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*Photocopy the Student Guide as needed for use in your classroom.
Blood Alcohol Determination

Overview
As members of a forensic team investigating a suspicious car collision, students determine the alcohol concentration in simulated blood samples taken from the two drivers. Students use samples of four known concentrations to establish a set of standards that they use to test the concentration in the unknown samples. Then, students draw conclusions on the basis of their test results and the testimonies from the involved drivers. This kit supports 30 students working in groups of 3. The activity requires approximately 40 minutes.

Objectives
Students will

• analyze blood alcohol concentration of simulated blood samples.
• calculate blood alcohol concentration using reference tables.
• graph blood alcohol concentrations over time.
• interpret test results and draw conclusions.

Content Standards
To view the national and local standards met by this kit, visit www.carolina.com/correlations.

Time Requirements
Preparation . . . . . . . . . . . . . . . . .15 minutes
Activity . . . . . . . . . . . . . . . . . . . .40 minutes

Materials
Included in the kit:
2 15-mL Alcohol Indicator Reagent
4 bottles of simulated blood — 0.0%, 0.04%, 0.08%, and 0.10%
2 bottles of simulated blood of unknown concentrations
60 divided plastic petri dishes
8 plastic pipets
Teacher’s Manual and reproducible Student Guide

Needed, but not supplied:
6 10-mL graduated cylinders
10 permanent markers
20 colored pencils, assorted colors
optional: rubber bands
Safety

Use this kit only in accordance with established laboratory safety practices, including appropriate personal protective equipment (PPE) such as gloves, chemical splash goggles, and lab coats or aprons. Ensure that students understand and adhere to these practices. Know and follow all federal, state, and local regulations as well as school district guidelines for the disposal of laboratory wastes. Students should not eat, drink, or chew gum in the lab and should wash their hands upon entering and before exiting the lab.

The Alcohol Indicator Reagent contains sulfuric acid. Sulfuric acid is very corrosive to skin and eyes. If contact occurs, immediately flush with large amounts of water. Dispose of any remaining reagent as hazardous waste, according to local standards.

The synthetic blood materials in this kit can be discarded after use according to local standards. The synthetic blood includes no biological material that might cause any health hazard when discarded.

Background

Ethyl Alcohol

Alcohol is a term used to describe a group of organic compounds which contain an –OH group attached to a carbon. Ethyl alcohol (ethanol) is a two-carbon alcohol produced by fermentation of sugar. Also known as drinking alcohol, ethanol acts as a central nervous system depressant when ingested.

\[
\text{H} - \text{C} - \text{C} - \text{O} - \text{H} \\
\text{H} \quad \text{H}
\]

Ethyl alcohol (ethanol)

Approximately 20% of ingested ethanol is absorbed into the bloodstream through the stomach walls; the other 80% is absorbed through the upper small intestine. Once in the bloodstream, ethanol is transported throughout the body. (Fat and bones are low in water and therefore absorb little ethanol.) Ethanol, following the path of deoxygenated blood in the body, ultimately passes through the lungs. In the lungs, small sacs called alveoli facilitate the exchange of vapors between the breath and blood. The lungs contain about 250 million alveoli, which are located at the ends of the bronchial tubes. The membrane of these sacs allows for the exchange of oxygen and carbon dioxide. Ethanol is a volatile substance, and, during alveolar gas exchange, some of the ethanol from the bloodstream vaporizes. Experimental evidence indicates a direct ratio between the amount of ethanol vapor exhaled in the breath and the concentration of liquid ethanol in the blood.

Effects of Alcohol on the Body

Alcohol is a central nervous system depressant. A variety of factors affect the absorption of alcohol in the body, including a person’s size or weight, stomach contents, type of beverage consumed, metabolism rate, and gender. The effects
Preparation

1. Review the entire Teacher's Manual and appropriate MSDS. Familiarize yourself with the instructions and assessment material in the Student Guide.

2. Photocopy the Student Guide for each student or group.

3. Set up 10 lab stations, one for each group, with the following items:
   - 6 divided petri dishes
   - 2 different-colored pencils
   - permanent marker

4. Set up an accessible central station with the following:
   - 4 bottles simulated blood of known concentration
   - 2 bottles simulated blood, unknown concentrations (from Mike and Wendy)
   - 8 plastic pipets
   - 6 10-mL graduated cylinders
   - alcohol indicator reagent

   Teacher Tip: The alcohol indicator reagent contains silver nitrate as a catalyst. Silver nitrate is light sensitive and must be stored in a dark bottle.

5. Assign each 10-mL graduated cylinder to a specific simulated blood sample (0.0%, 0.04%, 0.08%, 0.10%, Mike, Wendy). Label the graduated cylinder to indicate which blood sample it should be used with. This ensures that students do not contaminate their samples, and it eliminates the need to rinse the graduated cylinder thoroughly after each sample.

6. Gently shake each simulated blood sample bottle to ensure contents are thoroughly mixed.

7. If desired, wrap a rubber band around each simulated blood sample and each bottle of alcohol indicator reagent. Place a pipet in the rubber band to secure it to the bottle. This helps students use the appropriate pipet for each blood sample and avoid contamination.

Procedure

1. Divide the class into 10 groups of 3 students each.

2. Distribute one copy of the Student Guide to each student or group. Have students read the background sections of the Student Guide.

3. Review the objectives and materials used in the activity. Although there are no biological materials in the synthetic blood that would cause any health hazards, you may wish to discuss and/or implement relevant safety protocols as if working with real blood. Remind students to keep the lids on the blood sample bottles at all times except when in use as the volatile ethanol will escape.

4. Have student groups go to a lab station and begin the activity.

5. Once students have set up their activity, they will need to let it sit for 20 minutes. While students are waiting, they may begin work on calculations and questions. The BAC calculations do not require the results from their test.