Year 13 Science: Speciation and reproductive isolating mechanisms

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A zebra (2n = 44) and a horse (2n = 64) produce a zorse. How many chromosomes does the zorse have?

2. Two frog species breed in the same ponds, one in early spring and the other in summer. Name the isolating mechanism.

3. Two plant species with 2n = 14 and 2n = 18 hybridise. Give the hybrid's chromosome number, and its number after doubling.

4. Rowi and tokoeka were separated by glaciers into different forest refuges. Which mode of speciation is this?

5. A mule is healthy but cannot breed. Is this a prezygotic or postzygotic mechanism, and which one?

Exam-style question: cichlids in a crater lake

Lake Apoyo in Nicaragua is a small, isolated crater lake that formed less than about 23 000 years ago. It was colonised by the Midas cichlid, a deep-bodied fish that feeds near the lake bottom. A second species, the arrow cichlid, now also lives there: it is slender, feeds in open water, and mates only with other arrow cichlids. DNA shows the arrow cichlid evolved from Midas cichlids inside the lake.

6. Define speciation and a reproductive isolating mechanism.

7. Name two isolating mechanisms that could keep the two cichlids apart, and explain how each reduces gene flow.

8. Explain why this is sympatric rather than allopatric speciation.

9. Discuss the role of natural selection in the split, and why it happened quickly.

Fix the mistake

10. Correct this statement: "The geographic barrier is the reason they are now different species."

11. Correct this statement: "A mule is an example of hybrid inviability."

12. Correct this statement: "Geographic isolation is a postzygotic mechanism because the animals never meet."

13. Correct this statement: "A polyploid plant evolves slowly over many generations."

Answer key (for parents and tutors)

1. A zebra (2n = 44) and a horse (2n = 64) produce a zorse. How many chromosomes does the zorse have?
   22 + 32 = 54 chromosomes.
2. Two frog species breed in the same ponds, one in early spring and the other in summer. Name the isolating mechanism.
   Temporal isolation, a prezygotic mechanism: they breed at different times, so never mate.
3. Two plant species with 2n = 14 and 2n = 18 hybridise. Give the hybrid's chromosome number, and its number after doubling.
   7 + 9 = 16 chromosomes, sterile because none pair; doubled, 2 × 16 = 32, and fertile.
4. Rowi and tokoeka were separated by glaciers into different forest refuges. Which mode of speciation is this?
   Allopatric speciation: a geographic barrier stopped gene flow between the populations.
5. A mule is healthy but cannot breed. Is this a prezygotic or postzygotic mechanism, and which one?
   Postzygotic: hybrid sterility.
6. Define speciation and a reproductive isolating mechanism.
   Speciation is the process by which one species splits into two or more; a reproductive isolating mechanism is anything that prevents members of two groups producing fertile offspring together (Achieved).
7. Name two isolating mechanisms that could keep the two cichlids apart, and explain how each reduces gene flow.
   Habitat isolation: arrow cichlids live and feed in open water and Midas cichlids near the bottom, so they rarely meet to breed. Behavioural isolation: each fish chooses mates of its own body shape, so even when they meet they do not mate. Both are prezygotic and cut the flow of alleles between the groups (Merit for each linked to the fish).
8. Explain why this is sympatric rather than allopatric speciation.
   The lake is small and isolated with no barrier inside it, both species live in the same water, and DNA shows the arrow cichlid came from Midas cichlids within the lake, so the split happened without geographic separation (Merit).
9. Discuss the role of natural selection in the split, and why it happened quickly.
   The open-water niche was empty, so disruptive selection favoured both slender fish that fed well in open water and deep-bodied fish that fed well on the bottom, while intermediate fish did poorly at both. Because fish also chose mates like themselves, the two forms stopped exchanging alleles, so selection could push each gene pool further apart instead of being undone by interbreeding. Strong selection on an empty niche, plus assortative mating, explains how speciation happened in under about 23 000 years, a short time in evolutionary terms (Excellence).
10. Correct this statement: "The geographic barrier is the reason they are now different species."
    The barrier only stops gene flow; different mutations, selection and drift then change the gene pools until isolating mechanisms form.
11. Correct this statement: "A mule is an example of hybrid inviability."
    A mule lives a normal life, so it shows hybrid sterility; inviability means the hybrid dies or is too weak to reach adulthood.
12. Correct this statement: "Geographic isolation is a postzygotic mechanism because the animals never meet."
    Anything that stops mating or fertilisation is prezygotic; postzygotic means a zygote forms and the hybrid then fails.
13. Correct this statement: "A polyploid plant evolves slowly over many generations."
    Polyploidy isolates a plant from its parents in one generation, which is why it is called instant or sudden speciation.