MODERN GENETICS

The Genetic Code

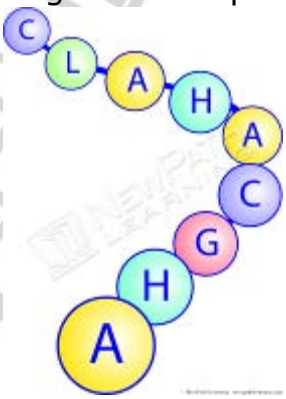
Through the years of research with DNA it has been discovered that the main function of a gene is to regulate the production of proteins within cells.

What Do Proteins Do?

Proteins establish the phenotype, physical characteristics, and many other traits of a particular organism. Recall from Topic 5 that DNA is made up of 4 different nitrogen bases, Adenine (A), Thymine (T), Guanine (G), and Cytosine (C).

One gene (nitrogen bases to w gen bases are arrang .

The specific genetic code determines the type of protein that will be produced within a cell. The genetic code is based on the number three, meaning that there are a total of three bases that code for the specific type of amino acid that needs to be produced. As we learned in Topic 4, amino acids are the building blocks of protein molecules.



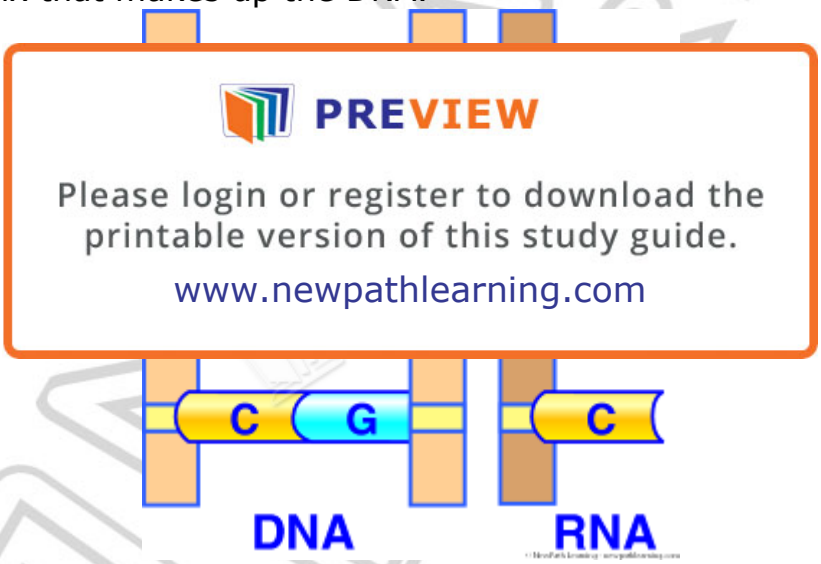
It is the order of the genetic code that produces specific amino acids that make up a protein.

How Cells Make Proteins

Amino acids are determined by the three nitrogen base genetic code and proteins are determined by the order of amino acid. This process is known as **protein synthesis**.

Throughout protein synthesis, the cell reads the information that is located on the DNA and produces a very specific protein. This process takes place in the cell ribosomes that are located in the cytoplasm. As we learned in Topic 3, the chromosomes are located in the nucleus and the ribosomes are located in the cytoplasm.

Before the process of protein synthesis can take place the genetic code needs to be taken from the nucleus and delivered to the cytoplasm by "messenger" otherwise known as the RNA (ribonucleic acid). RNA is different from DNA in that the RNA is made up of only half of the double helix that makes up the DNA.



RNA uses the nitrogen bases Adenine (A), Guanine (G), and Cytosine (C). Thymine (T) does not appear in RNA; rather Uracil (U) is used and partners up with Adenine (A).

Messenger and Transfer RNA

There is more than one type of RNA. The two that we will talk about are the messenger RNA (mRNA) and the transfer RNA (tRNA).
Messenger RNA's job is to copy the genetic code from the DNA in the nucleus and bring that message into the cytoplasm and attach it to the ribosome.

Transfer RNA's job is to pick up the amino acids and attach them to the growing protein.

Lesson Checkpoint: Is there one type of RNA?

Mutations

Mistakes occur in every process at some point. If a mistake occurs during the process of protein synthesis, it is called a mutation.

A mutation is a change that takes place on a gene or a chromosome. If a mutation occurs then the cell will make the wrong protein during protein synthesis. This does not sound to be of any concern, but a single mutation of a nitrogen base can cause a drastic change in the phenotype of an organism.

Other mutations could be the failure of chromosomal separation during meiosis. This can leave a cell with too few or too many chromosomes.

Are mutat

Mutations

- A mutat lity to survive dark environ environ ctively.
- A mutat bility to survive and reproduce. For example, if a moth lived in a dark environment and its phenotype mutates and makes it more noticeable by lightening its color against its environment. The organism's predators will be able to find it easier and its survival and reproduction will decrease.

Human Inheritance

In his research, Gregor Mendel found that traits in pea plants are controlled by a single gene that has two different alleles. Most of the time there is a dominant and a recessive allele that is passed down to the offspring.

This is also true for humans with some traits. The different alleles will generally have two drastically different phenotypes. For example, if you smile and you have dimples then you have the dominant allele for this gene. If you had the recessive allele then you would not have dimples at all.

Patterns of Inheritance

Traits are also known to have multiple alleles for a single gene. If a trait has multiple alleles, then there can be three or more forms of a gene that are possible to have for a single trait. You can think of this as similar to ice cream, in that there are more than the traditional two flavors of vanilla and chocolate. A person is still only able to carry two forms of the gene in their DNA.

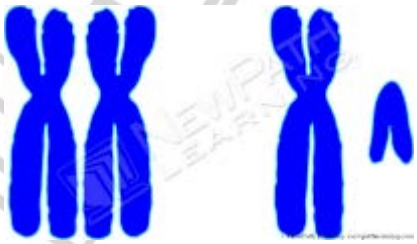
Eye color is an example of a gene with multiple alleles. As we all know, there are more than two different human eye colors. There are a total of eight different colors that a human eye could be. The trait is controlled by multiple alleles.

A trait can also be controlled by many different genes. For example, there are a large number of different phenotypes for human height. A number of genes can be involved with a trait giving it large variation spectrum.

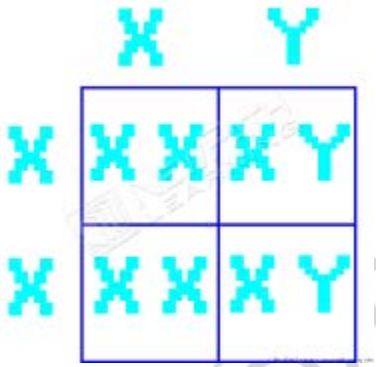
An organis g
represente ndividual.
Without th the
height tha

The Sex

Human offspring receives two sets of 23 chromosomes (totaling 46) from their parents. Each parent supplies one sex chromosome that is within that set. The sex chromosomes will determine if the offspring is a male or a female and they are the only pair of chromosomes that do not always match.



A female's sex chromosomes match, but a male's do not. A female will have two matching X chromosomes, while a male will have an X and a Y chromosome. The Y chromosome is a lot smaller than X chromosome. If you were to complete a Punnett square you would notice that the male sex cells determine the sex of the offspring.



Human Genetic Disorders

A genetic disorder is a disorder that is caused by inheriting abnormal genes from the parents. They are caused by mutations in a person's DNA either before or after meiosis.

The following are genetic disorders and how they are passed to offspring:

Cystic fibrosis – recessive allele

Sickle-cel ...e normal allele

Hemophil

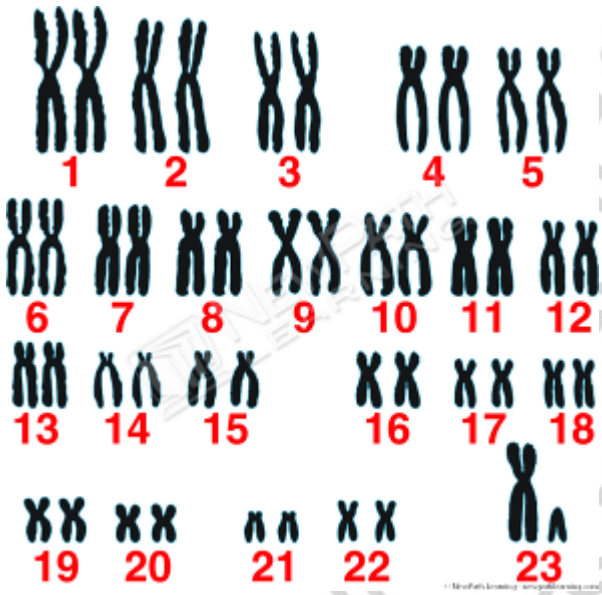
Huntingt

Down syn

Doctors ar... ...ocentesis and karyotype. An amniocentesis is a procedure that a doctor uses to take some of the fluid that surrounds a fetus while still in the womb. This allows the doctors to create a karyotype.

What Is a Karyotype?

A karyotype is a picture of the actual chromosomes of the organism. It can be used to see if there is a problem with the chromosomes.



Advances in Genetics

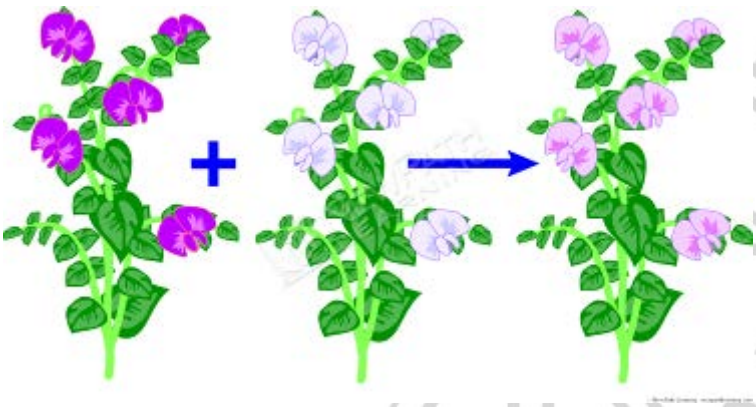
Ever since the discovery of heredity and genetics people have been working to isms that have desir genetic engineerin

Selective

Selective b have desirable t nods started ov ere was a wild grass that produced a very small amount of food. The Native Americans started saving the seeds of the plants that produced more and better food. After selectively breeding this plant species over many generations it developed into the food that is commonly known today as corn. There are two different techniques of selective breeding.

Two Selective Breeding Techniques

One technique is inbreeding where you breed organisms that have the same or very similar traits to produce offspring. The other technique is hybridization where you breed genetically different organisms to produce offspring.



What is Genetic Engineering?

Genetic engineering is when you transfer desirable genes into the DNA of a living organism. This method may someday be used to cure genetic disorders, make better food, and help develop better medicines.

A **clone** is a genetically identical organism reproduced from an original organism.

DNA is in e unique as the fingerp is different th town, state, cour

DNA finger mes. If a criminal were to leave cells from their body at the crime scene like blood, hair, or skin, then the scientists can use those cells to determine a DNA fingerprint and if it was a the criminals or not.