Mendelian Genetics

Objectives

1. Explain Mendel's Experiments to the study of genetics
2. Summarize the law of segregation and law of independent assortment
3. Predict possible offspring using a Punnett square

The story of Inheritance

- Began with aristotle
  - Man gave the shape
  - Woman gave birth
- 1700s
  - Life started in either egg or sperm
- 1800s
  - Discovery that sheep also took traits from parents
- 1900s
  - Gregor Mendel (pea plant investigator and father of modern genetics)
    - Theory of genetics
    - Found that peas could take on one of two types
    - Peas because they were easy to breed quickly
    - Theory of dominant and recessive genes
  - Inheritence was not from the blood
  - Genes could be inherited and overwritten
  - Found the double helix of DNA, and found that genes were inside them

Mendel's Law of Segregation

When creating offspring, the two alleles in a gene's genotype will be separated and only one will go to the offspring. The offspring will receive one allele from each parent to get the total of two alleles for that gene.

- Multiple-allele traits have more than two alleles for a single trait
- Segregation leads to having variation in the offspring

Punnett squares

The two alleles of one parent are the columns and the two alleles of the other parent are the rows.

- The crosses in the table are possible combinations in children for that gene

	A	B
C	AC	BC
D	AD	BD

Getting from genotypes to phenotypes

- Dominant alleles will always show if they are present
- Recessive alleles will only show if they are the only ones present

Ex: What is the phenotype of the Yy genotype?
Since the dominant Y allele is present, the phenotype is Y.

Ex: What is the phenotype of the yy genotype?
Sincle both alleles are recessive, the phenotype is recessive (y)

Monohybrid Cross

Is a cross between two organisms involving a singular trait.
It is used to predict possible results of the cross.

- Crossing **two Yy**

Ex: **Yy** cross **Yy**

	Y	y
Y	YY	Yy
y	Yy	yy

- All three genotypes are possible
  - YY - 25%
  - Yy - 50%
  - yy - 25%
- Both phenotypes are also possible
  - Y - 75%
  - y - 25%

Ex: **YY** cross **Yy**

	Y	Y
Y	YY	YY
y	Yy	Yy

- Two genotypes are possible
    - YY - 50%
    - Yy - 50%
- One phenotype is possible
    - Y - 100%

Dihybrid Cross

Is a cross between two organisms involving two traits simultaneously.
Similar to Monohybrid cross, except it is more complicated because it takes into account two traits.

- Along the top of the Punnett square will be all possible combinations of the two traits in the first organism
    - Each combination must have one from each trait, both from the same organism
    - You can imagine all the combinations to be a Punnett square with itself
        - The top being the First trait and the side being the second trait
- Across the side will be the same for the second organism

Ex: **Yy Xx** cross **Yy Xx**

1st organism: (these are all the possible combinations of its own alleles)

	Y	y
X	YX	yX
x	Yx	yx

The second organism happens to have the same allele combination
The entries in the table will become the row and column headers in the large table

	YX	Yx	yX	yx
YX	YYXX	YYXx	YyXX	YyXx
Yx	YYXx	YYxx	YyXx	Yyxx
yX	YyXX	YyXx	yyXX	yyXx
yx	YyXx	Yyxx	yyXx	yyxx

- All 9 genotype combinations are possible
    - YYXX - 1/16
    - YYXx - 2/16
    - YYxx - 1/16

- YyXX - 2/16
    - YyXx - 4/16
    - Yyxx - 2/16
    - yyXX - 1/16
    - yyXx - 2/16
    - yyxx - 1/16
  - All 4 Phenotype combinations are possible
    - YX - 9/16
    - Yx - 3/16
    - yX - 3/16
    - yx - 1/16

Ex: **YYXX** cross **yyxx**

1st organism: (the columns)

	Y	Y
X	YX	YX
X	YX	YX

2nd organism: (the rows)

	y	y
x	yx	yx
x	yx	yx

	YX	**YX**	**YX**	**YX**
yx	YyXx	YyXx	YyXx	YyXx
yx	YyXx	YyXx	YyXx	YyXx
yx	YyXx	YyXx	YyXx	YyXx
yx	YyXx	YyXx	YyXx	YyXx

- One genotype combination is possible
  - YyXx - 100%
- One phenotype combination is possible
  - YX - 100%

Mendel's Law of Independent Assortment

The law states that all genes are inherited independently of each other.
The inheritance of a certain gene does no effect other genes.

This means that if a certain offspring has a 50% change of having blue eyes when you know nothing about it, and now you know that his hair is black, the state of his hair being black does not affect his blue-eye-ness, therefore he will still have a 50% chance of getting blue eyes.

- It is redundant to go more than a dihybrid cross, as when you add more, all the genes will interact independently of each other.
- If this law was not true, it would mean that if you had black hair, you would not have a 50% chance of having blue eyes (more or less)

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Word	Meaning
Dominant gene	A gene that will show if it is present
Recessive gene	A gene that will only show if it is the only one present
Allele	"Versions" or "types" of a gene
Phenotype	The observed characteristics and traits of a gene
Genotype	The combinations of alleles that make up the gene
Homozygous	Having identical alleles make up the genotype
Heterozygous	Having different alleles make up the genotype