Teacher guidance

Key focus

Read a bar graph or histogram's values directly against the vertical scale, and add or subtract values across categories or intervals for a total or a difference. The modal category (bar graph) or modal class (histogram) is the tallest bar. A weighted average combines groups of different sizes by multiplying each group's average by its size, summing, then dividing by the combined size – never by averaging the group averages directly. For higher-ability students: estimate a mean from grouped data using each class's midpoint, estimate a median by linear interpolation within the class containing the middle value(s), read a cumulative frequency table or graph, and explain why comparing histogram bar heights directly only works when every class has the same width.

Suggested teaching sequence

1. Read individual values directly off a bar graph's or histogram's bars, and identify the difference between the two (a bar graph has gaps between categories; a histogram's bars touch because the horizontal axis is a continuous measurement scale grouped into equal intervals).
2. Add values across two or more categories or intervals to find a total or a difference.
3. Introduce the modal category / modal class: the tallest bar. Contrast it with simply reading the largest printed value.
4. Introduce the weighted average: when combining groups of different sizes, multiply each group's average by its size, sum, then divide by the combined size. Contrast with the common error of averaging the group averages directly.
5. For higher-ability students: estimate a mean from grouped data using each class's midpoint, weighted by frequency. Estimate a median by finding which class the middle value falls in, then interpolating across that class using the cumulative frequency.
6. Introduce the cumulative frequency table and graph (an "ogive"): cumulative frequency plotted against the upper class boundary. Read totals, differences, and a median estimate directly off the graph.
7. Extend to unequal class widths: explain why a taller bar does not necessarily mean a higher frequency once class widths differ, and introduce frequency density (frequency $\div$ class width) as the fair comparison.

Core examples to model

- Reading directly: a bar graph shows Football 8, Netball 5, Rugby $6 \Rightarrow 6$ students chose Rugby.
- Totals and differences: a histogram shows 5, 9, 7 across three equal-width intervals $\Rightarrow 9-5=4$ more in the middle interval than the first.
- Weighted average: Class A (18 students) averaged 64%, Class B (12 students) averaged $74\% \Rightarrow \dfrac{18(64)+12(74)}{30}=68\%$ combined – *not* $\dfrac{64+74}{2}=69\%$.
- Mean from grouped data: classes 0–10 (freq 4), 10–20 (freq 10), 20–30 (freq 6), midpoints

$5, 15, 25 \Rightarrow$ mean $= \dfrac{4(5) + 10(15) + 6(25)}{20} = 16.$

- Median from grouped data: $n = 30$, half $= 15$th value. Cumulative frequencies $6, 16, 25, 30$ place the median in the 20–40 class $\Rightarrow 20 + \dfrac{15 - 6}{10}(20) = 38$.
- Frequency density: classes 0–10 (freq 8) and 10–40 (freq 18) $\Rightarrow$ densities 0.8 and 0.6 – the narrower class is actually denser, even though its raw frequency is lower.

Watch for

- Averaging two group averages directly instead of weighting each by its group size.
- Reading a histogram's x-axis boundary values as if they were bar labels, rather than reading the bar's height against the frequency scale.
- Forgetting that a class's midpoint (not its lower or upper boundary) represents that class when estimating a mean.
- Placing the median in the wrong class by using the total frequency n instead of $n \div 2$ when reading the cumulative frequency.
- Comparing histogram bar heights directly when class widths are not equal, instead of using frequency density.
- Confusing a bar graph (gaps, categorical data) with a histogram (bars touch, continuous data grouped into intervals) when choosing the display or explaining why one interval can be wider than another.

Checks for understanding

- Can students read individual values from a bar graph or histogram, and add or subtract across categories or intervals?
- Can they identify the modal category or modal class, and distinguish a bar graph from a histogram?
- Can they calculate a weighted average across groups of different sizes?
- Can they estimate a mean from grouped data using midpoints, and estimate a median by linear interpolation or by reading a cumulative frequency graph?
- Can they explain why comparing histogram bar heights directly requires equal class widths, and use frequency density when it is not?