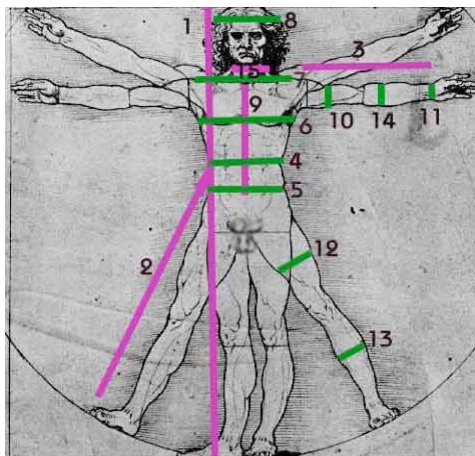


Synchrotron Investigations

7.5 Length

In this activity you will be estimating length. By using various mathematical and scientific tools you will then check the accuracy of your estimates.

In order to make the accurate measurements and to be able to check your estimates you can use any of the following equipment. You can also use any other valid method you think will work.



Vitruvian Man by Leonardo da Vinci, created around 1492

Materials

You may need a:

- ruler,
- tape measure,
- tape measure and similar triangles,
- clinometer, tape measure and trigonometry, and
- laser pointer and interference effects (used for very small widths/lengths).

Or you may decide to:

- measure the total width/length of multiple items and then divide by the number of items (used for small width/lengths).

Instructions

1. For each of the following lengths and distances, make an estimate and record in the table below. True measurements will be made later.
2. Remember to include units with each of your estimates.

Object	My estimate	True value	Percentage error	Method used
length of my teacher's car				
thickness of one sheet of A4 paper				
distance between threads in the scarf supplied				
my teacher's height				
height of the tallest school building				
flight distance: Melbourne to Perth				

3. Listed below, in no particular order, are some methods which you might use to make accurate measurements of these lengths. You may also be able to think of others.
 - For very long distances, use Google Earth or similar web based methods such as Sensis.
 - For medium distances, ask a family member to drive there and record the distance.
 - For short distances use a tape measure or, if that is not feasible, pace out the distance after calculating your average pace length.
 - If you have access to a clinometer you can easily use a tape measure, a clinometer and basic trigonometry to measure heights.
 - If it's a sunny day use a tape measure to measure the length of the object's shadow and your shadow. Similar triangles can then find the height.
 - If an object is very thin and it is not easy to measure its thickness then stack multiple objects together, measure the total thickness and divide by the number of objects. The result will only be an average but is likely to be reasonably accurate.
 - For very thin threads your teacher will have demonstrated how to use the interference patterns created by a laser pointer to find the thread's width or the spacing between threads.
4. Use one of these or another method to find the true value for each measurement.
5. Record your measurements in your table.
6. For each object, record the method you used.
7. Calculate the percentage error in each case.

8. Repeat this process for the quantities listed in the following table. You should find that your estimates are better!

Object	My estimate	True value	Percentage error	Method used
width of a student desk				
height of the school's flagpole				
length of the school bus				
width of a human hair				
flight distance: Sydney to Melbourne				

9. What was the result of your second round of estimations? Did you show improvement?

10. Of all the methods you used to obtain true values, which was the simplest? Why?

11. Of all the methods you used to obtain true values, which do you think was the most accurate? Why?

