How Best to Maintain a Metal Bridge?

Possible Assessment Strategies

An assessment of achievement of the objectives can be by formative methods and summative methods. As written records are requested, summative assessment based on post session marking is possible for some objectives. Formative assessment, however, can occur at all stages of the development of the script and be use to determine student achievement of all objectives.

The assessment needs to relate to the learning outcomes put forward. It determines whether the students have achieved the intended learning. As there are 4 learning outcomes, then 4 separate marks are possible (they can, of course, be combined).

1. *Identify factors affecting the rusting of iron (please note: the learning outcome is not concern with the 'rate of rusting' – that is another area of learning)*
   This will be shown during the initial brainstorming and reinforced by the experiments to be undertaken, although the final identification may not occur until the evidence has been collected after the experiment. The conclusion written by students will confirm whether this learning outcome has been achieved.

2. *Plan a series of experiments to identify factors affecting rusting.*
   The achievement of this learning outcome will be shown by the completing of parts 3 and 4 of the student worksheet.

3. *Explain factors found to affect the rusting of iron.*
   This will also be indicated by the conclusion made after the experimentation.

4. *Deduce a possible formula or structure for rust*

   This is determined from the classwork undertaken by the students individually at the end of the discussion.

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Part A Assessment based on Skills Attained

Formative assessment strategies

Award a social value grade (objectives 1 and 2)

The teacher listens to the discussions of the various groups,

x Not able to make a meaningful contribution to the discussions on the best method to maintain a metal bridge. Unable to make a choice other than based on economic grounds i.e. cheapest.

√ Able to participate in the discussion and recognise that a choice can be made on scientific as well as economic grounds. Can consider other factors e.g. environmental or social, but only when given guidance by the teacher.

√√ Able to play a significant role in the discussions and reflect on the many viewpoints from which a discussion could be made. Able to select an appropriate choice based on social as well a environmental, economic and scientific grounds. Appreciates any disparity that may occur between the best choice and actual practice within society.

Able to award a scientific method grade (objectives 3 and 4)

The teacher listens to the discussions of the various groups and reviews the experimental plans for determining facts for rusting to occur. The teacher asks questions for clarity where appropriate

x Not able to comprehend the data presented in the tables. Able to use little of previous scientific knowledge in suggesting ways to prevent rusting. Not able to develop experimental plans.

√ Able to interpret the data in the tables and determine the various costs. Able to plan a suitable experiment to show that both air (oxygen) and water are needed for rusting to occur, but may not set up a control of variables.

√√ Able to interpret the data and understand how the figures in the tables were derived. Able to plan the experiment with due attention to the controlling of variables and the use of appropriate.

Able to award a personal skills grade (objectives 5 and 6)

The teacher observes the group during the discussions

x Does not take part in the discussion or show interest in the topic. Does not help the group towards a decision. Ability to communicate scientifically is not illustrated.

√ Able to participate in the discussion, helping the group to eliminate non helpful choices from those put forward during the brainstorming session. Able to communicate with the group to derive a 'best method' using suitable scientific language. Able to present to others if points reinforced by the teacher.

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√√ Eager to participate and help others to join in. Leads the group to make choices ensuring all members of the group are permitted to make a contribution. Able to communicate both within the group and as a presentation in clear and scientific language.

Able to award a science concepts grade (objectives 7 and 8)

The teacher observes the various groups during the discussions. The teacher asks questions for clarity of understanding where appropriate

x Not able to eliminate inappropriate choices put forward during brainstorming on scientific grounds. Does not understand the rusting process.

√ Able to eliminate inappropriate choices from the brainstorming session. Understands the rusting process in terms of oxidation of iron in the presence of air and water and that this can be prevented by eliminating water or air and by setting up a metal couple using a more reactive metal.

√√ In addition are able to recognise that the some metals although suitable from the reactivity series point of view, are not usable on the basis of costs, too reactive, or in the case of metals such as aluminium, protected by an oxide layer.

Summative assessment

Able to award a science method grade (objective 3 and 4)

The teacher can assess written records of students on the experimental planning of an experiment to determine factors necessary for rusting to occur

x Written record poor. Unable to plan the experiment.

√ Written record complete. An experiment is described to determine the factors necessary for rusting with suitable conclusions.

√√ Very clear and detailed written record explaining the experimental procedures to determine the factors necessary for rusting pointing out how variables can be controlled for a fair result.

Able to award a science concept grade (objectives 7 and 8)

The teacher can assess the written record interpreting an experiment in which two dissimilar metals are put together

x Unable to interpret the findings from the experiment.

√ The written record interprets the experimental findings showing that iron is more reactive than copper and thus rusts in the presence of copper, but that iron is less reactive than zinc and magnesium and does not rust when in contact with these metals.

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√√ A very clear interpretation of the experimental findings showing that, in the presence of a suitable conducting medium, two dissimilar metals will sent up a reactivity cell and that the more reactive metal will corrode. The reactivity decreases from magnesium and zinc to iron and copper is less react that iron.

Part B Assessment by Lesson

Lesson 1

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Answers questions	Recognise that iron rusts and able to suggest what this means.	
2	Plans anvestigation	Puts forward suggestions on ways to investigate the factors that cause iron to rust.	
		Creates an appropriate experimental plan to the level of detail required by the teacher.	
		Puts forward an appropriate prediction/hypothesis.	
		Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control.	

Lesson 2

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Functioning in the group during experimentation	Contributes to the group discussion during the inquiry phases (raising questions, planning an investigation/ experiment, putting forward hypotheses/predictions, analyzing data, drawing conclusions, making justified decisions).	
		Cooperates with others in a group and fully participates in the work of the group.	

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		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	
		Shows tolerance with, and gives encouragement to, the group members.	
2	Performing the investigation or experiment	Understands the objectives of the investigation/experimental work and knows which tests and measurements to perform.	
		Performs the investigation/experiment according to the instructions/plan created.	
		Uses lab tools and the measurement equipment in a safe and appropriate manner.	
		Behaves in a safe manner with respect to him/herself and to others.	
		Maintains an orderly and clean work table.	

Lesson 3

	Dimension	**Criteria for evaluation** **The student:**	Mark/grade given (x,√,√√)
1	Interpret findings and make conclusions	Interprets data collected in a justifiable manner.	
		Explains why the experiments show that oxygen and water are necessary for rusting.	
2	Answers questions	Suggest what rust might be.	
		Able to indicate why the suggestion given was put forward.	

Lesson 4

	Dimension	**Criteria for evaluation** **The student:**	Mark/grade given (x,√,√√)
1	Suggest experimental procedure	Puts forward an appropriate experimental procedure to determine the sacrificial metal when two metals are put together.	
		Puts forward an appropriate prediction/hypothesis.	

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Lesson 5

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Put forward a reactivity series	Draws appropriate conclusions from the experimental data	
		Puts forward a series based on the evidence obtained	
2	Scientific or socio-scientific reasoning	Illustrates creative thinking/procedures in putting forward suggestions on which to base the decision	
		Gives a justified socio-scientific decision on the best way to protect the metal bridge, giving special attention to scientific components.	

Lesson 6

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Record experimental data collected	Makes and Records observations/data collected appropriately (in terms of numbers of observations deemed acceptable/accuracy recorded/errors given)	
2	Interpret or calculate from data collected and making conclusions	Interprets data collected in a justifiable manner including the use of appropriate graphs, tables and symbols	
		Draws appropriate conclusions related to the research/scientific question	
4	Examine charts.	Able to provide graphical representation as required	
		Able to present graphical representations of a suitable size and in suitable detail	
		Able to provide full and appropriate headings for diagrams, figures, tables	

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Lesson 7

	Dimension	**Criteria for evaluation** **The student:**	Mark/grade given (x,√,√√)
1	Scientific or socio-scientific reasoning	Participates in the discussion on the most appropriate way to maintain the metal bridge.	
		Gives a justified socio-scientific decision to an issue or concern, correctly highlighting the scientific component	

Part C Assessment based on Teacher Strategy

Assessment Tool based on the Teacher's Marking of Written Material

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Writes a plan or report of an investigation	Puts forward an appropriate research/ scientific question and/or knows the purpose of the investigation and experiments.	
		Creates an appropriate investigation to determine the factors affecting rusting and the manner in which to determine which metal is the sacrificial metal..	
		Puts forward an appropriate prediction/hypotheses	
		Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control	
2	Record experimental data collected	Makes and Records observations/data collected appropriately (in terms of numbers of observations deemed acceptable/accuracy recorded/errors given)	
3	Interpret or calculate from data collected and making conclusions	Interprets data collected in a justifiable manner including the use of appropriate graphs, tables and symbols	

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		Draws appropriate conclusions related to the research/scientific question	
4	Answers questions	Provides correct written answers to questions given orally or in written format	
		Provides answers in sufficient detail especially when called upon to give an opinion or decision	
5	Scientific or socio-scientific reasoning	Illustrates creative thinking/procedures in suggesting the may to protect the bridge	
		Gives a justified socio-scientific decision as to the best way to protect the bridge, correctly highlighting the scientific component	

Assessment Tool based on the Teacher's Observations

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Functioning in the group during experimentation or discussion	Contributes to the group discussion during the inquiry phases (raising questions, planning investigation/experiment, putting forward hypotheses/predictions, analyzing data, drawing conclusions, making justified decisions).	
		Cooperates with others in a group and fully participates in the work of the group.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	
		Shows tolerance with, and gives encouragement to, the group members.	
2	Performing the investigation or experiment	Understands the objectives of the investigation/experimental work and knows which tests and measurements to perform.	
		Performs the investigation/experiment according to the instructions/plan created.	

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		Uses lab tools and the measurement equipment in a safe and appropriate manner.	
		Behaves in a safe manner with respect to him/herself and to others.	
		Maintains an orderly and clean work table.	
3	Presenting the investigation or experiment orally	Presents the activity in a clear and practical manner with justified decisions.	
		Presents by illustrating knowledge and understanding of the subject.	
		Uses precise and appropriate scientific terms and language.	
		Presents with clarity and confidence using an audible voice.	

Assessment Tool based on the Teacher's Oral Questioning

	Dimension	Criteria for evaluation The student:	Mark/grade given (x,√,√√)
1	Questions to individuals in a Whole Class setting	Answers questions at an appropriate cognitive level using appropriate scientific language	
		Shows interest and a willingness to answer	
		Willing and able to challenge/support answers by others, as appropriate	
2	Questions to the group	Able to explain the work of the group and the actions undertaken by each member	
		Understands and can explain the science involved using appropriate language	
		Willing to support other members in the group in giving answers when required	
		Thinks in a creative manner, exhibits vision and can make justified decisions	
3	Questions to individuals in the group	Able to explain the work of the group and actions taken by each member	

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		Understands the purpose of the work and shows knowledge and understanding of the subject using appropriate scientific language	
		Can exhibit non-verbal activity (demonstrate) in response to the teacher's questions, as appropriate	

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