Howard County Public School System
Curriculum for High School Science

Grade 9: Earth and Space Systems Science

Overview:

High school Earth and Space Systems Science learning will equip students to address the following essential questions as identified within the Next Generation Science Standards:

1. How do the major Earth systems interact? How do the properties and movements of water shape Earth's surface and affect its systems?
2. What regulates weather and climate? How do people model and predict the effects of human activities on Earth's climate?
3. How do people reconstruct and date events in Earth's planetary history? Why do the continents move?
4. What is the universe, and what goes on in stars? What are the predictable patterns caused by Earth's movement in the solar system?

Students in high school develop understanding of a wide range of topics in Earth and Space Science (ESS) that build upon science concepts from middle school through more advanced content, practice, and crosscutting themes. The content of the performance expectations is based on current community-based geoscience literacy efforts and is presented with a greater emphasis on an Earth systems science approach. There are strong connections to mathematical practices of analyzing and interpreting data. The performance expectations reflect the many societally relevant aspects of ESS (natural resources, hazards, environmental impacts) with an emphasis on using engineering and technology concepts to design solutions to challenges facing human society. Visit the full NGSS storyline for Earth and Space Science for more information.

Students in Earth and Space Systems Science will participate in the Watershed Report Card (WRC) program as a ninth grade science experience. Through hands-on activities in the field and the classroom, students will analyze the health of the Howard County watershed. The study will culminate in development of an advocacy and action plan to enhance the health of the watershed. The WRC supports students' development of environmental literacy and is conducted in partnership with the Howard County Conservancy.

Performance Expectations:

The Next Generation Science Standards (NGSS), adopted as the Maryland Science Standards (MSS), are very different than previous standards documents. NGSS purposely combines the three dimensions of science learning into single, target statements for student learning known

as Performance Expectations (PE). The three dimensions of science learning are: Science and Engineering Practices (SEP), Crosscutting Concepts (CCC), and Disciplinary Core Ideas (DCI). Earlier science standards treated the three dimensions as separate and distinct. This treatment led to assessment and instruction that emphasized one dimension preferentially over the others. The combination of SEP, CCC, and DCI in each PE is not intended to limit instruction. Instead, the PEs are designed to guide assessment of student learning. The performance expectations for High School Earth Science support student learning in four main areas: *Earth's Systems, Weather and Global Climate Change, Earth's History,* and *Astronomy*. The performance expectations for high school Earth and Space Systems Science are listed below:

HS-ESS1- Earth's Place in the Universe

Students who demonstrate understanding can:

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.**
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.**
HS-ESS1-3.	**Communicate scientific ideas about the way stars, over their life cycle, produce elements.**
HS-ESS1-4.	**Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.**
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.**
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.**

HS-ESS2: Earth's Systems

Students who demonstrate understanding can:

HS-ESS2-1.	**Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.**
HS-ESS2-2.	**Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.**
HS-ESS2-3.	**Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.**

HS-ESS2-4.	**Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.**
HS-ESS2-5.	**Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.**
HS-ESS2-6.	**Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.**
HS-ESS2-7.	**Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.**

HS-ESS3: Earth and Human Activity

Students who demonstrate understanding can:

HS-ESS3-1.	**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.**
HS-ESS3-2.	**Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.**
HS-ESS3-3.	**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.**
HS-ESS3-4.	**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.**
HS-ESS3-5.	**Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.**
HS-ESS3-6.	**Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**

HCPSS Learning Sequence:

Students will continue to develop their understanding of the three disciplinary core ideas in the Earth and Space Sciences. The high school performance expectations in Earth and Space Systems Science allow high school students to explain more in-depth phenomena central not only to the Earth and space sciences, but to life and physical sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas

across the science disciplines. While the performance expectations shown in high school Earth and Space Systems Science couple particular practices with specific disciplinary core ideas, instruction will include the use of many science and engineering practices that lead to the performance expectations.

Earth and Space Science investigates processes that operate on Earth and also addresses Earth's place in the solar system and the galaxy. Earth and Space Science involves phenomena that ranges in scale from the unimaginably large to the invisibly small. The Earth and Space Systems Science course is comprised of four units:

Unit 1:	Unit 2:	Unit 3:	Unit 4:
Earth's Systems ***EL***	**Weather and Global Climate Change** ***EL***	**Earth's History**	**Astronomy**

EL *indicates that Maryland Environmental Literacy Standards are including within this learning sequence.*

Students develop understanding of a wide range of topics in Earth and Space Science using the science and engineering practices and crosscutting concepts. In *Earth's Systems*, students understand the dynamic and interrelated systems of the Earth including Earth materials, plate tectonics, and other large scale system interactions. Students will also participate in field work to collect data in support of the Watershed Report Card (WRC).

In *Weather and Global Climate Change*, students understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change. In the WRC strand, students will analyze the data collected during their field experiences.

In *Earth's History*, students construct explanations for scales of time over which Earth processes operate and make inferences about events in Earth's history based on the data record. Students will develop their advocacy plans for the WRC.

In *Astronomy*, students examine the processes governing the formation, evolution, and workings of the universe and Earth's place in it. The WRC will conclude with the Watershed Summit in April.