

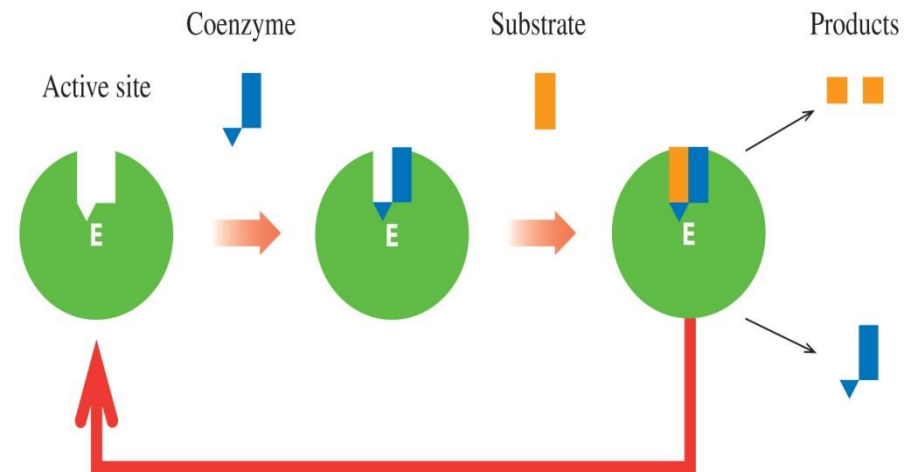
Calcium As A Cofactor For Many Enzymes

Protein kinases (PKs) are the effectors of phosphorylation

is a phototransferase enzyme that catalyzes the interconversion of adenine nucleotides, and plays an important role in cellular energy homeostasis.

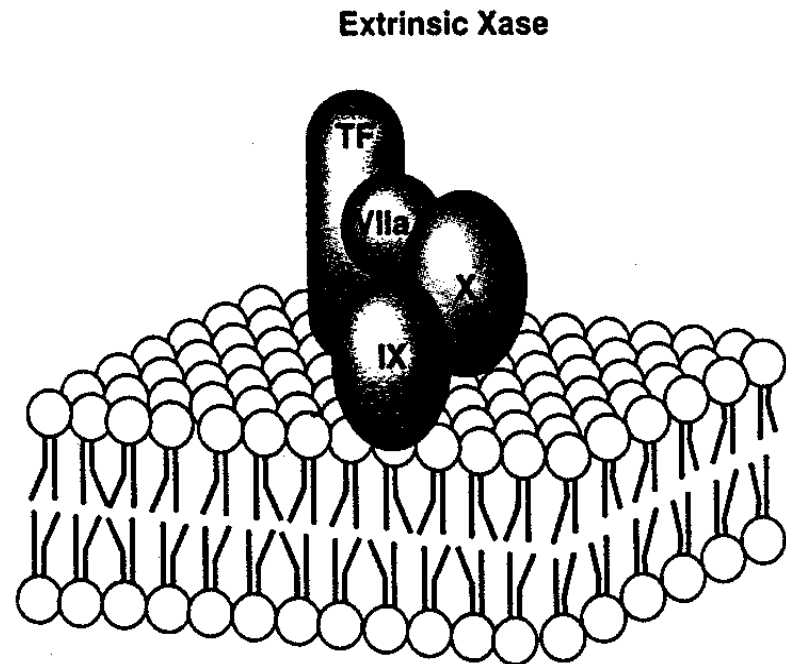
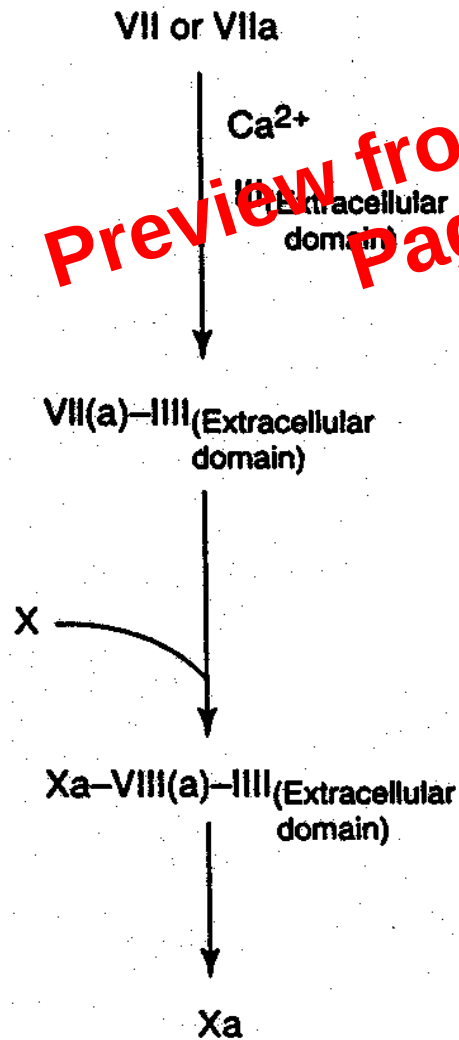
Calcium as a co-factor needed for the full activity of many enzymes, such as nitric oxide synthase, protein phosphatases, and adenylate kinase, but calcium activates these enzymes in allosteric regulation in a complex with calmodulin

catalyzing the production of nitric oxide (NO) from L-arginine. NO is an important cellular signaling molecule. It helps modulate vascular tone, insulin secretion, airway tone, and peristalsis



Role of Calcium in Blood Coagulation

Extrinsic Pathway and Protein Complex



Role of Calcium in Blood Coagulation

Clotting factors (thrombin, VII, IX and X) contain a unique modified glutamate residue called carboxyglutamate (Gla).

Synthesis of these Gla residues results from post-translational modifications of the newly synthesized factors in the liver endoplasmic reticulum by a vitamin K

This amino acid is a natural high affinity binder (or chelator) of calcium ions, hence the designation of calcium as a co-factor in the blood clotting cascade.

Calcium - Gla-factors complex allow specific interactions with acidic membrane lipids that ultimately lead to correct tertiary and quaternary protein structures recognized by other proteins in the pathway.

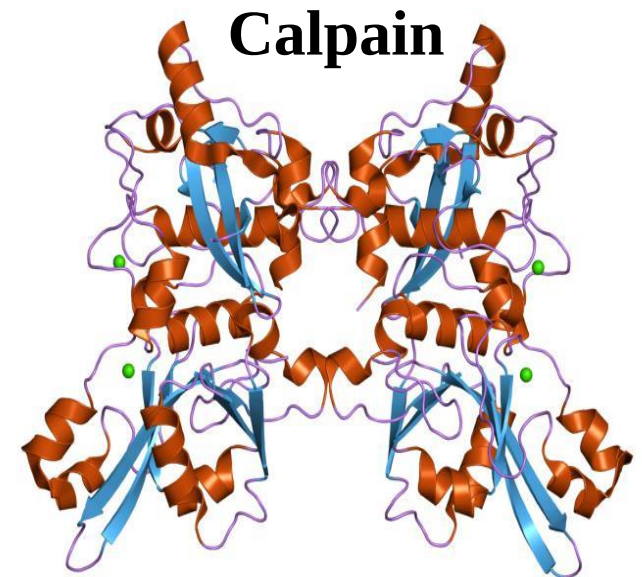
Role of calcium In muscle protein degradation

❖ A **calpain** is a protein belonging to the family of calcium-dependent nonlysosomal cysteine proteases expressed ubiquitously in mammals and many other organisms.

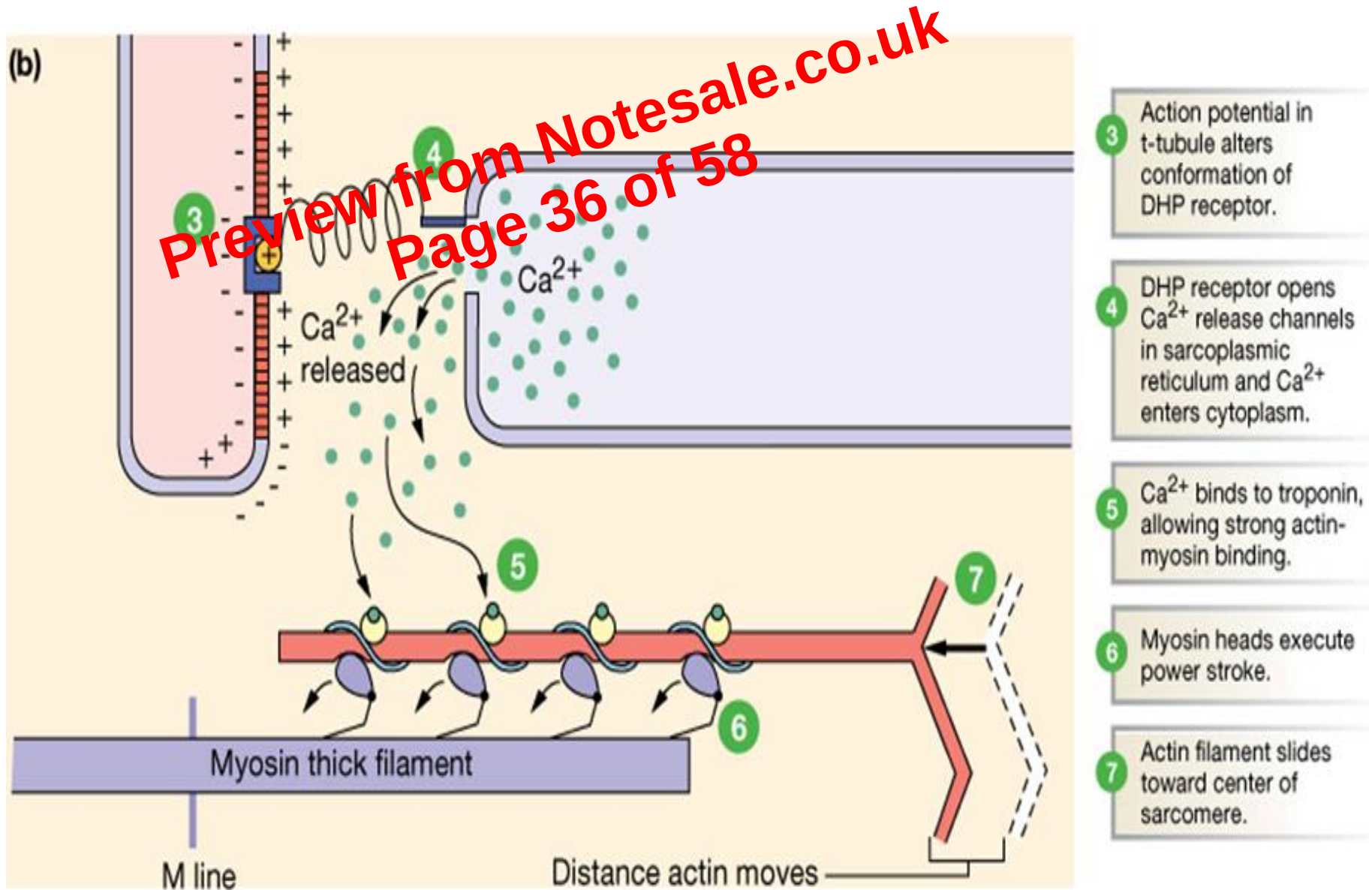
❖ Although the physiological role of calpains is still poorly understood but a transient and localized influx of calcium into the cell activates a small local population of calpains close to Ca^{2+} channels

❖ These calpains activates signal transduction pathway and catalyzing the controlled proteolysis of its target proteins

❖ Calpains have been implicated in apoptotic cell death, and appear to be an essential component of necrosis.



Role of Ca in Skeletal muscle contraction



Role Of Calcium In Fertilization

During ovulation mammalian eggs are arrested at metaphase of their second meiotic division and remain arrested until fertilized.

At the time of fertilisation sperm delivers phospholipase C into the egg which triggers a series of Ca^{2+} spikes lasting several hours

These Ca^{2+} spikes are necessary for all the events of fertilization, including exit from metaphase II arrest and extrusion of cortical granules that block the entry of other sperm.

These Ca^{2+} spikes can be termed as Ca^{2+} oscillations which **switches on** calmodulin-dependent protein kinase II (CamKII), which phosphorylates the egg-specific protein Emi2.

Role Of Calcium In Cell Injury

Causes of Cell Injury

Oxygen Deprivation (Anoxia)

Physical Agents

Chemical Agents

Infections Agents

Immunologic Reactions

Genetic Defects

Nutritional Imbalances

Injury mechanisms

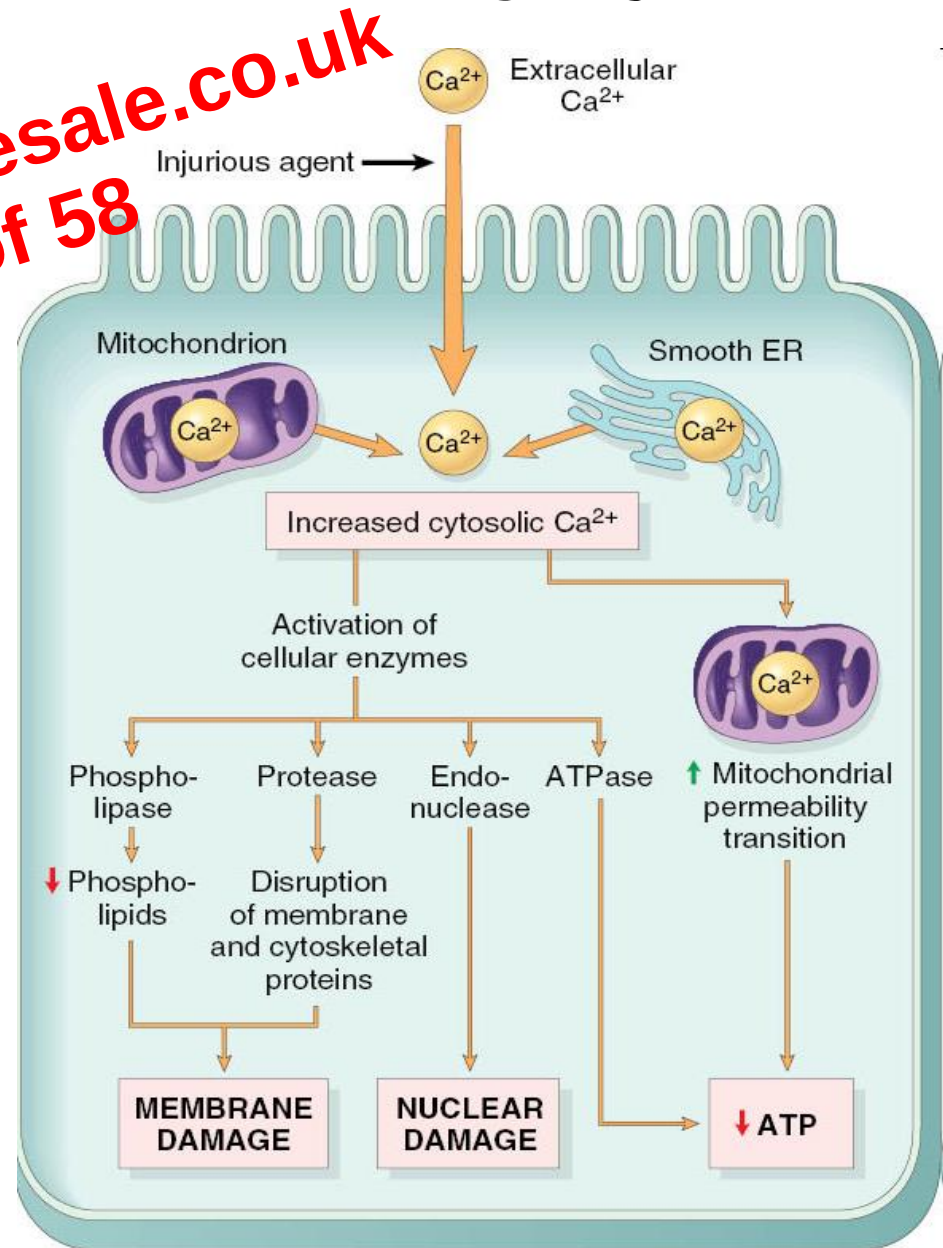
Decreased Atp

Mitochondrial Damage

Increased Intracellular Calcium

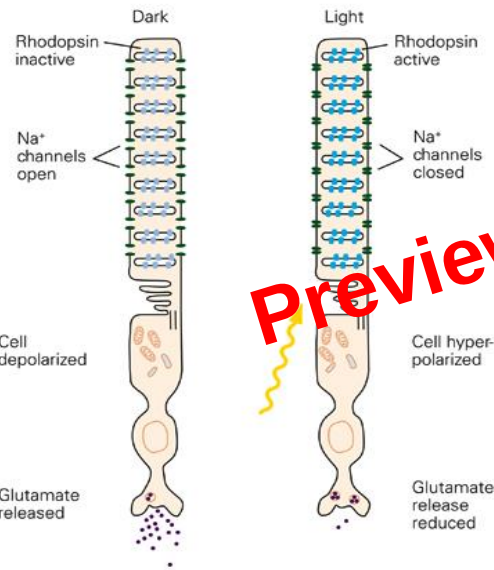
Increased Free Radicals

Increased Cell Membrane Permeability

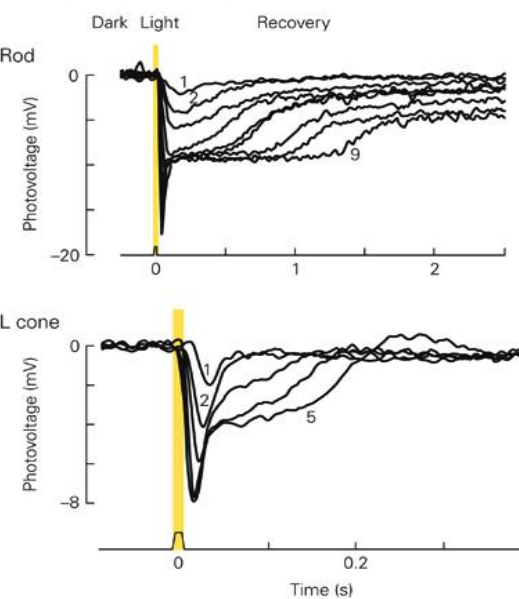


Role of Ca^{2+} in visual adaptation

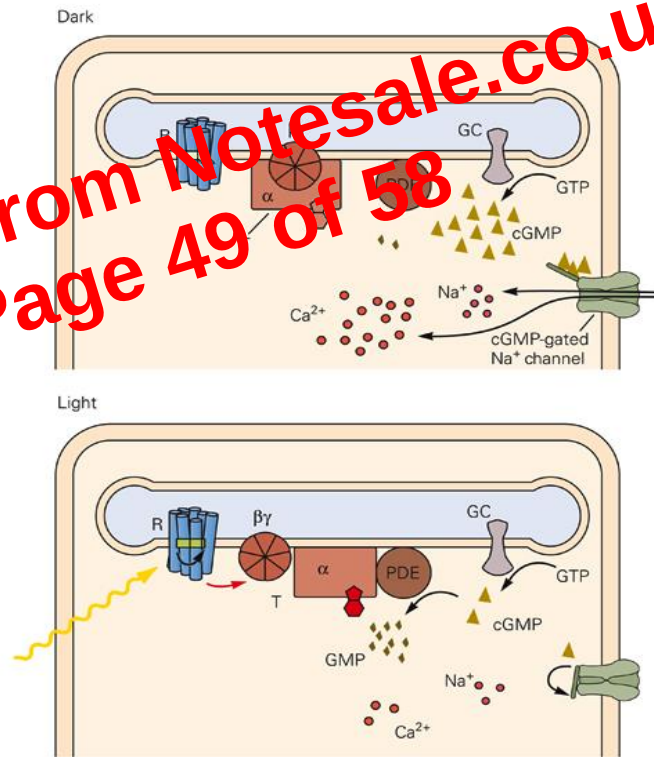
A Phototransduction and neural signaling



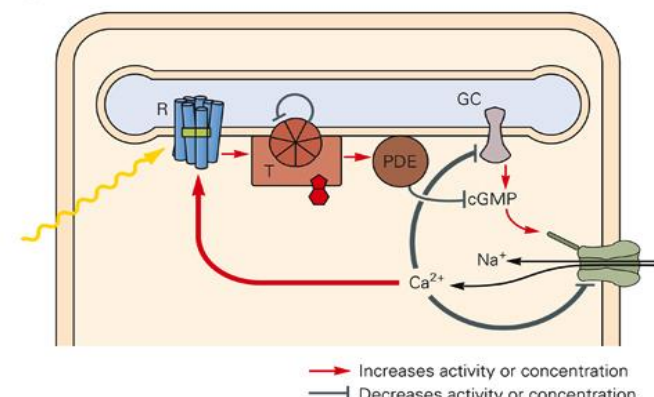
C Voltage response to light



B₁ Molecular processes in phototransduction



B₂ Reaction network in phototransduction



Phototransduction

- Starts with photon absorption by rhodopsin
- Transducin binds to activated rhodopsin, exchanges GTP for GDP
- Activated transducin dissociates into α and $\beta\gamma$ subunits
- The α subunit binds to, and activates, phosphodiesterase
- Intracellular cGMP concentration decreases
- Reduction in cGMP closes cGMP-gated cation channels in the plasma membrane
- Membrane potential hyperpolarizes
- Closing of cGMP-gated channel reduces intracellular calcium
- Reduced calcium counteracts the effects of light absorption

Role of Ca^{2+} in visual adaptation

