Unity and Diversity – Some Notes about Model-Based Reasoning

Much of the information here is replicated elsewhere—either in the materials for this triangle or as general resources on the website. However, since Unity and Diversity will be the entry unit for most classrooms, we’ve repeated…

Please be certain you’ve read the how-to guides on the website, including the materials and FAQs associated with the MBER Essentials page.

Here, we first provide you (yet again) with some information on the classroom “model moves” associated with facilitating model-based reasoning conversations. Then we highlight some specifics pertaining to Unity and Diversity since it will be your first time practicing the moves while discussing biology content.

**General PQM Notes**

Students will spend the year reasoning about patterns in nature (often data) we call “phenomena”. Often students will next generate a driving question that warrants an explanation. These are “how” or (even better) “why” questions.

“What?” kinds of questions are great, but they are really just a call for some more information about the phenomenon itself, not an underlying explanation. “What” questions are generally an opportunity to go deeper with the phenomenon, and you’ll see these kinds of moves throughout the curriculum as well.

Once students have a question that requires explanation, we usually try to elicit their initial ideas as soon as possible. The goal here is not to pull “correct” ideas into the classroom. Rather, the work of making student thinking explicit allows everyone to see what we already might know and where the holes in our understanding lie. The initial model ideas can be used to generate an initial explanation if appropriate. Going deeper into building the model enriches the explanation over time.

KEY for Model Moves:

(for more details, please see relevant information in the MBER Essentials on the website)

**Phenomena (P):** The Data or Pattern.

(Questions like “What?” go here too as they just ask the class to describe the phenomenon.)

**Questions (Q):** How/why? (These questions warrant further explanatory work.)

**Model (M):** Ideas used to answer questions (Q).

These are subject to revision, expansion, evaluation, etc.

The class can also move from one of these to another. For example, a learning segment might make the move “P🡪Q”. This means students are examining the phenomenon and working to generate a driving question. We often refer to such moves as “model moves”, even if they do not explicitly involve the “M” (model) vertex of the triangle.

**PQM in Unity and Diversity**

In Part 1, we are only dealing with the Phenomenon and Question. Students may have model ideas and the beginnings of an explanation depending on their background, but we don’t actually work to formally build a model until the very end of the year (in Part 2).

*In Part 2, this is accomplished in three ways:*

1. *students integrate all of the models developed throughout the year as they pertain to Natural Selection and also the Driving Question about Unity and Diversity; and*
2. *students connect ideas from the final model, speciation, to Unity and Diversity; and finally*
3. *students add common ancestry and descent with modification to round-out their understanding of how phylogenetic trees help us reason about Unity and Diversity.*

You will find that there are a number of ways to describe phenomenon, phrase driving questions, and list a series of consensus model ideas when doing this work with your students. The web page for each triangle/model describes the Phenomenon, Question and Model in a relatively succinct manner. However, your statements should almost always be driven by your students. So, if we looked across teachers and their classrooms, we might expect some variation among the descriptions of the phenomenon, the wording of the posted driving questions, and perhaps even some of the emphasized content of the model statements.

Even here in Unity and Diversity Part 1, the wording used in this document may not exactly reflect that on the website. But the spirit of what is being explored, and what is being made sense of, should be the same at its core. The following paragraphs detail some of the ideas you may explore in this triangle.

Broad P and Q for Unity and Diversity Part 1:

(P) There’s an incredible amount of biodiversity, yet all life shares some characteristics in common.

(Q) Why are all living things alike yet so different? (How did there come to be so much biodiversity on Earth and how did all those organisms come to have so much in common?)

*Unity-specific Model Moves:*

(P) What commonalities/unifying factors exist among all living things and how do we know (what is the evidence that supports this)?

(Q) Why do commonalties among all living things exist?

(M) Model ideas are amalgamated/generated/discussed in Unity and Diversity Part 2.

*Diversity-specific Model Moves:*

(P) Biodiversity can refer to either the differences that exist between different species or the variation within a species (or really can even refer to variation at other levels of organization). For our purposes, we are talking about biodiversity as the variation among species. Variation within a species will be addressed starting after model 2. *See note below.*

(Q) Why are there so many species and how did they come to be? How does biodiversity among species change over time?

(M) Students begin to generate model ideas to explain diversity among species as early as Model 2: Natural Selection, but all components of the model explaining diversity finally come together at the end of the curriculum in Unity and Diversity Part 2.

*A final note about P-Q-M and diversity WITHIN a species:*

Students may also ask about diversity *within* species. This will be addressed in some of the models that come late in the year, so you can parking lot these questions or you can go ahead and make them part of the overall question if that seems to make the most sense to the class. (Just be sure you’ve got the ideas about the big patterns of biodiversity among species for U and D Part 1.)

**(P)** Variation within species is a component idea in Natural Selection and helps us to explain how species change over time. Yet there are deeper questions we can ask about this intraspecific variation.

**(Q)** Why is there so much variation within a species and how did it come to be? In other words, what are some sources of variation and how did they come to be? (What evidence supports this?)

How is population diversity maintained (or not maintained)?

**(M)** Within a species, sources of variation include mutations, meiosis, fertilization, and differentiation, phenotypes (allelic expression). Natural selection both maintains and eliminates variation. These concepts are addressed throughout many models for the entire year and can transition us back to the Unity & Diversity component at the end of the year.