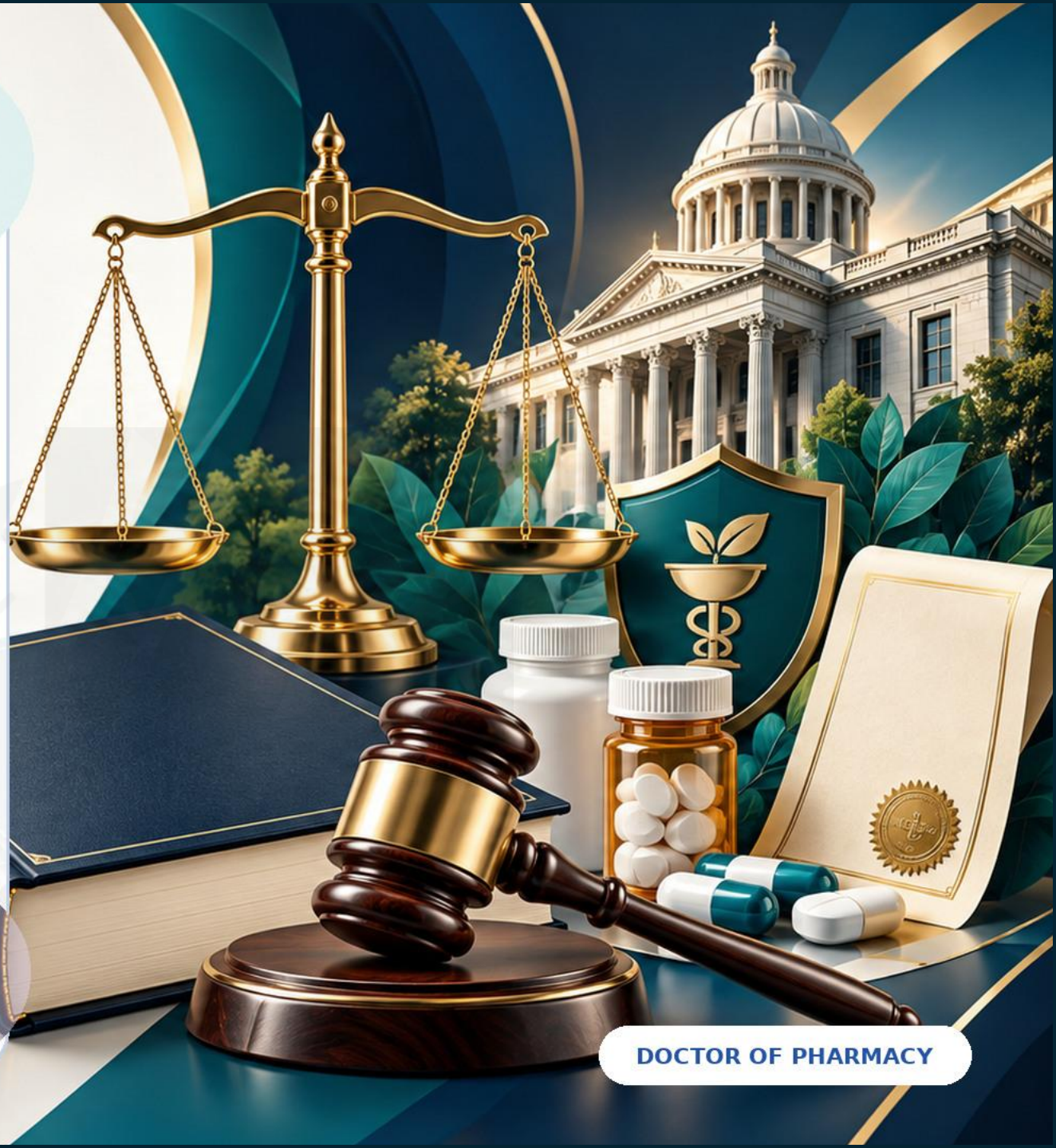
PHARM.D • YEAR 3

Pharmaceutical Analysis

CHAPTER 4

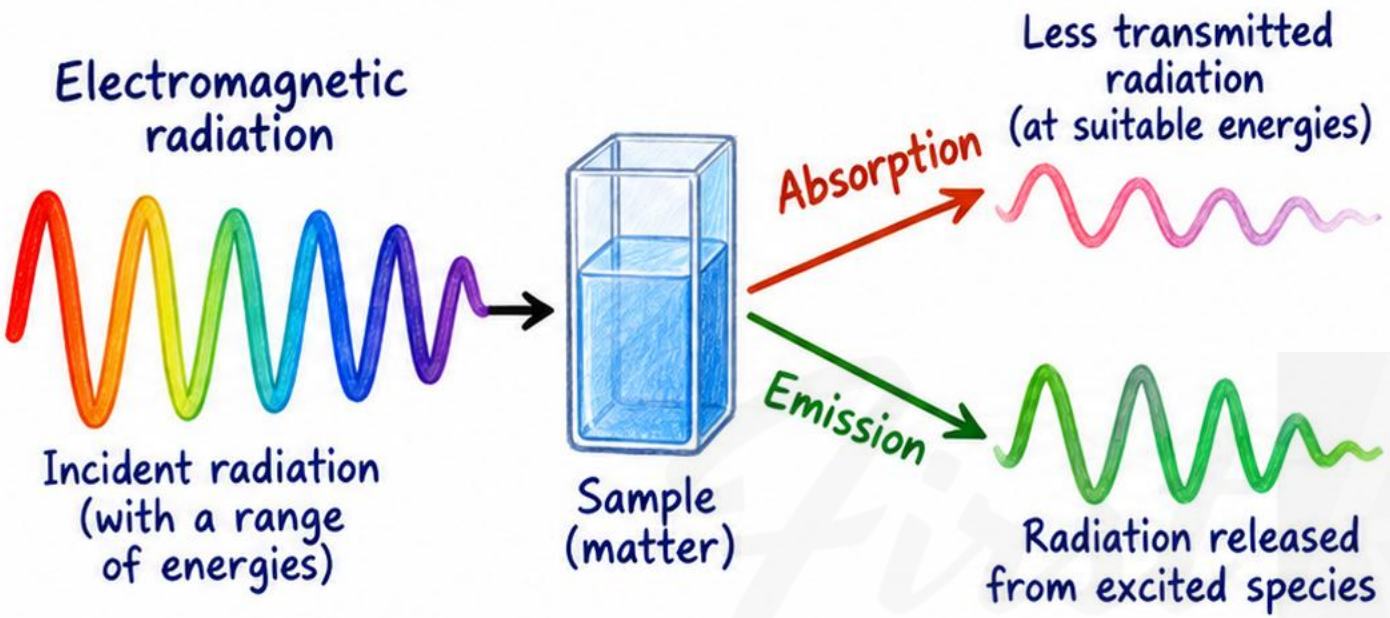
Spectroscopy

PPT CHAPTER COVER



DOCTOR OF PHARMACY

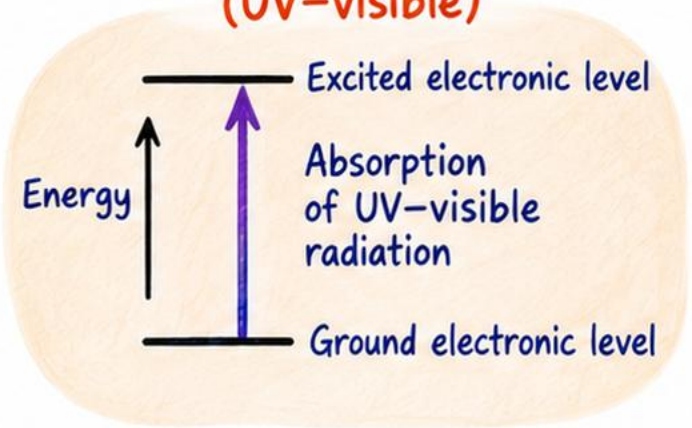
Spectroscopy: Matter and Radiation

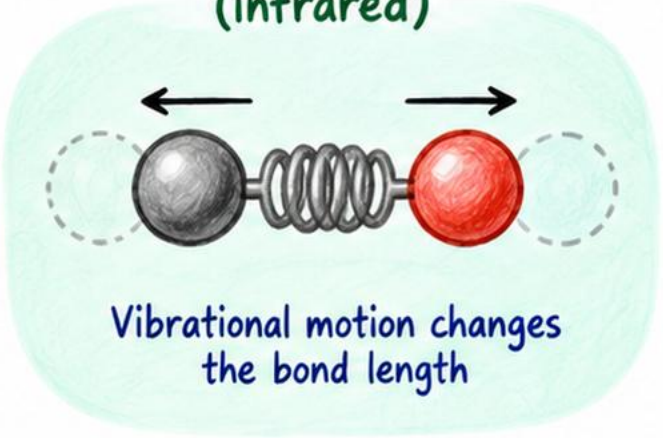


What is spectroscopy?

- Spectroscopy studies interactions between matter and electromagnetic radiation.
- A measured response can reveal composition, structure or concentration.
- Absorption removes radiation at suitable energies; emission releases radiation from excited species.

Different spectral regions





- Electronic transitions dominate many UV–visible measurements, while infrared commonly probes molecular vibrations.
- Different spectral regions probe different processes.

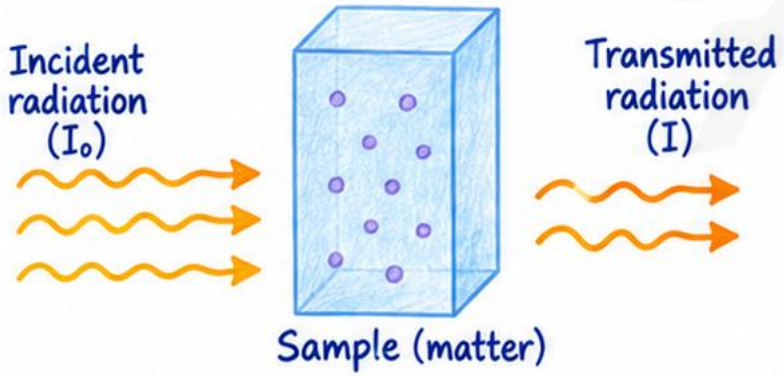
Key point

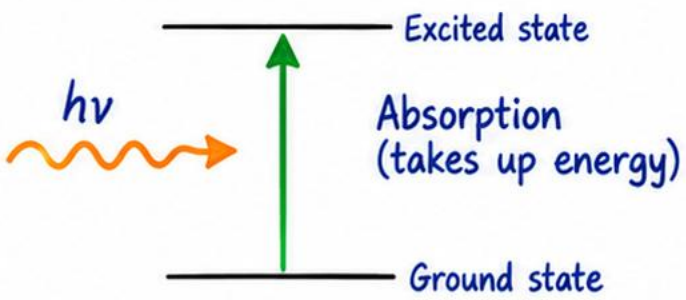
- Match the radiation energy and technique to the analytical question.

ABSORPTION, EMISSION AND SCATTERING

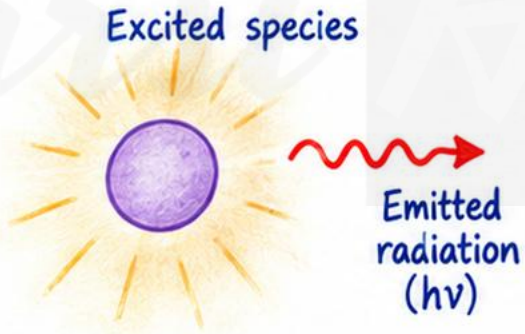
Absorption measures a decrease in incident radiation as matter takes up energy. Emission measures radiation released by excited species returning to lower-energy states. Scattering redirects radiation. Rayleigh scattering is elastic, with unchanged photon energy; Raman scattering is inelastic, with an energy shift. These are different measurement principles and require suitable optical arrangements and interpretation.

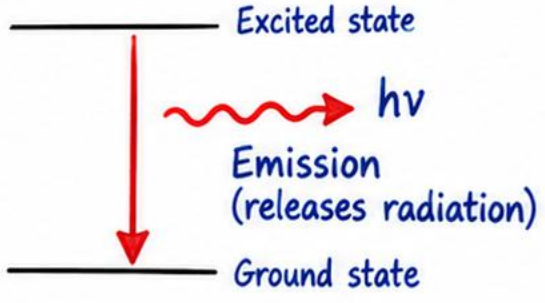
Absorption



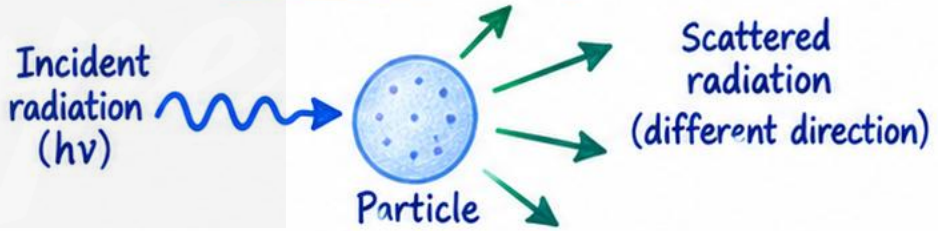


Emission

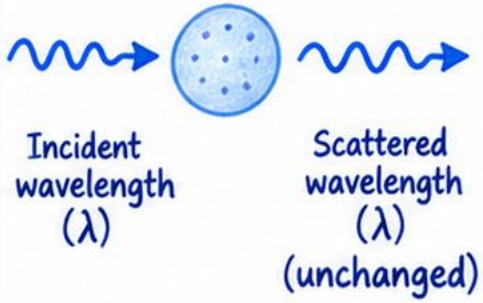




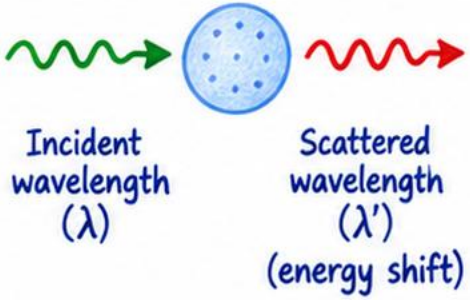
Scattering



Rayleigh scattering (elastic)



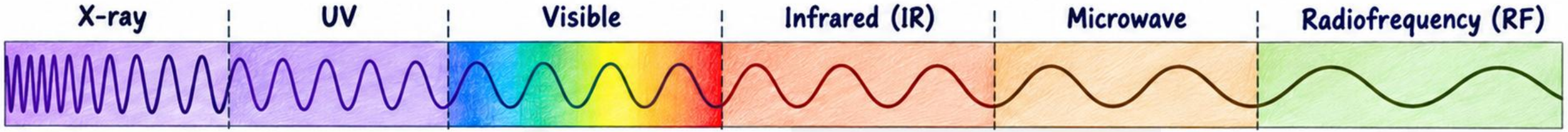
Raman scattering (inelastic)



SPECTRAL REGIONS AND TRANSITIONS

Higher energy
Shorter wavelength

Lower energy
Longer wavelength

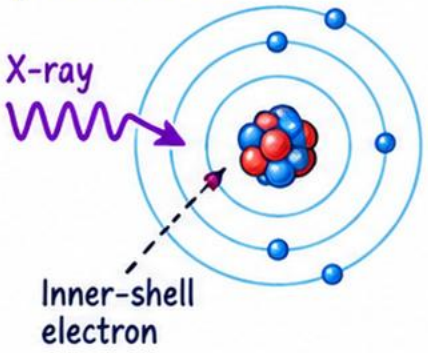


High frequency (ν)

Low frequency (ν)

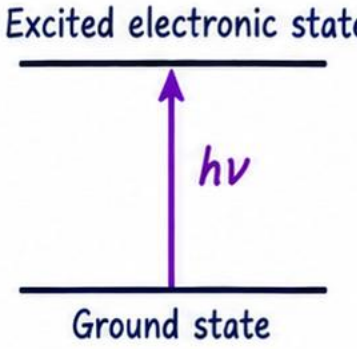
X-ray

X-ray methods involve higher-energy interactions, including inner-shell electronic processes.



UV–visible

UV–visible spectroscopy commonly probes electronic transitions.



Mid-infrared (IR)

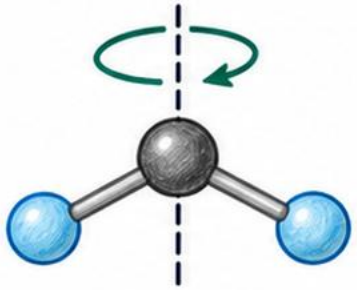
Mid-infrared spectroscopy probes many molecular vibrations.



Molecular vibration

Microwave

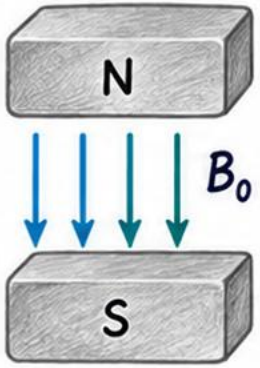
Microwave methods can probe rotational behaviour.



Molecular rotation

NMR (Radiofrequency)

NMR uses radiofrequency excitation of nuclear spins in a magnetic field.





Nuclear spin

The energy relationship is $\Delta E = h\nu = hc/\lambda$ for a matching transition; technique-specific selection rules also matter.

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