

# EL MUNDO DE LA MICROSCOPIA

SCOPE   
Scientists Changing Our Pre-college Education

# EL PODER DE AUMENTO DE LAS LENTES

- La lupa: 2-6 veces
- Lente de la cámara: hasta 83 veces (cámara digital), hasta 300 veces (cámara de television professional)
- Microscopio de luz: hasta 2.000 veces

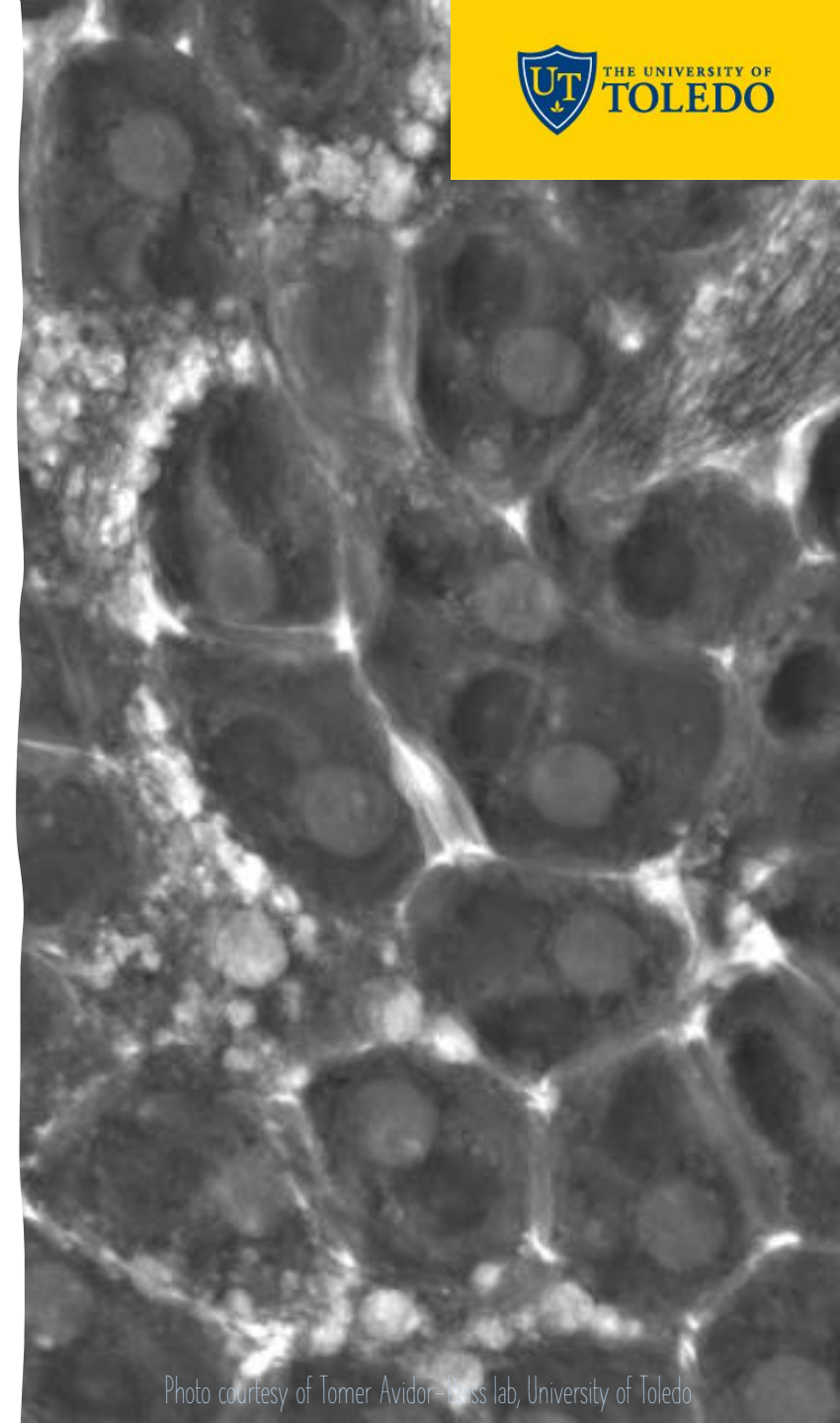
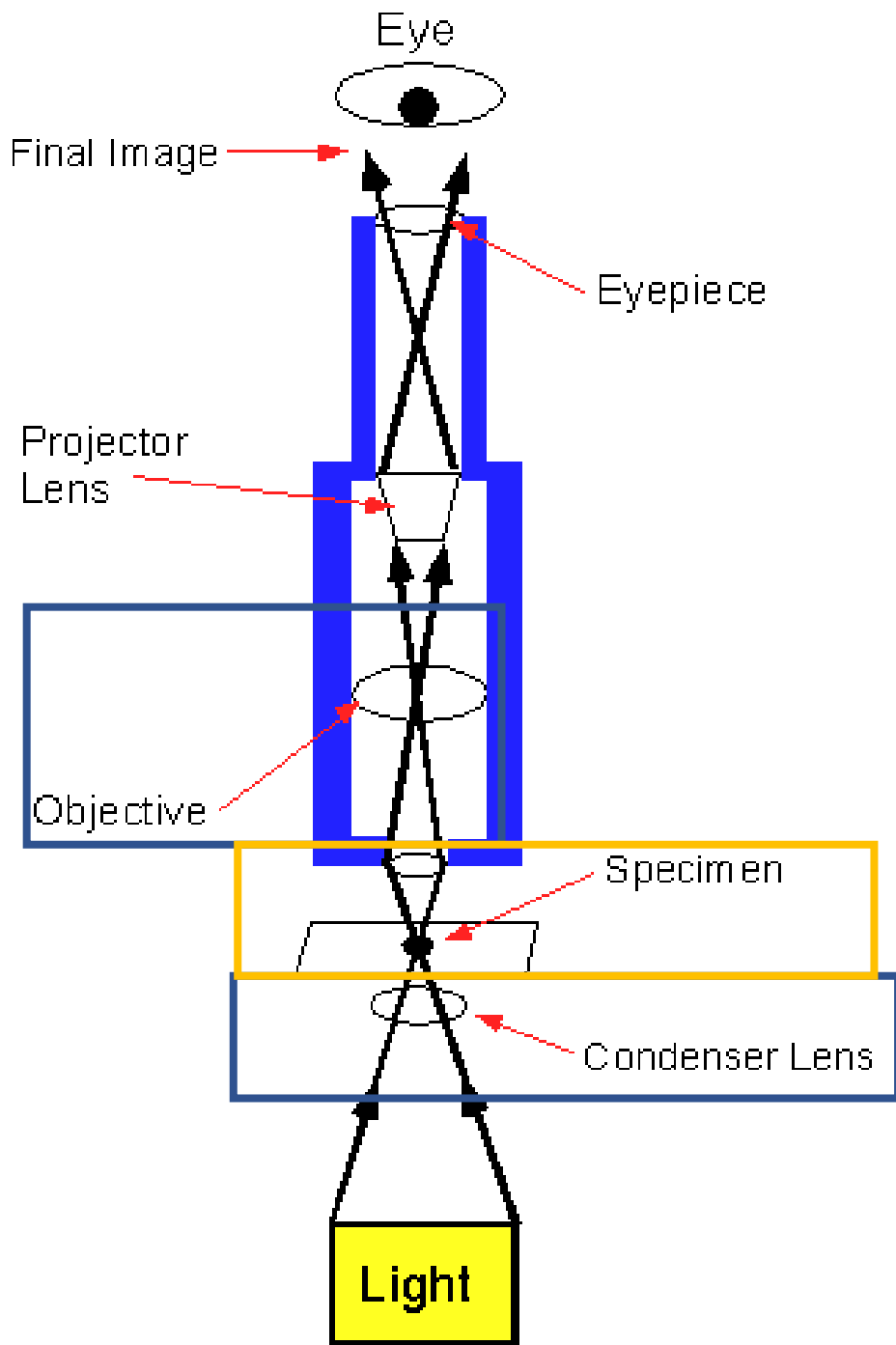


Photo courtesy of Tomer Avidor-Buss lab, University of Toledo

# MICROSCOPIOS DE LUZ



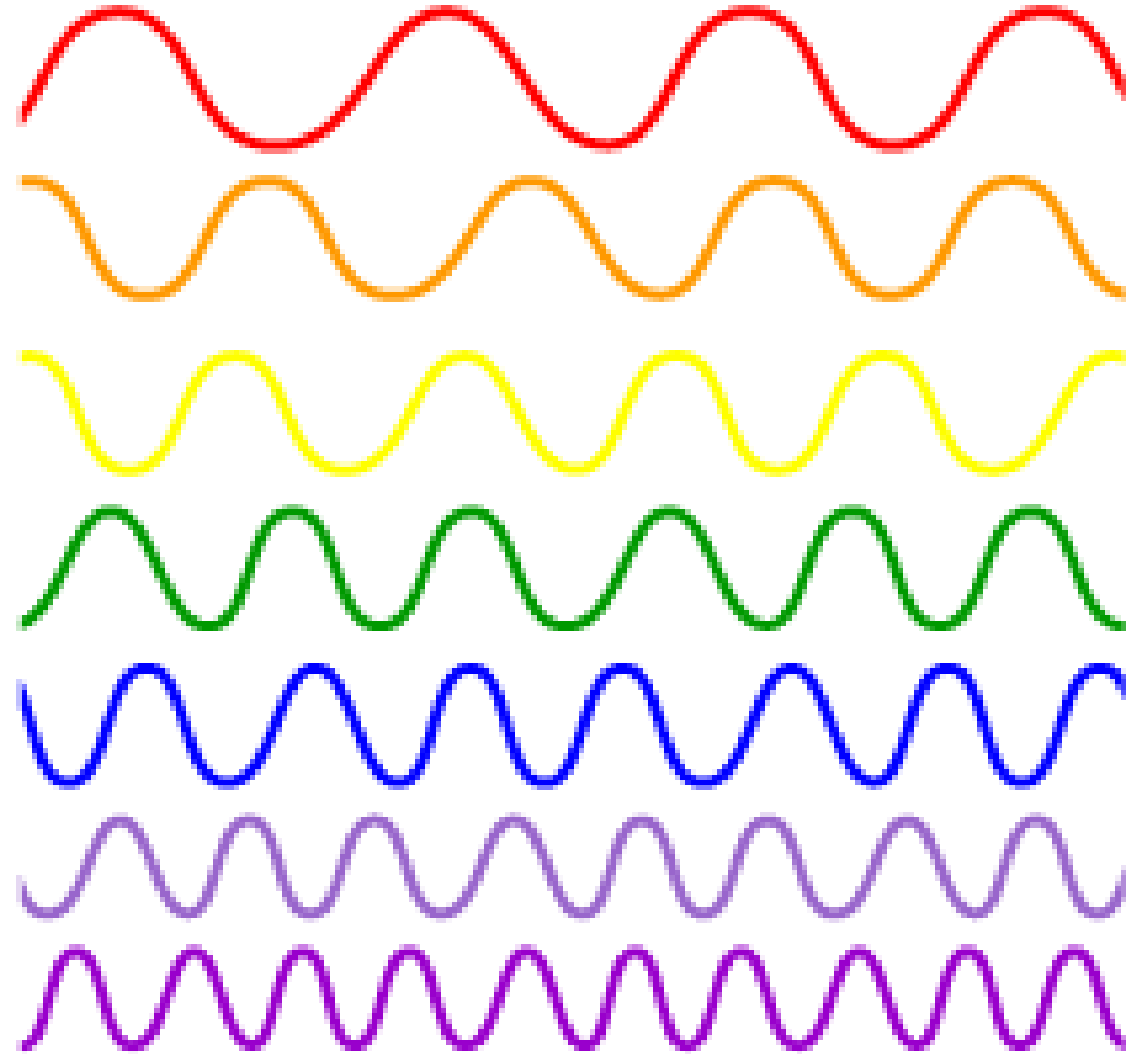
- Usan luz visible para ver la imagen
- Las lentes enfocan la luz
- La luz atraviesa la muestra
- Puede acercar a ~2.000 veces



# LA LIMITACIÓN DE LA LUZ

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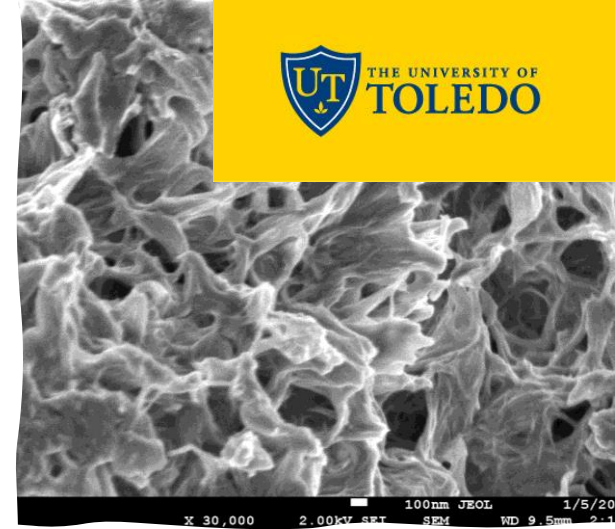
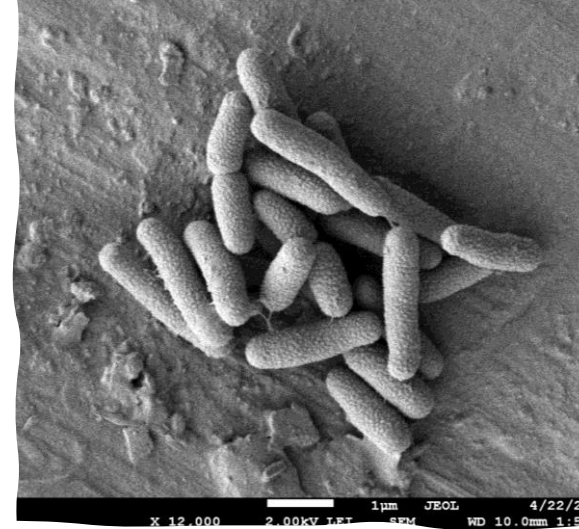
- La luz se mueve como una onda.
  - Los humanos solo pueden ver ciertas longitudes de onda, llamadas espectro visible.
  - Colores diferentes tienen longitudes diferentes de onda.
  - Si una cosa es más pequeña del longitud de onda de luz más pequeña, no podemos estudiar la cosa con este tipo de microscopio



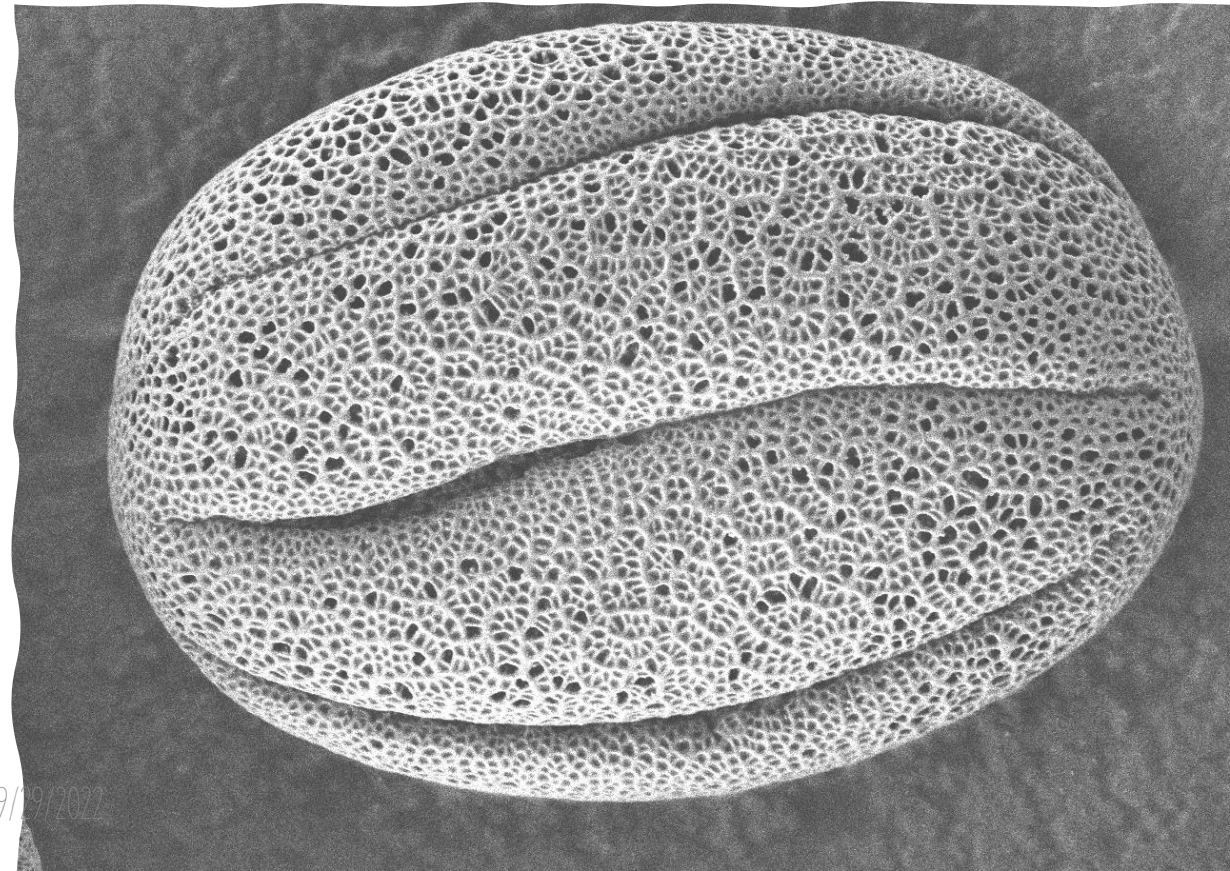
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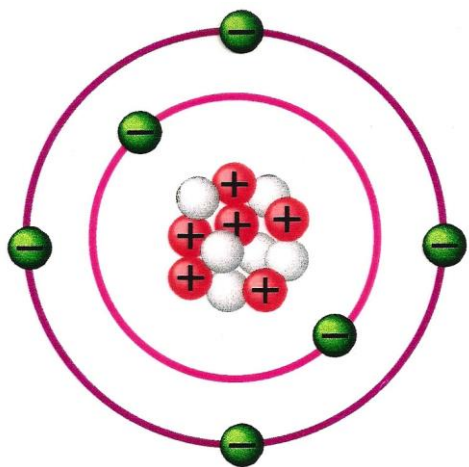
# WHAT IF WE WANT TO SEE SOMETHING SMALLER?

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- Although a light microscope can zoom in a lot, sometimes we need to zoom in further
  - Bacteria
  - Pollen
  - Nanoparticles





 - Electron

 - Proton

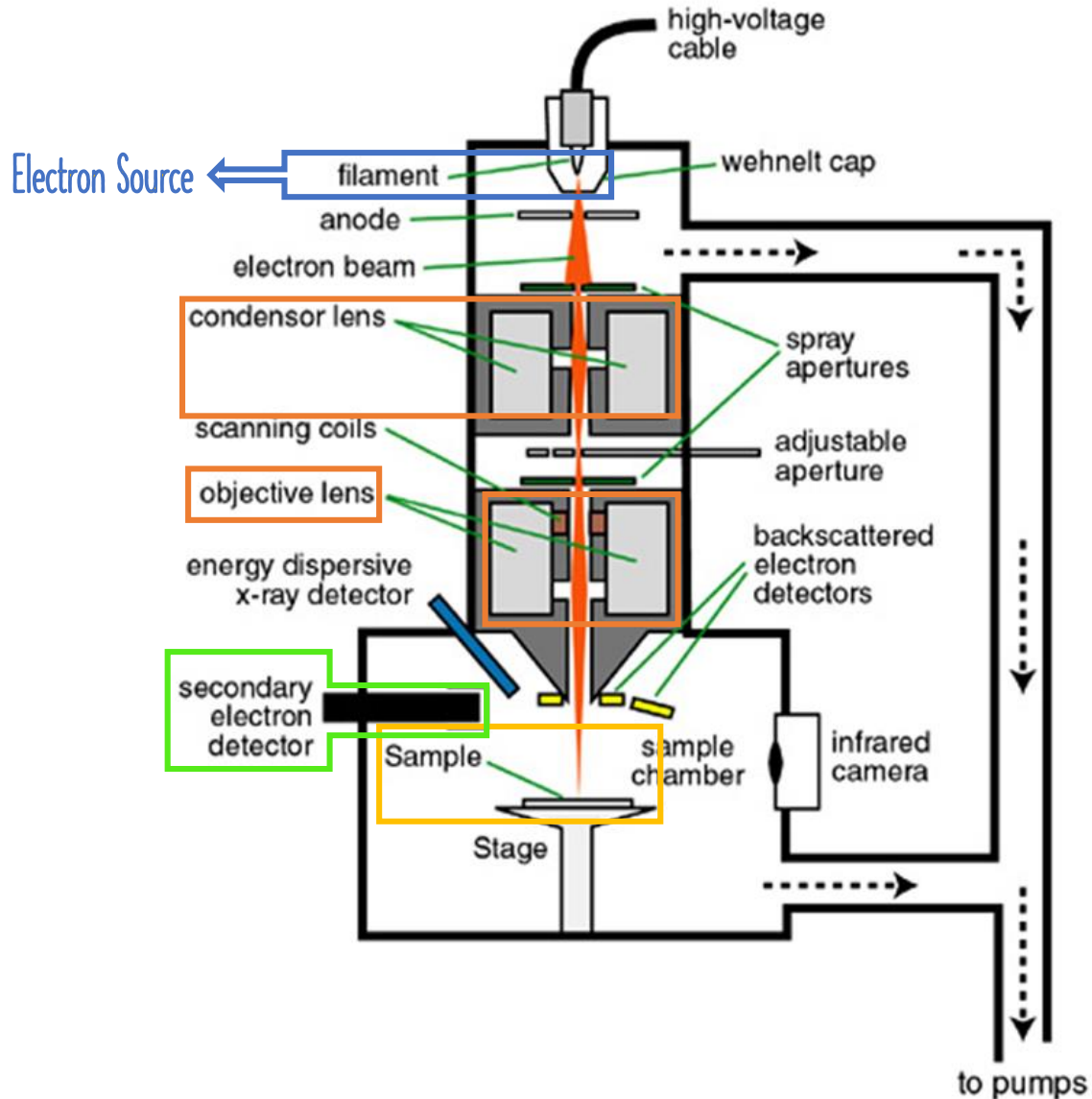
 - Neutron

<https://sciencepediablog.files.wordpress.com/2016/06/carbon.jpg?w=882>



# ELECTRONS!

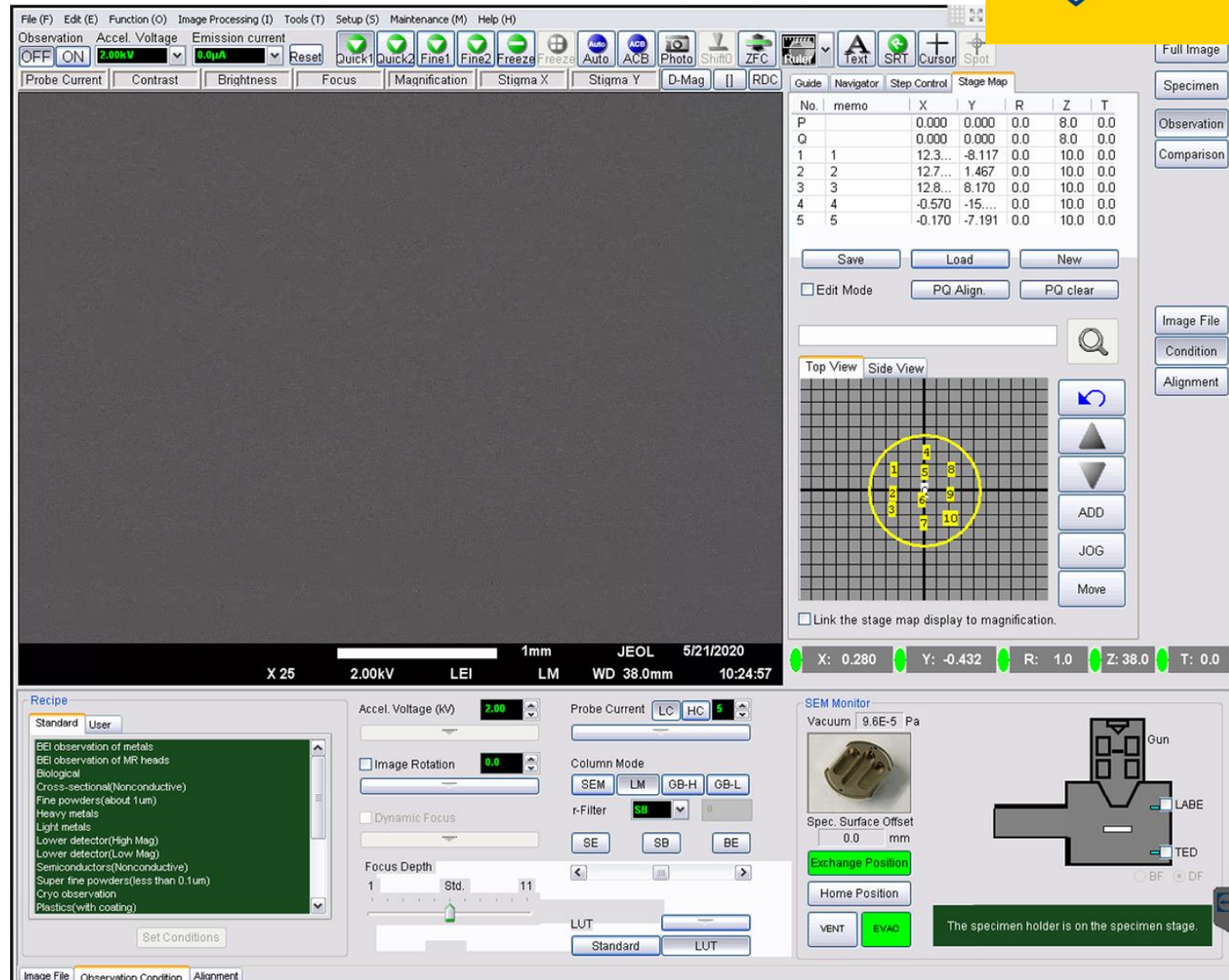
- Part of an atom
- Have a much smaller wavelength than light (~0.01 nanometers)
  - Only one wavelength (only one type of electron)
- Can easily be removed from an atom
  - Static electricity
  - Electric current



# SCANNING ELECTRON MICROSCOPE

- High electric current "frees" the electrons from a tungsten wire
- Magnets instead of lenses are used to focus the beam
- Scans the surface of the sample
- Can zoom in to 1,000,000 times
- Image is never in color!
  - Only one type of electron (no such thing as purple, green, blue electrons)

# REMOTELY CONTROLLING THE SEM



The screenshot displays the SEM software interface with the following components:

- Top Menu:** File (F), Edit (E), Function (O), Image Processing (I), Tools (T), Setup (S), Maintenance (M), Help (H).
- Observation Panel:** Accel. Voltage (2.00kV), Emission current (9.0µA), and various control buttons like Quick1, Quick2, Fine1, Fine2, Freeze, Auto, ACB, Photo, Shift0, ZFC, Rule, Text, SRT, Cursor, Spot.
- Stage Map:** A grid with a yellow circle highlighting a 10x10 area. A table below it lists stage coordinates:

No.	memo	X	Y	R	Z	T
P		0.000	0.000	0.0	8.0	0.0
Q		0.000	0.000	0.0	8.0	0.0
1	1	12.3...	-8.117	0.0	10.0	0.0
2	2	12.7...	1.467	0.0	10.0	0.0
3	3	12.8...	8.170	0.0	10.0	0.0
4	4	-0.570	-15....	0.0	10.0	0.0
5	5	-0.170	-7.191	0.0	10.0	0.0

- Bottom Status Bar:** X 25, 2.00kV, LEI, LM, WD 38.0mm, JEOL, 5/21/2020, 10:24:57. Real-time coordinates: X: 0.280, Y: -0.432, R: 1.0, Z: 38.0, T: 0.0.
- Recipe Panel:** Lists various observation recipes such as "BEI observation of metals", "Biological", "Cross-sectional(Nonconductive)", etc.
- SEM Monitor:** Shows Vacuum (9.6E-5 Pa) and a diagram of the SEM head with labels for Gun, LABE, and TED.