

Chapter 10 Cell Growth and Division

Key Concepts

What problems does growth cause for cells?

How do organisms grow?

produce more cells

cells of an adult are no larger than that of the offspring, adults just have more cells

Limits to Cell Growth

Two reasons cell divide

1. Larger cells create more demands of DNA

DNA controls cells functions

DNA is in the nucleus

Cells will not make extra copies of DNA when large

If cell becomes too large, then the DNA is asked to increase its support to the cell and it will not be able to do that.

Example - gas station

2. Larger cells have problems with moving enough nutrients and wastes through cell membrane

Food, oxygen, water, and waste materials travel through the membrane. How fast this can occur depends on the surface area of the cell which is the total area of the cell membrane.

How much oxygen and wastes that are produced depends on the volume of the cell.

This relationship between volume and surface area is why cells must divide.

Ratio of Surface Area to VolumeSurface Area = $L \times W \times \# \text{ of sides}$ Volume = $L \times W \times H$ Ratio of Surface Area to Volume = $\frac{\text{Surface Area}}{\text{Volume}}$

Volumes increases faster than Surface Area

Ratio of Surface Area to Volume

Cell Size	1 cm	2 cm	3 cm
Surface Area (length x width x # of sides)	$1 \text{ cm} \times 1 \text{ cm} \times 6 = 6 \text{ cm}^2$	$2 \text{ cm} \times 2 \text{ cm} \times 6 = 24 \text{ cm}^2$	$3 \text{ cm} \times 3 \text{ cm} \times 6 = 54 \text{ cm}^2$
Volume (length x width x height)	$1 \text{ cm} \times 1 \text{ cm} \times 1 \text{ cm} = 1 \text{ cm}^3$	$2 \text{ cm} \times 2 \text{ cm} \times 2 \text{ cm} = 8 \text{ cm}^3$	$3 \text{ cm} \times 3 \text{ cm} \times 3 \text{ cm} = 27 \text{ cm}^3$
Ratio of Surface Area to Volume	$6 / 1 = 6 : 1$	$24 / 8 = 3 : 1$	$54 / 27 = 2 : 1$

If a cell gets too large, it makes it more difficult for the cell to bring in enough nutrients and oxygen. Also, to get the waste products out.

Before the cell gets too large, it divides forming two daughter cells - process called **Cell Division**.

Double Check your understanding!

Two Reasons cells divide

1. too large causes more demands on the DNA
2. too large, cell has trouble moving nutrients and wastes

As a cell increases in size, which increases more rapidly, its surface area or volume?

volume

Calculate the surface area, volume and ratio of surface area to volume of an imaginary cubic cell measuring 4 cm on each side.

$$= \frac{3}{2}$$

Section 10-2 Cell Division

Key Concepts
What are the main events of the cell cycle?
What are the four phases of mitosis?

Video - Cell Division
<https://www.youtube.com/watch?v=Jc2QlmozYfk>

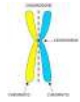
Chromosomes
Each cell must copy the genetic information before cell division can take place. Daughter cells will receive one copy of information. Two copies of information per cell.
Chromosomes carry the genetic information that is passed to the daughter cells.
DNA and proteins make up chromosomes.
Every organism has a specific number of chromosomes.
Humans = 46 23 pairs
Fruit Flies = 8
Carrots = 18
Turkey = 80
Chromosomes are usually not visible in most cells.
Chromosomes are spread out throughout the nucleus.
To start cell division, chromosomes coil up or condense into compact visible structures. Look similar to an X.

chromosomes
made of DNA and proteins


chromatid
coiled up information

sister chromatids
matching identical pairs of chromosomes


centromere
usually near middle where chromosomes are attached




The Cell Cycle
A series of steps that cells go through as they grow and divide.
Cell Cycle is divided into various phases:
Interphase, Mitosis, Cytokinesis
Each of these parts are divided into other parts.
Interphase
cell spends most of its time in interphase
G₁ phase
book does not mention this resting period
G₁ phase
cell growth
synthesize new proteins and organelles
S phase
chromosomes are replicated
DNA molecules created
proteins associated with chromosomes synthesized once a cell gets to the S phase it usually completes the cell cycle
G₂ phase
production of organelles needed for cell division
production of enzymes that check DNA for mistakes - repair if needed
completes growth
Mitosis
also called - M phase includes cytokinesis
broken down into 4 phases
Prophase
longest stage - spend 50-60% of mitosis in this stage
chromosomes become visible
nuclear envelope disappears
centrioles separate and move to poles to an area called the centrosome and organize the spindle - separates the chromosomes
spindle fibers form between centrioles
chromosomes attach to spindle fibers




Metaphase
chromosomes line up across the center of the cell
still attached to spindle fiber by the centromere-kinetochore





Anaphase
centromeres split
spindles start to pull
chromosomes to pole
chromosomes will move until they are at the poles



Telophase
chromosomes begin to disperse - uncoil
nuclear envelope re-forms and surrounds each group of chromosomes
spindle fibers break apart
nucleus forms



Cytokinesis
mitosis produces two nuclei
division of the cytoplasm
animal cells - cytoplasm is drawn inward and pinched into two equal parts
plant cells - cell plate forms between nuclei then a cell wall forms in the cell plate

Check your understanding!
Name the main events of the cell cycle.
cell grows, replicates its DNA, prepares to divide, and divides into two daughter cells
How do Prokaryotic cells divide?
binary fission
What are chromosomes made of?
DNA and proteins
List all phases of the cell cycle.
Interphase - G₁ phase, S phase, G₂ phase
Mitosis - Prophase, Metaphase, Anaphase, Telophase
Cytokinesis
Make sure you know what happens in each phase.
What function does the spindle serve during mitosis?
Helps separate the chromosomes.
Does cytokinesis start when telophase ends?
No, it actually begins during telophase.

<https://www.quia.com/r/131187.html>

https://www.quia.com/r/55090.html?AP_rand=1391686749

<http://www.syxum.com/cgi/online/gamem.cgi/quizzes/biology/mitosis.tdf?0>

<https://www.quia.com/mc/65901.html>

<https://www.quia.com/cc/65901.html>

<https://local-brookings.k12.sd.us/biology/ch10celldivision/MITOSIS%20XWD.html>



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

Section 10-3 Regulating the Cell Cycle

Key Concepts

How is the cell cycle regulated?

How are cancer cells different from other cells?

Controls on Cell Division

Cells will grow until a signal is given.

You cut yourself, your body begins the healing process by dividing rapidly by the edge of the injury. The process is completed when cells touch each other and the process of cell division is slowed down.

Cell Cycle Regulators

Tim Hunt and Mark Kirschner discovered that cells in mitosis contained a protein that when put into a nondividing cell, the cell would start to divide.

The protein that caused the cell to divide = **cyclin**.

Internal Regulators

proteins that respond to events that happen in the cell
will not let mitosis start until chromosomes are copied

External Regulators

proteins that respond to events outside the cell
direct cells to speed up or slow down the cell cycle

Uncontrolled Cell Growth

Cancer

cells lose ability to control growth
form masses called tumors