

Cell size limitations

2 main reasons why cells divide

- 1) The larger a cell becomes the more demands the cell places on its DNA
- 2) Larger cells are less efficient in moving nutrients and waste across the cell membrane

Ratio of surface area to volume

Surface Area: this is the area covered by the cell membrane

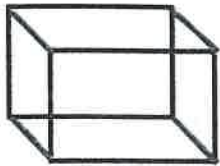
How is it calculated? $L \times W \times 6$

SA : V ratio

Volume: the space taken up by the inner contents of the cell

How is it calculated? $L \times W \times H$

Practice



1cm side
 SA: $1 \times 1 \times 6 = 6$
 V: $1 \times 1 \times 1 = 1$
 6:1

2cm side
 SA: $2 \times 2 \times 6 = 24$
 V: $2 \times 2 \times 2 = 8$
 3:1

3cm side
 SA: $3 \times 3 \times 6 = 54$
 V: $3 \times 3 \times 3 = 27$
 2:1

Considerations with surface area to volume ratio

Small Cell	Large Cell
<ul style="list-style-type: none"> - Surface area greater than the volume - Can get nutrients <u>in/out</u> easily - Can get wastes <u>out</u> easily - Cytoskeleton only has to transport nutrients <u>small</u> distances within cell - Signal proteins can communicate instructions for cell functions <u>quickly</u> since only have to travel <u>short</u> distances 	<ul style="list-style-type: none"> - Volume greater than the surface area - Will have trouble with bringing <u>nutrients</u> in since not as much <u>surface area</u> - Hard to get all wastes out - Cytoskeleton has to transport nutrients <u>long</u> distances within cell - Signal proteins must travel <u>large</u> distances and may not get there in time

Cell Division

: the process by which a cell divides into 2 new daughter cells

- Before the cell can divide the DNA must be copied first
- This solves the issue of having information overload since its daughter cells gets one complete copy of genetic information

2 main types of Cell Division and Reproduction

Asexual Reproduction	Sexual Reproduction
<ul style="list-style-type: none"> • Used mostly in <u>unicellular</u> organisms • Very <u>simple</u> • Efficient • Populations will <u>increase</u> quickly • Each cell is <u>genetically identical</u> • When conditions are just perfect, the <u>faster</u> they can reproduce and increase <u>survival</u> • Disadvantage: <u>since identical can kill easily</u> 	<ul style="list-style-type: none"> • Used mostly in <u>multicellular</u> organisms • More <u>complex</u> • Fusion of <u>2</u> separate <u>reproductive</u> cells • Each cell has <u>some</u> of the genetic info from the parent (thus not <u>identical</u>) • Requires more <u>time</u> • Must have <u>female</u> & <u>male</u> • Provides <u>genetic</u> diversity

Ex: Bacteria
yeast

Ex: plants
animals

Chromosome: Genetic information is bundled into packages of DNA
Chromatid: one of the 2 "sister" parts of a duplicated chromosome
Centromere: region of a chromosome where the 2 sister chromatids are attached
Eukaryote Chromosomes are found in the nucleus
Prokaryote Chromosomes do NOT have a nucleus
 Found in the cytoplasm
 In the shape of a ring/circle
 Go through Binary fission → produces identical offspring
 DNA copied then cell divides

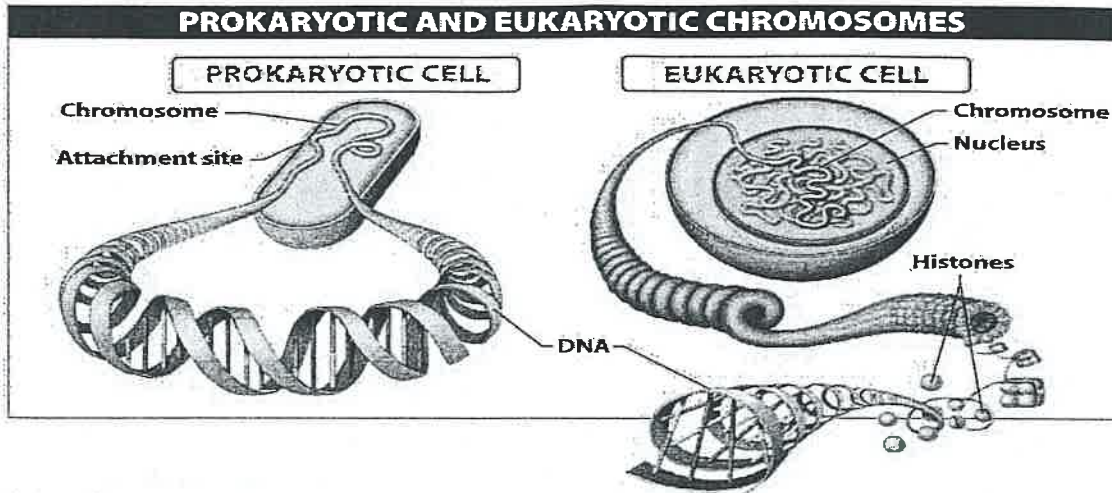


Figure 6-3
 What Is Life? A Guide To Biology
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Chromosomes make it possible to duplicate DNA precisely during cell division

THE CELL CYCLE (journal book pic)

Cells reproduce for 2 reasons

growth
to heal

There are 3 stages of the Cell Cycle:

- Interphase: the "in-between" period of growth
 Broken into 3 steps
 - Step #1 G₁ phase or Gap 1 phase
 - Step #2 S phase or Synthesis phase
 - Step #3 G₂ phase or Gap 2 phase
- Mitosis: The division of the nucleus
 Broken into 4 steps
 - Step #1 prophase
 - Step #2 metaphase
 - Step #3 anaphase
 - Step #4 telophase
- Cytokinesis: division of the cytoplasm

Stage #1: INTERPHASE (the in-between period of growth) (90% of life spent in this stage)

G1 Phase OR Gap1 phase: Cell Growth

- Cells do most of their growing
- Cells increase in size
- Make new proteins and organelles

S Phase OR Synthesis phase: DNA Replication

- DNA is synthesized when the chromosomes are replicated
- The cell at the end of S phase will contain twice as much DNA as it did in the beginning

G2 Phase OR Gap2 phase: Preparing for Cell Division

- Shortest of the parts of interphase
- Many of the organelles are produced

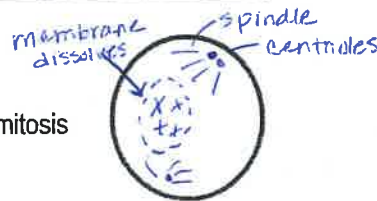
Stage #2/3: Mitosis and Cytokinesis

Mitosis: is the division of the nucleus

There are 4 parts (PMAT)

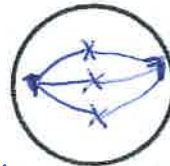
PROPHASE

- First phase of mitosis
- This is usually the longest part of mitosis
- The genetic material in the nucleus condenses
- The chromosomes (duplicated) are visible
- The nucleus and nuclear membrane dissolve/breakdown
- Centrioles move to ends of cell
- spindle fibers begin to form



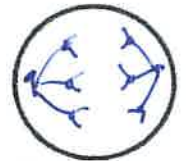
METAPHASE

- Second phase of mitosis
- This is usually the shortest part of mitosis
- The centromere of the duplicated chromosomes line up across the center of the cell
- Each chromosome is connected to spindle fibers at its centromere



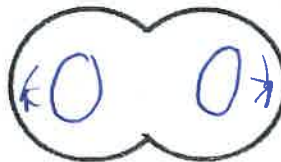
ANAPHASE

- Third phase of mitosis
- The sister chromatids separate into individual chromosomes and are moved apart
- The individual chromosomes moves along the spindle fibers to the opposite end of the cell



TELOPHASE

- Fourth phase of mitosis
- Chromosomes gather at opposite ends of the cell and lose their shape becoming a tangle of chromatin
- 2 nuclear membrane form around each cluster of chromosomes
- Spindles fibers dissolve
- Nucleolus becomes visible

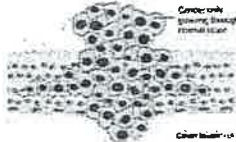


STAGE #3: CYTOKINESIS

- Usually occurs at the same time as telophase
- Cytoplasm pinches in half
- Each daughter cell has an identical set of duplicated chromosomes
- This completes the process of cell division by splitting 1 cell into 2

Cytokinesis differences

Plant cells: cell plate forms - pinches in → out
Animal cells: cytoplasm pinches out to in



Section 3 Regulating the Cell Cycle

- How does a cell know When to divide?
 - o muscle and nerve cells do not divide once they have been developed
 - o RBC, skin cells and digestive tract cells all grow rapidly throughout life
 - o CYCLINS regulates the cell cycle
 - These tell the cell it is time to go through the cell cycle
 - The cell is controlled by
 - internal regulators
 - o These allow the cell cycle to proceed only when certain events have occurred inside of the cell
 - external regulators
 - o Direct the cell to speed up or slow down during the cell cycle
 - Example: Growth factors
 - These stimulate growth and cell division
- Sometimes cells are bad
 - o they may die by accident (in an injury or just damaged)
 - o they may be programmed to die called apoptosis

CANCER

- a disorder in which body cells lose their ability to control growth
- cancer cells do not respond to the signals that regulate growth
- results in the uncontrolled growth & division of cells
 - o this can cause tumors to form
 - a mass of cell
 - Benign tumor
 - o These are non-cancerous and do NOT spread
 - Malignant tumor
 - o These are cancerous and do spread
 - o They invade and destroy the surrounding healthy tissue blocking and preventing Organs from functioning properly

Carcinogens