<table>
<tr><td></td><td colspan="2">Course Title: Astronomy
Course Description
Length of Course 1 year
Term 1 (August-November)</td></tr>
<tr><td>Essential Questions</td><td colspan="2">• Why is the night sky our ancestors saw different than the night sky we currently see and will be different than the night sky that our descendants will see?
• Why are there two different types of planets in our solar system (terrestrial versus Jovian)? And is this pattern seen in exosolar systems based on data collected by the Kepler Space Telescope?
• What is the average distance between planets (including their size scales) and why to artists and textbook depictions of it get it so wrong?
• Can humans send astronauts to Mars? And if we can what are the hazards and perils of sustained human presence on the red planet and during the interplanetary journey? What are the long term prospects of living on Mars or another world? Are all planets habitable?
• What is the average distance between asteroids in the main asteroid belt and why are artist and textbook depictions of it get it so wrong?
• What are the limitations in defining an object as a planet?
• Why can't we land a spacecraft on the Gas Giants and what would happen to an astronaut attempting such a feat?</td></tr>
<tr><td>Standards</td><td colspan="2">• No current state standards align</td></tr>
<tr><td>Concepts and Skills</td><td>Our Solar System and Exosolar Solar Systems: The Orderly Nature of the Cosmos

Describe why our solar system and all of the solar systems discovered using the Kepler Space telescope exhibit an orderly nature, with the sun (star) at the center of the solar system and the planets revolving around them in an ecliptic plane. Additionally, why does our solar system have an asteroid belt and a Kuiper Belt/Oort Comet cloud?

Students will be able to describe how we can keep track of planets, the two different types of planets that are typically encountered within a solar system (terrestrial and gas giants), the general structure of each, unique factors to each of the terrestrial and gas planets.

Additionally, students will be introduced to robotic missions to the planets and the strengths and weaknesses of manned missions to other terrestrial planets.

Practices
•Ask questions that arise from careful observations of phenomena.
•Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach)
•Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach)
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1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
8. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

CCR Writing Standards
1. Write arguments focused on discipline-specific content.</td></tr>
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	•Select appropriate tools to collect, record, analyze, and evaluate data. (teach) •Manipulate dependent and independent variables and collect data about a proposed process or system. (teach) •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach) •Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (teach) •Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. (reteach) •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach) •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach) •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in	2. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 7. Draw evidence from informational texts to support analysis, reflection, and research.

	order to address a scientific question or solve a problem.	
Content Objective	• Planetary Rotation versus Planetary Revolution - why do all of the planets revolve around the sun in the same direction (with the exception of Mercury) and why does the sun rotate in the same direction as the planets? How does this give evidence to how the solar system was formed? • Compare the relative sizes (mass and volume) of the planets to each other and the Sun. • What is the size and scale of distances between the earth and other planet's within our solar system? How do we measure distances within our own solar system and what is an Astronomical Unit? • What does the word planet mean (wandering stars)? And how did our ancestors keep track of these wandering stars in the night sky? Why were they considered wandering stars? • What is **retrograde motion**? • Where is most of the mass of the Solar System? • Planets (and the moon) do not emit light, they reflect light from the sun. • Why do the patterns in the stars in the night sky (the "constellations") change during the course of an earth year? Are they changing over the course of millennia? • How old is our solar system (including the earth) - and what evidence exists to provide proof of its age? How old is the Universe? • How do we know the moon is moving away from the earth? Is the earth moving towards the sun? • What is a planet and why is Pluto no longer considered a planet? Why is Ceres (which is larger than Pluto) considered an Asteroid in the Main Asteroid Belt, while Pluto is looking more like a giant ball of water, methane, and ammonia ice? What is the average distance between asteroids in the main asteroid belt and why are artist and textbook depictions of it so wrong? • Why are there two different types of planets in our solar system (terrestrial versus Jovian)? And is this pattern seen in exosolar systems based on data collected by the Kepler Space Telescope? • What is, and where are, the Frost Line and the Goldilocks Zone in our solar system? What are the similarities/dissimilarities with our frost line and goldilocks zone to other solar systems. • What are the rings of Saturn made of? Why do all of the gas giants have rings, albeit most are very faint? Could a terrestrial world have rings? What is the **Roche Limit**? • What is the internal structure of the terrestrial and Jovian planets? • Why does Mercury revolve in the opposite direction compared to the other planets? • Why is Mars red? Could humans ever live on Mars? - Why or why not? • What causes the colors of the seen in the atmospheres of gas giants? • Why does Venus have a thick atmosphere even though it does not have a substantial magnetosphere? • How are Venus and Mars similar to the Earth? How are they different? • Why are Neptune and Uranus in the wrong place? • Why does our solar system have an asteroid belt (including location)? • What is the Oort Comet Cloud and the Kuiper belt (including location)? • Why do some planets have natural satellites (moons) and others do not? • What are the differences between asteroids and comets and where can each of these solar objects be found and what is the difference in their orbital trajectories. • Where does our solar system end and what is "outside" of our solar system begin (including Voyagers destiny)? • Introduction to measuring distances within our own solar system ***radio astrometry*** • Why use robots to explore our solar system instead of humans? • How long does it take for unmanned robots to travel our solar system? What implications does this large travel time have on the possible for humans to travel other planets?	

	• What are the dangers confronted by astronauts traveling in interplanetary space? • What force keeps the planets from flying off into interstellar space and away from the sun? What keeps the sun in orbit around the center of the Milky Way galaxy? What keeps humans from flying off the earth? • Why did the earth separate into (relatively distinct) layers?
Assessments/ Products	**Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
Textbooks, Materials, and Resources	http://astro.unl.edu/animationsLinks.html http://ww2.valdosta.edu/~cbarnbau/astro_demos/frameset_moon.html Simulation shows tidal locking http://astro.unl.edu/classaction/animations/renaissance/retrograde.html Retrograde Motion sourceforge.net/projects/**celestia –** good visualization of astronomical objects. Allows users to view stars at different distances.

	Course Title: Astronomy **Course Description** **Length of Course 1 year** **Term 1 (August-November)**	
Essential Questions	• What conditions would predispose a planet to extreme seasonal conditions if it had (a) a near circular orbit (b) a highly eccentric orbit (c) both a highly eccentric and a planet with a maximal/minimal axial tilt? • Is there an optimal way to measure the length of a year to keep an accurate calendar? How will an inaccurate calendar change the way time is measured in the future or past? • Have the length and severity of the seasons changed over the course of millennia? Did our ancestors experience a different climate due to the Earth's axial precession? What effects could this have on our descendant's? • What would happen to the tides on earth if it had a more massive moon? Or if the moon was closer or farther away?	
Standards	• No current state standards align	
Concepts and Skills	**How the Earth would look without Seasons:** *Seasons and the Tides*	**CCR Reading Standards**

Students will be able to describe how the moon creates tides on the earth and what would happen to the tides if the moon was closer or farther away. Students will also be able to describe the significant effect the tides have on life on earth.

Additionally, students will discuss the importance of the earth's ocean in maintaining a relatively constant temperature around the earth (even though during some times of the year certain hemispheres have temperatures above and below the planetary average temperature).

Students will have to compare and contrast the difference between the seasons at different points on the earth's surface (for example at the equator on earth versus a point in Massachusetts which is approximately 42.3 degrees North of the equator) and how the tilt of the earth on its axis creates the season and how the average distance between the earth and the sun has little effect on the seasons on earth. Students will then compare the seasonal variation on earth to the seasonal variation on Mars to see how a highly eccentric orbit can cause additional variations in the seasons (in addition to those manifested by the tilt of the planet on its axis).

Practices

- Ask questions that arise from careful observations of phenomena.
- Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach)
- Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach)
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- Select appropriate tools to collect, record, analyze, and evaluate data. (teach)
- Manipulate dependent and independent variables and collect data about a proposed process or system. (teach)
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach)
- Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach)
- Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (teach)

9. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
10. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
11. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
12. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.
13. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*).
14. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
15. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
16. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

CCR Writing Standards

8. Write arguments focused on *discipline-specific content*.
9. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes.
10. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.
11. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
12. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
13. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate;

	•Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. (reteach) •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach) •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach) •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem.	synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 14. Draw evidence from informational texts to support analysis, reflection, and research.
Content Objective	• The earth is tilted on its axis and this tilt creates the seasons in the Northern and Southern Hemispheres. Although the distance from the earth and sun has negligible effects on the earth's seasons, it does have noticeable effect on other planets. • The earth rotates about its geographic poles and the rotation of the planet is fixed about these axises. • The tilt of the earth is essentially constant (with the exception of axial precession which occurs once every 26,000 years on earth) as it revolves around the sun. What will happen to the seasons over millennia to the seasons? • How do we measure a year? Tropical versus sidereal year. What is the purpose of a leap year? How will the time it takes to rotate on its axis (approximately 23 hours, 56 minutes, and 4 seconds) change the number of days in years thousands of years from now? • Why is it necessary to have an accurate calendar? And why every tribe/large society has kept one since ancient times. ○ Christian Calendar ○ Islamic/Jewish Calendars	

	o Modern Scientific Calendar • Why is counting the number of times the moon revolves around the earth not an appropriate way to keep track of the length of an earth year? • If a planet is not tilted on its axis in relationship to the ecliptic plane then it will not experience seasons. • What is tidal locking? And what does it mean for the moon to be tidally locked to the earth? • If a planet is tidally locked with its sun then one side of the planet will be forever in the dark. • Newton's Three Laws of Motion: What would happen to the solar system (planets, asteroids, comets) if the sun disappeared? • How do Kepler's Three Laws of Motion explain the motion of the planets around the sun? • What are the effects of the tilt of a planet on its axis (in relationship to the solar systems ecliptic plane)? • Why does the angle the earth makes with the ecliptic plane a more important determinant of temperature at a particular location, than the distance between the earth and the sun. • What is the difference between rotation of a planet on its axis and revolution of a planet around a star. • Mars has approximately the same tilt on its axis as the earth (and nearly the same length of day), but its seasons are more extreme, why? Compare the eccentricity of Earth's orbit to the eccentricity of Mars' orbit to see how the distance from the sun can influence the seasons. • What is the difference between the earth's geographic poles and its magnetic poles? • What influence does the acceleration of the earth's magnetic poles have on earth? • How often do the magnetic poles of earth "flip" and what evidence exists to prove this?
Assessments/ Products	**Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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	Course Title: Astronomy **Course Description**

	Length of Course 1 year **Term 1 (August-November)**	
Essential Questions	• Can life survive on a planet without and atmosphere or magnetosphere? And if life on earth came into existence without the protective atmosphere that it currently has, how did it do so and what could this mean about discovering life on other planets such as Europa?	
Standards	• No current state standards align	
Concepts and Skills	Atmospheres and Magnetospheres ***Could Life Survive on a Planet without a Magnetosphere?*** Students will be able to discuss the benefits of the Earth's atmosphere in blocking different forms of electromagnetic radiation (UV, x-rays, gamma rays) and which parts of the atmosphere are responsible for this protection. In addition students will discuss how the Earth's magnetosphere shields the earth from the solar wind and other high energy particles created in the universe (cosmic rays and other ionizing forms of radiation). Using radioactive half-life's students will discuss why the earth's core is still hot and how the "heaviest" (and most dense) elements migrated to the center of the planet during the formation of our planet. Moreover, students will explain what would happen to the earth's magnetosphere if the earth's core solidified by comparing the Earth to the moon, Venus, Mercury, and Mars. **Practices** •Ask questions that arise from careful observations of phenomena. •Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach) •Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach) •Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data (teach) •Select appropriate tools to collect, record, analyze, and evaluate data. (teach) •Manipulate dependent and independent variables and collect data about a proposed process or system. (teach) •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach) •Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) •Analyze data to identify design features or characteristics of the	**CCR Reading Standards** 17. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 18. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 19. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 20. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 21. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*). 22. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. 23. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 24. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 15. Write arguments focused on *discipline-specific content*. 16. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 17. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 18. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

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Content Objective	• What part of the atmosphere blocks ultraviolet, x-rays, and gamma rays? • Does the Earth's Magnetosphere shield the earth from any high energy particles produced by the sun or other stars? • What is the atmospheric window? And what frequencies of light is the atmosphere transparent and/or opaque to? • What parts of the atmosphere block/absorb different wavelengths of light? • Where did earth's atmosphere come from and how has it evolved/changed over time? • What would happen to life on earth if the sun disappeared (or stopped shinning)? • How did the earth come to have several different layers including a mantel and inner and outer core?	

	• Why is the earth's core still "hot"? • How did the earth separate into layers ("crust", mantle, inner and outer core). And how do we know that the earth has separate layers? How do the separation of the earth into layers provide evidence that the early solar system was very hot (at least the material the formed the earth)? • How does the liquid iron core which generates earth's magnetic field protect the earth from solar storms? What would happen to the earth's atmosphere if there were no liquid/solid core? • How and why is the atmosphere of Mars and Venus different than the atmosphere of earth? Why does Mercury not have an atmosphere? • What gases compose the earth's atmosphere and what are the layers? What is the significance of the layers in terms of weather and the interaction of the boundary of the atmosphere and space? • Radioactive elements that separated into several distinct layers in the earth's history generate heat, keeping the earth's core warm and producing the earth's magnetosphere.
Assessments/ Products	**Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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Essential Questions	• If the sun is composed of mostly hydrogen and helium, which emit only a few distance wavelengths of light, then why does the sun produce a nearly continuous spectrum of visible light? • How can we view the sun in other wavelengths of light and what can this information tell us about our star or the atmospheres of other stars and planets?

	• Do all humans see the same color when looking at the same object?	
Standards	• No current state standards align	
Concepts and Skills	Properties of Light and its Interaction with Matter ***How we study the Cosmos without leaving the Earth. Will we ever be able to find a planet in our Galaxy that could have life by Analyzing the light reflected off of its atmosphere?*** Students will be able to discuss the differences between mechanical and electromagnetic waves and they will be able to define each in terms of both wavelength and frequency of wave. Students will understand that we can use the properties of light to student distance planets and stars and chemicals here on earth. Students will view of the spectra of hydrogen and helium, as well as the spectra from a variety of light sources using electronic spectroscopes. They will also be able to analyze the sun's spectrum to see that the sun does not output all wavelengths of visible light equally. **Practices** • Ask questions that arise from careful observations of phenomena. • Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach) • Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach) • Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data (teach) • Select appropriate tools to collect, record, analyze, and evaluate data. (teach) • Manipulate dependent and independent variables and collect data about a proposed process or system. (teach) • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach) • Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (teach) • Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. (reteach)	**CCR Reading Standards** 25. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 26. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 27. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 28. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 29. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*). 30. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. 31. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 32. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 22. Write arguments focused on *discipline-specific content*. 23. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 24. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 25. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 26. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display

	•Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach) •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach) •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem.	information flexibly and dynamically. 27. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 28. Draw evidence from informational texts to support analysis, reflection, and research.
Content Objective	• What is an electromagnetic wave and how is it different than a mechanical wave? • Can you yell in space? Would anyone hear it? Can deaf people *sense* sound? • How can we use the finite speed of light to look backwards in time (as we look out into space)? • How can we use electromagnetic waves of varying wavelengths/frequencies to understand celestial objects that we cannot touch or send spacecraft to? • Why do we prefer to define a wave by its frequency and not wavelength? - That is, why do we often refer to an electromagnetic wave by frequency and not wavelength (because wavelength changes as an electromagnetic wave interacts with matter)? • Why is it important to look at our universe using a variety of different wavelengths of light? What can we learn from looking at the universe with different wavelengths of light? • Why does each chemical element have a different absorption and emission spectrum? • If sound is produced by the vibration of matter, how is light produced (chemical and nuclear sources of light)? • If the sun is mostly hydrogen and helium why does it essentially produce a continuous spectrum of light?	

	• Accelerating charges can produce electromagnetic waves and shift the frequency/wavelength of the light produced by the source.
	• What is color and how is it perceived by the eye and brain?
	• Inverse square law of light. Why we can't rewind time with precision (when looking into space).
	    ○ Apparent Magnitude versus Absolute Magnitude - Why objects viewed at different distances appear to be the same size.
	• Emitters versus reflectors (what are the sources of light in the universe and how does their interaction with matter allow us to see objects)? Why animals can't see in the dark but can still see objects in low lighting conditions?
	• Do all humans see the same color when looking at the same object?
	• How does light interact with the atmosphere (on Earth and other planets and in interstellar gases) to create the various colors seen in the atmosphere?
	    ○ Hue, Saturation, and Intensity
	    ○ Spectral Colors versus perceived colors using the Munsen Plot.
	    ○ Mie Scattering
	    ○ Rayleigh Scattering
	• Why is visible light (which is an electromagnetics wave) stopped by a wall, but your cell phone can still work inside of a windowless brick building (and your cell phone uses microwaves - an electromagnetic wave to transmit information)?
	• The spectrum of Hydrogen and Helium and why the sun emits an almost continuous spectrum of visible light.
	• What is the Solar Spectrum and how does it influence the color of the Earth's atmosphere (the color of the atmosphere should be violet according to Rayleigh scattering but it is blue).
	• Redshifts and blueshifts and how the visible spectrum shifts left or right (and how electromagnetic waves can be stretched or compressed based on whether a star is moving away or towards earth). Additionally how the shifting of a spectrum can tell us whether a star is moving towards or away from the earth).

Assessments/ Products	**Investigations:** • How a prism separates white light into its spectrum. • Building a cereal box spectrometer with a compact disk. • Spectral Analysis of light (from spectrum tubes, ambient light, fluorescent light, and light from an LCD or cell phone) using Arbor Scientifics R-scope. **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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<tr><td></td><td colspan="2">Course Title: Astronomy
Course Description
Length of Course 1 year
Term 1 (August-November)</td></tr>
<tr><td>Essential Questions</td><td colspan="2">• Why not make BIGGER telescopes to see farther back into time (or at objects far away)?
• Do we see the world upside down and backward because the cornea and lens of our eye projects an image of an object upside down and backwards onto the retina of our eyes?</td></tr>
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<tr><td>Concepts and Skills</td><td>Telescopes - From Galileo's Refractor to Newton's Reflector - Why not make BIGGER telescopes to see farther back into time?

Students will be able to discuss the limitations of a refracting telescope and how Newton improved the telescope by inventing a telescope using reflecting mirrors. Students will also discuss the limitations of light telescopes for exploring the universe and learn about other ways that we can gather and improve telescopes using adaptive optics.

Students will learn the thin lens equation and experiment with lens of different focal lengths

Practices
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• Refractors
• Thin lens equation and magnification
• Chromatic Dispersion and the limitation of refractors
• Interferometry
• Size limitations and diffraction limitations, making telescope arrays, putting telescopes into space and adaptive optics.</td></tr>
</table>

	• Space telescopes (Hubble, Kepler, and the Webb Space Telescopes - why does the Webb Space Telescope which views objects in the infrared help us see galaxies that are accelerating away from our own galaxy?).
Assessments/ Products	**Investigations:** • Measuring focal length of different lenses and applying the thin lens equation. • Optics of convex and concave mirrors. **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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	Course Title: Astronomy **Course Description** **Length of Course 1 year** **Term 1 (August-November)**	
Essential Questions	Why is the sun necessary for the existence of life itself?	
Standards	• No current state standards align	
Concepts and Skills	**Our Sun as a Star, Properties of Stars, and the Life Cycles of Stars:** Students will be able to describe how the sun produces light, the different regions of a star, the effects a star's initial mass has on its temperature and life time and the stars ultimate fate. In order to understand the nuclear chemistry of stars, students will need to learn the difference between nuclear and chemical reactions as well as the fundamental particles that make of matter (in addition to the proton, neutron, and electron students will need to learn about positrons and neutrinos).	**CCR Reading Standards** 41. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 42. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 43. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 44. Determine the meaning of symbols, key terms, and other

	Practices •Ask questions that arise from careful observations of phenomena. •Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach) •Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach) •Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data (teach) •Select appropriate tools to collect, record, analyze, and evaluate data. (teach) •Manipulate dependent and independent variables and collect data about a proposed process or system. (teach) •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach) •Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (teach) •Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. (reteach) •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to	domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 45. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*). 46. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. 47. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 48. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 36. Write arguments focused on *discipline-specific content*. 37. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 38. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 39. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 40. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 41. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 42. Draw evidence from informational texts to support analysis, reflection, and research.

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Content Objective	• The structure of the Sun
	• What are sunspots and what causes them?
	• Why does the sun have millions of magnetic poles?
	  ○ Solar Flares, Prominences, and Coronal Mass Ejections (CMES)
	  ○ How do CMEs effect the technology on our Planet?
	• Solar Activity Cycle
	• What gives the sun its granulated appearance?
	• Nuclear Fusion versus Nuclear Fission.
	  ○ Proton-Proton Chain reaction.
	
	• Why do stars shine? An introduction to Einstein's mass-energy relationship.
	• Colors, Temperatures, and Spectra of Stars
	• How do we measure distance to stars
	  ○ Contrast radio astrometry (for distances within our solar system, to the parallax method, to the use of Cepheid variable stars as measuring sticks).
	
	• Apparent brightness versus absolute magnitude of stars and the inverse square law of light.
	• How do we "weigh" stars?
	• Star clusters, open versus globular clusters.
	• How can we determine if a star is redshifted or blueshifted by looking at its spectrum? And what does that mean about the motion of the star in relationship to its motion towards or away from the earth?
	• The Hertzsprung-Russell (H-R) Diagram and the classification of stars into main sequence, supergiants, giants, and white dwarfs.
	• Star lifetimes along the main sequence. Star birth - star formation from a molecular cloud.
	• How does the conservation of angular momentum and a three-dimensional (not four or any higher order dimension) universe guarantee a flat solar system? And could there be solar systems that are not "flat"?
	• Introduction to subatomic particles
	  ○ Protons, Electrons, and Neutrons
	  ○ Isotopes of Hydrogen and Helium
	• Why stars shine:
	  ○ Neutrinos! How do we know they exist and where do they come from?
	  ○ proton-proton chain	

	○ Triple-alpha process ○ Carbon-Nitrogen-Oxygen (fusion) cycle ○ Stellar nucleosynthesis and the production of even larger atoms. ○ What are the relative abundances of atoms in the universe why are they distributed in such a way? ○ How is a nuclear reaction different than a chemical reaction? ○ What happens when stars begin to produce iron as a product of fusion reactions? And why do stars die within moments of producing iron in their core? • Compare the life of a low mass star to the life of a high mass star. • What will be the fate of Earth when the sun runs out of hydrogen to fuse? • The death of stars: Supernova's, Red Giants, and Planetary nebula, white dwarfs and neutron stars. • Pulsars, Singularities, and gravitational waves. • What are cosmic rays and where do they come from? • Why are Black Holes "black"? Have we ever "seen" one? Does photographic evidence exist? • What are gamma ray bursts and where do they come from?
Assessments/ Products	**Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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	Course Title: Astronomy **Course Description** **Length of Course 1 year** **Term 1 (August-November)**

<table>
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• What is the ultimate fate of the universe and will descendants of earth be around to witness the light emitted by the last star?
• What is the meaning of space-time?
• What do you mean that there are other geometries than Euclidean?</td></tr>
<tr><td>Standards</td><td colspan="2">• No current state standards align</td></tr>
<tr><td>Concepts and Skills</td><td>The Milky Way, Galaxies, and the fate of the Universe
What is our place in the universe? Students will learn about our place within our own galaxy and also what our place is within the entire universe.

From our place in the universe students will learn the scientific explanation to the origin of our universe and its possible fates, as evidence for both the beginning and end are becoming more clear.

Practices
•Ask questions that arise from careful observations of phenomena.
•Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach)
•Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach)
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•Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach)
•Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach)
•Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process
•Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem.
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47. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.
48. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
49. Draw evidence from informational texts to support analysis, reflection, and research.
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<td>Content Objective</td>
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Our Place in the Universe
• What does our Galaxy look like and how do we know it is a spiral galaxy?
  ○ How did Willhelm Hersel determine the approximate shape of our galaxy with his telescope?
• When did Astronomers first realize that there were other galaxies?
• How do stars orbit the galactic bulge of our galaxy? (Application of using adaptive optics to “watch” the revolution of stars around “the” black hole that is at the center of our galaxy.
  ○ Applying Kepler’s Laws to star motion around the galaxy.
• What is the difference between a dark nebula (absorption nebula) and a reflection nebula and why are some so colorful?
• The 21-centimeter line.
• What is “in” the space between the stars?
• How long would it take to count all of the stars in our galaxy?
• How long would it take to travel to the closest star to the sun?
• What does our galaxy look like when viewed in radio frequencies, infrared, x-ray, and gamma ray frequencies? How we see more with different types of electromagnetic waves.
• How is gas recycled within our galaxy? Is there anything between the stars in our galaxy (in the interstellar medium) and how do we know?
• Where do stars tend to form in our galaxy? And why don’t they tend to form in other regions?
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	• What lies in the center of our galaxy and how do adaptive optics allow us to make such an inference?
	• Would it be possible for other life forms to exist near the center of our galaxy? Would it be possible for other life forms to exist on stars on the edge of a galaxy? What is the distribution of heavy elements within our own galaxy? How do we know there is a distribution of heavy elements?
	• The major types of galaxies: Spiral, elliptical, and irregular
	• Galactic clusters - why do galaxies tend to cluster together?
	• Are there any patterns amongst galactic clusters?
	• Distances to galaxies.
	  ○ Main sequence fitting
	  ○ Cepheid Variables
	• How do we know that there is more matter in a galaxy that what we can actually see? Dark matter and rotation curves.
	• What is dark matter and what are some possible candidates "WIMP" that could possibly explain dark matter?
	• What other proof is there of dark matter? Gravitational lensing.
	• Hubble's Law and galactic redshifting.
	• The search for the most distance (and ancient galaxies) - the Hubble Deep Field.
	The Beginning and Fate of the Universe:
	• How do we know the universe's expansion is accelerating and what are the consequences to our view of the cosmos?
	• Is there a "center" or our universe?
	• What are the largest structures in the universe?
	• Matter and antimatter
	• The observable universe and the looking backwards in time.
	• How do we observe galaxy evolution?
	• What is the fate of the universe?
	  ○ Compare a never-ending expansion (accelerating, coasting, or critical expansion) to a recollapsing universe). How do we know the expansion of the universe is accelerating?
	  ○ Compare the "big nothing" to the collapsing universe.
	  ○ Will the expansion of the universe (the acceleration) violet General Relativity and exceed the speed of light?
	• Why did the universe begin to cool after the big bang? Homogeneity and isotropy are the results of universal inflation.
	• Cosmic Background Radiation and mapping the birth of the universe
	• When did the universe become transparent and why?
	• What particles form the foundation of the standard model?
	• What are the possible geometries of space time and how do we know the universe is a flat geometry?

Assessments/ Products	**Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and

	responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
Textbooks, Materials, and Resources	http://astro.unl.edu/animationsLinks.html http://ww2.valdosta.edu/~cbarnbau/astro_demos/frameset_moon.html Simulation shows tidal locking http://astro.unl.edu/classaction/animations/renaissance/retrograde.html Retrograde Motion