PEER Life Science Cells Are Us Gateway to the Cell Notes Outline Key

**Why It Matters**

* Gregor Mendel is considered the father of genetics.
* The physical origin of traits is genes made up of DNA found on chromosomes in the nucleus.
* Name three fields use DNA in important ways
  + Criminal justice
  + Medicine
  + Agriculture

**How We Know**

* Mendel used pea plants to discover the process of heredity or the passing of traits from parents to offspring.
* When Mendel bred a true breeding green pea plant and a true breeding yellow pea plant, all of the offspring were green/yellow. This color covered the other, making it dominant. The yellow is therefore recessive, meaning that it does not show up unless it is the only trait present.
* Fill in a Punnett square for a cross between two Gg pea plants.

|  |  |  |
| --- | --- | --- |
|  | G | g |
| G |  |  |
| g |  |  |

* + What fraction of the offspring would have green pods?
    - 3/4
* The two alternative forms of the pea pod color gene are found at the same place on a chromosome and are called alleles.
* Mendel came up with three laws of heredity. They are:
  + 1. The Law of Segregation: While each trait is defined by a pair of alleles for the same gene, parental alleles are randomly separated to sex cells so these cells only contain one version of the gene. Consequently, offspring only receive one allele from each parent.
  + 2. The Law of Independent Assortment: Genes for different traits are sorted separately from one another so that the inheritance of one trait is not dependent on the inheritance of another.
  + 3. The Law of Dominance: An organism with alternate forms of a gene will express the form that is dominant.
* Genes are generally defined as a piece of DNA in chromosomes that control a bodily trait.
* There are four DNA bases that pair together to create a DNA sequence: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). Each base only pairs with one other base in DNA. Adenine only pairs with thymine and cytosine only pairs with guanine.
  + Fill in the blanks with the appropriate base pair.
    - A - T
    - G - C
    - C - G
    - T - A
* Watson and Crick are credited with discovering the structure of DNA. The most useful x-ray crystallography was taken by Rosalind Franklin and Raymond Gosling. Through their research, they found that DNA has a double helix structure. This structure looks kind of like a spiral staircase where each step is a base pair (A, T, C, G) and the edges/railings are the sugar phosphate backbone.
* The first gene maps were done in fruit flies because they have a small genome (complete set of genes in an organism)
* DNA sequencing has shown that humans have only about 25,000 genes which is only about 1% of the total genome (the rest are involved in regulating protein production). This is only about twice as many genes as fruit flies have, and some mice and rice have more/fewer genes than humans. This could be due to:
  + Humans making more complex proteins
  + Humans having more regulatory genes that turn other genes on or off
  + Humans might use many genes to make one protein and therefore different combinations can make different proteins
* The main difference between us and other primates is less so what genes we do or don’t share as much as what genes are expressed.

**What We Know**

* Genes are found in chromosomes inside of the cell nucleus which is considered the “brain” of the cell.
* Humans have 23 pairs of chromosomes or 46 in total. Our reproductive cells only have 23 because they combine together at fertilization to make 46. As a result, half of your chromosomes come from your father through the sperm and half come from your mother through the egg.
* In humans, the last pair of chromosomes is different/the same in males and females. If the individual has X and X chromosomes, they are genetically female; while if they have an X and Y chromosome, they are genetically male.
* Different species have different numbers of chromosomes, and this number does not correlate with the complexity of the species.
* DNA stands for deoxyribonucleic acid.
* When a cell divides and DNA duplicates, the base pairs pull apart like a zipper unzipping. Each half of the unzipped chain is used as a template to form two new copies for the two new daughter cells.
* In order for DNA to make proteins, it must first be transcribed into messenger RNA (mRNA). During this process, DNA partially unzips like it did during replication, and RNA base pairs form a complement to the DNA gene. mRNA is similar to DNA except a base called uracil is substituted for thymine and pairs with adenine.
* After DNA is transcribed, the mRNA must be translated to code for amino acids.
  + There are 20 known amino acids used in the body. In order for the four nucleotide bases to code for all of these amino acids, it takes three bases to code for a single amino acid.
  + The string of mRNA that was formed by complementing the DNA segment, is then paired with a complementary transfer RNA or tRNA. The tRNA has three RNA bases and an amino acid. The tRNA matches with the mRNA three bases at a time and creates a string of amino acids in the order determined by the mRNA.
  + Translation occurs in an organelle called the ribosome. Sometimes ribosomes are found on the membranes of an organelle called the rough endoplasmic reticulum or RER.
  + After a protein has been made in the RER, it is usually moved into another membranous organelle called the golgi body which modifies proteins by adding sugar residues. This helps to give proteins their unique functions.

**Common Hazards**

* Aflatoxins are a family of toxins produced by certain types of fungi that are found in crops like corn, peanuts, cottonseed, and nuts.
* Aflatoxin can contaminate crops in the field, at harvest, and during storage.
* Exposure to aflatoxin can cause liver cancer because it causes chemical bonds to form on pieces of DNA that can trigger cancerous DNA replication and cell division.
* People are exposed to aflatoxins from the foods they eat. They are difficult/easy to detect because we cannot taste them or sometimes even see them.
* The young of all species of animals are most affected by aflatoxins and can experience digestive distress, anemia, jaundice, reduced appetite, and decreased growth.
* Exposure to aflatoxins can be avoided by:
  + Throwing away all food contaminated with mold
  + Storing food in a cool, dry place.
  + Buying only major brands of nuts and peanut butters
  + Discarding any nuts that look moldy, discolored, or shriveled.