
IMH TEP'S

LEGACY ACADEMY

8.7 How Breathalyzers Work

Grade 8 Activity Plan

8.7 How Breathalysers Work

Objectives:

1. To understand the physiological implications and social consequences of increased blood alcohol concentration
2. To understand the chemical reaction that occurs in order for a breathalyser to work.
3. To calculate Blood Alcohol Concentration using a breathalyser and using other relevant information
4. To clarify true and false myths associated with alcohol

Keywords/ concepts: Blood Alcohol Concentration (BAC), breathalyser, lungs, blood stream, alveoli, absorption, photocell, alcohol

Curriculum outcomes: 209-2, 209-4, 210-7, 304-9.

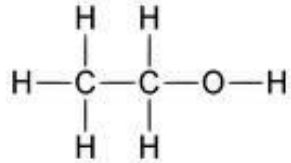
Take-home product: Myth/Fact sheet

Segment	Details
African Proverb and Cultural relevance. (5 min.)	"A bird can drink much but the elephant drinks more." Nigeria
Pre-test (10 min.)	Assess students' understanding on the principles upon which breathalysers work; Blood Alcohol Concentration (BAC); and consequences of excessive consumption of alcohol.
Background (15 min.)	Explain that the alcohol in alcoholic beverages is ethanol. Draw molecular structure. Allow students to identify elements present. Describe what makes the substance an alcohol. Outline the properties of ethanol and differences between methanol (some other alcohols) and ethanol.
Activity 1 (15 min.)	Write out the equation and describe the chemical reaction that takes place in a breathalyser, outlining the function of each substance.
Activity 2 (15 min.)	Explain what BAC is and how it is calculated. Allow students apply their knowledge of BAC in the game "BUSTED!"
Activity 3 (20 min.)	Encourage students to present their opinions on certain alcohol myths. Lead them to the discovering the answers by themselves through critical thinking.
Post-test (10 min.)	Quiz students by creating hypothetical situations of alcohol consumption, e.g. would the BAC be the same for a 250lb woman and a 165 lb man if they consumed the same amount of alcohol.? Why or why not? Assess their understanding on how breathalysers work.

Suggested interpretation of proverb: As will be seen in the activity, the blood alcohol concentration is highly dependent on body weight.

BACKGROUND INFORMATION

Alcoholic beverages include wines and beers. The alcohol in these beverages is a chemical called ethyl alcohol, or ethanol.



The molecular structure of ethanol (alcohol)

Once consumed, alcohol is absorbed through the stomach and small intestine and enters the bloodstream, which distributes the alcohol to other parts of the body, including the brain.

The physical affects of drinking alcohol range from loss of coordination, vision, balance, and speech. These affects usually wear off in a matter of hours after a person stops drinking.

It is a criminal offense if you drive with a Blood Alcohol Concentration (BAC) in Excess of .08%

Law enforcement officers use portable breath-testing machines to find out whether a driver has a blood alcohol level above the legal limit. A breathalyzer is a device that samples the breath of a suspect and uses a chemical reaction involving alcohol that produces a colour change.

Inside the breathalyzer are chemicals with different colours. Potassium dichromate is a yellow-orange compound. When alcohol vapor makes contact with the yellow-coated crystals, the colour changes from yellow to green. The degree of the colour change is directly related to the level of alcohol in the suspect's breath.

Measurements taken with the Breathalyzer are reported in units of percent blood-alcohol concentration (BAC).

In Nova Scotia a 24-hour roadside suspension for driving is given to those with a blood alcohol content of .05 to .08. You may be charged criminally if you have a BAC over .08%.

A blood alcohol concentration of 0.08% is equal to 0.08 grams of alcohol per 100 mL of blood.

The mathematical formula used to calculate a person's BAC is:

$$\text{BAC} = \frac{\text{grams of alcohol}}{\text{Body weight (g)} \times 0.55(\text{females}) \text{ or } 0.68(\text{male})}$$

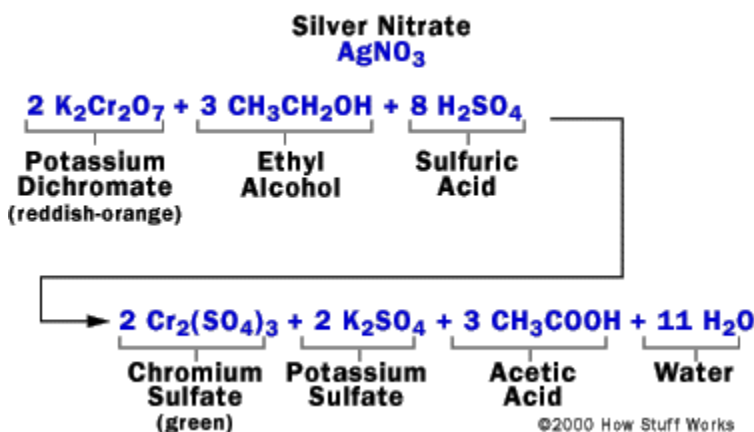
Activity 1: How a Breathalyser works

Purpose: To understand the chemical reaction that occurs in order for a breathalyser to work.

Suggested format: mentor should carry out experiment alone; encouraging students' contribution when possible; and taking all safety procedure into consideration.

Item	Quantity (for mentor only)
100ml beakers	6
Water	180ml
Sulphuric acid	100ml
Alcoholic substances	100ml of each
Potassium dichromate	
Stirring rod	1

Chemical reaction



Procedure:

1. Set up the demonstration with two 50 mL beakers. One of the beakers will be the reference.
2. Add 30 mL of water to each beaker. Dissolve a small amount of potassium dichromate in each beaker. Stir until the solid is dissolved.
3. To each beaker, add a few drops of sulfuric acid. This creates the acidic environment needed for the chemical reaction.
4. To one of the beakers, add alcohol. The other beaker is the reference. Watch what happens to the potassium dichromate when alcohol is present. Compare the colour observed in the alcohol added beaker to the reference beaker.
5. Repeat steps 1 to 3 (prepare about 4 more set ups), test up to four substances that are unknown to the students and allow them to determine alcohol content based on their observation.

Additional resources:

How breathalysers work -

<http://electronics.howstuffworks.com/gadgets/automotive/breathalyzer3.htm>

Activity 2: BUSTED!

Purpose: To calculate Blood Alcohol Concentration using a breathalyser and using other relevant information

Suggested format: mentor should set activity up in a game format, and encourage students to work in groups.

Item	Quantity (for mentor only)
100ml beakers	6
Water	180ml
Sulphuric acid	100ml
Alcohol	100ml

Procedure:

1. Make a scene of people using inflated balloons taped onto a plate
2. Create a hypothetical situation assigning data on body mass and grams of alcohol consumed to a number of people.
3. Allow students calculate their BAC's.
4. Mix a fixed amount (20 mL) of alcohol with varying quantity of water creating various levels of alcohol concentration for 6 spray bottles representing humans.
5. Allow students use breathalyzer to test their BAC.

Activity 3: Common Alcohol Myths

Listed below are a few common beliefs about alcohol. Mentors should discuss each with their students and help them deduce whether the beliefs are true or false.

Consumption of alcohol can warm up a person feeling cold.

Myth: It turns out that just one alcoholic drink can make you feel warmer, but it actually lowers your core body temperature.

Can breath mints, onions, mouth wash, and breath sprays cover the smell of alcohol and reduce the BAC in a person?

Myth: All those things can reduce the smell of alcohol on a person's breath, but they don't actually reduce a person's BAC. In fact, products such as mouthwash can actually "trick" the breathalyser by raising the BAC results. Eg. Some Listerine (mouthwash) contains 27% alcohol.

Can vodka cure bad breath?

True: This mouthwash recipe calls for 1 cup of vodka and 9 tablespoons of cinnamon. Combine the two in an airtight container and keep it sealed for two weeks to allow the cinnamon to fully infuse the vodka. It has been proven to effectively rinse away odour-causing bacteria.

Is there any truth to the term "BEER GOGGLES"?

Plausible: The term "beer goggles" refers to the theory that the more we drink, the more attractive people appear to us. Alcohol works as a depressant, meaning that it slows down one's central nervous system. This can change one's perception, increase sexual arousal, and impair one's general judgement.

A beer flood in 1814 killed nine people

True: On October 17th, 1814, a ruptured tank at the Meux and Company Brewery unleashed over 3500 barrels of beer onto the streets, creating a wave of beer that knocked down walls, flooded basements, and demolished houses. Eight people drowned. The ninth person died of alcohol poisoning after attempting to stop the flood by drinking the beer.

Sucking on a penny or putting it under your tongue will help you pass a breathalyser test if you've been drinking.

Myth: Just doesn't make any cents. (This should be uttered in a funny tone)

Drinking coffee will sober you up quickly.

Myth: your body processes alcohol at a rate of 0.015 percent of blood alcohol content per hour, regardless of gender, weight, height, etc.