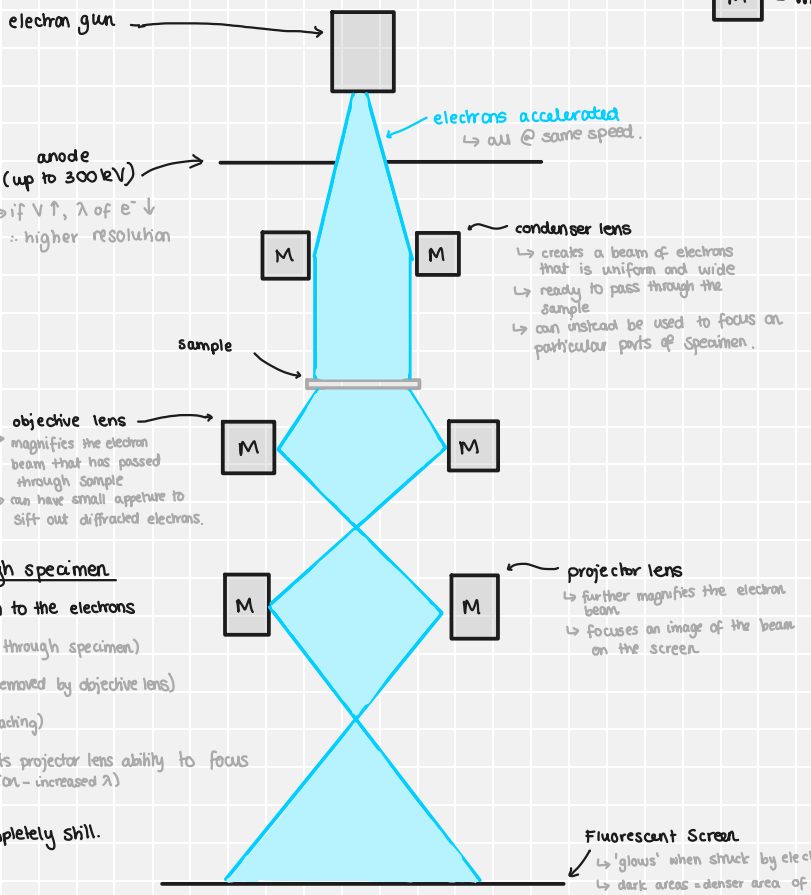
ELECTRON MICROSCOPES

Transmission Electron Microscope [TEM] - first prototype in 1931 (Knoll and Ruska)

↳ modern versions have resolutions of 63pm!

M = magnetic lens



when e⁻ beam passes through specimen

↳ different things can happen to the electrons

- **absorbed** (don't continue through specimen)
- **diffracted** (need to be removed by objective lens)
- **transmitted** (without interacting)
- **change speed.** (this affects projector lens ability to focus which decreases resolution - increased λ)

↳ TEM must be kept completely still.

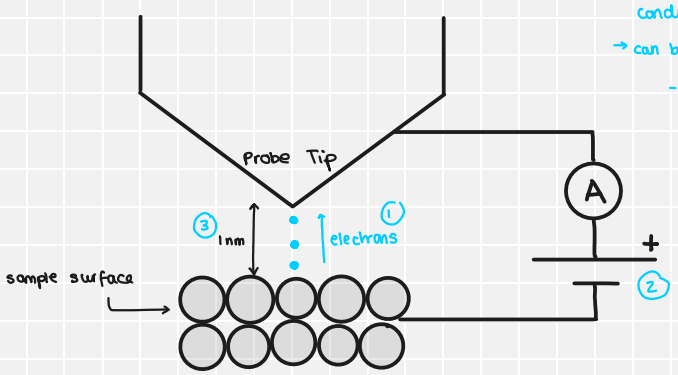
ELECTRON MICROSCOPES

got them a Nobel Prize!

Scanning Tunnelling microscope [STM] - created 1981 (Binnig and Rohrer)

↳ vertical resolution of 0.001 nm
↳ smaller than the size of an atom!

→ can be used in ultra-high vacuum conditions
→ can be used at temp range of -273°C → few 100 °C!



wave property.

1. Quantum Tunnelling allows electrons from the surface of the specimen to move across the gap to the probe
   ↳ creates a tunnelling current
2. A low p.d across sample ensures e^- only tunnel from sample to probe
   ↳ could also happen the other way if this was not their.
3. 1nm is used as this is the de Broglie λ of e^- @ room temp.
   ↳ creates a small but finite probability that e^- can jump the gap.

must be narrow enough.

Two modes of operation

mode 1: height of probe is kept constant
- ↳ variations in sample height affect gap width.
- ↳ as width ↓, more e^- jump gap, I ↑ and vice-versa
- ↳ can detect changes as small as 0.001nm.
- ↳ V must be kept constant

mode 2: constant current
- ↳ height of probe varies to keep current constant
- ↳ variations in probe height are measured with time.