Drugs

* Types
  + Analgesics fight pain (a or an or ant or anti = not in Latin, alges = pain in Greek, ia = condition in Latin)
  + OTC (Over The Counter) non-prescription legal drugs
    - Antitussives are cough medicines (tussive is Latin for cough)
    - Expectorants like Mucinex loosen sputum (expector = expel in Latin)
    - Antacids neutralize stomach acid
    - Laxatives alleviate constipation (Latin laxate = loosen)
    - Antipyretics alleviate fever (Greek pyro = fire)
    - Antihistamines alleviate allergy caused by histamine (a biochemical)
    - Some analgesics like NSAIDS (Non Steroidal Anti Inflammatory DrugS) but not opioids like OxyContin
    - Decongestants alleviate nasal congestion, allowing easier breathing, usually contain pseudoephedrine
    - Antidiarrheals alleviate diarrhea
  + Chemotherapy drugs are anticancer drugs, often antimetabolites which are metabolic toxins (poisons that impede metabolism, hopefully in cancer cells more than human cells), and alkylating agents that damage DNA (DNA replication happens more in cancer cells than healthy cells; cancer cells containing badly replicated DNA hopefully don’t function well)
  + Antibiotics work only against bacteria and not viruses
  + Contraceptives are antipregnancy drugs (contra = against in Latin, cept = taken)
  + Antivirals work against viruses like Relenza
  + Anesthetics block awareness; local blocks feeling of a body part and systemic (anesthesia) blocks complete awareness (consciousness) for surgery (aesthetic = Greek-German for perception or awareness)
  + Antihypertensives work to lower blood pressure (hypertension: hyper = above, tension = pressure)
    - Diuretics cause you to pee out Na+
    - Vasodilators dilate or open up blood vessels (vaso = vessel)
    - Beta blockers and calcium channel blockers slow down and relax heartbeat
  + Hormone regulators regulate hormones created in glands which circulate through bloodstream but do not cross the blood-brain barrier and get into the brain
    - Agonists replace missing or defective hormones or make hormones more effective
    - Antagonists block receptor sites that hormones bind to or make hormones less effective; example antihistamines block histamine receptors
  + Neurochemicals
    - Agonize or antagonize neurotransmitters made in the brain but which do not cross the blood-brain barrier and circulate through the bloodstream
    - Are used to alleviate psychiatric problems like depression, bipolar disorder, ADHD, PTSD, psychosis, schizophrenia, etc.
    - The 3 most commonly agonized/antagonized neurotransmitters are serotonin, norepinephrine, and dopamine
      * Serotonin gives you focus, concentrate on tasks; most common agonists are SSRI’s, Selective Serotonin Reuptake Inhibitors (keep neurons from reabsorbing serotonin and thereby shutting down its activity)
      * Norepinephrine moderates mood and body coordination
      * Dopamine is involved in motivation and motor control; is strongly agonized in addiction
    - Some neurochemicals are also made in glands or blood cells and act as hormones
      * Histamine is an example of this
      * In the body histamine is made in circulating (bloodstream) basophils (causes vasoconstriction or vasodilation depending on location of receptor), intestines (causes peristalsis which moves stool through intestines), and mast cells in mucus membranes (allergic reactions), among other places
      * In the brain histamine is a neurotransmitter which helps maintain alertness, and acts on the vagus nerve increasing heartbeat (the vagus nerve slows heartbeat)
      * Early antihistamines crossed the blood-brain barrier and caused drowsiness and rapid heartbeat
  + Opiates (derived from opium) and opioids (bind to same receptors as opium and include opiates) are agonists for the natural biochemicals which bind to these receptors
    - β-Endorphin is a natural biochemical which binds to opiate receptors which causes pleasure, stimulates production of dopamine, and blocks pain
    - Enkephalin is a natural biochemical which binds to opiate receptors and blocks pain only
    - Dynorphin, like enkephalin, blocks pain only
* Metabolism, with drugs, refers to the way in which the body eliminates, or rids itself of a drug
  + One of the things which is usually measured, if possible, is the half-life of a drug, which is the amount of time it takes your body to get rid of half of the original amount of a consumed drug
  + Most drugs are metabolized by the liver by a group of enzymes called cytochrome P450 enzymes; these are referred to using the designation CYP#∧#, where the #’s are numbers and the ∧ is a capital letter
  + Incompatible drugs often are metabolized by the same enzymes and cause toxic buildup by overloading these enzymes
  + Acetaminophen (Tylenol) is metabolized by CYP2E1, which creates NAPQI
    - Too much NAPQI is hepatotoxic (hepato means liver)
    - If acetaminophen is metabolized too quickly it makes enough NAPQI to be poisonous
    - Alcohol makes the liver produce more CYP2E1
    - More CYP2E1 means faster acetaminophen metabolism and too much NAPQI
    - Don’t drink and take Tylenol if you value your liver
  + Grapefruit and grapefruit juice are CYP3A4 inhibitors
    - They inactivate CYP3A4 by a considerable amount
    - More than half of prescription drugs are metabolized by CYP3A4
    - If you take a prescription drug be sure that it is OK to drink grapefruit juice or eat grapefruit with this drug before you do this; otherwise you may build up a too high concentration of the drug in your bloodstream and poison yourself
    - If you are a chemist and can properly do the correct calculations you might be able to take a lower dose of a drug than prescribed and save money by drinking grapefruit juice
* General classes and design of drugs
  + Design of new drugs is generally done using bioisosterism (bio = life, iso = same, sterism = shape)
    - Drugs are designed so that drug molecules have shapes which fit receptors better than natural biochemicals
    - Some are designed to block receptors and shut down some biochemical process (antagonists)
    - Some are designed to do the same chemistry as natural biochemicals which may be missing or defective in some people; the natural biochemicals may not be functional because they might be digested if given in pill form
  + General classes
    - Hormone regulators (antagonists and antagonists)
    - Neurochemicals (antagonists and antagonists)
    - Enzyme activators or inhibitors
    - Non-site-specific chemicals (alcohol and anaesthetics, for example)
    - Biofunction destroyers like alkylating agents which destroy DNA functionality
* Generic drugs
  + Are chemically identical to name-brand drugs, do the same chemistry
  + Generic drug names are called INN names
    - International Nonproprietary Name (INN) system developed and managed by WHO (World Health Organization)
    - Are constructed with endings, called stems, which relate to the function of drugs
    - Example: novacaine is a local anaesthetic used by dentists to numb nerve roots in teeth prior to drilling out and filling cavities; -caine is the ending assigned by WHO for generic names of local anaesthetics
* Recreational use
  + Addictive drugs agonize dopamine
    - Nicotine in tobacco is the most addictive drug known as defined by “capture rate”
    - Opioids
      * Oxycodone (trade name OxyContin)
      * Fentanyl
      * Heroin
      * Morphine
      * Codeine
      * Hydrocodone
    - Methamphetamine
      * Very addictive; probably between cocaine and heroin in addictiveness
      * Agonizes many neurotransmitters including dopamine, norepinephrine, serotonin, glutamate, GABA, NMDA, and others
      * Is a neurotoxin; damages brain neurons
    - Cocaine
      * Less addictive than opioids but still quite addictive
      * Is a dopamine reuptake inhibitor
    - Amphetamine (trade name Adderall)
      * Similar addiction profile to cocaine
      * Agonizes dopamine and serotonin
    - Alcohol
      * A CNS (Central Nervous System) depressant (impedes reaction time, for example)
      * Moderately addictive
      * Causes release of dopamine and serotonin
      * Abuse is destructive to liver (cirrhosis) and brain (brain shrinkage, neuron damage, and memory loss)
    - Cannabis
      * Smoking marijuana cases less lung cancer than tobacco, but still increases lung cancer risk
      * Some cannabinoids have mild anticancer activity
      * Smoking any plant (including marijuana) creates many of the same carcinogens as smoking tobacco
      * Cannabis addictiveness level is low; probably lower than alcohol addictiveness level
      * Cannabis contains a huge number bioactive chemicals; research is ongoing to attempt to use many of them as pharmaceutical drugs
      * Long-term heavy use seems to impair memory
    - Caffeine
      * Stimulant with very mild addictiveness
      * Blocks the depressant biochemical adenosine in the brain and elsewhere in the body, like the heart
  + Hallucinogens
    - Not addictive
    - Not harmful to most people
    - Recent research suggests that these may be beneficial
      * Seem to promote repair of damaged neurons
      * Seem to promote growth of new neurons (neurogenesis)
      * Seem to promote neural connectivity (improve neural networks responsible for intelligence)
    - Nitrous oxide (N2O, trade name Whippets)
      * Nonaddictive
      * Causes mild euphoria and hallucination
      * Agonizes dopamine by causing release of endorphins
      * Occasional use doesn’t seem harmful (dentists use it), but overuse causes vitamin B-12 deficiency and nerve damage