Year 12 Science: Surviving extreme environments: hot springs, ice and alpine cold

Name: _____ Date: _____

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

Practice

1. Venenivibrio grows from 45 to 75 °C. Could it grow in water at 37 °C?

2. Antarctic seawater is –1.9 °C, and fish body fluids freeze at about –1 °C. By how many degrees is the sea colder than that freezing point?

3. Why would a human enzyme stop working in 75 °C water?

4. Which organism avoids freezing and which tolerates it: the toothfish or the alpine wētā?

5. Why does growing best at 4 to 8% oxygen help Venenivibrio in a hot spring?

6. Write one condition, problem, adaptation chain for the toothfish, as an Excellence answer would.

Fix the mistake

7. Correct this statement: "The environment is extreme because it is really hot."

8. Correct this statement: "The toothfish's antifreeze works by adding salt to its blood."

9. Correct this statement: "The bacterium adapted to the heat because it wanted to survive."

10. Correct this statement: "I listed five adaptations with a sentence on each."

Answer key (for parents and tutors)

1. Venenivibrio grows from 45 to 75 °C. Could it grow in water at 37 °C?
   No: 37 °C is below its lowest growth temperature of 45 °C.
2. Antarctic seawater is −1.9 °C, and fish body fluids freeze at about −1 °C. By how many degrees is the sea colder than that freezing point?
   −1 − (−1.9) = 0.9 °C colder.
3. Why would a human enzyme stop working in 75 °C water?
   Heat breaks the weak bonds holding the enzyme's shape, so its active site changes shape (it denatures) and the substrate no longer fits.
4. Which organism avoids freezing and which tolerates it: the toothfish or the alpine wētā?
   The toothfish avoids freezing with antifreeze glycoproteins; the alpine wētā tolerates freezing.
5. Why does growing best at 4 to 8% oxygen help Venenivibrio in a hot spring?
   Hot water holds little dissolved oxygen, so needing only a little oxygen matches what the spring supplies.
6. Write one condition, problem, adaptation chain for the toothfish, as an Excellence answer would.
   For example: sea at −1.9 °C is colder than the −1 °C at which fish fluids freeze, so ice crystals entering in seawater and food would grow and tear cells; antifreeze glycoproteins in the blood and gut bind the crystals and stop them growing, so the fish stays unfrozen.
7. Correct this statement: "The environment is extreme because it is really hot."
   Give the numbers and the reason: Champagne Pool is about 75 °C, hot enough to denature the enzymes of almost every plant and animal.
8. Correct this statement: "The toothfish's antifreeze works by adding salt to its blood."
   Its antifreeze glycoproteins bind to tiny ice crystals and stop them growing; they do not work by making the blood saltier.
9. Correct this statement: "The bacterium adapted to the heat because it wanted to survive."
   Organisms do not choose adaptations; those with heat-stable proteins survived and reproduced, so the feature became common.
10. Correct this statement: "I listed five adaptations with a sentence on each."
    Merit and Excellence need links: for each key adaptation, say which condition it answers and how it solves the problem that condition causes.