Genetics & Probability
- Mendel’s laws:
  - segregation
  - independent assortment

reflect same laws of probability that apply to tossing coins or rolling dice

Genetics & Probability
- Calculating probability of making a specific gamete is just like calculating the probability in flipping a coin
  - probability of getting a P gamete?
  - probability making a P gamete?

Rule of Multiplication
- Chance that 2 or more independent events will occur together
  - probability of tossing heads each time? 50%
  - probability making a P gamete each time? 50%

Calculating Dihybrid Probability
- Rule of multiplication also applies to dihybrid crosses (as long as you don’t have linked genes on the same chromosome)
  - heterozygous parents — YyRr
  - probability of producing yyrr?
    - probability of producing y gamete = 1/2
    - probability of producing r gamete = 1/2
    - probability of producing yr gamete = 1/2 x 1/2 = 1/4
  - probability of producing a yyrr offspring = 1/4 x 1/4 = 1/16

Rule of Addition
- Chance that an event can occur 2 or more different ways
  - sum of the separate probabilities
    - probability of rolling a 7!
    - probability of Pp x Pp → Pp
Calculating Probability

\[
Pp \times Pp
\]

<table>
<thead>
<tr>
<th>sperm</th>
<th>egg</th>
<th>offspring</th>
</tr>
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<tbody>
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<td>( \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} )</td>
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\( Pp \times Pp \) = male / sperm

\( Pp \times Pp \) = female / eggs

\( Pp \times Pp \) = 1/2 sperm

\( Pp \times Pp \) = 1/2 egg

\( Pp \times Pp \) = offspring

Chi-square Test (Analysis)

- Test to see if your data supports your hypothesis
- Compare “expected” vs. “observed” data
  - Do the data occur in the predicted ratio of \( A : B \)? Is there no stat. sig. difference between expected and observed numbers? Is the variance from expected due to “random chance”? (not stat. sig.)
  - Is there a stat. sig. difference between expected and observed numbers? Is the variance from expected due to possibly a different inheritance pattern? (stat. sig.)

Pedigree Analysis

- Pedigree analysis reveals Mendelian patterns in human inheritance
  - data mapped on a family tree

Genetic Counseling

- Pedigree can help us understand the past & predict the future
- Thousands of genetic disorders are inherited as simple recessive traits (can be benign conditions to deadly diseases)
  - albinism
  - cystic fibrosis
  - Tay Sachs
  - sickle cell anemia
  - PKU

Recessive Diseases

- The diseases are recessive because the allele codes for either a malfunctioning protein or no protein at all
  - Heterozygotes (Aa)
    - carriers
    - have a normal phenotype because one “normal” allele produces enough of the required protein

How a hidden disease reveals itself...

\[
AA \times Aa
\]

\[
Aa \times Aa
\]

AA  x  Aa

A  A

A  a

A  A

A  a

A  A

A  a

A  A

A  a