

Evidence for Evolution & Speciation

Name: _____

Date: _____ Score: ____ / 24

Key ideas

Evolution is the change in the heritable traits of populations over many generations. Evidence comes from fossils, comparative anatomy, embryology, DNA and proteins, and the distribution of species (biogeography).

Homologous structures share an origin (common ancestor); **analogous** structures share a function but not an origin; **vestigial** structures are reduced remnants.

Speciation happens when populations become **reproductively isolated**, for example by a geographic barrier, and then evolve separately until they can no longer interbreed.

A Types of evidence

2 marks

Write the letter of the matching description (½ mark each).

1. _____ Fossil record

2. _____ Comparative embryology

3. _____ Molecular evidence

4. _____ Biogeography
- a. Comparing DNA or protein sequences between species

b. Remains or traces of organisms preserved in rock

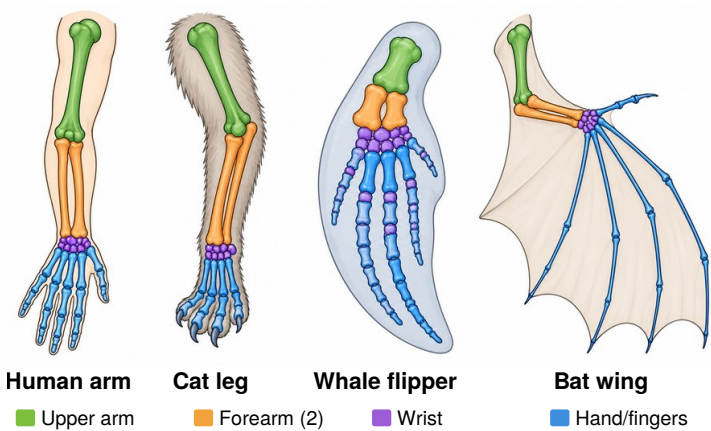
c. Similar species live near each other; island species resemble those on the nearest mainland

d. Comparing early stages of development, e.g. gill slits in all vertebrate embryos

B Homologous limbs

4 marks

Matching colours show matching bones.



5. Name the bone shown in green in all four limbs.

6. Why are these limbs described as homologous structures?
7. Give the main function of each limb.

8. What do these similar bone patterns suggest about the ancestry of these mammals?

C Homologous, analogous or vestigial?

3 marks

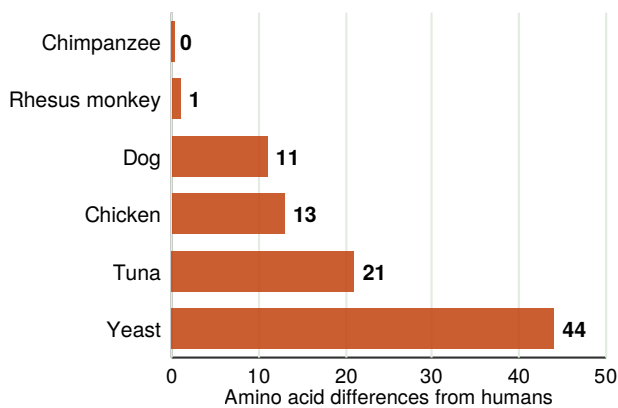
Write homologous, analogous or vestigial (½ mark each).

Example	Type	Example	Type
9. A whale's flipper and a human arm		12. A shark's fin and a dolphin's flipper	
10. A butterfly wing and a bird wing		13. The human tailbone (coccyx)	
11. Small pelvis bones inside a whale's body		14. A cat's front leg and a bat's wing	

D Molecular evidence

4 marks

Cytochrome *c* is a protein found in almost all living things. The graph shows how many of its amino acids differ from the human version.



15. Which organism is most closely related to humans? Explain using the data.

16. Rank the organisms from most to least closely related to humans.

17. Why do more distant relatives have more differences?

18. Human cytochrome *c* is 104 amino acids long. What percentage of the amino acids are the same in chickens and humans?

E Speciation

5 marks

Match each type of reproductive isolation to an example (½ mark each).

19. _____ Geographic isolation

20. _____ Temporal isolation

21. _____ Behavioural isolation

22. _____ Hybrid sterility

a. Two frog species live in the same pond, but one breeds in April and the other in June

b. A horse and a donkey produce a mule, which cannot reproduce

c. Squirrel populations on opposite sides of the Grand Canyon can no longer meet

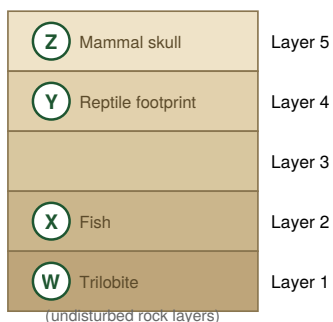
d. Two bird species ignore each other because their mating songs are different

23. What is a species, according to the biological species concept?

24. Describe how a single population can become two species through geographic isolation. (2 marks)

F The fossil record

4 marks



25. Which fossil is the oldest? Explain how you know.

26. List the fossils from oldest to youngest.

27. *Tiktaalik* is a 375-million-year-old fossil with fish gills and scales but also a neck and limb-like fins with wrist bones. Why is it called a transitional fossil?

28. Give one reason the fossil record has gaps.

G Spot the mistake

2 marks

29. A student writes: "Humans evolved from chimpanzees." Explain the error and correct it.

30. A student writes: "Vestigial structures are completely useless and will disappear soon." Explain the error and correct it.

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ANSWER KEY

Key ideas

Evolution is the change in the heritable traits of populations over many generations. Evidence comes from fossils, comparative anatomy, embryology, DNA and proteins, and the distribution of species (biogeography).

Homologous structures share an origin (common ancestor); **analogous** structures share a function but not an origin; **vestigial** structures are reduced remnants.

Speciation happens when populations become **reproductively isolated**, for example by a geographic barrier, and then evolve separately until they can no longer interbreed.

A Types of evidence

2 marks

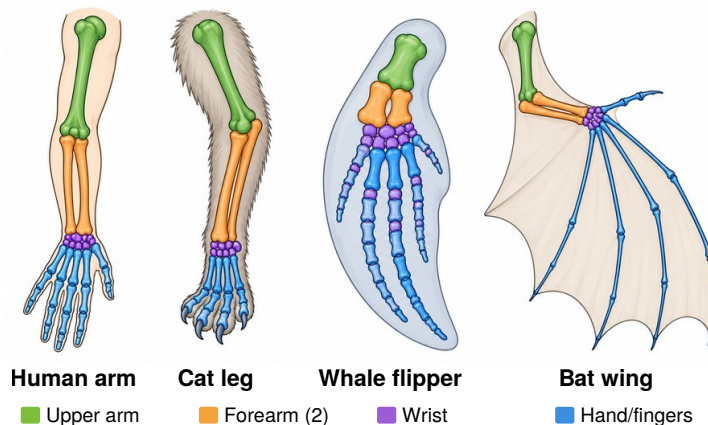
Write the letter of the matching description (½ mark each).

- | | |
|--|--|
| 1. <u> b </u> Fossil record | a. Comparing DNA or protein sequences between species |
| 2. <u> d </u> Comparative embryology | b. Remains or traces of organisms preserved in rock |
| 3. <u> a </u> Molecular evidence | c. Similar species live near each other; island species resemble those on the nearest mainland |
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B Homologous limbs

4 marks

Matching colours show matching bones.



- | | |
|---|---|
| <p>5. Name the bone shown in green in all four limbs.
The humerus (upper arm bone)</p> <p>7. Give the main function of each limb.
Grasping; walking; swimming; flying</p> | <p>6. Why are these limbs described as homologous structures?
Same bones in the same order, inherited from a common ancestor.</p> <p>8. What do these similar bone patterns suggest about the ancestry of these mammals?
A common ancestor; selection modified the limb for each lifestyle.</p> |
|---|---|

C Homologous, analogous or vestigial?

3 marks

Write homologous, analogous or vestigial (½ mark each).

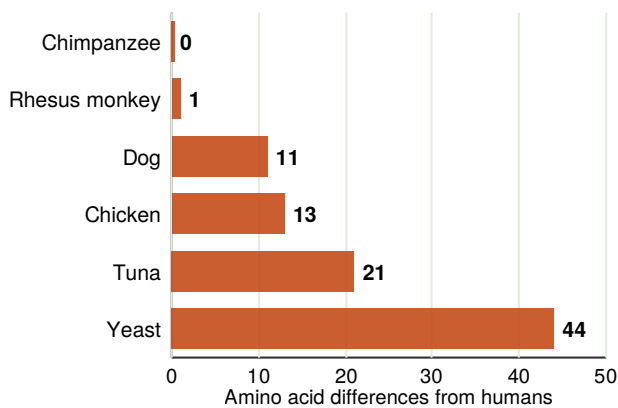
	Example	Type
9.	A whale's flipper and a human arm	Homologous
10.	A butterfly wing and a bird wing	Analogous
11.	Small pelvis bones inside a whale's body	Vestigial

	Example	Type
12.	A shark's fin and a dolphin's flipper	Analogous
13.	The human tailbone (coccyx)	Vestigial
14.	A cat's front leg and a bat's wing	Homologous

D Molecular evidence

4 marks

Cytochrome *c* is a protein found in almost all living things. The graph shows how many of its amino acids differ from the human version.



15. Which organism is most closely related to humans? Explain using the data.

Chimpanzee: 0 differences, the fewest.

16. Rank the organisms from most to least closely related to humans.

Chimpanzee, rhesus monkey, dog, chicken, tuna, yeast

17. Why do more distant relatives have more differences?

An older common ancestor gives more time for mutations to build up.

18. Human cytochrome *c* is 104 amino acids long. What percentage of the amino acids are the same in chickens and humans?

$(104 - 13) \div 104 \times 100 = 87.5\%$

E Speciation

5 marks

Match each type of reproductive isolation to an example (½ mark each).

19. c Geographic isolation

20. a Temporal isolation

21. d Behavioural isolation

22. b Hybrid sterility

a. Two frog species live in the same pond, but one breeds in April and the other in June

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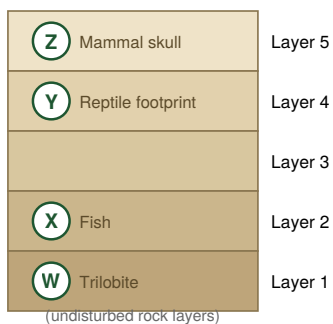
A group of organisms that can interbreed in nature and produce fertile offspring.

24. Describe how a single population can become two species through geographic isolation. (2 marks)

A barrier splits the population; mutations and natural selection change each group separately until they can no longer interbreed.

F The fossil record

4 marks



25. Which fossil is the oldest? Explain how you know.

W: the deepest layer formed first (law of superposition).

26. List the fossils from oldest to youngest.

W, X, Y, Z

27. *Tiktaalik* is a 375-million-year-old fossil with fish gills and scales but also a neck and limb-like fins with wrist bones. Why is it called a transitional fossil?

It has features of both fish and four-legged animals, a step from water to land.

28. Give one reason the fossil record has gaps.

Fossilization is rare; soft bodies seldom fossilize; erosion destroys many.

G Spot the mistake

2 marks

29. A student writes: "Humans evolved from chimpanzees." Explain the error and correct it.

They share a common ancestor; each species evolved separately from it.

30. A student writes: "Vestigial structures are completely useless and will disappear soon." Explain the error and correct it.

They are reduced remnants of ancestral structures; some keep minor functions and may persist for a long time.