Lesson Plan

Marvellous Machines
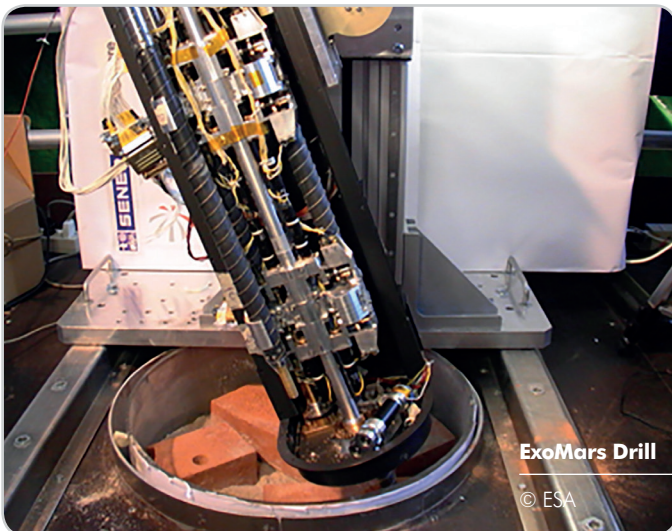# Instruction Sheet and Guidance

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Context

The ExoMars rover is an autonomous robot that will travel across the Martian surface searching for life. It will drill up to two metres below the surface of Mars collecting small samples, transferring them to a laboratory in the heart of the vehicle; here they will be crushed to a fine powder and tested for molecules that might provide evidence of life.

In this activity, the children are introduced to the work of space engineers; they use engineering skills to build a pulley machine that can pick up and transfer samples of Mars soil across a surface. They suggest improvements to their machines. Finally they test the samples for signs of life.

Resources

- Examples of machines eg lever, wheel, drill, wedge
- Cardboard pulley

Per group:
- 3m lengths of string
- 6 paper clips
- 2 plastic straws
- Thick cardboard (approx 10cm x 10cm)
- Sticky tape
- Scissors
- 3 containers of Mars 'soil'
- ½ effervescent tablet
- Warm water ¼ cup
- Teapoon or pipette

ExoMars Drill
© ESA

National curriculum links

Science – forces and magnets:

- Recognise and use a pulley as an example of a mechanical system
- Know that magnets can attract some materials from a distance (optional extension)

Design and technology:

- Use a range of materials and components according to their properties
- Evaluate their ideas and products against design criteria and suggest ways of improving products

Lesson starter

Show a wheel, lever, drill, wedge or screw as examples of simple machines. Do you recognise any? What do machines do? They make everyday tasks easier. Can you suggest examples in everyday life? Can you think of any in class or around the school?

Show the new robot, the ExoMars rover, that will be sent to planet Mars. It is looking for signs of life.

exploration.esa.int/science-e/www/object/index. cfm?fobjectid=53910

It has a special machine drill! Its job is to drill under the surface of Mars, take samples and move them inside the rover to be tested for evidence of life.

exploration.esa.int/mars/45796-the-exomars-drill-video
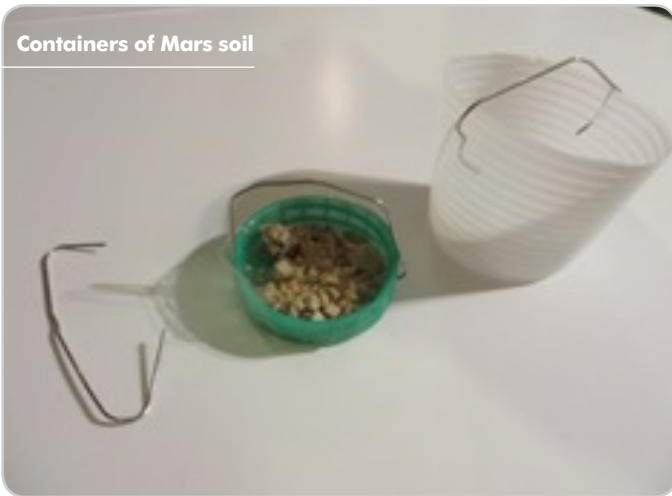
Pulley

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Main activity

Demonstrate the simple pulley and show the children the containers of simulated Mars soil. Explain that today they will be space engineers. They will build a pulley machine but they must adapt it so that it can hook and carry the containers of Mars soil across a surface to a testing area.

They can then test the three samples (one of which contains half a finely crushed effervescent tablet) to look for possible signs of life. Add warm water to each one, sufficient to cover the sample, stir and look for bubbles.

The children discuss their ideas and design their machines. Activity sheet 2a may be used to record their designs. After making and testing out their pulleys, they make any necessary improvements and then carry out the investigation

Containers of Mars soil

Pulley with strings looped around a chair leg

Plenary

Discuss the designs and the changes they made to their machine pulley. What problems did you have? How did you improve your pulley?

Space engineers often encounter problems and must think creatively, changing their designs to achieve success. Did they observe bubbles in any samples after adding water? How long did the bubbling last?

Explain that scientists are looking for evidence that life exists or once existed on Mars. They think any life would have been or is very tiny. Bubbles could be a sign that living things are there but they could also be due to a chemical reaction.

Further activities

Using your pulleys, what other things could you investigate? Further investigations might include changing the following:

- Type or length of string
- Height of strings
- Thickness, shape or size of card
- Length, angle or material of straws

> **Buried treasure!** Investigate how you could adapt your pulley machine to lift magnetic metal objects buried under a layer of sand. Maybe add a magnet? How far above the surface will it work?

STEM vocabulary

Machine	Runny	Smooth
Solid	Shiny	Soft
Liquid	Rough	Colour

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This is how the pulley will hook the sample

I will change this to make the pulley work better

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