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# Heredity and Prenatal Development:
Chapter 3

## PRINCIPLES OF HEREDITARY TRANSMISSION

- **Genotype**

- **Phenotype**

- **Chromosomes**: in the nucleus of the cell store and transmit genetic information.

- **DNA** (**deoxyribonucleic acid**) molecules make up chromosomes.

- **Gene** is a segment of a DNA molecule which contains instructions for making proteins.
  - Humans have approximately **30,000 genes** (Human Genome Project, 2001).

- **Cell Division**

  - **Mitosis**:

    - somatic (body) cells

  - **Meiosis**:

    - **Steps of Meiosis**: It halves the number of chromosomes so each gamete contains 23.
      - Why is this step necessary?

    - **Crossing over:** key part of first stage of meiosis
      - Why is this step necessary?

## Boy or Girl?

- **Fertilization**: When sperm and ovum unite at conception, the resulting **zygote** has

- The 22 pairs of matching chromosomes within a human cell.
- The twenty-third pair consists of **sex chromosomes**.

## PATTERNS OF GENETIC INHERITANCE

- Allele

- Homozygous

- Heterozygous

### Possible Outcomes If Person Is Heterozygous For A Trait

- **dominant allele** & **recessive allele**.

    - What are the possible genotypes for the following phenotypes?

        - Blood type Phenotypes: A, B, O.

- **intermediate (blended)**

- **codominance**

- **modifier genes**

## Possible Outcomes If Person Is Heterozygous For A Trait

- Complex traits follow **polygenic inheritance**

## Gene Disorders Sickle Cell Anemia

- West Africa & Mediterranean descent
  - **1 in 600** African Am. are **homozygous** and **1 in 10 are heterozygous.**
- Allele located on chromosome 11.
- Carriers of the trait are ….
  - Evolution
  - How environment & genes can interact

## Other Gene Disorders

- **Phenylketonuria – PKU**
  - environmental modifiable genetic disorder
  - mutation of gene on chromosome 12 (recessive)
  - Liver unable to produce an enzyme to break down phenylalanine.
  - Pregnant women with PKU should again reduce intake of phenylalanine ...
- **Most sex or X–linked disorders** occur when a recessive allele is carried on the X chromosome.
- Males are more likely to be affected – Why?
- **Sperm** carry twice as many mutations as eggs, suggesting that:

- **Red-green color blindness**
  - for son to be color-blind, what must mother be?
  - for daughter to be color blind what must parents be?

- **Hemophilia**

## Chromosomal Abnormalities

- Chromosomal defects occur during the process of **meiosis or mitosis** – uneven segregation.
- Because these abnormalities involve more DNA than single-gene disorders, they often produce disorders with many mental and physical symptoms.

## Sex Chromosome Abnormalities

- **Meiosis** of female cell should result in cells with single X chromosome, but could be XX or no X's.
- Turner Syndrome: If no X and fertilized by X sperm then XO.
- Super female: If XX and fertilized by X sperm then XXX.
- Klinefelter Syndrome: If XX and fertilized by Y sperm then XXY.

## Chromosomal Abnormalities: Down Syndrome

- **Down syndrome or trisomy 21**

## GENES AREN'T NECESSARILY = TO OUTCOMES (G vs. P)

- **What reason can we give for are inability to predict completely from genotype phenotype?**
  - genotype is only a **blueprint/recipe for development**
  - genotype only establishes a _____
  - A _____ is a person's unique, genetically determined response to a range of environmental conditions. This accounts for how children respond in different ways to the same environment.
  - **Canalization of trait**: is the tendency of heredity to restrict development to one or a few potential outcomes. Highly canalized traits require extreme environmental conditions to deter their genetically set outcomes.

## RESEARCH ON GENE - ENVIRONMENT INTERACTION

- **Genetic-Environmental Correlation**
  - The concept of **genetic-environmental correlation** states that our genes influence the environments to which we are exposed.
  - **Passive and Evocative Correlation**
    - In a **passive** correlation, a child has no control over the environment available to him or her. Parents create an environment compatible with their own heredity.
    - In an **evocative** correlation, a child behaves in ways consistent with his or her own heredity. The responses evoked from others will, in turn, strengthen the child's original response.
  - **Active Correlation**
    - An **active** correlation is more common at older ages. As children extend their experiences beyond the immediate family, they choose environments that complement their genetic tendencies.
    - This tendency to actively choose environments that complement our heredity is called **niche-picking**.
    - With age, genetic factors may become more important in determining the environments we experience and choose for ourselves.

## RESEARCH ON GENE - ENVIRONMENT INTERACTION

- **Environmental Influences on Gene Expression**
  - The relationship between heredity and environment is not a one-way street, from genes to environment to behavior.
  - Rather, it is **bidirectional**; genes affect children's behavior and experiences, but their experiences and behavior also affect gene expression.
  - Stimulation of both internal and external environments (to the child) triggers gene activity.