Year 12 Science: Biology investigation: catalase and temperature, start to finish

Name: _____ Date: _____

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

Practice

1. A student investigates how sugar concentration (0, 2, 4, 6 and 8%) affects how fast yeast respires, by counting carbon dioxide bubbles per minute. Name the independent and dependent variables.

2. Three catalase discs rise in 20 s, 22 s and 21 s. Find the mean time and the rate.

3. Write a hypothesis for the yeast investigation in question 1, with a biological reason.

4. At one temperature the discs take 20 s, 22 s and 45 s, and the student noted the third disc stuck to the tube. What should the mean be, and why?

5. A group's three repeats at every temperature were within 2 s of each other. Is that evidence of reliability or of validity?

6. In a field study comparing leaf size in sun and shade, why should leaves be picked at random?

Fix the mistake

7. Correct this statement: "My hypothesis is that temperature will affect catalase."

8. Correct this statement: "I graphed the time taken, so the graph shows the rate."

9. Correct this statement: "The high temperatures killed the enzyme."

10. Correct this statement: "My repeats were close, so my method was valid."

Answer key (for parents and tutors)

1. A student investigates how sugar concentration (0, 2, 4, 6 and 8%) affects how fast yeast respires, by counting carbon dioxide bubbles per minute. Name the independent and dependent variables.
   Independent: sugar concentration; dependent: bubbles of carbon dioxide per minute.
2. Three catalase discs rise in 20 s, 22 s and 21 s. Find the mean time and the rate.
   Mean = (20 + 22 + 21) ÷ 3 = 21 s; rate = 1 ÷ 21 = 0.048 s^{-1}.
3. Write a hypothesis for the yeast investigation in question 1, with a biological reason.
   For example: as sugar concentration increases from 0% to 8%, the number of bubbles per minute will increase, because glucose is the substrate for respiration, so more is available to the yeast's enzymes each second.
4. At one temperature the discs take 20 s, 22 s and 45 s, and the student noted the third disc stuck to the tube. What should the mean be, and why?
   (20 + 22) ÷ 2 = 21 s, leaving out the 45 s disc and recording why: it stuck, so its time did not measure the reaction.
5. A group's three repeats at every temperature were within 2 s of each other. Is that evidence of reliability or of validity?
   Reliability: close repeats show the data can be repeated; they do not show the method measured the right thing.
6. In a field study comparing leaf size in sun and shade, why should leaves be picked at random?
   To avoid sampling bias: if you choose the leaves yourself you may pick big or unusual ones, so the sample would not represent the plants.
7. Correct this statement: "My hypothesis is that temperature will affect catalase."
   A hypothesis predicts the direction of the change and gives a biological reason for it, such as collisions and denaturing.
8. Correct this statement: "I graphed the time taken, so the graph shows the rate."
   Time goes down as the reaction speeds up; convert to a rate (1 ÷ time) so the graph rises when the enzyme works faster.
9. Correct this statement: "The high temperatures killed the enzyme."
   Enzymes are not alive; heat denatures them by changing the shape of the active site so the substrate no longer fits.
10. Correct this statement: "My repeats were close, so my method was valid."
    Close repeats show reliability; validity comes from measuring the right thing and controlling every other variable.