New York State Testing Program
P-12 Science Learning Standards
Performance Level Descriptions
Physical Science: Chemistry
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THE STATE EDUCATION DEPARTMENT / THE UNIVERSITY OF THE STATE OF NEW YORK /
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Physical Science: Chemistry Performance Level Descriptions

Performance level descriptions (PLDs) help communicate to students, families, educators, and the public the specific knowledge and skills expected of students in order for them to demonstrate proficiency in each Learning Standard for Science. The PLDs serve several purposes in classroom instruction and assessment. They are the foundation of rich discussion around what students need to do to perform at higher levels, and they explain the progression of learning within a subject area. PLDs are also crucial in explaining student performance on the New York State (NYS) assessments since they make a connection between the scale score, the performance level (e.g., meets the expectation of the learning standards) and specific knowledge and skills typically demonstrated by students achieving at that level.

Policy Definitions of Performance Levels

For each subject area, students perform along a continuum of the knowledge and skills necessary to meet the demands of the Learning Standards for Science. There are students who meet the expectations of the standards with distinction, students who fully meet the expectations, students who minimally meet the expectations, students who partially meet the expectations, and students who do not demonstrate sufficient knowledge or skills required for any performance level. New York State assessments are designed to classify student performance into one of five levels based on the knowledge and skills the student has demonstrated. These performance levels for the Regents level science test are defined as:

NYS Level 5

Students performing at this level meet the expectations of the Science Learning Standards with distinction for Physical Science: Chemistry.

NYS Level 4

Students performing at this level fully meet the expectations of the Science Learning Standards for Physical Science: Chemistry. They are likely prepared to succeed in the next level of coursework.

NYS Level 3

Students performing at this level minimally meet the expectations of the Science Learning Standards for Physical Science: Chemistry. They meet the content area requirements for a Regents diploma but may need additional support to succeed in the next level of coursework.

NYS Level 2

Students performing at this level partially meet the expectations of the Science Learning Standards for Physical Science: Chemistry. Students with disabilities performing at this level meet the content area requirements for a local diploma but may need additional support to succeed in the next level of coursework.

NYS Level 1

Students performing at this level demonstrate knowledge, skills and practices embodied by the Science Learning Standards for Physical Science: Chemistry below that of a Level 2.

How were the PLDs developed?

Following research-based best practice for the development of PLDs, the number of performance levels and their definitions were specified prior to the articulation of the full descriptions. The New York State Education Department (NYSED) convened a group of NYS science educators to develop the initial draft PLDs for Physical Science: Chemistry. In developing PLDs, participants considered policy definitions of the performance levels and the knowledge and skill expectations for each grade level in the Science Learning Standards. Once they established the appropriate knowledge and skills from a particular standard for NYS Level 4 (fully meet), panelists worked together to parse the knowledge and skills across the other performance levels in such a way that the progression of the knowledge and skills was clearly seen moving from Level 1 to Level 5. This process was repeated for all of the standards within the course. The draft PLDs then went through additional rounds of review and edits from a number of NYS-certified educators, content specialists, and assessment experts under NYSED supervision.

How can the PLDs be used in Instruction?

The PLDS, which differentiate and stratify the overall continuum of knowledge and skills defined by the Learning Standards into five distinct levels of learning should be used as guidance by educators. NYSED encourages the use of the PLDs for a variety of purposes, including differentiating instruction to maximize individual student outcomes, creating formative classroom assessments and rubrics to help identify target performance levels for individuals or groups of students, and tracking student growth along the proficiency continuum as described by the PLDs. The knowledge and skills shown in the PLDs describe *typical* performance and progression. However, the order in which students will demonstrate the knowledge and skills within and between performance levels may be staggered (i.e., a student who predominantly demonstrates Level 3 knowledge and skills may simultaneously demonstrate certain knowledge and skills indicative of Level 4). Although the ranges of skills expected of students at each performance level are detailed in the PLDs, specific science concepts will be elaborated and expanded as those skills are applied in the science classroom. Because the Learning Standards for science encompass the Science and Engineering Practices (SEP), Disciplinary Core Ideas (DCI), and Crosscutting Concepts (CCC), each of them must be examined in depth. The integration of these three dimensions provides students with a context for the content of science, a sense of how science knowledge is acquired and understood, and a sense of how the sciences are connected through concepts that have universal meaning across the disciplines.

How are the PLDs used in Assessment?

PLDs are essential in setting performance standards (i.e., “cut scores”) for New York State assessments. Standard setting panelists use PLDs to determine the expectations for students to demonstrate the knowledge and skills necessary to *just barely* attain a Level 2, Level 3, Level 4 or Level 5 on the assessment. This knowledge and these skills drive discussions that influence the panelists as they recommend the cut scores on the assessment. PLDs are also used in question development. Question writers are assigned to write questions that draw on the specific knowledge and skills from a PLD. This ensures that each test has questions that measure student performance all along the continuum. Questions on the Science Regents Examinations will emphasize skills from the PLDs that can be measured via written assessment. Teachers can use the PLDs in the same manner when developing both formative and summative classroom assessments. Tasks that require students to demonstrate knowledge and skills from the PLDs can be tied back to the performance level with which the PLD is associated, providing the teacher with feedback about the students’ progress as well as a wealth of other skills that the students are likely able to demonstrate (or can aspire to in the case of the next-highest PLD).

Topic and PE	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Structure and Properties of Matter HS-PS1-1	Use the periodic table as a model to construct a representation of chemical behavior using relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	Use the periodic table as a model to describe the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	Use the periodic table as a model to identify the patterns of electrons in the outermost energy level of atoms and the relative properties of elements within a group or period.	Use the periodic table as a model to identify the patterns of electrons in the outermost energy level of atoms or relative properties of the elements within a group or period.
Structure and Properties of Matter HS-PS1-3	Plan and conduct multiple investigations to gather and evaluate evidence that compares the structure of substances at the bulk scale to explain the strength of electrical forces between particles.	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	Given a plan, conduct an investigation **or** given the results of an investigation or provided information, describe patterns of the relative strength of electrical forces between particles, based on structures, and/or the resulting properties at bulk scale.	Given a plan, conduct an investigation **or** given the results of an investigation or provided information, make a claim that compares the relative strength of electrical forces between particles of substances at the bulk scale.	Use data from an investigation or provided information to identify a pattern in bulk scale properties of substances as it relates to the relative strength of electrical forces between particles.
Structure and Properties of Matter HS-PS1-8	Develop, evaluate, and revise models to compare and contrast changes in the composition of the nucleus of the atom and scale of energy released during nuclear processes.	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.	Develop and/or use a model(s) to compare and/or contrast the changes in the composition of the nucleus of the atom or the scale of energy released during a nuclear process to other transformations.	Develop and/or use a model of a nuclear process to predict the changes in the composition of the nucleus of the atom.	Use a model/information to identify a change in the composition of the nucleus of the atom or a nuclear process.

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Structure and Properties of Matter HS-PS2-6	Compare, integrate, and evaluate scientific and technical information about the structure and function of various designed materials at the particulate-level to optimize the functionality of a product.	Communicate scientific and technical information about why the particulate-level structure is important in the functioning of designed materials.	Use scientific or technical information to explain how the particulate-level structure is important to the functioning of designed material(s).	Use information to describe how the particulate-level structure of designed material(s) supports its function.	Use information to identify a particulate-level structure or function of a designed material.
Structure and Properties of Matter HS-PS1-9 (NYSED)	Plan and conduct an investigation to gather and analyze data that validates the claim that the combined gas law describes the relationships among volume, pressure, and temperature for a sample of an ideal gas.	Analyze data to support the claim that the combined gas law describes the relationships among volume, pressure, and temperature for a sample of an ideal gas.	Use data/information that provides evidence to make and/or support a claim about the relationship between two variables in the combined gas law when the third variable and molar quantity are held constant.	Given data, construct a mathematical representation and/or calculate the value of an unknown variable in the combined gas law when the molar quantity is held constant.	Use data/information to identify the relationship between two variables in the combined gas law when the third variable and molar quantity are held constant.
Structure and Properties of Matter HS-PS1-10 (NYSED)	Evaluate the validity of claims, evidence, and/or reasoning of currently accepted explanations regarding formation, properties and behaviors of solutions at bulk scales.	Use evidence to support claims regarding the formation, properties and behaviors of solutions at bulk scales.	Use data/information that provides evidence to make and/or support a claim that identifies relationships between the formation, properties and/or behaviors of solutions at bulk scales.	Construct and/or use a mathematical representation as evidence to determine the quantities required to form or describe a solution.	Use data/information to identify a relationship between the formation, property, and/or behavior of one or more solutions.

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Chemical Reactions HS-PS1-2	Construct, revise, and evaluate explanations for the outcome of simple chemical reactions based on the predictable behavior of reactants, the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	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.	Construct or 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/or knowledge of the patterns of chemical properties.	Predict the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and/or knowledge of the patterns of chemical properties.	Given possible reaction outcomes, identify the outcome of a simple chemical reaction using the outermost electron states of atoms, trends in the periodic table, or knowledge of the patterns of chemical properties.
Chemical Reactions HS-PS1-4	Develop and critique models to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	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.	Develop and/or use a model to describe the energy associated with the formation and/or the breaking of a bond(s) between atoms.	Use a model to describe the release or absorption of energy from a chemical reaction system.	Use a model/information to identify the changes in energy in a chemical reaction system.
Chemical Reactions HS-PS1-5	Construct explanations and design solutions, using student-generated evidence, that apply scientific principles to explain how the rate of chemical changes are affected when conditions are varied.	Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied.	Use data/information that provides evidence to predict and explain how the rate of a physical or chemical change is affected when conditions are varied.	Predict and/or describe how the rate of a physical or chemical change is affected when conditions are varied.	Use provided information to identify the evidence for how the rate of a physical or chemical change is affected when conditions are varied.

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Chemical Reactions HS-PS1-6	Optimize the design of a chemical system by explaining how multiple changes to experimental conditions will increase the amounts of products in a system at equilibrium.	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	Explain how a change in the design of a chemical system and/or experimental conditions would affect the amount of products and/or reactants at equilibrium.	Identify a modification to the design or to the experimental conditions of a chemical system and/or describe the effect on the products and/or reactants at equilibrium.	Use information provided to identify a change in the experimental conditions that would modify the amount of products or reactants at equilibrium.
Chemical Reactions HS-PS1-7	Create and revise mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Construct a mathematical representation and/or calculate a quantity (e.g. # of particles, volume of a gas, etc.), using the relationship that atoms and/or mass are conserved during a chemical reaction.	Use or complete a mathematical representation to demonstrate that atoms and/or mass are conserved during a chemical reaction.	Use information provided to identify mathematical representations that demonstrate atoms and/or mass are conserved during a chemical reaction.
Chemical Reactions HS-PS1-11 (NYSED)	Plan and conduct multiple investigations to compare, explain, and predict properties and behaviors of acids and bases.	Plan and conduct an investigation to compare properties and behaviors of acids and bases.	Given a plan, conduct an investigation **or** given the results of an investigation or provided information, compare the properties and/or behaviors of acids and/or bases.	Given the results of an investigation or provided information, calculate a quantity or make a claim to identify a property and/or behavior of an acid or base.	Given an investigation plan or provided information, select appropriate tools and/or materials that could be used to identify a property or behavior of an acid or base.

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Chemical Reactions HS-PS1-12 (NYSED)	Evaluate claims and analyze evidence to communicate that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system.	Use evidence to illustrate that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system.	Use a model (e.g. electrochemical cell) or information that provides evidence to make a claim or support the argument that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system.	Use or provide evidence to demonstrate that some chemical reactions involve the transfer of electrons within a system.	Use provided information to identify a reaction or a component(s) in a model that illustrates the transfer of electrons within a system.
Energy HS-PS3-1	Create and revise 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.	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.	Use a given computational model or mathematical representation 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.	Use a mathematical representation, data or a given model to predict and/or describe the energy transfer of a component of a system.	Use mathematical representation or information provided to identify energy change(s) in one or more components of a system.
Energy HS-PS3-5	Develop and identify the limitations of a model of two objects interacting through electric or magnetic fields to explain the effect of the forces between objects, and describe the changes in energy of the objects due to the interaction.	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.	Develop a model of two objects interacting and illustrate the forces between objects or the changes in energy of the objects due to the interaction	Use a model of two objects interacting to describe and/or show the forces between objects or the changes in energy of the objects due to the interaction.	Use a model/information of two objects interacting to identify the forces between objects or the changes in energy of the objects due to the interaction.

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Waves and Electromagnetic Radiation HS-PS4-4	Gather and evaluate a variety of valid and reliable sources to formulate a claim on the effects that different frequencies of electromagnetic radiation have when absorbed by matter, citing qualitative evidence with scientific reasoning.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	Make and support a claim, using scientific and/or technical information, that describes the effects of a frequency and/or wavelength of electromagnetic radiation when absorbed by matter.	Use information that provides evidence to support a claim that describes the effects of different frequencies, relative energies, and/or wavelengths of electromagnetic radiation when absorbed by matter.	Based on evidence, identify the frequency, wavelength, relative energy, or effect on matter of electromagnetic radiation when one of these is provided.
Matter and Energy in Organisms and Ecosystems HS-LS1-5	Create a model, given input and output of matter and energy, to demonstrate how photosynthesis transforms light energy into stored chemical energy.	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Use a model to describe how the process of photosynthesis conserves energy and/or matter.	Use a model/information demonstrating photosynthesis to identify energy and matter components.	Use a model/information to identify how the process of photosynthesis transforms light energy into stored chemical energy.
Engineering Design HS-ETS1-1	Evaluate two or more major global challenges to specify qualitative and quantitative criteria and constraints for solutions, which could include new technologies that account for societal needs and wants.	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	Analyze a major global challenge to specify qualitative or quantitative criteria and constraints for solutions that account for societal needs and wants.	Given a major global challenge, describe the qualitative or quantitative criteria or constraint for the given solution that best accounts for societal needs or wants.	Given a major global challenge, identify the criteria or constraint for the given solution that best accounts for societal needs or wants.

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Engineering Design HS-ETS1-2	For a complex real-world problem, design multiple solutions to sub-problems based on student generated data and/or scientific information from other sources. Describe the rationale, criteria, and constraints of each sub-problem.	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Given a complex real-world problem, identify one smaller more manageable problem and describe a solution to that problem that can be solved through engineering.	Given a complex real-world problem that has been broken down into smaller, more manageable problems, identify a solution to one smaller problem that can be solved through engineering.	Identify the solution, from those provided, that addresses a smaller, more manageable real-world problem.
Engineering Design HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria by generating a prioritized list of criteria and trade-offs that account for a range of multiple constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. Explain how these solutions affect society and the environment.	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of multiple constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	Identify a solution to a complex real-world problem based on prioritized criteria and/or trade-offs (positives and negatives) for a range of constraints, such as cost, safety, reliability, aesthetics, as well as possible social, cultural, or environmental impacts.	Describe a solution to a complex real-world problem based on given criteria and constraints.	Identify the solution from those provided, to a complex real-world problem based on given criteria and/or constraints.

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Engineering Design HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to related complex real-world problems with numerous criteria and constraints on interactions within and between systems relevant to the problem.	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	Given data (from a computer simulation), describe the impact of proposed solutions to a complex real-world problem with limited criteria and constraints on interactions within and/or between systems relevant to the problem.	Given data (from a computer simulation), identify the impact of a proposed solution to a complex real-world problem, or the impact on an interaction within or between two systems relevant to the problem.	Identify the impact of a given solution to a complex real-world problem.