Grade 8 Science Standards

Domain: Physical Science - Structure and Properties of Matter			
Code:	**Strand:**	**Rating**	**Completed**
DMS.PS1.1	Develop models to describe the atomic composition of simple molecules and extended structures	Supporting	
DMS.PS1.3	Collect and analyze information to describe that synthetic materials come from natural resources and impact society.	Supporting	
DMS.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.	Supporting	
DMS.PS1.4.1	Investigate how the transfer of energy can affect the physical and chemical properties of matter	Priority	

Catholic Identity

- Compare solutions that further the Christian goals to best address an identified need or problem.
- Define environmental stewardship and recognize it as part of Catholic social teaching.
- Discuss a sense of order, balance and symmetry in God's Universe, e.g. symmetry, polarity.

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to predict and/or describe phenomena. (MS.PS1.1),(MS.PS1. 4)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not

Disciplinary Ideas

PS1.A: Structure and Properties of Matter

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS.PS1.1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) (Note: This Disciplinary Core Idea is also addressed by MS.PS1.2.)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS.PS1.4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS. PS1.4)

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS.PS1.1)

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS.PS1.3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, And Technology

supported by evidence. (MS.PS1.3)	locations. (MS.PS1.4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS.PS1.1) • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS.PS1.4) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS.PS1.3) (Note: This Disciplinary Core Idea is also addressed by MS.PS1.2 and MS.PS1.5.) **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS.PS1.4) • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS.PS1.4)	• Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS.PS1.3) **Influence of Science, Engineering and Technology on Society and the Natural World** • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS.PS1.3)

Domain: Physical Science - Chemical Reactions			
Code:	**Strand:**	**Rating**	**Completed**
DMS.PS1.2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	Priority	
DMS.PS1.2.1	Identify different kinds of matter based on the following physical properties: states, density, boiling point, melting point, solubility.	Priority	
DMS.PS1.2.2	Identify different kinds of matter based on the following chemical properties: reactivity, pH, oxidation (corrosion)	Priority	
DMS.PS1.2.3	Investigate how the transfer of energy can affect the physical and chemical properties of matter	Priority	
DMS.PS1.2.4	Classify matter in terms of elements, compounds, or mixtures (homogeneous, heterogeneous mixtures)	Priority	
DMS.PS1.2.5	Explain the systematic organization of the periodic table	Priority	
DMS.PS1.5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	Priority	
DMS.PS1.6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*	Supporting	
DMS.PS1.6.1	Identify various ways in which electrical energy is generated using renewable and nonrenewable resources (e.g., wind, dams, fossil fuels, nuclear reactions).	Priority	
DMS.PS1.6.2	Identify/ Explain several ways in which energy can be transformed, transferred or stored. (E.g. Batteries, mechanical to electrical, electrical to thermal, conduction, convection radiation.)	Priority	

Catholic Identity

- Define environmental stewardship in terms of renewable and non-renewable resources and recognize it as part of Catholic social teaching.
- Evaluate the scientific evidence used in various media to address a social issue using criteria accuracy, logic, bias, relevance of data, and credibility of sources; and discuss ethical implications.
- Discuss the perfection of God's Universe where the laws of chemistry can accurately predict future elements based on what we have discovered so far.

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms. (MS.PS1.5)

Disciplinary Ideas

PS1.A: Structure and Properties of Matter

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS.PS1.2) (Note: This Disciplinary Core Idea is also addressed by MS- PS1.3.)

Crosscutting Concepts

Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic- level structure. (MS.PS1.2)

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS.PS1.5)

Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS.PS1.2) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS.PS1.6) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS.PS1.2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena. (MS.-PS1.5)	**PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS.PS1.2),(MS.PS1.5) (Note: This Disciplinary Core Idea is also addressed by MS.PS1.3.) • The total number of each type of atom is conserved, and thus the mass does not change. (MS.PS1.5) Some chemical reactions release energy, others store energy. (MS.PS1.6) **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS.PS1.6) **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS.PS1.6) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS.PS1.6)	• The transfer of energy can be tracked as energy flows through a designed or natural system. (MS.PS1.6)

Domain: Physical Science - Forces and Interactions			
Code:	**Strand:**	**Rating**	**Completed**
DMS.PS2.1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*	Priority	
DMS.PS2.2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	Supporting	
DMS.PS2.3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	Supporting	
DMS.PS2.4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	Priority	
DMS.PS2.5	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	Priority	

Catholic Identity

- Research and describe how forces and gravity affects the design of churches and tall cathedral,e.g. domes, flying buttresses, columns, arches.

Science and Engineering Practices

Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between Variables, and clarifying arguments and models.

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS.PS2.3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple

Disciplinary Ideas

PS2.A: Forces and Motion

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS.PS2.1)
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS.PS2.2)
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS.-PS2.3),(MS.PS2.5)

Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS.PS2.1),(MS.PS2.4)

Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS.PS2.2)

Connections to Engineering, Technology, and Applications of Science
Influence of Science, Engineering, and

variables and provide evidence to support explanations or design solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS.PS2.2) • Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS.P 2.5) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas or principles to design an object, tool, process or system. (MS.PS2.1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS.PS2.4) **Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS.PS2.2),(MS.PS2.4)	other people, these choices must also be shared.(MS.PS2.2) **PS2.B: Types of Interactions** • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS.PS2.3) • Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS.PS2.4) • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS.PS2.5)	Technology on Society and the Natural World

Domain: Energy			
Code:	**Strand:**	**Rating**	**Completed**
DMS.PS3.1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	Supporting	
DMS.PS3.1.1	Calculate velocity as the rate of change of position over time and create a graph devised from measurements of moving objects and their interactions including: position-time graphs, velocity-time graphs.	Priority	
DMS.PS3.2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	Supporting	
DMS.PS3.3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*	Priority	
DMS.PS3.4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	Priority	
DMS.PS3.5	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	Priority	

Catholic Identity

- Evaluate the scientific evidence used in various media to address a social issue using criteria accuracy, logic, bias, relevance of data, credibility of sources, and discuss ethical implications.
- Discuss a sense of order, balance and symmetry in God's Universe, i.e. Law of Conservation of Energy and Mass
- Research explanations regarding the Shroud of Turin related to how it was created.
- Find connections between Catholic researchers and their contributions to the study of energy.

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms. (MS.PS3.2)

Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple

Disciplinary Ideas

PS3.A: Definitions of Energy

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS.PS3.1)
- A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS.PS3.2)
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts

Crosscutting Concepts

Scale, Proportion, and Quantity

- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS.PS3.1),(MS.PS3. 4)

Systems and System Models

- Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.

variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS.PS3.4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS.PS3.1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS.PS3.3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. Construct, use and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS.PS3.5

Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS.-PS3.4),(MS.PS3.5)

of matter present. (MS.PS3.3),(MS.PS3.4)

PS3.B: Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS.PS3.5)
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS.PS3.4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS.PS3.3)

PS3.C: Relationship Between Energy and Forces

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS.PS3.2)

ETS1.A: Defining and Delimiting an Engineering Problem

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS.PS3.3)

(MS.PS3.2)

Energy and Matter

- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS.PS3. 5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS. PS3.3)

Domain: Waves and Electromagnetic Radiation			
Code:	**Strand:**	**Rating**	**Completed**
DMS.PS4.1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	Priority	
DMS.PS4.2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	Supporting	
DMS.PS4.3	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	Supporting	

Catholic Identity

- Demonstrate Catholic responsibility through proper use of digital communication and digital citizenship.

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS.PS4.2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS.PS4.1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.

- Integrate qualitative scientific and technical information in

Disciplinary Ideas

PS4.A: Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS.PS4.1)
- A sound wave needs a medium through which it is transmitted. (MS.PS4.2)

PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS.PS4.2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS.PS4.2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS.PS4.2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS.PS4.2)

PS4.C: Information Technologies and Instrumentation

Crosscutting Concepts

Patterns

- Graphs and charts can be used to identify patterns in data. (MS.PS4.1)

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS.PS4.2)
- Structures can be designed to serve particular functions. (MS.PS4.3)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS.PS4.3)

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written text with that contained in media and visual displays to clarify claims and findings. (MS.PS4.3) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS.PS4.1)	• Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS.PS4.3)	***Connections to Nature of Science*** **Science is a Human Endeavor** • Advances in technology influence the progress of science and science as influenced advances in technology. (MS.PS4.3)