What is DNA?
- Cells use a chemical code called deoxyribonucleic acid or DNA
- DNA carries all of the cell’s instructions
- DNA is located in the nucleus
- During cell division it wraps around proteins to form chromosomes
- DNA is passed from parents to offspring

DNA’s Discovery
- In 1953, James Watson and Francis Crick discovered the structure of DNA
- The work of Rosalind Franklin lead to Watson and Crick’s discovery
  - Franklin said DNA is made up of two spirals

The Structure of DNA
- DNA is called a double helix because it looks like a twisted ladder
- The sides of the ladder are made of alternating sugar (deoxyribose) and phosphate molecules
- The steps of the ladder are made up of a pair of nitrogen bases
- There are 4 types of nitrogen bases
  - Adenine (A)
  - Thymine (T)
  - Guanine (G)
  - Cytosine (C)

DNA Pairing
- The nitrogen bases have a specific pairing pattern
  - Adenine (A) pairs with Thymine (T)
  - Guanine (G) pairs with Cytosine (C)
This pairing pattern occurs because the amount of adenine equals the amount of thymine; the amount of guanine equals the amount of cytosine. The pairs are held together by hydrogen bonds.

You Try….
- Write the matching nitrogen bases next to the strand of DNA
  C
  C
  G
  A
  T
  T
  A

Genes
- Every living thing carries a set of instructions that make it different from others.
- A chromosome is a structure found inside of the nucleus of the cell.
- Each chromosome contains DNA.
- A gene is a part of DNA that contains the instructions that control a trait.
- You have different genes for each of the different traits that you inherit.

Genes
- Each cell contains 46 chromosomes except for sex cells (eggs and sperm) which contain 23 chromosomes.
- Therefore, you receive half of your chromosomes from your mother (23) and half from your father (23) for a total of 46 chromosomes.
- Remember genes are located on your chromosomes.

Genetics
- In the 1800s, Gregor Mendel was interested in learning how characteristics are passed from parents to offspring.
- To study this he bred pea plants because they were easy to study.

Genetics
- The field of biology that investigates how characteristics are transmitted from parents to offspring is called genetics.
- Mendel’s work with pea plants formed the basis of genetics.
His results lead to heredity.

Heredity is the transmission of characteristics from parents to offspring.

**Pea Plant Characteristics**

- Mendel studied the seven characteristics of pea plants. Each characteristic occurred as one of two traits.

<table>
<thead>
<tr>
<th>Pea Plant Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Height</td>
<td>Tall stem or short stem</td>
</tr>
<tr>
<td>Pod Color</td>
<td>Green or Yellow</td>
</tr>
<tr>
<td>Pod Appearance</td>
<td>Inflated or Constricted</td>
</tr>
<tr>
<td>Seed texture</td>
<td>Smooth or Wrinkled</td>
</tr>
<tr>
<td>Seed color</td>
<td>Yellow or Green</td>
</tr>
<tr>
<td>Flower position on stem</td>
<td>Axial (along stem) or</td>
</tr>
<tr>
<td></td>
<td>Terminal (on top of</td>
</tr>
<tr>
<td></td>
<td>stem)</td>
</tr>
<tr>
<td>Flower color</td>
<td>Purple or White</td>
</tr>
</tbody>
</table>

**Mendel’s Work**

- Mendel collected seeds from pea plants and studied them.
- He then controlled how the plants reproduced.
- He eliminated any possibility that birds, insects, or wind would carry the pollen.
- He then bred plants that were pure for each trait.
- Pure plants only produced the same trait, for example, tall plants only produced tall plants

**Mendel’s Crosses**

- Mendel then crossed or bred pure pea plants by transferring pollen from one type of plant to another.
Mendel’s Observations
- All of the plants in the crosses listed are known as parental plants.
- Mendel labeled parental plants P₁ Generation.
- The offspring of the P₁ Generation are known as the F₁ Generation.
- Mendel noticed that all of the plants in the F₁ generation displayed only one of the traits from the P₁ generation.
- A trait is a characteristic, or feature of an organism.

Mendel’s Observations

\[
\text{Purple flower} \times \text{white flower} \\
\rightarrow \\
\text{F₁}
\]

Mendel’s Explanation
- Mendel concluded that one trait controls or dominates the other trait.
- For example, Mendel called purple flowers a dominant trait, the characteristic that prevails.
- Mendel called the trait that did not appear in F₁ the recessive trait, or the trait overridden by the dominant trait
  - Think of recessive traits as being hidden by the dominant trait
- In the flower example the white flower would be recessive.
Dominant vs Recessive

- If one parent has genetic material for a dominant trait and the other parent has material for a recessive trait, the offspring will be dominant.
- An offspring can only be recessive if each parent gives a recessive trait.
- Dominant traits are shown with a capital letter.
- Recessive traits are shown with a lower case letter.

Dominant or Recessive

- Which trait will the offspring have? Dominant or Recessive?
  - T = _______________
  - t = _______________
  - TT = _______________
  - Tt = _______________
  - tt = _______________

Punnett Square

- A Punnett Square is a diagram used to find the possible traits of offspring.
- Example: Presence of freckles
  - F = freckles
  - f = no freckles

- How many children will have freckles? ___________
- How many will not have freckles? ___________

Practice…

- T = tall
- t = short
How many offspring will be tall? _____
How many offspring will be short? ____

Practice...
A purple flower (PP) is crossed with a white flower (pp), what will be offspring be?

<table>
<thead>
<tr>
<th>Tt</th>
<th>Tt</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>t</td>
</tr>
<tr>
<td>t</td>
<td>t</td>
</tr>
</tbody>
</table>

Pedigree Chart
- A pedigree chart is a diagram that shows which family members have a certain trait.
- It is like a family tree that shows different generations.

Pedigree Chart
- Each row in the chart shows a different generation of family members.
- Squares = males
- Circles = females
- A circle and square connected by a straight line show parents
- A vertical line and bracket connects parents and children.
- Shaded circle or square means person has trait
Pedigree

- How many males have trait? _______
- How many females have trait? _______
- How many men are there? ___
- How many women are there? ___