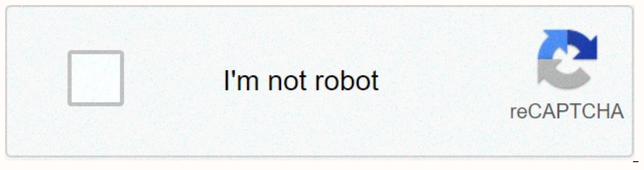

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Relationship between chromosomes genes and alleles

Updated July 29, 2019 by Eric Bank, MBA, MS Finance Deoxyribonucleic Acid, or DNA, is the substance that living organisms use to store genetic information -- that is, information that an organism inherits from its parents. The genetic code is organized into long strands called chromosomes, consisting of DNA and proteins. Sexually reproducing organisms normally have a characteristic number of chromosome pairs, with each member of the pair coming from each parent. A DNA allel is the appropriate location on a chromosome. Read more about the structure, function and importance of DNA. Let's take a closer look at chromosomes, genes, and alleal slates. DNA is a chain of repeatable sugar and phosphate units. One of four different nuleotide bases -- a single-ring or double-ringed molecule containing nitrogen -- hangs on each unit of sugar. The sequence of bases along the spine DNA sugar-phosphate describes the genetic code. In most organisms, a chromosome contains two strands of DNA joined in a double-helix structure in which the bases of one thread bind to those of the other. The base sequence in a thread determines the sequence in the sister component. This is because only certain bases can mate with each other. The cell machine translates this code into proteins that guide the shape, structure and chemical activities of the organism. Just a few portions of a strand of DNA -- genes -- protein code. Chromosome proteins, called histones, bind closely to double helix DNA. This binding compresses the long molecules of DNA so that it fits into a cell. Humans contain 23 pairs of chromosomes, and if you unwrap all the DNA from a human cell and put it from one end to the other, it would exceed six meters in length. Read more about what a chromosome is? A single set of chromosomes or haploids is stored in each parent's sexual cells. When fertilizing, the cells of the new embryo have a double, or diploid, sets of chromosomes. During cell division, a cell reproduces its complement of chromosomes, so that each daughter sells becomes the complete diploid set. Genes appear along the entire length of each chromosome, and each chromosome pair has a unique set of genes. You can only recognize genes from their information content -- the sequence of the bases of the nuleotides. Otherwise, the genes are indistinguishable from the rest of the chromosome. The place of a gene on a chromosome is its locus. You can designate a locus by counting the number of bases from the beginning of the chromosome to the beginning of the gene. Let's look at the definition of allela. In a diploid organism, the two corresponding genes in a chromosome pair, or alleles, could be identical or have different basic sequences. Each parent contributes one allele in each pair. Some -- the physical expression of genetic information -- requires the interaction of several different genes, making the relationships between more complex. In a diploid individual, two identical or homozygous alleles express the same trait -- that is, the same protein or structural enzyme. Heterozygous alles encode different information for the same trait. Often, one DNA allel dominates over the other, which means that its encoding determines the gene phenotype. The cell can only express a recessive trait if both alles are homozygous for this trait. For example, the color of a flower may depend on the information stored in the flower color alleles of the plant. If red is dominant, the flower may just be another color if the red DNA allele is absent. Mutations, which alter the basic sequences of alleles, can create evolutionary changes in a species or even the development of new species, but can also lead to defective descendants. About the author based in Greenville SC, Eric Bank has been writing business-related articles since 1985. He owns an m.B.a. from New York University and a finance student from DePaul University. You can see samples of his work at ericbank.com. If you see this message, it means that we have problems uploading external resources to our website. If you're behind a web filter, make sure that *.kastatic.org and *.kasandbox.org domains are unlocked. To prevent mistakes during reproduction, cells have a correction function to make sure that the bases are associated correctly. There are also chemical mechanisms to repair DNA that has not been copied properly. However, because of the billions of basic pairs involved in, and the complexity, the process of protein synthesis, mistakes can happen. Such mistakes can occur for many reasons (including exposure to radiation, drugs, or viruses) or for no apparent reason. Minor variations in DNA are very common and occur in most people. Most variations do not affect subsequent copies of the gene. Mistakes that are duplicated in subsequent copies are called mutations. Inherited mutations are those that can be passed on to offspring. Mutations can only be inherited when they affect reproductive cells (sperm or egg). Mutations that do not affect reproductive cells affect the offspring of the mutant cell (e.g. becoming cancer), but are not passed on to offspring. Mutations can be unique to a person or family, and the most harmful mutations are rare. Mutations that become so frequent that they affect more than 1% of a population are called polymorphisms (e.g. human blood types A, B, AB and O). Most polymorphisms have little or no effect on the phenotype (the actual structure and function of a person's body). Mutations can involve small or large segments of DNA. Depending on the size and the mutation may have no apparent effect or may alter the sequence of amino acids in a protein or reduce the amount of protein produced. If the protein has a different sequence of amino acids, amino acids, may work differently or not at all. An absent or non-functioning protein is often harmful or fatal. For example, in phenylketonuria, a mutation leads to the deficiency or absence of the enzyme phenylalanine hydroxylase. This deficiency allows the amino acid phenylalanine (absorbed from the diet) to accumulate in the body, eventually causing severe intellectual disability. In rare cases, a mutation introduces a change that is advantageous. For example, in the case of the sickle cell gene, when a person inherits two copies of the abnormal gene, the person will develop sickle cell. However, when a person inherits only a copy of the gene siclemia (called a carrier), the person develops some protection against malaria (a blood infection). Although protection against malaria can help a carrier survive, sickle cell disease (in a person who has two copies of the gene) causes symptoms and complications that can shorten life span. Natural selection refers to the concept that mutations that affect survival in a given environment are less likely to be transmitted to descendants (and thus become less common in the population), while mutations that improve survival are progressively more common. Thus, beneficial mutations, although initially rare, eventually become common. Slow changes that occur over time caused by mutations and natural selection in a collectively interbreeding population are called evolution. Not all genetic abnormalities are harmful. For example, the gene that causes sickle cell disease also provides protection against malaria. Genes and alleles are essential for basic genetics, but what are the differences between them? In this guide, we compare genes and alleles and provide simple definitions and examples for both. What is a gene? Genes are sections of DNA that determine certain traits or characteristics. Genes encode for proteins that influence things like the immune system, skin pigmentation, hormone production, and eye color. Genes are inherited from the parents of a cub, and they are responsible for the characteristics being passed down from one generation to the next. The genotype of an organism consists of its entire set of genes. Each human has a unique genotype, which explains the wide variety in human aspect and biology. What's an allel? When genes mutate, they can take several forms, with each shape differing slightly in their basic DNA sequence. These gene variants still code for the same trait (eg, hair color), but they differ in how the trait is expressed (eg, brown vs. blond hair). Different versions of the same gene are called alleles. Genes can have two or more possible alleles. Individual people have two alleles, or versions, of each gene. Because people have two genetics for each gene, we are known as diploid organisms. The higher the number of potential alles, the more hereditary trait. An incredible number of genes and gene forms under human genetic diversity, and they are the reason why there are no two humans are exactly the same. As an example, let's look at the color of our eyes. In a simplified model, we assume that there is only one gene that encodes eye color (although there are several genes involved in most physical traits). Blue, green, brown and brown eyes are encoded by the unique alle of the gene mentioned. The pair of alleles present on a person's chromosomes dictates what eye color will be expressed. are genes and alleles inherited? When people procreate, the child receives 23 chromosomes (long strands of DNA) from each parent. Each matching chromosome pair contains the same set of genes, with unique genes located at certain points known as the locus gene. This inheritance means that individuals have two genetic children for a particular trait, one inherited from their mother and the other from their father. They are known as maternal alleands and paternal alles. It is how these alles interact, which is responsible for the unique features. What is a dominant gene and what is a recessive gene? The totality of genes encoded on the 46 human chromosomes is known as their genotype. But not all genetic variations will be expressed. For example, you might have one brown eye allel and another for blue eyes, but you will therefore not have a blue eye and a brown eye. Individuals do not display encoded features on each pair of matching genes. Instead, the genes that are expressed lead to the phenotype, which is how the genes are expressed in observable characteristics. How does the body know what all-of-the-way to express? This boils down to the properties of alleles that are paired. Each individual has two children, or alleles, or a single gene. When alleles are the same, they are known as homozygous. When they are different, they are called heterozygous. Homozygotes code for the same trait, for example, blue eyes. If you have two blue alleles, your eyes will be blue. But if you have an allele for blue eyes and another for brown eyes, the color of the eyes will be dictated by whichever allele is dominant. A dominant allele is one that always determines the phenotype when it is present. On the other hand, a recessive allele is one that is not expressed when its pair allele is dominant. With the color of the eyes, the brown eye allele is dominant at the blue eye allele. This means that a child with a blue allel from their mother and a brown allel from their father will end up with brown eyes. But a child with two blue alleles will display the phenotype of the blue eye. Genes vs. Alle: Gene Alle Definition Chart A DNA Section That Encodes a certain trait A variant form of a gene The role of genes determines the individual traits Alles contribute to diversity in the expression phenotype determines the genotype of an organism Phenotype of an organism organism per genus locus One Two Two Different Types Paternal vs. Maternal Dominant vs. Recessive Examples Eye Color, Hair Color, Skin Pigmentation Blue Eyes, Brown Hair, Dark Skin