High-Energy Spectrometer

- Helps discover if Mars was ever a habitat for microbial life.

**PROS:**
- Helps show where on Mars has water, which is essential to life.
- Low mass and low power usage.

**CONS:**
- High cost.

Infrared Spectrometer

- Helps discover if Mars was ever a habitat for microbial life.

**PROS:**
- Detects minerals in detail, including those that formed in water, which is essential to life.
- Low mass and low power usage.

**CONS:**
- Medium cost.

Infrared Camera

- Makes discoveries about the environment on Mars.

**PROS:**
- Gives basic information about minerals and grain size of the soil on Mars.
- Low mass and low power usage.

**CONS:**
- Medium cost.

Low-Resolution Camera

- Makes discoveries about the environment on Mars.

**PROS:**
- Sees a very wide area of Mars.
- Low cost, low mass.
- Does not use much power.

**CONS:**
- Can’t see small details on Mars.

Medium-Resolution Camera

- Makes discoveries about the environment on Mars.

**PROS:**
- Sees twice as much detail as the Low-Resolution Camera.
- Low mass and low power usage.

**CONS:**
- Medium cost.
- Sees a smaller area on Mars than the Low-Resolution Camera.

High-Resolution Camera

- Makes discoveries about the environment on Mars.

**PROS:**
- Sees the most detail of all.

**CONS:**
- Sees only a tiny area of Mars.
- Costs the most.
- Has more mass and uses more power than other cameras.

Radioisotope Power System

- Gives your mission electricity.

**PROS:**
- Does not need the sun or a battery.
- Provides the most power of all.
- Works everywhere.
- Lasts over a decade.

**CONS:**
- Costs the most.
- Has the most mass.

Fuel Cell

- Gives your mission electricity.

**PROS:**
- Does not need the sun or a battery.
- Provides more power than solar panels.
- Works everywhere.

**CONS:**
- Lasts a few months.
- Costs more than solar panels.

On-board Battery

- A battery is required for all solar-powered missions.

**PROS:**
- Stores power collected by solar panels so your mission can survive when the sun is not visible.

**CONS:**
- Increases the cost, mass and power points for your mission.

Gives your mission electricity.

**PROS:**
- Does not need the sun or a battery.
- Provides the most power of all.
- Works everywhere.

**CONS:**
- Costs the most.
- Has the most mass.

On-board Battery

- A battery is required for all solar-powered missions.

**PROS:**
- Stores power collected by solar panels so your mission can survive when the sun is not visible.

**CONS:**
- Increases the cost, mass and power points for your mission.

Gives your mission electricity.

**PROS:**
- Does not need the sun or a battery.
- Provides the most power of all.
- Works everywhere.

**CONS:**
- Costs the most.
- Has the most mass.

On-board Battery

- A battery is required for all solar-powered missions.

**PROS:**
- Stores power collected by solar panels so your mission can survive when the sun is not visible.

**CONS:**
- Increases the cost, mass and power points for your mission.

Gives your mission electricity.

**PROS:**
- Does not need the sun or a battery.
- Provides the most power of all.
- Works everywhere.

**CONS:**
- Costs the most.
- Has the most mass.
Either wheels or tracks are required for rover missions.

**PROS:**
- Wheels carry rovers to discoveries beyond their landing sites.
- Medium speed and work on rocky terrain.

**CONS:**
- Have a little more mass, and use a little more power than tracks.

**PROS:**
- Have less mass and use less power than wheels.

**CONS:**
- Can make it harder to climb over some obstacles.
- Less precise steering.
Standard Microprocessor

At least one microprocessor is required for all Mars missions.

PROS:
• Provides mission “brainpower.”
• Low cost, mass and power usage.

CONS:
• Provides only basic functions needed to receive commands and send data.

Impact Probe

Probes can be added to enhance discoveries.

PROS:
• Pierces the Martian surface at high speeds to collect data from below the surface.
• Does not use power.

CONS:
• Adds cost and mass to your mission.

Airbags

Either airbags or retro rockets are required for Mars landers and rovers.

PROS:
• Protects spacecraft from impacts on rocks and slopes.

CONS:
• Higher cost and mass than rockets.
• Precise landings are difficult because the airbags bounce.

Rock Drill

Collects samples by drilling into rocks.

PROS:
• Low cost, low mass.
• Provides an added science point.

CONS:
• Medium power.

Heat Shield

Required to protect all landers and rovers traveling through the atmosphere to the surface.

PROS:
• Very low cost.
• Does not use power.

CONS:
• Medium mass.

Rotating Instrument Mount

Provides flexible structure for multiple science instruments.

PROS:
• Holds science instruments so they can collect data in a circle without moving the spacecraft.

CONS:
• Adds minor costs, mass and power usage to your mission.

Robotic Arm

Collects samples and carries a number of science instruments.

PROS:
• Doesn’t use much power.
• Low cost.
• Provides an added science point.

CONS:
• Medium mass.

Hypersonic Parachute

Required for all Mars landers and rovers.

PROS:
• Slows the spacecraft down prior to using airbags or retro rockets.
• Low cost.
• Does not use power.

CONS:
• Medium mass.

Retro Rockets

Either airbags or retro rockets are required for Mars landers and rovers.

PROS:
• Slows the spacecraft down for a controlled landing.
• Lower cost and mass than airbags.

CONS:
• Spacecraft can be damaged by landing in rocky terrain.

Hypersonic Parachute

Required for all Mars landers and rovers.

PROS:
• Slows the spacecraft down before using airbags or retro rockets.
• Low cost.
• Does not use power.

CONS:
• Medium mass.

Rock Drill

Collects samples by drilling into rocks.

PROS:
• Low cost, low mass.
• Provides an added science point.

CONS:
• Medium power.

Impact Probe

Probes can be added to enhance discoveries.

PROS:
• Penetrates the Martian surface at high speeds to collect data from below the surface.
• Does not use power.

CONS:
• Adds cost and mass to your mission.

Robotic Arm

Collects samples and carries a number of science instruments.

PROS:
• Doesn’t use much power.
• Low cost.
• Provides an added science point.

CONS:
• Medium mass.
Sorry! Congress reduced NASA's budget.

PROS:
• Low cost and mass.

CONS:
• Medium cost and mass.

EFFECT:
$15 million for your future research.

Spin-Off: Automobile Sensors

Hooray! Sensors created for your Mars mission help cars become more energy-efficient and easier to maintain!

PROS:
• Low cost and power.
• Can be used as a backup for the High-Gain Antenna.

CONS:
• Cannot send much information at one time.

EFFECT:
$25 million for your future research.

Spin-Off: Weather Prediction

Hooray! Your Mars mission discoveries gave new clues about Earth's atmosphere. Scientists can now predict weather better!

PROS:
• Low power usage.
• Allows you to make discoveries with your science tools.

CONS:
• Costs more and uses more power than the Low-Gain Antenna.

EFFECT:
$15 million for your future research.

Spin-Off: Communications

Hooray! People around the world can stay in touch more easily by using new communications technologies created for your Mars mission.

PROS:
• More “brainpower” lets the spacecraft make simple choices without commands from Earth.

CONS:
• Costs more and uses more power than the standard microprocessor.

EFFECT:
$35 million for your future research.

Budget Cut!

Hooray! Your Mars mission discoveries gave new clues about Earth's atmosphere. Scientists can now predict weather better!

PROS:
• Low power usage.
• Allows you to make discoveries with your science tools.

CONS:
• Costs more and uses more power than the Low-Gain Antenna.

EFFECT:
$15 million for your future research.

Main Memory Card

Stores all Mars data until it can be sent back to Earth. Required for all missions!

PROS:
• Low cost, mass and power usage.

CONS:
• None! Your mission does not have a continuous link with Earth, so you need a way to store your data.

EFFECT:
$35 million for your future research.
System Failure!

Sorry! During system testing, one science tool failed to work.

**EFFECT:**
Your mission loses one science tool.

Rocket Failure!

Sorry! Your rocket failed during testing. You had to buy another one.

**EFFECT:**
You cut out two science tools to help pay for the new rocket.