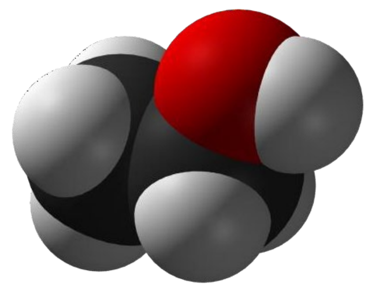
STUDY OF ALCOHOL

Objectives:

- After completing this lesson, the Officer will understand the alcohol molecule and its relationship to breath testing.
- After completion of the lesson the Officer will understand the effects, alcohol has on the human physiology including absorption and elimination.
- At the conclusion of this lesson the Officer will understand how alcohol consumption effects learned motor skills such as driving a vehicle.

Throughout this chapter you will gain a better understanding of the effects of alcohol on the human body and the effect alcohol consumption has on learned motor skills such as driving a car.

In the scientific community a drug is defined as "any substance, other than food, that by its chemical or physical nature alters structure or function in the living organism”. Drug is also defined in law enforcement as, “ any substance, that when taken into the human body, can impair the ability of the person to operate a vehicle safely.”



Ethanol molecule

Alcohol is one of the first drugs developed. Every society that has been studied has used alcoholic beverages. When the Pyramids in Egypt were opened, urns, which held beer, were found. The American Indians used a fermented beverage for feasts and ceremonies.

The effect of a drug or chemical is directly related to its concentration at that site in the body where it has the effect. Within limits, the higher the concentration, the greater the effect. Such sites may be in an organ, muscle, gland, nerve, or vessel. The effect of a drug may last as long as it is present in the critical site. All drugs are poisons and can cause death, if their concentrations are high enough, by making a body part or parts inactive.

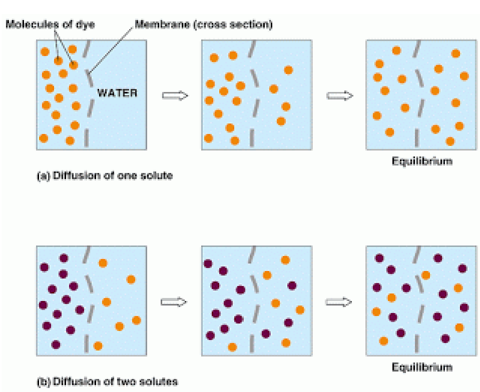
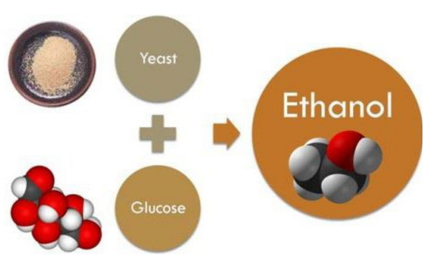


Fig 2. Diffusion from a high concentration to low concentration until equalized.

Now consider the implications of this as it applies to alcohol in the human body. Since alcohol is a small, water-soluble molecule, it can penetrate many body membranes by simply diffusing through them. (fig 2) In such cases, diffusion will continue until the alcohol concentration is the same on either side of the membrane. The rate of diffusion depends, in part, on the relative concentration of alcohol on either side of the membrane. The greater the difference the more rapid the diffusion. In other words, if the alcohol concentration is lower in the brain than in the arteries supplying the brain with blood, the alcohol in the blood will diffuse rapidly. The concentrations are constantly adjusting to accommodate absorption and elimination to maintain the equilibrium. The alcohol will spread throughout the body and will not stay localized. The effects on the different body parts will be different and more acute on some organs than others. There are two classifications of alcohol. The first is produced naturally through the process of fermentation.

The second is synthetically produced from refining petroleum. Alcohol synthetically produced is not sold for human consumption, so it is not taxed by the federal government. These products are usually denatured (poisoned) to discourage the consumption of this type of alcohol. Consuming denatured alcohol can be very unpleasant and possibly lethal.

All alcohol intended for human consumption must be naturally produced. Natural production of alcohol always begins with the process of fermentation (fig 3). Fermentation is the only process by which beer and wine are produced and it is the first step in the production of distilled spirits. In the manufacture of wine and beer the process produces a product with only about fifteen percent alcohol content. At that level of concentration, the yeast dies and fermentation ceases.



$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$$

Fig 3. Fermentation process

To produce a higher alcohol content, the fermented mixture must be distilled. Distillation is a process in which the solution containing alcohol is heated and the vapors collected and condensed into liquid form again (fig. 4). Since alcohol has a lower boiling point than water there is a higher percentage of alcohol in the distillate (the condensed liquid) than there was in the original solution. This distillate formed from the cooled vapors contains the alcohol plus some water and flavorings from the fermented mash. Throughout the process, it is essential that precautions be taken to insure that ethanol is the only alcohol collected. After the distillate is collected, it is commonly placed in charred wooden barrels for aging.

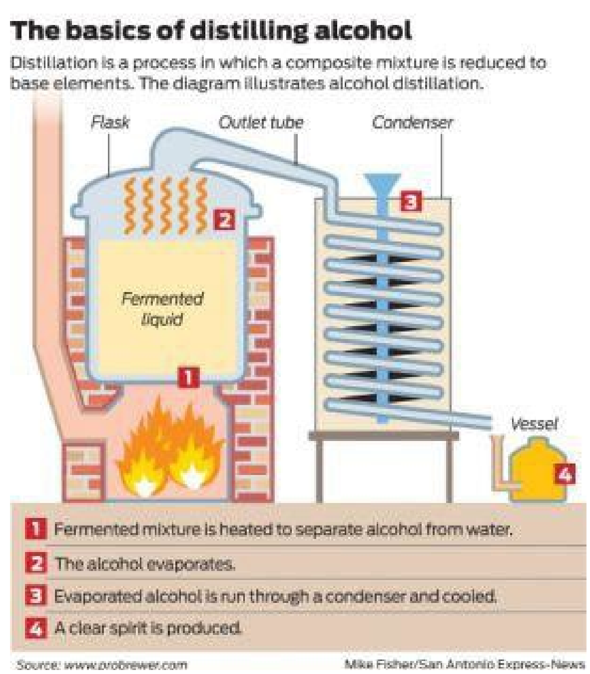


Fig 4. Distillation process

During the aging process certain chemicals are extracted from the wood and dissolved in the distillate. It is these chemicals, called congeners, which give aged, distilled spirits (whiskey, scotch, or rum) their distinctive color, aroma, and taste.

They do not contribute to the effects of an alcoholic beverage on the human body. They are added to disguise the taste of the ethanol and make the beverage more attractive. Colorless distilled spirits (vodka and gin) are not aged and consequently have only a faint odor in comparison to aged spirits. Distilled spirits usually contain from 40 to 50% ethanol by volume.

In the U.S., the proof number of a beverage represents twice the percent of alcohol by volume (for example, a 100-proof beverage contains fifty percent alcohol by volume). The proof system started in the old days. The saloonkeepers used to have to "prove “that they hadn't watered their kegs of "spirits"". It was found that whiskey poured over gun powder would burn if it was 50% alcohol. So, a beverage which was 50% alcohol was referred to as 100-proof.

There are four generally recognized groups of alcohol: (Table 1)

(a) Methanol - paint removers, fuels, solvents. This is the most toxic for humans, if consumed. It only takes about 75ml to cause death.

(b) Ethanol - beverage, medicines. Still toxic but is produced for human consumption. Toxicity level is approximately 400 to 500 ml.

(c) Isopropanol - antiseptic. The toxicity level is approximately 250ml, about twice as toxic as ethanol.

(d) Ethylene Glycol - coolant, solvent. Toxicity level is approximately 100ml, almost five times as toxic as ethanol, and almost as toxic as methanol.

Let us compare some different beverages:

1 beer (5%) = .60 fl. oz ethanol
1 oz whiskey 100 proof = .50 fl. oz.
5 oz. serving of wine (12%) = .60 fl. oz.
1 oz. 86 proof liquor = .43 fl. oz.
1½ oz. 86 proof liquor = .65 fl. oz.

For the purposes of discussion, one drink will be one 12 fluid ounce serving of beer, 5 oz. of wine, or 1 fluid ounce serving of 100 proof distilled spirits. A "drink" contains approximately one-half fluid ounce of pure ethanol.

Alcohol requires no digestion. That means when you drink alcohol, the alcohol molecule is absorbed unchanged. There are three ways alcohol can enter the human body: injection, inhalation, and ingestion. In laboratory experiments at Indiana University, it was shown that you cannot absorb enough alcohol through the skin to have a measurable blood alcohol content. (Men put on hip high waders and filled them with alcohol and wore them for several hours. No one absorbed alcohol, but it did make their legs wrinkled!) Alcohol can be directly injected into the body, but it is extremely dangerous. This produces a phenomenon referred to as the "bolus effect", a localized concentration of alcohol that can severely affect the heart and other vital organs.

COMMON ALCOHOLS

NAME	FORMULA	BOILING POINT	USES	TOXICITY AND METABOLITES
METHANOL (Methyl Alcohol Wood Alcohol)	CH_3OH	64.5EC	Denaturant Solvent Paint Remover Fuel	Approx. 75 ml. Formic Acid
ETHANOL (Ethyl Alcohol Grain Alcohol)	CH_3CH_2OH	78.3EC	Beverage Solvent Medicinal Vehicle Fuel	Approx. 400-500 ml Acetaldehyde (Acetic Acid)
ISOPROPANOL (Isopropyl Alcohol Rubbing alcohol)	$CH_3CH\text{-}OH$ CH_3	82.3EC	Denaturant Antiseptic	Approx. 250 ml Acetone
ETHYLENE GLYCOL (Antifreeze)	$CH_2\text{-}OH$ $CH_2\text{-}OH$	198EC	Coolant Solvent	Approx. 100ml Oxalic Acid

Table 1

For our purposes, a drink is a "normal dose". If we are talking about beer, one 12-ounce beer is a "drink". In Oklahoma, one 12-ounce beer contains .48 ounces pure ethanol. In beer that is "5 point (5%)", the contents are almost .60 fluid ounces ethanol. Wine is usually around 12% ethanol by volume, so a 5 fluid ounce serving of wine is around .50 fluid ounces of pure ethanol; therefore, all would have approximately the same effect on raising a person's blood alcohol concentration.

Another possible way for alcohol to enter the body is through inhalation. But in experiments that have been done, it has been shown that to inhale a measurable amount of alcohol, a person would have to inhale 5 to 8 gallons of air per minute – they would have to hyperventilate. If you can hyperventilate in a room saturated with alcohol for 6 hours, you could get drunk. But if the room has that much alcohol in the air your throat, eyes, and lungs would be irritated so fast and so badly that you would not be able to breath, much less hyperventilate for that long.

The mouth is the usual entrance for alcohol to enter the body and drinking is the usual method. Alcohol is absorbed into the bloodstream through the mucous lining of the entire gastrointestinal tract: the mouth, esophagus, stomach, and small intestine. The alcohol is not digested, but is absorbed in its raw state, virtually unchanged raw state. Immediately when you take a drink, absorption begins, into the mucous membranes of the mouth, through the esophagus to the stomach. The stomach is a tough pouch, so the most rapid absorption takes place in the first twelve inches of the small intestine, which is the duodenum. You cannot stop the absorption, but you can slow it down by eating food. You must, however, eat BEFORE you drink. Eating afterwards will not delay the absorption, nor will it sober you up faster. The food holds the alcohol in the stomach longer, so the alcohol is not released into the small intestine as fast. Your blood alcohol concentration rises more slowly and generally does not peak as high as if you drank on an empty stomach.

Some other factors which may affect the rate of absorption are the amount of alcohol consumed; the time spent drinking; the type of alcoholic beverage; whether the drink has carbonation (carbonation tends to promote absorption while fatty or oily beverages tend to slow down absorption); higher altitudes (tend to promote faster absorption). If too much alcohol is consumed too rapidly the stomach may become irritated and not release the contents, thereby slowing down the absorption. Some drugs, such as stimulants, will delay absorption while other depressants, besides alcohol, will speed up or enhance the absorption.

Once the alcohol has been absorbed into the blood, it is transported throughout the entire body. When alcohol is absorbed into the bloodstream, it is transported to and passes through the liver, where most (up to 90%) is oxidized. From the liver the alcohol next passes with the blood to the right side of the heart. The alcohol saturated blood then travels to the lungs and returns to the left side of the heart. When the alcohol saturated blood leaves the heart, it is distributed throughout the entire body. The blood leaving the heart reaches the brain tissue directly through the carotid arteries. Organs such as the brain, liver, and kidneys, which have a large blood supply, initially receive a considerable amount of the circulating blood containing alcohol. When absorption and distribution are complete, alcohol is distributed in areas of the body in proportion to their fluid/water content. Since the brain, liver and kidneys contain more water than any other organs, they receive the most alcohol. Since the liver is the only organ capable of breaking the alcohol down, or oxidizing it, the alcohol is retained there and causes more damage than to the other organs. Consider this question: If you absorb alcohol in proportion to the water content in your body what would be the difference in the way alcohol is absorbed by men and women?

Women's bodies have a higher percentage of fat for childbearing purposes. (If a woman's body does not have a certain percentage of fat, she will not be able to get pregnant.) Men's bodies are composed of more muscle tissue. Muscle contains more water than fat. So, if you have a man and woman who each weigh 100 pounds, who will reach a 0.10% blood alcohol concentration sooner, assuming they drink the same amount? The man would be approximately 68% (68 pounds) water, the woman 55% (55 pounds). So, if they are matching drink for drink, the alcohol is more diluted by the water content of the man's body, and he will be able to drink more alcohol before reaching a 0.10% BAC; therefore, the female will reach a 0.10% BAC faster because the alcohol is not as diluted by the bodies water content.

The body begins to eliminate alcohol almost as soon as it is absorbed. After a drink has been swallowed the alcohol can be detected on the forearm within 70 seconds. The presence of alcohol persists in the mouth for about fifteen minutes. Absorption continues as the beverage passes into the stomach and later into the small intestine. Since the alcohol absorbed through the mucous membranes lining the mouth is rapidly distributed to the surrounding tissue, the presence of alcohol can still be detected even after the alcoholic beverage has been swallowed. Residual mouth alcohol is the alcohol that remains in the mouth and can affect a breath alcohol test. Alcohol can be reintroduced back into the oral cavity under certain conditions. If alcohol is present in the stomach, and if some of the alcohol is regurgitated back into the mouth, then a portion of that alcohol would be absorbed by the mucous membranes lining the oral cavity. Regardless of how the alcohol is introduced into the mouth, the presence of residual alcohol diminishes below significant levels within fifteen minutes. If the observation period is interrupted for any reason the operator should restart the entire observation period. The rate of absorption varies slightly from person to person and even differs at times for the same person. Alcohol begins to pass into the bloodstream within one or two minutes after consumption.

Most alcohol is absorbed within fifteen minutes and nearly ninety percent is distributed throughout the bloodstream within one hour. By the time a drink gets to the large intestine all the alcohol has been absorbed. As a rule, complete absorption of a single alcoholic beverage is usually accomplished in from forty-five minutes to an hour if the individual was drinking on an empty stomach. But since people metabolize alcohol at different rates, it can take 90 minutes to 3 hours to be fully metabolized. A healthy liver can oxidize approximately .015% per hour -approximately one-half to two-thirds of an ounce. Although alcohol is absorbed rapidly, the body will metabolize alcohol at a slow fixed rate.

To understand how the Intoxilyzer test works, we must first understand how blood moves around the body. In the human circulatory system (Fig 5), arteries carry blood away from the heart and veins carry blood back to the heart. When a person drinks an alcoholic beverage, the alcohol first passes through the mouth, then moves down the esophagus, and finally enters the stomach. There, up to 20% of the alcohol is absorbed through the stomach walls into the portal vein of the circulatory system. The remaining alcohol stays in the stomach until the pyloric valve opens and allows the contents of the stomach to pass into the small intestine, where most of the remaining alcohol is absorbed into the bloodstream. Once in the blood, the alcohol is carried to the liver, where oxidation reactions begin to remove it from the bloodstream (the elimination process discussed earlier). From the liver, the blood moves toward the right side (right atrium or auricle) of the heart and is forced into the lower right chamber (right ventricle). At this point the blood contains large amounts of carbon dioxide but very little oxygen. The pumping of the heart sends the blood through the pulmonary artery to the lungs.

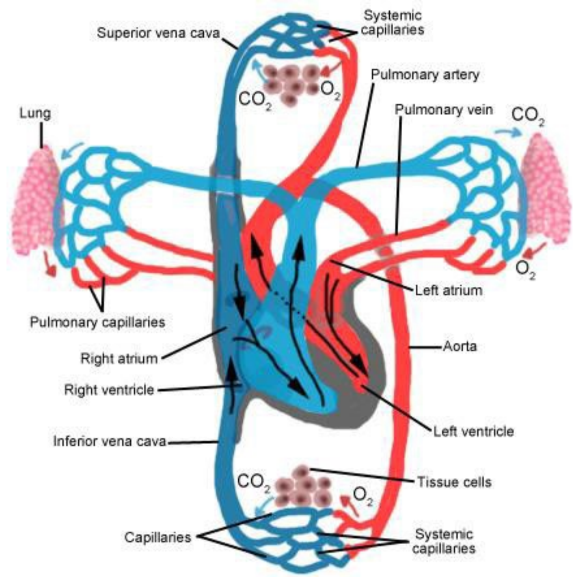


Fig 5. Cardiovascular system to lungs

In the lungs, the pulmonary artery branches into numerous small capillaries (Fig 6). These tiny blood vessels pass close by myriad (about 250 million!) pear-shaped sacs called alveolus bronchioles (commonly called alveoli) that are located at the ends of the bronchial tubes. The bronchial tubes are connected to the trachea, which in turn leads to the mouth and nose. In the alveoli, blood flowing through the capillaries comes in contact with oxygen in the air. A rapid exchange occurs in which air enters the alveoli and carbon dioxide exits the blood (Fig 7). If any volatile chemical is present in the blood (such as alcohol), it will pass into the alveoli during this exchange process as well. Thus, as the person who has consumed

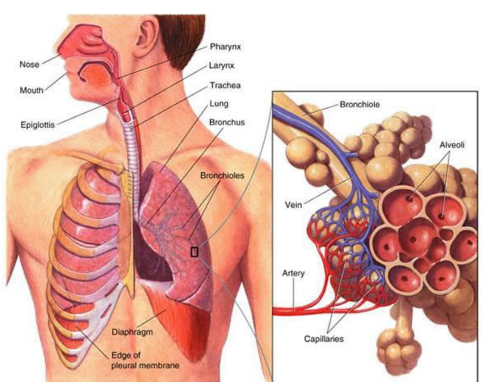


Fig 6. Bronchial tubes and alveoli

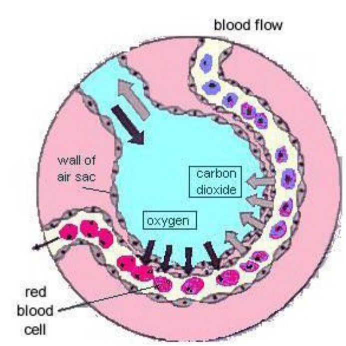


Fig 7. Diffusion of Oxygen and CO2

alcohol breathes, the carbon dioxide and alcohol are expelled through the nose and mouth, the alveoli are replenished with fresh air, and the blood becomes enriched with oxygen thanks to this new supply

The distribution of alcohol between the blood and the air in the alveoli can be determined by applying Henry's law: When a volatile chemical (alcohol) is dissolved in a liquid (blood) that is in contact with air (alveoli air), the volatile chemical is always present in a fixed concentration in the air at a given temperature. The normal temperature of expired air is 93 ° Fahrenheit (34° C). At this temperature, the ratio of alcohol in the blood to alcohol in alveoli air is approximately 2100 to 1. In other words, 1 mL of blood will contain the same amount of alcohol as 2100 mL of expired breath. Thus, the Intoxilyzer can compute the ratio to determine a person's BrAC based on the concentration of alcohol in his or her expired breath. [19]

There is nothing a person can do to speed up the metabolism process. Time is the only thing that rids the body of alcohol. Caffeine will not counteract the effects nor will a cold shower. Exercise will not speed up the metabolism enough to burn the alcohol off any faster.

Only time sobers an intoxicated person. It takes the average person's liver about an hour and a half to eliminate all the alcohol in a typical can of beer, glass of wine, or mixed drink. Consider that the average person burns off 0.015% per hour.

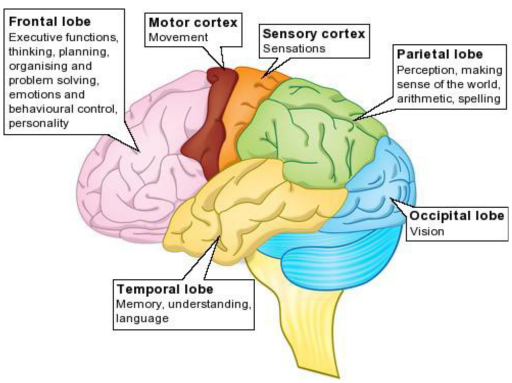
Alcohol is removed or eliminated from the body in several ways: metabolism, excretion, and evaporation. Metabolic processes account for the elimination of most of the alcohol consumed. As the alcohol is transported through the body with the blood it passes again and again through the liver. During each pass through the liver, a portion of the alcohol is metabolized by the enzyme Alcohol Dehydrogenase (ADH). The alcohol is oxidized to simpler compounds such as acetaldehyde and acetic acid. The acetic acid can then be broken down by another process into carbon dioxide and water. The carbon dioxide and water are eventually formed into urea and excreted through the kidneys. The rate at which alcohol is oxidized is constant for a particular individual but varies somewhat from one person to another. Reported rates for alcohol oxidation usually range from 0.010 to 0.03 per hour. Higher rates of oxidation have been reported but are usually associated with chronic consumption of large quantities of alcohol.

When a person consumes alcohol faster than the body eliminates alcohol (approximately 0.015 BAC per hour) alcohol concentrations in the blood increase to the point at which the individual becomes intoxicated.

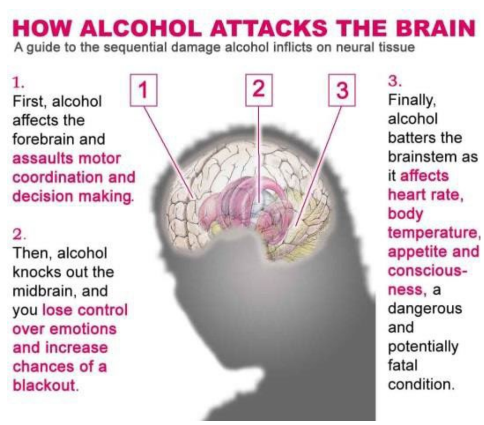
Intoxication refers to the loss of normal physical or mental faculties. Intoxication is based upon measurable changes in an individual's performance of specific task, such as operating a motor vehicle. The term "intoxication" should be separated from the more common term "drunk". The term drunk is used as a descriptive word denoting a particular type of observed behavior.

A tremendous amount of research has been performed to identify the progressive levels of intoxication, induced by alcohol, with regard to impairment in the operation of a motor vehicle. This information does not apply - legally - to either public intoxication or the operation of boats, planes, or trains.

Alcohol is a central nervous system (CNS) depressant. It is a nerve poison. The major activity of alcohol is to numb, depress, and finally, paralyze nerve activity. It directly affects the brain. It is not the alcohol concentration in the arms, legs, or other body parts that impairs a person's coordination but the alcohol concentration in the brain tissue. The alcohol acts to depress nerve transmission and to reduce coordination between various nerve centers. Depressing the nerve transmission results in the reduction of normal physical and mental faculties.



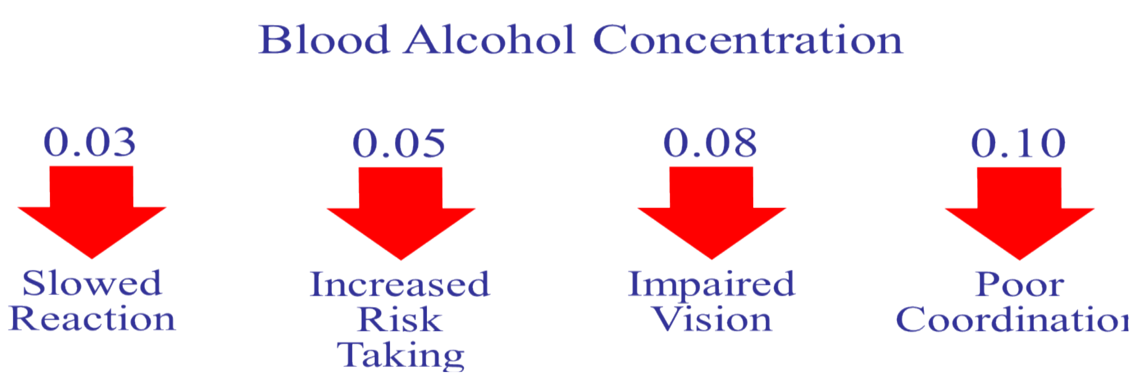
The brain is comprised of three main parts, the brain stem, the cerebellum, and the cerebrum. Imagine the brain as an onion. Each layer controls different functions of the body. The brain stem (the center) is the first part to develop, and it controls vital functions such as breathing, heart rate, blood flow, and so on. The next layer is the cerebellum which is located above the brain stem and controls large motor functions. Finally, the most complex portion of the brain, the outer layer, is the cerebrum that controls complex mental processes and skills. Since alcohol diffuses uniformly to all tissue, the alcohol concentration will also be a reflection of brain alcohol levels. As alcohol is ingested, the first drink immediately begins to affect the brain and its functions. The first functions affected are the higher powers: speech, memory, judgment, attention, and other complex mental operations. It is at this point that an individual is often observed to begin to lose his or her inhibitions. As more alcohol is consumed and the alcohol concentration continues to rise, the cerebellum is next affected, causing loss of coordination and physical movement skills. If an individual continues to consume alcohol, a point will be reached where the brain stem functions are affected, causing coma and finally death.



Courtesy of NIAAA

Research indicates that the impairment of brain functions such as those involved in perception, information processing, cognition and performance of tasks requiring divided attention occurs relatively quickly and at low alcohol dose levels. Furthermore, many findings suggest that such impairment is not caused by the direct effect on sensory receptor systems but is an indirect result of alcohol impairment of the central nervous system. It appears that impairment of brain function is more damaging to skilled performance than to gross movements or physical strength. The first things learned in life are the last things forgotten when under the influence of alcohol. The flip side of that is the last things learned are the first things forgotten. A person who would test at a 0.20 BrAC could probably remember their alphabet, but not be able to drive competently. The single fundamental fact regarding alcohol consumption is that increasing the alcohol concentration in the body results in increasing impairment of the normal physical and/or mental faculties. Research has demonstrated that between 0.00% and 0.04% alcohol concentration, most individuals do not demonstrate significant measurable impairment. There could be some impairment of a person's ability to see moving objects and his or her reaction time is beginning to be affected. Changes in personality and mental states are sometimes observed and some persons do show impairment even at this low level of alcohol concentration. When the alcohol concentration increases to between 0.05% and 0.08% most individuals demonstrate some degree of measurable impairment.

Judgment is the first area noticeably affected. Judgment is a general name given to various decision-making aspects of human behavior. Such topics as social inhibitions, self-evaluation, risk assessment, and perception of reality are all included under judgment. The ability to see clearly is affected. The ability to focus is impaired at 0.06%.



The ability to see in dim light is affected at 0.08% alcohol concentration. By the time a person reaches 0.10% BAC, the ability to see clearly is impaired and glare blindness has developed. The American Medical Association recommends that 0.05% BAC be established as per se evidence of alcohol-impaired driving. Behavioral changes are sometimes observed and there is a loss of social inhibitions. Fine muscular coordination is affected, and complex reaction time is lengthened. Complex reaction is the time required for a person to perform two tasks almost simultaneously. Above 0.08% alcohol concentration, current research has shown that all persons are impaired with regards to the operation of a motor vehicle. Increasing the alcohol concentration above 0.08% results in further impairment of normal physical and mental faculties. Alcohol does not cause people to perform an act which they fundamentally oppose. But if fear is the only thing keeping them from committing an act, the alcohol consumption will take away the fear and it is more likely they will commit an act they would not commit when sober. The ethics of robbing a bank are not changed by being drunk.

JUST FYI (For your information)

Who is most at risk?

Young people:

- At all levels of blood alcohol concentration (BAC), the risk of being involved in a crash is greater for young people than for older people.[6]
- Among drivers with BAC levels of 0.08 % or higher involved in fatal crashes in 2012, one out of every 3 were between 21 and 24 years of age (32%). The next two largest groups were ages 25 to 34 (27%) and 35 to 44 (24%).[1]

Motorcyclists:

- Among motorcyclists killed in fatal crashes in 2012, 29% had BACs of 0.08% or greater.[1]
- Nearly half of the alcohol-impaired motorcyclists killed each year are age 40 or older, and motorcyclists ages 40-44 have the highest percentage of deaths with BACs of 0.08% or greater (44%).[7]

Drivers with prior driving while impaired (DWI) convictions:

- Drivers with a BAC of 0.08% or higher involved in fatal crashes were seven times more likely to have a prior conviction for DWI than were drivers with no alcohol in their system? (7% and 1%, respectively).[1]

As the alcohol concentration continues to rise, it presents a threat to life. Persons with an alcohol concentration of 0.30% or greater should be carefully observed and consideration given to seeking medical assistance. This level of alcohol concentration may cause respiratory depression (the body's involuntary reactions are depressed, breathing stops). An individual with an alcohol concentration of 0.40% or greater may lapse into a coma. This level of alcohol could result in death, although persons receiving medical attention have survived higher levels. Generally, persons with extremely high BAC's are chronic alcoholics. The high in Oklahoma that we know of is 0.62% BAC. The highest recorded internationally is a 1.0% in Japan.

Alcohol will irritate mucous tissue. A drink of straight whiskey will cause many people to throw up for this reason. Novice or intemperate drinkers may drink quickly ("chugging" contests, etc.) and rapidly reach a BAC of 0.12% and activate the vomit center in the brain. If they continue drinking without letup, they can easily reach a BAC of 0.20%. A BAC in the range of 0.20% or higher may inactivate the vomit center and it will not react to increasing concentrations of alcohol. In such an individual, a fatal amount of alcohol can be ingested before coma ensues and when sufficient alcohol has been absorbed, death from respiratory depression will follow. In other words, a person may drink too much, too fast. They may throw up, and then drink again before their BAC peaks. They may pass out, their BAC is still rising, and they are already unconscious. They may throw up while they are passed out and drown in their own vomit or they may just go into respiratory depression or respiratory failure while they are passed out. If you drink too much too fast your body cannot metabolize the alcohol fast enough. Your alcohol concentration will continue to rise whether you are conscious or not.

The least understood phenomenon of alcohol consumption is tolerance. Tolerance is usually defined as "the effect that results from the chronic use of drug when a larger dose becomes necessary to achieve the desired effect". However, in discussing alcohol tolerance, it is more convenient to reverse this definition and consider tolerance as the effect where the expected changes in behavior or impairment in performance of specific task are not observed. There are two general types of tolerance: natural tolerance and learned tolerance.

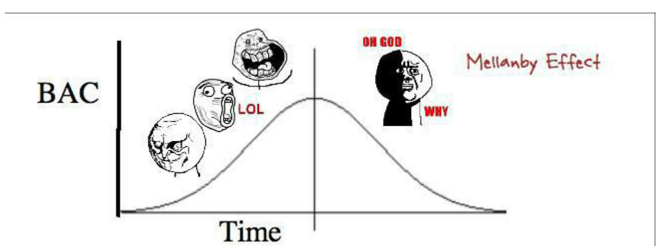
Natural tolerance consists of three areas: inborn tolerance, physical tolerance, and stress tolerance. Certain individuals demonstrate a natural inborn tolerance to low levels of alcohol concentration. These persons can perform a specific task as well and sometimes slightly better with a low level of alcohol compared to their performance when alcohol free. This effect may result from the alcohol lowering these individuals' anxiety in the testing situation. This type of tolerance has only been demonstrated at levels below 0.08% and is most prominent between 0.04% and 0.06% alcohol concentration. One form of natural tolerance is physical tolerance. The effect of a given alcohol concentration will always be greater in persons who are ill as compared to the same persons when healthy. These individuals' normal physical and mental faculties are already affected due to their sickness, and this adds to the effects of the alcohol.

Another form of natural tolerance is stress tolerance. In high stress or anxiety situations adrenalin is released in the human body to stimulate the body's response to the source of stress. In intoxicated individuals this results in those persons appearing less intoxicated than they really are. Stress tolerance is only a temporary effect lasting for a few minutes. Due to the transient nature of this response, it has been difficult to determine whether this effect results in a lessening of the influence of the alcohol on these persons, or if the adrenalin assists in making these individuals aware of their situation resulting in these persons attempting to consciously disguise their intoxication. Regardless of how a person appears, it is important to remember that it is the impairment of the individual's normal mental and physical faculties that are important. An individual may consciously or unconsciously attempt to disguise his intoxication but cannot alter the fact that his judgment, reactions, and coordination are impaired.

Learned tolerance consists of three areas: behavioral tolerance, acquired tolerance, and acute tolerance. Behavioral tolerance is a result of the influence of the social setting and the social customs associated with alcohol consumption in a particular situation. An individual will behave differently in different social settings even though the alcohol concentration in that person was the same on both occasions. An individual's mood or sense of well-being will also influence his behavior at a particular alcohol concentration. A person who is depressed and unhappy is usually more depressed and unhappy following the consumption of alcohol. This effect is usually best observed at low levels of alcohol concentration because higher levels may alter the person's perception of reality.

Another type of learned tolerance is acquired tolerance. Acquired tolerance results from the chronic use of alcohol. A chronic user of alcohol is accustomed to the effects of alcohol and any attempt to compensate for these effects. These persons attempt to alter their behavior in order that they do not appear intoxicated. Tests demonstrate that these persons are indeed impaired in judgment, reaction, and coordination, but have learned through experience to disguise their outward appearance of intoxication. A novice drinker (one who has not experienced the effects of alcohol) will demonstrate greater outward effects than those expected at a given alcohol concentration. This is due to the absence of an acquired tolerance.

The last type of learned tolerance is acute tolerance. This is sometimes referred to as the Mellanby Effect. Acute tolerance is the result of an individual comparing his own assessment of his present condition with his past condition. During the absorption phase of the alcohol concentration curve, the individual compares his perceived state with his condition when alcohol free. His perception has been altered so that the effects of the alcohol are overestimated. Later, during the elimination phase, the same individual compares his



The Mallanby Effect explains how an individual appears clinically more inebriated while getting drunk than at the same blood alcohol concentration while sobering up.

present perceived state with the peak phase of the alcohol concentration curve. His perception has been altered such that the effects of the alcohol are underestimated. In both instances, the alcohol concentration was equal and the person equally impaired.

Because of the various aspects of alcohol tolerance, judging an individual's level of intoxication can be very difficult when based solely on visual observation. The person's actions could have been caused by drugs, injury, or illness. Most people have not been closely associated with intoxicated individuals under circumstances, which would allow objective evaluation. One person's judgment of another's intoxication is often influenced by their interpersonal relationships and social prestige. Most well dressed, wealthy drunks are subjectively judged to be less impaired than someone who is not particularly clean or has on ratty clothes. The best method for determining intoxication is to analyze a suitable specimen to determine the alcohol concentration in that individual.

STAGES OF ACUTE ALCOHOLIC INFLUENCE/INTOXICATION

Blood Alcohol Concentration grams/100ml	Stage of Alcoholic Influence	Clinical signs/symptoms
0.01-0.05	Subclinical	No apparent influence Behavior nearly normal by ordinary observation Slight changes detectable by special tests
0.03-0.12	Euphoria	Diminution of attention, judgment and control Beginning sensory-motor impairment Slowed information processing Loss of efficiency in finer performance tests
0.09-0.25	Excitement	Emotional instability: loss of critical judgment Impairment of perception, memory and comprehension Decreased sensory response; increased reaction time Reduced visual acuity, peripheral vision, and glare recovery Sensory-motor incoordination; impaired balance Drowsiness
0.18-0.30	Confusion	Disorientation, mental confusion; dizziness Exaggerated emotional states (fear, rage, sorrow, etc.) Disturbances of vision (diplopia, etc.) and of perception of color, form, motion, dimensions Increased pain threshold Increased muscular incoordination; staggering gait; slurred speech Apathy, lethargy
0.25-0.40	Stupor	General inertia; approaching loss of motor functions Markedly decreased response to stimuli Marked muscular incoordination; inability to stand or walk Vomiting; incontinence of urine and feces Impaired consciousness; sleep or stupor
0.35-0.50	Coma	Complete unconsciousness; coma; anesthesia Depressed or abolished reflexes Subnormal temperature Incontinence of urine and feces Impairment of circulation and respiration Possible death
0.45	Death	Death from respiratory arrest

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