**HS-ESS1 Earth’s Place in the Universe**

**HS-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.**

Further explanation: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun’s core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun’s radiation varies due to sudden solar flares (“space weather”), the 11- year sunspot cycle, and non-cyclic variations over centuries.

Developing and Using Models, The Universe and its Stars, Energy in Chemical Processes and Everyday Life, Scale, Proportion and Quantity

**HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.**

Further explanation: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).

Constructing Explanations and Designing Solutions, The Universe and its Stars, Electromagnetic Radiation, Energy and Matter

**HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.**

Further explanation: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.

Obtaining, Evaluating, and Communicating Information, The Universe and its Stars, Energy and Matter

**HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.**

Further explanation: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.

Using Mathematical and Computational Thinking, Earth and the Solar System, Scale, Proportion, and Quantity

**HS-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.**

Further explanation: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions). Examples could also be found from looking at differences between coastal Maine and interior Maine rock types and their ages as evidence to explain the formation of land structures and plate boundaries that cause them.

Engaging in Argument from Evidence, The History of Planet Earth, Plate Tectonics and Large-Scale System Interactions, Nuclear Processes, Patterns

**HS-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth’s formation and early history.**

Further explanation: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth’s oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.

Constructing Explanations and Designing Solutions, The History of Planet Earth, Stability and Change