Science Standards Comparison Document

This document has been arranged to provide example comparisons at three different levels, 3rd grade, middle school and high school, to allow for a specific and conceptual comparison of standards. You will notice some of the following similarities and differences:

1. The strands at each grade level or band are identical. Students are still expected to master standards in Life Science, Physical Science, and Earth and Space Science. Some of the specific concepts within these strands may have shifted to allow for coherence and vertical support for future student learning.

2. The current standards use bullets or check marks (enabling skills) and examples to help specify the content or directions. The work group decided not to include these specific bullets or examples, as they want to allow flexibility within the proposed standards to allow districts to create their own curriculum. The current standards were deemed by the committee to be too limiting. The third grade example, below, is specific down to the enabling skills (E.g. vocabulary words) that may need to be learned to achieve the standard. By providing an example, the workgroup cautioned that teachers may be prone to only teaching that singular idea, instead of allowing students to engage in one or more ideas that may be more relevant to their lives.

    3.L.3.3. Students are able to describe ways humans impact air, water, and habitat quality.
    Example: water pollution from chemical waste
    • Define pollution.

3. The proposed standards utilize Science and Engineering Practices as the actions desired by each standard, instead of the Blooms Taxonomy verbs used in the current standards. This allows for students to practice the skills used by scientists and engineers and is much more descriptive in terms of what kids should be expected to do in science. The actions or skills desired by each standard can be located by looking for the bold terms on the subsequent pages. Each bold term represents what students are expected to do. The rest of the standards is the concept or idea that the students are expected to learn by doing. Note: Standards that have an asterisk at the end have an increased emphasis on engineering.

4. In the proposed middle school standards, the reader will notice that they are grade banded for grades six through eight as opposed to grade level in grades six, seven, and eight in the current standards. Following adoption of the proposed standards, a representative group of teachers, administrators, curriculum directors, and instructional coaches will be convened to determine the best pathway for converting these grade banded standards into grade leveled middle school science standards. The workgroup decided that this was an issue that needed more feedback from across the state before it was decided to ensure that the system fits the needs of the entire state.

Example 1: Third Grade Life Science Comparison

Current Third Grade Life Science Standards	Proposed Third Grade Life Science Standards	Comments:
(Knowledge) 3.L.1.1. I**dentify** the basic structures, functions, and needs of plants in relation to their environment. Examples: leaves, stems, roots, flowers • **Differentiate** between plants and animals. (Knowledge) 3.L.1.2. **Identify** characteristic features of animals and their related functions in relation to their environment. Examples: wings/ hollow bones, webbed feet, fins • **Differentiate** between plants and animals. (Comprehension) 3.L.1.3. **Describe** life cycles, including growth and metamorphosis, of familiar organisms. • **Differentiate** between adult males and females. Example: dull-colored female birds/colorful male (Analysis) 3.L.2.1. **Explain** how animals instinctively meet basic needs in their environment. • **Give examples** of basic needs. Example: Instincts such as baby birds know to open their mouths for food; newborn turtles know to go to water. (Comprehension) 3.L.3.1. **Describe** how species depend on one another and on the	3-LS1-1 **Develop models to describe** that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. 3-LS2-1 **Construct an argument** that some animals form groups that help members survive. 3-LS3-1 **Analyze and interpret data** to provide evidence that plants and animals have traits inherited from parents and that variations of these traits exist in a group of similar organisms. 3-LS3-2 **Use evidence and reasoning to support the explanation** that traits can be influenced by the environment. 3-LS4-1 **Analyze and interpret data** from fossils to provide evidence of the organisms and the environments in which they lived long ago. 3-LS4-2 **Use evidence and reasoning to construct an explanation** for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. 3-LS4-3 **Construct an argument with evidence** how some organisms thrive, some struggle to survive, and some cannot survive in a particular habitat. 3-LS4-4 **Make a claim** about the merit of a solution to a problem caused when the	1. The content is similar for both sets of standards. The concepts of organisms, structures, and processes, ecosystems, heredity and biological unity and diversity are included in both sets of standards. 2. Greater emphasis on process skills of science in the proposed standards, which are cognitively more demanding than the Bloom's Taxonomy verbs used in the current science standards. These verbs and process skills are in **bold** to help with the comparison. *3.* On the current standards: bullets indicate enabling skills necessary for current grade level mastery. Enabling skills verbs are also bold to indicate skills needed by students at grade-level. 4. The asterisk by the proposed standard(s) indicates that the standard has an emphasis on engineering practices.

environment for survival. • **Describe** cause-and-effect relationships in living systems. (Comprehension) 3.L.3.2. **Explain** how environments support a diversity of plants and animals. • **Describe** types of environments. Example: deserts and what lives there (Comprehension) 3.L.3.3. **Describe** ways humans impact air, water, and habitat quality. Example: water pollution from chemical waste • **Define** pollution. (Application) 3.L.3.4. **Examine** fossils and describe how they provide evidence of change in organisms. • **Define** a fossil.	environment changes and the types of plants and animals that live there may change.*	

Example 2: Middle School Physical Science Comparison

Current MS Physical Science Standards	Proposed MS Physical Science Standards	Comments:
(Knowledge) 6.P.1.1. **Identify** the subatomic particles that make up atoms. • Electrons, protons, and neutrons (Application) 6.P.1.2. **Classify** matter based on physical and chemical properties. Examples: mass, weight, volume, acidity, density, texture, color, melting point, boiling point ***Compare and contrast*** *compounds and elements.* Examples: sugar, salt, water (as compounds); Au, Fe, Na (as element	MS-PS1-1 **Develop models to describe** the atomic composition of simple molecules and extended structures. MS-PS1-2 **Analyze and interpret data** on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-3 **Obtain and evaluate information** to describe that synthetic materials come from natural resources and impact society. MS-PS1-4 **Develop a model** that predicts and describes changes in particle motion,	*1.* Content and concepts of matter and its interactions, forces, energy are similar. The depth of engagement in these concepts is much more significant in the proposed standards. The concept of waves is introduced in the proposed standards, while it is not in the current standards. 2. The asterisk by the proposed standard(s) indicates that the standard has an emphasis on engineering practices.

symbols) ***Use the Periodic Table*** *as a tool to describe elements.* Examples: symbols, metals/non-metals, groups/rows, families (Comprehension) 6.N.1.3. **Describe** phase changes in matter differentiating between the particle motion in solids, liquids, and gases. (Comprehension) 6.P.2.1. **Describe** how push/pull forces acting on an object produce motion. Examples: illustration of see-saw, sailboat on water, kite ***Demonstrate*** *how all forces have magnitude and direction.* *Newton's Laws of Motion* (Comprehension) 6.P.3.1. **Identify** types of energy transformations. Examples: mechanical to electrical, chemical to light, kinetic to potential (and vice versa) ***Explain*** *basic principles of electricity and magnetism including static, current, circuits, and magnetic fields.* ***Investigate*** *the properties of light (electromagnetic spectrum).* *Illustrate sunlight to chemical (photosynthesis).* (Analysis) 8.P.1.1. **Classify** matter as elements, compounds, or mixtures. Example: Na and Cl are elements that, chemically combined, form salt (NaCl) (compound). Example: Salt and water form a	temperature, and state of a pure substance when thermal energy is added or removed. MS-PS1-5 **Develop and use a model** to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. MS-PS1-6 **Design, construct, test, and modify** a device that either releases or absorbs thermal energy by chemical processes.* MS-PS2-1 **Design a solution** to a problem involving the motion of two colliding objects that illustrates Newton's Third Law.* MS-PS2-2 **Plan an investigation** to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. MS-PS2-3 **Ask questions** about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-4 **Construct and present arguments using evidence** to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS2-5 **Conduct an investigation** and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact MS-PS3-1 **Construct and analyze** graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. MS-PS3-2 **Develop a model** to describe that when the arrangement of objects interacting	3. Greater emphasis on process skills of science in the proposed standards, which are cognitively more demanding than the Bloom's Taxonomy verbs used in the current science standards. These verbs and process skills are in **bold** to help with the comparison. *4.* On the current standards: bullets indicate enabling skills necessary for current grade level mastery and italics indicate enabling skills for next higher grade level mastery. Enabling skills verbs are bold to indicate skills needed by students at current or the next grade-level. 5. These proposed standards will be assigned to a grade level or multiple grade levels by the Middle School Science Course Pathway Committee following adoption.

mixture that can be physically separated. Formulas (Application) 8.P.1.2. **Use the Periodic Table to compare and contrast** families of elements and to classify elements as metals, metalloids, or non-metals. • **Describe** the relationship between the organization and the predictive nature of the Periodic Table. • **Use the Bohr model to show** the arrangement of the subatomic particles of atomic numbers 1 through 18. ***Compare and contrast*** *other atomic models.* (Comprehension) 8.P.1.3. **Compare** properties of matter resulting from physical and chemical changes. Examples: weathering, burning, melting, acid rain *Ionic/covalent bonding*	at a distance changes, different amounts of potential energy are stored in the system. MS-PS3-3 **Design, construct, and test** a device that either minimizes or maximizes thermal energy transfer.* MS-PS3-4 **Plan an investigation** to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. MS-PS3-5 **Engage in argument from evidence** to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. MS-PS4-1 **Use mathematical representations** to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-**2 Develop and use a model** to describe how waves are reflected, absorbed, or transmitted through various materials. MS-PS4-3 **Obtain, evaluate and communicate information** to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	

Example 3: High School Physical Science Standards Comparison

Current HS Physical Science Standards	**Proposed HS Physical Science Standards**	**Comments:**
(Analysis) 9-12.P.1.1. **Use the Periodic Table** to determine the atomic structure of	HS-PS1-1 **Use the periodic table as a model** to predict the relative properties of elements	1. Content and concepts of matter and its interactions, forces, energy and

elements, valence number, family relationships, and regions (metals, nonmetals, and metalloids). • **Determine** protons, neutrons, electrons, mass number, and atomic number from the Periodic Table. • **Determine** the number of valence electrons for elements in the main (s&p) blocks of the Periodic Table. • **Identify** the relative metallic character of an element based on its location on the Periodic Table. (Comprehension) 9-12.P.1.2. **Describe** describe ways that atoms combine. • **Name and write** formulas for binary ionic and covalent compounds. Example: sodium chloride (NaCl), carbon dioxide (CO2) • **Compare** the roles of electrons in covalent, ionic, and metallic bonding. • **Discuss** the special nature of carbon covalent bonds. (Application) 9-12.P.1.3. **Predict** whether reactions will speed up or slow down as conditions change. Examples: temperature, concentration, surface area, and catalysts (Application) 9-12.P.1.4. **Balance** chemical equations by applying the Law of Conservation of Matter. • **Trace** number of particles in diagrams and pictures of balanced equations.	based on the patterns of electrons in the outermost energy level of atoms. HS-PS1-2 **Construct and revise an explanation** for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS-PS1-3 **Plan and carry out an investigation** to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. HS-PS1-4 **Develop a model** to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS-PS1-5 **Construct an explanation** based on evidence about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. HS-PS1-6 **Refine the design** of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* HS-PS1-7 **Use mathematical representations** to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS-PS1-8 **Develop models** to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	waves are similar. The depth of engagement in these concepts is much more significant in the proposed standards. The proposed standards focus on depth as opposed to the breadth. 2. The asterisk by the proposed standard(s) indicates that the standard has an emphasis on engineering practices. 3. Greater emphasis on process skills of science in the proposed standards, which are cognitively more demanding than the Bloom's Taxonomy verbs used in the current science standards. These verbs, practices and enabling skills are in **bold** to help with the comparison. 4. On the current standards: bullets indicate enabling skills necessary for current grade level mastery. Enabling skills verbs are also bold to indicate skills needed by students at grade-level.

Example: Write out an equation with symbols: Mg + 2HCL → MgCl2 + 2H2 (Comprehension) 9-12.P.1.5. **Distinguish** among chemical, physical, and nuclear changes. • **Differentiate** between physical and chemical properties used to describe matter. • **Identify** key indicators of chemical and physical changes. • **Describe** the effects of changing pressure, volume, or temperature upon gases. • **Identify** characteristics of a solution and factors that affect the rate of solution formation. • **Explain** the differences among nuclear, chemical, and physical changes at the atomic level. Examples: solute, solvent, concentrated, dilute, saturated, unsaturated, supersaturated Factors affecting rate: agitation, heating, particle size, pictures of particles (Analysis) 9-12.P.2.1. **Apply** concepts of distance and time to the quantitative relationships of motion using appropriate mathematical formulas, equations, and units. • **Evaluate** speed, velocity, and acceleration both qualitatively and quantitatively. Examples:	HS-PS2-1 **Analyze data** to support the claim that Newton's Second Law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-PS2-2 **Use mathematical representations** to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3 **Design, evaluate, and refine** a device that minimizes the force on a macroscopic object during a collision.* HS-PS2-4 **Use mathematical representations** of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. HS-PS2-5 **Plan and carry out an investigation** to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS2-6 **Communicate scientific and technical information** about why the molecular-level structure is important in the functioning of designed materials.* HS-PS3-1 **Create a computational model** to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-2 **Develop and use models** to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles	

Identify the sign (+,-, 0) of an object's acceleration based on velocity information. Predict whether an object speeds up, slows down, or maintains a constant speed based on the forces acting upon it. Calculate acceleration using the equation Aavg=ΔV/Δt. • Given distance and time, **calculate** the velocity or speed of an object. • **Create and interpret graphs** of linear motion. Example: Given a velocity-time or a distance-time graph with different slopes, determine the motion of an object. • **Distinguish** between velocity and acceleration as related to force. (Application) 9-12.P.2.2. **Predict** motion of an object using Newton's Laws. • **Describe** how inertia is related to Newton's First Law. • **Explain** the effect of balanced and unbalanced forces. • **Identify** the forces at work on action/reaction pairs as distinguished from balanced forces. Examples: Draw a linear force diagram for the forces acting on an object in contact with another. Identify action/reaction pairs.	(objects) and energy associated with the relative position of particles (objects). HS-PS3-3 **Design, build, and refine** a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-4 **Plan and carry out an investigation** to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics). HS-PS3-5 **Develop and use a model** of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. HS-PS4-1 **Use mathematical representations** to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2 **Evaluate questions** about the advantages of using a digital transmission and storage of information. HS-PS4-3 **Evaluate the claims, evidence, and reasoning** behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. HS-PS4-4 **Evaluate the validity and reliability of claims** in published materials of the effects	

• **Explain** how force, mass, and acceleration are related. (Application) 9-12.P.2.3. **Relate** concepts of force, distance, and time to the quantitative relationships of work, energy, and power. • **Apply** appropriate mathematical formulas and equations to concepts using appropriate units. Examples: Calculate power given force, distance and time. Calculate work done on an object given force and distance. (Application) 9-12.P.3.1. **Describe** the relationships among potential energy, kinetic energy, and work as applied to the Law of Conservation of Energy. • **Describe** how energy can be transferred and transformed to produce useful work. Examples: Diagram simple energy transfers, describing the objects and the forms of energy gained and lost. Use simple machines as an example of the transmission of energy. • **Given** the formulas, calculate the mechanical advantage and efficiency of selected systems. • **Explain** methods of heat transfer. Examples: conduction, radiation, and convection (Comprehension) 9-12.P.3.2. **Describe** how	that different frequencies of electromagnetic radiation have when absorbed by matter. HS-PS4-5 **Communicate technical information** about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*	

characteristics of waves are related to one another. • **Relate** wavelength, speed, and frequency (v= f). • **Distinguish** between transverse and longitudinal waves. Examples: Discuss changes in frequency of waves using the Doppler Effect. Compare the energy of different frequency ranges of waves with in the electromagnetic spectrum. Describe how different colors of light waves have different amounts of energy. (Application) 9-12.P.3.3. **Describe** electrical effects in terms of motion and concentrations of charged particles. 126 • **Relate** potential difference to current. • **Describe** how static electricity is different from current electricity. • **Interpret and apply** Ohm's Law. • **Describe** electrical attractions and repulsions. • **Describe** how magnetism originates from motion of charged particles.		