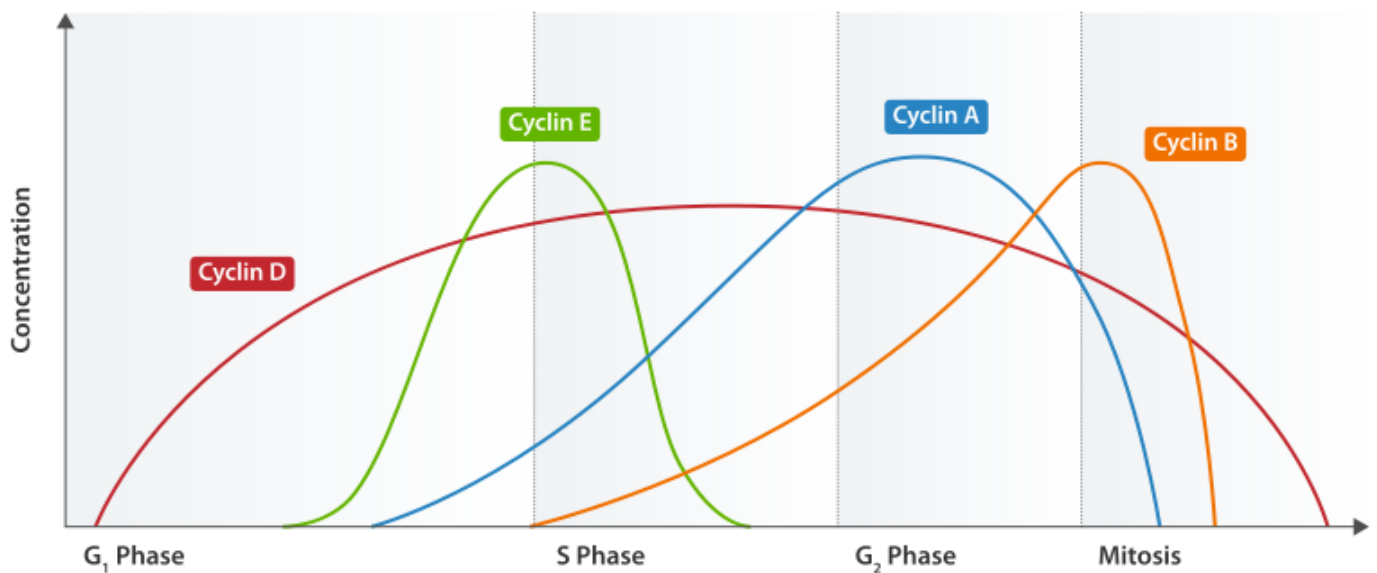


CONCEPT: CELL CYCLE CONTROL

Overview

- Cell cycle control relies on a core group of molecular _____ that turn on and off different steps of the cell cycle
 - **Cyclins** are proteins that turn protein kinases on and off
 - **Cyclin-dependent kinases (Cdk)** are cell cycle control protein kinases that are regulated by cyclins
 - Regulate cell cycle events by phosphorylating or dephosphorylating other proteins
 - Cdk protein levels remain the same – but cyclin levels vary, which controls activation/inactivation of Cdks
 - Rise is due to slow increase in gene transcription
 - Rapid fall is due to protein degradation

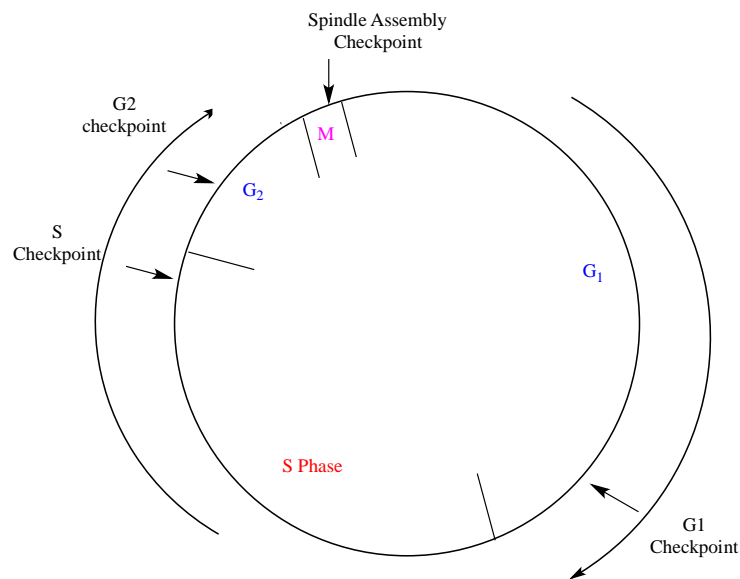
EXAMPLE: Rise and Fall of Cdks and cyclins



□ **Checkpoints** are _____ within the cell cycle that Cdks act

- **G₁ Checkpoint:** Cell cycle pauses to repair damaged DNA before S phase
- **START:** Point of no return when cell leaves G₁ and enters S phase
- **S Checkpoint:** Cell pauses to monitor integrity of DNA replication
- **G₂ Checkpoint:** Cell pauses to prevent division until DNA replication is complete

EXAMPLE: Cell Cycle Checkpoints



- There are a few important Cdks to know

Cyclins	Function
G1/S cyclin	Activate Cdks in late G ₁ – triggers START progression
G1 cyclins	Controls G1/S cyclins
S cyclins	Actiates Cdks after START to stimulate replication
M cyclins	Tiggers entry into Mitosis

Regulation

- Regulation of Cdks occurs in numerous ways

- **Cdk inhibitor phosphate:** Cdks must be dephosphorylated at a specific site to become active

- Cdks must be phosphorylated at one site and dephosphorylated at _____ to be active

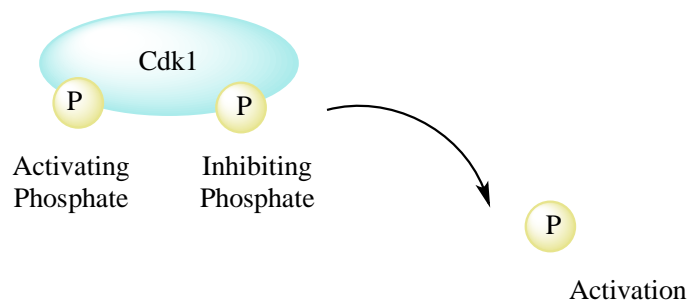
- **Cdc25** is responsible for removing the inhibitory phosphate

- **Cdk inhibitors:** Bind and block cyclin-Cdk complexes

- Cyclin levels: High = active Cdks, Low = inactive Cdks

- **Anaphase-promoting complex (APC)** degrades M and S cyclins by labeling them with ubiquitin

EXAMPLE: Cdk1 activation through dephosphorylation



PRACTICE:

1. True or False: Often, Cdks have to be dephosphorylated to become activated.
 - a. True
 - b. False
2. Which of the following cell cycle checkpoints occurs immediately before the start of S phase?
 - a. G₁
 - b. S
 - c. M

3. Which of the following proteins is responsible for removing the inhibitory phosphate on Cdks?
- a. S cyclins
 - b. APC
 - c. M cyclins
 - d. Cdc25