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energy - capability to do work

work - ability to transfer energy

3 forms of energy

solar -

chemical -

mechanical -

a basic character of a living organism is the ability to acquire and use energy

laws of thermodynamics

1st law - energy may be converted between two forms

2nd law - conversion of energy between forms results in the loss of energy evidenced as heat

– if the conversion is happening in an isolated system the degree of disorder always increases

entropy - amount of disorder in a system

cells: example of an isolated system

how do cells maintain order? through a constant input of energy

ATP - adenosine triphosphate

ATP is a nucleic acid containing three phosphate groups

adenine–ribose–phosphate-phosphate-phosphate

ribose - sugar

pops one phosphate off

adenosine biphosphate (like an uncharged battery)

“currency” restored when phosphate is added

cells use energy from chemical bonds found in organic nutrient

different structures of chemical bonds

carbohydrates (fancy word for sugars)

proteins

nucleic acids

fats

what differentiates macromolecules

functional groups: special combination of atoms

they provide chemical reactivity to certain chains

organic macromolecules

-long chains of smaller molecules

smaller molecules are referred to as monomers

longer chains are referred to as polymers

sugar - polysaccharide

amino acid - protein

nucleotide - nucleic acid

-monomers have a hydroxyl group at several locations along the hydrocarbon

-to link two monomers the hydroxyl group can be removed from one monomer and a hydrogen from the other to form water

-(referred to as dehydration)

hydroxyls go away, monomer becomes polymer with water molecules attached

hydrolysis

breaks down polymers

monomer – OH HO – monomer – OH

carbs - bread, pasta, cereals

lipids - oils, butter

protein - beans, meat, milk

carbohydrates

-can be used quickly as an energy source

-lots of hydroxyl groups makes it hydrophilic (water soluble)

-body is mostly water so carbs get everywhere in the body

monosaccharides - single carb units, sometimes called simple sugars - glucose, galatose, fructose

disaccharides - combinations of two monosaccharides, one of which is usually glucose - maltose, lactose, sucrose

polysaccharides - long chains of glucose molecules, may be either branched or unbranched - starch, glycogen, fiber

our bodies store glucose in the polysaccharide form of glycogen

fiber slows down digestive tract (the whole system slow down)

gluten - a protein found naturally in cereal grains like rye, barley, and wheat

celiac disease is an autoimmune response in the small intestine caused by the presence of gluten that results in the damage of the lining of the intestine

lipids

- used for long term storage
- lipids are hydrophobic
- triglycerides-a single glycerol unit attached to three fatty acid chains of varying length-energy storage
- cholesterol-carbons arranged in a ring like structure-cell membrane function and hormone production
- phospholipids-triglyceride modified to contain a phosphate group in place of one of the fatty acid chains-structure of the cell membrane

fats are from animals, oils are from plants

triglycerides: three fatty acid chains stored as an energy reserve through a linkage to glycerol

-fatty acid chains are long hydrocarbons that can vary in width and structure

-a glycerol unit is basically half of glucose

saturated fatty acids have single bonds (a solid structure), and this is worse because it can lead to heart issues and cardiovascular problems

unsaturated fatty acids have double bonds in their hydrocarbon tail, and have a bend in the structure

trans fats have no bend (similar to unsaturated fats but has no bend)

- usually found in processed foods

proteins

-have many various functions in our body

–enzymes are proteins

–proteins can be signaling molecules

-can also be used as an energy source

20 different amino acids - they are all hydrocarbons (central carbon) bound to hydrogen

protein structure

-primary: sequence of amino acids in the chain

-secondary: weak bonds, alpha helix or pleated sheet

-tertiary: when the groups from the different amino acids interact with each other, globular shape

-quaternary: more than one polypeptide

**Cells are the fundamental unit of life

- Prokaryotic cells
- Ex. bacteria
- Eukaryotic cells
- Ex. animal cells, plant cells
- DNA confined in the nucleus
- Nuclear envelope: double membrane around the nucleus
- Much larger
- 10x diameter
- 1000x volume
- Organelles with membranes

- No cell wall
- Except for plants
- Mitochondria: powerhouse of the cell
- Uses oxygen + glucose to produce energy (ATP)
- Two membranes
- Intermembrane space
- Electrical gradient
- Middle is the matrix
- Endosymbiotic theory
- Theory: an idea or system of ideas intended to explain something, usually based on general principles unrelated to the thing being explained.
- Double membrane
- Similar size to small bacteria
- Use oxygen to produce ATP
- Have their own genome (circular like bacteria)
- Have their own ribosomes
- Have their own transfer RNA
- Started with an ancestral cell that became eukaryotic, then the cell got hungry and “ate” a bacteria which allowed the ancestral cell to use oxygen to make energy due to having the bacteria and got another membrane from the ancestral cell
- Plasma membrane
- Separates inside and outside of the cell
- Semi-permeable
- Hydrophilic nutrients can’t make it through
- Hydrophobic lipids can make it through
- Phospholipid bilayer
- The middle part is hydrophobic (fatty acid cells)
- Outer parts are hydrophilic (phosphate groups)
- Also has proteins to get hydrophilic things into the cell
- Types of transport
- Passive
- No energy required
- Molecules move down the concentration gradient
- High to low concentration
- Includes
- simple diffusion
- The solution gets equally distributed

- facilitated diffusion
- Creates a protein channel to move the molecule into the cell
- Osmosis
- Water moves from high solute concentration to low solute concentration
- Tonicity
- isotonic solution
- same concentration of nonpenetrating solutes as normal body cells
- Constant cell volume
- hypotonic solution
- Lower concentration of nonpenetrating solute as normal body cells
- Cell swells up and maybe lysis (explodes)
- hypertonic solution
- Greater concentration of nonpenetrating solute as normal body cells
- Cell shrinks
- Active transport
- Requires energy
- Use ATP to activate a pump to move things against concentration
- Establishes electrical or potential gradient that our body can use to do wor
- The Na K ATPase pump generates an electrical potential across the membrane
- Bulk transport
- Transports big things or lots of things (costco)
- Two directions
- Endocytosis
- Movement into the cell
- Exocytosis
- Movement out of the cell
- Three forms
- Phagocytosis
- Membrane turns inwards and creates a vesicle to carry
- Pinocytosis
- A lot of a small thing
- Receptor-mediated endocytosis
- Makes a coated pit
- Cellular respiration
- Glucose breaks down, the carbon-carbon bonds become potential energy in ATP
- 4 stage process

- We get a lot of high-energy electrons as a result which are delivered to the stage where most ATP is made
- Glyolysis
- Glucose becomes two 3-carbon molecules called pyruvate
- Preparatory reactions
- Two pyruvate enters mitochondria
- Citric acid cycle (krebs cycle)
- The acetyl COA enter (from mitochondria)
- Electron transport chain

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Energy drinks

Claims

- Increase energy levels
- Increase mental awareness
- Reduce muscle fatigue

Table 4.1

- No carbs, lipids, or proteins

Classified as a dietary supplement not a food

Vitamins

- Organic molecules that assist enzymes in chemical reactions
- Help make coenzymes
- Helps substrate bind more easily
- Not used as energy
- Two classes
- water-soluble vitamins
- Viamin B and C
- Excess excreted in urine
- Need to replace regularly in diet (excreted quickly)
- fat-soluble vitamins
- Vitamins A, D, E, K
- Stored in adipose (fat) tissue

- B vitamins
- Table 4.2
- Already getting mostly enough from every day foods

Caffeine

- Natural chemical produced by some plants
- Both water-soluble (hydrophilic) and fat-soluble (hydrophobic)
- Rapid bodily absorption
- Psychoactive
- Can reach brain
- Receptor antagonist
- Blocks adenosine (cause drowsiness)
- Activates adrenaline
- Increase brain-muscle coordination
- Decrease reaction time
- Fight, flight, or freeze reaction
- Stimulant
- Goes to brain and blocks adenosine receptors
- Increase metabolic rate
- More energy generated by cellular respiration pathways
- Causes brin to produce hormones that result in the release of fatty acid chains from adipose tissue
- Can be used to produce ATP via cellular respiration
- Increase blood glucose levels
- Can be used to produce ATP via cellular respiration
- Tells the liver to take glycogen to break it into glucose and put it into your bloodstream, then the glucose can be used to make ATP
- If diabetic, blood glucose levels go even higher

Table 4.3

- Nonessential and essential amino acids
- Essential
- Phenylalanine (need to get it through diet, in many meat), maybe taking supplements if vegan
- Nonessential (our body makes it by itself)
- Taurine
- Tyrosine

Not regulated by FDA because its a supplement

Could the same effect from an energy drink be achieved in other ways

- Coffee
- Eating a few apple slices has enough vitamin b
- A handful of nuts has enough vitamin b

Use science to critically analyze claims

Logan paul PRIME (not required for exam)

- PRIME -> cardiac arrest in some school students
- Caffeine -> adrenaline
- Adrenaline responsible for heart rate
- Heart pumping too fast and too long can cause heart to stop
- Doesn't say how much caffeine (5 hour has 200mg, red bull has 80mg)
- But if you turn it over its written: 200mg
- Same as 5 hour energy, but marketed to kids
- PRIME has another product: hydration drink (not the canned one)
- Has no caffeine

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