

Tool 3 Template Example – 5E Storyline and Conceptual Flow

Unit: *Ecosystems: Interactions, Energy and Dynamics*
Instructional Sequence 1: *Wolves in Yellowstone*

Guiding Question for Sequence 1: *What happens when a predator comes back into an environment?*
Big Idea of Sequence 1: *Humans can affect the relationships among organisms in an environment*

5Es	Storyline Using Anchor Phenomena	Conceptual Flow Using DCI and CCC	SEP	Resources
<p>Engage</p>	<p>Anchor Phenomenon: The reintroduction of wolves into Yellowstone impacted the ecosystem in expected and unexpected ways.</p> <p>Guiding Question: How do living things, including humans, interact with each other and with non-living things in an environment?</p> <p>Students explore the living and non-living things of their local environment near school, and compare it to other areas. Then students learn about the re-introduction of wolves in Yellowstone in 1995.</p>	<p>Animals and plants live in variety of environments; humans are part of and can affect that environment.</p> <p>Animals need air, water and food - they eat plants and other animals. Plants also need food which they make from air, water and sunlight.</p>	<p>Constructing Explanations</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena <p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> Construct an oral argument supported by scientific reasoning to support or refute a solution to a problem 	<p>National Geographic Video – wolves, bison and ranchers in Yellowstone</p> <p>Interactive Map: Where Yellowstone Wolves Roam (website from PBS Nature).</p>
<p>Explore</p>	<p>Anchor Phenomenon: The reintroduction of wolves into Yellowstone impacted the ecosystem in expected and unexpected ways.</p> <p>Guiding Question: What impact can an organism have on the interactions between other organisms in a food web?</p> <p>Students develop the Yellowstone food web and explore how organisms interact with each other. They explore how humans and the reintroduction of the wolf affect the food web. Students revisit the local environment and construct a food web of the organisms there.</p>	<p>Food webs can represent patterns of feeding relationships among organisms in an environment.</p> <p>Cause and effect relationships represented in a food web may be used to predict phenomena.</p>	<p>Developing and Using Models</p> <ul style="list-style-type: none"> Use a model (a food web) to describe phenomena <p>Constructing Explanations</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena 	<p>Yellowstone food web cards and data sheet</p>

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<p>Explain</p>	<p>Anchor Phenomenon: The reintroduction of wolves into Yellowstone impacted the ecosystem in expected and unexpected ways.</p> <p>Guiding Question: What types of interactions occur between organisms?</p> <p>Students learn about organism relationships like predator-prey (e.g. wolves), competition (e.g. wolves and bears) and symbiosis (e.g. clown fish and anemones). They revisit the Yellowstone food web and identify different types of interactions that include how humans interact in the food web.</p>	<p>While the individual organisms in different environments may vary, the patterns of interactions (relationships) between organisms are consistent across different environments.</p> <p>These relationships between organisms, including humans, can be predatory, competitive or mutually beneficial.</p>	<p>Constructing Explanations</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative relationships between variables that predict and describe phenomena <p>Obtaining, Evaluating and Communicating Information</p> <ul style="list-style-type: none"> Critically read scientific texts adapted for classroom use to determine the central ideas and obtain scientific information to describe patterns in and evidence about the natural world. 	<p>Videos:</p> <ol style="list-style-type: none"> National Geographic (predator prey) PBS (competition) Untamed Science (symbiosis)
<p>Explore</p>	<p>Anchor Phenomenon: The reintroduction of wolves into Yellowstone impacted the ecosystem in expected and unexpected ways.</p> <p>Guiding Question: How do living and non-living factors affect populations?</p> <p>Students analyze Wolf and Elk data in Yellowstone to look at the pattern of interaction in a predator-prey relationship. Students analyze snow accumulation and Elk population data in Yellowstone to look at the impact of a non-living factor on a population.</p>	<p>Patterns consistent with predator-prey relationships can be observed in population data.</p> <p>Non-living factors can also affect populations.</p>	<p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Analyze and interpret data to provide evidence for phenomena 	<p>National Park Service. (2015). <i>Winter Count of Northern Yellowstone Elk</i>.</p>

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Explain	<p>Anchor Phenomenon: The reintroduction of wolves into Yellowstone impacted the ecosystem in expected and unexpected ways.</p> <p>Guiding Question: Does reducing a predator population have a positive or negative impact on an ecosystem?</p> <p>Students are introduced to the terms <i>ecosystem</i>, <i>biotic</i> and <i>abiotic</i>. Students will look at the data on the distribution of wolf packs, cattle ranchers and human populations in the greater Yellowstone ecosystem, number of wolf deaths caused by humans, and the number of livestock and pets killed by wolves. Students engage in an argument – Have wolf deaths caused by humans (ranchers, hunters and park rangers) had a positive or negative impact on the greater Yellowstone ecosystem?</p>	Humans can disrupt the patterns of interactions between predator-prey populations and affect ecosystems.	<p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> Construct an oral argument supported by empirical evidence and scientific reasoning to support or refute an explanation for phenomena. 	<p>Northern Yellowstone Cooperative Wildlife Working Group. (2013). <i>Annual Report</i>.</p> <p>U.S. Fish and Wildlife Service. (2014). <i>Rocky Mountain Wolf Recovery 2014 Interagency Annual Report</i>.</p>
Elaborate	<p>Anchor Phenomenon: The reintroduction of wolves in Adirondacks impacted the ecosystem including the deer and human populations.</p> <p>Guiding Question: What impact can the reintroduction of a predator have on an ecosystem that includes humans?</p> <p>Students construct explanations about the impact of deer on the Adirondack ecosystem. They make predictions about what the reintroduction of wolves in the Adirondacks would do to the ecosystem (including the impact on the deer and human populations).</p>	By examining both the natural and human-caused patterns of interactions between populations in an ecosystem, predications can be made about the effect of reintroducing a predator in an ecosystem.	<p>Constructing Explanations</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that predict and describe phenomena 	<p>Explanation Tool (C-E-R scaffold)</p> <p>U.S. Fish and Wildlife Service: <i>Northern Rocky Mountain Wolf Recovery Program 2014 Interagency Annual Report</i></p>

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Evaluate	<p>Anchor Phenomenon: Humans also impact the ecosystems in which they live in expected and unexpected ways.</p> <p>Guiding Question: What are the patterns of interactions between biotic and abiotic factors that affect ecosystems?</p> <p>Students identify the patterns of interactions in a variety of scenarios to explain the impact of one population on another (including predator-prey, competition and symbiosis), and the impact of abiotic factors on a population. They develop an argument about whether humans do (or do not) impact ecosystems.</p>	<p>Consistent patterns of interactions show relationships among organisms (competition, predation, and mutualism) and between organisms and abiotic components. These patterns of interaction predict similar phenomena across multiple ecosystems.</p> <p>Increases in human populations impact ecosystems.</p>	<p>Constructing Explanations</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that predict and describe phenomena <p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation for phenomena. 	<p>Cornell University College of Agriculture and Life Sciences' Biological Control: <i>Beneficial Insects Introduction Research</i> (website)</p> <p>Duke University's Dept. of Math: <i>Predator-Prey Models</i> (website)</p> <p>University of Wisconsin-Madison's Center for Limnology – <i>Crystal Lake Mixing Project: Smelt</i> (website)</p>