Chapter 1

Characteristics and classification of living organisms

1. 0610_s20_qp_42 Q: 5

The Galápagos Islands are a group of small islands in the Pacific Ocean.

In 1839 Charles Darwin published a book that described differences in a family of birds called finches.

Each species of Galápagos finch had:

- a different diet
- a different beak shape, as shown in Fig. 5.1.

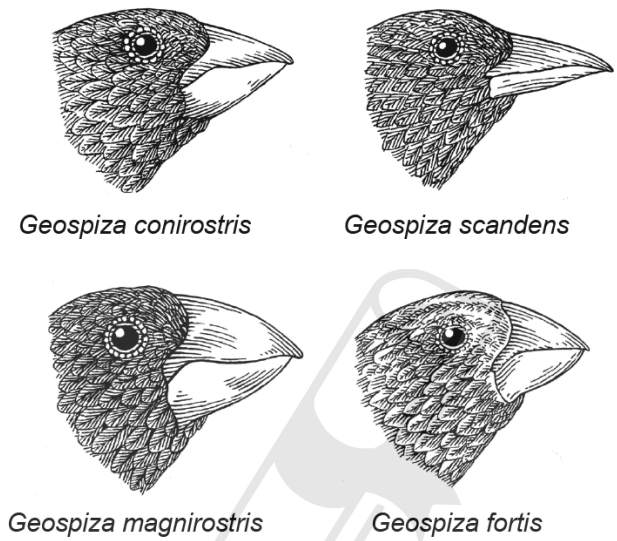


Fig. 5.1

(a) State the genus name for the Galápagos finches shown in Fig. 5.1.

..... [1]

(b) Galápagos finches share a common ancestor.

Suggest how Galápagos finches have evolved different shaped beaks.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 6]

2. 0610_w16_qp_41 Q: 6

A DNA molecule has two strands as shown in Fig. 6.1.

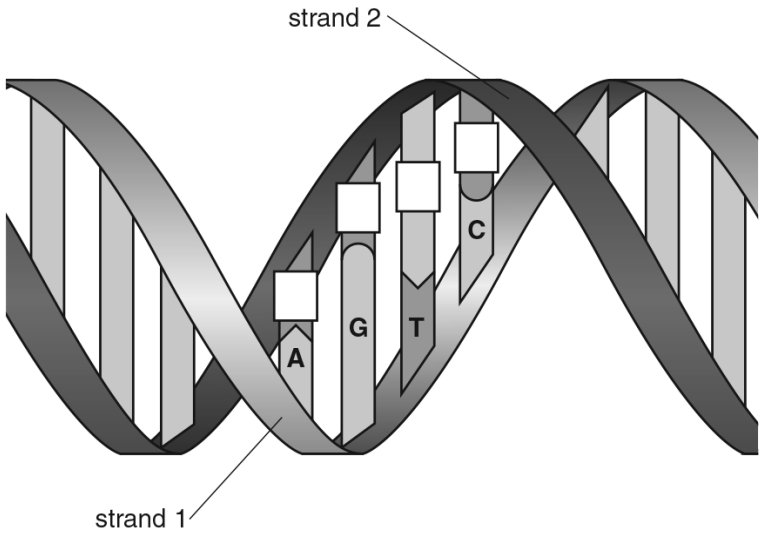


Fig. 6.1

(a) (i) Fill in the boxes on Fig. 6.1 to show the letter of the bases on strand 2 that will pair with the corresponding bases on strand 1. [2]

(ii) State the name for the structure of a DNA molecule as shown in Fig. 6.1.

.....[1]

When molecules of DNA are used to classify species, only one of the two DNA strands is sequenced.

First the DNA sequence from one strand of a DNA molecule from each species is lined up against one strand from another species.

The bases of the DNA sequences from the same strand can then be compared with each other.

Fig. 6.2 shows a short section from the DNA sequences of eight plant species. There are ten differences between species **A** and species **B**. These differences are shown in Fig. 6.2.

Species **A**: CTCCTCGGGT GACGGCCTAG CCCGTTGACG AATCCCATTC CTAAACTTT

Species **B**: CTCCTAGGGT GCAGGACTAG CCCGTTGACG AATCCCATTC CCAAGA

Species **C**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCACATTC CGATT

Species **D**: CTCATAGGGT GCAGGCCTAG CCCCTTGACG AATCCAATTC CGCTT

Species **E**: CTCATAGGGT GCAGGCCTAG CCCGTTGACG AATCCAATTC CGCTT

Species **F**: CTCCTAGGTT GCAGGCCTAG CCCTTTGAAG AATCACATTC CCCAA

Species **G**: CTCCTCGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CGAAA

Species **H**: CTCCTAGGGT GCAGGCATAG CCCTTTGACG AATCCCCTTC CAAAAT

Fig. 6.2

(b) The number of differences between the DNA sequences of the eight species shown in Fig. 6.2 are recorded in Table 6.1.

Count the number of differences between the DNA sequences shown in Fig. 6.2 for:

- species **C** and species **D**
- species **G** and species **H**

Write your answers in Table 6.1. [2]

Table 6.1

	species **A**	species **B**	species **C**	species **D**	species **E**	species **F**	species **G**	species **H**
species **A**		10	10	13	12	11	10	9
species **B**			7	8	7	7	7	6
species **C**					3	7	8	8
species **D**					1	9	9	8
species **E**						9	8	10
species **F**							6	7
species **G**								
species **H**								

(c) The most closely related species have the fewest differences between their DNA sequences.

State which **two** plant species shown in Table 6.1 are most **distantly related** to each other.

.....[1]

(d) The most closely related species have the shortest distance from a branching point on a classification tree.

Use the information in Table 6.1 to complete the classification tree in Fig. 6.3. Write the letter corresponding to species **B**, **C**, **D** and **G** in the box next to the correct branch of the classification tree. [3]

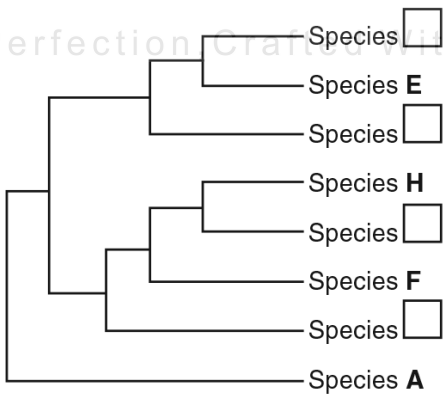


Fig. 6.3

(e) A modern method for improving crop productivity is to cut out sections of DNA carrying a useful gene from one organism and place them into another organism.

(i) Name the technique of inserting genes from one organism into another.

.....[1]

(ii) A gene for producing a vaccine has been inserted into banana plants.

Give **two** other examples in which crop plants have been changed by inserting genes. State one advantage for each example.

example 1 .....

advantage .....

.....

example 2 .....

advantage .....

.....
[4]

[Total: 14]

---

3. 0610_w16_qp_42 Q: 2

Fig. 2.1 is a diagram showing a small region of DNA.

Fig. 2.1

Fig. 2.2 shows part of the DNA enlarged to show the sequence of bases.

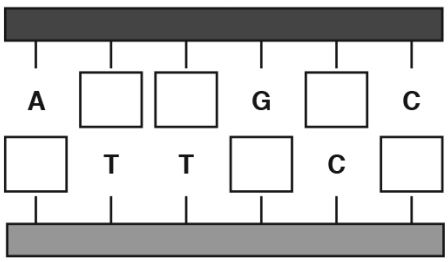


Fig. 2.2

(a) Complete Fig. 2.2 by adding the letters for the bases that are missing. [2]

(b) Fig. 2.3 shows how DNA is involved in protein synthesis.

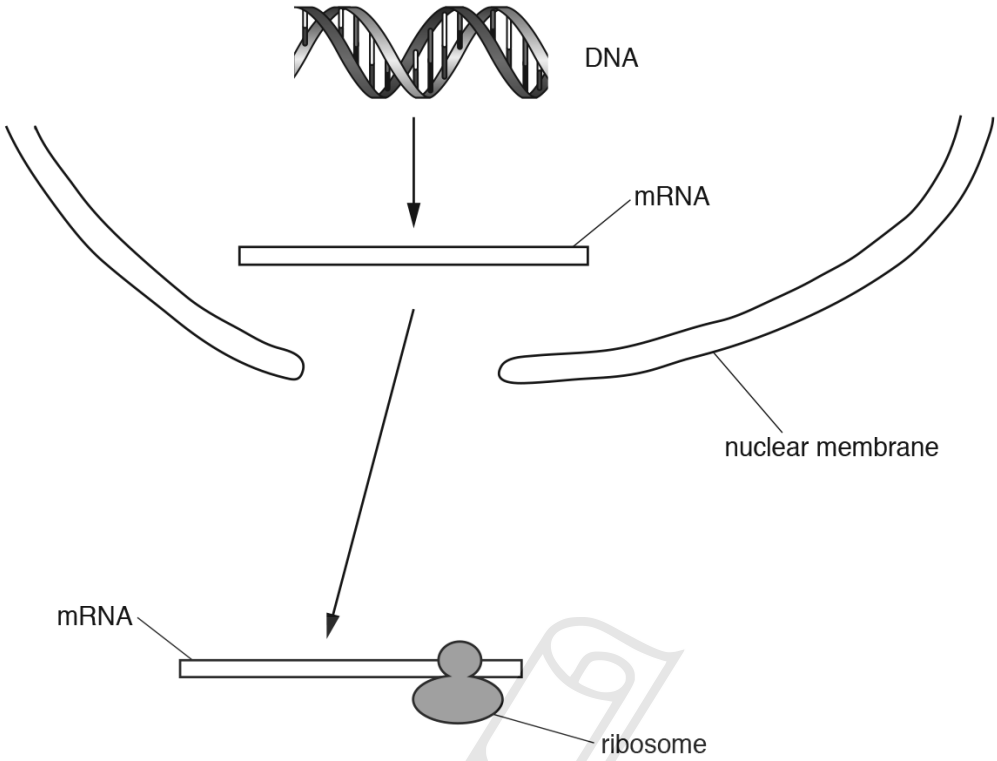


Fig. 2.3 not to scale

Explain how mRNA is involved in protein synthesis.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Base sequences of the DNA of different species are compared to investigate how species are related to one another. The most closely related species have the shortest distance from a branching point on a classification tree.

Fig. 2.4 shows how six species of fungi are related to each other.

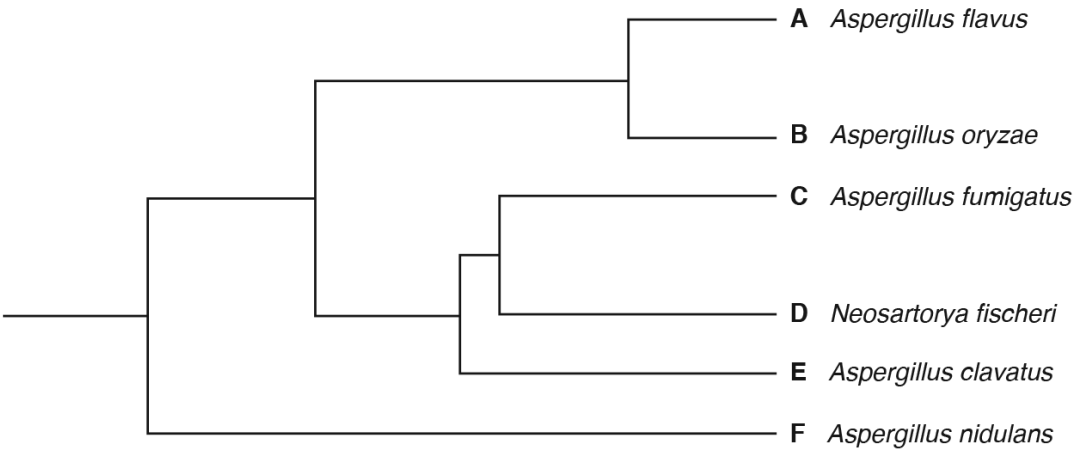


Fig. 2.4

(i) Use the letters on Fig. 2.4 to state the two species that are most closely related.

..... [1]

(ii) Use Fig. 2.4 to explain why *Aspergillus nidulans* is the most distantly related species from all of the other five species.

.....

.....

.....

.....

..... [2]

(d) Modern methods of classification rely on the analysis and comparison of base sequences in DNA.

Describe the type of evidence that scientists used for classifying organisms before they were able to sequence DNA.

.....

.....

.....

.....

..... [2]

[Total: 10]

4. 0610_m18_qp_42 Q: 1

(a) (i) Fig. 1.1 is a branching key used to identify different species of bacteria.

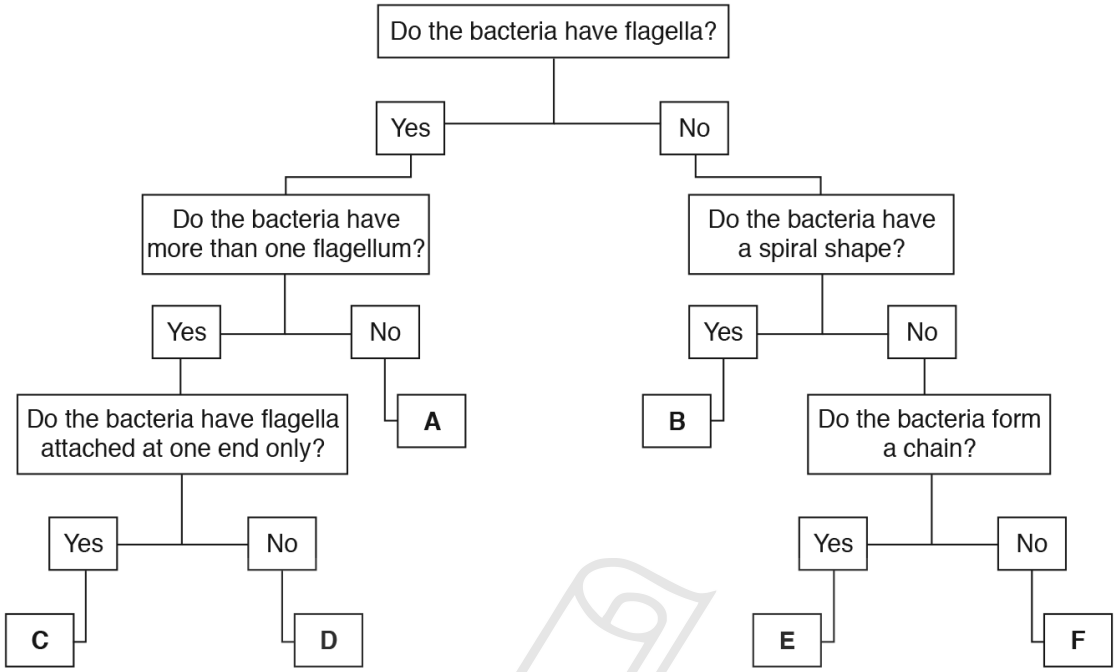
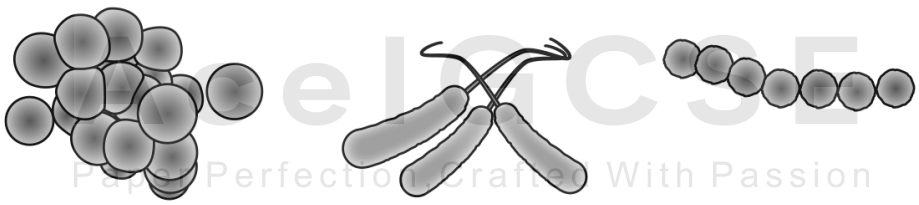


Fig. 1.1

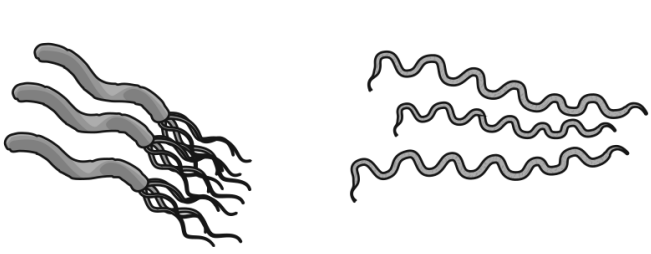
Fig. 1.2 shows six different species of bacteria.

Use the key to identify the six different species of bacteria.

Write the letters on the lines in Fig. 1.2.



....



....

[5]

Fig. 1.2

(ii) State the name of the kingdom that bacteria belong to.

..... [1]

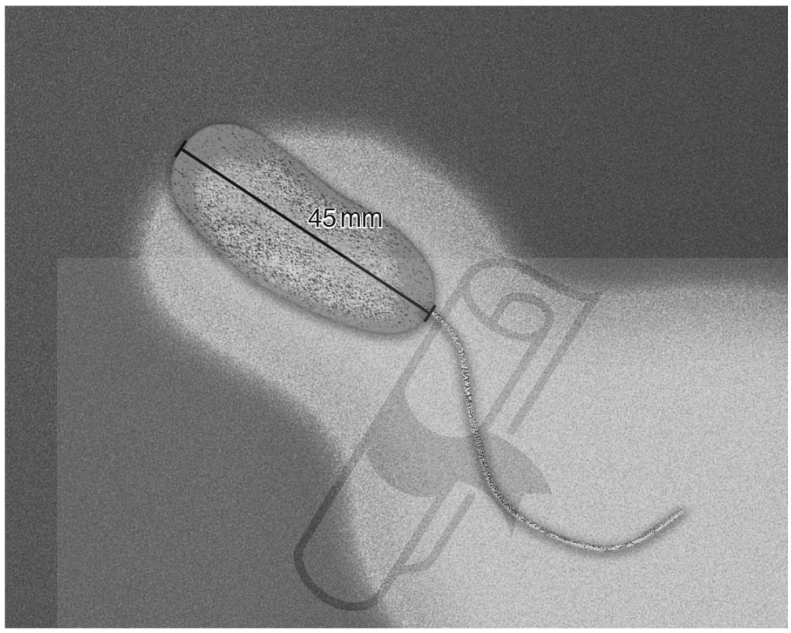
(b) State **one** similarity between the structure of bacteria and the structure of viruses.

.....

.....

.....[1]

(c) Fig. 1.3 is a photomicrograph of *Vibrio cholerae*, the bacterium that causes cholera.



magnification ×17 300

Fig. 1.3

(i) Write the formula that would be used to calculate the actual length of the bacterium (not including the flagellum) in Fig. 1.3.

[1]

(ii) The actual length of the bacterium shown in Fig. 1.3 is 0.0026 mm.

Convert this value to micrometres (μm).

Space for working.

..... μm [1]

(d) (i) Describe **and** explain the effects of cholera bacteria on the gut.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(ii) Suggest **one** treatment for cholera.

.....[1]

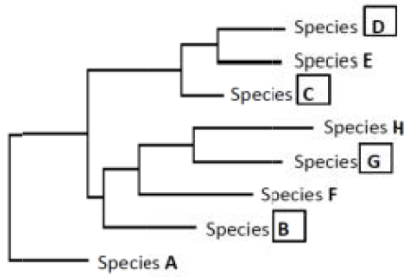
[Total: 14]

Answers

1. 0610_s20_MS_42 Q: 5

(a)(i)	*Geospiza* ;	**1**
(a)(ii)	*any five from:* natural selection ; variation (in beak shapes) ; mutation / description ; those birds with, selective advantage / unique beak shape, more likely to find food and survive ; the birds that survive reproduce ; pass on their alleles ; continues over many generations ; AVP ;	**5**

2. 0610_w16_MS_41 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	T, C, A, G;	2	all correct = 2 marks 2 or 3 correct = 1 mark
(a)(ii)	double helix;	1	
(b)	*species C with species D*: 4; *species G with species H*: 3;	2	
(c)	species **A** and species **D**	1	
(d)		3	4 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 marks
(e)(i)	genetic engineering;	1	
(e)(ii)	drought / salt / pollution / metal / frost / stress / cold, resistant; increased, yield / productivity; extend range where crops can be grown; herbicide resistance; increased yield / productivity; pesticide resistance; increased yield / productivity; crop plants produce own insecticides; less insecticide used; increased yield; vitamin / nutrient, enrichment / β carotene (Golden rice); increased nutritional value; pathogen resistant / Bt; increased productivity / less pesticide use; antigens / vaccines / pharmaceuticals; e.g. insulin cheap production of medicines; flavour / texture / ripening; Improved customer satisfaction / shelf life;	4	linked marking points 2+2 **R** bacteria (as not a crop plant) **A** 'more profit' once.
		Total: 14	

3. 0610_w16_MS_42 Q: 2

	Answer	Mark	Partial Marks
(a)	<table><tr><td>A</td><td>A</td><td>A</td><td>G</td><td>G</td><td>C</td></tr><tr><td>T</td><td>T</td><td>T</td><td>C</td><td>C</td><td>G</td></tr></table> TAA; CGG;	2	
(b)	1 mRNA is a copy of the, gene / DNA / base sequence; 2 gene / DNA, remains in the nucleus; 3 takes instructions to cytoplasm; 4 mRNA, passes through / attaches to / 'read by', ribosome; 5 base sequence determines sequence of amino acids (in proteins);	3	**A** transcription **I** genetic material / genetic code / genetic sequence **A** translation
(c)(i)	**A** and **B** / *Aspergillus flavus* and *A. oryzae*;	1	
(c)(ii)	long(est) distance from the branching point; branched / split, the longest time ago; no other species on its branch / AW; only one ancestor (in the diagram); many differences in base sequence (from the others);	2	**A** branched only once / only one branch
(d)	1 study, similarities / differences in, morphology / appearance / phenotype / features / characteristics / shape; 2 any example; e.g. presence or absence of wings 3 study, similarities / differences in, anatomy / internal structure of organisms; 4 any example; e.g. skeleton / organs / bones / teeth 5 AVP; study, similarities / differences in, any other type of evidence 6 AVP; any example of the type of evidence given	2	**A** compare morphologies **I** size **A** biochemistry, e.g. amino acid sequences in proteins, behaviour, e.g. courtship displays, ecology, e.g. niches / habitats, geographical distribution, e.g. New World monkeys
		Total: 10	

4. 0610_m18_MS_42 Q: 1

	Answer	Mark	Partial Marks
(a)(i)	*each row in this order:* **F A E** **C B D** ;;;;;	5	6 correct = 5 marks 4/5 correct = 4 marks 3 correct = 3 marks 2 correct = 2 marks 1 correct = 1 mark
(a)(ii)	prokaryote ;	1	
(b)	presence of genetic material / DNA / RNA ; presence of protein ;	1	
(c)(i)	(actual length of bacterium) = size / length, of the image ÷ magnification ;	1	
(c)(ii)	2.6 (□m) ;	1	
(d)(i)	**1** produces a toxin ; **2** bacteria / toxin, attach to the wall of the, small / large, intestine ; **3** correct ref to chloride ions ; **4** secretion / loss, chloride ions, into the, small intestine ; **5** causing a water potential gradient / water potential of the intestinal lumen is lowered ; **6** causing osmotic movement of water into the gut / water flows from, the cells / blood, into the, lumen / gut ; **7** loss of salts from the blood ; **8** causing, diarrhoea / dehydration ;	4	
(d)(ii)	oral rehydration (therapy / salts / treatment / solution) ; in-take of water, sugar and, salt / ions ; antibiotics ;	1	