

NATIONAL SCIENCE EDUCATION STANDARDS

Chain Gang—The Chemistry of Polymers

GRADE	CATEGORY	SUB-CATEGORY	STANDARD
K-4	Physical Science	Properties of Objects and Materials	Materials can exist in different states- solid, liquid, and gas. Some common materials such as water, can be changed from one state to another by heating or cooling.
K-4	Physical Science	Properties of Objects and Materials	Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.
K-4	Physical Science	Properties of Objects and Materials	Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers.
5-8	Physical Science	Transfer Of Energy	Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of the chemical. Energy is transferred in many ways.
5-8	Physical Science	Transfer Of Energy	Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
5-8	Physical Science	Transfer Of Energy	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.
5-8	Physical Science	Transfer Of Energy	Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object-emitted by or scattered from it-must enter the eye.
5-8	Science and Technology	Abilities In Technical Design	Communicate the process of technological design.
5-8	Science and Technology	Abilities In Technical Design	Design a solution or product.

5-8	Science and Technology	Abilities In Technical Design	Evaluate completed technological designs or products.
5-8	Science and Technology	Abilities In Technical Design	Identify appropriate problems for technological design.
5-8	Science and Technology	Abilities In Technical Design	Implement a proposed design.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Communicate scientific procedures and explanations.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Design and conduct a scientific investigation.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Develop descriptions, explanations, predictions, and models using evidence.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Identify questions that can be answered through scientific investigations.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Recognize and analyze alternative explanations and predictions.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Think critically and logically to make the relationships between evidence and explanations.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Use appropriate tools and techniques to gather and analyze, and interpret data.
5-8	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Use mathematics in all aspects of scientific inquiry.
9-12	History and Nature of Science	Historical Perspectives	In history, diverse cultures have contributed scientific knowledge and technological inventions.
9-12	History and Nature of Science	Science as a Human Endeavor	Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world.
9-12	Physical Science	Chemical Reactions	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.
9-12	Physical Science	Chemical Reactions	Catalysts, such as metal surfaces, accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes.
9-12	Physical Science	Chemical Reactions	Chemical reactions may release or consume energy.

9-12	Physical Science	Chemical Reactions	Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles.
9-12	Physical Science	Conservation of Energy and the Increase In Disorder	All energy can be considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.
9-12	Physical Science	Conservation of Energy and the Increase In Disorder	Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.
9-12	Physical Science	Conservation of Energy and the Increase In Disorder	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.
9-12	Physical Science	Motions and Forces	The electric force is a universal force that exists between any two charged objects.
9-12	Physical Science	Structure and Properties of Matter	Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus.
9-12	Physical Science	Structure and Properties of Matter	Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.
9-12	Physical Science	Structure and Properties of Matter	The physical properties of compounds reflect the nature of the interactions among its molecules.
9-12	Science and Technology	Abilities of Technological Design	Communicate the Problem, Process, and Solution
9-12	Science and Technology	Abilities of Technological Design	Evaluate the solution and its consequences.
9-12	Science and Technology	Abilities of Technological Design	Identify a problem or design an opportunity.
9-12	Science and Technology	Abilities of Technological Design	Implement a proposed solution.
9-12	Science and Technology	Abilities of Technological Design	Propose designs and choose between alternative solutions.
9-12	Science and Technology	Understandings About Science and Technology	Science often advances with introduction of new technologies.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Design and conduct scientific investigations.

9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Formulate and revise scientific explanations and models using logic and evidence.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Recognize and analyze alternative explanations and models.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Use technology and mathematics to improve investigations and communications.