CONCEPT: PSP SECONADRY MESSENGERS & PKC

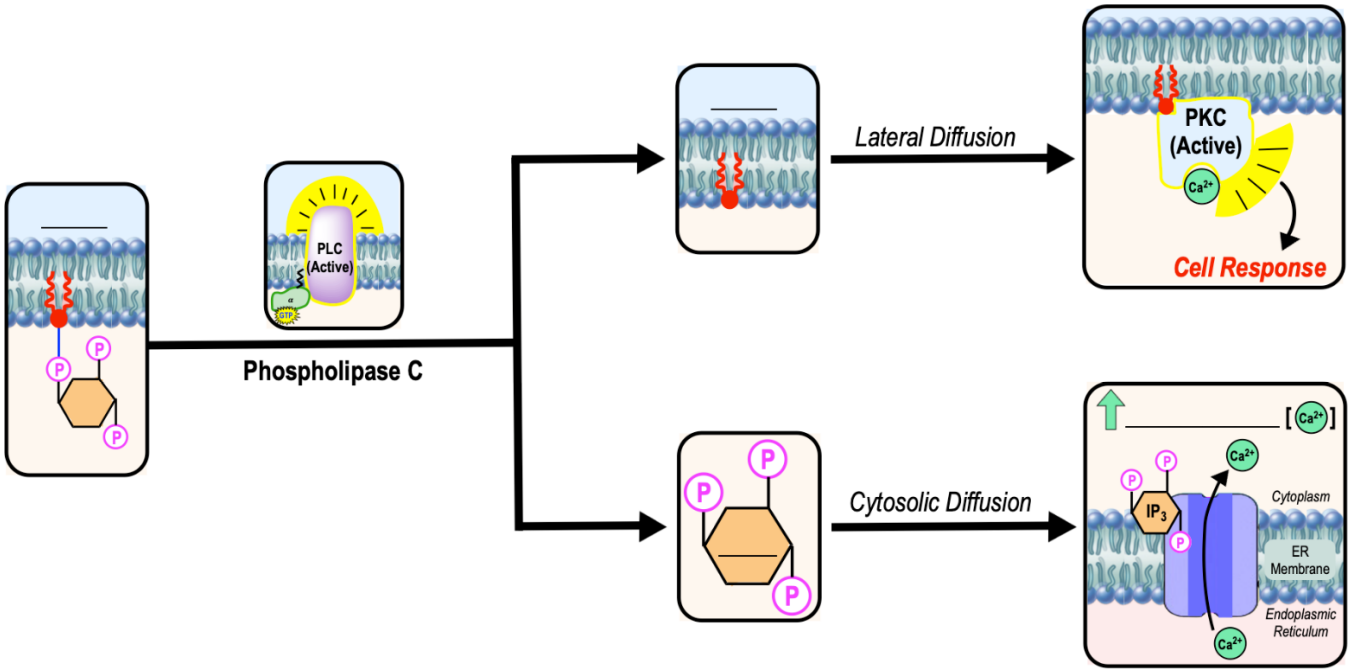
IP_3 + DAG

●Recall: Upon activation, *PLC* catalyzes hydrolysis of _____.

□ PLC hydrolysis of PIP_2 yields _____ & _____.

□ *IP_3* diffuses through cytosol to ER surface where it binds _____ channels, triggering an ↑ in cytoplasmic [*Ca^{2+}*].

□ *DAG* remains associated with membrane &, along with released *Ca^{2+}*, *activates* _____.



Ca^{2+} & Calmodulin

●Calcium (_____) is a common intracellular signal that can trigger many biochemical processes:

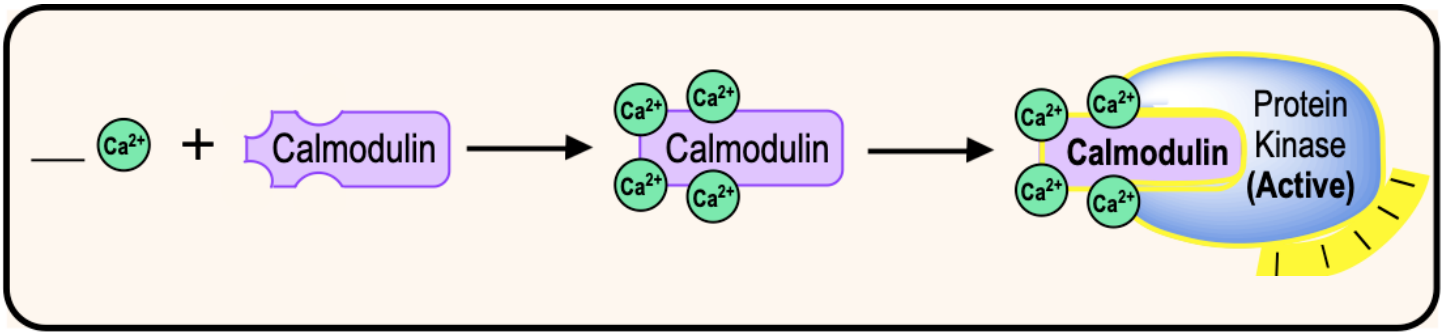
□ Ca^{2+} triggered processes include *muscle* _____ & *vesicle exocytosis* in neurons.

□ HOWEVER, in order to affect its targets, Ca^{2+} generally forms a complex with _____.

●***Calm****odulin* (_____): a *Ca^{2+}-modulated* cytosolic protein that activates a variety of targets (ex. kinases).

□ CaM is activated when all _____ Ca^{2+}-binding sites are occupied.

□ Active *CaM-Ca^{2+}-complex* binds to other target proteins to _____ them.



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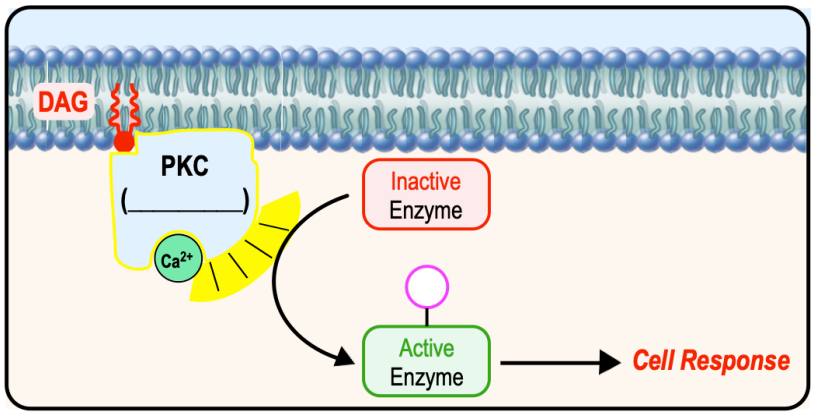
Protein Kinase C (PKC)

●***P**rotein **K**inase **C*** (_____): *phosphorylates* Ser/Thr residues on target proteins to alter their activity (similar to PKA).

□ PKC targets include enzymes, cytoskeletal proteins, & nuclear proteins regulating gene expression.



PRACTICE: All of the following are secondary messengers in cell signaling EXCEPT:

a) IP_3.
b) DAG.
c) Protein Kinase A.
d) Calcium Ions.
e) cAMP.

PRACTICE: In the phospholipase C signal transduction pathway, which two second messengers are produced?

a) Phospholipase C and protein kinase A.
b) PIP_2 and IP_3.
c) Phospholipase C and G.
d) IP_3 and DAG.
e) cAMP and ATP.

PRACTICE: Which of the following enzymes does diacylglycerol recruit to the membrane and activate when bound?

a) Phospholipase C.
b) Protein Kinase C.
c) Adenylate Cyclase.
d) Protein Kinase A.
e) Phospholipase A.
f) Calmodulin.

PRACTICE: Which of the following statements about calmodulin is TRUE?

a) Calmodulin causes the release of Ca^{2+} ions from the endoplasmic reticulum.
b) When associated with Ca^{2+}, calmodulin is deactivated and unable to affect the activity of its targets.
c) In the presence of Ca^{2+}, calmodulin binds to and activates CaM-dependent protein kinases.
d) Calmodulin binds to and activates Protein Kinase C (PKC) when active.

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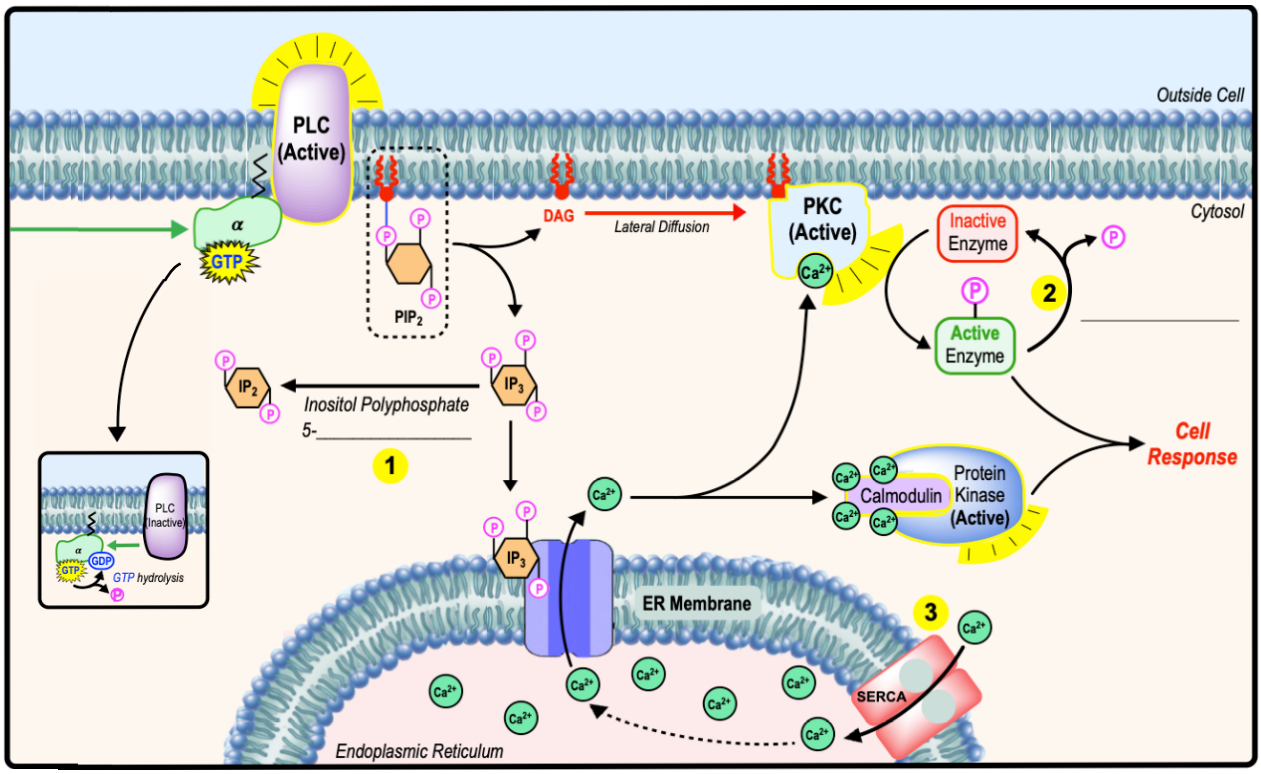
Inactivation/Termination of Phosphoinositide GPCR Signaling

●Recall: GTPase activity in the G protein α-subunit *inactivates/terminates* GPCR signaling pathways.

●HOWEVER, _____ other events also help *inactivate/terminate* the *Phosphoinositde GPCR signaling pathway*:

1. *IP_3*'s signaling affect is "*turned* _____" by ↓ [*IP_3*] using the enzyme *inositol polyphosphate 5-phosphatase*.
   - □ *Inositol polyphosphate 5-*_____: converts *IP_3* → _____ (*IP_2* does not release Ca^{2+}).
2. PKC's activity is *reversed* by *Ser/Thr* _____ (which remove phosphate groups from substrates).
3. Cytoplasmic [Ca^{2+}] *decreased* by the ***S**arcoplasmic/**E**ndoplasmic **R**eticulum **C**a^{2+} **A**TPase* (_____) *pump*.



PRACTICE: Protein Kinase C (PKC) is activated when bound by:

a) Ca^{2+} which leads to cytosolic protein phosphorylation.

b) Diacylglycerol which leads to cytosolic protein phosphorylation.

c) Ca^{2+} and Diacylglycerol which leads to extracellular protein phosphorylation.

d) Ca^{2+} and Diacylglycerol which leads to cytosolic protein phosphorylation.

e) Diacylglycerol which leads to extracellular protein phosphorylation.

PRACTICE: What is the effector enzyme in the phosphoinositide signal transduction system?

a) Diacylglycerol. b) Adenylate cyclase. c) Phospholipase C. d) Protein Kinase C.

CONCEPT: PSP SECONADRY MESSENGERS & PKC

PRACTICE: All of the following are functions served by phosphatidylinositol bisphosphate EXCEPT:

a) Phosphatidyl inositol bisphosphate can be hydrolyzed to produce diacylglycerol, a second messenger.
b) Phosphatidyl inositol bisphosphate can be hydrolyzed to produce inositol trisphosphate, a second messenger.
c) Phosphatidyl inositol bisphosphate can serve as the substrate to phospholipase C.
d) Phosphatidyl inositol bisphosphate will serve as a docking site for proteins containing a SH2 domain.

PRACTICE: Diacylglycerol is a(n) _____ that promotes _____.

a) Insulin agonist ; tyrosine phosphorylation.
b) Phosphodiesterase inhibitor ; cAMP accumulation.
c) Secondary messenger ; protein kinase C activation.
d) Steroid-like hormone ; protein dimerization.
e) Secondary messenger ; phospholipase C activation.
f) Lipid hormone ; receptor dimerization.