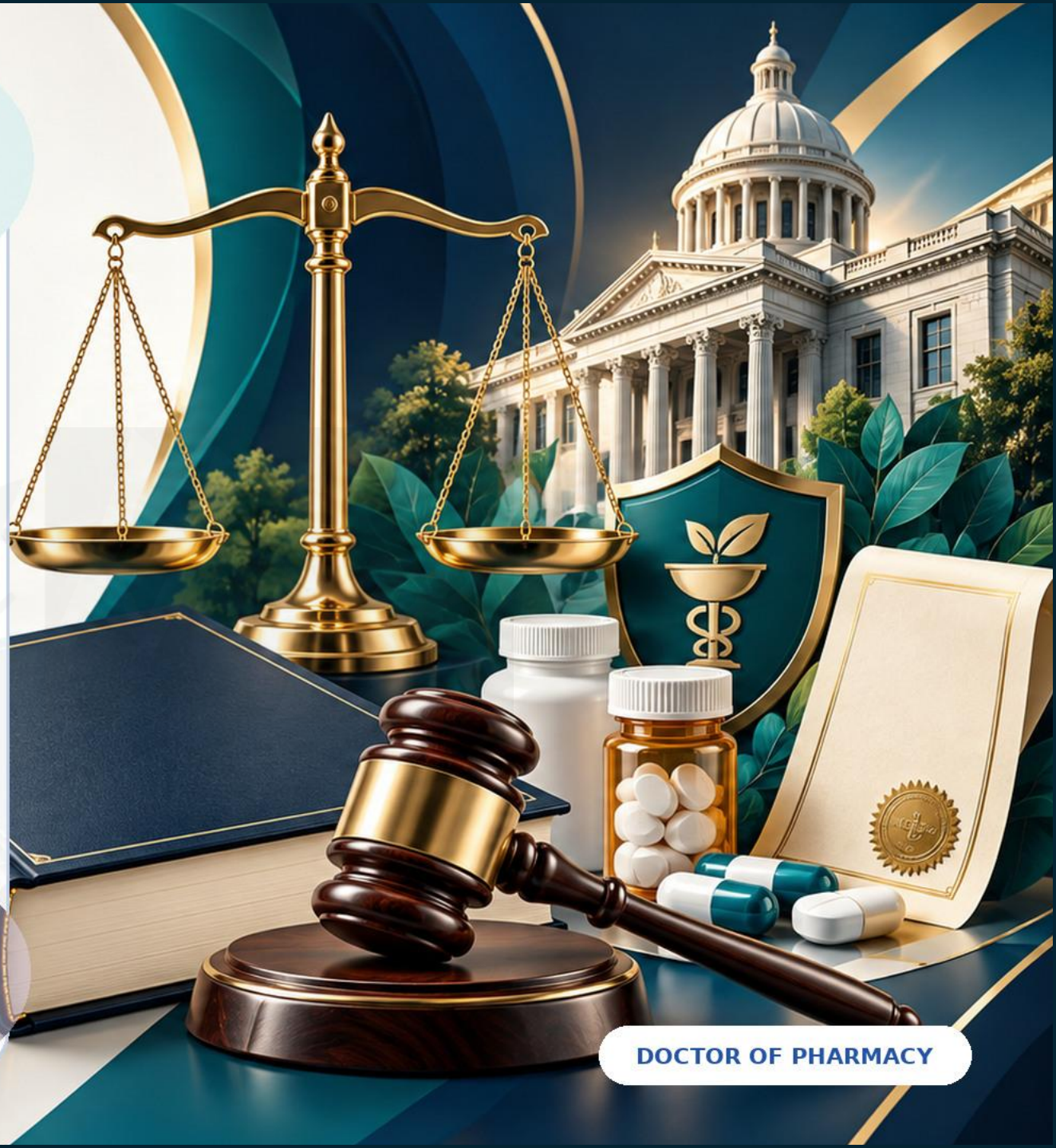
PHARM.D • YEAR 3

Pharmaceutical Analysis

CHAPTER 4.6

Atomic Emission Spectroscopy

PPT CHAPTER COVER

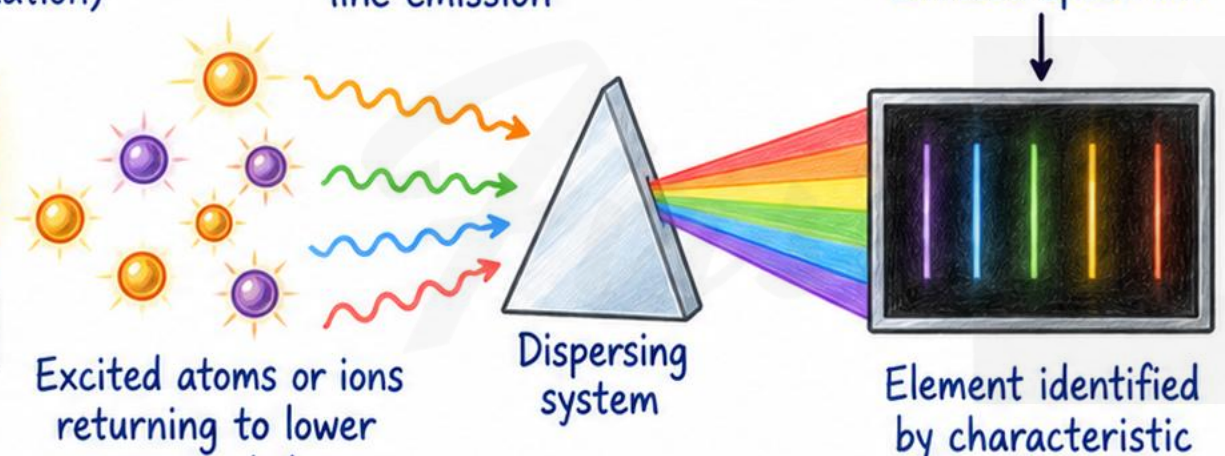


DOCTOR OF PHARMACY

ATOMIC EMISSION: IDENTIFYING ELEMENTS BY LIGHT

Excitation source

- Flame
- Electrical discharge
- or plasma
  (provides excitation)



Sample introduction and preparation depend on whether the material is liquid, solid or another form.



Principle

Atomic emission spectroscopy measures characteristic radiation from excited atoms or ions returning to lower energy states.
A flame, electrical discharge or plasma provides excitation.

Information obtained

The emitted spectrum helps identify elements, while calibrated line intensity estimates concentration.

Sample introduction and preparation

Sample introduction and preparation depend on whether the material is liquid, solid or another form.

Important limitation

A detected element does not reveal every molecular compound or oxidation state present in the sample.

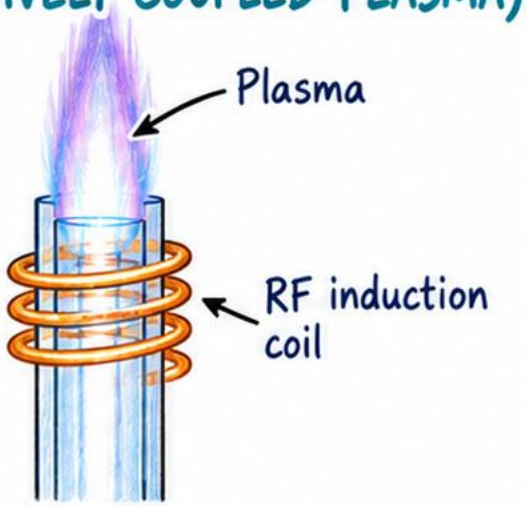
CHOOSING AN EXCITATION SOURCE

- Flames suit readily excited elements, particularly alkali and selected alkaline-earth elements.
- ICP provides high-energy excitation for a much wider element set.
- Arc and spark discharges can analyse suitable solid materials, including metals.
- Microwave-induced plasmas serve selected applications.
- Source stability affects precision and sensitivity.
- Technique selection depends on analytes, matrix and required limits—not simply on choosing the hottest source.

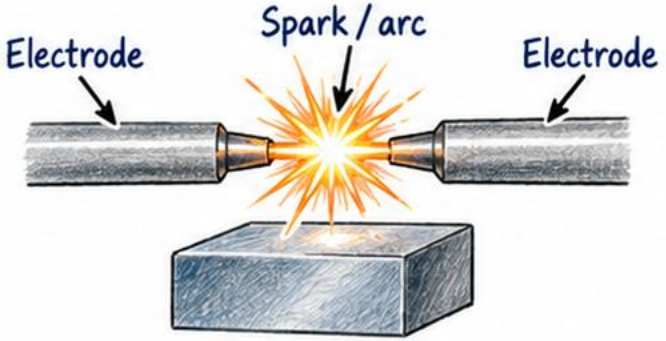
FLAME



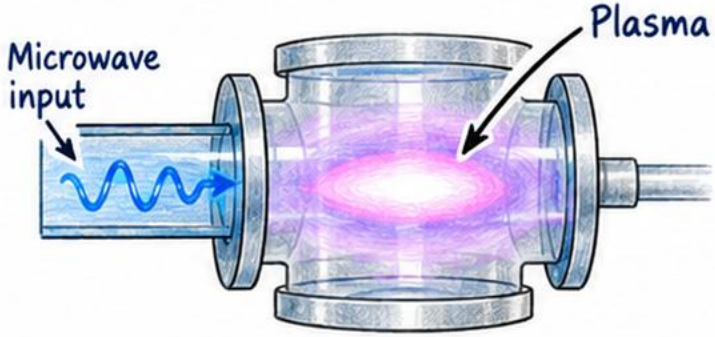
ICP (INDUCTIVELY COUPLED PLASMA)



ARC / SPARK DISCHARGE



MICROWAVE-INDUCED PLASMA



INDUCTIVELY COUPLED PLASMA

Principle

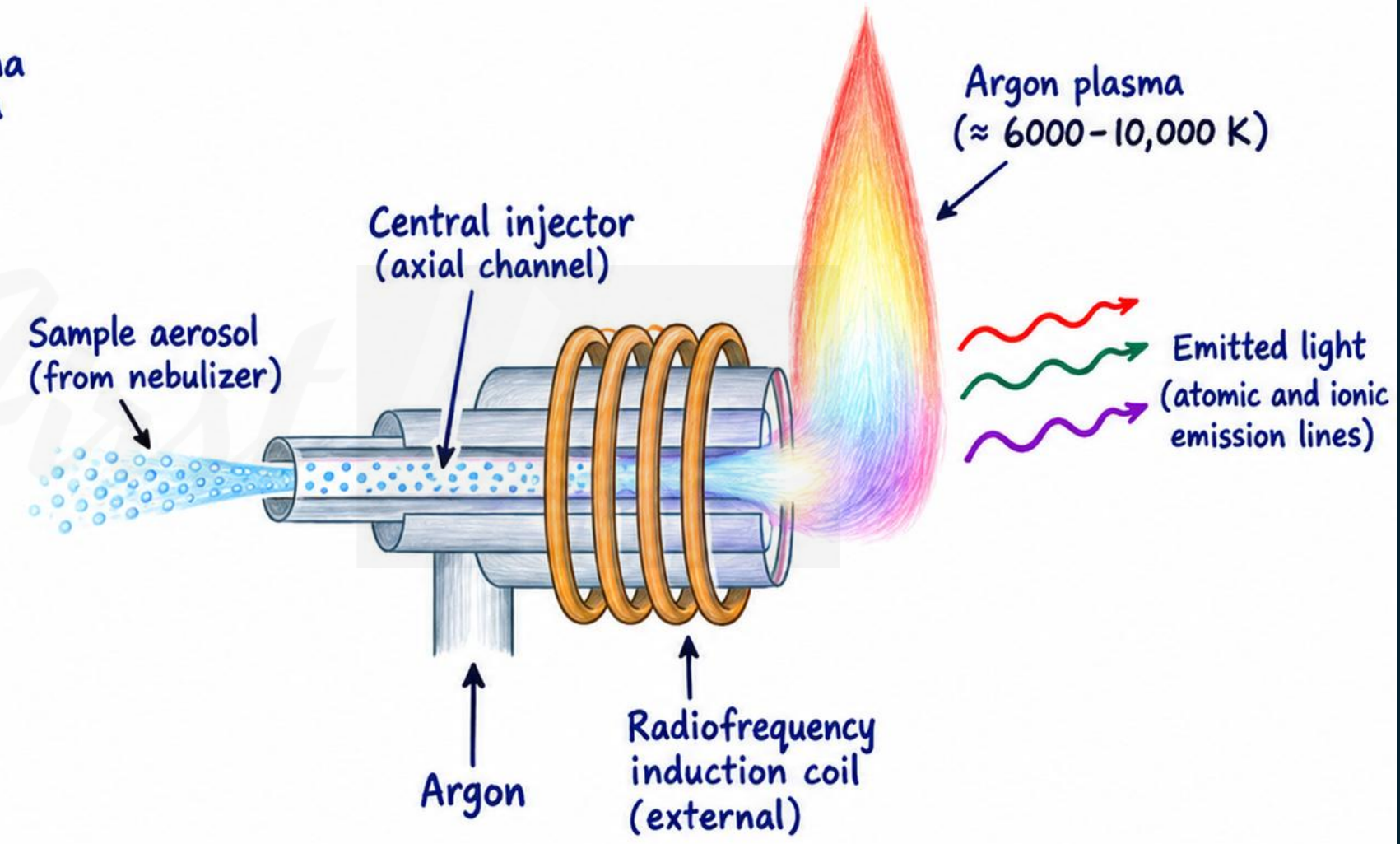
- ICP optical emission uses a plasma commonly sustained in argon by a radiofrequency induction coil.
- Typical plasma temperatures are several thousand kelvin, often around 6000–10,000 K, with substantial variation across the source.

Sample Processing

- Aerosol undergoes desolvation, vaporization, atomization and excitation.

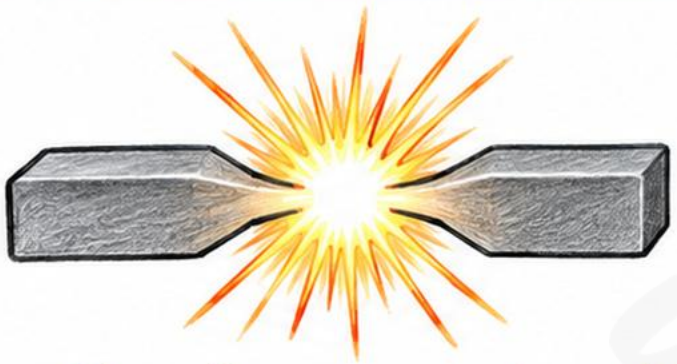
Analytical Features

- Atomic and ionic emission lines support multi-element analysis.
- High temperature reduces some chemical interferences, but does not eliminate spectral overlap, contamination or matrix effects.

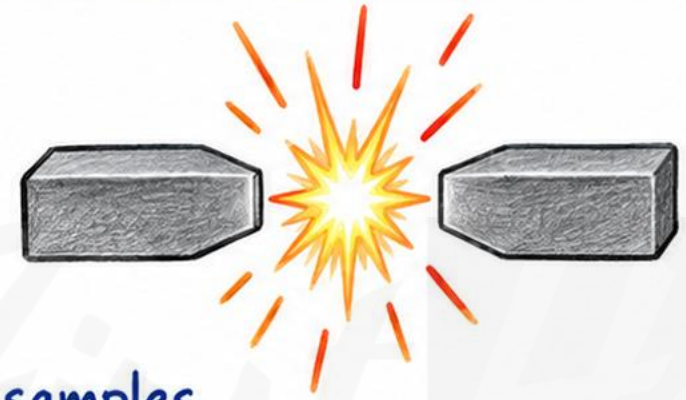


ARC, SPARK AND MICROWAVE SOURCES

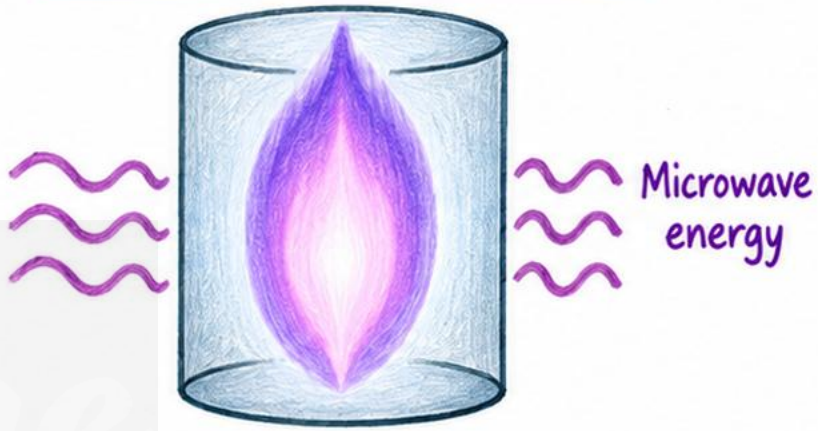
Electrical Arc Source



Electrical Spark Source



Microwave Source



- Transfers energy to suitable samples, vaporizing and exciting material for emission analysis.
- Especially useful for certain solid metals and alloys.

- Microwave energy can sustain a plasma in compatible systems.

Factors Affecting Reproducibility

- Sampling, homogeneity and discharge conditions affect reproducibility.

Calibration and Preparation

- Different sources require their own calibration and preparation, rather than being interchangeable attachments for every sample.

Less common for routine pharmaceutical solutions.

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