

Linkage and recombination

Genetics 371B Lecture 9

12 Oct. 1999

Explanation for the *Drosophila* cross (lecture 8 end):

...but how to explain the results of this *Drosophila* cross?

[*pr* = purple eyes; *vg* = vestigial wings

Both are recessive alleles; “+” alleles are wildtype]

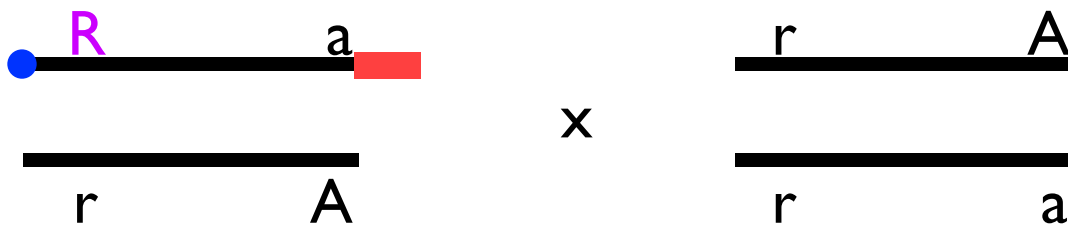
$$\begin{array}{ccccccc} pr^+ pr & sc^+ sc & \times & pr pr & sc sc & & \\ & & & \downarrow & & & \\ pr^+ sc^+ & pr^+ sc & & pr sc^+ & pr sc & & \\ 1339 & 151 & & 154 & 1195 & & \end{array}$$

Morgan's explanation, based on cytology of meiosis—**recombinant class** arising from crossover

How to test? What's needed?

Harriet Creighton & Barbara McClintock, maize
Curt Stern, *Drosophila*

Experimental setup:



R = colored endosperm
r = colorless
A = starchy endosperm
a = waxy

Note the two salient features that make this experiment feasible:
“knob” and translocation –
genetic markers –

Look for **colorless, waxy** progeny

Ask: what do the chromosomes look like in these progeny?

Their results:

Importance of crossovers?

- ◆ proper segregation of homologs
- ◆ new combinations of alleles

Mapping genes



Aa Bb x aa bb	Aa Dd x aa dd	Aa Ee x aa ee
500 AB	420 AD	350 AE
20 Ab	60 Ad	120 Ae
20 aB	60 aD	120 aE
500 ab	430 ad	350 ae

Can you deduce the map order of these genes?

Insight from Alfred Sturtevant (1913)—

If recombination sites are random,

- ◆ probability of recombination between a pair of genes...
- ◆ recombination probability in adjacent intervals...

⇒ **Recombination frequency** can be used as a measure of **genetic map distance**

1 map unit = 1 **centiMorgan** = 1% of meiotic products being recombinant

Constructing genetic maps

1. Are the loci linked? (What is a **locus** anyway?)
2. How much recombination?

How do we identify the recombinant gamete classes?

Parent

$$\begin{array}{cc} \underline{\underline{A \quad B}} \\ a \quad b \end{array}$$

Recombinant gametes*

$$\begin{array}{cc} \underline{\underline{A \quad b}} \\ & \& \\ \underline{\underline{a \quad B}} \end{array}$$
$$\begin{array}{cc} \underline{\underline{A \quad b}} \\ a \quad B \end{array}$$
$$\begin{array}{cc} \underline{\underline{A \quad B}} \\ & \& \\ \underline{\underline{a \quad b}} \end{array}$$

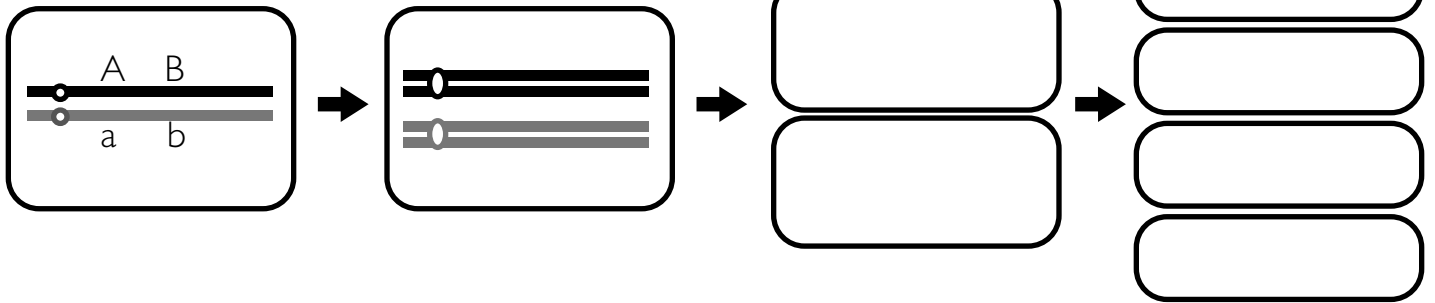
*Fill out the worksheet to be sure you understand this

Operational definition for “non-parental”:

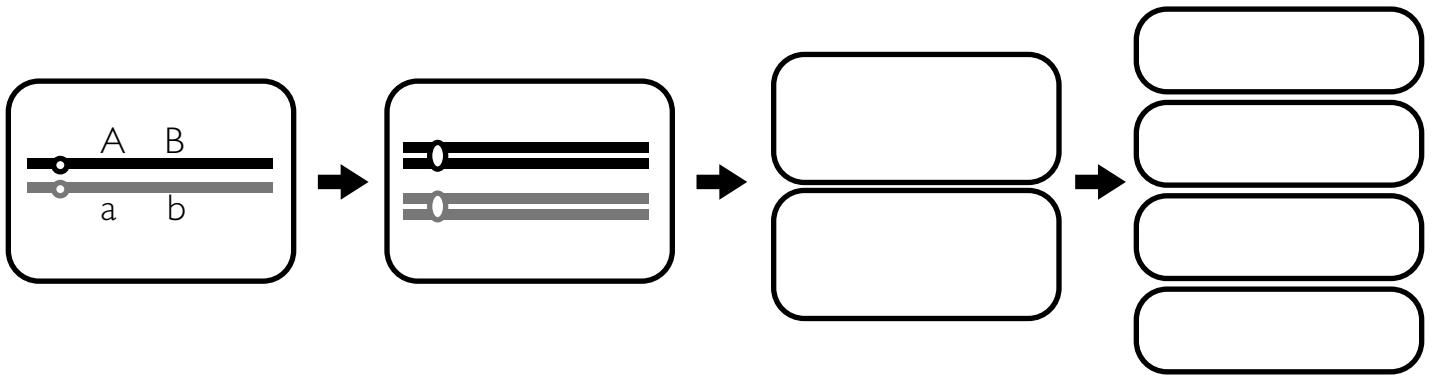
Generally, the cross is
heterozygote x homozygous recessive
...why?

Meiosis worksheet

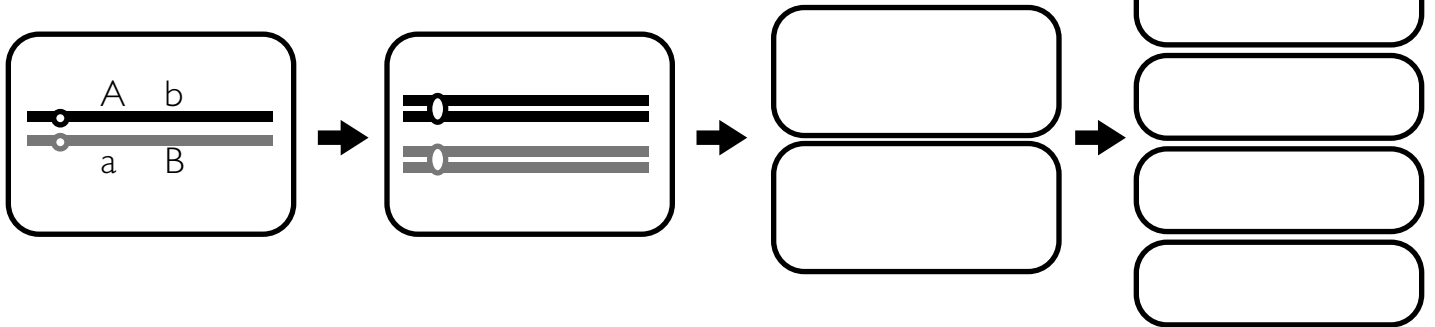
1. No recombination between A/a & B/b



2. Recombination between A/a & B/b



3. No recombination between A/a & B/b



4. Recombination between A/a & B/b

