Modeling Scientific Practice in High School Biology

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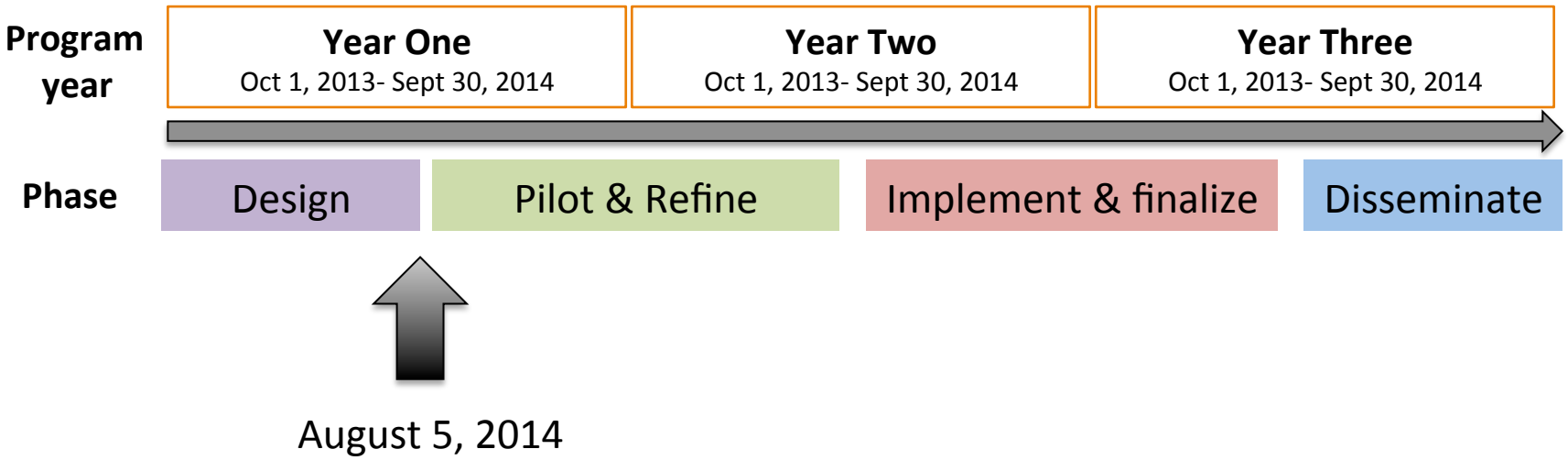
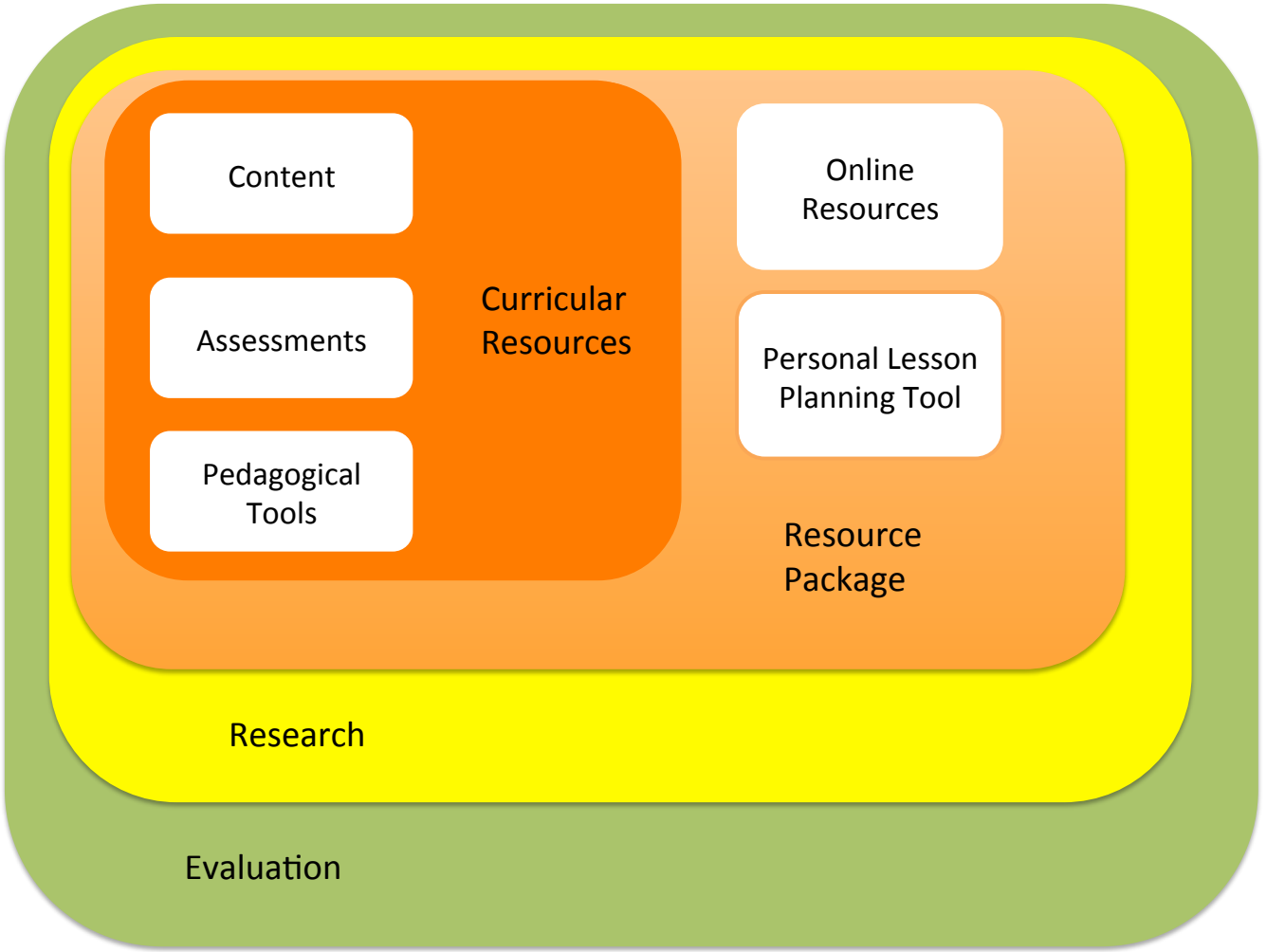
University of California, Davis

PI Meeting, August 5, 2014

The end goal: A yearlong NGSS-aligned curricular resource package for high school biology





Model-**B**ased **E**ducational **R**esource

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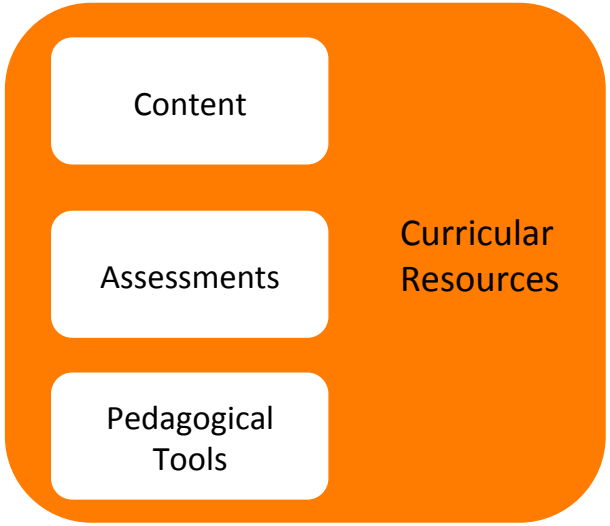

Model-**B**ased **E**ducational **R**esource

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Effective NGSS Curriculum

- Focused on student sense making
- Coherent, rigorous, focused on big ideas
- Leverages diversity of students' experiences
- Educative for teachers and students

Carlson, Davis, Buxton, 2014

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MBER Contribution to Theory and Practice

Theory: How can a focus on **model-based reasoning** support design of effective NGSS curricula?

Practice: What does this look like? In classrooms? For teachers? For students?

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Carlson, Davis, Buxton, 2014

What is a scientific model?

"Few terms are used in popular and scientific discourse more promiscuously as model."

– NGSS Framework

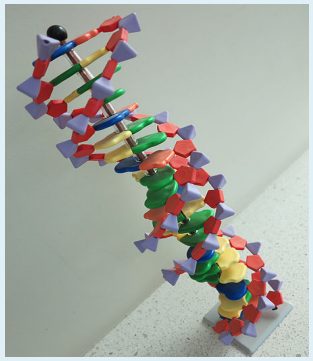
What is a scientific model?

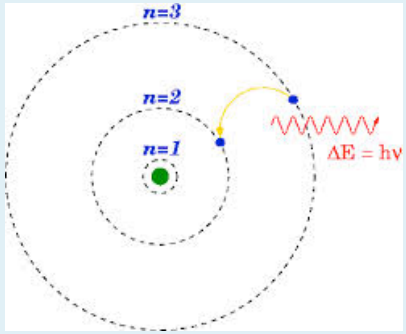
Models are **reasoning tools** that are developed and used by *cognitive agents* for the purpose of generating and refining *explanations* that address *questions* about *phenomena* in the world.

Models “of” vs. models “for”: A heuristic for recognizing and supporting model-based reasoning in the science classroom.
Gouvea and Passmore, in prep.

Models “of” vs. models “for”

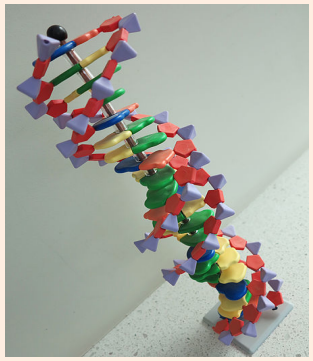
knowledge *of*

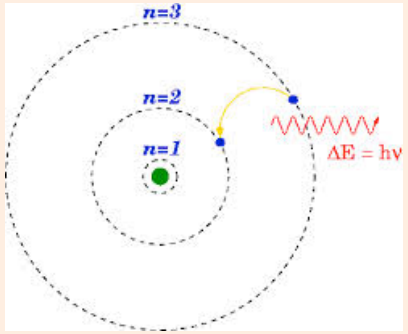




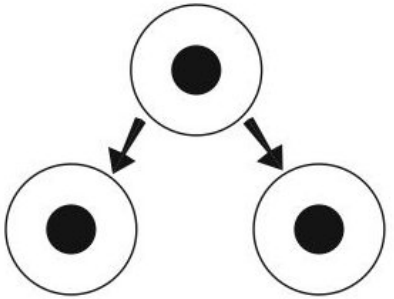
Models “of” vs. models “for”

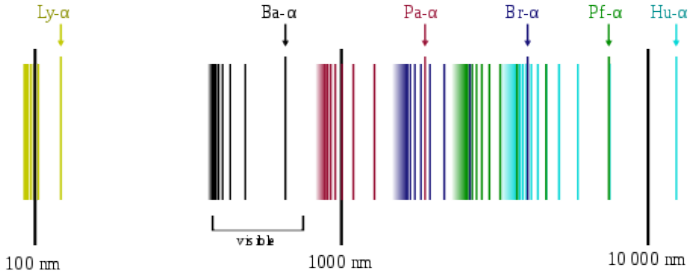
tools *for*





reasoning about





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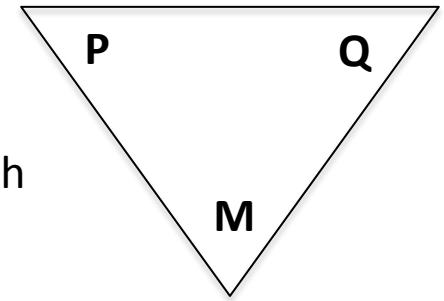
Model Triads

Phenomenon

- What are the puzzling patterns in the world about which we want students to reason?
- How to engage students with that phenomenon?



Question

- How to focus and bound the classroom inquiry?
- What is the explanation we want students to be able to generate?

Model

- How to make the relevant ideas clear and public for students?
- How to represent those ideas?

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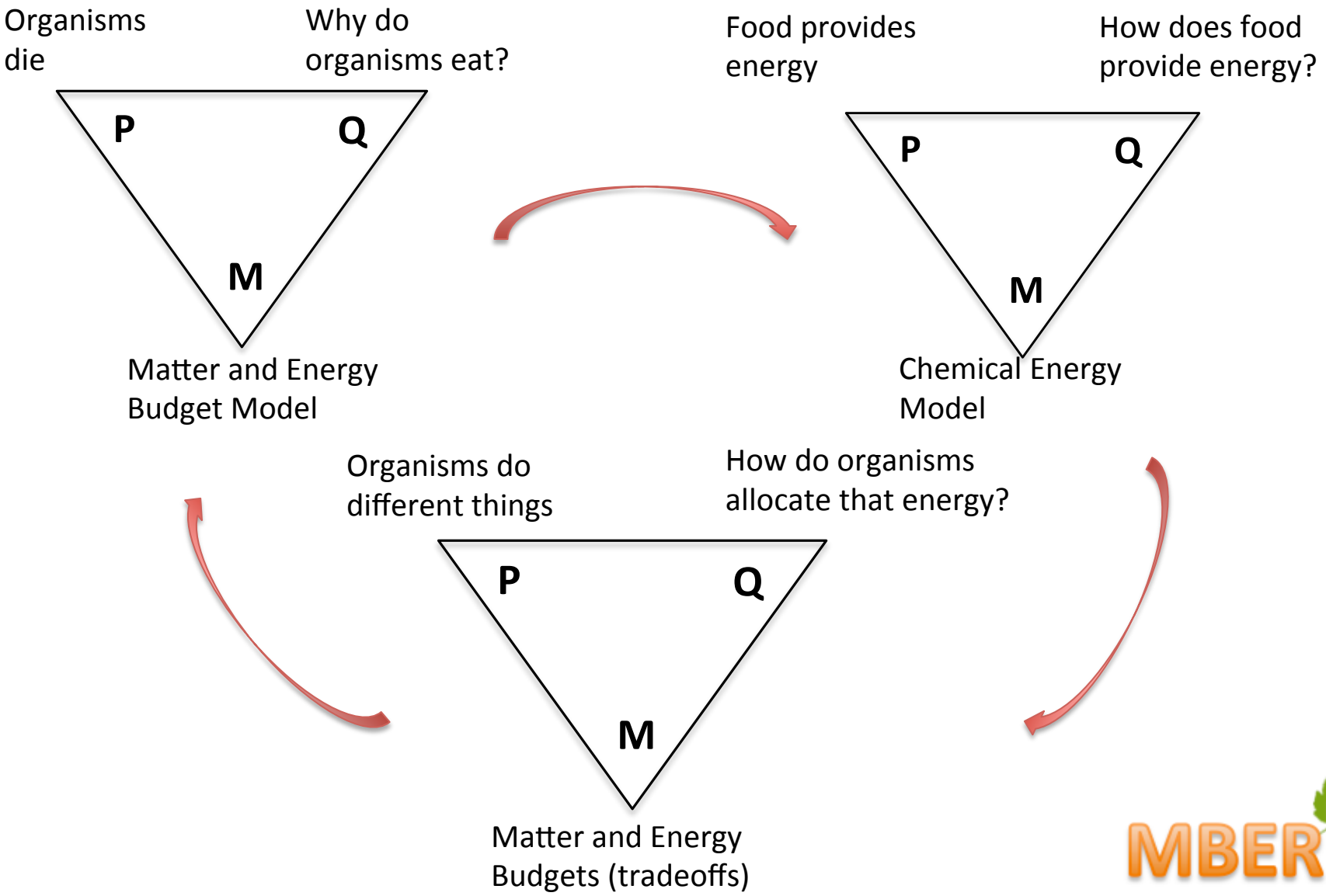
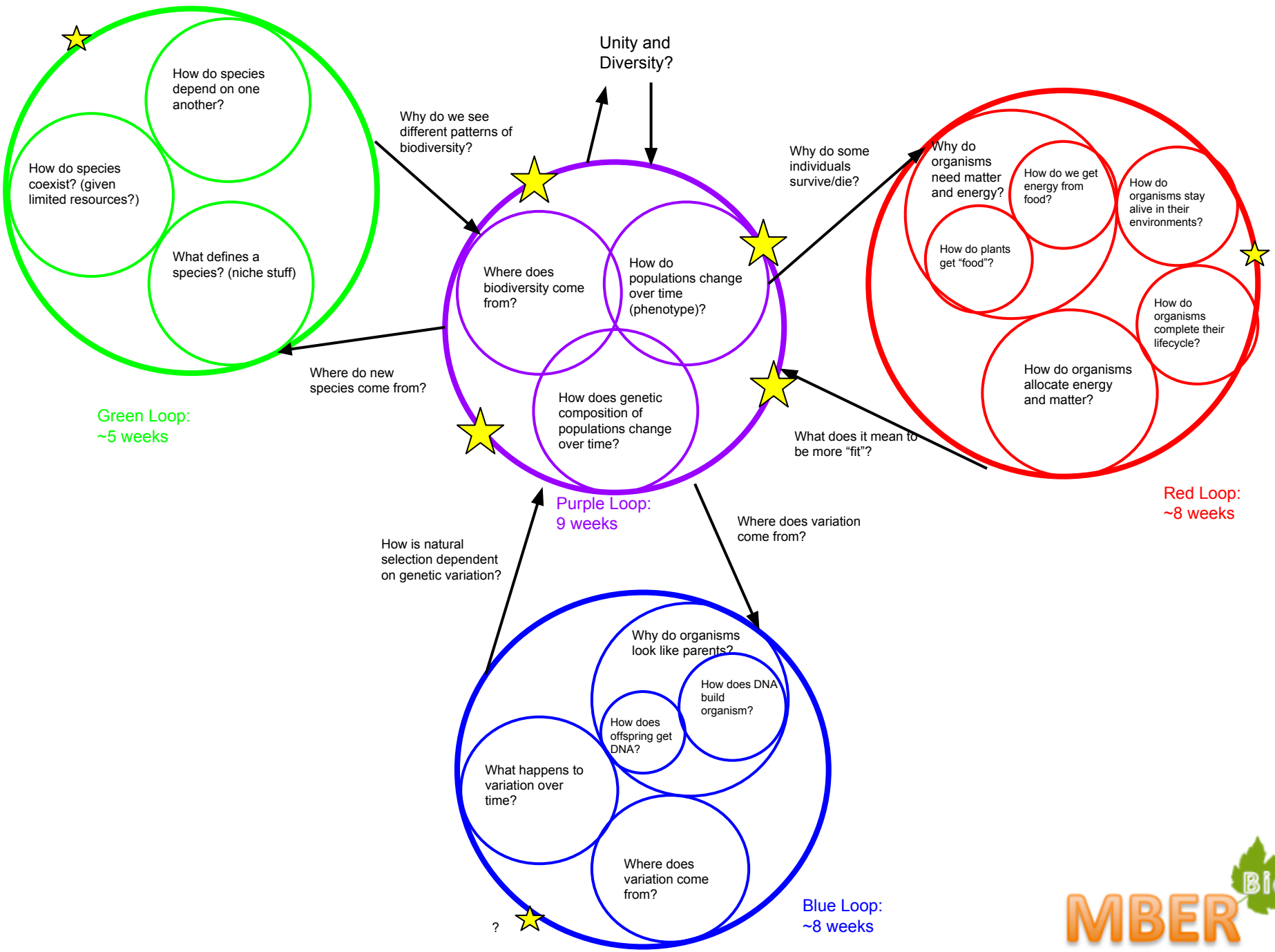
Coherence and Model Triads




Unity and Diversity?
How do species depend on one another?
How do species coexist? (given limited resources?)
What defines a species? (niche stuff)
Green Loop: ~5 weeks
Why do we see different patterns of biodiversity?
Where do new species come from?
Where does biodiversity come from?
How do populations change over time (phenotype)?
How does genetic composition of populations change over time?
Purple Loop: 9 weeks
Why do some individuals survive/die?
What does it mean to be more "fit"?
Why do organisms need matter and energy?
How do we get energy from food?
How do organisms stay alive in their environments?
How do plants get "food"?
How do organisms complete their lifecycle?
How do organisms allocate energy and matter?
Red Loop: ~8 weeks
How is natural selection dependent on genetic variation?
Where does variation come from?
Why do organisms look like parents?
How does DNA build organism?
How does offspring get DNA?
What happens to variation over time?
Where does variation come from?
?
Blue Loop: ~8 weeks

Model-based NGSS Curriculum

- **Coherent, rigorous, focused on big ideas**
  - looping structure as models are developed and refined
  - loops reflect chains of questioning through model hierarchy
- **Focused on student sense making**
  - model triads keep models for making sense of phenomena
- Leverages diversity of students' experiences
- Educative for teachers and students

MBER Team

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- Arthur Beauchamp
- Rich Hedman
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