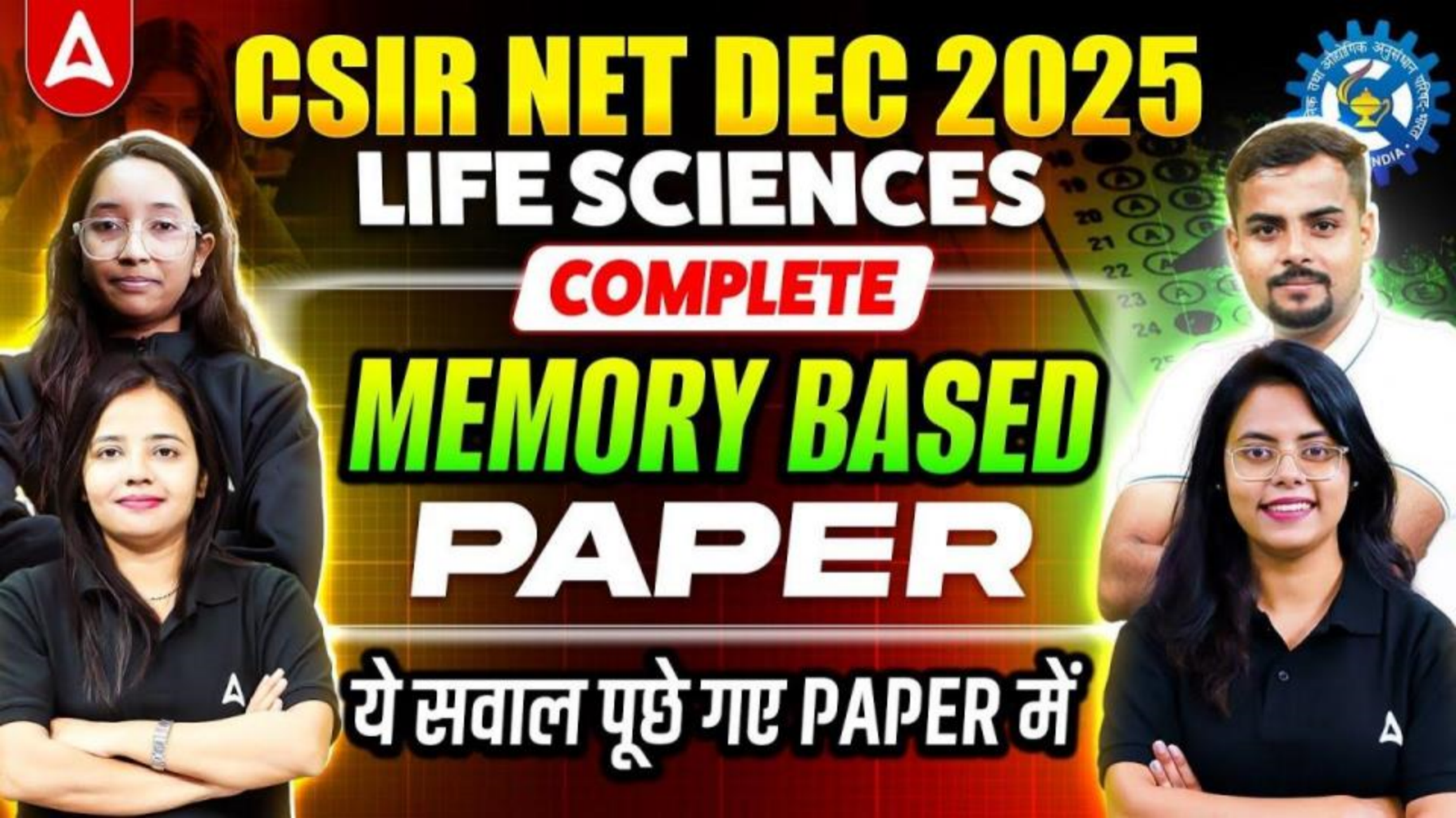
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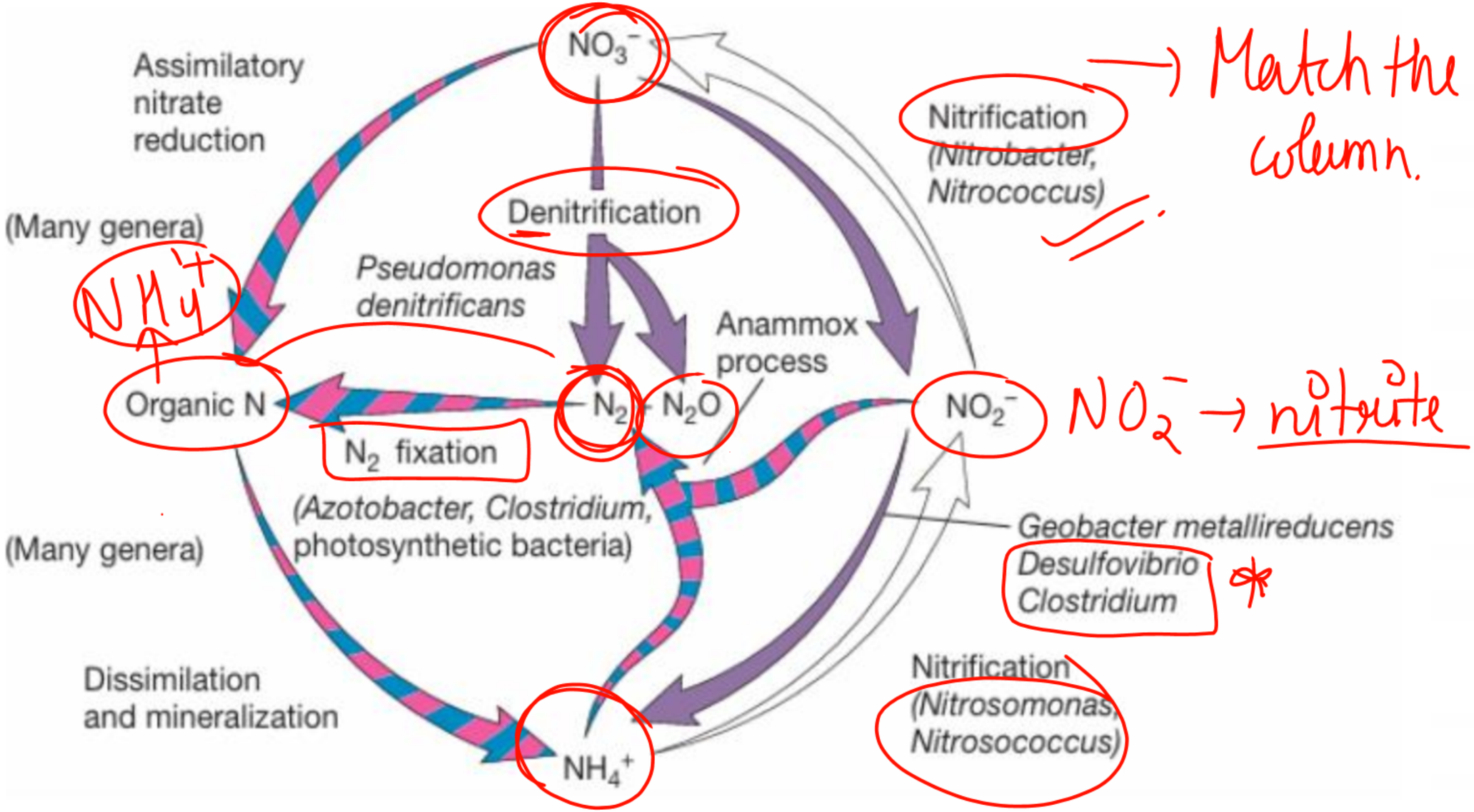

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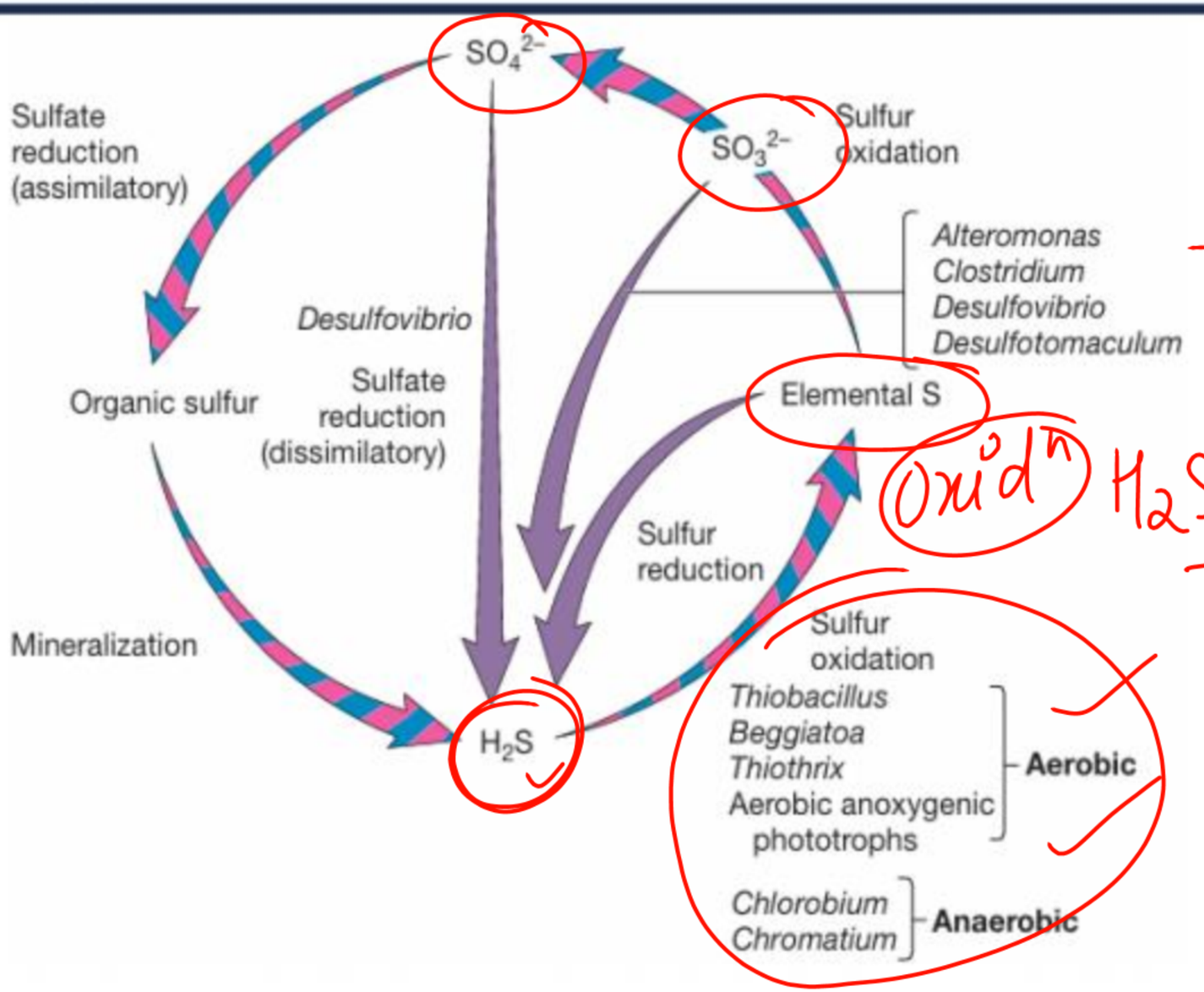

→ Equation

Oxid^n $H_2S \rightarrow S \rightarrow SO_3^{2-} \rightarrow SO_4^{2-}$

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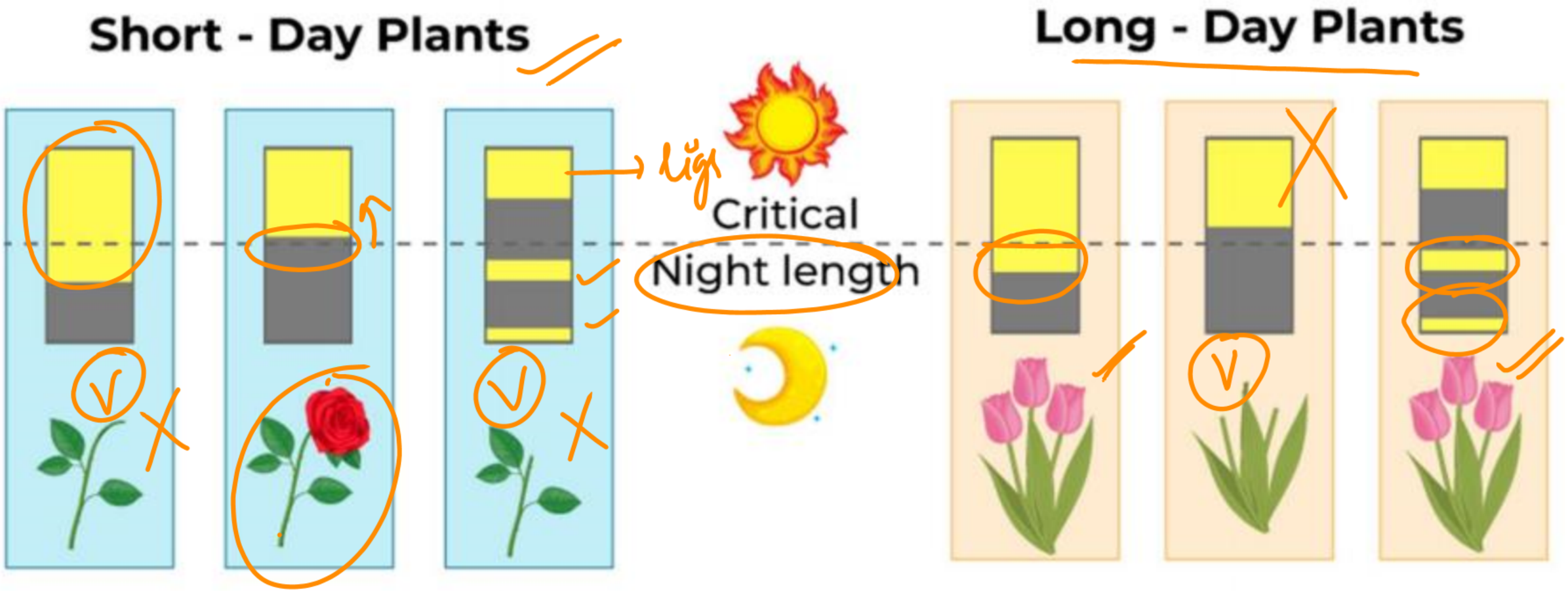

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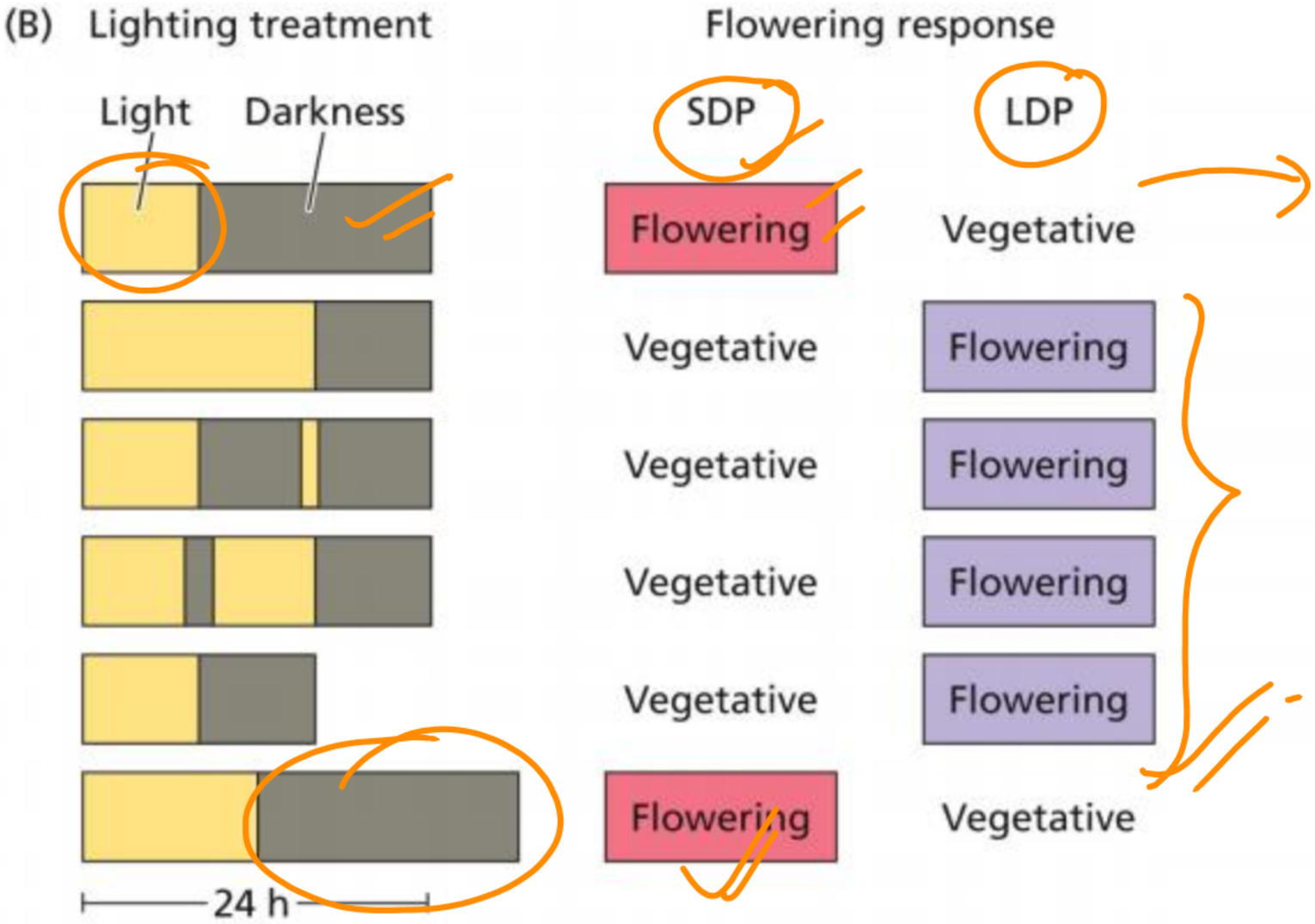
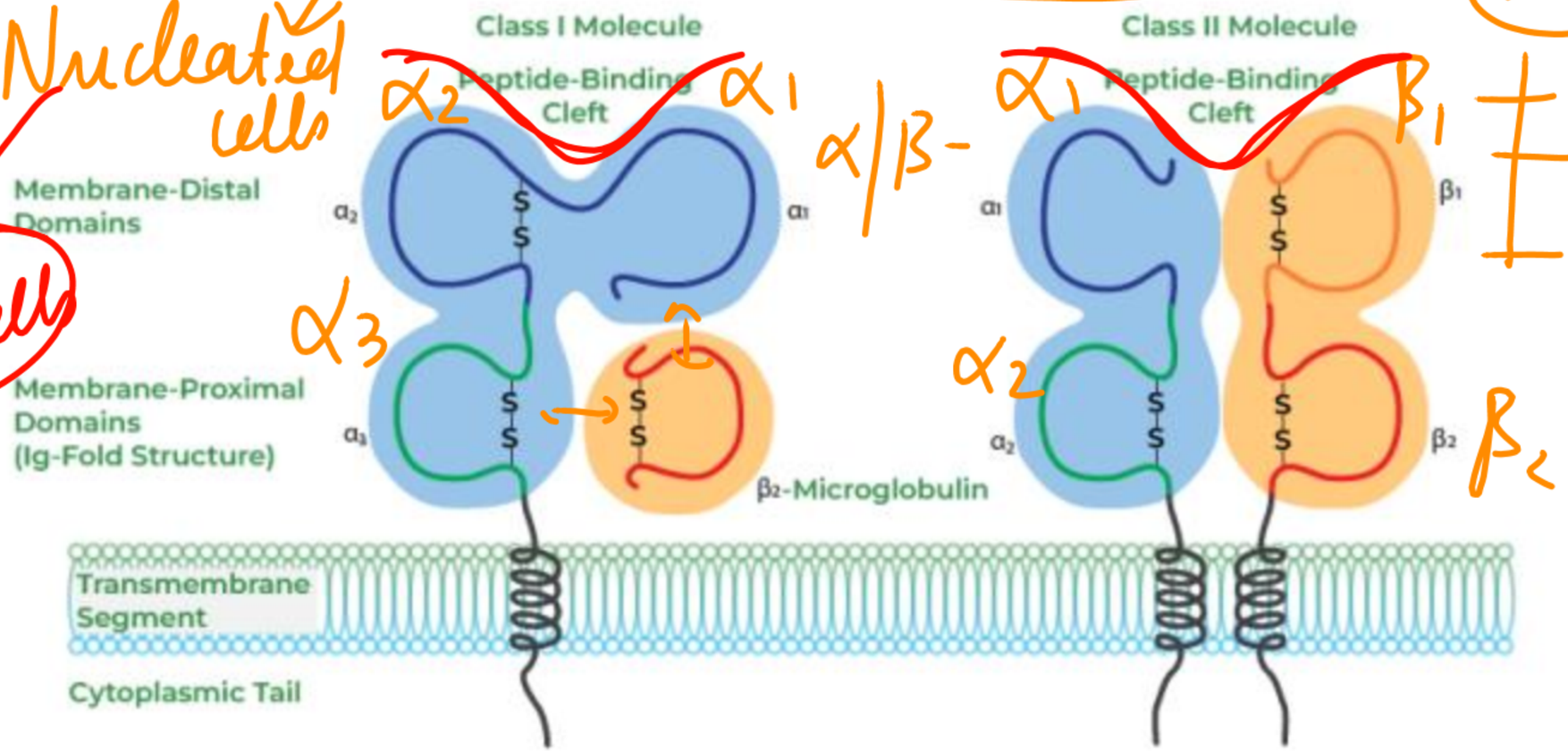


MHC Class I vs MHC Class II

APC

Nucleated cells

Tc cells



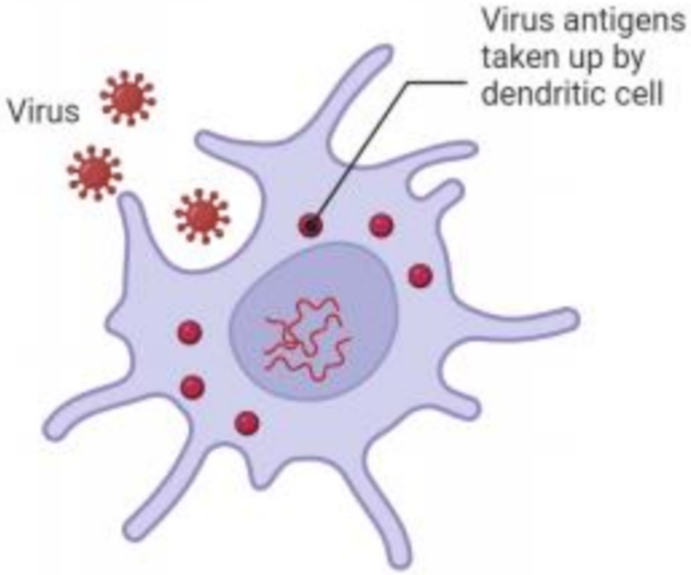
α/β-

B-cells
Dendrites
Macrophag

Different Types of Antigen Presenting Cells

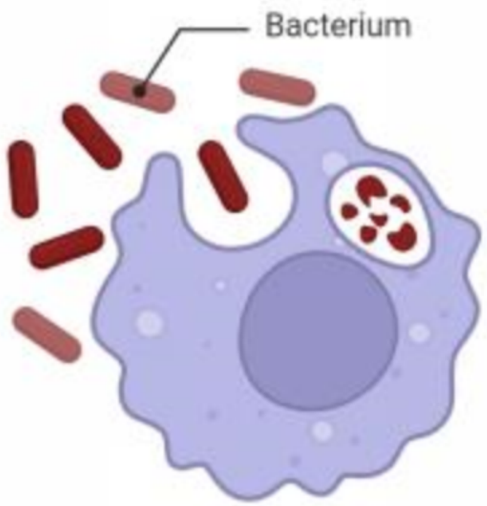
↳ MHC-II → T_H cells

Dendritic cell



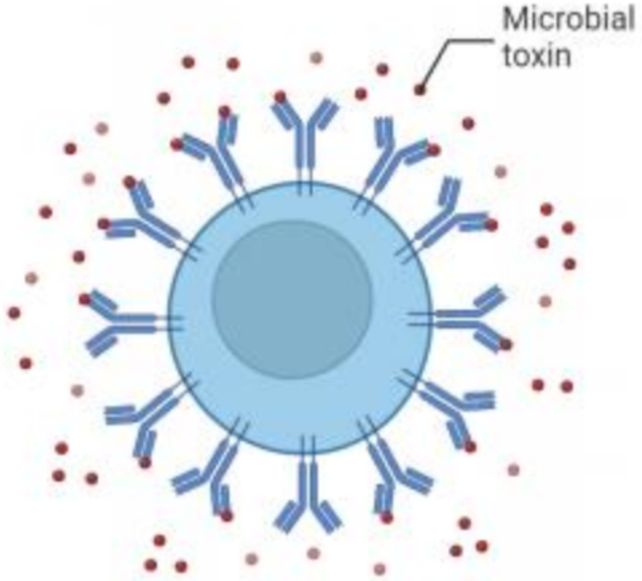
Viruses infecting dendritic cell

Macrophage



Bacteria infecting macrophage

B cell



Microbial toxins binding to B-cell receptors

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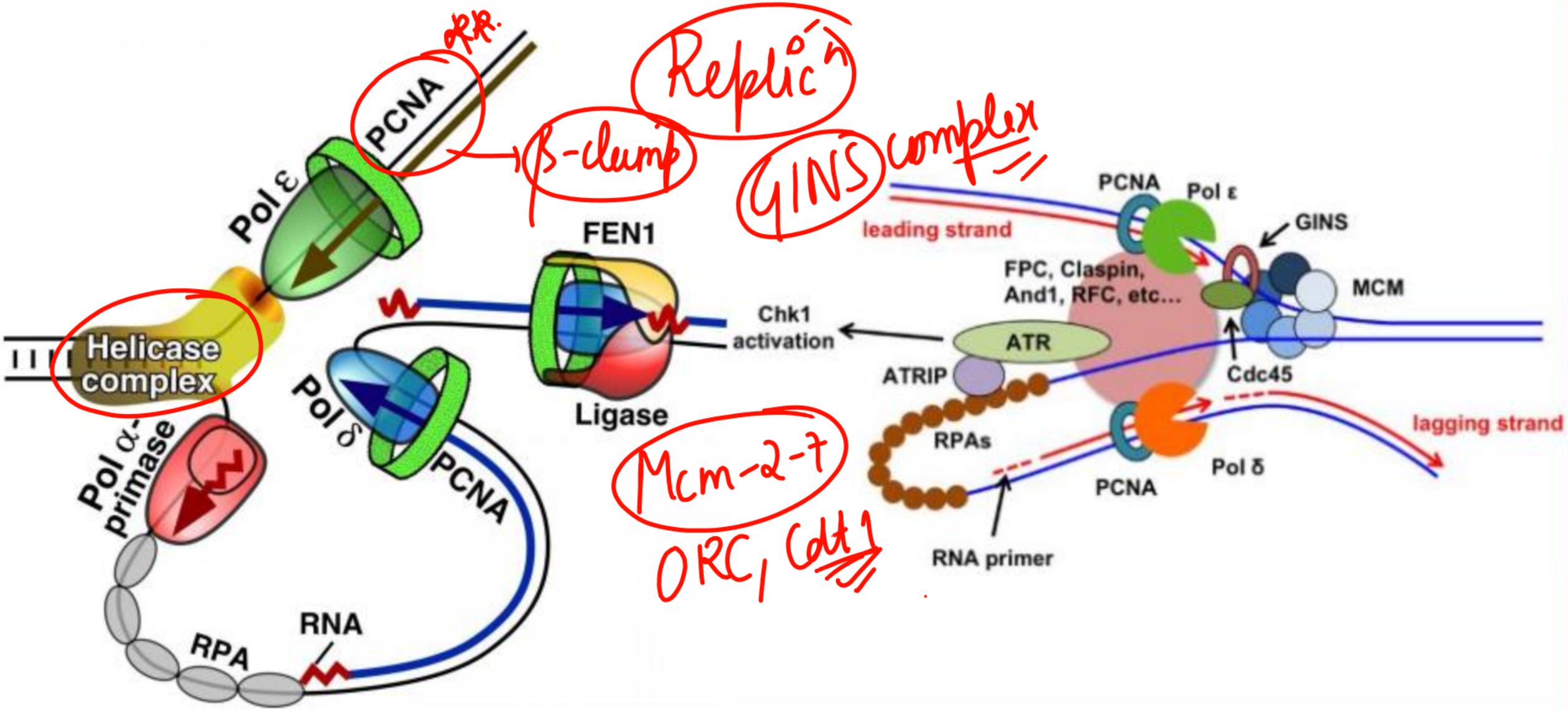
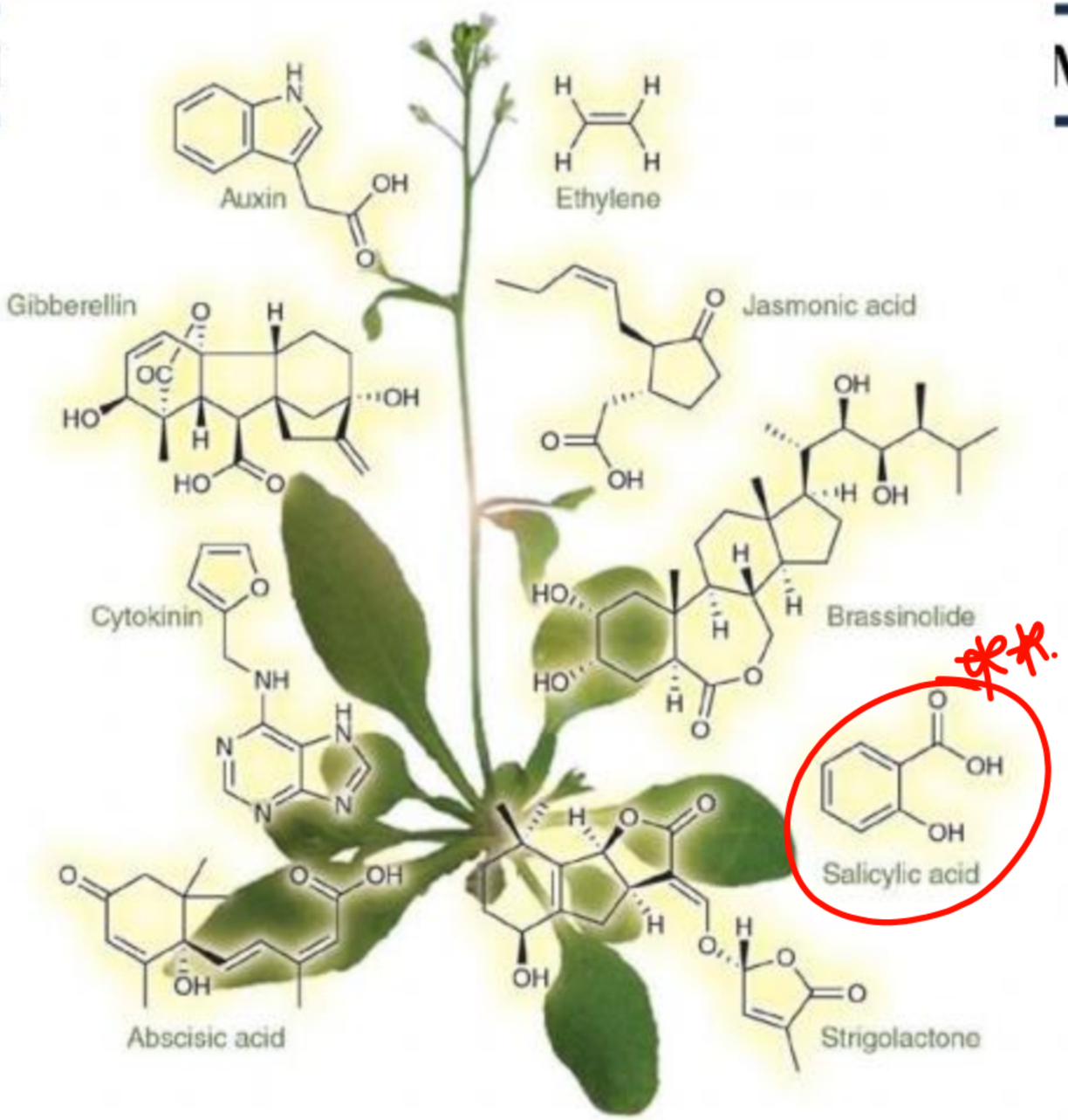


PLANT HORMONES

HORMONE	FUNCTION	LOCATION
Gibberellins	Increase the speed of seed germination; promote stem elongation; induce early blooming of flowers; increase fruit size	Shoot and root apical meristems; seeds
Auxins	Stimulate stem elongation; control seedling orientation; stimulate root branching; promote fruit development	Apical meristems; immature plant tissue
Ethylene	Increases the speed at which fruit ripens; stimulates leaf dropping and the death of flowers	All parts of the plant including the fruits
Abscisic acid	Inhibits growth and reproduction; inhibits seed germination; stimulates closure of stomata	Leaves; fruits; root tips; seeds
Cytokinins	Cause rapid cell division, in conjunction with auxin; induce seed germination; initiate new branches from lateral buds	Roots and fruits, primarily



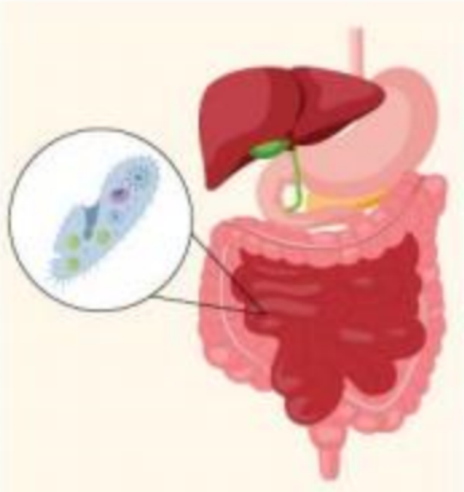
Symbiosis

A long-term association between two organisms of different species

(Nitrogen-fixing Bacteria and Leguminous Plants)

Mutualism

Both partners benefit



(Human and Protozoa)

Parasitism

One partner benefits, other is harmed

(A bird and a Tree)

Commensalism

One partner benefits, other unaffected

→ Plant symbiosis

* Frankia → higher plants
* Anabaena – Azolla

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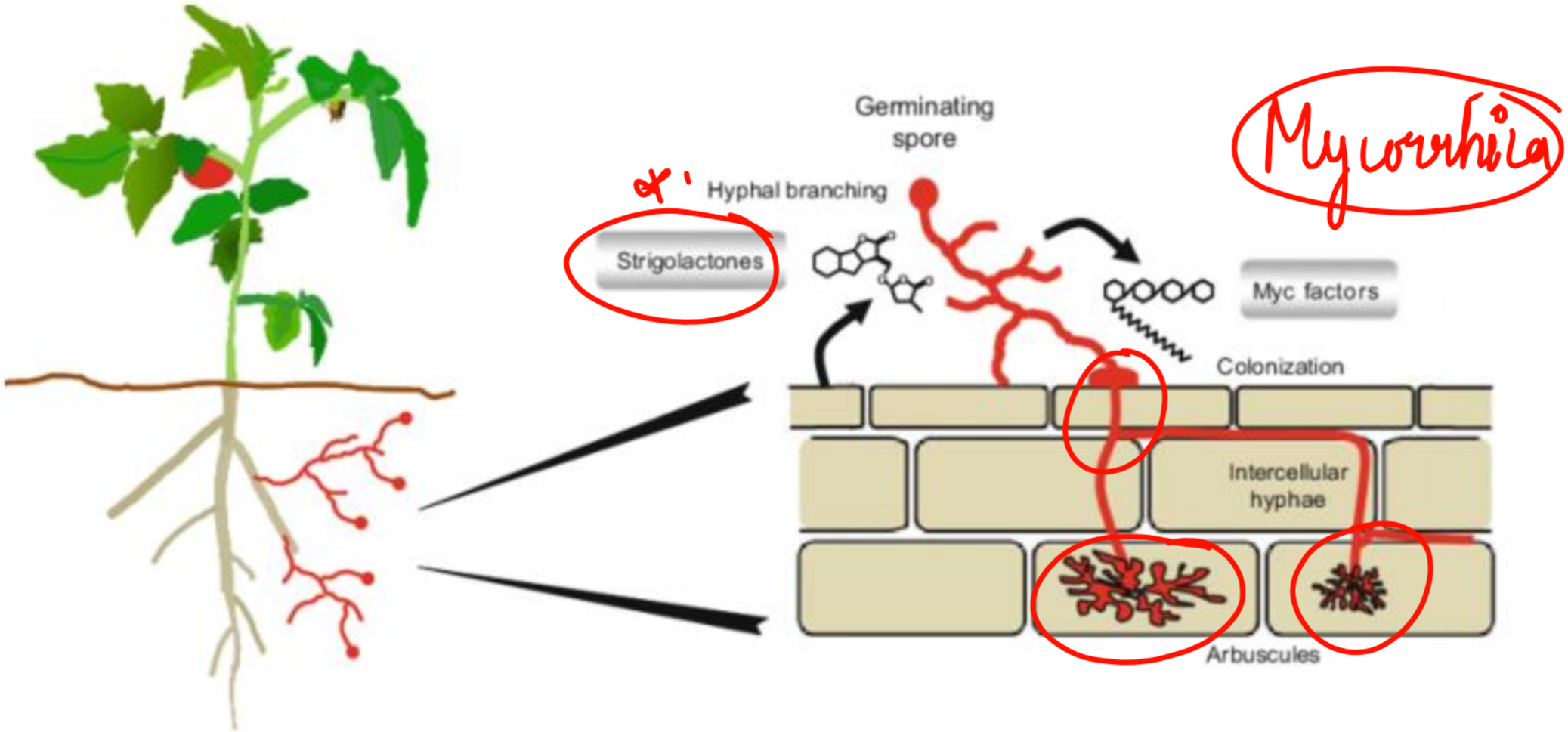
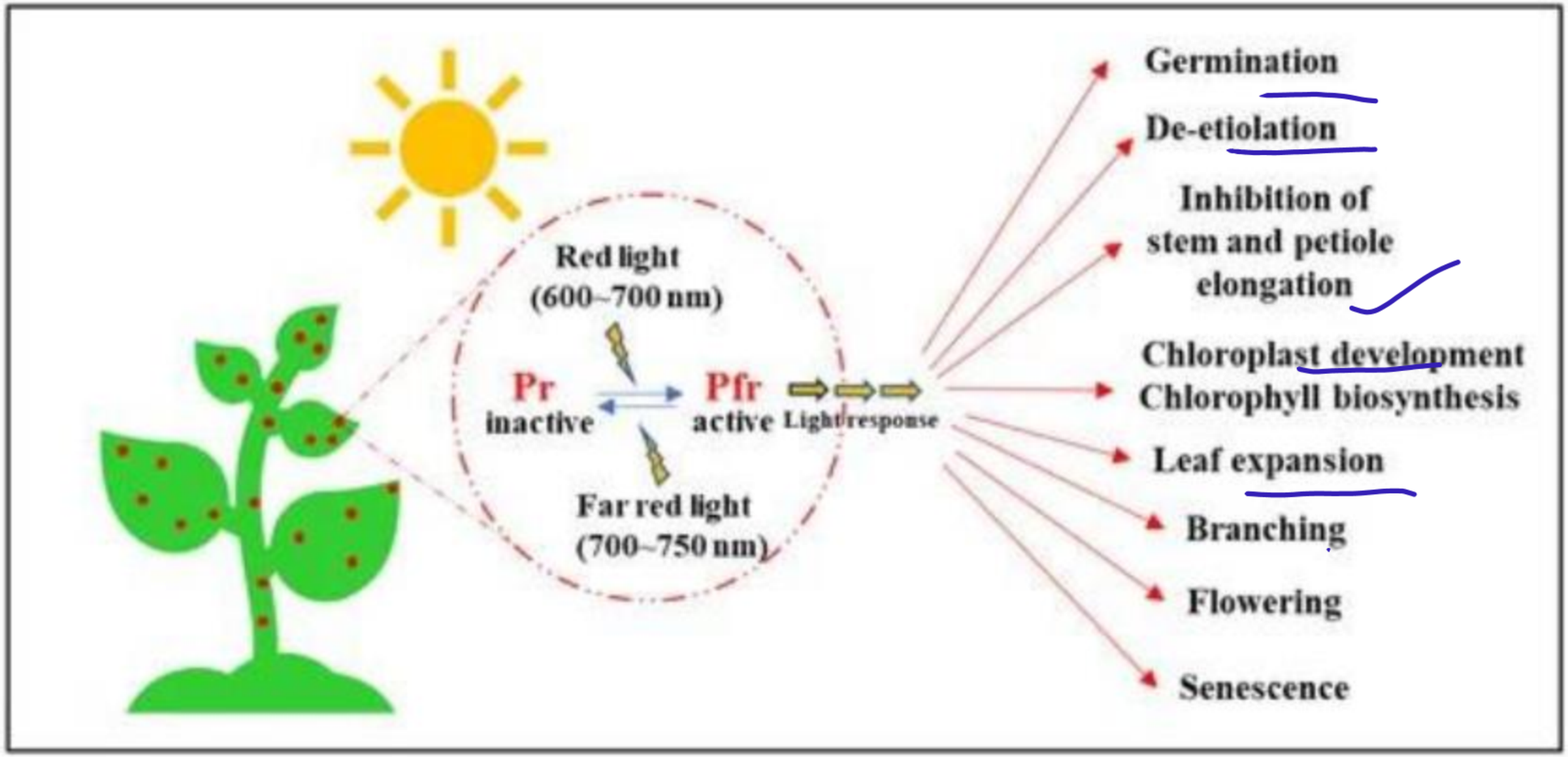
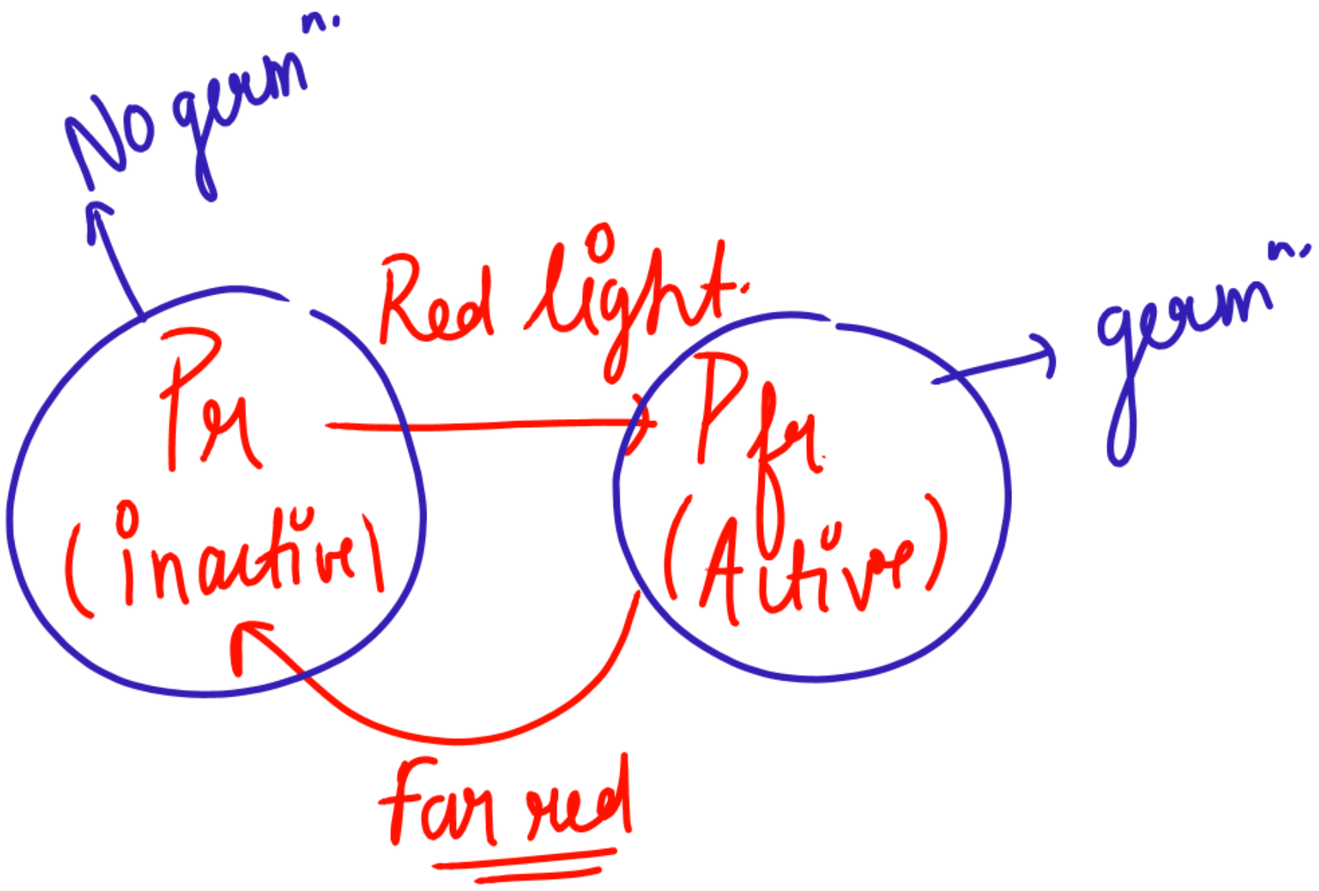



Red light
(600~700 nm)
Pr
inactive
Pfr
active
Light response
Far red light
(700~750 nm)
Germination
De-etiolation
Inhibition of
stem and petiole
elongation
Chloroplast development
Chlorophyll biosynthesis
Leaf expansion
Branching
Flowering
Senescence



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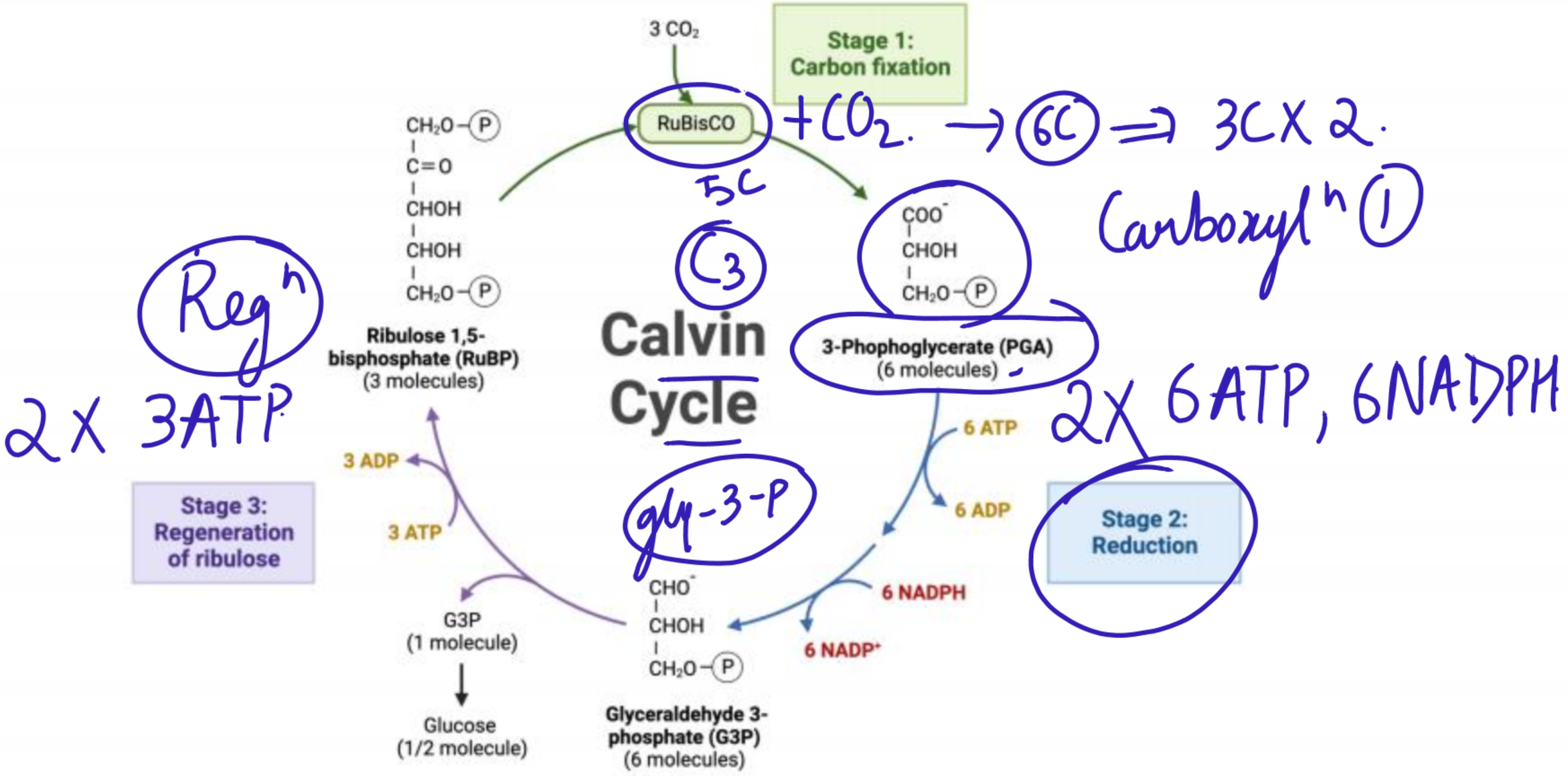

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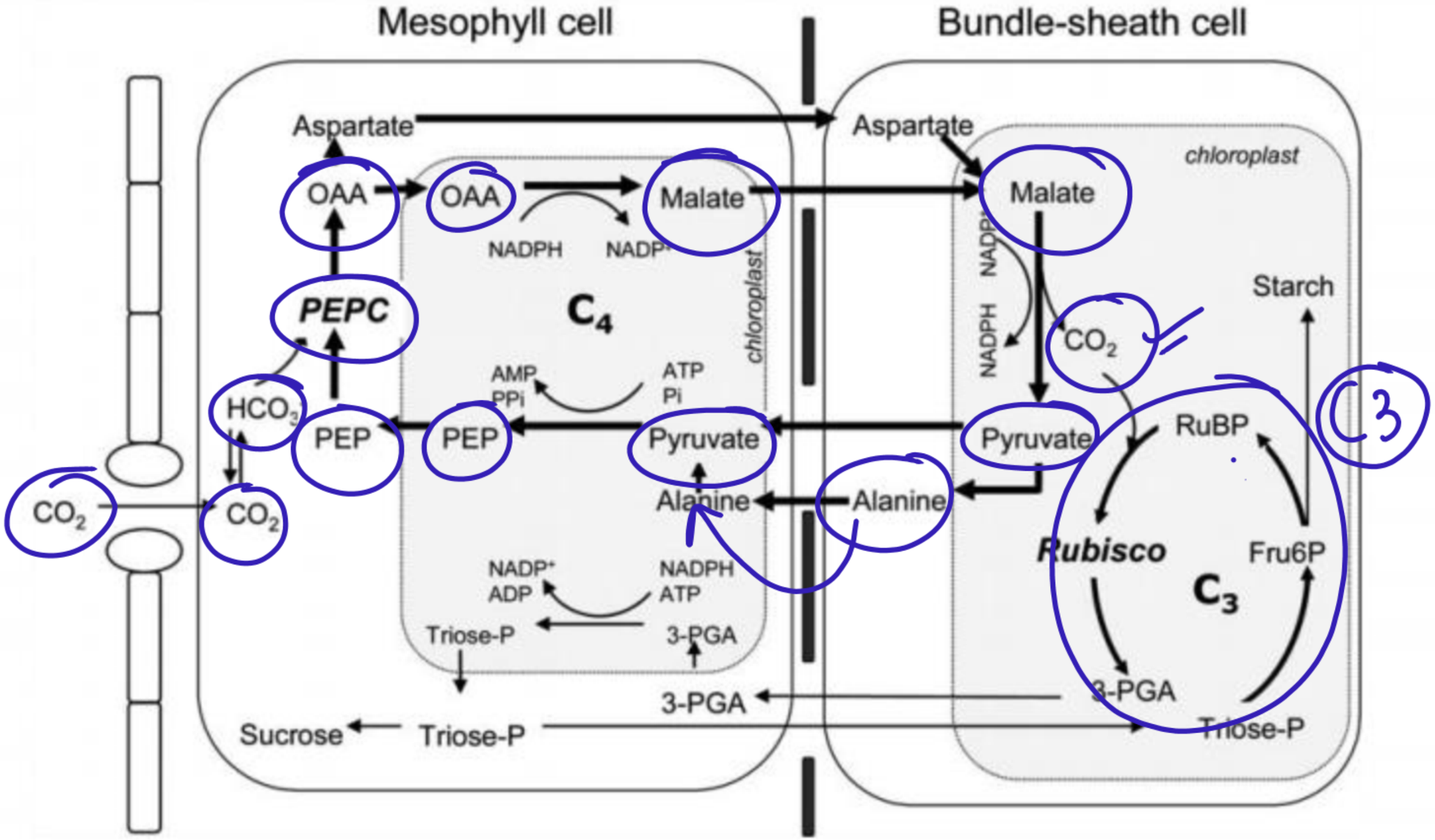

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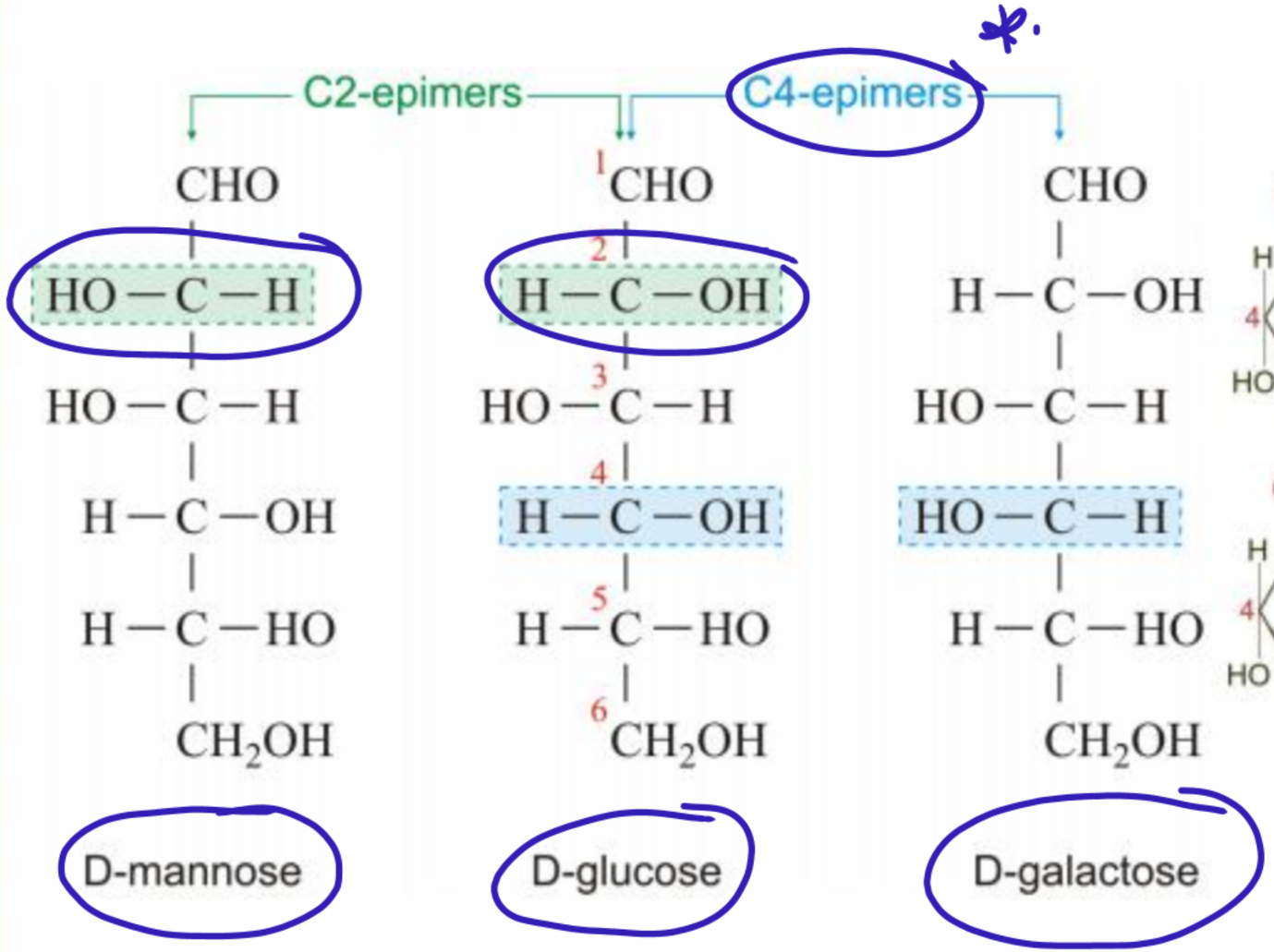

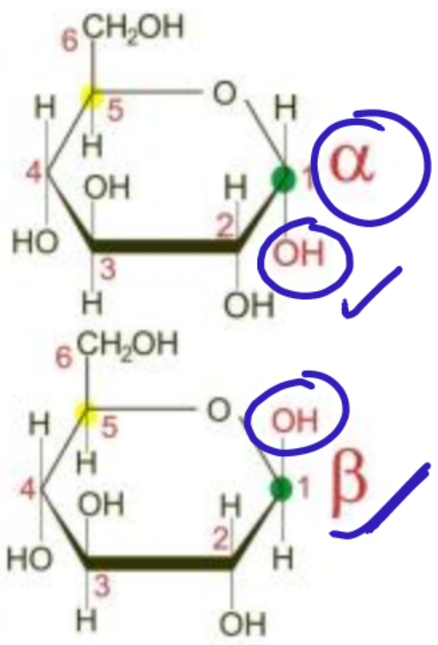

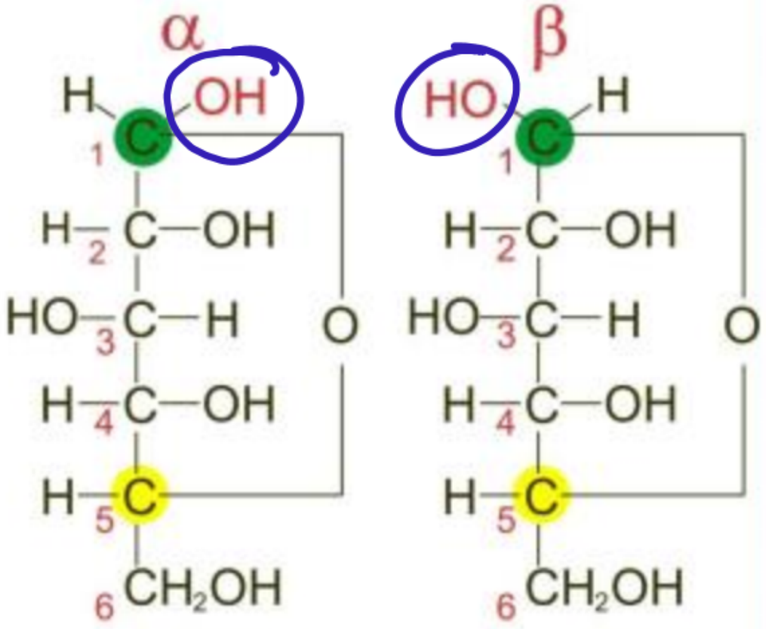

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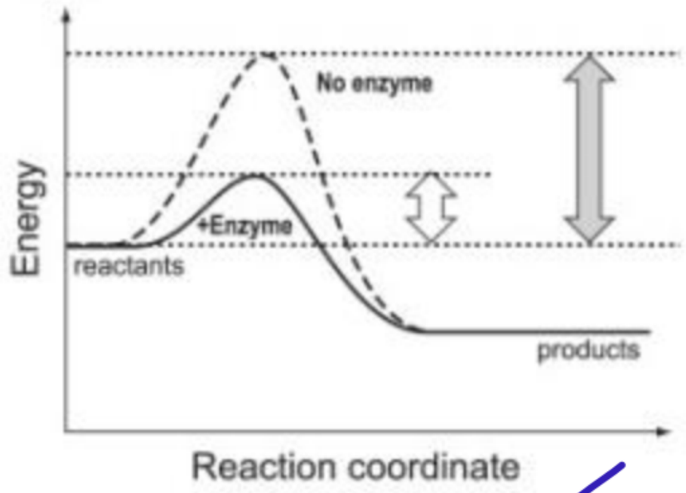
(A)

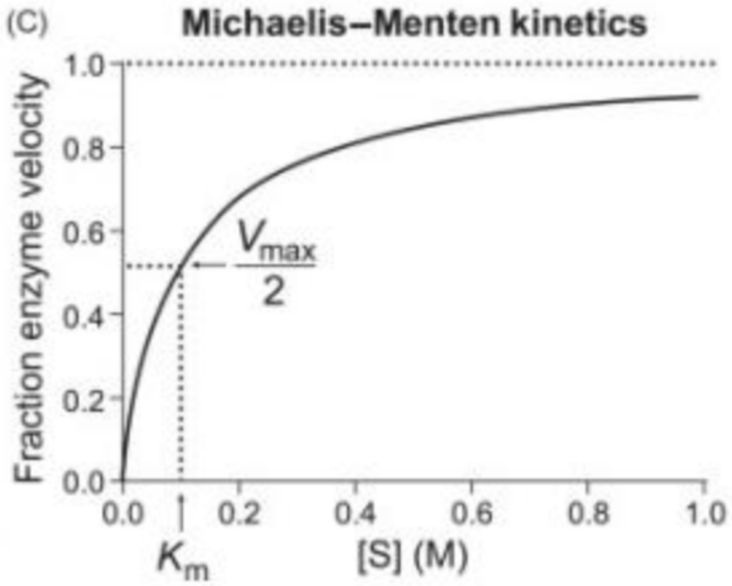
$$K_m = \frac{K_{-1} + k_2}{K_1}$$

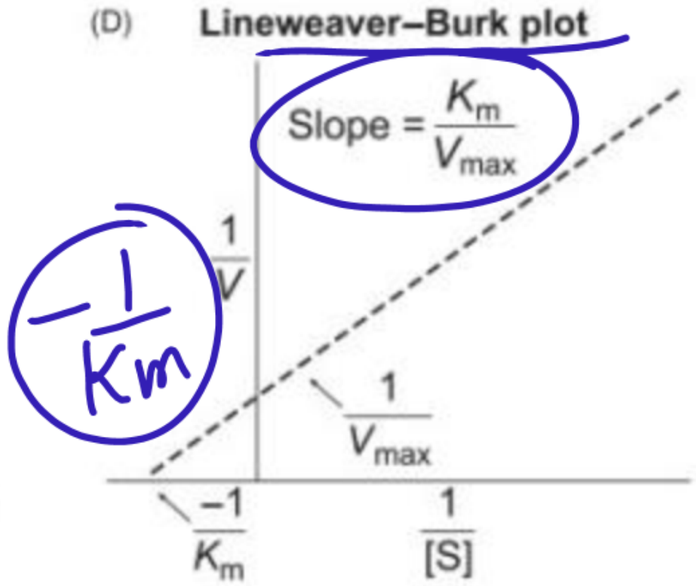
$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_{cat}} E + P$$

$$V = \frac{V_{max}[S]}{K_m + [S]}$$



Enzyme Kinetic





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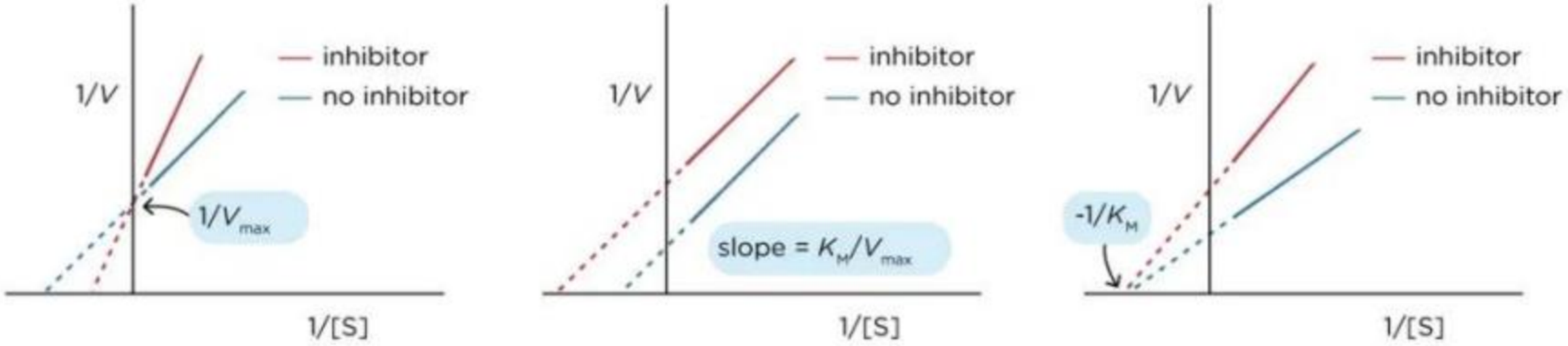
The Lineweaver-Burk plots for inhibition



Competitive inhibition

K_M increased

V_{max} unaffected

Uncompetitive inhibition

K_M reduced

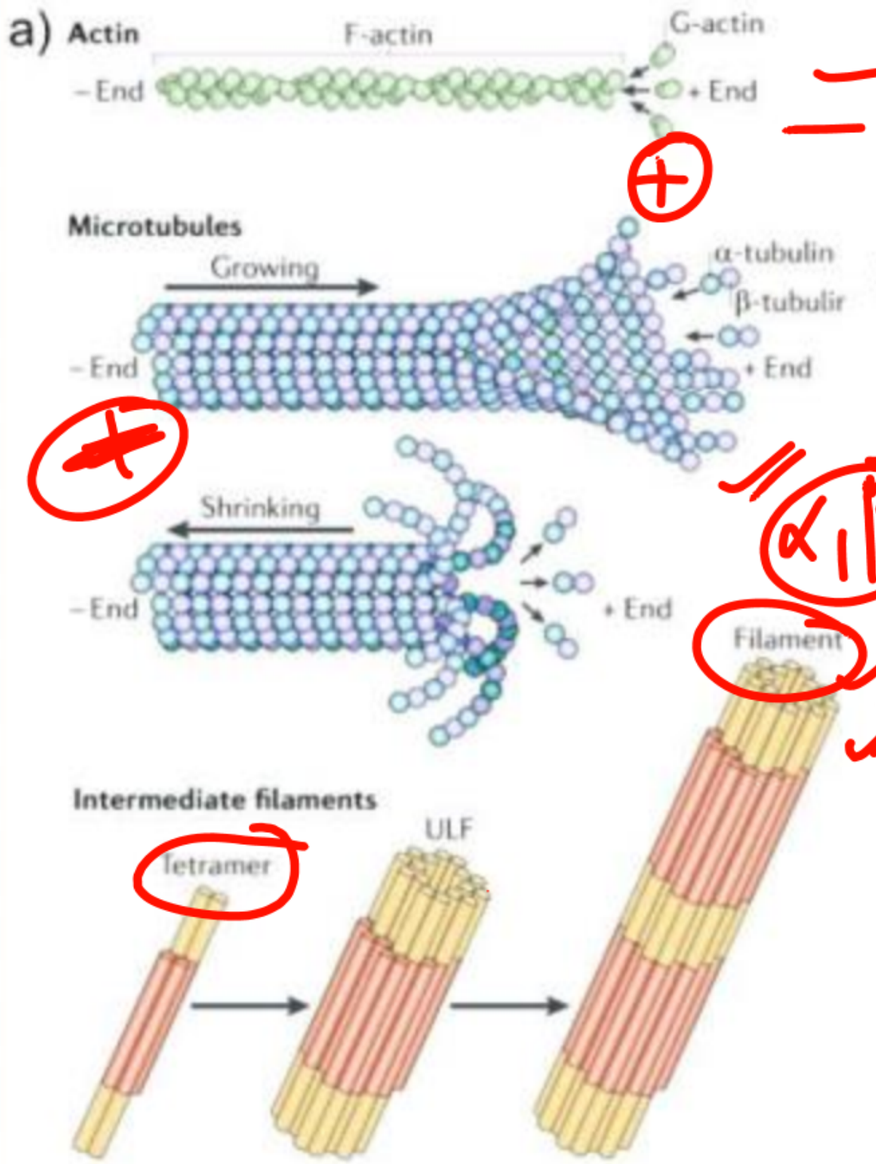
V_{max} reduced

Noncompetitive inhibition

K_M unaffected

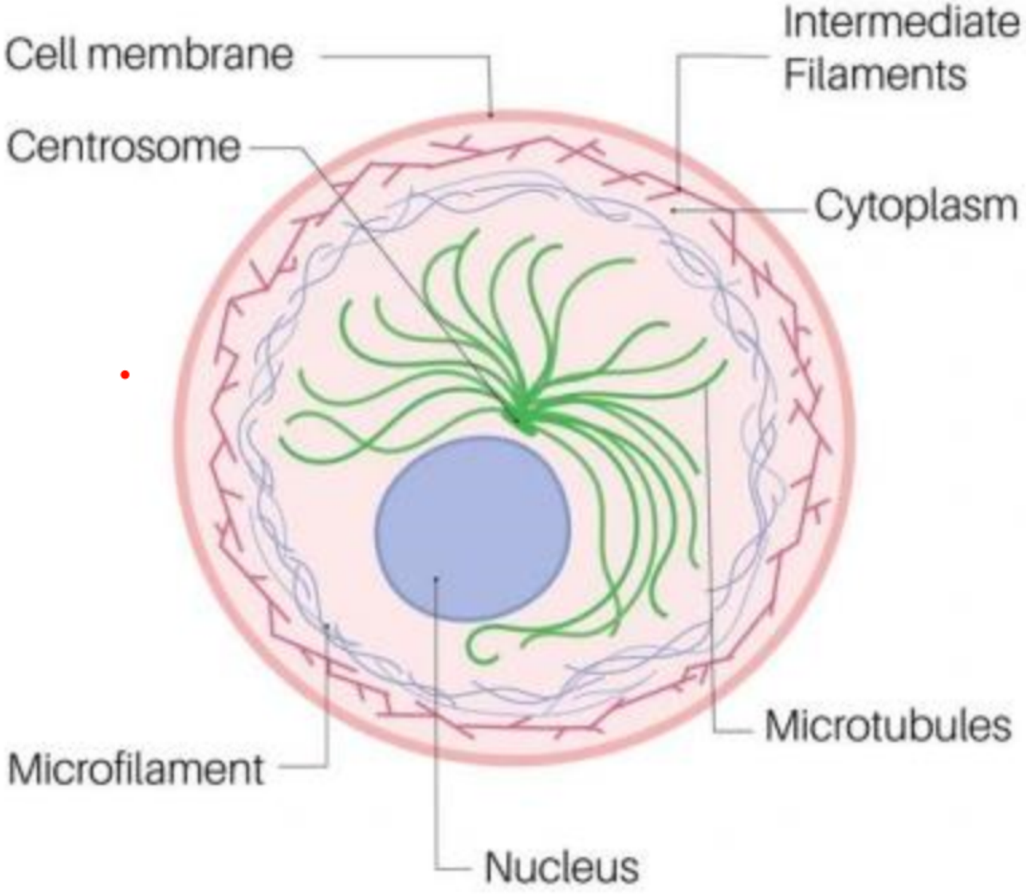
V_{max} reduced

Cytoskeleton



→ Microfilament

α, β



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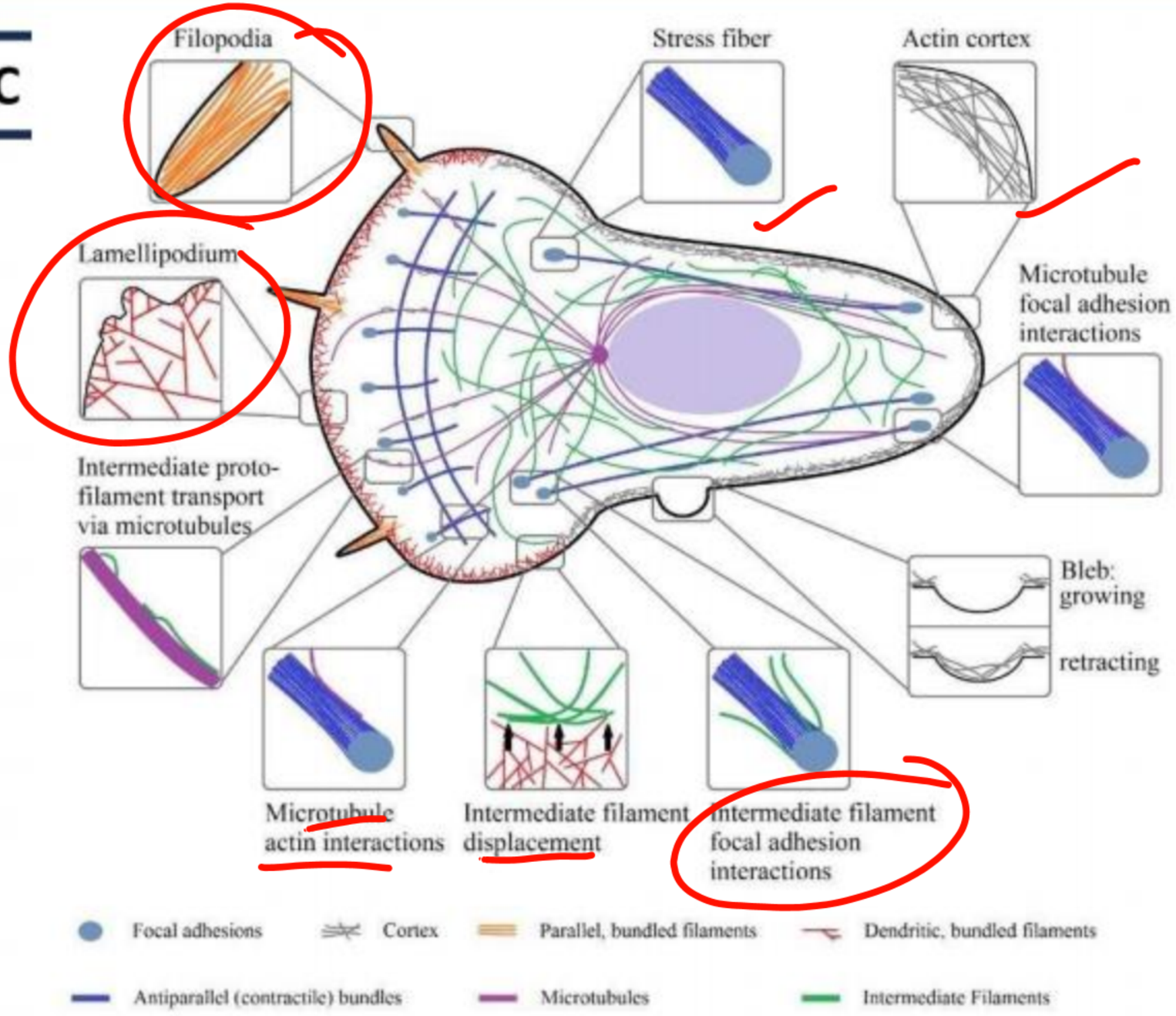

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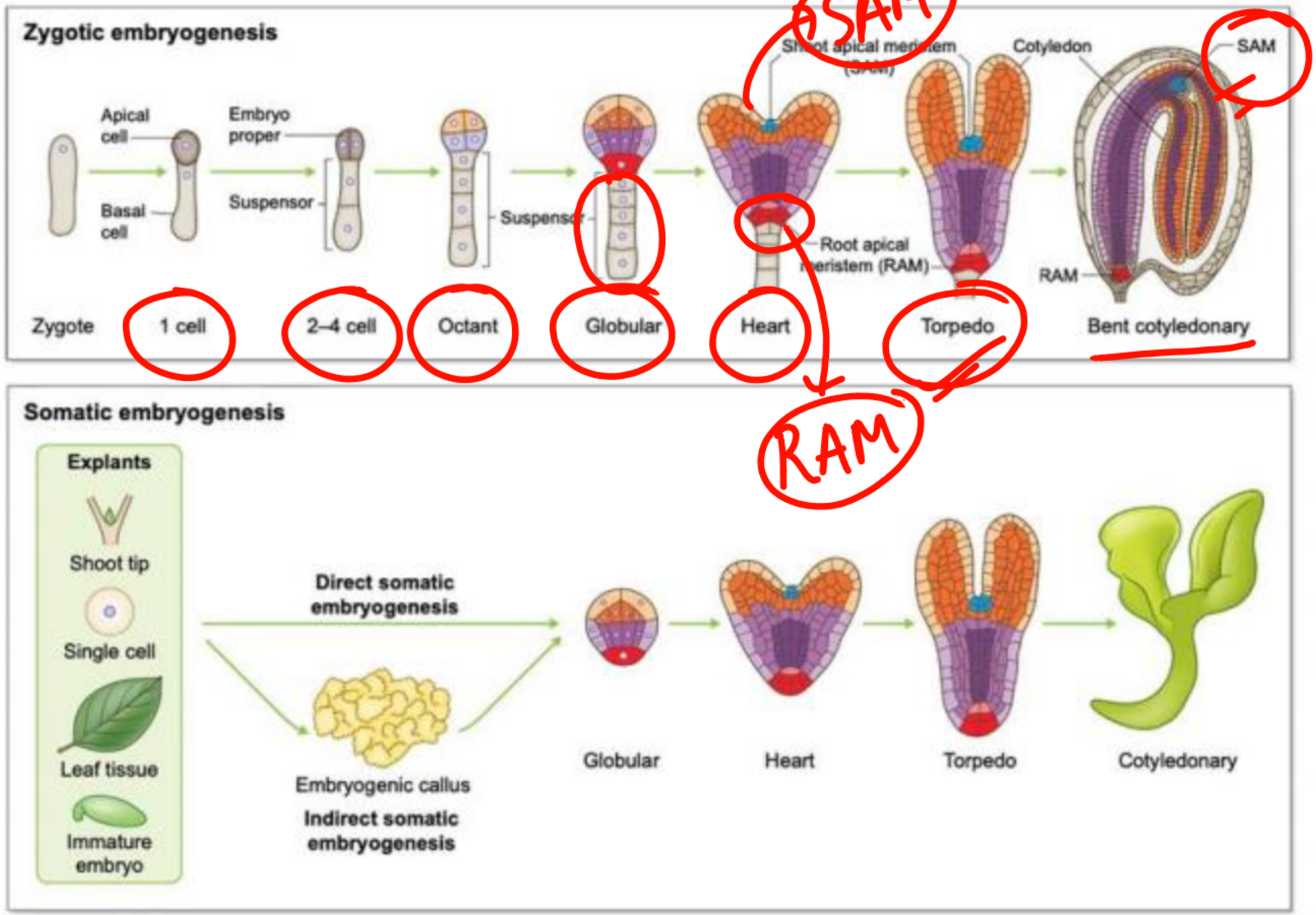

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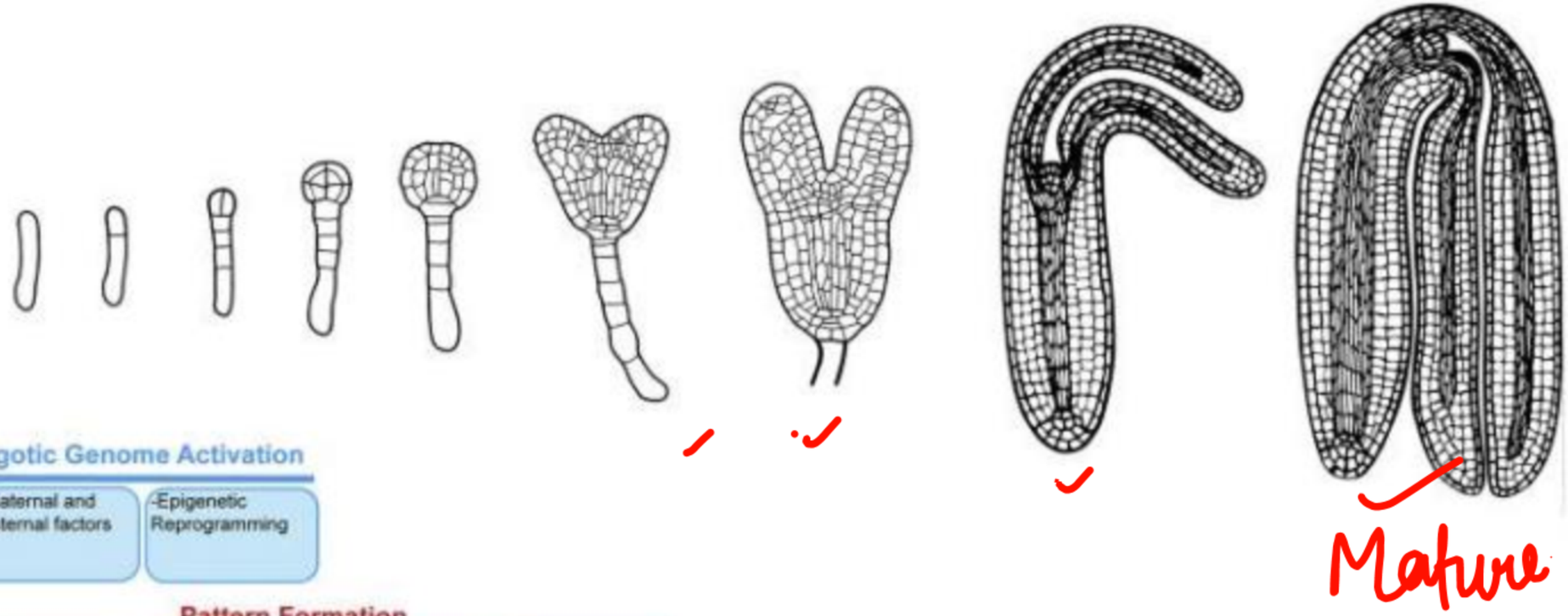

Zygotic Genome Activation

- -Maternal and Paternal factors
- -Epigenetic Reprogramming

Pattern Formation

- -SSP-YDA-MAPK signaling cascade
- -WRKY2-WOX8
- -Growth and Polarizing factors
- -Auxin synthesis
- -Auxin transporters
- -Auxin TFs
- -SOSEKI?
- -WOX5 - RAM TFs
- -lncRNA, miRNAs
- -Inner&outer layer TFs
- -SAM TFs
- -Cotyledon specification TFs
- -Endodermis differentiationTFs
- -Vascular tissues specification TFs

Maturation

- -Chlorophyll accumulation
- -TAG synthesis
- -Protein accumulation 12S globulins & 2S albumins
- -Secondary metabolite compound pathways
- -Cell division and expansion
- -Dessication and Dormancy TFs

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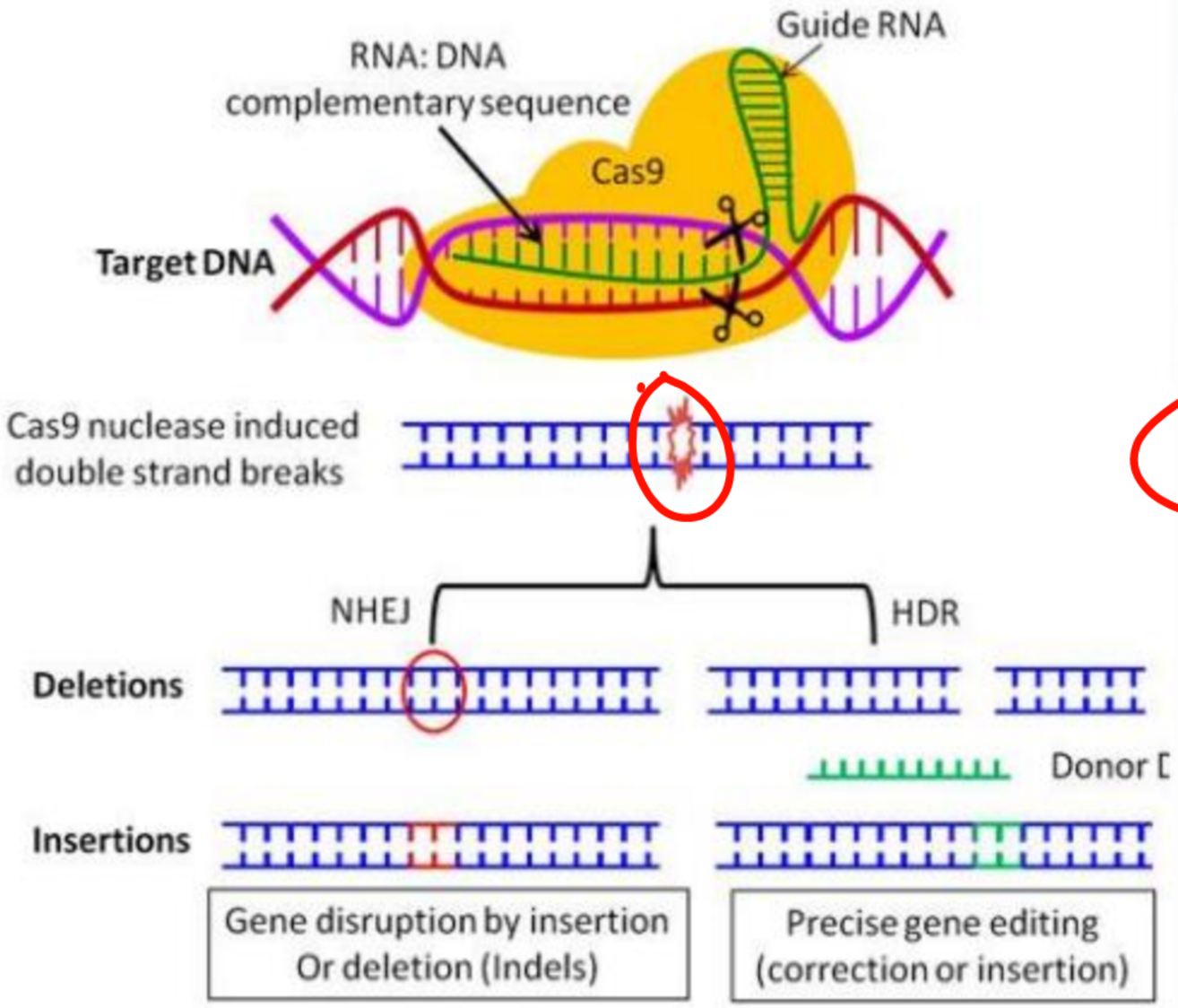
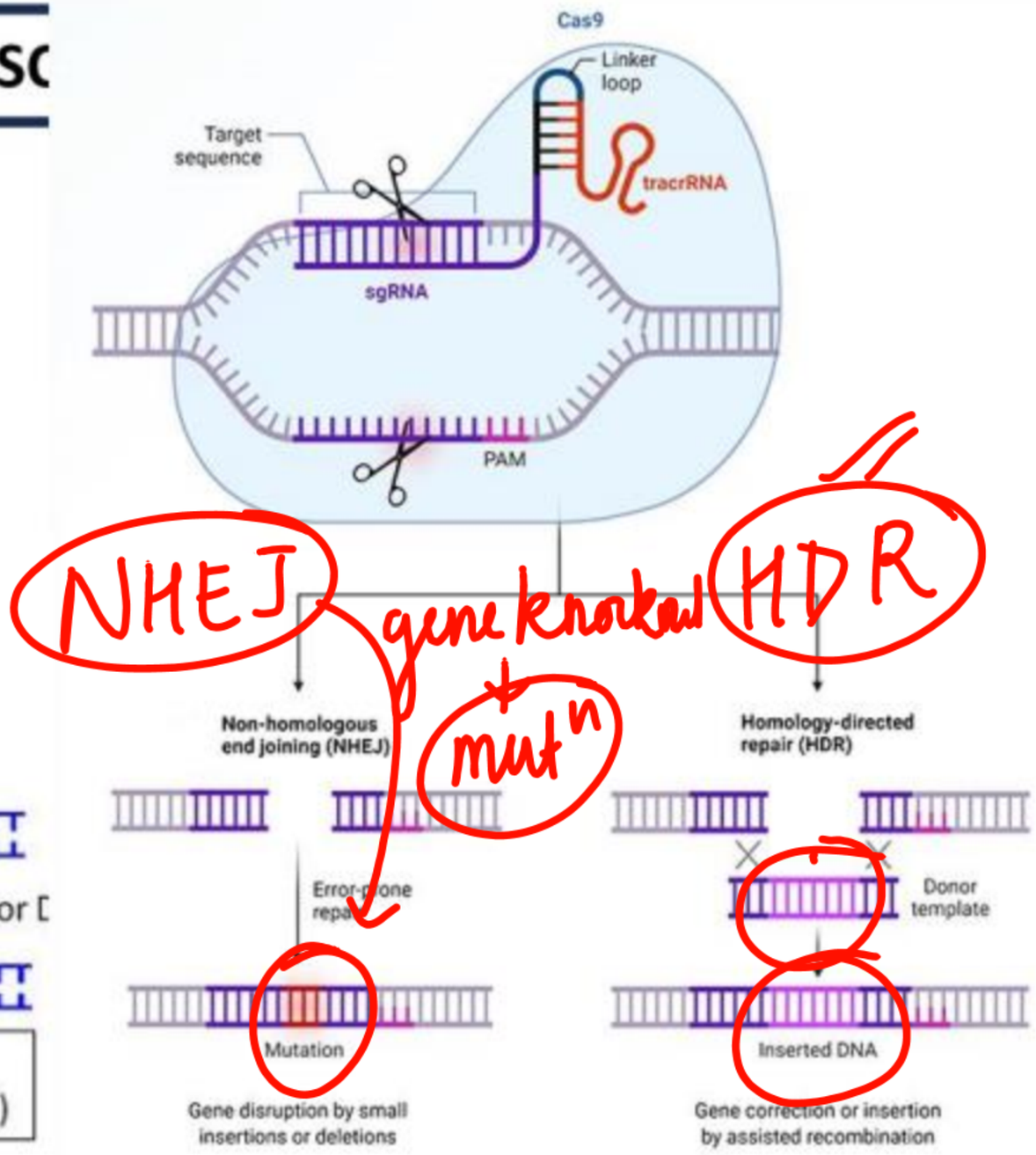
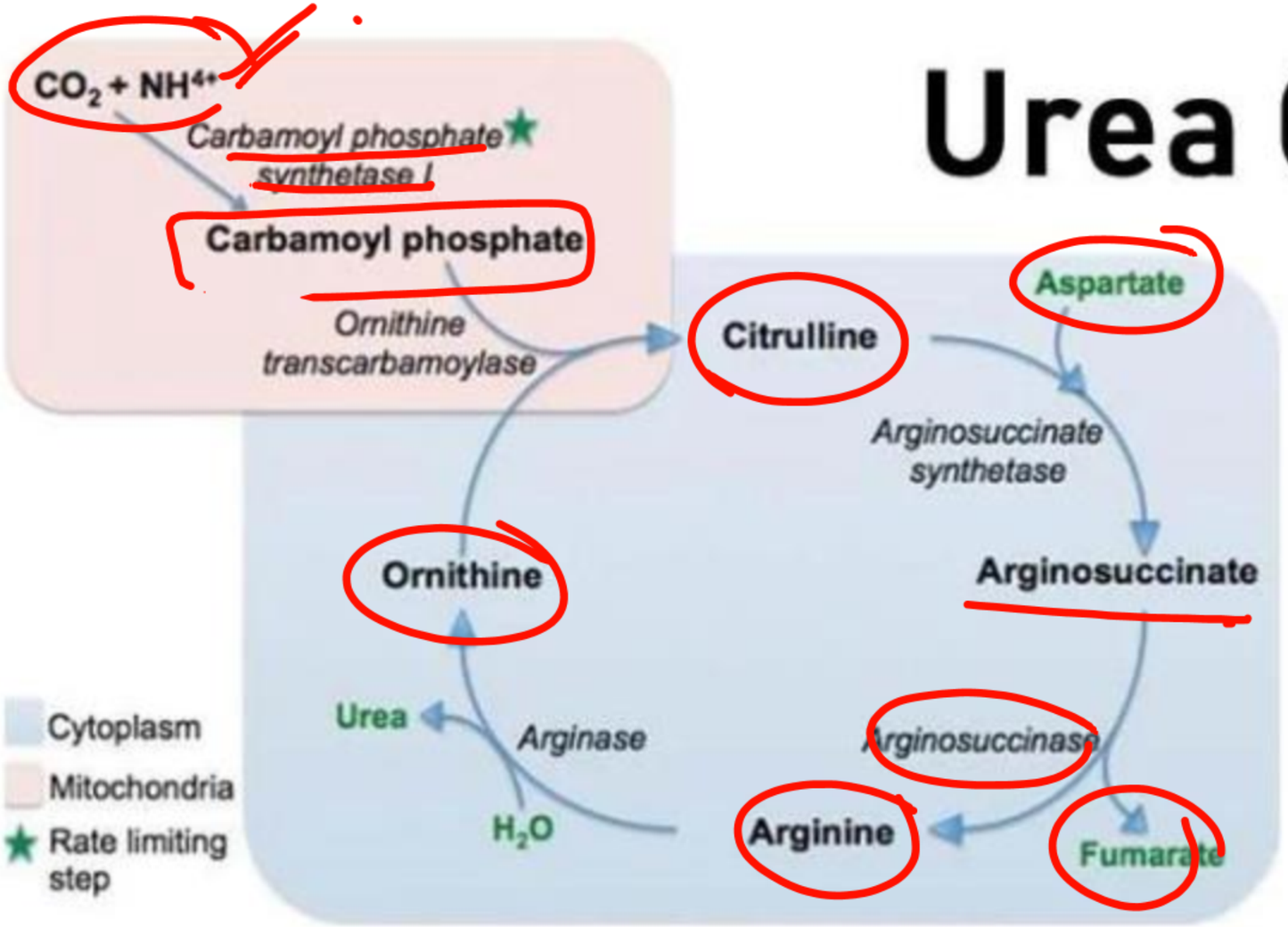




Urea Cycle



Enzymes & Steps

Viral disease ?

- Tetanus → Clostridium
- Rubella
- Smallpox.

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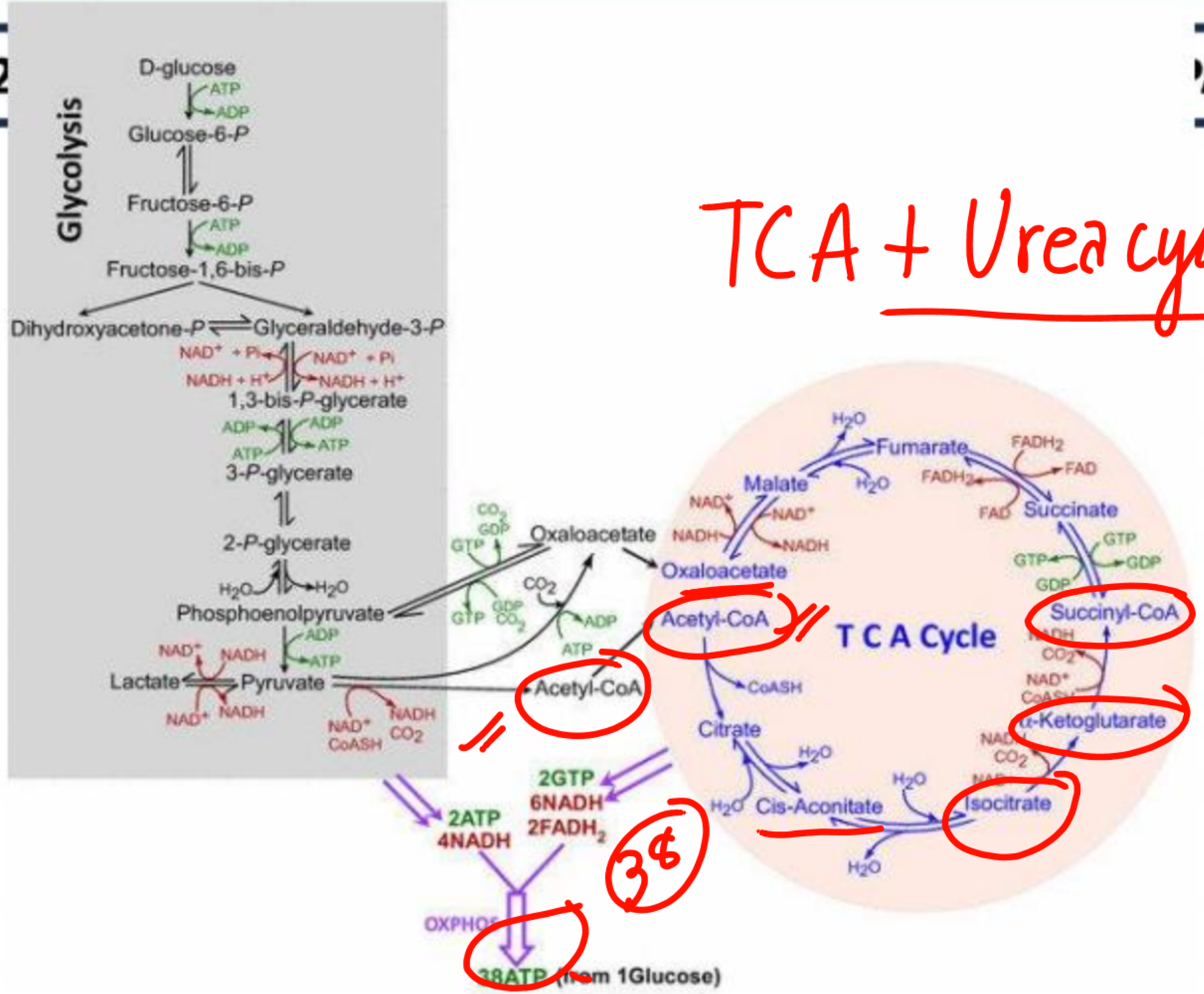
TCA + Urea cycle



pH, pKa.

$$pH = pKa + \log \frac{[\text{conjugate base}]}{[\text{Acid}]}$$

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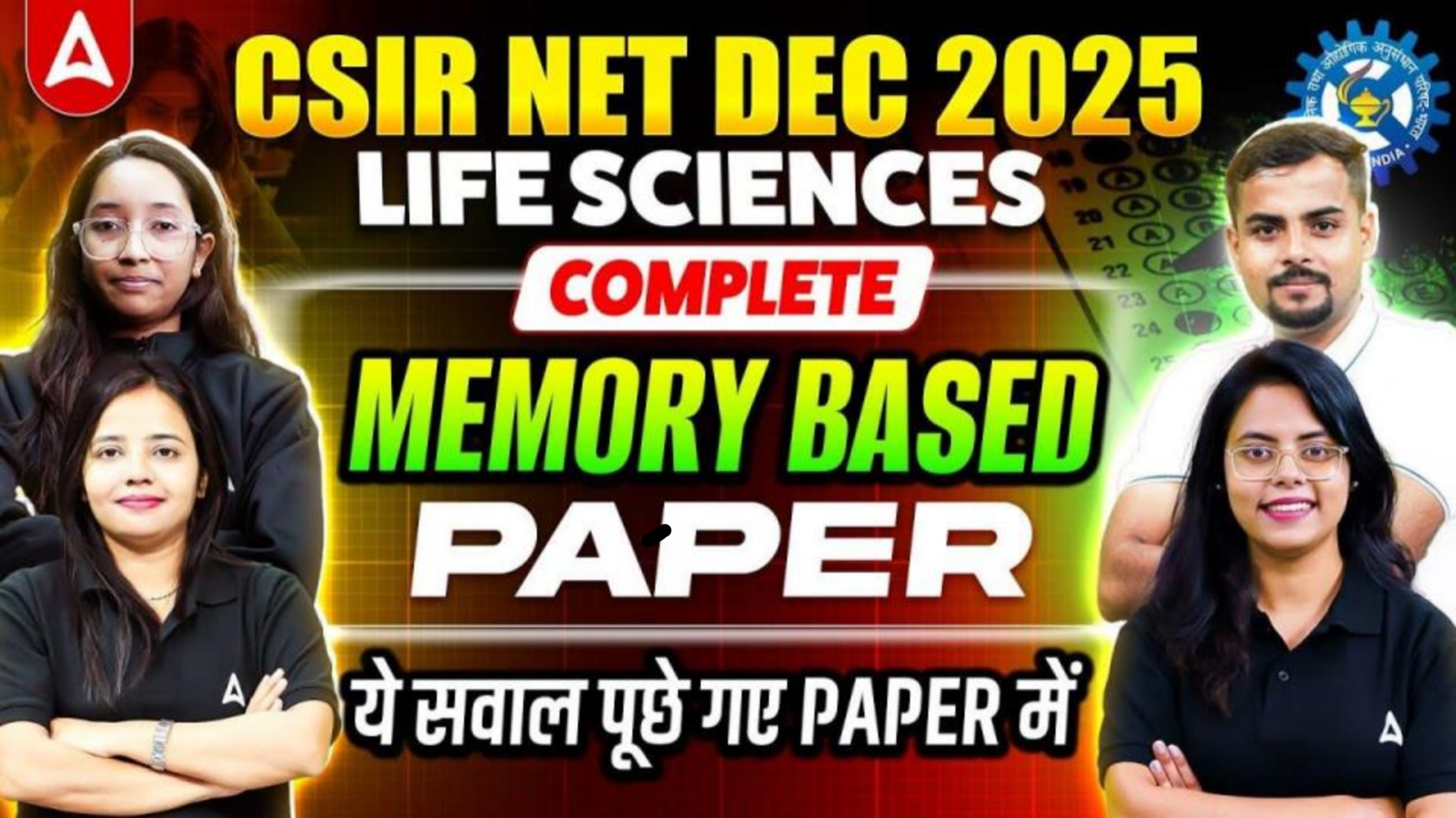
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Two antibodies raised against the same protein:

- Antibody A → works in Western blot (WB) but not in ELISA
- Antibody B → works in ELISA but not in Western blot

Technique	Protein State	Epitope Type Recognized
Western Blot	Denatured	Linear epitope
ELISA	Native	Conformational epitope

Western blot conditions:

- Protein is **denatured** (SDS + heat)
- 3D structure is **lost**
- Only **linear epitopes** are exposed

ELISA conditions:

- Protein usually in **native or near-native conformation**
- 3D structure is **intact**

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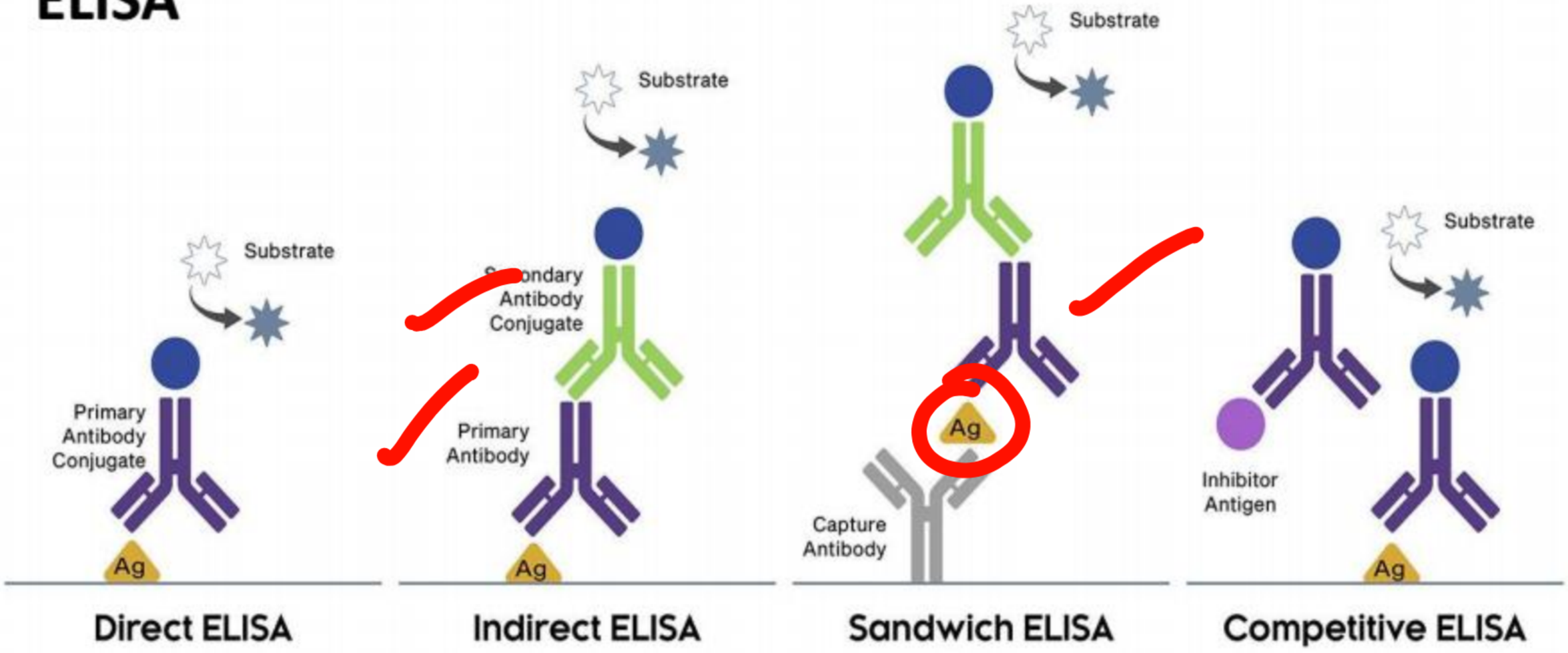
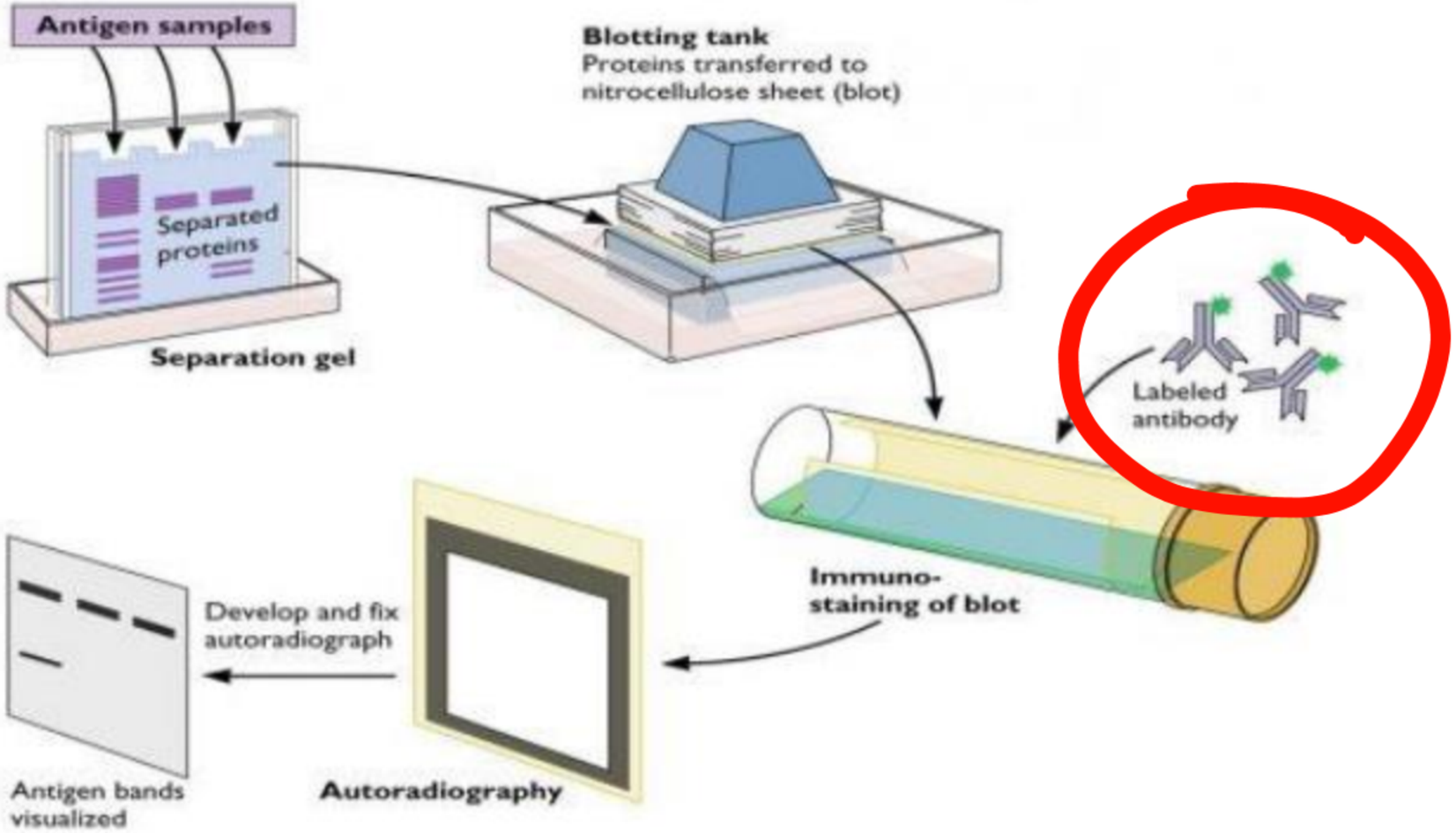
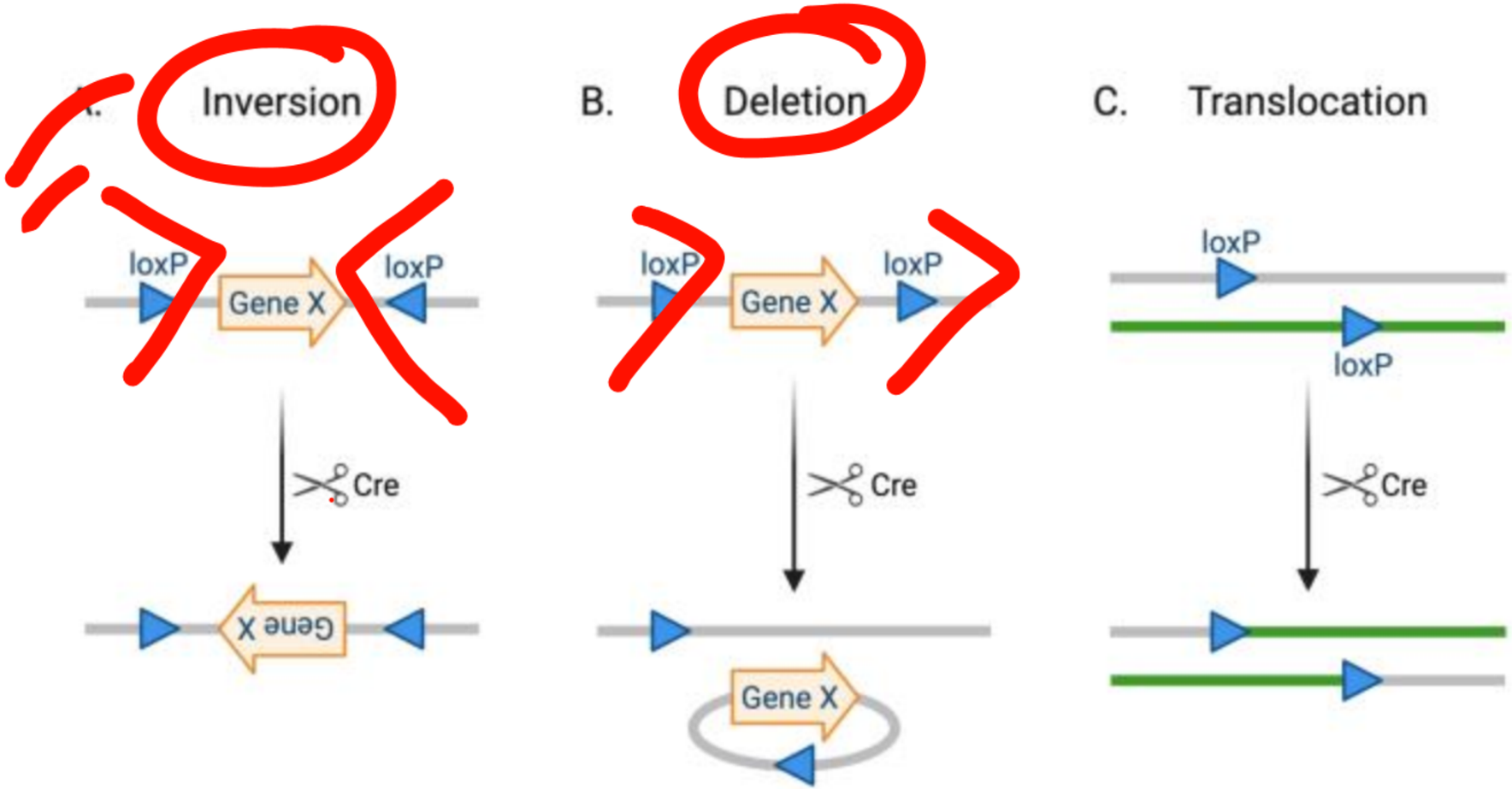
ELISA



Western Blotting Technique



Q – CRE LOX P

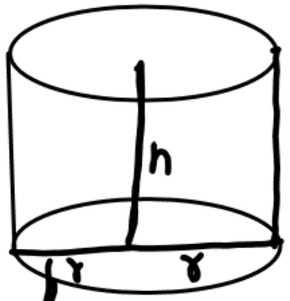

A. Inversion
B. Deletion
C. Translocation
loxP
Gene X
loxP
Cre
Gene X
loxP
Gene X
loxP
Cre
Gene X
loxP
loxP
Cre

Cylinder

Ratio & proportion

Probability

$$P(E) = \frac{\text{Favorable outcomes}}{\text{Total outcomes}}$$



D

volume $= \pi r^2 h$

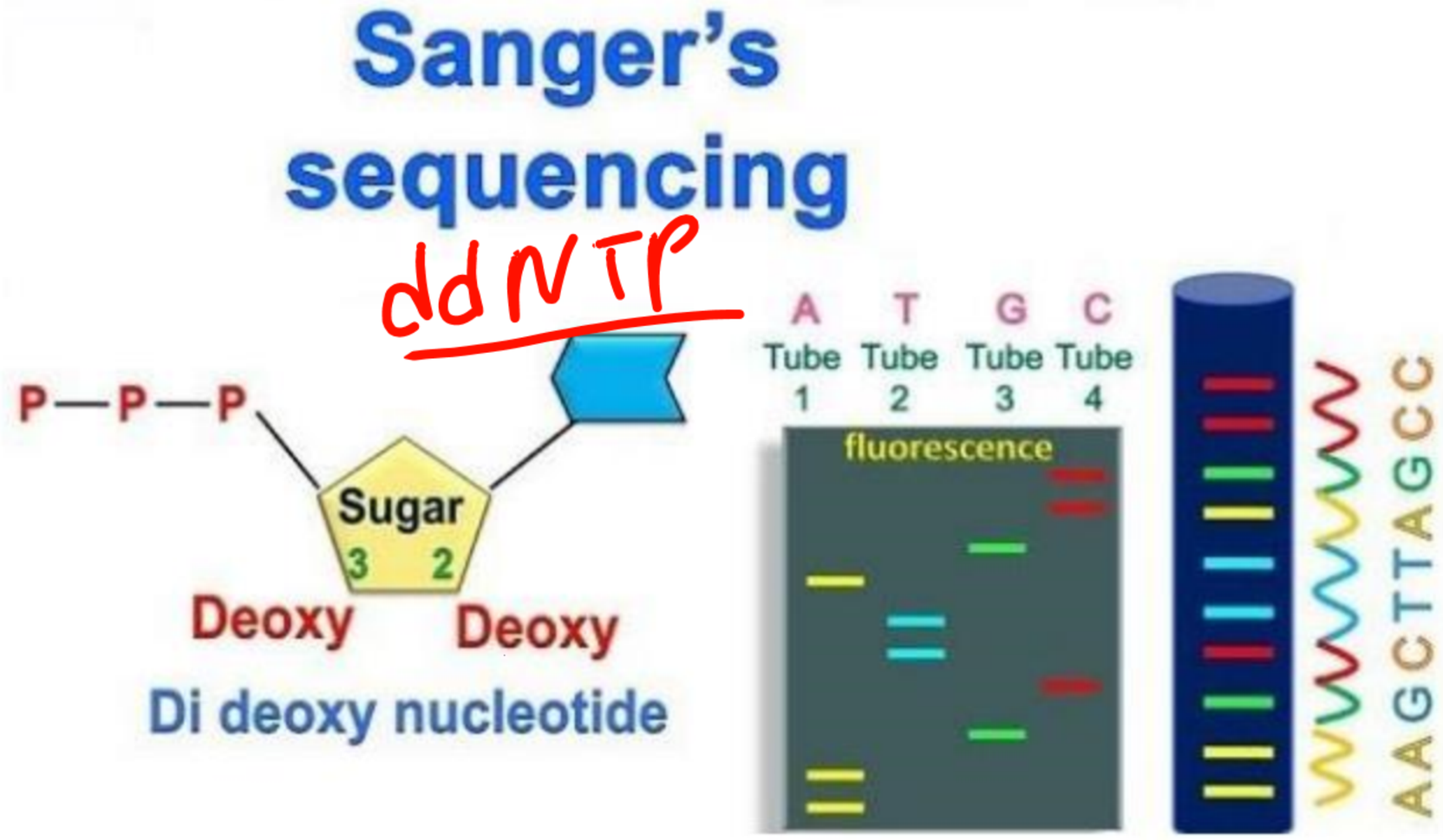
CSA $= 2\pi r h$

T.S.A = CSA + base(A) + Top(A)

$$\boxed{\begin{aligned} &= 2\pi r h + \pi r^2 + \pi r^2 \\ &= 2\pi r h + 2\pi r^2 \end{aligned}}$$

$= 2\pi r(r+h)$

Q – SANGER SEQUENCING



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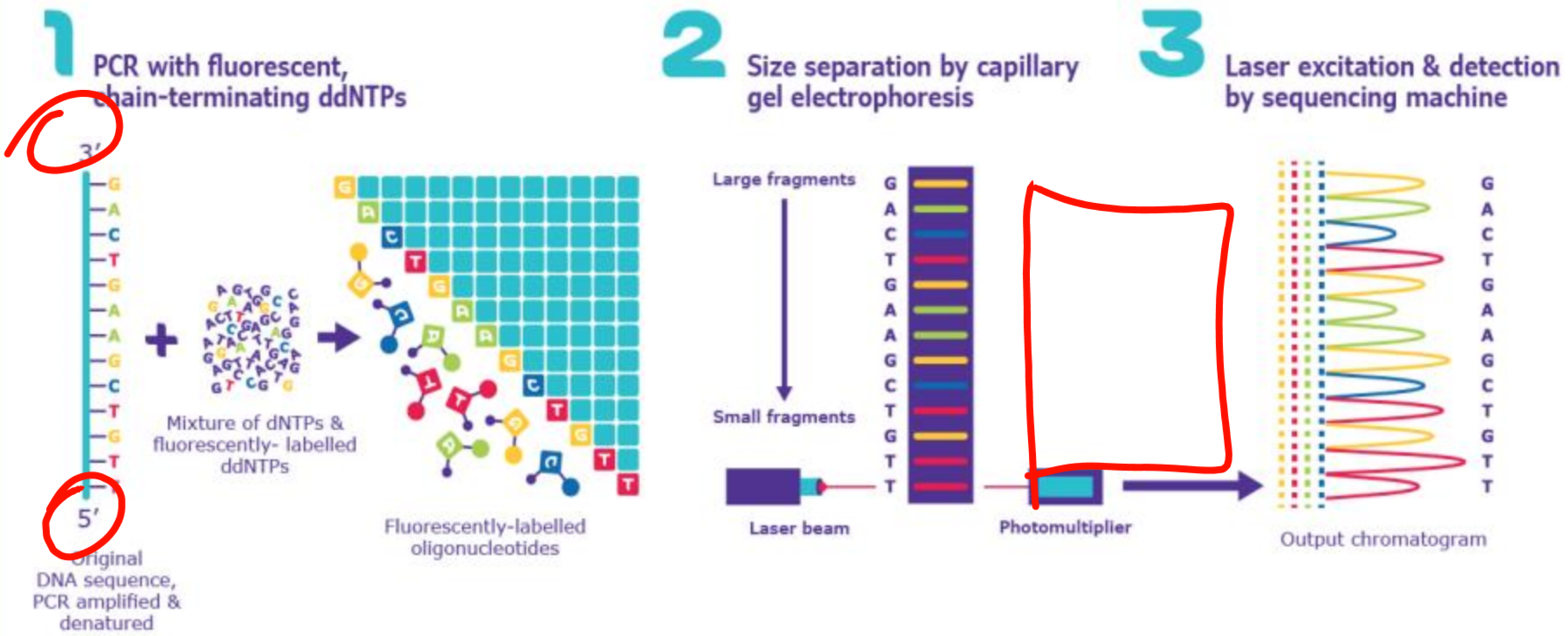

Vitamin B_{12} → Cyanocobalmin

↓

Cobalt (d-d)

FSH, LH ALDOSTERONE, GLUCOCORTICOID LEVEL IN PREGNANCY

Elevated levels of estrogen, progesterone, and inhibin produced by the placenta exert strong negative feedback on the pituitary gland, which suppresses the production and release of FSH and LH.

hypeoglycemic

Maternal glucocorticoid (cortisol) levels naturally rise significantly (about 3x) throughout pregnancy, peaking near delivery to help mature the fetus

Thyroxine (T4) levels naturally change in pregnancy, with total T4 increasing significantly due to high estrogen boosting thyroid-binding globulin, while free T4 (the active form) initially rises then stabilizes

Spontaneous

→ internal

LH, FSH

→ Ovulation

Ovulation → Cat

→ camel

Reflex ovulation

♀ ♂ → coitus

→ mating → ovulation

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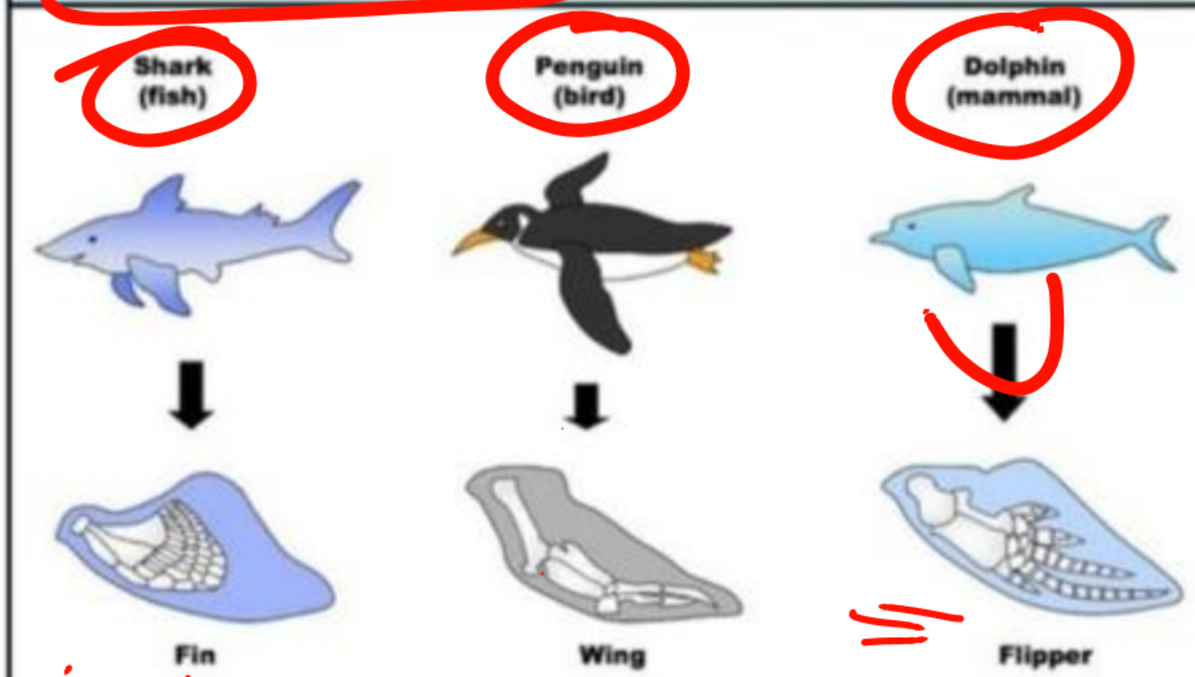
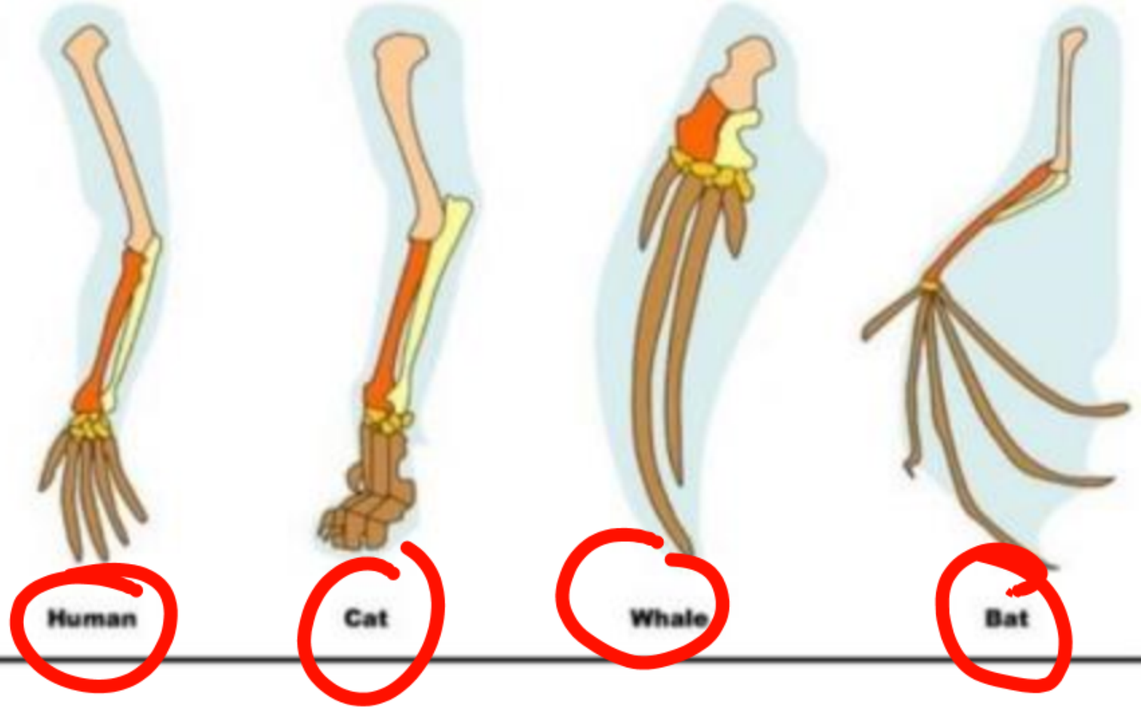
HOMOLOGOUS AND ANALOGOUS HORMONE

Analogous Structures *(Streamline Appendages)*



Homologous Structures *(Pentadactyl Limbs)*



Potato

(Analogous organ)

⇒ stem modification

⇒ sweet potato and potato.

Hardy Weinberg

$\Rightarrow p+q=1$

$\Rightarrow p^2+q^2+2pq=1$

dominant

recessive

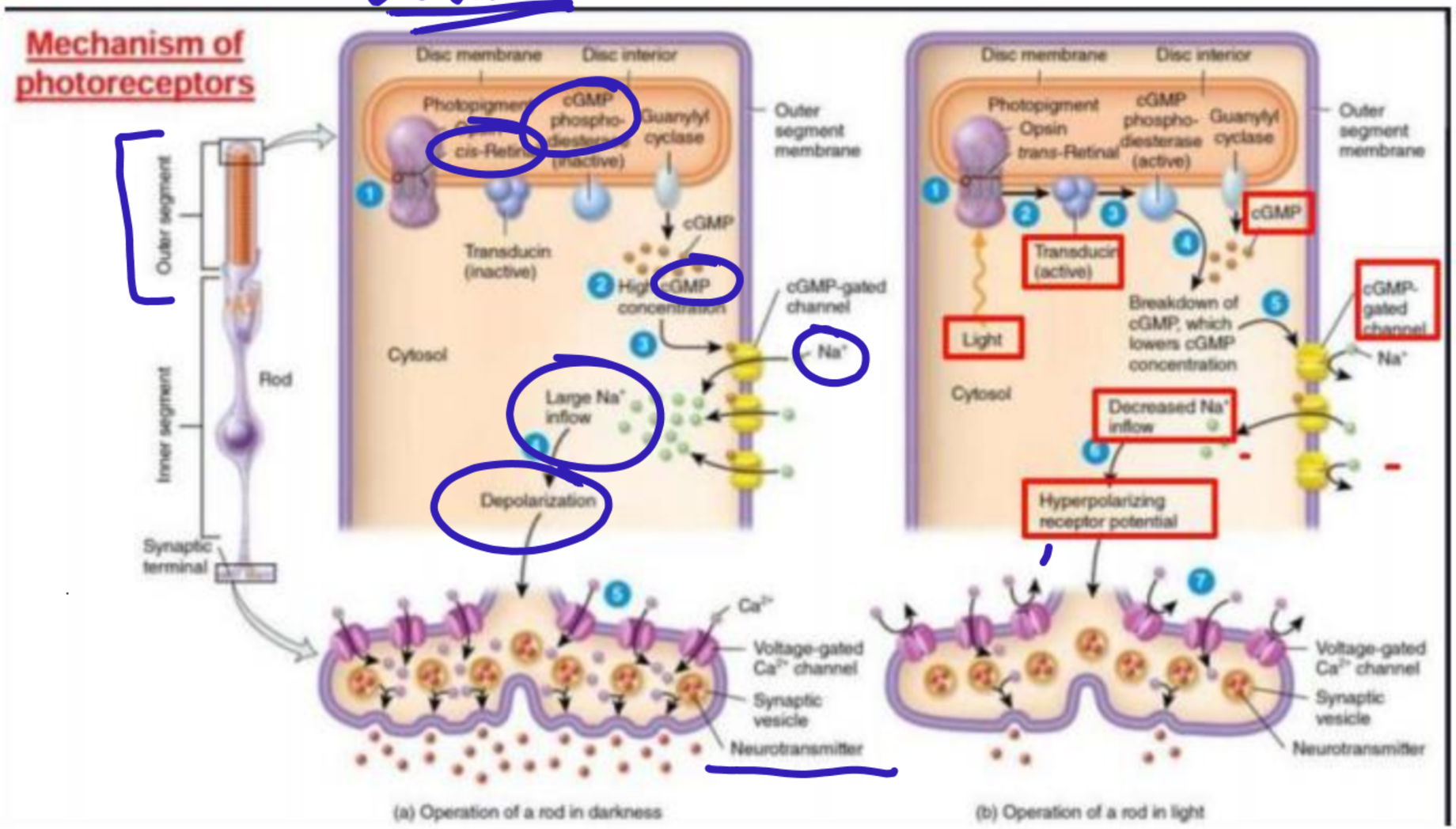
hetero.

$p+q+r=1$

$p^2+q^2+r^2+2pq+2qr+2rp$

EYE SIGNALLING

Dark



(a) Operation of a rod in darkness

(b) Operation of a rod in light

Photopigment Response to light

* Retinol dehydrogenase

  Retinol (Vit-A) $\xrightarrow{\downarrow}$ Retinal (used in vision)

* Retinal Reductase

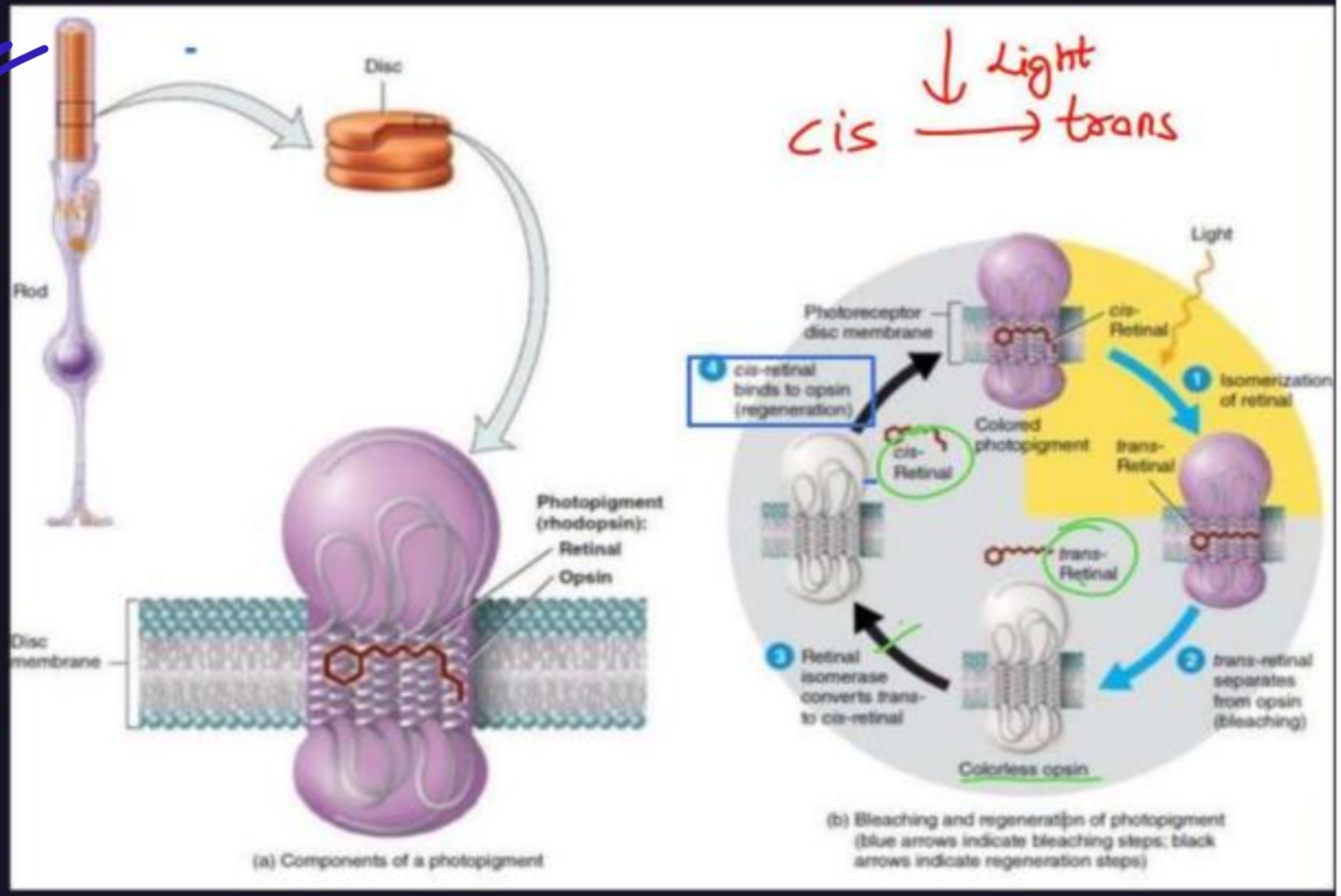
  Retinal $\xrightarrow{\downarrow}$ Retinol

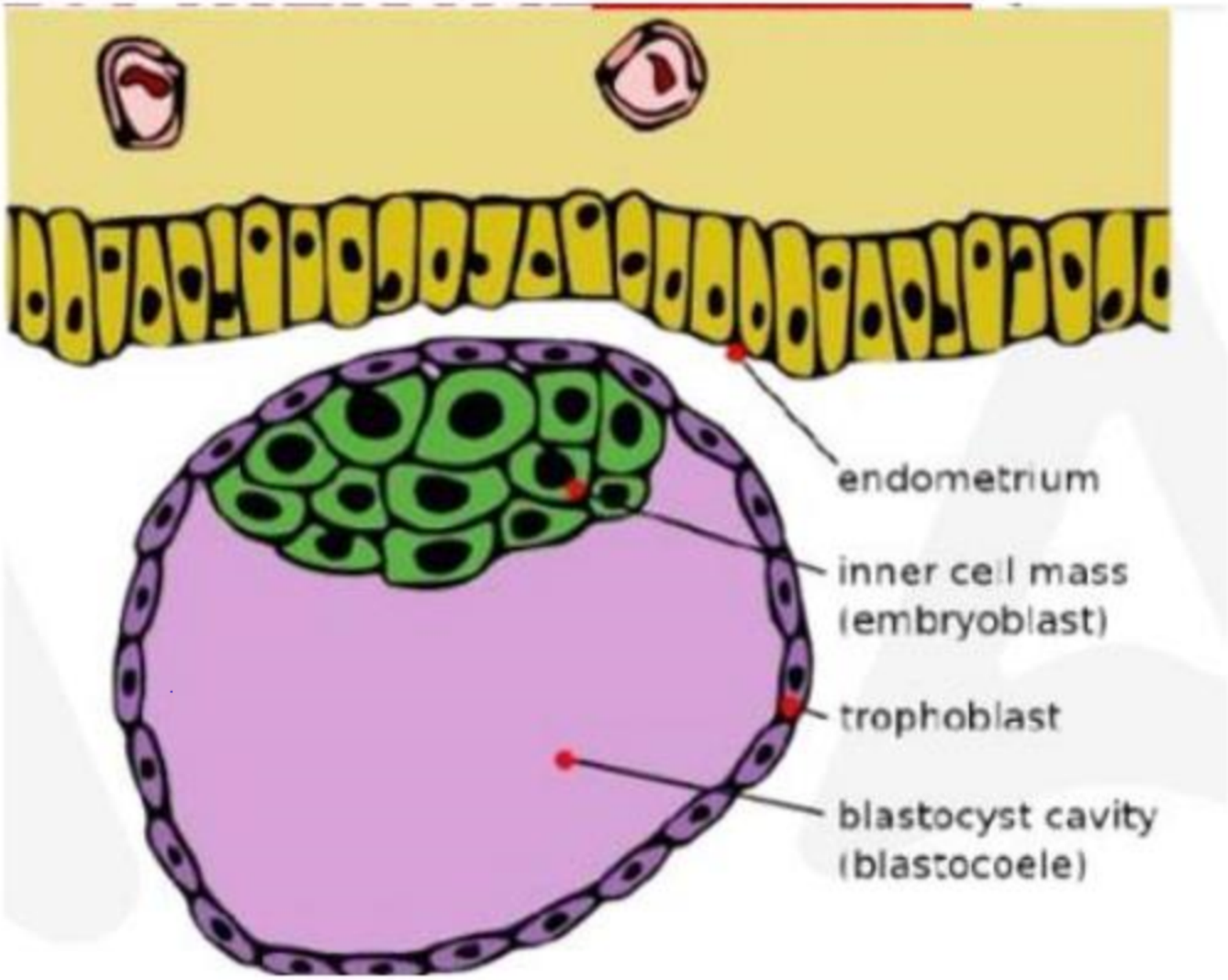
* Retinal isomerase

  one form of Retinal to another

* Retinal synthase

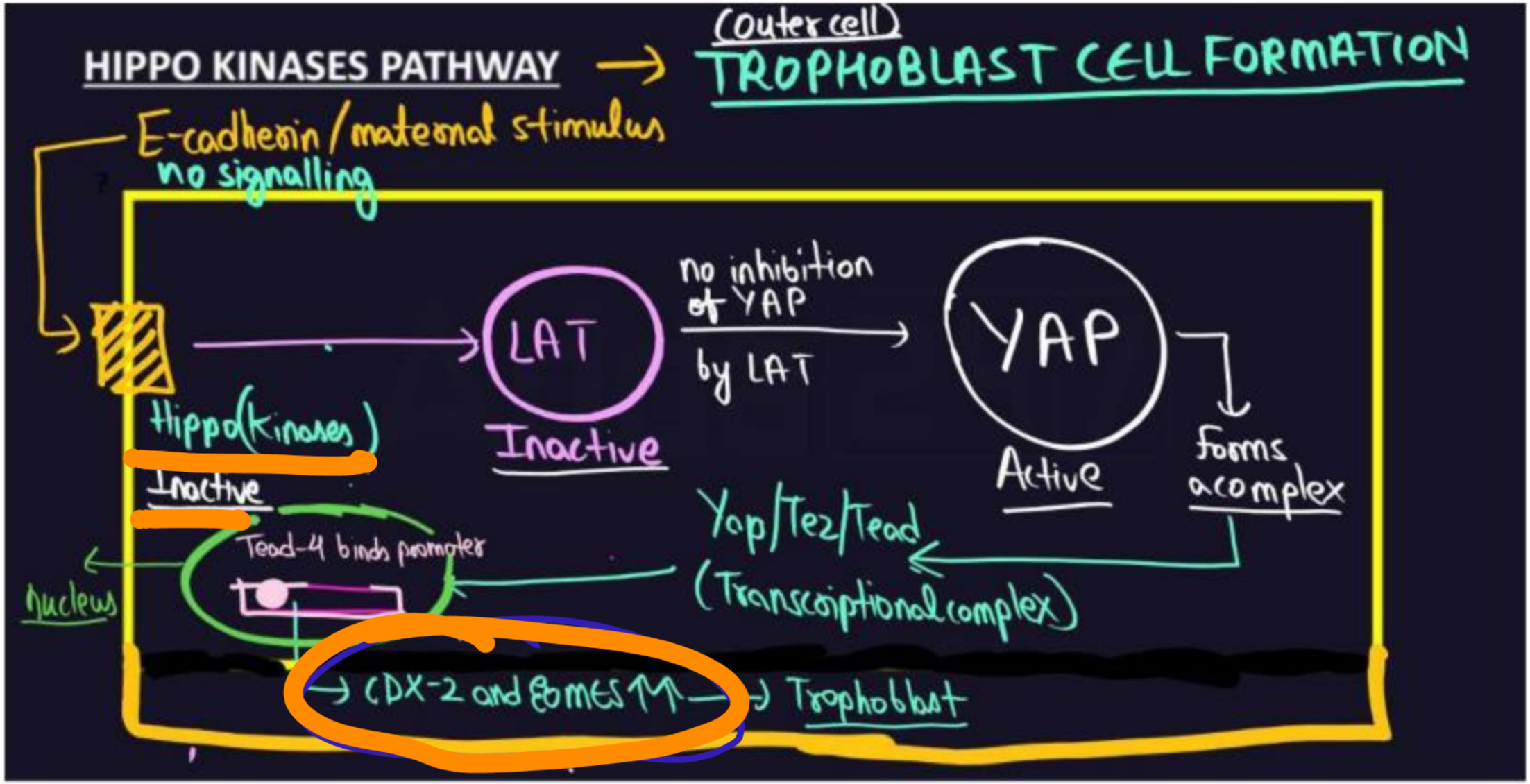
  help in Retinal synthesis





ICM or trophoblast

Hippo Kinnase Signalling


HIPPO KINASES PATHWAY
(Outer cell)
TROPHOBLAST CELL FORMATION
E-cadherin / maternal stimulus
no signalling
Hippo(kinases)
Inactive
LAT
Inactive
no inhibition of YAP by LAT
YAP
Active
forms a complex
Yap/Tez/Tead
(Transcriptional complex)
Tead-4 binds promoter
nucleus
CDX-2 and EOMES ↑
Trophoblast

HIPPO KINASES PATHWAY → outer stimulus / cadherin → outer cells → Trophoblast

* "Trophoblast" → CDX-2↑ and EOMES↑

* CDX-2 ⇒ promote formation of trophoblast

→ This step occurred → Yap {transcriptional complex}

CDX-2 ⊣ Oct4

Trophoblast ← [CDX-2, EOMES] ← Binding promoter ← Yap {transcriptional complex}

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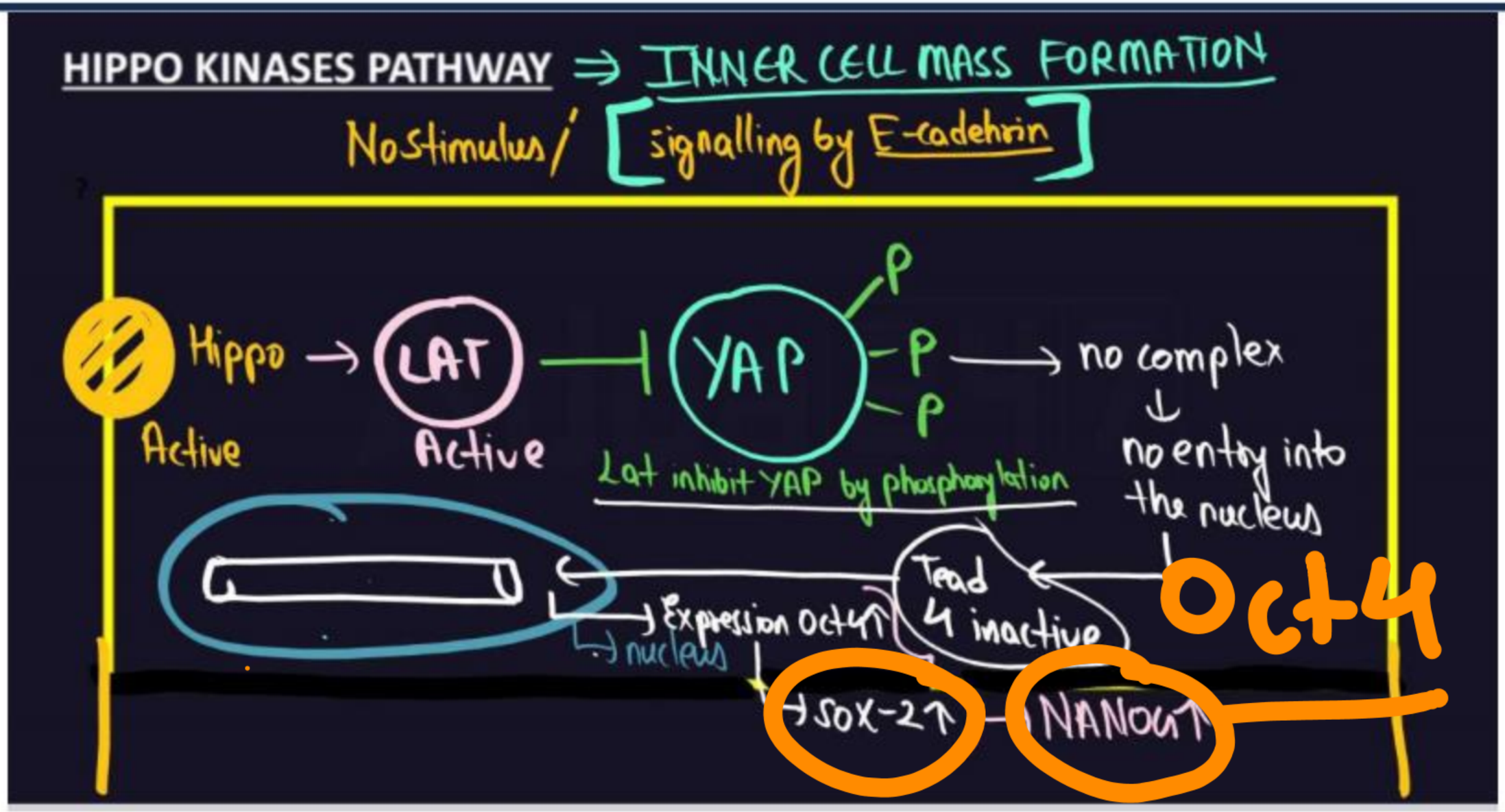

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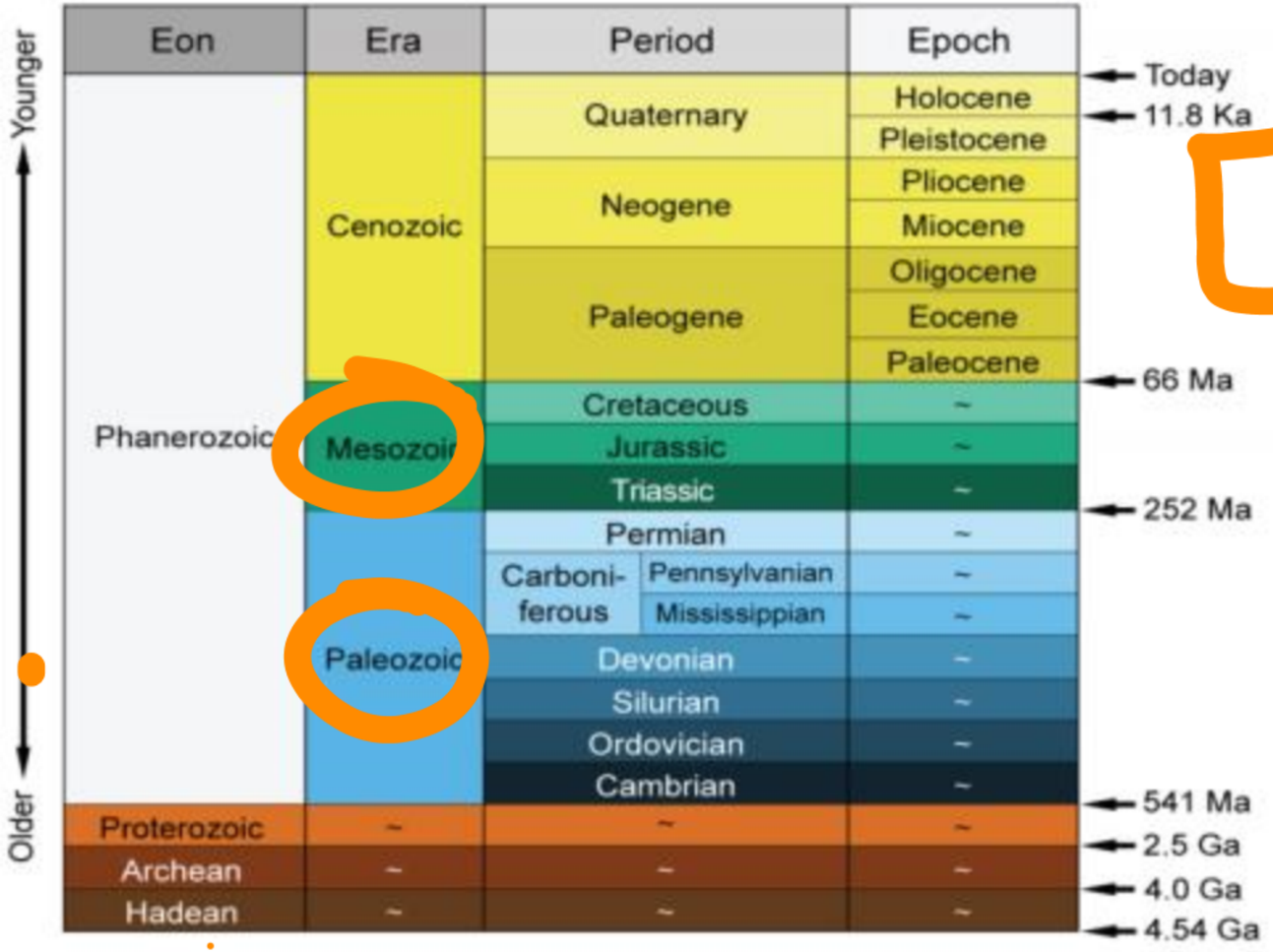
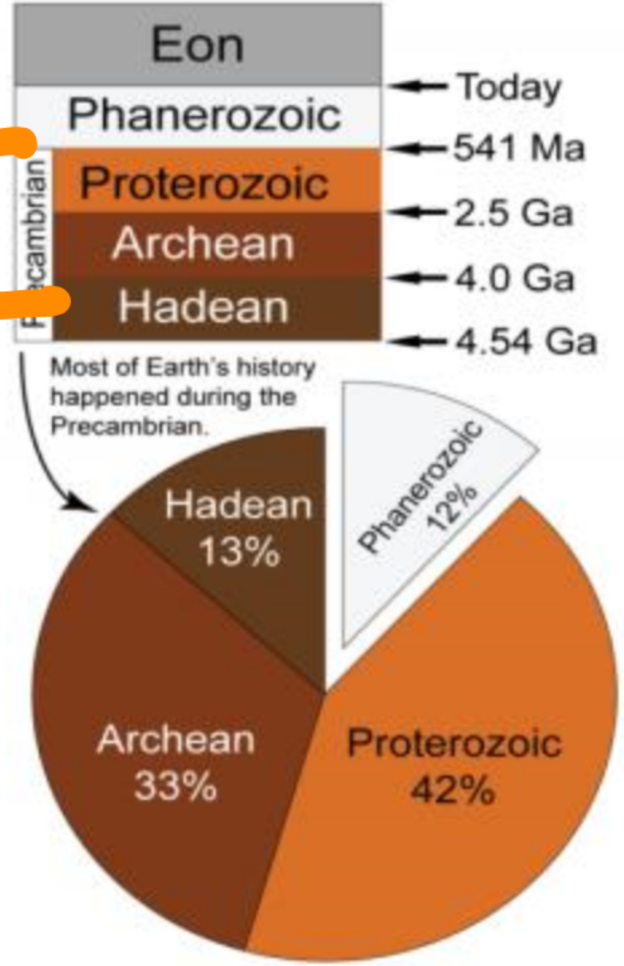
Q GEOLOGICAL TIME SCALE – MATCH THE FOLLOWING





Q HAMILTONS'S RULE

Bees

Altruism is favored by natural selection when:

Relatedness (proportion of shared genes)

$$rB > C$$

Cost to the altruist

Benefit to the recipient

***r* (Relatedness):** The probability that the altruist and recipient share the same gene by common descent (e.g., 0.5 for full siblings, 0.25 for half-siblings).

***B* (Benefit):** The increase in reproductive success (e.g., offspring) gained by the recipient due to the altruistic act.

***C* - (Cost):** The decrease in reproductive success (e.g., offspring) suffered by the altruist.

Hamilton's rule: $r * b > c$

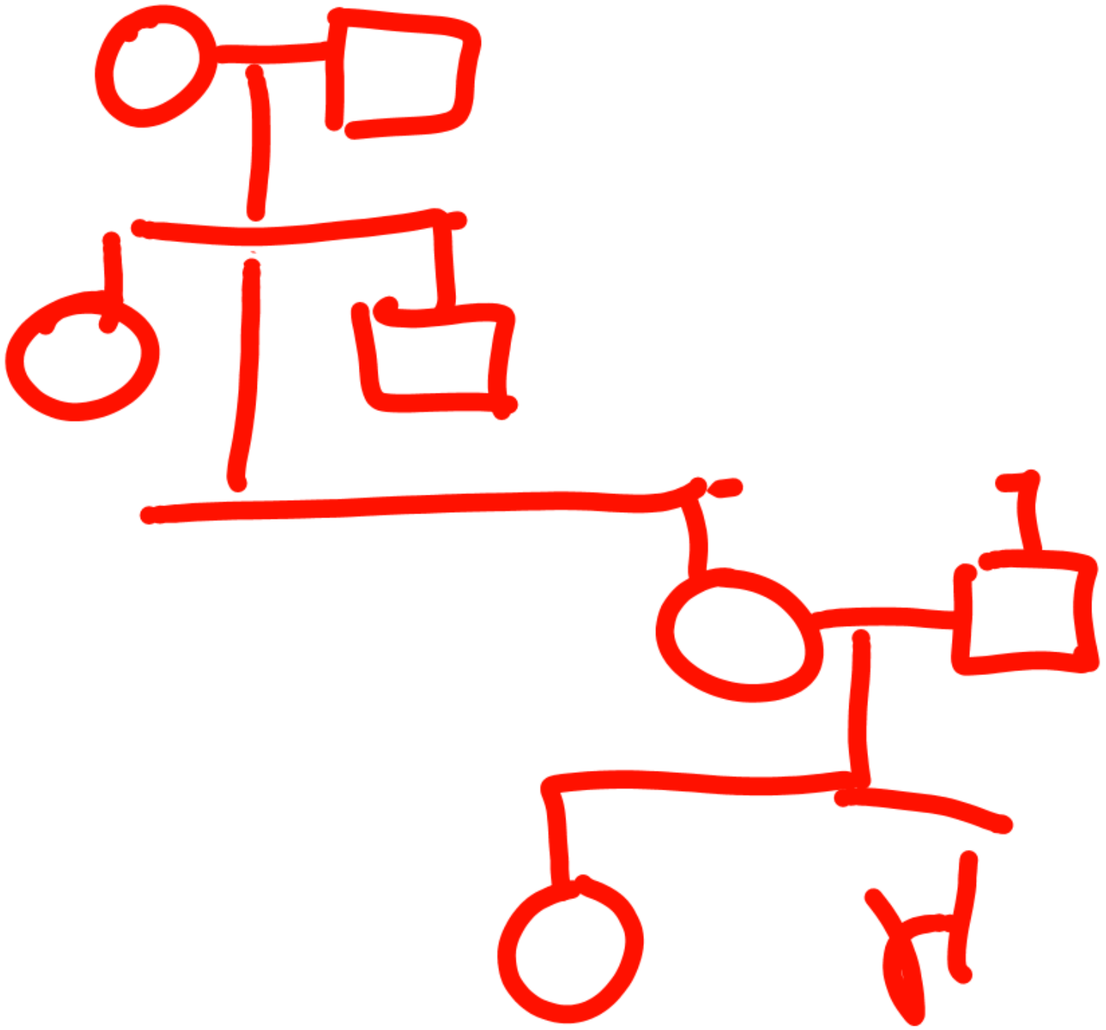
r = relatedness between altruist and recipient
b = increase in the recipient's fitness (offspring)
c = decrease in the altruist's fitness (offspring)

Full siblings:	$(0.5)\ b > c$	$b/c > 2$
Half siblings:	$(0.25)\ b > c$	$b/c > 4$
First cousins:	$(0.125)\ b > c$	$b/c > 8$

HAPLO - DIPLOID

Relatedness Values:

- Sister–sister (workers): r = 0.75
- Mother–daughter: r = 0.5
- Worker–brother: r = 0.25



DROSOPHILA

June 2025

→ GAP Gene

CSIR
DBT

↓

Dec 2025

→ Genes

Maternal

↓

Zygotic

- Gap
- Pair rule
- S

GAP GENES

- Krüppel (Kr)
- knirps (kni)
- hunchback (hb)
- giant (gt)
- tailless (tll)
- huckebein (hkb)
- buttonhead (btd)
- empty spiracles (ems)
- orthodenticle (otd)

Q. Which gene is common in maternal and zygotic genes?

A. Hb

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A+B+C

The primary pair-rule genes

- hairy,
- even-skipped
- Runt

Pair-rule genes (secondary)

- fushi tarazu (ftz)
- odd-paired (opa)
- odd-skipped (odd)
- sloppy-paired (slp)
- paired (prd)

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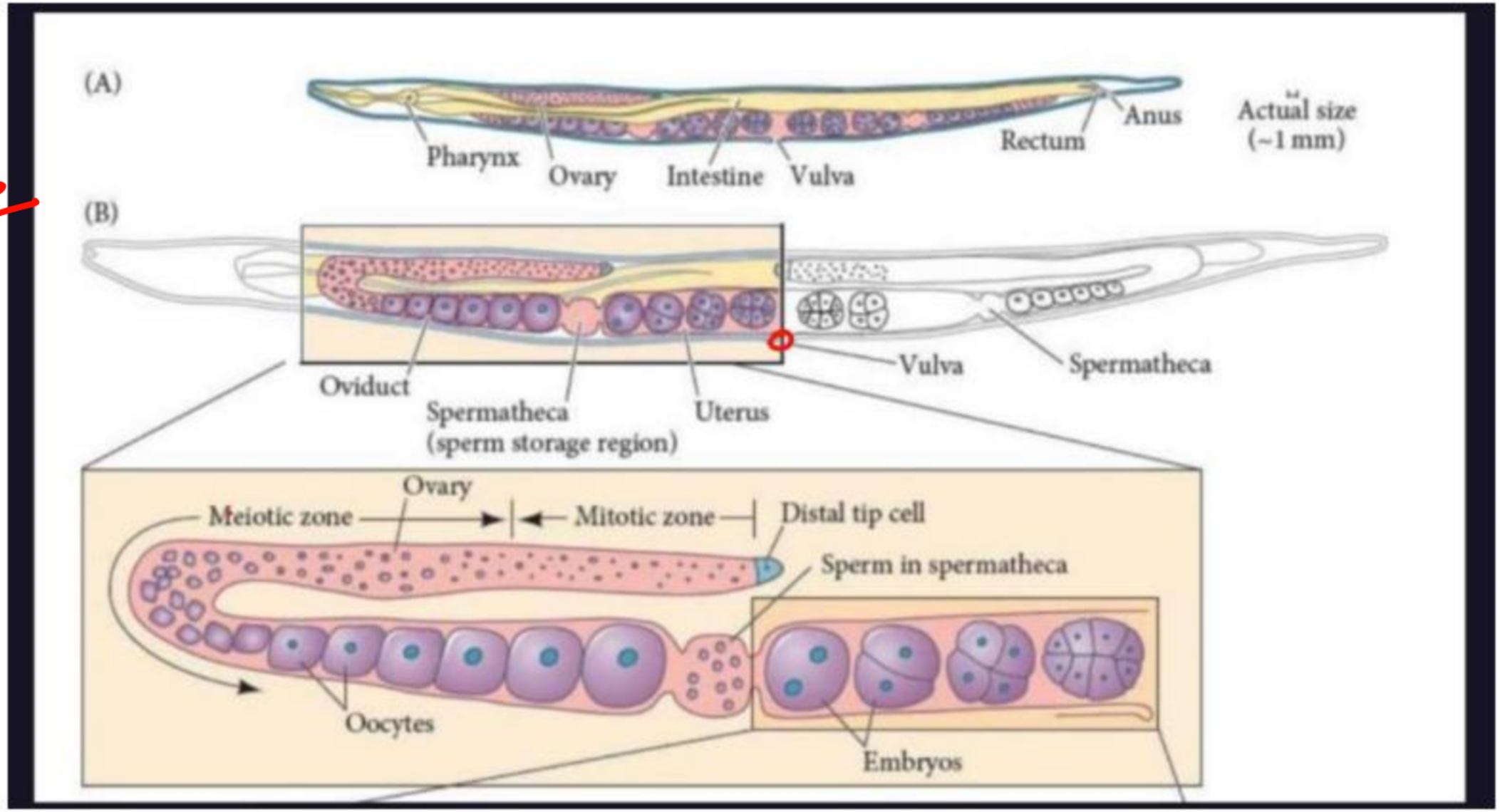
C. ELEGANS

Apoptosis

Bcl2



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Genetics

Tetratye

↳ ordered

Learn

	FDS	SDS	SDS
Tetrad	2:2	1:1:1:1	1:2:1
Octad	4:4	2:2:2:2	2:4:2

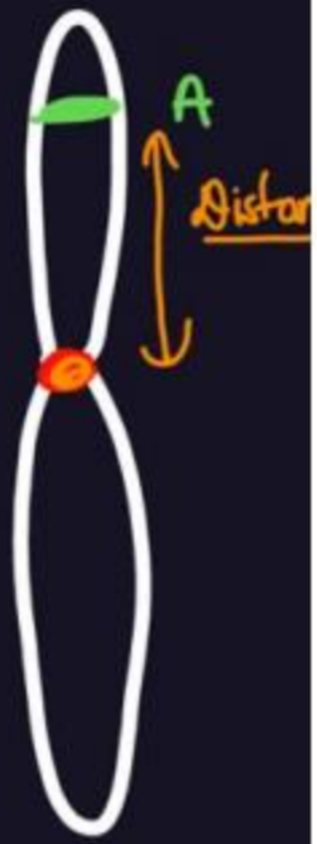
$$\frac{20}{40} \times 100$$

m+	1	m+	2
m	1	m+	
m+	1	m	2
m	1	m	
20		20	

Calculate the Map Distance

* Distance b/w Gene and centromere.

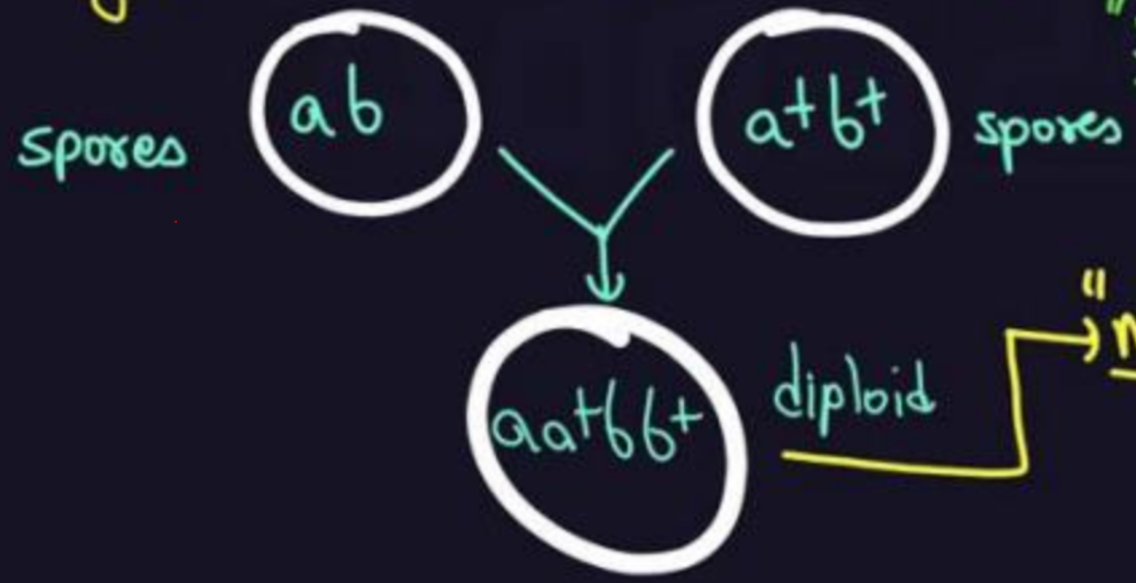
$$\text{map distance} \Rightarrow \frac{\frac{1}{2}\text{ no of SDS asci}}{\text{Total}} \times 100$$



Unordered Tetrad Analysis

⇒ 9+ is used to calculate distance b/w two genes.

⇒ Eg ⇒ Unordered spores ⟶ Eg ⇒ "Baker's yeast" or "Sacchromyces cerevisace"



→ "Meosis" (reductional division)

Three patterns are obtained

Parental Ditype

⇒ Sac → Ascus

⇒ Spores ⇒ Ascospores

⇒ parental combination alleles

PD

Tetratype

Sac ⇒ Ascus

Spores ⇒ Ascospores

2 parental type

2 recombinant type

TT

Non-parental Ditype

Sac ⇒ Ascus

Spores ⇒ Ascospores

⇒ All will be recombinant and no parental

NPD

$$\text{Map Distance} \Rightarrow \frac{\text{NPD} + \frac{1}{2}\,\text{Tetratype}}{\text{Total}} \times 100$$

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Tubular Reabsorption

Match the Following

PCT

⇒ Mainly reabsorption

- Early PCT
  - Antiporters
    - ⇒ Glucose ; A.A
    - ⇒ Lactate
    - ⇒ Pyruvate
    - ⇒ HCO_3^-
  - symporters
- Late PCT
  - Antiporter
  - → Cl^- paracellular

Henles loop

- Descending limb
  - ↓ Aquaporin 1
  - ↓ Water reabsorption > solute
- Ascending limb
  - thin
    - Aq = 3 ⊕
    - Aq = 1 ⊖
    - Solute > water
  - thick
    - solute > water
    - ⇒ Na^+; K^+; Cl^-
    - ⇒ Loop diuretics

DCT

- Early
  - ⇒ similar to Ascending
  - H_2O and Urea no permeability
- Late + Cortex Colle. T
  - ⇒ Intercalat
  - → Principle

Excretion flow chart

Nephrons → DCT

Nephrons → Henle's loop

Nephrons → PCT

PCT

Reabsorption

- ⇒ Water → osmosis
- ⇒ Na^+ → $Na^+ K^+$ pumps ; sym; anti
- ⇒ K^+ ; Cl^- ; HCO_3^- ; Ca^{+2} ; Mg^{+2} → diffusion → facilliated diffusion
- ⇒ Glucose → symporters ; faciliated diffus.
- ⇒ Aminoacids → symporter; " "
- ⇒ Urea (few) → diffusion

Secretion

- ⇒ H^+ → antiporters
- ⇒ NH_4^+ → antiporters
- ⇒ Urea → diffusion
- ⇒ Creatinine → small amount

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A+B+C+MT

B+C


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