



Regulation of Cell Cycle

IST-1.D.1

A number of internal controls or checkpoints regulate progression through the cycle.

IST-1.D.2

Interactions between cyclins and cyclin-dependent kinases control the cell cycle.

IST-1.E.1

Disruptions to the cell cycle may result in cancer and/or programmed cell death (apoptosis).

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Which checkpoint determines whether the cell will divide?

- A. G₁**
- B. S**
- C. G₂**
- D. M**

Which checkpoint determines whether the cell will divide?

A. G_1



The G_1 checkpoint occurs in the G_1 phase. This is the go-ahead signal. If a cell passes this checkpoint, it will usually complete cell division.

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**Which checkpoint inhibits
nondisjunction?**

- A. G₁**
- B. S**
- C. G₂**
- D. M**

Which checkpoint inhibits nondisjunction?

D. M



Nondisjunction is the process where sister chromatids or homologous chromosomes do not segregate to opposite poles. The M checkpoint ensures that all chromatids/chromosomes are attached to a microtubule for anaphase.

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Which checkpoint verifies DNA has “no errors” and replicated?

A. G₁

B. S

C. G₂

D. M

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Which checkpoint verifies DNA has “no errors” and replicated?

C. G₂



The G₂ checkpoint occurs prior to mitosis. This will ensure the DNA has copied with “no errors” and the cell is large enough for division.

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**What is the function of a
kinase?**

What is the function of a kinase?



Kinase is an enzyme that adds phosphate

Protein kinase is responsible for the phosphorylation cascade in transduction

Cyclin dependent kinase will phosphorylate proteins needs for cell division

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Describe the association between cyclin and CdK.

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Describe the association between cyclin and CdK.



Cyclin is produced during interphase. CdK is maintained at high levels in the cell. When the cyclin level reaches a certain amount, it will activate the CdK and allow for the progression into the M phase. This specific CdK is called MPF.

Maturation Promoting Factor

(but let's just call it mitosis promoting factor since you need it to enter mitosis)

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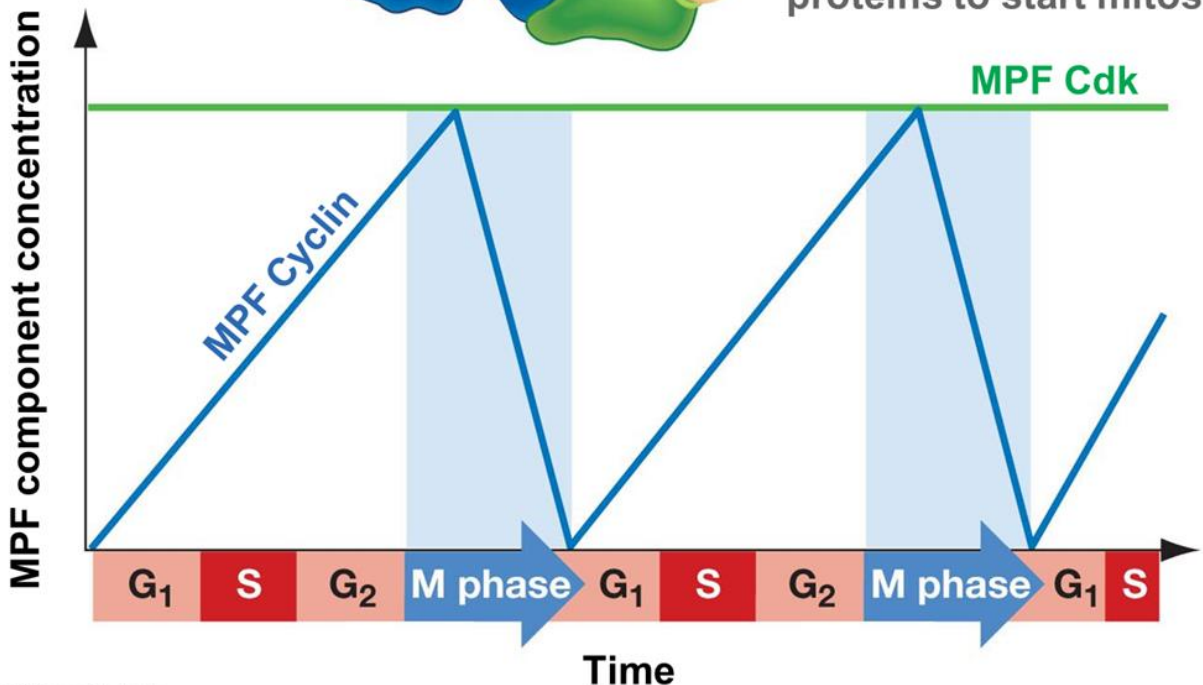
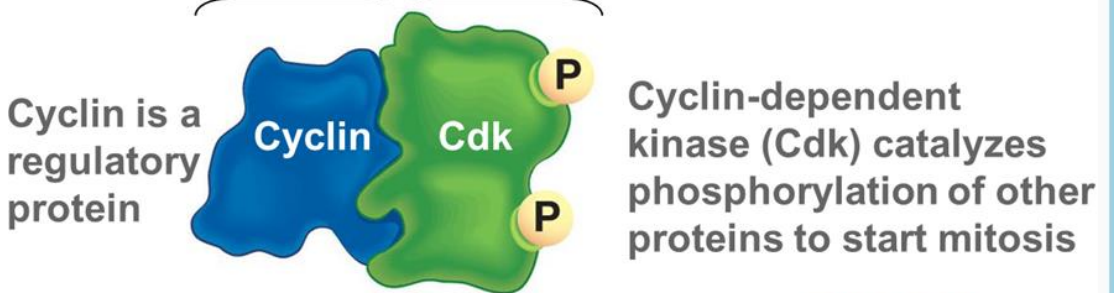
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Describe the association between cyclin and Cdk.

Mitosis-promoting factor (MPF)



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**What happens if the cell
incorrectly bypasses a
checkpoint?**

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What happens if the cell incorrectly bypasses a checkpoint?



- > **Cancer**
- > **Apoptosis**



What phase is the M checkpoint located in?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

What phase is the M checkpoint located in?

B. Metaphase



The M checkpoint is during metaphase when the sister chromatids are on the metaphase plate. This will check to ensure all microtubules are attached to chromatids to ensure equal division of chromosomes.



How does the level of cyclin and CdK vary during cell cycle?

- A. Cyclin increases, CdK remains the same**
- B. Cyclin decreases, CdK remains the same**
- C. Cyclin remains the same, CdK levels increase**
- D. Cyclin remains the same, CdK levels decrease**

How does the level of cyclin and CdK vary during cell cycle?

A. Cyclin increases, CdK remains the same



CdK is the cyclin dependent kinase. This enzyme will remain at a constant level throughout the cell cycle. The cyclin will build up through interphase. Once it reaches the optimal level, the enzyme will be activated.

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**Proto-oncogenes can
mutate into oncogenes**

- A. True**
- B. False**

Proto-oncogenes can mutate into oncogenes

A. True



Proto-oncogenes are normal cell division genes. When the proto-oncogene is mutated, it will cause the normal growth to be overactivated thus causes an increase in cell division with causes abnormal cell growth.

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If the cell doesn't get the go ahead signal in G_1 , where does it go?

- A. G_0
- B. G_1
- C. G_2
- D. S

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If the cell doesn't get the go ahead signal in G_1 , where does it go?

A. G_0



If the cell does not get the signal at G_0 , they will exit the cell cycle. Example cells include: nerve, muscle, or liver cells

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**What is the function of
a proto-oncogene?**

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What is the function of a proto-oncogene?



This is a gene that makes a normal cell cycle protein. There are many proto-oncogenes. Each one is responsible for making a protein involved in cell growth, division, and other processes. There is nothing “bad” about this gene, until it becomes overactivated/mutated causing the normal protein to be overproduced increasing the amount of cell cycle the cell undergoes.

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What is the function of a tumor-suppressor gene?

What is the function of a tumor-suppressor gene?



This is a gene that makes protein that inhibits the cell cycle. Again, this gene is perfectly fine until it becomes mutated. Once mutated, it might not make the protein that halts or inhibits the cell cycle.

There are three types:

Telling cells to slow down and stop dividing

Repairing damage to cellular DNA that results from dividing and could lead to cancer

Causing damaged cells to start a process called programmed cell death, or apoptosis.



What is the function of the M checkpoint?

- A. Check DNA is completed replication**
- B. Check DNA is undamaged**
- C. Check chromosomes are attached to kinetochores**
- D. Check cell should undergo division**

What is the function of the M checkpoint?

C. Check chromosomes are attached to kinetochores



The M checkpoint is during metaphase when the sister chromatids are on the metaphase plate. This will check to ensure all microtubules are attached to chromatids to ensure equal division of chromosomes.



What could result if the cell bypasses the M checkpoint?

- A. Crossing over**
- B. Independent assortment**
- C. Nondisjunction**
- D. Random fertilization**

What could result if the cell bypasses the M checkpoint?

C. Nondisjunction



The M checkpoint is during metaphase when the sister chromatids are on the metaphase plate. This will check to ensure all microtubules are attached to chromatids to ensure equal division of chromosomes. If this phase is bypassed, the sister chromatids might not segregate to opposite cells.



What stimulates progression from the G₂ checkpoint?

- A. Crossing over complete**
- B. Cyclin level rises to specific level to bind with CdKs**
- C. Independent assortment complete**
- D. Microtubules attached at all kinetochores (chromosomes)**

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What stimulates progression from the G₂ checkpoint?

B. Cyclin level rises to specific level to bind with CdKs



The G₂ checkpoint occurs prior to mitosis. This will ensure the DNA has copied with “no errors” and the cell is large enough for division. As the cell goes through interphase, the cyclin level will rise while the CdK level stays the same.