

<p>Important Concepts for Physical Science</p> <p>Grades 9-12</p> <p>Properties of Matter</p>	<p>Alaska State Science Standard B1: Students develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior</p> <p>Alaska State Science Standard B3: Students develop an understanding of the interactions between matter and energy, including physical, chemical, and nuclear changes, and the effects of these interactions on physical systems. (partially addressed)</p>
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Grade Level Expectations:

Grade Level Expectations: The student demonstrates an understanding of the structure and properties of matter by

[9] SB1.1 describing atoms and their base components (i.e., protons, neutrons, electrons)

[10] SB1.1 using the periodic table to describe atoms in terms of their base components (i.e., protons, neutrons, electrons)

[11] SB1.1 predicting the properties of an element (i.e., reactivity, metal, non-metal) using the periodic table and verifying the predictions through experimentation (L)

The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by

[9] **SB3.1** recognizing that a chemical reaction has taken place

[9] **SB3.3** recognizing that atoms emit and absorb electromagnetic radiation

[10] **SB3.1** describing the behavior of electrons in chemical bonding

[10] **SB3.2** recognizing that radioactivity is a result of the decay of unstable nuclei

11] SB3.1 predicting how an atom can interact with other atoms based on its electron configuration and verifying the results (L)

(there are additional GLEs for Science Standard B3, addressed elsewhere)

According to AAAS's Benchmarks for Science Literacy*, some of the things that students should know and understand by the end of the twelfth grade are:

*Atoms are made of a positively charged nucleus surrounded by negatively charged electrons. The nucleus is a tiny fraction of the volume of an atom but makes up almost all of its mass. The nucleus is composed of protons and neutrons which have roughly the same mass but differ in that protons are positively charged while neutrons have no electric charge.

- The number of protons in the nucleus determines what an atom's electron configuration can be and so defines the element. An atom's electron configuration, particularly the outermost electrons, determines how the atom can interact with other atoms. Atoms form bonds to other atoms by transferring or sharing electrons.

*Project 2061, American Association for the Advancement of Science, Benchmarks for Science Literacy. New York: Oxford University Press, 1993.

- Although neutrons have little effect on how an atom interacts with other atoms, the number of neutrons does affect the mass and stability of the nucleus. Isotopes of the same element have the same number of protons (and therefore of electrons) but differ in the number of neutrons.
- The nucleus of radioactive isotopes is unstable and spontaneously decays, emitting particles and/or wavelike radiation. It cannot be predicted exactly when, if ever, an unstable nucleus will decay, but a large group of identical nuclei decay at a predictable rate. This predictability of decay rate allows radioactivity to be used for estimating the age of materials that contain radioactive substances.
- When elements are listed in order by the masses of their atoms, the same sequence of properties appears over and over again in the list.
- An enormous variety of biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.
- The rate of reactions among atoms and molecules depends on how often they encounter one another, which is affected by the concentration, pressure, and temperature of the reacting materials.