Minneapolis Public Schools
Physical Science – Grades 11-12
STANDARDS AND BENCHMARKS ADDRESSED

KEY TO THE FOLLOWING STANDARDS FORMAT:

- *Italics indicates language added to the state standards by Minneapolis teachers.*
- **Bold words indicate "Power Benchmarks" that should be addressed in detail.**
- The other benchmarks are to be addressed when possible but as time permits.

II. PHYSICAL SCIENCE: CHEMISTRY

A. STRUCTURE OF MATTER

The student will understand the nature of matter including its forms, properties and interactions.

State Benchmarks:

1. The student will identify protons, neutrons and electrons as the major components of the atom, their mass relative to one another, their arrangement and their charge.
2. **The student will be able to explain the relationship of an element's position on the periodic table to its atomic number** and atomic mass**.**
3. The student will compare and contrast the properties of an element and its isotopes, and describe how isotopes can be used in research, medicine and industry.
4. The student will use the periodic table to identify regions, families, groups and periods.
5. The student will explain how neutral atoms become ions.
6. **The student will be able to explain how atoms form compounds through bonding.**
7. The student will compare and contrast the states of matter in terms of interactions between particles.
8. The student will differentiate between an atom and a molecule.
9. The student will differentiate between an element and a compound.

B. CHEMICAL REACTIONS

The student will describe chemical reactions and the factors that influence them.

State Benchmarks:

1. **The student will describe chemical reactions using words and symbolic equations*, using IUPAC names.***
2. The student will explain the influence of temperature, surface area, agitation and catalysts on the rate of a reaction.

3. **The student will distinguish between a chemical reaction and a nuclear reaction.**

4. **The student will explain how the rearrangement of atoms and molecules in a chemical reaction illustrates conservation of mass.**

5. **The student will describe how combining acids and bases produce a neutral solution.**

C. ENERGY TRANSFORMATIONS

The student will understand energy forms, transformations and transfers.

State Benchmarks:

1. **The student will be able to describe physical and chemical changes in terms of the law of conservation of energy.**

2. **The student will compare and contrast the amount of energy released through chemical reactions and nuclear fission and fusion.**

3. **The student will describe the risks and benefits of fossil fuels, renewable sources and nuclear power as sources of usable energy.**

4. **The student will describe applications of the different wavelengths of the electromagnetic spectrum.**

III. EARTH AND SPACE SCIENCE

A. EARTH STRUCTURE AND PROCESSES

The student will understand that the interactions of the atmosphere, biosphere, lithosphere, hydrosphere and space have resulted in ongoing change of the Earth system over geologic time.

State Benchmark:

1. **The student will apply the laws of thermodynamics to explain the cycling of materials and transfer of energy in the Earth system.**

C (I). THE UNIVERSE

The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.

State Benchmark:

1. **The student will explain how nuclear fusion produces energy and other elements.**

II. PHYSICAL SCIENCE: PHYSICS

C. ENERGY TRANSFORMATIONS

The student will understand energy forms, transformations and transfers.

State Benchmarks:

1. The student will know that potential energy is stored energy and is associated with gravitational or electrical force, mechanical position or chemical composition.
2. The student will differentiate between kinetic and potential energy and identify situations where kinetic energy is converted into potential energy and vice versa.
3. The student will differentiate between AC and DC current.
4. **The student will describe the production, storage and transmission of electricity.**
5. The student will describe applications of the different wavelengths of the electromagnetic spectrum.
6. **The student will describe energy, work and power both conceptually and quantitatively.**

D. MOTION

The student will understand the nature of force and motion.

State Benchmarks:

1. **The student will use Newton's three laws of motion to qualitatively and quantitatively describe the interaction of objects.**
2. **The student will describe the effect of friction and gravity on the motion of an object.**

E. FORCES OF NATURE

The student will understand the forces of nature and their application.

State Benchmarks:

1. The student will recognize the factors that affect the presence and magnitude of gravitational, electromagnetic, weak and strong nuclear forces.
2. **The student will identify the dominant force or forces in a variety of interactions.**

III. EARTH AND SPACE SCIENCE

C (I). THE UNIVERSE
The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.

State Benchmark:

1. **The student will explain how the sun, Earth and solar system formed.**

2. **The student will compare the characteristics of Earth with the characteristics and movement patterns of the other planets, their satellites and other objects in our solar system.**

C (II). THE UNIVERSE
The student will use astronomical data to reveal the structure, scale, and changes in the stars, galaxies and universe over time.

State Benchmark:

1. **The student will identify different types of stars and galaxies and describe how stars, galaxies and the universe change over time.**

2. **The student will describe the evidence from current technologies that has been used to understand the composition and the early history of the universe.**

3. The student will explain how Doppler evidence indicates our universe is expanding in all directions.

NOTE: The following History and Nature of Science Standards apply to both the Chemistry and Physics semesters of the Physical Science course.

I. HISTORY AND NATURE OF SCIENCE

A. SCIENTIFIC WORLD VIEW

The student will understand the ways of scientific thinking and that scientific knowledge changes and accumulates over time.

State Benchmarks:

1. **The student will be able to distinguish among hypothesis, theory and law as scientific terms and how they are used to answer a specific question.**
2. The student will be able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including but not limited to cell theory, atomic theory, theory of evolution, plate tectonic theory, germ theory of disease and big bang theory.
3. The student will recognize that in order to be valid, scientific knowledge must meet certain criteria including that it: be consistent with experimental, observational and inferential evidence about nature; follow rules of logic and reporting both methods and procedures; and, be falsifiable and open to criticism.
4. The student will explain how traditions of ethics, peer review, conflict and general consensus influences the conduct of science.
5. The student will recognize that some scientific ideas are incomplete, and opportunity exists in these areas for new advances.

B. SCIENTIFIC INQUIRY

The student will design and conduct a scientific investigation.

State Benchmarks:

1. **The student will design and complete a scientific experiment using scientific methods by determining a testable question, making a hypothesis, designing a scientific investigation with appropriate controls, analyzing data, making conclusions based on evidence and comparing conclusions to the original hypothesis and prior knowledge.**
2. **The student will distinguish between qualitative and quantitative data.**
3. **The student will apply mathematics and models to analyze data and support conclusions.**
4. **The student will identify possible sources of error and their effects on results.**
5. The student will know that professional scientists and engineers have ethical codes.
6. The student will give examples of how different domains of science use different bodies of scientific knowledge and employ different methods to investigate questions.

C. SCIENTIFIC ENTERPRISE

The student will understand the relationship between science and technology and how both are used.

State benchmarks:

1. The student will compare and contrast the purposes and career opportunities of engineering, technology and science.
2. The student will provide an example of a need or problem identified by science and solved by engineering or technology.
3. The student will provide an example of how technology facilitates new discoveries and the development of scientific knowledge.
4. The student will know that technological changes and scientific advances are often accompanied by social, political, environmental and economic changes.
5. The student will recognize that science and technology are influenced by cultural backgrounds and beliefs and by social needs, attitudes, values and limitations.

D. HISTORIC PERSPECTIVES

The student will recognize the historical and cultural context of scientific endeavors and how they influence each other.

State Benchmarks:

1. The student will be able to trace the development of a scientific advancement, invention or theory and its impact on society.
2. The student will provide examples of scientific advancements contributed by other civilizations and cultures.
3. The student will compare and contrast the differences between scientific theories and theories from other bodies of knowledge, and the importance of each in a science discussion.