Lecture 3 – Mendelian genetics
I. Dihybrid cross
   A. Cross

   B. Punnett square

   C. Branch Diagram
      1. for genotype:
         What’s the probability of WWGG?
         What’s the probability of WwGg?

      2. for phenotype:
         What’s the probability of round, green?
         What’s the probability of wrinkled, yellow?

   D. Dihybrid test cross – Consider F1 from previous example:
      What if cross unknown round, yellow X wrinkled, green and get all round, yellow?
What if cross unknown round, yellow X wrinkled, green and get 1/2 round yellow and 1/2 wrinkled, yellow?

E. Does parental combination of alleles matter?

II. Trihybrid cross
A. Principles are same as for mono- or dihybrid cross
B. Example:
round, yellow, purple flower X wrinkled, green, white flower

\[
\begin{align*}
(WWGGPP) & \quad (wwggpp) \\
\text{F}_1 & \quad \text{round, yellow, purple flower (WwGgPp)} \\
\text{F}_2 & \quad \text{round, yellow, purple (W--G--P--)} \\
& \quad \text{round, yellow, white (W--G--pp)} \\
& \quad \text{round, green, purple (W--ggP--)} \\
& \quad \text{wrinkled, yellow, purple (wwG--P--)} \\
& \quad \text{round, green, white (W--ggpp)} \\
& \quad \text{wrinkled, yellow, white (wwG--pp)} \\
& \quad \text{wrinkled, green, purple (wwggP--)} \\
& \quad \text{wrinkled, green, white (wwggpp)}
\end{align*}
\]

C. Punnett square:

\[
\begin{array}{cccccccc}
& WGP & wGP & WgP & wgP & WGp & wGp & Wgp & wgp \\
WGP & & & & & & & & \\
wGP & & & & & & & & \\
WgP & & & & & & & & \\
wgP & & & & & & & & \\
WGp & & & & & & & & \\
wGp & & & & & & & & \\
Wgp & & & & & & & & \\
wgp & & & & & & & & \\
\end{array}
\]

D. Branch diagram:
1. for genotype:
   What’s the probability of getting \(WWGgPp\) from this cross?
What’s the probability of getting $wwggpp$ from this cross?

2. for phenotype: What’s the probability of getting round, green and white from this cross?

What’s the probability of getting round, green and white from this cross?

III. Simple Probability

A. Intro. to simple probability – probability is the likelihood of a particular outcome

eg. 1: probability of rolling 1 with six-sided dice

eg. 2: probability of first child being girl

eg. 3: probability that offspring of heterozygous father will inherit $H$, the dominant mutation responsible for Huntington’s chorea.

B. Some rules of probability

1. limits of probability
   a. if event is certain:
   b. if event is certain not to occur:
   c. if probability of an event is $p$, the probability of all other outcomes =

eg. What is the probability of not rolling a 6?

C. Addition rule – mutually exclusive events

eg. 1: What is probability of rolling either 4 or 6?

eg. 2: Cross $Ww \times Ww$. What is probability of round progeny?

D. Multiplication rule – independent events

eg. 1: Probability of rolling 1, 3 X’s in a row?

eg. 2: Probability that first two offspring from $Ww \times Ww$ are round?

eg. 3: Probability of round, yellow peas, white flowers and dwarf plants ($dd$) from $WwGgPpDd \times$ self?
eg. 4: Probability that 4th child will be girl if the first 3 children were girls?

egl 5: Probability that first 4 children are girls?

E. Examples: You perform the following cross: AaBbCCDdEdFfgg X aaBbCcDdeeFfGg. (All unlinked)
1. What is the probability of obtaining aabbCCDDeeFFGg progeny?
2. What is the probability of obtaining AabbCcDdEeffGG progeny?

IV. Genetic notation
A. General
1. Often named for first mutation/mutant phenotype.
2. Gene names italicized, protein names not.
3. Upper case may be used to indicate dominant.
4. Plus indicates wild type, "−" indicates mutant.
5. Wild type - most common in nature or lab, or first found.
B. Examples of different styles of notation:
1. Mendelian
   a. dominant condition in capital letters
   b. recessive in lower case
2. research/medicine today
   a. wild type indicated by plus, often superscript
   b. recessive in lower case, sometimes with a "−"
   c. dominant mutations indicated by upper case
   d. two alleles of diploid separated by "/"