Pushing the Envelope

National Standards

Grades 6 – 8 Science

Source: Benchmarks for Science Literacy National Standards Science Literacy 2008

Lesson/Activity	Grades 6 – 8 Science Standards
History of Aviation Propulsion (pgs. 5-9)	1B/M1b Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
History of Aviation Propulsion (pgs. 5-9)	4F/M3a An unbalanced force acting on an object changes its speed or direction of motion, or both.
Types of Engines (pgs. 11-23)	1B/M1b Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
Types of Engines (pgs. 11-23)	4F/M3a An unbalanced force acting on an object changes its speed or direction of motion, or both.
Chemistry (pgs. 25-41)	1B/M1b Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
Chemistry (pgs. 25-41)	4F/M3a An unbalanced force acting on an object changes its speed or direction of motion, or both.
Physics and Math (pgs. 43-63)	1B/M1b Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
Physics and Math (pgs. 43-63)	4F/M3a An unbalanced force acting on an object changes its speed or direction of motion, or both.
Rocket Activity (pgs. 69-75)	1B/M1b Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data.
Rocket Activity (pgs. 69-75)	4F/M3a An unbalanced force acting on an object changes its speed or direction of motion, or both.

Pushing the Envelope

National Standards

Grades 9 – 12 Science

Source: Benchmarks for Science Literacy National Standards Science Literacy 2008

Lesson/Activity	Grades 9 – 12 Science Standards
History of Aviation Propulsion (pgs. 5-9)	1B/H1 Investigations are conducted for different reasons, including to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare theories.
History of Aviation Propulsion (pgs. 5-9)	1B/H3 Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible, practical, or ethical, they try to observe as wide a range of natural occurrences as possible to discern patterns.
History of Aviation Propulsion (pgs. 5-9)	4F/H1 The change in motion (direction or speed) of an object is proportional to the applied force and inversely proportional to the mass.
History of Aviation Propulsion (pgs. 5-9)	4F/H4 henever one thing exerts a force on another, an equal amount of force is exerted back on it.
History of Aviation Propulsion (pgs. 5-9)	4F/H8 Any object maintains a constant speed and direction of motion unless an unbalanced outside force acts on it.
Types of Engines (pgs. 11-23)	1B/H1 Investigations are conducted for different reasons, including to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare theories.
Types of Engines (pgs. 11-23)	1B/H3 Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible, practical, or ethical, they try to observe as wide a range of natural occurrences as possible to discern patterns.
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Pushing the Envelope

National Standards

Grades 6 – 8 Science

Source: NSTA National Standards Science 1996

Lesson/Activity	Grades 6 – 8 Science Standards
History of Aviation Propulsion (pgs. 5-9)	The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.
History of Aviation Propulsion (pgs. 5-9)	Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.
History of Aviation Propulsion (pgs. 5-9)	In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.
History of Aviation Propulsion (pgs. 5-9)	Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.
Types of Engines (pgs. 11-23)	The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
Types of Engines (pgs. 11-23)	If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.
Chemistry (pgs. 25-41)	A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
Chemistry (pgs. 25-41)	Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group.
Chemistry (pgs. 25-41)	Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.
Chemistry (pgs. 25-41)	In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.
Chemistry (pgs. 25-41)	Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.
Chemistry (pgs. 25-41)	Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
Physics and Math (pgs. 43-63)	A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
Physics and Math (pgs. 43-63)	An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
Physics and Math (pgs. 43-63)	If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.
Physics and Math (pgs. 43-63)	Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
Physics and Math (pgs. 43-63)	Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.
Rocket Activity (pgs. 69-75)	Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group.

Pushing the Envelope

National Standards

Grades 6 – 8 Science

Source: NSTA National Standards Science 1996

Lesson/Activity	Grades 6 – 8 Science Standards
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Rocket Activity (pgs. 69-75)	An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
Rocket Activity (pgs. 69-75)	If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.
Rocket Activity (pgs. 69-75)	In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.

Pushing the Envelope

National Standards

Grades 9 – 12 Science

Source: : NSTA National Standards Science 1996

Lesson/Activity	Grades 6 – 8 Science Standards
History of Aviation Propulsion (pgs. 5-9)	Scientists usually inquire about how physical, living, or designed systems function. Conceptual principles and knowledge guide scientific inquiries. Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.
History of Aviation Propulsion (pgs. 5-9)	Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.
History of Aviation Propulsion (pgs. 5-9)	Results of scientific inquiry--new knowledge and methods--emerge from different types of investigations and public communication among scientists. In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge. In addition, the methods and procedures that scientists used to obtain evidence must be clearly reported to enhance opportunities for further investigation.
History of Aviation Propulsion (pgs. 5-9)	Chemical reactions may release or consume energy. Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.
History of Aviation Propulsion (pgs. 5-9)	A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.
History of Aviation Propulsion (pgs. 5-9)	Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the earth's original formation.
History of Aviation Propulsion (pgs. 5-9)	Heating of earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
History of Aviation Propulsion (pgs. 5-9)	Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.
History of Aviation Propulsion (pgs. 5-9)	Normal adjustments of earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the earth's solid crust. As societies have grown, become stable, and come to value aspects of the environment, vulnerability to natural processes of change has increased.
History of Aviation Propulsion (pgs. 5-9)	In history, diverse cultures have contributed scientific knowledge and technologic inventions. Modern science began to evolve rapidly in Europe several hundred years ago. During the past two centuries, it has contributed significantly to the industrialization of Western and non-Western cultures. However, other, non-European cultures have developed scientific ideas and solved human problems through technology.
History of Aviation Propulsion (pgs. 5-9)	The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time, almost always building on earlier knowledge.
Types of Engines (pgs. 11-23)	Matter is made of minute particles called atoms, and atoms are composed of even smaller components. These components have measurable properties, such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and electrons holds the atom together.
Types of Engines (pgs. 11-23)	A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.

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Grades 9 – 12 Science

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Lesson/Activity	Grades 9 – 12 Science Standards
Types of Engines (pgs. 11-23)	Gravitation is a universal force that each mass exerts on any other mass. The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.
Types of Engines (pgs. 11-23)	Normal adjustments of earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the earth's solid crust. As societies have grown, become stable, and come to value aspects of the environment, vulnerability to natural processes of change has increased.
Chemistry (pgs. 25-41)	An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies.
Chemistry (pgs. 25-41)	Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically.
Chemistry (pgs. 25-41)	The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.
Chemistry (pgs. 25-41)	Solids, liquids, and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together. In solids the structure is nearly rigid; in liquids molecules or atoms move around each other but do not move apart; and in gases molecules or atoms move almost independently of each other and are mostly far apart.
Chemistry (pgs. 25-41)	Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.
Chemistry (pgs. 25-41)	Chemical reactions may release or consume energy. Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.
Chemistry (pgs. 25-41)	A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.
Chemistry (pgs. 25-41)	Catalysts, such as metal surfaces, accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes.
Chemistry (pgs. 25-41)	The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily less ordered.
Chemistry (pgs. 25-41)	Most cell functions involve chemical reactions. Food molecules taken into cells react to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts, called enzymes. The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to carry out the many functions of the cell.
Chemistry (pgs. 25-41)	Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.
Chemistry (pgs. 25-41)	Populations grow or decline through the combined effects of births and deaths, and through emigration and immigration. Populations can increase through linear or exponential growth, with effects on resource use and environmental pollution.

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Grades 9 – 12 Science

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Lesson/Activity	Grades 9 – 12 Science Standards
Chemistry (pgs. 25-41)	Humans have a major effect on other species. For example, the influence of humans on other organisms occurs through land use--which decreases space available to other species--and pollution--which changes the chemical composition of air, soil, and water.
Physics and Math (pgs. 43-63)	Objects change their motion only when a net force is applied. Laws of motion are used to calculate precisely the effects of forces on the motion of objects. The magnitude of the change in motion can be calculated using the relationship F = ma, which is independent of the nature of the force. Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object.
Physics and Math (pgs. 43-63)	The electric force is a universal force that exists between any two charged objects. Opposite charges attract while like charges repel. The strength of the force is proportional to the charges, and, as with gravitation, inversely proportional to the square of the distance between them.
Physics and Math (pgs. 43-63)	Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.
Physics and Math (pgs. 43-63)	Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes in current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.
Physics and Math (pgs. 43-63)	Newtonian mechanics
Rocket Activity (pgs. 69-75)	Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically.
Rocket Activity (pgs. 69-75)	The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.
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