

Orders of Magnitude

Ages 11-16 | KS3-KS4 | 25-35 minutes | Pairs or small groups

Estimate first. Reveal second. Write an exponent or prediction before checking the interactive journey or entity pages.

Name / pair: _____

Class: _____

Date: _____

CORE IDEA

One order of magnitude is a factor of ten.

The exponent difference tells you the number of 10x steps. A difference of 3 means $10^3 = 1,000$ times.

ACTIVITIES 1-3**1**

Which power of ten?

Choose the nearest power of ten in metres for: human, human hair, bacterium, football pitch, Mount Everest, Earth and Sun. Example: 1.75 m is nearest to 10^0 m.

A nearest power is an estimate of scale, not an exact measurement.

2

Put them in order

Place these from smallest to largest: virus, bacterium, human hair, human, blue whale, Mount Everest, Earth, Sun. Circle one pair whose spacing surprised you.

3

Count the orders of magnitude

Use nearest exponents for DNA and hair; Earth and Sun; Burj Khalifa and Everest. For each pair: subtract the exponents, then write the approximate multiplier. Example: $5 - 2 = 3$ orders, so $10^3 = 1,000$ times.

Exponent difference and multiplicative difference are related, but they are not the same statement.

Orders of Magnitude

Continue with standard form, estimation and reasoning. Keep units beside every value.

ACTIVITIES 4-6

4 Scientific notation / standard form

Rewrite in metres using a number from 1 up to (but not including) 10, multiplied by a power of ten: hair 0.00007 m; bacterium 0.000002 m; football pitch 105 m; Everest 8,848.86 m; Earth 12,742,016.8 m; Sun 1,391,400,000 m.

Example: 450,000 m = 4.5×10^5 m.

5 Estimate before revealing

Predict the nearest order of magnitude for DNA width, a virus, blue whale length, Saturn diameter, Mount Everest height and the mean Earth-Sun distance. Add one reason for each estimate, then check the web activity.

6 Big question

Why can a difference of only 6 in the exponent describe objects that feel unimaginably different in size? Which was harder to estimate: microscopic or astronomical scales? Explain your reasoning.

POWERS-OF-TEN REFERENCE

10^{-9} nanometres | 10^{-6} micrometres | 10^{-3} millimetres | 10^0 metres | 10^3 kilometres

Every +1 exponent step is x10. Every -1 step is /10. Negative exponents still describe positive lengths.

<https://justhowbig.com/education/orders-of-magnitude/>