**Lecture Outline**
**Introduction/Chemistry/Cells**

## *Module 1.2: Overview of A&P*

### ANATOMY & PHYSIOLOGY

**Anatomy –**
(Greek – "a cutting up")
**Physiology –**
(Greek – "relationship to nature")

**_____is always related to _____**

### Core Principles in A&P

- **Structure and Function Core Principle**
  – One of most basic principles in A&P; known as principle of *complementarity of structure and function*:
  - Form of a structure is always *such that it best suits its function*
  - Form follows function; applies to each level of organization even down to *chemical level*

### CHARACTERISTICS OF LIVING ORGANISMS

**Living Organisms** share distinct properties:

1. **Cellular composition: cells** are *basic units* of life
   a. -
   b. -

2. **Metabolism -** living organisms carry out a number of chemical reactions collectively known as **metabolism**

3. _____, where building outweighs breaking down processes, includes two forms:
   a. Increase in size of individual cells
   **b.**

4. _____– process that an organism uses to eliminate potentially harmful waste products created by metabolic processes

5. _____or **irritability** – ability of organisms to sense and react to changes or stimuli in their environment

6. _____– ability of an entire organism to move or movement of individual cells or of materials within or between cells of an organism

7. _____takes following two forms in multicellular organisms:
    a. Individual cells reproduce within organism during growth and to replace damaged or old cells
    b. Organism itself reproduces to yield similar offspring

## LEVELS OF STRUCTURAL ORGANIZATION AND BODY SYSTEMS

- Organism itself reproduces to yield similar offspring

- **Chemical level** – smallest level is foundation for each successive level, ranges from atoms to complex molecules
    _____**– hydrogen atom, lithium atom**
    _____**– water molecule, glucose molecule**
    _____**– protein molecule, DNA molecule**

- **Cellular level** – formed by groups of many different types of molecules combined in specific ways to form cellular structures
    - _____**– mitochondrion, Golgi apparatus, nucleus**
    - _____**– muscle cell, nerve cell; smallest unit of life**

        - two or more cell types cooperate to perform a common function
        - *Consist of two components:* ***cells*** *and surrounding* **extracellular matrix**
        - Vary from membrane sheets that cover body cavities to irregularly shaped cartilage found in nose

- _____ – consists of two or more tissue types combined to form a structure or **organ**
    - **skin, femur, heart, kidney**

- _____ – Consist of two or more organs that together carry out a broad function in body

- _____– organ systems function together to make up working human body, an organism

### *Module 1.3: Language of A&P*

## ANATOMICAL POSITION

- _____ – common frame of reference from which all body parts and regions are described:

    - Body is always referred to as if it were in anatomical position, even when it's in another position

    - "Right" and "left" always refers to right and left sides of body being described, not our own

## DIRECTIONAL TERMS

- **Anterior / Posterior**
- **Ventral / Dorsal**
- **Superior / Inferior**
- **Cranial / Caudal**
- **Proximal / Distal**
- **Medial / Lateral**
- **Superficial / Deep**

## REGIONAL TERMS

Body can be divided into two regions:

- axial region, which includes head, neck, and trunk and
- appendicular region which includes upper and lower limbs or appendages

- Antebrachial
- Axillary
- Brachial
- Cervical
- Costal
- Crural
- Femoral
- Gluteal
- Mammary
- Nasal
- Occipital
- Lumbar
- Pectoral
- Sternal
- Tarsal
- Vertebral

## PLANES OF SECTION

- Sagittal
  - Midsagittal
  - Parasagittal
- Frontal (coronal)
- Transverse (horizontal)
- Oblique

## *Module 1.4 Organization of the Human Body*

## BODY CAVITIES

- Dorsal Body Cavity – located on *posterior* side of body; subdivided into two cavities:
  - Cranial cavity –
  - Vertebral (spinal) cavity –
- Ventral Body Cavity - separated into *two divisions* by diaphragm:
  - Thoracic –
  - Abdominopelvic –

Thoracic cavity – divided into three smaller cavities:

- Pleural cavities –
- Mediastinum – (not within serous membrane)
- Pericardial cavity –

Abdominopelvic cavity – subdivided into two cavities:

- Abdominal cavity –
- Pelvic cavity

Abdominopelvic cavity can be divided up into *segments or quadrants*

Quadrants:

- Right upper quadrant (RUQ)
- Right lower quadrant (RLQ)
- Left upper quadrant (LUQ)
- Left lower quadrant (LLQ)

Segments:

- Right and left hypochondriac regions
- 
- Right and left lumbar regions
- 
- Right and left iliac or inguinal regions
- Hypogastric region

**ABDOMINAL PAIN**

- *Common complaint* of individuals seeking health care
- *Cause* of pain can be difficult to diagnose due to number of structures in abdominopelvic cavity; *four quadrant system* makes this easier

- RLQ –
- LUQ –

Serous membranes:

- Thin sheets of tissue; form certain cavities found in ventral cavity; surround heart, lungs, and many abdominal organs
- Within cavity between two layers is thin layer of fluid called serous fluid
- Visceral layer –
- _____ – outermost layer attached to surrounding structures (wall of cavity)

Body has three serous body cavities formed by three main serous membranes:

Pleural membranes

Parietal pleura

Visceral pleura

Thin space enclosed by pleural membranes forms_____cavities

Pericardial membranes

_____ pericardium (separates heart from mediastinum)

Visceral pericardium (lies directly on heart muscle)

Space created by pericardial membranes forms_____cavity

Peritoneal membranes, surrounds some of abdominal organs

Parietal peritoneum

_____ peritoneum

Space between these layers forms_____cavity

The peritoneum doesn't cover every organ

ex. kidneys duodenum, pancreas are called_____organs

## *Module 1.5: Core Principles in A&P*

### HOMEOSTASIS

- Physiological Processes Operate to Maintain Body's _____(maintenance of internal environment)
- Homeostatic imbalances – *disturbances* in homeostasis can lead to disease or death if uncorrected
- To prevent imbalance, most variables are controlled (regulated) variables; maintained within a narrow range, close to a normal value

### FEEDBACK LOOPS CORE PRINCIPLE

– two mechanisms vital to maintenance of homeostasis:

- _____ – less common than negative feedback loops; effector activity increases and reinforces initial stimulus
- _____ - oppose initial change in a regulated variable; reduce output
  - Each regulated variable has a set point or an established normal value (within a normal range)
  - _____- provide information about stimuli
  - _____ – change is compared to set point
  - _____– change is corrected

**CHILDBIRTH, PITOCIN, AND POSITIVE FEEDBACK LOOPS**

- Childbirth begins with **labor**; occurs by *positive feedback*:
  –
  –
- **Pitocin** (*synthetic* oxytocin) –

# Chapter 2: Chemistry of Life

## *Module 2.1: Atoms & Elements*

### MATTER

**Matter** – anything that has mass and occupies space;

- **Chemistry** – study of matter and its interactions
- _____– smallest unit of matter that retains original properties
- Made up of even smaller structures called **subatomic particles**

### ELEMENTS IN THE PERIODIC TABLE AND THE HUMAN BODY

- The human body is made up of four major elements:
  - 
  - 
  - 
  - 
- Also 7 **mineral** elements and 13 **trace** elements

## *Module 2.4: Inorganic Compounds: Water, Acids, Bases, & Salts*

### BIOCHEMISTRY

**Biochemistry** – the chemistry of life

- _____compounds generally do not contain carbon bonded to hydrogen; includes water, **acids**, **bases**, and **salts**
- _____– those that do contain carbon bonded to hydrogen

### WATER

**Water ($H_2O$)** makes up 60–80% of mass of human:

- The medium for metabolic reactions
- 
- Absorbs and transports heat
- 
- Acts as a lubricant between two adjacent surface

## SALTS AND ELECTROLYTES

- **Salts** - can dissolve in water to form cations and anions called _____
  - Capable of conducting electrical current
  - Important roles in metabolism

## *Module 2.5: Organic Compounds: Carbohydrates, Lipids, Proteins, & Nucleotides*

## CARBOHYDRATES

- _____, composed of carbon, hydrogen, and oxygen, function primarily as fuel; also have structural roles
  - _____– monomers from which all carbohydrates are made
    Examples: glucose, fructose, galactose, ribose, and deoxyribose
  - _____are formed by union of two monosaccharides
  - _____consist of many monosaccharides joined to one another
    - **Glycogen** *storage* polymer of glucose; mostly in skeletal muscle and liver cells
    - **Starch**

## LIPIDS

- **Lipids** –hydrophobic molecules including **fats** and **oils**
  - _____ – lipid monomers consisting carbon chains
  - _____ fatty acids – solid at room temperature
  - _____ fatty acids – liquid at room temperature

**THE GOOD, THE BAD, AND THE UGLY OF FATTY ACIDS**

Not all fatty acids were created equally:

*The Good*: **Omega – 3 Fats**

-
-

- *The Bad*: **Saturated Fats**

-
-

- *The Ugly*: **Trans Fats**

## TRIGLYCERIDE

- 
- 
- Most common lipid in body

## PHOSPHOLIPIDS

- Composed of a glycerol backbone, two fatty acid “tails” and one phosphate “head”
- A molecule with a polar group (phosphate head) and a nonpolar group (fatty acid tail)
- 

## STEROIDS

- Four-ring hydrocarbon structure
- _____– component of cell membrane

## PROTEINS

- Macromolecules:
- Enzymes
- 
- Are involved in movement
- Function in the body’s defenses
- 
- 
- Receptors
- 
- Twenty different_____are used to make proteins

## ENZYME DEFICIENCIES

Examples of *common enzyme deficiencies*:

- **Tay-Sachs Disease** –

- **Severe Combined Immunodeficiency Syndrome** (**SCIDs**) –

- **Phenylketonuria** –

## NUCLEOTIDES AND NUCLEIC ACIDS

- _____ – built from monomers of **nucleotides**
  - Makes up genetic material
- Nucleotide structure:
  - **Nitrogenous base** with a hydrocarbon ring structure
  - Five-carbon sugar (**ribose** or **deoxyribose)**
  -

## Adenosine triphosphate (ATP)

- Adenine attached to ribose and three phosphate groups; main source of chemical energy in body
- Synthesized from **ADP** and a **phosphate** using energy from oxidation of fuels (like glucose)
- Production of large quantities of ATP requires oxygen; why we breathe air

## DNA

–

- Composed of two chains that twist around each other to form a **double helix**

- DNA contains **genes** – provide **recipe** or **code** for **protein synthesis** – process of making every protein

DNA contains:

- **Deoxyribose** alternating with **phosphate group**
- Bases:

- DNA exhibits complementary base pairing;

Adenine always pairs with Thymine and Guanine always pairs with Cytosine

RNA

- **Ribonucleic Acid**– single strand of nucleotides
- Can move between nucleus and cytosol

–

- RNA contains the sugar **ribose**
-

# Chapter 3: Cells

## *Module 3.1: Introduction to Cells*

### BASIC PROCESSES OF CELLS

- **Cell metabolism** –
- **Transport** of substances cell has produced or ingested to a variety of destinations
- 
- _____ between cell and surrounding environment
- **Cell reproduction** – process that is necessary for growth and development and for replacement of old and damaged cells

### OVERVIEW OF CELL STRUCTURE

Most animal cells have 3 basic components:

- 
- 
- 

**Plasma membrane**

- Provides cell with structural support, means of communication, and cell identification
- Defines intracellular space (contains **intracellular fluid** (_____)), or **cytosol**, and separates it from extracellular space (contains **extracellular fluid** (_____))

**Cytoplasm** consists of:

- **Cytosol** –
- **Organelles** – variety of cellular structures with very specific functions
- **Cytoskeleton** –

**Nucleus**

- Contains most of cell's_____and is primary location for making most _____
- DNA and RNA control more specific organelle functions by coding for and synthesizing proteins

**Cell Size and Diversity**:

- Cells vary widely in size and structure
- This structural variation is an example of **Structure-Function Principle**

## *Module 3.2: Structure of the Plasma Membrane*

PHOSPHOLIPID BILAYER

**Phospholipids** have two key properties:

- A phosphate group (_____)
- Two fatty acids (_____) that face one another forming a water resistant

barrier

**Membrane Proteins**:

- Transport substances across plasma membrane as **protein channels**; others are **carrier proteins** that directly bind to and transport substances into and out of cell

- _____**-** bind to chemical messengers called **ligands**; trigger sequence of events within cell when bound
- _____– speed up chemical reactions; vital to maintaining homeostasis
- _____ – give cells shape and help maintain structural integrity
- _____**-** hold adjacent cells to one another, anchoring cells within a tissue and/or allowing cell to cell communication

Other membrane components include lipids, carbohydrates, glycolipids, and glycoproteins:

- _____– lipid molecule, stabilizes plasma membrane's fluid structure during temperature changes

- **Glycolipids** and **glycoproteins**, serve to identify cell as part of body

## DRUGS AND MEMBRANE RECEPTORS

Many drugs are designed to resemble **ligands** that *bind to membrane receptors*:

- **Agonists** –

- **Antagonists** –

## *Module 3.3: Transport across the Plasma Membrane*

### TRANSPORT ACROSS THE PLASMA MEMBRANE

The phospholipid bilayer is **selectively permeable**

- Substance may cross plasma membrane in several ways:

–

–

### PASSIVE TRANSPORT PROCESSES

**Passive transport includes the following processes**:

- **Diffusion**

–

–

•

- **Concentration gradient** – basic force that drives many types of passive transport
- Dye molecules will scatter due to their own kinetic energy, which all molecules have as long as thermal energy (heat) is present
- Movement will continue until the dye is uniform throughout container (**equilibrium)**

**Diffusion** –

**Simple diffusion** – mostly *nonpolar solutes* like oxygen, carbon dioxide, lipids, and hydrocarbons; pass straight through phospholipid bilayer without need for membrane protein

- _____ - involves charged or polar solutes such as ions and glucose; cross phospholipid bilayer with help of a **carrier** or **channel**

- _____– movement of water across a selectively permeable membrane down its concentration gradient
- Water moves from area with_____concentration of solute (more water molecules) across membrane to area with _____concentration of solute (less water molecules)
- **Osmotic pressure** – driving force exerted by solute molecules; causes water molecules to move until equilibrium is reached

**Tonicity** – way to compare osmotic pressure gradients between two solutions – cytosol and ECF

- Normally ECF is _____

- **Hypertonic** ECF – solute concentration of ECF is higher than inside cell
  - Osmotic pressure gradient pulls water out of cell and cell shrinks or _____
  - **Hypotonic ECF** – solute concentration of ECF is lower than inside cell
  - Osmotic pressure gradient pulls water into cell causing the cell to swell and possibly rupture or _____

## DEHYDRATION, SPORTS DRINKS, AND WATER

- Strenuous exercise results in water and electrolyte loss through sweating; ECF becomes *hypertonic*; hypertonic ECF draws water out of cells by osmosis
- **Sports drinks**
- **Plain water**

## ACTIVE TRANSPORT VIA MEMBRANE PROTEINS

- **Active transport** processes require energy in form of **ATP** to proceed as solutes move against their concentration gradients from_____concentration to _____ concentration

## ACTIVE TRANSPORT VIA VESICLES

Active transport using carrier proteins and channels is effective but has limitations; large macromolecules are too big to fit so must be transported by other means:

- _____are small sacs filled with large molecules
- Enclosed in a phospholipid bilayer; allows them to fuse with or be formed from plasma membrane
-

**Endocytosis**:

- _____ ("cell eating")
  – process where cells ingest large particles like bacteria or dead or damaged cells or parts of cell
- (fluid-phase endocytosis or "cell drinking")
  – process where cells engulf fluid droplets from ECF
- **Receptor-mediated endocytosis** – similar to pinocytosis; uses receptors to fill vesicles with a specific molecule

- _____– large molecules exit cell; known as **secretion**; vesicles fuse with plasma membrane, opening into ECF

- _____–molecules are brought into cell by endocytosis, transported across cell to opposite side, and then secreted by exocytosis

## *Module 3.4: Cytoplasmic Organelles*

### CYTOPLASMIC ORGANELLES

- **Organelles** are cellular machinery with specific functions vital to maintaining homeostasis

### MITOCHONDRIA

- 

- membrane-bound organelles involved in chemical energy production

- 

### PEROXISOMES

- Use oxygen to carry out several chemical reactions that produce **hydrogen peroxide** ($H_2O_2$); oxidizes toxic chemicals to less toxic compounds that can be eliminated from body before causing damage

- 

- Certain phospholipids synthesized in peroxisomes are critical to plasma membranes of specific cells or nervous system.

### RIBOSOMES

- **Ribosomes** -
  - Free in cytosol; usually make proteins needed within cell itself
  - Bound to membranes of other cellular structures; produce proteins destined for export outside cell

## ENDOPLASMIC RETICULUM

**Endoplasmic reticulum** (ER) – large folded phospholipid bilayer
Exists in two forms: _____ (**RER**) has ribosomes bound to it and _____ (**SER**) does not

**Rough endoplasmic reticulum (RER)** –

- Packages secretory proteins into **transport vesicles** made of a phospholipid bilayer
- Produces membrane components for membrane-bound organelles and plasma membrane, including integral and peripheral proteins

**Smooth endoplasmic reticulum** (**SER**) –

- Stores calcium ions by pumping them out of cytosol for future use
- Capable of several detoxification reactions; limits damage caused by certain substances
- Involved in lipid synthesis, manufacturing majority of plasma membrane phospholipids and cholesterol as well as a number of lipoproteins and steroid hormones

## GOLGI APPARATUS

_____ – group of flattened membranous sacs filled with enzymes and other molecules

- Proteins and lipids made by ER are further modified, sorted, and packaged for export in the Golgi
- Products packaged in Golgi can be secreted from cell by exocytosis

### CYSTIC FIBROSIS

- In **cystic fibrosis**, some cells are missing a protein component of a chloride ion channel
-
-
-

## LYSOSOMES

_____ – organelles responsible for digestion of worn out cell components or whole cells in some cases

•

• Macromolecules are broken down into smaller subunits that can be released to cytosol for disposal or reused to manufacture new macromolecules

### LYSOSOMAL DISEASES

Group of diseases resulting from *deficiency* of one or more *acid hydrolases* of lysosomes:

- **Gaucher's disease** –

- **Tay-Sachs disease** –

- **Hurler syndrome** –

- **Niemann-Pick disease** –

## *Module 3.5: The Cytoskeleton*

## THE CYTOSKELETON

• Gives the cell its characteristic shape and size by creating an internal framework

• Provides strength, structural integrity, and anchoring sites

•

• Performing specialized functions in different cell types; for example, phagocytosis by macrophages or contraction by muscle cells

## CENTROSOME / CENTRIOLES

• When cell is not dividing, **centrosome** is a microtubule-organization center located close to nucleus

•

## CELLULAR EXTENSIONS

Cellular extensions are formed by the inner framework of the cytoskeleton:

- 
- 
- 

## MICROVILLI

- Increase **surface area** of cells in organs specialized for absorption
- 

## CILIA

- Hair-like projections that stick out of the cell
- 

## FLAGELLA

- Beats in a whip-like fashion propelling entire cell
- 


**PRIMARY CILIARY DYSKINESIA**

- Rare genetic disorder characterized by defect in one or more protein components of cilia and flagella
- Affects many types of cells: respiratory passage linings, middle ear, uterine tubes (females), sperm (males)
  - 
  - 
  - 

## *Module 3.6: Nucleus*

## THE NUCLEUS

_____ – governing body that directs activities of the other cellular components

- _____ housed in nucleus contains code or plans for nearly <u>every</u> protein in body
- _____ within DNA direct different types of **RNA** to build a wide variety of proteins

Nucleus consists of three main structures:

- _____ – membrane that surrounds **nucleoplasm** that contains **nuclear pores**
- DNA and associated proteins are found in nucleus as a loose structural arrangement known as **chromatin** in a non-dividing cell
- _____- synthesis of ribosomal RNA and assembly of ribosomes

## NUCLEAR ENVELOPE

## CHROMATIN AND CHROMOSOMES

- _____– consists of one extremely long DNA molecule and **histone** proteins
- Reduces length of strand by about one-third
- During periods of cell division, chromatin threads coil tightly and condense into thick structures called **chromosomes**
- 
- **Sister chromatids** – each chromosome consists of identical copies

## *MODULE 3.7: Protein Synthesis*

## PROTEIN SYNTHESIS

- **Gene expression** – production of protein from specific gene
- Two processes actually make a specific protein:
  **Transcription** –

  **Translation** –

- DNA → Transcription → mRNA → Translation → Protein

## DNA & RNA Practice Exercise

| DNA | DNA | mRNA |
|---|---|---|
| G -- | G -- | |
| A -- | A -- | |
| G -- | G -- | |
| T -- | T -- | |
| A -- | A -- | |
| C -- | C – | |

## GENES AND THE GENETIC CODE

- _____– changes in DNA due to mistakes in copying DNA or induced by agents called **mutagens**
- Common mutagens include ultraviolet light and other forms of radiation, chemicals such as benzene, and infection with certain viruses
-

### TOXICITY OF THE "DEATH CAP" MUSHROOM

- *Amanita phalloides* (and other *Amanita*) are responsible for 95% of mushroom-related fatalities worldwide
- A *phalloides* is tasty and resembles many nontoxic mushrooms; main toxin inhibits *RNA polymerase*; prevents formation of new strands of mRNA
-
-
-

**REVIEW**

1. The process through which mRNA is made is termed
    a. Translation
    b. Replication
    c. Synthesis
    d. Transcription

2. During transcription, free nucleotides from the nucleoplasm are hydrogen bonded to
    a. Each other
    b. Complementary nucleotides of the DNA template strand
    c. Ribosomes
    d. RNA polymerase

3. A strand of mRNA contains the
    a. Instructions to build a ribosome
    b. Instructions to build a protein
    c. Instructions to build a carbohydrate
    d. Instructions to build a lipid

4. Protein synthesis is also called
    a. Transcription
    b. Replication
    c. Translation
    d. Differentiation

5. During translation, the language of_____is translated into the language of_____.
    a. Nucleotides, amino acids
    b. Amino acids, nucleotides
    c. Nucleotides, codons
    d. Anticodons, nucleotides

6. The DNA triplet TAG is complementary to the mRNA codon_____.
    a. ATC
    b. UAG
    c. CGG
    d. AUC

## Module 3.8: CellCycle

### THE CELL CYCLE

- Almost all cells go through the **cell cycle**
    - An ordered series of events from formation of cell to its reproduction by cell division

- Cell division is required for growth and development as well as for tissue repair and renewal

### PHASES OF THE CELL CYCLE

**Cell cycle** includes two main phases: interphase and M phase or cell division

- **Interphase** – period of growth and preparation for cell division:
    - **$G_1$ phase** (**1st gap**) –
    - **S phase** (**synthesis**) –
    - **$G_2$ phase** (**2nd gap**) –
- _____
    - Nuclear envelope encloses nucleus
    - Centriole pairs duplicated
    - Nucleus and nucleolus are clearly visible and individual chromosomes are not distinguishable

### REVIEW

7. DNA replication occurs in which phase of the cell cycle?
    a. G1
    b. G2
    c. S
    d. M

### PHASES OF THE CELL CYCLE

**M** is period of **cell division**; highlighted by two overlapping processes:

- **Mitosis** occurs when newly replicated genetic material is divided between two daughter cells
- **Cytokinesis** occurs when cell's proteins, organelles, and cytosol are divided between two daughter cells

## MITOSIS

- Division of genetic material in 4 stages
  - **Prophase**
  - **Metaphase**
  - **Anaphase**
  - **Telophase**

## PROPHASE

- Chromatin becomes compact to form chromosomes (two sister chromatids)
- Centrioles migrate to opposite sides of cell to organize spindle fibers
- Spindle fibers from each centriole attach to each sister chromatid
-

## METAPHASE

-

## ANAPHASE

-
- **Cytokinesis** may begin at end of this stage

## TELOPHASE

- Cytokinesis finishes dividing cytosol and organelles equally between two new daughter cells
-
-
- Chromosomes uncoil, becoming chromatin

## OVERVIEW OF MEIOSIS

- Cell division can occur either by_____(process that somatic cells are capable of) or_____that occurs in cells destined to become gametes

• **Meiosis** – cell divides to form daughter cells with half number of chromosomes

–

- Somatic cells are diploid (2n) because they have full paired set of chromosomes

- Meiosis proceeds through four basic phases:

  prophase, metaphase, anaphase, and telophase

- Phases occur in two successive divisions, unlike mitosis, where_____is first meiotic division and_____is second
- First division separates homologous pairs to produce haploid (*n*) cells
- Prophase I, Metaphase I, Anaphase I, Telophase I
- Meiosis II separates chromatids of each chromosome; cells stay haploid
- Prophase II, Metaphase II, Anaphase II, Telophase II


**SPINDLE POISONS**

- Mitotic spindle is critical to process of mitosis; if assembly or disassembly is inhibited by chemicals called **spindle poisons** (made by fungi and plants), errors in cell division occur that could lead to cell death

- Examples:
- _____ – inhibit microtubule function; fragment formed microtubules; used to treat *cancer*
- _____– inhibits assembly of microtubules; treats *gout*
- _____– inhibits function/assembly of microtubules in *fungi* (not humans); antifungal agent for skin, hair, and nails
- _____– prevent *disassembly* of microtubules; treat *cancer*

- Adverse effects – (especially in cells that divide rapidly like stomach, skin, and bone marrow) nausea, vomiting, hair loss, decreased blood cell production

## PHASES OF THE CELL CYCLE

1. Most cells in the body progress through the cell cycle but at vastly different rates depending on their function

•

• Cell cycle is precisely controlled so that cell formation is balanced with cell death

## CELL CYCLE CONTROL AND CANCER

- Cell may not proceed with division if the following conditions are not favorable: a.

  b. G**rowth factors** are secreted by other cells

2. Cells that cannot pass through checkpoints and cannot be repaired undergo a process of programmed cell death called _____

- Ex. – during fetal development hands and feet are initially webbed; cells in "webs" die to separate fingers and toes

- When changes in DNA of a cell cause loss of cell cycle control, uncontrolled cell division results and cells may form a growth or mass known as a **tumor**
- _____ – confined to its original location and does not invade surrounding tissues
- _____ – made up of cancer cells

–

–