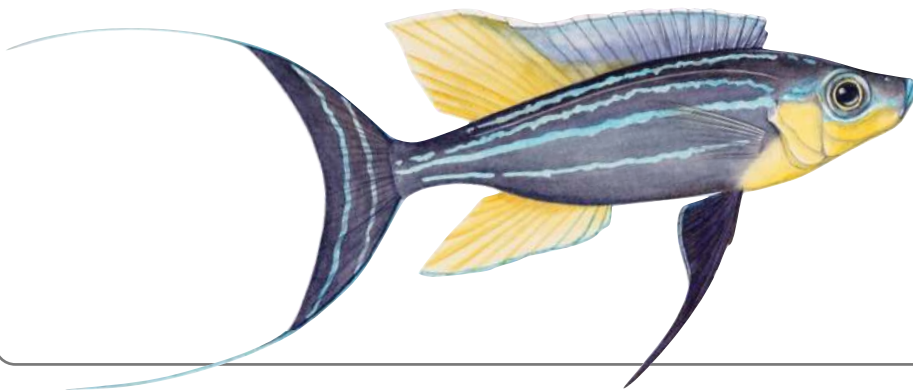




Walter Salzburger
Zoological Institute



Universität
Basel





Poll (1946)

① Taxonomists describe species based on diagnostic characters and taxonomy guidelines



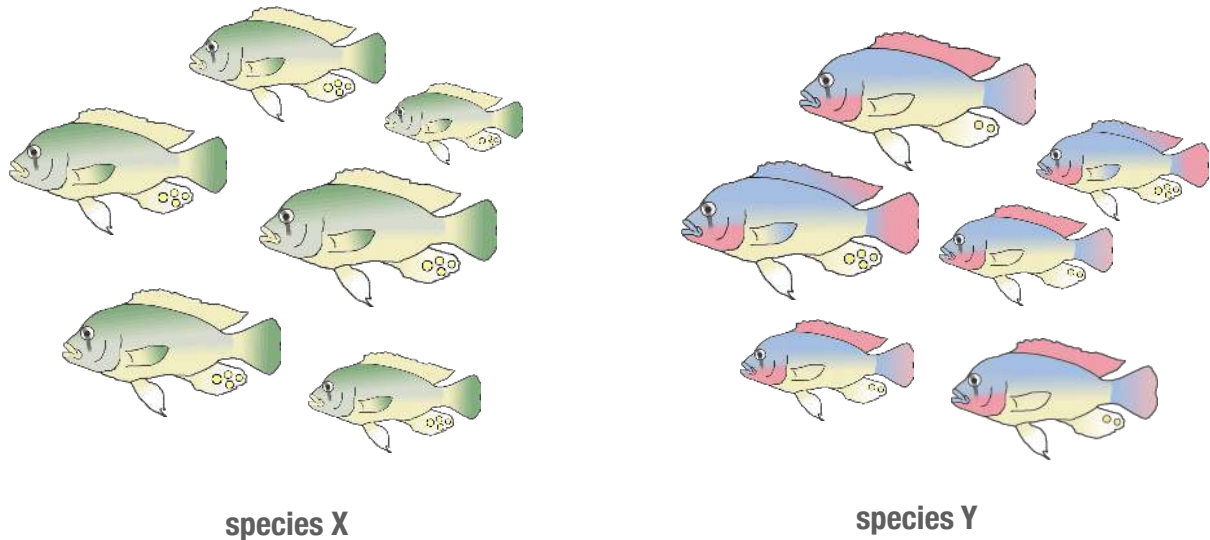
① Field guides and identification keys help in species identification



image: www.heliconius.org

① *Heliconius erato* and *H. melpomene* are morphologically similar because of mimicry

Members of a species share a gene pool; selection and drift operate within species.



① Evolutionary biologists interpret species as independent evolutionary units

The category species is defined according to a species concept

biological
species concept

A species is a group of interbreeding natural populations that is reproductively isolated from other such groups (Mayr 1963).

cohesion
species concept

A species is the most inclusive populations of individuals having the potential for phenotypic cohesion through intrinsic cohesion mechanisms (Templeton 1989).

ecological
species concept

A species is a lineages (or a closely related sets of lineages), which occupies an adaptive zone minimally different from that of any other lineage in range and which evolve separately from all lineages outside its range (Van Valen 1976).

evolutionary
species concept

A species is a single lineage of ancestral-descendant lineages that evolve separately from other such lineages and have their own evolutionary tendencies and historical fate (Simpson 1961; Wiley 1978).

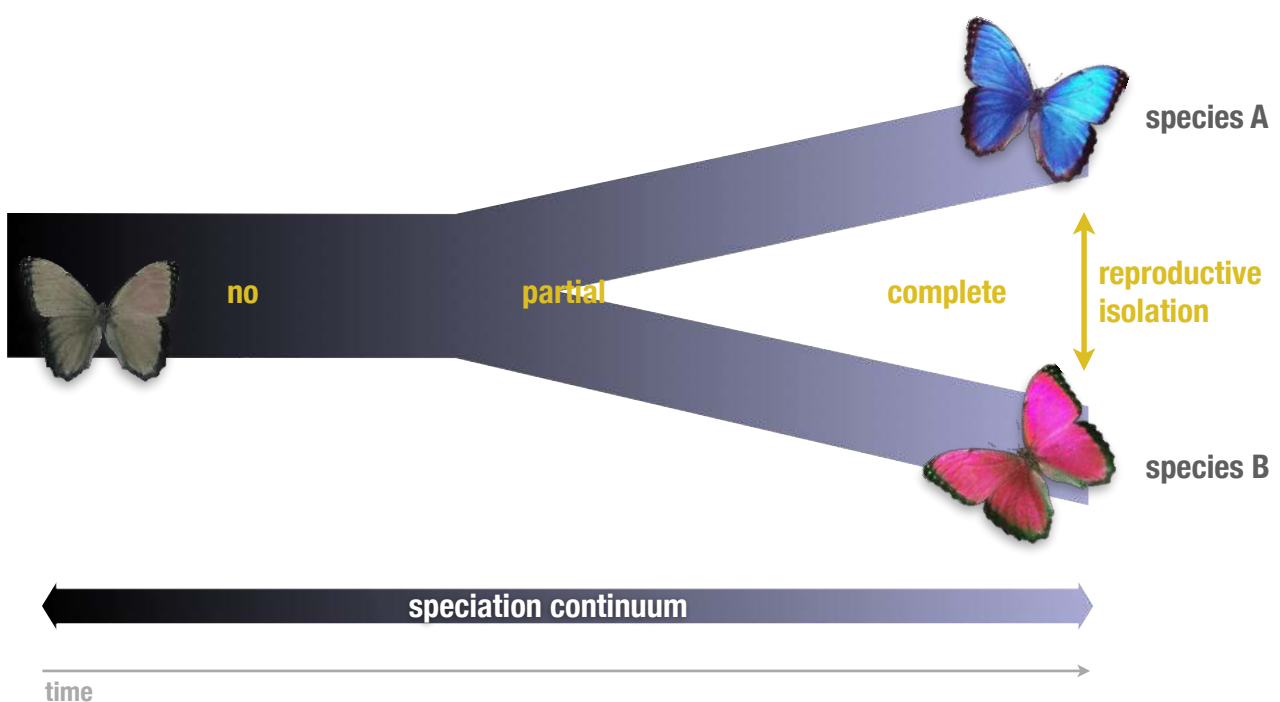
phylogenetic
species concepts

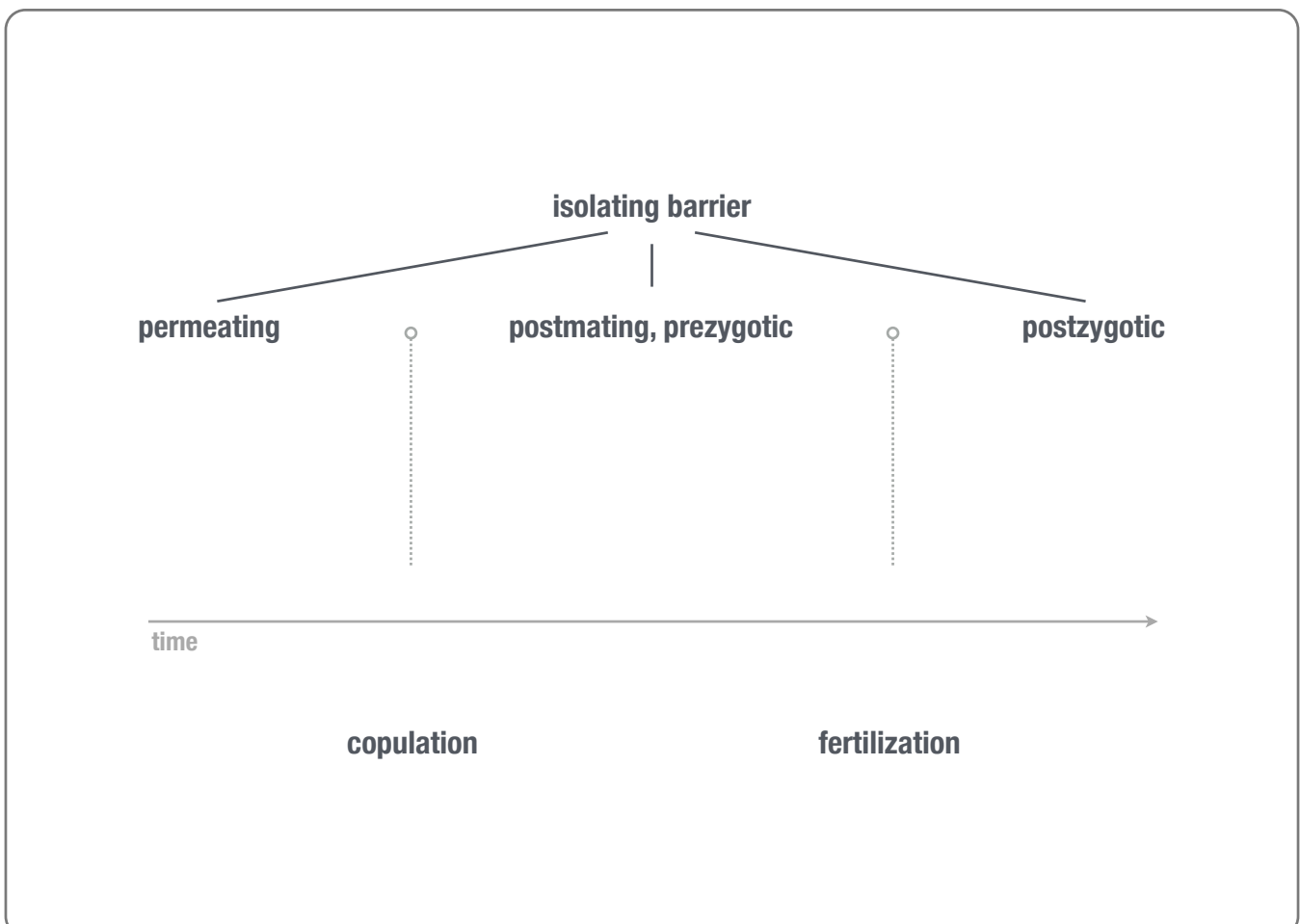
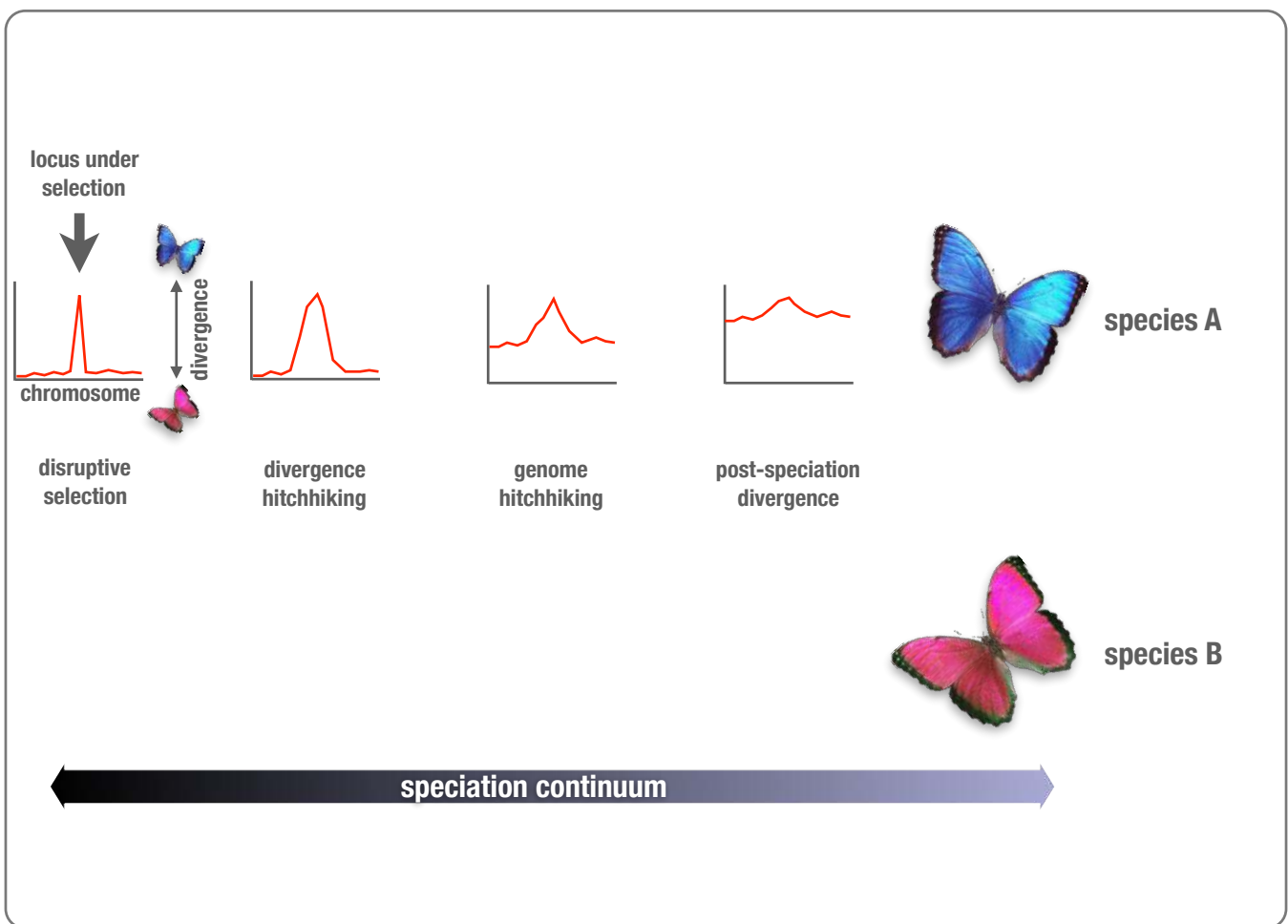
A species is the smallest monophyletic group of common ancestry (de Quieroz & Donoghue 1988). A phylogenetic species is a basal cluster of organisms that is diagnosably distinct from other such clusters (Cracraft 1989)

A species is a group of interbreeding natural populations that is reproductively isolated from other such groups (Mayr 1963).

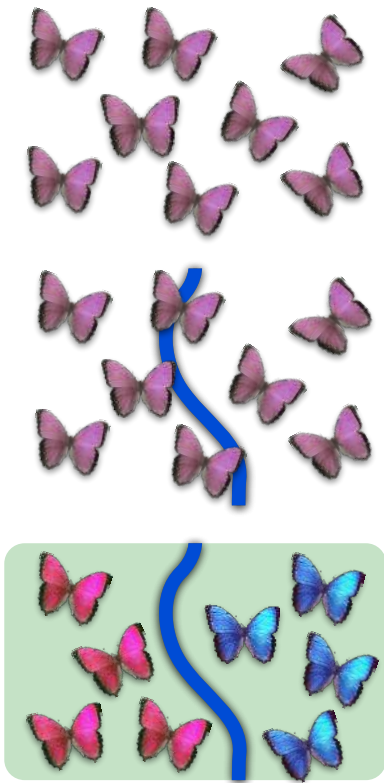


① The biological species concept places the category species within the framework of population genetics

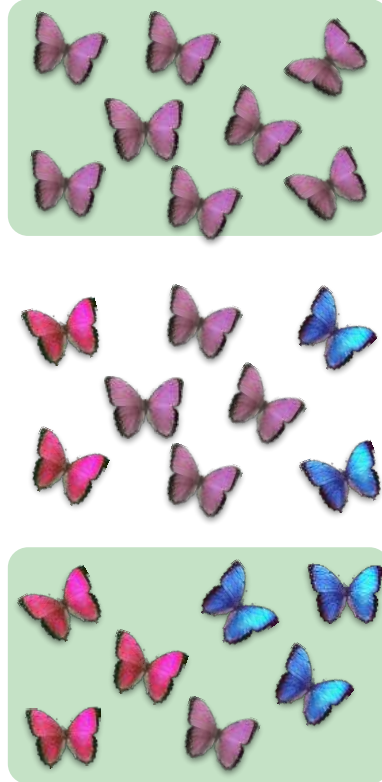




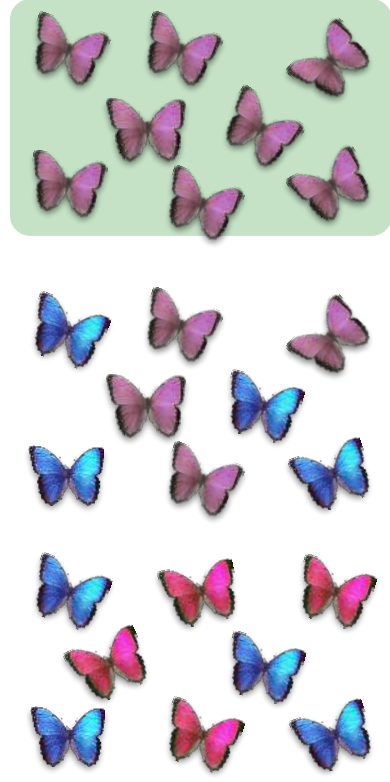
allopatric speciation



parapatric speciation

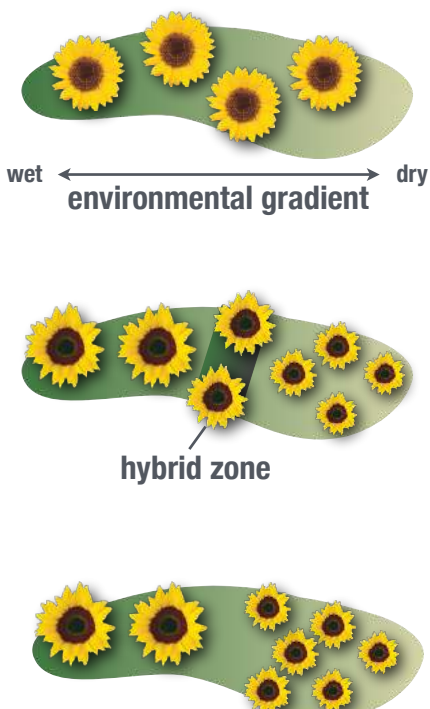


sympatric speciation



time

Clinal models



colonization

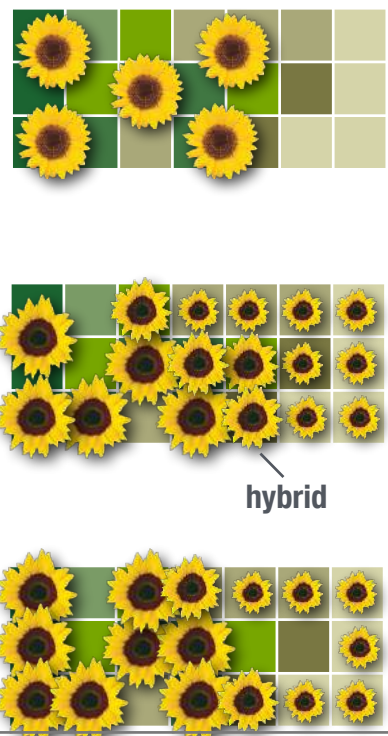


local adaptation



reproductive isolation

"Stepping-stone" models

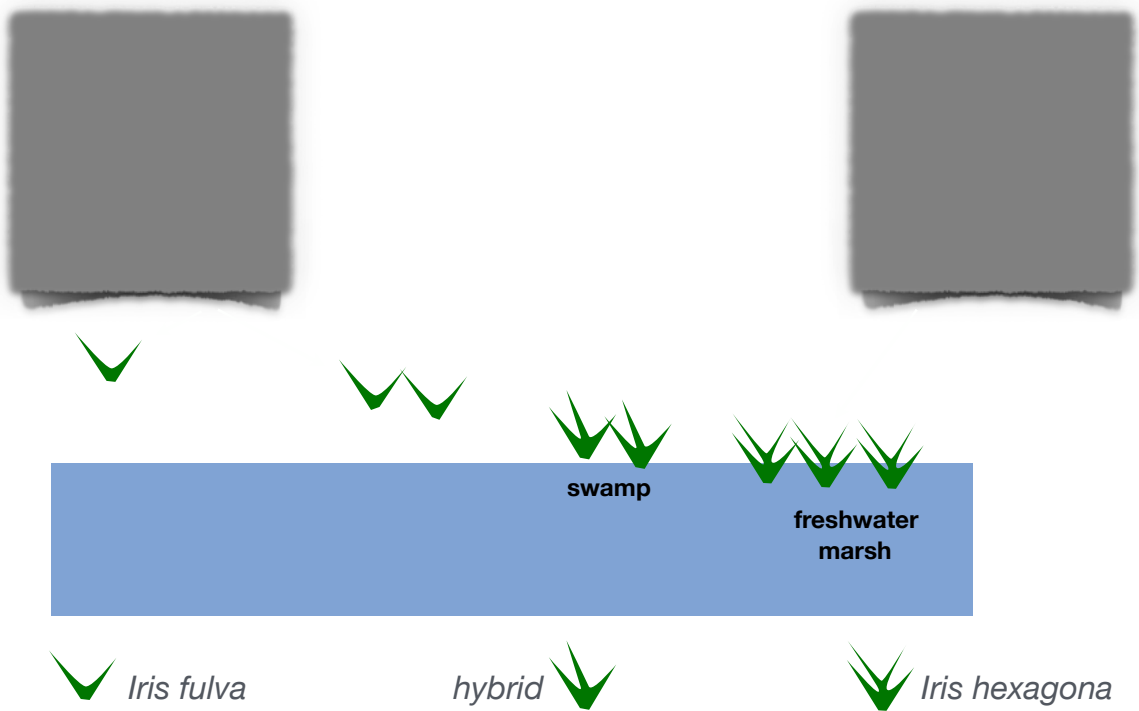


The evolution of reproductive isolation between populations by adaptation to different environments.



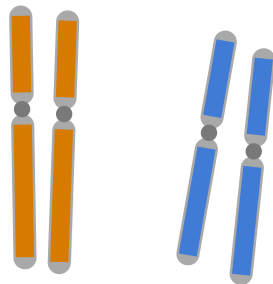
Jones et al. (2012) Nature

① Ecological speciation can happen in allopatry, parapatry and sympatry

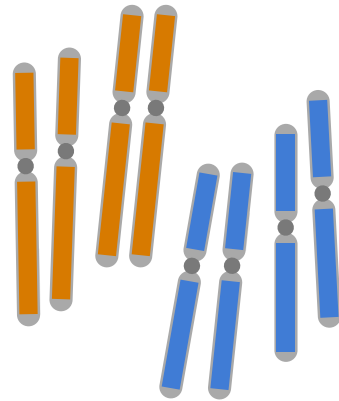


from: Arnold & Bennett (1993)

① Louisiana irises



diploid
($2n=4$)



tetraploid
($4n=8$)

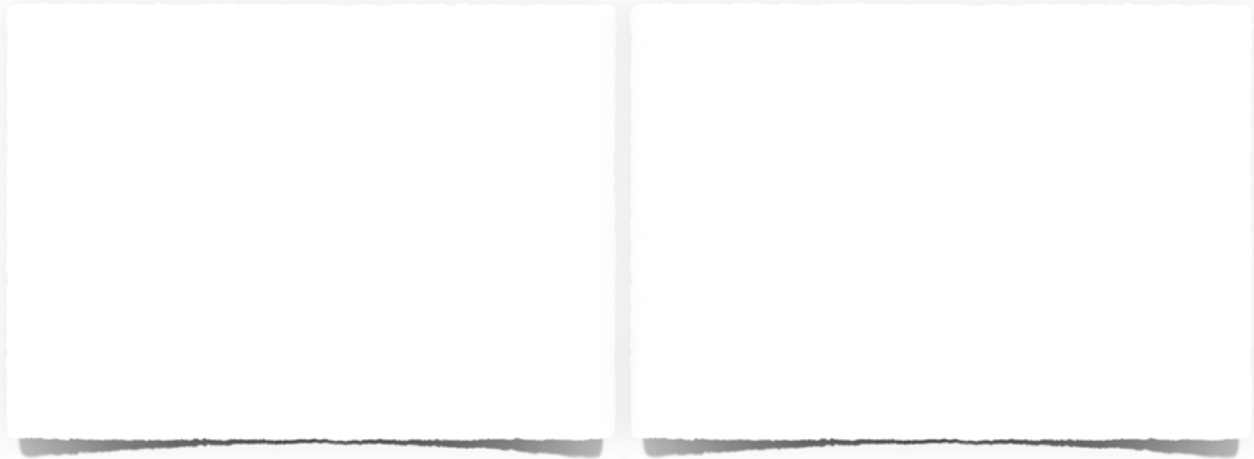
... is the process by which the forms of organisms in a population that are best adapted to the environment increase in frequency relative to less well-adapted forms over a number of generations (Ridley 2004)



... is the selection on mating behavior, either through:

competition among members of one sex (usually males) for access to members of the other sex or through

choice by members of one sex (usually females) for certain members of the other sex (Ridley 1996)



images: National Geographic, www.smh.com.au

There are fundamental difference between natural and sexual selection:

	fitness	competitors
sexual selection	individual fitness	other members of the same sex
natural selection	fitness of the genotype	other individuals in the same population

Both natural and sexual selection operate if the following conditions are met:

reproduction

organisms must reproduce to form new generations

heredity

offspring resemble parents (“like must produce like”)

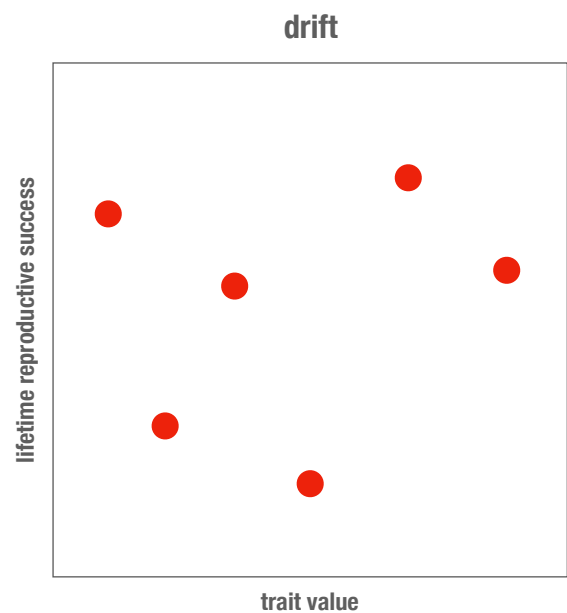
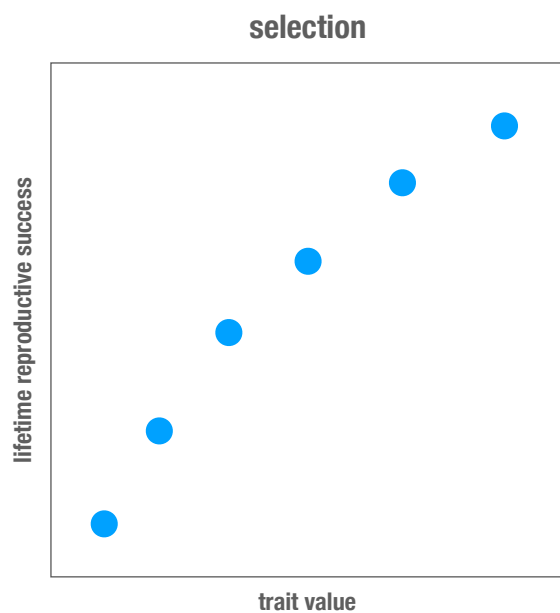
trait variation

individuals in natural populations vary in (adaptive) traits

variation in fitness

individuals in natural populations vary in the number of their offspring that survive to reproduce (‘lifetime reproductive success’)

(Natural) selection versus random drift



**Natural populations show variation at all levels, from gross morphology to DNA sequences.
Selection can only operate, if heritable variation exists.**

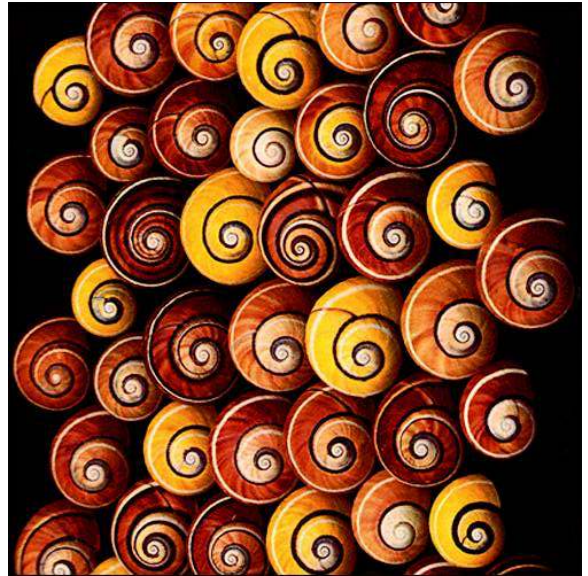


image: www.pbs.org

Heritable natural variation is generated by two processes, mutation and recombination

images: www.collective-evolution.com, N. Hunter/UC Davies

New mutations are only transmitted to the next generation, if they occur in germinal tissue.

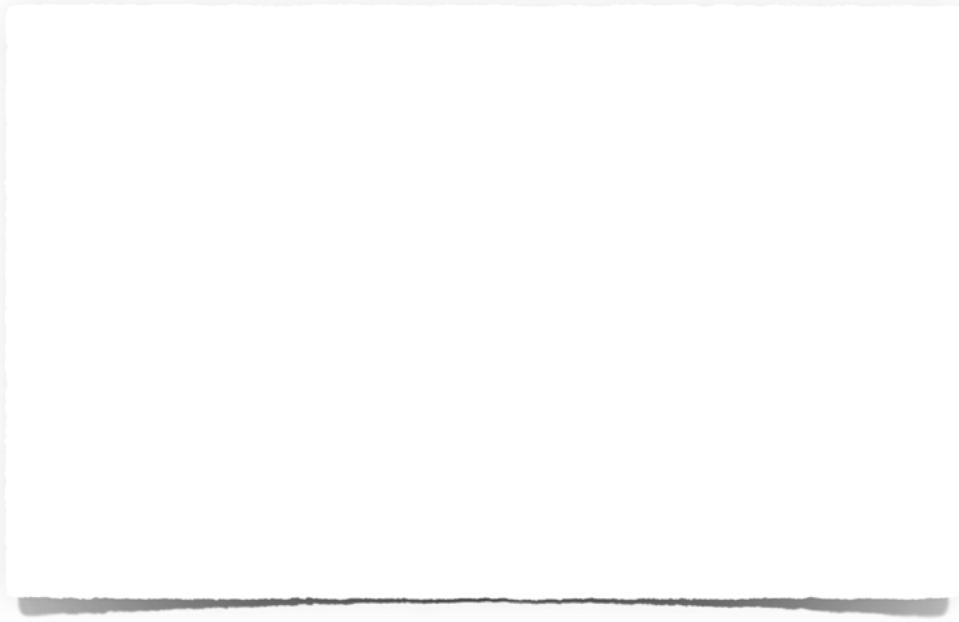
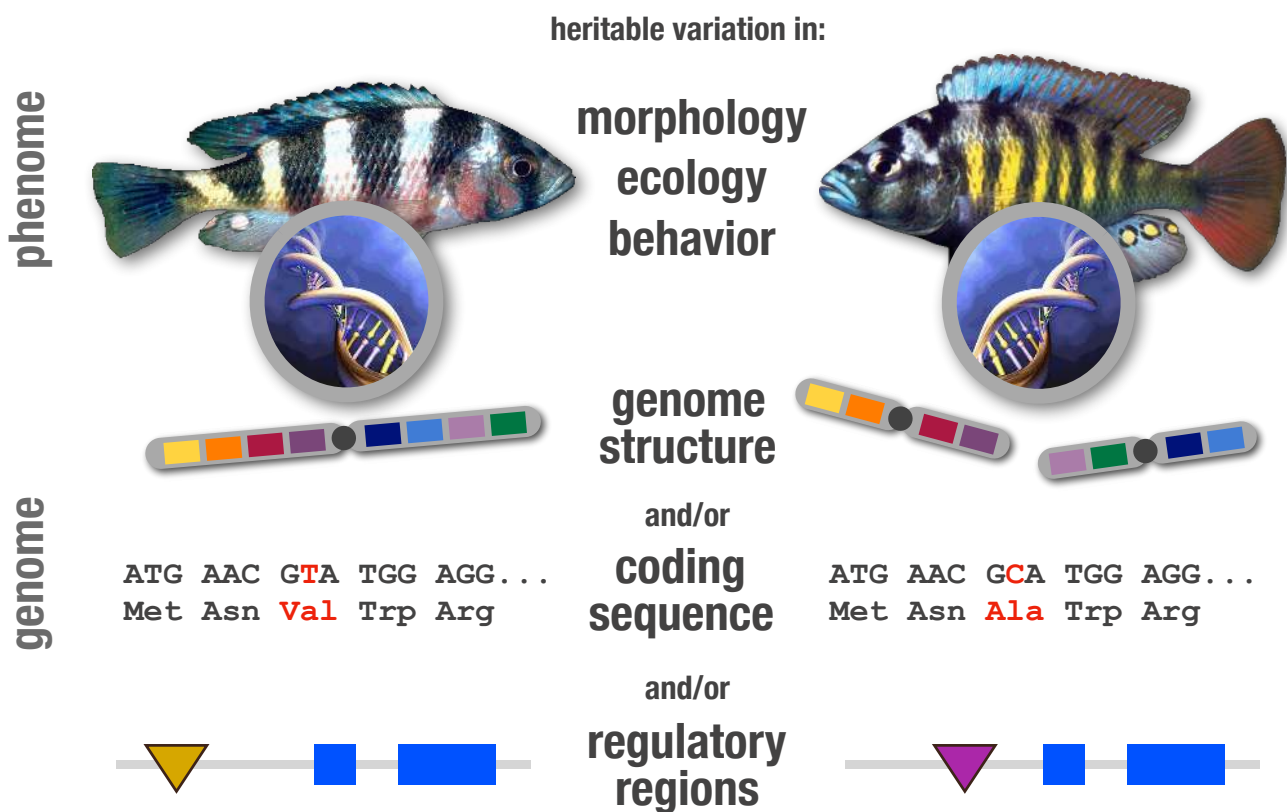
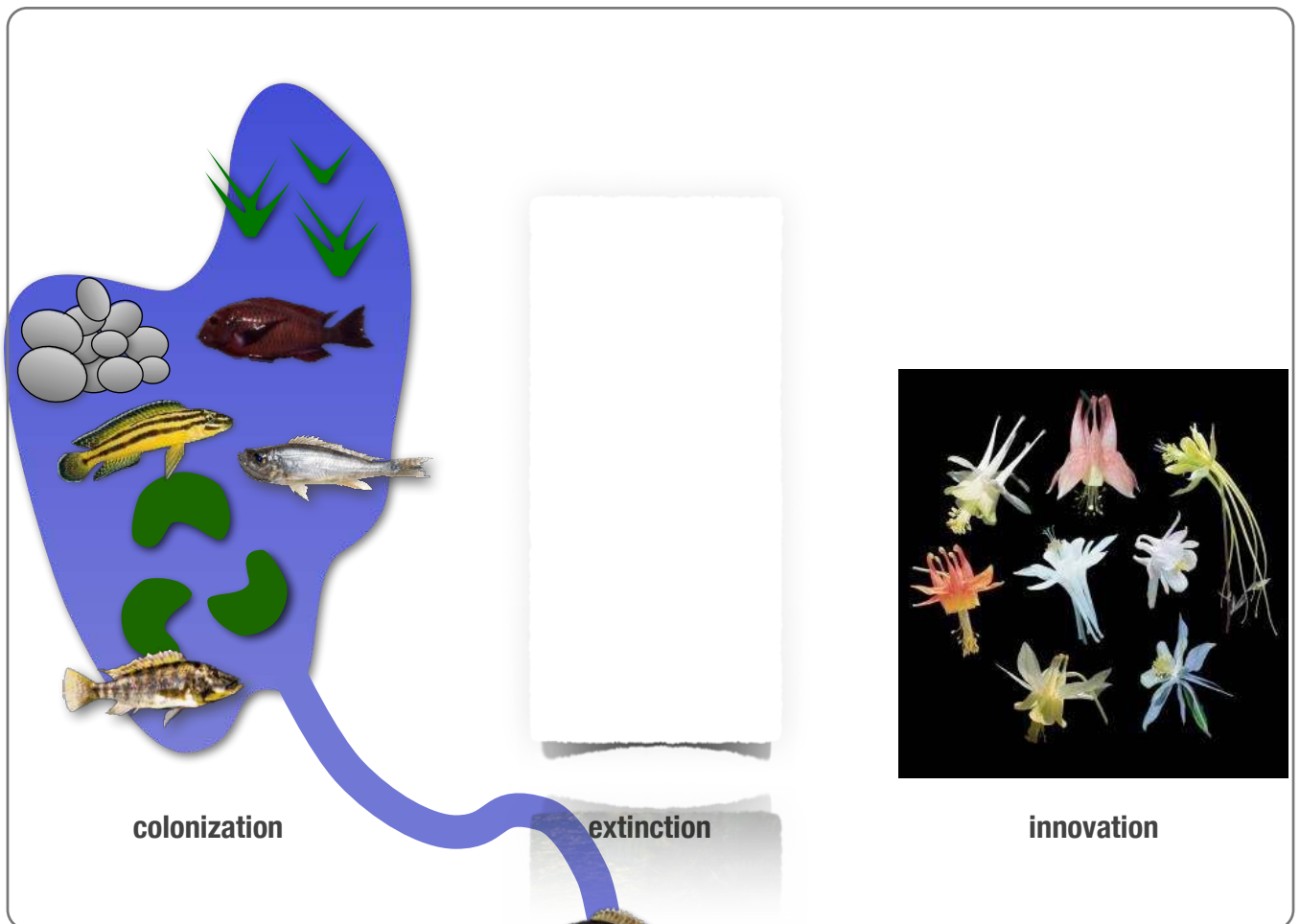
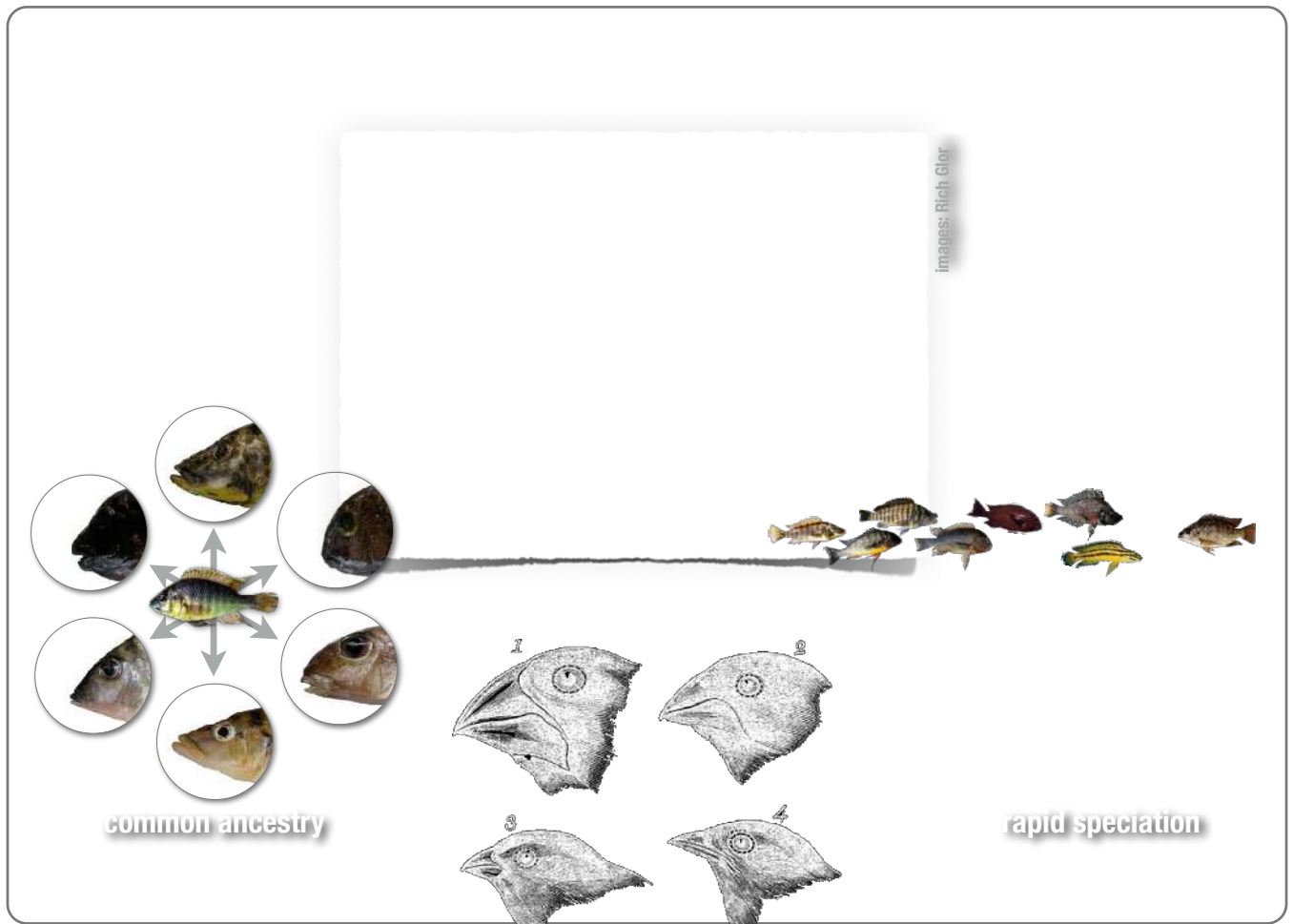


image: mun.ca





- Evolutionary key innovations permit a taxon to outcompete others or to exploit resources.

Columbines



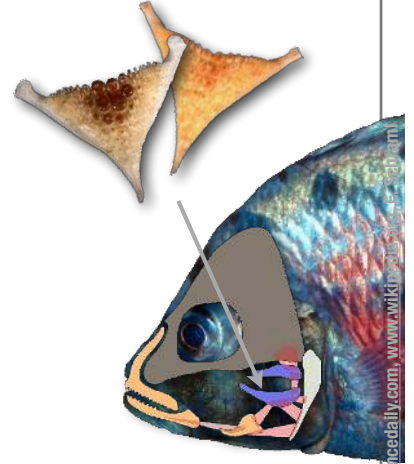
nectar spurs

Crocodile Icefishes



**antifreeze
glycoproteins**

Cichlid fishes



**pharyngeal jaw
apparatus**

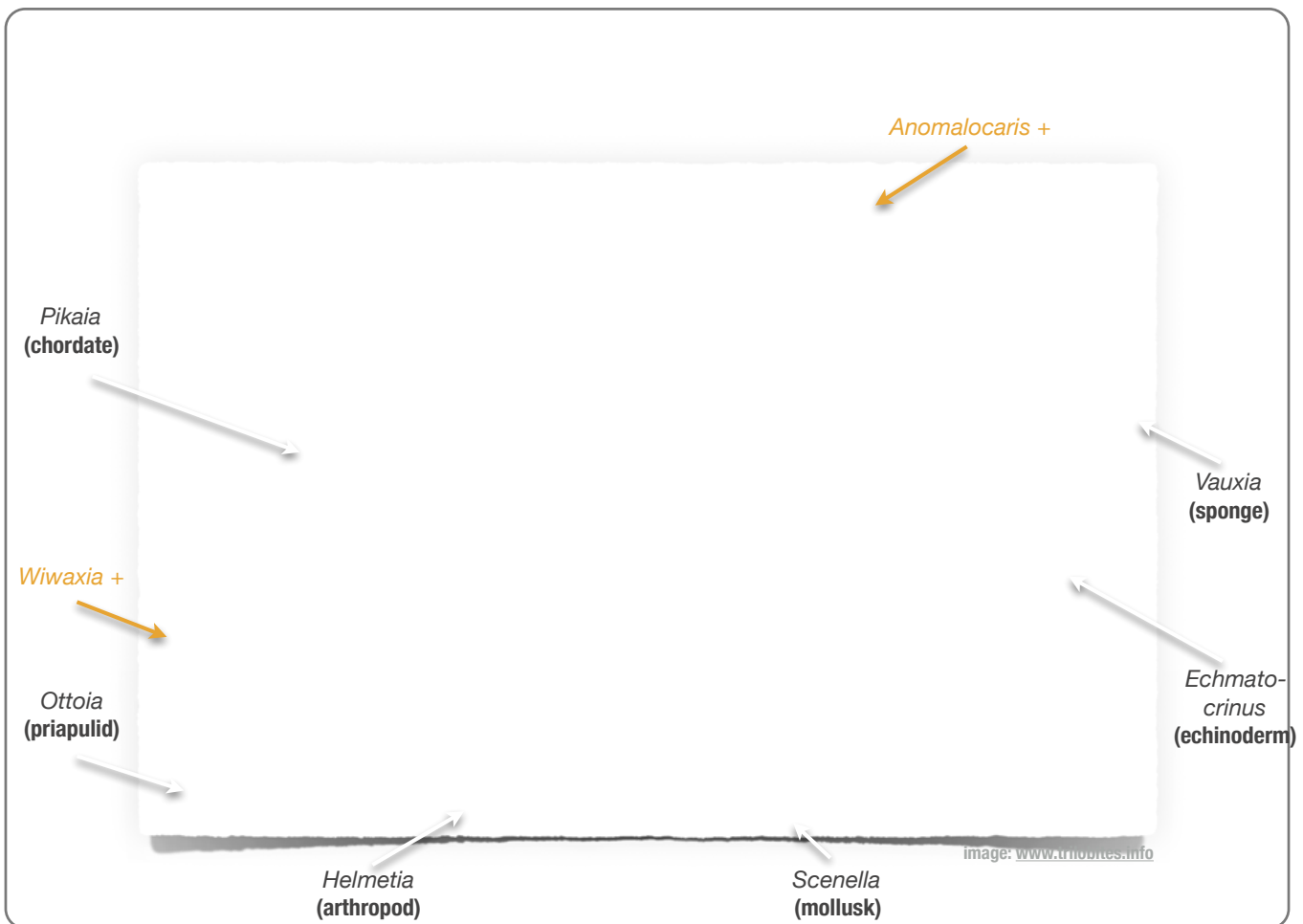
images: www.sciencedaily.com, www.wikipedia.org

The 'Cambrian evolutionary radiation' most likely was an adaptive radiation.



trilobite

image: www.field.ca



The 'big five' mass extinctions (based on marine fossils)

