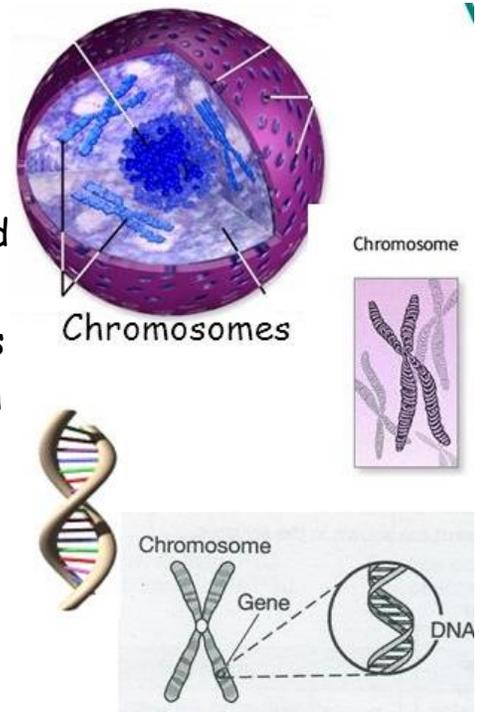


2. Inheritance and Probability

Heredity

- is controlled by the chromosomes that are inherited by offspring from parents
- the instructions for each trait are found in sections of chromosomes called **genes** which are arranged in a **specific order** on each chromosome
- different chromosomes are made up of different genes and different genes control different **traits**
- each trait is controlled by at least 2 forms of a gene called an **allele**
- kinds of traits inherited:



a) Species Characteristics

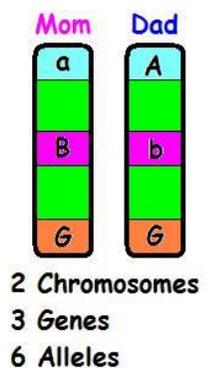
- = traits specific to **a group of organisms**
- ie. Robins always have red feathers



b) Individual Characteristics

- = traits making an individual within a species **unique**
- ie) fingerprints

- in complex organisms **gametes** are formed through **meiosis** and used to produce offspring via sexual reproduction
- as each parent contributes one gamete, an offspring is always different from its parents because it is a **combination** of the parents
- ie. A child has mother's hair color and father's nose
- each parent contributes half of the chromosomes so for each trait one allele is inherited from the **father**, and one comes from the **mother**



- = offspring can inherit different combinations of alleles from parents

:Probability: chance that an event will occur

- even though we inherit from our parents, our environment will affect the **full potential** of what we inherited
Ie. Sunlight - lightens hair and darkens freckles
- in genetics, we work with a strict **mathematical probability**, we do not consider items like the environment, or other factors
- NEVER consider things you have seen on television, or personal experiences when you answer genetics questions, use only probability mathematics

3. Mendel's Laws of Heredity

Gregor Mendel = Father of the science of genetics

- Austrian monk who studied garden peas and their traits
- Looked at peas because he observed that:
 - a) peas have a number of traits that are **expressed in 1 of 2 ways**
 - b) peas are both **self-fertilizing and cross-fertilizing**
- This allowed Mendel to look at single characteristics at a time and also to look at several generations of offspring to trace heredity
- He applied probability math to all his data formulating his laws

Mendel's Laws

A. The Law of Dominance

- When two different "factors" (alleles) control a trait:
 - the effect of one allele masks the effect of the other allele
 - :the expressed allele is known as dominant
 - :the masked allele is called recessive
- Mendel proved this by crossing plants with round seeds with plants having wrinkled seeds
 - All the offspring always had round seeds
 - = round is dominant and wrinkled is recessive
- Mendel's cross can be illustrated using a Punnett Square
 - = diagram which shows the probability of the offspring inheriting certain alleles from a cross between two different individuals
- In Mendel's experiment the parents were pure for their traits:
 - Round = RR wrinkled = rr
 - = homozygous

Monohybrid cross (1 trait is crossed)

$$P_1 = \underline{RR} \times \underline{rr}$$

| | | |
|---|----|----|
| | R | R |
| r | Rr | Rr |
| r | Rr | Rr |

Results = F₁ (First Filial Generation)

a) **Phenotype** (how trait is expressed or what you see)

= 100% round

b) **Genotype** (genetically or which alleles are possessed for a trait)

= 100% Heterozygous round (two different alleles)

= Hybrid (Rr)

B. The Law of Segregation

- Chromosomes (and therefore genes) are arranged in **homologous pairs**
- Since a pair of genes control each trait in a diploid (2n) organism, when gametes are formed, a homologous chromosome pair is **separated** so that each gamete gets only **one** of the 2 alleles for the trait therefore, depending on the allele donated by each parent, offspring can inherit:

2 dominant alleles

2 recessive alleles

1 dominant and 1 recessive allele

- Mendel proved this by crossing 2 plants from the F₁ generation

Parents: Heterozygous round seeds (hybrids): Rr

F₁ = Rr x Rr

| | | |
|---|----|----|
| | R | r |
| R | RR | Rr |
| r | Rr | rr |

Results = F₂ (Second Filial Generation)

a) **Phenotype:** 75% round

25% wrinkled

Ratio = 3:1 (probability)

b) **Genotype:** 25% (RR) homozygous dominant round

50% (Rr) heterozygous round

25% (rr) homozygous recessive wrinkled

Ratio: 1:2:1

<https://www.youtube.com/watch?v=0vAAf4g5iF8>

General Steps to Making a Punnett Square

- 1) Determine parents genotype - ex. AA or Aa or aa
- 2) Determine the possible gametes for each parent (sort alleles)
Ex. A parent who is AA can pass on only one type of allele: **A**
A parent who is Aa can pass on two types: **A** or **a**
- 3) Place the gametes from one parent vertically (across the top) and those from the other parent horizontally (along the side) of the square
- 4) Combine the traits together for each square. This represents the possible genotypes of each of the offspring
- 5) Interpret genotypes & phenotypes as required to determine the chance of one offspring inheriting any given genotype or phenotype (use %'s & ratios)