

Biol 130 first midterm notes

[Science](#), [Biology](#)



Unit 1 - Introduction to the Cell Robert Hooke - built the first microscope (30x magnification); viewed slices of cork called cellula (little rooms). Antoni Van Leeuwenhoek - worked with glass huge improvement in quality of lenses nearly 300x magnification became possible first to observe: * single-celled organisms "animalcules" * protists from pond water * bacteria from his mouth - "father of microbiology" * blood cells * banded pattern in muscle cells * sperm from ... 1830s - Compound microscope - improved magnification and resolution and allowed visualization of objects less than 1 μm. 1000-1500x magnification Beginning of Cell Theory Robert Brown (botanist) - noticed that every plant cell contained a round structure called it 'kernel'-nucleus Matthias Schleiden (another botanist) - all plant tissues are composed of cells; embryonic plant always arose from a single cell Theodor Schwann (zoologist) - similar observations in animal cells; recognition of structural similarities btw plants and animals! * Cell Theory formulated by Schwann Cell Theory 1. all organisms consist of one or more cells 2. the cell is the basic unit of structure for all organisms 3. added 20 years later: all cells arise only from pre-existing cells fact (scientific) - an attempt to state our best current understanding, based on observations and experiments (valid only until revised or replaced) Steps in Scientific Method 1. make observations 2. use inductive reasoning to develop tentative explanation (hypothesis) 3. make predictions based on your hypothesis 4. make further observations or design and carry out controlled experiments to test your hypothesis 5. interpret your results to see if they support your hypothesis Theory - a hypothesis that has been tested critically under many different conditions and by many different investigators . using a variety of different

approaches. By the time an explanation is regarded as a theory it is widely accepted by most scientists in the cell * the "solid ground" of science: evolution, germ theory, cell theory * If a theory is thoroughly tested and confirmed over many years by such large numbers of investigators that there is no doubt of its validity ... it may eventually be regarded as a law.

Gravity, laws of thermodynamics, laws that govern behaviour of gases ' Strands' of Cell Biology 13 cytology 1600s Hooke looks at cork Leeuwenhoek looks at lots of things 1800s Brown notes nuclei bio-chemistry synthesis of urea in lab fermentation done by cells! glycolysis Krebs cycle every cell comes from a cell Schleiden & Schwann formulate cell theory electron microscopy stains & dyes genetics Mendel, pea plants DNA chromosomes chromosome theory 1930s DNA double helix DNA sequencing Dolly the sheep! nano-technology! genetic code Light Microscopy:

Bright field - light passes through specimen, contrast is low and specimen is hard to see Phase contrast - contrast is changed by changing light in microscope DIC - uses optical modifications to change contrast between cell and background - due to density differential Staining - stain used to visualize cell and components, only some stains can be used on living cells 14 bright field phase contrast DIC unstained (sperm cells) stained blood cells tissue - small intestine Fluorescent Microscopy - fluorescent dyes bind to protein or DNA to see where they are in cells - tracks movement Electron Microscopy(Scanning & Transmission):

SEM - scan surface of specimen to form image by detecting electrons from outer surface. Good surface images TEM - forms image from electrons passing through specimen therefore fine details of internal organelles 16

SEM TEM Basic Properties of Cells: * are highly complex and organized * atoms molecules macromolecules (organelles) enclosed in plasma membrane * use the same ' genetic program' Central Dogma * DNA RNA protein * are capable of reproducing themselves * must first replicate genetic material acquire and use energy (" bioenergetics") and carry out a variety of chemical reactions (" cellular metabolism") * have many processes that are highly conserved at the molecular level * membrane structure, genetic code, ATP synthesizing enzymes, actin filaments, eukaryotic flagella, ... * engage in many mechanical activities * transport of materials in/out, within * assembly and disassembly of structures * motility / movement * respond to environmental signals * move away or toward stimuli * respond to hormones, growth factors, etc * are capable of self-regulation" homeostasis" most evident when control systems break down; defects in DNA replication, DNA repair, cell cycle control Two Classes of Cells - karyon = nucleus Prokaryotic Cells: lack of nucleus, NO CYTOSKELETON(very small), membrane bound organelles. Mostly unicellular. Bacteria and Archaea. Single, circular strand of DNA(fewer proteins). Cell wall in addition to PM 1-10 uM in diameter. 2 types: 1. Eubacteria - all have cells walls except for mycoplasma(resistant to antibiotics that target cell wall synthesis). Mycoplasma(smallest) Cyanobacteria (largest and most complex). 2.

Archaeabacteria - all have cell walls and are known as extremophiles, occupy broad range of habitats, halophiles= salty, acidophiles= acid, thermophiles= hot. Eukaryotic Cells: 10x larger than prokaryotic cells, membrane bound nucleus/organelles. More complex DNA due to histones/proteins. 4 groups: 1. Protists- very diverse group - mostly single

cells; algae, water molds, slime molds, protozoa 2. Fungi - single cell (yeast) or multi-cellular (mushrooms) and have cell walls. Heterotrophs; depend on external source of organic compounds 3. Plant cells - multi-cellular and have cell walls. . Animals - multi-cellular, no cell walls and are heterotrophs

Cytoplasm - everything between plasma membrane and nuclear membrane, includes all membrane-bound organelles (except nucleus) Cytosol - only fluid component Endomembrane system - internal membranes that are either in direct contact or connected via transfer of vesicles (sacs of membrane). including: nuclear envelope / membrane, endoplasmic reticulum (ER), Golgi apparatus, lysosomes, vacuoles Nucleus - stores genetic information Endomembrane System - creates intracellular compartments with different functions.

Endoplasmic reticulum (ER; rough, smooth), Golgi apparatus, lysosomes. Mitochondria - generate energy to power the cell Chloroplasts - capture energy from sunlight, convert to carbohydrate Cytoskeleton - regulates cell shape, movements of materials within the cell, movement of the cell itself

Flow of Traffic in EMS - Rough ER: synthesis of proteins for - export (secretion) - insertion into membranes - lysosomes Golgi apparatus: collection, packaging & distribution Lysosomes * cell ' stomachs' have enzymes that can digest ... * all 4 classes of biological macromolecules worn-out organelles (mitochondria replaced every 10 days) * material brought into cell by phagocytosis Phagocytosis - plasma membrane engulfs smaller molecule and then called phagosome. Lysosome takes it in and digests, small particles are released into the cytoplasm. Autophagy - lysosome digests a damaged organelle, small particles are released into cytosol.

mitochondria (all eukaryotic cells) and chloroplasts (plant cells): * contain DNA that encodes some (but not all) of their own proteins * have unusual double layers of membranes

Origin of Eukaryotic Cells: Endosymbiont Theory * once believed that eukaryotes evolved gradually, organelles becoming more and more complex * now accepted that early eukaryotes originated as predators * certain organelles (mitochondria, chloroplasts) evolved from smaller prokaryotes engulfed by larger cell * later chloroplasts and the ability to perform photosynthesis Symbiosis - Mutual Advantage advantage to host cell: * aerobic respiration (aerobic bacteria mitochondria) * photosynthesis (cyanobacteria chloroplasts) advantage to bacteria: * protected environments supply of carbon compounds from host cell's other prey Evidence Supporting Endosymbiont Theory mitochondria and chloroplasts ... * are similar size to bacteria, reproduced by fission like bacteria * have double membranes, consistent with engulfing mechanism * have their own ribosomes, which resemble those of prokaryotes rather than eukaryotes in terms of size, composition and sensitivity to antibiotics * have their own genomes, which are organized like those of bacteria last but not least: * are genetically similar to proposed 'parent' bacteria rather than eukaryotic cells Cytoskeleton important in: * cell shape * cell motility * movement / position of organelles * movement of materials within cell * movement of chromosomes during mitosis Cytoplasm in a living cell is never static * cytoskeleton is constantly being taken apart and rebuilt * organelles and vesicles are racing back and forth * can cross the cell in ~ 1 second * unattached proteins moving randomly, but rapidly * can visit every corner of

the cell within a few seconds * contents of cytosol are in constant thermal motion

Common to all cells: * selectively permeable plasma membrane * genetic code; mechanism of transcription and translation * ATP for the transfer of energy and metabolic pathways Model Organisms 45 Unit 2a - Intro to Cellular Chemistry Most Common Elements in Living Organisms: * C H O N - make up 96% - also P and S are common too * Exist as complex macromolecules and simpler forms like water and carbon dioxide nucleus - dense core in centre, consists of protons and neutrons electrons - continually orbit the nucleus # of protons - defining feature of an element = atomic number - # protons + # neutrons = mass of an atom = mass number - by default, an atom is 'neutral', with # protons = # electrons - electrons influence reactivity of an atom ... Atomic mass = atomic number + # of neutrons (electrons are neglected because mass is so small) Isotopes - same number of protons but different number of neutrons in the same element Anion - gain electron and are negatively charged Cation - lose electron and are positively charged

Outermost 'valence' shell influences an atom's reactivity * electrons in outermost shell valence electrons * unpaired valence electrons determine the number of bonds an atom can make * atoms with filled valence shell = most stable, atoms that are closest to filling are most reactive * elements abundant in organisms have at least one unpaired valence electron Some Definitions: covalent bonds - two or more atoms share pairs of valence electrons * strong bonds of biological systems non-covalent bonds, including * ionic bonds * hydrogen bonds (H-bonds) * hydrophobic interactions

- group of atoms held together by energy in a stable association compound - molecule composed of two or more different types of atoms

Types of Covalent Bonds * electrons shared 'equally' * non-polar covalent bond * can be single (like H₂), double (O₂) or even triple, depending on number of electrons shared * electrons not shared equally * polar covalent bond * one of the atoms has a stronger pull on the electrons than the other * pull on electrons = electronegativity * water is the most abundant molecule in biological organisms * human body is ~70% water water as a solvent can dissolve more types of molecules than other molecule known * the polarity of water is key to its role in biology hydrogen bonding - electrical attraction between electronegative atom and partial positive of hydrogen hydrophobic - no affinity for water - "water fearing" hydrophilic - affinity for water - "water loving"

Acid-base Reaction substance that gives up (donates) protons acid (increases [H⁺] in solution) substance that accepts protons base (decreases [H⁺] in solution) chemical reaction that involves transfer of protons acid-base reaction * most molecules act as either an acid or a base * water can be both (both gives up and accepts protons) weak acid: very few molecules dissociated (acetic acid, water) strong acid: readily gives up protons (hydrochloric acid) when pH = pK_a species is 50% ionized Carbon is the most important element in biology carbon atoms give biomolecules their shape but other atoms attached to carbons determine their reactivity * critical H, N, O containing attachments called functional groups *learn orgo functional groups for this course

Macromolecules * large, organized molecules that are typically created by polymerization * biological macromolecules (biomolecules) provide the

structure and carry out the activities of a cell 4 groups: *

- * carbohydrates(polysaccharides)
- * lipids(fats)
- * proteins
- * nucleic acids

* monomers of groups are different - chemical reactions used to make the chains are similar

Overview of Macromolecules 3 Proteins - more functions than any other group of macromolecule

- * enzymes - catalysis; accelerate chemical reactions
- transport - through cell membranes, in circulation
- * support - cytoskeleton, fibres of cartilage, hair, nails
- * signalling / regulatory - hormones, membrane proteins, intracellular messengers
- * movement- of the cell itself - contractile proteins, flagella - within the cell - motor proteins
- * defense - antibodies, complement proteins

Proteins are Polymers

- * amino acids are connected in linear polymers of a specific sequence
- * 20 genetically encoded amino acid monomers to pick from
- * string of amino acids (AAs) = peptide or polypeptide
- polypeptide folded and coiled into a specific conformation = protein
- * sometimes 2 or more peptide chains (subunits) combine to form mature, functional protein

Amino Acid Structure

AAs are ionized under physiological conditions ionization increases solubility, facilitates interactions with each other and other solutes, increases reactivity (zwitterions)

7 non-ionized ionized R group unique to each AA

oxygens tend to pull electrons away, making it easy to lose proton gains a proton

Amino Acid Side Chains - R Groups:

- * nonpolar - hydrophobic R groups no charged or electronegative atoms to form H bonds
- * insoluble in water
- * R groups bury themselves with the peptide chain to 'hide' from water
- * polar side chains - soluble in water
- * uncharged - but partial charges can form H-bonds
- * charged - groups containing acids or bases - highly soluble in water

AA are linked together by covalent peptide bonds: carbon from carboxyl group is

linked to N terminus of amino group. R groups and central C's do not participate in the bond. Condensation Reaction - making the chain Hydrolysis - breaking the chain Polypeptide chain: side chains extend from peptide-bonded backbone * chain is flexible - can rotate at single bonds on either side of peptide bonds * so side chains are not all projecting to one side! * chains can be from 2-3 to thousands of AAs in length * backbone is directional, convention is to number AA 'residues' starting at N terminus this is the primary sequence Sickle Cell Anemia - disease in which red blood cells are abnormally shaped. Caused by single point mutation which results in substitution of single amino acid in one chain of hemoglobin protein Protein Structure:

Primary Structure - unique sequence of amino acids Secondary Structure - Folding into elements of structure, hydrogen bonding between amino acids(R groups not involved). 2 shapes: alpha helix and beta pleated sheet(parallel and antiparallel). * learn more Tertiary Structure- interactions of elements of secondary structure forming a global fold, folded into these unique shapes by ionic bonds (electrostatic), hydrogen bonds, disulphide bridges, hydrophobic interaction, van der waals - dipole-dipole(all non-covalent except for S-S). Order of amino acids determines final shape.

Maintain globular shape even if very weak. Quaternary Structure - more than one polypeptide chain put together to form the final functional protein, linked by covalent and non-covalent interactions. Protein Domain - segment of polypeptide that forms a compact, stable and independently folding structure. Often the building blocks for larger, more complex proteins. Disulfide bonds * covalent stabilization of protein structure found in secreted

proteins (destined for a more hostile extracellular environment) * formed in ER (oxidizing environment)

Once folded, do proteins ever unfold? changes in physical or chemical conditions (pH, salt concentration, temperature) disruption of H-bonds, ionic bonds, disulfide bridges, etc that maintain the protein's shape protein 'denatures' or unfolds Possible to renature Do proteins ever fold incorrectly? any mutation that leads to a missing or incorrect amino acid can lead to incorrectly folded protein WHY?? 32 Possible outcomes: mutation - leads to incorrectly folded protein * protein never functions properly loss of function protein folds properly at first but unfolds under certain conditions eventually loss of function * protein misfolds AND is deposited in insoluble aggregates within cell * loss of function and disruption of other aspects of cell activity * many human diseases now known to be associated with misfolded proteins . Alzheimers, cystic fibrosis, type IIdiabetes, retinitis pigmentosa, Parkinsons, Creutzfeldt-Jakob, some cancers *read about catalysts and enzymes in Janelle's notes, page 8-9 Nucleic Acids: Information Polymers * deoxy ribo nucleic acid (DNA) sequence of subunits in DNA polymer directs RNA synthesis * ribo nucleic acid (RNA) * RNA directs ordering of AAs in a peptide chain * information stored as DNA sequences enables living organisms to pass on hereditary information * also allows each cell to pass on hereditary information to the next generation of cells Monomers of Nucleic Acids: Deoxyribo nucleotides - phosphate + deoxyribose + nitrogenous base(A, C, G, or T) Ribo nucleotides - phosphate + ribose + base (A, C, G, or U) Nucleic acids are linear (unbranched) polymers of nucleotides * each nucleotide consists of three parts: * a nitrogenous base a (5-carbon) pentose sugar * a

phosphate group Purines = A&G Pyrimidines = C, T and U * Ribose + base = nucleoside * Ribose + base + phosphate = nucleotide Functions of Nucleotides * monomeric units of RNA and DNA * important signal molecules within cells * cyclic adenosine monophosphate (cAMP) * important agents in energy transfer reactions * cleave off phosphate group to release stored energy * act as coenzymes - organic non-protein molecules required for enzyme function * usually adenine-containing nucleotides combined with B vitamins 8 condensation reaction 5' end - beginning of chain. Chains always built 5' 3'.

Look at above example phosphate group is 5' 3' end - where new bases can be added Polymerization rxn's are endergonic: * making phosphodiester bonds requires energy * energy comes from addition of 2 phosphate groups.

* Activated nucleotides = nucleotide triphosphates The most famous phosphorylated nucleotide ... adenosine triphosphate = ATP 11 adenine 4' 5' 5 6 1 2 3 9 4 8 7 1' 3' 2' O P CH2 O O O- P O O O- P O -O O- OH OH O NH2 N N N ribose adenine + ribose (= adenosine) Secondary Structure of DNA:

two strands of DNA align in ' antiparallel' arrangement with bases facing inwards. H-bonds form between bases. P P P P P P P C C G G A

A T T P O O O O O O O O O C G OH P Note: 3 H-bonds between C and G, 2 between A and T. Only space in the sugar phosphate backbone is for Pyrimidine and Purine to bond together. Features of DNA Double Helix * stabilized by H-bonds between complementary bases and hydrophobic interactions between bases * entire molecule water-soluble because charged phosphates backbone face outward * major and minor grooves are significant in regulation of gene transcription Higher Order DNA Structure:

DNA molecules can adopt higher order structure - Allows for compact packaging and strict regulation of gene expression

RNA vs DNA like DNA: sugar-phosphate backbone covalently linked by phosphodiester bonds * 4 different bases unlike DNA: * uracil (U) instead of thymine (T) * pairing is A-U, C-G * sugar is ribose instead of deoxyribose * hydroxyl group makes ribose much more reactive * RNA is much less stable than DNA

Secondary Structure of RNA: like DNA: * H-bonds form between complementary base pairs unlike DNA: * most of the time, this base-pairing is between bases on the same strand * leads to formation of 'stem and loop' structures with single-stranded regions and double-stranded antiparallel regions * H-bonding is spontaneous, stabilizes the molecule final molecule is single-stranded * Complex folds can result in some RNA having catalytic activity

Carbohydrates * Group of molecules that contain carbon, hydrogen and oxygen in a 1: 2: 1 ratio: $(CH_2O)_n$ Only monomers are in this ratio, oligomers you lose water * Monomer= monosaccharide * Dimer= disaccharide * Trimer= trisaccharide/oligosaccharide

Types: 1. Monosaccharides - simple sugars 2. Oligosaccharides - small chains (oligo= few) * Attached to proteins - glycoproteins * Attached to lipids - glycolipids 3. Polysaccharides - very long sugar chains

Typical Structural Features of Sugar Monomers: carbonyl group (either ketone or aldehyde) * lots of -OH groups * vary in length of carbon skeleton (C3, C5, C6, ...) - triose, pentose, hexose * isomeric forms (glucose, fructose, galactose) * identical chemical groups arranged differently * monosaccharides often form rings in solution

Isomers - same atoms, different arrangements structural isomer - identical groups but bonded to different carbons stereo (optical) isomer - identical groups bonded

to same carbons but in different orientations sixteen different hexose structures possible, all with formula $C_6H_{12}O_6$

$H-C-OH$ OH $H-C-OH$ H $HO-C$ $H-C-O$ $H-C-OH$ H $H-C-OH$ $H-C-OH$ $H-C-OH$ H $HO-C$ H
 $H-C-OH$ H structural isomer stereo- isomer $H-C-C-O$ $HO-C$ H $H-C-OH$ $H-C-OH$ H
 $HO-C$ H $H-C-OH$ H fructose glucose galactose *arrangement of hydroxyl groups make a big difference in biological function Disaccharide - 2 sugar monomer: * glucose + fructose = sucrose(table sugar) * glucose + lactose = lactose * glucose + glucose = maltose Formation of disaccharides by condensation reactions. monomers are linked when C1 of one monosaccharide binds to a C on another - often C4 geometry of bond different depending on whether OH group of C1 is in α or β position which C of other sugar is involved in linkage 7 C1, α C4 α -glucose α -glucose maltose, β -1, 4 glycosidic bond β -galactose β -glucose lactose, β -1, 4 glycosidic bond (glucose has flipped over) C1, α C4 Polymerization to build Polysaccharides starch both are storage forms for energy starch - plants; glycogen - animals both consist of α -glucose monomers linked by α -1, 4 bonds both coil into a helix (due to geometry of linkages) starch is mixture of unbranched amylose and branched amylopectin glycogen is highly branched lycogen Structural Polysaccharide in Plants: Cellulose 9 polymer of β -glucose, joined by β -1, 4 linkages each glucose is flipped relative to adjacent ones allows for H-bonding between adjacent strands extremely stable most abundant organic molecule on earth parallel strands joined by H-bonds Structural Polysaccharide in Animals: Chitin a component of cell walls of fungi, exoskeletons of arthropods (insects, crustaceans), radulas of molluscs, beaks of cephalopods second most abundant organic molecule on earth like

cellulose, joined by β 1, 4 linkages but rather than glucose, monomer is N-acetylglucosamine like cellulose, also strengthened by H-bonding btw strands

10 Structural Polysaccharide in Bacteria: Peptidoglycan component of bacterial cell walls the most complex CHO so far! two different alternating monomers linked by β -1, 4 bonds chain of amino acids attached to one of the sugars - peptide bonds instead of H-bonds (stronger) Significance of how monosaccharides are linked: * β -1-4 linkages of starch and glycogen readily hydrolyzed * β 1-4 linkages in structural polysaccharides very resistant to enzymatic degradation For example: enzymes that digest cellulose (cellulase) produced only by certain classes of bacteria, fungi and protozoa

Difference between glycosidic bonds from peptide and phosphodiester bonds: in common: * condensation reactions different: * peptide and phosphodiester bonds always occur at the same position within their monomers * each sugar monomer has several hydroxyl groups, and geometry of glycosidic bonds is highly variable

Functions of Carbohydrates: Structural: * cellulose, chitin and peptidoglycan

Cell-cell recognition: * membrane proteins covalently bonded to oligosaccharides

Energy Storage * β -1, 4 -linkages of starch and glycogen are readily hydrolyzed to release stored energy

Lipids * group of carbon-containing compounds that are largely non-polar / hydrophobic * significant proportion of a given lipid molecule is hydrocarbon * the only macromolecule that is not a polymer

major groups of lipids in cells: * fats / oils - energy storage * sterols * cholesterol - membrane component * steroids - hormones

* * Phospholipids * major component of biological membranes

Fats (Triacylglycerols, Triglycerides) * form that fat is stores in adipose tissue
* glycerol with 3 fatty acids attached * the link between glycerol and fatty acid = ester bond: condensation rxn (liberates water) * hydrophobic * fatty acid(carboxylic acid with long hydrocarbon tail) Saturated Fatty Acid - have maximum number of hydrogen atoms on each atom; straight and flexible because of only single bonds Unsaturated Fatty Acid - contain at least 1 double bond. The double bond is rigid and creates a kink in the chain. The rest of the chain however is free to rotate about C-C bonds.

Cis - H on the same side of double bond; don't solidify easily Trans - H on the opposite side of the double bond. Hydrogenation - making a fat saturated/more solid at room temperature to improve shelf life therefore less healthy. Sterols - group of steroids based on cholesterol(important component of cell membrane) Phospholipids : * 1 glycerol, 2 fatty acids, 1 phosphate group(polar head group) * Amphipathic = hydrophilic and hydrophobic regions - their most important feature with respect to biology
Micelles - sphere with hydrophobic tails 'hiding' in centre . Can only occur with relatively short tails Lipid Bilayer:

Universal Structure for all Biological Membranes composition varies with:
type of organism (prokaryote vs animal vs plant vs ...) type of cell within organism (muscle, liver, sperm, egg, ...) type of membrane within cell (plasma membrane, Golgi, ER) inner versus outer layer different patches or 'domains' within a particular membrane Fig 11-4 two closely apposed sheets of lipids, studded with proteins lipids serve as permeability barrier proteins perform most of the functions carbohydrates (sugars) attached to protein and lipids in a non-random manner *all membrane lipids are amphipathic

Lipid bilayers form spontaneously: hydrophobic molecules would exclude water, clustering together to minimize energy cost of organizing water molecules * form large droplets or surface film * amphipathic molecules are subject to conflicting forces * solved by formation of bilayer * energetically most favourable stable, spontaneous * lipid bilayers are ... * closed - no free edges * self-sealing * important feature for cell fusion, budding, locomotion Fluid Mosaic Model * The plasma membrane is described to be fluid because of its hydrophobic integral components such as lipids and membrane proteins that move laterally or sideways throughout the membrane.

That means the membrane is not solid, but more like a 'fluid'. * phospholipids are constantly moving spinning in place; travelling laterally within 'leaflet' * phospholipids are occasionally 'flipped' to the opposite leaflet during membrane synthesis but they rarely 'flop' back * even proteins cruise slowly through the membrane! Membrane fluidity - how easily lipid molecules move within a membrane leaflet Alignment of phospholipid tails * tightly packed tails membrane more viscous, less fluid * freely moving tails higher fluidity What aspects of phospholipid composition influence this? length of fatty acids * from 14-24 carbons, 18-20 carbons most common * degree of saturation of fatty acids # double bonds * typically one saturated fatty acid and one with one or more double bonds Cholesterol: * under physiological conditions, cholesterol makes membrane stiffer - less fluid * cholesterol can make up to 50% of plasma membrane lipid in some animal cells Regulation of Membrane Fluidity: - fluid state must be maintained for normal cell function strategies for maintaining membrane fluidity: * change composition of membranes * alter phospholipids

desaturate fatty acids (to deal with cold) eg cold water vs warm water fish *
change length of FA chains (yeast, bacteria) * adjust amounts of cholesterol
(animals) these mechanisms have been demonstrated in: * pond fish dealing
with dramatic day / night temp differences * cold-resistant plants *
extremophile bacteria living in hot springs * winter wheat preparing for
autumn ^ polyunsaturated FAs * sperm reduce their cholesterol just before
fertilization ... Functions of Lipids: * storage of chemical energy * signal
molecules * vitamins * wax coating on leaves * biological membranes