The Iterative Development of a Learning Progression Assessment Tool

Lea Bullard, University of Michigan School of Education

Amelia Wenk Gotwals, Michigan State University School of Education

Nancy Butler Songer, University of Michigan School of Education

Background

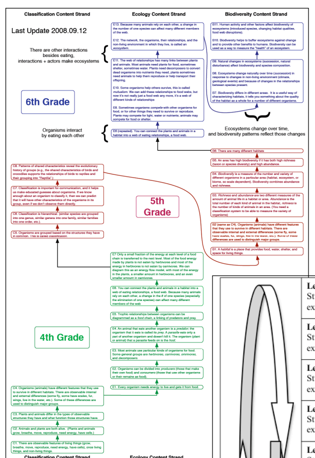
National science standards call for the development of complex thinking and reasoning skills by providing students opportunities to engage in practices such as asking questions, collecting and interpreting data, and explaining results (American Association for the Advancement of Science, 1993; Natioinal Research Council, 1996). Developing these abilities takes time, repeated exposures, and a scaffolding plan (NRC, 2000).

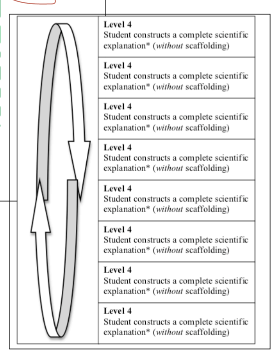
In work that is addressing these needs for science education, the *BioKIDS: Kids' Inquiry of Diverse Species* project has developed a learning progression that consists of a content progression and an inquiry reasoning progression focused on the development of evidence-based explanations.

We define learning progressions as

taking a stance about both the nature and the sequence of content and inquiry reasoning skills that students should develop over multiple curricular units and years. Learning progressions are successively more sophisticated ways of think about a topic that can be used a templates for the development of curricular and assessment products. Learning progressions-driven curricular and assessment products are one of several possible manifestations of a given learning progression. The learning progression can only be evaluated indirectly, through the evaluation of the curricular products, professional development modules, and assessment instruments that are constructed from the learning progressions template (Songer, Kelcey, & Gotwals, in press).

Using our learning progression template, we designed a set of tasks that mapped to the content and reasoning progression nodes. In order to gather rich evidence of how students at multiple ability levels construct scientific explanations, we created three ability levels of items based upon degree of scaffolding.





http://www.biokids.umich.edu

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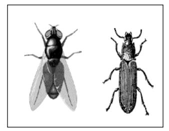
What types of tasks can elicit student understanding and skills?

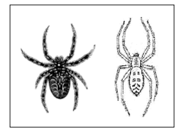
Iteration I

Shan and Niki collected four animals from their schoolyard. They divided the animals into two groups based on the physical characteristics of the animals:

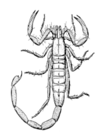
Group A



Group B



Below is a picture of a scorpion. Scorpions have several pairs of legs and a pair of claws. Scorpions also have a body with two parts (segments) and a tough outer covering.



Give a scientific explanation for the following question.

Scientific Question: Are scorpions more closely related to the animals in Group A or Group B?

Claim: Scorpions are more closely related to the animals in ____________________.

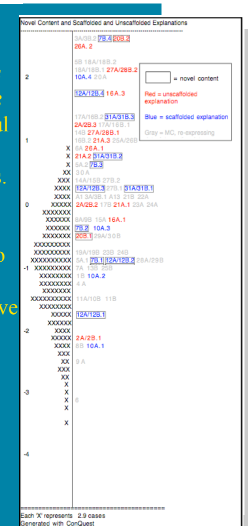
Evidence: Give 2 pieces of evidence to support the claim.

Reasoning: Provide the scientific reason that your evidence supports your claim.

Tasks that provide students of many ability levels with opportunities to show what they know:

Students were most successful at items with novel content when provided with scaffolds. Additionally, varying the degree of scaffolding allows learners more opportunities to articulate the middle knowledge between declarative fact and generating unscaffolded evidence-based explanations.

To attend to this, our revised assessment includes another level of scaffolding.



Tasks that have a high degree of curricular sensitivity to avoid student confusion and results distortion:

The first-round items were not presented in the format the students were used to seeing; because we do not focus on fading that particular support in our curriculum, we redesigned our second-round items to resemble the curricular activities.

Tasks that align with the cognitive processes of the learners:

Think alouds and cognitive interviews revealed that students tend to articulate their reasoning before their evidence. Our revised items reflect this.

Excerpt of think aloud:

Which two living things on David's lists are predators? The two living things on David's list that are predators would be snake grasshopper I mean snake and frog. I mean a snake would be a predator because predators eat on other living things and the things in the living things snakes eats are frogs and mice.

Iteration 2

This table shows school yard animal data collected using CyberTracker. Use the table to help you answer the question.

School Yard Animal Data

Animal Name	Zone A	Zone B	Zone C
Pillbugs	1	3	4
Ants	4	6	10
Robins	0	2	0
Squirrels	0	2	2
Pigeons	1	1	0

Write a scientific explanation for the following question.
Scientific Question: Which zone has the highest richness?

Make a CLAIM:
Write a sentence that answers the scientific question.

Hint: Think about the number of different types of animals in each zone.

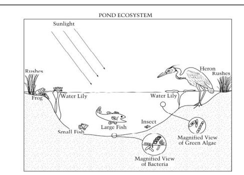
Give your REASONING:
Write the scientific concept or definition that you thought about to make your claim.

Hint: Think about the definition of richness.

Give your EVIDENCE:
Look at your data and find two pieces of evidence that help answer the scientific question.
1.

2.

Hint: Think about the richness of each zone.



Write a scientific explanation for the following question.

Scientific Question: If a rainstorm washed fertilizer into the pond, what would happen to the algae in the pond system after one month?

Make a CLAIM:
Write a sentence that answers the scientific question.

Give your REASONING:
Write the scientific concept or definition that you thought about to make your claim.

Give your EVIDENCE:
Look at your data and find two pieces of evidence that help answer the scientific question.
1.

2.

Item modified from NAEP (http://nces.ed.gov/NATIONSREPORTCARD/)

Conclusions

These examples are illustrative of our iterative approach to designing learning progressions assessment. We continue to refine assessment tasks that elicit student understanding along a learning progression so that we can draw valid conclusions about our progression. We attended to this in one round of our iterative process by increasing the opportunities for students of multiple ability levels to demonstrate what they know and can do, aligning our assessments increasingly tighter to our learning progressions template, and addressing the cognitive processes we observe in our students while they complete our assessment tasks.

References

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Songer, N., Kelcey, B., & Gotwals, A. (in press). How and when does complex reasoning occur? Empirically driven development of a learning progression focused on complex reasoning about biodiversity. *Journal of Research in Science Teaching*.