SCIENCE 8 **NAME_____**

CHAPTER 12: GENETICS: THE SCIENCE OF HEREDITY

NOTES

I. What is Heredity?

A. Gregor Mendel – an Austrian monk, in mid-1800s, studied the heredity of pea plants. He is considered the Father of Genetics

1. Studies seven traits of pea plants – seed shape, seed color, pod shape, pod color, flower color, flower position and stem heights
2. He noticed some plants were like their parents, but others were different
3. He wondered why and how could this happen?

B. Mendel's experiments – foundation of genetics, the study of heredity

1. Pea plant fertilization – pollen/sperm enters the egg by pollination
   a. Stamen produce pollen/sperm
   b. Pistil contains the egg
2. Pea plants can self-pollinate by the pollen of the same plant fertilizing the egg of the same plant
3. Mendel cut the stamens off of the flowers of plants so they couldn't self-pollinate
4. Cross-pollination – he used a paint brush to transfer pollen from one plant to another
5. Purebred – plants with the same trait even after many generations of crosses
6. Mendel crossed a pure tall plant with a pure short plant as the P1 generation
   a. F1 – filial1 generation had 100% tall plants. He crossed two of these plants to get..
   b. F2 – filial 1 generation … 75% were tall and 25% were short
   c. Somehow the short plant trait reappeared in the F2 generation

C. How do alleles affect inheritance?

1. Mendel explained his data saying that the factors affecting a trait must come in pairs and offspring inherit one factor from their mom and one from their dad
   a. Today – factors are called "genes."
   b. Alleles are the different forms of the genes, such as tall vs. short
   c. Some alleles are dominant and always show their phenotype/trait …tall plant
      I. Capitalize the dominant trait – T
   d. Some alleles are recessive and are hidden by the dominant trait, however, if the plant has both recessive alleles, it will have the recessive trait … short plant
      I. Lowercase for the recessive trait – t
2. Mendel crossed a pure TT plant with a pure tt plant … resulting in a hybrid tall plant of Tt
3. When he crossed the hybrid Tt with a Tt, he obtained 25% TT, 50% Tt and 25% tt.
4. Mendel showed that inheritance of genes usually are not a blend of the two alleles

II. Probability and Heredity

A. Probability – a number that describes how likely it is that an event will occur

1. Flip a coin – probability to get a heads is ½ or 50%
2. Predicts what is likely to occur, not what will occur
3. Mendel noticed that the probability of getting a tall plant after crossing a Tt x Tt is 75% and to get a small plant is 25%

B. Punnett square – a chart/box that shows all the possible ways alleles can combine in a genetic cross

1. Used to predict the outcomes of a genetic cross
2. Male alleles are written across the top and female alleles are up & down on the side

C. What phenotypes and genotypes?
    1. Phenotypes – physical, or visible, traits
    2. Genotype – the genetic makeup or alleles, such as TT, Tt or tt.
    3. Homozygous – pure, both alleles are the same … TT or tt
    4. Heterozygous – hybrid, both alleles are different … Tt

III. Patterns of Inheritance

A. How are traits inherited? Not all traits are like tall or short, but contain a variety
    1. Incomplete dominance – one allele is only <u>partially</u> dominant
        a. Snapdragons – RR (red) x WW (white) = RW (pink)
    2. Codominance – both alleles for a gene are expressed equally
        a. Chickens – F^W (white feathers) x F^B (black feathers) = F^W F^B (both black and white feathers)
    3. Multiple alleles – three of more possible alleles determine the trait, however, only two of the alleles can be inherited from the parents
        a. Rabbit's fur color – four possible alleles produce rabbits with fur ranging from brownish gray to all white
    4. Polygenic Inheritance – more than one gene affects a trait
        a. Human's height – we get a large range of heights
        b. Hair color, eye color, skin color
        c. Sunflowers – time it takes to flower ranges from 45 to 75 days

B. How do Genes and Environment Interact?
    1. Inherited trait – controlled by genes, such as ability to speak using vocal cords
    2. Acquired trait – learned traits – able to speak Spanish, English, French, German
        a. Haircut, making free throws
    3. Environmental factors can influence the way genes are expressed
        a. Sunflowers' genes can control flowering time, but it is influenced by sunlight, temperature, soil nutrients and water
        b. Smoking can affect cells to become cancerous
        c. Only changes in sex cells can be passed to offspring
        d. Changes to body cells (non-sex cells) can't be passed to offspring

IV. Chromosomes and Inheritance

A. How are Chromosomes, Genes and Inheritance Related?
    1. 1900s, Walter Sutton studies grasshoppers sex cells
    2. Chromosomes are involved in how traits are passed from parents to offspring
    3. Many organisms have different numbers of chromosomes
        a. Grasshoppers – 24, Human – 46, corn – 20, shrimp – 90
        b. Noticed sex cells of grasshoppers had 12 chromosomes and the fertilized egg had 24, one set of 12 from the father and one set of 12 from the mother
        c. Chromosome Theory of Inheritance – genes pass from parents to their offspring on chromosomes
    4. Lineup of Genes
        a. Humans – 23 pairs of chromosomes containing 20,000 to 25,000 genes
        b. Genes – segments of DNA in chromosomes that control our traits
        c. Genes are lined up in the same order on like chromosomes

B. What Happens During Meiosis?
    1. Chromosome pairs separate into two different cells
    2. The sex cells that form later have only half as many chromosomes as the other cells in the organism

3. DNA duplicates, one cell divides into two cells, and then the two cells divide into four genetically different cells containing ½ the number of chromosomes. These four cells become the sex cells
4. Each sex cell has only one chromosome from an original pair

C. How Do Sexual and Asexual Reproduction Compare?

1. Sexual reproduction – requires meiosis and combining of two genetically different sex cells
   a. Slow reproduction but allows for most genetic diversity
   b. Animals and flowering plants
2. Asexual reproduction – requires mitosis where one cell divides into two genetically identical cells
   a. Reproduce rapidly but have little diversity
   b. Bacteria by fission, hydra by budding, and sponges by regeneration

V. Advances in Genetics

A. How Can Organisms Be Produced With Desired Traits?

1. Selective breeding – process of selecting organisms with desired traits to be parents of the next generation
   a. Inbreeding – breed two organisms with similar characteristics
      I. Golden retriever with a golden retriever are both friendly and good coloring – goal … produce a friendly golden retriever
      II. Recessive traits may appear – hip problems
   b. Hybridization – breeders cross two genetically different individuals
      I. Cross corn with lots of kernels with corn that is resistant to disease hoping to get a hybrid of both traits
2. Cloning – an organism that has exactly the same genes as the organism from which it was produced
   a. African violets – cut the stem and plant an identical plant or clone
   b. Animals are cloned
3. Genetic Engineering – genes from one organism are transferred into the DNA of another organism
   a. Improve crops – insect resistant and longer life tomatoes or corn
   b. Medicines – such as Lilly's human insulin
      I. Human insulin gene cloned into a bacterial plasmid
      II. Large vats of bacteria are grown to produced lots of insulin
      III. Insulin is purified away from the bacteria and put in liquid for injections
4. Gene Therapy – inserts genes into cells to produce a desirable affect
   a. Tomatoes that resist cold and poor soil
   b. Blood-clotting genes for people with hemophilia
   c. Concerns of long-range effects