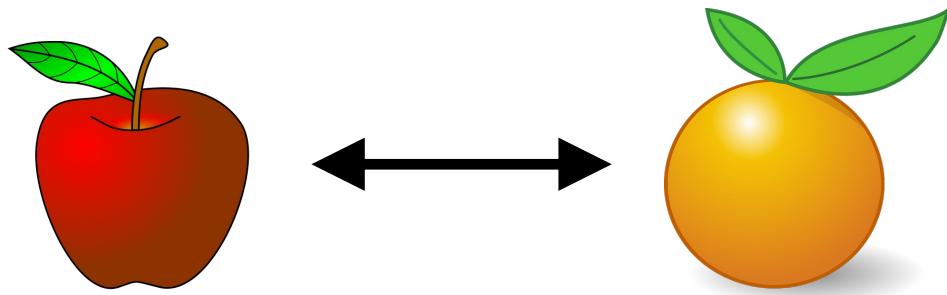


Homology & Plant Genomes



Comparing **apples** to **oranges** tells you
nothing about apples or oranges

Joel Sharbrough
July 27th, 2022

How **homologous** are the two amino acid sequences?

Seq1 – PLSQ**M**FFW**A**F

Seq2 – PLSQ**V**FFW**T**F

* * * * * * * *

* = Identical amino acid

Trick question –

Homology is an inference of shared common ancestry
Similarity is the criterion used to make that inference

Seq1 – PLSQ**MFFWAF**

Seq2 – PLSQ**VFFWT**F

* * * * * * * *

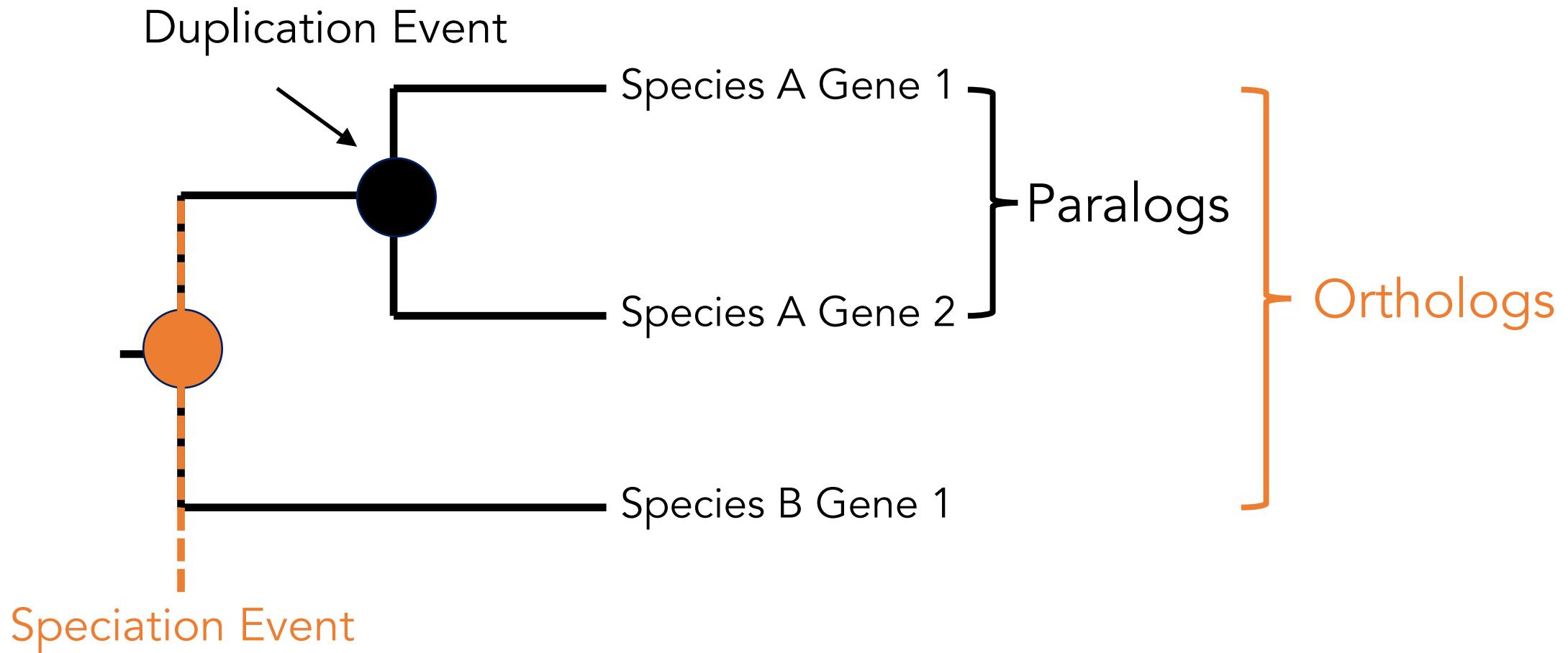
Homology is binary:

Either two sequences share a common ancestor, or they don't

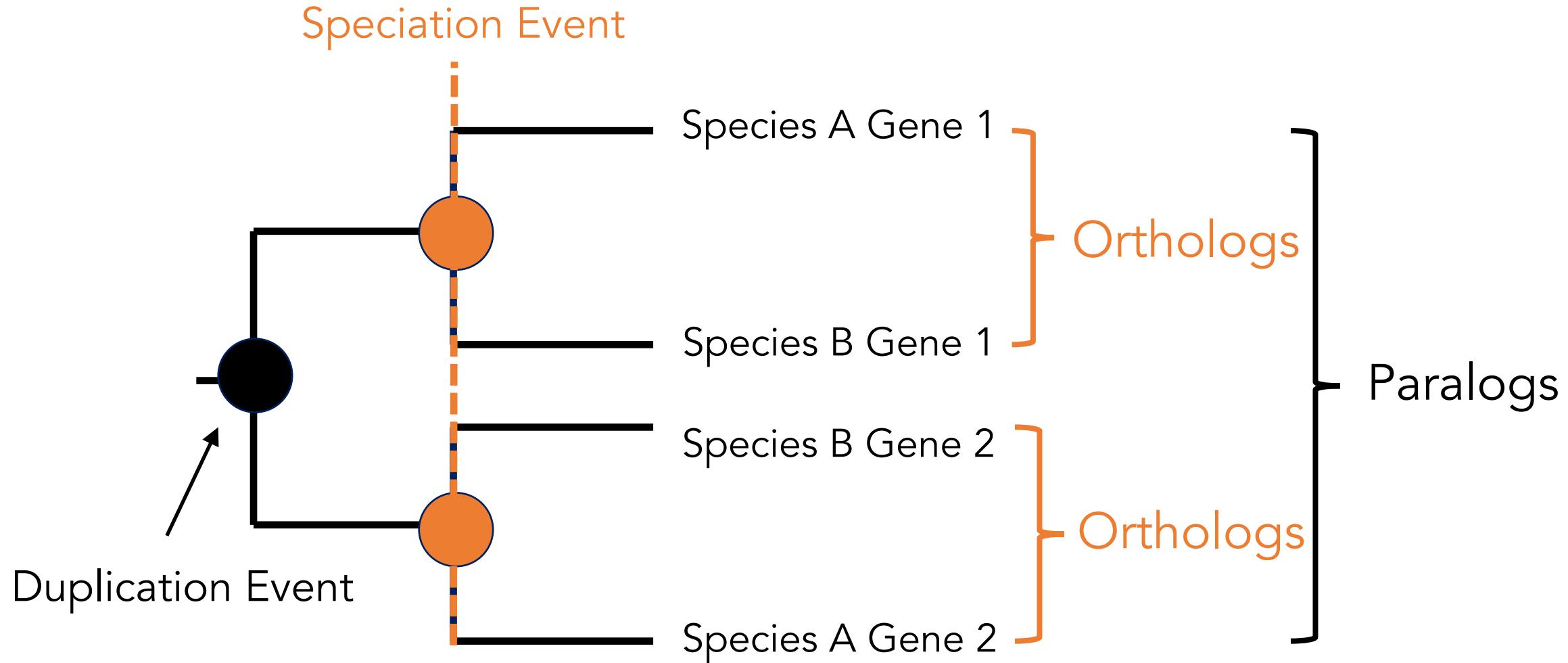
Homologs: Orthologous or paralogous?

- Orthologs are homologous sequences that are descended from a speciation event
- Paralogs are homologous sequences that are descended from a duplication event

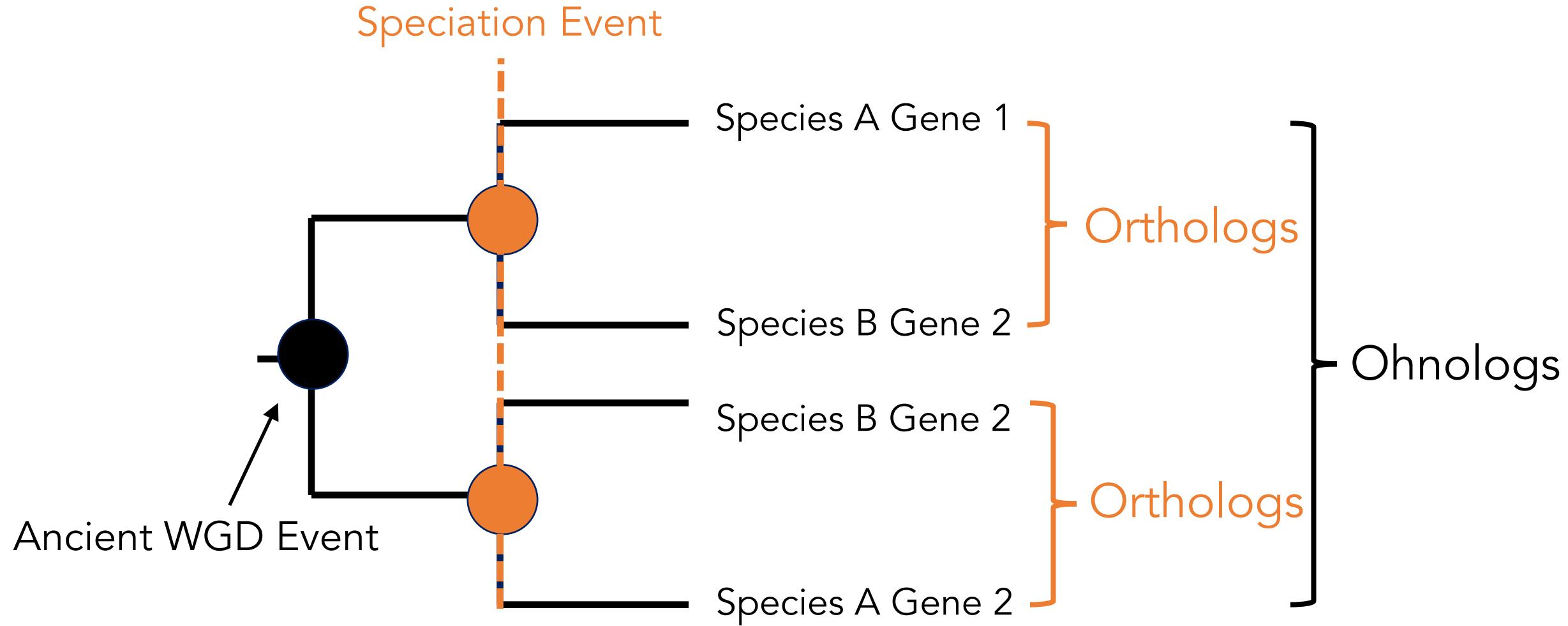
Homologs: Orthologous or paralogous?



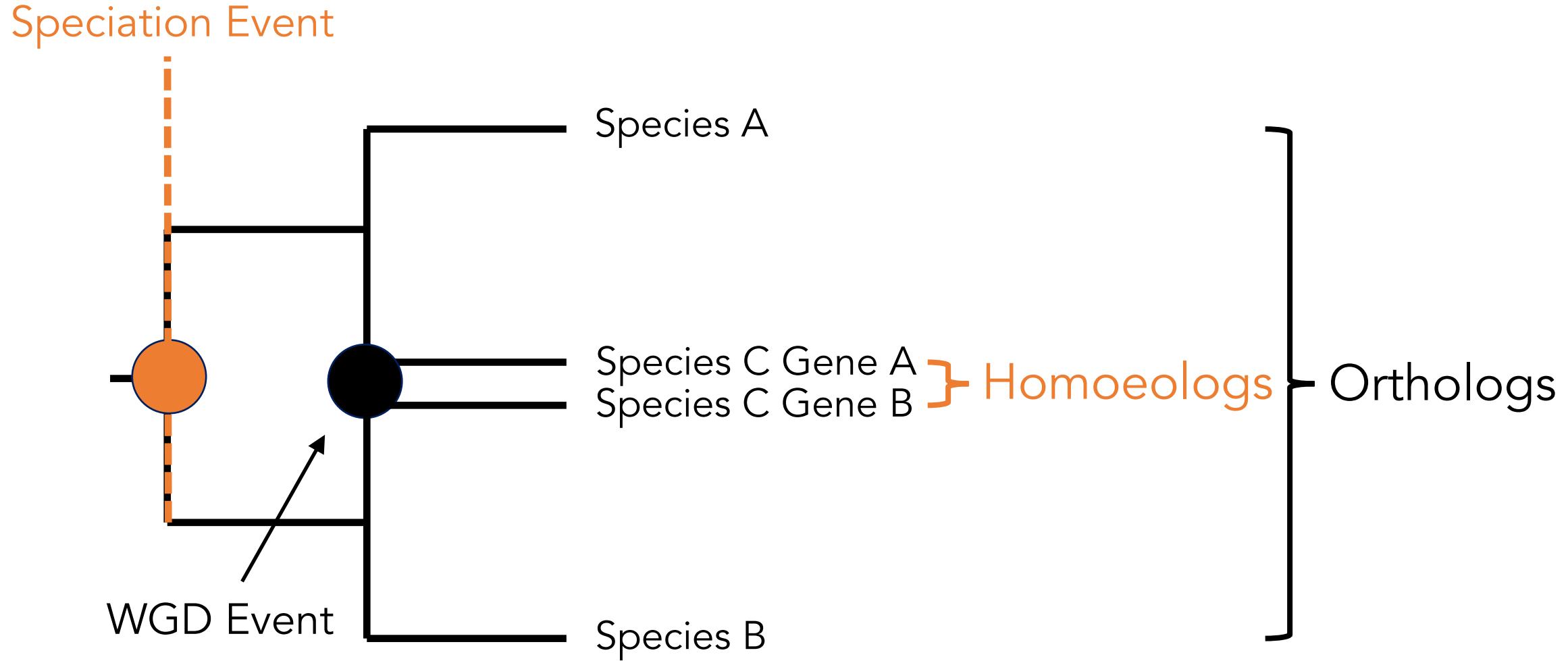
Homologs: Orthologous or paralogous?



Whole Genome Duplications



Hybrid Whole Genome Duplications



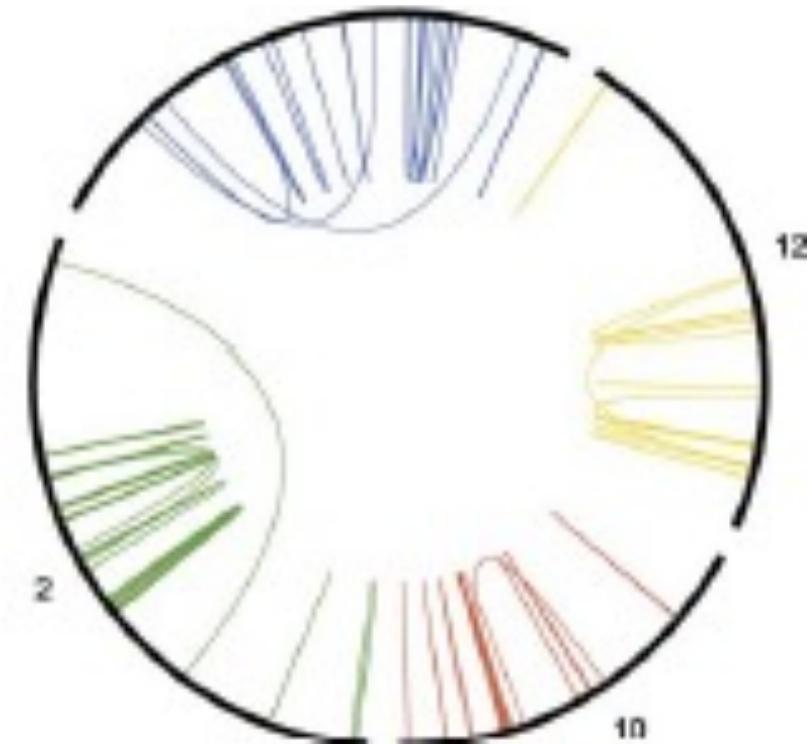
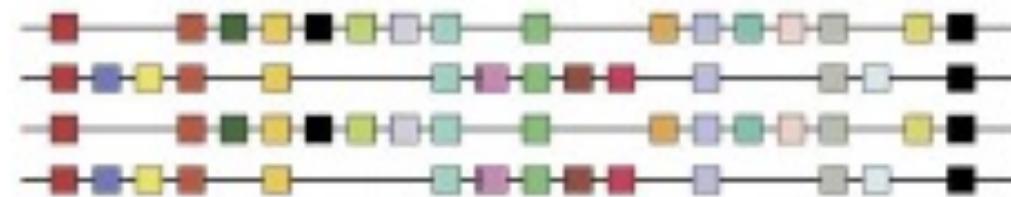
Homology can be assessed at different levels of organization

- Nucleotide/protein sequence
- Gene order (synteny)
- Phenotypes (e.g., morphology)

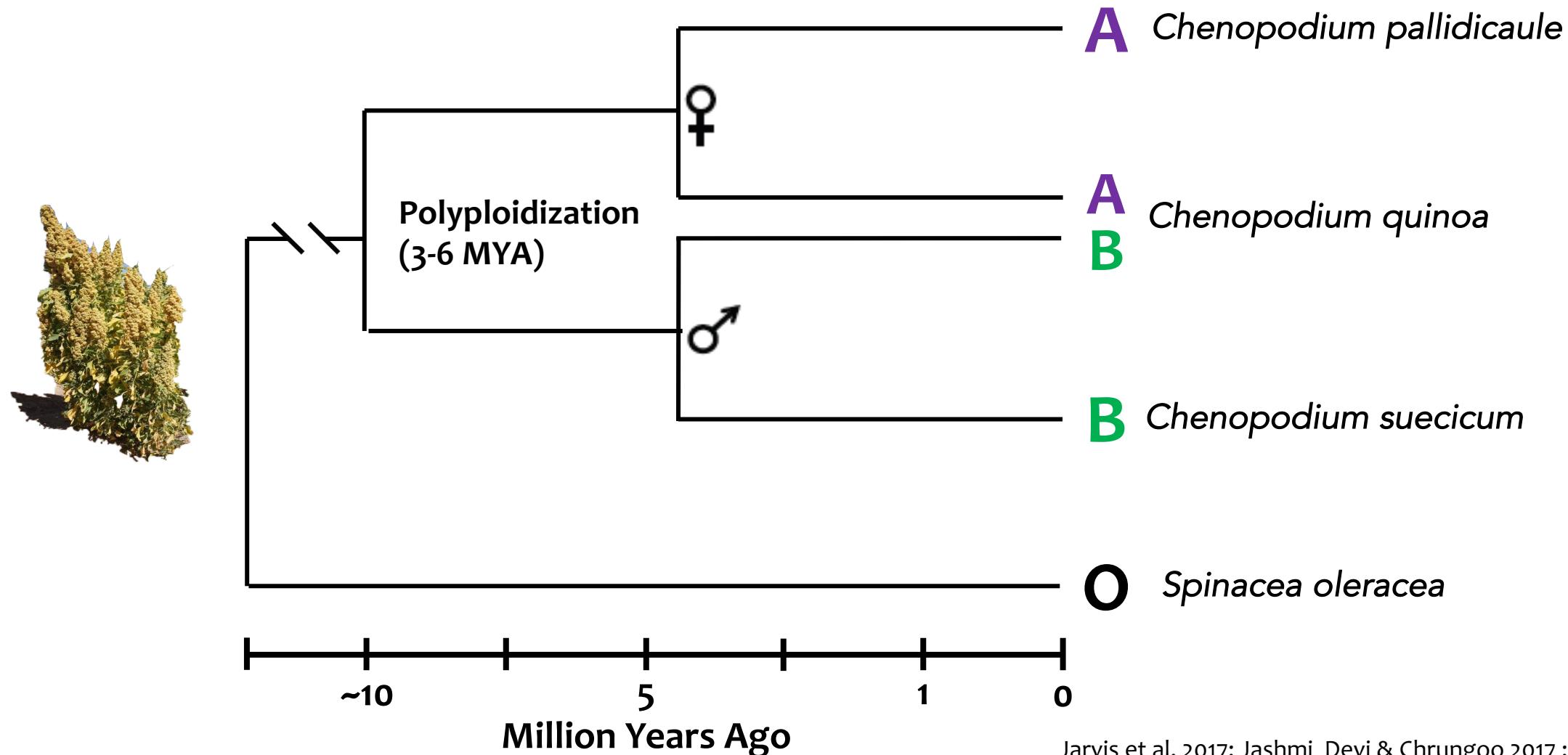
Syntenic homology

Gene order can evolve via:

- Structural rearrangements
- Transposition
- Duplication
- Deletion



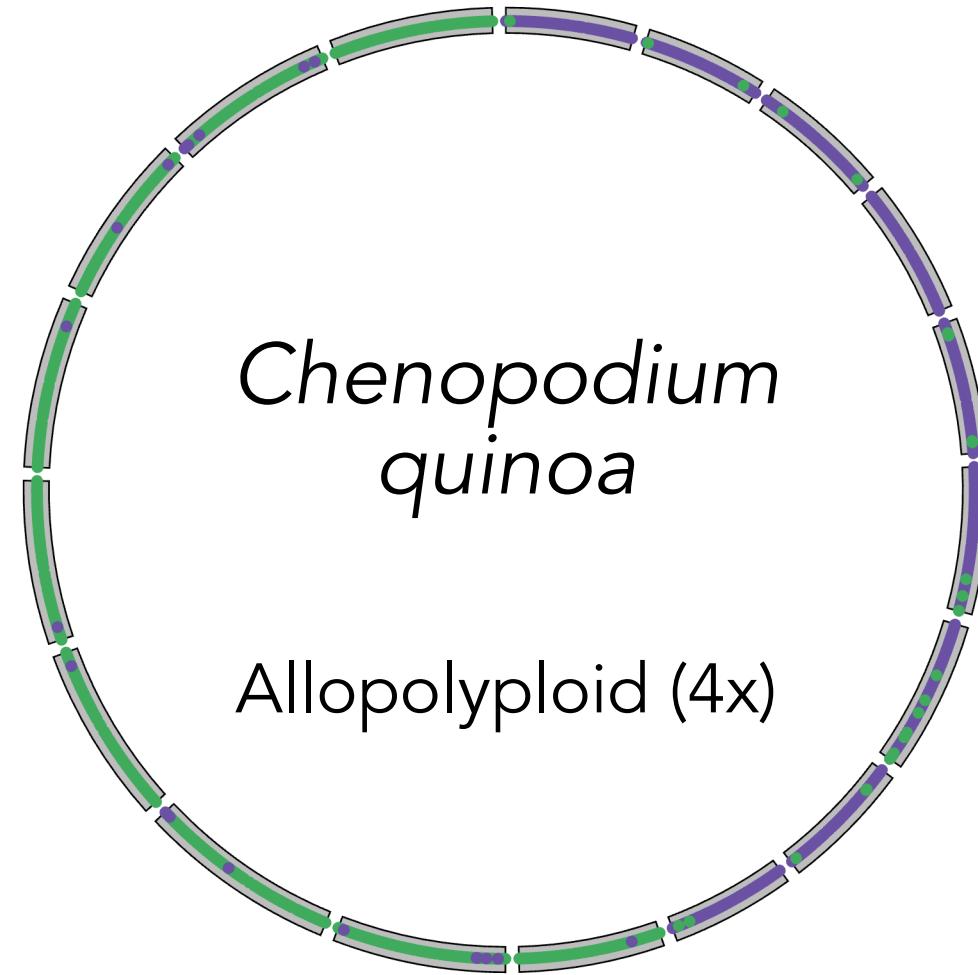
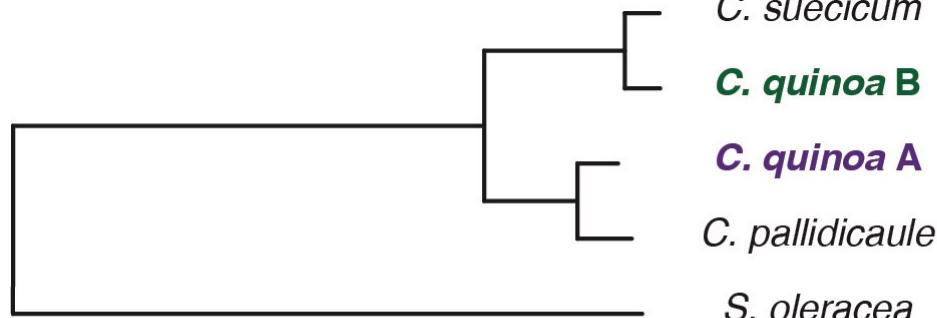
Allotetraploid quinoa is a good example of a plant with complex homology



Syntenic homology in quinoa

Gene order can evolve via:

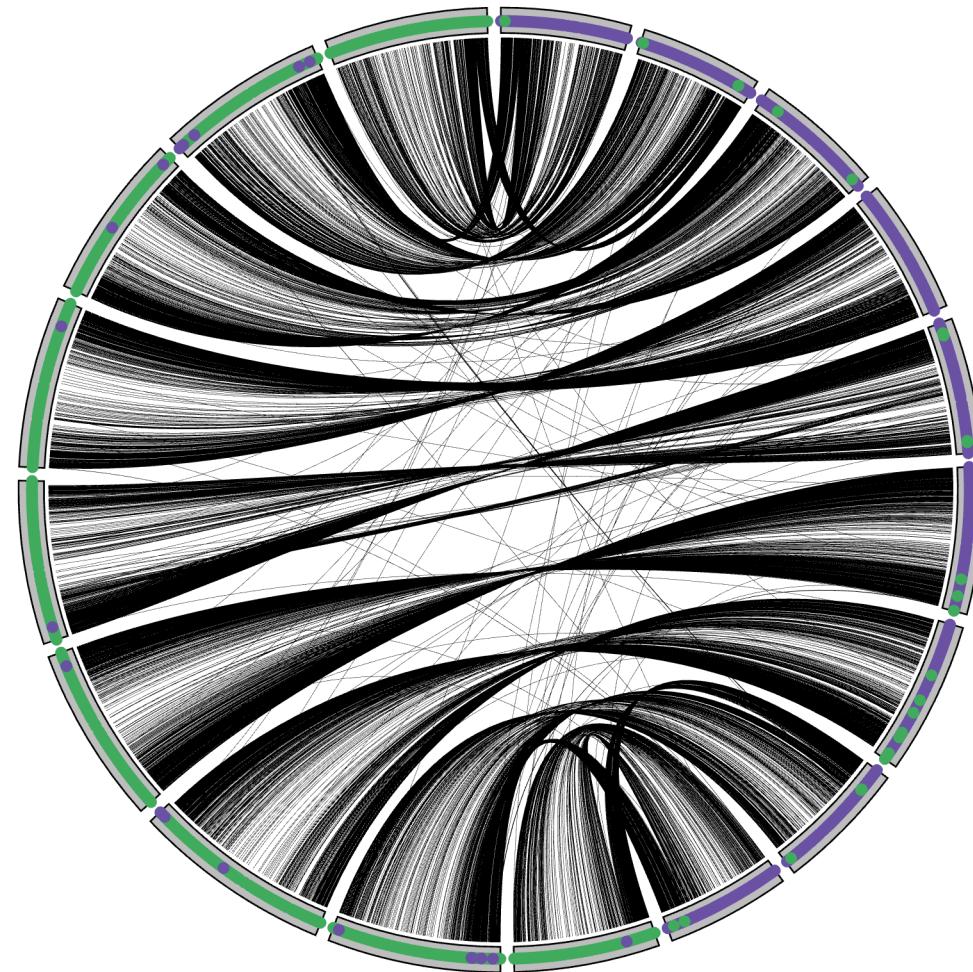
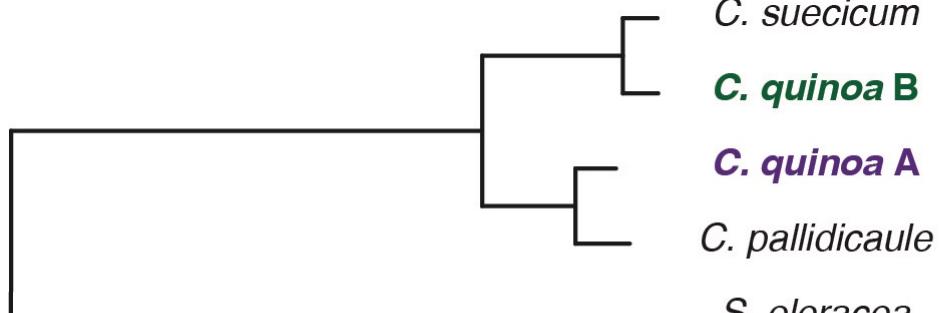
- Structural rearrangements
- Transposition
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Syntenic homology in quinoa

Gene order can evolve via:

- Structural rearrangements
- Transposition
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- Deletion

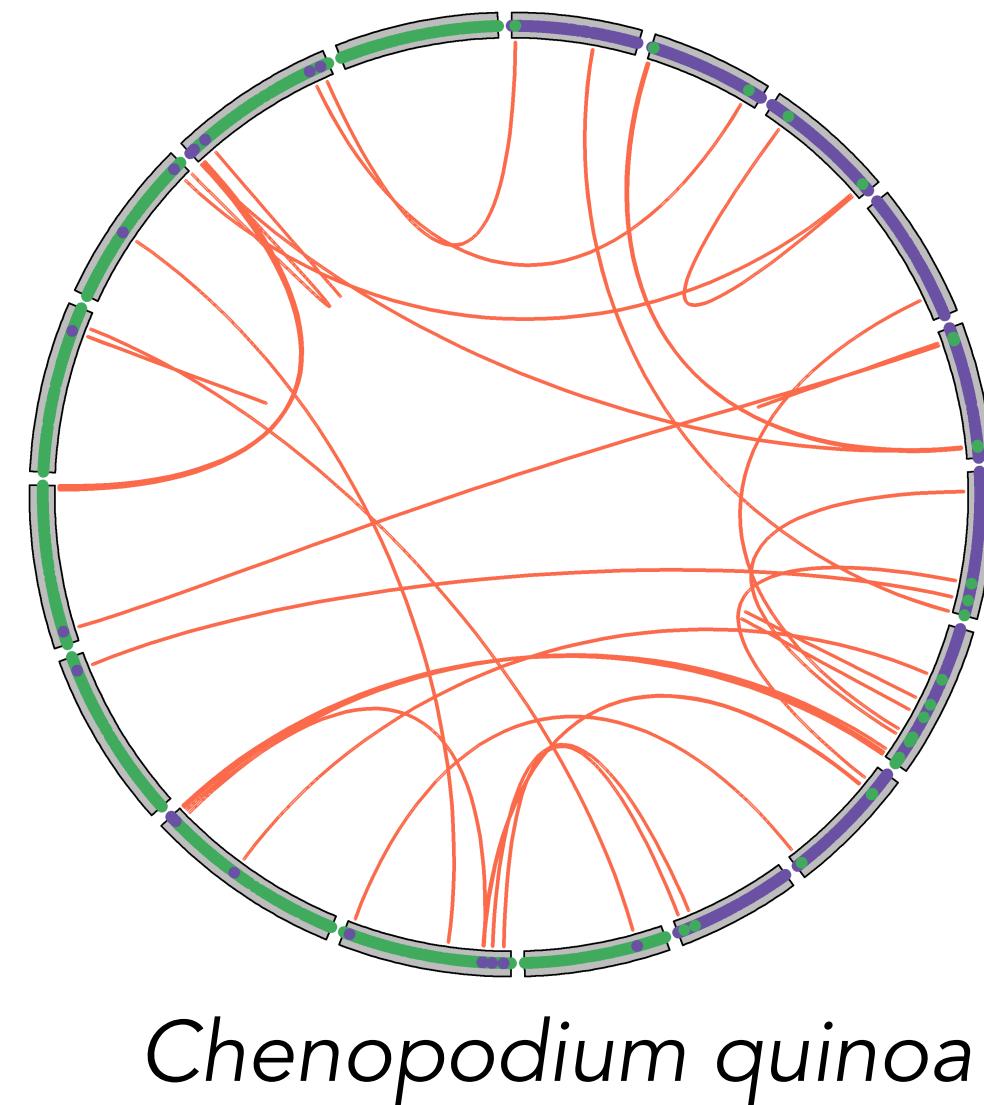
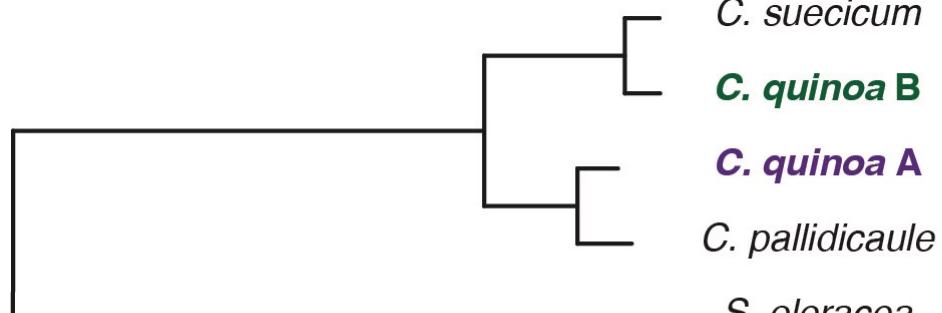


Chenopodium quinoa

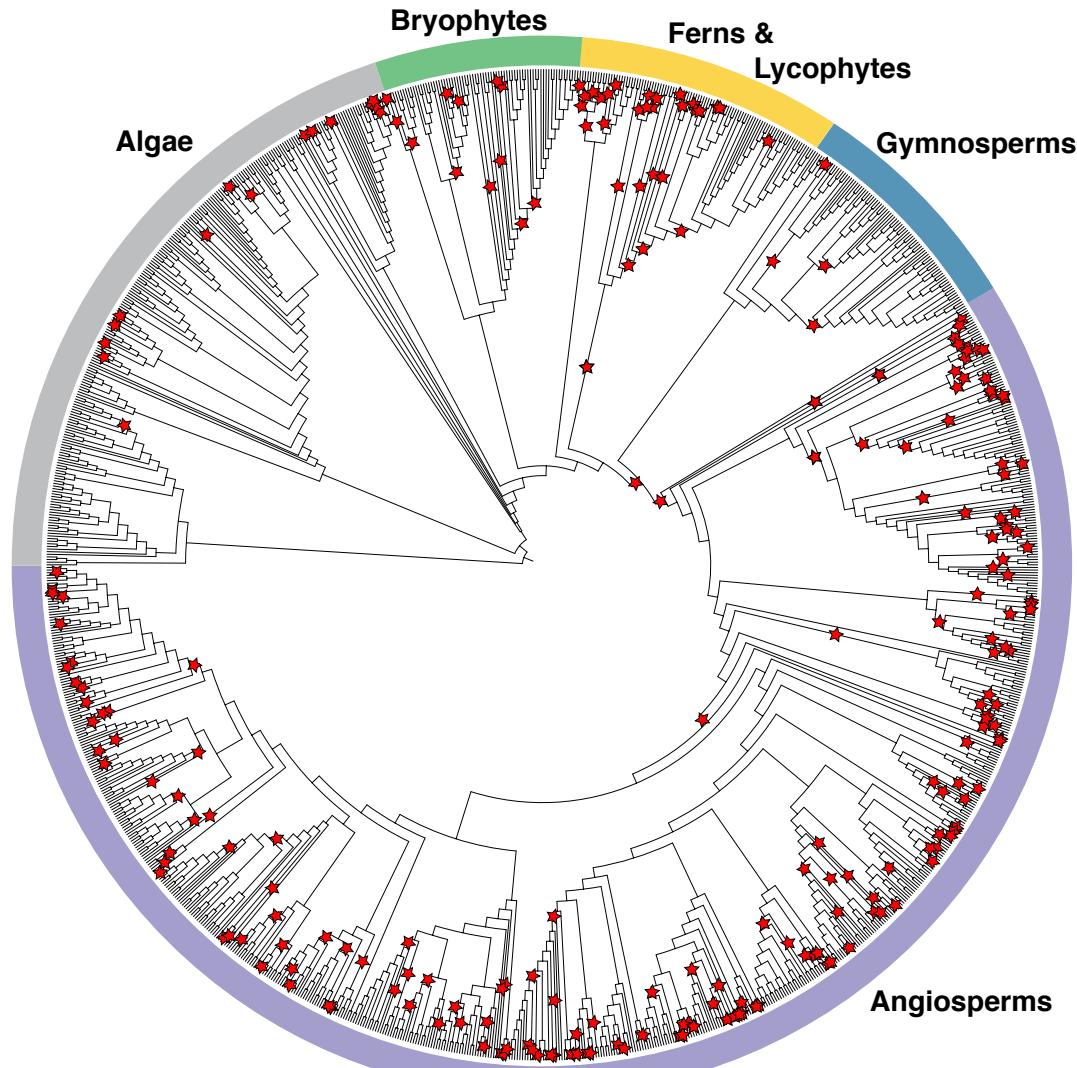
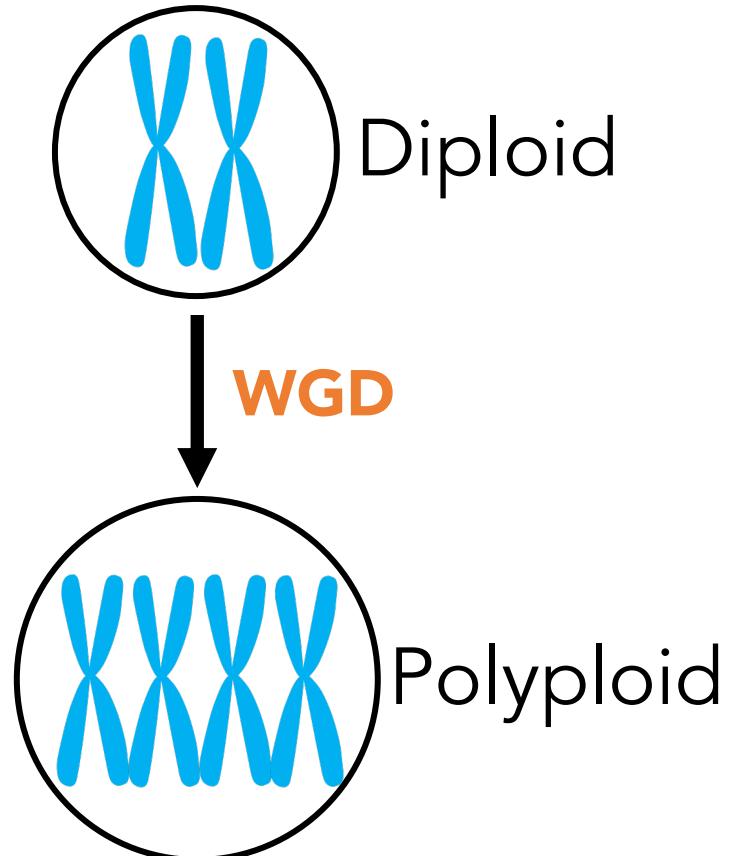
Syntenic homology in quinoa

Gene order can evolve via:

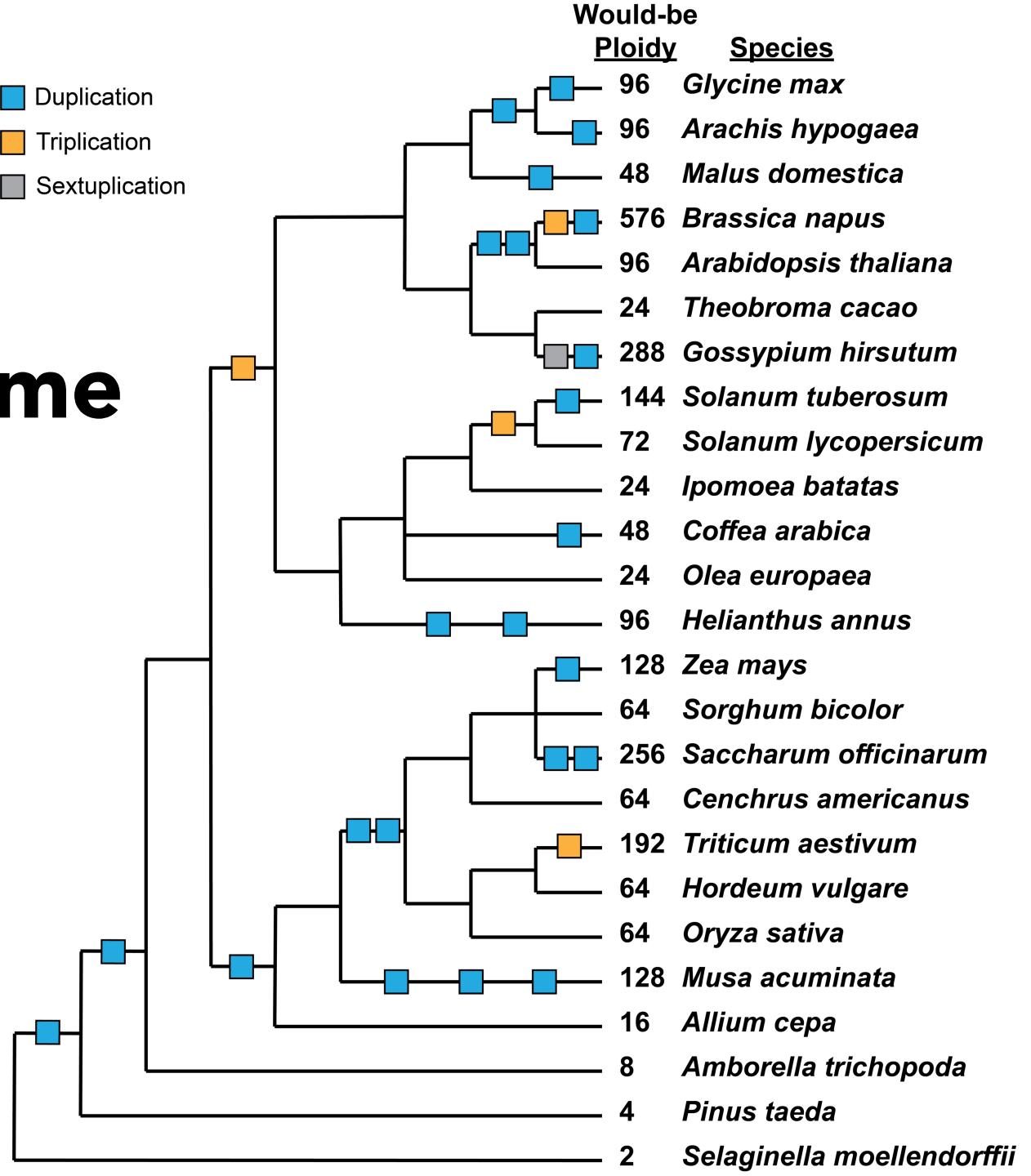
- Structural rearrangements
- Transposition
- Duplication
- Deletion



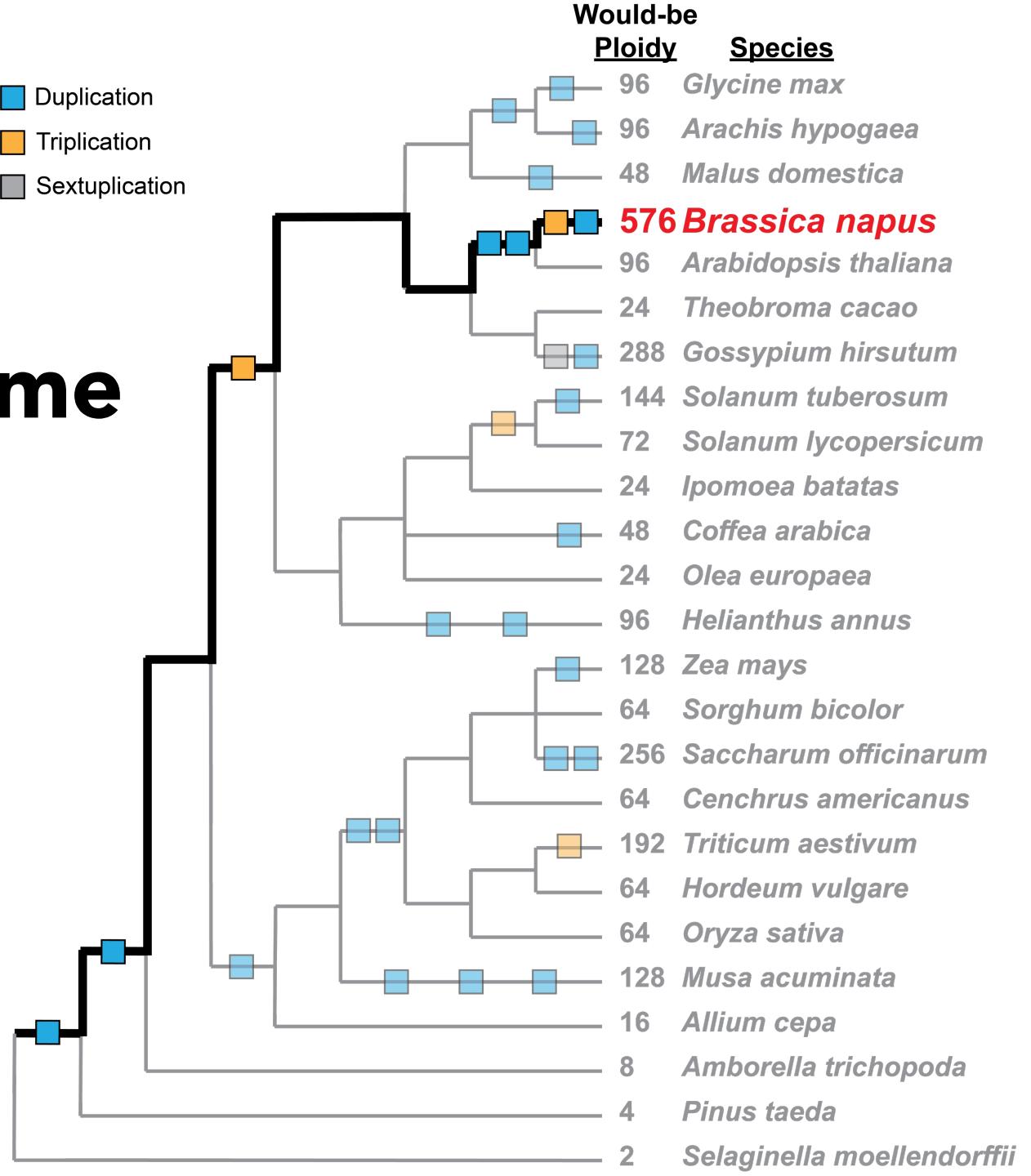
Plants have extensive history of Whole Genome Duplications (WGDs)



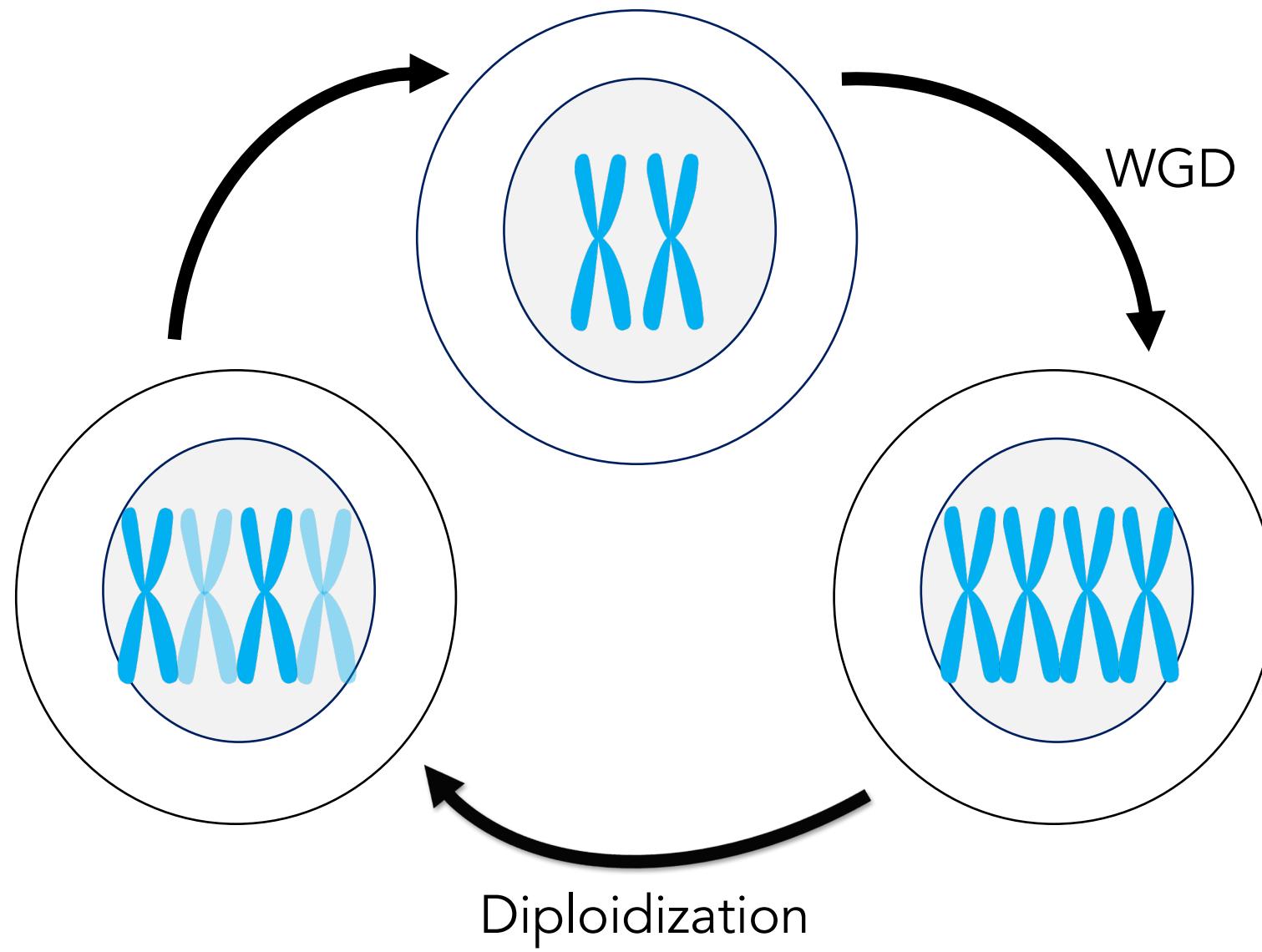
Plants have extensive history of Whole Genome Duplications (WGDs)



Plants have extensive history of Whole Genome Duplications (WGDs)



Wash-rinse-repeat cycle of whole-genome duplications



Makes homology very
difficult to assess!

How **homologous** are the two amino acid sequences?

Seq1 – PLSQMFFWAF

Seq2 – PLSQVFFWTF

* * * * * * * *

How ~~homologous~~ similar are the two amino acid sequences?

Seq1 – PLSQ**MFFWAF**

Seq2 – PLSQ**VFFWT**F

* * * * * * * *

Are they homologous?

Assessing homology in polyploid wheat

