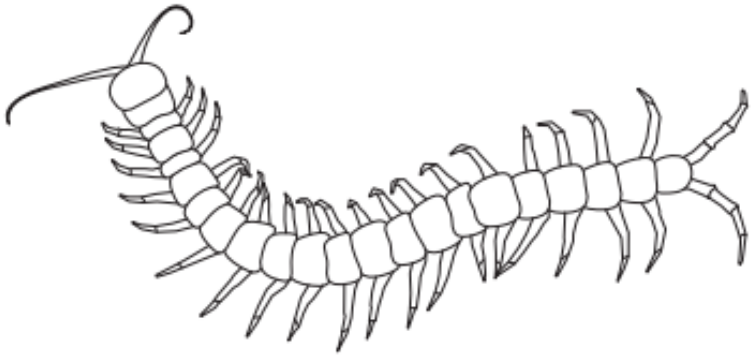
Ecosystem & sampling Mindmap

Selecting from Paired Statement Keys

1. The following paired statement key can be used to identify invertebrate groups.

1.	Six legs	*Hexapoda*
	More than six legs	go to 2
2.	8 legs	go to 3
	More than 8 legs	go to 4
3.	Curved sting	*Dromopoda*
	No curved sting	*Arachnida*
4.	1 pair of legs per body segment	*Chilopoda*
	2 pairs of legs per body segment	*Diplopoda*

Use the key to identify the invertebrate group to which the following organism belongs.



A Dromopoda
B Arachnida
C Chilopoda
D Diplopoda

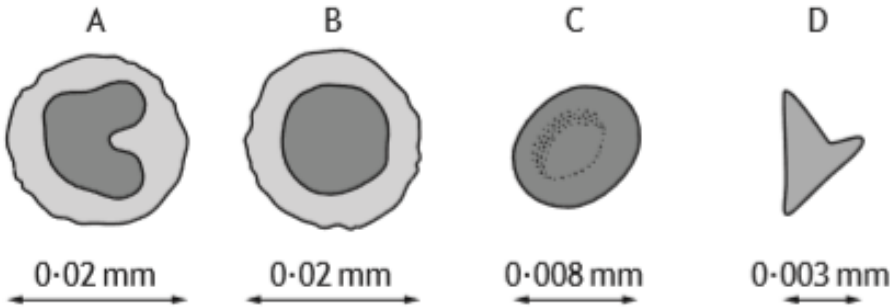
Selecting from Paired Statement Keys

2.

The following key can be used to identify the different components of blood.

1.	Nucleus absent	go to 2
	Nucleus present	go to 3
2.	Diameter greater than 0·005 mm	**red blood cell**
	Diameter less than 0·005 mm	**platelet**
3.	Nucleus is circular	**lymphocyte**
	Nucleus is not circular	**macrophage**

Use the key above to identify which of the diagrams represents a platelet.



Selecting from Paired Statement Keys

3. A sample of polluted water was collected from a river. Bacteria in the sample were grown in the laboratory and then examined using a variety of tests.

The results are shown in the table below.

Bacteria	*Gram stain reaction*	*Shape of cells*	*Reaction to penicillin*
P	positive	round	resistant
Q	positive	rod	resistant
R	negative	rod	resistant
S	positive	round	sensitive

The following key identifies the four types of bacteria.

1	Gram stain positive	.....	Go to 2
	Gram stain negative	.....	*Escherichia*
2	Round shaped cells	.....	Go to 3
	Rod shaped cells	.....	*Clostridium*
3	Sensitive to penicillin	.....	*Micrococcus*
	Resistant to penicillin	.....	*Staphylococcus*

Use the key to name the four bacteria.

Bacterium P _____

Bacterium Q _____

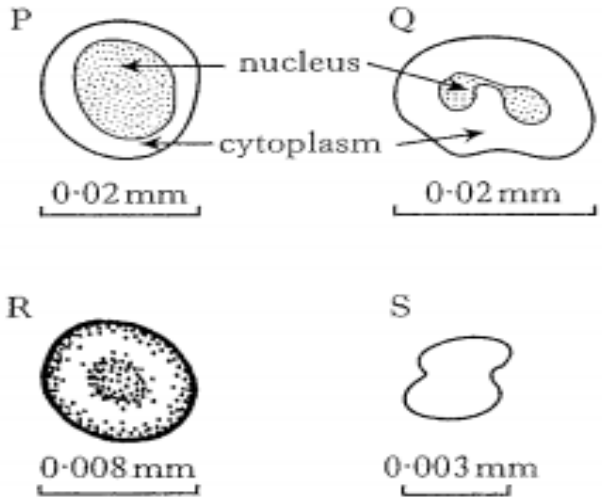
Bacterium R _____

Bacterium S _____ **2**

Selecting from Paired Statement Keys

4.

The key below can be used to identify four components of blood, P, Q, R and S.



1. Nucleus present..... go to 2
   Nucleus absent ..... go to 3
2. Large volume of cytoplasm present .. macrophage
   Small volume of cytoplasm present .. lymphocyte
3. Diameter greater than 0·005 mm ..... red blood cell
   Diameter less than 0·005mm ..... platelet

Which line in the table correctly identifies the blood components?

	P	Q	R	S
A	lymphocyte	red blood cell	platelet	macrophage
B	macrophage	lymphocyte	red blood cell	platelet
C	platelet	macrophage	red blood cell	lymphocyte
D	lymphocyte	macrophage	red blood cell	platelet

Completing Paired Statement Keys

The table below contains information about four species of tit birds found in Scotland.

1.

Species	Crown of head	Black breast stripe	Tail length
Coal tit	Black	Absent	Shorter than body
Blue tit	Blue	Absent	Shorter than body
Long tailed tit	Grey	Absent	Longer than body
Great tit	Black	Present	Shorter than body

Complete the paired statement key to identify the four birds.

1. Crown of head black go to 2

   Crow of head _____

2. Black breast stripe absent

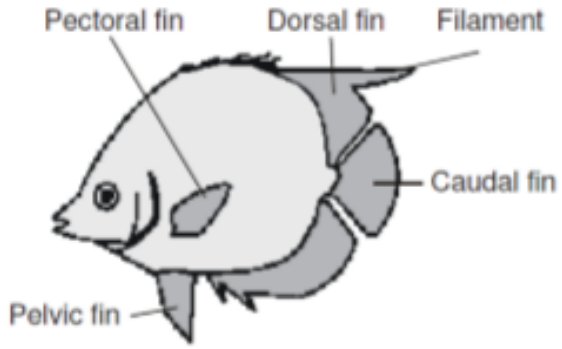
   Black breast stripe _____ great tit

3. Tail length _____ Blue tit

   Tail length longer than body

Completing Paired Statement Keys

2. The following diagram shows the fins of a butterfly fish.



The table below contains information about several species of butterflyfish in the genus *Chaetodon*.

Species	Pelvic fin	White spot below dorsal fin	Dark bars at tip of caudal fin	Dark spot on body near filament
C. auriga	Light	None	None	Small
C. quadrimaculatus	Dark	Two	None	None
C. reticulatus	Dark	None	Two	None
C. kleinii	Dark	None	One	None
C. ephippium	Light	None	None	Large

Use the information in the table to complete the paired statement key to identify the five butterfly fish species.

1. Pelvic fin dark — go to 2

   Pelvic fin light — go to 4

2. No white spot below dorsal fin

   _____

3. One Dark bars at tip of caudal fin

   _____

4. Small Dark spot on body near filament

   _____

3

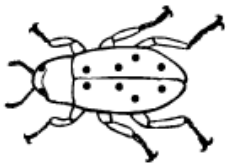
Completing Paired Statement Keys

3. The diagrams below show the invertebrates collected by the pupils.
They are not drawn to scale.

Earthworm

Snail

Spider



Beetle

Woodlouse

(i) Complete the following key using information from the diagrams.

1 Legs ..... Go to 2

No legs ..... [ ] **1**

2 12 legs or more ..... *Woodlouse*

Fewer than 12 legs ..... Go to 3

3 Spots on body ..... *Beetle*

No spots on body ..... [ ] **1**

4 Shell ..... *Snail*

[ ] ..... [ ] **1**

(ii) Give **three** features of the beetle mentioned in the key.

1 _____

2 _____

3 _____ **1**

Completing Paired Statement Keys

4. (*a*) The table below shows some features of five British butterflies.

Butterfly species	*Wing shading*	*Wing tip*	*Wing spots*
Large White	pale	black	yes
Orange Tip	pale	orange	no
Peacock	dark	blue	yes
Red Admiral	dark	white	yes
Wood White	pale	black	no

Complete the key using the information given in the table.

1 Pale wing shading . . . . . go to 2

Dark wing shading . . . . . [ ]

2 [ ] . . . . . [ ]

Orange wing tip . . . . . **Orange Tip**

3. Spots on wings . . . . . **Large White**

No spots on wings . . . . . [ ]

4. Blue wing tip . . . . . **Peacock**

[ ] . . . . . [ ]

3

Completing Paired Statement Keys

6. The following table gives information about some of the flowering plants found in the area.

Plant	*Height range* (cm)	*Flower colour*	*Flowering period* (months)
Pink Campion	30–90	pink	6
Ragwort	30–200	yellow	6
Meadow Grass	30–70	green	3
Buttercup	5–90	yellow	5

Using the information in the table, complete the three boxes in the paired statement key below. **3**

1. Flower colour is yellow — go to 2

   Flower colour is not yellow — [ ]

2. Height of plant can be over 100 cm — Ragwort

   Height of plant is under 100 cm — [ ]

3. Flowering period lasts only 3 months — Meadow Grass

   Flowering period is longer than 3 months — [ ]

Completing Paired Statement Keys

7. The table below describes the features of the fluid which lead to the diagnosis of several joint abnormalities.

		Feature of synovial fluid		
		Viscosity	*Cloudiness*	*Colour*
Diagnosis	*Normal*	high	zero	light yellow
	Inflammation	low	slight	dark yellow
	Infection	low	high	dark yellow
	Blood leakage	intermediate	high	pink

Use the information from the table to complete the paired statement key to identify the diagnoses.

1. Fluid pink ..... Blood leakage

   Fluid not pink ..... go to 2

2. Low viscosity ..... [ ]

   High viscosity ..... [ ]

3. [ ] ..... Infection

   [ ] ..... [ ]

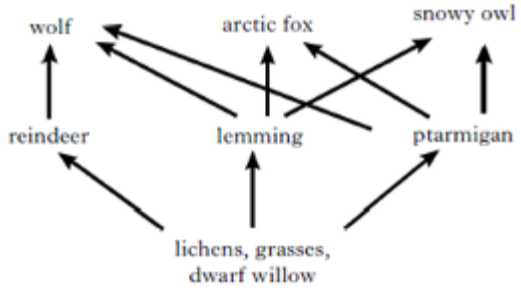
2

Ecosystem Questions

1. The total variety and abundance of all living things on Earth is described as

A ecosystem
B biodiversity
C community
D population

2. The diagram below shows part of a food chain in the Arctic tundra.

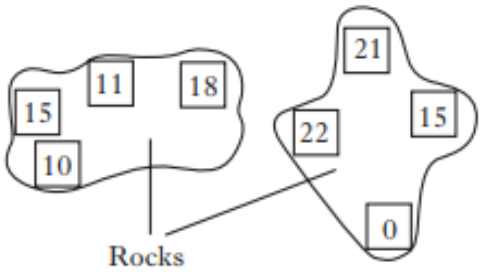


A population in this food web is all the

A plants
B reindeer
C animals
D living organisms

3. A survey was carried out on the number of mussels attached to rocks on a seashore. The positions of the mussels are shown by squares in the diagram below.

The numbers of mussels at each position are shown in the squares.



What is the average number of mussels found per square?

A 14
B 16
C 56
D 112

4. The table below shows the relationship between planting density and the mass of seeds harvested for a cereal crop.

Planting density (number of plants per square metre)	*Mass of seed harvested* (grams per square metre)
4	60
8	86
15	105
32	77
128	21

Calculate the percentage increase in mass of seed harvested as planting density Increases from 4 to 15 plants per square metre.

A 45%
B 75%
C 90%
D 105%

The questions below refer to the following statements about a woodland ecosystem.

A All the oak trees
B All the plants
C All the plants and animals
D All the oak trees and blackbirds

5. Which statement describes a population?

6. Which statement describes a community?

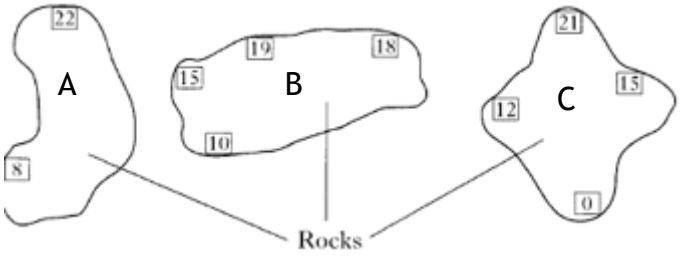
7. Which of the following statements is true of predation?

A It is an abiotic factor and causes a decrease in prey numbers
B It is an abiotic factor and causes an increase in prey numbers
C It is a biotic factor and causes a decrease in prey numbers
B It is a biotic factor and causes an increase in prey numbers

Sampling Biotic Factors

A survey was carried out to investigate the number of mussels attached to rocks on a sea shore. Quadrats measuring 10cm x 10cm were used in the survey.

The position of the quadrats and the number of mussels in each quadrat are shown in the diagram below.



8. How could the results have been made more valid?

A sample only 1 rock

B use a larger quadrat

C record a wide variety of species

D count each quadrat at the same time of day

9. How could the results have been made more reliable?

A sample only 1 rock

B use a larger quadrat

C record a wide variety of species

D count each quadrat at the same time of day

10. The most reliable data was gathered from

A area B only

B area B and C

C area A only

D area A and B only

11. Students used a quadrat to estimate the number of buttercups in a field. They threw the quadrat randomly three times in the area. In order to improve the reliability of their results they could have

A asked another group of students to check that they had counted correctly

B thrown the quadrat ten times instead of three

C only thrown the quadrat when conditions were at an optimum

D used a smaller quadrat for each of their samples.

Ecosystem Questions

12. Which of the following factors are both biotic?

A Predators and temperature
B Temperature and pH
C pH and grazing
D Grazing and predators

13. The following picture shows two lions in competition.

Which of the statements below refers to the type of competition shown above?

A Intraspecific competition—same species competing for the same resources.
B Intraspecific competition—same species competing for different resources.
C Interspecific competition—different species competing for similar resources.
D Interspecific competition—different species competing for different resources.

14. Which of the following factors are both abiotic?

A Disease and grazing
B pH and predation
C Grazing and temperature
D pH and temperature

15 Which row in the table identifies biotic and abiotic factors?

	Biotic factor	*Abiotic factor*
A	Disease	Rainfall
B	Light intensity	Temperature
C	pH	Soil moisture
D	Predation	Food availability

16. Which of the following best describes biodiversity?

A The variety of organisms in an environment.
B The abundance of organisms in an environment.
C The variety and abundance of organisms in an environment.
D All the plants in an environment.

17. Which of the following describes a community?

A All the animals and plants in an environment.
B All the living and non-living things in an environment.
C The place where an organism lives.
D The total number of one species of organism.

18. Which of the following describes an ecosystem?

A The role an organism plays in its community.
B All the animals and plants in an environment.
C All the living and non-living things in an environment.
D The place where an organism lives.

19. An example of a biotic factor affecting a population of plants is

A a leaf disease reducing the growth of lettuce plants
B acidic soil preventing the growth of daisies
C shade from buildings causing a decrease in the growth of grass
D a cold winter causing a decrease in the growth of geranium plants

Questions Sampling

1. Complete the table below by putting the following terms under the correct heading.

Light intensity, predation, moisture, pH, food availability, grazing, disease, temperature

Abiotic	Biotic

2. During a woodland survey, a group of students measured some abiotic factors. reading they took included the temperature of the air and the soil. (4)

a) Name one abiotic factor, other than temperature, which they could have measured.

_____

b) Describe how the students should have measured your chosen abiotic factor.

_____

_____ (1)

c) Describe an error the students might have made when testing your chosen abiotic factor.

_____

_____

(1)

3. Name a technique used to sample the invertebrates living among the leaves on forest floor and an error that could be made when using this technique.

Technique _____

Possible error _____

(1)

(1)

Sampling Biotic Factors

4. During a woodland survey, a group of students measured some abiotic factors. Readings they took included the temperature of the soil and the air.

(a) Name one abiotic factor, other than temperature, which they could have measured in the woodland and describe the method of measuring this factor. **2**

Abiotic factor _____

Method _____

_____

_____

(b) (i) During the survey, the students sampled the leaf litter in the woodland using pitfall traps.

However, when they checked the pitfall traps four days after setting them up, the students discovered that they were all empty.

Describe an error the students might have made which would explain why there were no invertebrates in the traps. **1**

_____

_____

_____

(c) The students saw a large number of butterflies in the woodland.

Give a reason why no butterflies were collected with the invertebrates. **1**

_____

_____

Questions

5. A group of students carried out a five year investigation into plant growth in an area of abandoned farmland.

They sampled the area using quadrats.

The results are shown in the table below.

	Average abundance of each plant		
Year	*Meadow grass*	*Ragwort*	*Pink campion*
2011	8	15	9
2012	16	14	7
2013	24	12	4
2014	25	8	2
2015	25	5	1

(a) (i) Calculate the average decrease per year in the abundance of ragwort over the five-year period. **1**

Space for calculation

_____

(ii) **Use information from the table** to suggest why the ragwort abundance decreased over the five-year period. **1**

_____

_____

_____

(b) The students also sampled invertebrates such as beetles and spiders.

Name a sampling technique they could have used and describe a possible source of error with this technique. **2**

Sampling technique _____

Source of error _____

Questions

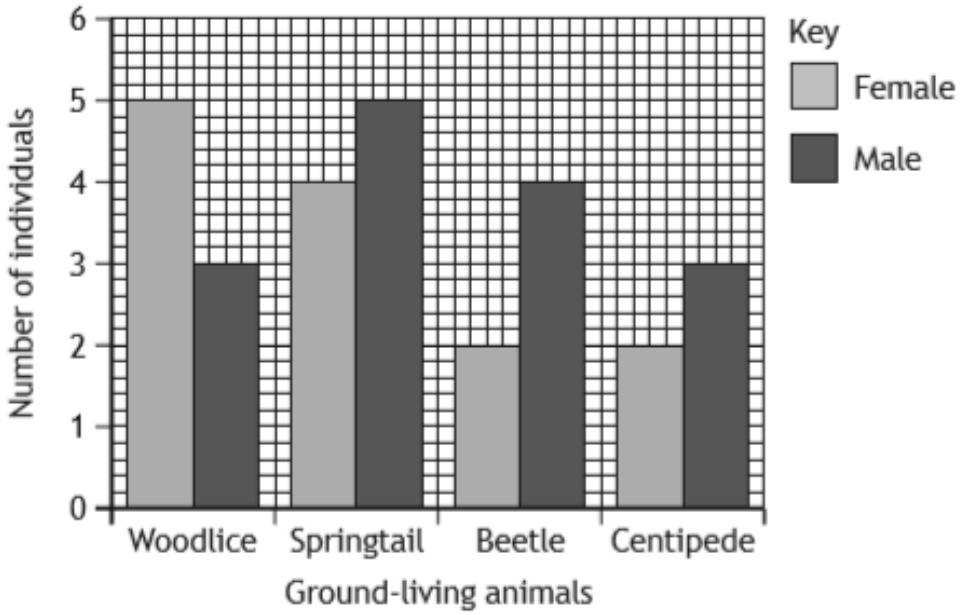
6. Sampling techniques can be used to estimate the abundance of plants and animals.

(a) In an investigation into ground-living animals in a woodland, a group of students collected and counted the animals they found.

(i) Name a sampling technique which could be used to collect the ground-living animals. **1**

_____

(ii) The students sorted the animals into male and female, counted them and recorded the results in a bar graph.



1 Identify the animal which had the greatest overall abundance. **1**

_____

2 The students concluded that males were always more abundant than females.

Identify the animal for which this is **not** true. **1**

_____

(iii) It was decided that the samples were not fully representative of the area.

Suggest how the investigation could be improved. **1**

_____

_____

Food Production

Food Yield

_____human population requires INCREASED food _____.

Food yield can be **increased** by the use of chemicals called

1. _____ 2. _____

Fertilisers

Increase crop yield by increasing the _____nutrient levels

(_____) of the _____ which allows

plants to produce _____ for _____ synthesis

Animals

_____plants/animals to obtain amino acids for _____synthesis.

Diagram

Food Production Question

1. ı gardener treated the soil in the area where he planted vegetables with a hemical to increase the yield.

(a) (i) The chemical added to the soil by the gardener contained nitrates.

Give the general name for this type of chemical. **1**

_____

(ii) Describe the use that plants make of nitrates. **1**

_____

(iii) When the vegetables were picked and weighed, the total yield was 42 kilograms. The previous year the total yield was 35 kilograms.

Calculate the percentage increase in yield. **1**

Space for calculation

_____ %

Food Production

Problems with Fertilisers

1. Fertilisers can _____ into fresh water, adding _____nitrates.

2. Extra unwanted _____will increase algal populations causing

   _____.

3. Algal blooms reduce _____, killing aquatic _____.

4. Dead plants/algae become _____ for _____

5. Increasing numbers of _____ reduce _____ levels for other organisms

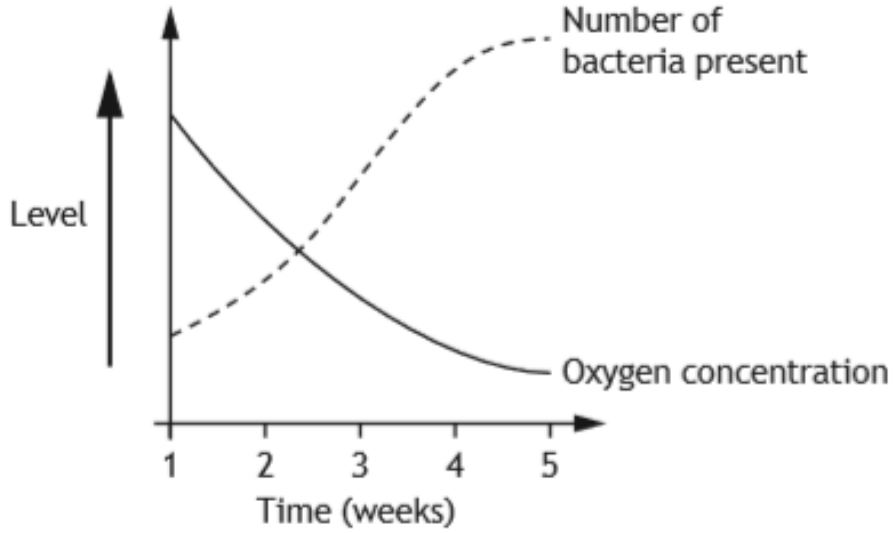
Solution

_____ crops can be used to reduce the need for fertilisers.

Food Production

1. Later in the year the gardener noticed that the algae in his pond had increased and now covered the surface of the water. He sampled the pond water over 5 weeks and measured its oxygen concentration and number of bacteria present.

   The results are shown in the graph.



(i) What name is given to the increased growth of algae in the pond? **1**

_____

(ii) Explain why the increased growth of algae resulted in an increase in the number of bacteria. **1**

_____

_____

Problems with Algae Bloom

There are organisms present in water that can indicate the level of fertiliser pollution in water or air pollution.

These species are called _____ species.

Definition of Indicator Species

Their _____/_____ indicates the level of

_____.

Example of Indicator Species	Environmental Conditions when present	Type of pollution
Stone fly nymph		
Mayfly nymph		
Lichen		Air

Algae Bloom & Indicator Species

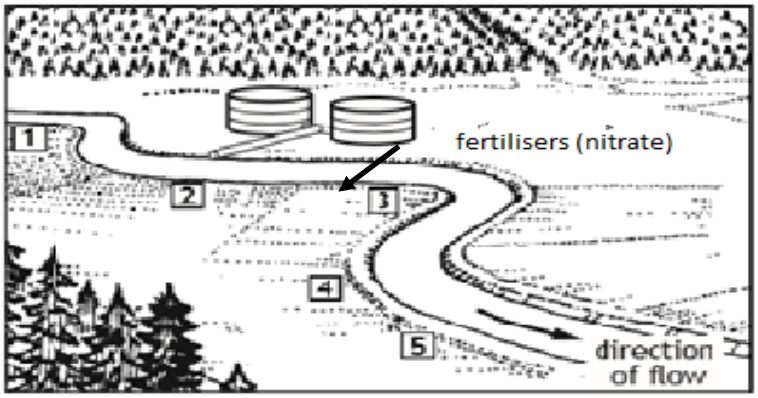
On the diagram below, fertilisers (nitrate) enters the water at position 3,

At position 4 and 5 the _____ levels in the water will be high/low due to

_____ of bacteria present from the algae bloom.

At position 1 and 2 _____ levels in the water will be high/low due to

_____ bacteria present as upstream from the algae bloom.

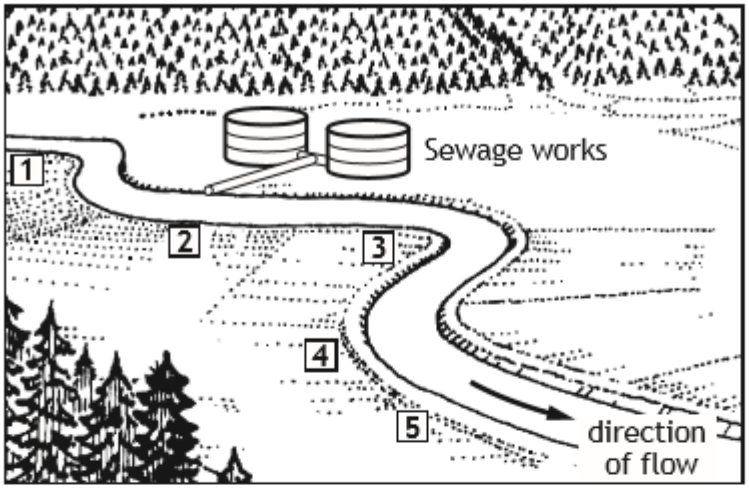


Position	Oxygen levels in water (high/low)	Presence/absence of indicator species that thrives in deoxygenated water
1		
2		
3		
4		
5		

Indicator Species Questions

1. MARK

A river was sampled at five sites as shown in the diagram below.



The following tables show the results of analysing the samples at each site.

Table 1

Site	*Oxygen levels* (Units)	*Number of bacteria per 100ml*
1	1·2	500
2	0·04	150 000
3	0·40	12 680
4	0·54	3 400
5	1·12	1 250

Table 2

Organism Present	*Site 1*	*Site 2*	*Site 3*	*Site 4*	*Site 5*
Mayfly nymphs	23	0	0	0	8
Stonefly nymphs	42	0	0	0	21
Caddis fly larvae	18	0	0	10	15
Fresh water shrimp	2	0	0	1	1
Blood worms	1	5	24	7	1
Sludge worms	1	67	43	9	0

Indicator Species Questions

(a) (i) Using data from Table 1, describe the relationship between the number of bacteria and the oxygen level in the water. 1

_____

_____

(ii) Methylene blue is a chemical which can be used to compare oxygen levels in the water. The lower the oxygen level, the faster methylene blue changes from blue to colourless.

A sample of water from each of the five sites was tested.

Predict which sample would lose its blue colour fastest. 1

Sample from site number _____

(b) Use data from Tables 1 and 2 to answer the following questions.

(i) State which of the organisms in the samples would be found in areas of high oxygen content. 1

_____

(ii) Sewage in the river is a form of water pollution.

Describe the effect this pollution has on the number of different types of organisms in this river. 1

_____

_____

(c) Some species are known as indicator species.

Explain what is meant by indicator species. 1

_____

_____

Indicator Species Questions

2 Levels of air pollution can be estimated by the presence or absence of organisms called lichens.

Air pollution level	*Most common type of lichen present*
Low	Shrubby
Medium	Leafy
High	Crusty

Environmental scientists carried out a study on lichen species at four different sites and obtained the results shown in the table below.

	Number of lichen species present		
Site	*Shrubby*	*Leafy*	*Crusty*
A	0	5	19
B	3	2	0
C	16	3	0
D	7	14	2

(a) (i) Site A had the highest levels of air pollution.

Using information from **both tables**, describe the evidence supporting this statement. **1**

_____

_____

(ii) Calculate the average number of leafy lichen species present at the four sites. **1**

Space for calculation

_____

(b) State the name given to species, such as lichen, which are used to estimate levels of pollution. **1**

_____

3 A river was sampled at six points along its length. The numbers of different animals, the oxygen concentration and the pH were recorded for each sampling point.

The results are shown in the table below.

	Sampling points					
	1	2	3	4	5	6
Mayfly nymphs	0	0	0	5	6	132
Dragonfly nymphs	1	1	0	0	1	1
Chironimid fly larvae	0	1	1	2	231	36
Molluscs	0	0	0	0	46	73
Oxygen concentration (%)	88	80	75	71	30	63
pH	5·6	6·0	6·5	7·3	7·5	8·0

Using these results identify which of the following conclusions is **correct**.

A Chironimid fly larvae do not survive in water of a low oxygen concentration.

B Molluscs survive better in water of a lower pH.

C The distribution of Dragonfly nymphs is not affected by changes in the pH and oxygen concentration of the water.

D The distribution of Mayfly nymphs is not affected by the oxygen concentration of the water.

Food Production

Pesticides (DDT)

Chemicals which are used to _____ plants/animals which

_____ crops _____ crop yield.

Problems with pesticides

Pesticides sprayed onto crops can _____ in the bodies

of organisms over time (bioaccumulation)

The chemicals pass along the _____, increasing in

_____ and reach _____ levels.

plants $\xrightarrow{\text{DDT}}$ greenfly $\longrightarrow$ blue tits $\longrightarrow$ birds of prey

Question

1. Pesticides sprayed onto crops can get into food chains. The following statements refer to stages in this process.

   J Pesticides are absorbed by plants.
   K Pesticides build up in animals.
   L Plants are eaten by animals.

   Identify the order of steps by which pesticides could reach lethal levels in the bodies of animals.

   Letter _____ $\longrightarrow$ Letter _____ $\longrightarrow$ Letter _____

Food Production

Alternative Solutions

Alternatives to pesticides to increase crop yield include:

1. _____ crops

   Produce GM crops that are resistant to pests.

   Example: _____ toxin in GM tomatoes

2. _____ control

   Use of a _____ or _____ to kill Pest

   Example 1: Lady birds are used to kill _____

   Example 2: Virus used to kill _____

Food Production Mindmap

Food Production Advantages/Disadvantages

Name of chemical	Fertiliser	Pesticides
Description	Provides _____ to help plants produce _____ ⟶	Chemicals which are used to _____ plants/animals which _____ crops.
Problem		DDT pesticides can _____ in bodies of organisms moving up food chain reaching _____ levels in top predators
Alternative		

Food Production Questions

1. Indicator species can provide information about

A number of organisms in a lake
B number of predators in a woodland
C levels of light in an ecosystem
D levels of pollution in a river

2. In 1997, the USA planted 8.2 million hectares of land with genetically engineered crops. By 1998 this had increased to 20.5 million hectares.

What was the percentage increase in the area sown between 1997 and 1998?

A 12.3%
B 66%
C 150%
D 166.7%

3. DDT can be sprayed onto crops to kill insects. It can be washed off the crops by rainwater and flow into rivers where it accumulates in food chains. A typical freshwater food chain and the concentration of DDT in each organism is shown below.

The percentage increase in DDT concentration between the trout and osprey is

Food chain:	algae	→ stickleback	→ trout	→ osprey
DDT concentration:	0·001	2·0	5·0	20·0

A 15
B 100
C 300
D 400.

4. Which of the following statements describes the sequence of events when fertiliser leaches into a loch?

A Algal bloom develops → algae die → oxygen concentration increases
B Algal bloom develops → algae die → oxygen concentration decreases
C Oxygen concentration increases → algal bloom develops → algae die
D Algae die → oxygen concentration decreases → algal bloom develops

5. The substance that provides nutrients to the soil for plants to make amino acids is

A pesticides
B GM crops
C fertilisers
D biological control

6. Using a predator to kill a pest is an example of using

A pesticides
B GM crops
C fertilisers
D biological control

7. Which of the following would NOT increase the yield of crops produced?

A pesticides and fertilisers
B pesticide and biological control
C fertilisers and biological control
D mutagenic agents and biological control

8. An ecosystem consists of abiotic factors plus a

A community and its biodiversity
B population and its biodiversity
C population and its habitat
D community and its habitat.

Food Production Questions

1. A food chain from a river is shown below.

Using the information in the food chain, answer the following questions.

a) (i) Identify an organism which is both predator and prey.

_____ 1

(ii) Pesticides are known to run off from the land into rivers and enter the food chains.

Name the organism which would accumulate the greatest concentration of pesticides in its body over a period of time.

_____ 1

b) State one way in which energy may be lost between stages in a food chain.

_____ 1

2. In the fish farm, nitrates have to be removed from the water to prevent Build up. In some situations living organisms remove nitrates from the soil.

a) Name the type of organism which absorbs nitrate from the soil.

_____ 1

b) Nitrates supply organisms with nitrogen.
Describe why nitrogen is needed.

_____

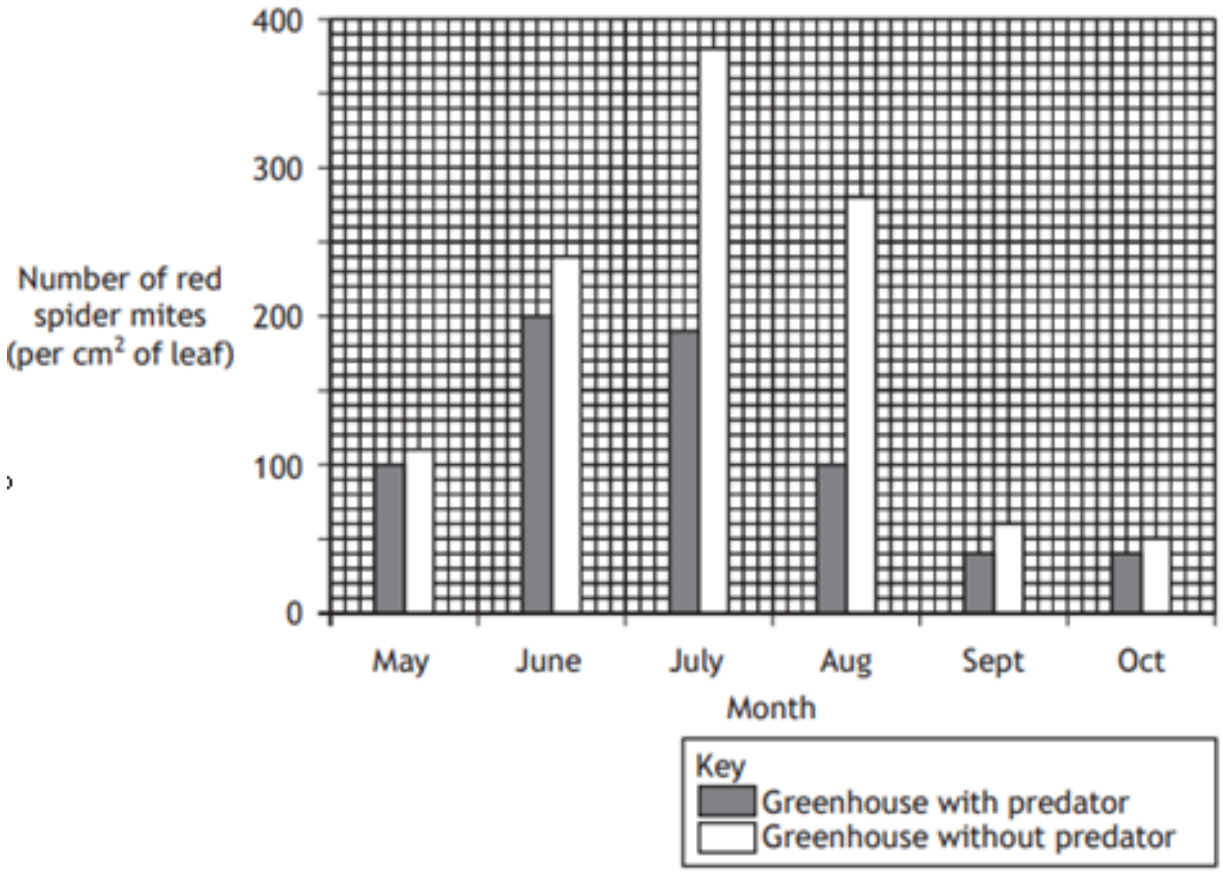
_____ 1

Food Production Questions

2. Red spider mites are a common pest which destroy tomato plants. Some of the mites are resistant to chemical pesticides.

Tomato growers aimed to investigate whether a predator would reduce the spider mite numbers in their greenhouse. Two identical greenhouses were used and the predator was released into only one greenhouse.

The results are shown in the graph below



a) With reference to the aim of this investigation, give the conclusion that the tomato growers would have drawn from these results.

_____

_____ 1

(ii) The greenhouse contains tomato plants without predators was included as a control experiment.

State the purpose of the control in this investigation.

_____

_____ 1

b) State the term which describes the use of a predator as an alternative to pesticides.

_____ 1

3. Fresh water environments such as Lake Malawi can be affected by human activities such the overuse of fertilisers.

Rearrange the following statements to show how this might occur.

1. nitrates leach into water
2. fish die
3. over use of fertilisers
4. oxygen levels decrease
5. algae bloom develops

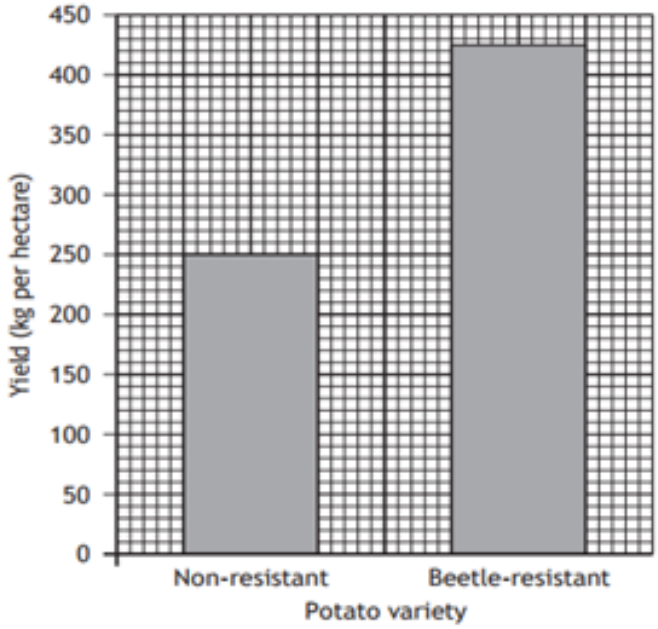
Place the statements numbers in the correct box. 1

Food Production Questions

4. Certain varieties of potato plant are eaten by beetles, reducing the yield of potatoes. A beetle resistant variety of potato plant was developed.

In an investigation, the beetle-resistant variety was grown outdoors in one field and the non-resistant variety grown in another.

The yields of both varieties were recorded and the results are shown in the graph below.



a) Describe how the reliability of the results can be improved.

_____

_____ 1

b) Calculate the difference in yield between the two varieties.

_____ kg per hectare 1

c) Identify a variable that would have to be kept the same between the two fields to ensure the results were valid.

_____ 1

d) Genetic engineering was used to develop the beetle-resistant variety of potato plant.

Before the development of genetic engineering, farmers used other methods to control the beetle numbers in their potato fields.

Name one of theses methods.

_____ 1

Types of Mutations & Mutation Rate

Mutation

_____ change to _____ material

Type of Mutation	Effect on survival	Example
Advantageous		
Disadvantageous		
Neutral		

<u>Rate of Mutations</u>

Mutations occur _____ i.e. cannot determine when they will happen.

However _____ factors can _____ the mutation rate.

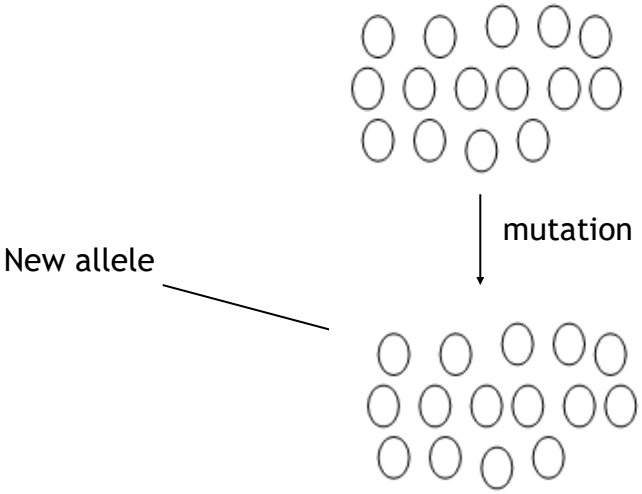
Environmental factors.

1. _____ 2. _____

E.g. E.g.

Advantageous Mutations

Diagram of alleles in a population



Mutations are the only source of new _____ in a population.

<u>Importance of Advantageous Mutations</u>

New alleles create _____ within a population making it possible for the population to _____ over time in response to _____ environment increasing _____.

Peppered moth example

New alleles & Adaptations

The following adaptations are a result of a spontaneous _____

which create _____ alleles which _____ survival

Desert Mammal Adaptations

Desert Plant Adaptations

Galapagos Finches

Natural Selection & Selection Pressures

Each species produces _____offspring than the environment can sustain creating a strong _____ pressure for _____.

Selection pressure and Alleles

Advantageous alleles

Increased selection pressure

For the best _____ individuals who have _____ alleles that create a selective _____ for _____.

Deleterious alleles

Decreased selection pressure

For poorly _____ individuals who have less _____ alleles which are removed as these individuals _____out.

Frequency of Advantageous alleles

Only those with _____ alleles are alive to _____passing on _____

The frequency of advantageous alleles will therefore increase/decrease within the population.

Bacteria Antibiotic resistance example

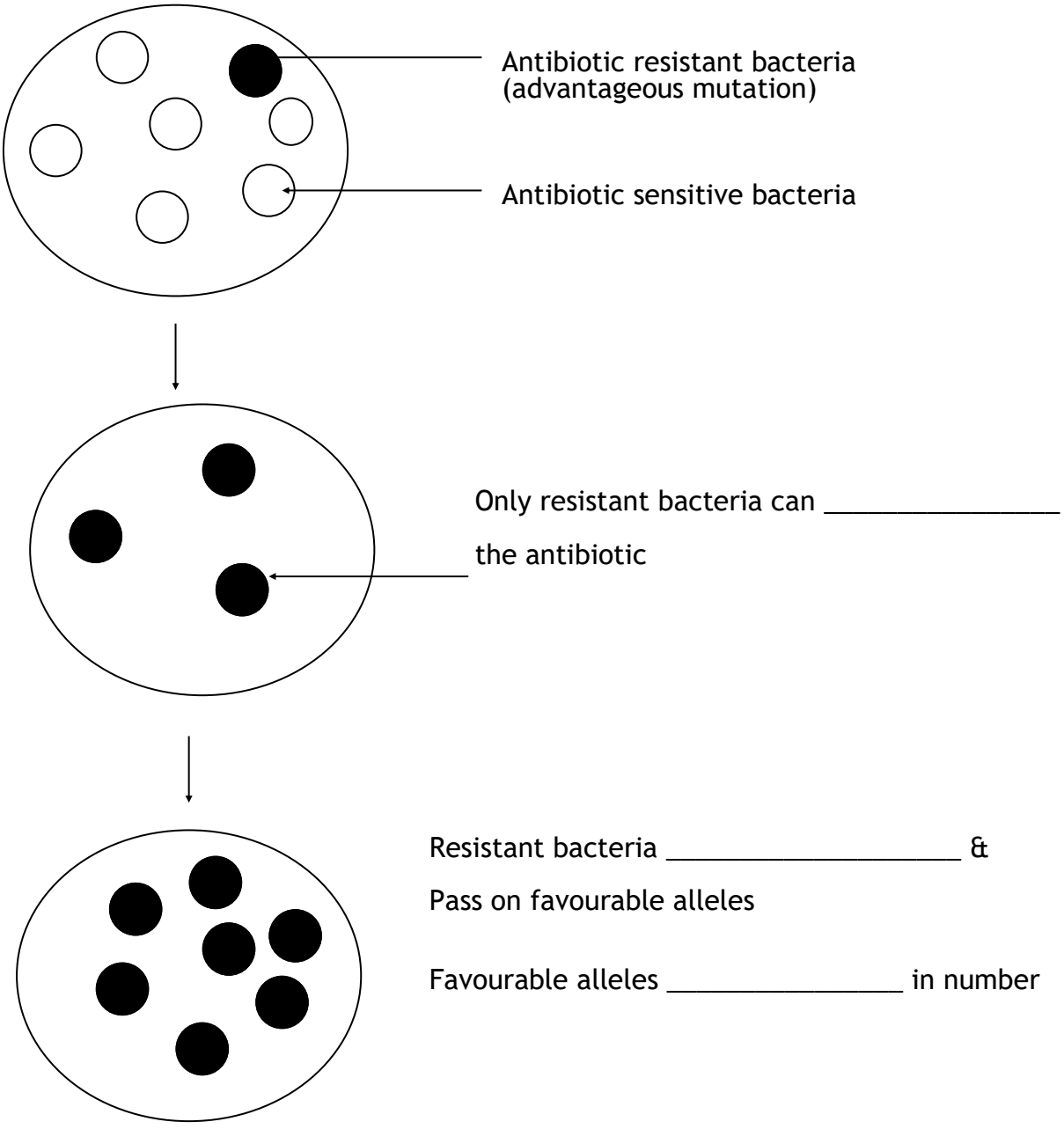
Allele 1

Bacteria sensitive to antibiotic and are killed by it.

Allele 2

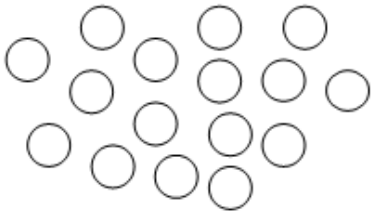
Advantageous mutation making bacteria _____ to antibiotic and are no longer _____

Petri dish containing antibiotic



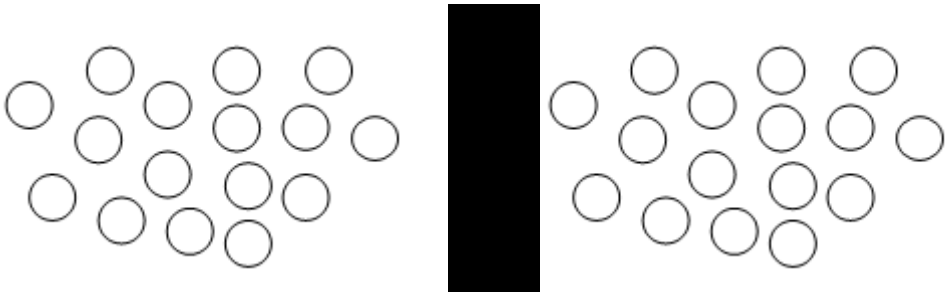
Speciation—I'M a New Species

_____ stage process where _____ species becomes _____ different species



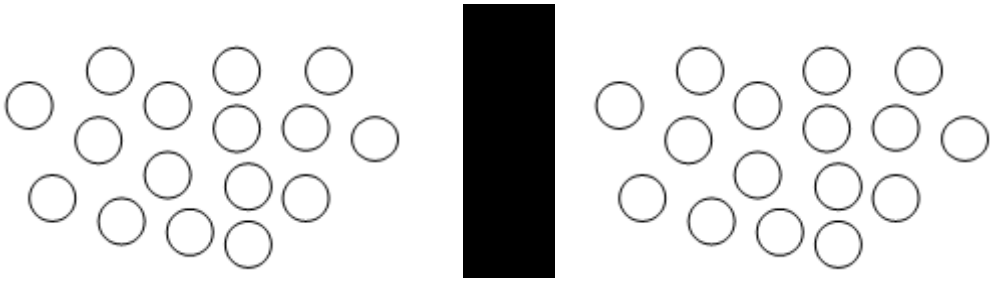
Step1

_____



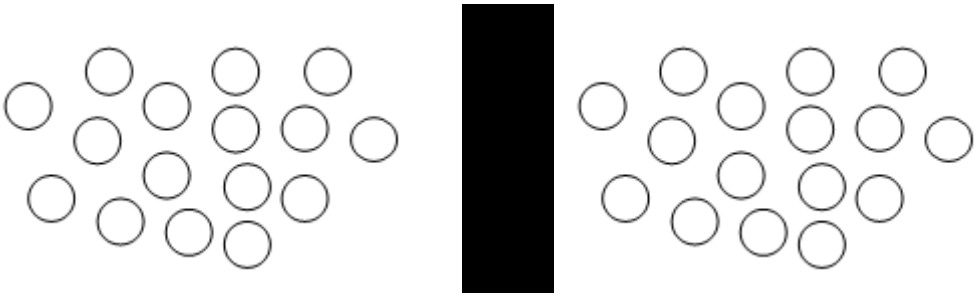
Step 2

_____



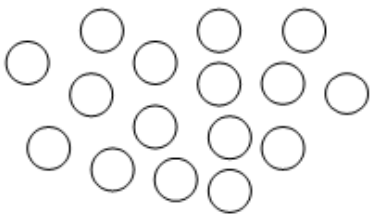
Step 3

_____



Step 4

_____

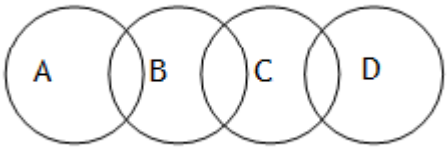


Speciation—I'M a New Species

Step 1: Isolation

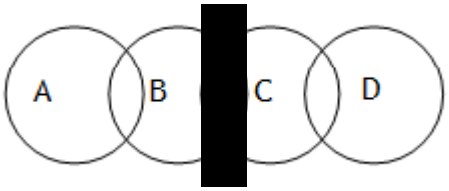
This prevents _____ between the two sub-populations

No isolation barrier



Number of species _____

Isolation Barrier



Number of species _____

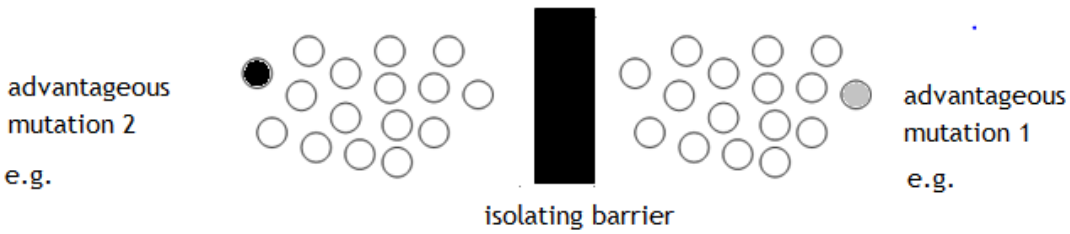
Types of isolation

Name of isolation	Example

Step 2: Mutation

Different _____ occur either side of isolating barrier.

Some of these mutations will be _____ to survival.



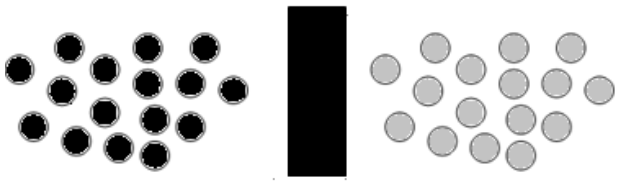
Speciation—I'M a New Species

Step 3: **Natural Selection**

aka _____

Natural selection selects for __________ mutations due to _____ selection pressures for those individuals that can _____.

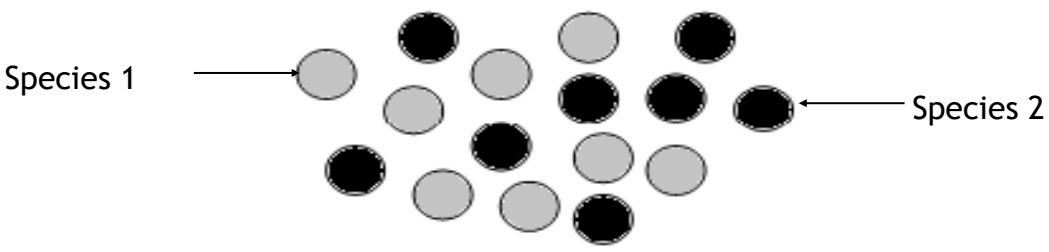
These individuals then _____ and pass on _____ alleles which _____ in frequency in the population.



Step 4: Two different species formed

The two groups cannot _____ to produce _____ offspring.

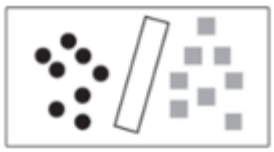
They are now _____ different species which are genetically _____.



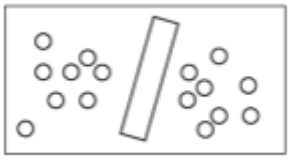
Speciation—I'M a New Species

1. Put the following steps in the correct order for speciation.

Step A

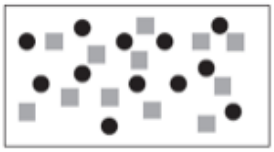


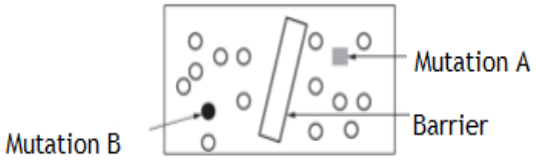
Step B



Step C

Step D





_____ → _____ → _____ → _____

2. State the three forms of isolation that prevent interbreeding between the two sub-populations.

_____

_____

_____

3. Another term for survival of the fittest is

_____

4. Describe the evidence that two different species are produced during speciation.

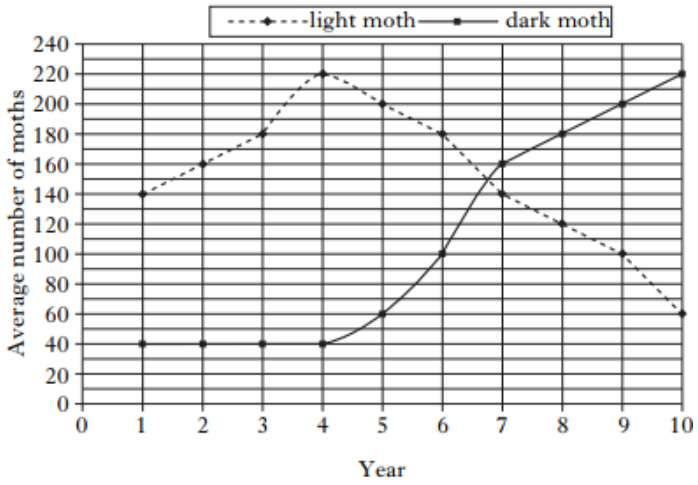
_____

_____

Speciation Mindmap

Speciation Questions

1. The graph below shows the average number of peppered moths, in a woodland, in June of each year over a 10 year period.



Studies have shown that an increase in the number of dark moths is related to an increase in the level of pollution in the atmosphere. Which of the following best describes what would happen to the number of moths if measures were introduced to reduce air pollution in year 10?

	Light moth	*Dark moth*
A	decrease	increase
B	increase	decrease
C	increase	increase
D	decrease	decrease

2. Survival of the fittest is also known as

A selection pressure
B natural selection
C selective advantage
D species selection

3. Which of the following is a source of new alleles in a population?

A mutation
B isolation
C natural selection
D environmental conditions

4. The peppered moth is found in two distinct forms. One form is dark coloured and the other is light coloured.

The moths rests on the trunks of the trees. Pale coloured tree-trunks in an area were darkened by pollution. What would happen to the numbers of the two forms of the Peppered Moth in that area.

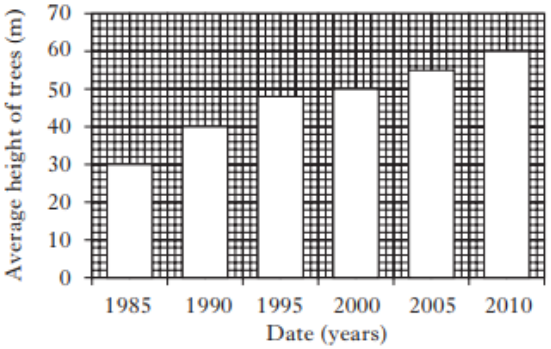
A the numbers of each form would increase

B the dark form would increase and the light form would decrease

C the numbers of each form would decrease

D the light form would increase and the dark form decrease

5. The chart below shows the average height of trees in a woodland over a 25 year period.

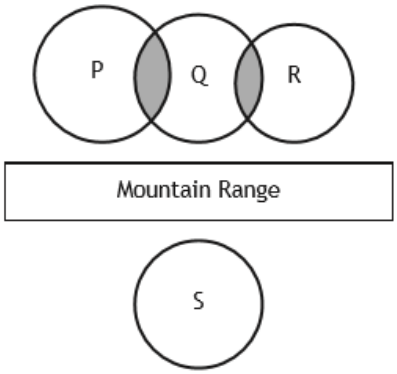


What is the percentage increase in tree height between 1985 and 2010?

A 30%
B 50%
C 60%
D 100%

Speciation Questions

6. The diagram below represents four populations of animals P, Q, R and S and areas of interbreeding. Interbreeding takes place in the shaded areas.



How many species may evolve over time?

A 1
B 2
C 3
D 4

7. Antibiotic resistance in bacteria is an example of evolution. Which of the following shows the sequence of events leading to this?

A Natural selection → mutation → use of antibiotic
B Mutation → natural selection → use of antibiotic
C Mutation → use of antibiotic → natural selection
D Natural selection → use of antibiotic → mutation

8. Mutations result in changes to genetic material. Which of the following is not true of mutations?

A Radiation can increase their rate.
B They always have a harmful effect.
C Genetic material is affected at random.
D New alleles may be produced

9. Which of the following is NOT a type of mutation?

A advantageous
B disadvantageous
C neutral
D random

10. Which of the following is the correct order of speciation?

A mutation, natural selection, isolation
B isolation, mutation, natural selection
C natural selection, isolation, mutation
D isolation, natural selection, mutation

11. Which of the following is NOT a type of isolating barrier?

A geographical
B ecological
C reproductive
D geological

12. The definition of a new species is that they

A can interbreed and can produce fertile offspring.
B can interbreed but cannot produce fertile offspring.
C cannot interbreed and cannot produce fertile offspring.
D cannot interbreed but can produce fertile offspring.

13. Natural selection occurs when there are selection pressures. Which of the following could be a result of selection pressures?

A Organisms with favourable alleles survive and reproduce.
B Organisms with new alleles always have an advantage.
C All alleles in a population increase in frequency.
D All alleles in a population decrease in frequency.

Speciation Questions

1. The Scottish crossbill is a small bird which is native to Scotland. It inhabits pine forests in northern Scotland and feeds on pine seeds using its crossed beak.

a) State the term used to describe the role of the Scottish Crossbill described above within its community.

_____ 1

b) The shape of a crossbill's beak is a structural adaptation which is the result of a new allele being produced.

Name the process by which new alleles are produced.

_____ 1

c) The Scottish Crossbill has been classified as a separate species but can still mate with other species of crossbill.

Give a feature of any offspring produced from this mating which proves the parents are different species.

_____

_____ 1

d) Decide if each of the following statements about evolution is True or false by Ticking the correct box.

If the statement is false, write the correct word in the correction box to replace the word underlined in the statement. 3

Statement	*True*	*False*	*Correction*
Genetic variation within a population allows the population to <u>adapt</u> in a changing environment.			
Isolation barriers can be geographical, <u>environmental</u> or reproductive.			
Sub-populations evolve until they become genetically <u>identical</u>.			

Speciation Questions

2. Light and dark varieties of a moth can be found in wood land areas. These moths rest on the barks of trees during the day and can be eaten by birds. Normally the bark of trees in the woodland is light coloured. However in industrial areas, pollutants cause the tree bark to darken.

a) The dark variety of the moth is the result of a random change in the genetic material. State the term used to describe this change.

_____

b) An investigation into the population of these moths in a woodland was carried out. The moths were captured, marked and released. 24 hours later the moths were recaptured. The results are shown in the following table.

Variety of moth	*Number of moths marked and released*	*Number of marked moths recaptured*	*Marked moths recaptured (%)*
Light	480	264	55
Dark	520	208	40

(i) Suggest a reason why the number of the moths recaptured was worked out as a percentage.

_____

_____ 1

(ii) The woodland was in a non-industrial area.
Explain why the percentage of light moths recaptured was higher than dark moths.

_____

_____ 1

(iii) Name the process which results in the better adapted variety of moth being more likely to survive and reproduce.

_____ 1

Speciation Quick Quiz

3. The Scottish wildcat (Felis sylvestris grampia) is under threat of extinction with only around 400 pure-bred cats in the wild.

Wildcats live in conifer forests, dense woodland or rocky areas. They are carnivores that feed on herbivores such as rabbits, mice and voles. Although their young are eaten by pine martens and foxes, the main threat to their existence is interbreeding with the domestic cat.

(i) Using information from the passage, complete the boxes below to show a food chain.

1

(ii) Complete the table below using named examples from the passage.

Term	*Named example*
habitat	
carnivore	
prey	

(iii) State what further evidence would be needed to support the hypothesis that wild cats and domestic cats are the same species.

_____

_____ 1

(iv) Conifer plantations can show low biodiversity. The tall trees growing close together block the light to any ground-living plants and there is limited animal life.

Describe what is meant by the term biodiversity.

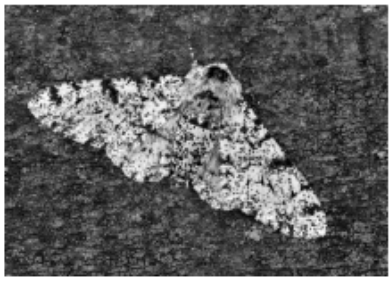
_____

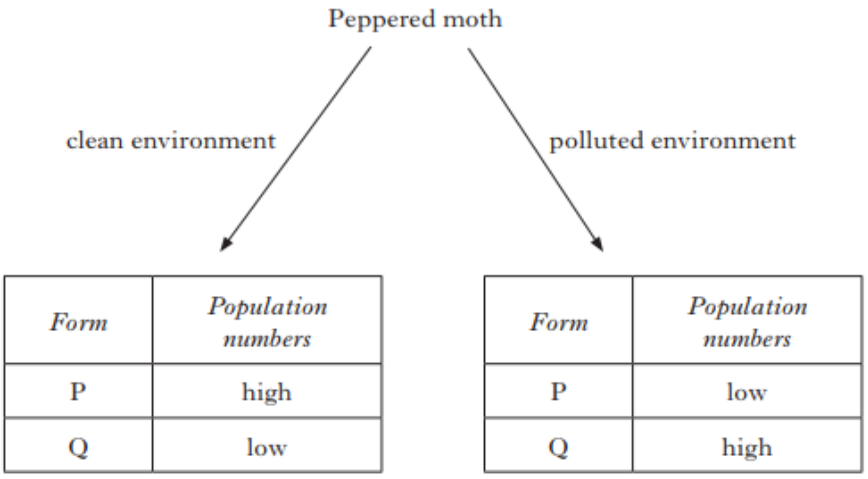
_____ 1

Speciation Quick Quiz

4. The peppered moth (Biston betularia) rests on the bark of trees.

The moth has two forms (P and Q) which are different colours.





Form	*Population numbers*
P	high
Q	low

Form	*Population numbers*
P	low
Q	high

(i) Underline one option in each set of brackets to make the following sentences correct .

In the polluted environment form Q is {difficult / easy} for predators to see since it is the {dark / light} form.

The numbers of each form in a population change over many generations due to {environmental impact / natural selection}. **2**

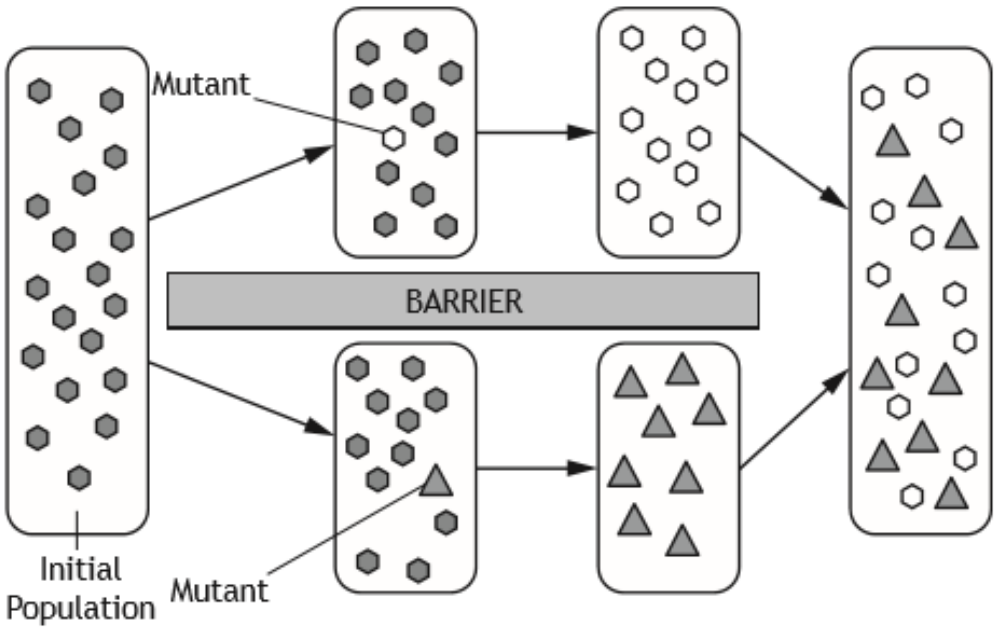
(ii) State the expected appearance of tree bark in the clean environment.

_____ 1

Speciation Quick Quiz

MARK

5. The following diagram shows the stages in the formation of a new species.



(a) Using the information in the diagram, describe how new species are formed. **4**

Speciation Quick Quiz

6. MARKS

Researchers have discovered an advantageous genetic mutation that causes high bone density in humans.

One man in the USA was discovered to possess this mutation after he walked away without injury from a serious car crash. Further studies have found several members of the same extended family with this mutation.

20 members of the family provided blood samples for DNA and biochemical testing. 7 of them were found to have high bone density. The same tests were performed on another group of 20 unrelated individuals with normal bone density.

The location of the gene mutation was able to be identified and it is hoped that the findings will help in developing medications to increase bone density for the treatment of conditions such as osteoporosis.

(a) (i) Calculate the percentage of the family who did **not** have the mutation for high bone density. **1**

Space for calculation

_____ %

(ii) Explain why the biochemical tests were also performed on the 20 individuals with normal bone density. **1**

_____

_____

(b) Name **one** factor which can increase the rate of mutation. **1**

_____

(c) Mutations are the only source of new alleles.

Explain why it is important that new alleles arise in a species. **1**

_____

_____

_____