

North Dakota Science Content and Achievement Standards

Grades 11-12

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North Dakota Department of Public Instruction

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Standard 1: Unifying Concepts

Standard 1: Students understand the unifying concepts and processes of science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
MODELS				
11-12.1.1. Explain how scientists create and use models to address scientific knowledge	Students explain all of the significant details of how scientists create and use models to address scientific knowledge.	Students explain most of the significant details of how scientists create and use models to address scientific knowledge.	Students explain some of the significant details of how scientists create and use models to address scientific knowledge.	Students explain few of the significant details of how scientists create and use models to address scientific knowledge.
SYSTEMS				
11-12.1.2. Identify the structure, organization, and dynamics of components within a system (e.g., cells, tissues, organs, organ systems, reactants and products in chemical equilibrium)	Students identify all of the significant details of the structure, organization, and dynamics of components within a system.	Students identify most of the significant details of the structure, organization, and dynamics of components within a system.	Students identify some of the significant details of the structure, organization, and dynamics of components within a system.	Students identify few of the significant details of the structure, organization, and dynamics of components within a system.
CONSTANCY AND CHANGE				
11-12.1.3. Explain how a system can be dynamic yet may remain in equilibrium (e.g., balance of forces, Le Chatelier's Principle, acid base systems)	Students explain how a system can be dynamic yet may remain in equilibrium with no errors.	Students explain how a system can be dynamic yet may remain in equilibrium with no significant errors.	Students explain how a system can be dynamic yet may remain in equilibrium with a few significant errors.	Students explain how a system can be dynamic yet may remain in equilibrium with many significant errors.
FORM AND FUNCTION				
11-12.1.4. Explain the relationship between form and function (e.g., atoms and ions, enzymes, aerodynamics)	Students explain all of the significant details relating form and function.	Students explain most of the significant details relating form and function.	Students explain some of the significant details relating form and function.	Students explain few of the significant details relating form and function.
11-12.1.5. Explain how classification can be based on the relationship between form and function (e.g., polar vs. nonpolar molecules, structure of periodic table , DNA vs. RNA)	Students explain how classification can be based on the relationship between form and function with no errors.	Students explain how classification can be based on the relationship between form and function with no significant errors.	Students explain how classification can be based on the relationship between form and function with a few significant errors.	Students explain how classification can be based on the relationship between form and function with many significant errors.

Standard 1: Students understand the unifying concepts and processes of science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
EVOLUTION AND EQUILIBRIUM <i>No benchmark expectations at this level</i>				

Standard 2: Science Inquiry

Standard 2: Students use the process of science inquiry.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
UNDERSTANDINGS ABOUT SCIENTIFIC INQUIRY				
11-12.2.1. Explain how new knowledge and methods emerge from different types of investigations and public communication among scientists	Students provide an insightful explanation of how new knowledge and methods emerge from different types of investigations and public communication among scientists.	Students provide a reasonable explanation of how new knowledge and methods emerge from different types of investigations and public communication among scientists.	Students provide an obvious explanation of how new knowledge and methods emerge from different types of investigations and public communication among scientists.	Students provide an unreasonable explanation of how new knowledge and methods emerge from different types of investigations and public communication among scientists.
ABILITIES NECESSARY TO DO SCIENTIFIC INQUIRY				
11-12.2.2. Select and use appropriate instruments, measuring tools, and units of measure to improve scientific investigations	Students select and use instruments, measuring tools, and units of measure to improve scientific investigations with no errors.	Students select and use instruments, measuring tools, and units of measure to improve scientific investigations with no significant errors.	Students select and use instruments, measuring tools, and units of measure to improve scientific investigations with a few significant errors.	Students select and use instruments, measuring tools, and units of measure to improve scientific investigations with many significant errors.
11-12.2.3. Use data from scientific investigations to accept or reject a hypothesis	Students use data from scientific investigations in an insightful way to accept or reject a hypothesis.	Students use data from scientific investigations in a reasonable way to accept or reject a hypothesis.	Students use data from scientific investigations in a superficial way to accept or reject a hypothesis.	Students use data from scientific investigations in an unreasonable way to accept or reject a hypothesis.

Standard 2: Students use the process of science inquiry.

Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
11-12.2.4. Formulate and revise explanations based upon scientific knowledge and experimental data	Students formulate and revise scientific explanations based upon scientific knowledge and experimental data in an insightful way.	Students formulate and revise scientific explanations based upon scientific knowledge and experimental data in a reasonable way.	Students formulate and revise scientific explanations based upon scientific knowledge and experimental data in a superficial way.	Students formulate and revise scientific explanations based upon scientific knowledge and experimental data in an unreasonable way.
11-12.2.5. Use technology and mathematics to improve investigations and communications	Students use technology and mathematics in insightful ways to improve investigations and communications.	Students use technology and mathematics in relevant ways to improve investigations and communications.	Students use technology and mathematics in typical ways to improve investigations and communications.	Students use technology and mathematics in superficial ways to improve investigations and communications.
11-12.2.6. Analyze data using appropriate strategies (e.g., interpolation, and extrapolation of data, significant figures, dimensional analysis)	Students analyze data using appropriate strategies in an insightful way.	Students analyze data using appropriate strategies in a reasonable way.	Students analyze data using appropriate strategies in a superficial way.	Students analyze data using appropriate strategies in an unreasonable way.
11-12.2.7. Design and conduct an independent investigation	Students design and conduct an insightful independent investigation.	Students design and conduct a reasonable independent investigation.	Students design and conduct a superficial independent investigation.	Students design and conduct an unreasonable independent investigation.
11-12.2.8. Communicate and defend a scientific argument	Students communicate and defend a scientific argument using almost all of the significant details.	Students communicate and defend a scientific argument using most of the significant details.	Students communicate and defend a scientific argument using some of the significant details.	Students communicate and defend a scientific argument using few details.

Standard 3: Physical Science

Standard 3: Students understand the basic concepts and principles of physical science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
PROPERTIES OF MATTER <i>No benchmark expectations at this level</i> ATOMIC STRUCTURE AND PROPERTIES				
11-12.3.1. Explain how the structure of an atom, isotope, or ion relates to its properties	Students explain how the structure of an atom, isotope, or ion relates to its properties with no errors.	Students explain how the structure of an atom, isotope, or ion relates to its properties with no significant errors.	Students explain how the structure of an atom, isotope, or ion relates to its properties with few significant errors.	Students explain how the structure of an atom, isotope, or ion relates to its properties with many significant errors.
11-12.3.2. Identify the basic organization of the periodic table (e.g., elements are listed according to the number of protons [atomic number]; repeating patterns of physical and chemical properties	Students identify the organization of the periodic table with no errors.	Students identify the organization of the periodic table with no significant errors.	Students identify the organization of the periodic table with few significant errors.	Students identify the organization of the periodic table with many significant errors.
ATOMS AND MOLECULES				
11-12.3.3. Compare and contrast the role of electrons in ionic and covalent bonding	Students compare and contrast the role of electrons in ionic and covalent bonding with no errors.	Students compare and contrast the role of electrons in ionic and covalent bonding with no significant errors.	Students compare and contrast the role of electrons in ionic and covalent bonding with few significant errors.	Students compare and contrast the role of electrons in ionic and covalent bonding with many significant errors.
11-12.3.4. Identify the basic bonding characteristics of carbon which lead to a large variety of structures	Students identify the basic bonding characteristics of carbon which lead to a large variety of structures with no errors.	Students identify the basic bonding characteristics of carbon which lead to a large variety of structures with no significant errors.	Students identify the basic bonding characteristics of carbon which lead to a large variety of structures with few significant errors.	Students identify the basic bonding characteristics of carbon which lead to a large variety of structures with many significant errors.
CHEMICAL REACTIONS				

Standard 3: Students understand the basic concepts and principles of physical science.

Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
11-12.3.5. Identify the effect of concentration, temperature, surface area, pressure, and catalysts on reaction rates as it relates to the Kinetic Theory.	Students identify the effect of concentration, temperature, surface area, pressure, and catalysts on reaction rates as it relates to the Kinetic Theory with no errors.	Students identify the effect of concentration, temperature, surface area, pressure, and catalysts on reaction rates as it relates to the Kinetic Theory with no significant errors.	Students identify the effect of concentration, temperature, surface area, pressure, and catalysts on reaction rates as it relates to the Kinetic Theory with few significant errors.	Students identify the effect of concentration, temperature, surface area, pressure, and catalysts on reaction rates as it relates to the Kinetic Theory with many significant errors.
11-12.3.6. Write the chemical formula and name for compounds using a table of element names, symbols, and oxidation numbers	Students write the chemical formula and name for an extensive variety of compounds using a table of element names, symbols, and oxidation numbers.	Students write the chemical formula and name for many different compounds using a table of element names, symbols, and oxidation numbers.	Students write the chemical formula and name for some different compounds using a table of element names, symbols, and oxidation numbers.	Students write the chemical formula and name for very few compounds using a table of element names, symbols, and oxidation numbers.
11-12.3.7. Balance chemical equations	Students balance chemical equations with no errors.	Students balance chemical equations with no significant errors.	Students balance chemical equations with few significant errors.	Students balance chemical equations with many significant errors.
FORCE AND MOTION				
11-12.3.8. Identify the principles and relationships influencing forces and motion (e.g., gravitational force, vectors, velocity, friction)	Students identify an extensive variety of principles and relationships influencing forces and motion.	Students identify a variety of principles and relationships influencing forces and motion.	Students identify some different principles and relationships influencing forces and motion.	Students identify very few principles and relationships influencing forces and motion.
FORMS OF ENERGY				

Standard 3: Students understand the basic concepts and principles of physical science.

Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
<p>11-12.3.9. Explain the relationship among thermal energy, temperature, and the motion of particles</p> <p>ENERGY TRANSFER AND TRANSFORMATION</p> <p>11-12.3.10. Apply the law of conservation of energy to a variety of situations</p> <p>11-12.3.11. Explain how energy is related to physical changes of matter (e.g., phase changes, temperature changes)</p> <p>VIBRATIONS AND WAVES</p> <p>11-12.3.12. Relate wave energy to wavelength and frequency</p> <p>ELECTRICITY AND MAGNETISM</p> <p>11-12.3.13. Explain how magnetic forces relate to electric forces</p>	<p>Students explain the relationship among thermal energy, temperature, and the motion of particles with no errors.</p> <p>Students apply the law of conservation of energy to an extensive variety of situations.</p> <p>Students explain all of the significant details relating energy to physical changes.</p> <p>Students relate wave energy to wavelength and frequency with no errors.</p> <p>Students explain how magnetic forces relate to electric forces with no errors.</p>	<p>Students explain the relationship among thermal energy, temperature, and the motion of particles with no significant errors.</p> <p>Students apply the law of conservation of energy to a variety of situations.</p> <p>Students explain most of the significant details relating energy to physical changes.</p> <p>Students relate wave energy to wavelength and frequency with no significant errors.</p> <p>Students explain how magnetic forces relate to electric forces with no significant errors.</p>	<p>Students explain the relationship among thermal energy, temperature, and the motion of particles with few significant errors.</p> <p>Students apply the law of conservation of energy to some different situations.</p> <p>Students explain some of the significant details relating energy to physical changes.</p> <p>Students relate wave energy to wavelength and frequency with few significant errors.</p> <p>Students explain how magnetic forces relate to electric forces with few significant errors.</p>	<p>Students explain the relationship among thermal energy, temperature, and the motion of particles with many significant errors.</p> <p>Students apply the law of conservation of energy to very few situations.</p> <p>Students explain very few of the significant details relating energy to physical changes.</p> <p>Students relate wave energy to wavelength and frequency with many significant errors.</p> <p>Students explain how magnetic forces relate to electric forces with many significant errors.</p>

Standard 4: Life Science

Standard 4: Students understand the basic concepts and principles of life science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
STRUCTURE AND FUNCTION				
11-12.4.1. Explain the importance of cell differentiation in the development of tissues, organs, organ systems, and multi-cellular organisms.	Students explain, with no errors, the importance of cell differentiation in the development of multi-cellular organisms.	Students explain, with no significant errors, the importance of cell differentiation in the development of multi-cellular organisms.	Students explain, with few significant errors, the importance of cell differentiation in the development of multi-cellular organisms.	Students explain, with many significant errors, the importance of cell differentiation in the development of multi-cellular organisms.
GENETICS AND REPRODUCTION				
11-12.4.2. Explain how types of DNA technology (e.g., genetic engineering, forensic science, cloning) may impact society now and in the future.	Students provide an insightful explanation how types of DNA technology may impact society.	Students provide a reasonable explanation how types of DNA technology may impact society.	Students provide a superficial explanation how types of DNA technology may impact society.	Students provide an unreasonable explanation how types of DNA technology may impact society.
NATURAL SELECTION AND BIOLOGICAL EVOLUTION				
11-12.4.3. Explain how change through time has ensured adaptation to changing environments	Students explain all of the significant details of how change through time has ensured adaptation to changing environments.	Students explain most of the significant details of how change through time has ensured adaptation to changing environments.	Students explain some of the significant details of how change through time has ensured adaptation to changing environments.	Students explain few of the significant details how of change through time has ensured adaptation to changing environments.
INTERDEPENDENCE AMONG ORGANISMS <i>No benchmark expectations at this level</i>				
MATTER AND ENERGY IN LIVING SYSTEMS <i>No benchmark expectations at this level</i>				

Standard 5: Earth and Space Science

Standard 5: Students understand the basic concepts and principles of earth and space science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
THE UNIVERSE 11-12.5.1. Explain how the Sun and other stars are powered by nuclear reactions (e.g., the fusion of hydrogen to form helium, formation of elements)	Students explain how the Sun and other stars are powered by nuclear reactions with few, if any, errors.	Students explain how the Sun and other stars are powered by nuclear reactions with no significant errors.	Students explain how the Sun and other stars are powered by nuclear reactions with few significant errors	Students explain how the Sun and other stars are powered by nuclear reactions with many significant errors
EARTH'S HISTORY <i>No benchmark expectations at this level</i>				
ENERGY IN THE EARTH SYSTEM 11-12.5.2. Explain how Earth systems are in dynamic equilibrium (e.g., cycling of energy and matter through the atmosphere, hydrosphere, and lithosphere)	Students explain all of the significant details that show how Earth systems are in dynamic equilibrium.	Students explain most of the significant details that show how Earth systems are in dynamic equilibrium.	Students explain some of the significant details that show how Earth systems are in dynamic equilibrium.	Students explain few of the significant details that show how Earth systems are in dynamic equilibrium.
CYCLES IN THE EARTH SYSTEM <i>No benchmark expectations at this level</i>				
GEOLOGIC PROCESSES, HUMAN ACTIVITIES, AND THE ENVIRONMENT 11-12.5.3. Explain the short-term and long-term effects of chemical processes (e.g., acid rain, CO ₂ emissions, ozone depletion, run-off) on the environment and society	Students explain an extensive variety of short-term and long-term effects of chemical processes on the environment and society.	Students explain a variety of short-term and long-term effects of chemical processes on the environment and society.	Students explain some different short-term and long-term effects of chemical processes on the environment and society.	Students explain few short-term and long-term effects of chemical processes on the environment and society.

Standard 6: Science and Technology

Standard 6: Students understand relations between science and technology.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
TECHNOLOGICAL DESIGN				
11-12.6.1 Select and use appropriate technologies, tools, and techniques to solve a problem (e.g., computer-assisted tools, Internet, research skills, CBL, graphing calculators)	Students select and use an extensive variety of appropriate technologies, tools, and techniques to solve a problem.	Students select and use a variety of appropriate technologies, tools, and techniques to solve a problem.	Students select and use some different appropriate technologies, tools, and techniques to solve a problem.	Students select and use very few appropriate technologies, tools, and techniques to solve a problem.
11-12.6.2 Identify examples of how new technologies advance science –	Students identify an extensive variety of examples of how new technologies have advanced science.	Students identify a variety of examples of how new technologies have advanced science.	Students identify some different examples of how new technologies have advanced science.	Students identify few examples of how new technologies have advanced science.
TECHNOLOGY AND SOCIETY				
11-12.6.3 Explain how designing and implementing technology requires weighing trade-offs between positive and negative impacts on humans and the environment	Students provide all of the significant details that explain how designing and implementing technology requires weighing trade-offs between positive and negative impacts on humans and the environment.	Students provide most of the significant details that explain how designing and implementing technology requires weighing trade-offs between positive and negative impacts on humans and the environment.	Students provide some of the significant details that explain how designing and implementing technology requires weighing trade-offs between positive and negative impacts on humans and the environment.	Students provide few of the significant details that explain how designing and implementing technology requires weighing trade-offs between positive and negative impacts on humans and the environment.

Standard 7: Science and Other Areas

Standard 7: Students understand relations between science and personal, social, and environmental issues.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
SCIENCE AND PERSONAL HEALTH <i>No benchmark expectations at this level</i>				
SCIENCE AND ENVIRONMENTAL ISSUES				
11-12.7.1. Explain the impact of environmental laws and policies on the environment and society (e.g., waste/pollutants from industry, carbon dioxide emissions, location and number of animals in a feedlot versus water supply)	Students explain the impact of an extensive variety of environmental laws and policies on the environment and society.	Students explain the impact of a variety of environmental laws and policies on the environment and society.	Students explain the impact of some different environmental laws and policies on the environment and society.	Students explain the impact of few environmental laws and policies on the environment and society.
11-12.7.2. Explain ways renewable and nonrenewable resources are managed (e.g., land reclamation, forest management, CRP, hunting licenses, energy –conserving technologies)	Students explain, with extensive significant detail, ways renewable and nonrenewable resources are managed.	Students explain, with t significant detail, ways renewable and nonrenewable resources are managed.	Students explain, with some significant detail, ways renewable and nonrenewable resources are managed.	Students explain, with little significant detail, ways renewable and nonrenewable resources are managed.
11-12.7.3. Explain the economic and social impact of using alternative energy resources	Students provide an insightful explanation of the economic and social impact of using alternative energy resources.	Students provide a reasonable explanation of the economic and social impact of using alternative energy resources.	Students provide a superficial explanation of the economic and social impact of using alternative energy resources.	Students provide an unreasonable explanation of the economic and social impact of using alternative energy recourses.
SCIENCE AND SOCIAL ISSUES				
11-12.7.4. Explain how science and technology can influence personal, industrial, and cultural decision-making (e.g., organ transplants, cloning, stem cell research, genetic manipulation, use of genetic profile, archeological discoveries, land management, resource management)	Students explain an extensive variety of ways science and technology can influence personal, industrial, and cultural decision-making.	Students explain a variety of ways science and technology can influence personal, industrial, and cultural decision-making.	Students explain some different ways science and technology can influence personal, industrial, and cultural decision-making.	Students explain few ways science and technology can influence personal, industrial, and cultural decision-making.

Standard 8: History and Nature of Science

Standard 8: Students understand the history and nature of science.				
Benchmark Expectations	PROFICIENCY DESCRIPTOR			
	ADVANCED PROFICIENT	PROFICIENT	PARTIALLY PROFICIENT	NOVICE
Grade 11-12				
<p>PEOPLE IN SCIENCE <i>No benchmark expectations at this level</i></p> <p>SCIENTIFIC KNOWLEDGE</p> <p>11-12.8.1. Identify the criteria that scientific explanations must meet to be considered valid (e.g., must be based on consistent and repeatable data, be consistent with experimental and observational evidence about nature, make accurate predictions about systems being studied, be logical, report methods and results, be open to question and reexamination, respect rules of evidence)</p> <p>SCIENCE AND SOCIETY <i>No benchmark expectations at this level</i></p>	<p>Students identify an extensive variety of criteria that scientific explanations must meet to be considered valid.</p>	<p>Students identify a variety of criteria that scientific explanations must meet to be considered valid.</p>	<p>Students identify some different criteria that scientific explanations must meet to be considered valid.</p>	<p>Students identify a limited variety of criteria that scientific explanations must meet to be considered valid.</p>