WAUCONDA SCHOOL DISTRICT 118
UNIT PLANNING ORGANIZER

Subject: Astronomy

Grade Level or Course: 11-12th Grade Semester Science Elective

Unit Two: Unit 3: Threshold #2-3 Stars and Thermonuclear Synthesis Pacing: 4 weeks

STAGE 1 – DESIRED RESULTS

Essential Questions:

1. Summarize the composition and physical properties of the interstellar medium.
2. Describe the characteristics of emission nebulae, and explain their significance in the life cycle of stars.
3. List the basic properties of dark interstellar clouds and explain the nature and significance of interstellar molecules.
4. Summarize the sequence of events leading to formation of a star like our Sun and how the mass of the star determines how star formation progresses.
5. Describe the nature of interstellar shock waves, and discuss their possible role in the formation of stars.
6. Explain why stars form in clusters, and distinguish between open and globular star clusters.
7. Describe the motions of the stars through space, and say how those motions are measured from Earth.
8. Distinguish between luminosity and apparent brightness, and explain how stellar luminosity is determined.
9. Explain the usefulness of classifying stars according to their colors, surface temperatures, and spectral characteristics.
10. Explain how physical laws are used to estimate stellar sizes and how the H-R diagram is used to identify stellar properties.
11. Outline how knowledge of a star's spectroscopic properties can lead to estimating distance and how the masses of stars are measured to determine stellar properties.
12. Explain the cyclical stellar evolution cycle and why stars evolve off the main sequence.
13. Summarize and describe the stellar cycle of medium mass sun-like star, low mass star, and high mass star.
14. Explain how the evolution of binary stars may differ from that of isolated stars.
15. Summarize and explain the sequence of events that take place in a type-I and type-II supernovae.
16. Explain the origin of elements heavier than helium, and discuss the significance of these elements for the study of stellar evolution.
17. Outline how the universe continually recycles matter through stars and the interstellar medium.
18. Describe the properties of neutron stars, and explain how these strange objects are formed.
19. Describe how black holes are formed, and discuss their effects on matter and radiation in their vicinity.
20. Present Einstein's theories of relativity, and discuss how they relate to neutron stars and black holes.
21. Explain the difficulties in observing black holes, and describe some ways in which a black hole might be detected.
22. Present the evidence for supermassive black holes in the centers of galaxies and explain how active galaxies fit into current theories of galactic evolution.
23. Describe the overall structure of the Milky Way Galaxy, and say you how the various regions differ from one another.
24. List the basic properties of normal galaxies and specify the basic differences between active and normal galaxies.

25. Describe how galaxies clump into groups and cluster.
26. Explain why astronomers think that most of the matter in the universe is dark and summarize what is known about the large-scale distribution of galaxies in the universe.
27. Summarize what is known about the large-scale distribution of galaxies in the universe.

Big Ideas:

- This unit will cover the formation of the star and the solar system. Once the solar system was formed the unit will cover how the Sun generates all of its energy and how the Sun is organized. This will cover how the Sun is a dynamic system with fusion at its core. The fusion creates the photons (light) which then travel through the Sun and hit Earth after traveling 93 million miles. Finally, the unit will discuss the solar system as a whole structure and how/why the structures of the Solar System orbit the Sun. This will show how the solar system formed and why everything orbits the Sun using Newtonian and Relativistic concepts. The unit will end by showing how the Sun generates and sustains the light/heat for Earth that life has used for the last 3.4 billion years.

1. “Interstellar space comprises a much bigger domain of real estate than anything yet studied in this book. extending into deeper space for hundreds and even thousands of light-years, on scales much larger than stars and planets, the interstellar medium is the place where nature conducts many of its changes. Rich in gas and dust, yet spread extraordinarily then we throughout the vast, dark regions Among the Stars, Interstellar matter occasionally reveals itself in silhouette, glows as nebulae, and contracts to form new stars.
2. “Few issues in astronomy are more basic than knowing how Stars originate. Stars are in the most numerous and obvious residence of the nighttime sky. Astronomers are eager to understand the details of how Stars emerge from the black messiness of interstellar space to become bright round balls of intent energy. The process is a remarkable one and we have learned much about it in the past few decades.”
3. “ Stars are everywhere in the nighttime sky. The naked eye can spot about six thousand of them, spread across 88 constellations. Millions more are visible even with binoculars or a small telescope. The total number of stars is impossible to count, and relatively few have been studied in detail. Yet it is the stars that tell us more about the fundamentals of astronomy than any other objects in the universe.”
4. “The story of the burst development and death of stars is one of the greatest accomplishments of 20th century science. yet, ironically, no one ever has seen even a single star pass through all of its many very changes. Like archaeologists to examine bones and artifacts from long ago to learn more about the evolution of human culture, astronomers observe stars of different ages to construct a consistent model of All Stars evolved over billions of years.”
5. “ There is something philosophically intriguing about the idea that the death of stars cause the birth of others. Build up, break down, change... Dust to dust is a scientific concept. Many of the elements composing our world in our cells are created in the violent explosions of long-gone stars. It sounds rather poetic that we are made of mostly Stardust but it happens to be true.”
6. “ The almost unimaginable violence of supernova explosions create objects so extreme in their behavior that they require us to reconsider some of our most cherished laws of physics. They open up a scientific fiction writer's dream of fantastic phenomena that border on reality. They may even one day for scientists to construct a whole new theory of the universe.”
7. “ Our Milky Way galaxy is just one among other galaxies in the observable universe-- a hundred billion galaxies! Or astronomers, the Milky Way plays much the same role for Galaxies is the sun does four stars. Our understanding of galaxies throughout the cosmos rest squarely on our knowledge of the size, scale, structure, and dynamics of our own Grand skits system of many varied Stars.”
8. “ Light collected tonight from the most distant galaxies was emitted by those objects long before the Earth even formed. racing. Captured in the many images of this book, the radiation tells us about not only the

properties of faraway galaxies but also a few things about the history of our galaxy and the universe in which we live."

9. "galaxies are among the grandest, most beautiful objects in the universe; each one is a colossal collection of hundreds of billions of stars held together Loosely by gravity. Galaxies dominate our view of deep space -- they seem to be everywhere -- yet they represent just a tiny fraction of all the matter in the cosmos. Best quantities of unseen Cosmic material called Dark Matter actually accounts for most of the mass in the universe."

NGSS Performance Standards:

- **HS-PS2-4:** HS-PS2-4: Gravitational and Electrostatic Forces Between Objects: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. (Patterns)
- **HS-ESS1-3:** Stellar Nucleosynthesis: Communicate scientific ideas about the way stars, over their life cycle, produce elements. (Energy and Matter)
- **HS-ESS1-4:** HS-ESS1-4: Orbital Motions: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (Scale, Proportion, and Quantity)
- **HS-ESS1-1:** HS-ESS1-1: Nuclear Fusion and the Sun's Energy: 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 in the form of radiation. (Scale, Proportion, and Quantity)
- **HS-PS1-8:** Fission, Fusion, and Radioactive Decay**:** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. (Energy and Matter)

NGSS - Science & Engineering

1. **Asking Questions and Defining Problems**: A practice of science to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.
2. **Developing and Using Models**: A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.
3. **Planning and Carrying Out Investigations**: Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.
4. **Analyzing and Interpreting Data**: Scientific Investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools -Including tabulation, graphical interpretation, visualization, and statistical analysis- to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.
5. **Using Mathematics and Computational Thinking**: In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used to for a range of tasks such as constructing simulations; statically analyzing data; and recognizing, expressing, and applying quantitative relationships.
6. **Constructing Explanations and Designing Solutions**: The products of science are explanations and the products of engineering are solutions.
7. **Engaging in Argument from Evidence**: Argumentation is the process by which explanations and solutions are reached.

8. **Obtaining and Evaluating**: Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

NGSS - Disciplinary Core Ideas:

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NGSS - Cross-Cutting Concepts

1. **Patterns**: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
2. **Cause and Effect**: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
3. **Scale, Proportion, and Quality**: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scale change.
4. **Systems and System Models**: A system is an organized group of related objects or components; models
5. **Energy and Matter**: Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
6. **Structure and Function**: The way an object is shaped or structured determines many of its properties and functions.
7. **Stability and Change**: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

STAGE 2 – EVIDENCE

Concepts (What students need to know)	Performance Tasks (What students will be able to do)	21st Century Skills
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Common Formative/Summative Assessments:

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Interim Assessments (Informal Progress Monitoring checks):

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Modified Common Assessments:

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Modified Interim Assessments:

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STAGE 3 – LEARNING PLAN
(INSTRUCTIONAL PLANNING)

Suggested Resources/Materials/Informational Texts

Suggested Research-based Effective Instructional Strategies

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Academic Vocabulary/ Word Wall	Enrichment/Extensions/ Modifications	Interdisciplinary Connection
Essential Vocabulary: . **Worth-knowing Vocabulary:** .		