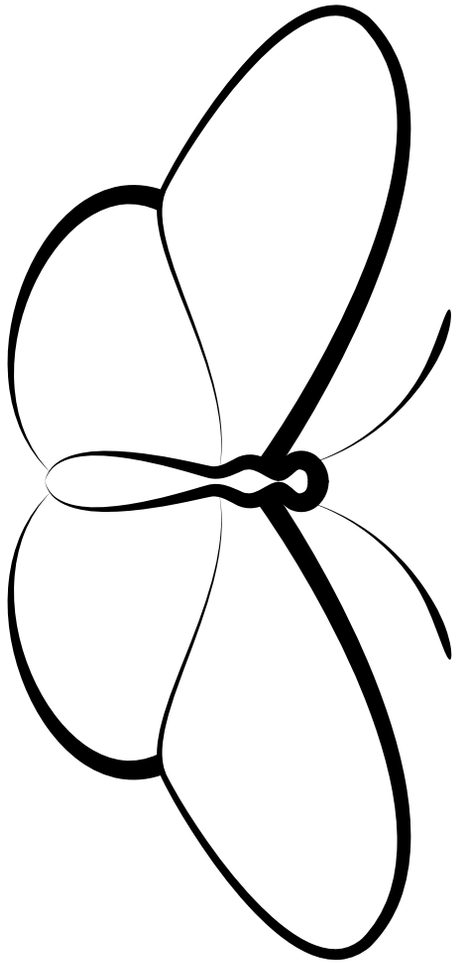
Patterns

There are over forty *Heliconius* species. The map below shows the patterns of just *one* species, *Heliconius melpomene.*

All of these patterns are made using just three genes, RED, YELLOW and BAND SHAPE. Each gene has several variants.

RED	*band*	*dennis*	*dennis+rays*	
YELLOW	*band*	*bar*	*margin*	*absent*
BAND SHAPE	*one*	*two*	*broken*	

Here is a butterfly to colour in. What patterns can you make using the RED, YELLOW and BAND SHAPE genes?



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Butterfly Evolution
From Jungles to Genomes

There are millions of different kinds of animals. How can we explain the diversity of animals we find in the world?

We are working on this question by studying butterflies from Central and South America. The dazzling variety of their wing patterns is produced by combining variants of a small number of genes.

History

In 1848, Henry Walter Bates and Alfred Russell Wallace sailed to South America to search for evidence of evolution.

Bates was particularly interested in the wing patterns of the *Heliconius* butterflies. He found butterflies with very different wing patterns at different locations along the Amazon river. But as he travelled between these locations, he found transitional forms between these patterns.

Bates returned to Britain just as Darwin published *On the Origin of Species*. Darwin believed Bates's butterflies were one of the best examples of evolution in the wild, but neither understood how the variation in wing patterns was produced.

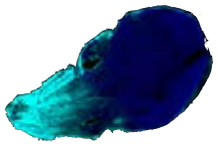
Genes

Butterfly wing patterns are produced by a small number of patterning genes.

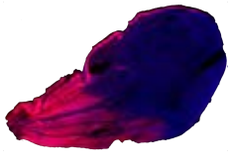
For example, a gene called ***optix*** switches on red colour.

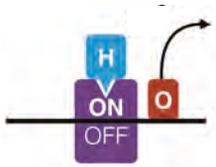
In butterflies with *dennis* patches, ***optix*** is switched on by another gene called ***homothorax***, which defines a region at the base of the wing.

But in other butterflies, ***optix*** does not have a ***homothorax*** switch, so isn't turned on at the base of the wing.



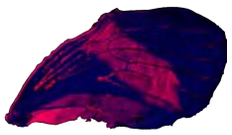
homothorax *is turned on at the base of the forewing in all* Heliconius *butterflies.*





dennis patch

homothorax *turns* ***optix*** *on in butterflies with dennis patches, because the* ***optix*** *switch fits* ***homothorax****.*



band

But other butterflies have different switches for ***optix*** *that don't fit* ***homothorax****, so* ***optix*** *is not switched on, and there is no dennis patch. Another gene, like* ***homothorax****, turns* ***optix*** *on in bands - but we don't know what it is yet…*

Mimicry

Distantly related species of *Heliconius* often have very similar wings.

For example, ***H. melpomene*** and ***H. erato*** are five times more distantly related than humans and chimpanzees, but have almost identical wing patterns.

Spot the difference!

H. erato (top) and H. melpomene (bottom). Can you see any differences between them?

These butterflies are poisonous due to toxins from the plants they eat when they are caterpillars.

Birds taste the butterflies and learn to associate their bright, bold wing pattern with poison after only a single taste.

Species mimic each other to gain safety in numbers. The more butterflies with the same pattern, the quicker the predators learn.

Warning patterns and their mimicry are great examples of evolution by natural selection.