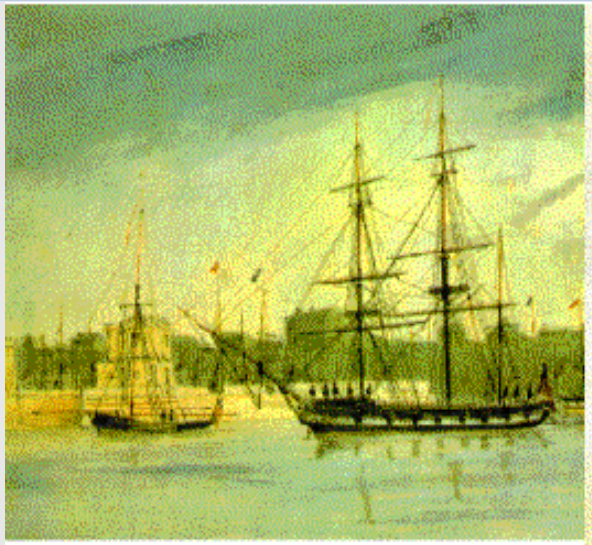
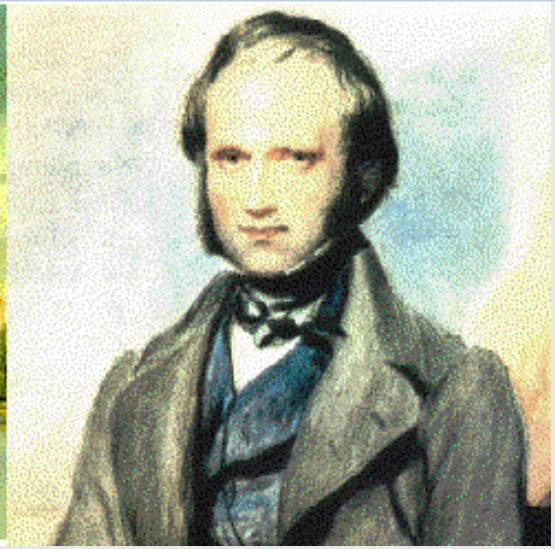




Macroevolution:

Part III Sympatric Speciation

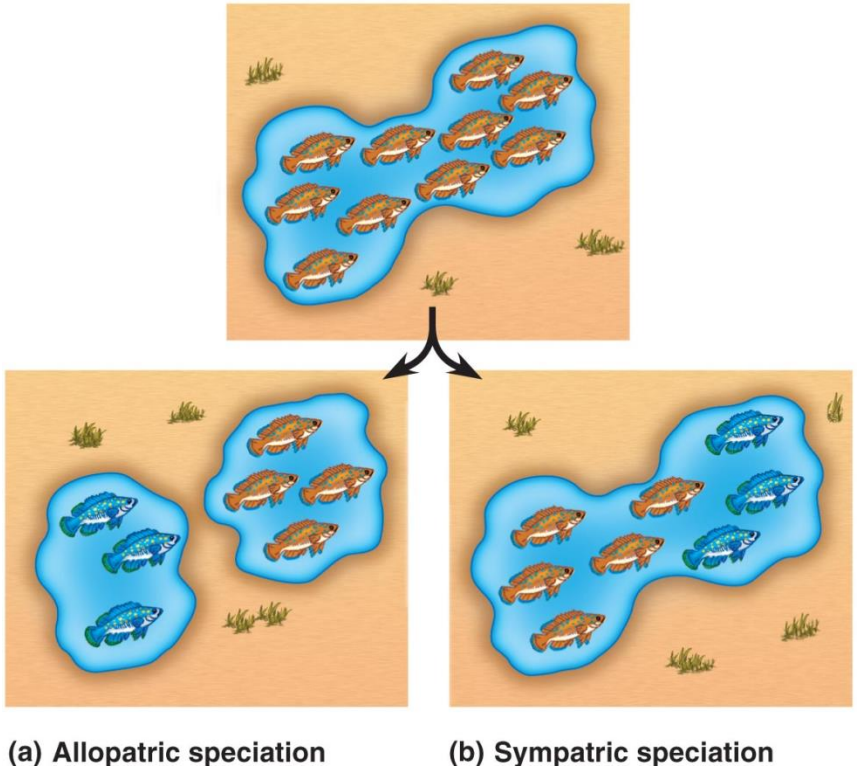
NATIONAL MATH + SCIENCE

Types of Speciation: A Review

- **Allopatric speciation** is the evolution of *geographically isolated populations* into distinct species. There is no gene flow, which tends to keep populations genetically similar.
- **Parapatric speciation** is the evolution of geographically *adjacent populations* into distinct species. Divergence occurs despite limited interbreeding where the two diverging groups come into contact.
- **Sympatric speciation** *has no geographic constraint* to interbreeding.
- These categories are special cases of a continuum from zero (sympatric) to complete (allopatric) spatial or geographic segregation of diverging groups.

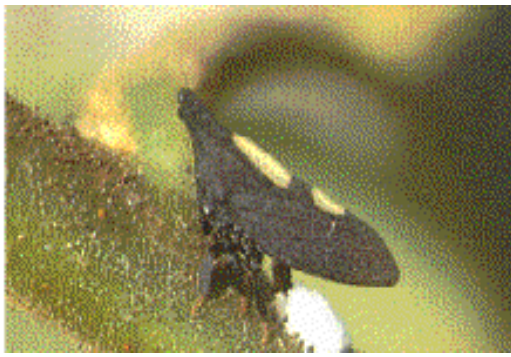
Sympatric Speciation

- Sympatric Speciation occurs *without* geographic isolation, thus it occurs at a local level.
- There is something within the environment that keeps a single species separated into two or more distinct groups.
- The end result is that the two groups evolve into separate species.



Sympatric Speciation & Habitat Differentiation

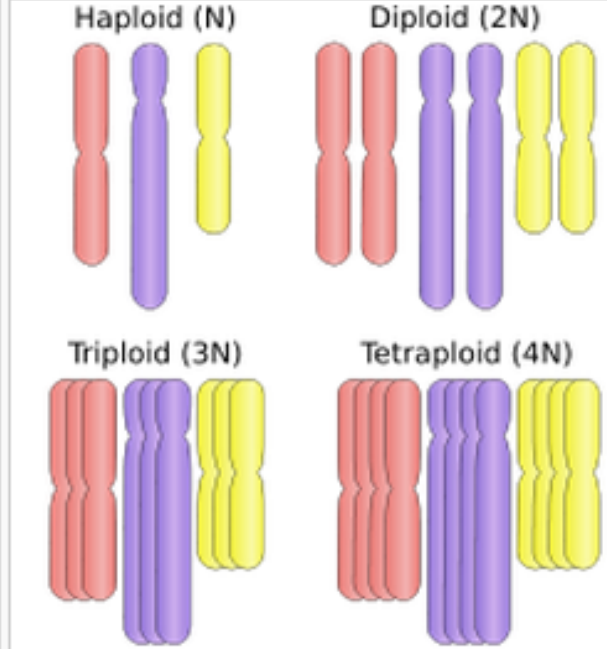
- Suppose that a certain species feeds on a particular host and only that host.



- Next, suppose a mutation occurs that allows it to feed upon a different
- Eventually, the species is divided into two groups that are separated from one another. Given enough time, speciation can occur.
- The species of treehoppers pictured above are host specific. The first lives on bittersweet while the second lives on butternut.

Sympatric Speciation: Polyploidy

- **Polyploidy** refers to instant speciation which occurs in most often in plants.
- Polyploid cells and organisms are those containing more than two paired (homologous) sets of chromosomes.
- Polyploidy may occur due to abnormal cell division, either during mitosis, or commonly during metaphase I in meiosis.



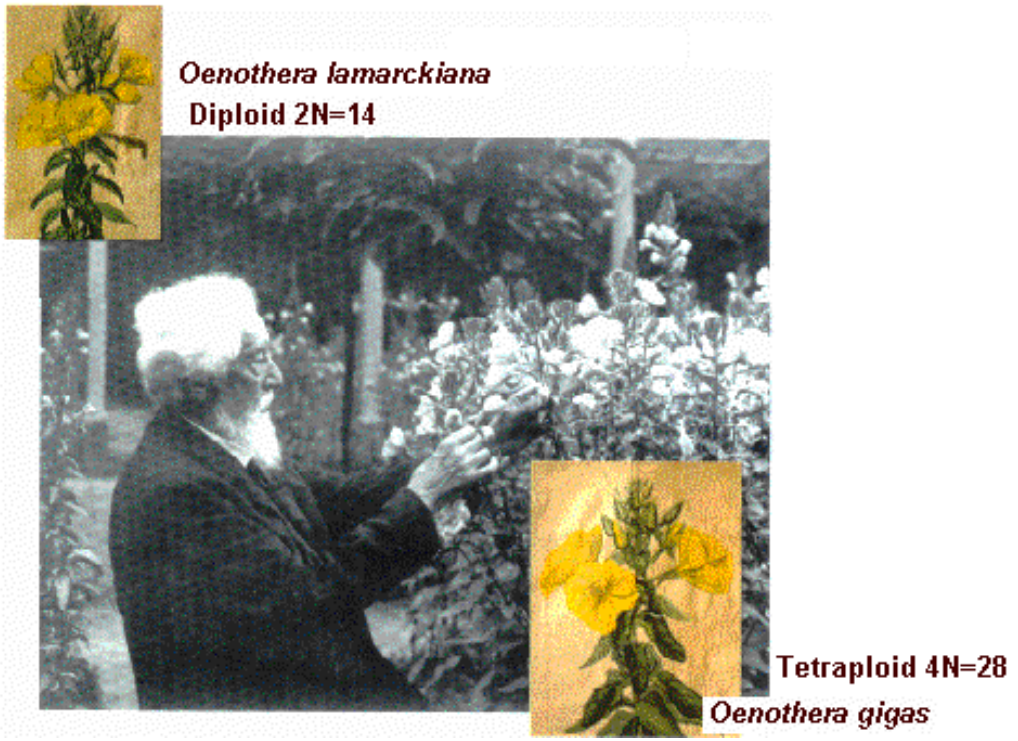
This image shows haploid (single), diploid (double), triploid (triple), and tetraploid (quadruple) sets of chromosomes. Triploid and tetraploid chromosomes are examples of polyploidy.

Sympatric Speciation: Polyploidy

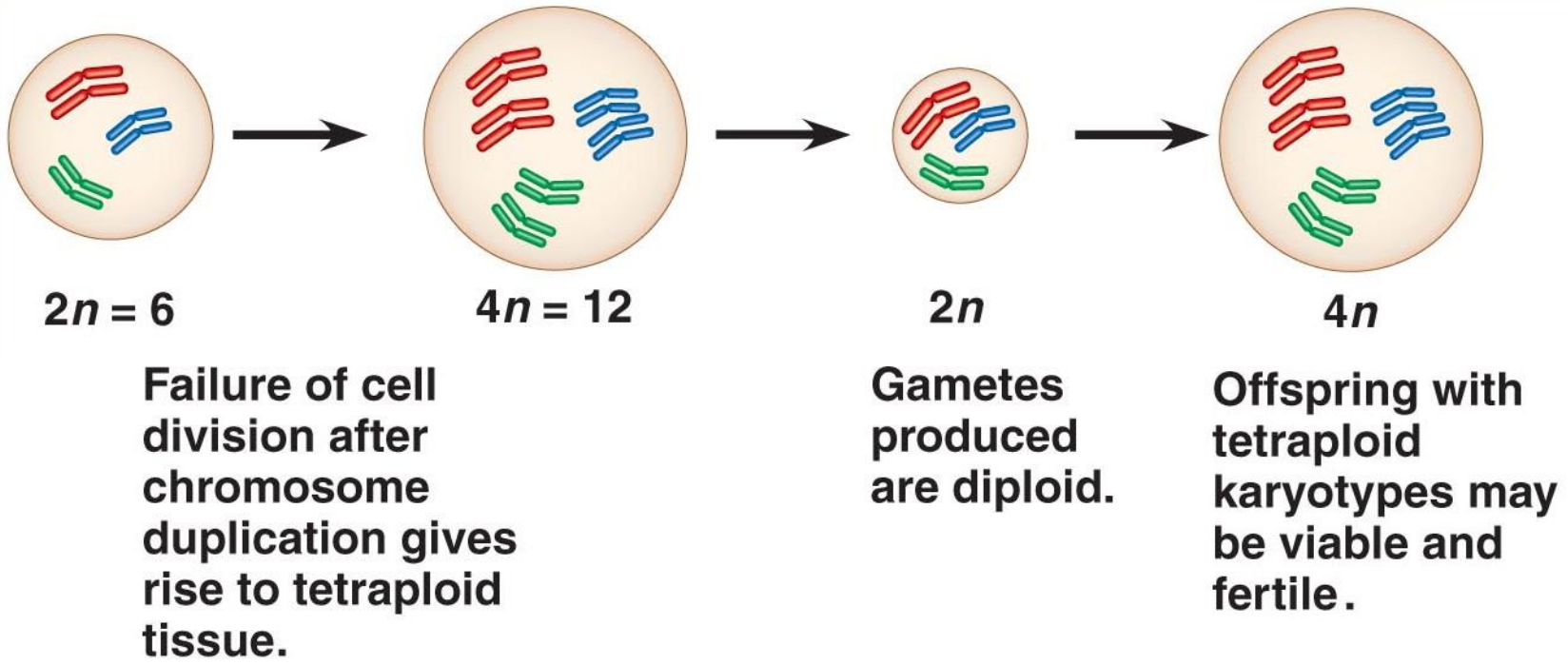
- **Autopolyploidy** refers to the occurrence in which the number of chromosomes double in the offspring due to total non-disjunction during meiosis.
- This was discovered by Hugo deVries when studying primroses.
- He noticed some of them were larger and very hardy.

Sympatric Speciation: Polyploidy

- The normal primrose is diploid with 14 chromosomes. 2N = 14
- In this species there was a total nondisjunction event resulting in primroses that are tetraploid. 4N = 28
- These primroses cannot successfully mate with the diploid species.

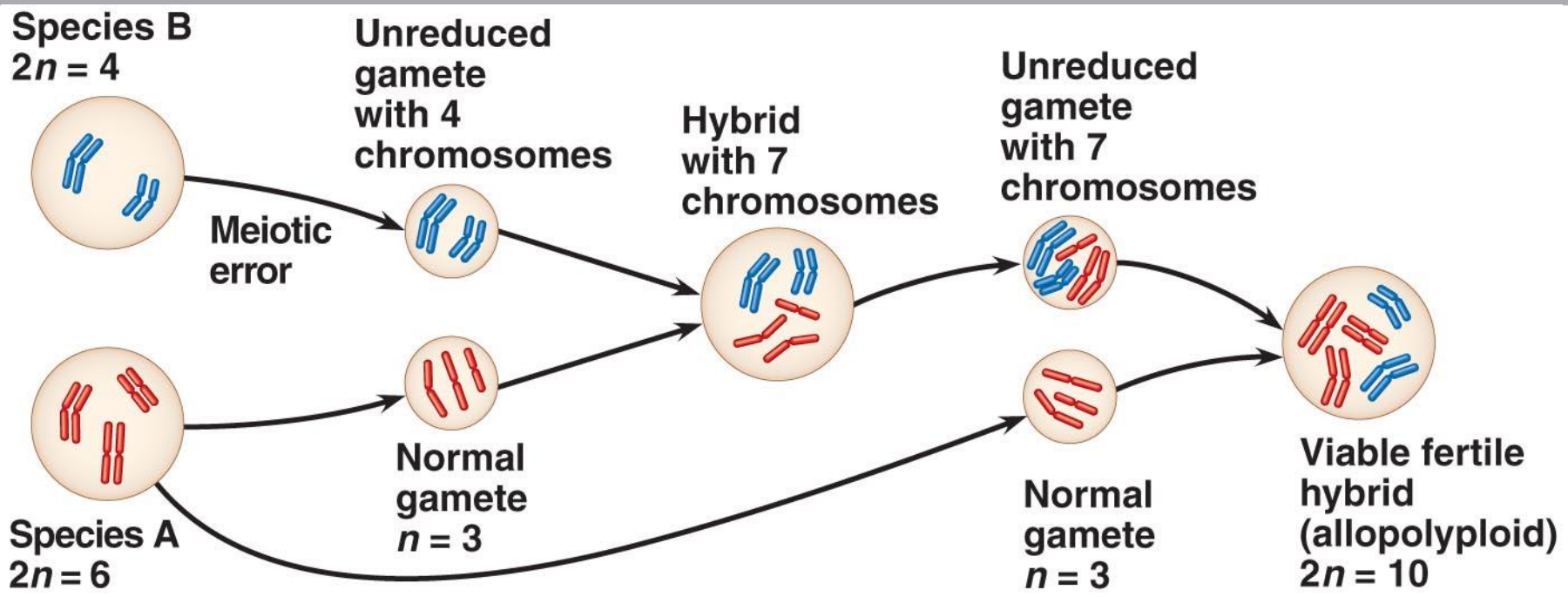


Sympatric Speciation: Autopolyploidy



This is the mechanism for **autopolyploidy**. A diploid plant becomes a tetraploid plant. The offspring look very much like the diploid plant but may be a little larger and more vigorous.

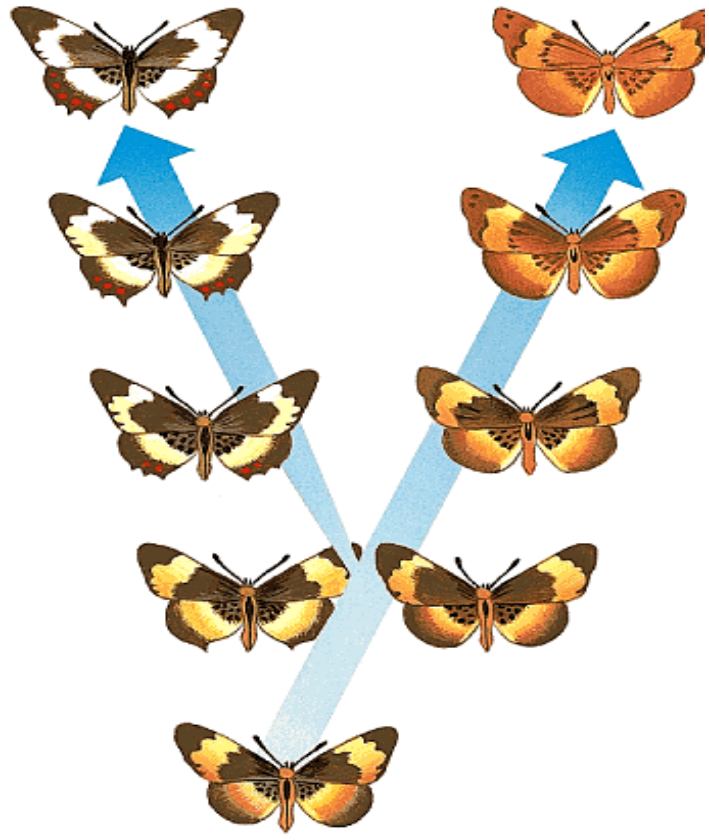
Sympatric Speciation: Allopolyploidy



- Allopolyploids are polyploids with chromosomes derived from different species.
- Precisely, it is the result of multiplying the chromosome number in an F1 hybrid.

Tempo of Evolution: Gradualism

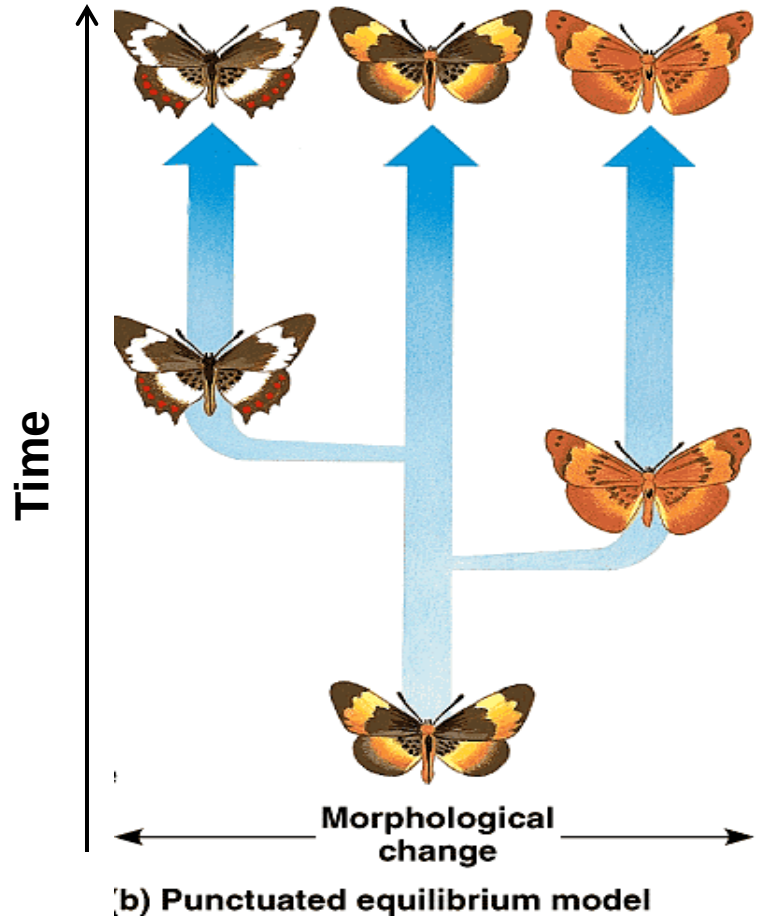
- Gradualism or phyletic gradualism is a model of evolution which theorizes that most speciation is slow, uniform and gradual.
- Evolution works on large populations over an expanse of time.
- The population slowly accumulate changes and evolves.
- When speciation occurred or is completed usually cannot be determined with respect to gradualism.
- The seasonal isolating mechanism is a good example.



(a) Gradualism model

Tempo of Evolution: Punctuated Equilibrium

- Most species will exhibit little net evolutionary change for most of their geological history, remaining in an extended state called stasis.
- Punctuated equilibrium occurs after some crisis in the environment. It may also be accompanied by a reduction in population size.
- Once natural selection occurs and the population evolves, the population may stay static for long periods of time once again.
- The fossil record supports both of these tempo types.



(b) Punctuated equilibrium model

Gradualism vs. Punctuated Equilibrium