NAME \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **UNIT 4**: 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 has the ability to 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>

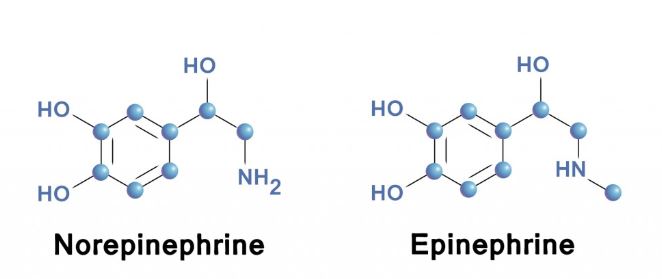
III) Hormone: A chemical substance produced by / secreted by a body gland, that controls and regulates the

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....

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

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<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 | Alcohol  Benzodiazapines  (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) | Opium  Heroin  Morphine  Codeine  Methadone  Hydrocodone  Hydrocodone and acetaminophen (Vicodin) | ***Bind strongly to receptors of endogenous opioids (e.g. endorphins) and affect GABA-pathways, ultimately increasing the levels of dopamine***  Analgesics  Cough Suppression via CNS depression  Anti-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 | Cocaine  Amphetamines  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 | LSD  Marijuana | ***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 |
| Stimulatory  Halluginogens | Ecstasy  Ketamine  PCP  Psilocybin  Mescaline | ***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.

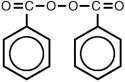
PET scans suggest that repeated exposure alters the structure of the brain, similar to the brains of addicts.

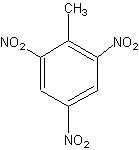
When former users "discuss" cocaine, or see images of others using cocaine, the dopamine levels in the brain of the former uses, rise ... and could be a reason for the high recidivism rate for use.

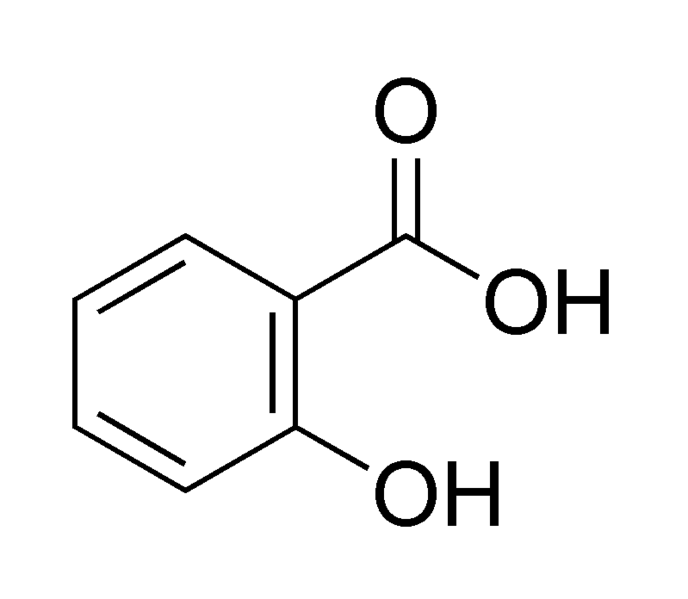
(Note: This sense of "relapse" dovetails nicely with the research reported in the 13 Sept 2010 showing of Larry King Live ... based upon interviews with brain researchers and psychologists)

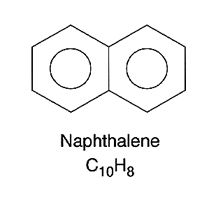
VI) BEND IT LIKE BENZENE….

Benzoyl Peroxide

[](http://www.drugs.com/PDR/images/15/10009101.jpg)

Trinitrotoluene [](http://en.wikipedia.org/wiki/Image:TNT.png)

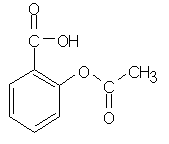


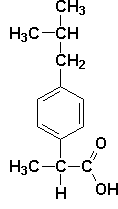
[](http://www.windows.ucar.edu/tour/link=/life/images/naphthalene_1_gif_image.html&edu=high)

Salicylic acid

**[Click to see a naproxen sodium molecule in 
3-D!](javascript:Start('pop/naproxen.htm'))**

Naproxen Sodium

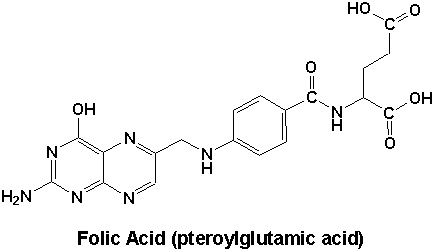
**[Click to see a acetaminophen molecule in 
3-D!](javascript:Start('pop/acetamin.htm'))**

**[](javascript:Start('pop/ibuprofn.htm'))**

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>

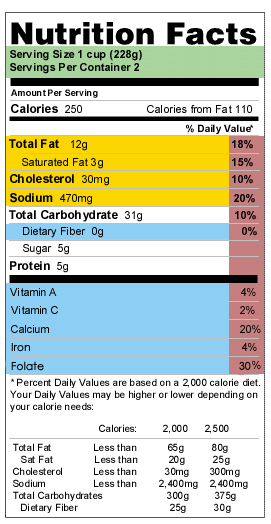
Acetaminophen <http://www.chemsynthesis.com/base/chemical-structure-18651.html>

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)

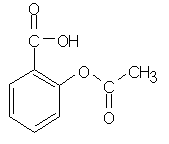
Fact3: Aspirin is an analgesic medicine (It \* reduces pain )

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.

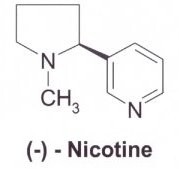
(Foye’s Principles of Medicinal Chemistry 6th ed. p. 954-5)

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!

NAME \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **UNIT 4**: SPECIAL FOCUS ON CHEMICALS (2): ETHANOL

I-IX) See part 1

X) Ethanol as a drug

A congressman was once asked about his attitude toward whiskey. “If you mean the demon drink that poisons the mind, pollutes the body, desecrates family life, and inflames sinners, then I’m against it. But, if you mean the elixir of Christmas cheer, the shield against winter chill, the taxable potion that puts needed funds into public coffers to comfort little crippled children, then I’m for it. This is my position, and I will not compromise.”

Mark Edward Lender and James Kirby Martin, *Drinking History in America: A History*

A) Essentially, a drug is any chemical (or mixture of chemicals) which affects the central nervous

system, causing a biochemical change. A drug can be used for diagnosis, treatment or prevention,

and, over the course of use, may (or may not,) become addictive.

B) What we term as liquor, is a mixture of ethanol, water, and various flavorings and compounds called

congeners. Today liquor is a governmentally regulated drug.

The 18th amendment to the US Constitution (circa 1920) established the ***prohibition*** of alcoholic

beverages, by out-lawing their production, transport and sale. It did not outlaw the consumption or

private possession of liquor!

The 21st amendment to the US Constitution (circa 1933) repealed the 18th amendment.

1) Ethanol (ethyl alcohol or grain alcohol) is the “active ingredient” in most recognized

liquors.

a) Formula: C2H5OH

b) Soluble in water and oddly, it is also soluble in gasoline

c) Flammable (combusts vigorously in the presence of O2)

d) It evaporates easily at most temperatures

e) Methanol, and isopropyl alcohol (rubbing alcohol) are **NOT the** same chemical as

ethanol.

C) The breakdown of ethanol in the human body

* The breakdown, or **oxidation**, of ethanol occurs in the **liver**.
* An enzyme in the liver called alcohol dehydrogenase strips electrons from ethanol to form acetaldehyde.
* A second enzyme, called aldehyde dehydrogenase, converts the acetaldehyde, in the presence of oxygen, to acetic acid, the main component in [**vinegar**](http://recipes.howstuffworks.com/how-vinegar-works.htm).
* The molecular structure of acetic acid looks like this:

**O** <http://recipes.howstuffworks.com/alcohol4.htm> **||   
 H3 C - C - O – H**

1) Alcohol is a CNS [Central Nervous System] Depressant. It affects the GABA

neurotransmitter the most. This system is involved in the control of muscle movement,

co-ordination, and breathing.

III) Alcohol Hangover

A) You must understand that virtually everything taken into the human body must go through the liver

and is in some way treated for disposal or further use. This holds true for ethanol.

Tuning off / disabling vasopressin activity

B) Causes of Production of acetaldehyde toxin

4 issues affecting the development of a hangover

Hangover The effects of glutamine rebound

The presence of congeners in the liquor

**The important chemicals involved:**

1) Vasopressin (Anti-Diuretic Hormone or ADH) is a **"good" hormone** to have working,

for you. When vasopressin is disabled (turned off), bad things happen...

2) Acetaldehyde (a-seat-a-al-duh-hide) is **a poison**. It is produced from the liver's action on

ethanol. It is a **bad thing to have**.

3) Glutamine (glū –ta – meen) is another **"good" hormone** ... however, the body's response

with producing glutamine, as alcohol begins to be diminished in concentration, in the body,

is unfortunate.

4) Congeners are a mixed bag. They are “born with” the alcohol. They are not produced by

the activity of alcohol in the body ... rather, they're in the bottle, with the alcohol, due to the

fermentation process.

Check out: <http://www.alcoholscreening.org/> How much is too much? C) Hangover Causation 1: Turning Off the Positive Activity of Vasopressin (ADH)

**What you need to know:**

A **diuretic** (di-yur-eh-tic) is a chemical which makes you urinate

**Causation:**

**\_\_disabling vasopressin**

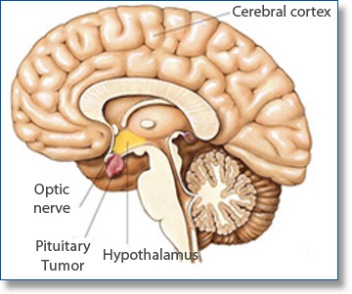
**\_\_\_making toxins**

**\_\_\_regaining glutamine**

**\_\_\_congeners**

An ***anti-diuretic*** is a chemical which helps return fluid to your body.

Vasopressin is also called ***anti*-diuretic hormone (ADH)**.

 When alcohol enters the bloodstream it causes the **pituitary gland** in the [brain](http://health.howstuffworks.com/brain.htm) to block the creation and/or the release of **vasopressin** (the antidiuretic hormone).

Without this chemical, the kidneys send [water](http://science.howstuffworks.com/h2o.htm) directly to the bladder

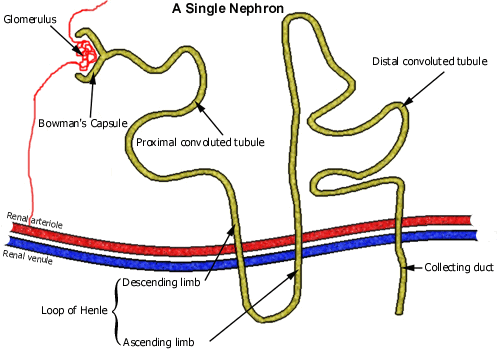
instead of reabsorbing water back into the body. This is why drinkers

have to make frequent trips to the bathroom after urinating for the first time

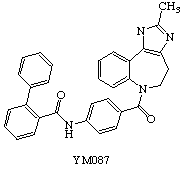
after drinking.

Headaches result from dehydration because the body's organs try to make up for their own water loss by **stealing water from the brain**, causing the brain to decrease in size and pull on the membranes that connect the brain to the skull, resulting in pain.

The frequent urination also expels salts and potassium that are necessary for proper nerve and [muscle](http://health.howstuffworks.com/muscle.htm) function; when sodium and potassium levels get too low, [headaches](http://health.howstuffworks.com/headaches-ga.htm), fatigue and nausea can result. Alcohol also breaks down the body's store of glycogen in the **liver**, turning the chemical into glucose and sending it out of the body in the urine. Lack of this key energy source is partly responsible for the weakness, fatigue and lack of coordination the next morning. In addition, the diuretic effect expels vital electrolytes such as potassium and magnesium, which are necessary for proper [cell](http://health.howstuffworks.com/cell.htm) function. <http://health.howstuffworks.com/hangover2.htm>



Vasopressin opens pores in the Loop of Henle and this allows water to move back into the body, helping to keep it hydrated.



Vasopressin



All The Important Points

D) Hangover Causation 2: Production of a toxin called, **acetaldehyde** (a-seat-a-al-duh-hide)

... *Okay, this gets a little complicated....*

**Causation:**

**\_\_disabling vasopressin**

**\_\_\_making toxins**

**\_\_\_regaining glutamine**

**\_\_\_congeners**

**What most never understand**: Acetaldehyde is a product of alcohol metabolism **and is more toxic**

than the alcohol!

H O

| ||

H―C―C―H

|

H

ACETALDEHYDE

H H

| |

H―C―C―O―H

| |

H H

ETHANOL

First, when we drink (moderately), alcohol is absorbed readily through the stomach lining (this can

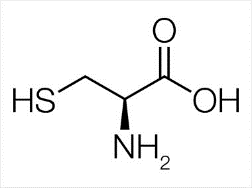
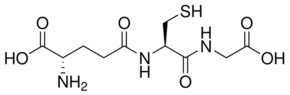
irritate the lining of the stomach ...more later on this....)

The alcohol (now in the bloodstream) eventually gets to the liver, where it is broken down by the

enzyme, alcohol dehydrogenase, turning the alcohol into the dangerous **toxin,** **acetaldehyde**.

The **acetaldehyde** is in turn attacked by another chemical called **glutathione** (which contains high

levels of the amino acid cysteine...[sis-teen: more later on this amino acid]).



cysteine (sis-teen) glutathione

<http://www.wacker.com/cms/en/products-markets/products/product.jsp?product=9372> <http://www.sigmaaldrich.com/catalog/product/sial/g4251?lang=en&region=US>

The attack of the cysteine-containing **glutathione** (glū-tah-thigh-own) is a defensive chemical that

attacks the toxic **acetaldehyde** to the **non-toxic** acetate (a substance similar to vinegar). The activity of

glutathione destroying acetaldehyde is a GOOD THING!

With very moderate alcohol intake, this process works well, leaving the **acetaldehyde** only a short

amount of time to do its damage. The liver’s stores of **glutathione** however, quickly run out when larger

amounts of alcohol enter the system. The liver’s ability to remove the **acetaldehyde** diminishes, until

more **glutathione** can be made. This down time allows the **acetaldehyde** to build up in the body and

remain for a longer period of time. <http://health.howstuffworks.com/hangover4.htm>

**All of the dangers of acetaldehyde are still unknown**. There is some debate as to whether it

enters into or is produced in the brain.

Once produced, it may inhibit enzymes designed to convert certain neurotransmitters from

aldehydes to acids. The neurotransmitters that accumulate may then react with the acetaldehyde

to form compounds which are startlingly similar to certain morphine-type compounds, **increasing**

**headache, nausea,** **lack of muscle coordination, and drowsiness.**

<http://www.elmhurst.edu/~chm/vchembook/642alcoholmet.html>

Outside of the brain, what seems to occur is that acetaldehyde reaches a saturation point and

it escapes into the blood stream. The accumulated acetaldehyde exerts its toxic effects by

•inhibiting the reactions in the mitochondria, which (if not bad enough) can result in even slower

removal of acetaldehyde (especially in alcoholics) which leads to further liver cell damage in the

forms of hepatitis and cirrhosis.

•interfering with the activation of vitamins <http://www.elmhurst.edu/~chm/vchembook/642alcoholmet.html>

•Research released in April 2014, through the National Institute of Health appears to conclude that

damage a gene involved in mitochondrial repair and muscle regeneration, appears to be the cause

of muscle weakness in chronic alcoholics.

*Additionally*:

•In the journal, *Nucleic Acids Research*, scientists from the National Institute on Alcohol Abuse and

Alcoholism (NIAAA) and the National Institute of Standards and Technology (NIST) report that

drinking alcoholic beverages has been linked to an increased risk of upper gastrointestinal cancer

and other types of cancer. It appears that polyamines – natural compounds essential for cell growth

– react with acetaldehyde to trigger a series of reactions that damage DNA, an event that can lead to

the formation of cancer. <http://alcoholism.about.com/od/cancer/a/blniaaa050803.htm>

Further Reading: *Even Moderate Drinking Can Affect Babies’ IQ* at: <http://tiny.cc/hfwW1> OR

<http://alcoholism.about.com/od/preg/a/blacer060603.htm>

 All The Important Points

E) Hangover Causation 3: The Negative Effects of Glutamine Rebound (glū –ta – meen)

*Warning: (Don't confuse glutathione and glutamine...both are "good" ...but, the*

*loss of one and the quick replenishing of the other cause problems)*

**Causation:**

**\_\_disabling vasopressin**

**\_\_\_making toxins**

**\_\_\_regaining glutamine**

**\_\_\_congeners**

After [alcohol](http://recipes.howstuffworks.com/alcohol.htm) consumption, a person may not [sleep](http://health.howstuffworks.com/sleep.htm) as soundly as normal because their body is

rebounding (coming back) from alcohol's depressive effect on the system.

When someone is **drinking**, alcohol **inhibits vasopressin, but it also inhibits a chemical called**

**glutamine**, **one of the body's natural stimulants**. When the drinker stops drinking, the body

tries to make up for lost time by producing more glutamine than it needs.

The increase in glutamine levels **stimulates the** [**brain**](http://health.howstuffworks.com/brain.htm) **while the drinker is trying to sleep**, keeping

them from reaching the deepest, most healing levels of slumber.

This is a large contributor to the fatigue felt with a hangover.

Severe glutamine rebound during a hangover also may be responsible for tremors, [anxiety](http://healthguide.howstuffworks.com/stress-and-anxiety-dictionary.htm), restlessness,

and increased blood pressure. <http://health.howstuffworks.com/hangover5.htm>



All The Important Points

F) Hangover Causation 4: The Negative Effects of the Presence of Congeners (Latin: *born together*)

**Causation:**

**\_\_disabling vasopressin**

**\_\_\_making toxins**

**\_\_\_regaining glutamine**

**\_\_\_congeners**

Congeners are chemicals *produced along with alcohol*, during fermentation, and maturation (aging).

Generally, darker colored liquors and wines have high concentrations. Such alcoholic drinks include;

whiskey, dark rum, red wines.

Congeners include various esters (recall your lab work), acids (lab work), aldehydes and higher

alcohols.

Strictly speaking they are impurities, but they give many of the darker colored liquors their flavor(s).

Their presence in the final spirit must be carefully judged; too many would make it undrinkable.

Their presence appears to enhance the effects of a hangover. <http://www.whiskymag.com/words/congeners.html>

Interestingly, according to *Alcoholism Clinical and Experimental Research*, congeners may have an

upside. They may help limit the amount of bleeding which occurs in the stomach when whiskey is

drunk.

Citation: Protective Effects of the Whisky Congeners on Ethanol-Induced Gastric Mucosal Damage ([Volume 31 Issue 3](http://www3.interscience.wiley.com/journal/118520167/issue), Pages 390 – 394

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All The Important Points

**An important side note** …. but not related directly to the hangover (yet possibly still pertinent …)

The Nausea Factor… A.K.A: **Worshipping At the Porcelain Idol**

Because alcohol is absorbed directly through the stomach, the [cells](http://science.howstuffworks.com/cell.htm) along the inside walls of the

stomach, the stomach lining can become irritated (inflamed). Alcohol also promotes secretion of

hydrochloric acid in the stomach, eventually causing the nerves to send a message to the brain that the

stomach's contents are hurting the body and must be expelled through [vomiting](http://healthguide.howstuffworks.com/nausea-and-vomiting-dictionary.htm) (reverse peristalsis).

This mechanism can actually lessen hangover symptoms in the long run because vomiting gets

rid of the alcohol in the stomach and reduces the number of toxins with which the body has to deal.

The stomach's irritation may also be a factor in some of the other unpleasant consequences of

excessive drinking of alcohol, such as diarrhea and lack of appetite. <http://health.howstuffworks.com/hangover5.htm>

The Breathalyzer <http://science.howstuffworks.com/breathalyzer3.htm>

There are three major types of breath alcohol testing devices, and they're based on different principles:

* **Breathalyzer** - Uses a chemical reaction involving alcohol that produces a color change
* **Intoxilyzer** - Detects alcohol by infrared (IR) spectroscopy
* **Alcosensor III or IV** - Detects a chemical reaction of alcohol in a fuel cell

Regardless of the type, each device has a **mouthpiece**, a tube through which the suspect blows air, and a **sample chamber** where the air goes. The rest of the device varies with the type.

The **Breathalyzer** device contains:

* A system to sample the breath of the suspect
* Two glass vials containing the chemical reaction mixture
* A system of photocells connected to a meter to measure the color change associated with the chemical reaction

|  |
| --- |
| breathalyzer-formula |

To measure alcohol, a suspect breathes into the device. The breath sample is bubbled in one vial through a mixture of sulfuric acid, potassium dichromate, silver nitrate and water. The principle of the measurement is based on the following chemical reaction:

In this reaction:

1. The **sulfuric acid removes the alcohol from the air** into a liquid solution.
2. The **alcohol reacts with potassium dichromate** to produce:
   1. chromium sulfate
   2. potassium sulfate
   3. acetic acid
   4. water

The silver nitrate is a **catalyst**, a substance that makes a reaction go faster without participating in it. The sulfuric acid, in addition to removing the alcohol from the air, also might provide the acidic condition needed for this reaction.

During this reaction, the reddish-orange dichromate ion **changes color** to the green chromium ion when it reacts with the alcohol; the degree of the color change is directly related to the level of alcohol in the expelled air.

To determine the amount of alcohol in that air, the reacted mixture is compared to a vial of unreacted mixture in the **photocell system**, which produces an **electric current** that causes the needle in the meter to move from its resting place.

The operator then rotates a knob to bring the needle back to the resting place and reads the level of alcohol from the knob -- the more the operator must turn the knob to return it to rest, the greater the level of alcohol.