Question 1 (12 marks)

Living organisms can be grouped according to their characteristics. This process is known as classification.

The diagram below shows how six different big cat species have been classified:

Jaguar
(*Panthera onca*)

Clouded leopard
(*Neofelis nebulosa*)

Cheetah
(*Acinonyx jubatus*)

Cougar
(*Puma concolor*)

Tiger (*Panthera tigris*)

Lion (*Panthera leo*)

Question 1a (1 mark)

Big cats are placed in the animal kingdom. **Select** the term from the list below that is **not** another kingdom used to classify living things.

- ○ Bacteria
- ○ Fungi
- ○ Plant
- ○ Virus

Question 1b (2 marks)

All big cats are classified as mammals. Mammals are a class of animals found in the chordate phylum. **State** a characteristic common to the chordate phylum and **state** one other class that belongs to this phylum.

Characteristic

Styles

Class

Styles

Question 1c (2 marks)

Snow leopards (*Panthera uncia*) are also big cats. **Select** and **justify** which species of cat they are most closely related to.

Styles

Question 1d (1 mark)

Living organisms can also be classified by comparing DNA sequences, as shown in the diagram below:

Lion	G	C	G	T	A	T	C	C	C	A
Tiger	G	C	A	T	A	A	G	G	T	A
Jaguar	G	T	G	T	A	T	G	C	C	A

Using the DNA sequences, **justify** which two species are most closely related.

Question 1e (2 marks)

All of the species in part (d) have evolved from a common ancestor. **Outline** why their DNA sequences have changed over time.

Question 1f (1 mark)

Proteins can also be compared when classifying organisms. **State** the name of the building blocks used to make proteins.

Question 1g (2 marks)

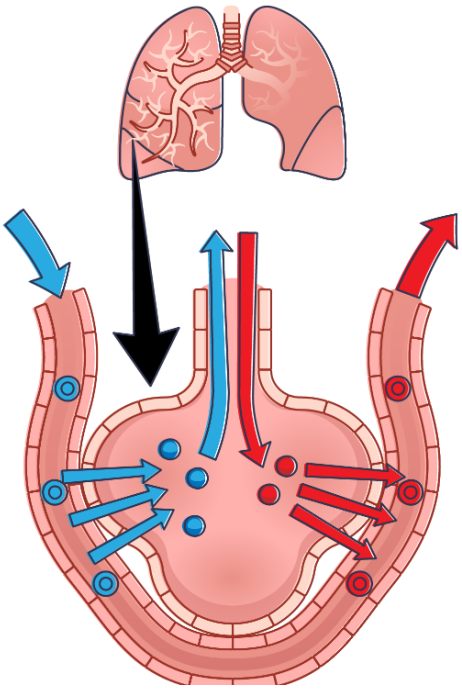
Proteins have many different functions in the body. Some proteins are hormones. **Identify** a hormone that affects blood sugar levels and **state** its action.

Question 1h (1 mark)

Like blood sugar levels, body temperature and water balance are maintained within a narrow range. **State** the name of this regulating process.

Question 2 (13 marks)

Smartwatches can provide wearers with data about their lifestyles, such as blood oxygen levels, pulse rates and breathing rates. The diagram below shows gas exchange occurring in the lungs:



Key:
- Oxygenated blood cell
- Deoxygenated blood cell

Diagram not to scale

Scroll down to continue

Question 2a (2 marks)

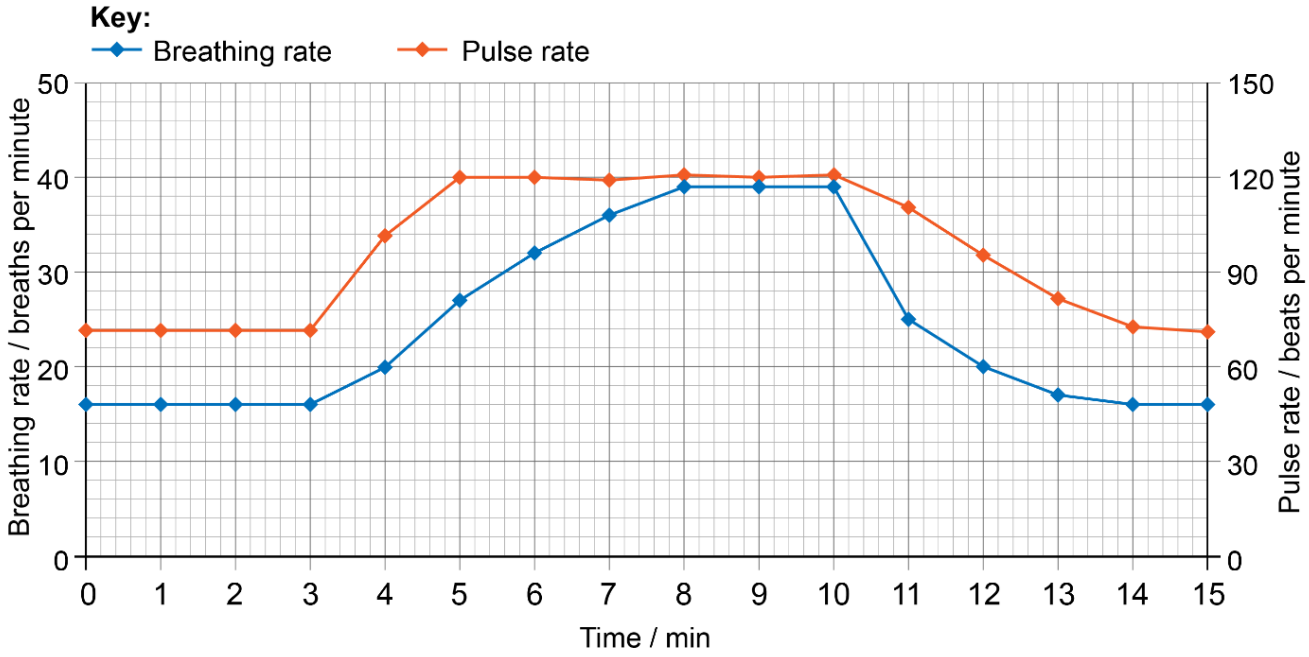
Outline how oxygen diffuses into the blood from the alveoli in the lungs.

Question 2b (2 marks)

Outline how oxygen is transported within the body by the blood.

Question 2c (5 marks)

The graph below shows pulse rate and breathing rate data from a smartwatch:



Use data from the graph to **explain** the changes seen when the wearer was exercising between 3 and 10 minutes.

Question 2d (2 marks)

The results of blood samples taken from four healthy males are shown in the table below:

	Alex	Denzel	Imad	Victor
White blood cells / per mm^3	6500	4500	5200	9500
Red blood cells / per mm^3	4 800 000	5 500 000	4 900 000	3 300 000
Platelets / per mm^3	250 000	260 000	240 000	270 000

©

Using the information in the table, **identify** the person most likely to resist infection from a virus. **Justify** your answer.

Using the information in the table, **identify** the person most likely to resist infection from a virus. **Justify** your answer.

Alex
Denzel
Imad
Victor

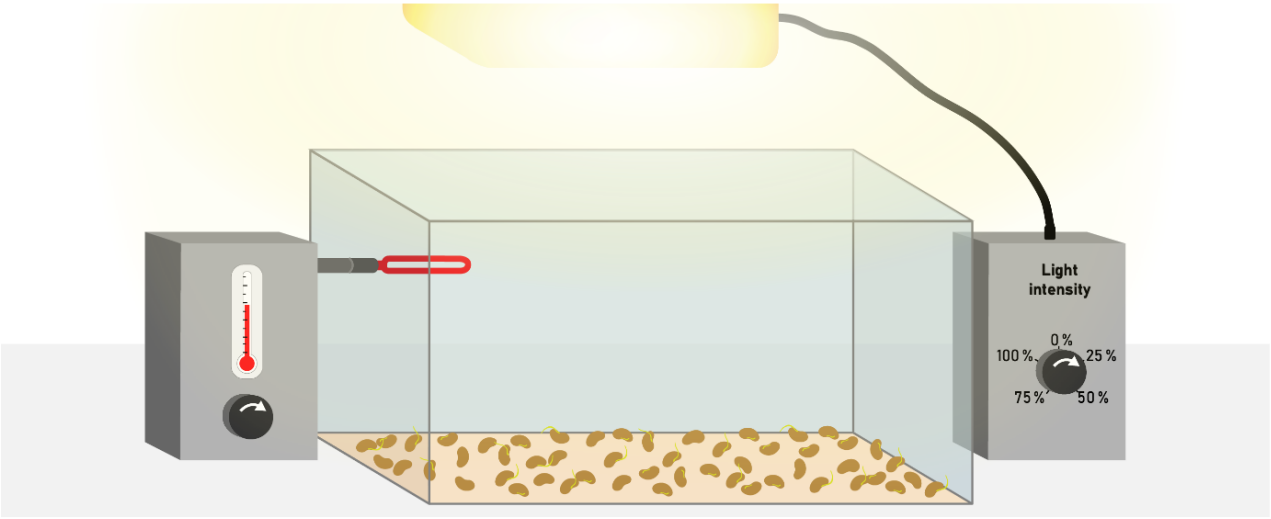
Styles

Question 2e (2 marks)

The blood samples were taken from four individuals of the same sex to support valid comparisons. **Suggest** two additional pieces of information that would also increase the validity of a comparison.

Question 3 (10 marks)

Light is an environmental factor that is essential for life on Earth. Different seeds need different environmental conditions to germinate. The image below shows an experiment to measure the effect of light intensity on seed germination. The experiment was conducted in a germination chamber.



The table below shows the results from an experiment using three different plant species: A, B and C. 10 seeds of each species were tested.

Light intensity / %	Number of seeds germinated		
	Species A	Species B	Species C
100	10	8	7
75	7	6	6
50	4	3	7
25	2	1	6
0	1	0	6

Not Started

Question 3a (1 mark)

Identify the plant species that had the highest number of germinated seeds at 75 % light intensity.

Question 3b (1 mark)

Suggest a reason for conducting the experiment at 0 % light intensity.

Question 3c (2 marks)

Identify a similarity and a difference in germination between species A and species B.

Similarity

Styles

Difference

Styles

Question 3d (1 mark)

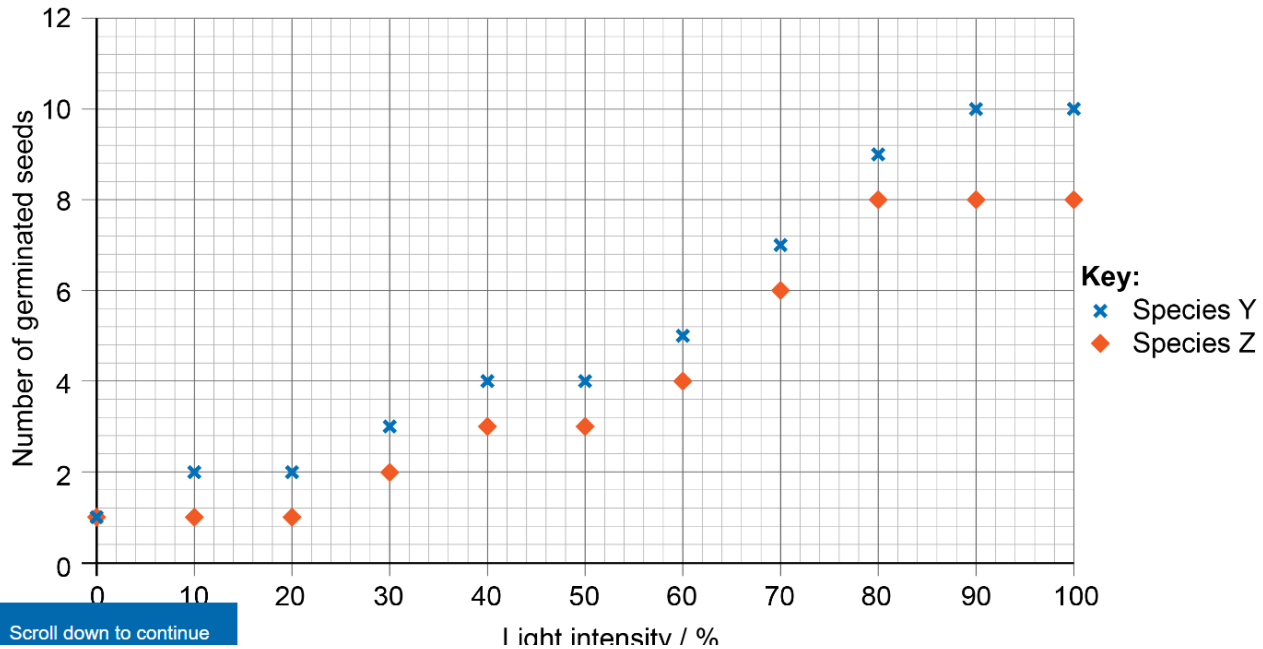
Suggest a reason for the results obtained for species C.

Question 3e (1 mark)

State the reason for conducting all experiments inside a germination chamber.

Question 3f (2 marks)

An agricultural company conducted an experiment to find the lowest light intensity that yields the highest number of germinated seeds for species Y and for species Z. The graph below shows the number of seeds that germinated at different light intensities.



Scroll down to continue

Light intensity / %

Identify the lowest light intensity the company could use to maximize seed germination for:

Species Y

Species Z

Question 3g (2 marks)

To minimize energy costs and maximize seed germination, the company decides to germinate the seeds of both species in one chamber. They decide to run the chamber at 85 % light intensity. **Outline** whether the company's decision is supported by the data in part (f).

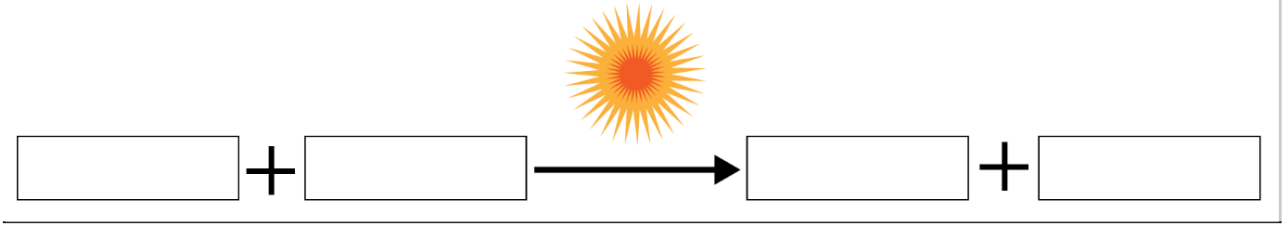
Question 4 (14 marks)

Construction of high-rise buildings in urban areas reduces the intensity of natural light reaching ground level.

Question 4a (1 mark)

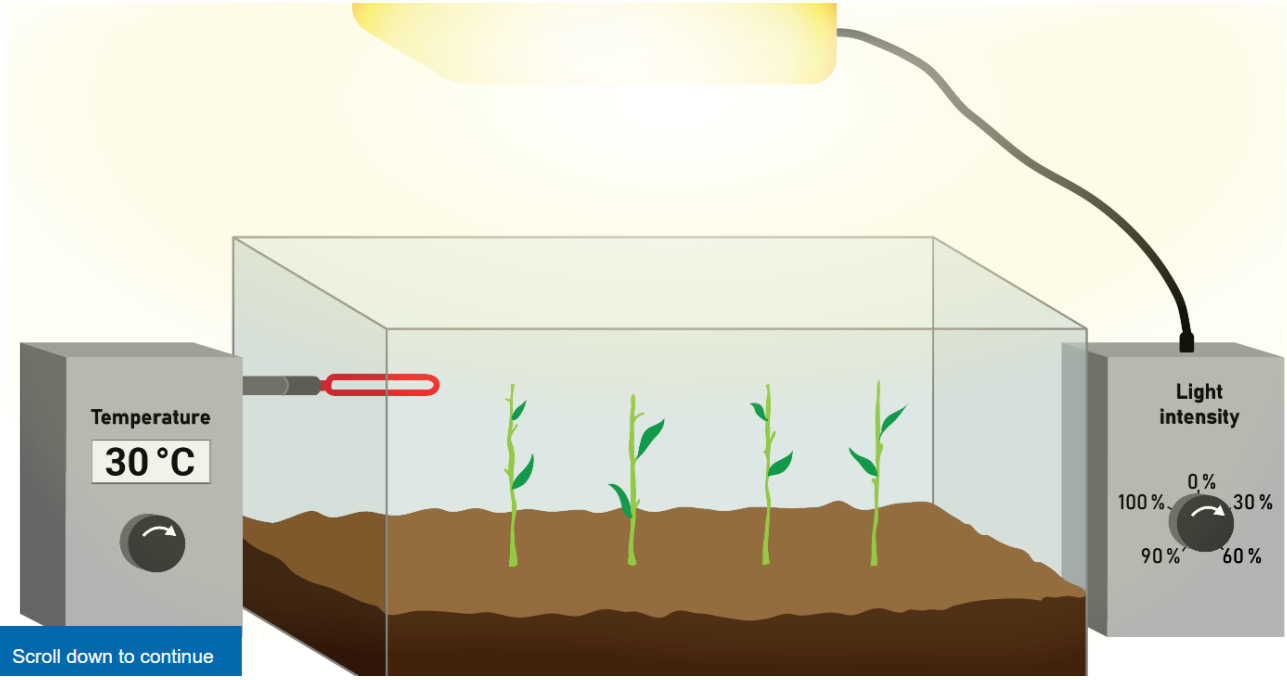
Light is needed for the process of photosynthesis. **Select** the correct location for each word to show the equation for photosynthesis.

Draggable items: Carbon dioxide | Glucose | Oxygen | Water

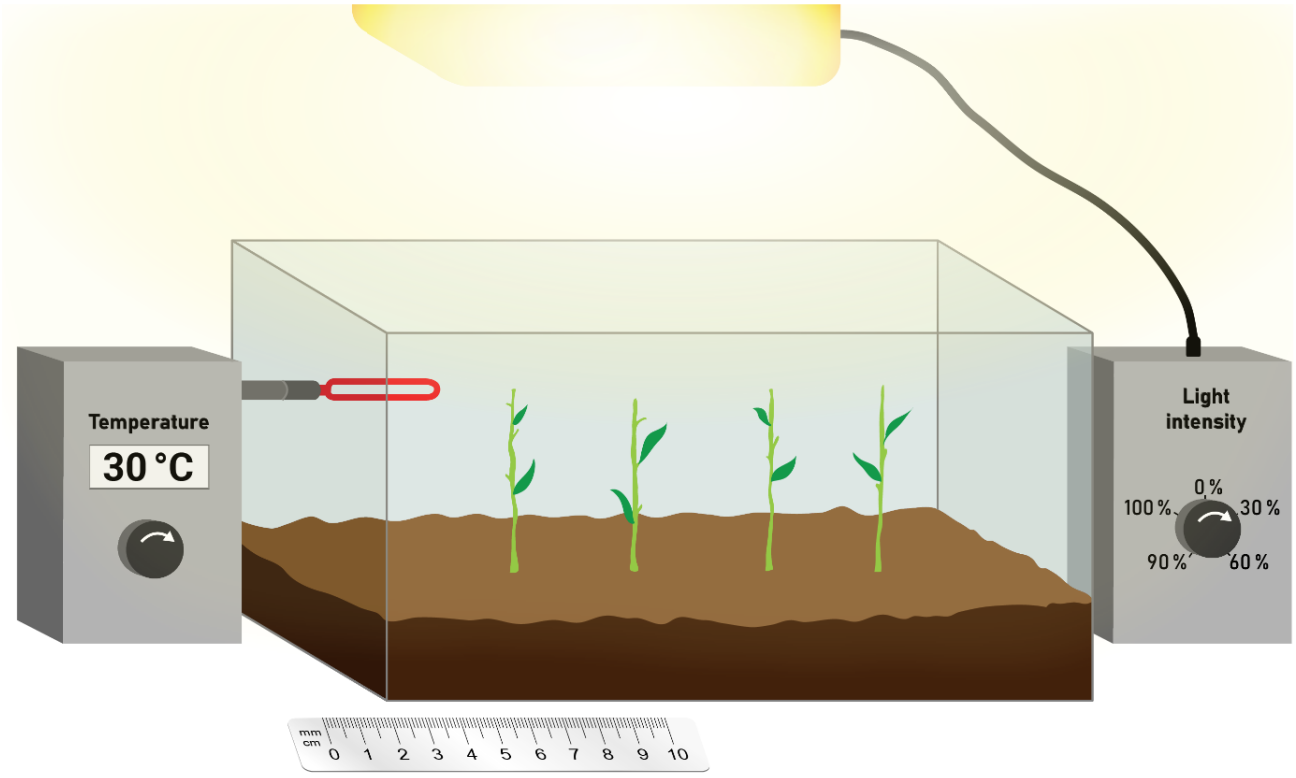


Question 4b (4 marks)

A student decided to conduct an experiment to measure the effect of light intensity on plant growth. The experiment they conducted is shown below:



Scroll down to continue



Identify the variables in this investigation.

Independent variable

Styles

Dependent variable

Styles

Control variable 1

Styles

Control variable 2

Styles

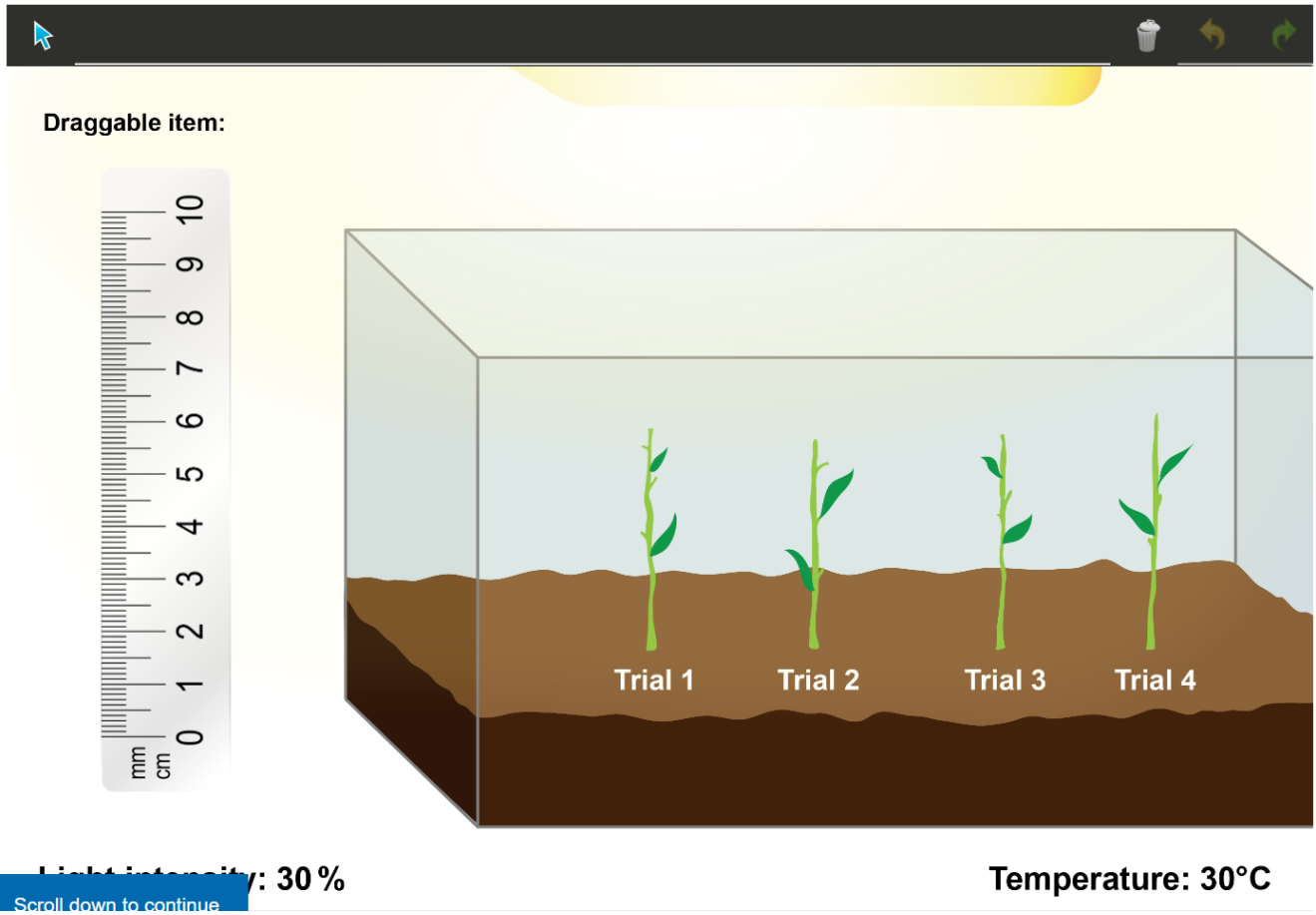
Special characters

Question 4c (2 marks)

The student predicted that if the light intensity increases then the length of the plant stem will also increase. **Justify** the student's prediction using scientific reasoning.

Question 4d (2 marks)

The student measured the plants after 10 days of exposure at each light intensity. **Measure** the length of the stem at 30 % light intensity for trial 4 and **calculate** the average length. Show your working in the box below and add your values to the table.


Draggable item:
0 1 2 3 4 5 6 7 8 9 10
mm
cm
Trial 1
Trial 2
Trial 3
Trial 4
Temperature: 30°C
Scroll down to continue

Light intensity: 30 % **Temperature: 30°C**

Light intensity	Length of the plant stem				
	Trial 1	Trial 2	Trial 3	Trial 4	Average
30	42	40	41		
60	52	55	52	53	53
90	58	62	63	61	61
100	60	59	64	61	61

Reset

Question 4e (1 mark)

State one improvement the student could make to the **presentation** of the data in part (d).

Question 4f (1 mark)

Suggest why the average lengths of the plant stem at both 90 % and 100 % light intensity are the same after 10 days.

Question 4g (1 mark)

Suggest a way to increase the length of the plant stem further.

Question 4h (2 marks)

The student predicted that if the light intensity increases then the length of the plant stem will also increase.

Comment on whether the data in part (d) supports the student's prediction. You must refer to data in your answer.

Question 5 (9 marks)

The student also noticed that urban areas have higher temperatures than rural areas. Therefore, they decided to measure the effect of temperature on plant growth. They used the method below:

1. Select plants with similar length of stems.
2. Place the plant in an enclosed container with a heater and carbon dioxide controller.
3. Conduct the experiment at different temperatures: 30°C, 35°C, 40°C, 45°C and 50°C.
4. Measure the increase in the lengths of the plant stems after 15 days.
5. Repeat the experiment for each temperature.

Question 5a (1 mark)

Justify why the student used the heater in this investigation.

Styles

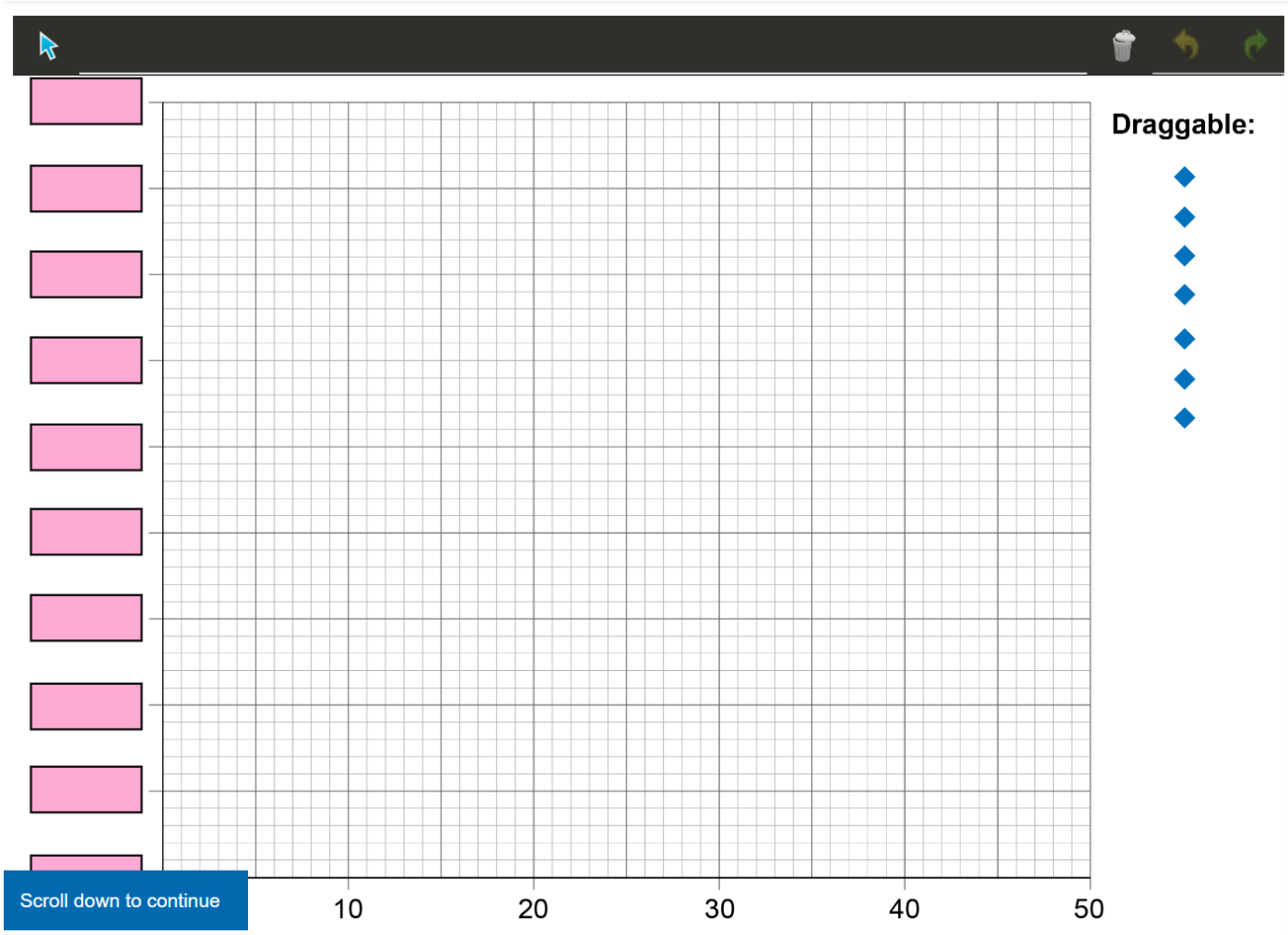
Special characters

Question 5b (3 marks)

The table below shows the increase in average length of plant stems against temperature:

Temperature / °C	Increase in average length of plant stems after 15 days / mm
30	9
35	21
40	42
45	43
50	2

Using the data provided in the table, **plot** a graph to show the effect of temperature on the increase in average length of plant stems.


Draggable:
Scroll down to continue
10
20
30
40
50

x axis label:

Styles

y axis label:

Styles

Question 5c (5 marks)

Interpret and **explain** the results in part (b).

Question 6 (16 marks)

Industrialization has resulted in more factories producing waste gases which cause acid rain. Acid rain leads to changes in soil pH which can affect plant growth.

Design an investigation to test how changing soil pH affects plant growth. You are provided with standard laboratory equipment and a range of solutions with pH between 3.5 and 10.0. In your answer, you should include:

- the independent variable, dependent variable and two controlled variables
- equipment you will use
- details of how to manipulate, measure or monitor the variables
- details of the method you will use to collect sufficient data
- a safety consideration.

Question 7 (10 marks)

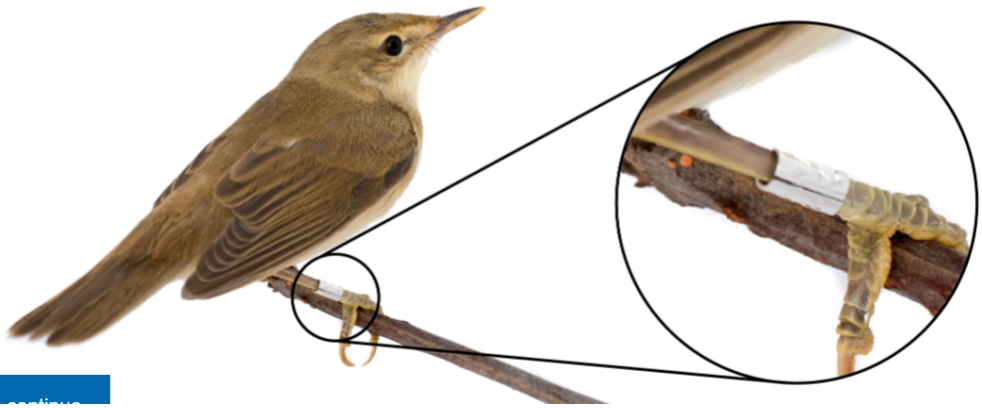
Animal tracking has been used for hundreds of years. It began as a method of hunting and of keeping track of animals. As technology has advanced, animal tracking has evolved into a method for scientific data collection.

Click on the arrow to move through the slides.

Bird banding is a method of collecting data for research, management and conservation. Bird banding uses plastic or metal rings placed around the leg of a bird. The band has a unique number or colour sequence allowing the bird to be identified individually. It does not harm the bird or affect its behaviour.

THEN

In 1902, 23 young birds were banded with aluminium rings marked with the year, a serial number and a return address. Only one of the 23 rings was returned from 89 km away. This was the first use of bird banding for scientific research.



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NOW

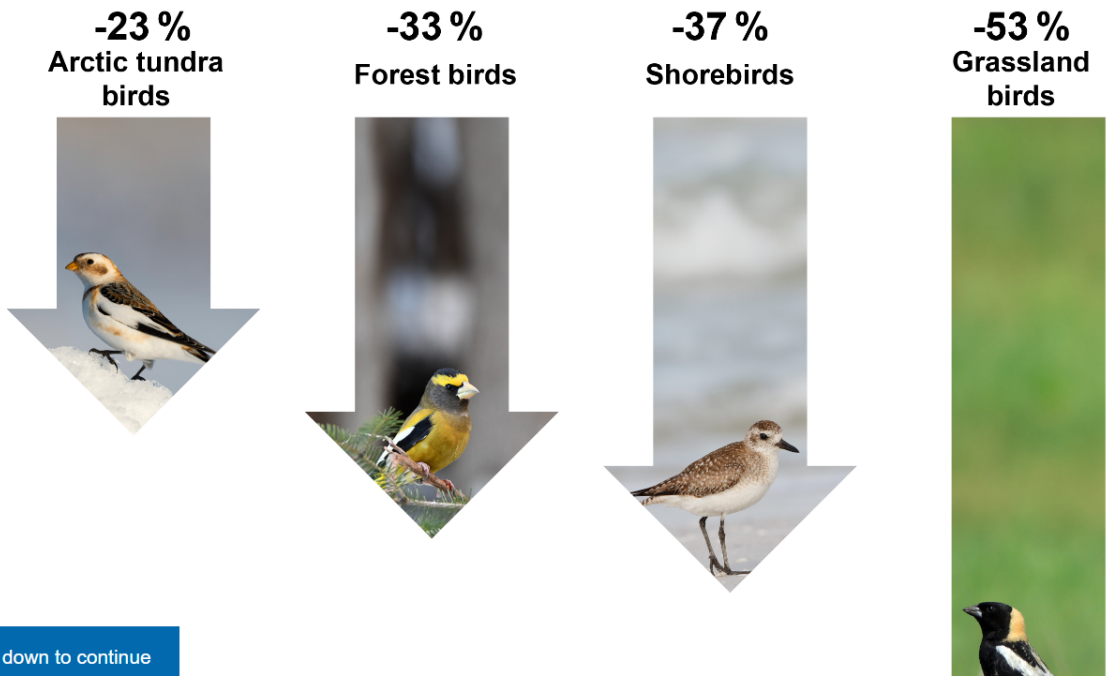
Bird banding is still an effective method for collecting data on birds. The bands have been improved by using lighter weight materials and colour-coded bands for improved identification. Currently, there are over 5 million records of banded birds from around the world.

Question 7a (2 marks)

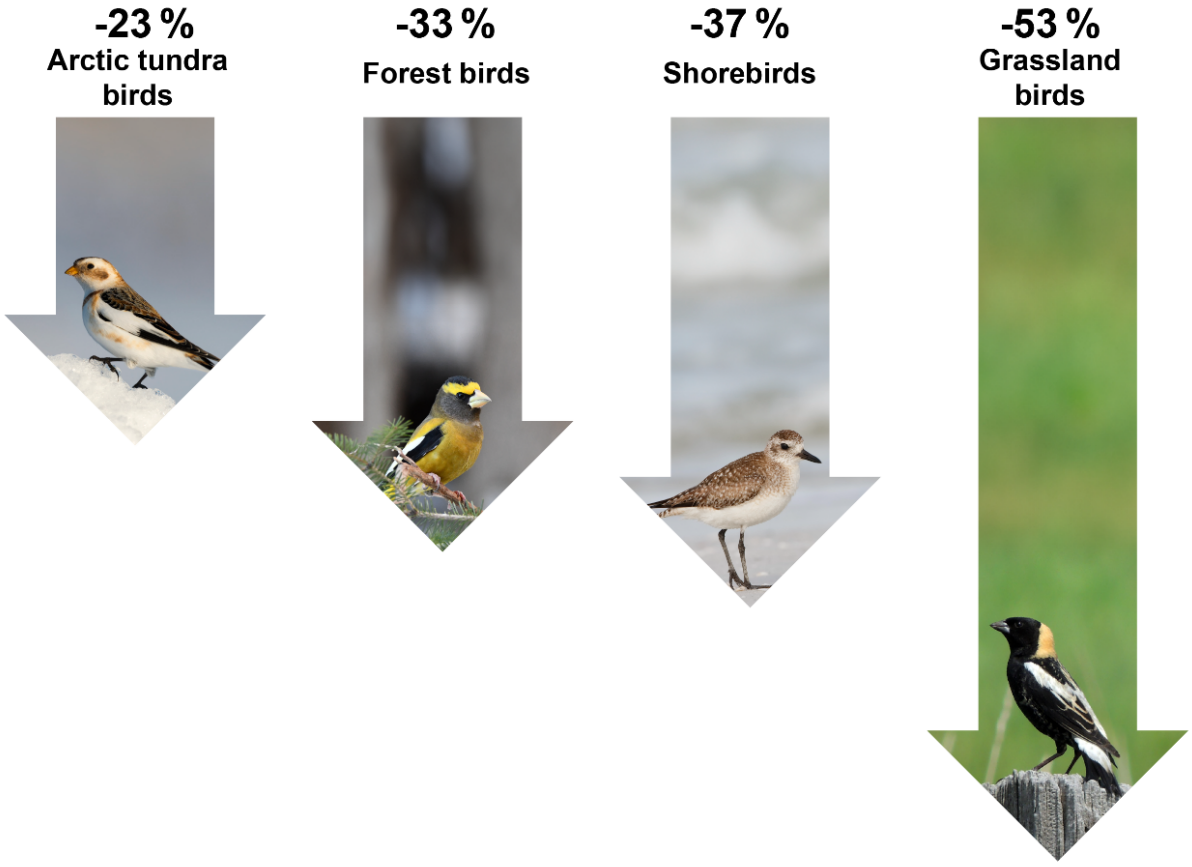
Bird banding has been used to scientifically track birds for over 120 years. Considering our technological advances, **suggest** two reasons why this simple method of data collection is still used today.

Question 7b (1 mark)

Bird populations are declining worldwide. The graph below shows population changes for four groups of birds living in different habitats:



Scroll down to continue


-23 %
Arctic tundra birds
-33 %
Forest birds
-37 %
Shorebirds
-53 %
Grassland birds

Select the group of birds whose population size has declined the most.

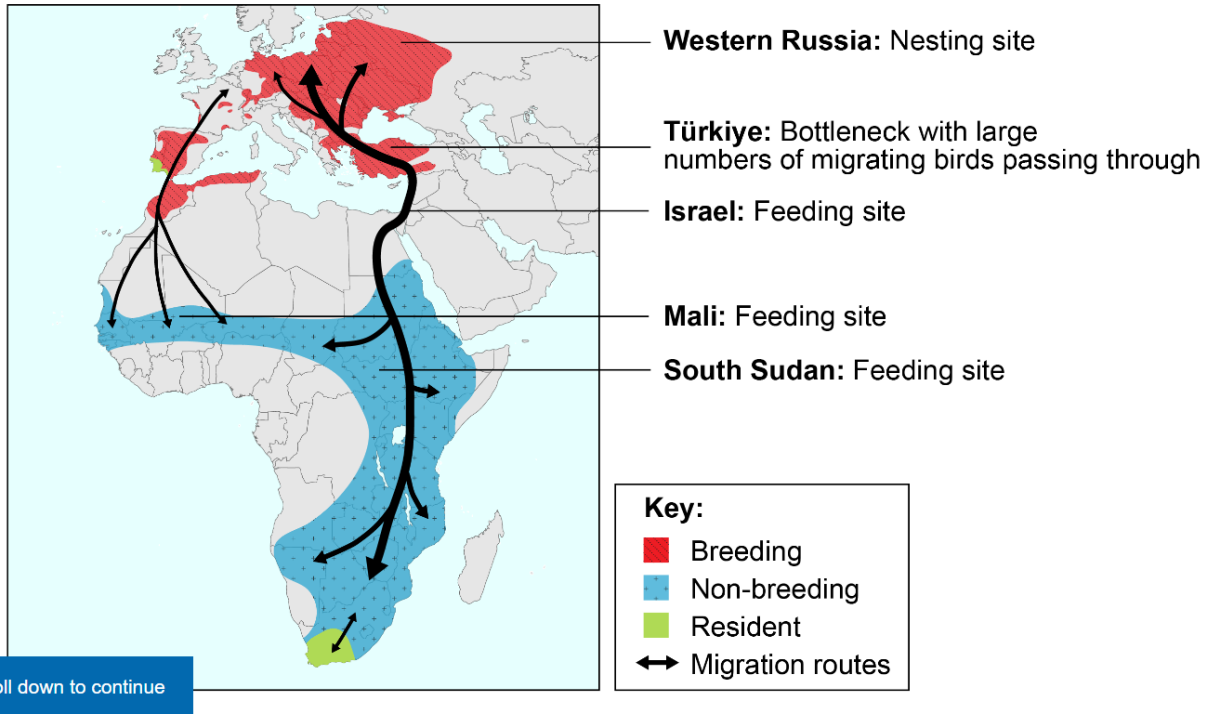
- Arctic tundra birds
- Forest birds
- Shorebirds
- Grassland birds

Question 7c (1 mark)

Suggest why the population size of the bird identified in part (b) has declined more than the others.

Question 7d (4 marks)

Scientists have used bird banding to collect information about the migration routes of birds. This can be used to understand the reasons for population decline.



Scroll down to continue

Explain how the different types of data from bird banding can help scientists monitor birds.

Breeding site locations

How the data can be used:

Population estimations

How the data can be used:

Feeding site locations

How the data can be used:

Lifespans and survival rates

How the data can be used:

Question 7e (2 marks)

Suggest two impacts of climate change on bird migration patterns.

Question 8 (16 marks)

Radio and satellite tracking systems provide information about an animal's location and movement.

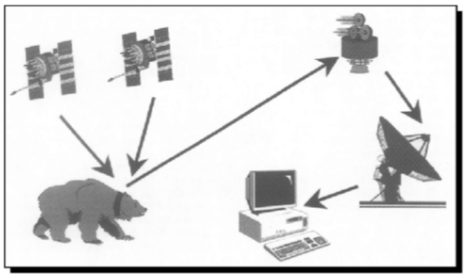
Click on an image to expand.

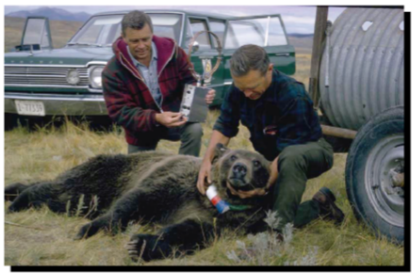
Radio and satellite trackers

Radio trackers use a tracking device that is tagged to an animal. The device transmits a signal to a receiver.

Radio trackers are used on small animals moving over short distances. Researchers must be close by to locate the signal before tracking is possible. Once within range, tracking can be done on foot or using a vehicle.

Satellite trackers are used on larger animals over longer distances. Researchers can locate signals from further away and can track animals from anywhere in the world. Satellite technology can now pinpoint a three-dimensional position to one metre of accuracy at any exact time, with a degree of accuracy of less than a second.





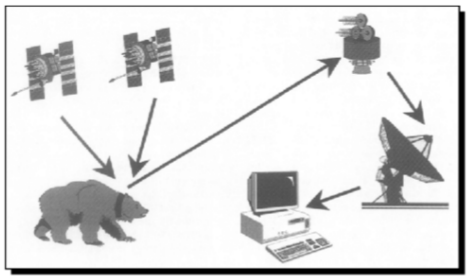
Scroll down to continue

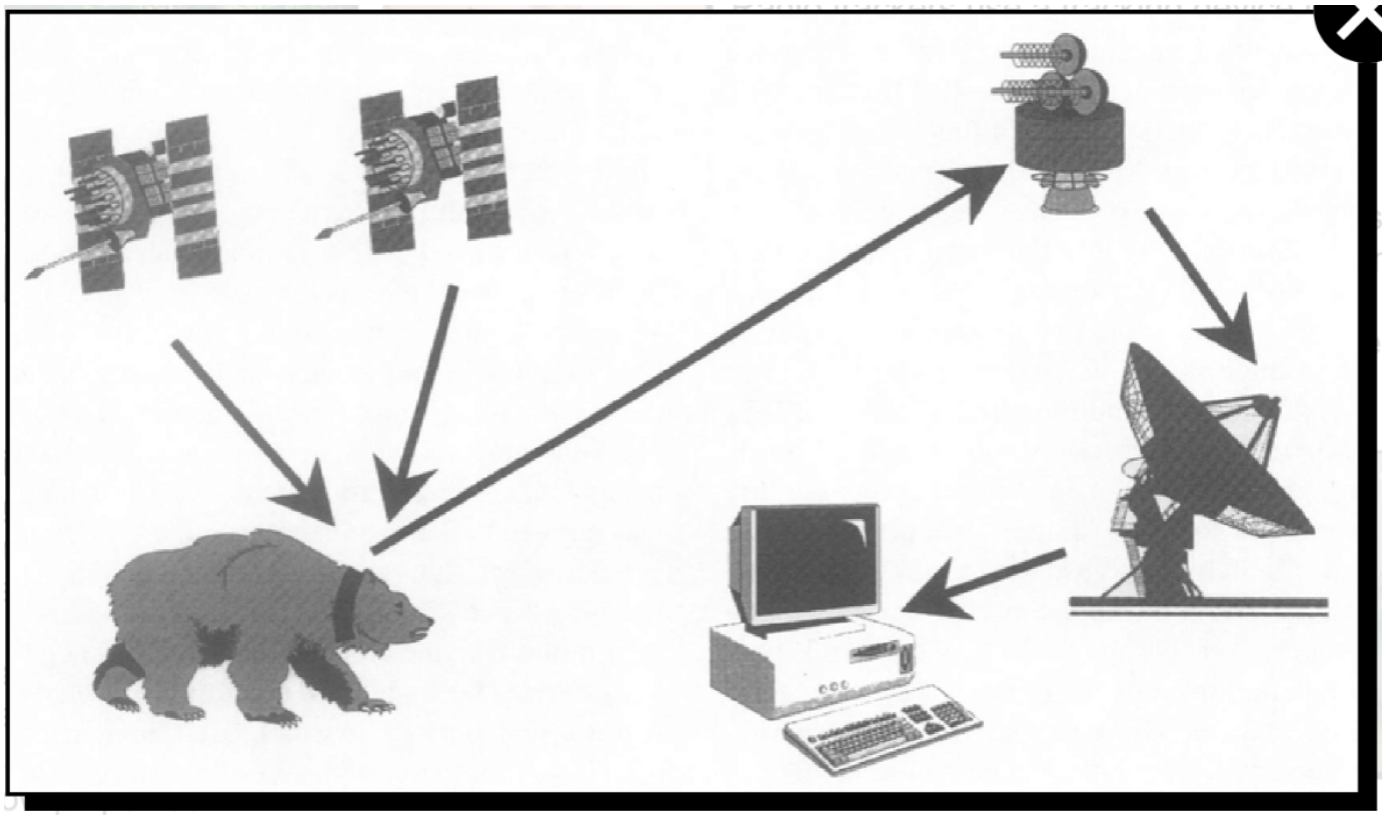
Radio and satellite trackers

Radio trackers use a tracking device that is tagged to an animal. The device transmits a signal to a receiver.

Radio trackers are used on small animals moving over short distances. Researchers must be close by to locate the signal before tracking is possible. Once within range, tracking can be done on foot or using a vehicle.

Satellite trackers are used on larger animals over longer distances. Researchers can locate signals from further away and can track animals from anywhere in the world. Satellite technology can now pinpoint a three-dimensional position to one metre of accuracy at any exact time, 24 hours a day, with a degree of accuracy of less than a second.

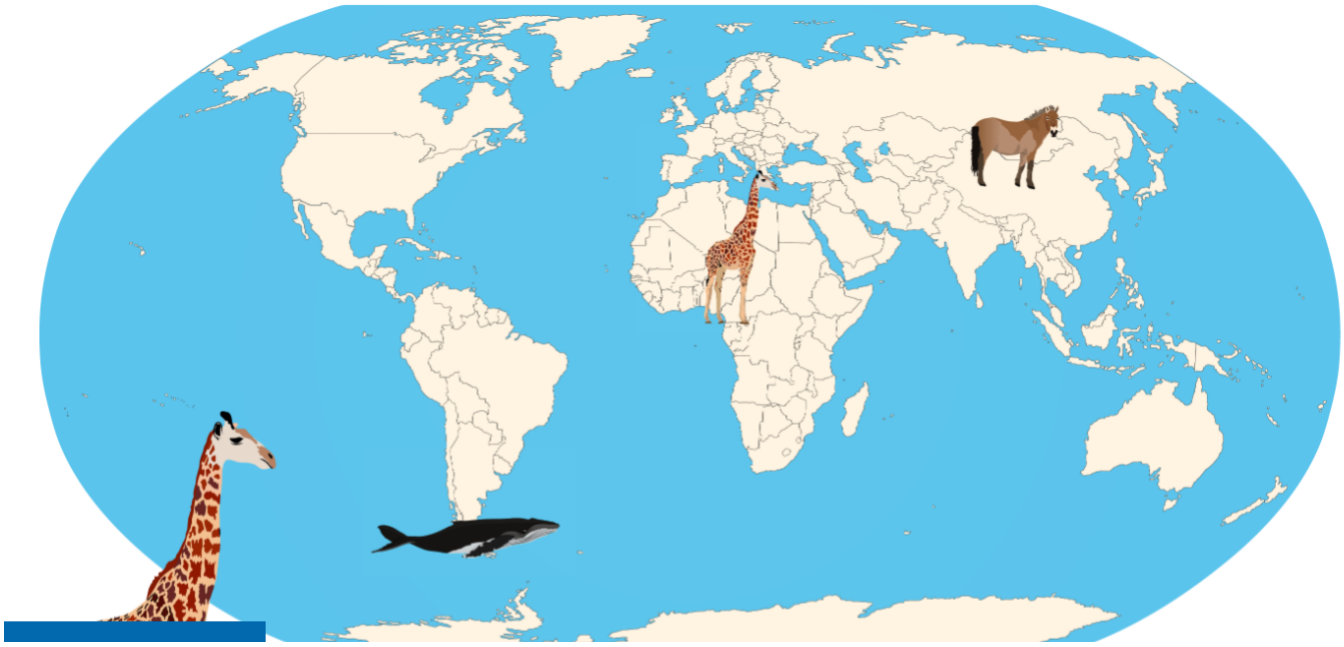


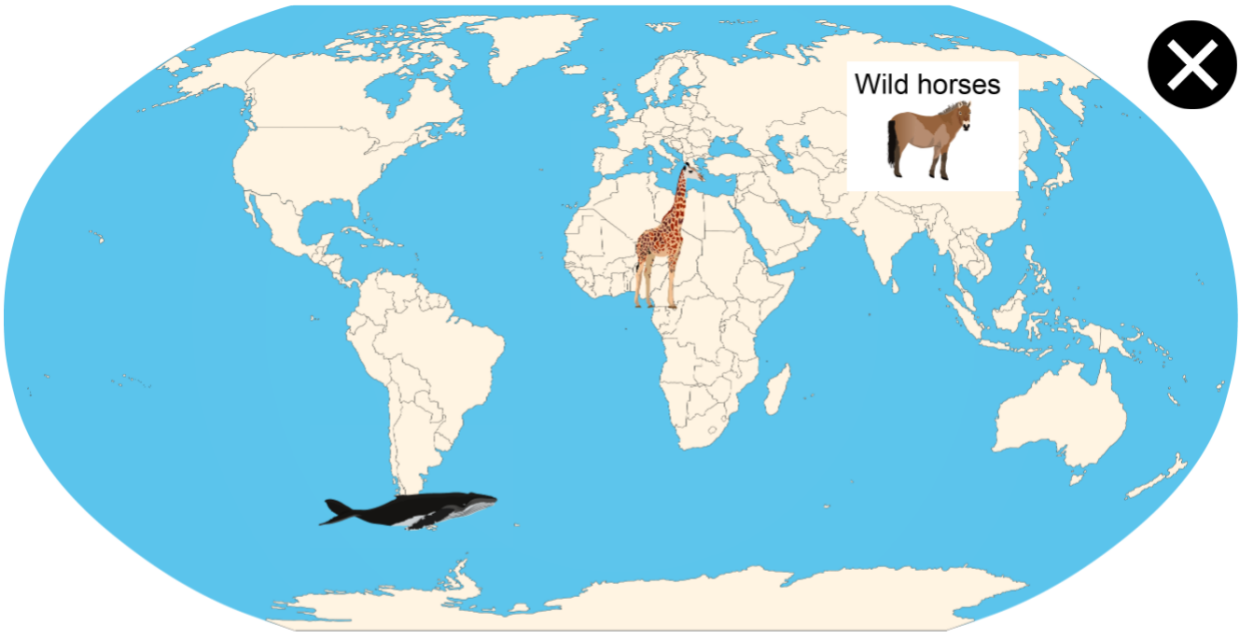


The interactive map below shows three examples where radio and satellite technology have been used in the conservation of different animals.

This media is interactive

Click on an animal on the map for more information.



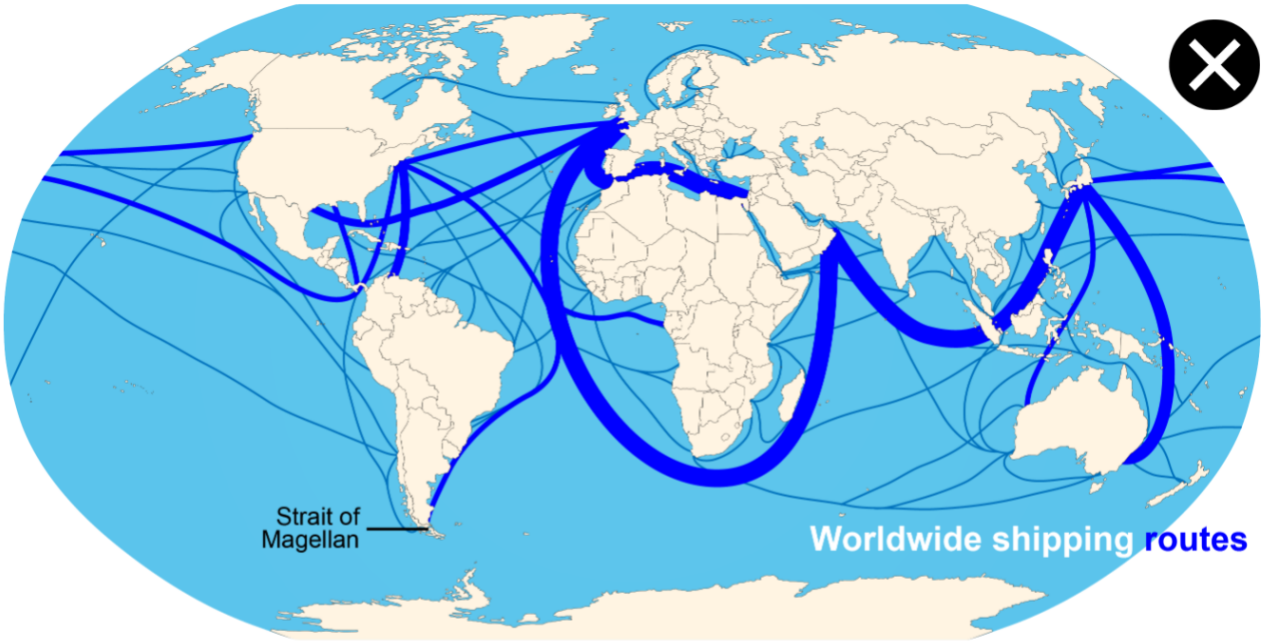


Wild horses

Wild horses were last seen in the Gobi Desert during the 1960s, after which the species was driven to extinction in the wild. Since then, wild horses have been bred in zoos to increase their numbers, tagged and reintroduced into protected national parks in China and Mongolia.

West African giraffe

Satellite tracking data has shown giraffes migrating through diverse habitats in eight different neighbouring countries.



Humpback whales

Satellite tags are used to determine how whale movements are impacted by shipping vessels in a high-traffic area. The Strait of Magellan is a heavily used shipping channel and a vital feeding area for humpback whales.

Using information from this task and your wider MYP studies, **discuss** and **evaluate** the use of radio and satellite technology for animal tracking. In your answer, you should include:

- how the technology has advanced our approach to the conservation of animals
- ethical considerations about the use of animal tracking devices
- political considerations for a tracker that can be used over a large area
- an economic consideration of radio and satellite trackers
- a concluding appraisal on the use of radio and satellite technology for tracking animals.