1. Understand principles of biological systematics
2. Define 'amphibians' from an evolutionary perspective.
3. Describe some of the challenges of modern systematics.

What defines an amphibian?
What defines an amphibian?

How do we categorize biological diversity?
What is an amphibian?

- Amphibians
- Mammals
- Reptiles
What is an amphibian?

- Tiktaalik
- Source: Nobu Tamura

What is an amphibian?

- Tetrapods
- Acanthostega
- Source: Nobu Tamura

What is an amphibian?

- Tetrapods
- Amniotes
- Source: Nobu Tamura
What is an amphibian?

Tiktaalik

Acanthostega

Dissorophoidea

Tetrapods

Amniotes

Reptiles

Mammals

Amphibians

Lissamphibia

“Modern amphibians”
Orders of Lissamphibia

- Gymnophiona
- Caudata
- Anura

How do we infer these relationships?

We build models to infer them from...

Morphological traits

DNA sequences

ATCCGTATTAGA
ATCTCTATTAGA
ATCCCTACTAGA
Why is it challenging?

Evolution is sometimes complicated.

These data can be difficult to interpret.

What is the relationship between shared traits and evolutionary history?

A, B, and C are tips that define a clade (i.e., monophyletic). A clade contains all descendants of a common ancestor.
A, B, and D are tips representing a paraphyletic (or polyphyletic) group, because not all descendants of their common ancestor are included.

We classify organisms based on monophyletic groups (i.e., clades).

Trait 1 is a synapomorphy of the clade consisting of A, B, and C, with respect to other tips.

A synapomorphy is a shared, derived character.

Trait 2 is a symplesiomorphy in the clade consisting of A, B, and C.

A symplesiomorphy is a shared ancestral trait not found in all descendants of that ancestor.
A homoplasy is a shared trait not found in a common ancestor.

What is the relationship between shared traits and evolutionary history?

It’s variable. But using appropriate models and suitable data can help us infer the latter from the former.
De Queiroz (2007)

...but now, we sometimes think
...but now, we sometimes think

Evolution is sometimes complicated.

Amphibian case studies

Source: Todd Pierson
Asymmetric reproductive isolation between terminal forms of the salamander ring species *Ensatina eschscholtzii* revealed by fine-scale genetic analysis of a hybrid zone

"[Previous work suggests] the biogeographic history of *Ensatina* is much more complex, having featured periods of geographic isolation and multiple instances of secondary contact."

"Geographic variation in hybridization frequency among the four contact zones at the end of the ring suggests that reproductive isolation may not be uniform across contact zones..."

River basin reorganization and the two-lined salamander (*Eurycea bislineata*) species complex
In a population. The reproductive mode used by unisexuals, there was no indication that any particular genome is consistently inherited in a clonal fashion. North Bass) have a haplotype that demonstrates an isolation event. We examined highly variable microsatellite loci, and described as having all three reproductive modes. Diploid and polyploid unisexuals have nuclear genomes that combine the unisexuals. Unisexuals...