# Year 13 Science: Biology investigation: temperature and Daphnia heart rate

Name: _____ Date: _____

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

## Practice

1. A Daphnia's heart beats 58 times in 15 s. What is its heart rate in beats per minute?

2. Five Daphnia at 15 °C gave 210, 224, 198, 215 and 203 beats per minute. Find the mean.

3. Using the class's means, calculate Q10 between 15 °C and 25 °C.

4. Why did the class leave each Daphnia at the test temperature for 5 minutes before counting?

5. Why is counting five different Daphnia better than counting one Daphnia five times?

6. The 30 °C group had the largest standard deviation. Give a biological reason.

7. Name one source of error that would make every reading too high, and how to reduce it.

8. Another class found Q10 = 2.1 between 10 and 20 °C. Give one reason the two classes could differ.

## Fix the mistake

9. Correct this statement: "I counted the same Daphnia five times, so I have five repeats."

10. Correct this statement: "The error bars overlap, so temperature had no effect."

11. Correct this statement: "Higher temperature denatures the enzymes, so heart rate falls at 25 °C."

12. Correct this statement: "My results prove the hypothesis."

## Answer key (for parents and tutors)

1. A Daphnia's heart beats 58 times in 15 s. What is its heart rate in beats per minute?
   **58 × 4 = 232 beats per minute.**
2. Five Daphnia at 15 °C gave 210, 224, 198, 215 and 203 beats per minute. Find the mean.
   **(210 + 224 + 198 + 215 + 203) ÷ 5 = 1050 ÷ 5 = 210 beats per minute.**
3. Using the class's means, calculate Q10 between 15 °C and 25 °C.
   **Q10 = 300 ÷ 200 = 1.5.**
4. Why did the class leave each Daphnia at the test temperature for 5 minutes before counting?
   **So the Daphnia's body, an ectotherm, reached the water temperature before the heart rate was measured; otherwise it would still reflect the culture temperature.**
5. Why is counting five different Daphnia better than counting one Daphnia five times?
   **Different animals vary, so five individuals show whether the effect holds for Daphnia in general; one animal counted five times only tests the counting.**
6. The 30 °C group had the largest standard deviation. Give a biological reason.
   **At 30 °C Daphnia are near their upper limit, so heat stress affects individuals differently; some keep up a fast rate while others slow.**
7. Name one source of error that would make every reading too high, and how to reduce it.
   **The microscope lamp warming the slide during counting raises the real temperature above the set value, so the heart beats faster; switch the lamp off between counts or use a cool LED light.**
8. Another class found Q10 = 2.1 between 10 and 20 °C. Give one reason the two classes could differ.
   **Their Daphnia may have been a different age, size or culture, or kept at a different temperature before the test, which changes their metabolic rate.**
9. Correct this statement: "I counted the same Daphnia five times, so I have five repeats."
   **Those are repeat readings of one animal; independent repeats need five different Daphnia, so the result applies to Daphnia in general.**
10. Correct this statement: "The error bars overlap, so temperature had no effect."
    **Overlap means the difference between those two groups is uncertain, not that there is no effect; look at the whole trend and test it.**
11. Correct this statement: "Higher temperature denatures the enzymes, so heart rate falls at 25 °C."
    **The data show heart rate still rising at 25 °C; describe what the data show before reaching for an explanation.**
12. Correct this statement: "My results prove the hypothesis."
    **Results support or do not support a hypothesis; a small sample from one culture cannot prove it.**