

# Overarching Essential Questions for the NGSS Cross-Cutting Concepts

## **Crosscutting Concept #1: Patterns**

*How can patterns be used to predict results and solve problems?*

*What is the relationship between patterns and natural phenomena?*

*What is involved in identifying a pattern?*

*How can you use identified patterns to justify claims?*

## **Crosscutting Concept #2: Cause/Effect**

*Why is understanding cause and effect important to your life?*

*How can cause and effect relationships help predict or explain future events?*

*How can data mislead you in determining a cause & effect relationship?*

*How do you distinguish between a cause and a correlation?*

## **Crosscutting Concept #3: Scale, Proportion and Quantity**

*How do scale, proportion and quantity affect what can be observed?*

*How do conceptual models allow me to observe and test what I cannot see?*

*How can mathematical models be used to understand and/or predict scientific events?*

## **Crosscutting Concept #4: Systems and System Models**

*What is a system?*

*How are the parts of a system related to the entire system?*

*How are system models used to predict and understand real world situations or scientific phenomena?*

## **Crosscutting Concept #5: Matter and Energy**

*What is energy, and what does it mean for it to be conserved?*

*How are energy and matter related?*

*How is energy measured?*

## **Crosscutting Concept #6: Structure and Function**

*What is the connection between structure and function?*

*How does structure and function apply to a given problem?*

*What affects structure and function?*

## **Crosscutting Concept #7: Stability and change**

*How do we measure change?*

*How can something appear stable when it is actually changing?*

*How does scale affect our ability to observe change?*

# Overarching Essential Questions for the NGSS Science And Engineering Practices

## **Practice #1: Asking Questions and Defining Problems**

*What are the characteristics of a good, testable question?*

*What are the characteristics of a problem worth investigating?*

*Which questions would you ask if you obtained unexpected results?*

## **Practice #2: Developing and Using Models**

*How does your model relate to the real world?*

*What are the advantages and limitations of a model?*

*When and why is it appropriate to change a model?*

## **Practice #3: Planning and Carrying Out Investigations**

*How does planning for a scientific investigation address data collection that is valid, reliable, ethical and repeatable?*

*Why is it important to collect data about the performance of a proposed tool, object, process or system under a range of conditions?*

## **Practice #4: Analyzing and Interpreting Data**

*How are graphical representations of large data sets constructed and used to identify relationships?*

*How can we analyze data with more precision and accuracy?*

*Why is error analysis important?*

## **Practice #5: Using Mathematics and Computational Thinking**

*How can mathematics be used to solve problems?*

*How can mathematics be used to communicate an idea and/or defend an argument?*

*When and how can mathematical ideas and data be generalized?*

## **Practice #6: Constructing Explanations and Designing Solutions**

*How can we identify when something is (or is not) a solution to a problem?*

*How can data be used to summarize and/or draw conclusions about an experiment?*

*When is it appropriate to use numerical data/patterns and the results of an experiment to make generalized statements about science?*

*Why is it important to consider the constraints and/or criteria when designing and evaluating solutions?*

## **Practice #7: Engaging in Argument from Evidence**

*How do scientists respond to different perspectives?*

*Why is it important to acknowledge the weaknesses of your argument?*

*How do you construct an argument using evidence to evaluate a scientific claim?*

## **Practice #8 – Obtaining, Evaluating, and Communicating information**

*How do we decide what to believe about a scientific claim?*

*How can we make an informed decision?*

*What are the benefits of communicating information in multiple ways?*

*How does science change over time?*

Source: Stevenson High School Science Department and Feeder Middle School Science Teachers

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## **NGSS Core Ideas – Essential and Guiding Questions for Physical Sciences**

### **PS1: Matter and Its Interactions**

*How can one explain the structure, properties and interactions of matter?*

#### **PS1.A: Structure and Properties of Matter**

*How do particles combine to form the variety of matter one observes?*

#### **PS1.B: Chemical Reactions**

*How do substances combine or change (react) to make new substances?*

*How does one characterize and explain these reactions and make predictions about them?*

#### **PS1.C: Nuclear Processes**

*What forces hold nuclei together and mediate nuclear processes?*

### **PS2: Motion and Stability: Forces and Interactions**

*How can one explain and predict interactions between objects and within systems of objects?*

#### **PS2.A: Forces and Motion**

*How can one predict an object's continued motion, change in motion, or stability?*

#### **PS2.B: Types of Interactions**

*What underlying forces explain the variety of interactions observed?*

#### **PS2.C: Stability and Instability in Physical Systems**

*Why are some physical systems more stable than others?*

### **PS3: Energy**

*How is energy transferred and conserved?*

#### **PS3.A: Definitions of Energy**

*What is energy?*

#### **PS3.B: Conservation of Energy and Energy Transfer**

*What is meant by conservation of energy? How is energy transferred between objects or systems?*

#### **PS3.C: Relationship between Energy and Forces**

*How are forces related to energy?*

#### **PS3.D: Energy in chemical Processes and Everyday Life**

*How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used?*

**PS4: Waves and Their Applications in Technologies for Information Transfer**

*How are waves used to transfer energy and information?*

**PS4.A: Wave Properties**

*What are the characteristic properties and behaviors of waves?*

**PS4.B: Electromagnetic Radiation**

*What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?*

**PS4.C: Information Technologies and Instrumentation**

*How are instruments that transmit and detect waves used to expand human senses?*

**NGSS Core Ideas – Essential and Guiding Questions for Life Sciences**

**LS1: From Molecules to Organisms: Structures and Processes**

*How do organisms live, grow, respond to their environment and reproduce?*

**LS1.A: Structure and Function**

*How do the structures of organisms enable life's functions?*

**LS1.B: Growth and Development of Organisms**

*How do organisms grow and develop?*

**LS1.C: Organization for Matter and energy flow in Organisms**

*How do organisms obtain and use the matter and energy they need to live and grow?*

**LS1.D: Information Processing**

*do organisms detect, process and use information about the environment?*

*How*

**LS2: Ecosystems: Interactions, Energy, and Dynamics**

*How (and why) do organisms interact with their environment and what are the effects of these interactions?*

**LS2.A: Interdependent Relationships in Ecosystems**

*How do organisms interact with the living and nonliving environments to obtain matter and energy?*

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**

*How do matter and energy move through an ecosystem?*

**LS2.C: Ecosystems Dynamics, Functions and Resilience**

*What happens to ecosystems when the environment changes?*

**LS2.D: Social Interactions and Group Behavior**

*How do organisms interact in groups so as to benefit individuals?*

**LS3: Heredity: Inheritance and Variation of Traits**

*How*

*are characteristics of one generation passed to the next?*

*How can individuals of the same species and even siblings have different characteristics?*

**LS3.A: Inheritance of Traits**

*How are the characteristics of one generation related to the previous generation?*

**LS3.B: Variation of Traits**

*Why*

*and how do individuals of the same species vary in how they look, function and behave?*

**LS4: Biological Evolution: Unity and Diversity**

*How can there be so many similarities among organisms yet so many different kinds of plants, animals and microorganisms?*

**LS4.A: Evidence of Common Ancestry and Diversity**

*What evidence shows that different species are related?*

**LS4.B: Natural Selection**

*How does genetic variation among organisms affect survival and reproduction?*

**LS4.C: Adaptation**

*How does the environment influence populations of organisms over multiple generations?*

**LS4.D: Biodiversity and Humans**

*What is biodiversity, how do humans affect it, and how does it affect humans?*

**NGSS Core Ideas – Essential and Guiding Questions for Earth and Space Sciences**

**ESS1: Earth's Place in the Universe**

*What is the universe, and what is Earth's place in it?*

**ESS1.A: The Universe and Its Stars**

*What is the universe, and what goes on in the stars?*

**ESS1.B: Earth and the Solar System**

*What are the predictable patterns caused by Earth's movement in the solar system?*

**ESS1.C: The History of Planet Earth**

*How do people reconstruct and date events in Earth's planetary history?*

## **ESS2: Earth Systems**

*How and why is Earth constantly changing?*

### **ESS2.A: Earth Materials and Systems**

*How do Earth's major systems interact?*

### **ESS2.B: Plate Tectonics and Large-Scale Systems Interactions**

*Why do the continents move, and what causes earthquakes and volcanoes?*

### **ESS2.C: The Roles of Water in Earth's Surface Processes**

*How do the properties and movements of water shape Earth's surface and affect its systems?*

### **ESS2.D: Weather and Climate**

*What regulates weather and climate?*

### **ESS2.E: Biogeology**

*How do living organisms alter Earth's processes and structures?*

## **ESS3: Earth and Human Activity**

*How do the Earth's surface processes and human activities affect each other?*

### **ESS3.A: Natural Resources**

*How do humans depend on Earth's resources?*

### **ESS3.B: Natural Hazards**

*How do natural hazards affect individuals and societies?*

### **ESS3.C: Human Impact on Earth Systems**

*How do humans change the planet?*

### **ESS3.D: Global Climate Change**

*How do people model and predict the effects of human activities on Earth's climate?*

## **NGSS Core Ideas – Essential and Guiding Questions for Engineering, Technology and Applications of Science**

### **ETS1: Engineering Design**

*How do engineers solve problems?*

#### **ETS1.A: Defining and Delimiting an Engineering Problem**

*What is a design for? What are the criteria and constraints of a successful solution?*

#### **ETS1.B: Developing Possible Solutions**

*What is the process for developing potential design solutions?*

**ETS1.C: Optimizing the Design Solution**

*How can various design solution be compared and improved?*

**ETS2: Links among Engineering, Technology, Science and Society**

*How are engineering, technology, science and society interconnected?*

**ETS2.A: Interdependence of Science, Engineering, and Technology**

*What are the relationships among science, engineering, and technology?*

**ETS2.B: Influence of Engineering, Technology and Science on Society and the Natural World**

*How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?*