

LINKAGE: violates "independent assortment"

1/22/92, rvsd 1/26/94, 1/19/96, 1/22/97, 1/23/98, 19 Jan 00, 19 Jan 01, 21 Jan 04, 19Jan05, 24Jan08, 21Jan09, 22Jan10, 21Jan11, 20Jan12, 23Jan12
 SGML p. 95-, GMSLG: p. 123-, 7th: pp 142-153, 9th: 129-140

Exceptions (violations) of Mendelian-predicted behavior can yield new insights
 Bateson and Punnett studying sweet pea:

cross: **PP:LL x pp:ll**

	phenotype	expected	observed
Purple/red, Long/round grains:	PL	3911 (9)	4831
PPLL x ppll: PpLl F ₁ (p 142), then selfed	Pl	1303 (3)	390
F ₂ (selfing), 6952 progeny did not produce 9:3:3:1 ratio: (note excess of parental types)	pL	1303 (3)	393
	pl	435 (1)	1338
	Total:	6952	

postulated "coupling"

Morgan found similar prob in *Drosophila* (purple eyes / vestigial wings x w.t.), introduced **test cross** technique (dominant phenotype of unknown genotype)
 page 131: (Note alternate convention for wild type (+) vs mutant (letters))

pr/pr · vg/vg x +/+ · +/+;

F1: pr/+ · vg/+ (then crossed times pr/pr · vg/vg = TEST CROSS)

TEST CROSS: (notation: + = wildtype) direct analysis, parental genotype (use doubly homozygous recessive, should get 1:1:1:1 if independent), got:

(p. 142) phenotype	expected:	observed
++	710	1339 (excess of parental types)
pr vg	710	1195 "
+ vg	710	151
pr +	710	154
	Total:	2839

Morgan postulated **both genes on same chromosome (= "linkage")**
 segregate together (violated Mendel's 2nd law)

If genes are located on same chromosome, how do they separate? (Rare)

RECOMBINATION: meiosis: 1N differs fr either parental 1N genotype.

Evidence: Can be seen as **chiasmata**: exchange between non-sister homologous chromosomes

Note difference between **INTERchromosomal** recombination: (*independent assortment*)

INTRACHROMOSOMAL recombination: *by recombination*

VIDEO: <http://www.youtube.com/watch?v=op7Z1Px8oO4&feature=related>

"**Recombinant type**" phenotype defined as one trait from one parent, one trait from other parent

Recombination frequency: (total recombinant events/total progeny) = distance between in %

Interchromosomal freq = ~50% (25% of each recombinant type in test cross, i.e., Ab and aB)

Intrachromosomal freq = <50% zB: fr Morgans expt: (151 + 154)/2839 (total) = 10.7 %)

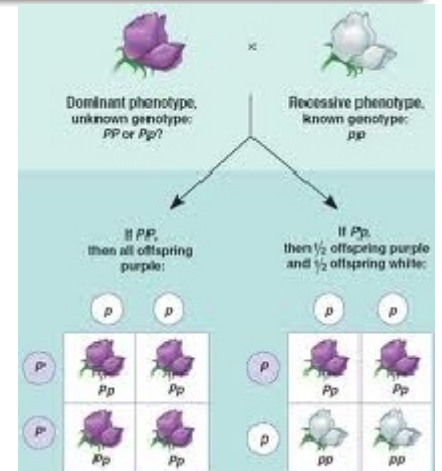
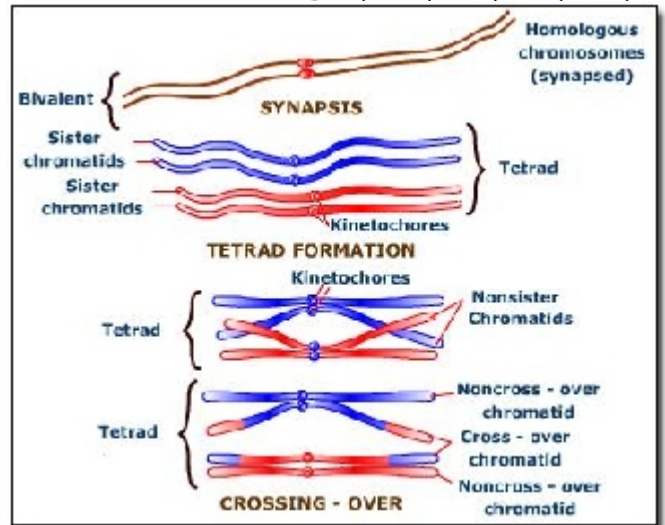
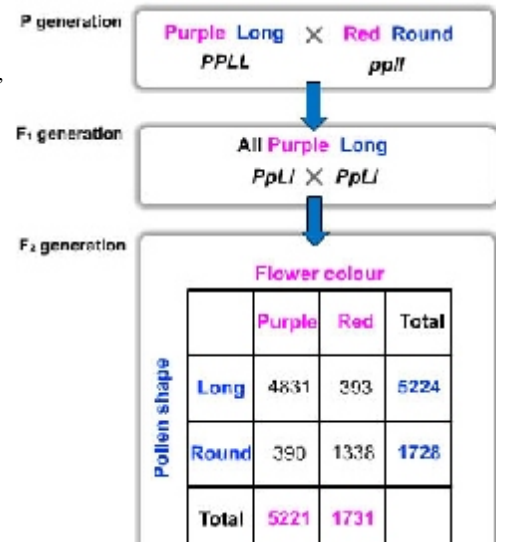
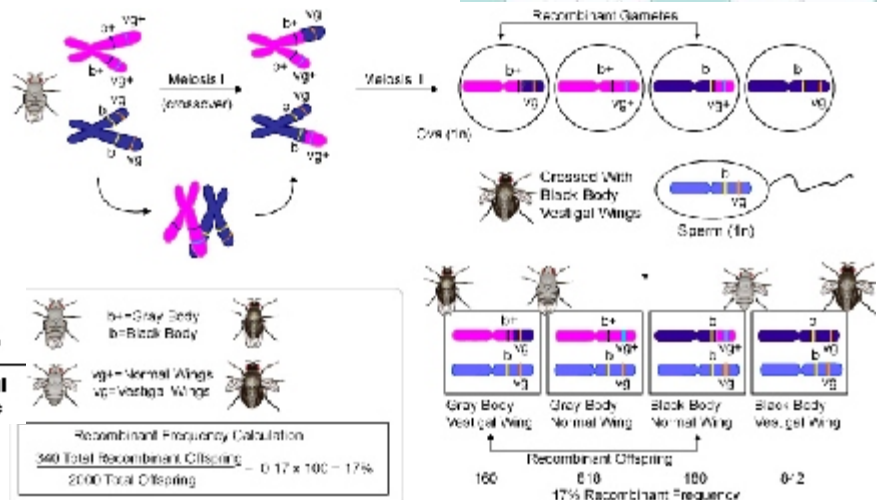
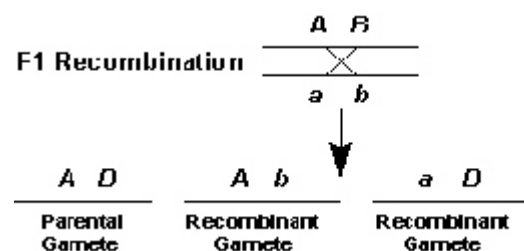
LINKAGE MAPS: (p 129 and 139) AAbb x aabb: F1 = AaBb

Sturtevant (undergrad student of Morgan) proposed: Aa:Bb:

linear relationship on chromosome:

greater distance loci, more prob of cross over:

genetic map unit = distance yields 1% recombinants.



[OMIT2008, 2010, etc?:]

Linkage of genes on X chromosome easier than autosomal:

male is hemizygous, his phenotype = genotype

(y = yellow body) (+ = brown) / (+ = red eye) (w = white eye)

P: yw^+/yw^+ fem x y^+w/Y male

	phenotype	expected:	observed
<i>zB</i> : heterozygous female x male			
will produce sons reflecting females genotype:	yw:	1128	43
<i>Drosophila</i> :	y^+w :	1128	2146
	yw^+ :	1128	2302
	y^+w^+ :	1128	22
Count only males:		total	4513
F_1 : yw^+/y^+w x yw^+/Y :		rec freq: $(43 + 22)/4513 = 1.4\%$	