New York Science

# Physical Science - Disciplinary Core Ideas

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| **Structure and Properties of Matter** PS1.A | **A** | **Substances are made of one type of atom or combinations of different types of atoms. Individual atoms are particles and can combine to form larger particles that range in size from two to thousands of atoms.** PS1.A-1 |
| | **B** | **Each substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.** PS1.A-2 |
| | **C** | **In a solid, the particles are closely spaced and vibrate in position but do not change their relative locations. In a liquid, the particles are closely spaced but are able to change their relative locations. In a gas, the particles are widely spaced except when they happen to collide and constantly change their relative locations.** PS1.A-3 |
| | **D** | **Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).** PS1.A-4 |
| | **E** | **The changes of state that occur with variations in temperature and/or pressure can be described and predicted using these models of matter.** PS1.A-5 |
| | **F** | **Mixtures are physical combinations of one or more samples of matter and can be separated by physical means.** PS1.A-6 |
| | **G** | **Each substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.** PS1.A-7 |
| **Chemical Reactions** PS1.B | **A** | **Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different particles, and these new substances have different properties from those of the reactants.** PS1.B-1 |
| | **B** | **The total number of each type of atom is conserved, and thus the mass does not change.** PS1.B-2 |
| | **C** | **Some chemical reactions release energy, others absorb energy.** PS1.B-3 |
| **Forces and Motion** | **A** | **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).** PS2.A-1 |

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| | **B** 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. PS2.A-2 |
| | **C** 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 other people, these choices must also be shared. PS2.A-3 |
| **Types of Interactions** PS2.B | **A** Electric and magnet (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. PS2.B-1 |
| | **B** 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 has a large mass - e.g Earth and the sun. PS2.B-2 |
| | **C** 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). PS2.B-3 |
| **Definitions of Energy** PS3.A | **A** The term "heat" is used in everyday language refers both to thermal energy (the motion of particles 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; if refers to the energy transferred due to the temperature difference between two objects. PS3.A-1 |
| | **B** Temperature is not a form of energy. Temperature is a measurement of the average kinetic energy of the particles in a sample of matter. PS3.A-2 |
| | **C** 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. PS3.A-3 |
| | **D** A system of objects may also contain stored (potential) energy, depending on their relative positions. PS3.A-4 |
| | **E** 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, phases (states) and amounts of matter present. PS3.A-5 |
| **Conservation of Energy and Energy Transfer** PS3.B | **A** When the motion energy of an object changes, there is inevitably some other change in energy at the same time. PS3.B-1 |
| | **B** 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 mass of the sample and the environment. PS3.B-2 |

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| | **C** Energy is spontaneously transferred out of hotter regions or objects and into colder ones. PS3.B-3 |
| | **D** An electric circuit is a closed path in which an electric current can exist. PS3.B-4 |
| **Relationship Between Energy and Forces** PS3.C | **A** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. PS3.C-1 |
| **Wave Properties** PS4.A | **A** A simple wave has a repeating pattern with a specific wavelength, frequency and amplitude. PS4.A-1 |
| | **B** A sound wave needs a medium through which it is transmitted. PS4.A-2 |
| **Electromagnetic Radiation** PS4.B | **A** 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. PS4.B-1 |
| | **B** The path that light travels can be traced as straight lines, except when it hits a surface between different transparent materials (e.g. air and water, air and glass) obliquely where the light path bends. PS4.B-2 |
| | **C** A wave model of light is useful for explaining brightness, color and the frequency-dependent bending of light at a surface between media. PS4.B-3 |
| | **D** However, because light can travel through space, it cannot be a mechanical wave, like sound or water waves. PS4.B-4 |
| **Information Technologies and Instrumentation** PS4.C | **A** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. PS4.C-1 |
| **Defining and Delimiting an Engineering Problem** ETS1.A | **A** 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. ETS1.A-1 |
| **Developing Possible Solutions** ETS1.B | **A** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. ETS1.B-1 |
| **Optimizing the Design Solution** ETS1.C | **A** 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. ETS1.C-1 |

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**B** **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.** ETS1.C-2