Mimicry

What is mimicry? PPT examples
Flies and wasps—what type of mimicry is that?
How are monarchs and viceroys different?
What traits are being mimicked?
    Bright, warning colors: Aposemetism
    Other examples?

Why be aposematic?
A mystery as far back as Darwin and Wallace—Wallace proposed it was a warning
Because attacks are costly, even if you're distateful: may still be injured or killed
Characteristics of apomixis: contrast with background, 2 or more contrasting colors, lack of hiding or escape behaviors.
A very reliable signal—cost of lying is high (being visible but not distasteful)

How does aposemetism evolve?
A difficult question—it provides protection at high enough numbers, but for the first few that doesn't exist
Hypotheses:
    -Drift lets it accumulate in populations until it reaches critical mass
    -First few escape from search image of predators, enough of an advantage to accumulate
    -If there's a big benefit, once a few have it, it might spread quite quickly

Batsian vs Mullerian mimicry
Batsian: Weakens the effect of the signal, when one species is dishonest
    -The strength of this effect depends on the relative frequency of the two species
    -If the unpalatable is more common, it'll be a weak effect, and they probably won't change
    -If the palatable is common, then they will really weaken the signal, and the target species may be under selection to change their pattern
Mullerian: Strengthens the signal, because always unpalatable
    -Which one "follows" the other depends on their relative frequencies
For both types, the evolutionary dynamics of mimicry are fundamentally frequency-dependent

So, the hypothesis is that mimicry is adaptive to avoid predation, etc. How do you actually test this?

1972, Benson. Wanted to test the efficacy of Mullerian mimicry. He took individuals of a mimic species, and painted their wings to disrupt the pattern. They had lower survival.

Did this actually demonstrate his point? (no; it could be that the selection was on the pattern itself, not on the fact that the pattern matched the other species)

1989, Mallet and Barton.

Had two mimic morphs, that were geographically separated. Moved individuals of one morth into the territory of the other, and vice versa. Found that the imports had lower survival.

Did this one demonstrate Mullerian mimicry? (no; could have been other mechanisms of local adapatation)

What the experiments need to actually ask: Does resembling the other species prevent attacks?

2001, Kapan. 3 species: H. cydno (white and yellow morphs), H. eluchia (yellow) and H. Sapho (white)

Cydno morphs vary geographically; generally, they resemble whichever of the other two species are more common locally, although they can also co-exist.

2 experiments to test two predictions. Hand out student problems, have them work through them.
Are you convinced?

Heliconius
Genus of butterflies in South America
Most important model system for mimicry (What kind, if all distateful?)

The two most studied species are *H. erato* and *H. melpomene*
Not closely related, but have co-geographically diverging morphs; that is, look like each other locally, although a lot of variation within species. Called "mimicry rings"

Speciation: Mimicry may cause speciation.
Hybrids, which don't match either pattern, are more likely to be targeted by predators.
If one population jumps into a new ring, it should lead to RI with the old ring.

-different from the other types of RI we discussed, because imposed by extrinsic factors (predators)

Observe positive mating—prefer mates that have the same pattern. The gene for preference is linked to one for wing color. That lets them evolve together, without recombining away; this coevolution of the two traits leads to the radiation.

What do we know about *melpomene* and *erato?*
Early crosses indicated a large Mendelian locus that switch portions of the wings between colors. ie, one gene would control whether the tips are red or white or black, another would control whether the next region down was red or white or black, etc. Together, these build up variable patterns.

Nijout (Duke professor) found 22 mimicry loci in *melpomene* and 17 in *erato*.
Mostly, these were shared between the two species.

People started to talk about the idea of a "supergene": some of the color loci had mapped to the same spot, indicating tight linkage. These could all be inherited as a block, which might make sudden changes more likely. There was a strong signature of selection around the locus in multiple species.
Further work identified this region, named it *optix*
Hypothesis: change at one locus of large effect can cause an individual to jump to a new mimicry ring, becoming isolated from the old one. After that, smaller genetic changes are selected for that make it more closely resemble the new ring.

Introgression: the movement of genes between species via hybrids.
Shown to be important in *Heliconius*, will be in the paper.
"Adaptive introgression": foreign genes will persist in a species if they are advantageous.
Potentially, this could maintain similarities between species; for example, if a color-related gene introgressed from one into the other, it wouldn't have to be independent evolution of the same pattern

ABBA-BABA test
Trees on the board
Incomplete lineage sorting: when there is standing variation preceeding a node in a tree; one lineage might get one variant, while the other might get the other. In that case, the ABBA and BABA patterns should be equally likely.

If, however, the two species share alleles in either an ABBA pattern more frequently than BABA, that indicates introgression. This test is central to one of the papers.