

Chapter 12 – The Cell Cycle

Living species MUST possess the ability to r _____ if they are to flourish.
The “Cell Cycle” follows the life of a cell from its o _____ until its d _____.

The Key Roles Of Cell Division

Cell division allows _____ (#)-celled organisms to reproduce.

Cell division allows multicellular organisms to develop from _____ (#) cell(s).

Once growth in a multicellular organism is complete, cell division insures that tissues are r _____ and
r _____.

In order for cell division to occur and preserve genetic continuity, each daughter cell must receive an equal amount of
_____ from the parent (mother) cell.

Before cell division, a cell must _____ its own DNA.

Cell Division Distributes Identical Copies Of DNA To Its Daughter Cells

All of an organism’s genes constitute its g _____ (ie. its DNA endowment.)

How many chromosomes do prokaryotes possess? _____

Eukaryotes usually have _____ (one / a number of) chromosomes.

DNA molecules are packaged into nuclear organelles called c _____.

The name “chromosome” means “colored body” and was granted because chromosomes are easily s _____.

All members of a species have the same number of _____ in their somatic (body) cells.

Human somatic cells have _____ (#) chromosomes.

Human gametic cells have _____ (#) chromosomes.

Each eukaryotic chromosome encases _____ (#) DNA molecule(s).

Each DNA molecule contains _____ or even _____ of genes.

In a non-dividing cell, the DNA is found in union with protein, making a long, thin
complex called _____.

This complex condenses only in preparation for cell _____.

DNA replication must occur _____ (before / after) condensation.

A condensed, replicated strand of DNA is called “a pair of _____” or “sister
_____”.

Are sister chromatids genetically identical? _____ (Yes / No)

The potion of the sister chromatids that “holds them together” is the
_____.

During cell division, sister chromatids are pulled _____ (toward / away from) each
other.

“Division of the nucleus” is a succinct definition of the term _____.

“Division of the cytoplasm” is a succinct definition of the term _____.

At the conclusion of cell division, each daughter cell has _____ (the same / half of) the DNA of the mother cell.

At the conclusion of cell division, each daughter cell has _____ (the same / half of) the cytoplasm of the mother cell.

I inherited _____ (#) chromosomes from my parents. My mom gave me _____ (#) and my dad gave me _____ (#).

At the moment of my creation, I was a _____ (#)-celled organism and my name was z _____.

I am composed of _____ (thousands / millions / billions / trillions / zillions) of cells.

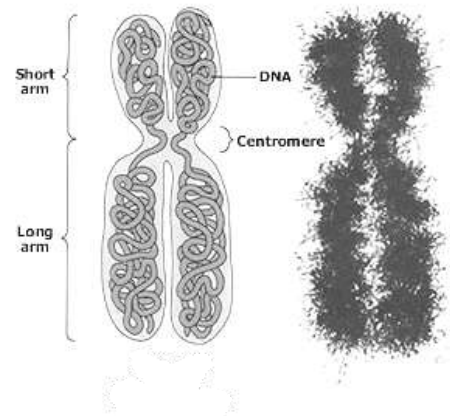
Gametes are not made by mitosis...THEY are generated by a modified form of mitosis called _____.

Meiosis occurs only in my _____.

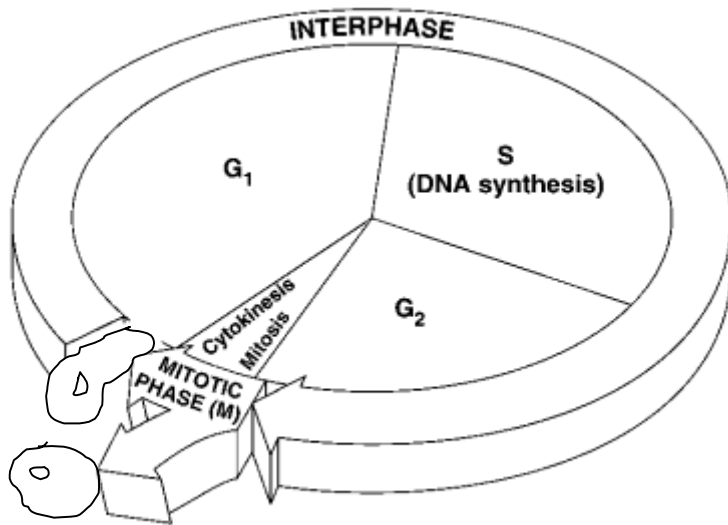
Meiosis reduces the number of chromosomes in a human cell from _____ (#) to _____ (#).

When, someday, I parent a baby, I shall give that baby _____ (#) of my own chromosomes. I sure hope they are my good ones,
like the ones that give me my beautiful _____ and astounding ability to _____.

A discussion of meiosis is postponed until Campbell Chapter _____. I probably need to grow up a little before I’m ready for that
particular discussion.



The Mitotic Cell Cycle



Mitosis occurs only during the ___ phase.
 Please color the Mitotic Phase *arrow* yellow.
 The “rest” of the Cell Cycle is called i_____.
 Please color the Interphase *arrow* blue.
 Cellular growth occurs during the _____ phase.
 Please color G₁ purple.
 Chromosomes are duplicated during the _____ phase.
 Please color the S phase orange.
 A cell readies itself for cell division during the ___ phase.
 Please color G₂ green.
 Color “Cytokinesis” brown.
 Color “Mitosis” pink.
 The longest phase is the ___ phase.
 The shortest phase is the ___ phase.

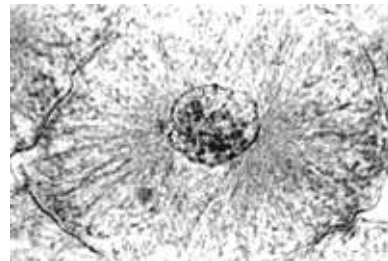
The Five Phases Of Mitosis

Campbell divides mitosis (M phase) into 5 subphases. Put them in the proper order from 1 – 5.

_____ anaphase _____ metaphase _____ prometaphase _____ telophase _____ prophase

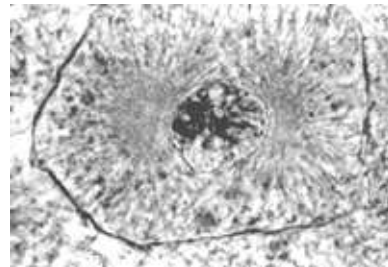
During late interphase.....

- _____ Is there a nuclear envelope?
- _____ Has the DNA replicated itself?
- _____ Are there 1 or 2 centrosomes?
- _____ Are nucleoli visible?
- _____ Has the assembly of the spindle from microtubules begun?
- _____ Has the DNA condensed, making it visible?



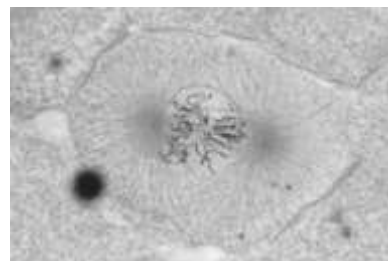
During prophase.....

- _____ Are there still discreet nucleoli?
- _____ Has chromatin condensation begun?
- _____ The mitotic spindle is formed from cytoskeletal elements called _____.
- _____ Is the position of the centrosomes fixed?
- _____ Do the centromeres move closer together or farther apart?
- _____ Has nuclear dissolution begun?



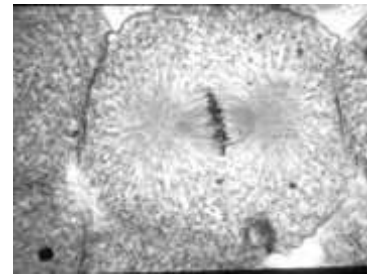
During prometaphase.....

- _____ Has the nuclear envelope dissipated?
- _____ Have the microtubules invaded the nuclear area?
- _____ Have the sister chromatids separated?
- _____ Has each kinetochore formed?
- _____ Is cellular division complete?
- _____ Does the DNA continue to condense?
- _____ Have the centrosomes reached the cellular “poles”?



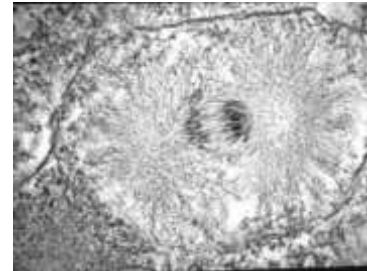
During metaphase.....

- _____ Does cytokinesis occur?
- _____ Is the metaphase "plate" fully formed?
- _____ What is the entire apparatus of microtubules called?
- _____ Are the centrosomes arranged "in a row"?
- _____ Has the "cleavage furrow" appeared?
- _____ Are sister chromatids still united?



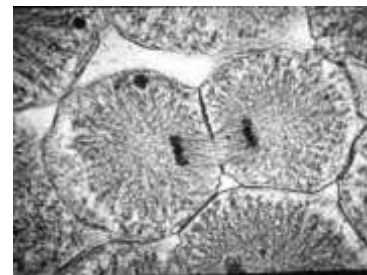
During anaphase.....

- _____ Does sister chromatid separation occur?
- _____ Does the nuclear envelope reform?
- _____ Do the separated sister chromosomes move "toward" or "away from" each other?
- _____ As the chromosomes move, do the centrosome "lead" or "follow"?
- _____ Do the cell poles move "closer together" or "farther apart"?



During telophase.....

- _____ Does the cell *elongate* or *shorten*?
- _____ Does the nuclear envelope reform?
- _____ Do the chromosomes duplicate again?
- _____ Does fertilization occur?
- _____ Do the chromosomes de-condense?
- _____ Does the spindle persist?
- _____ Is there evidence that cytokinesis has begun?

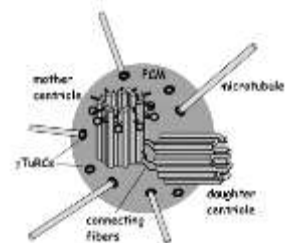


During which phase.....

- _____ Does nuclear envelope dissolution begin?
- _____ Do the sister chromatids line up along the cellular equator?
- _____ Does cytokinesis (if it is to occur) occur?
- _____ Does nuclear condensation begin?
- _____ Is the spindle finally fully-formed?
- _____ Do sister chromatids separate and become chromosomes?
- _____ Does the spindle break apart?
- _____ Do kinetochores form?

The Centrosome

- _____ Is the centrosome part of the intramembranous system?
- _____ The function of the centrosome is to organize the cell's _____.
- _____ Located in the center of the centrosome are a pair of _____.
- _____ Do animal cells have centrioles? Do most plant cells?
- _____ During what part of the cell cycle does centrosome replication occur?
- _____ Can an animal cell divide without centrioles?
- _____ Centrosome gives rise to cytoskeletal structures called _____.
- _____ By the end of prometaphase, centrosomes are located at opposite _____.

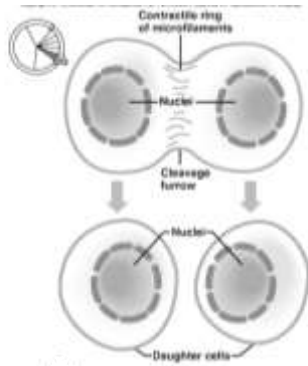


- _____ What part of the sister chromatids does the spindle attach to?
- _____ The sister chromatids are pulled equally toward both poles until their centromeres end up aligned along the cell's _____.

Separation Of Sister Chromatids

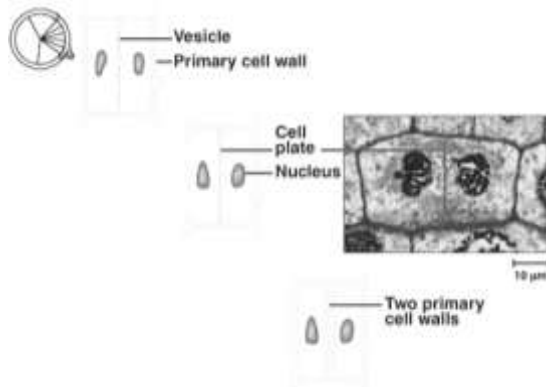
_____ Within the centromere, sister chromatids are held together by _____.
 _____ When these **** (answer above) are inactivated, the sister chromatids are pulled _____
 _____ (apart / toward one another).
 _____ Once separated, sister chromatids may now be officially called _____.
 _____ Chromosome movements is accomplished via “_____” along the microtubule.
 _____ Anaphase cells elongate because nonkinetochore microtubules _____ (lengthen / shorten).

Cytokinesis In Animal Cells

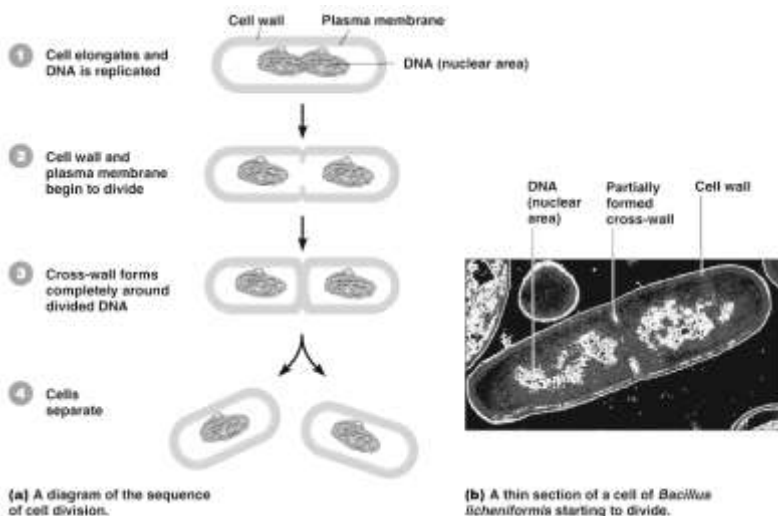


The names of the microfilaments that participate in cytokinesis in animal cells are _____ and _____.
 These are the two proteins of _____ cells!
 The ring of actin filaments moves along the myosin filaments and constricts the middle of the cell like a _____.
 Eventually, the mother cell is pinched into two. The last phrase uttered by the mother cell before separation occurs is “_____”!

Cytokinesis In Plant Cells



Plant cell cytokinesis is different than animal cell cytokinesis because plant cells have c_____ w_____ to contend with.
 In plant cells (during telophase), the organelle that moves along the microtubules is the _____. They move toward the middle of the cell. There, they coalesce to form the c_____ p_____. The p_____ m_____ of the two daughter cells unite, each with its own primary c_____ w_____.



The Evolution of Mitosis

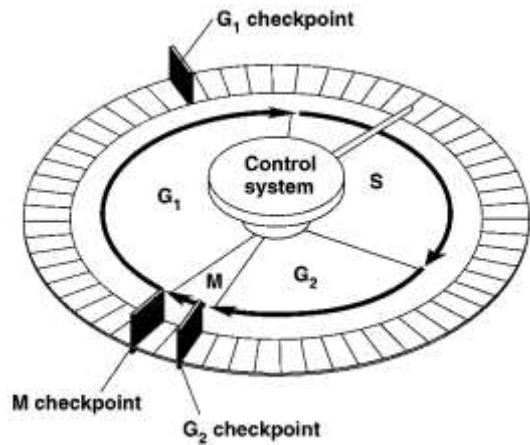
Because prokaryotic cells preceded eukaryotic cells, we might speculate that the ancestral origins of this precise, complex process began in bacteria. Bacteria utilize a simple form of cell division called _____.
 During this process, the single, circular strand of bacterial _____ replicates. The now-duplicated (or doubled) strand of DNA is separated via a process that is currently being researched. Whatever the mechanism, as the bacterial cell divides (fission) the two (binary) circular strands of DNA move apart. Prokaryotes _____ (do / do not) have mitotic spindles.

REGULATION OF THE CELL CYCLE

The cell cycle control system proceeds on its own, driven by a built-in clock. BUT, the cell cycle is regulated by both internal and external controls at certain _____.

The three major checkpoints are during _____, _____, and _____ phases.

Generally, animals cells have built-in _____ signals that are overridden by _____ signals when the proper signals are received from e _____ and i _____ sources.



G₁ CHECKPOINT is often called the _____
In mammal cells. If given the go-ahead cells will complete the cell cycle and d _____. It will enter a _____ phase if there is no go-ahead signal. This is common for many of our cells. Some mature cells will never divide such as specialized _____ and _____ cells.

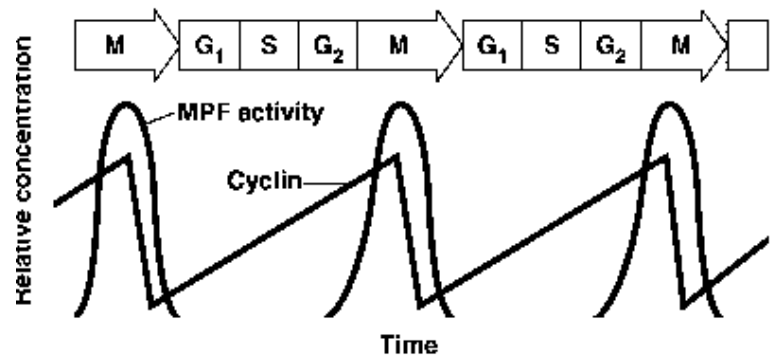
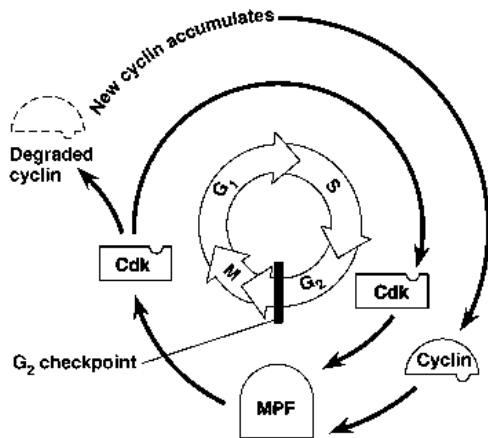
G₂ CHECKPOINT (from G₂ into _____ phase) is triggered by MPF - _____, also known as "M-phase-promoting factor."

_____ is a protein whose concentration increases during the life of the cell, then fall sharply during cell division. (see graph below)

A KINASE is a protein that _____ or _____ other proteins by phosphorylating them.

MPF is a complex of a Cdk - _____, which is inactive until bound to a cyclin molecule. MPF causes the initiation of the _____ phase by causing the _____ to fragment and by activating other k _____.

MPF also causes its own shut down or inactivation by starting a process that destroys c _____.



M PHASE CHECKPOINT is between _____ and _____. APC (_____) is kept inactive by signals from k _____ that have not been attached to spindle fibers. Once all the _____ have attached, APC becomes active and causes the inactivation of proteins that hold _____ chromatids together and also triggers the breakdown of c _____. What is the benefit of having this checkpoint?

EXTERNAL CUES

g _____ f _____ are proteins that stimulate cells to divide.
 d _____ d _____ i _____ prevents crowded cells from dividing.
 a _____ d _____ is the requirement of cells to be attached to a substratum.

CANCER HAS ESCAPED! FROM THE CELL CYCLE CONTROLS (think fat, blobby prison escapee)

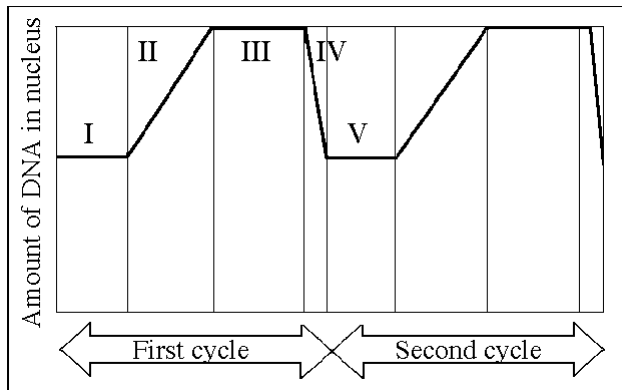
There are many types of cancer and many causes. Some of the common features are cancer cells often do not respond to or ignore the effects of _____ factors, _____ inhibition, and _____ dependence.
 Many cancer cells can be considered “i _____” if given a constant supply of nutrients. The most famous cell line, started in 1951, is known as _____ cells. So named because of their donor, _____.
 Most normal mammalian cells divide _____ to _____ times before dying off.

If cancer cells evade destruction by the immune system, then they may continue to divide and form a dense mass of cells or _____.
 _____ tumors generally do not cause serious problems and can be surgically removed.
 _____ tumors typically impair function of organs and are difficult to surgically remove.
 Traveling to other parts of the body through the lymph of blood vessels and starting new tumors is termed _____.
 _____ and _____ are the two most common cancer treatments.

WE WILL DO THE REST IN CLASS TOGETHER

The data were obtained from a study of the length of time spent in each phase of the cell cycle by cells of three eukaryotic organisms designated beta, delta, and gamma.

Minutes Spent in Cell Cycle Phases				
Cell Type	G ₁	S	G ₂	M
Beta	18	24	12	16
Delta	100	0	0	0
Gamma	18	48	14	20



Identify the phase of the cell cycle:

- I –
- II –
- III –
- IV –
- V –