

1 Grey tree frogs are found in the USA.

The photograph below shows a grey tree frog.



Magnification $\times 1$

Cope's grey tree frog and the eastern grey tree frog are both found in the USA.

These species of grey tree frog are very similar in appearance, but have different mating calls.

A number of scientists believe that the eastern grey tree frog evolved from Cope's grey tree frog during the last ice age.

These species have different numbers of chromosomes in their nuclei. Cope's grey tree frog has two copies of each chromosome. The eastern grey tree frog has four copies of each chromosome. As a result, the cells of the eastern grey tree frog are larger.

(a) The genetic relationship between these two species of grey tree frog has been studied using DNA profiling (DNA fingerprinting).

A small sample of DNA was taken from each species of grey tree frog. This DNA was amplified, fragmented and used to produce a DNA profile (DNA fingerprint) for each species.

* (i) Describe how a DNA profile was produced from this small sample of DNA.

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(ii) Suggest how these DNA profiles were compared.

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(b) Scientists in different parts of the USA are investigating the possibility that the difference in cell size is responsible for the different mating calls. This is contributing to an understanding of the evolution of grey tree frogs.

Suggest **two** ways in which the results of their investigations can be shared.

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(Total for Question 1 = 11 marks)

2 Carl Woese suggested that living organisms could be grouped into three domains.

(a) The Eukarya domain includes the plant kingdom.

Plants are different from other groups of organisms in the Eukarya domain as they have cellulose cell walls. The cellulose molecules in the cell wall are arranged in microfibrils.

The table below gives four features of a cellulose molecule and a cellulose microfibril.

If the feature is present place a tick (✓) in the box and if it is absent, place a cross (✗) in the box.

(4)

Feature	Cellulose molecule	Cellulose microfibril
Alpha (α) glucose		
1,4-glycosidic bonds		
1,6-glycosidic bonds		
Hydrogen bonds		

(b) Eukarya is one of the three domains.

Name the other **two** domains.

(2)

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2.

(c) Scientists classify organisms into taxonomic groups, such as the three domains.

Explain how organisms can be classified into taxonomic groups.

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(d) When Carl Woese first suggested that all organisms could be classified into one of the three domains, his ideas were not accepted.

Suggest how Woese's idea was critically evaluated.

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(Total for Question 2 = 11 marks)

3 The scientist Carl Woese suggested that living organisms could be grouped into three domains. There are specific differences between the organisms in the three domains.

(a) Place a cross in the box (☒) that correctly identifies the names of the three domains suggested by Woese.

(1)

- A Animalia, Archaea and Eukarya
- B Animalia, Bacteria and Prokaryotae
- C Archaea, Bacteria and Eukarya
- D Archaea, Eukarya and Prokaryotae

(b) Carl Woese's ideas were not accepted when he first suggested that every organism could be classified into one of three domains.

(i) Suggest **two** ways in which Woese communicated his findings to the scientific community.

(2)

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(ii) Describe how the scientific community would have evaluated Woese's theory.

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(c) Woese suggested that organisms could be placed in taxonomic groups based on molecular phylogeny. Explain what is meant by this statement.

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(Total for Question 3 = 9 marks)

- 4 The group of birds, known as warblers, contains many species which are very similar in external appearance.

Two of these species, the chiffchaff, *Phylloscopus collybita*, and the willow warbler, *Phylloscopus trochilus*, are so similar that many experts can identify them only by listening to their individually-characteristic songs.

These songs are used during breeding to mark territory and attract mates.

The photographs below show these two warblers.



Chiffchaff



Willow warbler

Magnification $\times 0.75$

- (a) Although chiffchaffs and willow warblers are often found at the same time in the same woodlands, they do not interbreed.
- (i) Suggest why successful interbreeding between chiffchaffs and willow warblers would make some scientists doubt their classification as separate species.

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(ii) Suggest reasons why the two species do not interbreed.

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(b) Records show that very little change in the appearance of chiffchaffs and willow warblers has occurred during the last two hundred years.

Suggest why the rate of change in the appearance of these two species is relatively slow.

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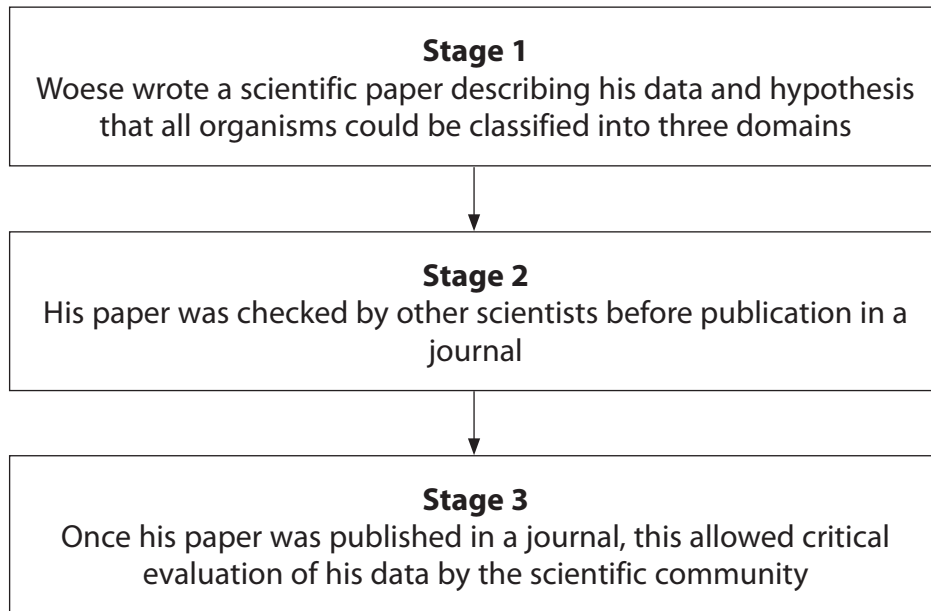
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(Total for Question 4 = 9 marks)

5 Woese, a scientist, collected data that allowed him to propose the hypothesis that all organisms could be classified into three domains.

(a) The diagram below shows some of the stages Woese used to publicise his new data and hypothesis.



(i) In stage 1, Woese suggested three domains, including the Bacteria and the Eukaryota (Eukarya). Name the third domain.

(1)

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(ii) In stage 2, Woese's paper was checked by scientists before publication. Explain why his paper was checked by scientists at this stage.

(1)

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(iii) Suggest **two** ways, other than publication in a journal, that scientists can use to present their data to the **scientific** community.

(2)

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(iv) Explain what is meant by the phrase 'allowed critical evaluation of his data by the scientific community' in stage 3.

(2)

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(b) The table below compares some features of two domains.
Complete the table by placing a tick (✓) in the box, if the feature may be present in the domain or a cross (✗) if it is absent.

(4)

Feature	Domain	
	Bacteria	Eukaryota
Ribosomes		
Smooth endoplasmic reticulum		
Cell (surface) membrane		
Slime capsule		

(Total for Question 5 = 10 marks)