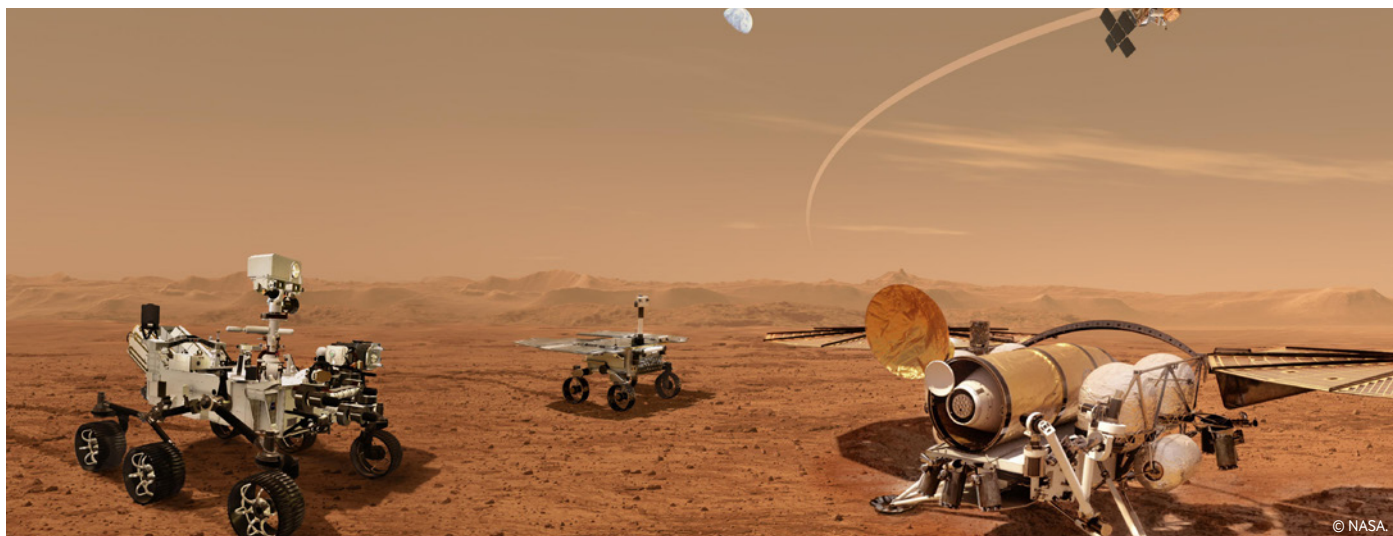


I bet you didn't know

Weird, wiggly crawling wheels roam Mars



Concept image of future Mars exploration.



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GLOSSARY

NASA - the 'National Aeronautics and Space Administration', a government organisation in the United States that is responsible for science and technology related to air and space

rover - a vehicle designed for exploring on a moon or a planet

What is the surface of Mars like? How would you drive across it?

The surface of the Moon and Mars are like a sandy bank. Scientists have been designing motor vehicles (**rovers**) that can drive on these surfaces. The best rovers have wheels that wiggle.

What happens if you ride your bike or your scooter up a sand bank?

It is tricky! You and your bike or scooter might get stuck. This happened to a **NASA** Mars rover called Spirit. In 2010, it became stuck in a sand trap and the mission was ended (Figure 1).



Figure 1. A computer-drawn picture showing how Spirit's wheels became stuck in soft material on Mars.

Have you seen a car trying to move in wet mud or loose sand? What happens?

Have you tried walking, driving, or riding a bicycle in sand? Why do you think it is difficult?

Have you found ways to make moving this way easier?

For many vehicles driving on sand or mud, the wheels spin, slip and sink. Mud or sand builds up all around the wheels. The same could happen with a rover.

How do planetary rovers move?

Rovers have six wheels attached to large **limbs** that rock up and down (Figure 2). These are called the rockers. The force pushing down into the ground is the same through each wheel. This means that the rover can move over large, solid objects of up to 40 cm without getting stuck. This is great for firm ground, but not on loose, sandy ground when the wheels spin, slip and sink.

Why is it important to redesign planetary rovers?

Rovers must travel over uneven, dusty ground, known as **regolith**. The risk of the wheels getting stuck is great. If this happens, the rover will not be able to travel far from where it has landed. Scientists will only be able to collect information from a small area.

Scientists need reliable rovers that can travel long distances. Then we will learn more about moons and planets in space.

How did engineers solve this problem?

To solve the problem of getting stuck on different surfaces, NASA engineers suggested that the way the rover moved over these surfaces could be changed by a computer. There could be different ways of moving on different surfaces.

GLOSSARY

limb - a structure like a leg or an arm

regolith - a layer of loose solid material covering the surface of a planet

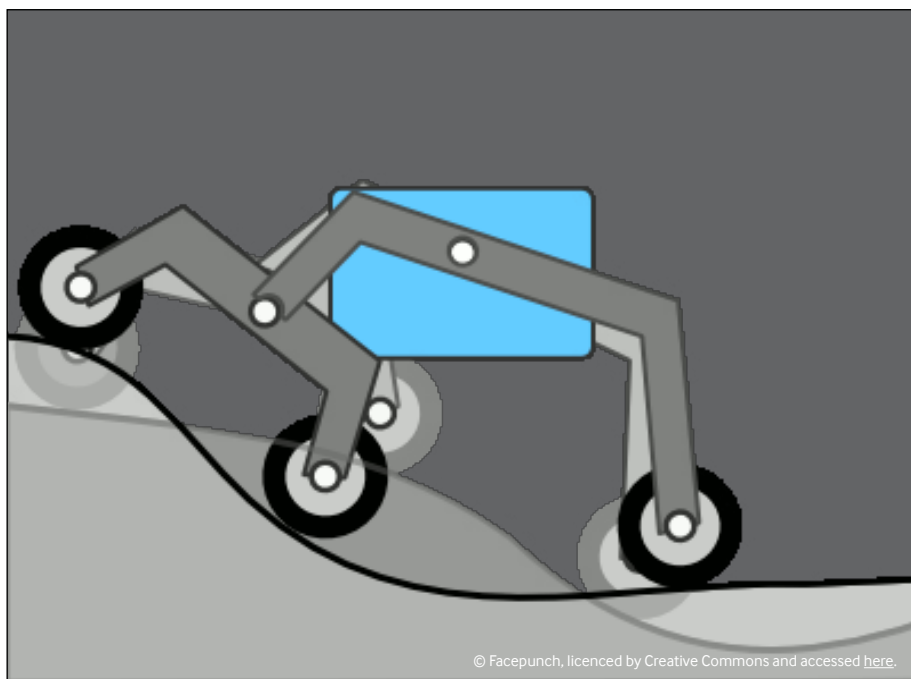


Figure 2. The Rocker-bogie system for a rover.

Scientists in Daniel Goldman's laboratory worked with NASA engineers to create small model rovers (Figure 3). The 'Mini Rover' has limbs that can lift the wheels up and down, and wheels that can wiggle as you can see in this **film**. This allows the rover to crawl and swim through loose sandy material. Think about the moves you make when you swim through water to move faster or change direction. This is what the Mini Rover can do in the sand.

The Mini Rover was tested on dry poppy seeds because they are non-sticky and they do not cause damage to the rover. It was also tested on wet sand. Each wheel of the Mini Rover was computer-controlled to create different paddling movements. The Mini Rover can 'swim' uphill on slopes of up to 15°.

Why do you think scientists and engineers make models?

What are the advantages of making models? What might be the disadvantages?

How did the engineers test their ideas using model rovers?

More tests are needed to make sure that a full-size rover can travel across a wide variety of surfaces. The weight and size of the rovers will affect how these vehicles move on Earth and on Mars.

Why is this research important?

Scientists use rovers to take photographs on the Moon and Mars, to collect information relating to the weather and the types of rocks there, and to take samples of the surface. Since 1970, four rovers have landed on the Moon and six on Mars. If rovers can move reliably across tricky surfaces, scientists will be able to get more information about the unexplored areas of these places.

You can find out more about the Mars exploration [here](#) and practical activities are described in the accompanying **Teacher Guide**.

What next?

As rovers explore new areas, scientists may identify signs of life on Mars. When scientists know more about what it's like on Mars, they could prepare for humans to explore there (Figure 4). Rovers could also be used on Earth to explore places that are hard for humans to visit.

What can a rover do to find out more about a planet?

Where do you think that rovers could be useful on Earth?



Figure 3. The Mini Rover.



Figure 4. An artist's impression of what it might look like if humans live on Mars.

The paper that inspired this work was:

Material remodelling and unconventional gaits facilitate locomotion of a robophysical rover over granular terrain.

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