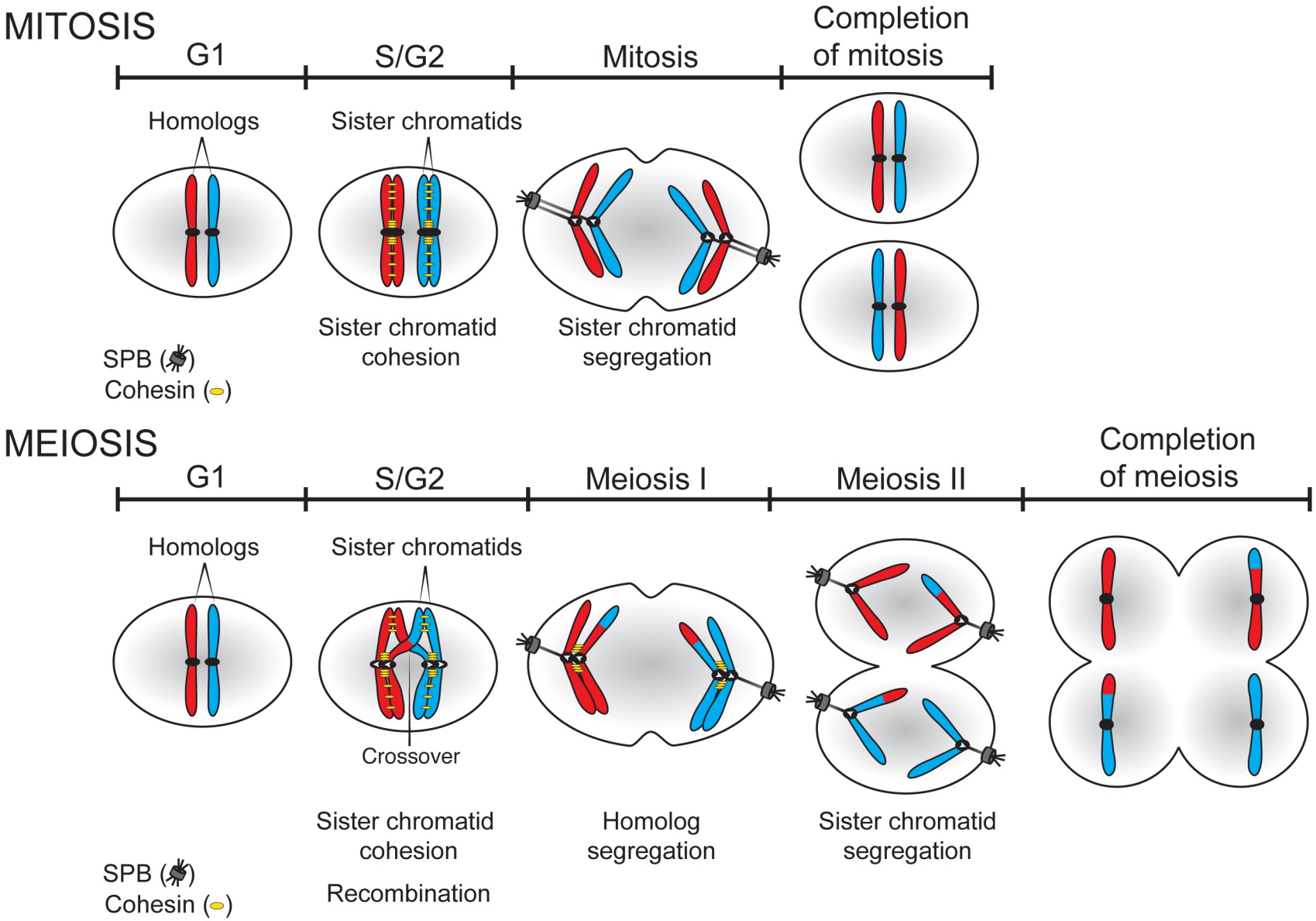
Tetrad Analysis and Fungal Genetics

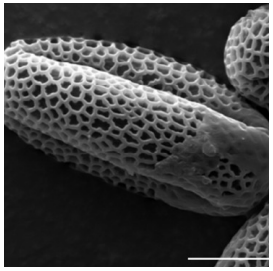
Meiotic cell division produces haploid gametes



Gametes come in many shapes and sizes

Gametes (i.e. products of meiosis)

Arabidopsis

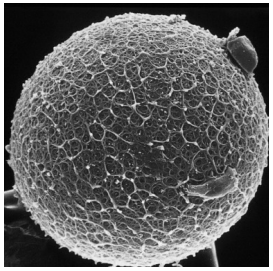


Lehner et al., 2010

Fruit fly

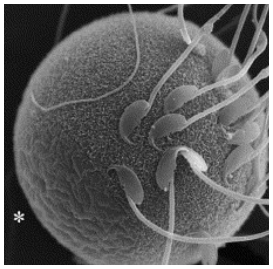
Landis et al., 1997

Human



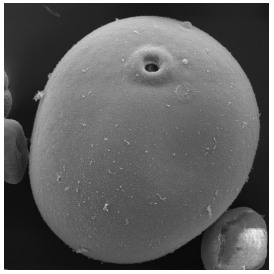
Wellcome Images

Mouse



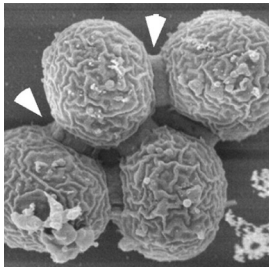
Runge et al., 2007

Maize



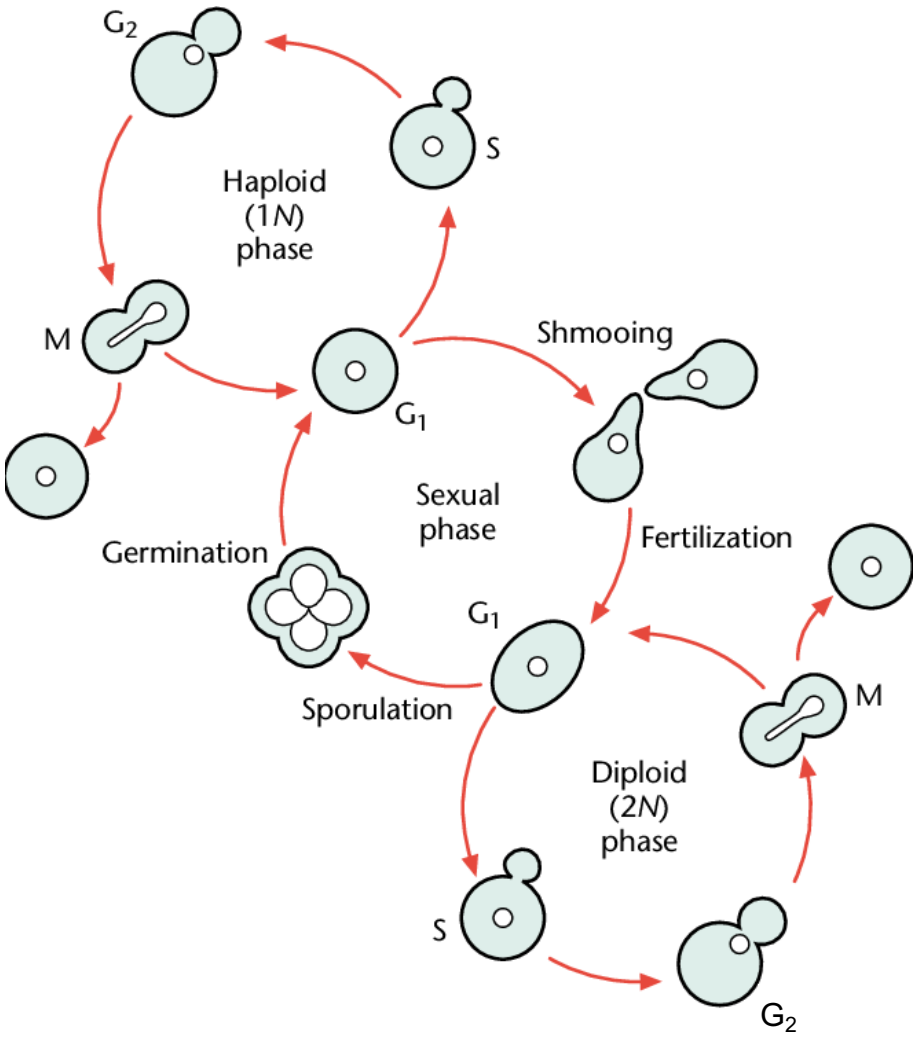
Dartmouth EM facility

Yeast

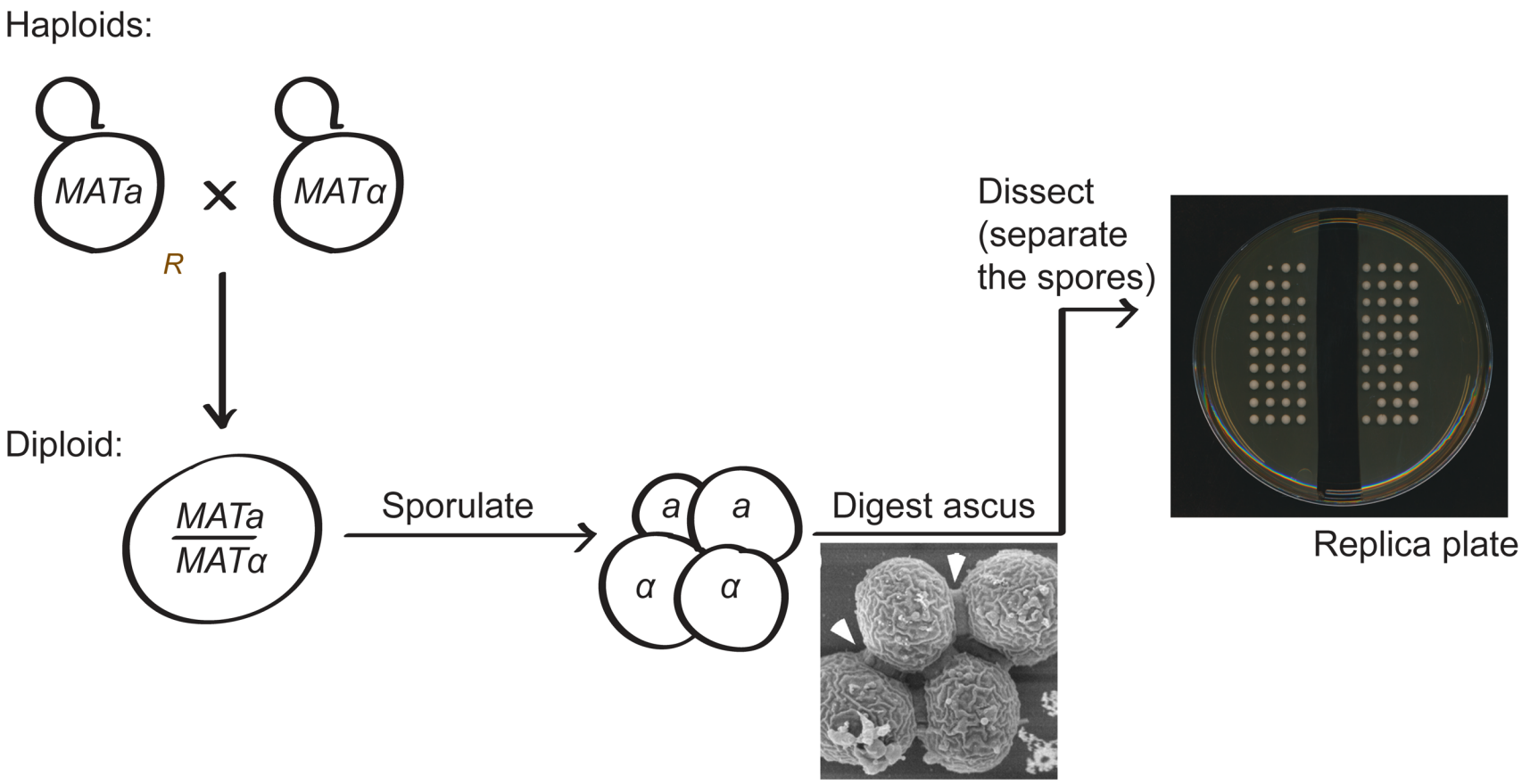


Coluccio et al., 2004

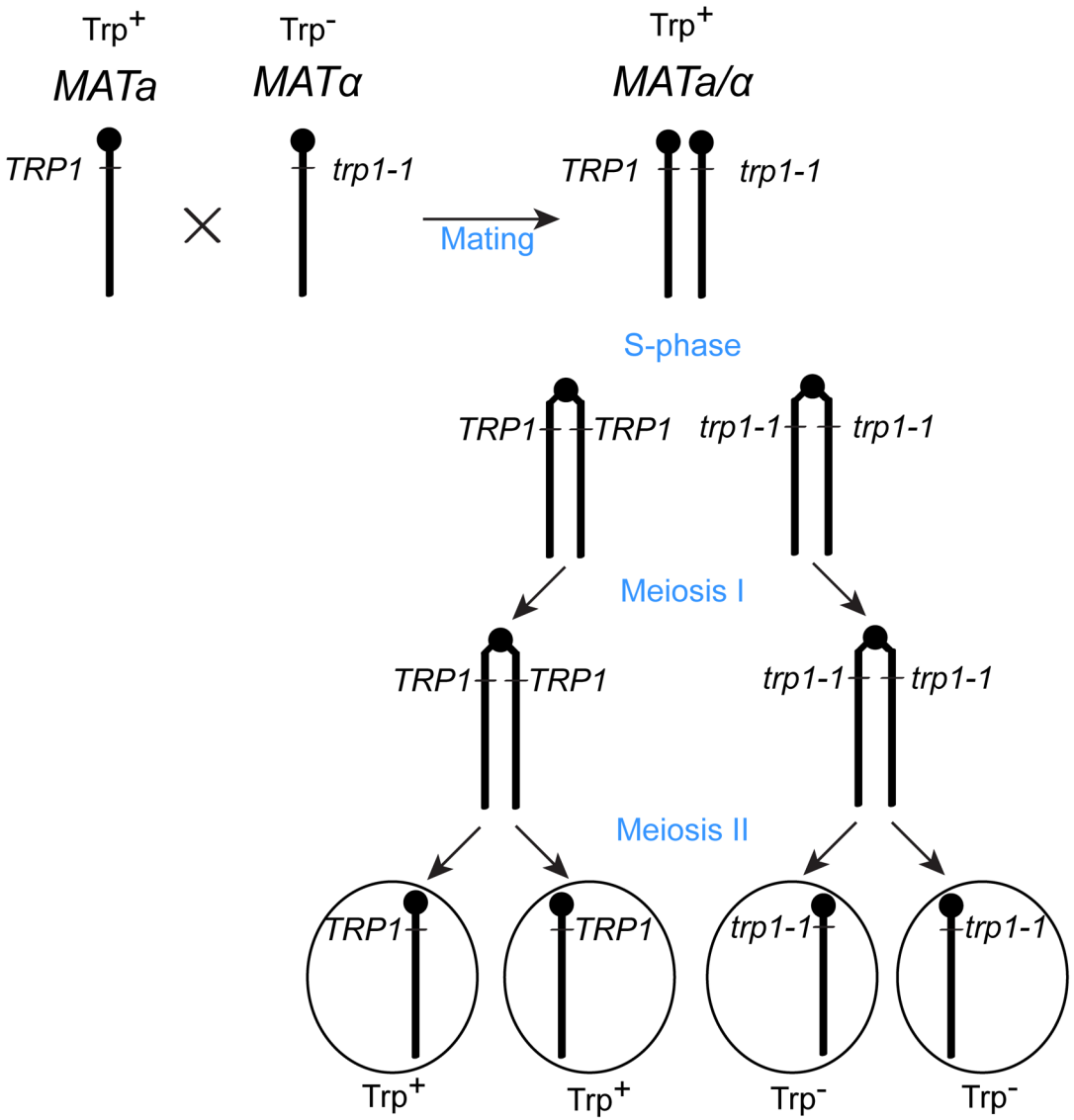
Budding Yeast Life Cycle

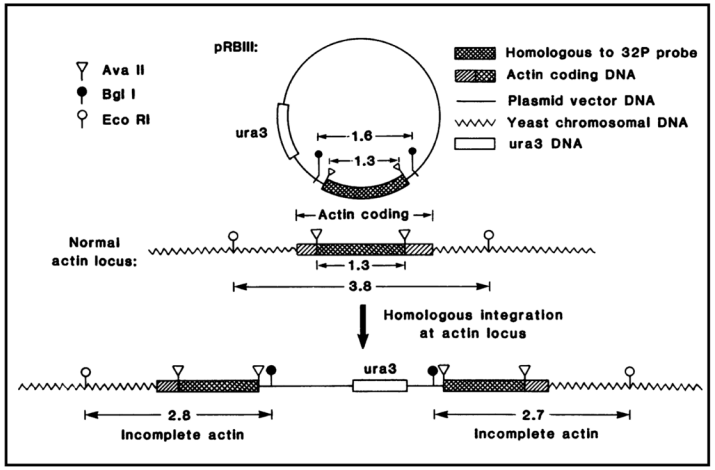


Tetrad dissection



A single allele segregates 2:2

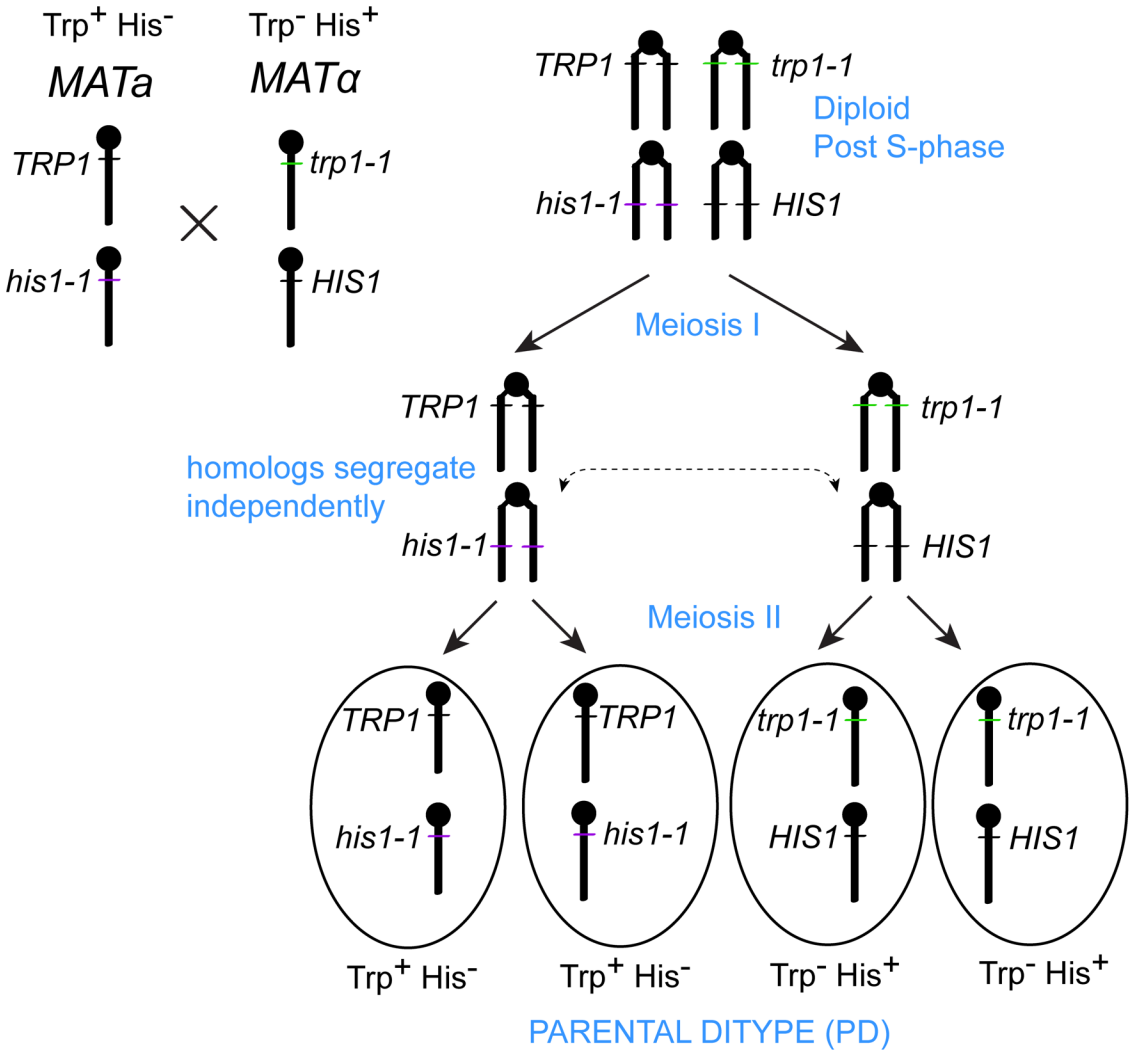


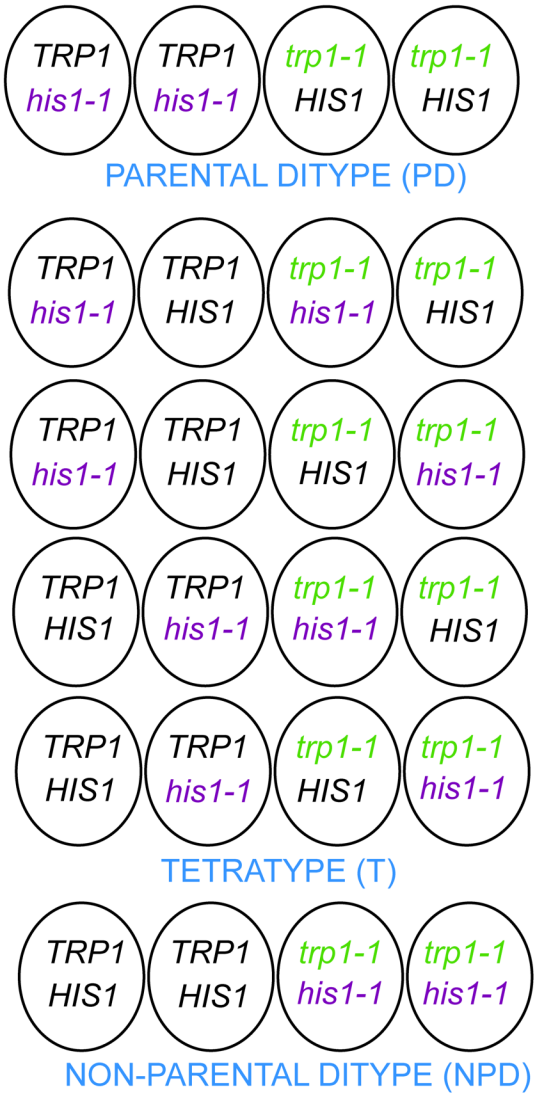


Trans-formant	Locus of inte-gration	Viable spores per tetrad				Ratio of spores
		4	3	2	1	ura$^+$:ura$^-$
1	Actin	0	1	11	3	0:28
2	Actin	0	0	16	1	0:33
5	Actin	0	0	9	0	0:18
6	Actin	0	0	10	1	0:21
3	Ura 3	13	3	0	0	30:31
4	Ura 3	5	3	0	0	15:14

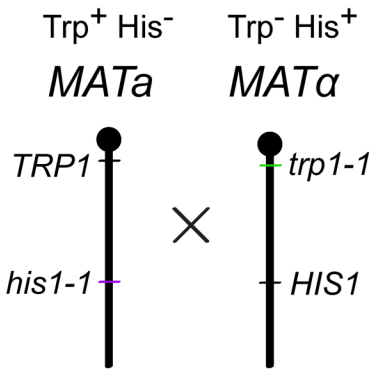
Shortle et al., 1982

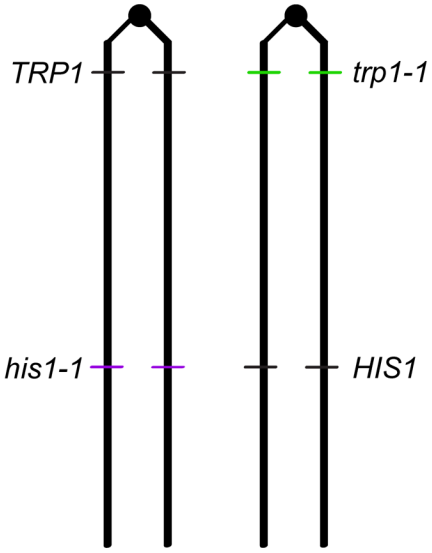
Pairwise analysis of two genetic markers



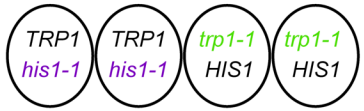


Linkage analysis in a tetrad

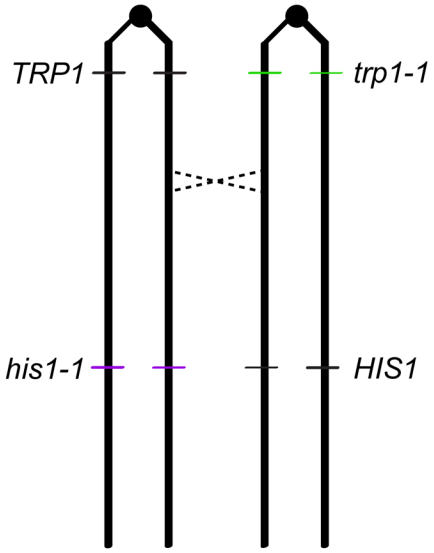




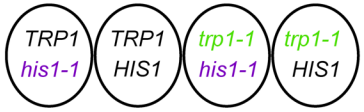
No Crossover



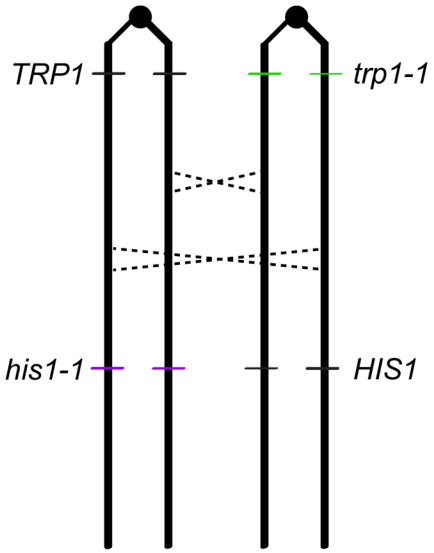
PARENTAL DITYPE (PD)



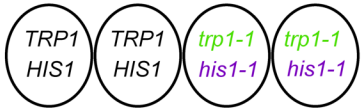
Single Crossover



TETRATYPE (T)

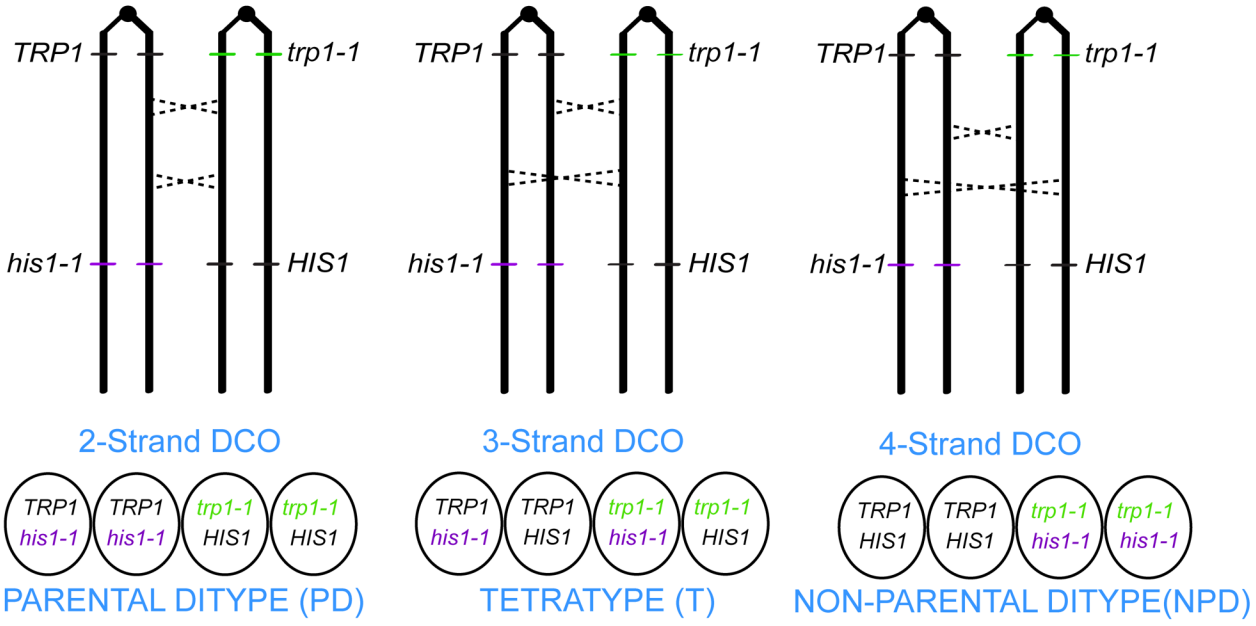


4-Strand Double Crossover



NON-PARENTAL DITYPE(NPD)

Perkins Mapping Equation



Naive formula

$$cM = 100 \frac{(NPD + 1/2T)}{total}$$

NCO = PD - NPD

SCO = T - 2NPD

DCO = 4NPD

Total CO = SCO +2DCO

Total CO = T - 2NPD + 2(4NPD)

Total CO = T + 6NPD

Total Tetrads = PD + T + NPD

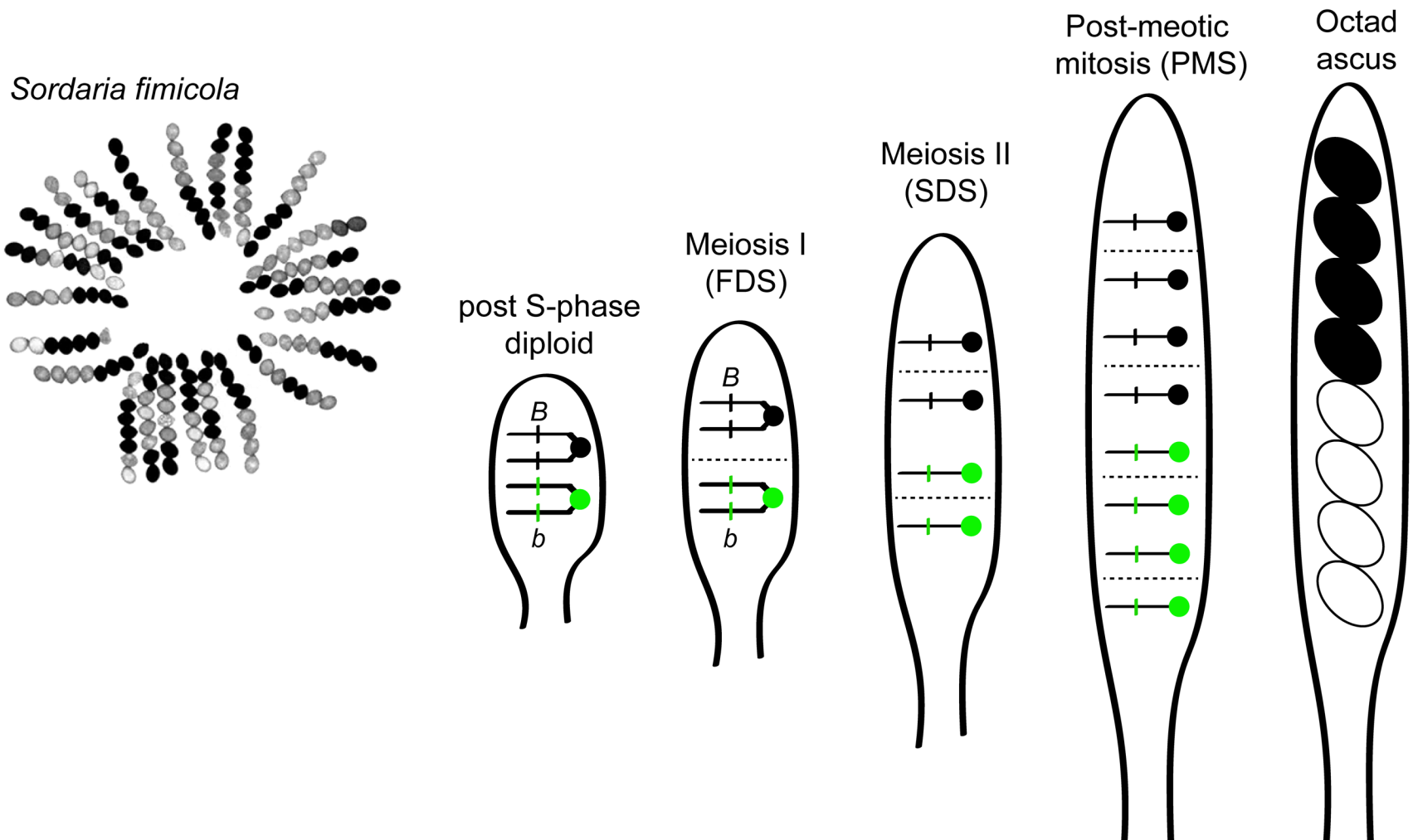
Because each CO produces RF of 50%

RF = 50(T + 6NPD)

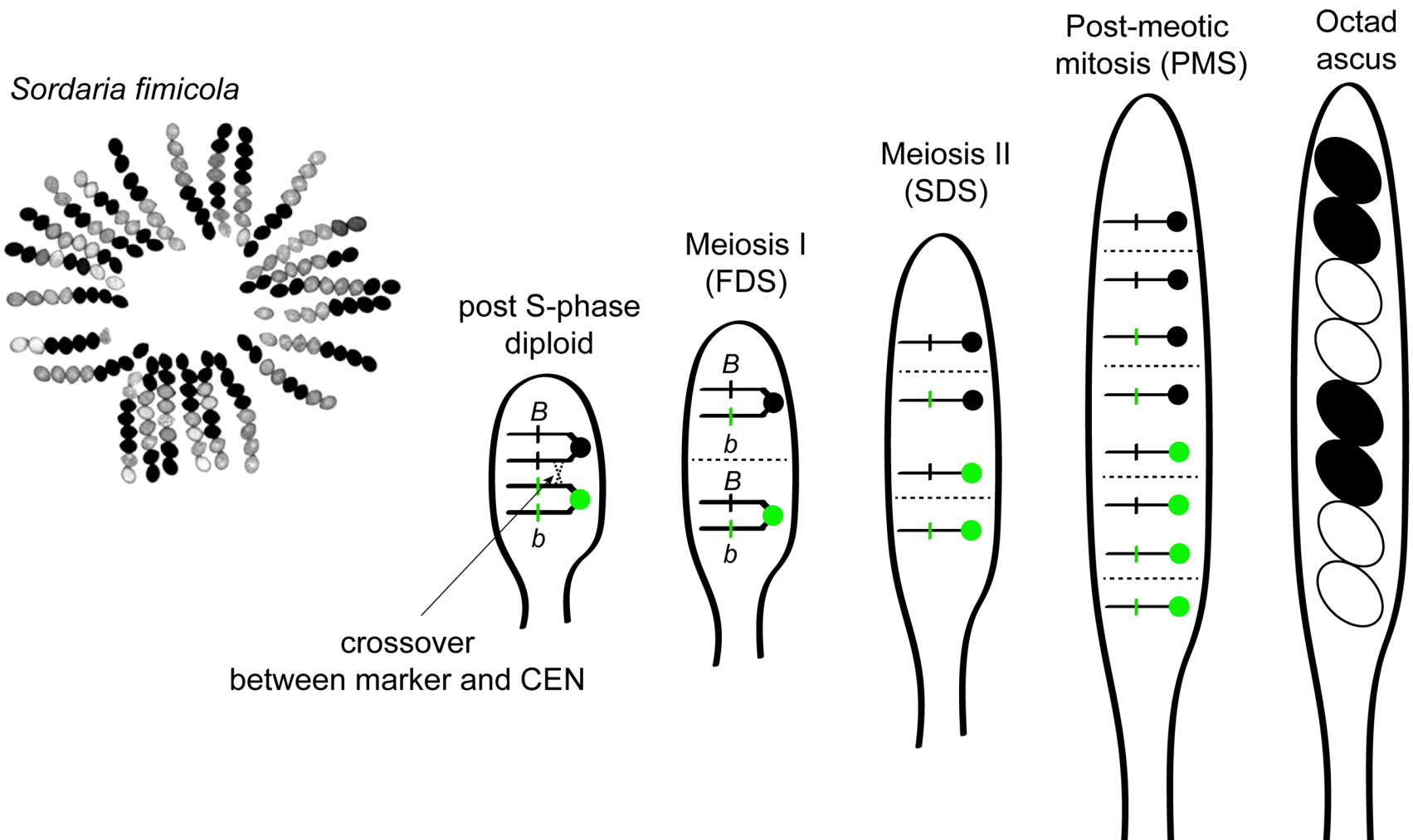
$$RF = \frac{1/2(T + 6NPD)}{\text{tota tetrads}}$$

Perkins 1949

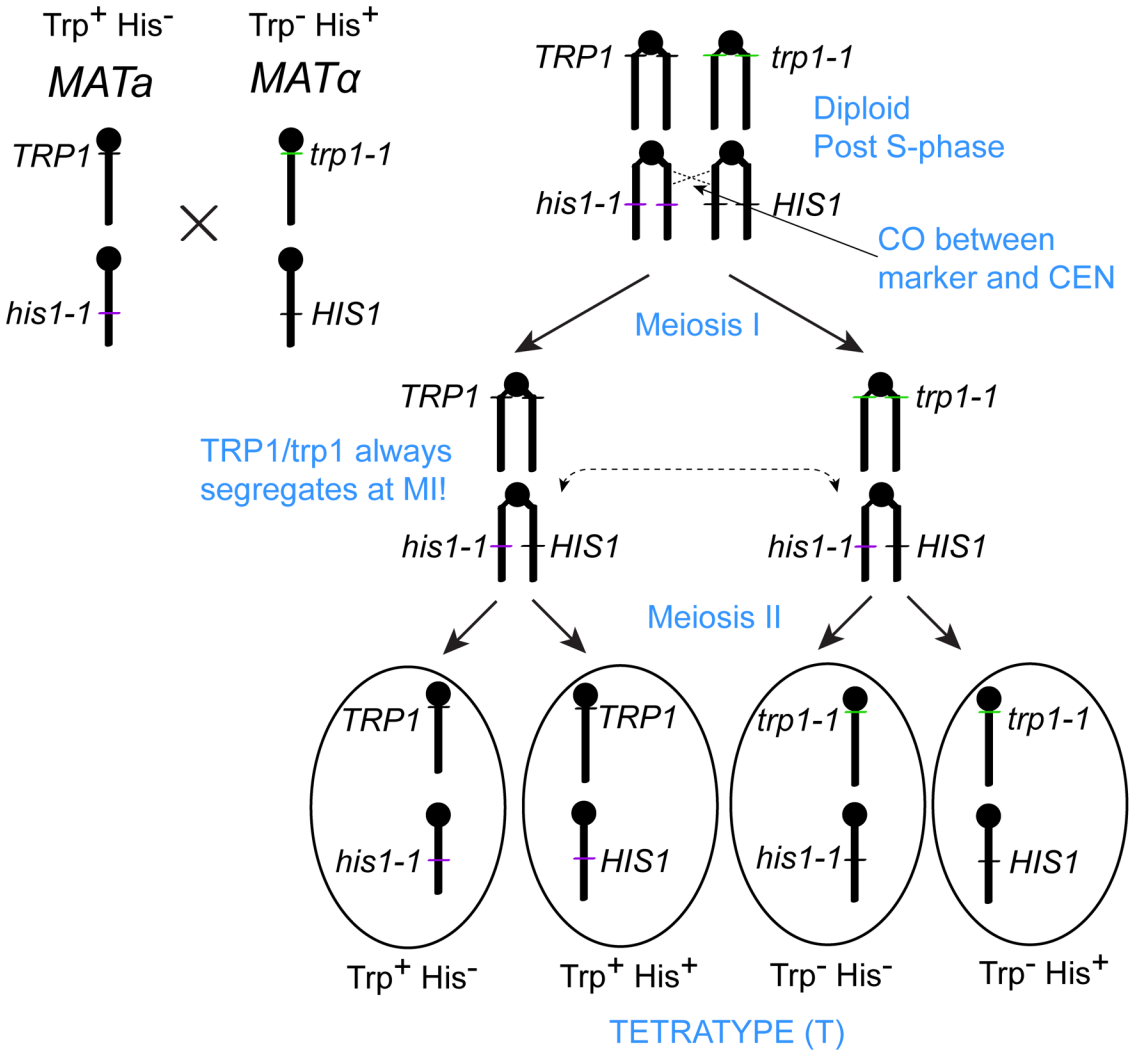
Ordered Octads



First division segregation vs. second division segregation



Centromere mapping



PD = 50
NPD = 50
T = 0

These data support close CEN linkage of both markers

PD = 18
NPD = 22
T = 76

These data support two unlinked markers

PD = 35
NPD = 33
T = 32

%SDS/2 = CEN linkage
~16 cM

Aneuploid segregation

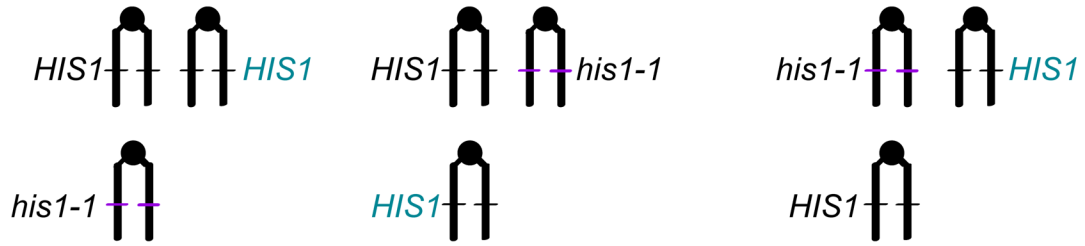
- Triploids are largely sterile

- Tetraploids are fertile

- Aneuploid segregation (2n+1, 2n-1):

Possible homolog orientations at meiosis I

2n +1
Post S-phase



ALL 4:0
$His^+ : His^-$

4:0, 3:1, and 2:2
$His^+ : His^-$

4:0, 3:1, and 2:2
$His^+ : His^-$

Where do the 3:1 segregants come from?