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A Framework for K-12 Science Education

Three Dimensions of the Framework

(Book p3, PDF p18)

I. **Scientific and Engineering Practices:** Standards of Science Practice

<u>Eight Standards of Science Practice</u> (Section 3) (42, 57)

1. Asking Questions & Defining Problems (54, 69)
2. Developing and Using Models (56, 71)
3. Planning and Carrying Out Investigations (59, 74)
4. Analyzing and Interpreting Data (61, 76)
5. Using Mathematics, Information & Computer technology, and Computational Thinking (64, 79)
6. Constructing Explanations and Designing Solutions (67, 82)
7. Engaging in Argument from Evidence (71, 86)
8. Obtaining, Evaluating, and Communicating Information (74, 89)

II. **Crosscutting Concepts**: Those having applicability across science disciplines

<u>Seven Crosscutting Concepts of the Framework</u> (Section 4) (84, 99)

A. Patterns (85, 100)
B. Cause and effect (87, 102)
C. Scale, proportion, and quantity (89, 104)
D. Systems and system models (91, 106)
E. Energy and matter (94, 109)
F. Structure and function (96, 111)
G. Stability and change (98, 113)

III. **Disciplinary Core Ideas**: Describes the core ideas of Physical, Life, Earth & Space Sciences, and of the relationships among Science, Engineering and Technology.

<u>Physical Science</u> Section 5 (103, 118)

- Core Idea PS1: **Matter and its Interactions** (106, 121)
  - -PS1.A Structure and Properties of Matter
  - -PS1.B Chemical Reactions
  - -PS1.C Nuclear Processes
- Core Idea PS2: **Motion and Stability: Forces and Interactions** (113, 128)
  - -PS2.A Forces and Motion
  - -PS2.B Types of Interactions
  - -PS2.C Stability and Instability in Physical Systems
- Core Idea PS3: **Energy** (120, 135)
  - -PS3.A Definition of Energy
  - -PS3.B Conservation of Energy and Energy Transfer
  - -PS3.C Relationship Between Energy and Forces
  - -PS3.D Energy in Chemical Processes and Everyday Life
- Core Idea PS4: **Waves & Applications in Technologies for Information Transfer** (130, 145)
  - -PS4.A Wave Properties
  - -PS4.B Electromagnetic Radiation
  - -PS4.C Information Technologies and Instrumentation

<u>Life Sciences</u> (Section 6) (139, 154)

- Core Idea LS1: **From Molecules to Organisms: Structures and Processes** (143, 158)
  - -LS1.A Structure and Function
  - -LS1.B Growth and Development of Organisms
  - -LS1.C Organization for Matter and Energy Flow in Organisms
  - -LS1.D Information Processing
- Core Idea LS2: **Ecosystems: Interaction, Energy, and Dynamics** (150, 165)
  - -LS2.A Interdependent Relationships in Ecosystems
  - -LS2.B Cycles of Matter and Energy Transfer in Ecosystems
  - -LS2.C Ecosystems Dynamics, Functioning, and Resilience
  - -Ls2.D Social Interactions and Group Behavior
- Core Idea LS2: Heredity: **Inheritance and Variation of Traits** (157, 172)
  - -LS3.A Inheritance of Traits
  - -LS3.B Variation of Traits
- Core Idea LS4: **Biological Evolution: Unity and Diversity** (161, 176)
  - -LS4.A Evidence of Common Ancestry and Diversity
  - -LS4.B Natural Selection
  - -LS4.C Adaptation
  - -LS4.D Biodiversity and Humans

<u>Earth and Space Sciences</u> (Section 7) (169, 184)

- Core Idea ESS1: **Earth's Place in the Universe** (173, 188)
  - -ESS1.A The Universe and Its Stars
  - -ESS1.B Earth and the Solar System
  - -ESS1.C The History of Planet Earth
- Core Idea ESS2: **Earth's Systems** (179, 194)
  - -ESS2.A Earth Materials and Systems
  - -ESS2.B Plate Tectonics and Large0Scale System Interactions
  - -ESS2.C The Roles of Water in Earth's Surface Processes
  - -ESS2.D Weather and Climate
  - -ESS2.E Biogeology
- Core Idea ESS3: **Earth and Human Activity** (190, 205)
  - -ESS3.A Natural Resources
  - -ESS3.B Natural Hazards
  - -ESS3.C Human Impacts on Earth Systems
  - -ESS3.D Global Climate Change

<u>Engineering, Technology, and Applications of Science</u> (Section 8) (201, 216)

- Core Idea ETS1: **Engineering Design** (204, 219)
  - -ETS1.A Defining and Delimiting and Engineering Problem
  - -ETS1.B Developing Possible Solutions
  - -ETS1.C Optimizing the Design Solution
- Core Idea ETS2: **Links Among Engineering, Technology, Science and Society** (210, 225)
  - -ETS2A. Interdependence of Science, Engineering, and Technology
  - -ETS2.B Influence of Engineering, Technology and Science on Society & Natural World

<u>Integrating the Three Dimensions</u> (Section 9) (217, 232)

This framework is a multiyear progression that deepens understanding of crosscutting concepts and disciplinary core ideas. All three dimensions need to be integrated into the system of standards, curriculum, instruction, and assessment. There is no single approach on how to integrate these dimensions and examples of how it can be achieved are needed.