Hawai‘i DOE Content & Performance Standards
(HCPS III) Resources

For teachers’ convenience we have provided a complete copy of Hawaii’s standards with benchmarks and assessment information on the Compact Disk (CD) included with this curriculum (see front pocket).

These standards are also available online at http://standardstoolkit.k12.hi.us/index.html or on our Web site at www.cds.hawaii.edu/kahana (see Standards Appendix).

Below you will also find abbreviations for all the sciences identified in the Hawai‘i state standards, plus another way of viewing these standards, from the perspective of common science disciplines studied at colleges and universities.

Abbreviations

SC.ES = Earth and Space Science
SC.ENV = Environmental Science
SC.HP = Human Physiology
SC.MS = Marine Science
SC.PH = Physics
SC.PAH = Plants & Animal in Hawai‘i
SC.BS = Biological Science
SC.CH = Chemistry
SC.Z = Zoology

A Scientist’s View: The Standards by Science Fields

A. Content Area: All Sciences
1. The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process
Scientific Inquiry

1.1 Describe how a testable hypothesis may need to be revised to guide a scientific investigation

1.2 Design and safely implement an experiment, including the appropriate use of tools and techniques to organize, analyze, and validate data

1.3 Defend and support conclusions, explanations, and arguments based on logic, scientific knowledge, and evidence from data
1.4 Determine the connection(s) among hypotheses, scientific evidence, and conclusions
1.5 Communicate the components of a scientific investigation, using appropriate techniques
1.6 Engage in and explain the importance of peer review in science
1.7 Revise, as needed, conclusions and explanations based on new evidence
1.8 Describe the importance of ethics and integrity in scientific investigation
1.9 Explain how scientific explanations must meet a set of established criteria to be considered valid

2. The Scientific Process: NATURE OF SCIENCE: Understand that science, technology, and society are interrelated

Science, Technology, and Society
2.1 Explain how scientific advancements and emerging technologies have influenced society
2.2 Compare the risks and benefits of potential solutions to technological issues

B. Content Area: Zoology and Biological Science (ZB)

3. Structure and function in Animals—Understand the relationship between the structure and function of an animal’s body.

Patterns of Organization
3.1 Illustrate the different types of body symmetry (e.g., radial, bilateral, asymmetry)
3.2 Evaluate the different levels of bodily organization (e.g., unicellular, diploblastic, triploblastic) and the body plans associated with each (e.g., acoelomate, pseudocoelomate, coelomate)
3.3 Compare vertebrates and invertebrates

Physiology and Life Cycles
3.4 Trace the development of genetically identical stem cells into specialized cells (e.g., skin, liver, muscle, nerve)
3.5 Trace the life cycles of various groups of animals (e.g., plasmodium, cnidarians, nematodes, insects, tunicates, anurans)
3.6 Compare the physiology of the nine major phyla of the animal kingdom

4. Animals and the Environment—Understand the interaction of animals with their environment

Behavior and Symbiosis
4.1 Explain how animals’ behavior (e.g., parental care, division of labor, niche, innate hive behavior in insects) may enhance the species’ chances of survival
4.2 Determine how species enhance their rate of survival by using symbiosis (e.g., mutualism, commensalism, parasitism) and mimicry

5. Genetics and Evolution—Understand the relationship between genetics and evolution

Genetics
5.1 Describe how evolution works in terms of a change of frequency of alleles in a population
5.2 Describe how evolution depends on variation with individuals, population genetics, and the species gene pool
5.3 Use the assumptions of the Hardy-Weinberg Theorem to test the occurrence of different evolutionary mechanisms (e.g., genetic drift, gene flow, mutation, natural selection, balanced polymorphism, speciation)

Evolution
5.4 Explain how the adaptations of the different phyla enhance their survival
5.5 Use evidence (e.g., molecular, anatomical, fossil) to determine the phylogeny of a species

C. Content Area: Environmental Science (ES)

3. Earth Science — Understand the physical systems of the earth
Forces that shape the earth
3.1 Judge the effects of ocean currents on climate
3.2 Compare different erosion processes
3.3 Categorize different wind patterns and their effect on weather
3.4 Compare different methods of generating electricity (e.g., fossil fuels, nuclear)

4: Life Science — Understand the interconnections of living systems
Systems and Connections
4.1 Explain how scientists organize the biosphere
4.2 Explain why populations undergo cyclic fluctuations
4.3 Explain how ecosystems respond to human activities
4.4 Use models to represent the process of succession

Flow of Matter and Energy
4.5 Explain the relationship between the carbon cycle and fossil fuels
4.6 Describe how the availability of resources (e.g., energy, water, oxygen, minerals) limits the amount of life an environment can support

5: Interdependence of The Environment and Human Societies — Understand the interdependence between environmental systems and human societies.
Human Impact
5.1 Explain how economic and societal decisions affect global and local ecosystems
5.2 Assess the effect of human actions on an environmental system
5.3 Explain how population growth and natural resource consumption affect global sustainability

Resource Use
5.4 Describe the relationship between the environment and the growth rate of a population
5.5 Compare the consumption of natural resources by different nations
5.6 Explain why recycling and conservation of resources are important
D. Content Area: Marine Science (MS)

3. Oceanography — Understand the physical features of the ocean and its influences on weather and climate.

   Physical Characteristics of the Ocean
   3.1 Explain how sea level rises and falls
   3.2 Describe the effect of plate tectonics on the topography of the ocean floor
   3.3 Explain how the ocean participates in the geochemical cycling of elements

   Tides, Waves, and Currents
   3.4 Describe the causes and characteristics of tides
   3.5 Describe how waves and currents move using physical principles
   3.6 Explain how erosion occurs and the effects of sedimentation

   Oceans Influence
   3.7 Describe the relationship between fresh bodies of water, watersheds, and the ocean
   3.8 Explain how the ocean influences weather and climate
   3.9 Explain how El Niño influences global weather patterns

4. Ecological Systems — Understand the locations and characteristics of marine ecosystems.

   Ecosystems
   4.1 Differentiate freshwater, brackish, and saltwater ecosystems
   4.2 Explain how estuaries provide productive and important nursery areas for many marine species
   4.3 Describe the characteristics of coral reefs
   4.4 Describe the unique properties of deep ocean communities

   Influence of Water
   4.5 Explain how chemical factors (e.g., pH, salinity, dissolved O2, nutrients) affect the distribution of life in the ocean
   4.6 Describe how physical factors (e.g., light, temperature, pressure, current) define the region/zone in the ocean

5: Structure, Function, and Interdependence — Understand the structure, function, and interdependence of marine organisms.

   Structure and Function
   5.1 Explain how adaptations help animals survive in a marine environment
   5.2 Compare the characteristics of marine organisms (e.g., planktonic, invertebrate, vertebrate)
   5.3 Compare forms of marine symbiosis

6: Interdependence of Humans and the Ocean — Understand the interdependence of humans and the ocean.

   Influence of the Ocean on Human Society
   6.1 Describe the effects of natural oceanic hazards (e.g., hurricanes, tsunamis) on people
   6.2 Describe the relationship between the ocean and human cultural development
Human Impact

6.3 Evaluate mariculture in terms of use of technology and environmental impact
6.4 Explain how human activities and development lead to marine pollution (e.g., point sources, non-point sources)
6.5 Describe how urbanization has impacted the ocean
6.6 Explain how ocean resources are managed

E. Content Area: Physical Science (PS)

6. Physical, Earth and Space Science: NATURE OF MATTER AND ENERGY:
Understand the nature of matter and energy, forms of energy (including waves) and energy transformations, and their significance in understanding the structure of the universe

Energy and its Transformation

6.1 Describe endothermic and exothermic chemical reactions
6.2 Explain how the law of conservation of energy is applied to various systems
6.3 Describe different examples of the concept of entropy
6.4 Explain that changes in thermal energy can lead to a phase change of matter

Waves

6.5 Compare transverse and longitudinal waves and their properties
6.6 Explain and provide examples of electromagnetic radiation and sound using a wave model

Nature of Matter

6.7 Explain how elements are arranged in the periodic table and describe trends among elemental properties
6.8 Describe interactions among molecules
6.9 Describe the factors that affect the rate of chemical reactions
6.10 Explain how atoms bond using valence electrons
6.11 Describe a variety of chemical reactions

Energy and its transformation

6.12 Describe nuclear reactions and how they produce energy

7. Physical, Earth, and Space Sciences: FORCE AND MOTION:
Understand the relationship between force, mass, and motion of objects; and know the major natural forces: gravitational, electric, and magnetic

Forces and Motion

7.1 Apply the laws of motion to determine the effects of forces on the linear motion of objects
7.2 Use vectors to explain force and motion
7.3 Explain the relationships among the gravitational force, the mass of the objects, and the distance between objects
7.4 Explain the magnetic and electric forces in the universe
F. Content Area: Earth and Space Science (ES)
8. Physical, Earth, and Space Sciences: EARTH AND SPACE SCIENCE: Understand the Earth and its processes, the solar system, and the universe and its contents
Forces that Shape the Earth & Earth in the Solar System
  8.1 Describe how elements and water move through solid Earth, the oceans, atmosphere, and living things as part of geochemical cycles
  8.2 Describe how to estimate geologic time
  8.3 Explain the possible origins and evolution of the solar system
  8.4 Describe how heat and energy transfer into and out of the atmosphere and their involvement in global climate
  8.5 Explain the effects of movements of crustal plates
  8.6 Describe how winds and ocean currents are produced on the Earth's surface
Forces that Shape the Earth
  8.7 Describe climate and weather patterns associated with certain geographic locations and features
  8.8 Describe the major internal and external sources of energy on Earth
Universe
  8.9 Describe the physical and nuclear dynamics involved in the life cycle of a star
  8.10 Compare different theories concerning the formation of the universe

G. Content Area: Chemistry (CS)
3: Properties of Matter – Understand different states of matter
Acids and Bases
  3.2 Use the pH scale to characterize acid and base solutions
  3.3 Calculate the pH from the hydrogen-ion concentration
  3.4 Explain that buffers stabilize pH in acid-base reactions
Gases and their Properties
  3.5 Apply gas laws to relationships between pressure, volume, and temperature of any amount of an ideal gas or any mixture of ideal gases using PV = nRT
  3.6 Explain the diffusion of gases using the Kinetic Molecular Theory of Matter
Temperature
  3.7 Convert between Celsius and Kelvin temperature scales
4: Atomic Structure and Bonding – Understand properties of the periodic table, atoms, and bond formation
Periodic Table
  4.1 Explain how columns in the periodic table represent elements with common properties and identify metals, semimetals, nonmetals, and halogens
4.2 Identify the essential characteristics of alkali metals, alkaline earth metals, and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms

4.3 Use the periodic table to determine the number of valence electrons of an element

Nature of Matter

4.4 Explain that the nucleus of the atom is much smaller than the atom, but contains most of its mass (e.g. protons and neutrons have almost two thousand times more mass than an electron)

4.5 Explain that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck’s relationship (E=hv)

4.6 Explain that atoms combine to form molecules by sharing the outermost electrons to form covalent, or metallic bonds or by transferring electrons to form ionic bonds

4.7 Describe why the chemical bonds between atoms in molecules, such as H2, CH4, NH3, C2H4, N2, Cl2, and many large biological molecules are covalent

4.8 Explain the movement and properties of atoms and molecules in liquids

4.9 Describe how electronegativity and ionization energy relate to bond formation

4.10 Identify and explain physical properties of substances (e.g. melting points, boiling points, and volatility) based on the strength of molecular attractions

5: Chemical Reactions – Understand the nature of chemical interactions and solutions

H. Content Area: Physics

3. Matter & Energy Conservation – Understand the nature of momentum & energy transformations

Matter

3.1 Measure or determine physical quantities such as density and mass of samples

3.2 Differentiate among mass, weight, and inertia

Energy and Momentum

3.3 Differentiate between energy & momentum both quantitatively & conceptually, & recognize that both are conserved

3.4 Describe ways that energy can be transformed from one form to another (e.g., potential energy to kinetic energy)

3.5 Use the equations for changes in kinetic energy (KE = ½ mv²) and gravitational potential energy (PE = mgh) to calculate changes in energy
3.6 Differentiate between different energy manifestations (e.g., kinetic \( \text{KE} = \frac{1}{2}mv^2 \), gravitational potential \( \text{PE} = mgh \), thermal, chemical, nuclear, electromagnetic, or mechanical)

**Conservation Laws**

3.7 Use the conservation of energy law to solve problems involving an energy transformation

3.8 Use the conservation of energy and momentum laws to predict both quantitatively and qualitatively the results of interactions of objects within simple systems

3.9 Describe circumstances under which each conservation law (i.e., energy, momentum, mass) may be used

**4. Force and Motion** – Understand the relationship between force, mass and motion of objects

4.1 Solve problems using the universal law of gravity

4.2 Solve two-dimensional trajectory problems

4.3 Solve two-dimensional problems involving balanced forces (i.e., statics)

4.4 Analyze motion in terms of position, time, velocity and acceleration, both quantitatively and qualitatively

4.5 Describe the nature of centripetal force and centripetal acceleration (e.g., the formula \( a = \frac{v^2}{r} \)), and use these ideas to predict the motion of an object

**Relationship between force, mass, and motion**

4.6 Use Newton’s Laws (e.g., \( F = ma \)) together with the kinematic equations to predict the motion of an object

4.7 Resolve two dimensional vectors into their components, and use the resultant vectors to solve problems involving force and motion, both graphically and quantitatively

**5. Heat and Thermodynamics** – Understand the laws of thermodynamics, and their applications

**Heat and Temperature**

5.1 Explain that heat flow and work are two forms of energy transfer between systems

5.2 Differentiate between heat, specific heat, and temperature

**Laws of Thermodynamics**

5.3 Explain the laws of thermodynamics, and describe some practical applications

**Heat Engines**

5.4 Calculate heat flow, work, and efficiency in an ideal heat engine, and understand that real heat engines lose some heat to surroundings

5.5 Use the first law of thermodynamics to describe the work cycle of a heat engine

5.6 Explain how the law of conservation of energy applies to work in a heat engine
6. Waves – Understand the nature of waves, including the characteristic properties of the...

Mechanical Waves
   6.1 Analyze transverse and longitudinal waves in mechanical (e.g., springs, wave tanks) and non-mechanical media (e.g., seismic waves, sound waves)

Calculations
   6.2 Solve problems involving wavelength, frequency, amplitude, speed, absorption, reflection, and refraction

Optics
   6.3 Use the concepts of wave motion to predict qualitatively and quantitatively the various properties of a simple optical system

Electromagnetic Spectrum
   6.4 Describe the range of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared radiation)

7. Electric and Magnetic Phenomena – Understand the nature and applications of electricity and magnetism

Electric and Magnetic Fields
   7.1 Describe the relationships among charged particles, electrical current, electrical potential, electric fields, and magnetic fields
   7.2 Demonstrate and explain how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil
   7.3 Explain how currents are induced in conductors by changing magnetic fields
   7.4 Describe how electric and magnetic fields contain energy and act as vector force fields
   7.5 Calculate the force on a charged particle in an electric field using the formula \( F = qE \), where \( E \) is the electric field at the position of the particle
   7.6 Calculate the magnitude of the force on a moving particle with charge \( q \) in a magnetic field, using the formula \( F = qvB\sin\alpha \), where \( v \) and \( B \) are the magnitudes of vectors \( v \) and \( B \) and \( \alpha \) is the angle between \( v \) and \( B \)

Electric Circuits
   7.7 Analyze simple arrangements of components (e.g., resistors, capacitors, transistors) in series or parallel circuits, both quantitatively and qualitatively
   7.8 Predict the current, voltage, and power in simple direct current electric circuits

Coulomb's Law
   7.9 Solve problems involving the forces between two electric charges (Coulomb’s Law)

8. Modern Physics – Understand the general concepts related to the theory of special relativity, and the constituent particles that make up atoms

Relativity
8.1 Explain the general concepts related to the theory of relativity (e.g.,
nothing can travel faster than the speed of 
Newton’s Law
8.2 Explain that Newton’s Laws are not exact but give a very good
approximation unless an object is moving close to the speed of light
or is small enough
Quantum physics
8.3 Describe the constituent particles that make up matter, and the
scale at which quantum effects become important

I. Content Area: Human Physiology
3. Structure & Function —Understand cells, tissues, & orientation
Cancer & Homeostasis
3.1 Analyze, using evidence, the process of cellular division as it
relates to human physiology
3.2 Explain how cells, tissues, & organs maintain homeostasis through
cellular transport mechanisms
Tissues & Orientation
3.3 Classify the various types of human tissue (e.g., muscle, epithelial,
connective, nervous) by structure & function
3.4 Use correct terminology (e.g., proximal, dorsal, medial, lateral,
visceral, superficial, deep) to describe the orientation of body parts
& regions
4. Organ Systems —Understand the functions of various organ systems.
Circulatory & Respiratory systems
4.1 Evaluate the function of the various structures within the circulatory
system in transportation & cellular support
4.2 Determine the function of the various structures of the respiratory
system in gas exchange
Nutrition, Digestion, & Excretion
4.3 Evaluate the structure & function of the digestive system in
transportation & absorption of nutrients
4.4 Explain how the excretory system regulates body wastes
Muscular, Skeletal, & Integumentary systems
4.5 Explain how the muscular system functions (e.g., locations, origins,
insertions, muscle groups, types of muscles)
4.6 Explain how the skeletal system functions to support & protect the
body
4.7 Relate the structure of the integumentary system to its functions
Nervous System
4.8 Trace & describe the pathway of a neural impulse
4.9 Explain how the central nervous system functions in regulating
physiological activities
4.10 Describe the relationship between the peripheral nervous system &
how the body responds to maintain a stable internal environment
Reproductive & Endocrine Systems
  4.11 Compare the reproductive organs in the male & female body in terms of structure & function
  4.12 Determine the role of the reproductive system in human growth & development
  4.13 Trace the development of a human from the formation of gametes, fertilization, embryonic development, & gestation
  4.14 Determine the role of hormones & feedback loops in bodily functions

5: Interdependence of Body Systems—Understand the interdependence of body systems & the hazards associated with system failure & aging.
Interdependence
  5.1 Analyze the interdependence of various body systems to each other
  5.2 Determine the relationship between the skeletal & muscular systems

System Failure & Aging
  5.3 Identify potential system failures due to the effects of aging
  5.4 Explain how a disorder in any major organ system affects normal body function

J. Statistics
11: Data Analysis, Statistics, and Probability: FLUENCY WITH DATA: Pose questions and collect, organize, and represent data to answer those questions
Data Collection and Display
  MA.S.11.1: Develop a hypothesis for an investigation or experiment
  MA.S.11.2: Recognize the variables and controls in an experiment or investigation
  MA.S.11.3: Select appropriate display for a data set (e.g., frequency table, histogram, line graph, bar graph, stem-and-leaf plot, box-and-whisker plot, scatter plot)
  MA.S.11.4: Recognize features of representations of data that can produce misleading interpretations
  MA.S.11.5: Recognize sampling, randomness, bias, and sampling size in data collection and interpretation
  MA.S.11.6: Describe the purpose and function of a variety of data collection methods (e.g., census, sample surveys, experiment, observation)
  MA.S.12.1: Use measures of central tendency and spread to interpret data

K. Geography
Spatial Organization, Dynamics, and Interaction
  SS.12G.1.1: Describe the relative location, size of, and distances among significant physical features and their relationship to political features
  SS.12G.1.2: Explain different patterns of land use (e.g., land use in urban, suburban, and rural areas)
Nature of Regions
SS.12G.2.1: Describe factors that contribute to the dynamic nature of regions (e.g., human influences such as migration, technology, and economic development; physical influences such as environmental change and ecosystem dynamics)
SS.12G.2.2: Describe why places and regions are important to individual human identity and as symbols for unifying or fragmenting society (e.g., physical and symbolic characteristics of places, effects of climate on culture)

Physical Systems
SS.12G.3.1: Explain ecosystems in terms of their biodiversity and productivity (e.g., food chains, plant and animal communities, grasslands, forests, deserts, tundra, wetlands, coral reefs)

Human Systems
SS.12G.4.1: Investigate the physical characteristics of urban areas (e.g., size, structure, arrangement) and how those characteristics have changed over time
SS.12G.4.2: Assess the impact of human migration on physical and human systems (e.g., effects on ecosystems, resource use, and economic development; effects on population characteristics such as religion and average age)
SS.12G.4.3: Assess the physical and human impact of emerging urban forms in the present-day world (e.g., megalopolis or edge cities, metropolitan corridors, transportation technology, ethnic enclaves)

Interaction and Influences
SS.12G.5.1: Describe contemporary issues in terms of Earth’s physical and human systems
SS.12G.5.2: Explain the ways in which technology influences the human capacity to modify the physical environment (e.g., fossil fuels, diesel machinery, steel plow, strip mining; technologies that have allowed for advances in dams, irrigation, and desert settlements)
SS.12G.5.3: Investigate the relationships among resources (e.g., gold, water, oil, fish), their distribution by humans, and the exploration, colonization, and settlement of different regions of the world (e.g., mercantilism, imperialism, Gold Rush, Alaska pipeline)