NAME \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **UNIT 4**: (1) SPECIAL FOCUS ON CHEMICALS: FUEL,

NEUROCHEMISTRY / LICIT / ILLICIT DRUGS

I) Fuel from biomass: The Fischer-Tropsch Process (mid-1920s)

 A) Biomass (e.g. sawgrass, municipal waste, algae, forest residue) is turned into a gas (gasified). The organic

 molecules of this gas are purified and turned into \*syngas ….which is a **mixture** of CO(g) and H2(g)

 1) Syngas is then used to turn them into a stream of liquid **hydrocarbons** (organic compounds made only

 of C and H (eg heptane C7H14, octane C8H18). (D. B. Lowe; The Chemistry Book 2016)

 a) The products are used as synthetic fuel (gasoline) and lubricating oils.

 b) The process does not ***need*** biomass … Countries lacking oil, have used coal or

 natural gas (CH4) …. But the interest today is to use biomass supplies, thus we do NOT

 need to increase the consumption of crude oil, per se….

c) Using Fischer-Tropsch does not wean us away from fossil fuel combustion, and thus it

 does not move us away from the challenges of climate change. It will give us time to deal

 with the challenge.

 2) Essentially, the process is about \*the polymerization of CO into larger hydrocarbons

 a) According to Ullmann's Encyclopedia of Industrial Chemistry, the reaction is essentially:

 \*(2n + 1) H2 + n CO → CnH2n+2 + n H2O

where “n” runs between 10 to 20 “moles”.

 b) Most of the hydrocarbon products tend to be used as diesel fuel …(Chains of C = 9 to 25)

 some alcohol may also be produced

 3) The process relies on metal catalysts (Fe, Co, Ni), and fairly high pressure (10 atmospheres).

 A catalyst often decreases the energy required to make a reaction occur. Thus, a catalyst tends

 to speed up a reaction, which normally plods along.

 Check out Catalysis of H2O2 (controlled) <https://www.youtube.com/watch?v=S3o-_tQ7MME> (start: 3:20)

Check out Catalysis of H2O2 (uncontrolled Elephant’s Toothpaste)

 <https://www.youtube.com/watch?v=XXn4fP3CnJg> (start: 7:55)

II) The Male and Female Brain (Based on work published by Dr. Louann Brizendine)

 A) The "big hormones” for men: Testosterone, Vasopressin, and Müllerian inhibiting substance

 (Note that estrogen is made in men, primarily by the adrenal glands. There is some solid evidence that suggests it helps in bone

 growth. The production increases right through puberty. Also, oxytocin plays a major role in "fatherhood" and influences the

 behavior of older men)

 B) The "big hormones" for women: \*Estrogen (Esterdiol), Progesterone and Oxytocin.

 (Note that the ovaries make both estrogen and testosterone. The adrenal glands make testosterone as well)

 C) In men, testosterone levels \*increase 20-fold from age 9 to 15

 D) There are 2 brain centers that vary tremendously in men and women: hypothalamus and amygdala

 1) The amygdala is a primitive brain section. It triggers fear and aggressive protection. It is

 larger in men and will spark problem solving and fixing situations, when loved ones are

 distressed.

 E) By 12 months, a boy can ignore his mother's facial changes ... just the opposite occurs in girls.

 F) Vasopressin: When blended with cortisol (stress hormone) and testosterone the male brain becomes

 territorial about space (e.g. bedroom) and sensitive to perceived or real

 "putdowns"....prepare for the fight or flight response.

 Vasopressin and Testosterone alter a teen boy's sense of reality. In a similar fashion,

 Estrogen and Oxytocin change the way teen girls perceive reality

 \*Vasopressin causes a boy to see neutral faces as hostile and unfriendly

 ....while it makes girls see neutral faces as friendly

II) Neurotransmitter: A chemical that is released from a nerve cell which thereby transmits an impulse from a

 nerve cell to another nerve, muscle, organ, or other tissue. A neurotransmitter is a

 \*messenger of neurologic information from one cell to another.

 <http://www.medterms.com/script/main/art.asp?articlekey=9973>

III) Hormone: A chemical substance produced by / secreted by a body gland, that controls and regulates the

 activity of certain cells or organs. <http://www.medterms.com/script/main/art.asp?articlekey=3783>

 Essentially, a hormone is secreted by one tissue and travels by way of \*body fluids to affect

 another tissue in your body. In essence, hormones are "chemical messengers."

 see: <http://women.webmd.com/normal-testosterone-and-estrogen-levels-in-women>

IV) A few important examples....

 (noradrenaline) (adrenaline)

 Check out: <https://reset.me/story/norepinephrine-a-key-player-in-stress-depression-and-adhd/>



Check out: <https://cen.acs.org/biological-chemistry/microbiome/Serotonin-helps-gut-microbes-thrive/97/i35>

Check out: <https://www.medicalnewstoday.com/kc/serotonin-facts-232248>



 <https://web.northeastern.edu/rmelloni/schwartzer.html> Check out: <https://sciencebeta.com/dopamine/>

 See: <http://thebrain.mcgill.ca/flash/d/d_03/d_03_p/d_03_p_que/d_03_p_que.html>

 and “approach behaviors” Beginner Molecular and Advanced Molecular

V) Classes of Drugs (A Rather Arbitrary Listing ...)

 A)

|  |  |  |
| --- | --- | --- |
| Class | Examples | ***Effects*** / Uses |
| Depressants | \*AlcoholBenzodiazapines (Valium, Xanax)Barbiturates (Seconal, Nembutal) | ***Decrease CNS activity (arousal, excitability) in a variety of ways. Benzodiazapines, for instance, increase the efficiency of synaptic transmission of the neurotransmitter GABA by acting on its receptors.***Muscle relaxant, sedative, anti-convulsant |
| Opioids (Opiates, Narcotics) | \*OpiumHeroinMorphineCodeineMethadoneHydrocodoneHydrocodone and acetaminophen (Vicodin) | ***Bind strongly to receptors of endogenous opioids (e.g. endorphins) and affect GABA-pathways, ultimately increasing the levels of dopamine***AnalgesicsCough Suppression via CNS depressionAnti-diarrhea |
| Antidepressants | SSRI: *Selective Serotonin Reuptake* I*nhibitors* (Prozac, Zoloft)MAOI: *Monoamine Oxidase Inhibitors* (Parnate)Tricyclics (amitriptyline) | ***Bind or occupy reuptake receptors thus modifying neurotransmitter levels in the synapse***Treatment for depression by affecting the concentrations of various neurotransmitters (e.g. serotonin, norepinephrine)Serotonin is a monoamine |
| Stimulants | \*CocaineAmphetamines\*Nicotine (minor)Caffeine (minor)Ephedrine (minor)Pseudoephedrine (minor) | ***Affects dopamine and serotonin pathways by blocking reuptake receptors in the synapse***Heightens psychological and sensory-motor functioning; Treatment for ADHD, narcolepsy, appetite control, sinus decongestion, anti-fatigue |
| Hallucinogens | LSDMarijuana | ***LSD affects the serotonin pathway and seems to re-direct the impulse into more varied and deeper portions of the brain, away from the normal pathways******THC binds directly to numerous receptors for naturally-occurring cannabinoids (metaphorically similar to how opiates work)***produce altered states of consciousness, hallucinogens;may increase sense of “well-being”, anti-nausea, appetite stimulant |
| StimulatoryHalluginogens | EcstasyKetaminePCPPsilocybinMescaline | ***Molecular structures (especially Ecstasy) resemble LSD******and amphetamines, thus produce a combination of psychomotor stimulant and hallucinogenic effects based upon dose***veterinary anesthetic |

|  |  |
| --- | --- |
| Class | ***Effects*** / Uses |
| Steroids | Anabolic steroids are synthetically produced variants of the naturally occurring male hormone testosterone. Both males and females have testosterone produced in their bodies: males in the testes, and females in the ovaries and other tissues. The full name for this class of drugs is androgenic (promoting masculine characteristics) anabolic (tissue building) steroids (the class of drugs).Steroid abuse has been associated with cardiovascular diseases (CVD), including heart attacks and strokes, even in athletes younger than 30. Steroids contribute to the development of CVD, partly by changing the levels of lipoproteins that carry cholesterol in the blood. Steroids, particularly the oral types, increase the level of low-density lipoprotein (LDL) and decrease the level of high-density lipoprotein (HDL). High LDL and low HDL levels increase the risk of atherosclerosis, a condition in which fatty substances are deposited inside arteries and disrupt blood flow. If blood is prevented from reaching the heart, the result can be a heart attack. If blood is prevented from reaching the brain, the result can be a stroke.Steroids also increase the risk that blood clots will form in blood vessels, potentially disrupting blood flow and damaging the heart muscle so that it does not pump blood effectively. (usdoj) |

Sources: <http://www.addictionscience.net/ASNclass.htm>

  <http://thebrain.mcgill.ca>

 <http://www.usdoj.gov/dea/concern/steroids.html>

 <http://www.elmhurst.edu/~chm/vchembook/674narcotic.html>

As an aside ... which I find fascinating.... From: *Cocaine* (2010) National Geographic Channel HD as seen on 24 October 2010 at 10:30 a.m.

# On the extraction of Cocaine from the leaf of coca plant (Ethroxylon coca)...

The coca leaves are dried and manually crumbled. They are then treated with concrete powder, lime and a bit of water.

The leaves are then soaked in gasoline for approximately 4 hours. The cocaine from the concrete powder, lime, cocoa mixture is dissolved into the gasoline. The leaves are pressed ensuring a maximum extraction, and this pressing and the original gasoline liqueur are mixed.

The gasoline liqueur is neutralized with soda crystals (a.k.a. washing soda or sodium carbonate: Na2CO3(s)), heated to evaporate any fluid to a paste, and allowed to dry to powder.

Some new research argues that cocaine is addictive .. which flies in the face of the beliefs of the 1980s and 90's.

PET scans suggest that repeated exposure alters the structure of the brain, similar to the brains of addicts.

When former users "discuss" cocaine, or see images of others using cocaine, the dopamine levels in the brain of the former uses, rise ... and could be a reason for the high recidivism rate for use.

(Note: This sense of "relapse" dovetails nicely with the research reported in the 13 Sept 2010 showing of Larry King Live ... based upon interviews with brain researchers and psychologists)

 VI) BEND IT LIKE BENZENE….

Benzoyl Peroxide



Trinitrotoluene 





Salicylic acid

****

Naproxen Sodium

****

****

 Ibuprofen

 Acetaminophen

 Acetylsalicylic acid



TNT <http://hyperphysics.phy-astr.gsu.edu/hbase/organic/aromatic2.html>

BP <http://www.uspbpep.com/usp28/v28230/usp28nf23s0_m8310.htm>

Napthalene <http://www.eoearth.org/article/Health_effects_of_Naphthalene/1-methylnaphthalene/2-methylnaphthalene>

Salicylic acid [http://en.wikipedia.org/wiki/File:Salicylic\_acid\_methyl\_ester\_chemical\_structure.png](http://en.wikipedia.org/wiki/File%3ASalicylic_acid_methyl_ester_chemical_structure.png)

Acetaminophen <http://www.chemsynthesis.com/base/chemical-structure-18651.html>

Acetylsalicylic <http://chrom.tutms.tut.ac.jp/JINNO/DRUGDATA/07acetylsalicylic_acid.html>

Ibuprofen Gray et al. Braving the Elements. Sausalito : University Science Books. 1995

Naproxen: Gray et al. Braving the Elements. Sausalito : University Science Books. 1995

Folic acid <http://www.guidechem.com/cas-757/75708-92-8.html>

 Folic Acid: The B vitamin (B9) folic acid helps prevent birth defects. When BOTH a man and woman have enough folic acid in their diet before pregnancy (and the women while she is pregnant), a baby is less likely to have a major birth defect of the brain or spine.

Most women do not know how important folic acid is for their bodies and for the health of a baby they might have in the future. They also do not know that a woman needs to take folic acid every day, starting before she is pregnant, for it to work to prevent birth defects. Recent reports suggest that this is true

for men as well.

Birth defects of a baby’s brain or spine happen in the first few weeks of pregnancy, often before a woman knows that she is pregnant. That is why

it is important for a woman to get enough folic acid each day, starting before she is pregnant.

A woman’s body uses folic acid to make healthy new cells for her baby. Scientists are not sure how folic acid works to prevent birth defects, but they do know that it is needed for making the cells that will form a baby’s brain, spine, organs, skin, and bones.

Every woman needs folic acid for the healthy new cells her body makes every day, ***even if she is not planning to get pregnant.* New studies suggest that folic acid is necessary for healthy sperm. Hence men need it as well**.

(<http://www.cdc.gov/ncbddd/folicacid/basics.htm>)

http://womenshealth.gov/faq/easyread/folic-etr.htm

VII) NSAIDS (a slightly mis-leading title …. because I’m including Tylenol…)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Acetylsalicylic Acid(Bayer Aspirin) | Acetaminophen(Tylenol) | Ibuprofen(Advil, Motrin) |
| Anti-pyretic(fever reduction) | \* Very Good | \* Good | \* Very Good |
| Anti-inflammatory(anti-swelling) | \* Very Good | \* None | \* Superior |
| Analgesic(pain reduction) | \* Very Good | \* Good to Very Good | \* Very Good |

 A) Issues:

 **Aspirin** and “thinning blood”: In reality, the presence of aspirin helps prevent

 \* the clot-forming platelets from actually clotting…

 by inhibiting the production of thromboxanes and prostaglandins. Aspirin can successfully

 block the activity of the ***cyclo-oxygenase*** enzymes: COX-1 and COX-2.

 New NSAIDs, like *Celebrex* are a selective COX-2 inhibitor ... but aspirin in non-selective.

 Aspirin and bleeding: \* Some bleeding does occur with aspirin

 \* (approximately 1 to 2 mL per dose in stomach bleeding .... prostaglandins play a role in

 maintaining the stomach’s mucosal coating)

Aspirin and Reye’s Syndrome It appears that aspirin can cause severe \* kidney,

 liver and brain damage (and even death),

 in adolescents with flu-like symptoms such as high fever.

**Acetaminophen** \* Sever liver damage can occur with alcohol use

and acetaminophen. The metabolism of acetaminophen produces a small amount of NAPQI

(N-acetyl-p-benzoquinoneimine). With small excesses of acetaminophen, it the liver becomes

becomes overwhelmed, NAPQI is not eliminated quickly enough and begins to kill liver cells.

 See: <http://www.medpagetoday.com/ProductAlert/Prescriptions/24320>

 or <http://tinyurl.com/4mo3vln>

**Ibuprofen**; There have been some reports that heart patients should speak

with their doctor(s), due to a rare occurrence of blood clotting. \* Excessive use

 causes liver damage. Stomach and intestinal bleeding do occur. The inhibition

 of platelet blood clotting is very short-lived.

 See also the story of Kenny Easley ... around 1989, Seattle Seahawks...

APPLICATIONS TO PHYSICAL THERAPY

IONTOPHORESIS \* *i-on-toe-for-ee-sis*)





 Fact1: ***Algesia*** (al-gee-zee-ah) is the fancy word for \* ***pain***

 Fact2: The word for \*“without pain” is ***an***algesia (as in analgesic)

 Fact3: Aspirin is an analgesic medicine (It \* reduces pain )

 Fact4: Aspirin is called acetylsalicylic acid (a-seat-a-sale-ih-sill-ic)

 Fact5: The major pain-relieving portion of an aspirin molecule is the acetyl group.

acetyl or acetate ion

(C2H3O2)-1 or CH3COO-1(aq)



Fact6: Aspirin works by having the acetyl (or acetate ion) block up an enzyme that makes

 a hormone used to sense pain.

 acitve site: **the pain**



 **molecule reactant must**

 **get to this interior receptor/active site**

 Diagram 1 Diagram 2

 The Open Enzyme The Blocked H O

 Channel Channel | ||

 H ―C―C―O―

 ✹ |

 H

 ✹ ✹

 The **reactant** for a pain molecule

 tries to get to the interior of the enzyme but the reactant is blocked by the acetyl group that has

 bonded across the open channel of the enzyme so the pain molecule is not made

 Fact7 Vinegar contains acetic acid (which is made from the acetyl or acetate ion)

 HC2H3O2(aq) = H+1 + (C2H3O2)-1

 So, if we could get the acetate ion of vinegar to an injured area of the body ...



 Injured area covered with a pad soaked with CH3COO-1(aq)+ H+1(aq)

 hooked up to a battery

VII) Benzoyl Peroxide: Benzoyl peroxide is the staple of some acne fighting arsenals and it does

 have anti-inflammatory properties. But it is more than just an

 anti-inflammatory. It is also antibacterial and an anti-comedonal (reduces

 oil production / pore blocking) Overuse of the complex will only irritate

 your skin even further. For that reason, use benzoyl peroxide as directed.

 (http://www.acnesquad.com/reduce-swelling-of-cystic-acne-htm)

Sidebar: **On Inflammation:** Inflammation is a normal and essential response to any noxious stimulus that threatens the host and may vary from a localized response to a generalized response. The resulting inflammation can be summarized as follows:

 • “initial injury causing release of inflammatory mediators such as: histamine, serotonin, leukokinins,

 and prostaglandins

 • vasodilation

 • increased vascular permeability and exudation

 • leukocyte migration, chemotaxis, and phagocytosis

 • proliferation of connective tissue cells

Anti-inflammatory drugs may act by interfering with any one of several mechanisms.”

(Foye’s Principles of Medicinal Chemistry 6th ed. p. 954-5)

IX) Nicotine:

Not many people realize that nicotine is also sold commercially as a pesticide! And every year, many children go to the emergency room after eating cigarettes or cigarette butts, due to the dangers of ingesting nicotin. Sixty milligrams of nicotine (about the amount in three or four cigarettes if all of the nicotine were absorbed) will kill an adult, but consuming only one cigarette's worth of nicotine is enough to make a toddler severely ill.

What happens to people after ingesting nicotine? **Nicotine poisoning** causes vomiting and nausea, headaches, difficulty breathing, stomach pains and [seizures](http://health.howstuffworks.com/seizure-during-full-moon.htm). Each of these symptoms can be traced back to excessive stimulation of cholinergic neurons.

People poisoned by [**organophosphate insecticides**](http://health.howstuffworks.com/wellness/drugs-alcohol/question440.htm) experience the exact same symptoms. With organophosphates, **acetylcholine** builds up at synapses and overstimulates the neurons. Because nicotine is so similar to acetylcholine, and binds to cholinergic receptors, nicotine in excess produces the same overstimulation and toxicity. The more nicotine binding to the nicotinic cholinergic receptors, the more acetylcholine is subsequently released and free to activate other subsets of cholinergic receptors. <http://health.howstuffworks.com/wellness/drugs-alcohol/nicotine7.htm>



<http://coep.pharmacy.arizona.edu/curriculum/nicotine_alcohol/index.html>

See: <http://www.phschool.com/science/science_news/articles/more_than_a_kick.html>

 Nicotine may promote wrinkles!