

- 1 **Chapter 7**  
Linkage, Recombination & Eukaryotic Gene Mapping
- 2
- 3 **Independent Assortment?**
  - ▶ Mendel (1822-1884)
  - ▶ Chromosomal Theory
    - ▶ Sutton 1903
  - ▶ Linked genes
    - ▶ Same linkage group
- 4 **Notation**  
AA BB x aa bb

- 5 **Complete Linkage**
  - ▶ Nonrecombinant (parental) gametes
    - ▶ Nonrecombinant progeny
  - ▶ Recombinant gametes
    - ▶ Recombinant progeny
- 6 **Calculating Recombination Frequency**  
Maximum proportion of recombinant gametes is 50%

- 7
  - ▶ Interchromosomal recombination
    - ▶ Different chromosomes
    - ▶ 50% nonrecombinant gametes
    - ▶ 50% recombinant gametes
  - ▶ Intrachromosomal recombination
    - ▶ Same chromosome
    - ▶ < 50% recombinant gametes
    - ▶ 50% recombinant gametes (if genes far apart)
- 8

$$\text{Recombinant frequency} = \frac{\text{recombinant progeny}}{\text{total progeny}} \times 100\%$$

$$8+7/55+53+8+7 = 5/123$$

$$5/123 \times 100\% = 12\%$$

- 9
  - ▶ Coupling (cis configuration)
 
$$\begin{array}{cc} p+ & b+ \\ p & b \end{array}$$
  - ▶ Repulsion (trans configuration)
 
$$\begin{array}{cc} p+ & b \\ p & b+ \end{array}$$


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10  **Predicting outcomes**

- ▶ Recombinant frequency = 16%
- $$\begin{array}{cc} T & D \\ \hline t & d \end{array} \times \begin{array}{cc} t & d \\ \hline t & d \end{array}$$
- ▶ Expect 4 gametes (2 nonrec & 2 recomb)
  - ▶ recombinant  $16\% / 2 = 8\%$
  - ▶ Nonrecombinant  $100\% - 16\% = 84\%$ 
    - ▶  $84\% / 2 = 42\%$
- ▶ Other parent expect 1 type of gamete
  - ▶ Probability of 1.00
- ▶ predict frequency of progeny use "and" equation
  - ▶  $.42 \times 1.00 = .42$  non recombinant progeny
  - ▶  $.08 \times 1.00 = .08$  recombinant progeny

11  **Testing for independent assortment**

- ▶ When progeny # do not show obvious linkage use a contingency table and chi-squares
- ▶
- ▶ Working in groups of 2-3 walk through and take notes on the German cockroach example pg 171-173.
- ▶ Then use your notes to help you solve the following:
  - ▶ Handout

12  **Gene Mapping**

- ▶ Genetic Maps
  - ▶ Determined by recombination
  - ▶ Map units (mu)  $1=1\%$  recombination
    - ▶ Centimorgans (cM)
- ▶ Physical maps
  - ▶ Physical distances
  - ▶ Base pairs (bp)
- ▶

13  **Gene Mapping**

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14 

- ▶ Different linkage groups (50% recombination)
- ▶
- ▶
- ▶ Double crossover error with long distance
  - ▶ Map distance underestimated
- ▶

15  **Genetic map w/two point cross**

- ▶ Testcross between 2 genes
- ▶ Loci                      recombination frequency %
  - ▶ a – b                      50
  - ▶ a – c                      50

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- ▶ a – d            50
- ▶ b – c            20
- ▶ b – d            10
- ▶ c – d            28

▶  
▶

16  **7.3 Three-point testcross**

- ▶ More efficient
- ▶ More accurate
- ▶
- ▶ Example:
  - ▶ Aa Bb Cc
  - ▶ Coupling configuration
    - ▶ Two single crossovers
    - ▶ One double crossover

17 

- ▶ Drosophila example
  - ▶ st – scarlet eye
  - ▶ st+ - red eye
  - ▶ e -ebony body
  - ▶ e+ - gray body
  - ▶ ss - spineless
  - ▶ ss+ - bristiles

18 

- ▶ Offspring of 3pt test cross
  - ▶  $2^3 = 8$  phenotypic classes

Gene order

1. Determine nonrecombinants
2. Identify double crossovers
  - What is different from nonrecombs
- 3.

19 

3. Resort information using gene order
4. Mark single & double crossovers
5. Calculate recombination frequencies ( $\mu$ )
  - ▶ st – ss
    - ▶  $50+52+5+3/755=$
  - ▶ ss – e
    - ▶  $43+41+5+3/755=$
  - ▶ st – e
    - ▶  $14.6+12.2=$

20  **Interference & coefficeint of coincidense**

- ▶ Firs crossover inhibits second (interference)
  - ▶ Double crossover offspring less than expected
    - ▶ (recomb freq of first X recomb freq of second = expected)
    - ▶  $0.146 \times 0.122 = 0.0178$              $0.0178 \times 755 = 13.4$  expected
- ▶ Coefficient of coincidence

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- ▶ = number observed double / number expected double
- ▶  $8/13.4 = 0.6 = 60\%$
- ▶
- ▶ Interference =  $1 - \text{coefficient of coincidence}$ 
  - ▶ Interference =  $1 - 0.6 = 0.4 = 40\%$
  - ▶ 40% of expected will not be observed in the cross due to interference

□

21  **Genetic map w/three point cross**

- ▶ Testcross between 3 genes
- ▶ Handout
- ▶

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