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CONCEPT: HISTORY OF GENETICS

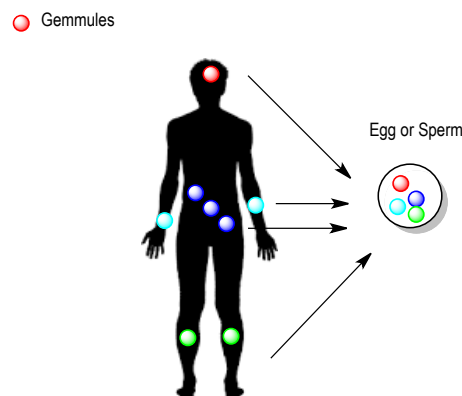
- The earliest use of genetics was through _____ of plants and animals (8000-1000 B.C.)
 - **Selective breeding (artificial selection)** is the process of breeding organisms for certain phenotypic traits
 - No one knew the principles of what controlled this breeding and had no way to predict what would happen
 - "Like begets like"

EXAMPLE: Carrots having undergone artificial selection



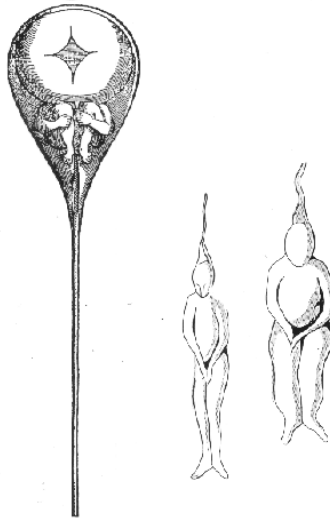
- Aristotle and the Hippocratic School of Medicine suggested that *humors* in the male body had traits (300s B.C.)
 - **Pangenesis:** stated that *gemmae* particles were carried from different body parts to reproductive organs
 - These gemmules were passed onto the _____
 - Allowed for inheritance of acquired characteristics (ex. Musical ability)

EXAMPLE: Diagram of Pangenesis



- Two theories of inheritance between 1650 and 1850 A.D.
 - **Epigenesis**: stated that the organism was derived from substances found in the sex cells
 - **Preformation**: stated that the sex cells contained a **homunculus** (miniature adult) that grew

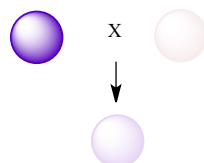
EXAMPLE: A Homunculus



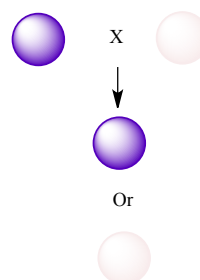
- Gregor Mendel, an Austrian monk, began studying _____ plants in the 1800s.
 - **Blending theory of inheritance**: stated that children were a blend of parental traits (like blending paints)
 - This theory was believed at the time of Mendel's studies
 - Mendel disproved this by mating purple flowers and white flowers – they didn't yield a mixed color
 - Mendel proposed that *particles* (not fluids) controlled heredity (the particles are now known as genes)
 - He also proposed that each pea plant has two copies of each particle controlling one trait (color)
 - He also proposed that one would be more dominant than the other – which chooses the trait

EXAMPLE:

Blending Theory of Inheritance



What Mendel Saw



- Mendel, was largely forgotten until the 1900s
 - Published his work in 1866 in the Proceeding of the Natural History of Society of Brunn
 - William Bateson rediscovered Mendel's work in the 1900s – and termed Genetics
 - Thomas H. Morgan demonstrated Mendel's genes were on chromosomes (1910)
 - *Chromosomal Theory of Inheritance*

PRACTICE:

1. Match the following inheritance theory with the appropriate definition.

- I. Pangenesis _____
- II. Epigenesis _____
- III. Preformation _____
- IV. Blending Theory of Inheritance _____

- A. Children were derived from substances found in the sex cells
- B. Children are a blend of parental traits
- C. Sew cells contain a miniature adult, which will keep growing until adulthood
- D. Gemmule particles were carried from different body parts to reproductive organs

2. Which of the following terms describes the process of breeding organisms for certain phenotypes?
- Natural Selection
 - Artificial Selection
 - Pangeneses
 - Epigenesis




3. Mendel proposed that _____ controlled inheritance?
- Fluids
 - Nomunculus
 - Gemmules
 - Particles

CONCEPT: MODERN GENETICS

- Today, genetics is used to study mutation and disease to improve _____ and _____
 - **Single nucleotide polymorphisms (SNPs)** are small variations (one nucleotide) in an individual's genome
 - In an Icelandic study of 78 children there were 4933 new SNPs
 - Mostly, these small variations come from the father (why? Sperm is made continuously – eggs aren't)
 - Lactose tolerance is a common example of a _____ in action
 - Adults with two SNPs in a *lactase* regulatory region, can digest lactose – those without it are intolerant

EXAMPLE:

Individual

1. 
ACTGATGGGATCCTAGGTACGATTAGCC
2. 
ACTGATG**C**GATCCTAGGTACGATTAGCC
3. 
ACTGATGGGATCCT**T**GGTACGATTAGCC

- Technology has advanced and made studying and altering these differences much easier
 - **Biotechnology** – manipulating biology for industrial purposes (ex: Golden rice and Vitamin A)
 - **Gene therapy** – Clinical transfer of normal genes into individuals with mutated genes
 - **Proteomics** – Study of a set of proteins in a cell under certain conditions
 - **Bioinformatics** – Use of software that helps analyze and store the large breadth of data
 - **Model organisms** – are organisms used to study the basics of genetics

PRACTICE:

1. Proteomics is the study of what?
 - a. DNA
 - b. RNA
 - c. Transcripts
 - d. Proteins

2. True or False: Single nucleotide polymorphisms are common in the human population.
 - a. True
 - b. False

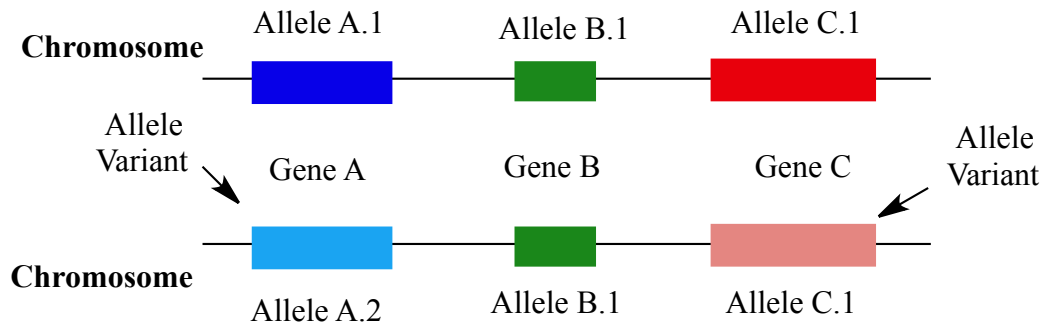
3. Bioinformatics is especially useful at what?
 - a. Transferring normal genes into individuals with diseases
 - b. Using software to analyze large data sets
 - c. Using biology for industrial purposes

CONCEPT: FUNDAMENTALS OF GENETICS

Genetics Basics

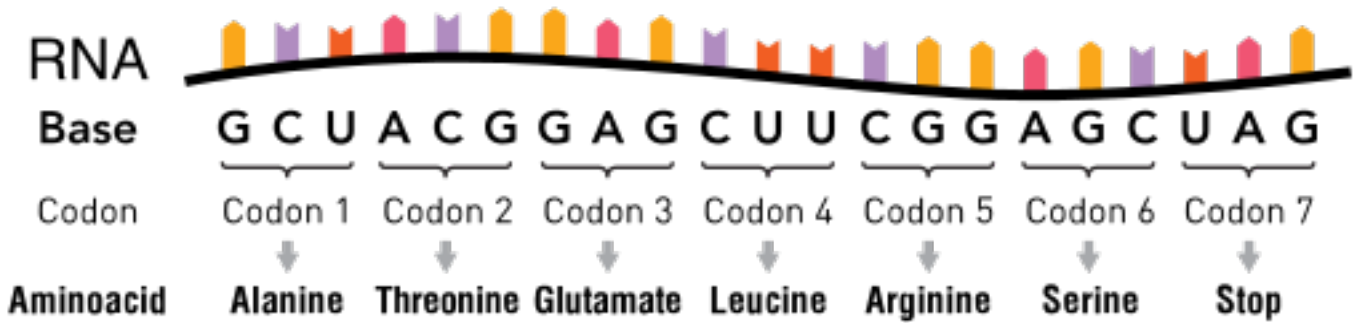
- DNA is the fundamental _____ of genetics
 - DNA is made up of four bases (nucleotides): **Adenine (A), Thymine (T), Guanine (G), Cytosine (C)**
 - *Chargoff's Rules* state that A & T (2 H⁺ bonds) pair together and G & C (3 H⁺ Bonds) pair together
 - The two strands of DNA are *complementary*, and form a double helix
 - DNA contains **genes**, which are stretches of DNA that carry the information for a protein
 - Genes have **regulatory elements** that control whether or not the gene is expressed
 - Genes come in different _____
 - An **allele** is a gene variant
 - In diploid cells there are two alleles per gene

EXAMPLE: Alleles vs. Genes



- To go from DNA to Protein there are two main steps
 - **Transcription** is the process of turning DNA into messenger RNA (mRNA)
 - It can also create transfer RNA (tRNA) and ribosomal RNA (rRNA)
 - **Translation** is the process of turning mRNA into proteins
- DNA does not encode a _____ in a 1:1 ratio
 - A **codon** made up of three nucleotides encoded for one amino acid, which is used to build proteins

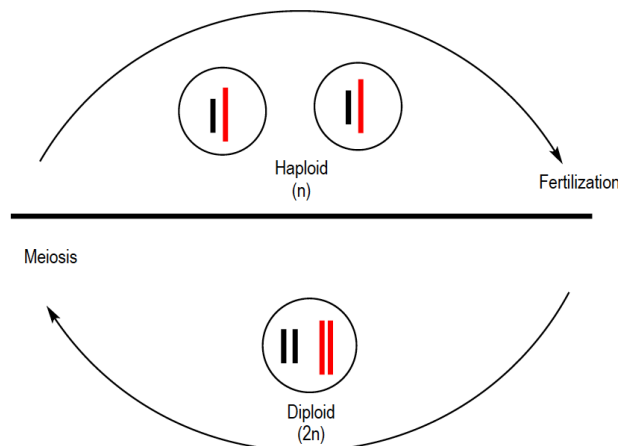
EXAMPLE: Codon Code



Chromosomal Fundamentals

- Chromosomes contain many _____
 - **Homologous chromosomes** are chromosomes that exist in pairs
 - **Diploid (2n)** organisms have homologous chromosomes (a chromosome pair)
 - **Haploid (n)** organisms have only one chromosome copy
 - **Chromosomal theory of inheritance** describes that inherited traits come from genes on chromosomes
 - Passed through **gametes** (sex cells)
- **Meiosis** is the process of creating _____
 - In Diploid individuals it takes a (2n) cell and produces 4 (n) cells
- **Mitosis** is the process of creating somatic cells (all cells but gametes)
 - Turns (2n) cells into two (2n) cells



EXAMPLE: Meiosis and Chromosomes



Descriptive Genetics

- The genetics of an individual can be described in two many ways
 - The **genotype** is the set of alleles for a given trait by an organism
 - The **phenotype** is the observable features
- Genes can present themselves as many different types of _____
 - *Morphological Traits* – affect the appearance of the organisms
 - *Physiological Traits* – affect the ability of an organism to function properly
 - *Behavioral Traits* – affect the way an organism responds to its environment

EXAMPLE:

Phenotype	Genotype
 Yellow	Aa
 Green	aa

A = dominant allele
a = recessive allele

- There are three divisions of **Genetics**, which is the study of individual heredity and variation
 - **Transmission genetics:** Studies the ability to pass traits onto the next generation
 - **Molecular genetics:** Studies the gene activity at a molecular level (DNA replication, transcription, etc..)
 - **Population genetics:** Studies genes in terms of an entire population

PRACTICE:

1. True or False: In a diploid cell, the number of alleles is the same as the number of genes.

2. What is an allele?
- a. A nucleotide variant
 - b. Different variants of a gene
 - c. Proteins
 - d. Codon

3. The chromosomal theory of inheritance states that....
- a. Traits come from the mixing of fluids from two parents
 - b. Traits come from only chromosomes found in the egg cell
 - c. Traits come from genes on chromosomes
 - d. Traits comes from complementary DNA strands

4. Which one of the following is NOT a division of Genetics?
- a. Transmission genetics
 - b. Molecular genetics
 - c. Breeding genetics
 - d. Population genetics