Mars Rocks!

Suitable for UK KS4 students or ages 14-16

Notes for teachers

At a glance

Evidence collected from Mars rovers tell us that the surface of Mars was once covered in rivers and lakes – and possibly even early life. However, scientists are puzzled as to how Mars was once warm enough to permit liquid water. One idea is that its atmosphere was once much thicker and rich in carbon dioxide. If this is true, then rocks on Mars should be high in carbonate minerals.

This activity is a suggestion about how a GCSE required practical (making a soluble salt) can be incorporated into a real-life context. Students will explore how the reaction between metal oxides and acids create salts, before applying this to a reaction that may have happened in Martian lakes billions of years ago.

Learning Outcomes

- Students carry out the practical technique of how to make a soluble salt from a reaction between acid and metal oxide
- Students learn how to write the word and symbol equation for the reactions of metal oxides and acids

Each student will need

- Copy of student worksheet pages 1-3
- Copy of practical instructions – see web links
- scissors

The class will need access to

- eye protection
- dilute sulfuric acid (1.0 mol/dm^3) (IRRITANT)
- copper(II) oxide powder
- spatulas
- glass rods
- measuring cylinders
- beakers: 100 cm^3 and 250 cm^3
- Bunsen burners/tripods/gauzes/heatproof mats
- filter funnels and paper
- small conical flasks
- evaporating basins
- crystallising dishes.

Possible Lesson Activities

1. Starter activity

- Ask the class: 'why do you think scientists want to explore Mars?'. You can show them a short clip about Mars Rover Spirit, which discovered carbonate-rich minerals. (see web links).
- Discuss that one reason is the search for life, or evidence that there was once life and in 2020 NASA will send a new rover to the Martian surface with one of its objectives to search for evidence of ancient life on the planet.
- Tell them that scientists across the world are researching what Mars might have been like billions of years ago. Introduce the research of Lucy Kissick, a PhD student at The University of Oxford by showing the class the Oxford Sparks clip 'Using your science to explore the climate history of Mars' (see web links).

2. Main activity: Making a soluble salt

- Give each student a copy of page 1 of the student worksheet and ask them to read through it. This outlines the background behind the reasons for Lucy's research. The important part is the reaction between carbonic acid in the lake water and the minerals in the rocks. Explain that Mars' famous red surface is caused by iron compounds, such as iron oxide in its rocks.
- Ask the class to work in pairs. Tell them that they are going to carry out a reaction similar to the one that Lucy thinks may have happened on the surface of Mars billions of years ago. Instead of reacting iron oxide with carbonic acid, they will be reacting copper oxide with sulfuric acid. Give each student a copy of the method, which can be downloaded from the web links. They carry out the method to produce crystals of copper(II) sulfate.

3. Main activity: Writing equations

- Ask students to complete questions on page 2 of the student worksheet. This guides them into writing the word and symbol equations for the reaction they have just done plus other metal oxides and acids. They can cut out and use the ion cards on page 3 to help them work out the formulae of the oxides and the salts formed.
- By answering question 4 they will explain what compounds scientists should be looking for on Mars as evidence that its atmosphere was once rich in carbon dioxide.

4. Plenary

- Check that students correctly identified the reaction that happened in lakes on Mars as:
  Iron(II) oxide + carbonic acid → iron(II) carbonate + water
  $FeO + H_2CO_3 \rightarrow FeCO_3 + H_2O$
- Explain that carbonate-rich rocks have been found on Mars but not as many as scientists predict, if the theory about it having a carbon dioxide rich atmosphere in the past is correct. One part of Lucy's research is finding out possible reasons for this.

5. Homework

An idea for a homework activity for higher tier students is to set these questions:

1. Calculate the maximum mass of iron(II) carbonate that can be produced when 10 g of iron(II) oxide reacts with excess carbonic acid.

Relative atomic mass (A_r) Fe: 56, O: 16, H: 1, C: 12

Answer: Moles of FeO = 10 ÷ (56 + 16) = 0.138…

Mass of $FeCO_3$ = 0.138… x (56 + 12 +(16 x 3)) = 16.1 g

2. A student did this reaction in the lab. They only made 11.6 g of iron(II) carbonate. Calculate the percentage of the maximum mass they made (this is called the percentage yield).

Answer: (11.6 ÷ 16.1) x 100 = 72%

3. Suggest why they made less than the maximum mass of iron(II) carbonate.

Answer: The reaction was incomplete - some of the iron(II) oxide did not react to form iron(II) carbonate.

There were losses of iron(II) carbonate during the experiment, such as during pouring or filtering.

Web links

Mars Rover Spirit:

https://www.youtube.com/watch?v=SwxVgCGmOjQ

Oxford Sparks video 'Using your science to explore the climate history of Mars':

https://www.oxfordsparks.ox.ac.uk/content/using-your-science-explore-climate-history-mars

Student and technician instructions for the practical 'Making soluble salts: preparation of pure dry copper sulfate crystals':

https://filestore.aqa.org.uk/resources/science/AQA-8464-8465-PRACTICALS-HB.PDF

Safety disclaimer: The practical work suggestions given here have not been tested by us for safety. While the suggested practical work is based on existing laboratory experiments, you should always carry out your own risk assessment, especially before using or making a hazardous procedure, chemical or material. All practical work should be supervised by a qualified science teacher with suitable knowledge of the equipment used and carried out in a properly equipped and maintained laboratory. For more information, refer to www.cleapss.org.uk/.