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.

**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.

The outcome of an EEI is a written scientific report.

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.

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.
## Instrument-specific criteria and standards

<table>
<thead>
<tr>
<th>Standard A</th>
<th>Standard B</th>
<th>Standard C</th>
<th>Standard D</th>
<th>Standard E</th>
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<tbody>
<tr>
<td><strong>Knowledge and conceptual understanding</strong></td>
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<tr>
<td>- reproduction and interpretation of complex and challenging reaction rate concepts, theories and principles</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>- comparison and explanation of complex reaction rate concepts, processes and phenomena</td>
<td>- comparison and explanation 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 simple phenomena</td>
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<td>- linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex and challenging reaction rate situations.</td>
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<td>- application of algorithms, principles, theories and schema to find solutions in simple reaction rate situations.</td>
<td>- application of algorithms, principles, theories and schema.</td>
<td>- application of simple given algorithms.</td>
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<td>- formulation of justified significant questions/hypotheses which inform effective and efficient design, refinement and management of investigations</td>
<td>- formulation of justified questions/hypotheses which inform design and management of investigations</td>
<td>- formulation of questions and hypotheses to select and manage investigations</td>
<td>- implementation of given investigations</td>
<td>- guided use of given procedures</td>
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<td>- assessment of risk, safe selection and adaptation of equipment, and appropriate application of technology to gather, record and process valid data</td>
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<td>- assessment of risk, safe selection of equipment, and appropriate application of technology to gather and record data</td>
<td>- safe use of equipment and technology to gather and record data</td>
<td>- safe directed use of equipment to gather data</td>
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<td>Evaluating and concluding</td>
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<td>- analysis and evaluation of complex scientific interrelationships</td>
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<td>- description of scientific interrelationships</td>
<td>- identification of simple scientific interrelationships</td>
<td>- identification of obvious scientific interrelationships</td>
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<td>- exploration of scenarios and possible outcomes with justification of conclusions/recommendations</td>
<td>- explanation of scenarios and possible outcomes with discussion of conclusions/recommendations</td>
<td>- description of scenarios and possible outcomes with statements of conclusion/recommendation</td>
<td>- identification of scenarios or possible outcomes</td>
<td>- statements about outcomes</td>
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<td>- discriminating selection, use and presentation of scientific data and ideas to make meaning accessible to intended audiences through innovative use of range of formats.</td>
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<td>- selection, use and presentation of scientific data and ideas to make meaning accessible in range of formats.</td>
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