

## **Grades 11 – 12 Advanced Science Stems and Proficiencies**

### **Earth and Space Science**

**ESS1 - The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.**

1. ATMOSPHERE, CLIMATE, & WEATHER
  - 1) Identify and describe the layers of the atmosphere.
  - 2) Understand the effects of solar influences, such as flares and sunspots, on atmospheric conditions.
2. COMPOSITION & FEATURES OF EARTH MATERIALS
3. FOSSILS AND GEOLOGIC TIME
4. OBSERVATION OF EARTH FROM SPACE
5. PROCESSES AND RATES OF CHANGE OF THE EARTH'S SURFACE
6. ROCK CYCLE
  - 1) Describe the processes that transform one type of rock into another, such as lithification, metamorphosis, and weathering on a chemical level.
  - 2) Describe the various types of igneous, sedimentary, and metamorphic rocks found on Earth.
7. WATER AND THE EARTH'S SURFACE

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**ESS2 - The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.**

1. EARTH, SUN AND MOON
  - 1) Understand how the Nebular Hypothesis, fusion, and the process of differentiation contributes to the structure and organization of the universe.
2. ENERGY
3. SOLAR SYSTEM
4. VIEW FROM EARTH

**ESS3 - The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.**

1. SIZE AND SCALE
  2. STARS AND GALAXIES
  3. UNIVERSE
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**ESS4 – The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand, and solve local and global issues.**

1. DESIGN TECHNOLOGY
    - 1) Recognize the importance of technology as it relates to science, for purposes such as: access to space and other remote locations, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.
  2. TOOLS
  3. SOCIAL ISSUES (LOCAL AND GLOBAL)  
USES OF EARTH MATERIALS
    - 1) Explain the environmental effects of using both renewable and nonrenewable resources and provide examples of how man is addressing these effects on the environment.
    - 2) Provide examples of how man's use of Earth materials has changed over time, and use those examples to explain how the relationship between science and technology has gradually grown closer in the past century.  
ENVIRONMENTAL CHANGE
    - 3) Research and evaluate a current environmental issue within the State of New Hampshire, such as a dispute regarding the conversion of a natural environment to human use, and construct a defense that supports environmental protection.
  4. CAREER TECHNICAL EDUCATION CONNECTIONS
    - 1) Understand the various scientific fields that use scientific content and skills and distinguish between professional and skilled science jobs/careers in Earth or space sciences.
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## **Life Science**

### **LS 1 – All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).**

1. CLASSIFICATION
    - 1) Differentiate between prokaryotic and eukaryotic cells at the biochemical level, using cell wall composition, DNA structure, and other biochemical pathways.
  2. LIVING THINGS AND ORGANIZATION
    - 1) Compare the processes of mitosis and meiosis, including disruptions to the cycles, such as disease or cancer.
    - 2) Explain the process of cell differentiation, using stem cells as an example.
  3. REPRODUCTION
    - 1) Compare and contrast the alternation of generations life cycles and understand the variations of the haploid and diploid phases that produce diplontic, haplontic, and isomorphic alternation of generations in living organisms.
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### **LS 2 – Energy flows and matter recycles through an ecosystem.**

1. ENVIRONMENT
  2. FLOW OF ENERGY
  3. RECYCLING OF MATERIALS
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### **LS 3 – Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).**

1. CHANGE
  2. EVIDENCE OF EVOLUTION
  3. NATURAL SELECTION
    - 1) Understand the types of mutations that cause changes in DNA, and cause the appearance of new alleles, such as frameshift and point mutations, and the chromosomal mutations of insertion, deletion, translocation, and duplication.
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**LS4 – Humans are similar to other species in many ways, and yet are unique among Earth’s life forms.**

1. BEHAVIOR
  
  2. DISEASE
  
  3. HUMAN IDENTITY
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**LS5 – The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.**

1. DESIGN TECHNOLOGY
    - 1) Recognize the importance of technology as it relates to science, for purposes such as: access to information about living systems, medical diagnosis, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.
  
  2. TOOLS
  
  3. SOCIAL ISSUES (LOCAL AND GLOBAL)
    - MEDICAL TECHNOLOGIES
      - 1) Explain how genetic engineering is used to modify the DNA structure of an organism and describe how this process is used to research and develop medically useful products, such as insulin.
      - 2) Summarize arguments on both sides of a medical research controversy, such as stem cell research, cloning, or zootransplantation.
  
    - BIOTECHNOLOGIES
      - 3) Analyze and evaluate a biotechnology system in New Hampshire, that focuses on a specific goal, such as pharmaceutical development, and describe all elements of the system, identifying the costs and the benefits.
  
  4. CAREER AND TECHNICAL EDUCATION CONNECTIONS
    - 1) Understand the various scientific fields that use scientific content and skills and distinguish between professional and skilled science jobs/careers in the life sciences.
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## **Physical Science**

**PS1 – All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).**

1. COMPOSITION
    - 1) Understand the basic building blocks of matter are quarks and leptons.
    - 2) Recognize the main ideas of string theory.
    - 3) Identify the sub-orbital shapes and geometric orientations of the orbitals electrons can occupy in atoms.
  2. PROPERTIES
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**PS2 – Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.**

1. CHANGE
    - 1) Explain the complete mole concept and identify ways in which it can be used, such as to differentiate between actual and relative mass.
  2. CONSERVATION
  3. ENERGY
    - 1) Explain the concept of entropy.
    - 2) Understand that activation energy is required to make a chemical reaction proceed, whether or not it is exothermic or endothermic.
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**PS3 – The motion of an object is affected by force.**

1. FORCES
    - 1) Understand the four fundamental forces found in nature: gravitation, electromagnetism, strong nuclear force, and weak nuclear force.
    - 2) Describe the gauge particles that are exchanged by each of the fundamental forces.
    - 3) Understand the basic principles of unified field theories.
  2. MOTION
    - 1) Explain general concepts related to the theory of special relativity: time dilation, length contraction, and mass expansion.
    - 2) Understand the basic idea behind the theory of general relativity.
    - 3) Describe the predictions made by the theory of general relativity, and the evidence that supports it.
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**PS4 – The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.**

1. DESIGN TECHNOLOGY

- 1) Relate the transfer of energy through conduction, convection and radiation to design technologies.

2. TOOLS

- 1) Demonstrate the appropriate use of a variety of input devices, such as scanners, voice/sound recorders, and digital cameras.

3. SOCIAL ISSUES (LOCAL & GLOBAL)

ENERGY, POWER AND TRANSPORTATION

- 1) Compare two different energy systems that are used to produce large amounts of electrical power for New Hampshire residents, and describe the advantages and disadvantages of each system.
- 2) Design a transportation system that meets most human's need for reliable and affordable transportation, while having a minimal impact on the environment.

MANUFACTURING

- 1) Describe the various types of manufacturing systems, such as customized production, batch production, and continuous production, and explain that manufacturing results in two types of good, durable and non-durable goods.
- 2) Understand that a manufacturing system includes design of the product and methods of obtaining raw materials, as well as actual production, marketing, sales, maintenance, servicing, repair, and final disposal of the remains of the product.

4. CAREER TECHNICAL EDUCATION CONNECTIONS

- 1) Understand the various scientific fields that use scientific content and skills and distinguish between professional and skilled science jobs/careers in the physical sciences.
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