Lectures 1: Mendelian Genetics

Particulate Inheritance – discrete units of heredity (genes) that are inherited intact through the generations

Mendel's Experiments
* Used pure-breeding (genetically identical) lines of garden peas
* Examined crosses involving seven different characters

Monohybrid cross
* Cross between pure lines differing in a single character of interest.
  i.e., Seed color -- Yellow versus Green: what Mendel observed
  The F1 were all Yellow. However, Green Segregated out in F2 – strong evidence for discrete units of heredity, as "green" unit obviously present in F1, appears in F2 (3:1 ratio of Yellow: Green in F2).
Mendel also found that Parental, F1, and F2 Yellow peas behaved quite differently:

Mendel's explanation:
* Genetic information exists as discrete units occurring in pairs
* YY is the genotype of the pure Yellow line
* yy the genotype of pure Green line
* Y dominant to y (y is recessive to Y)
* YY, Yy (denoted by Y-) = Yellow
* yy = green

The discrete units segregate out in the F2.

When he examined each F2 yellow family separately, Mendel found:
* 2/3 of the F2 yellows give 1/2 yellow, 1/2 green
* 1/3 of F2 yellows gave all yellow progeny
Genetic Notation
* **Phenotype**: Seed color
  Yellow phenotype is dominant to green phenotype
* **Genotypes**
  YY homozygous dominant
  Yy heterozygous
  yy homozygous recessive
* ** Alleles**
  Y is dominant
  y is recessive

Dihybrid crosses
* **Crossing pure**—breeding lines differing in two characters
Example: for Seed shape
  RR, Rr = round
  rr = wrinkled
Cross yellow, wrinkled pure line with round green

<table>
<thead>
<tr>
<th>Type</th>
<th>Genotype</th>
<th>Phenotype</th>
<th>Number</th>
<th>Genotypic ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental</td>
<td>Y−R−</td>
<td>yellow round</td>
<td>315</td>
<td>9/16</td>
</tr>
<tr>
<td>Recombinant</td>
<td>yy−R−</td>
<td>green round</td>
<td>108</td>
<td>3/16</td>
</tr>
<tr>
<td>Recombinant</td>
<td>Y−rr</td>
<td>yellow wrinkled</td>
<td>101</td>
<td>3/16</td>
</tr>
<tr>
<td>Parental</td>
<td>yy rr</td>
<td>green wrinkled</td>
<td>32</td>
<td>1/16</td>
</tr>
</tbody>
</table>

Ratio of yellow (dominant) to green (recessive) = 12:4 or 3:1
Ratio of round (dominant) to wrinkled (recessive) = 12:4 or 3:1
Mendel observed Independent Assortment:

* How are these ratios computed?

Pr(R−) = Pr(RR) + Pr(Rr) = 1−Pr(rr) = 3/4

Same for Pr(Y−) = 3/4

Pr(R−,Y−) = Pr(R−)*Pr(Y−)

= 3/4 * 3/4 = 9/16

Assumes R and Y are independent, i.e., Independent assortment

  o Pr(R−,yy) = 3/4 * 1/4 = 3/16

  o Pr(rr, Y−) = 1/4 * 3/4 = 3/16

  o Pr(rr, yy) = 1/4 * 1/4 = 1/16

Mendel cheated (or was very lucky):
The seven characters he used to show independent assortment were all on different chromosomes. Hence they are not linked.