

# Manned/Unmanned spacecraft

## Novice

- Awareness that humans and robots have explored the surfaces of the terrestrial planets, some of the moons of the gas giants, some comets, and some asteroids.
- US missions include Gemini, Mercury, Apollo, and the Space Shuttle.
- Russian missions include Sputnik, Soyuz, Vostok, and Luna.
- Humankind has had a continuous presence in space aboard the ISS since November 2000.
- Spaceflight has benefited from both competition between the USA and the USSR during the Cold War, and from collaboration in the modern era.
- Current missions include the ISS, New Horizons to Pluto and the Kuiper Belt, and the Mars rovers Curiosity and Opportunity.

## Intermediate

- Identify major goals of some missions.
- Science and engineering complement each other in the cycle known as research and development (R&D).
- Voyager 1 and 2 are the only missions that have left the Solar System. Travel to even the next nearest star (Proxima Centauri) is prohibitively long.
- The energy source of a mission depends on how close it is to the Sun – closer missions allow for solar power, while further missions use radioisotope thermoelectric generators (RTGs).

## Expert

- Critically analyze Moon Hoax Conspiracy Theory claims.
- Ideas for future interstellar travel, such as generation ships, solar sails, plasma drives, and sci-fi ideas such as wormholes and warp drives.
- Spacecraft don't directly follow Kepler's Laws due to propulsion.
- Thrust is governed by conservation of momentum.

## Related NGSS

Grade Level	Student Performance Expectations
3-5	<b>3-5 ETS1-1.</b> <b>Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</b> <b>3-5 ETS1-2.</b>

	<p><b>Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</b></p> <p><b>3-5 ETS1-3.</b>  <b>Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</b></p>
MS	<p><b>MS-PS1-4</b>  <b>Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</b></p> <p><b>MS-PS3-3</b>  <b>Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.</b></p>
HS	<p><b>HS-ESS1-4</b>  <b>Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</b></p> <p><b>HS-PS3-5</b>  <b>Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</b></p>

### **Related CCSSM**

See content sheets on Distance, Exoplanets, Kepler's Laws, Light, Robotics, and Thermoelectrics.