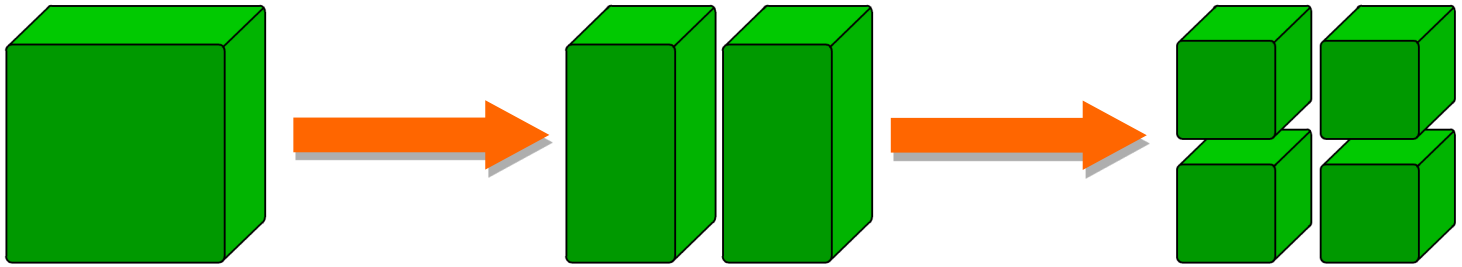
Surface Area, Catalysts and Reaction Rates

Effect of surface area on rate of reaction

Any reaction involving a solid can only take place at the surface of the solid.

If the solid is split into several pieces, the surface area increases. What effect will this have on rate of reaction?



low surface area **high surface area**

This means that there is an increased area for the reactant particles to collide with.

The smaller the pieces, the larger the surface area. This means more collisions and a greater chance of reaction.

Surface area and particle collisions

How does surface area affect particle collisions?

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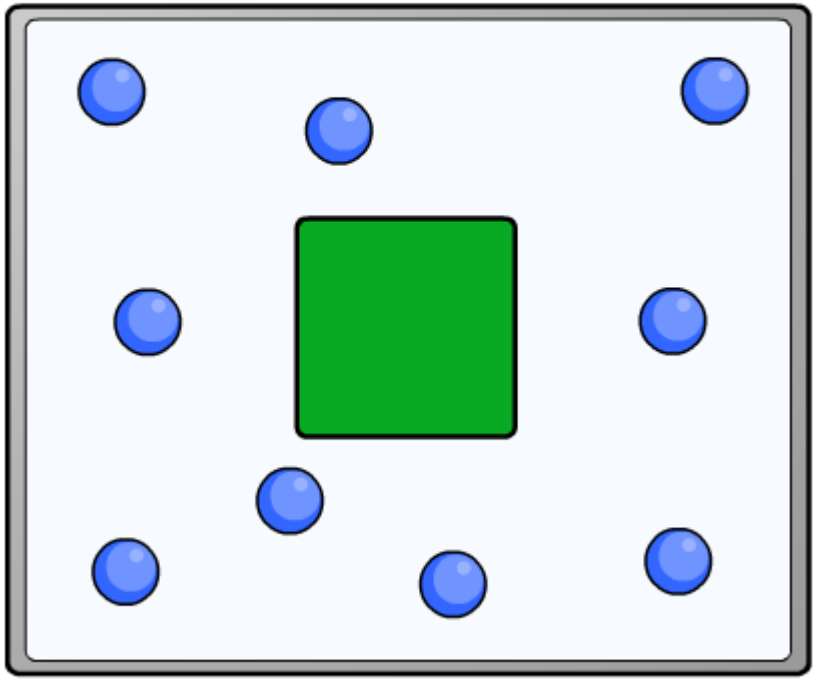
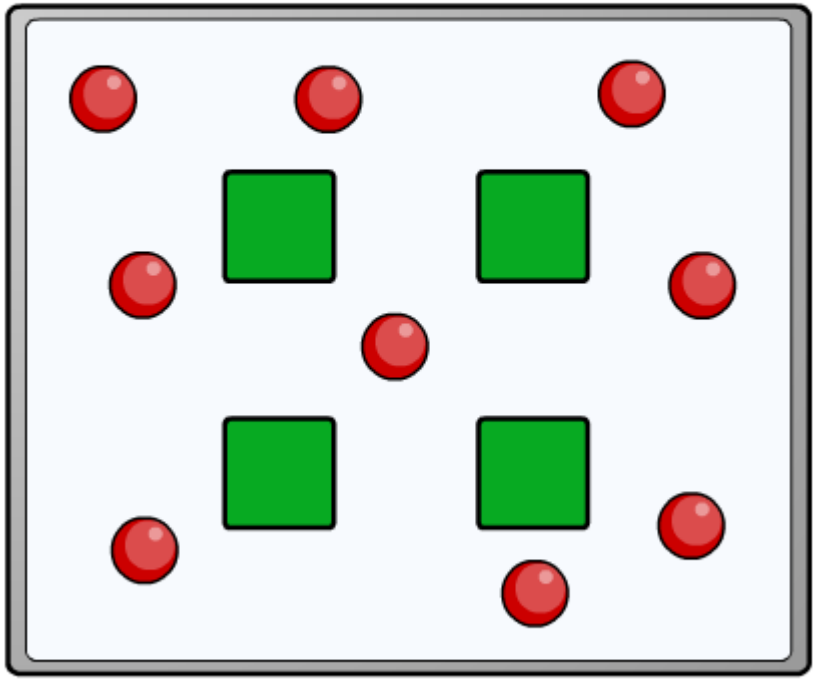




small surface area

large surface area

Reaction between a carbonate and acid

Marble chips are made of calcium carbonate. They react with hydrochloric acid to produce carbon dioxide.

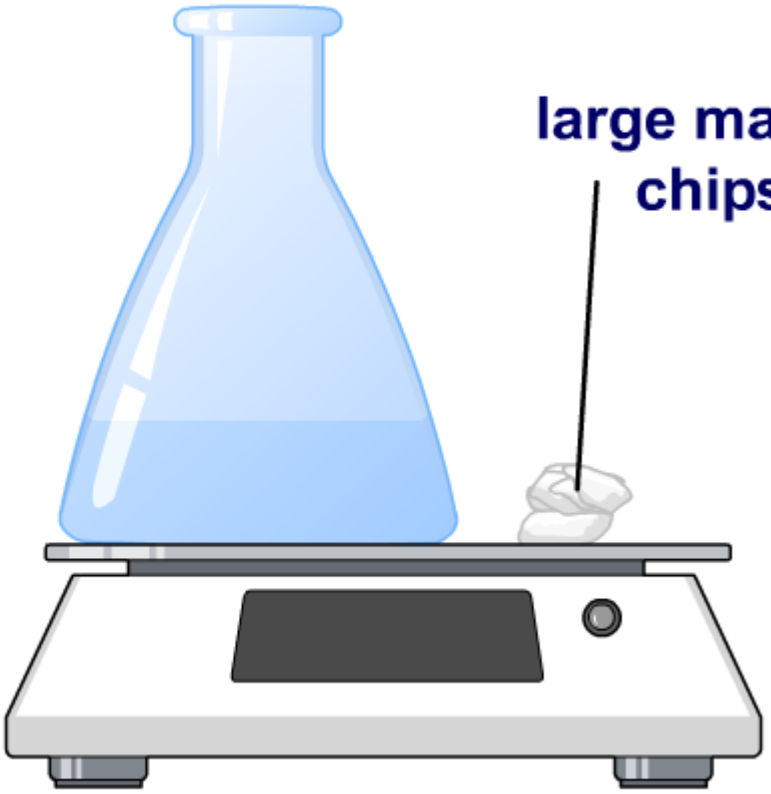
calcium carbonate + **hydrochloric acid** → **calcium chloride** + **water** + **carbon dioxide**

$CaCO_3$ (aq) + $2HCl$ (aq) → $CaCl_2$ (aq) + H_2O (aq) + CO_2 (g)

The effect of increasing surface area on the rate of reaction can be measured by comparing how quickly the mass of the reactants decreases using marble chips of different sizes.

The effect of surface area on rate

How does surface area affect rate of reaction?



The reaction between different sized marble chips and hydrochloric acid can be used to investigate the effect of surface area on rate of reaction.

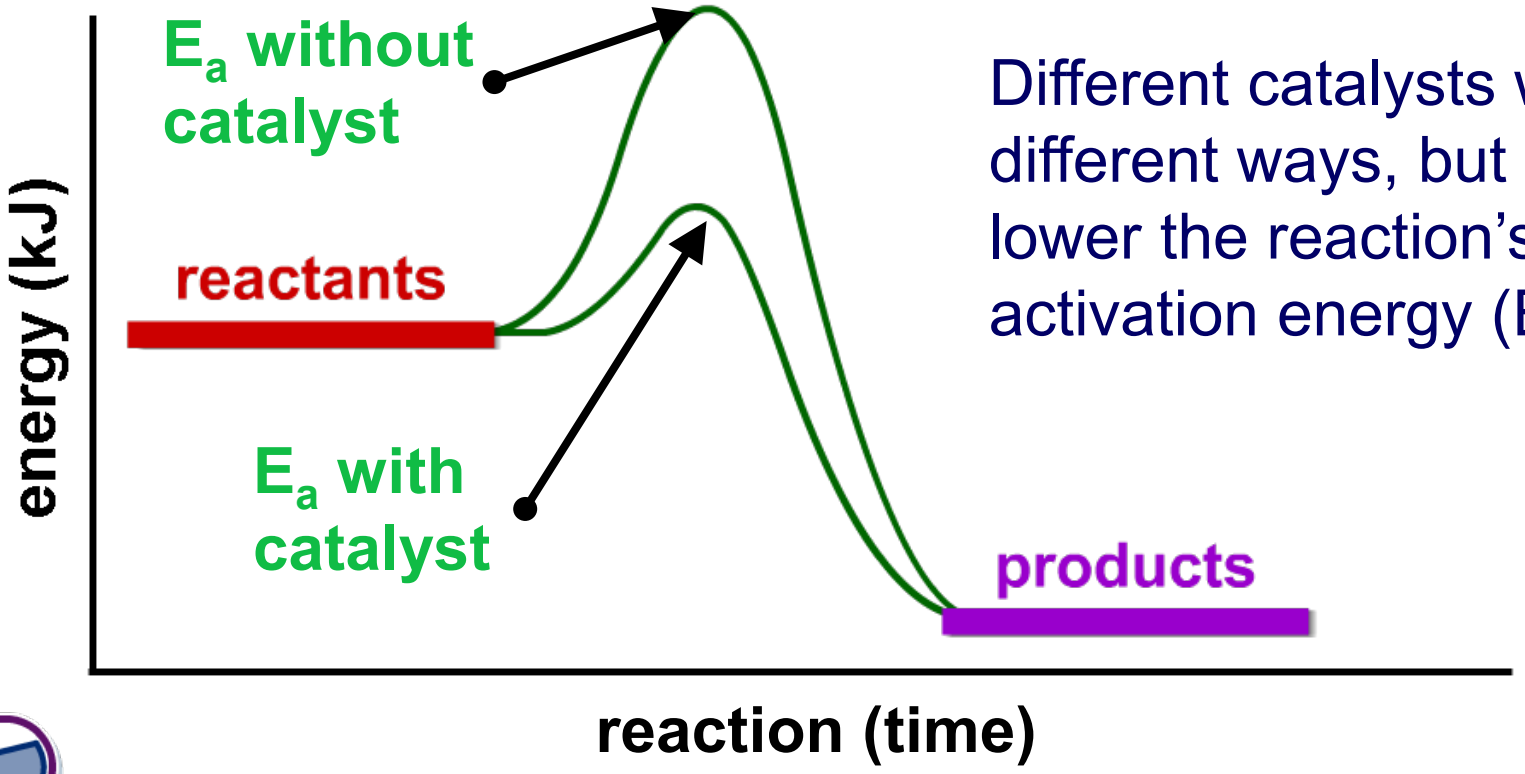
Click "**start**" to find out how.

start

What are catalysts?

Catalysts are substances that change the rate of a reaction without being used up in the reaction.

Catalysts never produce more product – they just produce the same amount more quickly.



Different catalysts work in different ways, but most lower the reaction's activation energy (E_a).

Everyday catalysts

Many catalysts are transition metals or their compounds. For example:

- **Nickel** is a catalyst in the production of margarine (hydrogenation of vegetable oils).
- **Iron** is a catalyst in the production of ammonia from nitrogen and hydrogen (the Haber process).
- **Platinum** is a catalyst in the catalytic converters of car exhausts. It catalyzes the conversion of carbon monoxide and nitrogen oxide into the less polluting carbon dioxide and nitrogen.

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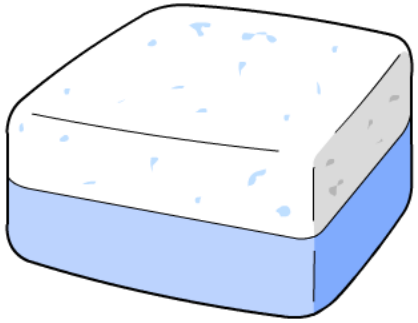
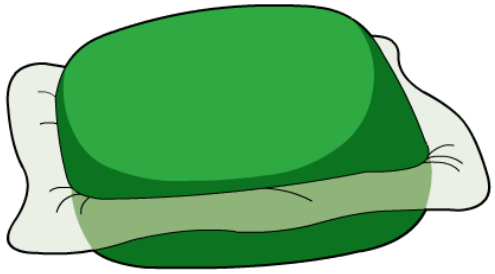
Catalysts in industry

Why are catalysts so important for industry?



- Products can be made more quickly, saving time and money.



- Catalysts reduce the need for high temperatures, saving fuel and reducing pollution.

Catalysts are also essential for living cells. Biological catalysts are special types of protein called **enzymes**.