Extended experimental investigation: Reaction rate

This sample has been compiled by the QSA to help teachers plan and develop assessment instruments for individual school settings. It demonstrates the following criteria:

- Knowledge and conceptual understanding
- Investigative processes
- Evaluating and concluding

Assessment instrument

Note: Words in italics are quoted from the syllabus.

Teachers can provide the research question or it may be instigated by the student or the teacher. Teachers should negotiate to ensure safety and the possibility of success.

Extended experimental investigation (EEI): Reaction rate

Task
Develop an experiment to investigate a factor or factors that affect the rate of a chemical reaction. Present the results of your investigation as a written scientific report.

Guidelines

- Use the preliminary experiment to design an investigation that will focus on one or more factors affecting reaction rates. In your investigation you should consider refinements to the method already given to provide more accurate data. Other suitable reactions may be investigated.
- Alternative research questions may be investigated subject to negotiation with your teacher.
- Students will be assigned into groups of 3–4 to develop and perform the experiment. Analysis and reporting will be conducted individually.
- Four weeks of class time will be set aside for this investigation.

An EEI may last from four weeks to the entirety of the unit of work.

Teachers must allow some class time for students to be able to effectively undertake each component of the EEI. However, independent student time will probably be required to complete the EEI.

For a four-week EEI, most of the class time and homework would be assigned to completing the EEI.

The outcome of an EEI is a written scientific report.

Teachers may allow elements of the EEI to be conducted in small groups or pairs.

Group work reduces the amount of equipment required.
Management checkpoints

Week 1: Perform preliminary investigation
- Perform background research

Week 2: Design experiment
- Submit prac. request form
- Submit risk assessment
- Start data collection

Week 3: Continue data collection
- Begin report writing

Week 4: Draft due
- In-class conferencing
- Submit report and journal.

Report requirements

The final report should include at least the following:
- Aim or hypothesis
- Summary of results
- Discussion
- Conclusion

Any other information relevant to the experiment (e.g. method, raw data, calculations, preliminary graphs, research and references) may be documented in a journal. The recommended word length for the discussion and conclusion is 1500 words.

Preliminary experiment

Apparatus:
- 1 M hydrochloric acid
- large marble chips
- volumetric flask
- cotton wool
- electronic balance
- stopwatch
- small measuring cylinder

Method

1. Place approximately 10 g of large marble (CaCO3) chips in a volumetric flask. Place a wad of cotton wool in the top of the volumetric flask.
2. Measure 10 mL of 1 M hydrochloric acid into a small measuring cylinder.
3. Place the measuring cylinder and the flask on the pan of an electronic balance and tare the balance.
4. Remove the cotton wool from the flask. Quickly, pour the hydrochloric acid into the flask, replace the measuring cylinder on the balance and start the stopwatch. Replace the cotton wool in the flask.
5. Record the mass every 30 seconds until it remains the same for 2 minutes.
6. Construct a graph of the total mass lost against time for this reaction.

A simple given preliminary experiment allows students to design, refine and manage investigations (IP: A standard) while ensuring that they gain some meaningful data. It also reduces the amount of time that may be spent in preliminary trials.

Teachers must provide feedback during the research process. Supervision of data collection, drafting and conferencing are also strategies to ensure authentication of student work.

‘Judgments should be made using evidence available on or before the due date’ (A–Z of Senior Moderation). Drafts, journals and teacher observations can be used as evidence in cases of late or non-submission.

A student should clearly articulate the hypothesis or research question.

Scaffolding must be provided. Scaffolding should be reduced from Year 11 to Year 12.

This EEI gives less scaffolding than would be provided in Year 11 where scaffolding should model the process and familiarise students with the expectations for the report.

The recommended word length for the Discussion/Evaluation/Recommendations/Conclusion of a Year 12 EEI is 1000–1500 words. Students who write more than this may not have demonstrated discriminating selection of scientific ideas (E&C: A standard).

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## Instrument-specific criteria and standards

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<thead>
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<td><strong>Knowledge and conceptual understanding</strong></td>
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<td>• reproduction of reaction rate concepts, theories and principles</td>
<td>• reproduction of simple ideas and concepts</td>
<td>• reproduction of isolated facts</td>
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<td>• <strong>comparison and explanation</strong> of complex reaction rate concepts, processes and phenomena</td>
<td>• <strong>comparison and explanation</strong> of reaction rate concepts processes and phenomena</td>
<td>• explanation of simple processes and phenomena</td>
<td>• description of simple processes and phenomena</td>
<td>• recognition of isolated phenomena</td>
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<td>• linking and application of algorithms, concepts, principles, theories and schema <strong>to find solutions</strong> in <strong>complex and challenging</strong> reaction rate situations.</td>
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<td>• application of algorithms, principles, theories and schema <strong>to find solutions</strong> in simple reaction rate situations.</td>
<td>• application of algorithms, principles, theories and schema.</td>
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<td>• formulation of <strong>justified significant</strong> questions/hypotheses which inform <strong>effective and efficient design, refinement and management</strong> of investigations</td>
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<td>• formulation of questions and hypotheses to select and manage investigations</td>
<td>• implementation of given investigations</td>
<td>• <strong>guided use</strong> of given procedures</td>
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<td>• assessment of risk, safe <strong>selection and adaptation</strong> of equipment, and appropriate <strong>application</strong> of technology to <strong>gather, record and process</strong> valid data</td>
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<td>• <strong>safe use</strong> of equipment and technology to <strong>gather and record</strong> data</td>
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<td><strong>description</strong> of scenarios and possible outcomes with <strong>discussion</strong> of conclusions/recommendations</td>
<td><strong>identification</strong> of scenarios or possible outcomes</td>
<td><strong>statement</strong>s about outcomes</td>
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