**Mendel’s laws:**
- Segregation
- Independent assortment

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

**Calculating probability of making a specific gamete is just like calculating the probability in flipping a coin.**
- Probability of tossing heads? 50%
- Probability of making a P gamete...

**Outcome of 1 toss has no impact on the outcome of the next toss.**
- Probability of tossing heads each time? 50%
- Probability of making a P gamete each time? 50%

**Calculating probability**

<table>
<thead>
<tr>
<th>Male / Sperm</th>
<th>Female / Eggs</th>
<th>Offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pp</td>
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</tbody>
</table>

**Rule of multiplication**
- Chance that 2 or more independent events will occur together
  1. Probability that 2 coins tossed at the same time will land heads up
    - $1/2 \times 1/2 = 1/4$
  2. Probability of Pp x Pp → pp
    - $1/2 \times 1/2 = 1/4$
Calculating dihybrid probability

- Rule of multiplication also applies to dihybrid crosses
  - Heterozygous parents — YyRr
  - Probability of producing yyRr?
    - Probability of producing Yy gamete = 1/2
    - Probability of producing yR gamete = 1/2
    - 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 Pp x Pp → Pp
      - Sperm | Egg | Offspring
      - Pp x Pp
      - 1/2 x 1/2 = 1/4
      - Pp + Pp
      - 1/2 x 1/2 = 1/4

Chi-square test

- Test to see if your data supports your hypothesis
  - Compare “observed” vs. “expected” data
    - Is variance from expected due to “random chance”?
- Other important aspects:
  - Null Hypothesis: that there is no significant difference in proportions between groups

Chi-square test

- Equation:
  \[ \chi^2 = \sum \frac{(O_{\text{observed}} - E_{\text{expected}})^2}{E_{\text{expected}}} \]

Chi-square test

- Determine degrees of freedom (df):
  - df = Total possible outcomes – 1
  - (row numbers)(column numbers) - 1
- Compare answer to a chi-squared significance chart:
  - P value = chance alone caused this result, i.e., if P = 0.05, less than a 5% chance this was random