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**SYNOPSIS:**

From fireworks to missiles to space flight – the science of propulsion makes a major impact on our world. This program takes a look at how the process of propulsion is developed for use in space science. Its application to crucial military technology helps keep the military strong and secure. In the future, new technologies will propel us into the far reaches of our solar system and beyond. This program describes several different propulsion systems including airplanes, rockets, missiles, and trains, with a detailed description of the differences in solid fueled and liquid fueled rockets.

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**CURRICULUM UNITS:**

Chemistry  
Engineering  
Physics

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**CAREER OPPORTUNITIES:**

Aeronautical Engineer  
Chemist  
Computer Scientist  
Electrical Engineer  
Mechanical Engineer  
Physicist

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**PROGRAM OVERVIEW:**

Rocketry moved into the realm of science and discovery in the latter part of the 17th century when English scientist Sir Isaac Newton laid the scientific foundation for modern rocketry with his “Three Laws of Motion.” The first two laws dealt with inertia as well as the relationship between an object’s mass, its acceleration, and the applied force. Newton’s 3rd law explains the principle of “action-reaction” which states that “for every action there is an equal and opposite reaction”. That ultimately laid the foundation for the future development of propulsion technology. With Newton’s laws in mind, propulsion is the act of affecting an object’s inertia or momentum through a mechanical force called thrust. Thrust is a vector quantity having both magnitude and direction.

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**ISSUES & CRITICAL THINKING:**

- 1) Compare and contrast solid and liquid fuel rocket propulsion. Which is most appropriate for rockets designed to explore Mars? Which is most appropriate for the design of fireworks?
- 2) Identify the sustainable advantages of rocket propulsion using the solar wind. Distinguish between sustainable and non-sustainable propulsion methods.
- 3) Acting as a NASA engineer, prioritize future projects, and the methods of propulsion that will be used. Defend the reasons for your sequence of prioritizing.
- 4) Design a plan to use a method of propulsion to solve a transportation issue in your local community.
- 5) Research balloon rockets online, and demonstrate the use of balloon rockets in class. Conclude which type of propulsion fuel, solid or liquid, is most closely demonstrated using balloon rockets.

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## GLOSSARY:

**Thrust-** The act of applying force to propel something.

**Inertia-** The resistance of a body to changes in its momentum.

**Momentum-** A measure of the motion of a body equal to the product of its mass and velocity.

**Vector Quantity-** A quantity which is fully described by both magnitude and direction.

**Liquid Oxygen-** A clear, pale blue liquid obtained by compressing oxygen, then cooling it below its boiling point; often used as an oxidizer in liquid rocket propellants.

**Solid Fuel-** Commonly used in rockets with a motor that uses solid propellants - a fuel and an oxidizer.

**Liquid fuel-** Combustible or energy-generating molecules that can be harnessed to create mechanical energy.

**Volatility-** The property of changing readily from a solid or liquid to a vapor with traits of being unpredictably irresolute.

**Fischer-Tropsch Process-** A catalyzed chemical reaction in which synthesis gas, a mixture of carbon monoxide and hydrogen, is converted into liquid hydrocarbons of different forms.



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# PROPULSION- TECHNOLOGICAL ADVANCES

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