Natural Selection and Camouflage

What is Camouflage?

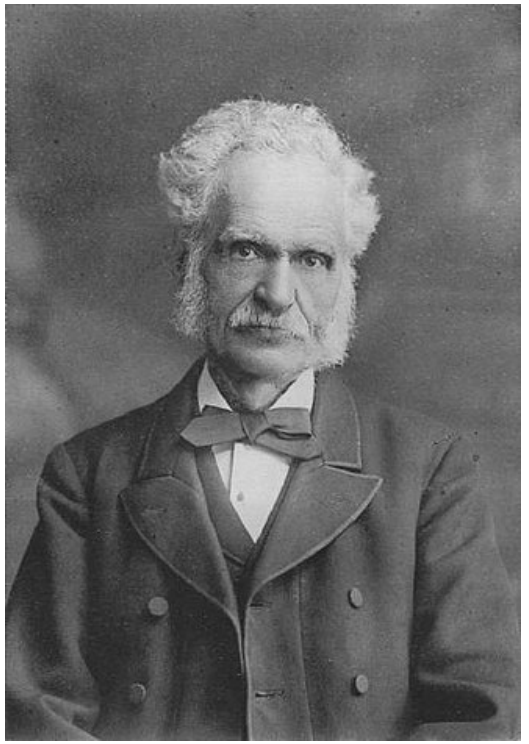
- **Crypsis –** making animals or objects hard to see
  - Most of the animal camouflage is crypsis, using color or pattern to blend into the background
  - Some species have changeable coloration and can actively change their coloration to match background colors
- **Mimesis –** disguising itself as something else
- **Motion dazzle –** using contrasting patterns + motion to disorient the viewer and make the individual more difficult to locate or determine how fast it is moving

Crypsis examples

Mimesis examples

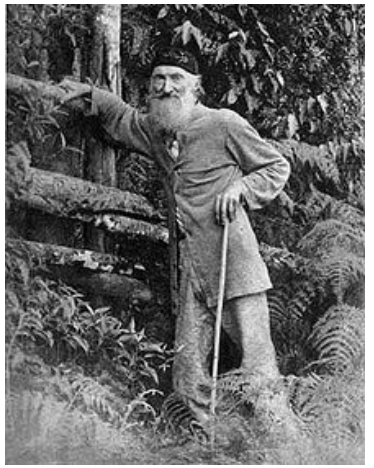
Batesion Mimicry

- Named British scientist Henry Walter Bates
- An **unprotected** species closely resembles an unpalatable or harmful species and is similarly avoided by predators
- Common in butterflies and other insects



Müllerian Mimicry

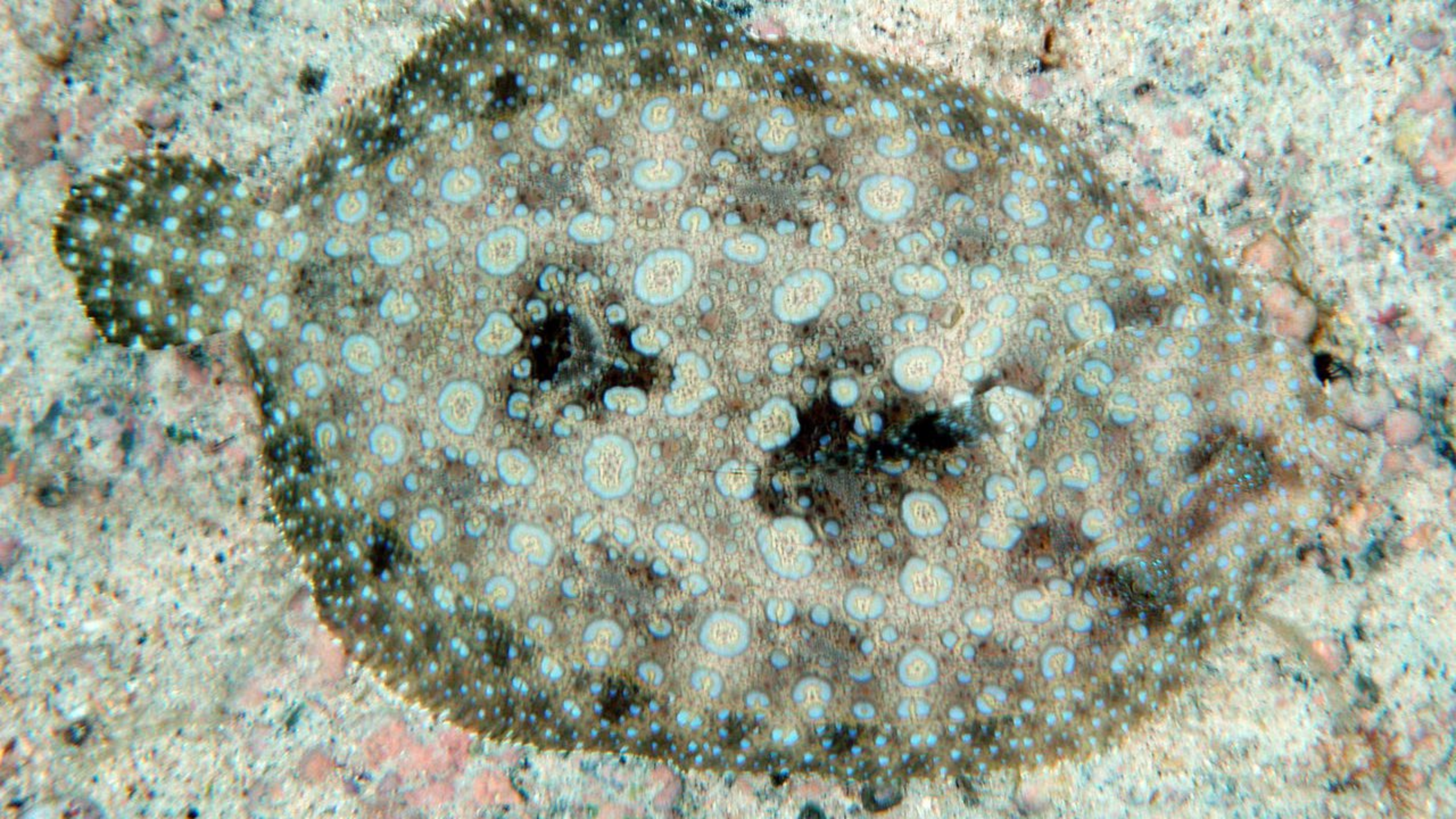
- Named after German zoologist Fritz Mueller
- When two or more poisonous or unpalatable species closely resemble each other and are therefore avoided
- All mimics share the benefits of the coloration since the predator will recognize the coloration of an unpalatable group
- The viceroy and monarch butterflies are a common example



Self Mimicry

- A misleading term for animals that have one body part that visually mimics another (often eyes)
- Also used by predators to confuse prey about direction or to appear less threatening
- Can be used to appear bigger, confuse direction of movement, or confuse identification

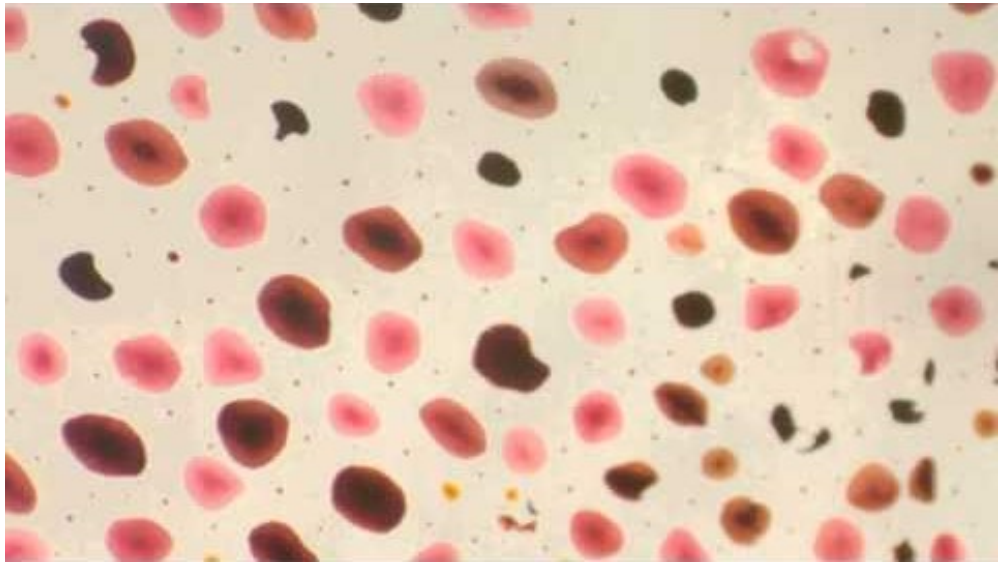
Active coloration change examples

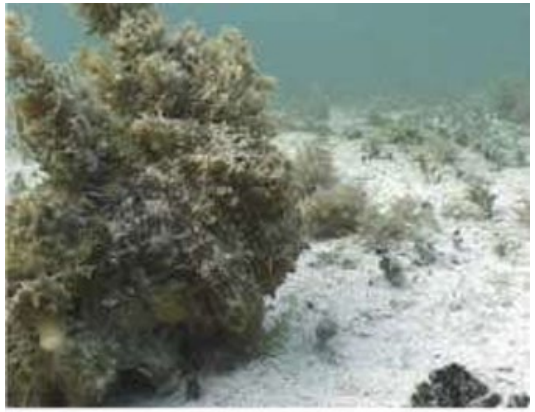



BBC

How do these animals change color?

- ***Chromatophores***: Cells which contain or produce pigments or reflect light to produce color
- ***Biochromes***: include true pigments, such as carotenoids and pteridines. Absorb certain wavelengths of light to create color
- ***Schemochromes***: change the way light is reflected – often causing iridescence



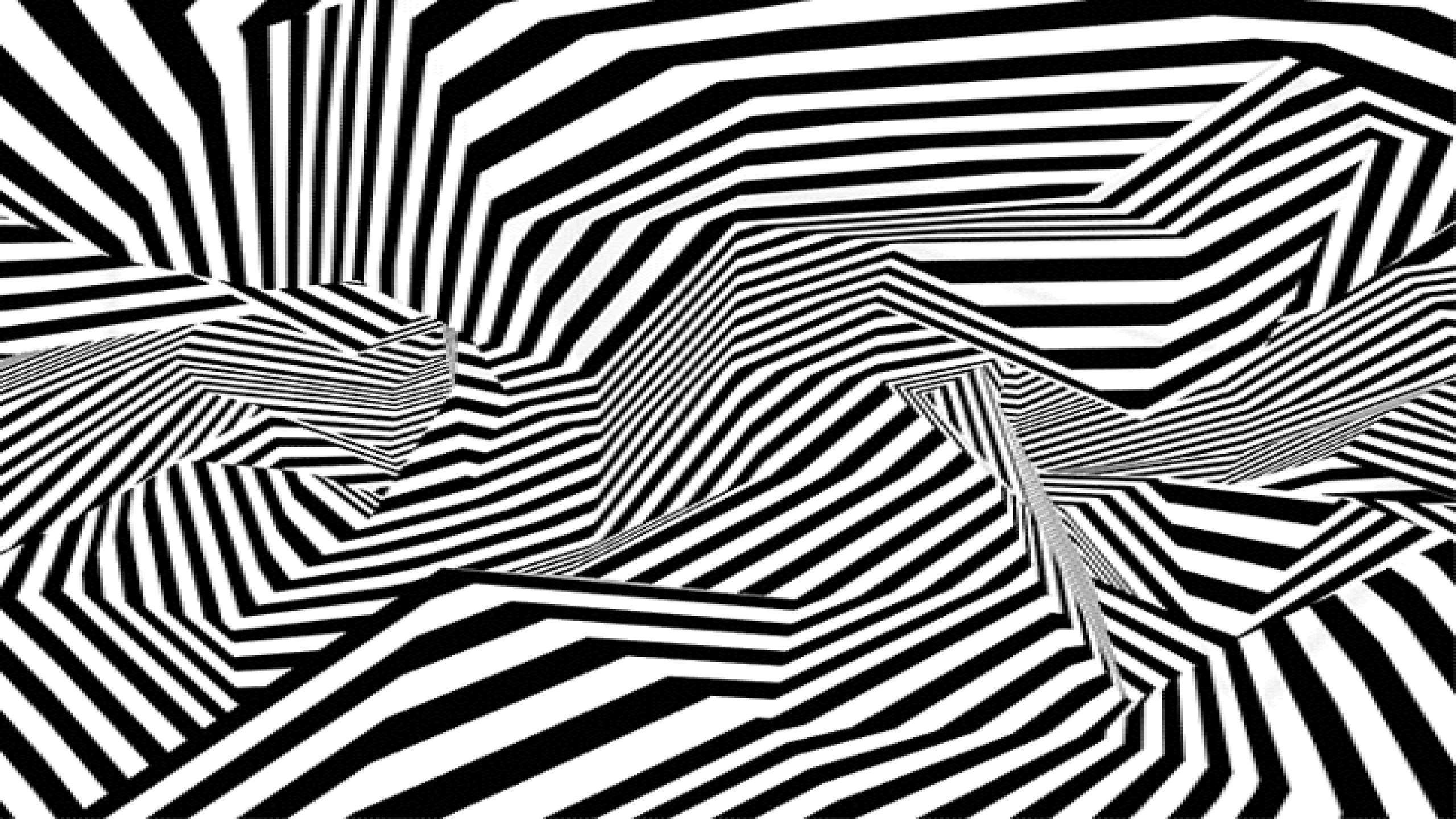


Second:frame 0:00

0:08 (270 msec)

2:02 (2,070 msec)

Motion Dazzle



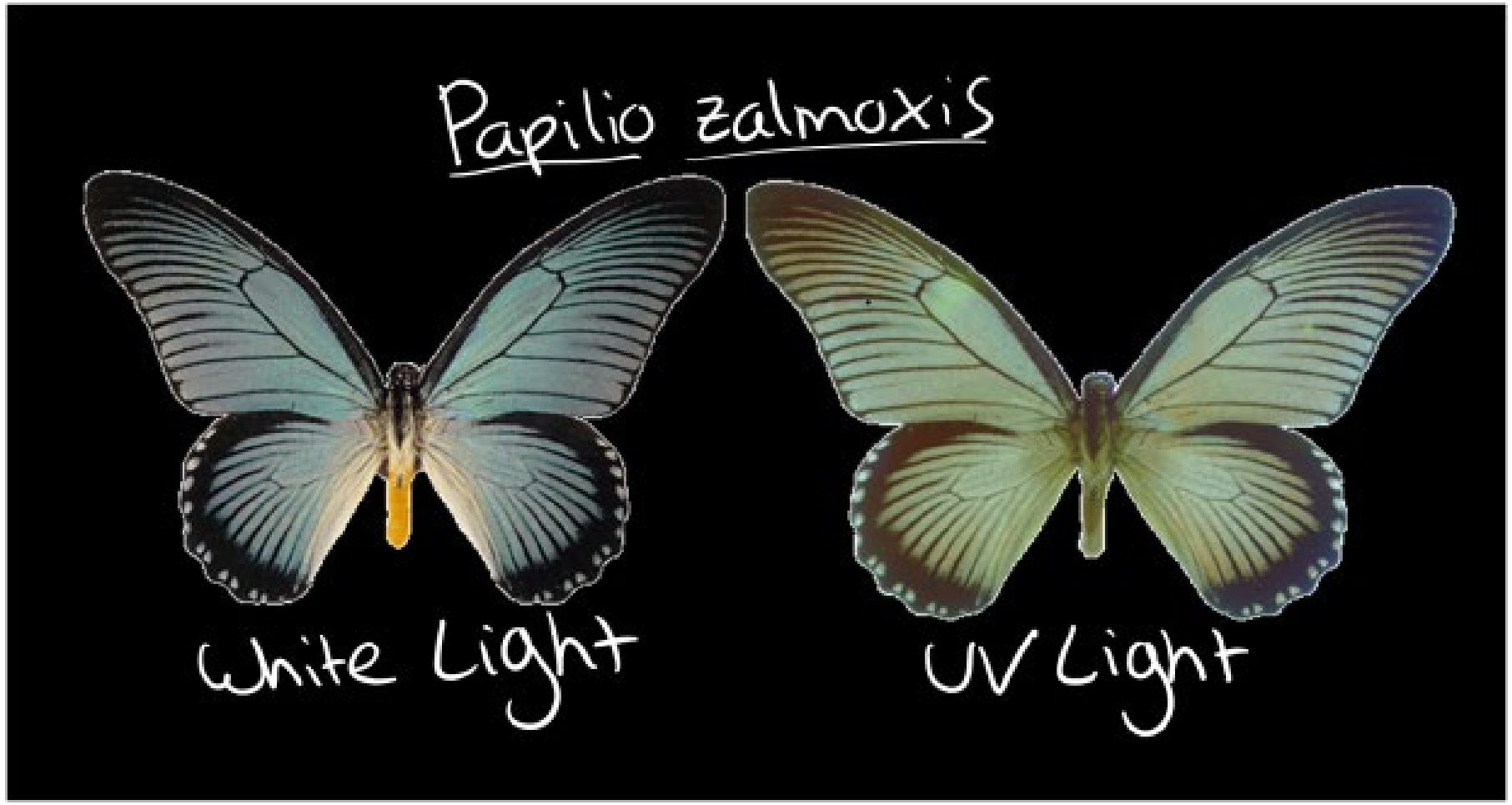
Natural Selection and Camouflage

Natural Selection and Camouflage

- Natural selection works where individuals that survive and reproduce pass on their mutations to their offspring, so mutations that enable better survival are more likely to be passed on
- Camouflage evolved this same way – individuals that are better at disguising themselves survive longer or catch more prey and pass their genes onto their offspring

Mimicry is an Arms Race

- Mimics and the species they are trying to fool are in an ongoing struggle
- Mimics are under selection to avoid being spotted by their predators, but those predators are under selection to be able to spot the mimics

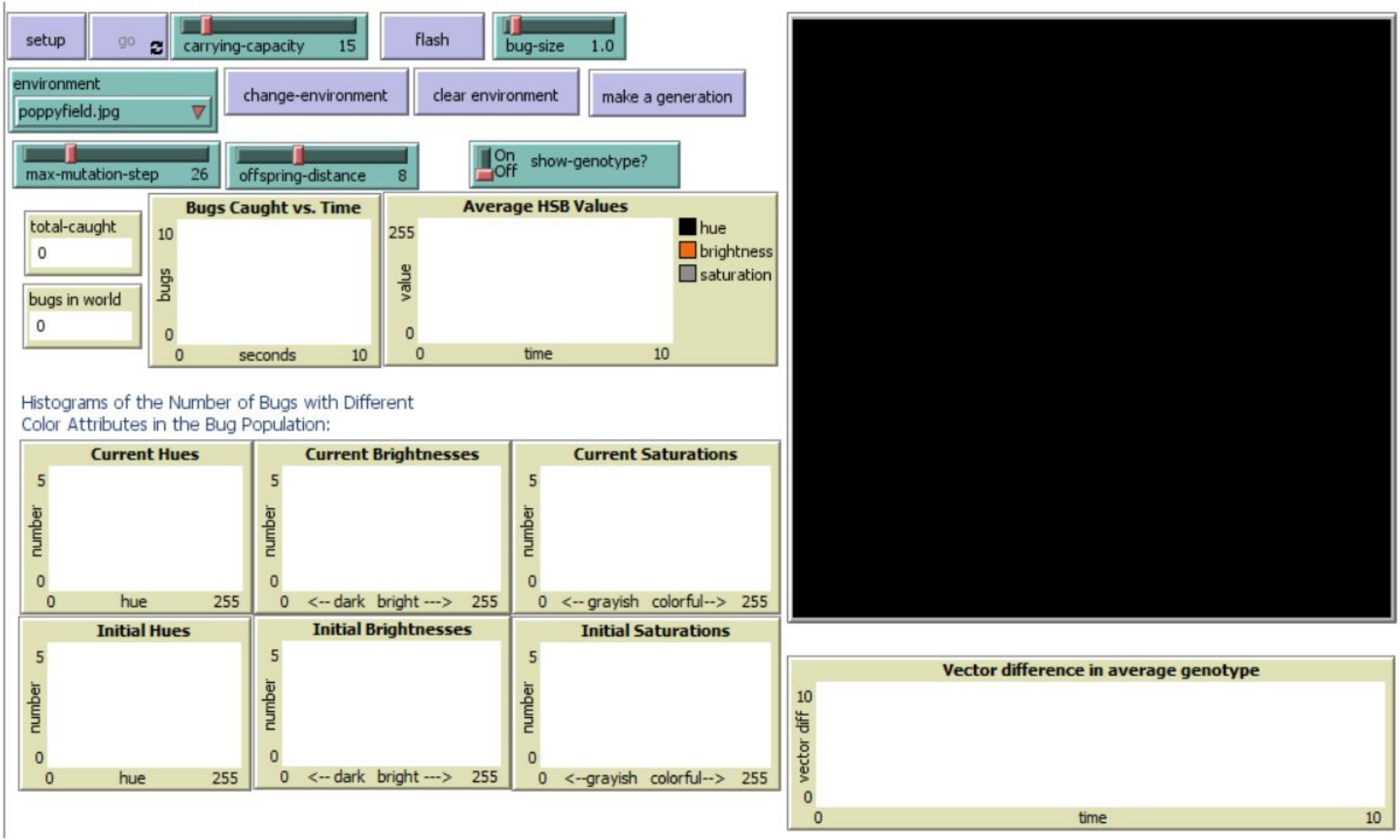


Tangent: How do mimics make sure they can still mate with the right species? If they get too visually similar this can pose a major challenge. Some species use special markings or markings in different visual spectra (like UV) that are visible to them but not to their predators

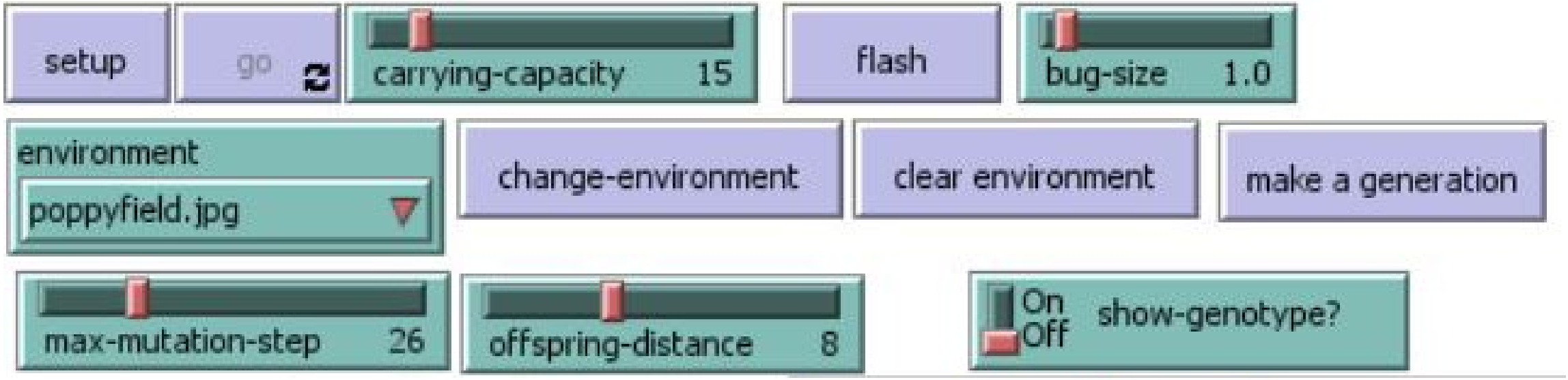
Today’s Model

Bug Hunt Camouflage

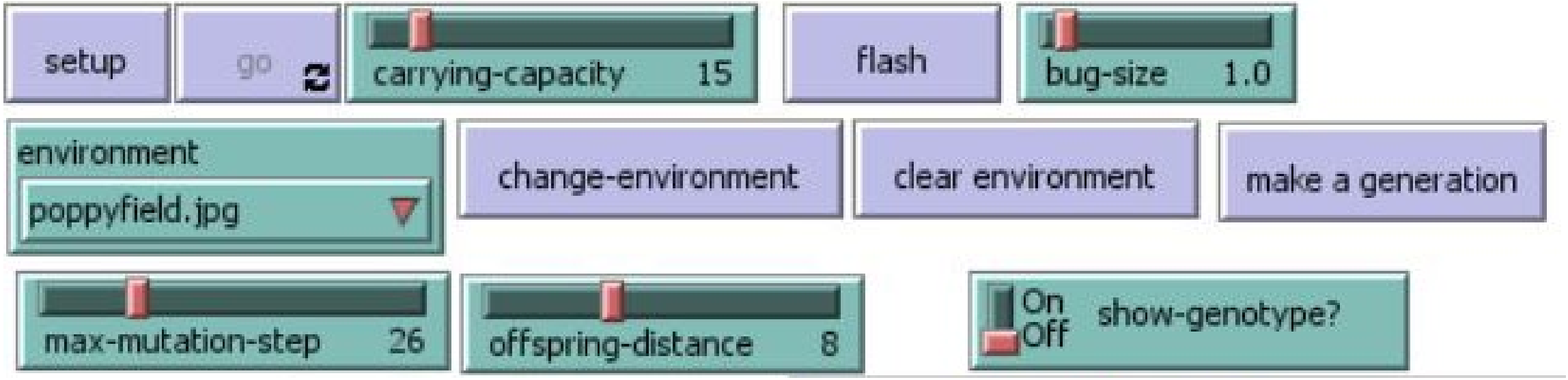
- Today we'll be using a NetLogo model to look at the evolution of camouflage
- You'll play the role of a predator (bird) trying to catch prey (butterflies) against a colored background.


setup
go
carrying-capacity 15
flash
bug-size 1.0
environment
poppyfield.jpg
change-environment
clear environment
make a generation
max-mutation-step 26
offspring-distance 8
On
Off
show-genotype?
total-caught
0
bugs in world
0
Bugs Caught vs. Time
10
bugs
0
0
seconds
10
Average HSB Values
255
value
0
0
time
10
hue
brightness
saturation
Histograms of the Number of Bugs with Different Color Attributes in the Bug Population:
Current Hues
5
number
0
0
hue
255
Current Brightnesses
5
number
0
0
<-- dark bright --->
255
Current Saturations
5
number
0
0
<-- grayish colorful-->
255
Initial Hues
5
number
0
0
hue
255
Initial Brightnesses
5
number
0
0
<-- dark bright --->
255
Initial Saturations
5
number
0
0
<--grayish colorful-->
255
Vector difference in average genotype
10
vector diff
0
0
time
10

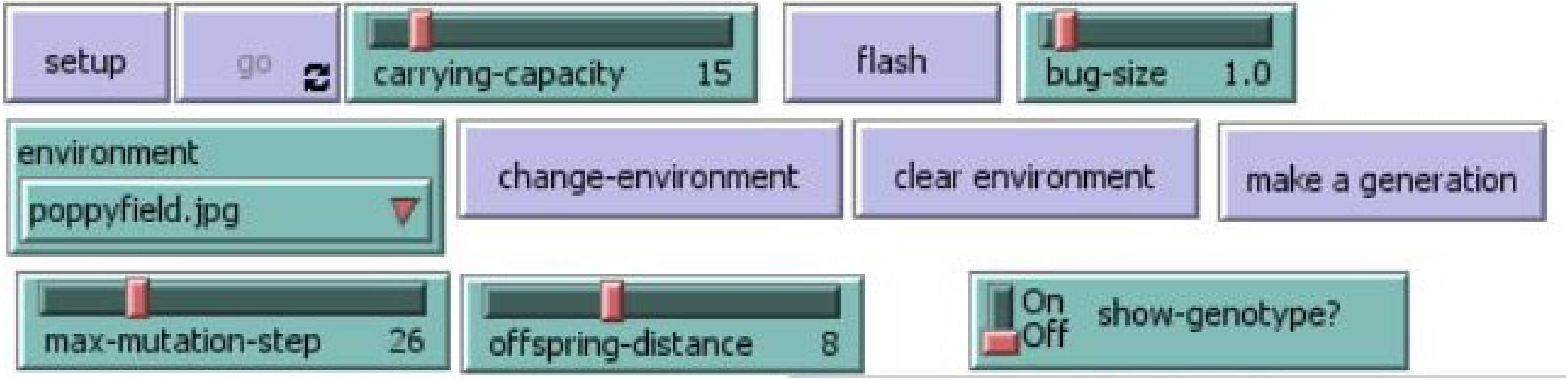




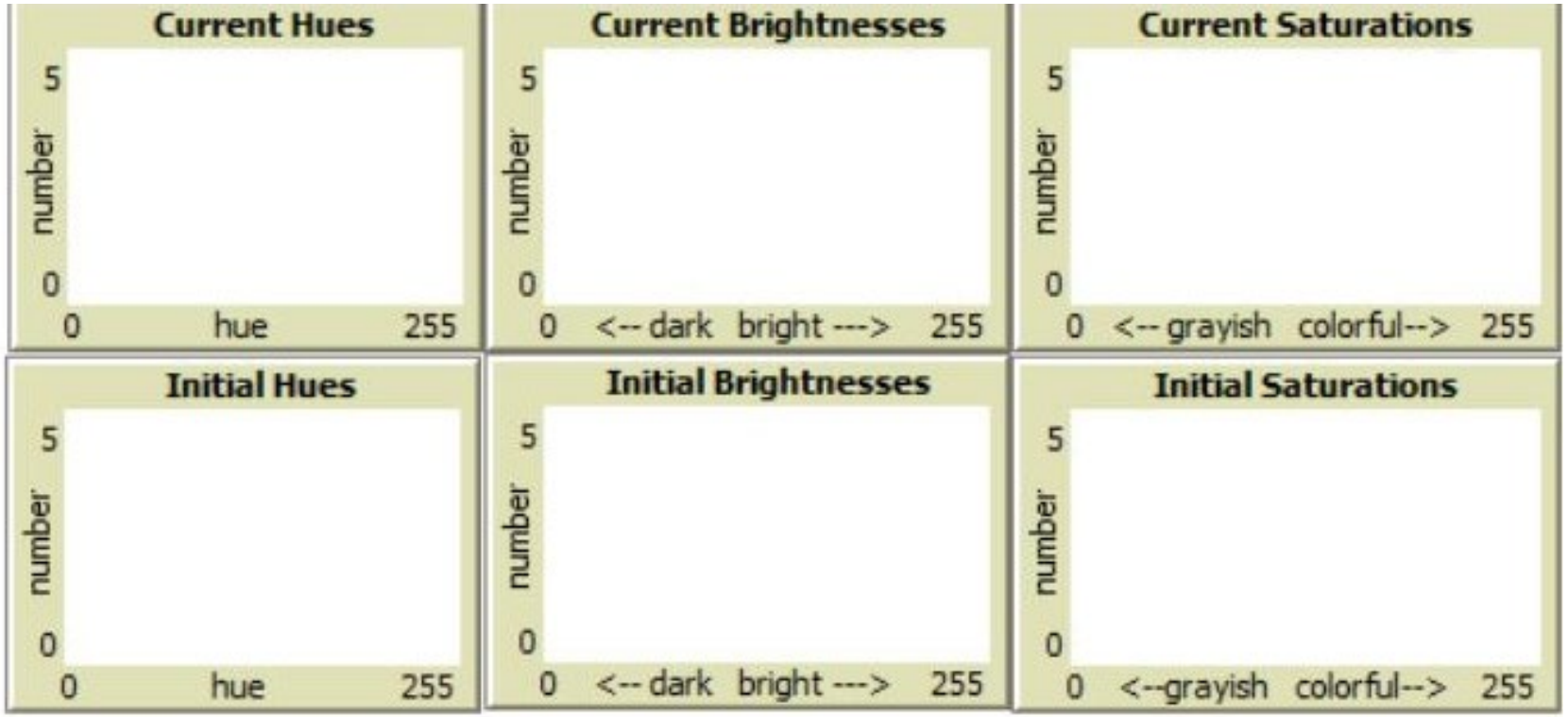
- The purple buttons control the environment.
- To setup the environment press ‘setup’
- To run the model press ‘go’ – this will cause more butterflies to appear, click on them as quickly as possible
- ‘flash’ causes the background to flash black to help you see the butterflies more easily (don’t use this unless instructed)
- ‘change-environment’ allows you to change the environment in the middle of the model
- ‘clear environment’ will clear the environment to a black screen
- ‘make a generation’ causes all the current butterflies to reproduce and new butterflies will appear



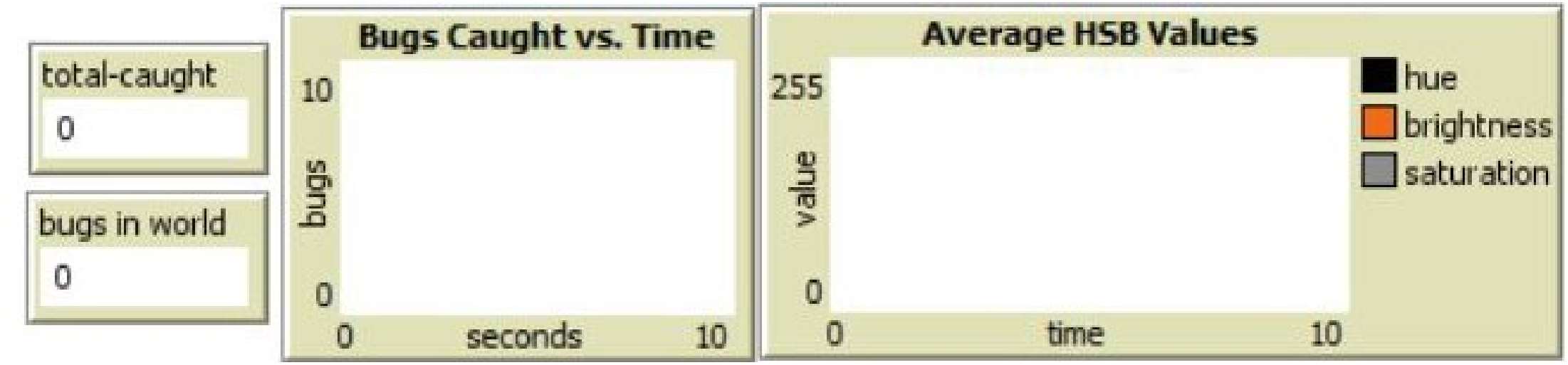
- The green buttons allow you to control different pre-sets in the model
- ‘carrying capacity’ is the maximum number of butterflies, and the number that are created when you make a generation
- ‘bug-size’ changes the size of the butterflies
- ‘environment’ changes the background image (and then use the ‘change-environment’ button to make that change)



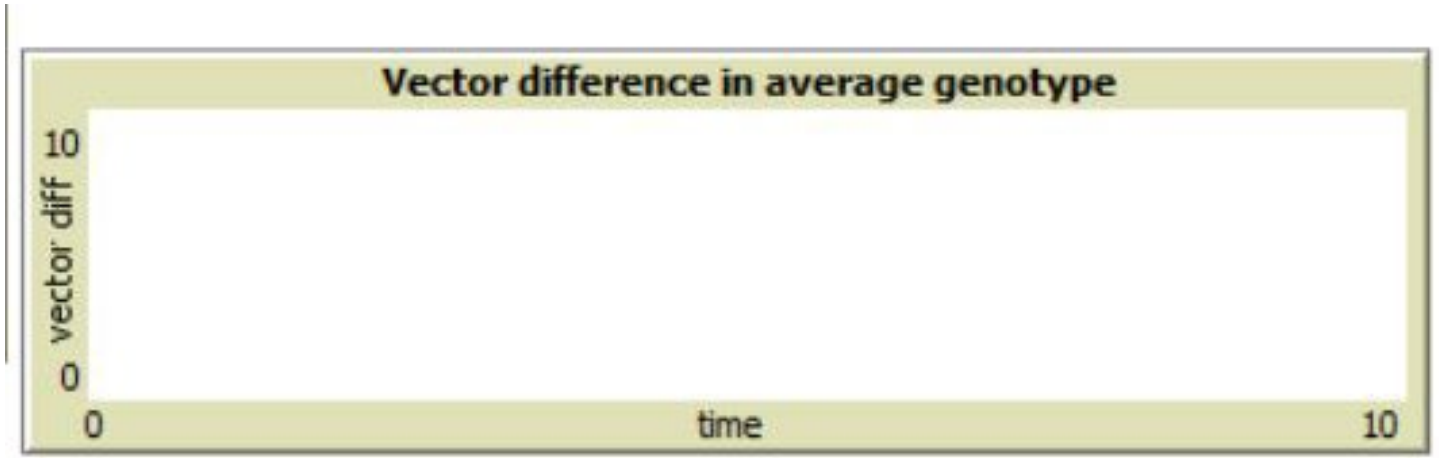
- ‘max-mutation-step’ determines how much the pigment genes can drift from their current values in each new generation.
  - For example, a ‘mutation-step’ of 1 means that the gene frequency for any of the three pigments could go up 1, down 1, or not change at all in the offspring.
- ‘offspring-distance’ determines how far away (in patches) an offspring could show up from a parent.
  - For example, a distance of 5 means the offspring could be 0, 1, 2, 3, 4, or 5 patches away from the parent.



- The histograms of “CURRENT HUES” and “INITIAL HUES” shows a distribution of hues in the current and starting populations.
- The histograms of “CURRENT SATURATIONS” and “INITIAL SATURATIONS” shows a distribution of saturations (of colors) in the current and starting populations. Low values represent “grayish” colorations and high values represent “vivid” colorations.
- The histograms of “CURRENT BRIGHTNESSES” and “INITIAL BRIGHTNESSES” shows a distribution of brightnesses (of colors) in the current and starting populations. Low values represent “dark” colorations and high values represent “light” colorations.



- The plot “BUGS CAUGHT VS TIME” give a measure of your progress and performance as a predator.
- The plot of “AVERAGE HSB VALUES” shows how the average values for the hue, saturation, and brightness of the bugs changes over time.



- The plot of “VECTOR DIFFERENCE IN AVERAGE GENOTYPE” shows how the average values the genotype of the population change overtime. The plot shows the vector difference between the average value of red gene frequency, green gene frequency, and blue gene frequency for the current population as compared to the initial population.
- This is like the summary of how different the colors are from the initial colors

Practice using the model

- Press SETUP
- Press GO
- Click on as many bugs as possible as quickly as you can
- When you can’t find anymore, press MAKE-GENERATION
- Click on as many bugs as you can
- Press FLASH
- What do you notice?