

EVENTS THAT CONTROL THE CELL CYCLE

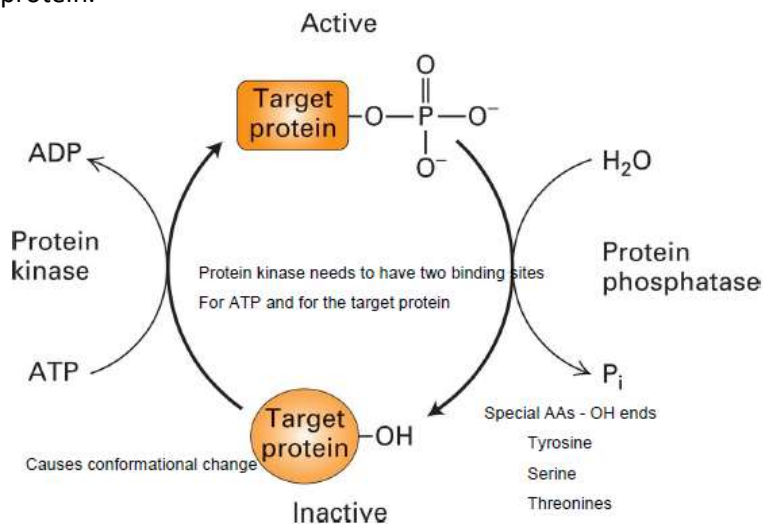
These three parts play a key role and interact with each other:

- Protein synthesis
 - proteins are translated during all phases except mitosis. Because of this, mechanisms other than protein production influence the cell cycle.
- Protein phosphorylation
 - can activate or inactivate a molecule
- Protein degradation
 - Protein turnover can be a form of regulation
 - Ubiquitin mediated degradation breaks down cytosolic and nuclear proteins.

1. PHOSPHORYLATION

Inactive target protein has an OH group. Protein kinase makes ATP donate a P and the group becomes PO₄.

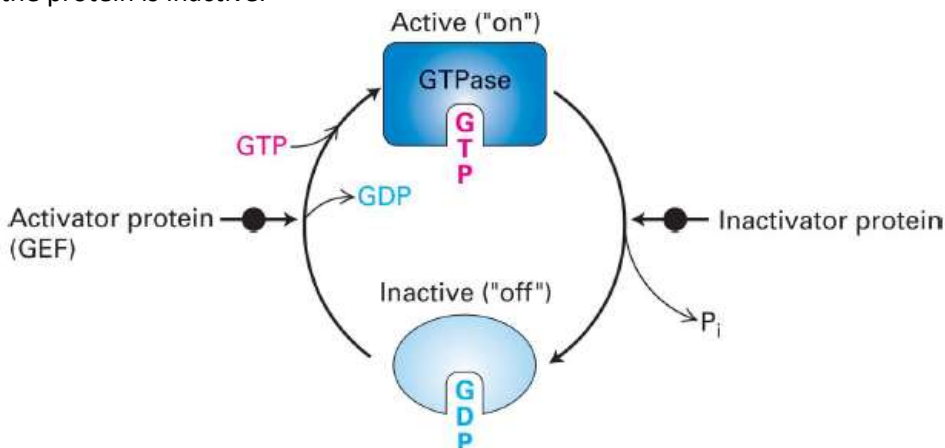
Active target protein has a PO₄ group. Protein phosphatase allows H₂O to take a P to inactivate the protein.



2. GTP-ASE SWITCH

Inactive protein is bound to GDP. An activator protein makes it release GDP and it can accept GTP and becomes active.

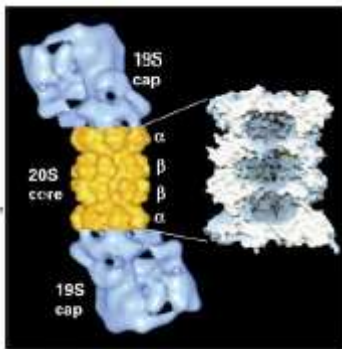
Active protein is bound to GTP. An inactivator protein makes the GTP lose a P. It becomes GDP and the protein is inactive.



3. UBIQUITIN-PROTEASOME MEDIATED PROTEIN DEGRADATION

- Ubiquitin is covalently linked to proteins that need to be degraded (ubiquitinated)
- Highly conserved 76 residue protein.
- The C-terminus of ubiquitin is attached to the E1 enzyme
- It is then transferred to the E2's
- E3 transfers Ub to the amine group of a lysine residue
- It is then taken to the **proteasome**, a large complex with a hole in the middle which has proteolytic activity. The caps recognise and partially unfold the protein.
- The group goes inside the proteasome and the protein is degraded with ATP hydrolysis.
- Ub is cleaved and recycled.

Polyubiquitination = when many Ub molecules are attached together via a lysine within one Ub molecule.



Proteasome

4. CDKs - CYCLIN-DEPENDENT KINASES

- CDKs are seen at a constant level.
- It is their activity level that changes.
- CDKs are activated by cyclin subunits.
- CDK/Cyclin complexes activate many proteins with phosphorylation and this progresses cells through the cycle.

Experimentally identifying cyclin

- Sea urchin gametes were combined and monitored. The cyclin levels increased to a point and then disappeared because the cyclin is degraded after activating mitosis.