

sequence overview



Background

These SPICE resources can be drawn together into a learning pathway for students to develop their understanding of properties of mechanical waves and how they relate.

The pathway is designed for teachers of year 10 chemistry, but may also be used with students in earlier or later years at the discretion of the teacher.

Links to the Australian Curriculum: Science

Science understanding concepts include:

Chemical sciences

Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSU187)

- investigating how chemistry can be used to produce a range of useful substances such as fuels, metals and pharmaceuticals
- predicting the products of different types of simple chemical reactions
- using word or symbol equations to represent chemical reactions
- investigating the effect of a range of factors, such as temperature and catalysts, on the rate of chemical reactions

Science as a human endeavour concepts include:

Nature and development of science

Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community (ACSHE191)

Use and influence of science

Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities (ACSHE195)

The values and needs of contemporary society can influence the focus of scientific research (ACSHE230)

Science inquiry skills concepts include:

Questioning and predicting

Formulate questions or hypotheses that can be investigated scientifically (AC SIS198)

Planning and conducting

Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (AC SIS199)

Processing and analysing data and information

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (AC SIS204)



Background

The pathway is structured around a constructivist model based on the 5-Es where teachers may:

- **Engage** students' interest and minds in the concept of reaction rates. Students watch a video about photochemical smog and chemical reactions that cause its formation.
- provide opportunities for students to **Explore** what they know about factors that affect reaction rates. Students investigate a real world reaction, in the laboratory, to find ways to speed up or slow down reactions.
- **Explain** concepts. Students use an animation to examine relationships between reaction rates, collision theory, energy profile diagrams and kinetic energy distribution graphs.
- **Elaborate** on concepts. Students apply their knowledge in different contexts and extend their knowledge of reaction rates through a brief study of enzymes and creation of a multimedia presentation.
- **Evaluate** students' progress through the pathway.

Learning pathway



Reaction rates 1: Photochemical smog

Photochemical smog comprises a teacher guide, background sheet and video.

This resource introduces students to study of reaction rates. It shows how environmental factors can increase chemical reactions that occur in the atmosphere to produce photochemical smog. See the teacher guide for detailed information on the purpose and use of this resource.



Activity: reaction rate circuit

The purpose of this activity is to give students:

- experience with changing reaction rates,
- opportunities to explore some factors that affect the rate of a chemical reaction, and
- a chance to identify ways that the rate of reaction can be measured.

The activity

Students complete a circuit of five simple rates of reaction experiments.

Introduce students to the activity and discuss lab safety instructions. Then, working in groups, students complete the five experiments, clarifying what they know about reaction rates in relation to the following focus questions. To do this they may use a group strategy such as 'placemat'.

- How is the reaction rate measured for each experiment?
- What factor affecting the reaction rate is measured in each experiment?
- What other factors can affect the rate of a reaction?

Experiments

All teachers have an arsenal of reaction rate experiments and the following activities are provided as a guide only.

<p>1. Disappearing act (concentration)</p> <ul style="list-style-type: none"> • three test tubes, clearly labelled • 0.5M, 1M and 2M hydrochloric acid • three magnesium strips 	<p>Set out test tubes and label with three different molarities of hydrochloric acid.</p> <p>Put 20 mL of each molarity of hydrochloric acid into the corresponding test tube.</p> <p>Drop a magnesium strip into each test tube at the same time.</p> <p>Observe which magnesium strip disappears first.</p>
<p>2. Balloon races (temperature)</p> <ul style="list-style-type: none"> • two conical flasks • teaspoon • 100 mL vinegar for each flask • 100 mL hot water • 100 mL cold water • bicarbonate of soda • two balloons 	<p>Pour cold water and hot water into separate labelled flasks.</p> <p>Add vinegar to each flask.</p> <p>Add a teaspoon of bicarbonate soda to each flask and quickly place a balloon over the top of each.</p> <p>Record what happens.</p>
<p>3. Rhubarb, rhubarb (state of subdivision)</p> <ul style="list-style-type: none"> • rhubarb stalks • 100mL vinegar for each flask • three beakers • beaker with 30 mL of water • potassium manganate (VII) solution • white tile • stirrer • two conical flasks • stopwatch 	<p>Cut from a rhubarb stalk three pieces of equal length (about 5 cm each).</p> <p>Cut one piece in half, and cut another piece into quarters.</p> <p>Place one beaker containing water, and an empty beaker, on a white tile.</p> <p>Pour 30 mL of potassium manganate solution into the empty beaker, add a 5 cm piece of rhubarb, start stopwatch and stir.</p> <p>Continue stirring until the liquids in the two beakers look the same colour, then stop timer.</p> <p>Record the time.</p> <p>Repeat this process with the halved pieces of rhubarb, and then with the quartered pieces.</p>
<p>4. Elephant toothpaste (catalysis)</p> <ul style="list-style-type: none"> • clean 1.5 or 2 L plastic bottle • tray to place bottle, for easy cleanup • hydrogen peroxide (6% solution works well) • 20 g of dry yeast (one packet) • 60 ml of warm water • food colouring (for coloured effect only) • liquid dishwashing detergent • small beaker 	<p>Mix yeast and warm water in a beaker. Pour 125 ml of hydrogen peroxide into a plastic bottle.</p> <p>Add a small amount (about a teaspoon) of detergent to the bottle.</p> <p>Add a few drops of food colouring.</p> <p>Add the beaker of yeast. The reaction should take place rapidly.</p> <p>Yeast is a biological catalyst for this reaction, increasing the breakdown of H_2O_2 to H_2O and O_2. Potassium iodide can also be used in place of yeast as a chemical catalyst.</p>
<p>5. Nature of reactants</p> <ul style="list-style-type: none"> • magnesium strip • aqueous silver nitrate and dropper • 3.0 M hydrochloric acid • two test tubes • test tube rack • stop watch 	<p>Fill each test tube with 20 mL of hydrochloric acid.</p> <p>Drop a magnesium strip into one of the test tubes, and record the time it takes for it to disappear.</p> <p>Put two or three drops of silver nitrate into the other test tube of hydrochloric acid and record the time.</p> <p>Explain differences in time in terms of the nature of reactants.</p>

Reaction rates 2: Investigating reaction rates

Investigating reaction rates comprises a teacher guide and worksheet.

Students choose a real-world chemical reaction and investigate how they can change its rate in the laboratory. This resource can also be used to explore the role of science in society. See the teacher guide for detailed information on the purpose and use of this resource.



Reaction rates 3: Controlling reactions

Controlling reactions comprises a teacher guide, learning object and student worksheet.

This resource uses an interactive learning object to explain the relationship between reaction rates, collision theory, energy profile diagrams and kinetic energy distribution graphs. See the teacher guide for detailed information on the purpose and use of this resource.



Activity: reaction rates podcast

The purpose of this activity is for students to:

- reflect on their learning about the complexities of reaction rate kinetics, and relate this to their real life investigations completed earlier;
- apply their knowledge of reaction rate kinetics to a real life chemistry reaction; and
- use current technology and science literacy skill to communicate understanding of reaction rates to others.

Activity

If podcasting equipment is not available for use, students can present their understanding of their investigation in terms of reaction rate kinetics, in report form or a slide presentation.

Show students examples of science podcasts to demonstrate how science information can be communicated to an audience. Encourage class discussion on what makes an effective science presentation.

In groups, students brainstorm information that needs to be communicated about reaction rates and the experiment they completed. The outline of the podcast should include what was under investigation, what happened and an explanation of this, using reaction rate kinetic theory.

Students should use notes and multimedia collected from their real life experiment to start to develop a presentation, write a script in full, then use computers to develop podcasts.

Podcasts can be presented to the class, uploaded to a class blog to access for revision, or uploaded to the school Internet site to allow students a broader audience for their creative learning object.

Reaction rates 4: Enzymes

Enzymes comprises a teacher guide, fact sheet and worksheet.

This resource extends and applies students' understanding of reaction rates by looking at enzymes as a biological catalyst. See the teacher guide for detailed information on the purpose and use of this resource.

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