Taking it Further: Producing Ethanol from Fermentation

Answer the questions below.

1. Name the alcohol that contains two carbon atoms.
   Ethanol
2. State the functional group of the alcohols.
   Hydroxyl group (OH)
3. Explain why alkenes are described as unsaturated.
   They contain a C=C double bond.
4. Explain what is meant by the term anaerobic.
   In the absence of oxygen
5. Name the process that takes place in cells to release energy.
   Respiration

Do Now

Taking it Further: Producing Ethanol by Fermentation

Do Now:

1. Name the alcohol that contains two carbon atoms.
2. State the functional group of the alcohols.
3. Explain why alkenes are described as unsaturated.
4. Explain what is meant by the term anaerobic.
5. Name the process that takes place in cells to release energy.

Drill:

1. State the chemical formula of ethanol.
2. Compare the structures of ethene and ethanol.
3. Give a use of ethanol.

Do Now

Taking it Further: Producing Ethanol by Fermentation

Read Now:

Fermentation is an anaerobic chemical process because takes place in the absence of oxygen. It is used to make many products for humans, including bread and alcoholic drinks. It has also now been suggested that eating fermented foods, such as kimchi or kombucha, can have a beneficial effect on gut health. Foods that have been fermented have started to undergo breakdown by microorganisms such as yeast or bacteria, which produces products that give the food a different flavour. Gut microbiologists suggest that eating fermented food, which contain cultures of different microorganisms, can increase the gut biodiversity and provide health benefits.

1. Explain why fermentation is an anaerobic process.
2. Give an example of a product that humans make from fermentation.
3. Give an example of a fermented food.
4. Describe the advantages of eating fermented food that microbiologists suggest.

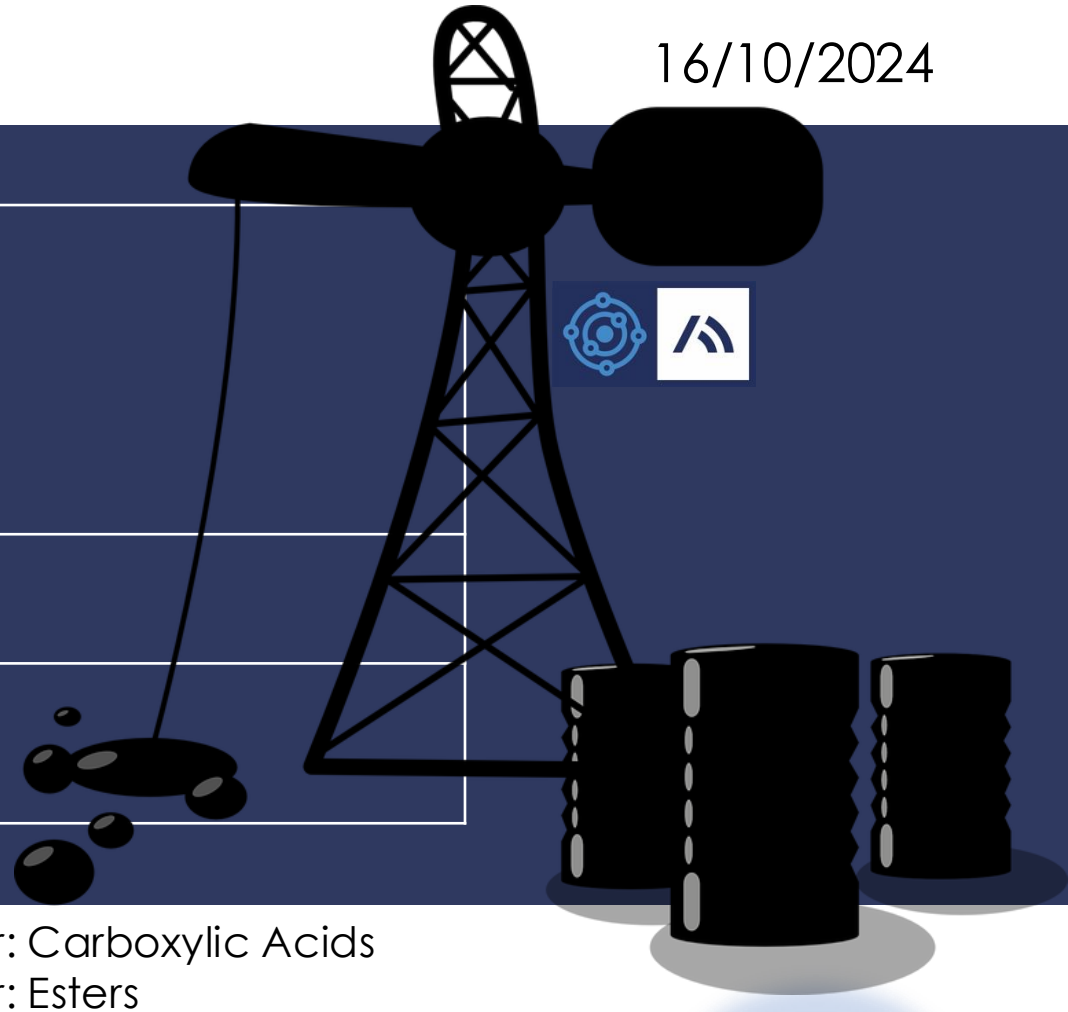
Do Now

16/10/2024

Taking it Further: Producing Ethanol by Fermentation

C5.1.8

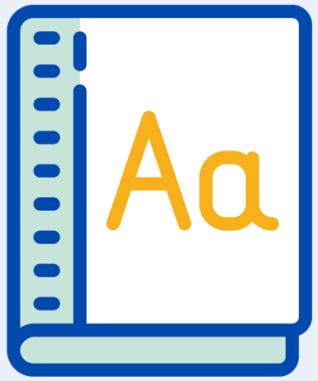
Science Mastery



Following this lesson, students will be able to:

- State the equation for the production of ethanol through fermentation
- Describe the conditions required for fermentation
- Describe the advantages and disadvantages of producing ethanol by fermentation

Key Words:



alcohol **ethanol** **fermentation**

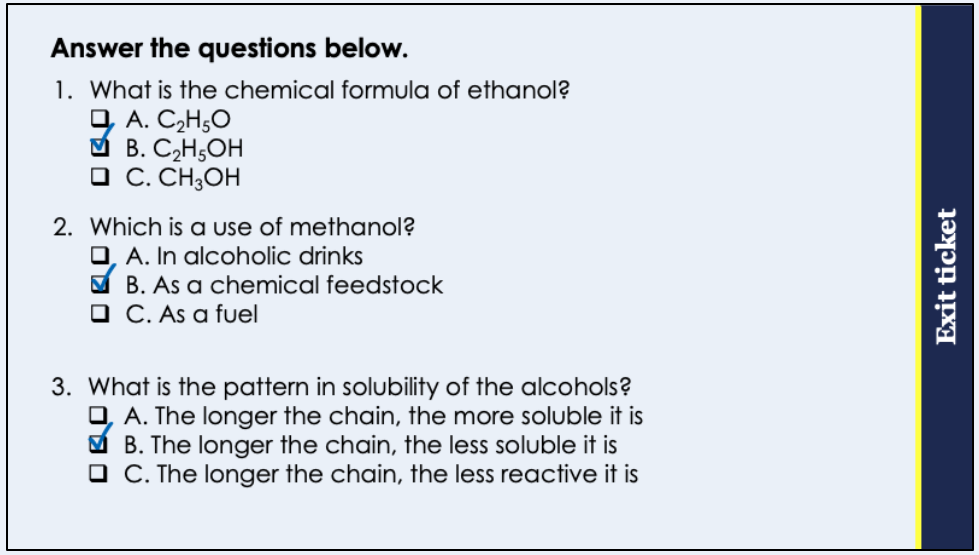
anaerobic **yeast**

Lesson Objectives

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the **pre-unit quiz**.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Answer the questions below.

1. What is the chemical formula of ethanol?
   - ☐ A. C_2H_5O
   - ☑ B. C_2H_5OH
   - ☐ C. CH_3OH

2. Which is a use of methanol?
   - ☐ A. In alcoholic drinks
   - ☑ B. As a chemical feedstock
   - ☐ C. As a fuel

3. What is the pattern in solubility of the alcohols?
   - ☐ A. The longer the chain, the more soluble it is
   - ☑ B. The longer the chain, the less soluble it is
   - ☐ C. The longer the chain, the less reactive it is

Exit ticket

Fix-it

Ethanol

Ethanol is an **alcohol**.

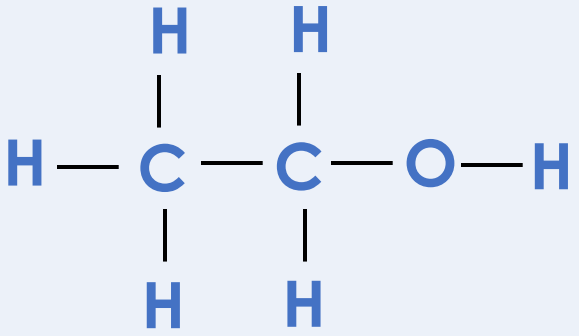
It is useful as a solvent, a fuel or in alcoholic drinks.

It can be made in different ways:

- **Fermentation**
- **Hydration of ethene**

Ethanol

C_2H_5OH



Fermentation

Fermentation is when microorganisms start to break down glucose in the absence of oxygen.

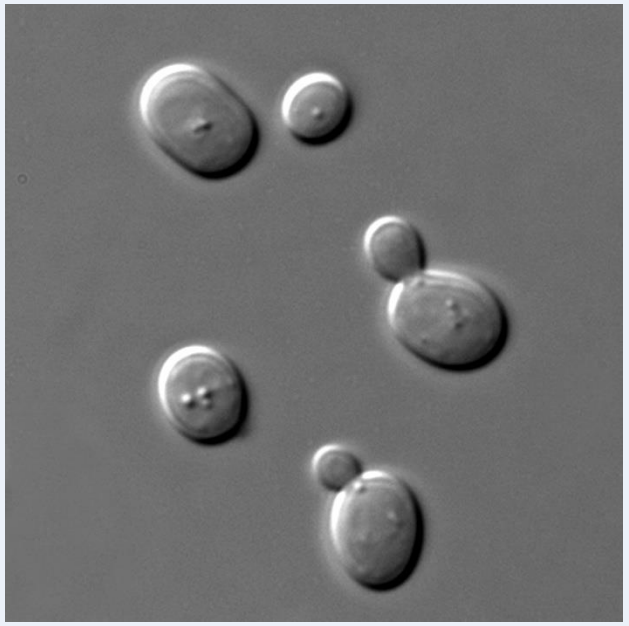
Glucose ⟶ ethanol + carbon dioxide

Did you know?
One yeast cell is tiny - just one teaspoon holds about 75 billion cells

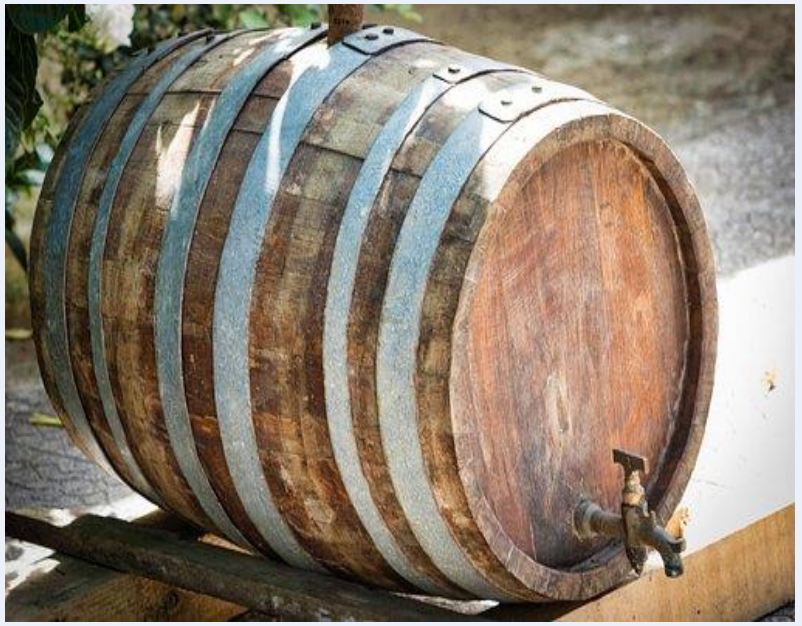
Ethanol can be used to make alcoholic drinks, as a solvent or as a fuel, either by itself or mixed with petrol.

Ethanol produced through fermentation can be **distilled** to increase the **purity**.

Carbon dioxide produced is also useful in baking.



Conditions for Fermentation



For fermentation to take place, there must be:

- A **sugar solution**, mixed with **yeast**
- **No** air or **oxygen** getting in (anaerobic)
- A warm temperature (**25 - 35 °C**)

The **enzymes** in yeast can be **denatured** if they are over heated, meaning they can no longer function.

Fermentation is a **slow** process and can take days or even weeks.

Which statements do you agree with?

Fermentation is an aerobic process

Fermentation is an anaerobic process

Ethanol can be used as a fuel

Ethanol can be used in baking

Talk Task

How could the purity of ethanol be increased by distillation?

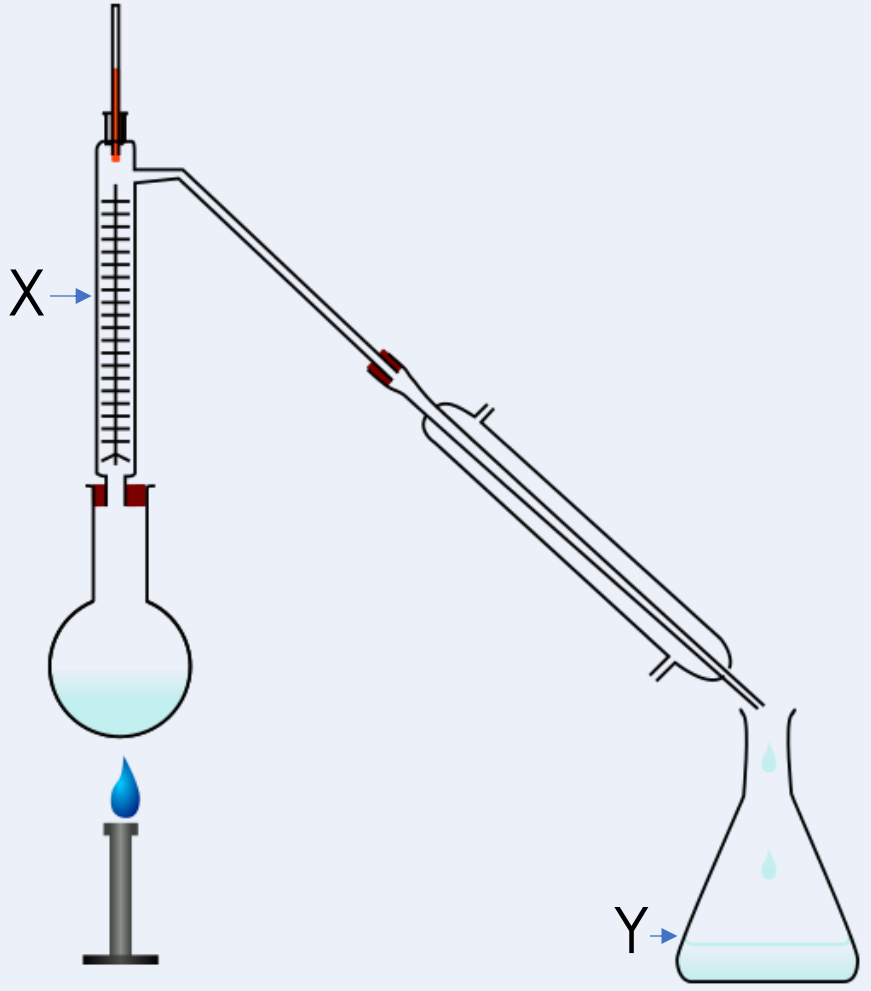
A solution of ethanol can be purified using distillation.

What changes of state would be involved in distillation?

What would be found at point X?

What would be found at point Y?

Boiling point of water: **100 °C**
Boiling point of ethanol: **78 °C**



Talk Task

Determine whether each of these statements is true or false

1. Ethane is made using fermentation **False**
2. Fermentation is an aerobic process **False**
3. Fermentation produces lactic acid **False**
4. Fermentation produces ethanol and carbon dioxide **True**
5. Ethanol is found in alcoholic drinks **True**
6. Ethanol can be mixed with petrol and used as a fuel **True**

Check for understanding

Drill

1. Explain why fermentation is an anaerobic process.
2. State the reactant for fermentation.
3. State the products of fermentation.
4. Describe the conditions required for fermentation.
5. Give a use of ethanol produced through fermentation.
6. Give a use of carbon dioxide produced through fermentation.
7. Describe how ethanol produced through fermentation can be purified.

Check for understanding

Drill answers

1. It takes place in the absence of oxygen.
2. Glucose
3. Ethanol and carbon dioxide
4. A temperature of 25-35 °C, no oxygen and a sugar solution mixed with yeast.
5. As a solvent, a fuel or in alcoholic drinks
6. In baking (to make dough rise)
7. Using distillation, as ethanol has a lower boiling point than water so can be separated using evaporation and condensation.

Check for understanding

I: Describe: *to recall facts, events or processes in an accurate way*

Example question:

Describe the advantages of producing ethanol by fermentation.

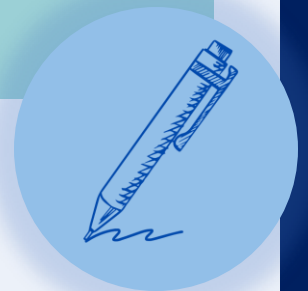
Rate of reaction	Low
Purity of ethanol produced	10-15%
Energy usage	Low
Raw material used	Sugar

Model answer:

- Fermentation does not use much energy
- Fermentation uses sugar as the raw material, which is a renewable resource

To 'describe', your answer should:

- Use **bullet points** to keep your answer clear
- Cover enough points to **fully answer** the question
- Use scientific **keywords** in your answer
- '**Say what you see**' if there is a diagram, graph or table.



Writing like a scientist

We: Describe: *to recall facts, events or processes in an accurate way*

Example question:

Describe the <u>disadvantages</u> of producing ethanol by fermentation.

Rate of reaction	Low
Purity of ethanol produced	10-15%
Energy usage	Low
Raw material used	Sugar

Model answer:

- Fermentation takes a long time as there is a low rate of reaction
- Fermentation produces ethanol with relatively low purity, so may need to be distilled

To 'describe', your answer should:

- Use **bullet points** to keep your answer clear
- Cover enough points to **fully answer** the question
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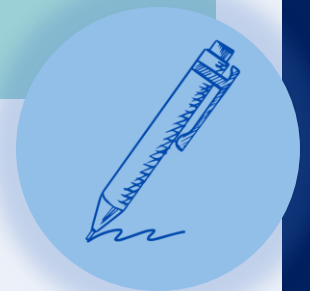

Writing like a scientist

You: Describe: *to recall facts, events or processes in an accurate way*

Example question:

Describe the advantages and disadvantages of producing ethanol by fermentation.

Rate of reaction	Low
Purity of ethanol produced	10-15%
Energy usage	Low
Raw material used	Sugar

Model answer:

- Fermentation takes a long time as there is a low rate of reaction
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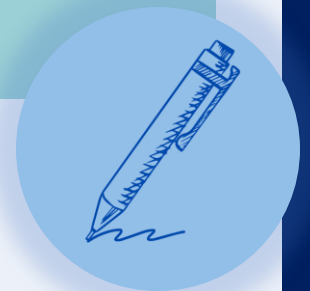

Writing like a scientist

Answer the questions below.

1. Choose the word equation for fermentation.
   - ❑ A. Glucose → lactic acid
   - ☑ B. Glucose → ethanol + carbon dioxide
   - ❑ C. Glucose + ethanol → carbon dioxide

2. Why should fermentation take place at a warm temperature?
   - ❑ A. So the reaction does not happen too quickly
   - ☑ B. So the enzymes in yeast are not denatured
   - ❑ C. So the ethanol can be evaporated

3. What is a disadvantage of producing ethanol by fermentation?
   - ❑ A. It is a very quick process
   - ☑ B. It can take days or weeks
   - ❑ C. It does not require much energy

Exit ticket

Feedback

Lesson C5.1.8	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!