Unit Project

Inquiry Investigation

Rust Formation (Student textbook page 156)

Pedagogical Purpose

In this investigation, students are challenged to design and implement an experiment to test metal corrosion. This investigation allows students to apply the skills they have developed through previous activities and investigations in this unit.

Planning	
Materials	A variety of hardware made of steel, iron, and aluminum. containers (jars or beakers) water salt Paint, oil or any other material used to protect from corrosion. **BLM A-44 Unit 2 Inquiry Investigation Rubric** (optional)
Time	50 min
Safety	Caution students to handle sharp objects carefully. Any nails that drop should be picked up immediately.

Background

Corrosion is the formation of an oxide. Aluminum reacts with oxygen to form aluminum oxide (a white coating), iron becomes iron oxide (a red coating) and steel will turn black. Corrosion can be accelerated by the addtion of water and further accelerated by the presence of salt or acidic substances. To protect from corrosion, car manufacturers paint surfaces that are exposed to water and road salt. In addition, some cars are treated with a coating of oil on the undercarriage that has not been painted.

Skills Focus

- design and conduct an investigation
- control variables
- communicate using an appropriate format

Activity Notes and Troubleshooting

- Direct students to analyze only a few variables in this investigation. As a class, brainstorm the various factors and then decide on two or three factors to design tests for. The factors that are easiest to test for are the presence of salt in the water, the application of a coating like paint or oil, and the amount of water the metal is exposed to.
- Discuss the importance of controlling some variables so that results can be compared fairly.
- To maintain consistency, give students parameters for their design and a list of materials they can use for their tests. Do not allow additional materials.
- Students should work in groups of no more than four. Assign a specific role to each group member.
- Results of this experiment will take several days. Begin it as soon as possible after students have the skills they need to design a fair test so that results can be obtained by the end of the unit.
- Provide an area in the classroom for the experiements to sit undisturbed and allow students a few minutes at the beginning of each class to observe their metals.
- Have all students use a predict/observe/explain format for this activity.

Additional Support

- ELL Form heterogeneous groups so that English language learners and students facing challenges are supported.
- If students require more structure, design the observation table together so that students include the appropriate data.
- DI Spatial learners could draw pictures of the setup and/or draw a flow chart of the experiment process.
- Enrichment—Ask students to create an awareness advertisement about preventing corrosion. In their advertisement, they should list the factors that contribute to corrosion, the signs of corrosion, and methods that can be used to prevent corrosion.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Considered few factors that affect rusting of metals.	Considered some factors that affect rusting of metals.	Considered a variety of factors that affect rusting of metals.	Considered numerous factors that affect rusting of metals.
Thinking and Investigation	Prediction made is lacking in clarity.	Prediction is made with some clarity.	Prediction made with considerable clarity.	Prediction for the variable selected made with a high degree of clarity.
	Conducts the experiment, carrying out the procedure safely and recording data accurately with limited effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately with some effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately with considerable effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately in a highly effective manner.
	Identifies sources of uncertainty with limited accuracy.	Identifies sources of uncertainty with some accuracy.	Identifies sources of uncertainty with considerable accuracy.	Identifies sources of uncertainty with a high degree of accuracy.
Communication	Results are communicated with limited effectiveness.	Results are communicated with some effectiveness.	Results are communicated with considerable effectiveness.	Results are communicated with a high degree of effectiveness.
	Few or none graphs and tables are provided.	Graphs and tables provided are lacking in detail and accuracy.	Accurate graphs and tables are provided.	Detailed and accurate graphs and tables are provided.
Application	Makes connections between science, technology, society and the environment with limited effectiveness.	Makes connections between science, technology, society and the environment with some effectiveness.	Makes connections between science, technology, society and the environment with considerable effectiveness.	Makes connections between science, technology, society and the environment with a high degree of effectiveness.

Please also see **BLM A-44 Unit 2 Inquiry Investigation Rubric**.

An Issue to Analyze
Evaluating the Use of Road Salt (Student textbook page 157)

Pedagogical Purpose

In this investigation, students use what they have learned in this unit to analyze the impact of road salt on our environment.

Planning	
Materials	research material or internet access **BLM G-13 Citing Sources** (optional) **BLM G-32 Cause and Effect Map** to **G-39 Double Bubble Organizer** (optional) **BLM A-45 Unit 2 An Issue to Analyze Rubric** (optional)
Time	60 min

Background

Road salt is used to lower the freezing point of ice on our roads. It is not pure salt. The addition of impurities improves traction. Salt damages roadside vegetation, runs off into water supplies, and increases corrosion in vehicles. Sand is used in many municipalities instead of salt. Sand improves traction but does not melt the ice. While it is messy to clean up and kills some vegetation, it does not produce as much leachate to damage aquatic ecosystems.

Skills Focus

- formulate scientific questions
- identify and locate relevant sources
- select, organize, and record relevant information
- analyze information gathered for reliability and bias
- draw and justify conclusions
- communicate using a variety of formats

Activity Notes and Troubleshooting

- Have students write their questions the day before they start their research. Collect the questions and give students feedback or suggestions about where to find information. A process check like this will improve accountability and student success at the task.
- Allow students to work in pairs on the research but have students communicate their findings individually.
- Remind students to be critical of the sources they use for their research. Review Science Toolkit 8: How to do a Research-Based Project, on pages 358 to 361 of the student textbook, with students.
- Show students several graphic organizers to choose from for their research. Fishbone, concept maps, and cause and effect maps may be particularly suitable for this project. See **BLMs G-32 Cause and Effect Map** to **G-39 Double Bubble Organizer**.
- Require students to cite their sources at the end of their presentation. Provide students with **BLM G-13 Citing Sources**, and read it with them.

Additional Support

- If students have difficulty formulating a question, discuss how to change a statement into a question by modelling the first research criteria which states "the benefits of using salt on winter roads". Change this into a question with students. For example, "What are two benefits of using salt on winter roads?"
- Allow students to be creative in their choice of presentation. They could make a role play or a comic strip instead of a poster or slide show. As long as the presentation matches the intended audience and communicates the content, more choice will lead to more buy-in from students.
- ELL Consider giving English language learners a reduced number of questions to research. Have them focus on completing the PMI chart, which they can use to justify their opinion on the issue.
- Enrichment—Have students debate the issue in small groups or role play a town hall meeting about road salt and assign students the roles of different community stakeholders, for example, snow removal officer, young mother, business owner, and automechanic.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Demonstrates limited knowledge of specific issues related to the use of road salt and other chemicals.	Demonstrates some knowledge of specific issues related to the use of road salt and other chemicals.	Demonstrates considerable knowledge of specific issues to the use of road salt and other chemicals.	Demonstrates a high degree of knowledge of specific issues related to the use of road salt and other chemicals.
Thinking and Investigation	Used few resources to investigate environmental damage caused by road salt.	Used some resources to investigate environmental damage caused by road salt.	Used a variety of resources to investigate environmental damage caused by road salt.	Used many resources to investigate environmental damage caused by road salt.
	Little analysis of problem provided.	Some analysis of problem provided.	Problem analyzed using a PMI chart.	Detailed analysis of problem provided using a PMI chart.
Communication	Communicates a position on the issue with supporting evidence, using appropriate scientific vocabulary, with limited effectiveness, creativity, and clarity.	Communicates a position on the issue with supporting evidence, using appropriate scientific vocabulary, with some effectiveness, creativity, and clarity.	Communicates a position on the issue with supporting evidence, using appropriate scientific vocabulary, with considerable effectiveness, creativity, and clarity.	Communicates a position on the issue with supporting evidence, using appropriate scientific vocabulary, with a high degree of effectiveness, creativity, and clarity.
Application	Proposes alternatives to using salt and provides rationale with limited effectiveness.	Proposes alternatives to using salt after considering positive and negative impacts, and provides rationale with some effectiveness.	Proposes alternatives to using salt after considering positive and negative impacts, and provides rationale with considerable effectiveness.	Proposes alternatives to using salt after considering positive and negative impacts, and provides rationale with a high degree of effectiveness.

Please also see **BLM A-45 Unit 2 Inquiry Investigation Rubric**.