



LES Science and Technology (Theory)

TEACHER'S GUIDE SECONDARY 3

ÉDUC'ALCOOL'S "YOU BE THE JUDGE" SCHOOL PROGRAM

Éduc'alcool's "You Be the Judge" program was designed for students in every year, from Elementary Grade 5 through Secondary V. The goal of the program is to:

- delay the start of drinking as long as possible;
- help young people learn responsible behaviour when faced with peer pressure;
- help them understand that you don't have to drink to have fun;
- help them become critical, informed consumers;
- show them how to distinguish between abusive and moderate drinking.

TEACHING MATERIALS ARE COMPREHENSIVE AND FREE

The teaching materials correspond to students' current reality and focus on two main aspects:

- giving them a better understanding of the impact of alcohol on growth and development in the human body;
- providing them with better tools to help them become independent so they can resist the influences around them.

The material is in the form of a **learning and evaluation situation (LES)**. It follows the progression of learning and provides for skills evaluation, as established by the Québec Education Program developed by the Ministry of Education, Recreation and Sports. The program for each year includes:

- a **Teacher's Guide**
- a **Student Workbook**
- a **skills evaluation tool**

All the material necessary for this LES is available at educalcool.qc.ca.

There is no ideal way to make children wait as long as possible before they start drinking alcohol. By the age of nine, one in every four children has tried alcohol. Some do it without their parents' knowledge, either at home or with friends, emptying adults' glasses or finishing off a bottle of something, without necessarily making a distinction between beer, wine, cider or spirits. Others, however, drink occasionally with their parents' consent, since the parents prefer to introduce them to alcohol in controlled circumstances and with strict guidelines.





Putting Alcohol to the Test of Science



SUMMARY OF THE LEARNING AND EVALUATION SITUATION

Our relationship to alcohol should be based on scientific fact, and it's important to know what those facts are.

This learning and evaluation situation is an opportunity for students to become aware of and adopt healthy habits, in the event that they ultimately decide to drink. They will use what they already know and gather the scientific information they need—about binge drinking, calculating blood alcohol content, what happens when you mix alcohol with energy drinks, etc.—to help the characters in this module agree on how to behave, should they find themselves in the presence of alcohol at parties.

While the situations illustrated here are fictional, they can be a useful starting point for conversations about the impact of alcohol on the human body, and about the **living world** and the **material world**, with a particular focus on the digestive, respiratory, circulatory, excretory and nervous systems.

CONNECTION TO THE QUÉBEC EDUCATION PROGRAM

Broad Areas of Learning: Health and well-being. Media literacy.

Focuses of development: Awareness of the consequences of personal choices on health and well-being. Awareness of the place and influence of the media in students' daily life and in society.

Competencies in science and technology (theory):

- CD2 (Makes the most of his/her knowledge of science and technology).
- CD3 (Communicates in the language used in science and technology).

Target concepts:

THE LIVING WORLD SYSTEMS:

- Digestive system (stomach, liver, pancreas, food)
- Respiratory and circulatory systems (blood, blood vessels, gas exchanges - alcohol in exhaled breath)
- Excretory systems (kidney, blood balance, diuretic effect)
- Nervous system (role of central nervous system)

THE MATERIAL WORLD PROPERTIES:

- Characteristic physical properties (density)
 - Solution properties (concentration)
 - Characteristic chemical properties (indicators)
- TRANSFORMATIONS:
- Physical (dilution)
 - Chemical (digestion)

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activities

GETTING STARTED

Activity 1 A party at Isabelle's

Competency in SCIENCE AND TECHNOLOGY (theory): Makes the most of his/her knowledge of science and technology.

Evaluation criteria: Formulates appropriate questions; provides relevant explanations or solutions; provides suitable explanation of answers, solutions or decisions.

1. Appropriate interpretation of the issue

- Understands the issue and relevant aspects
- Comes up with an initial solution

2. Appropriate explanations or solutions

- Provides or justifies explanations related to the issue
 - Justifies decisions (or opinions) based on scientific knowledge
 - Uses the correct terminology, rules and conventions
-

Activity 2 How does being 18 change things?

2.1 Fred's older brother and their parents

2.2 Blood alcohol content and calculations

Competency in SCIENCE AND TECHNOLOGY (theory): Makes the most of his/her knowledge of science and technology.

Evaluation criteria: Comes up with an initial solution; provides or justifies explanations related to the issue; justifies decisions (or opinions) based on scientific knowledge.

Activity 3 Mixes to avoid

Competency in SCIENCE AND TECHNOLOGY (theory): Makes the most of his/her knowledge of science and technology.

Evaluation criteria: Comes up with an initial solution; provides or justifies explanations related to the issue; justifies decisions (or opinions) based on scientific knowledge.

For all activities 1, 2 and 3 (the whole module)

Competency (theory): Communicates in the language used in science and technology.

Evaluation criteria: Provides sufficient explanations using appropriate terminology and in accordance with the rules and conventions of science.

REVIEW



INTRODUCE THE PROGRAM

GRAB STUDENTS' ATTENTION WITH "GETTING STARTED"

REVIEW SCIENCE MATERIAL COVERED IN PREVIOUS YEARS (properties of mixtures and solutions)

Just say the word "alcohol" and an image, an ad, a slogan or a fact seems to pop into your mind, doesn't it? But what do we really know about alcohol? What exactly do we know about those little ethanol molecules that constitute pure alcohol?

If you consider that more than 80% of Quebecers drink fairly regularly, it would make sense for people to know something about what they're doing. Providing such information is part of Éduc'alcool's mission.

WATCH THE FOLLOWING VIDEO: *La science a testé l'alcool (Alcohol has been scientifically tested)*



HAVE STUDENTS DEFINE THE FOLLOWING TERMS, USING RELIABLE SOURCES:

- **Ethyl alcohol (ethanol):** Also known as absolute alcohol, ethanol is the least dense of all the alcohols. It is a colourless liquid, miscible in all proportions with water. It is an addictive psychoactive drug, one of the oldest known recreational drugs, and is the principal type of alcohol found in alcoholic beverages. *Larousse*
- **Blood alcohol content (BAC):** The concentration of alcohol in the blood.
- **Some of the information you need to calculate a person's BAC:** The person's weight, what they have drunk, the concentration of alcohol in the drinks...

Material previously covered

Basic Secondary 3 information about the digestive, respiratory, circulatory, excretory and nervous systems should have been covered before embarking on this learning situation. The Éduc'alcool document "*Alcohol and the Human Body*" refers to these systems and allows students to use their previously gained knowledge.

Activity 1

A party at Isabelle's

- Divide students into groups.
- Explain the three-step assignment:
 1. Give your opinion, based on your current knowledge (what the student knows or thinks about the problem to be solved).
 2. Research: Using reliable sources, look for new information and understanding about the problem to be solved.
 3. Rationale: Answer the initial question again, using your new-found knowledge.
- Allow time to complete the assignment (*Student Workbook*, p. 3-4). To do so, students need to read the following documents:
 - ***Alcohol and Health: Alcohol and the Human Body***
 - ***Alcohol and Health: The Effects of Early Alcohol Use***
 - ***Alcohol and Energy Drinks: Don't Get Your Kicks from this Mix!***
- Have students present their answers to the whole class and discuss (see Appendix 1, p. 8-9). This allows students to "own" their understanding and knowledge. It also gives them an idea of the kind and quality of answers expected.





Activity 2

How does being 18 change things?

2.1 Fred's older brother and their parents

- Introduce the set-up:

SET-UP

Fred's parents were OK with him going to the party provided that he didn't drink. Then they had the same conversation with their older son Steve (a young adult) about responsible drinking.

- Explain the assignment, which also has three steps (*Student Workbook*, p. 5-6):
 1. Give your opinion, based on your current knowledge (what the student knows or thinks about the problem to be solved).
 2. Research: Using reliable sources, look for new information and understanding about the problem to be solved. To do so, students need to read the following documents:
 - **Drinking games can be deadly**
 - **Alcohol and Health: Alcohol and the Human Body** (students need to find information on how alcohol is digested and eliminated, and what the low-risk drinking limits are).
 3. Rationale: Answer the initial question again, using your new-found knowledge.
- Have students present their answers to the whole class and discuss (see Appendix 2, p. 10-11).

2.2 Blood alcohol content and calculations

- Explain the assignment: Calculate Steve's BAC, using different weights and drinks (*Student Workbook*, p. 7-8).
- If necessary, cover or review the characteristics and physical properties of solutions.
- Help students understand the calculation process: project Appendix 3, questions 1-4.
- Ask students to answer question 5 (*Student Workbook*, p. 8).
- As a class:
 - Compare students' answers.
 - Give the answers to question 5 (see Appendix 3, p. 13).
 - Refer to the **Blood Alcohol Content spreadsheet** (Excel document available on the *Éduc'alcool* website): students can check their calculations and account for the metabolic elimination of alcohol.
 - Introduce the **Blood Alcohol Calculator** on the *Éduc'alcool* website.
 - Discuss the effect of body mass on blood alcohol content to help students understand the reasons why some people feel the effects of alcohol more quickly than others.
 - Convey the warning: **the blood alcohol calculator is approximate**. It takes a blood or breath sample to determine a person's exact BAC.
 - Explain how the breath can contain alcohol: some alcohol (10%) is eliminated unmodified, through urine and perspiration, but it is also eliminated through the breath, since it has been brought to the lungs by the blood.
 - This might be a good time to introduce the single-use breathalyzer.



Activity 3

Mixes to avoid

- Introduce the set-up:

SET-UP

Steve doesn't really like the taste of alcohol, plus he's a little tired. So he wants to mix his alcohol with an energy drink.

- Explain the three-step assignment (*Student Workbook*, p. 9-10):
 1. Give your opinion, based on what you already know (what the student knows or thinks of the problem to be solved).
 2. Research: Using reliable sources, look for new information and understanding about the problem to be solved. To do so, students should use the documents read in activities 1 and 2.
 3. Rationale: Answer the initial question again, using your new-found knowledge.
- As a class, go over the answers in Appendix 4, p. 14-15.

Review

ASK STUDENTS:

- How can science convince people to adopt healthy drinking habits? (Answers to be entered in the *Student Workbook*, p. 10).
- Did you know that Éduc'alcool has developed tools and applications related to drinking? See the *Blood Alcohol Calculator*, the *Calcoholator* and the *Drink Dashboard* on the website.

APPENDIX 1

ANSWER SUPPORT FOR TEACHERS

Activity 1 A party at Isabelle's

1 Both sides of the argument: Fred and his parents

- ◆ List at least **three** arguments Fred could use to reassure his parents.
 - **Adults will be there.**
 - **I'm a responsible person.**
 - **I'm not usually influenced by others.**
 - **There will be more than just alcohol to drink.**

- ◆ List at least **three** arguments his parents could use to convince Fred not to drink.
 - **You have to consider the possibility that you'll be influenced by the people there.**
 - **There could be drinking games and binge drinking.**
 - **You're only 15 and the legal age for buying alcohol is 18.**

appendix

2 Research

Fred's conversation with his parents highlights certain facts about the effects of alcohol on the human body, which you now have to document, using scientific explanations.

	SCIENTIFIC INFORMATION
1. Differences according to age, sex and weight	<p>Pre-teens, teens and seniors do not tolerate alcohol as well as adults 18-65 because they generally weigh less. The same holds for women, who have less body liquid than men, and the same amount of alcohol will produce a higher concentration in the blood. (<i>"Alcohol and the Human Body,"</i> p. 5)</p>
2. The effects of alcohol on the brain	<p>The effects of alcohol are observed most quickly in the brain.</p> <p>Alcohol interferes with a number of brain functions by stimulating the pleasure centres.</p> <p>The adolescent brain is more exposed to the harmful effects of alcohol. Studies have shown the impact of alcohol on decision-making and the ability to learn. (<i>"Alcohol and the Human Body,"</i> p. 7)</p>
3. High-risk behaviours	<ul style="list-style-type: none">- Some researchers believe that teens who drink too much do so mainly because of their inability to anticipate the consequences of their actions. This puts adolescents doubly at risk for alcohol abuse: their capacity to think properly and make good judgements is still developing, and they are thrill seekers. (<i>"The Effects of Early Alcohol Use,"</i> p. 3)- Moderation is unfortunately not the rule with teenagers. In fact, when they drink teens tend to drink a great deal. (<i>"The Effects of Early Alcohol Use,"</i> p. 5)- Abusive drinking affects memory and brain plasticity in adolescents more than in adults.- Excessive drinking at an early age also increases the likelihood of risky decision-making, and this does not seem to diminish over time. (<i>"The Effects of Early Alcohol Use,"</i> p. 8)- Alcohol probably contributes to poor judgement with regard to sexual behaviour. Alcohol also probably facilitates the expression of violence in those who are predisposed to it. (<i>"The Effects of Early Alcohol Use,"</i> p. 10)

3 Rationale

Why do Fred's parents want him not to drink?

All answers above are acceptable.

APPENDIX 2

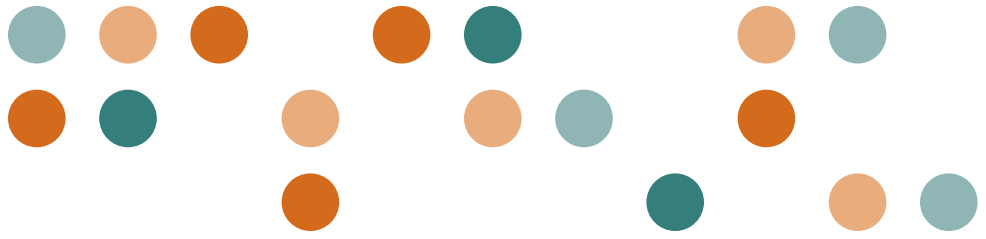
ANSWER SUPPORT FOR TEACHERS

Activity 2 Steve's discussion with his parents

1 Considering the messages you have already seen about alcohol on TV, posters and online:

- ◆ List two things Steve could say to his parents:
 - I can use a breathalyzer if I'm not sure.
 - I know the recommended alcohol limits.
 - I'm going to eat while I drink.

- ◆ List two things Steve's parents could recommend for him:
 - You don't always react the same way to drinking every time (it's different when you're tired, for example).
 - Exceeding the limit is easier than you think.
 - Fun shouldn't be related to how much you drink.
 - Make sure you know what you're drinking (percentage alcohol).
 - To make sure you know exactly how much you're drinking, don't let anyone refill your glass as you go.



2 Research

Look up scientific information that can help you better understand what happens when you drink alcohol, and allow you to help Steve make an enlightened decision. Make note of scientific data for the following:

	SCIENTIFIC INFORMATION
Digestion and elimination of alcohol	<ul style="list-style-type: none"> - The enzyme dehydrogenase transforms alcohol into acetaldehyde, a highly toxic substance that has an impact on the entire body. No matter how much you drink, your liver can metabolize only 15-17 mg of alcohol an hour. (<i>"Alcohol and the Human Body,"</i> p. 4)
Binge drinking	<ul style="list-style-type: none"> - Binge drinking can often result in severe intoxication. - When blood alcohol content reaches or exceeds 400 mg of alcohol per 100 ml of blood (commonly known as ".40"), it can cause an ethylene coma and even death. (<i>"Drinking games can be deadly"</i>)
Drinking limits to avoid intoxication	<p>50 to 100 mg/100 ml (.05 to .10) = slight euphoria: mild intoxication</p> <ul style="list-style-type: none"> - Euphoria (feeling of well-being and satisfaction) - Loss of inhibitions - Increased talkativeness and liveliness - Progressive decline in attention, concentration and judgement - Possible psychomotor impairment <p>(<i>"Drinking games can be deadly"</i>)</p>

3 Rationale

Using your new-found knowledge, come up with some advice that Steve's parents could offer him.

Mild intoxication occurs starting at 50 mg/100 ml, which makes that the limit to avoid intoxication.

APPENDIX 3

ANSWER SUPPORT FOR TEACHERS

Activity 2.2 Blood alcohol content

To help Steve stick to the limit and avoid becoming intoxicated, calculate the concentration of alcohol in his blood (his blood alcohol content, or BAC) after drinking different amounts.

To calculate BAC, you will need the following information:

- the number of drinks consumed
- the volume of each drink
- the alcohol content of each drink
- Steve's body weight (mass)

The following will also help you with your calculations.

Formulas and measures

A = BAC (g/l)	$V_{\text{alcohol}} = V_{\text{all drinks}} \cdot C$
C = Alcohol content of the drink (% v/v)	
$V_{\text{alcohol}} =$ Total volume of alcohol present (ml)	$Q = V_{\text{alcohol}} \cdot P$
Q = Quantity of alcohol in grams (g)	
P = Density of alcohol (g/ml), i.e. 0.8 g/ml	$A = \frac{Q}{M \cdot K}$
M = Mass (weight) of the person (kg)	
K = Diffusion coefficient (varies according to amount of water in the body) i.e. 0.6 l/kg for a woman and 0.7 l/kg for a man	

EXAMPLE

Tony (180 cm, 70 kg) drinks two beers (355 ml, 6% alcohol). Calculate his BAC.

1. Calculate the total volume of drinks consumed:

Two drinks X 355 ml = 710 ml

2. Calculate the volume of alcohol (V_{alcohol}) in the drinks, knowing that the alcohol content of each drink is 6% v/v:

Isolate the unknown variable using fractions:

$$\frac{6 \text{ ml of alcohol}}{100 \text{ ml}} = \frac{x}{710 \text{ ml}} = 42.6 \text{ ml of alcohol}$$

Or calculate the volume using the formula:

$$V_{\text{alcohol}} = V_{\text{all drinks}} \cdot C (\% \text{ v/v})$$

$$V_{\text{alcohol}} = \frac{710 \text{ ml} \cdot 6 \text{ ml of alcohol}}{100 \text{ ml}} = 42.6 \text{ ml of alcohol}$$

3. Calculate the quantity of alcohol in grams (Q) in the total volume of drinks consumed, knowing that the density of alcohol is 0.8 g/ml:

$Q = ?$ $V_{\text{alcohol}} = 42.6 \text{ ml}$ $\rho = \frac{0.8 \text{ g}}{\text{ml}}$	<table border="1" style="margin-bottom: 5px; width: 100%;"> <tr> <td>$Q = V_{\text{alcohol}} \cdot \rho$</td> </tr> </table> $Q = 42.6 \text{ ml} \cdot \frac{0.8 \text{ g}}{\text{ml}} = 34.08 \text{ g of alcohol}$	$Q = V_{\text{alcohol}} \cdot \rho$
$Q = V_{\text{alcohol}} \cdot \rho$		

4. Calculate the blood alcohol content (BAC) (g/l):

$A = ?$ $M = 70 \text{ kg}$ $K = \frac{0.7 \text{ l}}{\text{kg}}$	<table border="1" style="margin-bottom: 5px; width: 100%;"> <tr> <td>$A = \frac{Q}{M \cdot K}$</td> </tr> </table> $A = \frac{34.08 \text{ g}}{70 \text{ kg} \cdot \frac{0.7 \text{ l}}{\text{kg}}} = \frac{0.7 \text{ g}}{\text{l}} \text{ or } \frac{0.07 \text{ g}}{100 \text{ ml}}$	$A = \frac{Q}{M \cdot K}$
$A = \frac{Q}{M \cdot K}$		



ANSWER: Tony has blood alcohol content (BAC) of 0.07% (m/v).

5. Now calculate Steve's BAC under the following conditions:

BLOOD ALCOHOL CONTENT	ANSWERS:
a) He weighs 50 kg and drinks three beers (355 ml each, 5% alcohol)	1.2 g/l
b) He weighs 75 kg and drinks two shooters (45 ml each, 40% alcohol)	0.55 g/l
c) He weighs 60 kg and drinks two beers (355 ml each, 6.1% alcohol)	0.8 g/l
d) He weighs 50 kg and drinks two beers (355 ml each, 5% alcohol)	0.8 g/l
e) He weighs 60 kg and drinks two beers (355 ml each, 4% alcohol)	0.5 g/l

Discuss the differences in blood alcohol content according to the variables.

APPENDIX 4

ANSWER SUPPORT FOR TEACHERS

Activity 3 Mixes to avoid

1 Answer these two questions:

- ◆ What recommendations could you give Steve about mixing alcohol and energy drinks?

Don't mix alcohol and energy drinks because:

- You could end up drinking more, or too much, alcohol.
- Energy drinks stimulate the brain and that temporarily gives you more energy to party. But that increases the risk of drinking more alcohol.
- It's dangerous to drink too much.

- ◆ If Steve decides to mix alcohol and energy drinks, what are some of the things you think he might feel the next morning when he goes to work?

Tired, despondent, incredibly thirsty, muscle pains, headache, loss of appetite, nausea, diarrhea, rapid heart rate (tachycardia), palpitations, trembling, etc.



2 Research

Read official publications containing scientific data about mixing alcohol and energy drinks that can help you better understand the effects of such mixes, and allow you to help Steve **make an enlightened decision**.

<p>Number of drinks:</p>	<p style="text-align: center;">SCIENTIFIC INFORMATION</p> <p>Mixing alcohol with energy drinks doesn't mean you can drink more. The alcohol may be diluted, but the amount is still the same.</p>						
<p>Effects when you drink the mix:</p>	<p>The combination of alcohol plus energy drink increases the speed at which you consume alcohol and thus increases the amount you drink per occasion. You end up drinking more and more.</p> <p>Because caffeine and alcohol are both diuretics, they prevent water from being reabsorbed by the kidneys and increase elimination, resulting in a chain reaction. The real danger is when you continue to drink alcohol instead of water. That just dehydrates you further and makes you thirstier. It's hard to get off the merry-go-round! ("Alcohol and Energy Drinks: Don't Get Your Kicks from this Mix!")</p>						
<p>Consequences and effects of alcohol abuse on the human body the next day:</p>	<p style="text-align: center;">PHYSICAL</p> <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Fatigue • Tremendous thirst • Muscle pain • Muscle cramps • Headache • Loss of appetite • Stomach ache • Nausea • Vomiting • Diarrhea </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Increased systolic blood pressure • Rapid heart rate (tachycardia) • Palpitations • Trembling • Significant visual-spatial problems • Impaired psychomotor skills </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Sweats • Pulmonary edema • Hypersensitivity to noise • Hypersensitivity to light • Dizziness • General and paradoxical reduction in sleep time • Increase in slow-wave sleep </td> </tr> </table> <p style="text-align: center;">PSYCHOLOGICAL</p> <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Despondency • Distress • Anxiety </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Reduced attentiveness • Reduced concentration • Reduced short-term memory </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Notable sensation of anxiety or depression • Notable sensation of irritability </td> </tr> </table>	<ul style="list-style-type: none"> • Fatigue • Tremendous thirst • Muscle pain • Muscle cramps • Headache • Loss of appetite • Stomach ache • Nausea • Vomiting • Diarrhea 	<ul style="list-style-type: none"> • Increased systolic blood pressure • Rapid heart rate (tachycardia) • Palpitations • Trembling • Significant visual-spatial problems • Impaired psychomotor skills 	<ul style="list-style-type: none"> • Sweats • Pulmonary edema • Hypersensitivity to noise • Hypersensitivity to light • Dizziness • General and paradoxical reduction in sleep time • Increase in slow-wave sleep 	<ul style="list-style-type: none"> • Despondency • Distress • Anxiety 	<ul style="list-style-type: none"> • Reduced attentiveness • Reduced concentration • Reduced short-term memory 	<ul style="list-style-type: none"> • Notable sensation of anxiety or depression • Notable sensation of irritability
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3 Rationale

Can you drink too much? Is it dangerous? **Yes and no.**

NO, mixing alcohol with an energy drink is not dangerous in itself, provided you drink a reasonable amount.

YES, because it's easy to drink a lot, which means you end up drinking too much. When you drink too much alcohol+energy drink, you're drinking too much alcohol!

And drinking too much alcohol is definitely DANGEROUS.