



Appleton Area School District

K-12 Science Standards

*AASD Board Approved, June 1999
Revised, July 2004*

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Introduction

The AASD K-12 Science Standards are organized into primary, intermediate, middle, and high school levels and align with the Wisconsin State Standards. The content standards identified within each of these levels represent what students should know and be able to do by the end of grades three, six, eight, and twelve. These standards will provide the framework for developing Appleton Area School District grade level/course curricula.

Mission

The study of science encourages students to examine the world around them. As individuals, they will use scientific processes and principles to make informed personal and public decisions. Students will become scientifically literate and apply scientific thinking, reasoning, and knowledge throughout their lives.

**K-12 Science Standards Committee
May, 1999**

AASD GOALS FOR K-12 SCIENCE

- **Students will know about science themes and connect and integrate them into what they know about themselves and the world around them.**
- **Students will realize that scientific knowledge is public, replicable, and continually undergoing revision and refinement based on new experiments and data.**
- **Students will realize that science includes questioning, forming hypotheses, collecting and analyzing data, reaching conclusions, evaluating results, and communicating procedures and findings to others.**
- **Students will use science to explain and predict changes that occur around them.**
- **Students will use science to evaluate consequences in order to make responsible choices.**
- **Students will use their knowledge of science concepts and processes in making informed choices regarding their lifestyles and the impact they have on their environment, and enhance their natural curiosity about their environment.**
- **Students will understand that science and technology affect the Earth's systems and provide solutions to human problems.**

STRAND A: SCIENCE CONNECTIONS

Students in the Appleton Area School District will understand that there are unifying themes: systems, order, organization, and interactions; evidence, models, and explanations: constancy, change, and measurement; evolution, equilibrium, and energy; form and function among scientific disciplines.

K-4	5-8	9-12
<p><i>By the end of grade four, AASD students will...</i></p> <p>A.4.1 Conduct science investigations, ask and answer questions that will help decide the general areas of science being addressed</p>	<p><i>By the end of grade eight, AASD students will...</i></p> <p>A.8.1 Develop understanding of the science themes to frame questions that will help decide the general areas of science</p>	<p><i>By the end of grade twelve, AASD students will...</i></p> <p>A.12.1 Apply the underlying themes of science to develop defensible visions of the future</p>
<p>A.4.2 Investigate science-related problems and decide what evidence, models, or explanations previously studied can be used for investigation</p>	<p>A.8.2 Identify examples of themes that are included or excluded from specific science systems</p>	<p>A.12.2 Show how conflicting assumptions about science themes lead to different opinions and show how these opinions and decisions have diverse effects on an individual, a community, and a country, both now and in the future</p>
<p>A.4.3 Investigate science-related problems and decide what data can be collected to determine the most useful explanations</p>	<p>A.8.3 Defend explanations and models by collecting and organizing evidence</p>	<p>A.12.3 Give examples that show how partial systems, models, and explanations are used to give quick and reasonable solutions that are accurate enough for basic needs</p>
<p>A.4.4 Decide which science themes are important in investigating a specific science-related problem</p>	<p>A.8.4 Collect evidence to show that models are based on the evidence available to scientists at the time</p>	<p>A.12.4 Construct arguments that show how conflicting models and explanations of events can start with similar evidence</p>
<p>A.4.5 Decide what changes have occurred when investigating a specific science-related problem</p>	<p>A.8.6 Use models and explanations to predict actions and events</p>	<p>A.12.5 Show how the ideas and themes of science can be used to make real-life decisions about careers, work places, life-styles, and use of resources</p>
	<p>A.8.7 Design investigations to test the usefulness and limitations of a model</p>	<p>A.12.6 Identify and replace inaccurate personal models and explanations of science-related phenomena using evidence learned or discovered</p>
	<p>A.8.8 Use themes to predict future events or changes in the natural world</p>	<p>A.12.7 Re-examine the evidence and reasoning that lead to conclusions drawn from investigations</p>

STRAND B: NATURE OF SCIENCE

Students in the Appleton Area School District will understand that science is ongoing and inventive, and that scientific understandings have changed over time as new evidence is found.

K-4	5-8	9-12
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
B.4.1 Use references to help answer science-related questions and plan investigations	B.8.1 Explain how models and their interpretation change as new evidence arises	B.12.1 Show how cultures and individuals have contributed to the development of major ideas in science
B.4.2 Acquire information about people who have contributed to the development of major ideas in science	B.8.2 Identify and describe the people, cultures, and conditions that led to major scientific developments	B.12.2 Identify the cultural conditions that are usually present during great periods of discovery, scientific development, and inventions
B.4.3 Show how the major developments of scientific knowledge have changed over time	B.8.3 Explain how the general rules of science apply to the development and use of evidence in scientific investigation, models and applications	B.12.3 Relate the major themes of science to human progress in understanding science and the world
	B.8.4 Question the validity of the types of reasoning and evidence used in pseudoscience	B.12.4 Show how basic research and applied research contribute to new discoveries, inventions, and applications
	B.8.6 Explain how scientific knowledge applies to social issues	B.12.5 Explain how science is based on assumptions about the natural world and themes that describe the natural world
	B.8.5 Explain ways in which science knowledge is shared, checked, and extended, and show how these processes change over time	

STRAND C: SCIENCE INQUIRY

Students in the Appleton Area School District will investigate questions using scientific methods and tools, revise their personal understanding to accommodate knowledge, and communicate these understandings to others.

K-4	5-8	9-12
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
C.4.1 Use vocabulary of the unifying themes to ask questions about science	C.8.1 Use resources and equipment to investigate questions	C.12.1 Ask and write questions suggested by current social issues, scientific literature, and observations of phenomena
C.4.2 Use scientific content being learned to ask questions, plan investigations, make observations, make predictions, and offer explanations	C.8.2 Identify data and locate sources of information to answer questions	C.12.2 Review previous research on questions, build hypotheses that might answer the questions, design possible investigations, and describe results that might emerge from investigations
C.4.3 Select multiple sources of information to help answer questions selected for classroom investigation	C.8.3 Design and conduct investigations that provide quantitative or qualitative data to answer questions	C.12.3 Design and conduct responsible and safe investigations to help answer questions
C.4.4 Use science equipment safely and effectively to collect data relevant to questions and investigations	C.8.4 Predict results of investigations through observation	C.12.4a Choose the best data collection procedures and materials available, and use them competently
C.4.5 Use data collected to develop explanations and answer questions generated by investigation	C.8.5 Use acceptable scientific knowledge, models, and theories to explain results and to raise further questions about investigations	C.12.4b Calculate the degree of precision of the resulting data from data collection
C.4.6 Communicate results of investigations in ways audiences will understand	C.8.6 Relate inferences to scientific knowledge and to data collected	C.12.5 Use explanations and models from science to develop likely explanations for the results of investigations
C.4.7 Support conclusions with logical arguments	C.8.7 Communicate data and conclusions to an audience	C.12.6 Present the results of investigations to groups concerned with the issues being investigated
C.4.8 Ask additional questions that might help focus or further an investigation	C.8.8 Use computer software and other technologies to organize, process, and present data	C.12.7 Evaluate articles and reports from a variety of sources using criteria related to standards of experimental design

STRAND C: SCIENCE INQUIRY (continued)

K-4	5-8	9-12
D.4.7 Develop record systems to organize and record information	C.8.9 Evaluate, explain, and validate questions, hypotheses, and conclusions of investigations	
	C.8.10 Discuss the importance of results and implications of work with peers, teachers, and other adults	
	C.8.11 Raise further questions which still need to be answered	

STRAND D: PHYSICAL SCIENCE

Students in the Appleton Area School District will demonstrate an understanding of the physical and chemical properties of matter, the forms and properties of energy, and the ways in which matter and energy interact.

K-4	5-8	9-12
Matter		
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve AASD students will...</i>
D.4.1 Understand that objects are made of more than one substance	D.8.1 Observe, describe, and measure physical and chemical properties of elements and other substances	D.12.1 Describe atomic structure and the properties of atoms, molecules, and matter during physical and chemical interaction
D.4.2 Group and/or classify objects and substances based on properties of materials	D.8.2 Use the major ideas of atomic theory and molecular theory to describe physical and chemical interactions	D.12.2 Explain the current view of forces that hold the atom together and illustrate how nuclear interactions change the atom
D.4.3 Understand the characteristics of solids, liquids, and gases	D.8.4 Conduct investigations and use the science themes to develop explanations of physical and chemical interactions and energy exchanges	D.12.3 Explain exchanges of energy in chemical interactions and exchanges of mass and energy in atomic/nuclear reactions
D.4.4 Observe and describe changes in matter and construct explanations for the changes	D.8.10 Explain how models of the atomic structure of matter have changed over time	D.12.5 (a) Identify patterns in chemical and physical properties of the elements, and (b) use them to predict likely chemical changes and interactions
D.4.5 Construct models of matter undergoing change		D.12.12 Explain changes in matter using the science themes and knowledge of chemical, physical, atomic, and nuclear interactions
Motion and Forces		
D.4.6 Observe and describe objects at rest or in motion	D.8.5 Describe the forces acting on objects in motion	D.12.7 Qualitatively and quantitatively analyze changes in the motion of objects and the forces that act on them and represent analytical data both algebraically and graphically
	D.8.6 Explain motion in relation to real-life situations	D.12.8 Differentiate the fundamental forces and explain their impact on the universal system

STRAND D: PHYSICAL SCIENCE (continued)

K-4	5-8	9-12
Energy		
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
D.4.8 Discover the characteristics of energy (including light, heat, electricity, sound, and magnetism)	D.8.7 Define energy and conservation of energy	D.12.9 Investigate the behaviors of light, heat, and sound and describe their similarities and differences
	D.8.8 Describe and investigate the properties of electromagnetic radiation, gravity, and sound as they interact with material objects	D.12.10 Illustrate the laws of conservation of energy using the science themes
	D.8.9 Use models to explain the behaviors of various forms of energy transmission	
Chemical Reactions		
	D.8.3 Summarize how chemical interactions and behaviors lead to new substances	D.12.4 Explain how substances interact with one another to produce new substances
		D.12.6 Identify the types of chemical interactions, including endothermic, exothermic, oxidation and reduction, and acid/base reactions using investigation

STRAND E: EARTH AND SPACE SCIENCE

Students in the Appleton Area School District will demonstrate an understanding of the structure and systems of the earth and other bodies in the universe and their interactions.

K-4	5-8	9-12
Earth		
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
E.4.1 Investigate and understand components of soil, its origin, and importance to plants and animals	E.8.1 Explain and predict changes in major features of (a) land, (b) water, and (c) atmospheric systems	E.12.1 Understand the major external and internal sources of energy on Earth
E.4.2 Investigate the composition of rocks, minerals, and soils	E.8.2 Describe underlying structures of the Earth that cause changes in the Earth's surface	E.12.2 Understand that elements exist in fixed amounts and move through the solid earth, oceans, atmosphere, and living things as part of geochemical cycles
E.4.3 Identify and describe land and water masses	E.8.3 Describe climate, weather, ocean currents, soil movements and changes in the forces acting on the earth	E.12.4 Analyze the past, present, and projected use of resources and technology and how it affects the environment
E.4.5 Identify the seasons and their characteristics	E.8.4 Analyze the influence living organisms have had on the earth's systems, including their impact on the composition of the atmosphere and the weathering of rocks	
E.4.5 Investigate and understand basic weather found in Wisconsin	E.8.5 Investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils	
E.4.6 Find patterns and cycles in the earth's daily, yearly, and long-term changes	E.8.6 Investigate human use of the Earth's resources over the past 100 years. Explain that the basis for efforts to conserve and recycle renewable and nonrenewable resources are a result of past use	
E.4.7 Describe renewable and nonrenewable resources in the home and community		
E.4.8 Give examples of resources used in mining, forestry, farming, and manufacturing		

STRAND E: EARTH AND SPACE SCIENCE (continued)

K-4	5-8	9-12
<i>Space</i>		
E.4.4 Identify celestial objects and note changes in their patterns	E.8.7 Describe the general structure of the solar system, galaxies, and the universe, explaining the nature of the evidence used to develop current models of the universe	E.12.3 Explain prominent scientific theories of the origin of the universe and the solar system and relate these theories and their implications to geologic time on Earth
	E.8.8 Using past and current models of the structure of the solar system, explain the daily, monthly, yearly, and long-term cycles of the earth	

STRAND F: LIFE AND ENVIRONMENTAL SCIENCE

Students in the Appleton Area School District will demonstrate an understanding of the characteristics and structures of living things, the processes of life, and how living things interact with one another and their environment.

K-4	5-8	9-12
Organisms		
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
F.4.1 Explain the basic needs of organisms	F.8.1 Understand the structure and function of cells, organs, tissues, organ systems, and whole organisms	F.12.1 Distinguish between cell structures and their underlying functions
F.4.2 Compare plant and animal structures and functions	F.8.2 Show how organisms have adapted structures to match their functions, providing means of encouraging individual and group survival within specific environments	F.12.1 Explain that cell functions involve chemical reactions
	F.8.3 Differentiate between single-celled and multiple-celled organisms, comparing the cell functions of specialized cells for each type of organism	F.12.2 Explain how cell differentiation and reproduction is regulated through the expression of different genes
Life Cycles		
F.4.3 Give examples of plant and animal life cycles	F.8.4 Explain how heredity is comprised of the characteristic traits found in genes within the cells of an organism	F.12.3 Investigate how the instructions for specifying the characteristics of the organism are carried in the DNA in all organisms
F.4.3 Explain that plants and animals grow to resemble the parents	F.8.5 Understand how organisms both reproduce and pass on characteristics of their species	F.12.3 Determine that most cells contain chromosomes that allow for variation between generations
		F.12.3 Model the spontaneous process of changes in DNA (mutations)
		F.12.5 Explain that species variation allows for variable levels of survival based upon principles of natural selection
		F.12.5 Diagram a biological classification scheme based upon evolutionary relationships between organisms

STRAND F: LIFE AND ENVIRONMENTAL SCIENCE (continued)

K-3	5-8	9-12
Environment and Behavior		
F.4.4 Explain how animals depend on plants	F.8.6 Understand that organisms are capable of regulating internal body conditions in response to internal and external stimuli	F.12.6 Explain how biological evolution accounts for the diversity of a species
F.4.4 Relate an organism's pattern of behavior and survival to the nature of that organism's dynamic environment	F.8.7 Understand that an organism's behavior evolves through adaptation to its environment and that environmental change necessitates adaptation for survival of a species	F.12.6 Summarize how the evidence of common ancestry, chemical processes, and internal structures demonstrate unity among organisms
	F.8.8 Show how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet	F.12.7 Investigate how organisms both cooperate and compete in ecosystems
	F.8.9 Explain how some of the changes on the earth have contributed and continue to contribute to changes in the balance of life and affecting the survival or population growth of certain species	F.12.8 Explain that population size is dependent upon the amount of resources and environments available
	F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends	F.12.8 Summarize how matter affects Earth cycles among the living and nonliving components of the biosphere
		F.12.9 Explain that energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers
		F.12.12 Trace how the sensory and nervous systems of various organisms react to changes in internal and external environment and transmit survival or learning stimuli to cause changes in behavior or responses

STRAND G: SCIENCE APPLICATIONS

Students in the Appleton Area School District will demonstrate an understanding of the relationship between science and technology and the ways in which that relationship influences human activities.

K-4	5-8	9-12
<i>By the end of grade four, AASD students will...</i>	<i>By the end of grade eight, AASD students will...</i>	<i>By the end of grade twelve, AASD students will...</i>
G.4.1 Identify the benefits of technology used in jobs in Wisconsin	G.8.1 Identify and investigate careers in science or technology and the skills and academic courses needed for the career	G.12.1 Identify personal interests in science and technology; account for implications that these interests might have for future education, and options to be considered
G.4.2 Describe technological advances in the workplace over time	G.8.2 Explain how current scientific and technological discoveries influence work and careers	G.12.2 Design, build, evaluate, and revise models and explanations related to the earth and space, life and environmental, and physical sciences
G.4.3 Determine science discoveries that have led to changes in technologies which are being used in the work place	G.8.3 Illustrate the impact that science and technology have on careers, systems, society, environment, and quality of life	G.12.3 Analyze the costs, benefits, or problems resulting from a scientific or technological innovation, including implications for the individual in the community
G.4.4 Identify the combinations of simple machines in a commonly used device	G.8.4 Propose a design (or re-design) of an applied science model or a machine that will have an impact in the community	G.12.4 Show how a major scientific or technological change has had an impact on work, leisure, or the home
G.4.5 Ask questions and find answers about how devices and machines were invented and produced	G.8.5 Investigate a specific local problem to which there has been a scientific or technological solution	G.12.5 Choose a specific problem in our society, identify alternative scientific or technological solutions to that problem and argue its merits
	G.8.6 Use sources to identify examples of how scientific discoveries have resulted in new technology	
	G.8.7 Show evidence of how science and technology are interdependent using examples from personally conducted investigations	

STRAND H: SCIENCE IN SOCIAL AND PERSONAL PERSPECTIVES

Students in the Appleton Area School District will use scientific information and skills to make decisions about themselves, Wisconsin, and the world in which they live.

K-4	5-8	9-12
<p><i>By the end of grade four, AASD students will...</i></p> <p>H.4.1-2 Describe how science and technology have helped and sometimes hindered progress in state and local issues</p>	<p><i>By the end of grade eight, AASD students will...</i></p> <p>H.8.1 Evaluate the scientific evidence used in various media</p>	<p><i>By the end of grade twelve, AASD students will...</i></p> <p>H.12.1 Analyze the costs, risks, benefits, and consequences of a proposal concerning resource management in the community and determine the potential impact of the proposal on life in the community and the region</p>
<p>H.4.3 Show how science has contributed to meeting personal needs</p>	<p>H.8.2 Present a scientific solution to a problem involving the Earth and space, life and environmental or physical science and participate in a consensus-building discussion to arrive at a group decision</p>	<p>H.12.2 Evaluate proposed policy recommendations in science and technology for validity, evidence, reasoning, and short- and long-term implications</p>
<p>H.4.4 Develop a list of issues about which citizens must make decisions and discuss ways of finding information about the issues</p>	<p>H.8.3 Understand the consequences of decisions affecting personal health and safety</p>	<p>H.12.3 Show how policy decisions in science depend on many factors, including social values, ethics, beliefs, time-frames, and considerations of science and technology</p>
		<p>H.12.4 Advocate a solution or combination of solutions to a problem in science or technology</p>
		<p>H.12.5 Investigate how current plans or proposals concerning resource management, scientific knowledge, or technological development will have an impact on the environment or community</p>
		<p>H.12.6 Evaluate data and sources of information when using scientific information to make decisions</p>
		<p>H.12.7 Construct a plan for making decisions that includes the use of current scientific knowledge and scientific reasoning</p>