

Science in a Technical World
correlated with
New Jersey Core Curriculum Content Standards

Science Standards and Progress Indicators

Standard 5.1:

**All Students Will Learn To Identify Systems Of Interacting Components
And Understand How Their Interactions Combine To Produce The
Overall Behavior Of The System**

Descriptive Statement: The material world and the world built by humans both provide examples of systems where interacting parts work together as a whole. This standard asks students to analyze, understand, and design systems of integrating parts

Cumulative Progress Indicators

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

7. Recognize that the behavior of a system may be different from the behavior of its components.
8. Explain how feedback can be used to control the behavior of a system.
9. Identify and diagram feedback loops that occur in biological or ecological systems.
10. Identify and diagram feedback loops designed for common control systems, such as home light switches and thermostats.

Individual Title Abbreviations:

Carbonated Beverage=The Carbonated Beverage Industry
Paint=Plant Research and Development
Plant Tissue=The Plant Tissue Culture Industry
Polymer=Polymer Research and Development
Pulp and Paper=Pulp and Paper Research and Development
Wastewater=Upgrading the Wastewater Treatment Plant
Food=Food Safety
Petroleum=Refining Petroleum
Drugs=Discovering New Medicinal Drugs

**Lab=Medical Laboratory Technology
Forensics=Forensic Science
Semiconductors=Making Semiconductors**

Standard 5.2:

All Students Will Develop Problem-Solving And Inquiry Skills, Reflected By Formulating Usable Questions And Hypotheses, Planning Experiments, Conducting Systematic Observations, Interpreting And Analyzing Data, Drawing Conclusions, And Communicating Results

Descriptive Statement: Students best learn science by doing science. Science is not merely a collection of facts and theories but a process, a way of thinking about and investigating the world in which we live. This standard addresses those skill that are used by scientists as they discover and explain the physical universe—skills that are an essential and ongoing part of learning science.

Cumulative Progress Indicators

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

1. Select and use appropriate instrumentation to design and conduct investigations. (*See, in each individual volume, Laboratory Activities “Materials,” for example, Carbonated Beverage 12, 14, 16, 21, 23; Paint 13, 15, 31, 37; Paper 10, 14, 18, 22, 26, 30, 33*)
2. Use technology to present the design and results of investigation. (*See, in each individual volume, “Using Your Multimedia,” for instance, Paint xiv-xvii, 11, 29, 41; Wastewater 1, 28, 39; Carbonated Beverage 4,23, 49; Food 14, 16, 19, 24, 25, 56; Lab6, 9, 24*)
3. Evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit. (*See, for instance, Carbonated Beverage, 15-16, 51-52; Paint 35, 77; Plant Tissue 17-18, 20-21, 29, 34-35, 37; Polymer 39, 54; Wastewater 22; Food 14, 16, 20, 27-28, 31, 41, 61, 67; Petroleum 14-15, 17, 34-35, 41*)
4. Explain how experimental results lead to further investigation. (*See, in each individual volume, “Arriving at Conclusions,” for instance, Paint 21, 27, 30, 35, 38, 43, 48-49, 53-54, 55-57, 60-61, 66, 72, 74-75, 77, 80; Carbonated Beverage 22, 27, 35, 40, 51; Wastewater 32, 48, 54; Polymer 19, 24, 29, 39, 47; Plant 10, 21, 26, 34, 47; Pulp and Paper 12, 16, 21, 38; Drugs 15, 19, 22, 24-25, 30-31, 38, 44-45, 52, 56, 58, 67; Lab 20, 26, 27, 33, 36, 38, 40, 45, 50*)

Standard 5.3:
**All Students Will Develop An Understanding Of How People Of Various
Cultures Have Contributed To The Advancement Of Science And
Technology, And How Major Discoveries And Events Have Advanced
Science And Technology**

Descriptive Statement: Science is a human endeavor involving successes and failures, trials and tribulations. Students should know that many people of all cultures have contributed to our understanding of science and that science has a rich and fascinating history. This standard encourages students to learn about the people and events that have shaped or revolutionized important scientific theories and concepts.

Cumulative Progress Indicators

Building upon knowledge and skills gained in the
Preceding grades, by the end of Grade 12, students:

6. Recognize the role of the scientific community in responding to changing social and political conditions. (*See, in each individual title, "Industry Overview," describing the social and political conditions underlying each unit, for instance, Pulp and Paper 3-4; Plant 3-5; Polymer 3-5; Wastewater 3-6; Carbonated Beverage 3-6; Paint 3-6; Petroleum 5-10; Food 5-6; Drugs 5-8; Semiconductors 3-6; In addition, Forensics, "Overview of the Field," 3*)
7. Examine the lives and contributions of important scientists and engineers who effected major breakthroughs in or understanding of the natural world. (*Polymer 2; Plant 1-2; Food 29; Drugs 28*)

Standard 5.4:
**All Students Will Develop An Understanding Of Technology As An
Application Of Scientific Principles**

Descriptive Statement: Understanding the unique interdependence of science and technology is an important goal of science education. This standard is an attempt to show students how the application of scientific knowledge can be used to improve the human condition and how technological development affects the quality of life.

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

1. Recognize that technological problems often create a demand for new scientific knowledge, and cite present and past examples of the interrelationship and mutual influence of science, technology, and society. (*See Paint 36, 42, 54, 67; Polymer 2, 3-4, 20, 41, 45; Plant Tissue 1-4, 16, 22, 31, 40; Pulp and Paper 5, 19, 30, 36, 49; Wastewater 4-6, 14, 45; Carbonated Beverages 17, 28-29, 41; Food 20-33, 63; Petroleum 26; Drugs Passim; Lab 15, 16, 22, 23, 41, 42, 44, 46-47*)
2. Participate in a design project that identifies a problem, proposes and implements a solution, and evaluates the consequences of that solution. (*See title in STW features one or more design projects; see, for instance, Carbonated Beverage: “The Problem” 1; “Your Role in Solving the Problem,” 1-2; “Getting Started on the Problem,” 7, 9; “Defining the Problem,” 11; Forensics 1-2).*)

Standard 5.5:
**All Students Will Integrate Mathematics As A Tool For
Problem-Solving In Science, And As A Means Of Expressing
And/Or Modeling Scientific Theories**

Descriptive Statement: Galileo is credited with asserting that “mathematics is the language with which God wrote the Universe.” Science cannot be practiced or learned without appreciation of the role of mathematics in discovering and expressing natural laws. This standard recognizes the need for students to fully integrate mathematics skills with their learning of science.

Cumulative Progress Indicators

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

1. Express the results of mathematical operations based on the degree of precision in the input data.
2. Use computer spreadsheets, graphing, and database programs to assist in quantitative analysis. (*See, for instance, Forensics 34, 36*).
3. Evaluate the possible effects of measurement errors on calculations.
4. Express physical relationships in terms of mathematical equations derived from collected data.
5. Use mathematical models to predict physical phenomena.

Standard 5.8
All Students Will Gain An Understanding Of The Structure And
Behavior Of Matter

Descriptive Statement: Exploring the nature of matter and energy is essential to an understanding of the physical universe. This standard leads students from their experiences with the states and properties of matter, to the development of models of the atom and the underlying principles of chemistry.

Cumulative Progress Indicators

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

6. Know that atoms consist of a nucleus surrounded by electrons, and that the arrangement of the electrons determines the chemical behavior of each element.
7. Know that the nucleus consists of protons and neutrons, and that each atom of a given element has the same number of protons, but that the number of neutrons may vary.
8. Explain how atoms can form bonds to other atoms by transferring or sharing electrons.
9. Demonstrate different types of chemical reactions and the various factors affecting reaction rates.
10. Explain how the Periodic Table of Elements evolved and how it relates atomic structure to the physical and chemical properties of the elements. (*See, for instance, Drugs 32-33, 37*).

Standard 5.9:
**All Students Will Gain An Understanding Of Natural Laws As They Apply To
Motion, Forces, And Energy Transformations**

Descriptive Statement: Basic principles of physics emerge in this standard, where the study of force and motion leads students to the concept of energy. All forms of energy are introduced and investigated, and principles of transformation and laws of conservation are developed.

Cumulative Progress Indicators

Building upon knowledge and skills gained in the preceding grades, by the end of Grade 12, students:

11. Explain the mathematical relationship between the mass of an object, the unbalanced force exerted on it, and the resulting acceleration.
12. Prove that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.
13. Know that gravity is a universal force of attraction between masses that depends on the masses and the distance between them.
19. Know that electrically charged bodies can attract or repel each other with a force that depends on the size and nature of the charges and the distance between them.
1. Explain the similarities and differences between gravitational forces and electrical forces that act at a distance.

2. Know that the forces that hold the nucleus of an atom together are stronger than electromagnetic forces and that significant amounts of energy are released during nuclear changes.
3. Explain how electromagnetic waves are generated, and identify the components of the electromagnetic spectrum.
23. Explain that all energy is either kinetic or potential and that the total energy of the universe is constant.

Cross-Content Workplace Readiness Standards and Progress Indicators

Standard 5: All Students Will Apply Safety Principles

Descriptive Statement: Safety is an important component of all content areas, especially the arts, health and physical education, science, occupational education programs, and any content area where hands-on activities take place. Students need to learn behaviors that will ensure their own safety and health and that of others. They also should become familiar with the rules and laws governing safety and health so they can act responsibly implement these standards.

Cumulative Progress Indicators

All students will be able to:

1. Explain how common injuries can be prevented.
2. Develop and evaluate an injury prevention program.
3. Demonstrate principles of safe physical movement.
4. Demonstrate safe use of tools and equipment.
5. Identify and demonstrate the use of recommended safety and protective devices.
6. Identify common hazards and describe methods to correct them.
7. Identify and follow safety procedures for laboratory and other hands-on experiences.

8. Discuss rules and laws designed to promote safety and health, and their rationale.
9. Describe and demonstrate procedures for basic first aid and safety precautions.

(For Indicators #1-9, see in each individual volume, "Safety in the Laboratory," for instance, Pulp and Paper xviii-xix; see also "Safety" cautions throughout each volume, for instance Plant 12, 16, 24, 27, 31-32, 36, 38, 45))