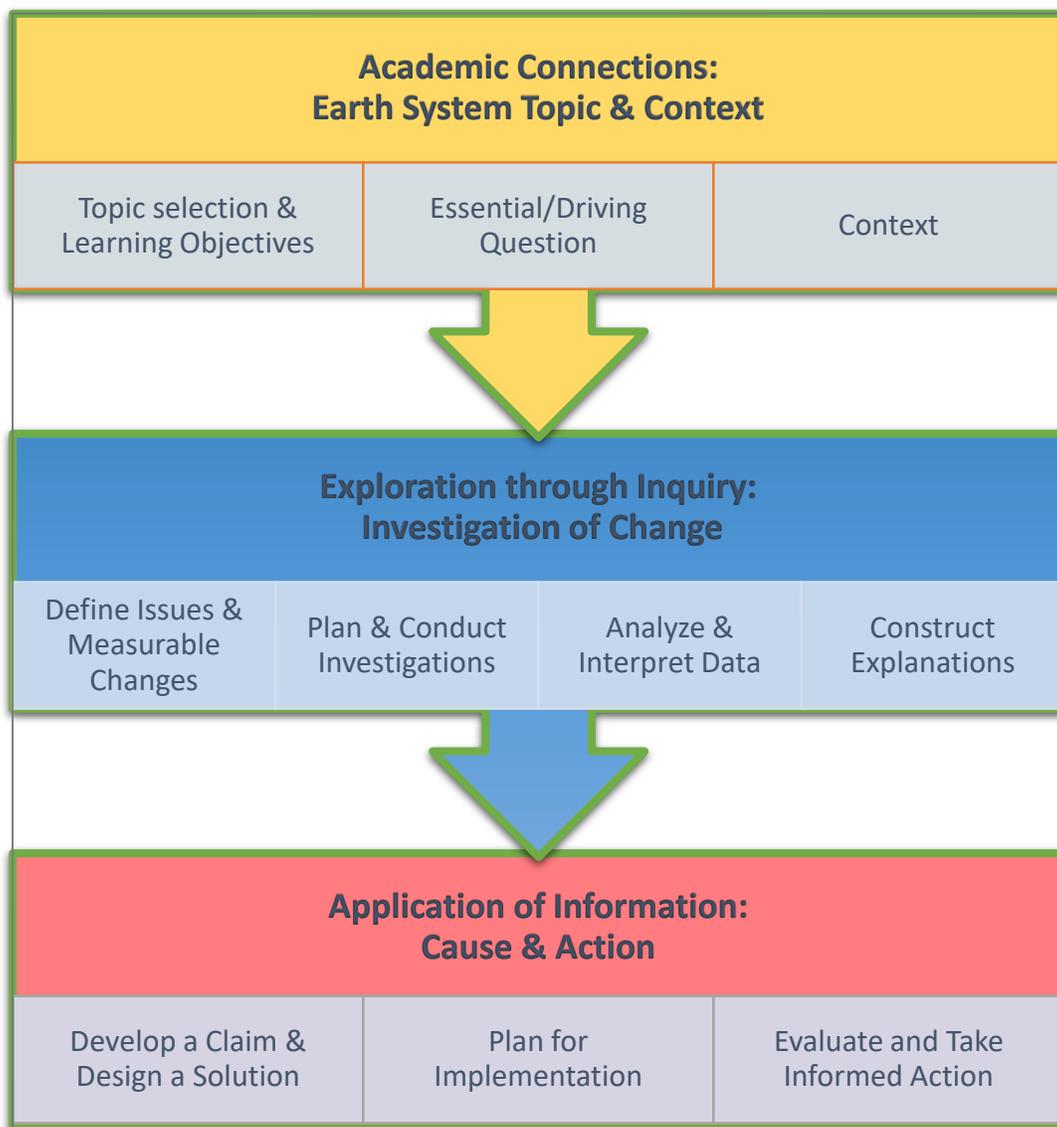
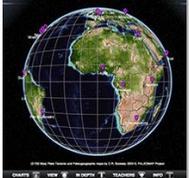


# SYSTEMS PLANNING GUIDE BIOINTERACTIVE



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Academic Connections: Earth System Topic & Context				
<p><i>Resource criteria*:</i></p> <p><i>Connecting topics to curriculum standards, performance expectations, and/or learning objectives</i></p> <p><i>Overarching standards- based statement to guide inquiry, investigations and development of explanations and claims</i></p> <p><i>Establishes relevancy, initiates conceptual links and connections to phenomena</i></p> <p><i>Elicits questions, prompts investigation(s), supports inquiry, informs development of actionable claims</i></p>	<p><b>Earth System Topic:</b> Ecosystems</p> <p><b>NGSS Disciplinary Core Idea:</b> LS2.C Ecosystem Dynamics, Functioning &amp; Resilience</p> <p><b>NGSS Performance Expectations:</b> (HS-LS2-6) Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.</p>			
	<p><b>Essential/Driving Question:</b></p> <p><b>How are ecosystems impacted when the environment changes?</b></p>			
	<p><b>Context:</b> Students will use resources to conceptualize earth systems functions and changes</p>			
	<b>Resource</b>	<b>Earth system connections</b>	<b>Available data</b>	<b>Focal questions for exploration</b>
	<p><a href="#">EarthViewer</a> Click &amp; Learn, App, activities</p>  <p>and</p> <p><a href="#">BiomeViewer</a> interactive</p> 	<p><b>Plate tectonics</b> determines the movement of landmasses and <b>distribution of continents and oceans</b> across the globe influence <b>atmospheric and ocean circulation</b> patterns.</p> <p>Different latitudes receive variable amounts of <b>solar radiation</b> that is <b>reflected and absorbed</b> through time due to the spin, <b>tilt, and orbit of the Earth</b>. Differential heating of the Earth’s surface results in <b>climate zones and ecosystems</b> that determine <b>species ranges, productivity and biomass, and population sizes</b>.</p>	<p>Historic data for carbon dioxide concentrations, temperature, biodiversity, climate, wildlife, patterns of human settlement and agriculture</p>	<p>How has climate changed in earth’s geologic past and how might these changes affect ecosystems?</p> <p>How are changes in the past similar/different than more recent changes?</p> <p>What factors and variables should be studied to understand how a system (ecosystem, biome, etc) functions and the species living in it?</p>

\*informed by instructional approaches defined by NGSS, C3 Framework, Common Core, & P21 Framework

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<b>Resource criteria*:</b>		<b>Exploration through Inquiry: Investigation of Change</b>		
<p>Define issue for investigation and identify change variables to measure</p> <p>Select resources for investigations that:</p> <ul style="list-style-type: none"> <li>establish relationships between variables</li> <li>make predictions</li> <li>define protocols to measure/ collect/ select sources of data</li> <li>research authenticity and reliability of information</li> <li>evaluate, analyze and interpret information through modeling and graphical representations</li> <li>construct explanations and develop evidence-based conclusions</li> </ul>		<p>Students will use selected resources to plan &amp; conduct investigations about measurable changes in earth systems, analyze data and construct evidence-based explanations about how environmental changes can impact ecosystems</p>		
Resource	Measurable changes to build conceptual links	Available data	Investigative questions	
<p><a href="#">Creating Chains and Webs to Model Ecological Relationships</a></p> 	<p>The stability of <b>populations</b> in an <b>ecosystem</b> is determined by the distribution of <b>biomass</b> across the <b>ecosystem</b>. Variation in <b>biomass and productivity</b> can impact <b>species interactions</b> and <b>species ranges</b>. Disruptions to <b>climate</b> systems due to <b>weather events, fire</b>, drought, soil formation/erosion or human activities (deforestation, habitat loss, agricultural activities, population growth) can cause changes in <b>population sizes</b> and lead to <b>extinction or diversification</b>.</p>	<p>Creating, manipulating and comparing different models of species relationships and energy flow through a system: food chain, energy pyramid and food web</p>	<p>What is the energy flow through an ecosystem?</p> <p>What is the relationship and interaction between species in an ecosystem?</p> <p>What happens to the flow of energy and interrelationship of species when there is a disturbance?</p>	
<p><a href="#">Niche Partitioning and Species Coexistence</a></p> <p>and</p> <p><a href="#">Niche Partitioning Activity</a></p> 	<p>How <b>populations</b> use resources in an <b>ecosystem</b> is determined by <b>species interactions</b>, such as competition or facilitation. Stresses on <b>productivity and biomass</b> can impact the number of individuals that can survive in a <b>population</b>, and alter <b>species ranges and diversity</b>. If <b>population sizes</b> and the <b>species ranges</b> are small, <b>extinction</b> can occur.</p>	<p>Identification of species habits, behaviors and relationships to determine role and function in ecosystem; how species interactions inform health and resiliency of ecosystem</p>	<p>How do species coexist and share the resources in an ecosystem?</p> <p>How do we know if species are competing for resources?</p> <p>Can ecosystems support many of the same kinds of species and maintain ecosystem health?</p>	

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Application of Information: Cause & Action			
<p><i>Students will develop a claim about the causes of changes in earth systems and design an actionable and implementable solution to manage/reduce impact to ecosystems for conservation, preservation and improved quality of life</i></p>			
<p><b>Resource criteria*:</b></p> <p><i>Develop evidence-based claims from investigations about cause of change</i></p> <p><i>Design a solution/model a theory to address claim and mitigate/remediate measurable impact</i></p> <p><i>Plan for implementation, identify phases, stakeholders and timetable for action</i></p> <p><i>Collaborate and communicate to verify effectiveness of solution and take informed action</i></p>	<p><b>Case study/Resource</b></p>		
	<p><b>GORONGOSA RESOURCES</b></p> <p>Restoration and conservation efforts and strategies in Gorongosa National Park also address local community needs</p>		<p><a href="#">Conserving and Restoring Ecosystems</a></p> <p><a href="#">Restoring Mozambique's National Treasure</a></p> <p><a href="#">A Science-Based Approach to Restoring Gorongosa's Wildlife</a></p> <p><a href="#">Gorongosa National Park Interactive Map</a></p>
<p><b>Causes of change</b></p>		<p>Questions addressed by actionable claims/solutions</p>	
<p>The effects of war and <b>population growth</b> have disrupted the <b>ecosystems</b> in Gorongosa National Park: Sections of rainforest were <b>deforested</b> to make room for <b>agricultural activities</b> to increase <b>food availability/nutrition</b> for the <b>population</b>, which caused <b>erosion</b> of topsoil and impacted <b>freshwater availability</b>, affecting the <b>productivity/biomass</b> of the <b>ecosystem</b>. <b>Species ranges</b> were impacted due to <b>habitat loss</b>, limiting food availability. <b>Hunting</b> and poaching have led to the near <b>extinction</b> of several species. A large-scale <b>restoration</b> effort utilizing ingenuity and <b>innovation</b> is underway in Gorongosa to both conserve the local <b>ecosystems</b> and to improve the <b>quality of human life</b> for the Mozambican people.</p>		<p>How do we conserve ecosystems?</p> <p>When we try to restore damaged ecosystems, what state do we restore them? At what point might they recover on their own?</p> <p>Who are the stakeholders who can collaborate to mitigate/remediate environmental changes?</p> <p>How do we evaluate the effectiveness of conservation efforts?</p>	

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