E2 ASTRONOMY Unit for 5th & 6th grade

Compelling Questions	WHAT IS THE UNIVERSE AND WHAT IS EARTH'S PLACE IN IT? How and why has human understanding of celestial phenomena changed over time?
NGSS Practices & Standards and Teaching Tolerance Social Justice Anchor Standards	**NGSS - ESS1 Earth's Place in the Universe** 5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. 5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in night sky. MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses, and seasons. MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system. **NGSS - ETS1 Engineering Design** 3-5 ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5 ETS1-2 Generate and compare multiple possible solutions to be a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5 ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. NGSS SCIENCE & ENGINEERING PRACTICES: **Developing and Using Models; Asking Questions and Defining Problems; Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions; Obtaining, Evaluating, and Communicating Information; Analyzing and Interpreting Data; Engaging in Argument from Evidence;** **Teaching Tolerance Social Justice Anchor Standards** JUSTICE DOMAIN 11. Students will recognize stereotypes and relate to people as individuals. 12. Students will recognize unfairness on the individual level and injustice at the institutional or systemic level. 13. Students will analyze the harmful impact of bias and injustice on the world, historically and today. 15. Students will identify figures, groups, events, and a variety of strategies and philosophies relevant to the history of social justice around the world. ACTION DOMAIN 16. Students will express empathy when people are excluded or mistreated because of their identities. 17. Students will recognize their own responsibility to stand up to exclusion, prejudice, and injustice.

Staging the Question & Engaging Wonder	How can we maintain/inspire our sense of wonder and mystery as we study the natural world scientfically? (Week 1) Astronomy Pre-Assessment, How Far? How Old? How Big? Visit to Amherst College Mead Art Museum- Dimensionism: Modern Art in the age of Einstein The Known Universe (AMNH - TYSON!), COSMOS: A Spacetime Odyssey Episode 1			
Core Ideas	**The UNIVERSE & ITS STARS**	**EARTH & THE SOLAR SYSTEM**	**HUMAN ACTIVITY & SOCIAL JUSTICE**	**ENGINEERING DESIGN - Water Bottle Rockets**
Driving Questions	***What are ways we can model the relative size and distance of solar system?*** ***What is the life cycle of a star?*** ***What is the structure and scale of the Universe?*** ***others??***	***How is what humans see and experience on Earth explained by the Earth's motion and position relative to other celestial objects?*** ***Why do we experience day and night on Earth?*** ***How can the motion of earth explain seasons, eclipses, and lunar phases?*** ***How do we explain the patterns observed in the moon's appearance over the course of a month?*** ***How does appearance of some stars change in different seasons?***	***How and why has human understanding of celestial phenomena changed over time?*** ***How do First Nations people represent and interpret the cycles that happen within the solar system?*** ***Why aren't there more white women and people of color in astronomy?***	**What makes a rocket fly straight?** **What makes a rocket fly far?** **Why use water to make the rocket fly?**
Learning Objectives	**Students will know:** • Characteristics and positions of the inner and outer planets. • The sun is a star that appears larger and brighter than other stars	**Students will know:** • Earth's tilt and movement around the Sun causes the changes of seasons. • Night and Day (Dark and Light) are due to the Earth rotating or spinning	**Students will know:** • Different cultures have different uses for celestial phenomena. First Nations Elders use solar patterns and cycles (i.e. the moon and stars) for tracking	**Students will be able to:**: • Design and build a water bottle rocket that flies straight and in the desired direction. • Explain center of drag, and center of

	because it is closer. Stars range greatly in their distance from Earth ● Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. ● Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **Students will be able to:** ● create scale-distance and/or scale-size models to represent the major components of the solar system. ● critically evaluate how evidence is continually questioned in order to validate scientific knowledge about the solar system. ● compare the relative size and distance of the planets in the Solar System ● use a calculated scale for establishing relative distances ● predict circumference and distance using a model ● explain scientific processes (scale, use of models)	on its axis ● The different moon phases: how much of the moon seen depends upon its position in relation to earth and the sun. ● The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. ● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. ● This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	time and for survival in nature. ● the concept of strong objectivity and to ask these questions ● Who is doing the research? ● Who controls the direction of the research? ● Who does the research benefit? ● Who does the research harm? **Students will be able to:** ● Critically evaluate how evidence is continually questioned in order to validate scientific knowledge about the solar system. ● Critically evaluate how race, class, gender impacts who astronomy resonates with	mass, and draw their relationships to each other for a straight-flying rocket. ● Explain why water is more effective than air for propelling bottle rockets. ● Explain the steps in the design process as they created their rockets, highlighting successes and failures, and suggesting further improvements.

Lesson plans/ resources	Video: CRASH COURSE ASTRONOMY #1 Video Resources 5E Plan - Solar System Scale & Size Unit 1: Origin of Our Universe & Solar System	5E Unit: Earth-Sun-Moon System 5E - Evidence for Earth's rotation 5E - Phases of the Moon	*Hidden Figures* Discussion Astronomy in Color Astrobetter: Diversity Four Directions Teachings Science Under the Scope (Sophie Wang)	Teach Engineering: Water Bottle Rockets
Assessment: Performance Tasks	Performance Task: Hunting for Earth 2.0 ***If the Earth could no longer sustain human life, where could we go?***	Performance Task: Modeling Celestial Phenomena and Making Predictions ***How is what humans see and experience on Earth explained by the Earth's motion and position relative to other celestial objects?***	Performance Task: Hunting for Earth 2.0 ***If the Earth could no longer sustain human life, where could we go?***	Performance Task: Water Rockets Competition ***How can you build a water rocket designed to fly the greatest distance OR achieve the greatest hang time?***
Other Assessment Evidence **(Formative and summative assessments used throughout the unit)**	➢ Project Presentations throughout the lesson in the form of models, illustrations, research, and presentations. Science rubric for each assignment. ➢ Student-teacher conferences ➢ Exit slips ➢ Group discussions ➢ Models/ activities ➢ Non-fiction reading response assignments ➢ Class Notes			
			"Appeals for preserving the wilderness or looking up at the cosmos may not resonate for those without access to green spaces or unpolluted skies – often low-income communities of color."	