Objectives

- Explain how genes and alleles are related to genotype and phenotype

- Use the information in a Punnet Square

- Explain how probability can be used to predict possible genotypes in offspring.

- Describe three exceptions to Mendel's observations.

Chromosomes and Genes

- Mendel did not know how cells distributed "factors", nor what the "factors" were

- Over thirty years later, Walter Sutton proposed that Mendel's "factors" were chromosomes

- **gene**- _____

- **allele**- _____
  - equivalent to Mendel's "factors"

Allele Notation

- dominant alleles represented by _____
  - ex) "tall plant" is dominant over "short plant", so _____ = tall

- recessive alleles represented by _____ of the same letter as the dominant allele
  - ex) "short plant" is recessive to "tall plant", so "short plant" = _____

Homozygous vs Heterozygous

- **homozygous**: *condition in which the two alleles for a trait are* _____
  - ex: For tall plant: _____, or short plant: _____

- **heterozygous:** *condition in which the two alleles for a trait are* _____
  - ex: Tall plant: _____ (since T is dominant, it masks the short allele)

Genotype vs. Phenotype

- <u>**genotype**</u>: _____
  - ex: For a heterozygous tall plant, the genotype would be "_____"

- ex: For a homozygous tall plant, the genotype would be "_____"
- **phenotype**: *the _____ of an organism*
  - ex: For a plant with GENOTYPE tt, the **phenotype** is "_____"

Punnet Squares

- **Punnet square:** _____
- To make a Punnet square:
  - 1) make a 2 X 2 square
  - 2) write the alleles for the _____ parent along the top of the square, and the alleles for the _____ along the left side
  - 3) In each of the middle squares, write the two alleles that intersect in that square
    - Note: Always write the _____ allele first, if one is present!

Example: Punnet Square

- Draw a Punnet square for the cross of Mendel's pure tall plant (homozygous tall) with a pure short plant (homozygous short). Tall is dominant to short.
  - 1) make 2 X 2 square
  - 2) write alleles for female on top, male on side
  - 3) fill in squares with alleles from where the row and column intersects

Make a Punnet Square below!

Probability

- **probability**: _____

  _____

- Ex: What is the probability of rolling an even number on a dice:

- Answer: There are _____possible even numbers out of 6 on a dice, so the probability would be _____ (all of these are the same thing!)

Calculating Probabilities

- To calculate the probability of more than one event occurring, you just _____ the probabilities of each individual event occurring, assuming that the events are **independent** (that they don't affect each other)

- Ex: What is the probability of getting three heads in a row when you flip a coin three times?

  - Ans: _____

Example: Probabilities in Genetics

- If you crossed two plants that are heterozygous, what is the probability of getting a tall plant? (Tall is dominant to short)

Make a Punnet Square →

- After filling in the Punnet square, _____ possible offspring are tall, so the probability would be _____

Exception #1 To Mendel's Principles: Incomplete Dominance

- **incomplete dominance**- _____

  _____

- offspring have an intermediate phenotype from the two alleles
- ex) snapdragons

Snapdragon Punnet square

- In cases of incomplete dominance, we use the prime symbol (') instead of small letters to indicate the second allele

- So R = red
- R' = white
- Results: genotypes: 100% RR'
- Phenotypes: 100% pink

Snapdragon (F1)

- Here's the F1 generation of 4 o'clock flowers
- Results:
  - 1:2:1 (RR, RR', R'R') genotypes
  - 1:2:1 (red, pink, white) phenotypes

Exception #2: One Gene, Many Traits

- Sometimes, a single gene influences several traits, so Mendel's rules aren't as obvious
- Ex: the gene that causes _____ affects fur color, as well as eye color
- in humans, the gene also affects vision!

Exception #3: Many Genes, One Trait

- Sometimes, it takes several genes to express one trait.
- Ex:

  _____

- These traits tend to have a wide range of possibilities!

Importance of Environment

- Our traits are not only due to our genes!
- Environmental factors play a role in our development.
- ex: Just because you have Olympic gold medal athletes as parents does not mean that you will be a super athlete!
- you need to _____ to be successful! (all environmental factors)