

The Vernal Window Timeline NGSS Matrix

<p>Standards HS-LS2 Interdependent Relationships</p>		
<p>Performance Expectations <i>Statements in black text below are the direct connections to the core of the “Tracking the Vernal Window Bundled Global Observations to Benefit the Environment (GLOBE) protocols” unit, statements in black text indicate areas with direct connection to the Vernal Windows Timeline Activity, and statements in grey are directly addressed when completing the entire unit.</i></p> <p>HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changes conditions may result in a new ecosystem.</p>		
Dimension	Name and NGSS Code/citation	Specific Connections to Classroom Activity
<p>Science and Engineering Practices</p>	<p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments (HS-LS2-6) ● Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. ● Respectfully provide and/or receive critique on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions. ● Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. <p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> ● Plan and conduct an investigation individually and 	<p>Students work as a small group to prepare an oral argument for the order of events on their vernal window timeline.</p> <p>Students listen to oral arguments presented by each small group about the order of vernal window events, ask questions to understand reasoning, and propose what additional evidence (data) they would need to come to a class-wide conclusion.</p> <p>Students use the data collected by themselves through GLOBE protocols and scientists to write a claim, evidence, reasoning statement that suggests the order of vernal window events in the next 1-5 years.</p> <p>Students use discussions of the timeline to determine what data they will need to collect using GLOBE protocols or other available datasets to draw</p>

	<p>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 limitation on the precision of the data</p> <ul style="list-style-type: none"> ● Select appropriate tools to collect, record, analyze, and evaluate data. <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> ● Analyze data using tools, technologies and/or models in order to make valid and reliable scientific claims or determine an optimal design solution ● Consider limitation of data analysis (e.g., measurement error, 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 and/or model of a proposed process or system. 	<p>conclusions about the vernal window at their location. They may plan some or all of the investigation depending on age, experience, and time available.</p> <p>Students review GLOBE protocols, then gather measurement tools and data sheets.</p> <p>Students will use data tables and graphs to understand collected and researched data on snowpack, stream flow, canopy green-up, etc. in order to establish if their timeline hypothesis was correct or needs adjustment.</p> <p>Students will discuss if the data they collected is valid and reasonable to use when assessing their hypothesis (were they able to collect data regularly, were measurements taken precisely, etc.).</p> <p>Students use self-collected data to compare to data collected by previous classes and/or scientific datasets for how the current location’s vernal window may be changing.</p> <p>Students will explore measurement results as they compare to their original timeline hypothesis and discuss why new evidence may be different than what they had predicted.</p>
<p>Disciplinary Core Ideas</p>	<p>LS2.C. Ecosystem Dynamics, Functioning and Resilience</p> <ul style="list-style-type: none"> ● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to 	<p>Students learn about the importance of the vernal window to the stability of temperate forest ecosystems. They make measurements to confirm the current window’s timeline of events. They explore questions about how ecosystem processes might change under different climate conditions.</p>

	<p>becoming a very different ecosystem. Extreme fluctuations in condition or the size of any population, however can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2), (HS-LS2-7)</p> <ul style="list-style-type: none"> Moreover, anthropogenic changes (induced by human activity) in the environment--including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change--can disrupt an ecosystem and threaten survival of some species. (HS-LS2-7) <p>ESS2.E. Biogeology</p> <ul style="list-style-type: none"> The many dynamics and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) 	<p>Students explore through scientific research or conversations with scientists how a change in the vernal window due to climate change would impact plant and/or animal species at their location.</p> <p>Students learn about the relationships between a change in snowpack, soil frost depth, green-up, and/or soil respiration at their site and the global carbon cycle through additional research.</p>
<p>Crosscutting Concepts</p>	<p>Stability and Change</p> <ul style="list-style-type: none"> Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS-6), (HS-LS2-7) <p>Energy and Matter</p> <ul style="list-style-type: none"> 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--it only moves between one place and another place, between objects and/or fields, or between systems. 	<p>Students collect data about the current vernal window at their location and explore how the timeline of events might change in the future due to climate change.</p> <p>Students are introduced to the ecosystem processes that define the vernal window in temperate forest ecosystems including if they are part of the carbon cycle, water cycle, or energy flow.</p> <p>Students are exposed to the idea that if the timing of ecosystem processes changes, how their carbon, water, and energy move within and between systems will be impacted.</p>

Connections to Nature of Science

- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6), (HS-LS-8)

Students engage in discussion within small groups using logic and reason to develop a vernal window timeline of events. They continually refine their thinking as they receive critique from peers, collect their own data and/or analyze a scientific dataset.

Common Core State Standards Connections*ELA/Literacy*

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Mathematics

HSN-Q.A.3 Choose a level of accuracy appropriate to the limitations on measurements when reporting quantities.

Students use self-collected data and scientific datasets (and conversations with scientists or peer research papers) to determine the timeline of ecosystem processes within the current vernal window and how they might change in the future.

Students write a claim, evidence, reasoning statement about the expected timeline of events in the vernal window over the next 1-5 years.

Students review GLOBE protocols and decide what level of precision to use when making measurements and recording data.