Pattern Analysis of Student Thinking (PAST)

HS-LS2-6 ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE: DON'T BOX ME IN NIANGUA RIVER DARTERS ASSESSMENT TASK

PE

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.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment biodiversity.

DCI

HS-LS2-6:
Ecosystem Dynamics, Functioning, and Resilience:

- 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 becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

HS-LS2-7:
Ecosystem Dynamics, Functioning, and Resilience:

- Anthropogenic changes (induced by human activity) in the environment can disrupt an ecosystem and threaten the survival of some species.

Biodiversity and Humans:
(secondary to HS-LS2-7)

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity.
- Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.
- Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Developing Possible Solutions:

- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

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TASK 1 – *Interpret patterns of Darter distribution from a range map*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
In this task, students interpret visual data to make causal predictions about the Niangua Darter population and distribution changes over time. Students should connect the figure to the introductory information on page 1 to make their claim about possible causes. By having students consider the data necessary to explain the patterns, question 3 is intended to guide them to identify possible questions and observations for further investigation.	**Question 1** ● Described patterns related to Niangua Darter Population. ● Recognized patterns but did not describe. ● Description not relevant to Niangua Darter Population.	● "Fish seem to only be present near the ends of the tributaries" ● "Darters are isolated in smaller waters" ● "There are not as many now as there was before" ● "Most of the map is blue but there is some red"	Facilitate small group and whole class discussions in which students interact with the map and share their observations. Students can generate questions for a driving question board related to the data presented. These questions can be grouped and discussed so that students can see the value in asking investigable and researchable questions.
	Question 2 ● Students provide plausible causes for the decrease of the population and the distribution of the Niangua Darter ● Students provide incomplete or no cause or illogical cause or cause excluded based on text.	● "The presence of resources and absence of things trapping them" ● "More pollution and predators in larger waters" ● "Flowing downstream and being trapped there" ● "Overfishing of the species" ● "They like the water better there"	
	Question 3 ● Asked appropriate questions/observations. ● Asked unrelated questions/observations. ● Did not ask questions/observations.	● "Why are darters spread out in such small areas?" ● "What is present at the ends of the streams that isn't present in the other areas?"	

Focus SEP/CCC: Students use empirical evidence to predict specific causal factors that lead to changes in Darter population distribution. They ask questions that arise from careful observation of Darter population distribution data to seek additional information that explain the causes of patterns in the data.

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TASK 2 – *Make a claim about how low water crossings impact the environment and darter range expansion*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
The intent of this task is to have students connect the impact of human-created structures (low water crossings) on the stability of the river ecosystem. Specifically, students are expected to recognize how impacts of the crossings on the ecosystem also affect the movement of darters, which could reduce or improve their ability to expand their range into other parts of the river system. Students are asked to consider both positive and negative effects.	**Question 4** ● Described possible effects of installing low water bridges.	● Low water bridges do not get clogged, do not change elevation or velocity of the stream. ● Larger wider opening so large objects will not clog them. ● Easier for the fish to move.	Students can collaborate to discuss different outcomes for the river ecosystem as the low water bridges are installed. For each possible outcome that students propose, the class can ask questions about what possible observations or data would be seen if that outcome occurred. Guide the students to the idea of data serving as evidence for that outcome. This structure serves to scaffold students to be able to provide evidence to support the given claim in the task.
	Question 5 ● Student discusses the stability of the river ecosystem in relation to the installation of low water bridges.	● Easier for darters to move to new areas and expand populations and ranges. ● Could cause big fish to move in and eat all darters.	
	Question 6 ● Provided specific evidence to support and refute the claim. ● Provided minimal or irrelevant evidence.	● "Range and population would expand because removing barriers allows for migration to new areas." ● "Vented fords change elevation and velocity."	

Focus SEP/CCC: Students examine what is known about the small-scale mechanism of low water crossings to make and defend a claim about how their installation will impact river darter behavior based on evidence about the cause and effect relationships in the system.

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TASK 3 – *Use evidence and reasoning to support multiple claims about changes to darter population size after installation of low water crossings*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
In this final task, students are asked to make two different claims about how low water crossings changed the river darter populations which are supported by evidence. Since evidence for both claims comes from the same data set, to adequately support their thinking students must identify relevant data. Students should be able to evaluate data in order to determine how it supports or refutes a claim. Students should be able to provide logical reasoning for why and how the selected data supports or does not support a claim. Students should be able to make application of the DCI concept to the scenario.	**Question 7** ● Made a specific supportable claim. ● Made a generalized claim.	● "The population grew more, expanding into other streams." ● "Low water crossings helped the population increase due to a more available way for fish to move around."	Students can be provided with other scenarios that include claims with supporting evidence, and reasoning. Students can collaboratively evaluate the evidence for each claim to determine if the evidence and reasoning either supports or does not support the claim. Students can then be given a scenario with accompanying data and can work together to construct claims with evidence and reasoning for the given scenario. This will provide students the opportunity to practice evaluating and constructing claims with supporting evidence and reasoning.
	Question 8 ● Supporting evidence from text and maps is presented. ● Evidence presented is not relevant or does not support the claim.	● "Since construction, more than 55 miles of continuous habitat has been created." ● "There are long streams on the map."	
	Question 9 ● Students provide a reasonable alternate claim with supporting evidence and reasoning.	● "Perhaps they did not spread out rapidly because some of the 55 miles could not sustain them." ● "Fish could be exposed to more pollution and die off."	

Focus SEP/CCC: Students construct and defend written claims based on data and evidence about the effectiveness of low water crossings that reflects scientific knowledge about how human-induced changes to the river ecosystem affects the behavior and survival of darters. They propose causal relationships which recognize that changes in the system at the small scale of individual low water crossings may not have equal effects across the entire river system.

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