

Microscopic View

Now we are about to explore our microscopic world. We will get to know our tiny universe through the lens of biology, chemistry and physics. At the microscopic dimensions, we all are made up of the same elements. There is no difference between us and the universe.

Let us start the journey, going inward:

Back to point A

10^0

Now we have returned to the starting point of this trip, and this distance is within reach of our arm...



Again we start with a familiar dimension where we can see a leaf at 1 m distance.

Learning & Thinking

10^{-1}
10 cm

We are closing in to a distance of 10 cm, and now we can describe what a leaf looks like.



At this dimension, the leaf is magnified. It still looks like a leaf. However its surface structures are easily seen. Instead of meters, we change the units of measurement to centimeters.

Zoom in at a closer look

10^{-2}
1 cm

From this distance we can observe the fine structures of a leaf.



We are beginning to lose the overall appearance of the leaf while the structures of the leaf become more apparent.

Cellular structure

10^{-3}
1 mm

The cellular structure of the leaf tissue begins to appear.



At this dimension, the cellular structure is appearing, just like the view in a microscope. The unit of measurement changes from meter to millimeter.

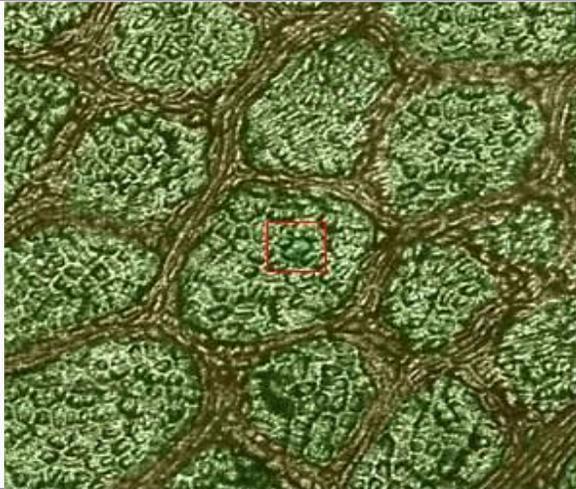
We are entering the dimension of the **cellular biology**. We are exploring cell anatomy, structures that make up the entities of our world.

Micro view of cells

10^{-4}

100 micro

Cells can be seen clearly. You can observe how cells are architected together.



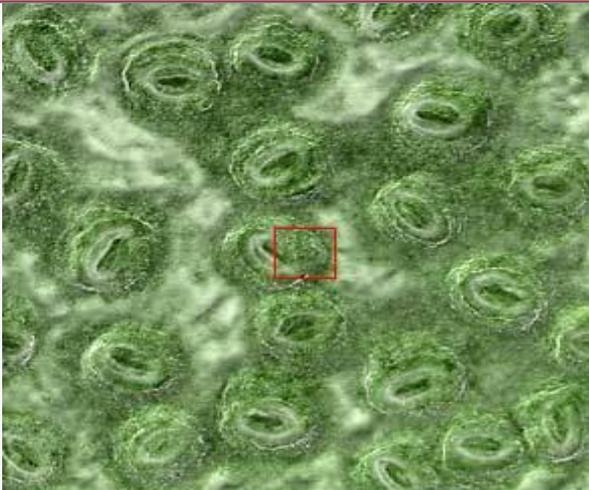
This is a higher powered view under a microscope at the cellular level. The leaf is no longer visible but its component cells are seen. A leaf is no longer one entity but a combination of different entities of cells. A smaller unit called micron (1/1000 of a mm) is introduced.

Cells

10^{-5}

10 micron

Our journey is entering inside the cell...



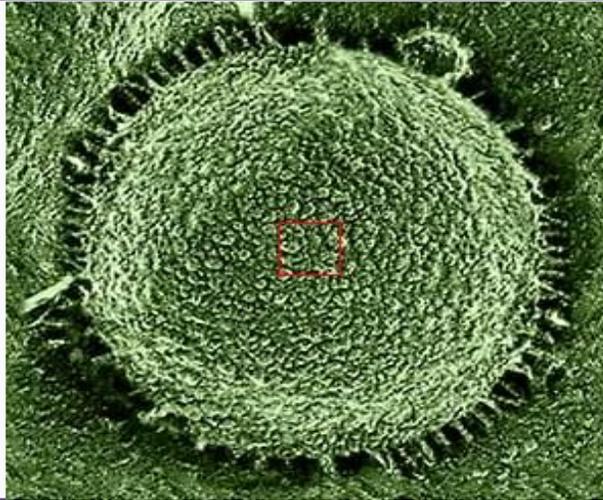
At this dimension, inner structures of cells appear. The small mouth-like opening called stoma are pores for the leaf to breath (gaseous exchange).

Cell Nucleus

10^{-6}

1 micron

Cell nucleus
can be seen
now



We are at the magnification of electron microscopy. Next, we are replacing our units from microns to a smaller units call Angstrom (1 millionth of a mm).

Chromosome

10^{-7}

1,000
angstrom (Å)
(parts per hundred
million cm)

We alter the
measure unit again
to observe more
tiny objects

Now you can see
the chromosome of
cells.



In plant and animal cells, DNA is tightly packaged into thread-like structures called chromosomes.

The DNA

10^{-8}
100 Å

Under this microscopic view, we are able to see the DNA double helix chains

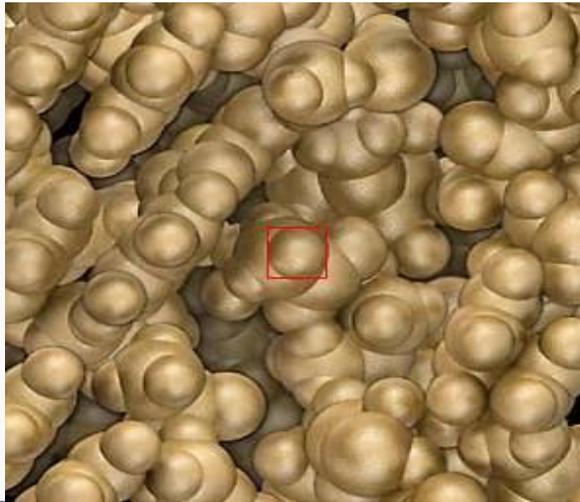


DNA is known as double helix because there are two intertwined strands within each molecule of DNA. We are now at the level of molecular biology.

DNA chains

10^{-9}
10 Å

We see the DNA chain is made up of nucleotide molecules joint together...let us go inside a molecule



A nucleotide is one of the structural components, or building blocks, of DNA and RNA.

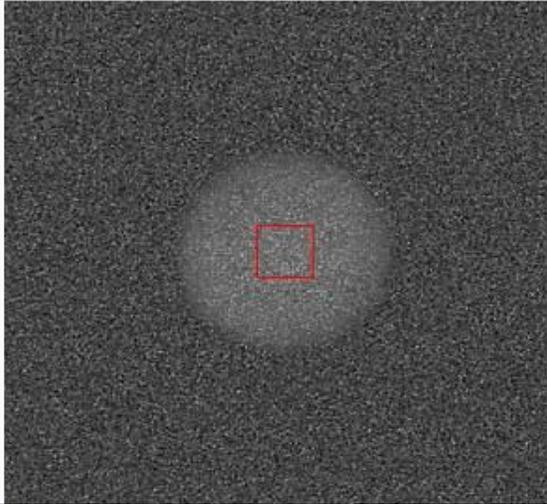
Similarity of macro/micro view

10^{-10}

1 Å

Looking at the electrons clouds of a carbon atoms (that make up all living things on earth).

You will see that the microscopic view looks very similar to the macroscopic universe.



We are entering the realm of physical chemistry and atomic science.

Atomic nucleus

10^{-11}

10 picometer

In this atomic world, we see electrons circulating around the atomic nucleus, made up of protons & neutrons



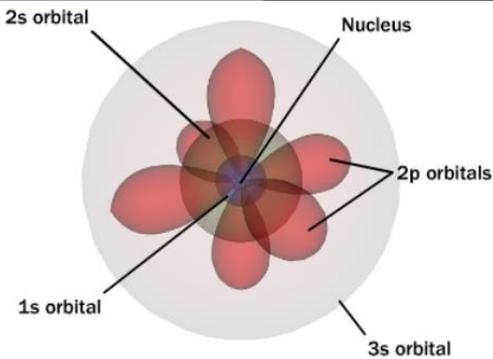
A smaller unit picometer appears, which is 1×10^{-12} m, or one trillionth (1100000000000) of a meter.

Infinite space

10^{-12}

1 picometer

Seems to be an infinite amount of space between the electron orbit and the nucleus...



Microscopic view

10^{-13}

100 femtometer

1 picometer = 1,000 femtometer

Under this unbelievable microscopic view, we can see the atomic nucleus...



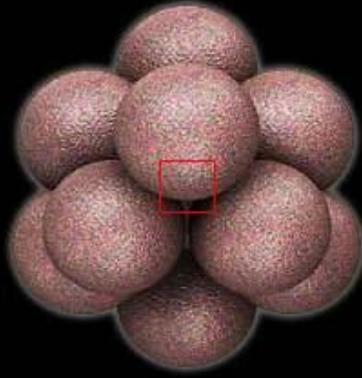
From picometer comes femtometer (10^{-15} meters) to accommodate smaller particles and dimensions.

Atomic nucleus

10^{-14}

10 femtometer

Finally, we can
see the carbon
atomic nucleus
...let us go inside
the nucleus



Most atoms have three different subatomic particles, protons, neutrons are packaged together into the center of the atom and the very smaller electrons whizz around the outside.

https://www.google.ca/webhp?source=search_app#q=inside+atomic+nucleus&

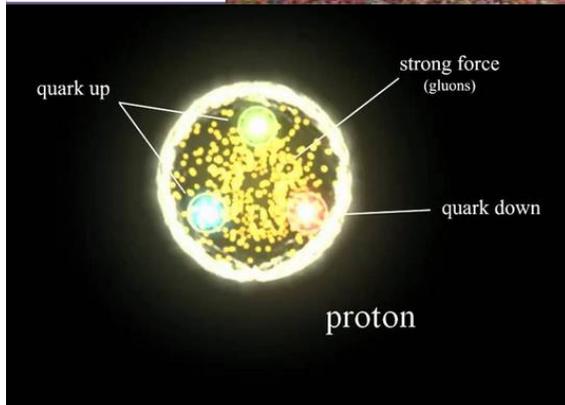
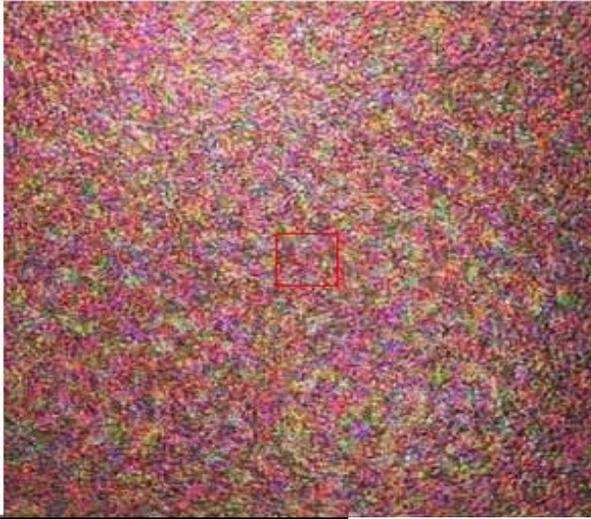
Do these things really exist? Of course they do. They are part of us but not visible to our naked eye and out of sight.

Nucleus to proton

10^{-15}

1 femtometer

Now we enter the world of scientific imagination, face to face with the proton

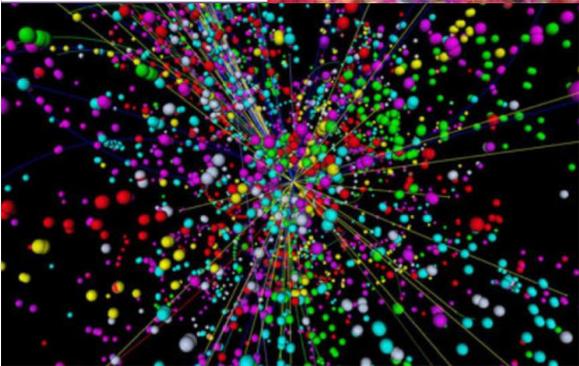
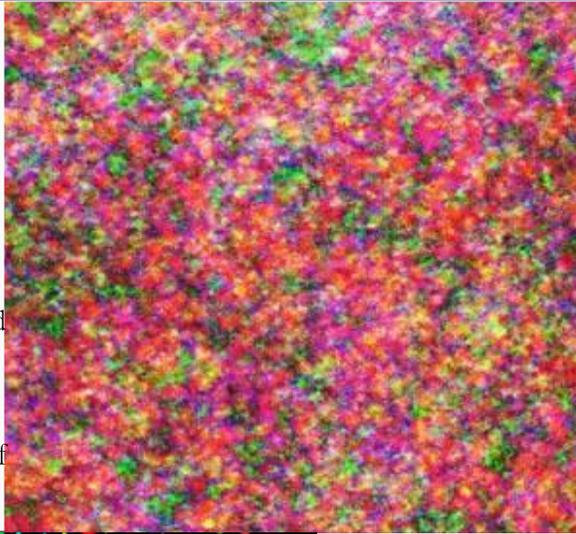


Learning & Thinking

10^{-16}

100 Atometers

Seeing the Quark Particle that make up the proton. We cannot get any closer. We have reached the limit of modern science, the boundaries of our current understanding of our physical universe

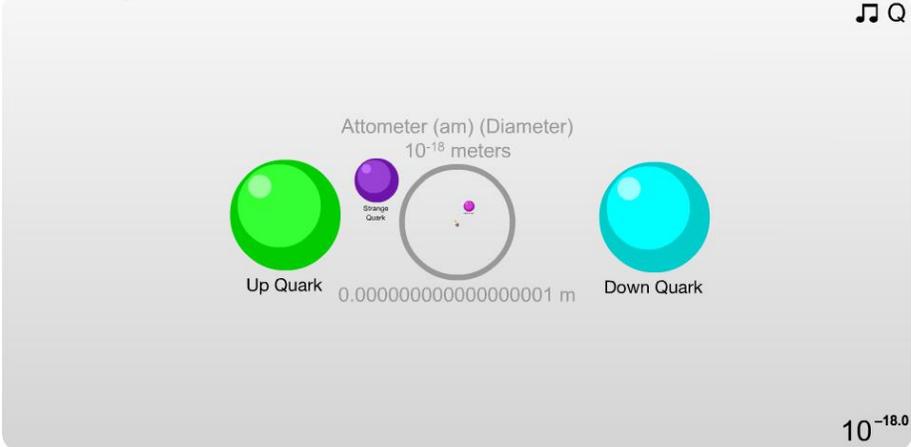


Smaller unit, Attometer (10^{-18} meter), is used to refer to sub atomic particles.

We are at the infinitesimal limit of our scientific knowledge.

Our present scientific knowledge covers dimensions from 10^{-16} to 10^{23} . Both microscopic and macroscopic infinite views are reached. That is the limit of our knowledge.

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<https://www.youtube.com/watch?v=uaGEjrADGPA>