School District of Marshfield Course Syllabus

Course Name: Science Exploration
Length of Course: Semester
Credit: 1/2 Credit

Program Goal:

The School District of Marshfield K-12 Science Program will prepare and motivate learners to explore, problem solve and collaborate with their classmates to interpret science and explain the world around them. Learners will acquire knowledge and evidence that promotes creative solutions through the evaluation and understanding of scientific theories and evidence. Learners will collect, analyze and reason with scientific data through investigations that ultimately allow for the generation of scientific explanations. Critical thinking skills will elevate natural curiosity, make sense of scientific data and promote scientific literate citizens.

Course Description:

Science exploration is all about discovering what opportunities are available to the student in high school science classes. We will perform an overview of the essential science topics. Starting from the very beginning students will learn and cement their skills in observation and measurement, to think methodically and critically as they address questions about the fundamental nature of the world around them. There will be a focus on the foundations of the four primary physical sciences (Earth Science, Biology, Physics, and Chemistry) with digressions into topical science that utilize what the student has learned to examine issues such as infectious diseases, climate and more. By the end of this course students will be prepared to succeed in their future science endeavors at Marshfield High School.

Wisconsin Standards for Science (SCI)	
Crosscutting Concepts (CC)	
CC1: Students use science and engineering practices, disciplinary core ideas, and ***patterns*** to make sense of phenomena and solve problems.	
Patterns	CC1.h: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.
CC2: Students use science and engineering practices, disciplinary core ideas, and ***cause and effect*** relationships to make sense of phenomena and solve problems.	
Cause and Effect	CC2.h: Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
CC3: Students use science and engineering practices, disciplinary core ideas, and an understanding of ***scale, proportion and quantity*** to make sense of phenomena and solve problems.	
Scale, Proportion, and Quantity	CC3.h: Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
CC4: Students use science and engineering practices, disciplinary core ideas, and an understanding of ***systems and models*** to make sense of phenomena and solve problems.	

Systems and System Models	CC4.h: Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.
CC5: Students use science and engineering practices, disciplinary core ideas, and an understanding of ***energy and matter*** to make sense of phenomena and solve problems.	
Energy and Matter	CC5.h: Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
Science and Engineering Practices (SEP)	
SEP1: Students ***ask questions and define problems***, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	
Asking Questions SEP1.A	SEP1.A.h: Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. Ask questions to clarify and refine a model or an explanation. Evaluate a question to determine if it is testable and relevant.

	Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design.
Defining Problems SEP1.B	SEP1.B.h: Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. Clarify and refine an engineering problem.
SEP4: Students ***analyze and interpret data***, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	
Analyze and Interpret Data SEP4.A	SEP4.A.h: Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. Evaluate the impact of new data on a working explanation or model of a proposed process or system.

	Analyze data to optimize design features or characteristics of system components relative to criteria for success.
SEP8: Students will ***obtain, evaluate and communicate information***, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	
Obtain, Evaluate, and Communicate Information SEP8.A	SEP8.A.h: Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.
Life Science (LS)	
LS1: Students use science and engineering practices, crosscutting concepts, and an understanding of ***structures and processes*** **(on a scale from molecules to organisms)** to make sense of phenomena and solve problems.	
Organization for Matter and Energy Flow in Organisms LS1.C	LS1.C.h: The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
Information Processing LS1.D	LS1.D.h: Organisms can process and store a variety of information through specific chemicals and interconnected networks.

LS2: Students use science and engineering practices, crosscutting concepts, and an understanding of ***interactions, energy, and dynamics within ecosystems*** to make sense of phenomena and solve problems.	
Interdependent Relationships in Ecosystems LS2.A	LS2.A.h: Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. The combination of the factors that affect an organism's success can be measured as a multidimensional niche.
Cycles of Matter and Energy Transfer in Ecosystems LS2.B	LS2.B.h: Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways, and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
Ecosystem Dynamics, Functioning, and Resilience LS2.C	LS2.C.h: If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
Social Interactions and Group Behavior LS2.D	LS2.D.h: Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
LS4: Students use science and engineering practices, crosscutting concepts, and an understanding of ***biological evolution*** to make sense of phenomena and solve problems.	
Biodiversity and Humans LS4.D	LS4.D.h: Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.
Physical Science (PS)	
PS1: Students use science and engineering practices, crosscutting concepts, and an understanding of ***matter and its interactions*** to make sense of phenomena and solve problems.	
Nuclear Processes PS1.C	PS1.C.h: Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.
PS2: Students use science and engineering practices, crosscutting concepts, and an understanding of ***forces, interactions, motion and stability*** to make sense of phenomena and solve problems.	
Types of Interactions PS2.B	PS2.B.h: Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields.

	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects,
PS3: Students use science and engineering practices, crosscutting concepts, and an understanding of ***energy*** to make sense of phenomena and solve problems.	
Definition of Energy PS3.A	PS3.A.h: Systems move towards more stable states.
Conservation of Energy and Energy Transfer PS3.B	PS3.B.h: The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).
PS4: Students use science and engineering practices, crosscutting concepts, and an understanding of ***waves and their applications in technologies for information transfer*** to make sense of phenomena and solve problems.	
Information Technologies and Instrumentation PS4.C	PS4.C.h: Large amounts of information can be stored and shipped around as a result of being digitized.
Earth and Space Science (ESS)	
ESS1: Students use science and engineering practices, crosscutting concepts, and an understanding of ***Earth's place in the universe*** to make sense of phenomena and solve problems.	
The Universe and Its Stars ESS1.A	ESS1.A.h: Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory.
The History of Planet Earth ESS1.C	ESS1.C.h: The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
ESS2: Students use science and engineering practices, crosscutting concepts, and an understanding of ***Earth's systems*** to make sense of phenomena and solve problems.	
Earth Materials and Systems ESS2.A	ESS2.A.h: Feedback effects exist within and among Earth's systems.
Plate Tectonics and Large-Scale System Interactions ESS2.B	ESS2.B.h: Radioactive decay within Earth's interior contributes to thermal convection in the mantle.
The Roles of Water in Earth's Surface Processes ESS2.C	ESS2.C.h: The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
Biogeology ESS2.E	ESS2.E.h: The biosphere and Earth's other systems have many interconnections that cause a continual coevolution of Earth's surface and life on it.
ESS3: Students use science and engineering practices, crosscutting concepts, and an understanding of the ***Earth and human activity*** to make sense of phenomena and solve problems.	

Natural Resources ESS3.A	ESS3.A.h: Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
Engineering, Technology, and the Application of Science (ETS)	
ETS1: Students use science and engineering practices, crosscutting concepts, and an understanding of ***engineering design*** to make sense of phenomena and solve problems.	
Defining and Delimiting Engineering Problems ETS1.A	ETS1.A.h: Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Key Vocabulary:			
Invertebrate	Vertebrate	Carnivore	Omnivore
Herbivore	Convection	Data	Hypothesis
Astronomy	Geology	Meteorology	Glacier
Element	Electron	Plasma	Liquid
Chemical	Oxygen	Gene	Solstice
Equinox	Eclipse	Fossil	Weather
Climate	Biology	Speed	Velocity
Earthquake	Caldera	Trench	Divergent
Galaxy	Universe	Infer	Independent
Dependent	Density	Potential	Work
Energy	Gravity		

Topics/Content Outline- Units and Themes:

Units:

- Astronomy & Earth Science
- Physics
- Chemistry
- Biology
- Infectious Disease
- Resources and the Environment