

# Using molecular approaches to understand the drivers of population divergence and speciation

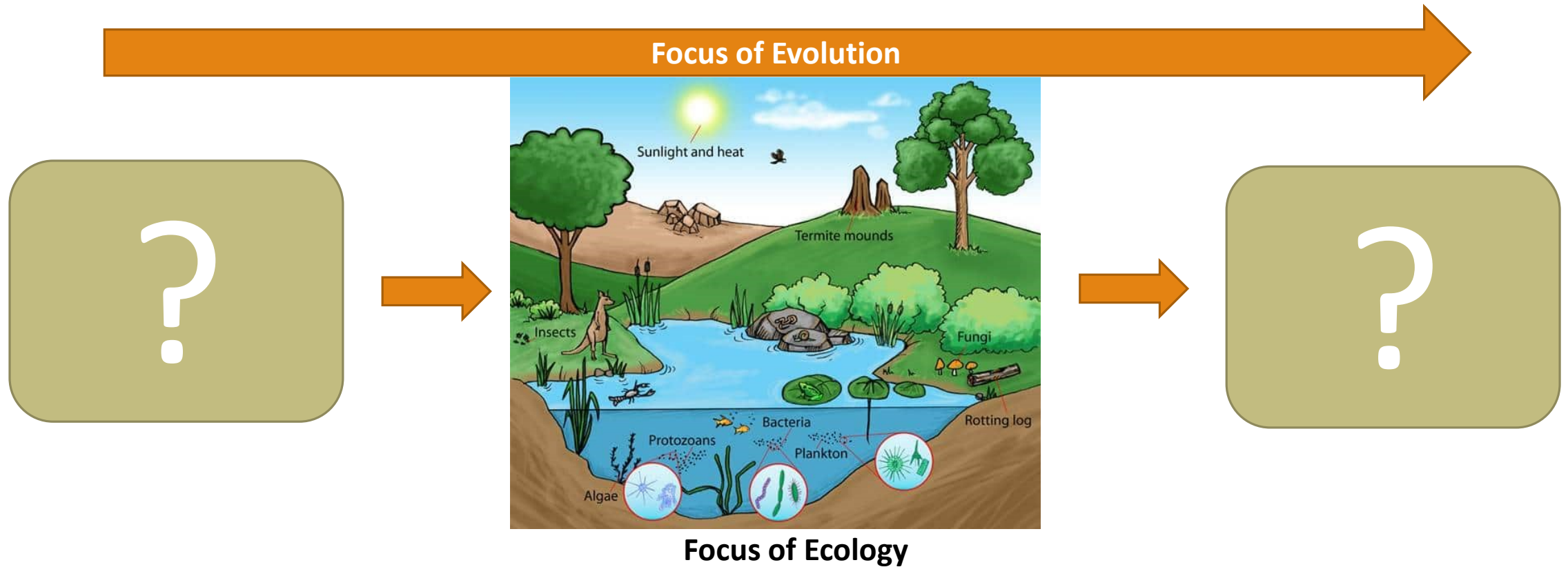
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2025 MMEE COURSE



# MMEE; Ecology & Evolution

Do they always live like as they do now?

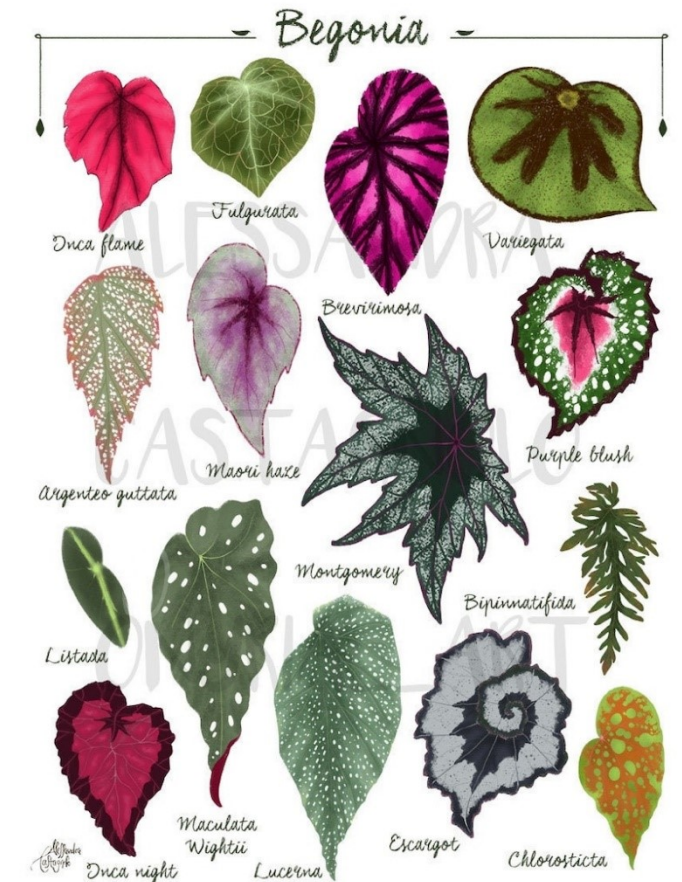


# Classical ecology&evolution has **limited resolution**

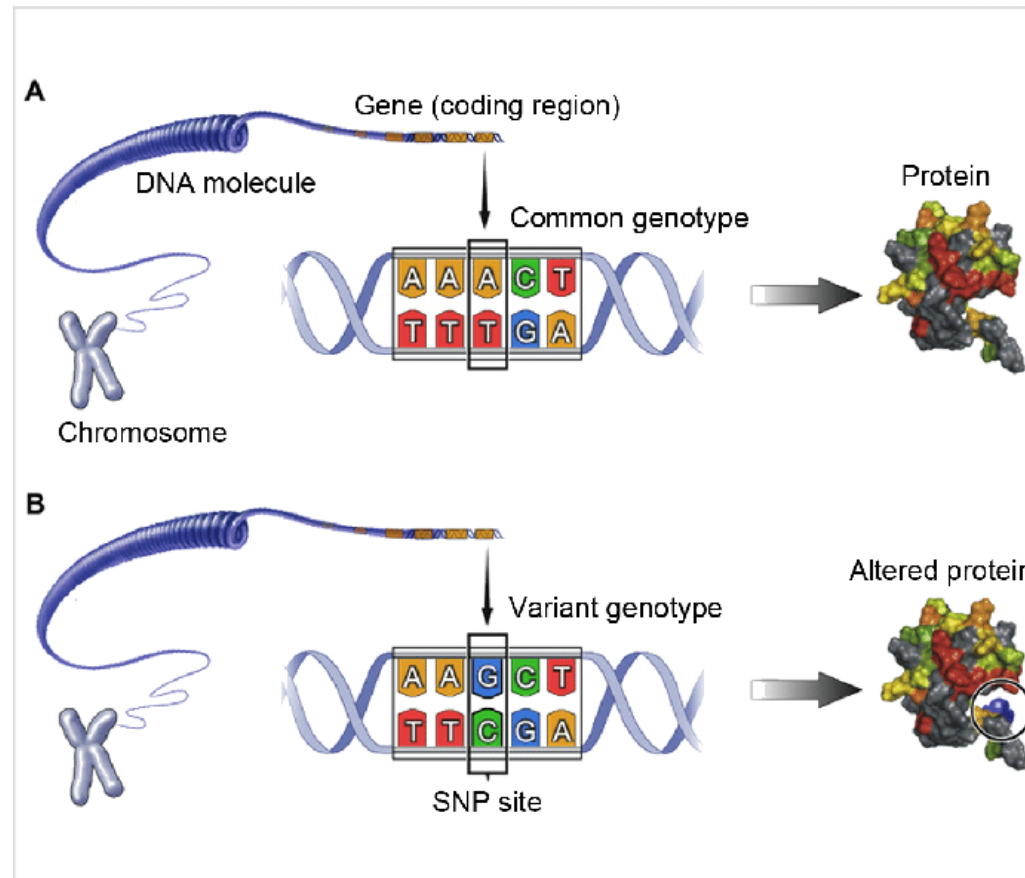
Nature can confuse us with organism morphology



Nikaido et al, 1999



# SNPs can alter protein structure, so the function and ultimately phenotype



Iglesias et al, 2020

# Targeted marker sequencing for identification

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Good marker genes can reflect the difference among individual in molecular level





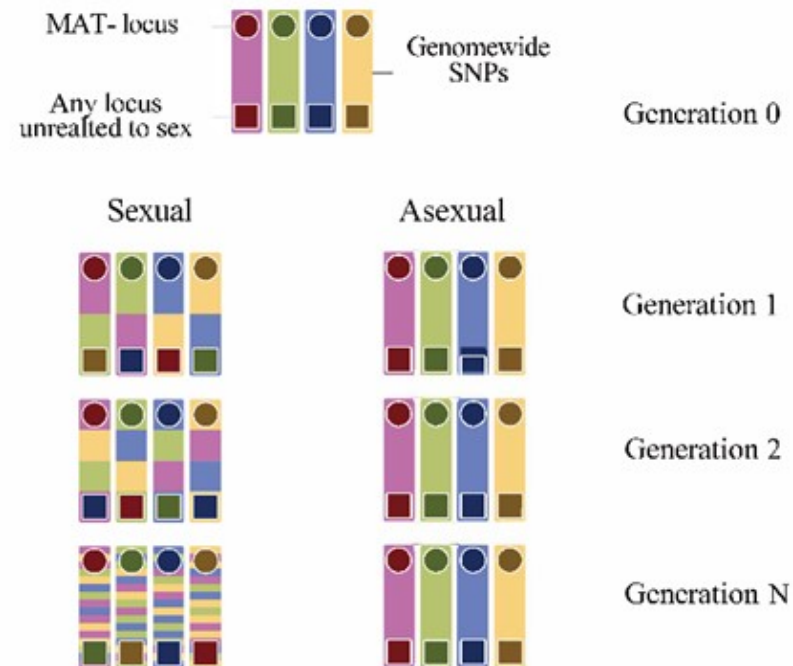
# Genome encodes far higher number of genes than the number of markers we use

	Organism	# of protein-coding genes	# of genes naïve estimate: (genome size /1000)	BNID
viruses	HIV 1	9	10	105769
	Influenza A virus	10-11	14	105767
	Bacteriophage λ	66	49	105770
	Epstein Barr virus	80	170	103246
prokaryotes	<i>Buchnera sp.</i>	610	640	105757
	<i>T. maritima</i>	1,900	1,900	105766
	<i>S. aureus</i>	2,700	2,900	105500
	<i>V. cholerae</i>	3,900	4,000	105760
	<i>B. subtilis</i>	4,400	4,200	111448
	<i>E. coli</i>	4,300	4,600	105443
eukaryotes	<i>S. cerevisiae</i>	6,600	12,000	105444
	<i>C. elegans</i>	20,000	100,000	101364
	<i>A. thaliana</i>	27,000	140,000	111380
	<i>D. melanogaster</i>	14,000	140,000	111379
	<i>F. rubripes</i>	19,000	400,000	111375
	<i>Z. mays</i>	33,000	2,300,000	110565
	<i>M. musculus</i>	20,000	2,800,000	100308
	<i>H. sapiens</i>	21,000	3,200,000	100399, 111378
	<i>T. aestivum</i> (hexaploid)	95,000	16,800,000	105448, 102713

# However, loci of an organism do not co-evolve together in most organisms

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**a**



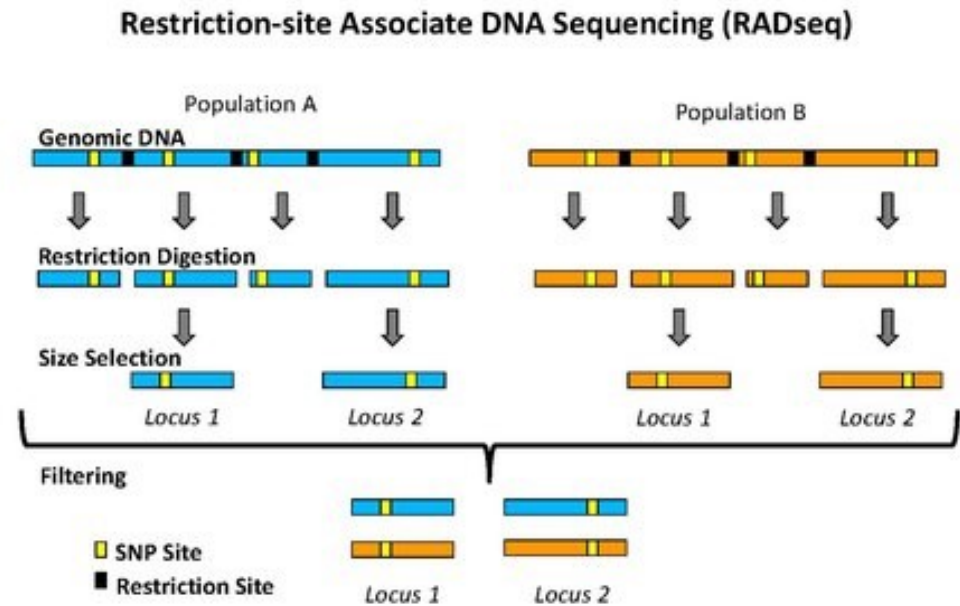
Lee et al, 2024

# Cost is the main problem

Restriction enzyme associated DNA sequencing (RAD sequencing)

Double digested RAD sequencing

-> Sequence the subset of genome

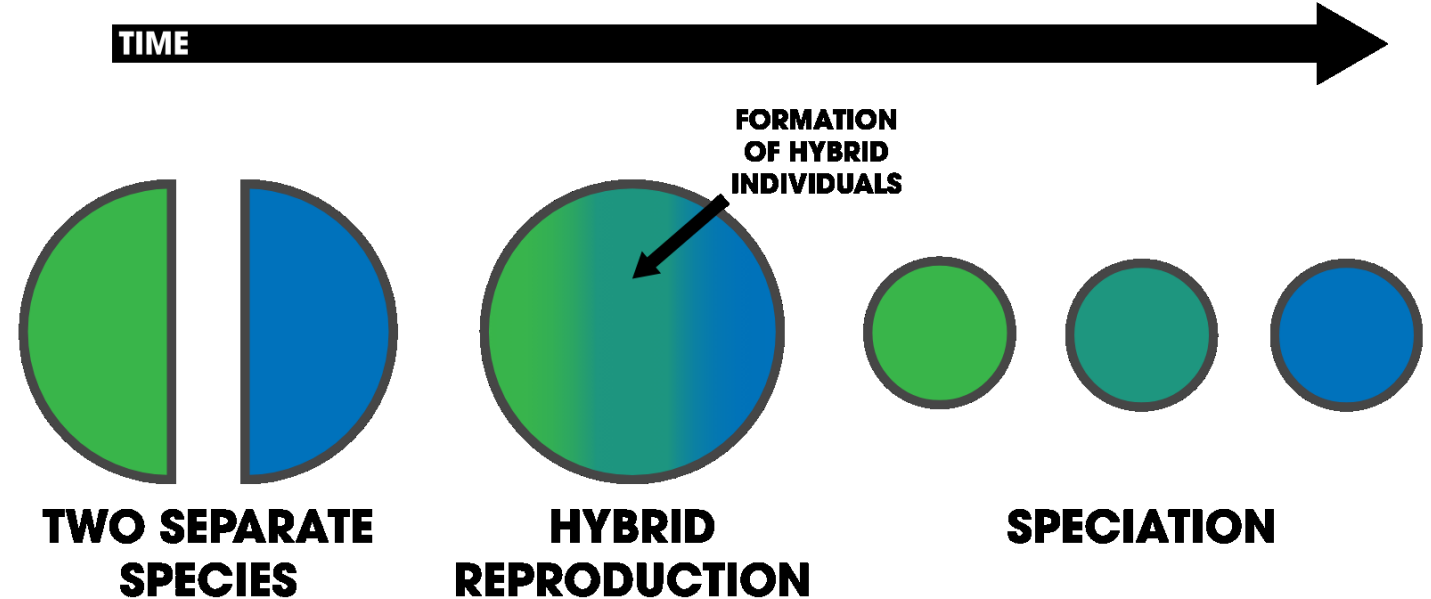




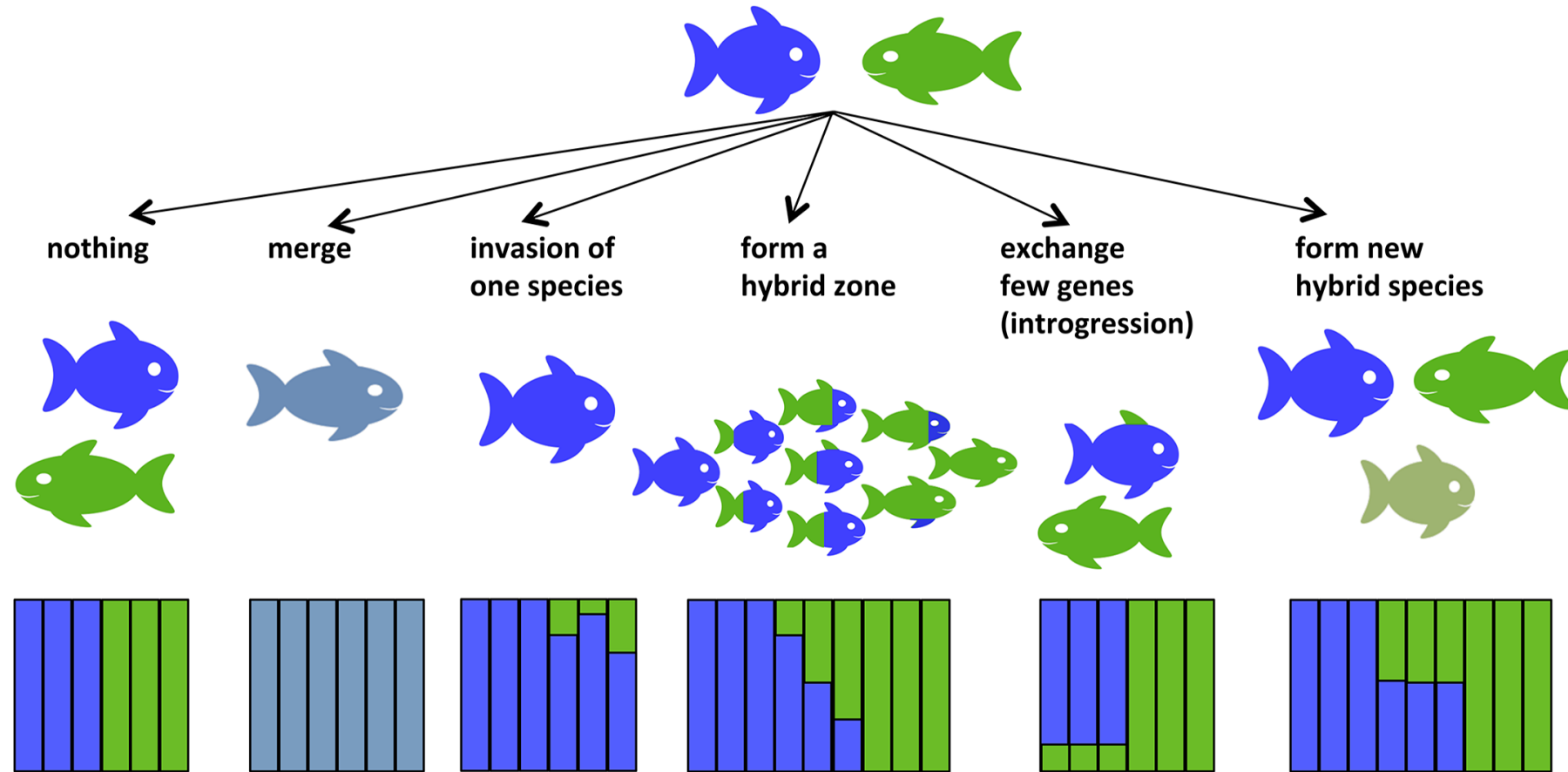
# Speciation is continuum, and we cannot detect phenotypically until certain threshold

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**Genome** investigation is a wonderful tool to detect this **even before it becomes obvious for phenotypes**



# Theoretical models of hybridization



Runemark et al, 2019

# During the practical parts of MMEE...



## Types of Speciation

