



Unity and Diversity

Big Patterns of Biodiversity in Our World
(Seeing the World as a Biologist)

Version August 2018

How to use these slides...

The following presentation was designed to support the implementation of the MBER-Biology curriculum—a student-centered sense-making classroom. It is NOT ready to show to students in its current form. You will notice there are two kinds of slides.

(1) **Teacher Notes slides** that provide information and notes for teachers and are not meant to be shown to students. These slides are marked by the colored band in the header (as displayed above on this slide).

(2) **Student slides** designed to facilitate student sense-making as you move through the Learning Segments and are intended for use in the classroom during instruction. In the “Presenter Notes” field you will find useful information for each particular slide.

We have combined teacher slides and student slides so you can have almost everything you need in one place as you explore the flow of each triangle. You will need to either hide (see note below) or delete the **Teacher Notes** slides to use it as a presentation in your classroom.

This presentation **is not meant to stand alone**, however. Instead, we hope you use it in conjunction with the website. As you step through the slides, reference the table on the triangle webpage (<https://www.modelbasedbiology.com/content/research-team/model-3-chemical-reactions-burning-ethanol>). The Learning Segments and associated resources outlined in the PowerPoint directly correspond to the Learning Segments described in the table featured on the webpage. It may also help you to print out and have the student Doodle Sheet in front of you. Looking over the table as you preview the slides will help you stay oriented to the overall flow, track which resources go with the segment and access additional supports all while keeping in mind the high-level goals of each learning segment and how the model is developed over the course of days.

We expect (and hope) you will modify this presentation keeping in mind the MBER philosophy. As a contributor you will be part of a community that helps improve the curriculum over time.

Thanks!

The MBER team

Symbols

We use these symbols to communicate to students the following actions:



Think



Share



Write down



Work in
research groups

PQM [For Teachers Only]

Because this is likely your entry triangle for the year, there are additional notes about phenomena, questions and models that can be found in downloadable resources (UD1 03 Supplemental Notes About Model-Based Reasoning). Be sure to read those notes for variations on the ideas here. The wording on this slides (for each triangle) may not reflect the website directly, but it should closely match the general spirit of what is written there.

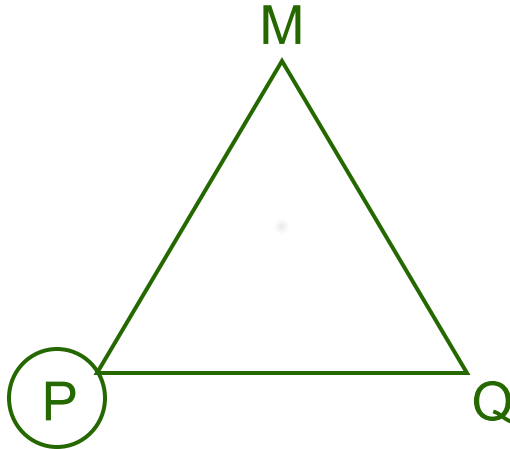
Phenomenon: Life is diverse, yet there are some commonalities across organisms. We can see patterns of "nested similarity" where some kinds of life are more similar than others. Among much of the diversity we see, there is a striking pattern where organisms are fairly well matched to their environments.

Question: What might account for these patterns of Unity and Diversity? OR How can all organisms on Earth share so many characteristics and yet be so different? (Have YOUR students generate some kind of reasonable question if possible. If not, give them a question or some questions that you feel are driving for the year.)

Model: No model at this time. Students may have some ideas that explain unity and diversity, but the curriculum doesn't address model-building for these big questions until the end of the year (see Unity and Diversity Part 2).

LS01 Teacher Resource: Learning Segment Overview

Time: 40-55 minutes



P: Students explore the phenomenon of biodiversity.

Resources you will need:

Odd-One-Out Images**

(prep on your own)

UD1 01 Odd One Out Teacher Notes

UD1 01 Odd One Out Student Handout

Websites of interest:

Check individual slides for resources.

MBER Essentials:

Norms of Conversation

Notes and Details:

Students work in groups on an activity called "The Odd One Out", which showcases some of our planet's biodiversity in sets of 4 or 5. At each station, students must decide in their group which organism is the "odd one out" and record their reasoning. There are many ways to go about setting up this activity, please read the teacher notes in their entirety.

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LS01 Teacher Resource: Notes

Your students are about to experience their first Biological Phenomenon. This activity takes some preparation so please read the teacher notes for the Odd One Out activity. Be creative with your groupings and enjoy the student conversations.

This learning segment is all about the activity; exploration and observation of the phenomenon. There are no right or wrong answers, but it is important that the students explain why they chose the organism as the odd one out.

Provide clear instructions for the students and tell them where to record their ideas. In this case, you can use the provided Odd One Out Student Handout or a similar resource of your own.

The discussion about the activity will take place in the next learning segment.

LS01 Teacher Resource: Notes

You must prepare the materials for the Odd-One-Out activity on your own. A couple of samples are pictured below from a classroom that uses a mixture of preserved and live specimens. Alternatively, download pictures from the internet. Remember, groupings should provide a relatively obvious choice for which organism is the “odd one”.



“Four Fish and One Starfish (Sea Star)”



“Plant Parts versus Fungus Parts”

Life on Earth



Directions for Odd-One-Out

1. Go to your lab table and inspect the items there.



2. Decide as a group which item doesn't belong with the others.

3. Write your answer and explain why you chose it.



4. When directed, move to the next table and repeat steps 1, 2, and 3.



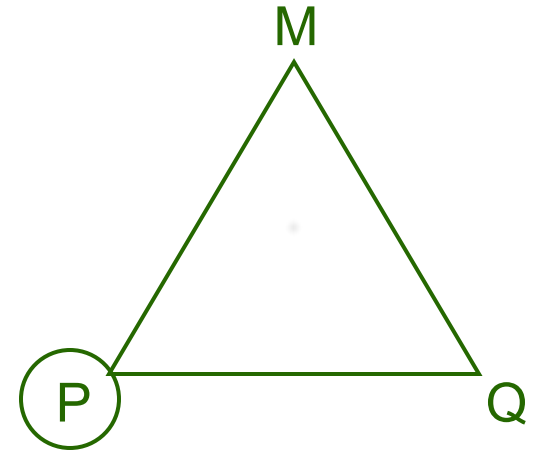
Helpful Guidelines

1. Many items are **VERY** fragile. If it is in a container, **DO NOT** remove it.
2. Especially important not to shake or tilt jars.
3. If you are looking at a part of something, for the purposes of the activity pretend you are looking at the whole thing.
4. If you're looking at something that is dead or preserved, pretend it is still alive.

LS01 Teacher Resource: What did we figure out?

What did we figure out?

Our planet is full of wonderful diverse organisms, and as different as they all are, they also have some similarities. In the next learning segment, we will discuss these similarities and differences.



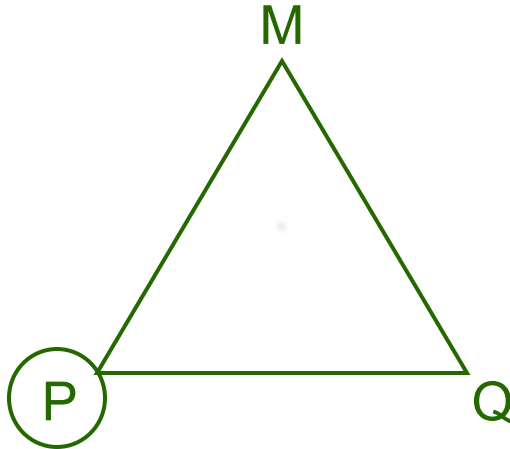
UD1 LS01 Teacher Reflection Notes:

Things that went well...

Things I would change...

LS02 Teacher Resource: Learning Segment Overview

Time: 10-15 minutes



P: Students process the activity and work to describe patterns of unity and diversity.

Resources you will need:

UD1 Doodle Sheet
(Odd One Sheets for reference)

Websites of interest:

Check individual slides for resources.

MBER Essentials:

Whiteboards
Norms of Conversation

Notes and Details:

We process the previous activity and generate a list of unifying characteristics of life. We also explore two additional patterns. First, we notice “nested similarity”, the idea that some kinds of organisms are more similar than others (despite the fact that ALL organism share certain features). This emerges directly from “The Odd One Out” activity.

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LS02 Teacher Resource: Notes

Students next see a second phenomenon by looking at an example of three praying mantis species. Students may observe that species' characteristics are related to their environments. These additional big patterns round out the list of phenomena students will next use to generate an overall driving question for the year.

In this segment your students will process the Odd One Out activity by discussing the kind of criteria they used to decide how the organisms were different and similar. This will lead them to the idea that as different as they all are they can all be grouped into a single category of living things.

The students (individually, then in pairs and then as a whole class) generate a list of what all living things have in common. Post this list in your classroom.

Students have now made 2 distinct observations that will be discussed in this learning segment.

1. There is a huge number of different, unique organisms.
2. Despite their differences, all organisms have many things in common.

This idea of organisms sharing similarities, lead to the practice of classifying living things.

In the last part of this learning segment students will look at different praying mantids and think about why they are so different. This discussion leads to the idea that the environment is somehow evolved with the diversity of life, and sets up the next learning segment and the development of the overall driving question for the year. Although the mantids provide an example of adaptation, don't worry too much about developing ideas around adaptation now as the students will explore adaptation later in in the year.



Discussion

Were you always in agreement?

What kinds of criteria did you use?

(And which were the most important?)

So there are lots of kinds of things and they look really different (aka “diversity”).

Is there any ONE category we could put them all into?

Yep – all are living things!



A tiny
sample of
> 8.75
million
species
on Earth
today.



Think about how you know they are living things. What is it about them that caused you to define them as “living”?



Write down your ideas about what ALL living things have in common in Doodle Box A.



Share with your partner.



Then add any new ideas (your partner's or yours) in Doodle Box B.

Commonalities

Initial class list:

What are the unifying factors/commonalities among all living things? (provide examples)



Record our class list in Doodle Box C.

We want a list that is complete, but as short as possible.

CHECK TO SEE:

- ✓ Is it true of ALL living things?
- ✓ Is there anything missing?

So far we have observed that:

- 1. There are a huge number of different, unique organisms (aka biodiversity)*
- 2. All organisms have many things in common.*



What thoughts (or questions) do you have about these two observations?



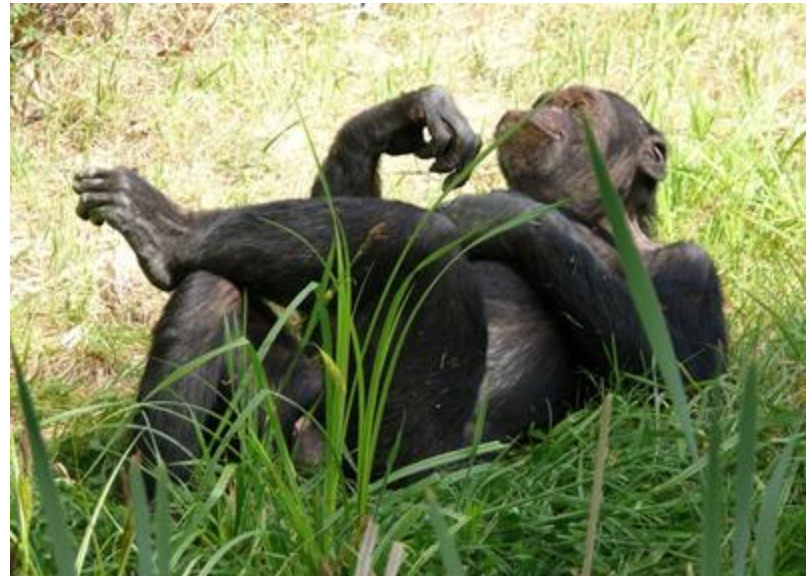
Record your thoughts/questions in Doodle Box D.

All organisms have some similarities, but when you grouped them, you found that some are more alike than others.

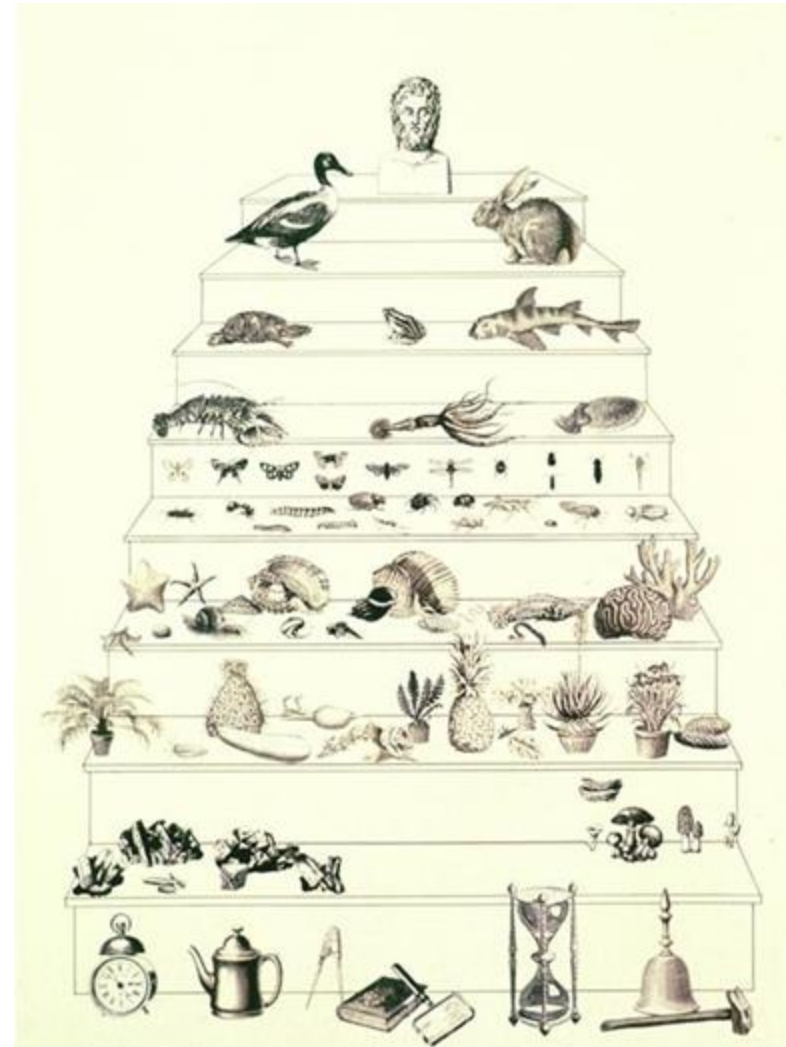
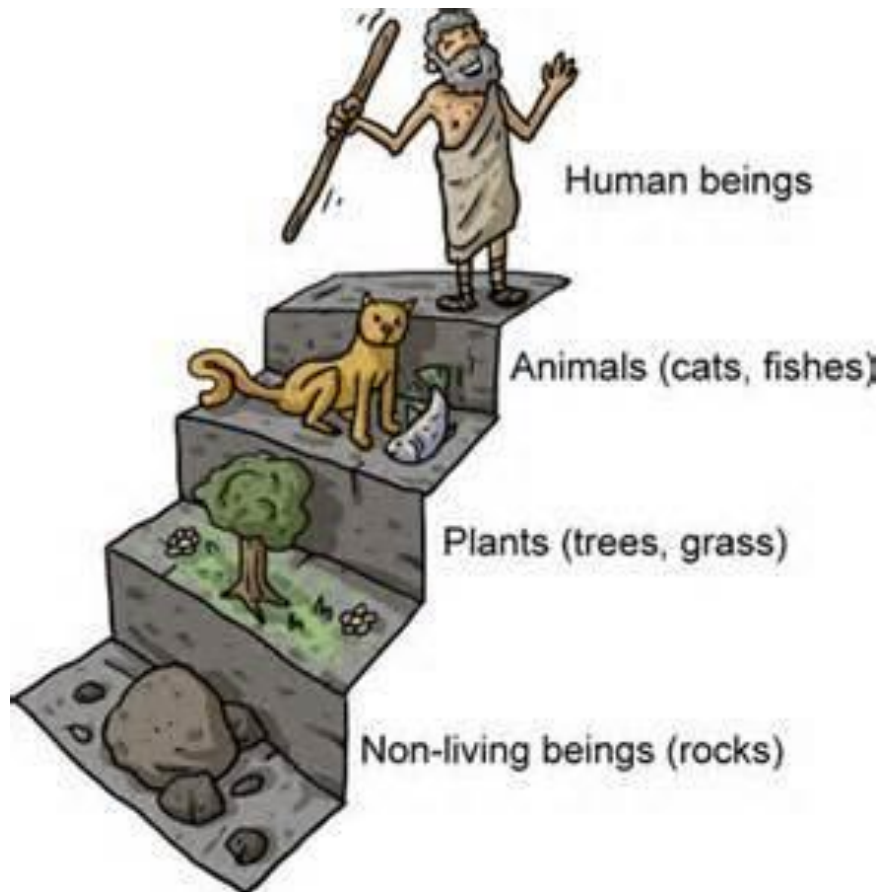


What do you think about this pattern?
What might it mean?

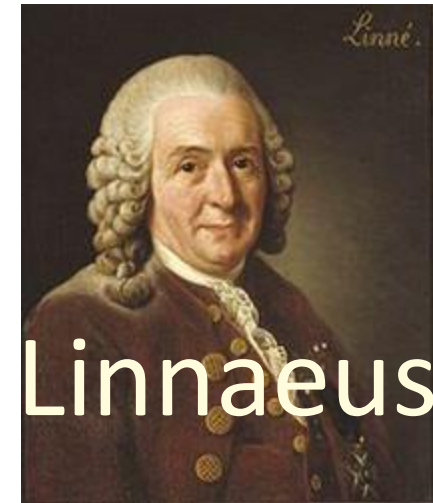
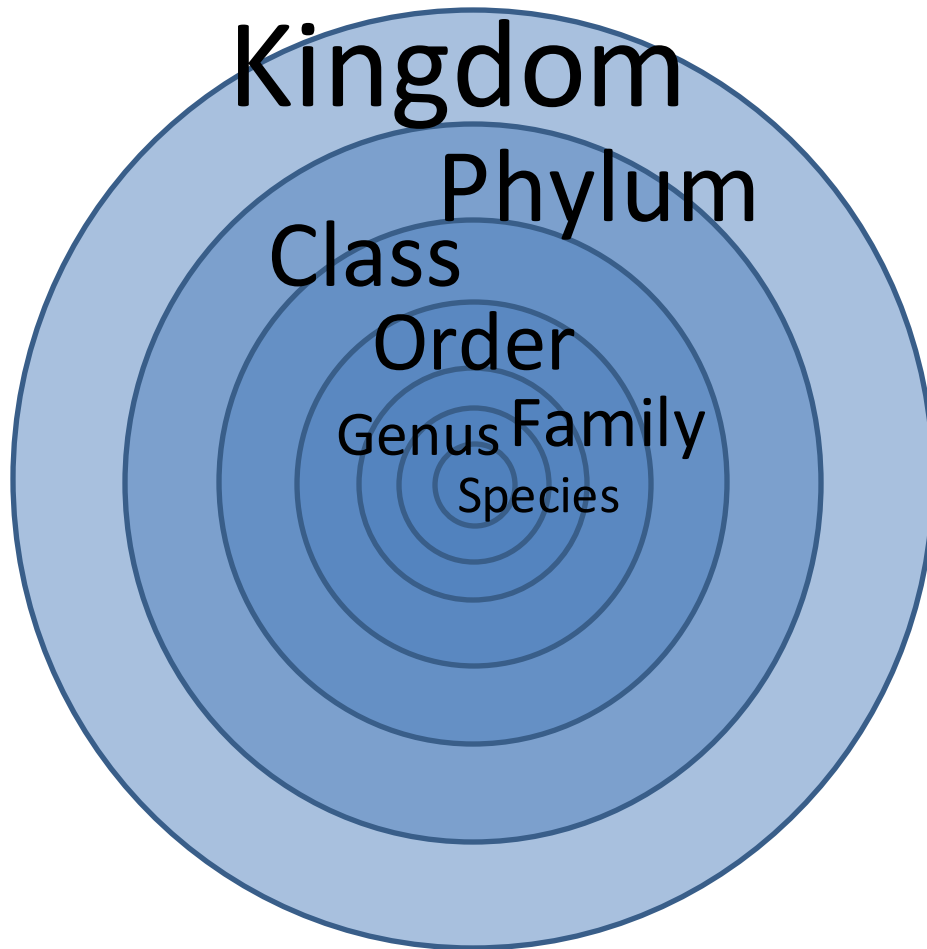
We see lots of similarities among living things, even between ourselves and other organisms.



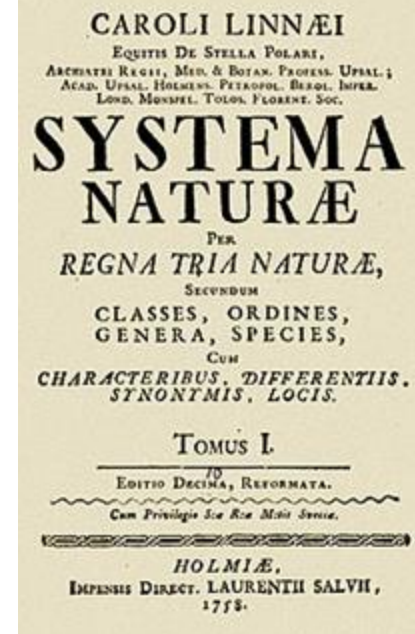
Humans have noticed these patterns throughout history and have tried classifying life in many ways.



We still use the “taxonomy” or organization of life put forward by Carl Linnaeus.



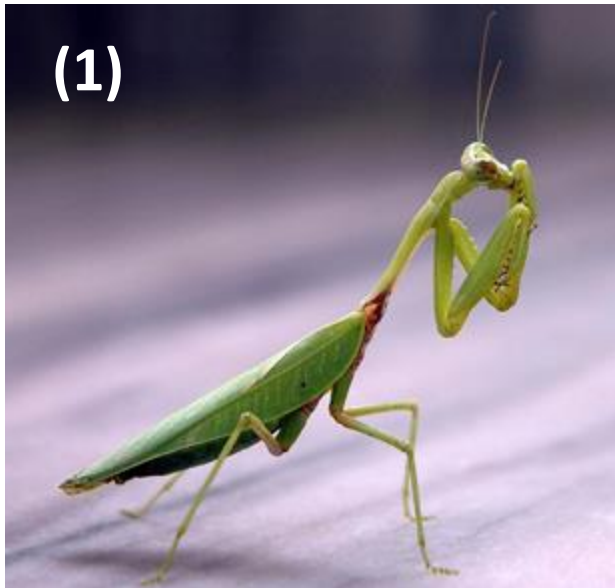
Linnaeus



Let's look at one last example of similarities and differences.

Think of a praying mantis.

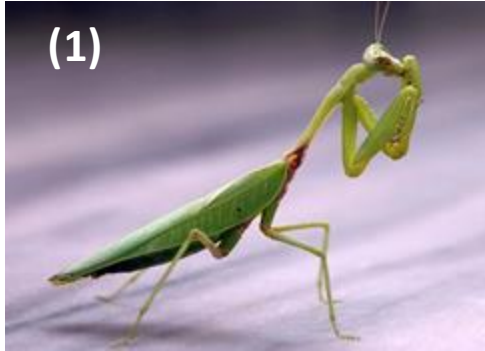
Is this what came to mind?



Then what about these?
Are they praying mantids?



<https://www.youtube.com/watch?v=QdfGCscTMak> - cool!



What might account for their differences?
What might account for their similarities?

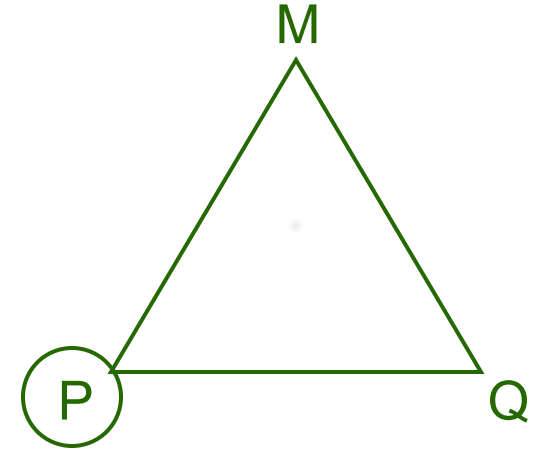


Write your ideas in Doodle Boxes E and F.

LS02 Teacher Resource: What did we figure out?

What did we figure out?

Despite all the diversity of life on our planet there are several characteristics that every living organism has in common. We also figured out that the environment plays a role in how similar organisms can be very different.



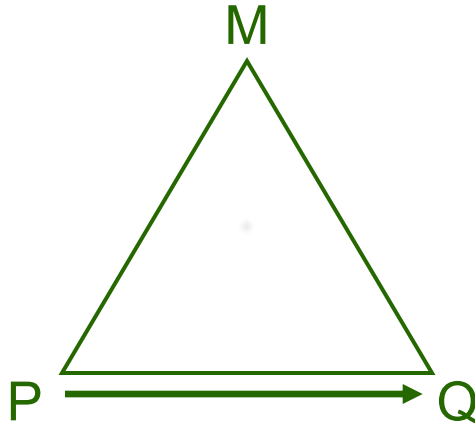
UD1 LS02 Teacher Reflection Notes:

Things that went well...

Things I would change...

LS03 Teacher Resource: Learning Segment Overview

Time: 20 minutes



P→Q: Students generate a driving question (and perhaps sub-questions) for the year.

Resources you will need:

UD1 Doodle Sheet
UD1 03 Supplemental Notes
About Model-Based Reasoning

Websites of interest:

Check individual slides for resources.

MBER Essentials:

Whiteboards
Norms of Conversation

Notes and Details:

Your students have now seen a broad pattern of unity and diversity among biological organisms. Additionally, they've seen patterns of “nested similarity” and the match between organisms and their environment. All of these observations constitute the Big Phenomenon for the year.

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LS03 Teacher Resource: Notes

Students will now develop their overall question for the year. It is important for the students to develop the question, but ok for you to message it into a question similar to: How are the organisms on our planet so different yet they share so many similarities. The students may even add a part about the environment. (What role does the environment play in the differences and similarities of life on our planet?)

Decide how you will co-generate the driving question.

Students can work in groups to come up with multiple candidate questions. After each group shares their question, the class can come to a consensus about which question, or combination of questions makes the most sense.

It is up to you how much you want/need to direct generation of this question. It should relate to unity and diversity as a pattern and be a sense-making questions (a “how” or “why” question that warrants a deeper explanation). Students will return at the end of the curriculum to try an answer it, so it needs to be rich enough. And don’t worry about getting the exact, “right” question. You and your students can always revise and add to this question.

Many possible sub questions exist within this broader question: Be mindful to take the opportunity to address any sub-questions students may generate as opportunities arise throughout the year.

Write the question on poster paper and post in the classroom. This will help to remind everyone that one of your goals for the year is to make sense of several models so you can fully answer the Overall Question of the Year.

In summary:

→ Have STUDENTS generate their OWN QUESTION as much as possible.

SAMPLE QUESTION: “How did there come to be so much biodiversity on Earth and how did all those organisms come to have so much in common? (In other words, How are living things alike yet so different?)”

*And maybe- “Why are some organisms more similar than others?”

Also, remember there is no model development here. Acknowledge that we aren’t going to answer the question now. and be explicit with students that you’ll come back to looking at this pattern again at the **end** of the year. They’ll have a chance to see how much they’ve learned!

OVERALL QUESTION FOR THE YEAR:

[insert question here]

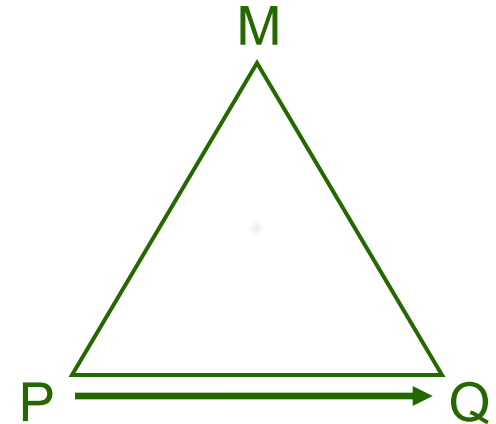


Let's record this question
(or these questions) in Doodle Box G.

LS03 Teacher Resource: What did we figure out?

What did we figure out?

We formed a question about life on this planet that will drive the year's instruction. We wondered about the phenomena of life being so different yet having several similar characteristics, and we wondered about the role the environment plays in all this unity and diversity. We will work throughout the year to develop a series of models that will help us answer our overall question at the end of the year.



UD1 LS03 Teacher Reflection Notes:

Things that went well...

Things I would change...