PHOTOSYNTHESIS: UNIT-II

Study Material for

B.Sc. Part III

Botany Hons.

Paper VI

and

B.Sc Part II (subsi)

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PHOTOSYNTHESIS: UNIT-II

- PHASES OF PHOTOSYNTHESIS
- PHOTOSYSTEM- I & II

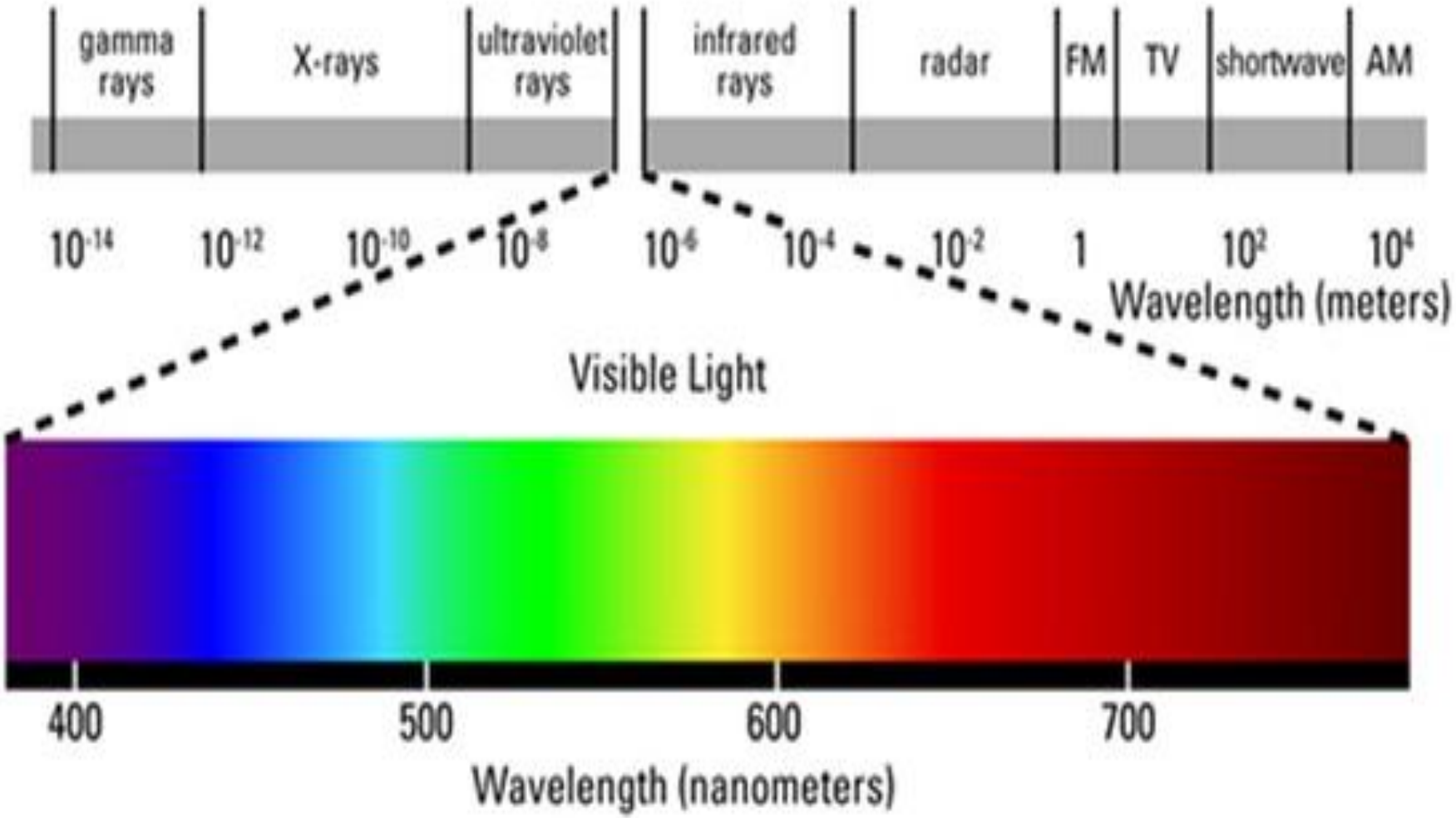
PHASES OF PHOTOSYNTHESIS

- The whole process of Photosynthesis comprises of **Photochemical** and **Biosynthetic Phases**
- **Radiant energy** plays an important role in initiating the process of Photosynthesis
- **Visible rays** represents a part of Radiant energy which travels down to earth from sun
- Only a part of **visible spectrum** takes part in Photosynthesis
- **White light** which comes down to the earth from sun is composed of **different wavelengths**

PHASES OF PHOTOSYNTHESIS

- Ranging from **long waves** of **Red light** to successively **shorter waves** to **Violet light**
- **The complete visible spectrum** is composed of red, orange, yellow, green, blue, indigo and violet colours
- Our **eyes can perceive** only the visible rays of wavelengths between **390nm to 780nm**
- The portion of the spectrum between **400nm and 700nm** is called **Photosynthetically Active Radiation (PAR)**

SPECTRUM OF RADIANT ENERGY



PHASE OF RADIANT ENERGY

- All the pigments can not absorb light and get activated at once
- All the **accessory pigments other than** chlorophyll a **(chl a)** absorb light energy and transfer it to chl a at the site of action
- The energy is transferred from molecule to molecule from **ground state or singlet state** to **excited state (**unstable state**),** in form of **photons**
- **Channelization of radiant energy:**

excited second singlet state → excited first singlet state → ground state

Internal conversion: (Expulsion of electrons)

excited second singlet state → excited first singlet state → **excited triplet state** → ground state

PHASE OF RADIANT ENERGY AND FATE OF ELECTRONS DURING PHOTOSYNTHESIS

- From first singlet state the excited electron may return to the ground state in two ways :

  (i) Losing extra energy in the form of heat

  (ii) Losing extra energy in form of radiant energy (Fluorescence)

- Some of the excited molecules goes upto internal conversion metastable triplet state and return back by losing extra energy in the form of heat and radiant energy (Phosphorescence)
- The electrons carrying extra energy are expelled out and are consumed further in other chemical reaction and molecular activity of the cell

❖ **The chl-a molecule takes part in the photochemical reaction in the same way mentioned above**

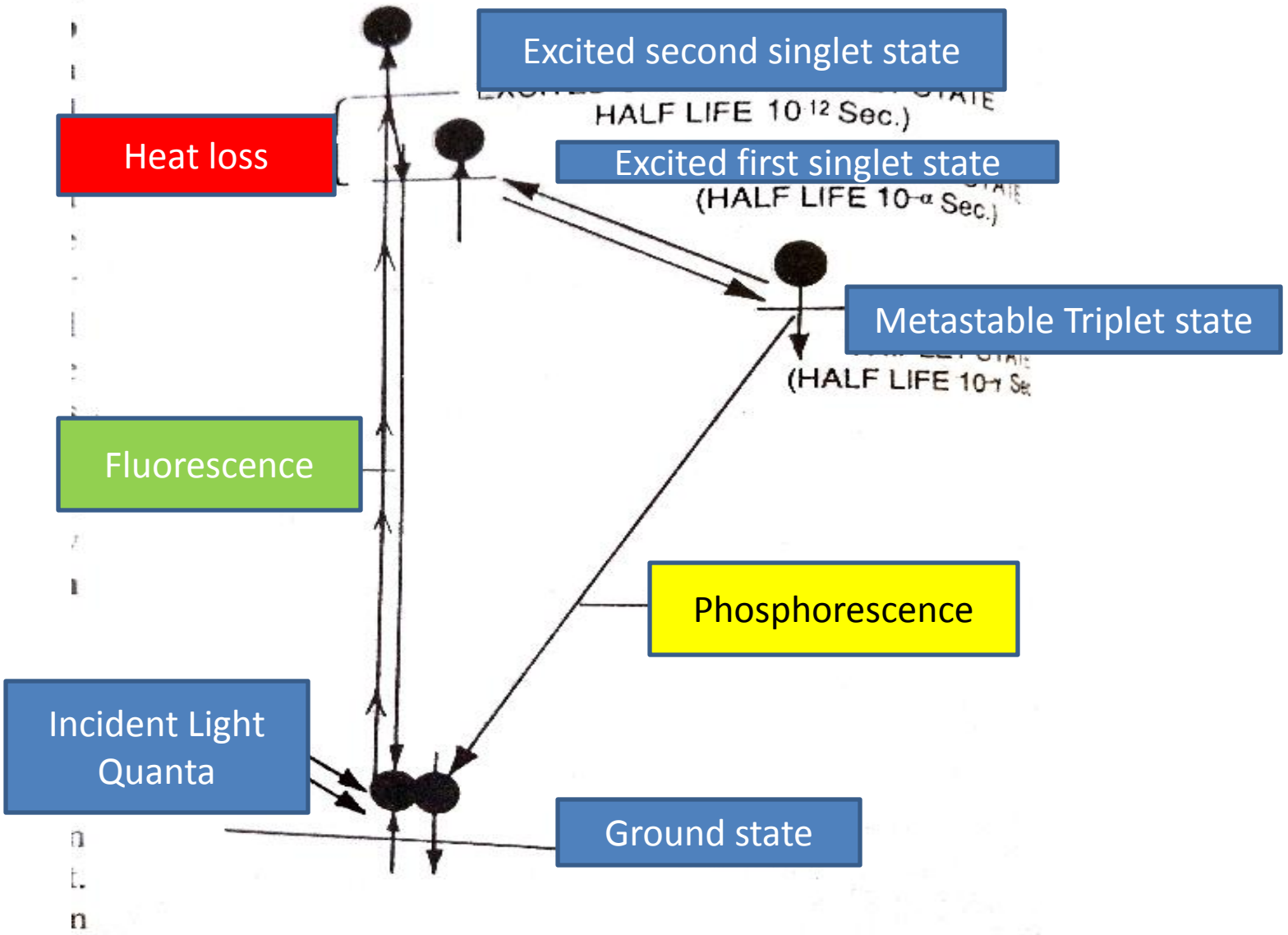


Diagram to show excitation state of molecules to Fluorescence or Phosphorescence

PIGMENT SYSTEM I AND PIGMENT SYSTEM II

- The process of Photosynthesis takes place by two photochemical processes
- Each process is associated with a specific group of light absorbing pigments
- **chl a** 683 (P_{680}) and **chl a** 703(P_{700}) are anchored in thylakoids in separate unit of organisation called **Photosystems**
- **Light energy for PS-I is collected by chl a** 683 and for PS-II is collected by chl a 673
- A single Photosystem consists of about 250 to 400 pigment molecules
- These light absorbing group of pigments are known as **pigment system I** (photosystem I) **a**nd **pigment system II** (photosystem II)
- The primary function of two photosystems (PSI and PSII), which interact with each other is to trap light energy and convert it to chemical energy (ATP)
- ATP is utilized by living cells as a source of energy (chemical form)
- Photosynthetic unit is known as **Quantasomes**

DIFFERENCE BETWEEN PS-I AND PS-II

PHOTOSYSTEM-I (PS-I)

- It is involved both in cyclic and non-cyclic Photophosphorylation
- PS-I is located on the outer surface of thylakoid
- It receives electron from PS-II and produces strong reductant which reduces NADP+ to $NADPH_2$
- The reaction center of PS-I is P_{700}
- Molecular oxygen is not evolved in this system

PHOTOSYSTEM-II (PS-II)

- Involved only in non-cyclic Photophosphorylation
- It is located in the inner surface of the thylakoid
- PS-II donates electron to PS-I where NADP+ is reduced
- The reaction center of PS-II is P_{680}
- This system is responsible for the photolysis of water and involves evolution of molecular oxygen

PHOTOSYNTHESIS: UNIT-II

- .....TO BE CONTD IN UNIT-III.