

DCI: Matter and Its Interactions**MS.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)

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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), (MS-PS1-3)

DCI: Matter and Its Interactions**MS.PS1.A: Structure and Properties of Matter**

Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)

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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 locations. (MS-PS1-4)

DCI: Matter and Its Interactions**MS.PS1.A: Structure and Properties of Matter**

Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)

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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)

DCI: Matter and Its Interactions**MS.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-PS1-3), (MS-PS1-5)

DCI: Matter and Its Interactions**MS.PS1.B: Chemical Reactions**

The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)

DCI: Matter and Its Interactions**MS.PS1.B: Chemical Reactions**

Some chemical reactions release energy, others store energy. (MS-PS1-6)

DCI: Energy**MS.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. (MS-PS1-4)

DCI: Energy

MS.PS3.A: Definitions of Energy

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. (MS-PS1-4)

DCI: Engineering Design

MS.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. (MS-PS1-6)

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences 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)

DCI: Engineering Design

MS.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. (MS-PS1-6)

DCI: Engineering Design

MS.ETS1.C: Optimizing the Design Solution

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. (MS-PS1-6)

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences 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)

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences 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)

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences 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 supported by evidence. (MS-PS1-3)

Science and Engineering Practices

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. 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)

Crosscutting Concepts

Patterns

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

Crosscutting Concepts

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

Crosscutting Concepts

Energy and Matter

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

Crosscutting Concepts

Energy and Matter

The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Crosscutting Concepts

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)