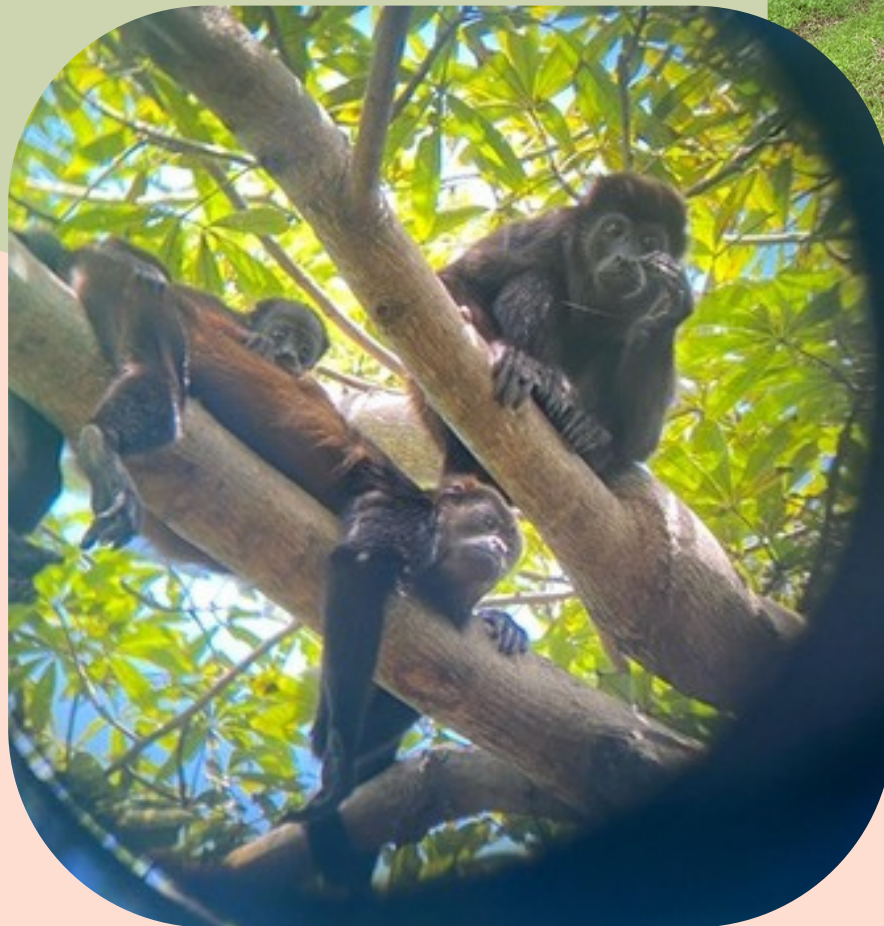




My Field For Dummies: **Hybridization**

Cheyenne Graham





Cheyenne Graham

3rd year PhD student

University of Michigan- Speer
and Duffy Labs





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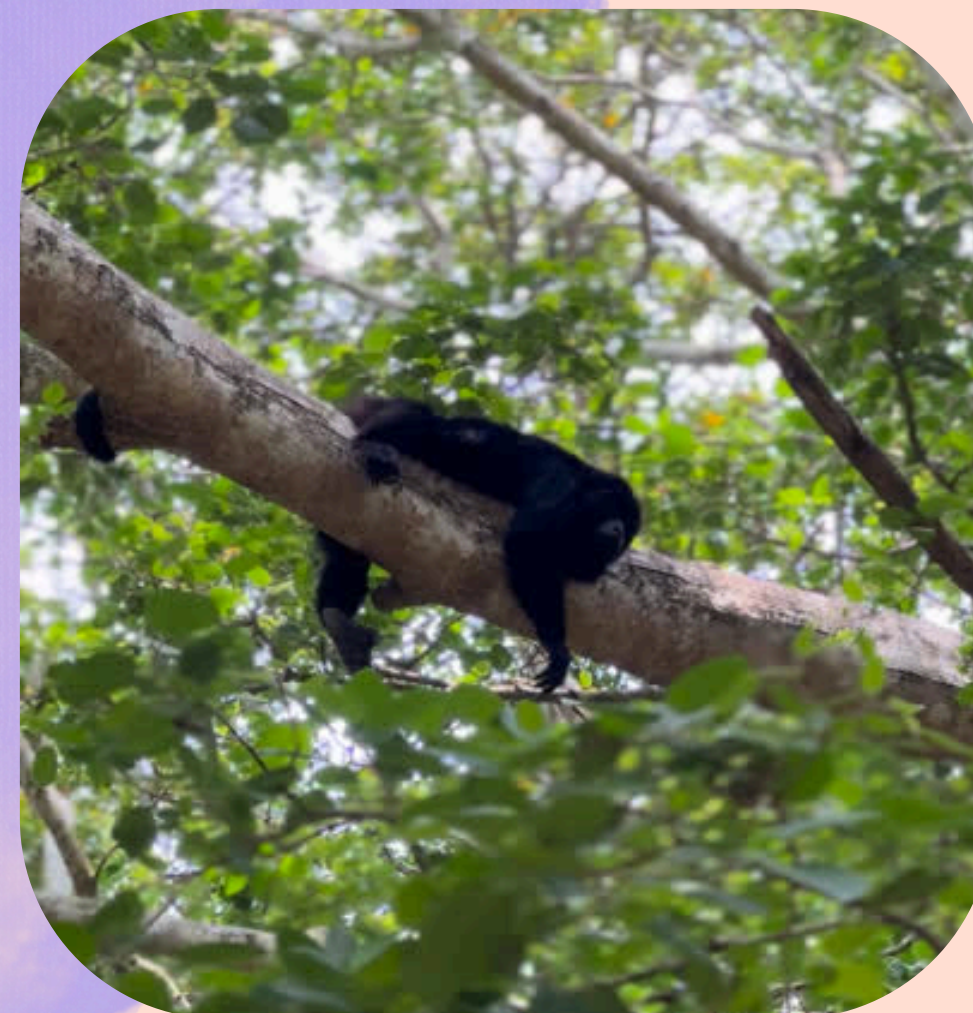




~~What is hybridization?~~



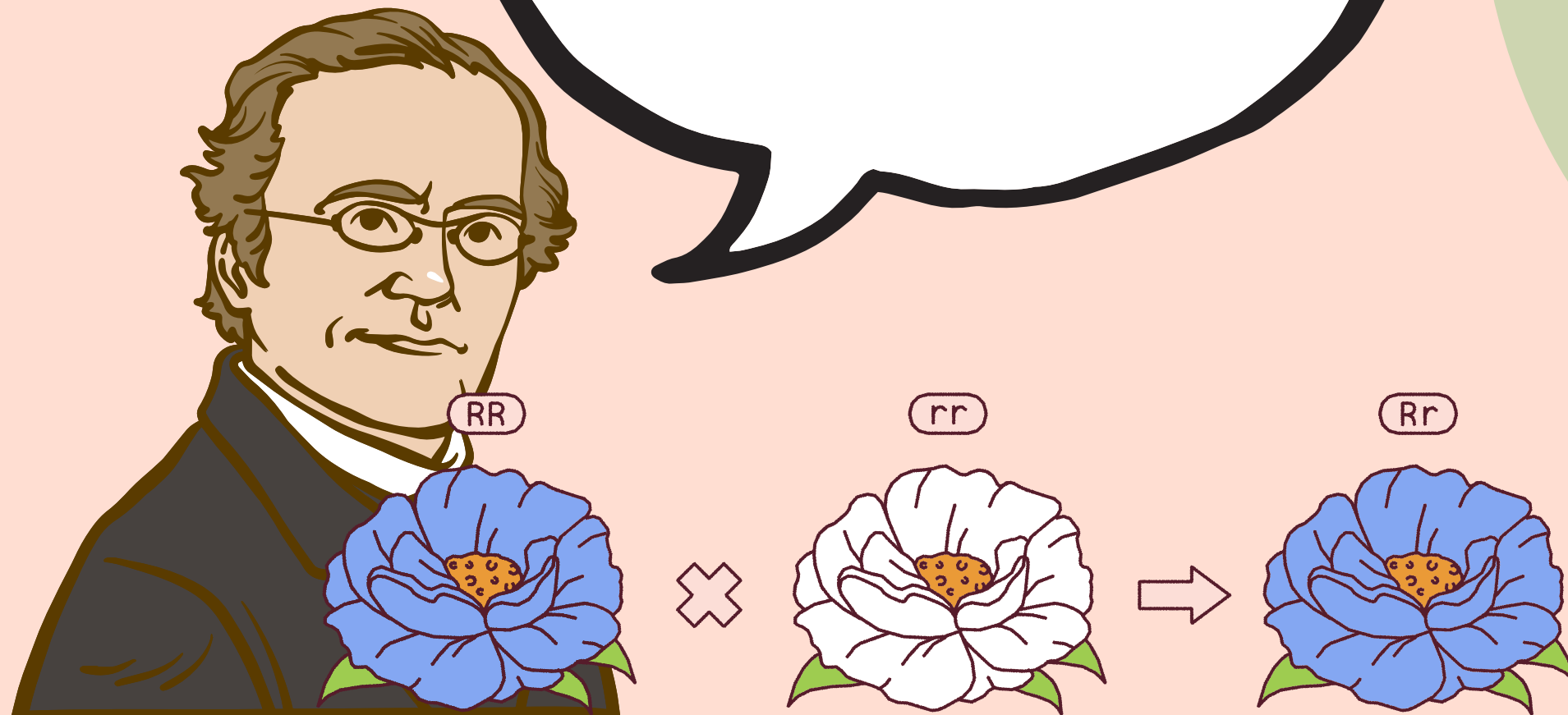
Animal Bias...
oops



1

What is hybridization?

Yuh I did that

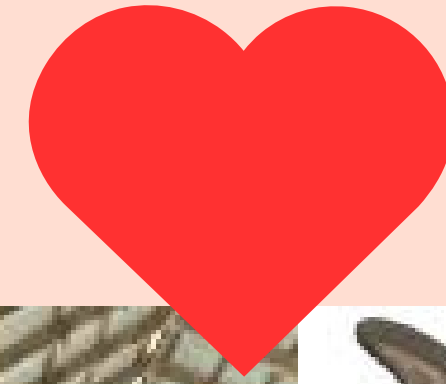


Hybridization in plants is
very common and well
studied



What is hybridization?

What is Hybridization?



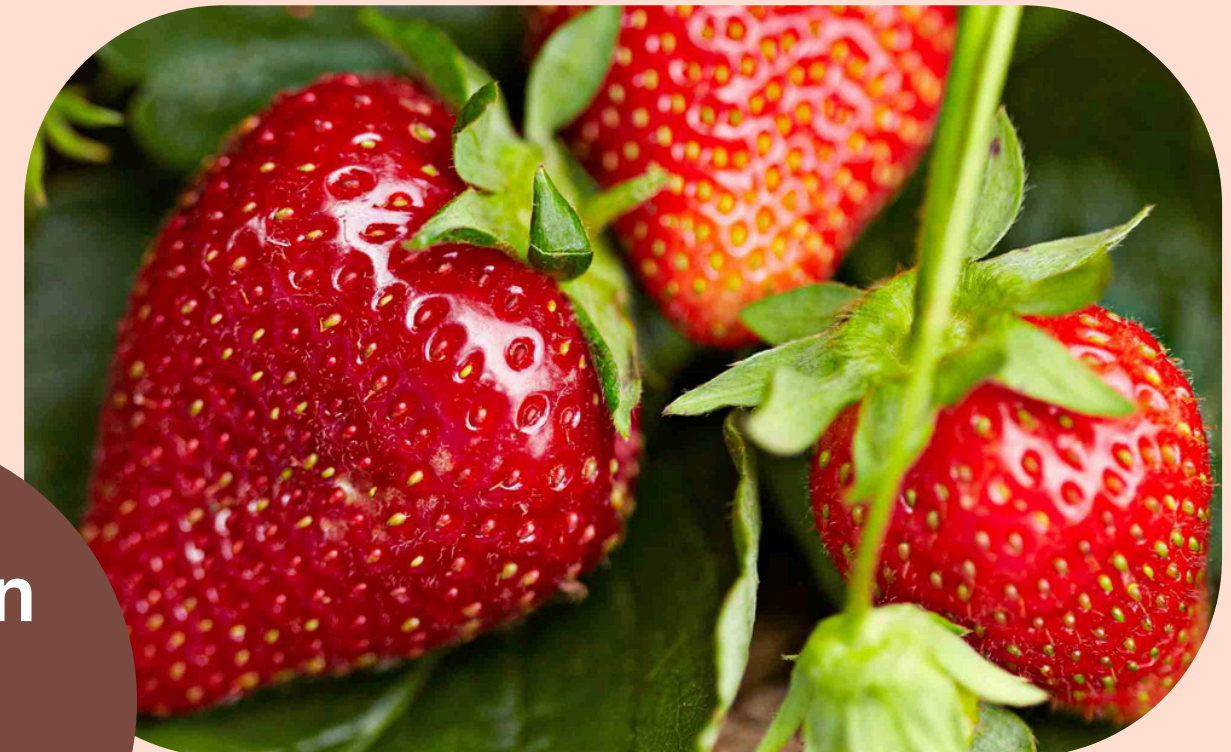


What is hybridization?

What is Hybridization?



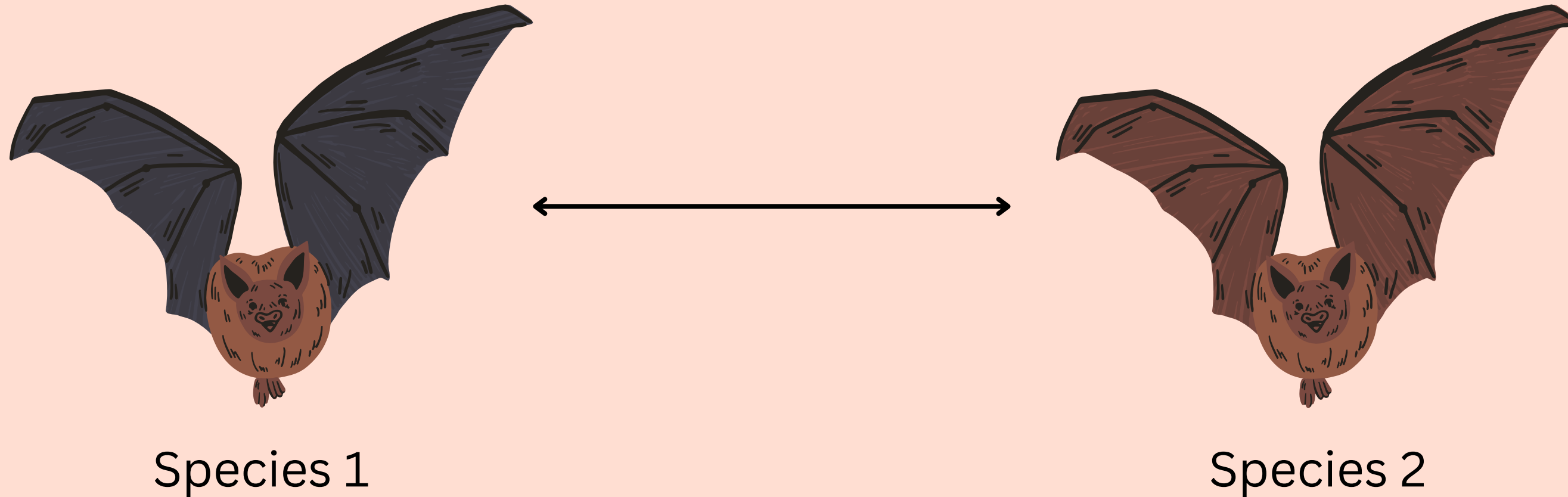
Liger!



Common
garden
Strawberry



What is hybridization?



Population: is a group of individuals of the same species living in the same place at the same time.

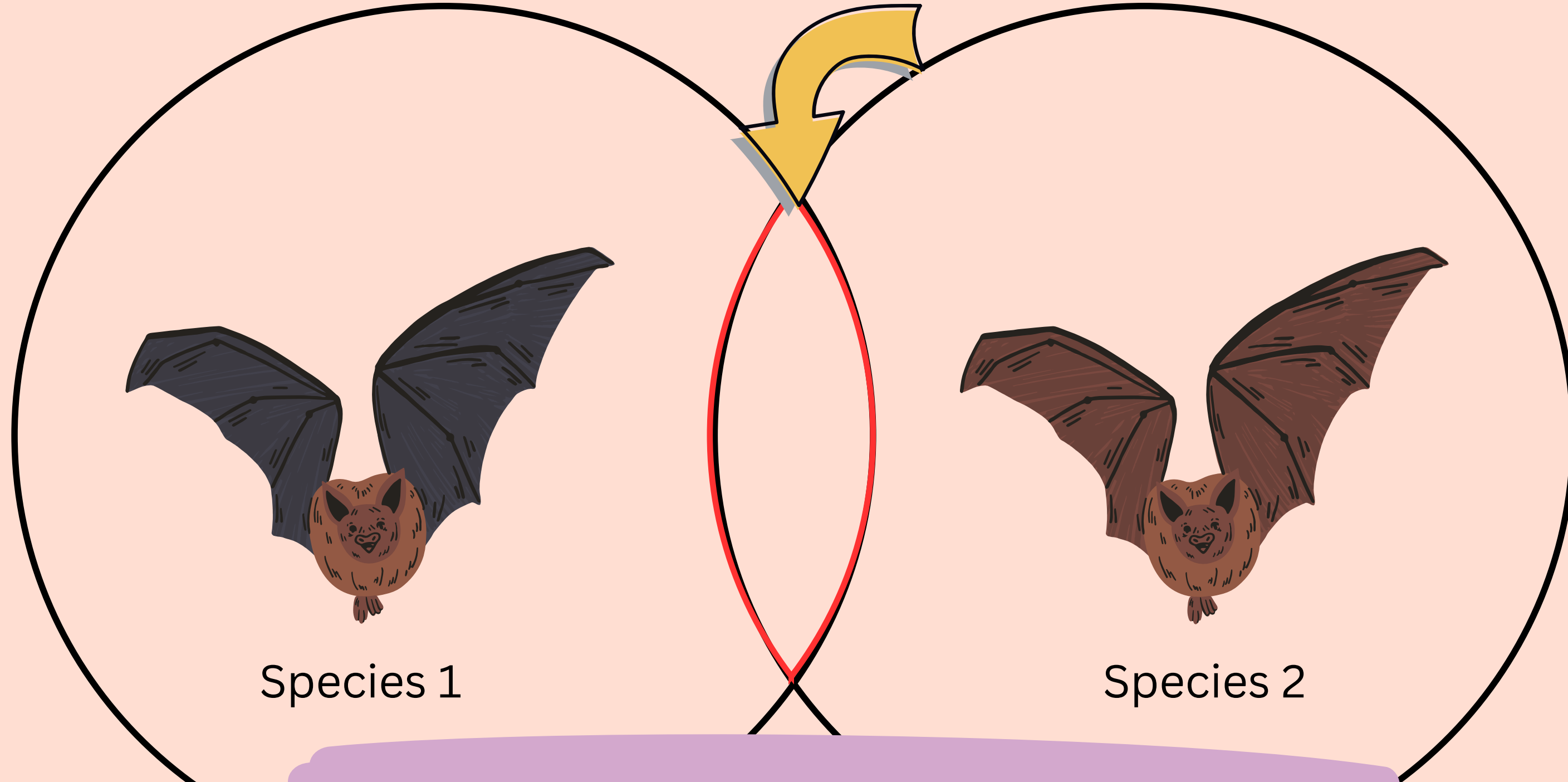
Gene: segments of DNA that contains instructions to make specific traits or functions

Gene pool: collection of genes within a species

Gene flow: Movement of genes between populations



What is hybridization?



Species 1

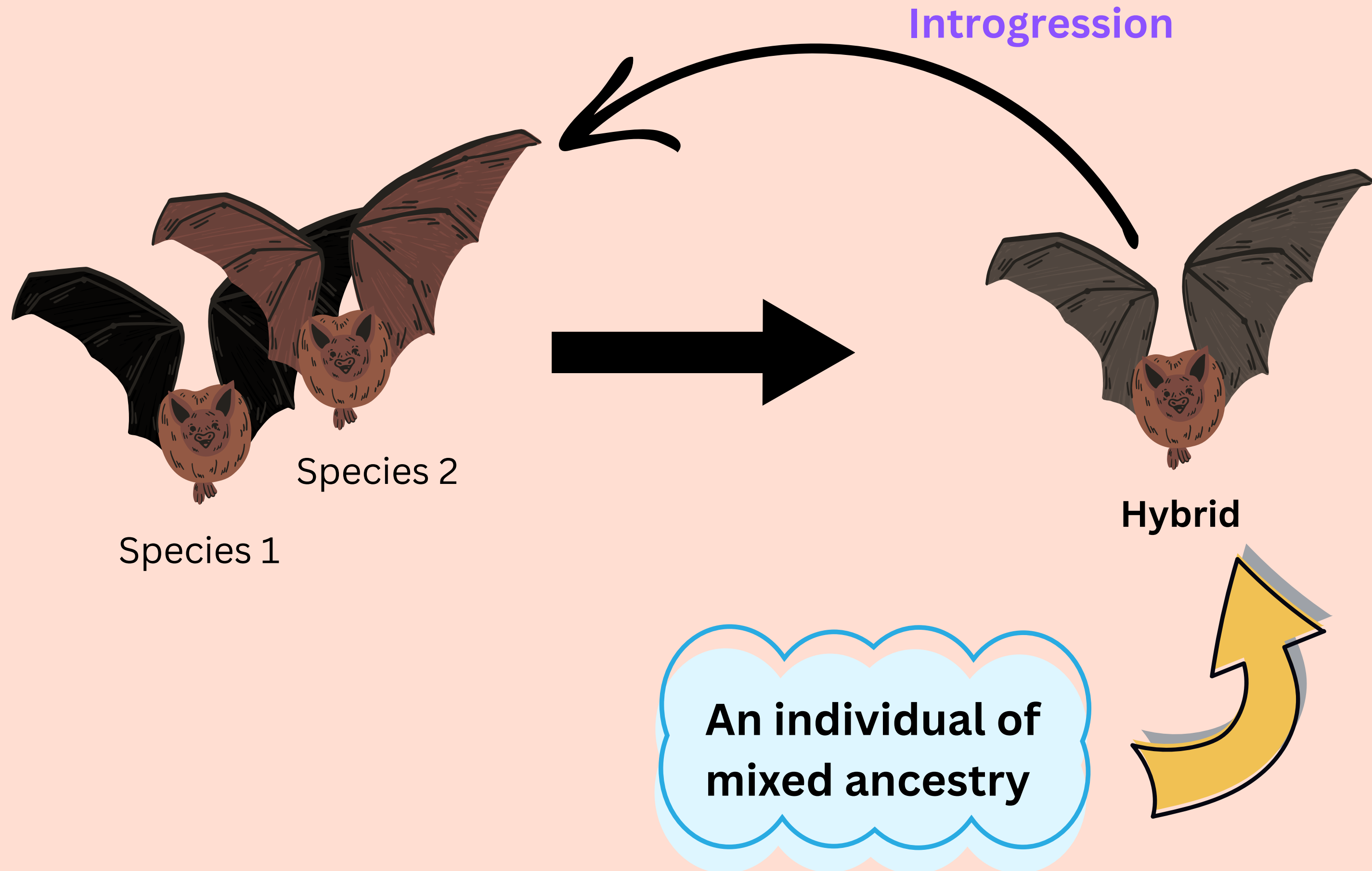
Species 2

HYBRID ZONES

The location in which species boundaries overlap and hybridization occurs

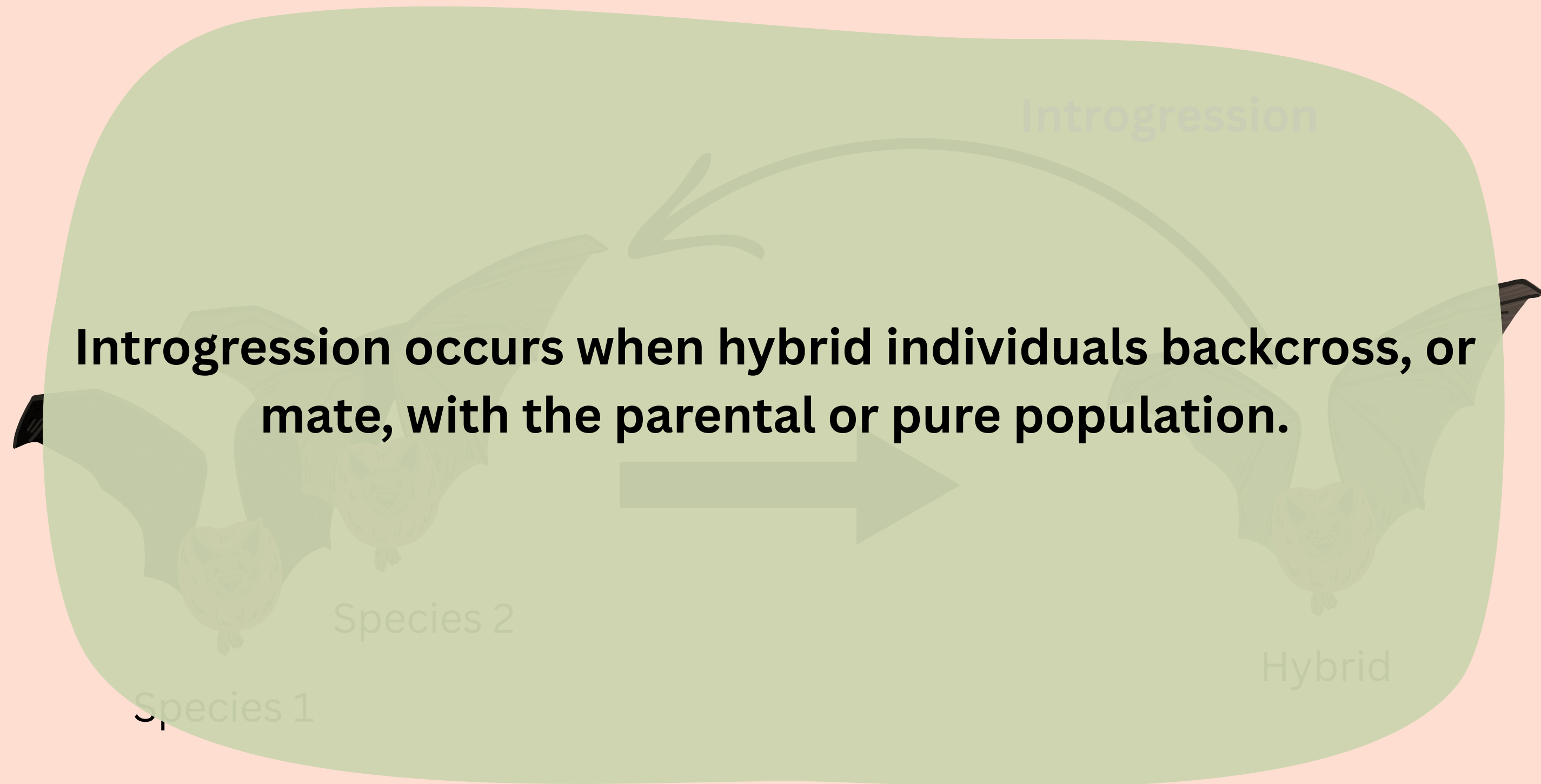


What is hybridization?



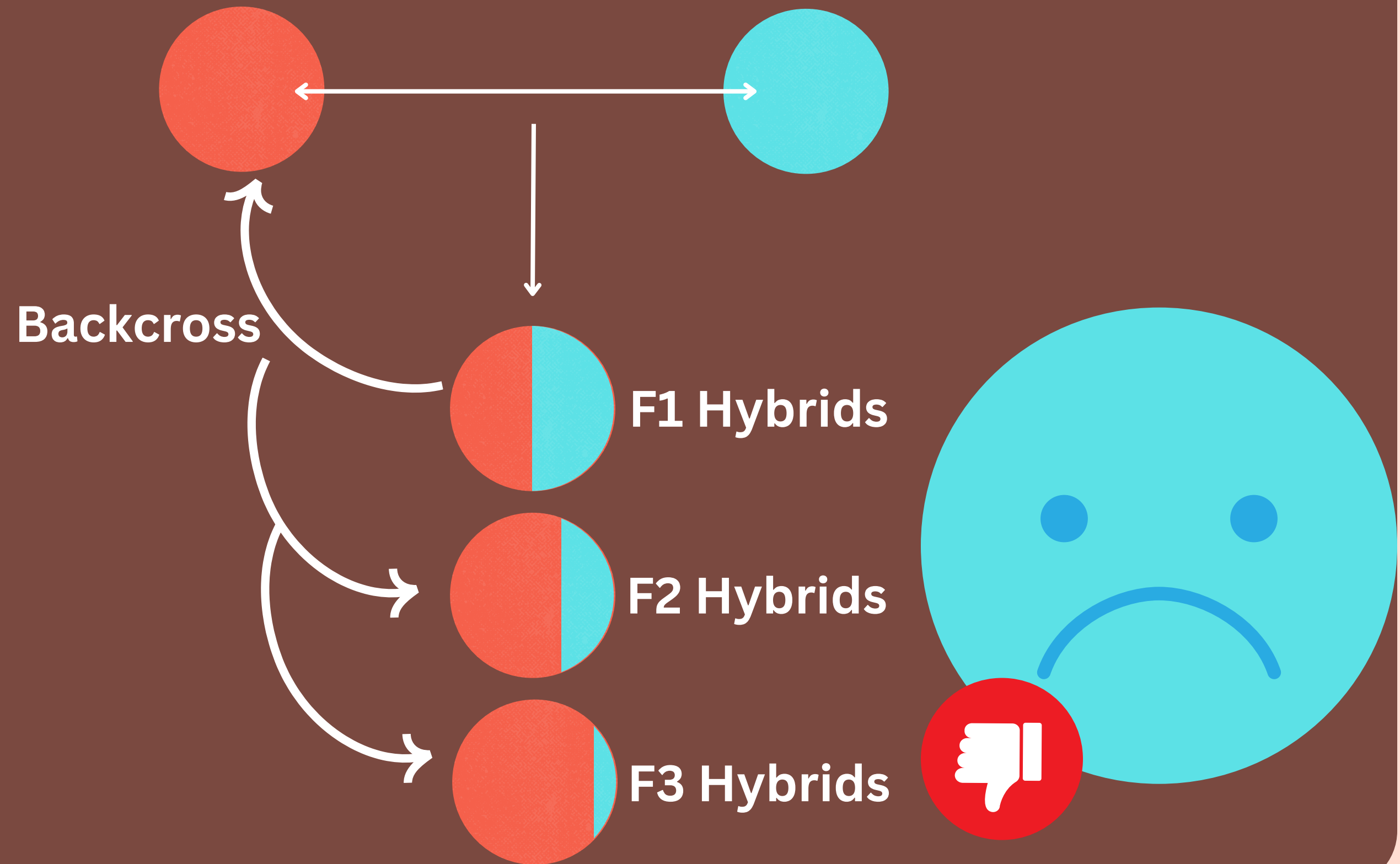


What is hybridization?



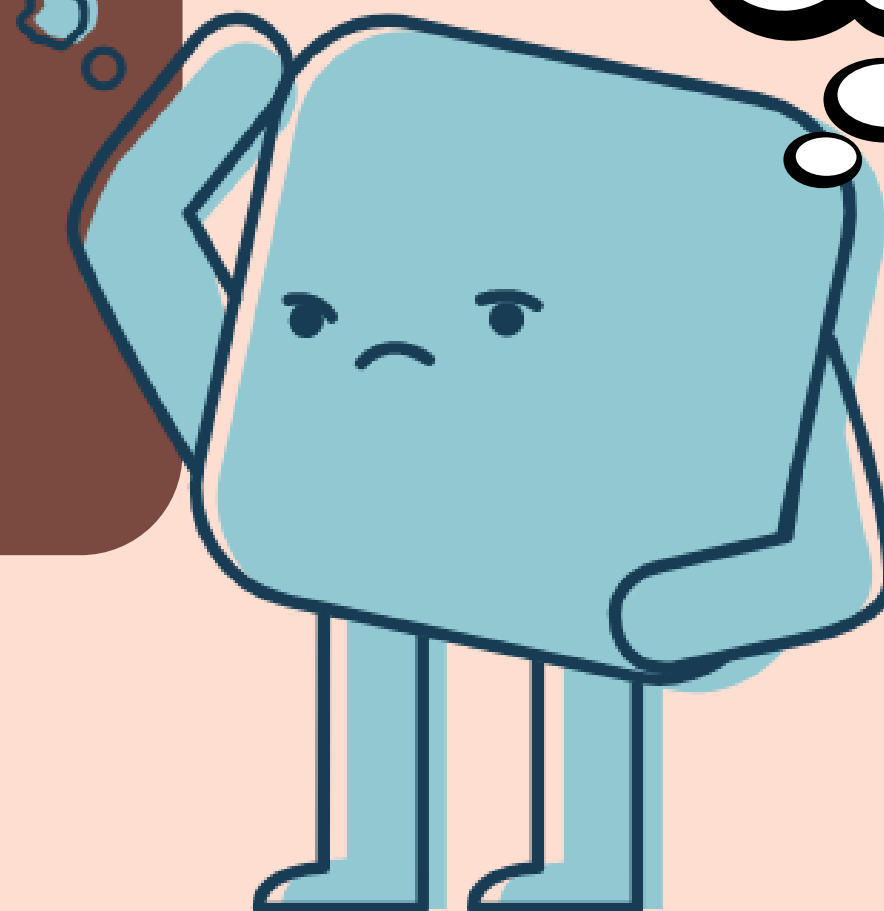
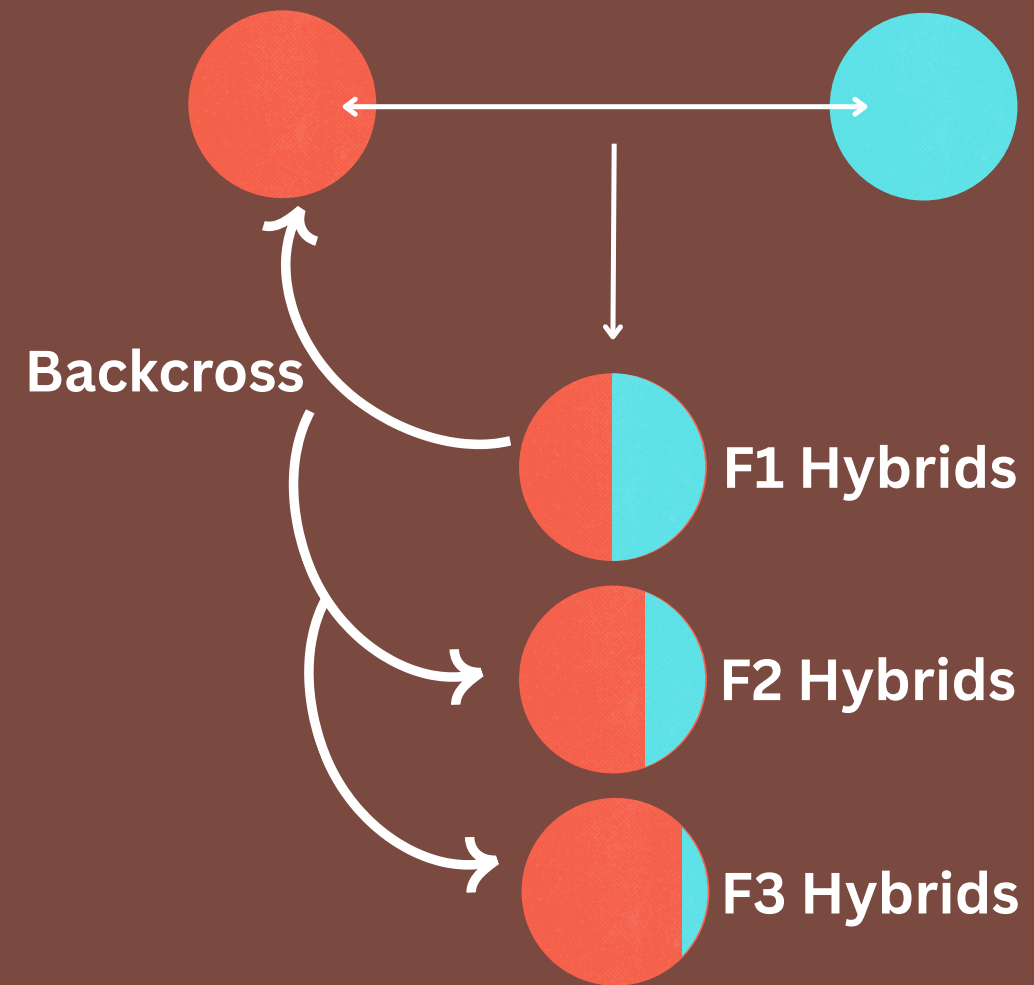


What is hybridization?





What is hybridization?



Conservation!



What is hybridization?

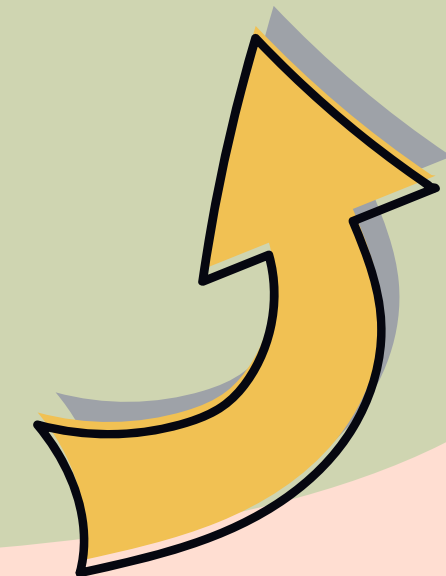


Genetic Swamping:

Blue When repeated hybridization and backcrossing cause the gene pool of one population to be overwhelmed by genes from another.

Gene Pool

We will come back to this





What is hybridization?



Two distinct species
mate, exchange
genes and reproduce

But...there's more

What is Hybridization?: Reproductive Isolation

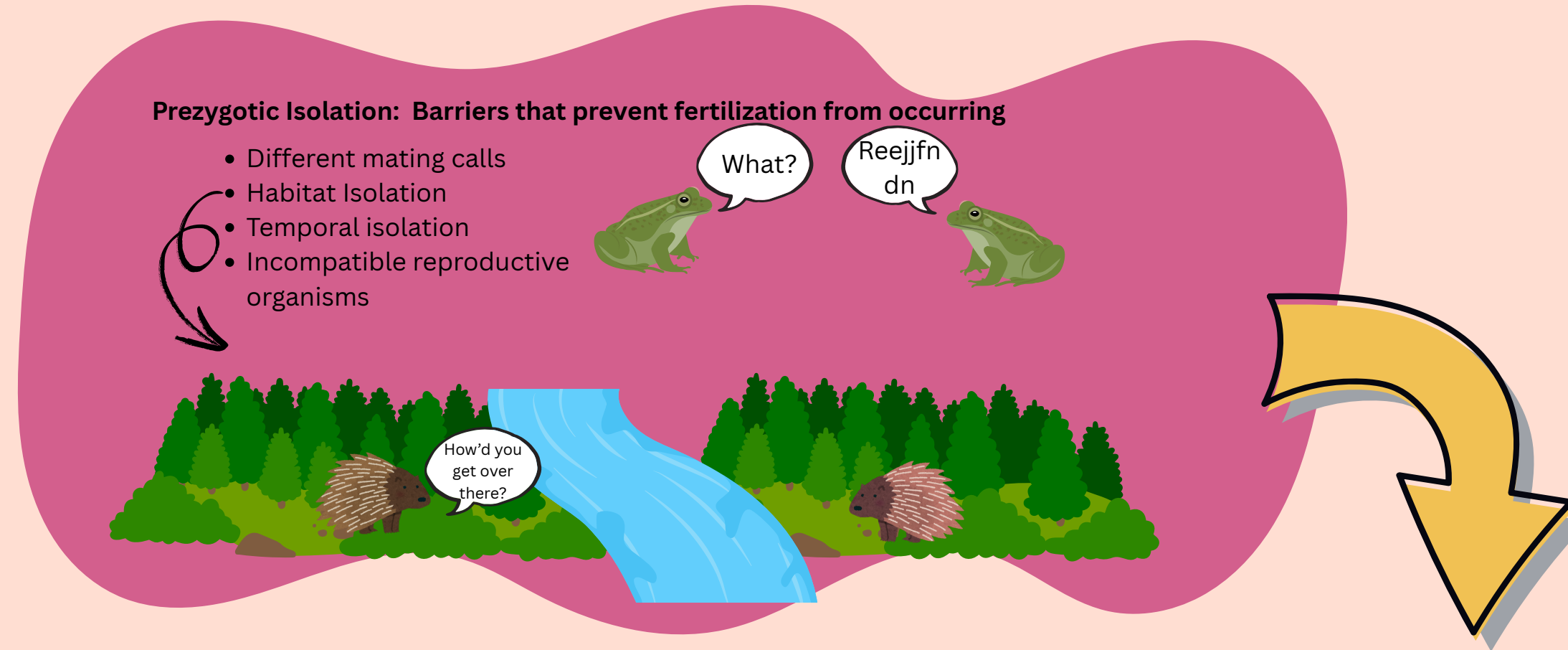
Prezygotic Isolation: Barriers that prevent fertilization from occurring

- Different mating calls
- Habitat Isolation
- Temporal isolation
- Incompatible reproductive organs





What is Hybridization?: Reproductive Isolation

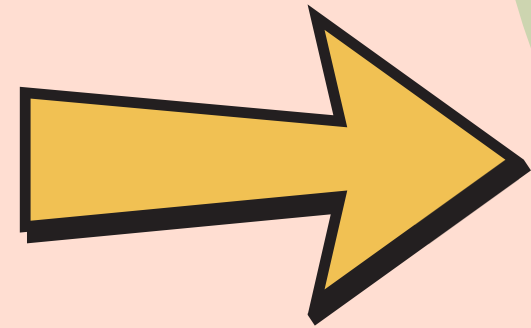


Postzygotic Isolation: Barriers that occur after fertilization

- Hybrid inviability —————> Individuals do not survive past fertilization
- Hybrid sterility —————> Individuals do not have the ability to reproduce



Successful Hybridization



Hybrid Vigor: Hybrid individuals exhibit improved traits compared to parentals

Adaptive Introgression: When beneficial **alleles** from one species get introduced into another species' gene pool

Hybrid Speciation: Hybrids form a new stable species

Hybridization increases measures of innate and cell-mediated immunity in an endangered bird species

Daniel M Tompkins¹, Robin A Mitchell, David M Bryant



Fig. 1. Parakeet phenotypes. Clockwise from top left: Forbes', 'slight hybrid', 'distinct hybrid', red-crowned.

Hybrid Vigor: Hybrid individuals exhibit improved traits compared to parentals

Hybrids
exhibited higher
measures of immunity



Successful Hybridization: Adaptation

Climate Change

Adaptation

a trait or change that helps an organism survive and reproduce in its environment.





Successful Hybridization: Adaptation

Climate Change



Adaptation

Not all species can adapt
Adaptation does not occur
overnight

Climate Change

- Hybrids adapt to changing climate
- Alleles introduced to parental gene pool



**Adaptive
Introgression**

Why does hybridization matter?

Hybridization increases measures of innate and cell-mediated immunity in an endangered bird species

Daniel M Tompkins¹, Robin A Mitchell, David M Bryant

 JOURNAL ARTICLE

Hybridization as a Source of Variation for Adaptation to New Environments

R. C. Lewontin, L. C. Birch

Article | [Open access](#) | Published: 30 January 2023

Natural hybridization reduces vulnerability to climate change

[Chris J. Brauer](#), [Jonathan Sandoval-Castillo](#), [Katie Gates](#), [Michael P. Hammer](#), [Peter J. Unmack](#), [Louis](#)

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Adaptive introgression in animals: examples and comparison to new mutation and standing variation as sources of adaptive variation

[Philip W. Hedrick](#) 

Original Article |  **Open Access** | 

Hybridization in the Anthropocene – how pollution and climate change disrupt mate selection in freshwater fish

[Wilson F. Ramirez-Duarte](#) , [Benjamin M. Moran](#), [Daniel L. Powell](#), [Claudia Bank](#), [Vitor C. Sousa](#), [Gil G. Rosenthal](#), [Molly Schumer](#), [Chelsea M. Rochman](#)

Why does hybridization matter?

Hybridization.... isn't always great

Hybridization increases measures of innate and cell-mediated immunity in an endangered bird species

Daniel M Tompkins ¹, Robin A Mitchell, David M Bryant

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3 Negative Consequences of Hybridization

Marine genetic swamping: hybrids replace an obligately estuarine fish

DAVID G. ROBERTS,* CHARLES A. GRAY,*† RONALD J. WEST* and DAVID J. AYRE*

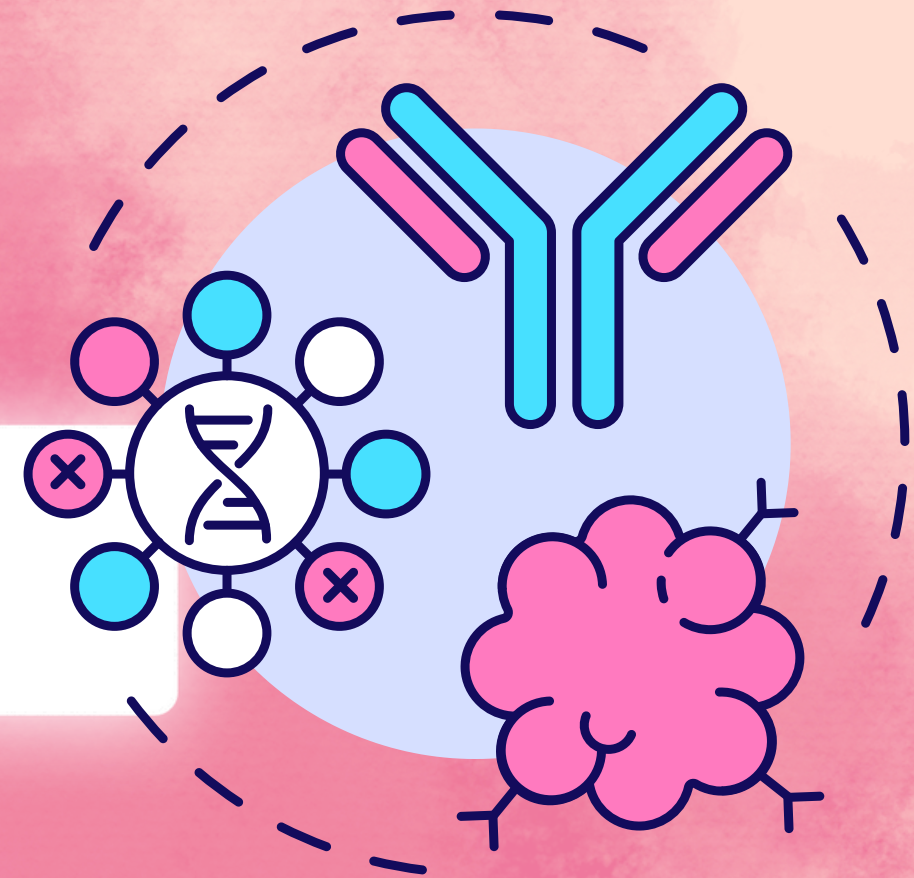
**School of Biological Sciences, Institute for Conservation Biology and Environmental Management, University of Wollongong, Wollongong, NSW 2522, Australia, †Wild Fisheries Program, Cronulla Fisheries Research Centre, PO Box 21, Cronulla, NSW 2230, Australia*



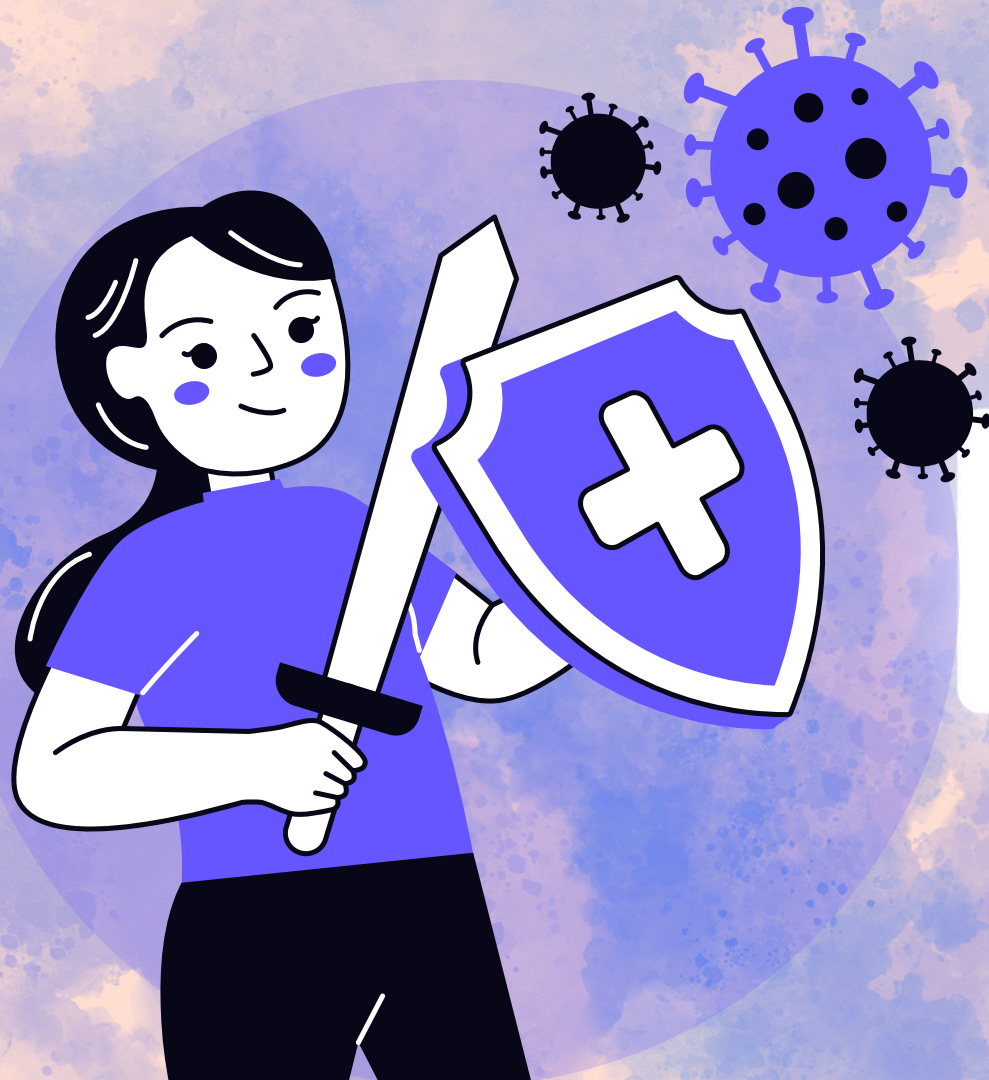
*Acanthopagrus
Butcheri*

- Hybrids outcompete parentals
- Genetic Swamping
- Loss of local adaptations

Immunology- the study of the immune system and its function



Immunity – the ability of an organism to defend itself against pathogens (like viruses, bacteria, parasites)



Why it matters in hybrids:

Hybridization can introduce new immune genes or combinations of genes.

This may lead to hybrid vigor in immunity (stronger responses, broader pathogen resistance).

Hybridization increases measures of innate and cell-mediated immunity in an endangered bird species

Daniel M Tompkins¹, Robin A Mitchell, David M Bryant



Fig. 1. Parakeet phenotypes. Clockwise from top left: Forbes', 'slight hybrid', 'distinct hybrid', red-crowned.

Article

Karyotypic stasis and swarming influenced the evolution of viral tolerance in a species-rich bat radiation

Nicole M. Foley¹ ✉, Andrew J. Harris^{1,2}, Kevin R. Bredemeyer^{1,2}, Manuel Ruedi³, Sebastien J. Puechmaille^{4,5}, Emma C. Teeling⁶, Michael F. Criscitiello^{2,7}, William J. Murphy^{1,2,8} ✉



Where are the wormy mice? A reexamination of hybrid parasitism in the European house mouse hybrid zone

Stuart J E Baird¹, Alexis Ribas, Miloš Macholán, Tomáš Albrecht, Jaroslav Piálek, Joëlle Göüy de Bellocq



How does hybridization influence immunity in bats and rats?



Myotis



Rattus

Does this influence virus diversity?

If there are hybrids, is there greater immune gene variation and less parasite diversity?

How does hybridization
influence immunity in
bats and rats?



Myotis

Does this influence
virus diversity?

4 Hybridization and Immunology: My Research



- 1 **Unique Tolerance**
- 2 **Long lived**
- 3 **Cancer Resistance**



Chapter 1

Ancestral Introgression in Belizian bats

Study System:

- *Myotis* ————— Promiscuous
- *Artibeus* ————— Harem



Foley et al. (2024)





Myotis bats have a history of ancestral introgression

This introgression may have introduced beneficial immune alleles

Volume 4, Issue 2, 14 February 2024, 100482

Article

Karyotypic stasis and swarming influenced the evolution of viral tolerance in a species-rich bat radiation

Nicole M. Foley¹  , Andrew J. Harris^{1 2}, Kevin R. Bredemeyer^{1 2},
Manuel Ruedi³, Sebastien J. Puechmaille^{4 5}, Emma C. Teeling⁶,
Michael F. Criscitiello^{2 7}, William J. Murphy^{1 2 8}  

1 Chapter 1

Overview

Chapter 1 aims to uncover how **ancestral introgression** influences **immune gene variation** and **viral tolerance** in *Myotis* bats by comparing their immune responses to *Artibeus* bats, which lack a history of introgression.



Hybridization is complex

Positive outcomes

It can generate variation for adaptation (e.g., hybrid vigor, adaptive introgression).

Negative outcomes

It can also threaten biodiversity (e.g., genetic swamping, loss of local adaptations).

Understanding hybridization helps us predict species survival, extinction risk, and resilience in a changing world.

Any Questions?

