Mars Rovers
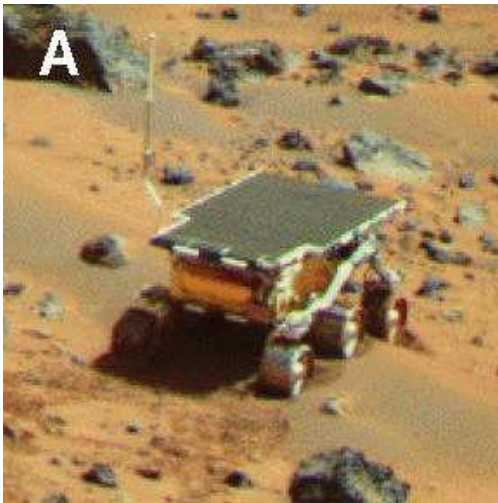
Three rovers are now on Mars and two (Spirit, and Opportunity) continue to transmit data back to Earth. Here we explore the unique method of these missions for landing on Mars.
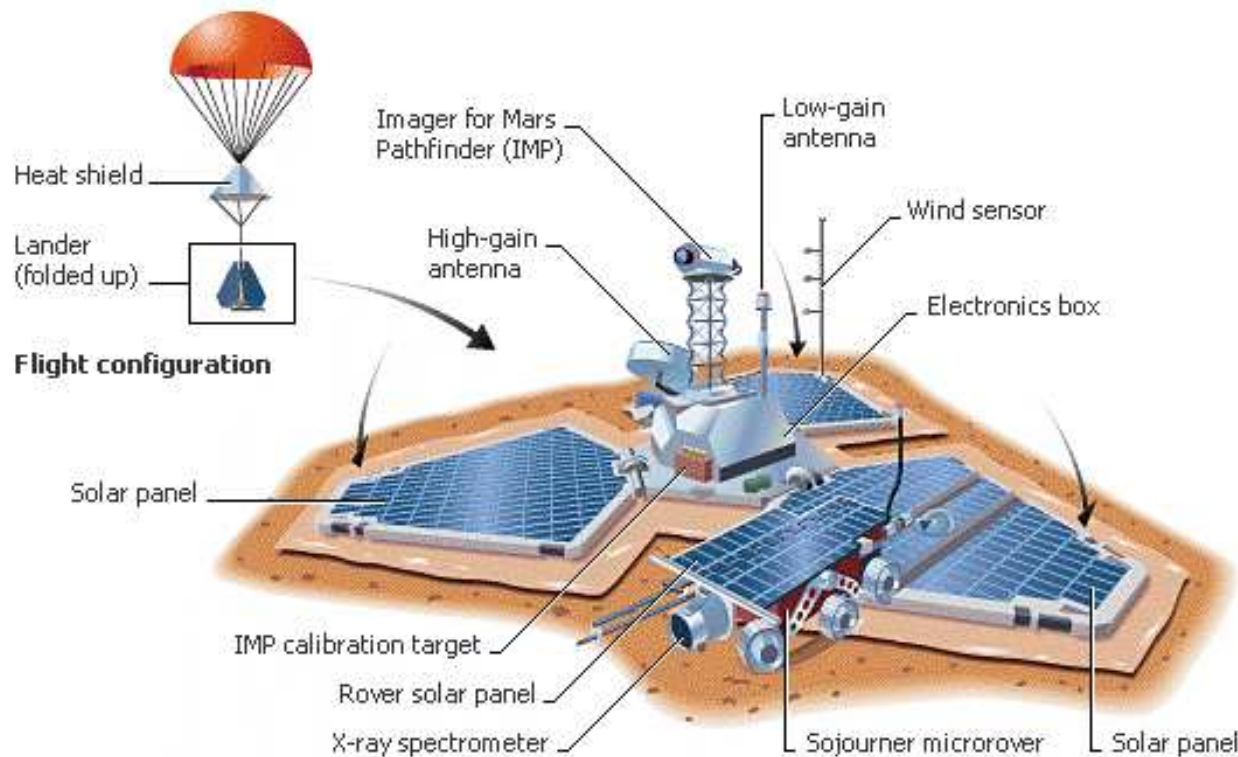
Sojourner

The Bounce!

Descent, and Egress

To save cost and weight the Mars rovers used a unique combination of parachutes, rockets, and airbags to cushion the landing on Mars.

The petals unfold.

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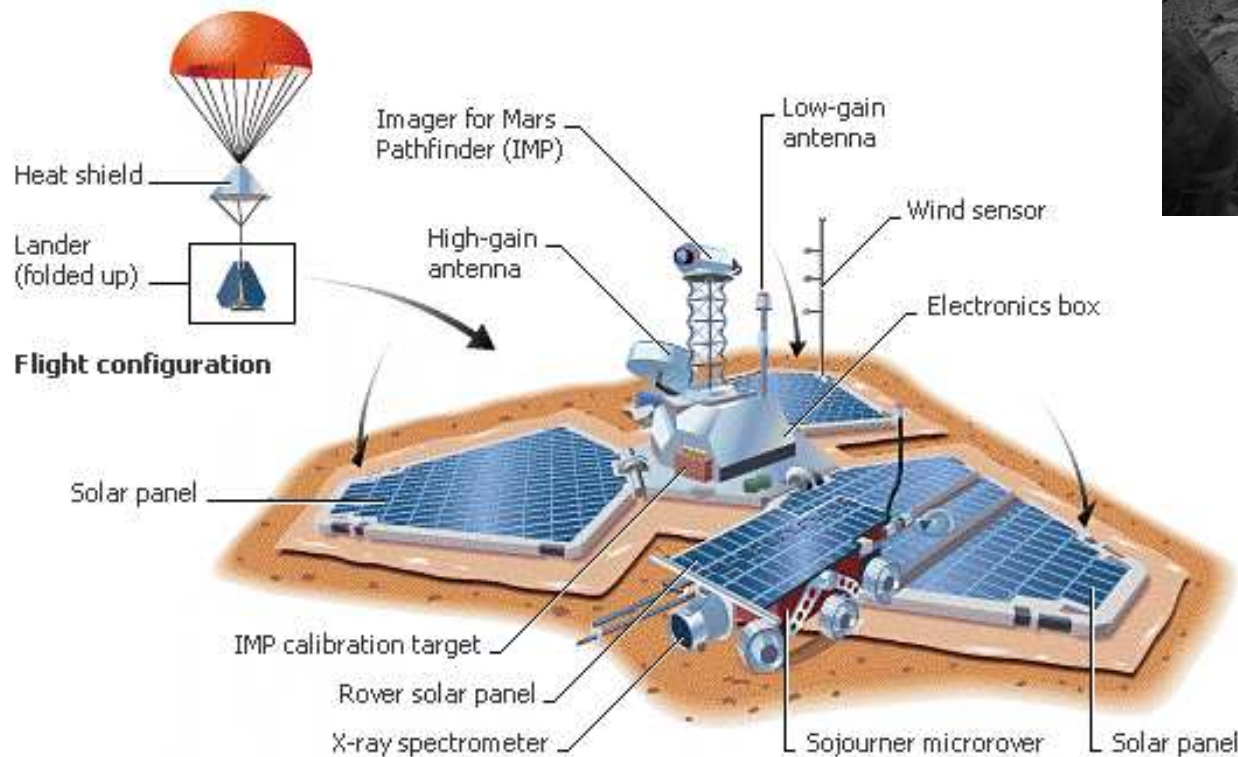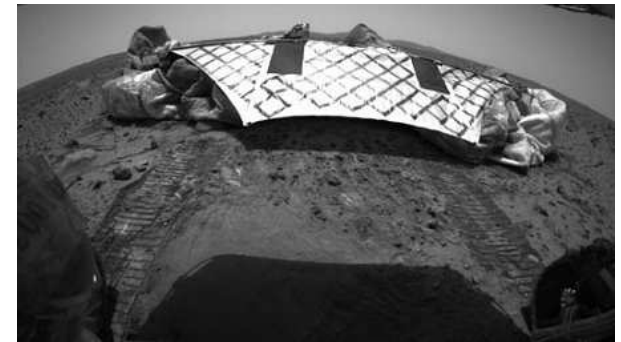
Looking back from Spirit!

The petals unfold.

Flight configuration:
- Heat shield
- Lander (folded up)

Labels:
- Imager for Mars Pathfinder (IMP)
- Low-gain antenna
- Wind sensor
- High-gain antenna
- Electronics box
- Solar panel
- IMP calibration target
- Rover solar panel
- X-ray spectrometer
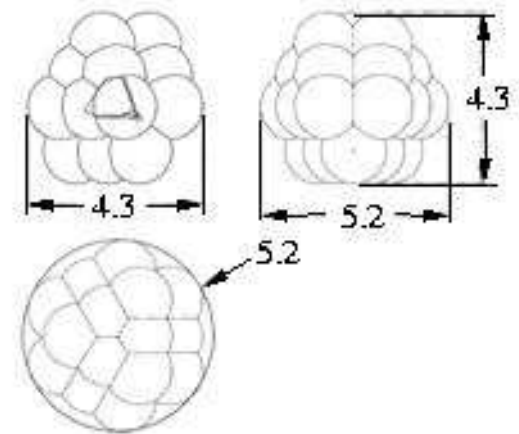- Sojourner microrover
- Solar panel

Bumpy Landing

On July 4, 1997 the Mars rover spacecraft landed in the Ares Vallis region of Mars. It used parachutes, small rockets, and airbags instead of the conventional, rocket-powered landing. The airbags were lighter and cheaper than rockets, but it meant Pathfinder bounced when it landed. It landed with a vertical velocity of about $12.5 \ m/s$. How high did Pathfinder bounce? Assume the acceleration created by the compression of the airbags is a_1. When the bag rebounds the magnitude of the acceleration a_2 will be lower than during compression because some of the initial velocity and energy has been lost due to friction, gas leakage out of the bag, *etc.*. Assume the bag rebounds to its full size. Some useful parameters are listed below. Would this be an acceptable way for astronauts to land? Why? How would you test the validity of the model?

$$a_1 = 170 \ m/s^2 \qquad a_2 = 120 \ m/s^2 \qquad g_{Mars} = 3.8 \ m/s^2$$

$$R_{bag} = 0.9 \ m \qquad m_p = 274.5 \ kg$$

The Twin Peaks in Ares Vallis.

4.3

4.3

5.2

5.2

The airbags.