

UNIT OVERVIEW

STAGE ONE: Identify Desired Results			
Established Goals/Standards	Long-Term Transfer Goal		
	<p><i>At the end of this unit, students will use what they have learned to independently...</i> LONG TERM GOAL: Students will begin to study their year investigation of the essential question “How do Astronomical and Earth events and processes cause Rochester, NY to change over time”. This year investigation will end in a field study to the Rochester Gorge off Seth Green Drive in the City of Rochester where students figure out if the claims made by scientists are true: Rochester, NY was once underneath water! They will do this by looking at sedimentary rocks and fossils from the outcrop. This will allow students to pull together concepts learned throughout the entire half-year investigation. This culminating project ties the whole year together.</p> <p>UNIT GOAL: This portion deals with the astronomy component of “How do Astronomical and Earth events and processes cause Rochester, NY to change over time?” The goal is that students will be able to participate in a debate on whether or not it is ethical to develop technologies to deflect near Earth asteroids to protect Earth from a catastrophic, potentially life ending, collision. This idea comes from a reading passage, that students read, by Carl Sagan in the “Pale Blue Dot”. It is a very dramatic reading that allows students to “feel” both sides of the argument. They then must pull together all of the different celestial motions (revolution/rotation), forces (gravity) and the concept of geologic time to debate whether NASA is dropping the ball by not funding this research. This will be done as a full class debate where students must use specific vocabulary in the context of the debate. Students will then summarize their position independently utilizing science vocabulary and answer how their decision could “change Rochester, NY over time. Students will be able to transfer their understanding of astronomy and participate in constructing scientific explanations based on research and evidence that is then used as a platform for argumentation.</p> <p>This unit will also seek to give students experience using qualitative observations and models to make meaning of abstract concepts. This is the first unit of the year and “science skills” will be taught in the service of science content and built upon over time.</p>		
	Meaning		
	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Enduring Understandings <i>Students will understand that...</i> Most objects in the solar system are in regular and predictable motion.</p> <ul style="list-style-type: none"> • These motions explain such phenomena as the day, the year, seasons, phases of the moon, eclipses, and tides. </td> <td style="width: 50%; vertical-align: top;"> <p>Essential Questions <i>Students will consider such questions as...</i></p> <ol style="list-style-type: none"> 1) Geologic Time: What is geologic time and how will it help us gain perspective on how to study our essential question? 2) Celestial Bodies and the formation of the universe: </td> </tr> </table>	<p>Enduring Understandings <i>Students will understand that...</i> Most objects in the solar system are in regular and predictable motion.</p> <ul style="list-style-type: none"> • These motions explain such phenomena as the day, the year, seasons, phases of the moon, eclipses, and tides. 	<p>Essential Questions <i>Students will consider such questions as...</i></p> <ol style="list-style-type: none"> 1) Geologic Time: What is geologic time and how will it help us gain perspective on how to study our essential question? 2) Celestial Bodies and the formation of the universe:
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	<p>Gravity influences the motions of celestial objects. The force of gravity between two objects in the universe depends on their masses and the distance between them.</p> <p>Nine planets move around the Sun in nearly circular orbits.</p> <ul style="list-style-type: none"> • The orbit of each planet is an ellipse with the Sun located at one of the foci. • Earth is orbited by one moon and many artificial satellites. <p>Earth's coordinate system of latitude and longitude, with the equator and prime meridian as reference lines, is based upon Earth's rotation and our observation of the Sun and stars.</p> <p>Earth rotates on an imaginary axis at a rate of 15 degrees per hour. To people on Earth, this turning of the planet makes it seem as though the Sun, the moon, and the stars are moving around Earth once a day. Rotation provides a basis for our system of local time; meridians of longitude are the basis for time zones.</p> <p>The Foucault pendulum and the Coriolis effect provide evidence of Earth's rotation.</p> <p>Earth's changing position with regard to the Sun and the moon has noticeable effects. • Earth revolves around the Sun with its rotational axis tilted at 23.5 degrees to a line perpendicular to the plane of its orbit, with the North Pole aligned with Polaris.</p> <p>During Earth's one-year period of revolution, the tilt of its axis results in changes in the angle of incidence of the Sun's rays at a given latitude; these changes cause variation in the heating of the surface. This produces seasonal variation in weather.</p> <p>Seasonal changes in the apparent positions of constellations provide evidence of Earth's revolution.</p> <p>The Sun's apparent path through the sky</p>	<p>What is out there (space) and how do we know?</p> <ol style="list-style-type: none"> 3) How do the stars we see in our night sky form? How are they similar and different from the Sun? 4) Rotation: How does the "spin" of the Earth cause Rochester to change from night and day? How do we know? 5) Phases of the moon: Why does the moon look so different all the time? 6) Revolution/Seasons/gravity: How does the motion of the Earth around the sun cause Rochester, NY to change throughout the year? 7) How does the revolution of the moon around the Earth cause Lake Ontario to change throughout the day? 8) How does the revolution of the Earth around the sun, and its tilt, cause the Sun's path to change over time in Rochester, NY? 9) Pulling it all together: Is it ethical to develop technology to change the orbits of near Earth asteroids?
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	<p>varies with latitude and season.</p> <p>Approximately 70 percent of Earth’s surface is covered by a relatively thin layer of water, which responds to the gravitational attraction of the moon and the Sun with a daily cycle of high and low tides.</p> <p>The universe is vast and estimated to be over ten billion years old. The current theory is that the universe was created from an explosion called the Big Bang. Evidence for this theory includes:</p> <ul style="list-style-type: none"> • cosmic background radiation • a red-shift (the Doppler effect) in the light from very distant galaxies. <p>Stars form when gravity causes clouds of molecules to contract until nuclear fusion of light elements into heavier ones occurs. Fusion releases great amounts of energy over millions of years.</p> <ul style="list-style-type: none"> • The stars differ from each other in size, temperature, and age. • Our Sun is a medium-sized star within a spiral galaxy of stars known as the Milky Way. Our galaxy contains billions of stars, and the universe contains billions of such galaxies. <p>Our solar system formed about five billion years ago from a giant cloud of gas and debris. Gravity caused Earth and the other planets to become layered according to density differences in their materials.</p> <ul style="list-style-type: none"> • The characteristics of the planets of the solar system are affected by each planet’s location in relationship to the Sun. • The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density. Asteroids, comets, and meteors are components of our solar system. Impact events have been correlated with mass extinction and global climatic change. Impact craters can be 	
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		<p>identified in Earth's crust.</p>	
Acquisition			
		<p><i>What knowledge will students learn as part of this unit?</i></p> <ul style="list-style-type: none"> • <i>How the universe, galaxy and solar system formed</i> • <i>Evidence for the formation of the universe.</i> • <i>Rotation of the Earth causes changes throughout the day and evidence for this movement</i> • <i>Revolution of Earth and tilt causes changes throughout the year and evidence for this movement</i> • <i>How the tilt of Earth causes the</i> • <i>The organization of the solar system.</i> • <i>Moon's affect on Earth and its phases</i> • <i>Formation of Earth and Moon</i> 	<p><i>What skills will students learn as part of this unit?</i></p> <ul style="list-style-type: none"> • <i>Use models to represent and revise their thinking overtime.</i> • <i>Making qualitative and quantitative observations</i> • <i>Making predictions</i> • <i>Asking questions based on observation and data</i> • <i>Use and become proficient with certain tables and diagrams in the Earth Science Reference Tables.</i> • <i>How to construct and ellipse</i> • <i>How to use a spectrometer.</i>

STAGE TWO: Determine Acceptable Evidence	
	Assessment Evidence
<p>Criteria for to assess understanding: <i>(This is used to build the scoring tool.) Rubric attached to bottom</i></p>	<p>Performance Task focused on Transfer:</p> <p>Students will participate in a debate, or generate an argument that is recorded as a podcast, script or radio broadcast regarding the dangers of moving near Earth asteroids into orbit with Earth.</p> <hr/> <p>Other Assessment Evidence:</p> <ul style="list-style-type: none"> • Daily bridge activities • Daily summary narratives • Ticket out the door, daily closure questions

	<ul style="list-style-type: none"> • Two formal NYS style assessments. • Other formative assessment practices
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T, M, A <i>(Code for Transfer, Meaning Making and Acquisition)</i>	STAGE THREE: Plan Learning Experiences	
	<p>Learning Events:</p> <ol style="list-style-type: none"> 1. Students “experience” astronomical and geologic time by “creating the universe” 2. Students investigate “what’s out there and how do we know through a stationed activity that requires them to analyze diagrams and manipulate models 3. Students investigate the formation of the universe, our galaxy and the solar system and evidence for this. 4. Students uncover patterns about the structure of our solar system and generate theories about how the solar system is organized. 5. The difference in orbital speeds is analyzed through a lab. 6. Lab on using models to predict the path of the sun across the sky throughout the year. 7. Shadow lengths lab 8. Rotation of Earth intro and time zone lab 9. Moon phases and tides lab 10. Intro to near earth asteroids, reading and research 11. Project: Debate/podcast construction and presentation. 	<p>Evidence of learning: <i>(formative assessment)</i></p> <ul style="list-style-type: none"> • Daily bridge activities • Daily summary narratives • Ticket out the door, daily closure questions • Two formal NYS style assessments. • Other formative assessment practices
East High School, Rochester, NY	Based on UbD (ASCD) by G. Wiggins and J. McTighe	

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Assessment Rubric for Performance Task for content portion of debate rubric

<p>Meets the standard of excellence.</p> <p>5</p>	<p><i>Significant</i> information is presented about <i>all</i> of the following:</p> <ul style="list-style-type: none"> • How Earth fits into the universe, including: <ul style="list-style-type: none"> – formation and evolution of the solar system – Earth's distance from, and orbit of, the Sun – Earth's place in the galaxy – the galaxy's place in the universe • How solar activity influences Earth, what the hazardous and beneficial effects of solar radiation include, and how the Sun and the other stars are structured. • What Earth's orbital and gravitational relationships with the Sun and the Moon are. • What comets and asteroids are, how they behave, how likely it is that one will collide with Earth, and what would happen if a collision occurs. • Why extraterrestrial influences on the community are a natural part of Earth system evolution. <p><i>All</i> of the information is accurate and appropriate. The writing is clear and interesting.</p>
<p>Approaches the standard of excellence.</p> <p>4</p>	<p><i>Significant</i> information is presented about <i>most</i> of the following:</p> <ul style="list-style-type: none"> • How Earth fits into the universe, including: <ul style="list-style-type: none"> – formation and evolution of the solar system – Earth's distance from, and orbit of, the Sun – Earth's place in the galaxy – the galaxy's place in the universe • How solar activity influences Earth, what the hazardous and beneficial effects of solar radiation include, and how the Sun and the other stars are structured. • What Earth's orbital and gravitational relationships with the Sun and the Moon are. • What comets and asteroids are, how they behave, how likely it is that one will collide with Earth, and what would happen if a collision occurs. • Why extraterrestrial influences on the community are a natural part of Earth system evolution. <p><i>All</i> of the information is accurate and appropriate. The writing is clear and interesting.</p>
<p>Meets an acceptable standard.</p> <p>3</p>	<p><i>Significant</i> information is presented about <i>most</i> of the following:</p> <ul style="list-style-type: none"> • How Earth fits into the universe, including: <ul style="list-style-type: none"> – formation and evolution of the solar system – Earth's distance from, and orbit of, the Sun – Earth's place in the galaxy – the galaxy's place in the universe • How solar activity influences Earth, what the hazardous and beneficial effects of solar radiation include, and how the Sun and the other stars are structured. • What Earth's orbital and gravitational relationships with the Sun and the Moon are. • What comets and asteroids are, how they behave, how likely it is that one will collide with Earth, and what would happen if a collision occurs. • Why extraterrestrial influences on the community are a natural part of Earth system evolution. <p><i>Most</i> of the information is accurate and appropriate. The writing is clear and interesting.</p>

<p>Below acceptable standard and requires remedial help.</p> <p style="text-align: center;">2</p>	<p><i>Limited</i> information is presented about the following:</p> <ul style="list-style-type: none"> • How Earth fits into the universe, including: <ul style="list-style-type: none"> – formation and evolution of the solar system – Earth’s distance from, and orbit of, the Sun – Earth’s place in the galaxy – the galaxy’s place in the universe • How solar activity influences Earth, what the hazardous and beneficial effects of solar radiation include, and how the Sun and the other stars are structured. • What Earth’s orbital and gravitational relationships with the Sun and the Moon are. • What comets and asteroids are, how they behave, how likely it is that one will collide with Earth, and what would happen if a collision occurs. • Why extraterrestrial influences on the community are a natural part of Earth system evolution. <p><i>Most</i> of the information is accurate and appropriate. Generally, the writing does not hold the reader’s attention.</p>
<p>Basic level that requires remedial help or demonstrates a lack of effort.</p> <p style="text-align: center;">1</p>	<p><i>Limited</i> information is presented about the following:</p> <ul style="list-style-type: none"> • How Earth fits into the universe, including: <ul style="list-style-type: none"> – formation and evolution of the solar system – Earth’s distance from, and orbit of, the Sun – Earth’s place in the galaxy – the galaxy’s place in the universe • How solar activity influences Earth, what the hazardous and beneficial effects of solar radiation include, and how the Sun and the other stars are structured. • What Earth’s orbital and gravitational relationships with the Sun and the Moon are. • What comets and asteroids are, how they behave, how likely it is that one will collide with Earth, and what would happen if a collision occurs. • Why extraterrestrial influences on the community are a natural part of Earth system evolution. <p><i>Little</i> of the information is accurate and appropriate. The writing is difficult to follow.</p>

Debate Rubric

Debate	5 NASA Scientist	3 Astronomer Scientist in training	1 Astronomy Student	Teacher	Self
Use of scientific vocabulary and concepts (rotation, revolution, apparent motion, light comes from the Sun, celestial bodies follow regular orbits, etc.)	Student uses scientifically appropriate language and incorporates key vocabulary and concepts every time they present a point.	Student uses scientifically appropriate language and incorporates key vocabulary and concepts most every time present a point (greater than 50%).	Student does not use scientifically appropriate language when participating in the debate.		
Debate skills	Talking points were relevant and in response to a point brought up by the opposing side. These points were backed by concrete evidence that is explicitly stated.	Talking points were relevant and in response to a point brought up by the opposing side. These points were slightly grounded in evidence but had components of the student's opinion.	The student introduces points that are not relevant or in response to a point brought up by the opposing side. These points are ground in only opinion and not evidence.		

<p>Narrative Content</p>	<p>The student summarizes their position and backs this position with concrete evidence. The student then projects how this position might impact Rochester, NY in the future.</p>	<p>The student summarizes their position and backs this position with mostly concrete evidence. The student then projects how this position might impact Rochester, NY in the future.</p>	<p>The student summarizes their position but this is not backed by concrete evidence.</p> <p>Or</p> <p>The student does not adequately summarize their position.</p>		
<p>Narrative Format</p>	<p>The student follows the formal writing procedure.</p>		<p>The student did not follow the formal writing procedure.</p>		