Science GE DOK Alignment Chart **EARTH/SPACE SCIENCE** **Grades 9-12** **GE 44**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: The universe, earth and all earth systems have undergone change in the past, continue to change in the present and are predicted to continue changing in the future.			
DOK 3 **ESS3(9-11)** **NOS-5** **DOK 2**	**S9-12:44** **(DOK 2)** **Students demonstrate their understanding of Characteristics of the Solar System by…** • Explaining how our understanding of the nature and composition of the atmosphere of inner and outer planets has been advanced through the use of sophisticated technology. **AND** • Explaining the effect of distance from the sun on the nature of the planets (e.g., inner vs. outer planets).	Science Concepts: a. Our solar system developed from a giant cloud of gas and debris of exploding stars 4.6 billion years ago, and everything on earth, including organisms, is made of this material. b. As the earth and other planets formed, the heavier elements fell to their centers. On planets close to the sun (Mercury, Venus, Earth and Mars) the lightest elements were mostly blown or boiled away by radiation from the newly formed sun; on the outer planets (Jupiter, Saturn, Uranus, Neptune, and Pluto) the lighter elements still surround them as deep atmospheres of gas or as frozen solid layers.	**(DOK 3)** • Explain how each of the following has contributed to our understanding of the characteristics of the inner and outer planets: refracting/reflecting telescopes on earth, radio telescopes, X-ray telescopes, space probes, and space telescopes. **(DOK 2)** • Describe 3 similarities and 3 differences between the inner and outer planets of our solar system.

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DOK 3 ESS3(9-11) NOS-6 ESS3(9-11) POC +SAE-8 **DOK 3** ESS3(9-11) NOS-6 **DOK 2** ESS3(9-11) NOS-5	**S7-8:45** (DOK 3) **Students demonstrate their understanding of Processes and Change over Time within Systems of the Universe by…** • Explaining the process of star formation (i.e. our sun) in relation to its size, including the interaction of the force of gravity, fusion and energy release. **AND** • Explaining the process of the **Big Bang** Theory and its effect on the Universe today, citing evidence to support its occurrence (e.g., Doppler effect/red shift). **AND** • Explaining how technology through time has influenced our understanding of the vastness (i.e., light years) and the nature of the universe (e.g., Ptolemy, Copernicus, Kepler, Einstein).	Science Concepts: a. Stars formed by gravitational clumping of hydrogen and helium out of clouds of molecules of these lightest elements until nuclear fusion of these light elements into heavier ones began to occur, releasing great amounts of energy over millions of years and resulting in the initial formation of elements. The process of star formation continues today, as some stars explode, creating new clouds from which other stars from and eventually dissipate with changes in matter and energy Stars differ in size, temperature and age, but appear to be made of the same elements found on earth and behave according to the same physical principles. b.. The Universe expanded explosively into being perhaps between 10 and 20 billion years ago from a hot, dense, chaotic mass. c. The nature of electromagnetic waves (radio waves—the longest, to gamma rays, the shortest) has provided a useful tool to determine the movement of objects in the Universe. Because light from almost all distant galaxies has longer wavelengths that comparable light here on earth, astronomers believe the whole Universe is continuing to expand. Mathematical models are used to study evidence from many sources to explain events in the Universe. A variety of increasingly sophisticated technology is used to learn about the Universe (e.g., visual telescopes, radio telescopes, X-ray telescopes, computers, space probes, atomic accelerators. d. Scientific theories on the nature of the Universe have evolved significantly through the past 2000+ years Ptolemy, Copernicus, Kepler, Galileo), and new views are emerging.	

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DOK 3 **DOK 3** **ESS1(9-11)SAE + POC-3** **DOK 2**	**S9-12:46** **(DOK 3)** **Students demonstrate their understanding of Processes and Change over Time within Earth Systems by…** • Citing and explaining evidence that illustrates how despite changes in form, conservation in the amount of earth materials occurs during the Rock Cycle. **AND** • Explaining how the heat (energy) produced by radioactive decay and pressure affects the Rock Cycle. **AND** • Explaining the processes by which elements (e.g., carbon, nitrogen, oxygen atoms) move through the earth's reservoirs (soil, atmosphere, bodies of water, organisms).	Science Concepts: a. The formation, weathering, sedimentation and reformation of rock constitutes a continuing "rock cycle" in which the total amount of material remains the same, while its form changes (e.g., **Conservation of Mass**). b. The earth's systems have internal sources of energy (heat), such as radioactive decay and pressure which create heat. c. The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Movement of this matter between reservoirs, driven by the earth's internal and external sources of energy, is often accomplished by a change in the physical and chemical properties of the matter in the solid earth, atmosphere, and organisms.	

Science GE DOK Alignment Chart **EARTH/SPACE SCIENCE** **Grades 9-12** **GE 47**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: The universe, earth and all earth systems have undergone change in the past, continue to change in the present and predicted to continue changing in the future.			
DOK 2 **ESS1(9-11)INQ + POC-1** **ESS1(9-11) NOS-2** **ESS1(9-11)SAE + POC-3** **DOK 2** **ESS1(9-11)INQ + POC + MAS-4** **DOK 2**	**S9-12:47** **(DOK 2)** **Students demonstrate their understanding of Processes and Change over Time within Earth Systems by…** • Using a model, diagram or computer simulation to demonstrate how convection circulation of the mantle initiates the movement of crustal plates which then causes earthquake and volcanic activity (e.g. Mid-Atlantic Ridge, North American and European plate collisions producing the Green Mountains). **AND** • Analyzing samples of rock sequences to determine the relative age of the rock structure. **AND** • Comparing the usefulness of various methods of determining the age of different rock structures (e.g. relative dating vs. C-dating vs. K-Ar dating. If rock structure is less than 500,000 years old, K-Ar dating cannot be used and C-dating can only be used for tens of thousands of years).	Science Concepts: a. The convection circulation of the earth's mantle slowly moves the solid crustal sections of the earth's continents and ocean basins over the denser, hot layers beneath—separating in some areas and pressing against one another in other areas resulting in plate collisions—mountain building—volcanic activity—islands. b. Interactions among solid earth, atmosphere, oceans and organisms have resulted in ongoing change of earth's systems (e.g., effects of earthquakes, volcanic eruptions, and glacial activity). c. The age and changes of the earth and its inhabitants can be extrapolated from rock sequences and fossils in the earth's sediments and land forms and also through the decay rates of radioactive isotopes, indicating a long history (Lyell's Principles of Geology, fossil records, Charles Darwin).	

Science GE DOK Alignment Chart **EARTH/SPACE SCIENCE** **Grades 9-12** **GE 48**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: The universe, earth and all earth systems have undergone change in the past, continue to change in the present and predicted to continue changing in the future.			
DOK 2 DOK 2 DOK 2 DOK 2	**S9-12:48** **(DOK 2)** **Students demonstrate their understanding of Processes and Change over Time within Earth Systems by…** • Explaining the uniqueness of the earth's characteristics (e.g., solar intensity, gravity related to size of earth, makeup of atmosphere). **AND** • Explaining how water as a molecule is also unique in its ability to retain heat, compared to land and air on earth. **AND** • Diagramming and explaining local and large scale wind systems (e.g., land and sea breezes and global wind patterns, Coriolis effect). **AND** • Predicting weather for a particular location, using weather map data (barometric pressure, frontal systems, isobars, isotherms, mountain effects, lake/ocean effects, ocean currents, temperature/humidity) and examining world weather maps and identifying the most likely locations where extreme weather might occur (e.g., blizzards thunderstorms, hurricanes, tornadoes).	Science Concepts: a. Of all the diverse planets and moons in the solar system, earth's unique physical/chemical characteristics, its position, its atmosphere and its intensity of solar radiation that allows for the existence of liquid water. Water is a unique molecule generating unique properties that influence the earth's weather (ability to retain heat, melting, boiling, and freezing points). The intensity of radiation from the sun allows water to cycle between liquid and vapor, which supports life as we know it on earth. b. The earth's climatic patterns and weather are governed by the transfer of heat energy between atmosphere and land and oceans. Heat transfer at boundaries of atmosphere and oceans causes the circulation of wind and ocean currents, which influence the composition (temperature and moisture content) and the movement of large air masses). c. The meeting of air masses with different characteristics causes our most.	**(DOK 2)** • Using the information indicated by the location of the frontal systems in the Vermont weather map provided, predict the weather occurring in Montpelier, Vermont at the time the map represents. **(DOK 3)** • Using the information indicated by the location of the frontal systems in the Vermont weather map provided, predict the weather occurring in Montpelier, Vermont at the time the map represents; and justify your prediction.

Science GE DOK Alignment Chart **EARTH/SPACE SCIENCE** **Grades 9-12** **GE 49**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: The universe, earth and all earth systems have undergone change in the past, continue to change in the present and predicted to continue changing in the future.			
DOK 3-4 **DOK 3** **DOK 3-4** **DOK 2**	**S9-12:49** **(DOK 3)** **Students demonstrate their understanding of Processes and Change within Natural Resources by …** • Comparing the availability of natural resources and the impact of different **management plans** (e.g., management of forests depends upon use, lumber production, sugarbush, deer habitat, mining, recreation) within the management area (forest, farmland, rivers, streams). **AND** • Choosing a Vermont ecosystem and tracing its **succession** before and after a damaging event, showing how the ecosystem has been restored through the maintenance of atmosphere quality, generation of soils, control of the water cycle, disposal of wastes and recycling of nutrients (e.g., flooding, former mining sites, glacial impact, deforestation, recovery of rivers from sewage/ chemical dumping, burning of fossil fuels). **AND** • Explaining a natural chemical cycle that has been disrupted by human activity and predict what the long term effect will be on organisms (e.g., acid precipitation, global warming, ozone depletion, pollution of water by phosphates, mercury, PCBs,etc.). **AND** • Tracing the processes that are necessary to produce a common, everyday object from the original raw materials to its final destination after human use, considering alternate routes—including extraction of raw material, production and transportation, energy use and waste disposal throughout, packaging and recycling and/or disposal (e.g., aluminum can, steel).	Science Concepts: a. Human activities can enhance potential for accelerating rates of natural change. b. Natural ecosystems provide many basic processes that affect humans—maintenance of atmospheric quality, generation of soils, control of the water cycle, disposal of wastes and recycling of nutrients, etc. c. Materials and habits from human societies affect both physical and chemical cycles on earth, and human alteration of these cycles can be detrimental to all organisms. d. Natural ecosystems provide the raw materials for the development of many products for human use (e.g. steel, glass, fertilizers).	**(DOK 3)** • Design and conduct an investigation to compare a natural system with one altered by human activities (e.g. acid rain, agricultural runoff, forest management, pollution, fertilizer or toxic emissions).