**Dorchester County Public Schools**

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| ***Every Child a Success*** | **Science Daily Instructional Lesson Plan\*** |
| **Grade/Subject:** Environmental Science | **Unit:** Studying Space |
| **Teacher:** Casey O’Bier | **Lesson Topic:** Measuring Distances in Space |
| **Date:** 9/6/16-9/20/26 | **School:** Cambridge South Dorchester High School |
| **Performance Expectation(s):**HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.                                                  HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. |
| Disciplinary Core Idea(s):ESS1.B: Earth and the Solar System: Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the Sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.  PS2.A: Forces and Motion: Newton’s second law accurately predicts changes in the motion of macroscopic objects. |
| **Science and Engineering Practice(s)**: Using Mathematical and Computational Thinking: Use mathematical or computational representations of phenomena to describe explanations.   Analyzing and Interpreting Data: Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.   Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena: Theories and laws provide explanations in science. |
| **Crosscutting Concept(s)**: Scale, Proportion, and Quantity: Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).                                                     Interdependence of Science, Engineering, and Technology: Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.   Cause and Effect: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |
| **STEM Standards of Practice**:1. Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content 2. Integrate Science, Technology, Engineering, and Mathematics Content 3. Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics. 4. Engage in Inquiry 5. Engage in Logical Reasoning 6. Collaborate as a STEM Team 7. Apply Technology Strategically  |
| **Student Learning Objectives**: SWBAT1. Develop and revise answers to questions regarding measurements in space, planets, and stars.
2. Model the distances between objects in our solar system.
3. Communicate their explanation for how scientists measure distance and position in space using models.
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| 5E Stages | What are the students doing ? |
| **Engage** | Students will be paired up to review an image of Earth and an image of the Sun, including the following: [Sun rotation sequence](https://app.discoveryeducation.com/player/view/assetGuid/1a0b6b70-626c-47fc-a718-4ea5d3bf03af) and [Earth as it appears from space](https://app.discoveryeducation.com/player/view/assetGuid/87894769-ec43-4672-8759-3ae1a4fe4834). As they view the images, partners should discuss the guiding questions provided for them. Students will discuss their responses as a class. Students will then view the video segments [Stars](https://app.discoveryeducation.com/player/view/assetGuid/BCFA3C07-4B25-49ED-BF5E-4D538E2DA158) and [Characteristics of a Planet](https://app.discoveryeducation.com/player/view/assetGuid/34062733-021A-48E6-8E30-E8D8880C2D39) and explore the vocabulary terms [star](https://app.discoveryeducation.com/player/view/assetGuid/376B4F35-9013-425D-83F2-638BC86A5B5D) and [planet](https://app.discoveryeducation.com/player/view/assetGuid/11296010-2B88-45A2-A4F2-811B44AE5FBE), developing and revising their answers to the guided questions based on the information in these resources. A close reading session will then occur using the “Thinking about Measuring Distances in Space” text. |
| **Explore** | Students will model the distances between objects in our solar system by completing the “Student Investigation: Matters in Measurement” lab. Students will convert between metric and non-metric units in this lab to determine the distances of earthly objects and compare that to the distances of objects in space.  |
| **Explain** | * Students will engage in discussion checkpoints throughout a guided PowerPoint. Students will then answer the question “How do you think scientists measure distance and position in space?” which will become their claim for their scientific explanation. Students will then represent their scientific explanation using a model (physical or diagram) and create a video demonstrating their model. They will use an oral communication method, such as a video of themselves, a conversation with another student, or a skit, and present their explanation to the class.
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| **Elaborate/ Extend** | *Project: Light Years*- Students will develop their own math problem (with a partner) to represent how you can use light years to model distances in space. Students will then Research 5 different galaxies (in groups) and the distance they are in light years from our solar system. They will design a scale model that demonstrates the relative distances of these galaxies. |
| **Evaluate** | Students will demonstrate understanding of concepts related to measurement in space by achieving 70% or better on the unit assessment.  |
| **Closure:** |
| **Vocabulary:** distance, position, star, planet, constellation, parallax, celestial sphere, light year | **Formative Assessments:**Revised Answers: Guided Q’sMatters in Measurement LabScientific Explanation VideoProject: Light Years (math problem)Model of the Galaxies Project  | **Summative Assessments:**Unit Conversion QuizMeasuring Distances in Space Test |
| **Questions:****Engage Q:**Star vs. Planet-* *Which object is a star, and which is a planet?* (The Sun is a star, and Earth is a planet.)
* *What are the main differences between stars and planets?* (Students should know that stars are at the centers of solar systems and that planets orbit stars. Students should also know that stars, unlike planets, generate light and energy through nuclear reactions in their cores, and that stars are typically much larger than planets.)
* *How far apart are these two objects?* (Answers may vary, but students should explain their reasoning.)
* *How far are these objects from other stars and planets in the universe?* (Answers may vary, but students should explain their reasoning.)

Orion-* *Are all the stars that make up this constellation about the same distance from Earth?*
* *Some stars in this photograph have about the same brightness. Are they the same distances from Earth?*
* *How do scientists know how far apart these stars are?*
* *How is distance measured in space?*

**Explanation Q:*** *How do you think scientists measure distance and position in space?*

**Elaborate Q:**How can you use light years to measure distances in space?Can you model the vast distances between galaxies? |
| **Planning Component Reminders:*** Problem-Solving
* Differentiate Instruction
* UDL Principles
 | * Disciplinary Literacy Expectations (Close Read; Construct Explanations; Engage in Argument; Discourse/Student Talk)
* Discovery Education Resources
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\* Even though the template says daily it can be used for a chunk of learning (multiple days), as well as for unit planning. The important thing is to consistently incorporate these components into instruction.

**5E Defined**

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| **ENGAGE:*** capture attention
* activate prior knowledge
* connect to the storyline or real world problem
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| **EXPLORE:*** test ideas and develop knowledge using explorations, investigations, and experiments
* modify and record ideas as they change due to activities
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| **EXPLAIN:*** analyze data/information and construct explanations
* communicate understandings orally and in writing
* describe possible solutions
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| **EXTEND:*** modify/ refine procedures, prototypes, models, solutions, arguments, essays, etc.
* apply or practice in a new setting
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| **EVALUATE:*** self- assess understanding of concepts
* demonstrate understanding of concepts through performance-based tasks
* reflect and/or revise answers or solutions to a complex question, issue, challenge, or real world problem
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