National Science Education Standards Correlation

National Science Education Standards by the National Research Council
Content Standards: 9-12, Physical Science

Sections listed are the main sections covering the standards topics related to physics. Explore the sections surrounding those listed to see more in-depth exploration of the topics as well as sample problems and interactive simulations.

	Physics for Scientists and Engineers	**Principles of Physics**	**Conceptual Physics**
Structure of Atoms			
●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.	44.1, 44.2, (also 23.1, 42.9)	43.1, 43.2, (also 23.1, 41.9)	38.1, 38.2, (also 22.1, 36.8)
●The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.	44.3	43.3	38.3
●The nuclear forces that hold the nucleus of an atom together, at nuclear distances, are usually stronger than the electric forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure, and is the process responsible for the energy of the sun and other stars.	44.5, 44.13, 44.14	43.5, 43.13, 43.14	38.5, 38.13, 38.14
●Radioactive isotopes are unstable and undergo spontaneous nuclear reactions, emitting particles and/or wavelike radiation. The decay of any one nucleus cannot be predicted, but a large group of identical nuclei decay at a predictable rate. This predictability can be used to estimate the age of materials that contain radioactive isotopes.	44.15 - 44.21	43.15 - 43.21	38.15 - 38.18

	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics
Motions and Forces			
●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.	5.2, 5.5, 5.10	5.2, 5.5, 5.10	5.2, 5.5, 5.10
●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.	13.1	13.1	12.1
●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.	23.7, 23.9	23.7, 23.9	22.6, 22.8
●Between any two charged particles, electric force is vastly greater than the gravitational force. Most observable forces such as those exerted by a coiled spring or friction may be traced to electric forces acting between atoms and molecules.	23.10, 23.11	23.10, 23.11	22.9, 22.10
●Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces. These effects help students to understand electric motors and generators.	Chapters 30 - 32, 34. Main sections on motors and generators: 30.27, 32.17	Chapters 30 - 32, 34. Main sections on motors and generators: 30.26, 32.14	Chapters 28 - 29. Main sections on motors and generators: 28.19, 29.10
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. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily less ordered.	7.22, 8.11, 16.1, 35.9, 44.13, 44.14, 22.8	7.19, 8.10, 16.1, 34.6, 43.13, 43.14, 22.8	6.16, 7.8, 15.1, 30.1, 38.13, 38.14, 21.5

	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics
●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.	7.8, 7.16, 16.19, 25.1, 32.38, 35.9	7.6, 7.13, 25.1, 32.30, 34.6	6.4, 6.10, 24.1, 30.1
●Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.	20.10	20.10	19.9
●Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels.	22.8, 19.25, 19.28, 19.29	22.8, 19.22, 19.25, 19.26	21.5, 18.17, 18.19, 18.20
Interactions of Energy and Matter			
●Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.	16.1, 16.19, 17.10, 35.1, 35.9	16.1, 17.8, 34.1, 34.6	15.1, 16.4, 30.1
●Electromagnetic waves result when a charged object is accelerated or decelerated. Electromagnetic waves include radio waves (the longest wavelength), microwaves, infrared radiation (radiant heat), visible light, ultraviolet radiation, x-rays, and gamma rays. The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength.	35.8, 35.1, 42.4	34.5, 34.1, 41.4	30.5, 30.1, 36.3
●Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts. These wavelengths can be used to identify the substance.	42.2, 42.4, 42.12	41.2, 41.4, 41.11	36.2, 36.3, 36.9
●In some materials, such as metals, electrons flow easily, whereas in insulating materials such as glass they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures some materials become superconductors and offer no resistance to the flow of electrons.	23.5, 42.14, 27.8	23.5, 41.13, 27.5	22.4, 36.11, 25.5