

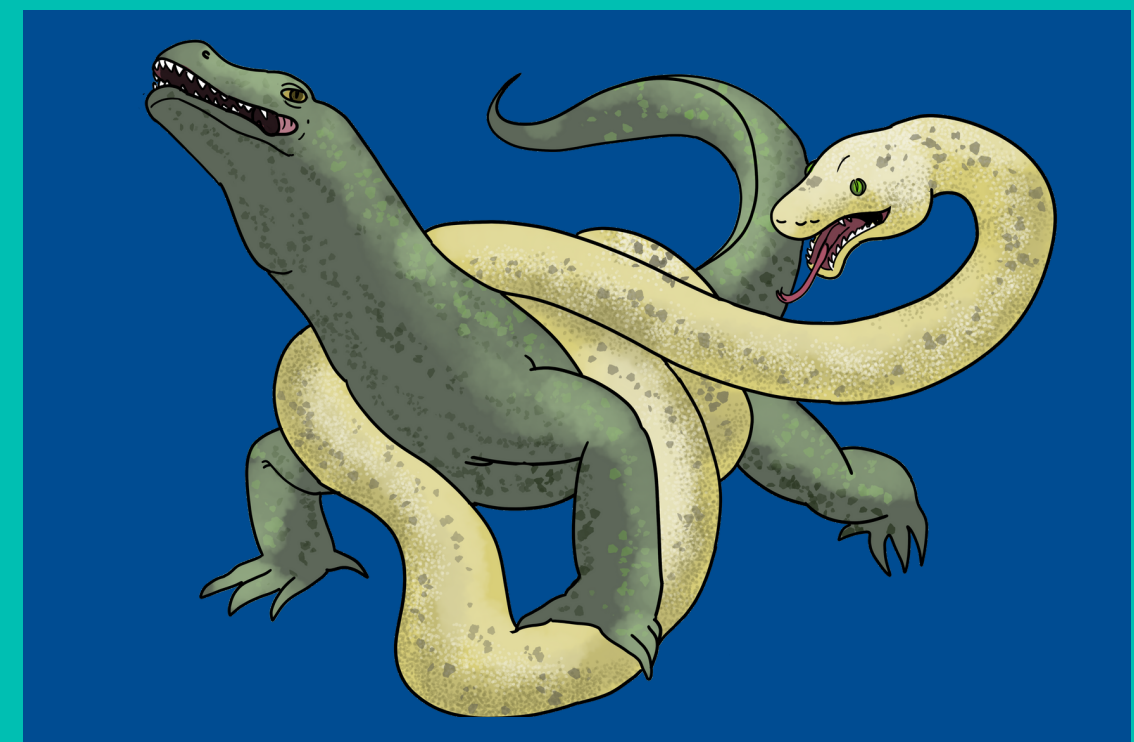
NCSE
National Center for
Science Education

Evolution Lesson Set One

The Origin of a Species: A Snake in the Grass

<https://ncse.ngo>

LIN ANDREWS
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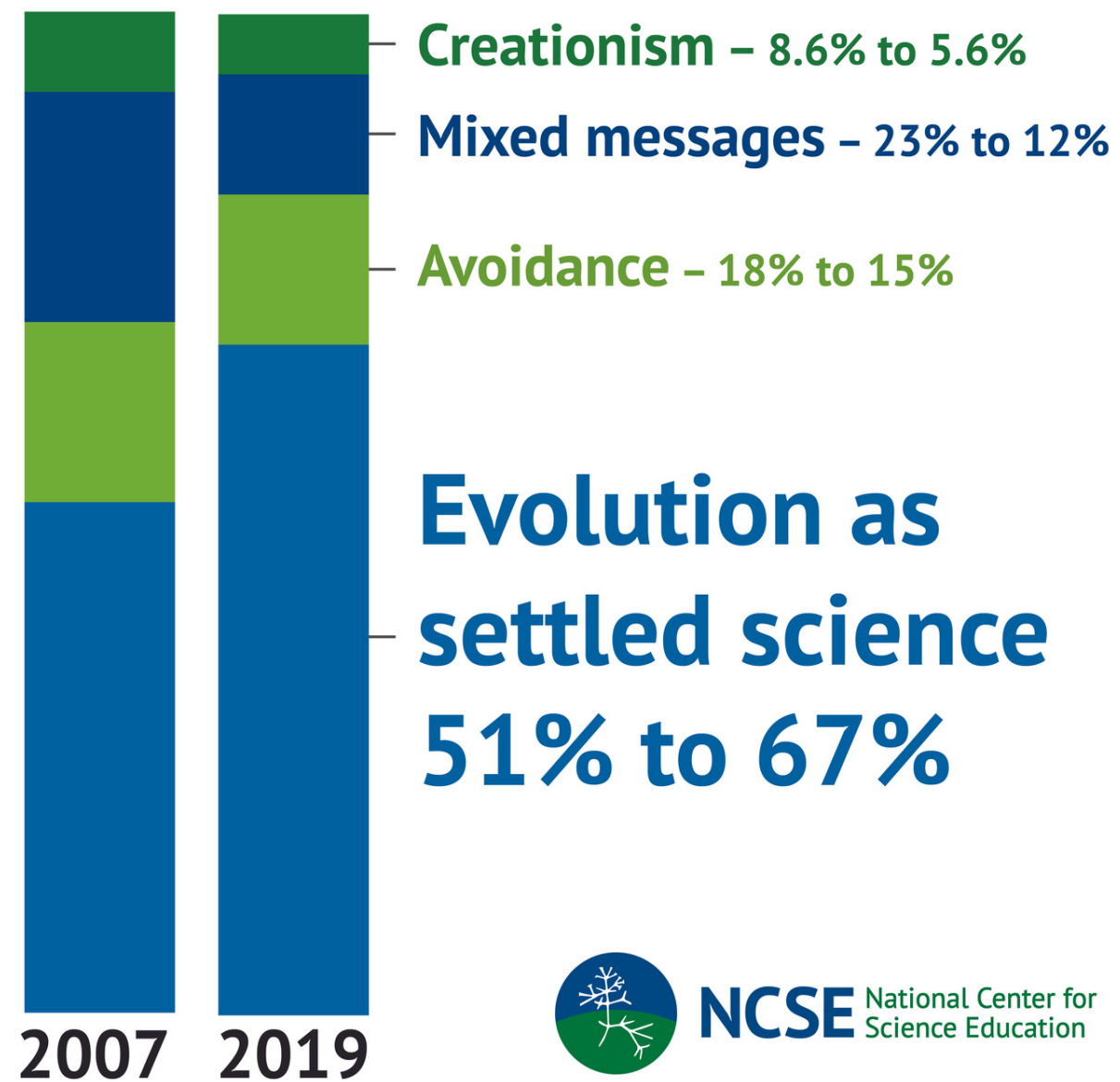
NCSE Supporting Teachers Program Team





33% of teachers don't teach
evolution as settled
science.

CITATION: Plutzer, E., Branch, G. & Reid, A. Teaching evolution in
U.S. public schools: a continuing challenge. *Evo Edu Outreach* 13,
14 (2020). <https://doi.org/10.1186/s12052-020-00126-8>



The Good News

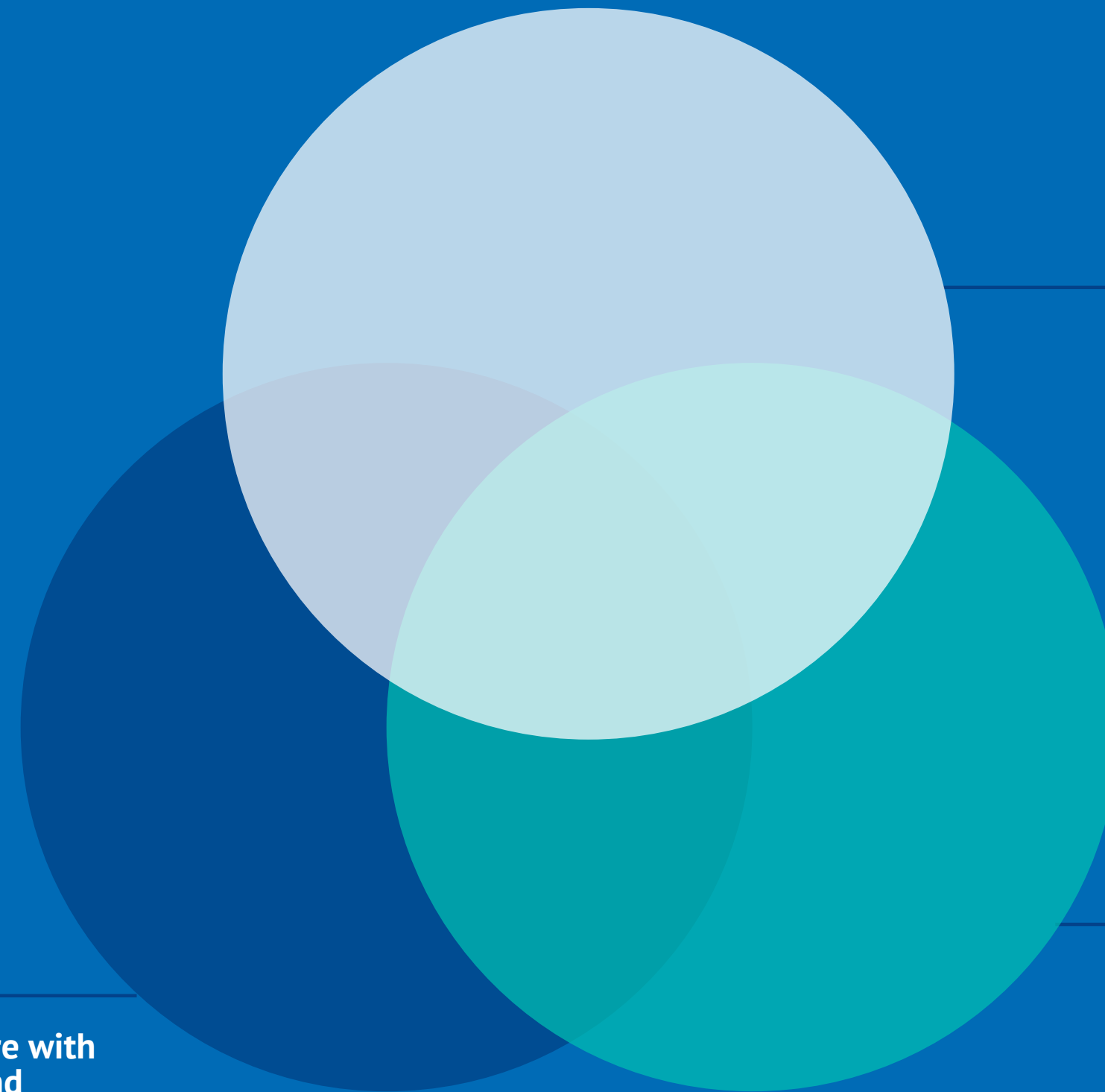
SURVEY COMPARISON

Citation:

Plutzer, E., Branch, G. & Reid, A. Teaching evolution in U.S. public schools: a continuing challenge. *Evo Edu Outreach* 13, 14 (2020).



NCSE Works to Improve Science Education



Supporting Teachers

NCSE gives science teachers the tools and skills they need to help their students overcome misconceptions and misinformation about climate change, the nature of science, and evolution.

Investigating Science Education

NCSE aims to produce high-quality research relevant to understanding, maintaining and improving science education, especially with regard to socially but not scientifically controversial topics.

Catalyzing Action

NCSE vigilantly monitors efforts to interfere with the accurate teaching of climate change and evolution and strategically mobilizes local communities and educators to respond effectively when problems arise.



**MISCONCEPTION
BASED
APPROACH**



**LESSON
FLEXIBILITY**



**FUN & ENGAGING,
BUT THOUGHT
PROVOKING**

Teacher Support Program

-What Makes Us Unique?





NCSE Classroom Resources

NCSE Evolution Lesson Set One The Origin of a Species: A Snake in the Grass



Evolution Lesson Sets



Target Misconceptions

ADDRESSING & DEBUNKING



MISCONCEPTION ONE:

Every species arose uniquely.

MISCONCEPTION TWO:

Evolutionary processes cannot result in significant changes -- including the emergence of new species -- in populations over time.

MISCONCEPTION THREE:

No one has observed speciation.

MISCONCEPTION FOUR:

Organisms of different species have vastly different DNA sequences, resulting in different characteristic traits.

FALLACY

FACT

Next Generation Science Standards

SEP

Asking Questions and
DEfining Problems

Analyzing and Interpreting
Data

Construction epxlans
and Designing Solutions

DCI

LS4.A Evidence of Common
Ancestry and Diversity

LS4.C Adaptation

CCC

Patterns

Cause and Effect



NCSE Teacher Ambassador

Evolution Lesson Set One Lead Writer



REBECCA BREWER

Michigan HS Teacher

Besides teaching and leading professional learning opportunities, Rebecca has recently co-authored the third edition of *Biology Now*, a high school biology textbook. She also trains teachers in the use of MiniOne Systems, as well as creates digital educational resources for Science Friday and PBS NewsHour Extra. Most recently, Brewer was selected as a BSCS teacher co-designer for the Climate Education Pathways curriculum currently in development.

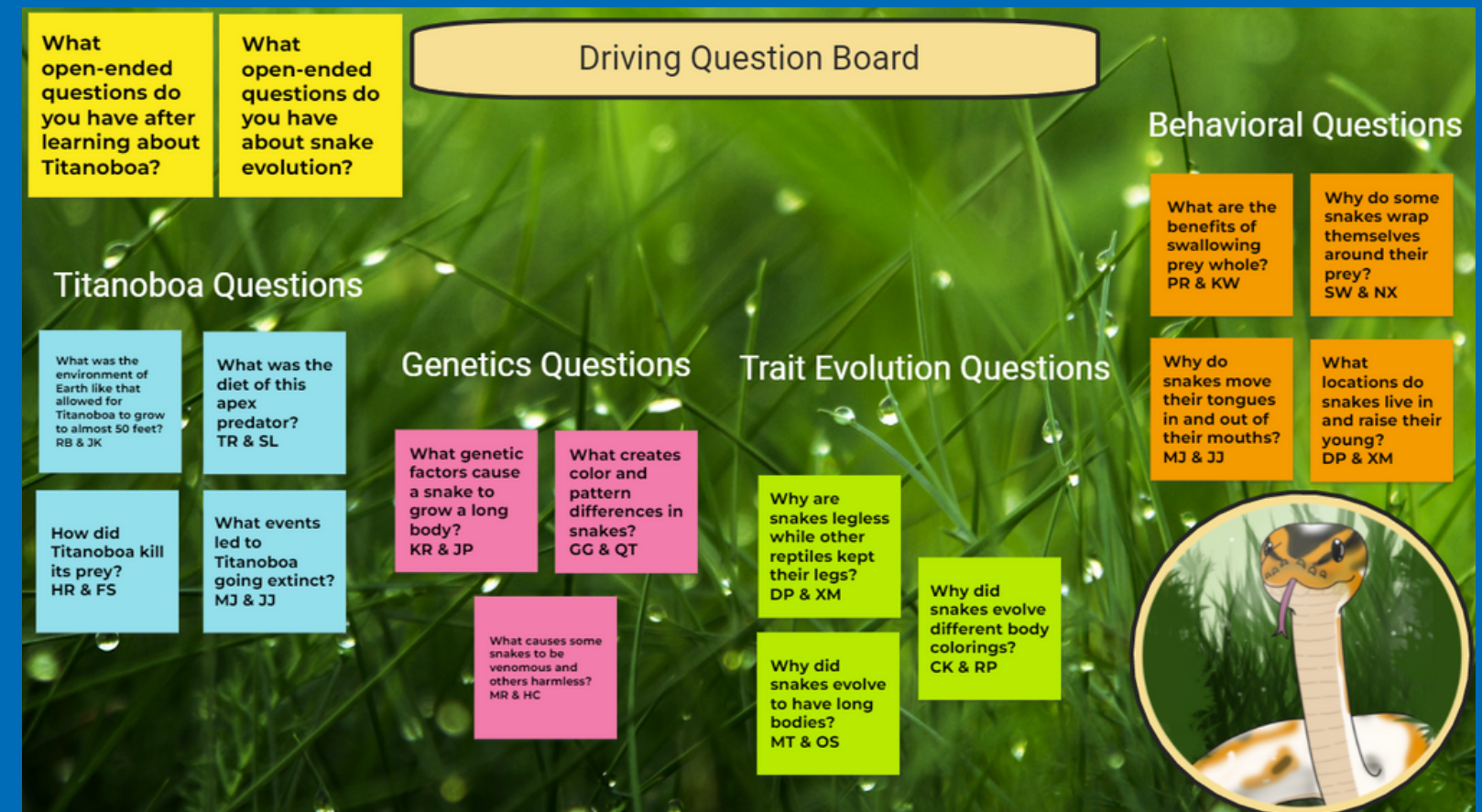
Brewer also serves as the National Association of Biology Teachers OBTA Director for Michigan and was an OBTA honoree herself in 2008.



Anchoring Phenomenon: A Titan of a Snake

What was the largest snake to ever live?

- Show *Smithsonian Channel* video featuring *Titanoboa cerrejonensis*
- Model the size of *Titanoboa*
- Generate a driving question board



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Titanoboa compared to today's heaviest and longest snakes



Green anaconda compared to *Titanoboa*



Titanoboa compared to a reticulated python

Part A: Back-to-Back

What evidence is there that Titanoboa was the largest snake that ever lived?

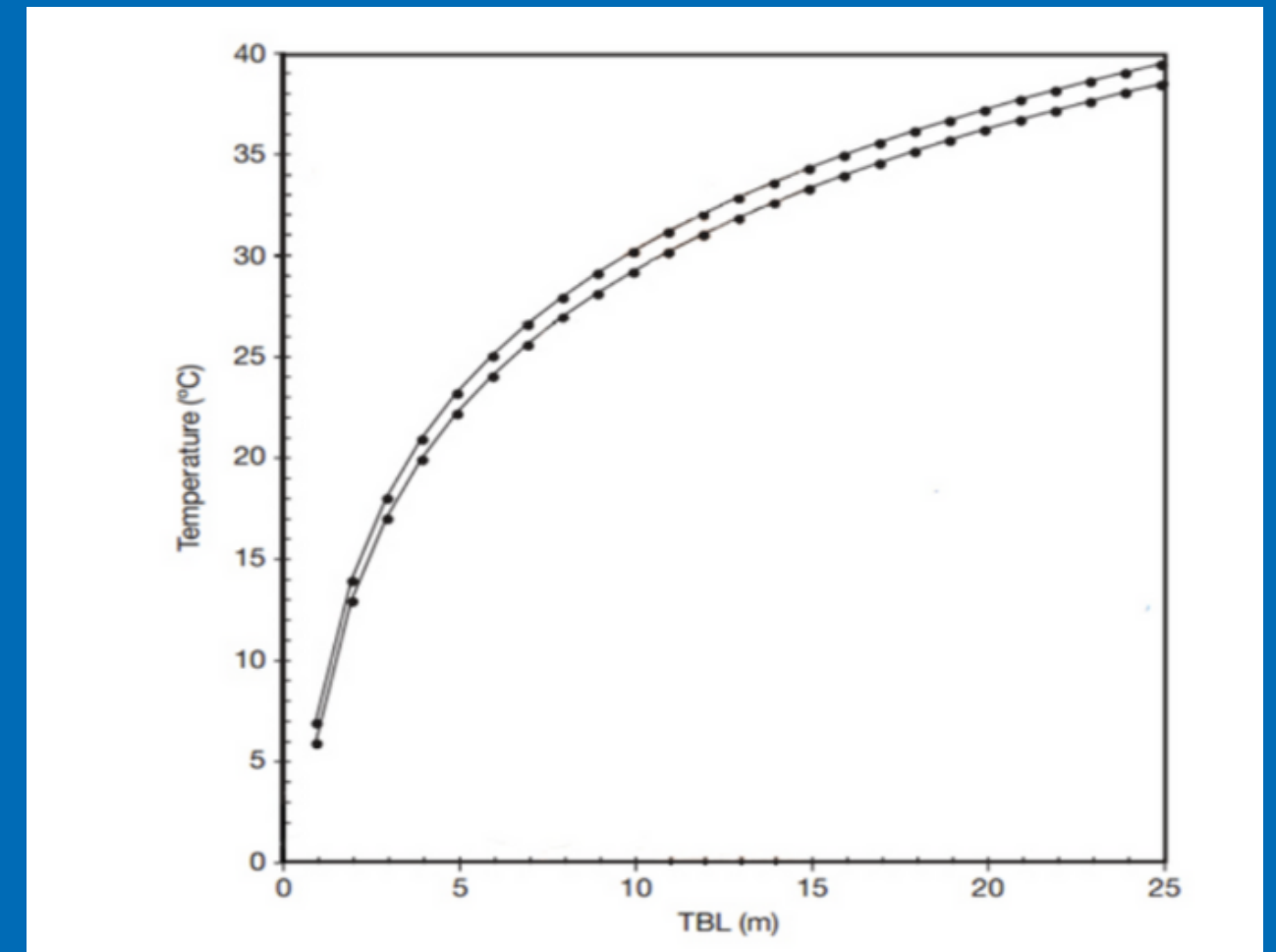
- Learn about the 2004 discovery of *Titanoboa cerrejonensis* in Columbia
- Join the research team to measure vertebrae (3D prints or cards), then calculate body lengths

What factor contributed to Titanoboa growing so large?

- Analyze graphs to determine the role of temperature on body size



Dr. Jonathan Bloch of the University of Florida



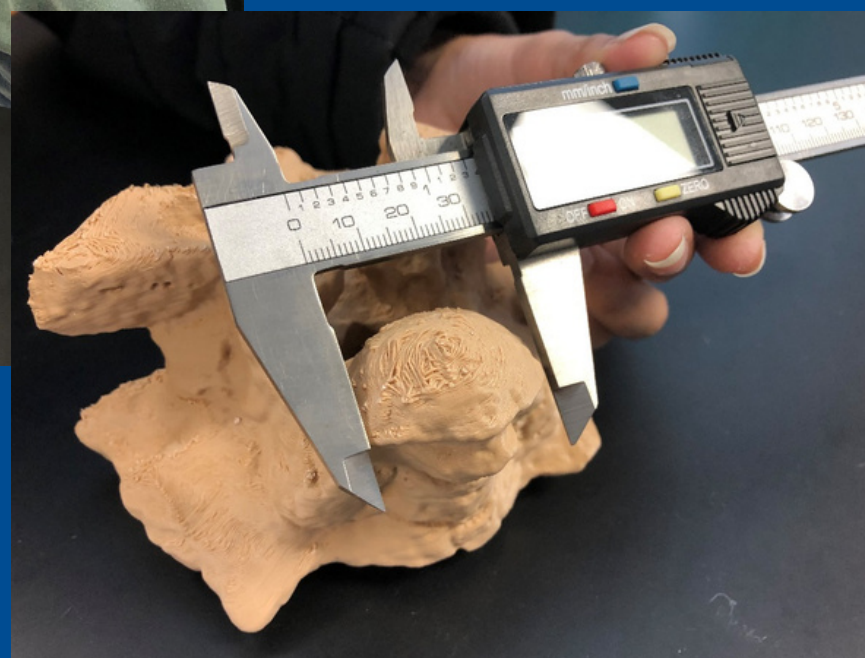
Based on a teacher resource from PaleoTEACH



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Comparing Snake Vertebrae

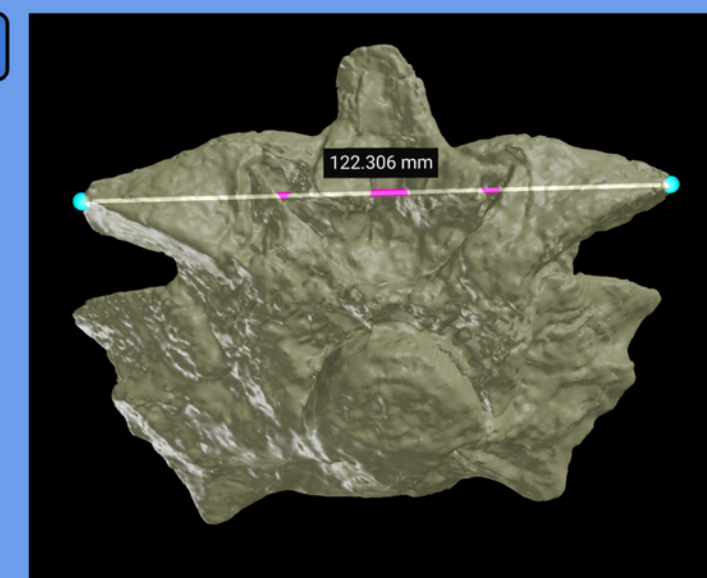


3D printed vertebrae option



Titanoboa
Titanoboa cerrejonensis

Sample One



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Evolution Lesson Set 1: A Snake in the Grass

Card vertebrae option

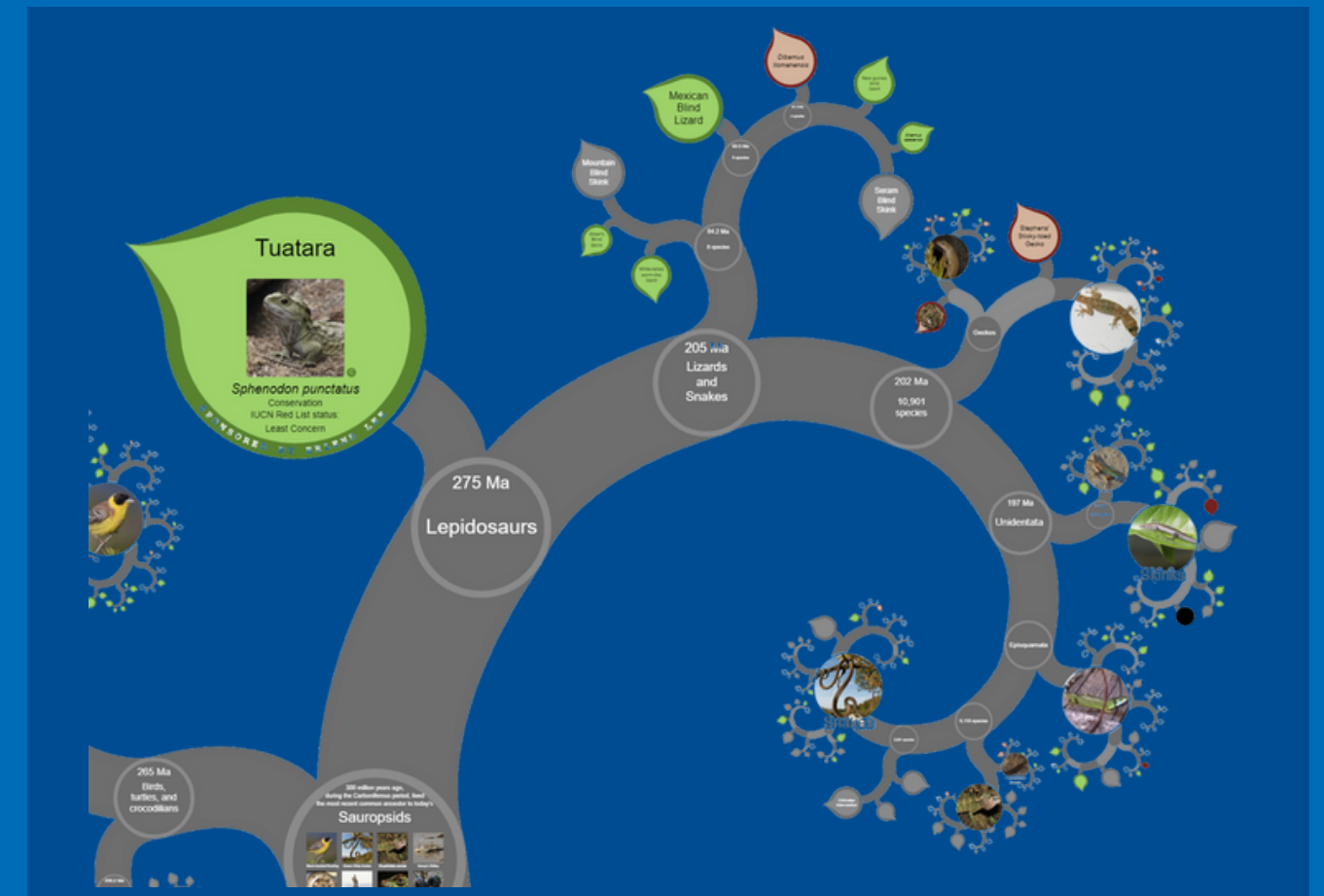
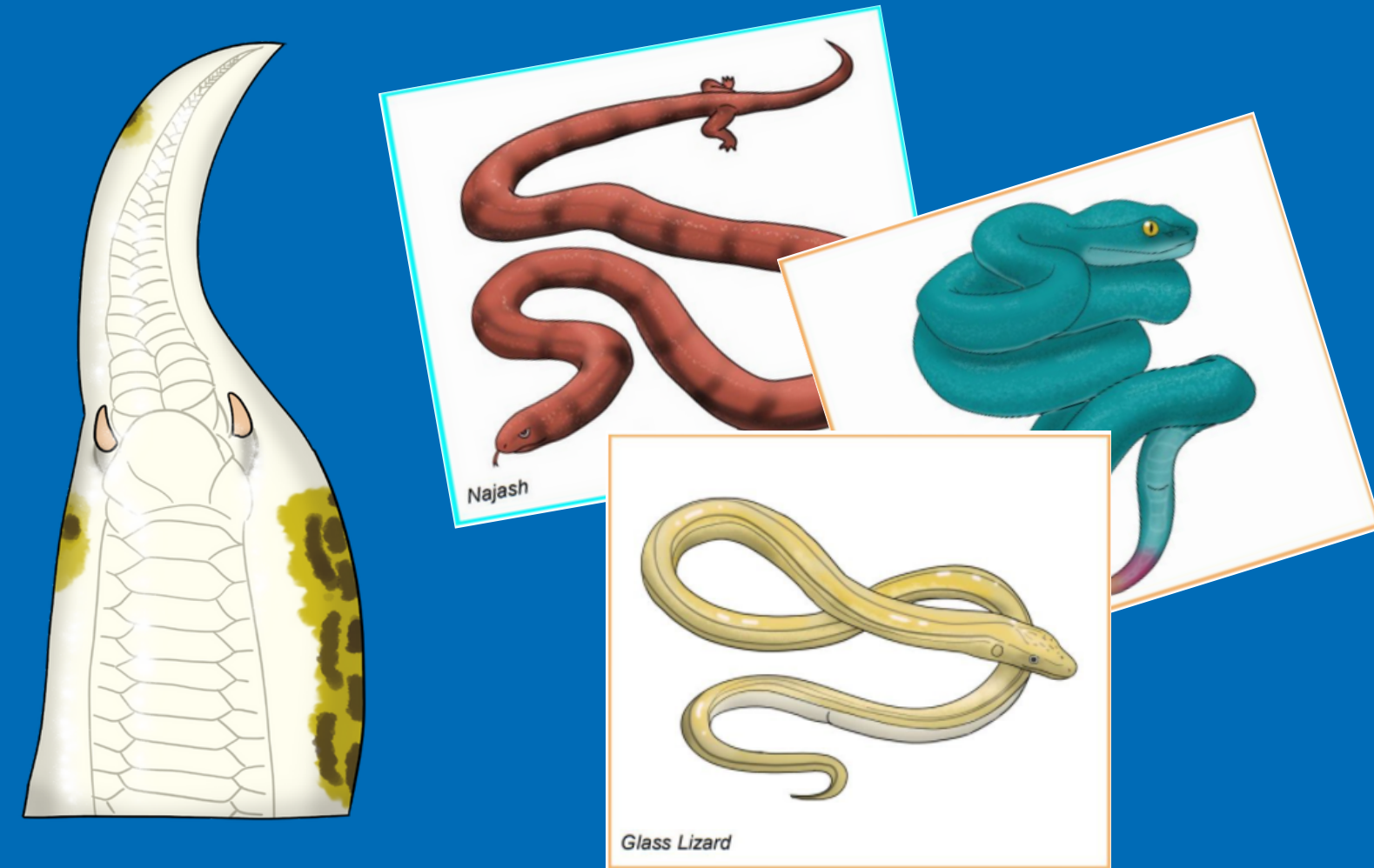
Part B: Out on a Limb

What do you notice and wonder?

- Student prompt: Observe scutes (underbelly) of a ball python

How did squamates (scaled reptiles) evolve?

- Use cards to model speciation and generate phylogenetic trees
 - Focus = limb reduction
- Gallery walk + peer feedback + class discussion
- Compare student models to expert-derived trees
 - Ex. OneZoom



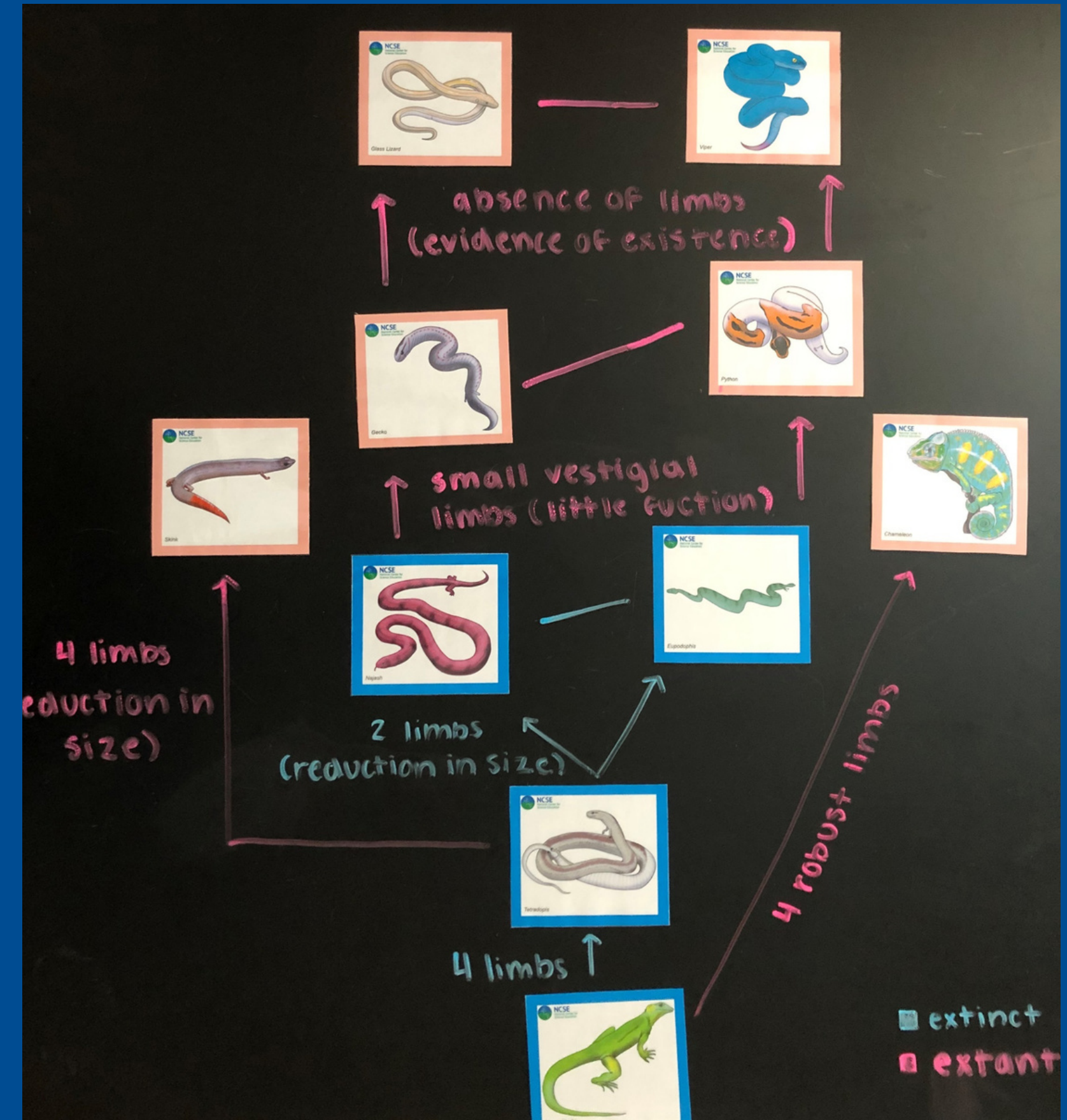
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Student-Derived Phylogenetic Tree Example



Collaborative Group Work



Part C: Do You Dig It?

What selective pressure/s contributed to limb loss?

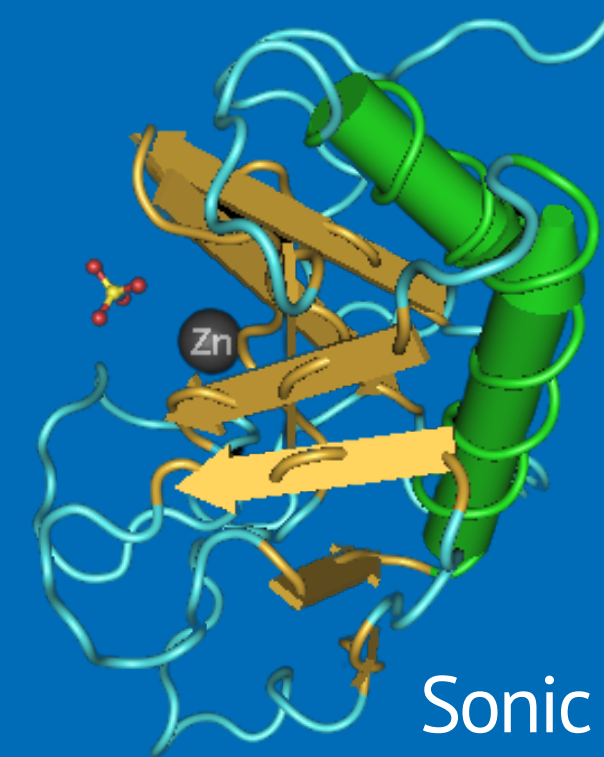
- Two students compete to capture prey in a burrow
- Discuss other advantages to limblessness

What genetic changes caused limb loss in snakes?

- Show University of Florida evolutionary development video that highlights the Sonic Hedgehog gene -- a gene involved in body plan formation



Limbed & Limblessness Model Simulation



Sonic Hedgehog Protein



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Do You Dig It?




Do You Dig It?



Copy link

What is the evolutionary advantage for snakes to be limbless?

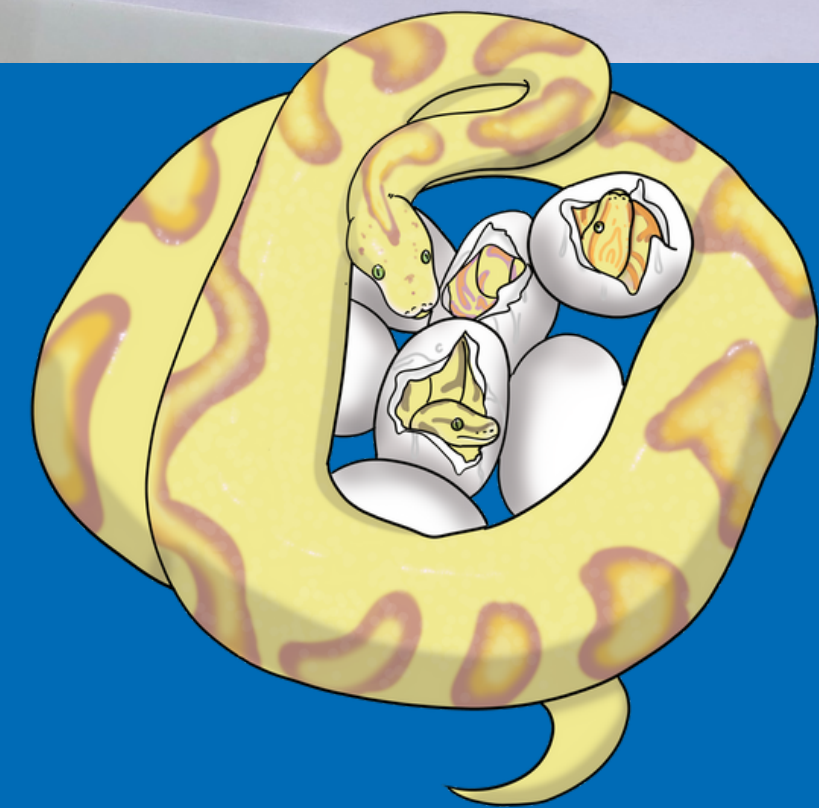
Watch on  YouTube

Part D: A Twisted Tale



How is selective breeding influencing snake traits?

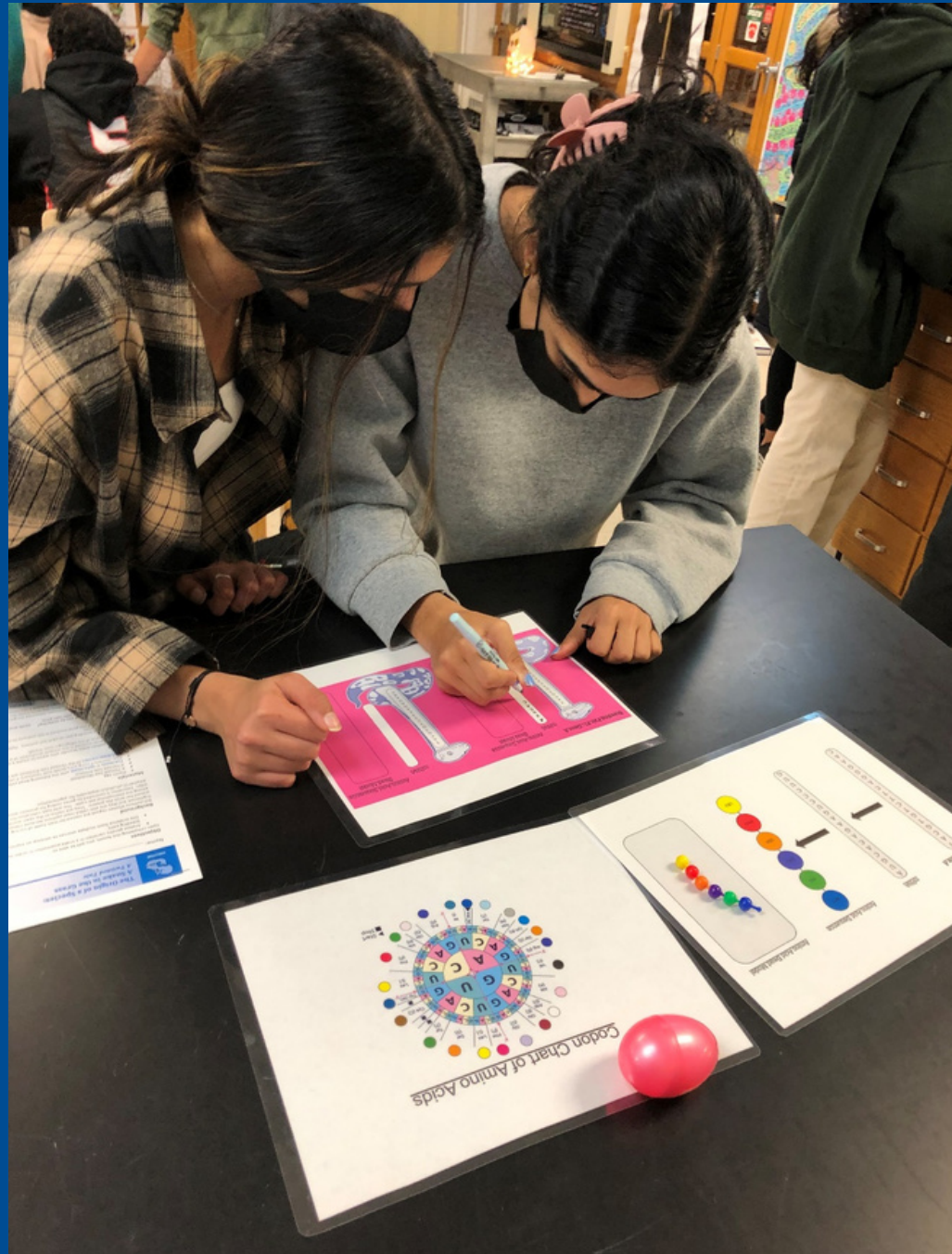
- Become a snake breeder!
- Use beads to model protein synthesis of genes involved in melanin production
- Compare the genetic changes of the offspring to the wild-type sequences
- Hatch out spiral baby snakes from eggs



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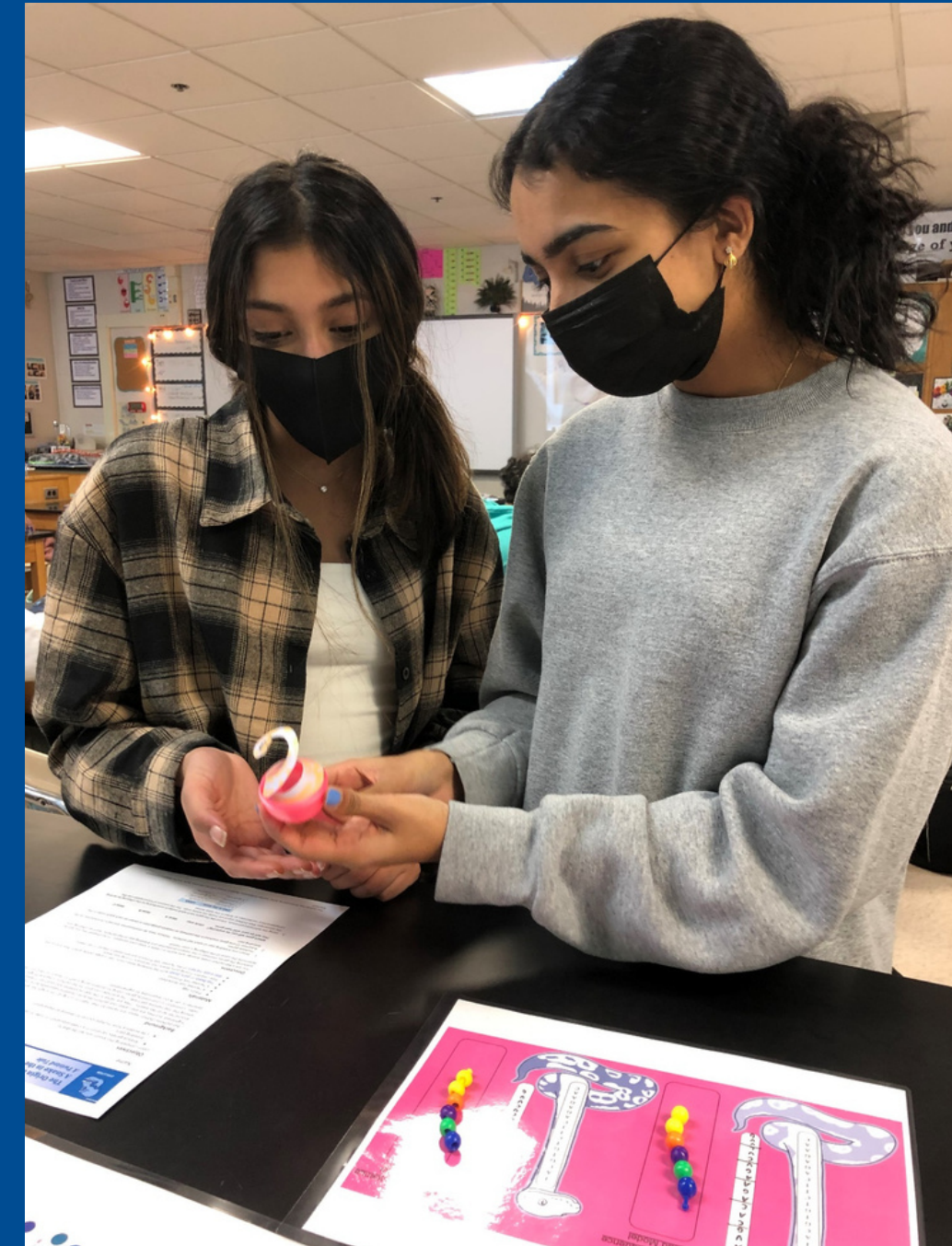
Baby-making time (Rated G)!



Modeling Protein Synthesis



Hatching baby snakes!



Proud parents

Target Misconceptions Addressed

DEBUNKED!



FACT ONE:

The concept of *species* helps humans provide discrete names to the diversity of our world, but all species share a common ancestry and are a part of a continuous spectrum of life.

FACT TWO:

Such significant changes—including, but not limited to, the emergence of new species—can indeed result from the processes of natural selection, mutation, migration, genetic drift, and reproductive isolation (in numerous variations and combinations).

FALLACY

FACT

Target Misconceptions Addressed

DEBUNKED!



FACT THREE:

Scientists have numerous examples of speciation that have occurred, including speciation events that are currently happening at the present time. Additionally, the fossil record supports the current findings of speciation.

FACT FOUR:

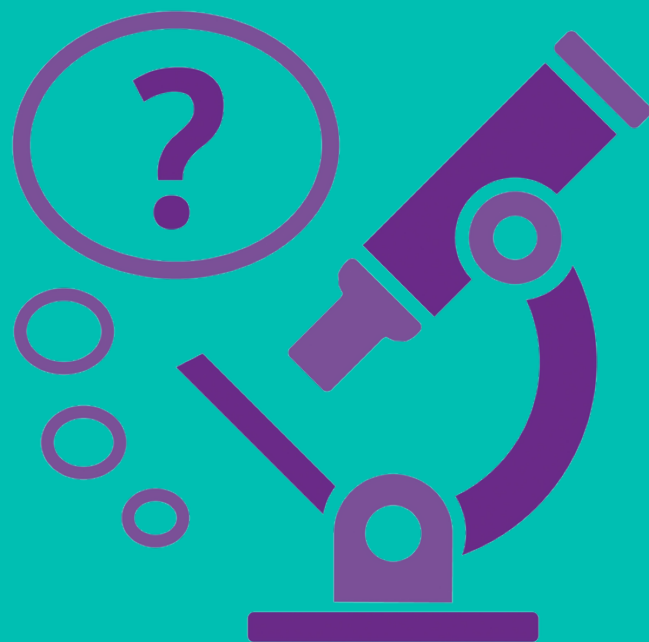
Because all organisms share many of the same genes, DNA variability alone cannot account for the variety of characteristic traits for each species. Another factor in speciation is the different regulatory genes that dictate the development of many of the different traits of each organism.

FALLACY

FACT

New Lessons Coming in March!

FOR MORE INFORMATION, VISIT [NCSE.NGO](https://ncse.ngo)



NATURE OF SCIENCE



CLIMATE CHANGE



EVOLUTION

Questions?



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