# *Reaction rates* **Teacher background notes**

**In this investigation, factors which affect reaction rates are investigated by conducting experiments. Students will then use their knowledge and understanding of reaction rates to take on the role of a process chemist charged with controlling the time taken for a specific reaction to take place.**

## [Australian Curriculum: Science links](http://assist.asta.edu.au/resource/3177/reaction-rates-cle)

## Learning intentions

Students will be able to:

* observe and understand that chemical reactions take place at different rates
* identify factors which can affect reaction rates
* explain the effect of surface area, concentration and temperature on reaction rates
* plan appropriate investigation methods to manipulate the rate of a chemical reaction, taking account of fair testing
* make careful and accurate observations
* make predictions based on scientific understanding
* construct graphical representations of data and use these to determine relationships between variables
* construct conclusions based on evidence.

## Suggested time for this CLE

The time needed to complete the *Reaction rates CLE* will depend on the depth of the prior knowledge of students, the time to perform the five investigations (‘Surface area and reaction rate’, ‘Concentration and reaction rate’, ‘Temperature and reaction rate’, ‘Catalysts and reaction rate’, ‘Challenge – You are the process chemist’) and follow up with any further extension activities. Allow 4–6 hours.

## Prior conceptual knowledge

Science / Year 9 / Science Understanding / Chemical Sciences

*Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is not created or destroyed* [*(ACSSU178)*](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU178)

*Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer* [*(ACSSU179)*](http://www.australiancurriculum.edu.au/Curriculum/ContentDescription/ACSSU179)

## New concepts to be introduced

The concept of reaction rate is explored. Students need a clear understanding of what happens in a chemical reaction (from year 9) in order to start to explore the factors that affect the reaction rate.

### Reaction rate

A reaction rate is an expression of how quickly the reactants change into the products. (Technically the reaction rate is expressed as the change in concentration divided by the change in time.)

For a given reaction, quite often (for practical purposes) the time taken for the reaction to be completed is used as an indication of the reaction rate i.e. how fast the reaction occurs. In these investigations, students will use time as an indicator of how fast a reaction takes place – for given quantities of reactants. The given quantities of reactants allow the reaction time to be a fair representation of the reaction rate and consequently it is fair to use the time taken to compare the reaction rates. However, students need to appreciate that time and rate are different quantities. Time is a single quantity whereas rate is a change in the amount of substance in a specific time.

### Collision theory

The following information is provided as background to explain why different factors affect reaction rates. It is not expected that this be taught, as the curriculum only requires year 10 students to explain how factors affect reaction rate not why. Collision theory is specified in the year 11 chemistry course.

The collision theory proposes that reactions take place when there are successful collisions between reacting particles. A successful collision means the bonds break, atoms rearrange and new bonds form.

A successful collision depends firstly on the particles colliding. Secondly, the particles must collide with sufficient energy and in the correct orientationfor the bonds to break, atoms to rearrange and new bonds to form.

The collision theory explains the influence various factors have on the reaction rate. For example, when particles have more kinetic energy (due to an increased temperature) they move faster so there are more collisions in the same time period and the collisions involve more energy so the probability of successful collisions id increased thus increasing reaction rate.

When there are more particles or better access to particles, then reactions are more likely to occur. Catalysts are chemicals that increase the rate of reactions by providing and alternative reaction pathway but they are not used up in the reaction. The presence of a catalyst will increase the reaction rate.

## Possible misconceptions

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| **STUDENTS MAY THINK…** | **INSTEAD OF THINKING…** |
| Time for the reaction is the same as the rate. | Rate is a measurement which compares the change in two quantities – time it takes a certain quantity of reactants to react or products to form.  The time for a specific reaction can be an indication of the rate at which it takes place. However, the rate is measured by the change of concentration of the reactants or products over time. |
| Reactions always go to completion. | Not all reactions go to completion.  Some reactions reach a chemical equilibrium (balanced state) so reactants and products are present. |
| The rate doesn’t change as the reaction proceeds. | The rate of reaction is not constant with the reaction proceeding more rapidly initially and then the rate decreasing as the number of reacting particles decrease. When the rate is measure over the duration of a reaction it is an average. |

## Links to further information

Further background information can be found in the following comprehensive units of work. The information presented in these units of work is at year 11 standard. Students at year 10 level are not expected to understand these concepts. Teachers should use the units as background information for themselves.

* ‘Rate of Reaction’, GCSE Chemical reactions and tests, BBC Bitesize website <https://www.bbc.co.uk/bitesize/guides/z3nbqhv/revision/1>