HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

SCIENCE CURRICULUM

ASTRONOMY

AUGUST 2021

Hillsborough Township Public Schools
Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
Introduction to Astronomy	5 Days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- Some objects in the night sky twinkle.

Anchoring activity:
- What constitutes real science? Is astrology a real science?

Essential questions:
- What are some common misconceptions about space?
- What do you wonder about space?

Enduring Understandings

- True science requires repetition of tests, continuous analysis of data, and plausible explanations. It is a useful and ongoing process.
- The atmosphere creates challenges to observing the universe and can alter the appearance of objects in the night sky
- There are many space related phenomena that are misinterpreted by the public.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	**ESS1.A: The Universe and its Stars** • Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)	**Cause and Effect** • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller

Hillsborough Township Public Schools
Astronomy Curriculum

Using Mathematical and Computational Thinking • Use mathematical or computational representations of phenomena to describe explanations. **Constructing Explanations and Designing Solutions** • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. **Engaging in Argument from Evidence** • Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. **Obtaining, Evaluating, and Communicating Information** • Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and	**ESS1.B: Earth and the Solar System** • Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)	scale mechanisms within the system. **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. **Stability and Change** • Systems can be designed for greater or lesser stability. **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

mathematically).		

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- WHST.9-12.7 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.
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

Computer Science and Design Thinking

- 8.2.12.ED.2 Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.
- 8.2.12.ED.3 Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
- 8.2.12.NT.2 Redesign an existing product to improve form or function.

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others

Social-Emotional Learning Competencies

- **Self Awareness:** Recognize the impact of one's feelings and thoughts on one's own behavior
- **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills
- **Relationship Skills**: Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways

Learning Targets	Investigations/Resources	Formative Assessment

Hillsborough Township Public Schools
Astronomy Curriculum

Test the validity of astrology.	Astrology vs. Astronomy- What's the difference?	Class presentation/discussion
Understand that good statistical analysis requires a large population sample.	PhET Activity (statistics and/or probability simulation)	Do Now
Construct an explanation for why stars twinkle in the night sky.	Hot air activity	Do Now
Given a common misconception about space, analyze and interpret, and correct the misconception (ie. light spectra, motion of distant galaxies, etc.)	Common misconceptions	Do Now

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this: • Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Astronomy CA1: Astronomy Basics	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

Hillsborough Township Public Schools
Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
The Origin and Fate of the Universe	4 Weeks

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- Expanding universe , gravitational lensing, galaxies spinning apart

Anchoring Activity:
- Episode of The Universe Series: The Big Bang, Dark Matter

Essential Questions:
- How did the universe begin? How will it end? How old is the universe? What materials make up the universe and what is the percentage of each?
- What is dark matter, how does it affect the material around it, and how do we know that it exists?

Enduring Understandings

- The universe began with the Big Bang 14 billion years ago.
- From that, matter and energy continue to spread throughout the universe
- The universe is made of more material than that which we can see.
- There are several schools of thought as to how the universe will "end"

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a	**ESS1.A: The Universe and Its Stars** • The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1)	**Patterns** • Empirical evidence is needed to identify patterns.

system. **Planning and Carrying Out Investigations** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. **Using Mathematics and Computational Thinking** • Create a computational model or simulation of a phenomenon, designed device, process, or system.	• The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3) • The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) • Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3) **ESS1.B: Earth and the Solar System** • Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) **PS4.B: Electromagnetic Radiation** • Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in	**Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Energy and Matter** • Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable.

	microscopic quantities. *(secondary to HS-ESS1-2)*	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with Mathematics
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
- HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how those variables are related.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- WHST.9-12.1 Write arguments focused on discipline-specific content.
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Computer Science and Design Thinking

- 8.2.12.ED.1 Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
- 8.2.12.ED.2 Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback

Career Readiness, Life Literacies, and Key Skills

Hillsborough Township Public Schools
Astronomy Curriculum

- 9.4.12.IML.3 Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.4 Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
- 9.4.12.IML.8 Evaluate media sources for point of view, bias, and motivations.

Social-Emotional Learning Competencies

- **Self Awareness:**
  - Recognize one's feelings and thoughts
  - Recognize one's personal traits, strengths, and limitations
- **Self Management:** Understand and practice strategies for managing one's own emotions, thoughts, and behaviors

Learning Targets	Investigations/Resources	Formative Assessment
Through mathematical and computational thinking, develop a model of the history of the universe by creating a timeline	Geometry of Space	Space-Time discussion
Use this model to illustrate the various events that have taken place over time.	Expanding Universe of Students	Expanding Universe discussion
Analyze and interpret data that shows how red shift and microwave radiation are examples of evidence to support the concept of the big bang.	Cosmic Calendar	Timeline assessment
Create a model that will relate the shape of the universe to its possible boundaries.	Ed Puzzle: The Universe	EdPuzzzle
Mathematically prove that the universe is not only made up of visible matter.	History of the Universe...Nova	Exit ticket: Video Reflection

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

• Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Astronomy CA 2: The Big Bang	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

Hillsborough Township Public Schools
Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
The Observable Universe	3 weeks

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- A picture of the observable universe

Anchoring Activity:
- How Big is the Universe?

Essential Questions:
- How can the size of the universe be measured?

Enduring Understandings

- The universe continues to expand and is currently believed to have a radius of 14.7 billion light years.
- The speed of the most distant objects in the universe can be estimated by observing the light emitted from those objects.
- Objects at the edge of the universe are moving faster than those further inside.
- The universe is divided into realms, each of which grows exponentially as you move outwards.
- In addition to the material that is visible in space, there exists a massive amount of dark matter which greatly influences the universe.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
- HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems	**ESS1.A : The Universe and Its Stars** • The star called the sun is changing and will burn out over a lifespan of approximately	**Patterns** • Empirical evidence is needed to identify patterns.

or between components of a system. **Using Mathematical and Computational Thinking** • Use mathematical or computational representations of phenomena to describe explanations.	10 billion years. (HS-ESS1-1) • Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3)	**Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Computer Science and Design Thinking

- 8.2.12.ETW.1 Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
- 8.2.12.ETW.2 Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
- 8.2.12.EC.3 Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.TL.1 Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task.
- 9.4.12.TL.2 Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.IML.5 Evaluate, synthesize, and apply information on climate change from various sources appropriately

Social-Emotional Learning Competencies

- **Responsible Decision-Making:**
  - Develop, implement, and model effective problem-solving and critical thinking skills
  - Identify the consequences associated with one's actions in order to make constructive choices

Learning Targets	Investigations/Resources	Formative Assessment
Develop and use models of objects and areas of the universe to comprehend the scope of its size.	Sizing Up the Universe (How Big, How Far, How Old?)	Discussion of activities performed
Analyze and interpret data to determine in what order certain objects developed in the universe.	Realms of the Universe	Do nows, discussion of activities performed
Use mathematics to scale the distances involved in studying the universe.	Finding Our Way	Do nows, discussion of activities performed

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
• Astronomy CA 3: The Sun	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

Hillsborough Township Public Schools
Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
Galaxies and Stars	3 weeks

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- star birth or death video

Anchoring Activity:
- TWIG episode: We Are Made of Stars

Essential questions:
- How are stars created?
- What determines their life cycle?
- What happens to stars when they die?

Enduring Understandings

- Stars have a predictable life cycle which is influenced by the starting mass of the star.
- All of the heavy elements found in the universe originate during the death of a star.
- Black holes are formed during the death of supermassive stars.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction
- HS-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation
- HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Asking Questions and Defining Problems	**ESS1.A : The Universe and Its Stars**	**Cause and Effect**

• Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. **Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Using Mathematics and Computational Thinking** • Create a computational model or simulation of a phenomenon, designed device, process, or system.	• The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) • Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3) **PS3.C: Relationship Between Energy and Forces** • When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)	• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. **Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. **Stability and Change** • Systems can be designed for greater or lesser stability. **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that

		system • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Computer Science and Design Thinking

- 8.2.12.EC.3 Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
- 8.2.12.ED.4 Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
- 8.2.12.ED.5 Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
- 8.2.12.ED.6 Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.IML.3 Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.4 Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.
- 9.4.12.TL.2 Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Hillsborough Township Public Schools
Astronomy Curriculum

Social-Emotional Learning Competencies		
• **Self Management:** Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals • **Social Awareness:** Recognize and identify the thoughts, feelings, and perspectives of others		
Learning Targets	**Investigations/Resources**	**Formative Assessment**
Ask questions as to what the points of light in the night sky really are and define the problems associated with gathering evidence to answer the questions.	A Star is Born	Do now: Properties of stars
Carry out investigations as to the character and appearance of black holes.	Black Holes Activity	Do now : Characteristics of black holes
Construct explanations for the events that occur during the life and death of a star. Also explain why different stars have different life cycles.	Universe Videos: Star Life Cycle Dark Matter	Do now: HR diagram
Construct an explanation as to where the heavy elements in the universe originated.	Hubble Tuning Fork Kahoot Review	Do nows (life cycle, black holes, star properties)
Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)		
Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this: • Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.		
Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**	
• Astronomy CA 4: Stars and Galaxies	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.	

Hillsborough Township Public Schools
Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
Astronomical Tools and Instruments	3 weeks

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- Images of objects in the universe taken by the Hubble telescope

Anchoring Activity:
- Remember the Egg activity

Essential Questions:
- How can distant objects be observed?
- How do we know what they are made of?
- How can we see vast distances in space?
- What does the instrumentation tell us about the universe?

Enduring Understandings

- The universe can be observed through a variety of telescopes.
- These telescopes can gather many forms of light and interpret the data in a variety of ways
- The composition of the universe can be determined by the analysis of starlight.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-PS4-2 Evaluate questions about the advantages of using a digital transmission and storage of information.
- HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter
- HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects
- HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**

Hillsborough Township Public Schools
Astronomy Curriculum

Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Obtaining, Evaluating, and Communicating Information** • Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **Constructing Explanations and Designing Solutions** • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	**PS3.A: Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2) • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2), (HS-PS3-3) • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) **PS4.B: Electromagnetic Radiation** • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)	**Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. **Stability and Change** • Systems can be designed for greater or lesser stability. **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

	• The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Computer Science and Design Thinking

- 8.2.8.NT.2 Analyze an existing technological product that has been repurposed for a different function.
- 8.2.8.NT.3 Examine a system, consider how each part relates to other parts, and redesign it for another purpose.
- 8.2.8.ED.1 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.IML.8 Evaluate media sources for point of view, bias, and motivations
- 9.4.12.IML.9 Analyze the decisions creators make to reveal explicit and implicit messages within information and media

Social-Emotional Learning Competencies

- **Self Awareness:**
  - Recognize one's feelings and thoughts
  - Recognize the importance of self-confidence in handling daily tasks and challenges
- **Self Management:** Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals

Learning Targets	Investigations/Resources	Formative Assessment
Develop and use models to demonstrate how light is gathered and interpreted.	Herschel Experiment Liquid Crystal Demo Telescope Tech	Presentation of telescope function and lab to class
Obtain, evaluate, and communicate information about the various types of telescopes.	Spectroscopy Multiwave Pixel This Gyroscopes Blinded by the Light	Discussion: Types of telescopes
Plan and carry out an investigation to model how gathered signals can be converted to digital images.	Collecting EM Radiation Remember the Egg Down to Earth Paint by the Numbers Every Picture Tells a Story Segmented Mirror Challenge	Match the Telescope to Type of EM Radiation Detected

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied

strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.	
Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Astronomy CA 5: The Tools of the Trade	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

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Astronomy Curriculum

Unit Title	**Time Frame/Pacing**
Living and Working in Space	2 Weeks

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- Possible effects to human body NASA considered at beginning of space program.

Anchoring activity:
- The Effects of Microgravity on the Body activity

Essential questions:
- What are the factors that must be addressed to live and work in space?
- What types of space stations have been or are being used today?
- How are humans able to travel in space? How can machinery be lifted from the earth and brought into orbit or sent beyond our orbit?

Enduring Understandings

- In order for humans to explore our universe they must be able to endure harsh conditions and function in inhospitable places.
- Humans have been living and working in space since the 1970s and continue to do so on the International Space Station.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
  HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Asking Questions and Defining Problems	• Newton's second law accurately predicts	**Patterns**

• Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. **Using Mathematics and Computational Thinking** • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. **Engaging in Argument from Evidence** • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. **Obtaining, Evaluating, and Communicating Information** • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	changes in the motion of macroscopic objects. (HS-PS2-1) • Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2) • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2), (HS-PS2-3)	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. **Structure and Function** • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking		
Math • MP.2 Reason abstractly and quantitatively.		

- HSS.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- HSS.ID.C.9 Distinguish between correlation and causation.
- HSA.SS.E.A.1 Interpret expressions that represent a quantity in terms of its context.

ELA

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- WHST.11-12.7 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.

Computer Science and Design Thinking

- 8.2.8.ED.5 Explain the need for optimization in a design process.
- 8.2.8.ED.6 Analyze how trade-offs can impact the design of a product
- 8.2.8.EC.1 Explain ethical issues that may arise from the use of new technologies.
- 8.2.8.EC.2 Examine the effects of ethical and unethical practices in product design and development.

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.TL.3 Analyze the effectiveness of the process and quality of collaborative environments.
- 9.4.12.TL.4 Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem

Social-Emotional Learning Competencies

- **Social Awareness**: Demonstrate an awareness of the differences among individuals, groups, and others' cultural backgrounds
- **Relationship Skills:**
  - Identify ways to resist inappropriate social pressure
  - Demonstrate the ability to prevent and resolve interpersonal conflicts in constructive ways

Learning Targets	Investigations/Resources	Formative Assessment
Develop and use a model of the human body to	Effects of Microgravity	Drawings of various adverse effects to systems

illustrate the possible harmful effects of working in microgravity.	Work Clothes for Space	
Build and test a model to illustrate how materials can be engineered for use.	Abracadabra of Engineering	Drawings of various adverse effects to systems

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
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Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Astronomy CA 3: Rocketry	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.