# 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

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| Grade Level | Student Performance Expectations  |
| 3-5 | **3-5 ETS1-1.**

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| **Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.** |
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**3-5 ETS1-2.**

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| **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.** |

**3-5 ETS1-3.****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.** |
| MS | **MS-PS1-4****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.****MS-PS3-3**

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| **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** |

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| HS | **HS-ESS1-4****Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.****HS-PS3-5**

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| **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.** |

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# Related CCSSM

See content sheets on Distance, Exoplants, Kepler’s Laws, Light, Robotics, and Thermoelectrics.