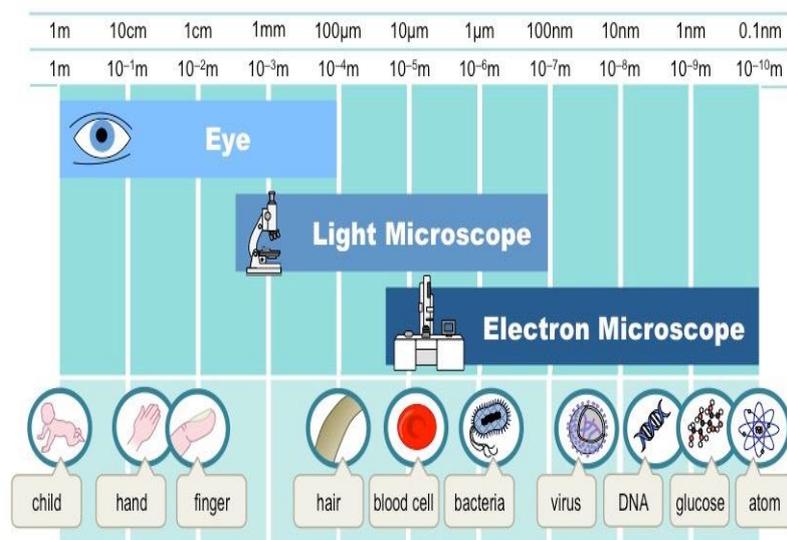


## “What is cryo-electron microscopy, the Nobel prize-winning technique?”

The 2017 Nobel Prize in Chemistry: The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2017 to **Jacques Dubochet**, **Joachim Frank** and **Richard Henderson** for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution.

### What is electron microscopy?

The electron microscope is a type of microscope that uses a beam of electrons to create an image of the specimen. It is capable of much higher magnification and has a greater resolving power than a light microscope, allowing it to see much smaller objects in finer detail due to its much shorter wavelength (100,000 times smaller than visible light). The particles reveal even the tiniest structure.



Figuring out the shape of proteins and other biological molecules is crucial to understand their function. For instance, the structure of a virus gives essential clues to how it invades a cell.

## Glossary

**Nobel Prize:** is awarded annually by the Royal Swedish Academy of Sciences to scientists

**Microscopy:** using microscopes to view objects and area of objects that cannot be seen with the naked eyes

**Resolution (microscopy):** the shortest distance between two points on a specimen

**Magnification (microscopy):** a measure of the ability of a lens or other optical instruments to magnify, expressed as the ratio of the size of the image to that of the object

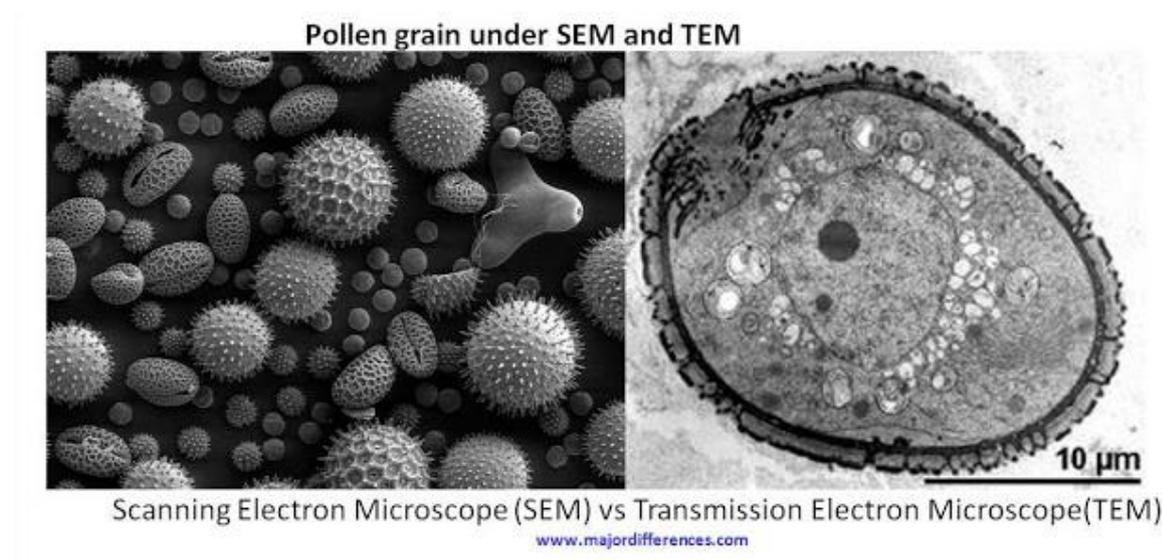
**Electron:** negatively charged particle

**Microcephaly:** is a condition where a baby's head is much smaller than expected. During pregnancy, a baby's head grows because the baby's brain grows. Microcephaly can occur because a baby's brain has not developed properly during pregnancy. Microcephaly has been linked with the following problems: seizures, developmental delay, hearing loss, etc.

## What are the types of electron microscope?

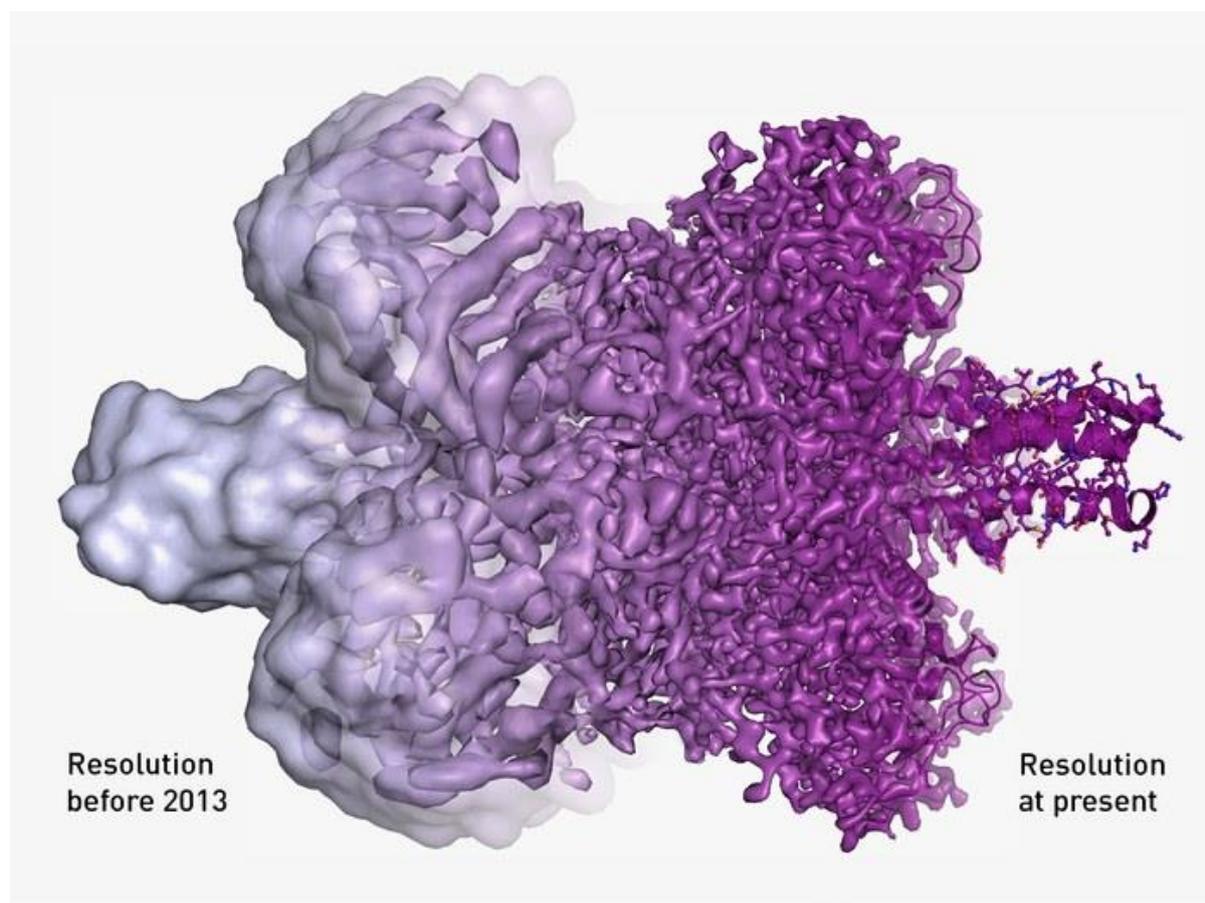
There are two types of electron microscope used commonly:

Scanning electron microscopy (SEM)	Transmission electron microscopy (TEM)
Use to produce excellent images of the surfaces of cells and small organisms.	Used to study the ultra-structure of the cell and its components. It can see objects as small as a protein molecule or even at nano level.
Electron beam scans over the surface of the sample	Electron beam pass through the sample
Low resolution than TEM	High resolution
Magnification power: 100,000X	Magnification power: 5,000,000X
Produces three dimensional, black and white images	Produces two-dimensional, black and white images
<b>Similarities between SEM and TEM</b>	
<ul style="list-style-type: none"> <li>- Type of object: non-living</li> <li>- Source of radiation: electron</li> </ul>	



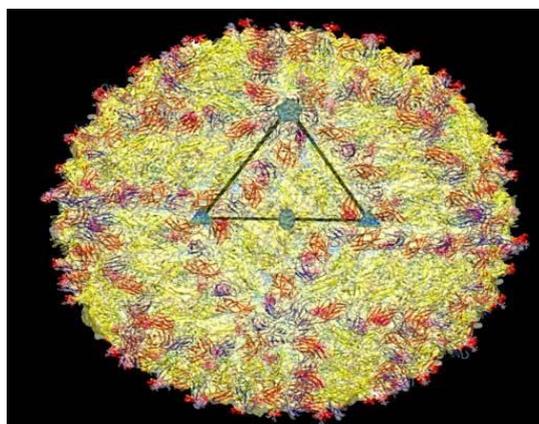
### What is cryo-electron microscopy and what is its uniqueness?

- It is a form of TEM where a beam of electron is sent through a biological molecule that has been **frozen quickly** with liquid nitrogen-cooled ethane (water contained in cell solidified into glass-like structure known as vitrified water that provides clearer & crystal-free image)  
**Note:** Cooling the samples was expected to protect the biological molecules from electron damage and prevents them from getting dehydrated in the electron microscope vacuum chamber.
- It allows the observation of **specimens that have not been stained or fixed**, showing their native environment
- HISTORICALLY, the electron beam of TEM fried the biological molecules being studied, and the use of a vacuum resulting in biological molecules drying out and collapsing. It is good enough to study dead cell with TEM but it is impossible to catch biological molecules in their natural state.
- On the other hand, Cryo-electron microscopy produces **INTACT, three-dimensional** structures of biological molecules.
- Detailed images of life's complex machineries in atomic resolution could now be achieved with the invention of cryo-electron microscope.



**Do you know that....?**

Zika virus which associated with microcephaly in fetuses, its microscopic structure was studied with cryo-electron microscopy. By using it, scientists have made high-resolution, 3D image and demystify the structure of Zika virus.

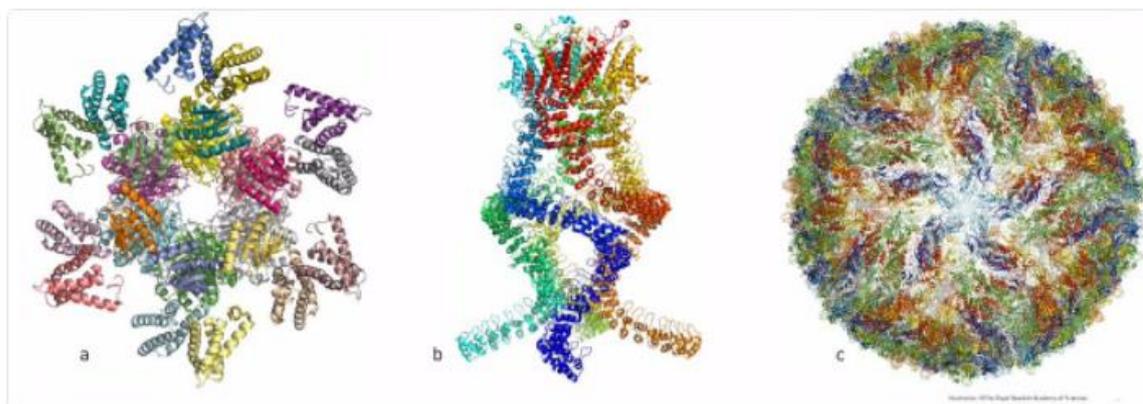


Microscopic structure of Zika Virus

The sites of the virus where antibodies could attach to, have been identified and Zika virus could then be disabled. By doing so, it could lead to development of new antiviral drug. It will not be able to do so without the implementation of cryo-electron microscope.

The same technique was used to figure out the structure of proteins involved with circadian rhythms (also known as biological clock) too, the advances that were recognized with this year's Nobel Prize in Medicine.

Atomic structures of a) protein complex that governs circadian rhythm b) pressure sensor of the type that allows us to hear c) Zika virus



*“Now we can see the intricate details of the biomolecules in every corner of our cells, in every drop of our body fluids.”*

Prof Dr Sara Snogerup Linse

Professor of Physical Chemistry at Lund University, Sweden

Chairman of committee for Chemistry Nobel's prize year 2017



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15<sup>th</sup> October 2017

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