THE WORK OF GREGOR MENDEL

- Genetics- ______________________________.
- ______________________________- Austrian monk- the father of genetics- carried out his work on ____________________.
  - Pea flowers are naturally ____________________, which means that sperm cells fertilize the egg cells in the same flower, thus the new flower inherits all of their characteristics from the single plant that bore them.
- ______________________________- organisms that produce offspring identical to themselves if allowed to self-pollinate.
  - ie: one stock of seeds would produce only tall plants, another only short plants. One stock would produce yellow seeds, another only green seeds.
- ______________________________- produced seeds that had two different plants as parents.

GENES AND DOMINANCE

- __________- a specific characteristic that varies from one individual to another.
- Each original pair of plants is called the P (________________) generation.
- The ____________________ are called the F₁ (first filial) generation.
- _______________- the offspring of crosses with different traits.
• _____________ - chemical factors that determine an organism’s traits. Genes are passed from parents to their offspring (one gene from each parent).
• _____________ - different forms of a gene.
  – ie: forms that produce tall vs. short plants or round vs. wrinkled seeds.
• **Principle of Dominance** - _______________________________________________________________________
  _______________________________________________________________________
  – An organism with a _____________ allele for a specific form of a trait will always exhibit that form of the trait.
  – An organism with a _____________ allele for a specific form of a trait will exhibit that form only when the dominant allele for the trait is not present.

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<thead>
<tr>
<th>Seed Shape</th>
<th>Seed Color</th>
<th>Seed Coat Color</th>
<th>Pod Shape</th>
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<tr>
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<td>Wrinkled</td>
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<tr>
<td>F₁</td>
<td>Round</td>
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**SEGREGATION**

• The reappearance of the recessive trait indicated that at some point the paired alleles are separated or go through _____________ during the formation of gametes.
• **Gametes** - ____________________________________________________________________________
  ____________________________________________________________________________
GENETICS AND PROBABILITY

• Probability

  – Remember, past outcomes do not affect future outcomes.
  – The principles of probability can be used to predict the outcomes of genetic crosses.

• Punnett Square

• organisms that have two identical alleles for a particular trait (__________).
  – Homozygous organisms are __________________ for a particular trait.
• organisms that have two different alleles for the same trait. (____)

• Phenotype

• Genotype

  – Homozygous dominant, heterozygous, homozygous recessive

• Probabilities predict ________________. Thus, the larger the number of offspring, the closer the resulting numbers will be the expected values.

TWO FACTOR CROSS
INDEPENDENT ASSORTMENT

- genes for different traits segregate independently, such that the genes for one trait do not influence another trait.

PATTERNS OF INHERITANCE

- Some alleles are neither dominant nor recessive, and many traits are controlled by __________________________ or __________________________.

- __________________________- one allele is not completely dominant over another.
  - In incomplete dominance, the __________________________ phenotype is somewhere in between the two homozygous phenotypes.

- __________________________- both alleles contribute to the phenotype.
  - Ex: __________________________

- __________________________- genes having more than two alleles.
  - This does not mean that an individual can have more than two alleles, it means that more than two possible alleles exist in a population for a given trait.
  - Ex: human blood type

- __________________________- controlled by two or more genes.
  - Ex: skin color of humans- controlled by more than four different genes.
APPLYING MENDEL’S PRINCIPLES

• Mendel’s principles don’t apply only to plants.

• In the early 1900s, _____________________________ found a model organism to advance the study of genetics, the common _____________________________.

• Fruit flies were an ideal organism for several reasons:
  – They could produce plenty of offspring, and they did so quickly
  – Morgan and other biologists learned that Mendel’s principles applied not to just pea plants, but other organisms and humans too.

GENETICS AND THE ENVIRONMENT

• The characteristics of any organism are not determined solely by the genes it inherits, but by the interaction between genes and the _____________________________.
  – Ex: genes may affect a flower’s height and the color of its flowers, but these same characteristics are also influenced by climate, soil conditions, and availability of water.

CHROMOSOME NUMBER

• The Chromosomal Theory of Inheritance - ____________________________

• ____________________________ - chromosomes form in pairs, one from the male parent and one from the female parent.

• ____________________________ - a cell that contains both sets of homologous chromosomes. (2N) Example: ____________________________
  – Diploid cells contain two complete sets of chromosomes and two complete sets of genes.

• ____________________________ - a cell only containing one set of chromosomes. (N) Example: ____________________________
MEIOSIS

• **Meiosis**- a process of _______________ division in which the number of chromosomes is cut in half through separation of homologous chromosomes in a diploid cell.
  
  o Meiosis takes place in two distinct divisions: __________ and __________

• _________________ - cells undergo DNA replication, forming duplicate chromosomes. Nucleus breaks down.

• **Meiosis I**
  
  – __________ - each chromosome pairs with its corresponding homologous chromosome to form a tetrad. Crossing over occurs in prophase I.
  
  – ____________ - chromosomes line up in the middle of the cell and attach to spindle fibers.
  
  – ____________ - spindle fibers pull chromosomes toward opposite ends of the cell.
  
  – _________________ - nuclear membrane reforms and the cell divides into two cells.
  
  – _________________ - in prophase I, homologous chromosomes exchange portions of their chromatids.
    
    o This produces new combinations of alleles and allows for more genetic variation.

• **Meiosis II**
  
  – _________________ - meiosis I resulted in two haploid daughter cells with half the number of chromosomes as the original cell.
  
  – _________________ - the chromosomes line up in the middle of the cell.
  
  – _________________ - sister chromatids are separated and move toward opposite ends of the cell.
  
  – _________________ - nuclear membranes form and meiosis II results in four haploid daughter cells.

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GAMETE FORMATION

- In male animals, meiosis results in __________ equal-sized gametes called sperm.
- In many female animals, only _________ egg results from meiosis. The other three cells, called __________________________, are usually not involved in reproduction.
PARING MITOSIS AND MEIOSIS

• Mitosis results in the production of ___________________________ cells, whereas meiosis produces ___________________________ cells.

GENE MAPS

• ___________________________ studied gene linkage on ___________________________.

  His conclusions:
  – Each chromosome is actually a group of linked genes.
  – Mendel’s principle of independent assortment still holds true.

• It is the ___________________________ that assort independently, not the individual genes.

• Crossing-over during meiosis sometimes separates genes that had been on the same chromosomes onto homologous chromosomes.
  – Crossover events occasionally separate and exchange linked genes and produce new combinations of alleles, which helps generate ___________________________.

• Alfred Sturtevant (student to Morgan)
  – Reasoned that the ___________________________ apart two genes are, the more likely they are to be separated by a crossover event.
  – This allowed him to use recombination frequencies to determine the distances between genes.

• ___________________________ - shows the relative location of genes on a chromosome.
  – If two genes are ____________ together, the recombination frequency between them should be ____________, since crossovers are ____________.
  – If they are ________ apart, recombination rates between them should be ____________.
HUMAN CHROMOSOMES

- ____________________________ - a picture of chromosomes grouped together in pairs.
  - Humans have __________ chromosomes. Two of them are sex chromosomes, because they determine an individual's sex. The remaining 44 chromosomes are called ____________________________.
  - Females are __________ and males are __________.

HUMAN TRAITS

- ____________________________ - shows the relationships within a family.
  - The phenotype of organisms are only partly governed by the genotype. Many traits are strongly influenced by the ____________________________, nutrition, and exercise.
    - Environmental effects are not inherited though, only genes are inherited.

HUMAN GENES

- The Human Genome- ____________________________________________

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**HUMAN BLOOD GROUPS**

- The Rh blood group is determined by a single gene with two alleles- positive and negative.
  - The positive Rh+ allele is ________________.
- The ABO blood group has three alleles ______, ______, and _____.
  - Alleles I^A and I^B are _______________________. These alleles produce molecules known as antigens on the surface of red blood cells.
  - The i allele is ________________________ and produces no antigen.

**BLOOD GROUP CHART**

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FROM GENE TO MOLECULE

- In some diseases, such as cystic fibrosis, and sickle cell disease, a small change in the DNA of a single gene affects the structure of a protein, causing a serious genetic disorder.

HUMAN GENES AND CHROMOSOMES

- **Sex-Linked Genes**

  - Males have just one X chromosome, thus all X-linked alleles are expressed in males, even if they are recessive.

  ![Diagram of X and Y chromosomes with alleles and phenotypes]

SAMPLE SEX-LINKED PROBLEMS

1. Hemophilia is a rare recessive hereditary disease of the blood. The blood of individuals with this condition does not clot properly. Without the capacity for blood clotting, even a small cut can be lethal.

   a. A woman who is homozygous dominant for normal blood, marries a man with normal blood. Show the punnett square and possible phenotypic outcomes of their offspring.

   b. A woman who is heterozygous for normal blood marries a man who has hemophilia. Show the punnett square and possible phenotypic outcomes of their offspring.
HUMAN GENES AND CHROMOSOMES

• __________________________- an inactive form of an X chromosome in females.
• __________________________- when homologous chromosomes fail to separate in meiosis.
  – Nondisjunction can lead to an abnormal number of chromosomes.