3 Dimensions of the NGSS

I. Crosscutting Concepts
   A. Patterns
   B. Cause and effect
   C. Scale, proportion, and quantity
   D. Systems and System models
   E. Energy and matter: Flows, cycles, and conservation
   F. Structure and function
   G. Stability and change

II. Science and Engineering Practices
   A. Asking questions (Science) and defining problems (Engineering)
   B. Developing and using models
   C. Analyzing and interpreting data
   D. Using mathematics & computational thinking
   E. Constructing explanations and designing solutions
   F. Engaging in argument from evidence
   G. Obtaining, evaluating, and communicating information

IIA. Skills within the Practices
   1. Creativity
      a. Think creatively
         Use a wide range of idea creation techniques
         Create new and worthwhile ideas
      b. Work creatively with others
         Develop and Communicate new ideas with others
         Be responsive to diverse perspectives
         Understand creativity as long term
      c. Implement innovations
         Make a useful contribution
   2. Communication
      a. Communicate clearly
      b. Use multiple technologies and communication strategies
      c. Communicate in diverse environments
      d. Listen effectively for knowledge, meaning, values and attitude
      e. Communicate for diverse purposes
3. Critical Thinking  
   a. Reason effectively  
   b. Use systems thinking  
   c. Make judgments and decisions  
   d. Solve problems  

4. Collaboration  
   a. Demonstrate flexibility  
   b. Work effectively with diverse teams  
   c. Make compromises for a shared goal  
   d. Assume shared responsibility  

III. Core Ideas within Disciplines  
   A. LS- Life Science Core Ideas\(^1\)  
   B. ESS- Earth and Space Science Core Ideas\(^2\)  
   C. PS- Physical Science Core Ideas\(^3\)  
   D. ETS- Engineering and Technology Science Core Ideas\(^4\)  

**LS: Life Science Core Ideas\(^1\)**  

**LS1A:** Structure and Function  
**LS1B:** Growth and Development of Organisms  
**LS1C:** Organization for Matter and Energy Flow in Organisms  
**LS1D:** Information Processing  
**LS2A:** Interdependent Relationships in Ecosystems  
**LS2B:** Cycles of Matter and Energy Transfer in Ecosystems  
**LS2C:** Ecosystems Dynamics, Functioning and Resilience  
**LS2D:** Social Interactions and Group Behavior  
**LS3A:** Inheritance of Traits  
**LS3B:** Variation of Traits  
**LS4A:** Evidence of Common Ancestry and Diversity  
**LS4B:** Natural Selection  
**LS4C:** Adaptation  
**LS4D:** Biodiversity and Humans
ESS: Earth and Space Science Core Ideas

ESS 1: Earth’s Place in the Universe
   ESS1A: The Universe and its Stars
   ESS1B: Earth and the Solar System
   ESS1C: The History of Planet Earth

ESS2: Earth’s Systems
   ESS2A: Earth Materials and Systems
   ESS2B: Plate Tectonics and Large-Scale Systems
   ESS2C: The Role of Water in Earth’s Surface Processes
   ESS2D: Weather and Climate
   ESS2E: Biogeology
   ESS2B: Earth and the Solar System

ESS3: Earth and Human Activity
   ESS3A: Natural Resources
   ESS3B: Natural Hazards
   ESS3C: Human Impacts on Earth Systems
   ESS3D: Global Climate Change

PS- Physical Science Core Ideas

PS1: Matter and its Interactions
   PS1A: Structure and Properties of Matter
   PS1B: Chemical Reactions
   PS1C: Nuclear Processes

PS2: Motion and Stability: Forces and Interactions
   PS2A: Forces and Motion
   PS2B: Types of Interactions
   PS2C: Stability and Instability in Physical Systems

PS3: Energy
   PS3A: Definitions of Energy
   PS3B: Conservation of Energy and Energy Transfer
   PS3C: Relationship Between Energy and Forces
   PS3D: Energy in Chemical Processes and Everyday Life
PS4: Waves and Their Applications in Technologies for Information Transfer
   PS4A: Wave Properties
   PS4B: Electromagnetic Radiation
   PS4C: Information Technologies and Instrumentation

ETS: Engineering & Technology Core Ideas

ETS1: Engineering Design
   ETS1A: Defining and Delimiting and Engineering Problems
   ETS1B: Developing Possible Solutions
   ETS1C: Optimizing the Design Solution

ETS2: Links Among Engineering Technology, Science, and Society
   ETS2A: Interdependence of Science, Engineering, and Technology
   ETS2B: Influence of Engineering, Technology, and Science on Society and the Natural World
Next Generation Science Standards

K-8

Quick Reference

*National Science Teachers’ Association, 2013*

Key to NGSS

*Italics* — Core Idea within individual Discipline

A-E — Subheading of Core Ideas (not included in individual standards)

First number — indicates grade level

Uppercase Letters — Acronym for individual Discipline (PS=Physical Science)

Second number — Number of the Core Idea within individual Discipline

Third number — Performance standard within Core Idea
K-2 Life Science

K-LS1 From Molecules to Organisms: Structures and Processes
   K-LS1-1. Use observations to describe patterns of what plants and animals need to survive

1-LS1 From Molecules to Organisms: Structures and Processes
   1-LS1-1. Mimic how organisms use their parts to help survive
   1-LS1-2. Use texts and media to show behavior of parents help offspring survive.

1-LS3 Heredity: Inheritance and Variation of Traits
   1-LS3-1. Model how young plants and animals are like, but not exactly like, their parents.

2-LS2 Ecosystems: Interactions, Energy, and Dynamics
   2-LS2-1. Investigate to determine if plants need sunlight and water to grow.
   2-LS2-2. Model the function of an animal in dispersing seeds or pollinating plants.

2-LS4 Biological Evolution: Unity and Diversity
   2-LS4-1. Observe plants and animals to compare the diversity of life in different habitats.

3-5 Life Science

3-LS1 From molecules to Organisms: Structures and Processes
   3-LS1-1. Life cycles

3-LS2 Ecosystems: Interactions, Energy, and Dynamics
   3-LS2-1. Animals form groups that help members survive.

3-LS3 Heredity: Inheritance and Variation of Traits
   3-LS3-1. Evidence that plants and animals have traits inherited from parents and variation
   3-LS3-2. Show that traits can be influenced by the environment

3-LS4 Biological Evolution: Unity and Diversity
   3-LS4-1. Fossil evidence of organisms of the past
   3-LS4-2. Show how variation of traits may provide advantages
   3-LS4-3. Survival of organisms in habitats
   3-LS4-4. Environmental change and survival

4-LS1 From Molecules to Organisms: Structures and Processes
   4-LS1-1. Internal and external structures which support survival
   4-LS1-2. Information processing of organisms

5-LS2 Ecosystems: Interactions, Energy, and Dynamics
   5-LS2-1. The movement of matter among plants, animals, decomposers, and the environment.
Middle School Life Science

**MS-LS1 From Molecules to Organisms: Structures and Processes**
- MS-LS1-1. Cells in living organisms
- MS-LS1-2. Anatomy and function of cells
- MS-LS1-3. Subsystems of the body
- MS-LS1-4. Animal behavior and specialized plant structures in reproduction
- MS-LS1-5. Environmental and genetic factors in development
- MS-LS1-6. Photosynthesis
- MS-LS1-7. Chemical reactions of molecules in food processing
- MS-LS1-8. Sensory receptors and the brain

**MS-LS2 Ecosystems: Interactions, Energy, and Dynamics**
- MS-LS2-1. Resources available in ecosystems
- MS-LS2-2. Interactions of organisms in ecosystems
- MS-LS2-3. Matter and energy in living and nonliving parts of an ecosystem
- MS-LS2-4. Effects of changes in ecosystems
- MS-LS2-5. How to maintain biodiversity

**MS-LS3 Heredity: Inheritance and Variation of Traits**
- MS-LS3-1. How changes to genes result in harmful, beneficial, or neutral effects
- MS-LS3-2. How asexual reproduction results in identical genetic information while sexual reproduction results in varied genetic information

**MS-LS4 Biological Evolution**
- MS-LS4-1. The fossil record and life forms
- MS-LS4-2. Anatomic similarities in life forms and their fossils
- MS-LS4-3. Similarities in embryo development
- MS-LS4-4. How variation of traits effect survival
- MS-LS4-5. Technology and inheritance
- MS-LS4-6. Increase or decrease of traits over time
K-2 Earth and Space Science

K-ESS2 Earth's Systems
  K-ESS2-1. Observations of local weather over time
  K-ESS2-2. How plants and animals change the environment to meet their needs

K-ESS3 Earth and Human Activity
  K-ESS3-1. Model the relationship between plants/animals and the place they live
  K-ESS3-2. Ask questions about the purpose weather information for severe weather
  K-ESS3-3. How to reduce the impact of humans/animals on the local environment

1-ESS1 Earth’s Place in the Universe
  1-ESS1-1. Observations of the sun, moon, and stars to describe patterns
  1-ESS1-2. Amount of daylight observed at different times of the year

2-ESS1 Earth’s Place in the Universe
  2-ESS1-1. Earth’s changes occur slowly or quickly

2-ESS2 Earth’s Systems
  2-ESS2-1. Solutions to prevent wind or water from changing the land
  2-ESS2-2. Model shapes of land and water bodies in the area
  2-ESS2-3. Where water in solid or liquid form is found on Earth

3-5 Earth and Space Science

3-ESS2 Earth's Systems
  3-ESS2-1. Represent weather data from a particular season in tables & graphs
  3-ESS2-2. Describe climates of regions of the world

3-ESS3 Earth and Human Activity
  3-ESS3-1. Merit of a solution that reduces the impacts of a weather-related hazard

4-ESS1 Earth's Place in the Universe
  4-ESS1-1. Rock formations & fossils in rock layers

4-ESS2 Earth's Systems
  4-ESS2-1. Rate of erosion by water, ice, wind, or vegetation
  4-ESS2-2. Interpret data from maps to describe patterns of Earth’s features

4-ESS3. Earth and Human Activity
  4-ESS3-1. Describe how energy and fuels are derived from natural resources and the effect on the environment
  4-ESS3-2. Solutions to reduce the impacts of natural Earth processes on humans
5-ESS1. *Earth’s Place in the Universe*
5-ESS1-1. Brightness of sun/stars due to distance from Earth
5-ESS1-2. Describe & graph changes in day and night and in seasons

5-ESS2 *Earth's Systems*
5-ESS2-1. Ways the geosphere, biosphere, hydrosphere, & atmosphere interact
5-ESS2-2. Describe & graph water in reservoirs

5-ESS3 *Earth and Human Activity*
5-ESS3-1. Protecting Earth’s resources

**Middle School Earth and Space Science**

**MS-ESS1 Earth's Place in the Universe**
MS-ESS1-1. Cycles of the Earth-sun-moon system
MS-ESS1-2. Gravity within solar systems
MS-ESS1-3. Scale properties of objects in the solar system
MS-ESS1-4. Rock strata and the geological time scale

**MS-ESS2 Earth's Systems**
MS-ESS2-1. Geoscience processes on Earth
MS-ESS2-2. Earth cycles and the flow of energy
MS-ESS2-3. Fossils and rocks, continental shapes, & seafloor in plate motion
MS-ESS2-4. Water cycle
MS-ESS2-5. Motion and interaction of air mass & resulting weather
MS-ESS2-6. Earth rotation & uneven heating in climate determination

**MS-ESS3 Earth and Human Activity**
MS-ESS3-1. Geoscience processes and the distribution of resources on Earth
MS-ESS3-2. Technology to alleviate natural hazards and disasters
MS-ESS3-3. Monitor the human impact on the environment
MS-ESS3-4. Human population and consumption of natural resources
MS-ESS3-5. Global warming
K-2 Physical Science

K- PS2 *Motion and Stability: Forces and Interactions*
  K-PS2-1. Pushes and pulls
  K-PS2-2. Pushes and pulls and speed and direction

K-PS3 *Energy*
  K-PS3-1. Observe the effect of sunlight on Earth’s surface
  K-PS3-2. Design & build a structure to reduce the effects of sunlight

1-PS4 *Waves and Their Applications in Technologies for Information Transfer*
  1-PS4-1. Vibration and sound
  1-PS4-2. Objects in darkness can be seen only when illuminated
  1-PS4-3. Investigate light’s interaction with different materials
  1-PS4-4. Light and sound in communication

2-PS1 *Matter and Its Interactions*
  2-PS1-1. Classify materials by properties
  2-PS1-2. Test materials to determine their possible uses
  2-PS1-3. Disassemble an object of several pieces and construct a new object
  2-PS1-4. Reversion of changes caused by heating or cooling

3-5 Physical Science

3-PS2 *Motion and Stability: Forces and Interactions*
  3-PS2-1. Balanced and unbalanced forces on matter
  3-PS2-2. Motion of objects and prediction of future motion
  3-PS2-3. Electric and magnetic interaction
  3-PS2-4. Magnets

4-PS3 *Energy*
  4-PS3-1. Relationship of speed and energy of an object
  4-PS3-2. Transfer of energy
  4-PS3-3. Energy changes due to collision of objects
  4-PS3-4. Conversion of energy

4-PS4 *Waves and Their Applications in Technologies for Information Transfer*
  4-PS4-1. Model the amplitude and wavelength which causes objects to move
  4-PS4-2. Model light and vision
  4-PS4-3. Use of patterns to transfer information
5-PS1 *Matter and Its Interactions*
- 5-PS1-1. Model matter at the subatomic level (too small to be seen)
- 5-PS1-2. Measure and graph weight of matter undergoing changes
- 5-PS1-3. Observe and measure materials to identify them based on their properties
- 5-PS1-4. Determine whether combination of substances forms a new substance

**Middle School Physical Science**

**MS-PS1 Matter and its Interactions**
- MS-PS1-1. Atomic composition of molecules
- MS-PS1-2. Determine when chemical reactions have occurred
- MS-PS1-3. Sources for, and the impact of, synthetic materials
- MS-PS1-4. Changes to substances when thermal energy is added or removed
- MS-PS1-5. Show that the total number of atoms remain in chemical reactions
- MS-PS1-6. Endothermic and Exothermic reactions

**MS-PS2 Motion and Stability: Forces and Interactions**
- MS-PS2-1. Newton’s Third Law of Motion
- MS-PS2-2. Changes in an object’s motion and the forces upon the object
- MS-PS2-3. Strength of electric and magnetic forces
- MS-PS2-4. Gravity and the mass of interacting objects
- MS-PS2-5. Fields of force (electric, magnetic, etc.)

**MS-PS3 Energy**
- MS-PS3-1. Relationship of Kinetic Energy, mass and speed
- MS-PS3-2. Potential Energy and the arrangement of objects
- MS-PS3-3. Minimize or maximize thermal energy transfer
- MS-PS3-4. Kinetic energy transfer, type of material, mass, & temperature
- MS-PS3-5. Motion and the transfer of energy

**MS-PS4 Waves and their Applications in Technologies for Information Transfer**
- MS-PS4-1. Mathematical models of amplitude and energy in waves
- MS-PS4-2. Reflection, absorption, and transmission of waves
K-2 Engineering & Technology

K-2-ETS1 *Engineering Design*
- K-2-ETS1-1. Define a problem to solve by developing a new or improved tool
- K-2-ETS1-2. Model how the shape of an object helps it function
- K-2-ETS1-3. Analyze data from two objects that solve a problem

3-5 Engineering & Technology

3-5-ETS1 *Engineering Design*
- 3-5-ETS1-1. Define a design problem including constraints, and success criteria
- 3-5-ETS1-2. Describe multiple solutions and their merits
- 3-5-ETS1-3. Design and do tests on a design prototype

Middle School Engineering & Technology

**MS-ETS1 Engineering Design**
- MS-ETS1-1. Define the criteria and constraints of a design problem
- MS-ETS1-2. Evaluate design solutions
- MS-ETS1-3. Analyze test data to identify best characteristics of each solution
- MS-ETS1-4. Redesign for the best solution

STEM Definitions

- **Science** is the study of our natural world (National Science Education Standards, National Research Council, 1996).
- **Technology** is the modification of the natural world to meet human wants and needs. (ITEA, 2000)
- **Engineering** is design under constraint (William Wulf, Past-president of National Academy of Engineering)
- **Mathematics** is the study of any patterns or relationships (AAAS, 1993)