1 Hour and 30 Minutes

SESSION VIII

ALCOHOL AS A DRUG

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Upon successfully completing this session the student will be able to:

- Describe a brief history of alcohol.
- Identify common types of alcohols.
- Describe the physiologic processes of absorption, distribution and elimination of alcohol in the human body.
- Describe does response relationships that impact alcohol's impairing effects.

CONTENT SEGMENTS

A. A Brief Overview of Alcohol

B. Physiological Processes

C. Symptomatology of Alcohol

D. Dose-Response Relationships

E. Questions for Review

LEARNING ACTIVITIES

- Instructor-Led Presentations
- Oral Quiz

I. ALCOHOL AS A DRUG

Display Slide VIII-1: Alcohol As A Drug

Display Slide VIII-2: Objectives

Briefly review the objectives, content and activities of this session.

Pose this question to the class: "This is a course on drug impairment recognition. Why do we have a session on alcohol?"

GUIDE the students' responses to bring out these and other appropriate points:

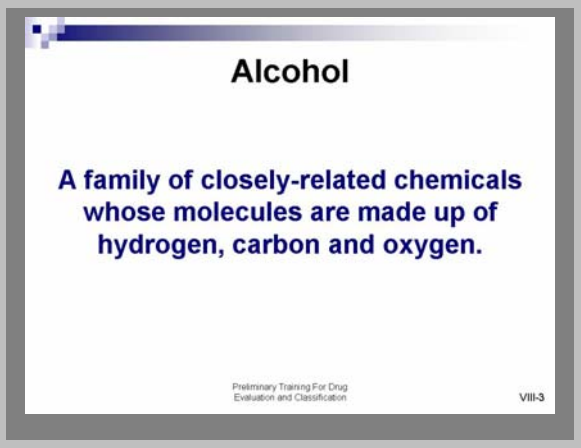
- Alcohol is a drug. In fact, alcohol is the most commonly abused drug.

- As DREs, the students will often encounter persons who are under the combined influence of alcohol and some other drug.

- Point out: By understanding the basic fundamental concepts of how alcohol effects the body, students will gain a better understanding of the concept of how drugs effect the body.

A. A Brief Overview of Alcohol

Display Slide VIII-3: Alcohol



The word "alcohol" refers to a number of distinct but similar chemicals.

- Each of the chemicals that is called an "alcohol" is composed of the three elements: hydrogen, carbon, and oxygen.

- Each of the "alcohols" is a drug within the scope of our definition.

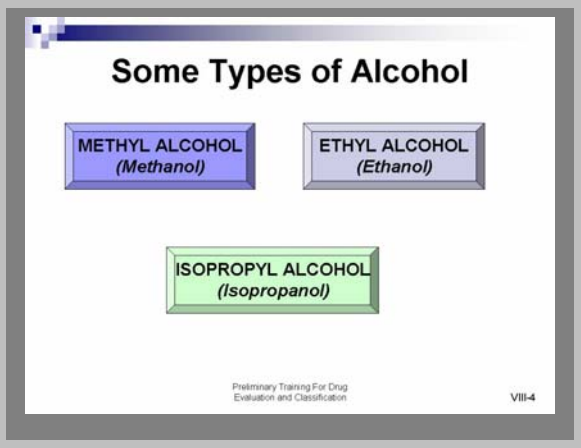
  - Clarification: All of the "alcohols" are chemicals that impair driving ability.

- But only one can be tolerated by the human body in substantial quantities.

  - Clarification: Most "alcohols" are highly toxic and will cause blindness or death if consumed in significant quantities. Only one is intended for human consumption.

Ask students: What are the names of some of the chemicals that are "alcohols"?

Display Slide VIII-4: Some Types of Alcohol



Common Alcohols

Three of the more commonly known "alcohols" are Methyl, Ethyl, and Isopropyl.

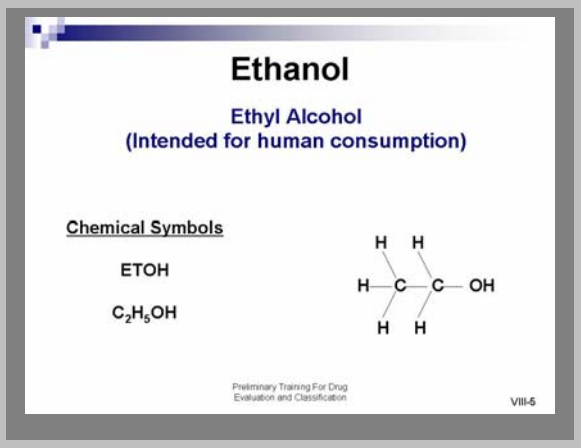
- Methyl Alcohol, also known as Methanol, or "wood alcohol."
- Ethyl Alcohol, also known as Ethanol, or "beverage alcohol."
    - Emphasize: Ethanol is the only kind of alcohol that humans can tolerate in significant quantities.
- Isopropyl Alcohol, also known as Isopropanol, or "rubbing alcohol."

Ethanol Alcohol

Ethanol is the kind of alcohol on which we will focus, because it is the only type intended for human consumption.

- Ethanol is the active ingredient in beer, wine, whiskey, and other alcoholic beverages intended for drinking.
- Like all "alcohols," ethanol is composed of hydrogen, carbon and oxygen.
- Chemists use a number of different symbols to represent ethanol.

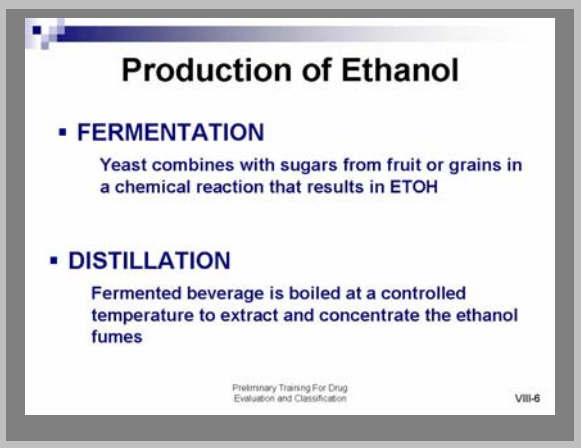
Display Slide VIII-5: Ethanol



- For our purposes, we will use the symbol "ETOH."
    - The "ET" represents "ethyl" and the "OH" represents an oxygen atom and hydrogen atom, bonded together in what the chemists refer to as the "hydroxyl radical." All alcohols have a hydroxyl radical in their molecules.

Ethanol has been around for a long time. People drank it long before they learned to write.

Display Slide VIII-6: Production of Ethanol



Selectively reveal the first part only.

Ethanol is a naturally occurring drug. That is, it is produced through a process called fermentation.

In fermentation, spores of yeast, carried by the wind, come in contact with fruit or grain that has fallen to the ground.

Sugars in the fruit or grain chemically react with yeast, and produce ethanol.

- Point out that humans almost certainly first encountered ethanol that had been produced accidentally in this fashion.

Of course, today we don't sit around waiting for the wind to bring yeast to fallen fruit. Most fermentation takes place on purpose, under controlled conditions.

Through the process of fermentation, we can produce a beverage that has, at most, about 14% ethanol.

Ask students: "Why can't fermentation produce a higher ethanol concentration than 14%?"

- When the ethanol concentration reaches 14%, the yeast die, so fermentation stops.

Reveal the lower part of the visual.

If we want to have higher concentration ethanol beverages, we have to use another step in the production.

Distillation is the process used to produce a higher concentration of ethanol.

In distillation, a fermented beverage is heated to the point where the ethanol begins to boil.

- Point out that ethanol starts to boil at a lower temperature than water.

- The ethanol vapor is collected and allowed to cool until it turns back into a liquid.

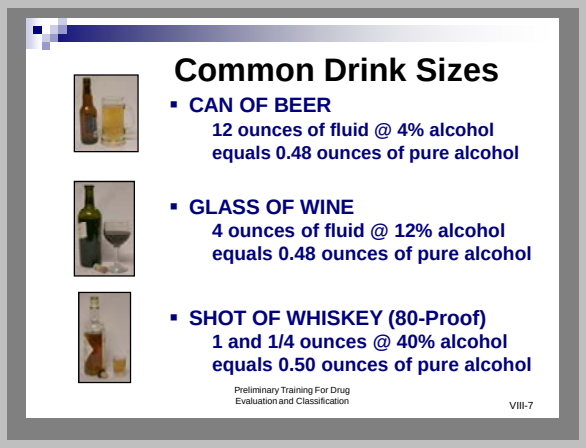
- By repeating the process of heating the liquid and collecting and cooling the vapors, higher and higher concentrations of ethanol can be produced.

- Ethanol beverages that are produced by distillation are called distilled spirits.

Ask students to name some "distilled spirits" (e.g., whiskey, vodka, gin, rum, etc.)

Over the centuries in which people have produced ethanol, some general or common sized servings of different beverages have evolved.

Display Slide VIII-7: Common Drink Sizes



Reveal only the "beer" part.

Beer is usually served in 12-ounce cans or bottles. Since beer averages an ethanol concentration of four percent, a can or bottle contains a bit less than one-half ounce of pure ethanol.

Reveal the "wine" part of the visual.

Four ounces of wine with an alcohol concentration of 12% contains approximately one half ounce of pure alcohol.

Reveal the "whiskey" part of the visual.

Whiskey and other distilled spirits are dispensed in a "shot" glass, which usually contain one and one-quarter ounces of liquid.

Since whiskey usually has an ethanol concentration of 40%, a "shot" of whiskey has exactly one-half ounce of pure ethanol.

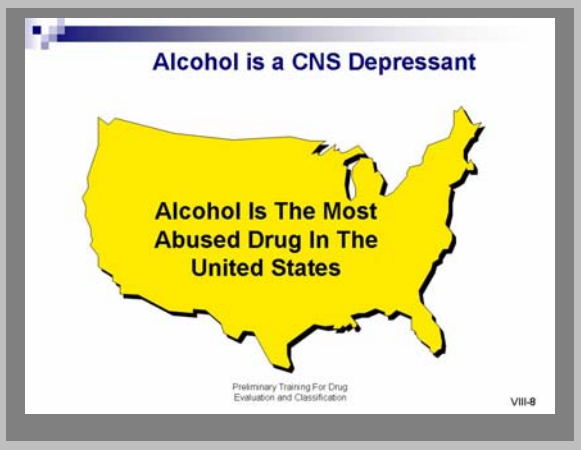
- Point out that the "proof" of a distilled spirit is equal to twice the ethanol concentration.

For all practical purposes, standard sized servings of beer, wine, and whiskey all pack the same "punch."

Solicit students' comments and questions on this overview.

B. Physiologic Processes

Display Slide VIII-8: Alcohol is a CNS Depressant



Alcohol is the most abused drug in the United States.

Ethanol is a Central Nervous System Depressant.

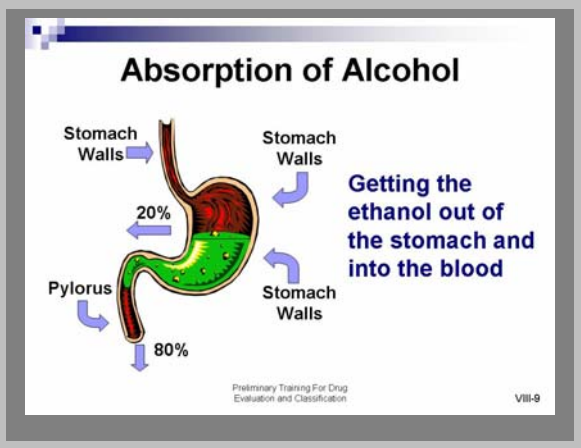
- It doesn't impair until it gets into the brain.
- It can't get into the brain until it first gets into the blood.
- It can't get into the blood until it first gets into the body.
- Point out: This concept is true with all drugs that impair.

There are a number of ways in which alcohol can get into the body.

- It can be injected into a vein via hypodermic needle.
- It can be inhaled, i.e., alcohol fumes can be brought into the lungs, and some molecules will pass into the blood.
- Point out that a person would have to inhale concentrated alcohol fumes for a prolonged period of time in order to develop a significant blood alcohol concentration.
- It could also be inserted as an enema and ingested by quickly passing from the large intestine into the blood.

- But the vast majority of times that alcohol gets into the body, it gets there via drinking.

Display Slide VIII-9: Absorption of Alcohol



Once the alcohol is in the stomach, it will take two routes to get into the blood.

Point to that "route of passage" on visual.

One interesting thing about alcohol is that it is able to pass directly through the stomach walls.

Under normal conditions, about 20% of the alcohol a person drinks gets into the blood by diffusing through the walls of the stomach.

But most of the alcohol usually passes through the base of the stomach into the small intestine, from which it passes quickly into the blood.

Point to that "route of passage" on visual.

Another interesting thing about alcohol is that it does not have to be digested before it can move from the stomach to the small intestine.

- When a person eats food, the food must remain for a time in the stomach.
- Acids and enzymes in the stomach must begin to break down the food to prepare it to pass to the lower portion of the gastrointestinal track.
- While the initial digestive process is underway, a muscle at the base of the stomach will constrict, and shut off the passage to the small intestine.

Point to the pylorus on the visual.

- That muscle is called the pylorus, or pyloric valve.

Since alcohol doesn't have to be digested, the pylorus does not constrict when alcohol enters the stomach.

- If we drink on an empty stomach, the pylorus stays wide open.
- The alcohol will pass immediately through the base of the stomach, into the small intestine, and quickly move into the bloodstream.

Pose this question to the class:

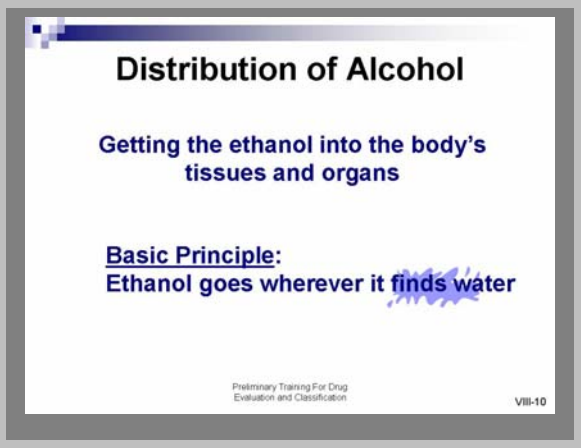
But what will happen if there is food in the stomach when the person drinks alcohol?

- Food will cause the pylorus to constrict.
- While the pylorus is closed, nothing will move from the stomach to the small intestine.
- Any alcohol that is in the stomach will be "trapped" there, along with the food.
- The alcohol will not get into the blood as quickly, and the blood alcohol concentration will not get as high, as if the drinking had been done on an empty stomach.
- While the alcohol is trapped in the stomach, the acids and enzymes will start to react with it and break it down.
- By the time the pylorus opens, some of the alcohol will have been chemically changed, so there will be less available to get into the blood.

Solicit students' comments and questions about the absorption of alcohol into the blood.

Once the alcohol gets into the blood, the blood will carry it to the various tissues and organs of the body.

Display Slide VIII-10: Distribution of Alcohol



Reveal the top part only.

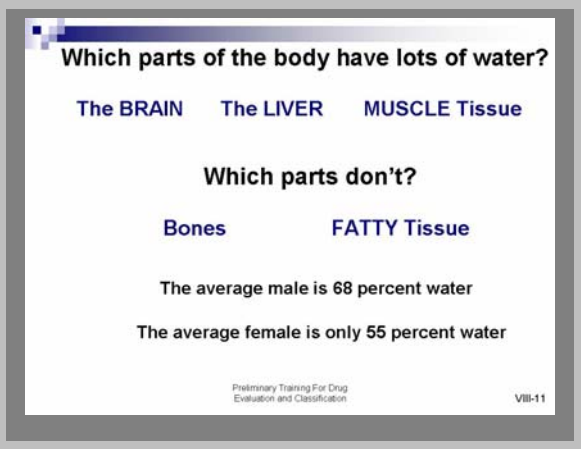
- Alcohol is attracted to water. The blood will deposit the alcohol in all the parts of the body where water is found.
- Parts of the body that have a lot of water will receive a lot of alcohol.
- Parts of the body that have only a little water will receive little alcohol.

Now reveal the lower part of the visual.

Pose this question and solicit responses from students.

Next, display the first part of the visual.

Display Slide VIII-11: Parts of Body with Water



Which parts of the body have a lot of water?

- Brain
- Liver
- Muscle tissue
- Kidney

Pose this question and solicit responses from students.

Next, display the second part of the visual.

Which parts contain very little water?

- Bones
- Fatty tissue

The muscle tissue will receive a relatively high proportion of the alcohol that a person drinks.

Point to "muscle tissue" on visual.

The fatty tissue will receive very little of the alcohol.

Point to that "fatty tissue" on visual.

Here is an interesting and significant difference between men and women: pound-for-pound, the average male has much more water in his body than the average female.

Now reveal the last part of the visual.

Ask students to suggest why this significant difference exists.

- The female body has more fatty tissue than does the male body.
    - Clarification: The female's extra fatty tissue serves as a "shock absorber" and thermal insulator to protect a baby in the womb.
- Pound-for-pound, the average female has more fat and less muscle than does the average male.
- Since fatty tissue has very little water, the average female, pound-for-pound, has less water than the average male.
- This means that the average woman has fewer places in her body in which to deposit the alcohol she drinks.

Ask students: Suppose a woman and a man who weigh the exact same drink exactly the same amount of alcohol under exactly the same conditions. Who will reach the higher BAC?

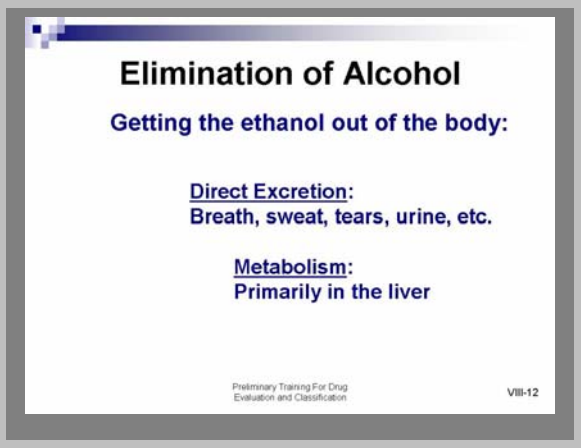
Solicit students' comments and questions about the distribution of alcohol in the body.

The woman's blood alcohol concentration will be higher than the man's because she has less water in which to distribute the alcohol.

As soon as alcohol gets into the body, the body begins working to get rid of it.

Reveal only the top part of the visual.

Display Slide VIII-12: Elimination of Alcohol



- Some alcohol is simply expelled directly from the body, i.e., on the breath, in the sweat, in urine, etc.

Reveal the middle part of the visual.

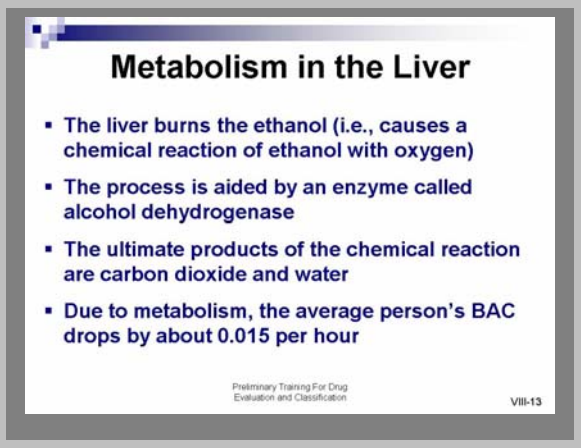
- Relatively little of the alcohol we drink is directly expelled from the body.
    - Clarification: Only about 2 – 10% of the alcohol we consume is directly excreted in the breath, urine, etc.
- The body eliminates most of the alcohol by chemically breaking it down.

Reveal the bottom part of the visual.

Ask students: What organ in the body is primarily responsible for chemically breaking the alcohol down?

- The liver is primarily responsible for breaking down, or metabolizing, the alcohol.
    - Clarification: Some metabolism of alcohol also takes place in other parts of the body, including the brain. The liver does the vast majority of the job.

Display Slide VIII-13: Metabolism in the Liver



Reveal the first "bullet" of the visual.

Metabolism of alcohol actually consists of a slow, controlled burning of the alcohol.

Reveal the second "bullet."

- In the burning process, the alcohol combines with oxygen.
- The liver has an enzyme called alcohol dehydrogenase, which helps to speed up the reaction of oxygen with the alcohol.
    - Clarification: The enzyme does not react with the alcohol itself, but simply makes it easier for the oxygen to react with the alcohol. The technical term for something that helps a chemical reaction while not itself taking part in the reaction is a catalyst.
- Alcohol dehydrogenase is a catalyst for the metabolism of alcohol.
- The reaction of alcohol with oxygen ultimately produces carbon dioxide and water, which can be directly expelled from the body.

Reveal the third "bullet."

- The speed with which the liver burns alcohol varies from person to person, and will change from time to time for any particular person.

Reveal the final "bullet."

POSE this problem to the class: Suppose a person reaches a peak BAC of 0.15. How long will it take for his or her body to eliminate all of the alcohol? [Answer: ten hours. (0.15 – (x hours)(0.015/hour) = 0, x = 10]

- BUT ON THE AVERAGE: Due to metabolism, a person's BAC will drop by about 0.015 per hour.

For the average male, a BAC of 0.015 is equal to the alcohol content of about two-thirds of a "standard drink."

- i.e., about two-thirds of a can of beer.

- Or about two-thirds of a glass of wine, or two-thirds of a shot of whiskey.

For the average woman, a BAC of 0.015 is equal to the alcohol content of only one-half of a "standard drink."

- So the average male can "burn up" about two-thirds of a drink in an hour.

- But the average female can only burn up about one-half of a drink in an hour.

- In other words: suppose a person gulps down a can of beer, or a glass of wine, or a shot of whiskey; if the person is an average man, it will take him about an hour and one-half to burn up that alcohol; if the person is a woman, it will take her about two hours.

Pose this question to the class:

How can we speed up the metabolism of alcohol?

- We can't speed it up.
- Drinking coffee won't help.
- A cold shower won't help.
- Exercise won't help.

Our livers take their own sweet time burning the alcohol.

Solicit students' comments and questions about the elimination of alcohol from the body.

C. Symptomatology of Alcohol

Prior to the start of this session, draw the following chart on the dry erase board or flip-chart.

	ALCOHOL
HGN	> present
VGN	> (high dose) present
LACK CONV	> present
PUPIL SIZE	> normal
RCTN LIGHT	> slow
PULSE RATE	> down
BLOOD PRESS	> down
TEMP	> normal

- Point out that ETOH may elevate the pulse rate in lower BAC levels.

Ask students: "What category of drugs is alcohol most closely associated?"

Indicators of Alcohol Influence Found in Eye Exams

- HGN will be present.

Write "Present" on the HGN line.

Ask: "Does alcohol cause Vertical Gaze Nystagmus?"

- Vertical Gaze Nystagmus may be present, especially with high doses (for that individual) of alcohol.

Write "Present" on the VGN line. Denote in parentheses "(high doses)."

Ask: "Does alcohol cause the eyes to be unable to converge?"

- Under the influence of alcohol, Lack of Convergence frequently will be present.

Write "Present" on the LACK CONV line.

Ask: "How do Depressants affect pupil size?"

- Alcohol does not affect pupil size; therefore, alcohol usually leaves the pupils normal in size.

Write “Normal” on the PUPIL SIZE line.

- Alcohol will cause pupillary reaction to light to be sluggish.

Write “Slow” on the RCTN LIGHT line.

Indicators of Alcohol Influence Found in Checks of Vital Signs

Ask: “How does alcohol affect pulse rate?”

- Pulse rate will usually be down. However, some subjects have been found to have elevated pulse rates at lower BACs.

Write “Down” on the PULSE line. Refer to the matrix exception for pulse.

Ask: “How does alcohol affect blood pressure.”

- Blood pressure response to alcohol will normally be down.

Write “Down” on the Blood Press line.

Ask: “How does alcohol affect body temperature?”

- Alcohol usually leaves temperature near normal.

Write “Normal” on the TEMP line.

Ask: “How does alcohol affect muscle tone?”

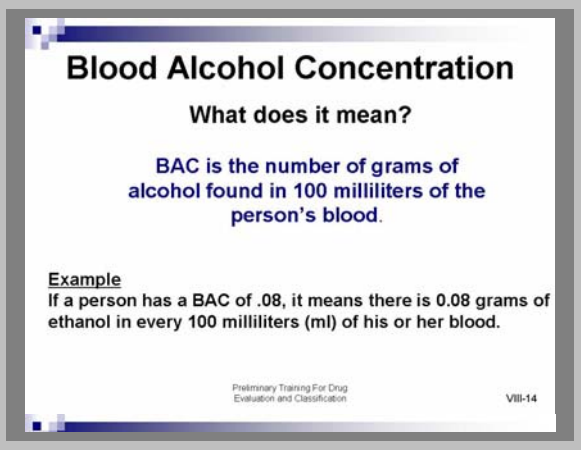
- Alcohol usually causes flaccid muscle tone.

Write “Flaccid” on the MUSCLE TONE line.

Solicit students’ questions about the signs and symptoms of alcohol.

D. Dose-Response Relationships

Display Slide VIII-14: Blood Alcohol Concentration

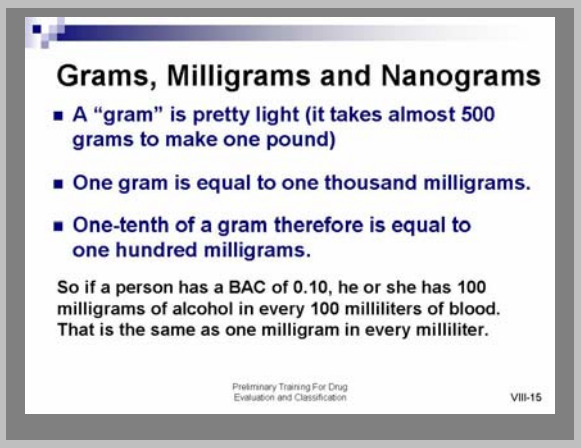


Reveal only the question at the top.

What does "Blood Alcohol Concentration" mean?

Solicit students' responses.

Display Slide VIII-15: Grams, Milligrams and Nanograms



Reveal the middle part of the visual.

- Blood alcohol concentration means the number of grams of pure ethanol that are found in every 100 milliliters of a person's blood.

- A gram is a measure of weight; it takes almost 500 grams to make a pound.

    - Instructor, for your information: It actually takes 454 grams to make a pound.

- A milliliter is a measure of volume. It takes about 500 milliliters to make a pint.

- Example: A 12-ounce can of beer has about 350 milliliters.

- The so-called "illegal limit" of BAC is 0.08 in all states.

- Point out that in 2005, all 50 states had adopted 0.08 BAC.

- If a person has a BAC of 0.08, it means there is 0.08 grams (g) of ethanol in every 100 milliliters (ml) of his/her blood.

- Point out that BAC results are reported in a variety of units. Two common variations are milligrams/milliliters and percent. There are 1000 milligrams (mg) in one gram; therefore, 0.08 grams equals 80 milligrams (mg) and a BAC of 0.08 would be reported as 80 mg of ethanol/100ml of blood. Percent means parts of 100.

Pose this question to the class:

How much alcohol does a person have to drink to reach a BAC of 0.08?

- Take an average male weighing 175 pounds and in reasonably good physical shape.

- Assume he does his drinking on an empty stomach.

- He would have to gulp down about 4 to 5 cans of beer, or 4 to 5 glasses of wine, or five shots of whiskey in a fairly short period of time to reach 0.08 BAC.

- In terms of pure ethanol, that would amount to just about two and one-half fluid ounces, or about two shot glasses.

Display two standard-sized shot glasses filled with water.

If these two shot glasses were filled with pure ethanol, we would have just enough of the drug to bring an average man to a BAC of approximately 0.10.

Hold up the two shot glasses while posing the next question.

So answer this: Does it take a lot of ethanol or only a little to impair a person? Solicit students' responses to the question.

In one respect, it certainly doesn't take much ethanol to impair; just two full shot glasses will more than do the trick for a full-sized man.

Hold up the glasses again.

BUT COMPARED TO OTHER DRUGS, it takes an enormous quantity of ethanol to cause impairment.

In order to compare ethanol to other drugs, we have to review some more units of weight.

Reveal only the first "bullet."

- We're already familiar with the gram. It weighs only about one five-hundredth of a pound.

Reveal only the second "bullet."

- The milligram is much lighter still and it takes about one thousand milligrams to make a gram.
    - Instructor, for your information: The prefix "milli" derives from the Latin word mille, meaning one thousand.
- That means it takes nearly five hundred thousand milligrams to make a pound.

Reveal only the third "bullet."

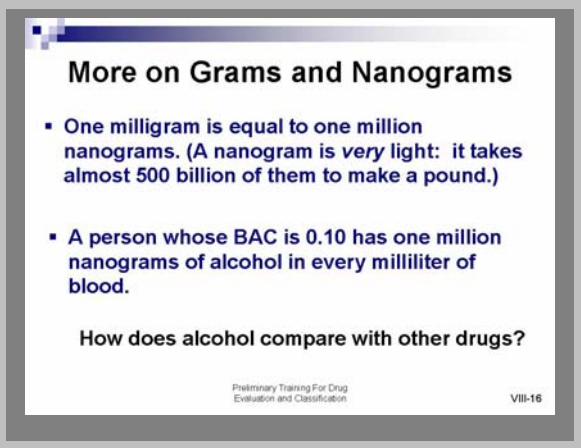
- If one gram is equal to one thousand milligrams, then one tenth of a gram is equal to one hundred milligrams.
    - Clarification: 100 is one-tenth of 1,000.

Now reveal the remainder of visual.

- So a person with a BAC of 0.10 has 100 milligrams of ethanol in every 100 milliliters of his or her blood.

- That is exactly the same as saying there is one milligram of ethanol in every one milliliter of blood.

Display Slide VIII-16: More on Grams and Nanograms



Reveal only the first "bullet."

Here is a new term: the nanogram.

Now reveal the parenthetic sentence on the visual.

- It takes a million nanograms to make a milligram.

Now reveal the second "bullet" on the visual.

- That means it takes one billion nanograms to make a gram.

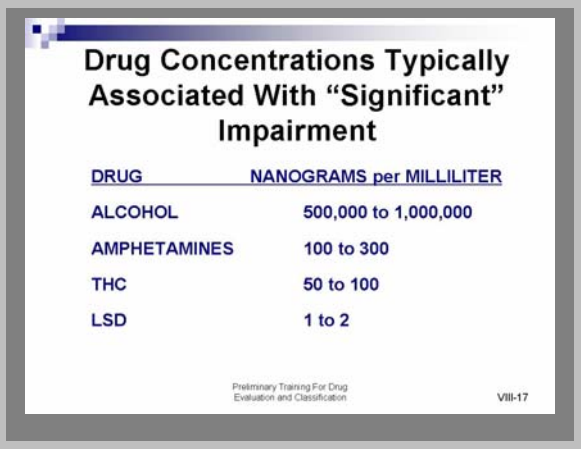
- And that means that it takes almost five hundred billion nanograms to make a single pound.

- So if a person's BAC is 0.10, he or she has one million nanograms of pure ethanol in every milliliter of blood.

What kinds of concentrations of other drugs does it take to produce impairment?

Don't solicit responses to this question; it is purely rhetorical.

Display Slide VIII-17: Drug Concentration Typically Associated With "Significant



IT IS MOST IMPORTANT to understand that we cannot state exact correspondences between alcohol concentrations and other drug concentrations.

Reveal only the "alcohol" segment of the visual.

- For example, we can say that someone with a blood alcohol concentration between 0.05 and 0.10 will exhibit significant impairment because there is a large body of scientific research that backs up that statement.
- So we can say that research shows that significant impairment will be found with alcohol at concentrations of 500,000 to one million nanograms per milliliter.

Point to the alcohol line on the visual.

- But we can't say exactly how much cocaine, THC, morphine, or any other drug would take to produce exactly the same impairment that we would find at 0.10 BAC.
- In part, this is because we do not have extensive scientific research for most other drugs.
- But also it is because many other drugs do not impair in the same way that alcohol impairs.

- Example: Unlike alcohol, some other drugs (such as THC and PCP) readily deposit in fatty tissue and may continue to cause impairment even after they have cleared from the blood.

Nevertheless, based on the available research, it is possible to make some general statements about drug concentrations that can safely be said to induce significant driving impairment.

Reveal the Amphetamine line on the visual.

- First example: Amphetamines.

Hold up the two shot glasses again.

- Researchers agree that if we had two shot glasses full of pure amphetamines, we'd have enough to impair as many as ten thousand people.

Ask students: What if these shot glasses were full of pure THC, the active ingredient in Cannabis?

- Second example: Cannabis.

Reveal the Cannabis (THC) line on the visual.

- Available evidence suggests that if these two little glasses were full of pure THC, we'd have enough drug to impair as many as twenty thousand people.

ONCE AGAIN, hold up the two shot glasses.

Ask students: But what if these glasses were full of pure LSD?

Reveal the LSD line on the visual.

- Many researchers believe that significant impairment results from very low LSD concentrations.

- If these two glasses contained pure LSD, we could impair up to one million people.

What does all this mean? This is a rhetorical question.

- First, it means that compared to alcohol, most other drugs are very powerful: a little goes a long way.

- Example: A person who is "only" carrying one fluid ounce of LSD (hold up one shot glass) would be capable of impairing "only" the entire population of, say, Wyoming.

- Second, it means that laboratories may be stretched to the limits of their technologic capabilities when we send them samples and request certain drug analyses.

- All analytic techniques have detection thresholds, i.e., minimum concentrations of drugs that must be present if a scientific confirmation of the presence of the drug is to be obtained.

- If the concentration of the drug is less than the detection threshold, the laboratory simply will not be able to confirm that the drug is present.

- The problem is that some people will be significantly impaired at drug concentrations that are below the lab's detection threshold.

- What this means is that a DRE sometimes examines a subject, concludes correctly that he or she is under the influence of a certain drug category, perhaps even obtains an admission from the subject that he or she has taken a drug, gets a toxicological sample and sends it to the lab, only to have the lab report that "no drugs were found."

When this happens to you – and it will – it is important that you don't let yourself become discouraged.

- As a DRE, all you are expected to do is the best that you can do given the tools available.

- You will never become perfect in your diagnosis of drug impairment.

- There will be times when you will "miss" the fact that a subject is impaired.

- And there may be times when you will conclude that a subject is under the influence of a drug when, in fact, he or she isn't.

- We rely on the laboratory to corroborate our opinions, to help make sure that an innocent person is not punished because of an honest mistake in judgment on our part.

- The problem is that the laboratory isn't perfect either: the toxicologists won't always be able to corroborate your opinion, even though your opinion is accurate.

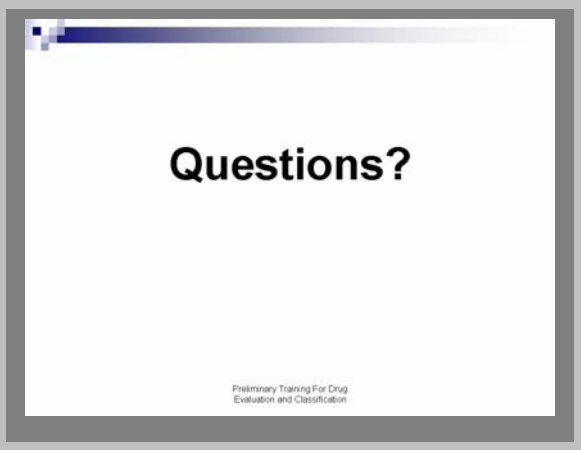
Solicit students' comments and questions about dose-response relationships involving alcohol and other drugs.

E. Questions for Review

Direct students to turn to the review questions at the end of Section VIII of their Student Manual.

Pose each question to the class and solicit responses. Make sure all students understand the correct answers.

Display Slide VIII-18: Questions



Solicit students' comments and questions about "Alcohol as a Drug."

REVIEW QUESTIONS

1. Name three different chemicals that are alcohols. Which of these is beverage alcohol, intended for human consumption? What is the chemical symbol for beverage alcohol?

   Methyl, Ethyl and Isopropyl (or Methanol, Ethanol and Isopropanol or Wood Alcohol, Beverage Alcohol and Rubbing Alcohol). Ethanol is the beverage intended for human consumption. The four letter chemical symbol for alcohol is ETOH.

2. What is the name of the chemical process by which beverage alcohol is produced naturally? What is the name of the process used to produce high-concentration beverage alcohol?

   1. Fermentation
   2. Distillation

3. Multiple Choice: "Blood alcohol concentration is the number of _____ of alcohol in ever 100 millimeters of blood."

   A. grams
   B. milligrams
   C. nanograms

   "A" - grams

4. True or False: Pound-for-pound, the average woman contains more water than does the average man.

   <u>False</u>. The average woman actually has a good deal less water, pound-for-pound, than the average man. She has about 55% water, he is about 68% water.

5. What do we mean by the "proof" of an alcoholic beverage?

   "Proof" means twice the ethanol percentage of the beverage. For example, 80 proof vodka is 40% ethanol.

6. Every chemical that is an "alcohol" contains what three elements?

   The three elements common to all alcohols are <u>carbon</u>, <u>hydrogen</u>, and <u>oxygen</u>.

7. True or False: Most of the alcohol that a person drinks is absorbed into the blood via the small intestine.

   The statement is <u>true</u>. Under normal conditions, about 80% of the ethanol in the stomach will pass through the pyloric valve into the small intestine, from which it will quickly move into the bloodstream.

8. What is the name of the muscle that controls the passage from the stomach to the lower gastrointestinal tract?

   The muscle is called the <u>pyloris</u>, or <u>pyloric valve</u>.

9. True or False: Alcohol can pass directly through the stomach walls and enter the bloodstream.

   The statement is <u>true</u>. Usually, about 20% of the ethanol a person drinks diffuses through the stomach walls to enter the blood.

10. Multiple Choice: Suppose a man and a woman who both weigh 160 pounds arrived at a party and started to drink at the same time. And suppose that, two hours later, they both have a BAC of 0.10. Chances are….

    A. He had more to drink than she did.
    B. They drank the same amount of alcohol.
    C. He had less to drink than she did.

    "A" – more to drink

11. In which organ of the body does most of the metabolism of the alcohol take place?

    The liver is where most metabolism takes place.

12. What is the name of the enzyme that aids the metabolism of alcohol?

    Alcohol dehydrogenase is the enzyme that serves as a catalyst for alcohol's metabolism in the liver.

13. Multiple Choice: Once a person reaches his or her peak BAC, it will drop at a rate of about _____ per hour.

    "B" – 0.015 percent. (But remember, this is an average value, with wide variations among individuals).

14. Multiple Choice: If a person has a blood alcohol concentration of 0.10, then there are _____ nanograms of alcohol in every milliliter of his or her blood.

    A. one million
    B. one hundred thousand
    C. ten thousand
    D. one thousand
    E. one hundred

    "A" – one million

15. True or False: It takes about thirty minutes for the average 175 pound man to "burn off" the alcohol in one 12-ounce can of beer.

    The statement is <u>false</u>. The average 175 pound man will need more like ninety minutes to metabolize the alcohol.