EXAM 2 REVIEW

CHAPTER 5: THE STRUCTURE AND FUNCTION OF LARGE BIOLOGICAL MOLECULES

LIPIDS are the only macromolecules that are NOT polymers

POLYMERS are formed into macromolecules, they are long, chain-like molecules built by MONOMERS, the smaller "building blocks" that are linked together by covalent bonds. Some monomers have functions of their own!

MACROMOLECULES are formed by large carbohydrates, proteins, and nucleic acids

CARBOHYDRATES

are a source of energy and provide structural support, they include sugars + polymers of sugars, carbs also include a carbonyl group (>C=O) and a hydroxyl group (—OH)

CARBOHYDRATES INCLUDE 3 LEVELS OF STRUCTURE + CLASSIFICATION

Monosaccharides: Glucose (6-carbon), Fructose (6-carbon), Galactose (6-carbon), Ribose (5-carbon) — molecular formulas that are usually multiples of CH_2O; classified by location of carbonyl group (aldose or ketose)

Disaccharides: Lactose (glu+galac), Maltose (glu + glu), Sucrose (glu+fruc) — formed by dehydration reaction; covalent bond GLYCOSIDIC LINKAGE

Polysaccharides: "polymer"

- cellulose (plants), strengthens plant cell walls; glucose polymer, glucosidic linkages differ in 2 ring forms (α)alpha (β)beta
- starch (plants), stores glucose for energy; "plastids" are storage structures for starch!
- Glycogen (animals), stores glucose for energy, hydrolysis of glycogen releases glucose when we need sugar
- Chitin (animals+fungi), strengthens exoskeletons and fungal cell walls

PROTEINS have a wide range of functions, such as catalyzing reactions and transporting substances into/out of cells

NUCLEIC ACIDS store genetic information in gene expression

CHAPTER 6: TOUR OF THE CELL

ANIMAL V. PLANT CELL

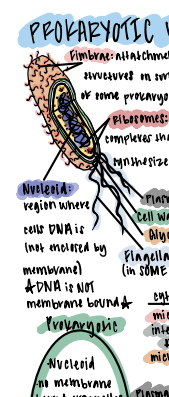
- lysosome
- chloroplasts
- intermediate filaments
- cell wall
- microvilli
- vacuole
- centrosome
- plasmodesmata
- flagellum

BOTH ANIMAL + PLANT CELLS

- nucleus
- smooth + rough ER
- microfilaments + microtubules
- mitochondria
- peroxisome
- golgi body
- ribosomes
- plasma membrane

ENDOMEMBRANE SYSTEM regulates protein traffic and performs metabolic functions. it INCLUDES... nuclear envelope, endoplasmic reticulum, golgi apparatus, lysosomes, plasma membrane, and various types of vesicles and vacuoles

PROKARYOTIC V. EUKARYOTIC CELLS



All eukaryotic cells have...

- Plasma membrane
- Nucleus
- Endoplasmic Reticulum
- Mitochondria
- Peroxisome
- Golgi apparatus
- Microvilli
- Microtubules

Nucleus: nucleolus, chromatin, nuclear envelope

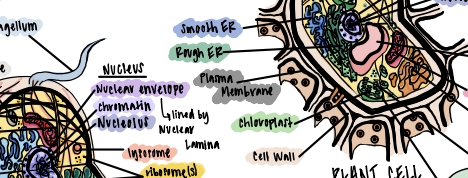
cytoskeleton: microtubules, microfilaments

run antiparallel

~ base pairing example ~

A=T
G≡C

ANIMAL V. PLANT CELL DIAGRAMS



DEHYDRATION REACTION V. HYDROLYSIS REACTION

removes water molecule,	adds a water molecule,
CREATING/SYNTHESIZING a polymer	BREAKING down a polymer
COVALENT BOND found in ALL macromolecules is a HYDROGEN BOND!!!	★ fats are constructed from GLYCEROL and FATTY ACIDS ★
a CONDENSATION REACTION connects monomers	glycerol is a three carbon alcohol w/ a hydroxyl (—OH) group attached to each carbon.

FUNCTIONS OF CARBOHYDRATES

- fuel; carbon sources that can be converted to other molecules or combined into polymers.

SUCROSE: glucose + fructose, found in plants (beets, sugarcane)

LACTOSE: glucose + galactose, found in animals (cow's milk)

MALTOSE: glucose + glucose, found in plants (grains)

SUMMARY

SATURATED V. UNSATURATED

SATURATED fatty acids have the maximum number of hydrogen atoms and NO double bonds

UNSATURATED fatty acids have 1 or more double bonds (double bonds) — "cis" double bond causes bending

★ fatty acids can vary in length (# of carbons), and in the # and locations of double bonds

water molecules hydrogen bond to each other and exclude fats

WHAT BOND DOES A FAT FORM? an ESTER LINKAGE

SATURATED fatty acids are SOLID @ room temperature, phospholipids tightly packed in membranes (saturated fats)

UNSATURATED fatty acids are LIQUID @ room temperature, phospholipids loosely packed in membranes (unsaturated fats or oils)

HYDROGENATION is the process of converting unsaturated fats to saturated fats by adding hydrogen

MAJOR FUNCTION OF FATS is to STORE ENERGY!

CELLULOSE

glucose polymer, found in plants → the cellulose in human food passes through digestive tract as roughage in a wide range of functions

STARCH

glucose polymer, found in plants

★ enzymes that digest starch by hydrolyzing include fibers

GLYCOGEN

glucose polymer, found in animals

CHITIN

glucose polymer, found in animals (exoskeleton) and fungi (cell walls), ONLY POLYSACCHARIDE W/ NITROGEN!!

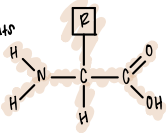
Starch	Cellulose
· 1-4 linkage of α glucose monomers	· 1-4 linkage of β glucose monomers
· HELICAL	· STRAIGHT/UNBRANCHED
· glucose polymer	

★ glycosidic linkages differ ★

α linkages cannot hydrolyze β linkages.

PROTEINS can be: enzymes, defensive proteins, storage proteins, transport proteins, hormones, receptor proteins, motor proteins, or structural proteins

components



amino acid monomer (20 types)

ENZYMES catalyze reactions

STRUCTURAL provide structure and support

DEFENSE protect against disease

HORMONES coordinate organismal responses

MOTOR function in cell movement

STORAGE store amino acids

TRANSPORT transport substances

RECEPTOR receive signals from outside the cell

NUCLEIC ACIDS

polymers made of a nucleotide (monomer)

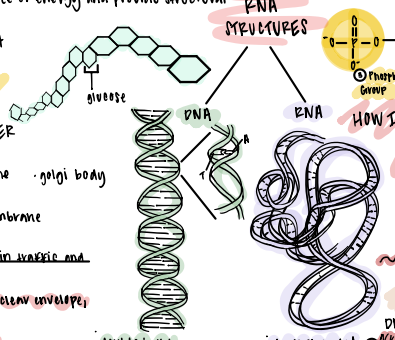
~ NITROGENOUS BASES ~

Purines	Pyrimidines
· Adenine (A)	· Cytosine (C)
· Guanine (G)	· Thymine (T) DNA ONLY (ana tour time)
★ LARGER	· Uracil (U) RNA ONLY
purines have one 6-membered ring fused to a 5-membered ring.	★ have one 6-membered ring of carbon and nitrogen atoms ★

COMPONENTS OF A NUCLEOTIDE

- ① Nitrogenous Base
- ② sugar (pentose)
- ③ Phosphate Group

DNA and RNA STRUCTURES



single stranded

~ base pairing example ~

- can occur between 2 nucleotides of the same DNA molecule

run antiparallel

A=T
G≡C

DNA and RNA

DNA provides its own instructions for its own replication AND directs RNA synthesis AND through RNA, controls protein synthesis

carries out protein synthesis

!gene expression!

GENE EXPRESSION the process of DNA directing RNA synthesis and through RNA, controls protein synthesis

DNA → RNA → protein

HOW IS A PROTEIN MADE + EXPORTED OUT OF THE CELL?

Ribosomes carry out protein synthesis

STEPS! things to know... ☞ only given time, free ribosomes are suspended in the cytosol AND bound ribosomes are attached to the rough ER or Nuclear envelope.

- ① DNA in Nucleus
- ② RNA in Ribosomes
- ③ synthesized in Rough ER
- ④ carried in Vesicle
- ⑤ modified in Golgi Body
- ⑥ FINAL DESTINATION OF PROTEIN

3 TYPES

The MITOCHONDRIA "Endosymbiont Theory" and CHLOROPLAST(S) contain their own DNA and Ribosomes

OF CYTOSKELETAL FIBERS

	structure	diameter	protein subunit
MICROTUBULES (hair name; new cells only it carried by vesicle)		25nm (largest!)	tubulin dimer
INTERMEDIATE FILAMENTS (animals only)		8-12nm	Keratins (hair is anchored to epidermal tissue)
MICROFILAMENTS		7nm	Actin

functions: movements in cell division and organelle movement along w/ cell motility

functions: in anchoring of the nucleus and other organelles + formation of nuclear lamina

functions: in maintainance of cell shape ~

functions: in changes of cell shape, muscle contraction, cytoplasmic streaming (plants), cell motility, and cell division (animals)

MEMBRANE-BOUND RIBOSOMES

synthesize/produce proteins that make to LEAVE THE CELL

FREE-FLOATING RIBOSOMES

produce/synthesize proteins that STAY IN THE CELL

cell w/ mostly free ribosomes and a cell w/ predominantly rough endoplasmic reticulum?

QUESTION... What is the difference between a proteins structure determines how it works

CELL JUNCTIONS!!! are how neighboring cells, adhere, interact and communicate

PLANT CELLS

"communicating" PLASMODESMATA are channels that connect cells, plasma membrane is continuous through channels (filled w/ cytosol)

ANIMAL CELLS

"communicating" GAP JUNCTIONS are proteins extending from each cell's membrane that form a connecting pore

DESMOSOMES

are made of intermediate filaments (keratin), they "staple" cells together

MACROMOLECULES CHART

name	components	examples	functions
LIPIDS	① Triglycerol (glycerol + 3 fatty acids)	Triglycerols (fats/oils) ~ glycerol + 3 fatty acids ~ SATURATED or UNSATURATED	important energy source! found in foods; butter, oils, ext.
	② Phospholipids (head w/ P group) (phosphate)	Phospholipids ~ phosphate group + glycerol + two fatty acids ~	lipid bilayers of membranes (hydrophobic tails / hydrophilic)
	③ Steroid backbone	Steroids ~ four fused rings w/ attached chemical groups ~	component of cell membranes (cholesterol) signaling molecules that travel throughout the body (hormones)

~ fats separate from water bla

A FATTY ACID consists of a carboxyl group (>C=O)

PROTEINS include a wide variety of functions

AMINO ACIDS (20 of them!!!!) are organic molecules w/ an amino group(s) and carboxyl group(s), they DIFFER in their properties due to differing side chains, called R groups

amino acids

PROTEINS are all constructed from the same set of 20 amino acids

POLYPEPTIDES are unbranched (polymer) polymers built from the amino acids (monomer)

Polypeptide structure!

each polypeptide has a unique linear sequence of amino acids, carboxyl end (C-terminus) and an amino end (N-terminus)

FOUR LEVELS OF PROTEIN STRUCTURE are linked by covalent (peptide bond) bonds called PEPTIDE BONDS

- PRIMARY (inherited structure from DNA): unique sequence of amino acids
- SECONDARY (hydrogen bond): regions stabilized by hydrogen bonds between atoms of the polypeptide backbone
- TERTIARY (hydrogen bonds, ionic bonds, disulfide bridges, Van der Waals interactions): 3D shape stabilized by interactions between side chains.
- QUARTERNARY (hydrogen bonds, Van der Waals interactions): results when a protein consists of multiple polypeptide chains

covalent?

DENATURATION: when a protein unravels + loses it's shape

A FUNCTIONAL protein consists of one or more polypeptides precisely twisted, folded, and coiled into a unique shape, sequence of amino acids determine its 3D structure, a proteins structure

- Glycocalyx

Both
Plasma Mem.
Ribosomes
Flagellum
Cell Wall

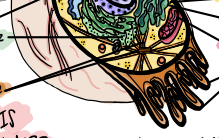
- endomembrane system
- microvilli
- Nucleus
- cytoprotection
- Plasmodesmata
- Lower organelles
- chloroplasts
- centrosome
- mitochondria

Eukaryotic

Smooth ER

Rough ER

centrosome



golgi body

mitochondria

microvilli

ANIMAL CELL

WHAT IS CHROMATIN??

the complex of DNA and proteins that makes up eukaryotic chromosomes.

when cell isn't dividing, chromatin exists in its dispersed form

PASSIVE TRANSPORT

DOWN the concentration gradient

NONPOLAR/ SMALL MOLECULES CAN MOVE EASILY ACROSS MEMBRANE

ALL CELLS HAVE...

- Plasma membrane
- cytosol
- chromosomes
- ribosomes

ORGANELLES!!!!

PEROXISOMES are specialized metabolic compartments that produce H_2O_2 and convert it to water

- detoxifying alcohol
- breaking down fatty acids

LYSOSOME (S) are used in digestion (breaking down) food, etc.

2 processes that utilize lysosomes

PHAGOCYTOSIS

both carry out intracellular digestion

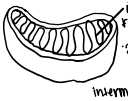
AUTOPHAGY

to ENGULF, require acidic pH

RECYCLING of damaged goods

VACUOLES are large vesicles derived from the ER and Golgi Apparatus

MITOCHONDRIA is the power-house of the cell, site of cellular respiration ... structure



- inner membrane folded into cristae
- 2 compartments

intermembrane space

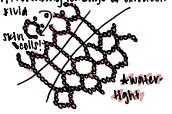
mitochondrial matrix

CILIA V. FLAGELLUM

smaller/ more

longer/ fewer

INTEGRAL V. PERIPHERAL

transmembrane

TIGHT JUNCTIONS happen when the plasma membranes of neighboring cells are tightly pressed against each other, preventing leakage of extracellular fluid