Can we see carbon nanotubes?

We can take
pictures of carbon nanotubes
with a special microscope that
uses electrons to see things.

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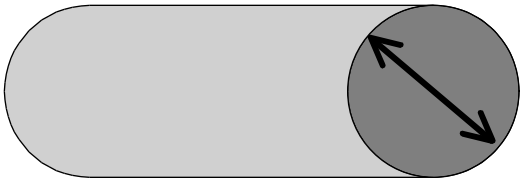
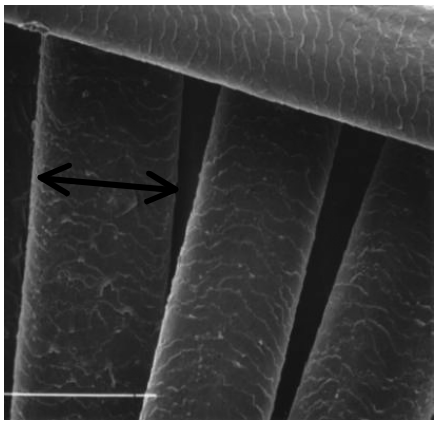
Growth of Carbon Nanotubes with Controlled Morphologies

Let's compare...

How small is a nanometer compared to the diameter of a hair ??

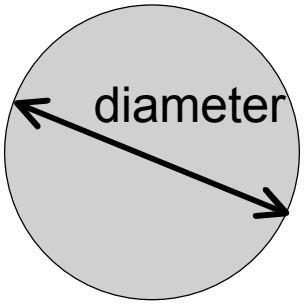
Diameter of a human hair
= 20-60 μm $40X10^{-6}$ m





Let's measure some things

Use a metric ruler to measure the diameter of your wrist.



How does this compare to your neighbor's wrist measurement.

Can you find the average diameter to the wrists for everyone in the room?

Let's compare...

Let's compare the diameter of our wrist to the diameter of hair.

Item	Diameter	Factor
Wrist	40 mm = $40X10^{-3}$ m	1000
Hair	40 μm = $40X10^{-6}$ m	

Let’s compare…

What if we could magnify a piece of hair? And what if we could wrap a string around that hair so we could trace out its circumference?

Let’s magnify the hair 100,000 times! Then the 40 µm diameter would be a 4 meter diameter.

Let's compare...

If we stand in a circle to represent our magnified piece of hair, how big would a carbon nanotube be??

Item	Diameter	Factor
Hair	40 μm = $4X10^{-5}$ m	10,000
Nanotube	4 nm = $4X10^{-9}$ m	

Let's compare...

Is it the size of a wrapping paper tube, dowel rod, pencil, birthday candle, toothpick, pencil lead??

Let's compare...

What we need to figure out is what diameter is 1/10000 of our circle.

The circle has a diameter of 4 m,

so the "nanotube" would have a diameter of 0.4 mm.