8.2 Endothermic reactions

In this topic you will:

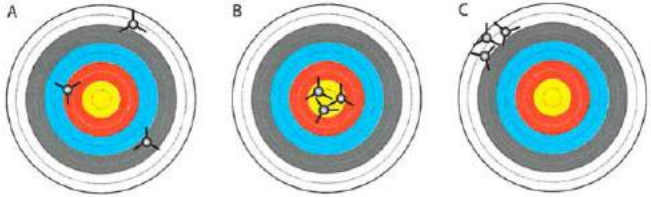
- learn about chemical reactions that absorb energy
- distinguish between exothermic and endothermic reactions and processes
- learn about the use of exothermic and endothermic reactions and processes.

Getting started

When you make any scientific measurements, you are told that you need to be accurate and precise.

- What do you think this means? Discuss it with your partner.

Look at these three archery targets.



- If you are being accurate, where should your arrows hit the target?
- If you are being precise, should all your arrows be near to one another or spread out?
- Which archer, A, B or C, has been precise but not accurate?
- Which archer, A, B or C, has been neither precise nor accurate?
- Which archer, A, B or C, has been both accurate and precise?

Share your answers and ideas with the class.

Key words

endothermic process

endothermic reaction

DISSOLVING SALT IN WATER

PHOTOSYNTHESIS

COOKING AN EGG

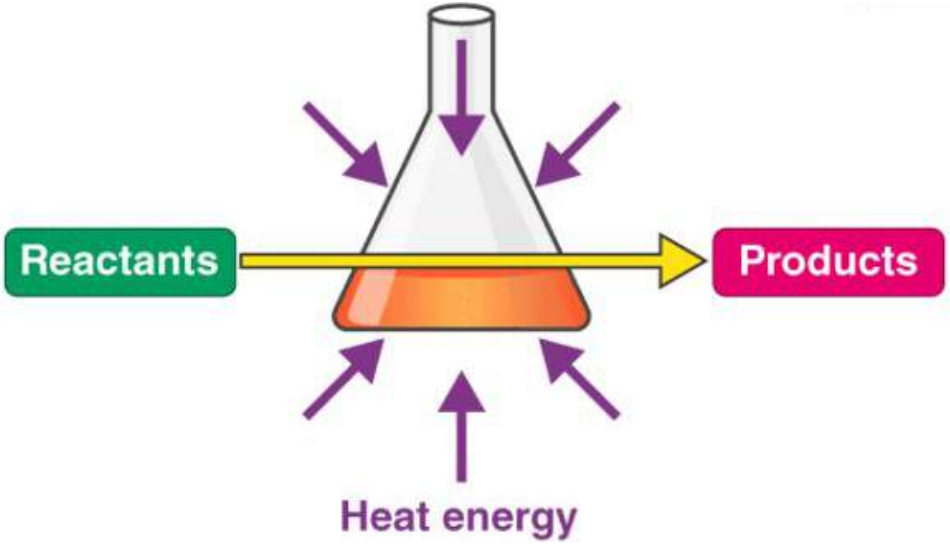
BAKING BREAD

WATER EVAPORATION

Endothermic reactions

These chemical reactions **absorb energy** from the surroundings and change it to chemical energy stored in the chemical bonds.

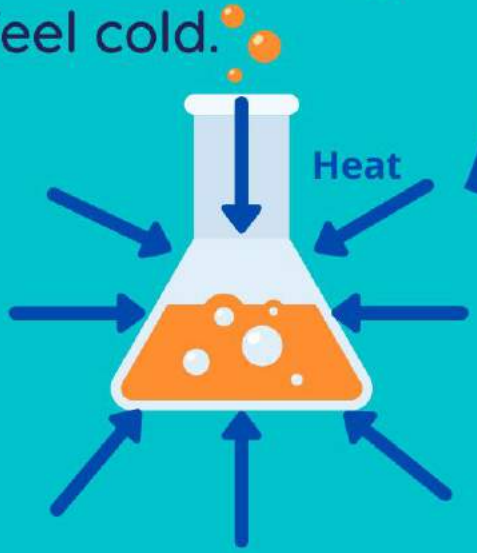
When such reactions take place, temperature at the end of reaction is lower that the start of the reaction.

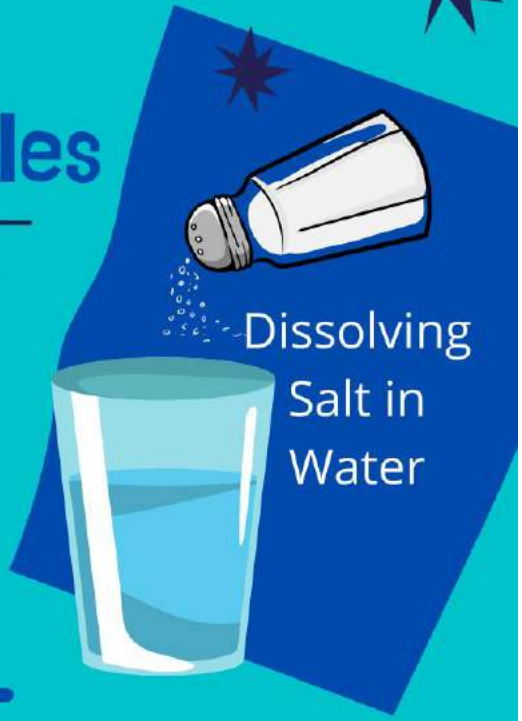


Endothermic Reaction Examples

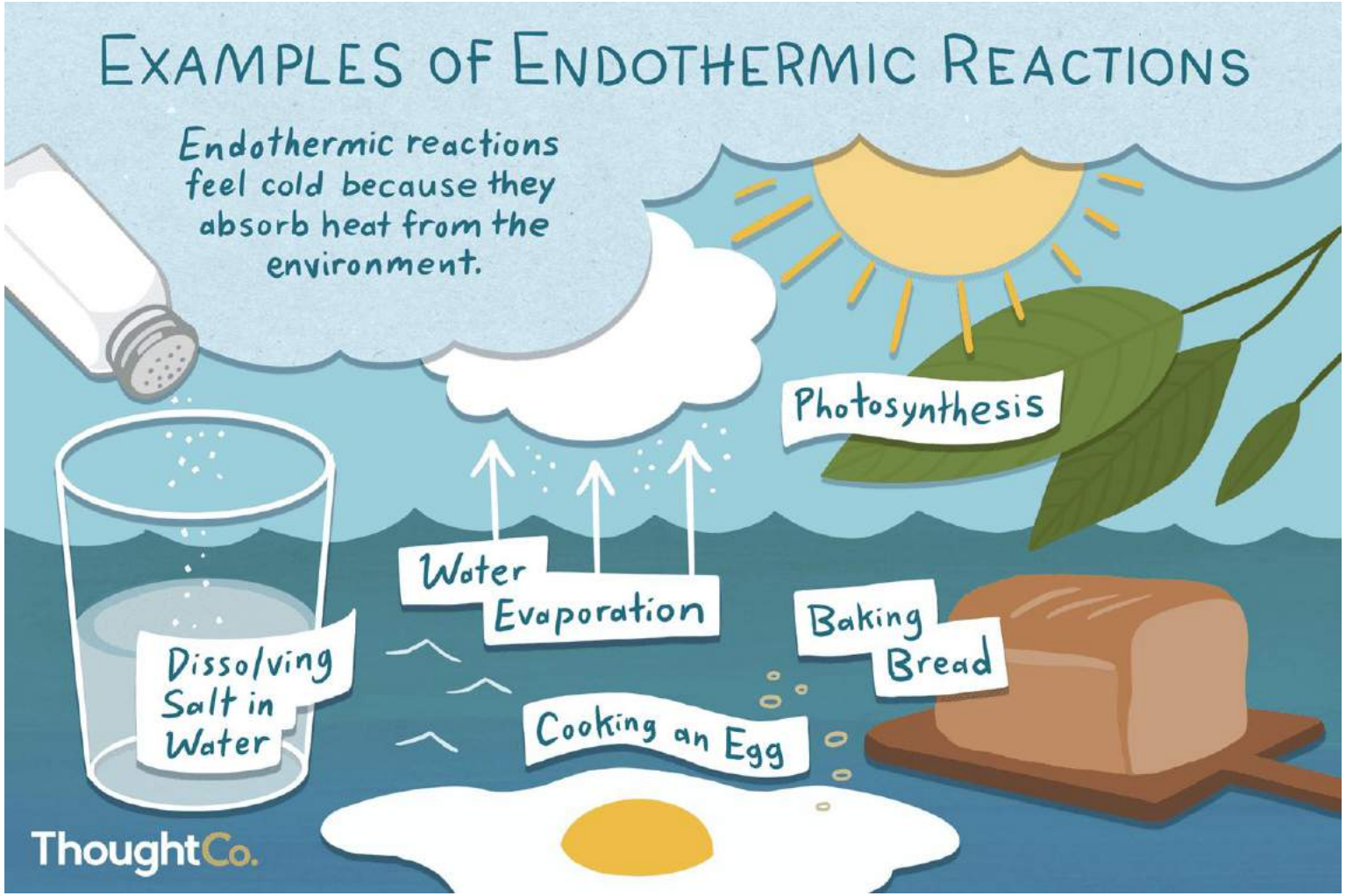
Endothermic reactions absorb heat from their surroundings and feel cold.

Photosynthesis





Dissolving Salt in Water


EXAMPLES OF ENDOTHERMIC REACTIONS
Endothermic reactions feel cold because they absorb heat from the environment.
Photosynthesis
Water Evaporation
Baking Bread
Dissolving Salt in Water
Cooking an Egg
ThoughtCo.

Eating sherbet sweets - endothermic reaction

Thermal energy absorbed from surroundings → stored in the form of chemical bonds → test tube feels colder

Sodium hydrogencarbonate + citric acid → sodium citrate + water + carbondioxide

This reaction takes place in our mouth

Sherbet - mixture of dry citric acid and sodium hydrogencarbonate

Eat sherbet sweet → these substances dissolve in saliva → react together → gives a cool, *fizzy* feeling in mouth (refreshing)

Questions

1 Look at the word equation again:

sodium hydrogencarbonate + citric acid ⟶ sodium citrate + water + carbon dioxide

a What are the reactants?

b Which are the products?

2 What is an endothermic reaction?

3 Explain why eating sherbet sweets makes your mouth feel cooler.

4 You may also get a 'fizzy' feeling in your mouth when you eat sherbet. Why is this?

Dissolving potassium chloride in water - endothermic process

Adding potassium chloride in water → it dissolves → beaker gets cold

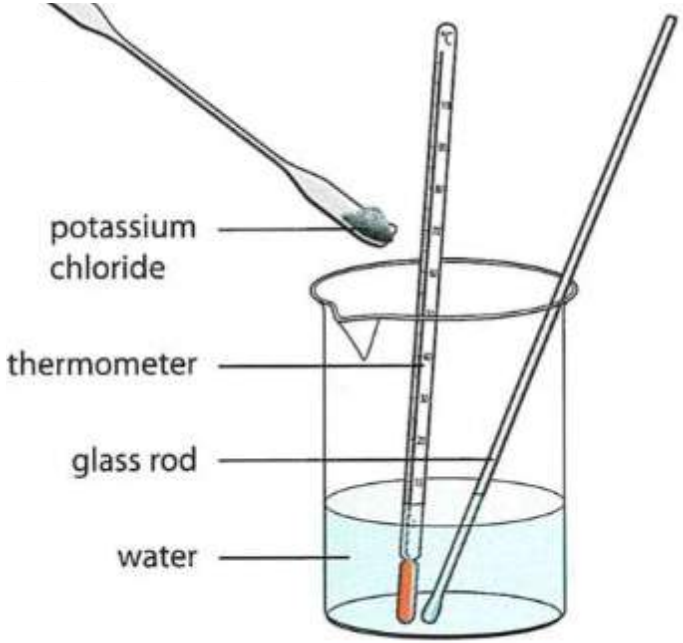
No reaction takes place

No new products formed

Only a solution of potassium chloride forms

Decide what is solute and solvent in this example?

Thermal energy absorbed from surroundings makes the beaker feel cold

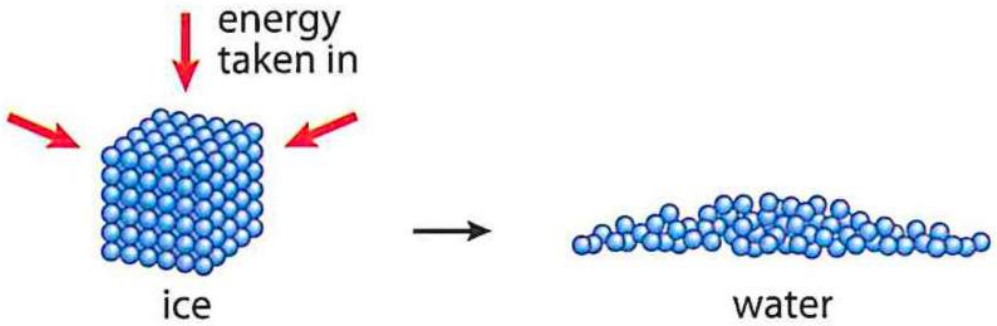


Melting of ice - endothermic process

Thermal energy is absorbed from surroundings as solid ice changes to liquid water

Particles in ice,

- arranged in rows
- tightly packed
- only vibrate about fixed positions
- strong forces between them



As particles absorb thermal energy from surroundings,

- vibrate more and more
- have enough energy to overcome the forces holding them
- begin to move and slide past one another

Water is now in a liquid state

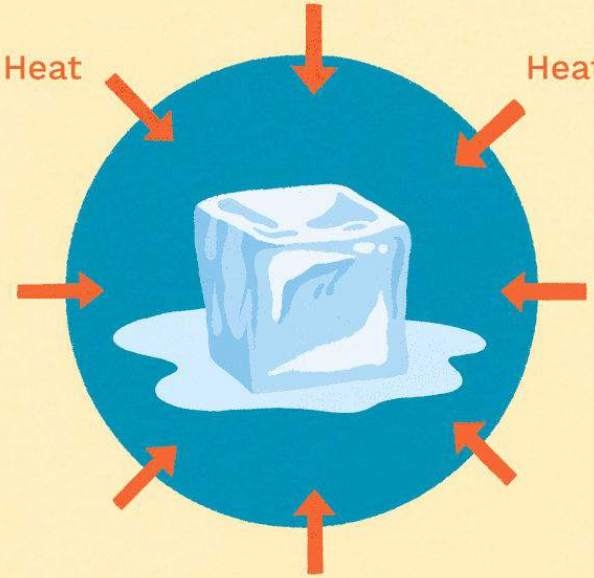
Questions

5 Why is ice melting called an endothermic *process* and not an endothermic *reaction*?

6 Suggest a change of state, other than ice melting, that is an endothermic process.

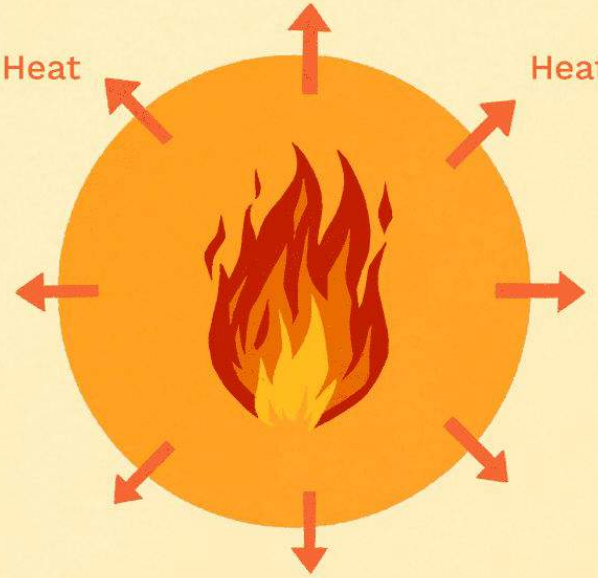
7 When you have been swimming and you come out of the pool, you may feel cold. Use your understanding of endothermic processes to explain why.

8 Suggest whether water freezing is an endothermic or exothermic process. Can you explain your suggestion?



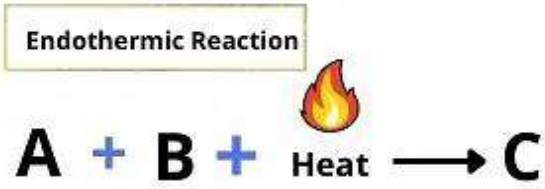
Endothermic

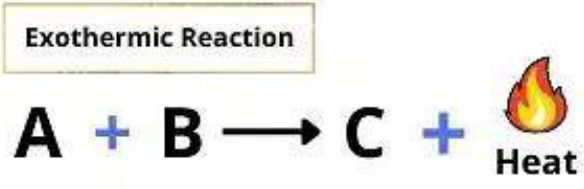
The endothermic reaction is cooler than surroundings



Exothermic

The exothermic reaction is hotter than surroundings





Using endothermic process - ice packs when injured

Ice packs are stored in fridge or freezer until needed

When placed on injured area → heat is transferred to ice pack → ice melts

Injured area cools down, prevents it from swelling

Ice pack stored back in fridge again

Using endothermic process - ice packs when injured

These packs are used when there is no fridge or freezer

These packs have compartment system

- One contains ammonium nitrate
- Other contains water

When you push on the pack → compartment breaks → substances mix → ammonium nitrate dissolves in water → temperature drops

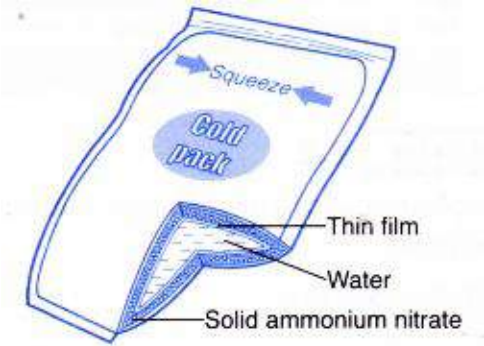
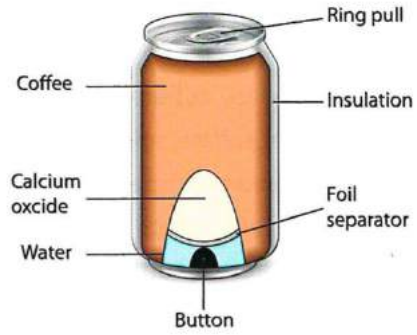


Figure *Structure of a cold pack*

Using exothermic reactions - self heating cans of food or drink

Such cans contain a small compartment at the bottom separated by foil

- One contains calcium oxide
- Other contains water



A self-heating can

Pressing a button breaks foil seal → two parts are mixed

Calcium oxide + water → Calcium hydroxide

Reaction gives off heat (thermal energy) → transferred to food/drink

- Useful in remote areas with no power
- Useful on camping sites
- Expensive; sometimes heating is not uniform

Questions

9 Explain why self-heating cans are very expensive.

10 Explain why a self-heating food container can only be used once.

11 Describe **one** advantage and **one** disadvantage of each of the two types of icepack described above.