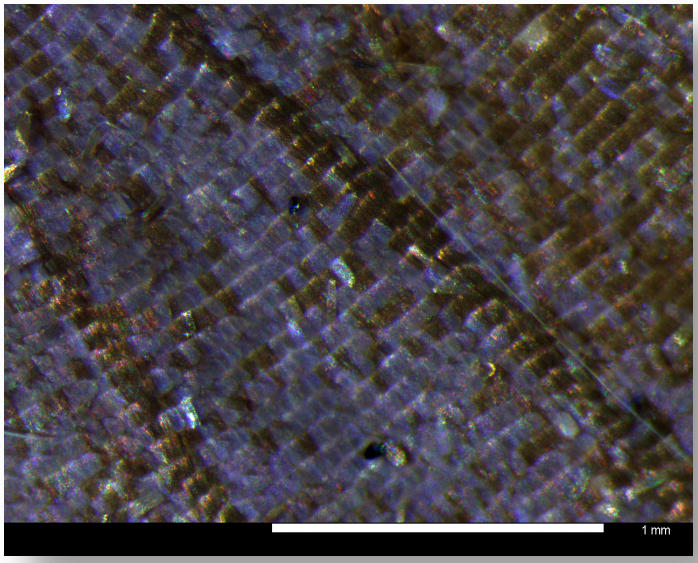
Measuring microscopic things

Sometimes it is useful to know the real size or length of an object. In everyday life we can get out a ruler and measure it directly. The size can then be recorded either as meters, centimeters or millimeters, or as feet and inches.

Micrometers

Once the object gets to be very small though, it is necessary to move to a different kind of measurement. Instead of millimeters we measure in thousands of a millimeter.

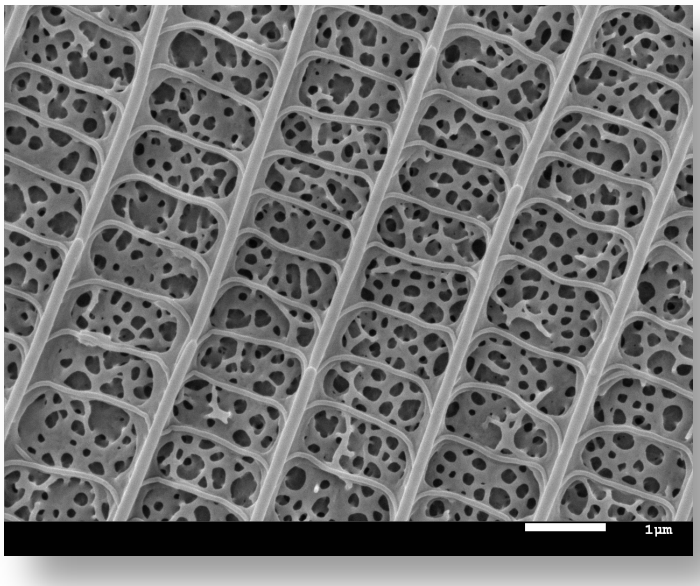
Such a tiny division is called a micrometer. It is given a special symbol: µ, meaning micro. So when 1 µm is seen, we read this as one micrometer.



Nanometers

There are smaller measures too. Just like there are 1000 µm in 1 mm, there are 1000 nanometers (nm) in 1 µm.

When we want to measure the size of an object shown in a micrograph (photograph taken using a microscope), we have to rely on the bar shown at the bottom of the image. **Find the white bars in the micrographs with a number at the end.**



The colored image is of a butterfly wing seen through a light microscope. Notice that the bar reads 1mm. The grey image is of one wing scale seen using a scanning electron microscope at high magnification. The bar on this image reads 1 µm.

Calculating size

To calculate the real size of the wing scales in the top image we either measure it on screen or it might be easier to print out this sheet.

First measure the length of the white bar (on the printed page). This comes to about 43.5 mm depending on your printer.

Next, **note the real length of the white bar**, which is 1 mm (the number next to the white bar).

Then, **measure the width of a loose wing scale**. This comes to about 1.9 mm (on the printed page) again, depending on your printer.

Now comes the part where we work out how wide that wing scale really is in the real world.

Multiply the width of the wing scale in millimeters (1.9 mm or whatever you measure) by the size the bar tells us is its real length (1 mm). Divide the answer by the length of the bar in millimeters (43.5 mm or whatever you measure) to get the real width of the wing scale:

(1.9 x 1)/43.5 = 0.044 mm.

If we multiply this number by 1000, it gives us the size in micrometers:

44 µm

Try this method with the SEM micrograph of a butterfly wing scale in the bottom image. **Calculate how far apart the long ridges are on a single butterfly scale.**

Since the bar is about 11 mm long on the printed image, and this equals a real world length of 1 µm, and the ridges are about 17.5 mm apart on the printed image, the answer should be that the ridges are really 1.59 µm apart.

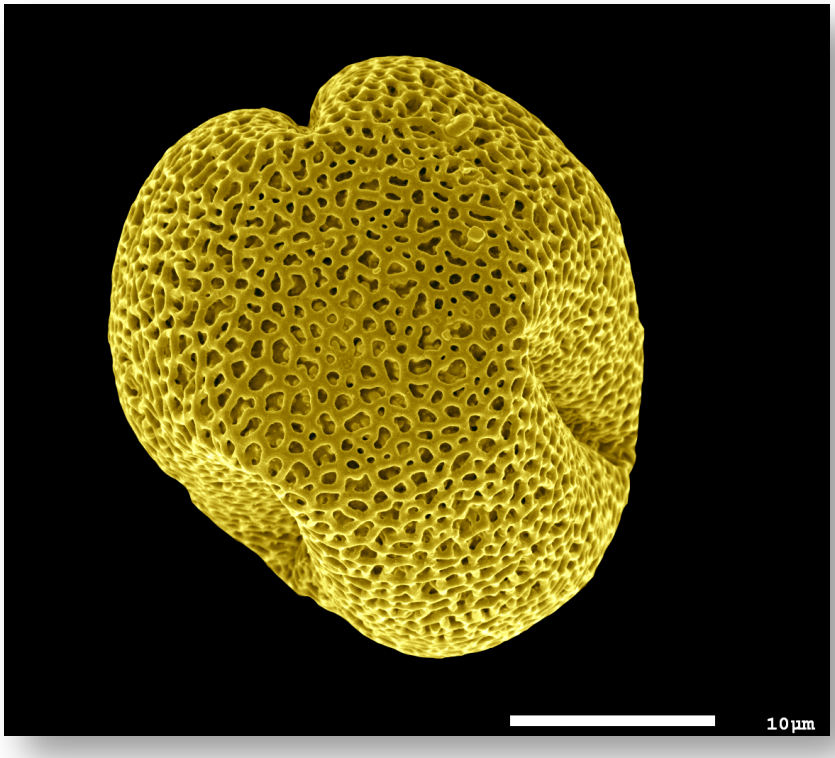
Note that the bar is usually referred to as a scale bar, meaning that it scales up or down depending on whether a picture is enlarged or reduced in size, always remaining accurate. In this context the word 'scale' has nothing to do with wing or fish scales.

You have a go

Here is another example that is not worked through.

Calculate the real size of this pollen grain from yellow clover, in the SEM micrograph below. You should get an answer in micrometers.

How many of these pollen grains would fit into a single millimeter?



Internet resources

This is a video that shows how to calculate real size from an image using the bar:

https://www.youtube.com/watch?v=5h5IFY-PYRw