**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)

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)

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 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)

**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)

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)

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.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**
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)

**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)