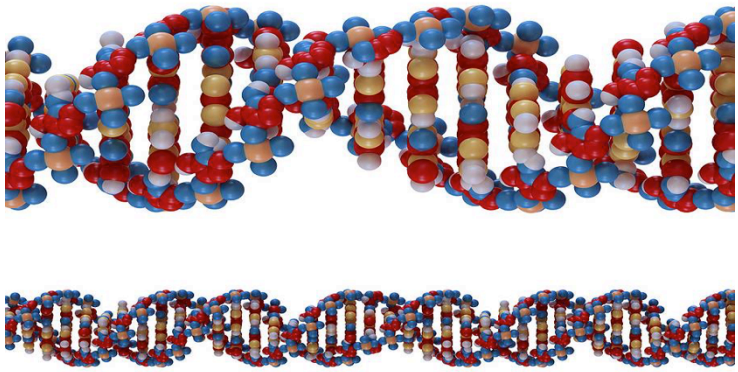
Name: _____ Date: _____ Group: _____

DNA, Chromosomes, and Genes

1 You have most likely already learned about deoxyribonucleic acid (DNA), chromosomes, and genes. You have learned that all three of these substances have something to do with heredity in organisms. You have also learned that all living organisms contain some type of genetic material. Have you made the link that these three components are actually one and the same? Let us start at the beginning.



2 What exactly is DNA? All biological organisms carry the same basic genetic code on their DNA. However, each organism is slightly different from the next, both within species and between species. The differences between and among species are due to specific alterations in the nucleotide sequences found on the DNA strand.

3 The DNA molecule is made of two long chains of specific chemical building blocks, and these chains form a double helix structure unique to the DNA molecule. Each link on the chain includes a nucleotide, a pentose sugar, and a phosphate group. Specifically, it is the sequence of nucleotides along the DNA strand that create an organism's genetic code, and these links are ordered in a way that allows the code to be copied and read. Therefore, this information can be duplicated and transferred from one generation to the next. But how is the information encoded on the DNA strand copied and transferred? This is where chromosomes and genes come into play.

4 What exactly is a chromosome? A DNA strand and a chromosome are the same thing, just in different forms. A chromosome is simply a highly coiled version of a DNA strand. Most prokaryotes have one DNA molecule and therefore one chromosome. Eukaryotes may have many DNA molecules, and therefore many chromosomes. In order for the genetic information carried on the DNA strand to be passed from one generation to the next, the cell must first replicate the genetic material and then transfer the genetic material from parent to offspring in a process known as reproduction. Through these processes, the genetic material from the DNA strand is condensed, organized, and packaged into individual chromosomes, the structure of which makes it easier to transfer the genetic material from parent cell to daughter cell during replication, or to the next generation during reproduction.

5 What exactly is a gene? The gene is the basic unit of heredity. The information for specifying the traits of an organism, such as hair color, is carried on the DNA strand in sequences known as genes. Genes are found at specific locations (loci) along the chromosomes, which you will remember are simply condensed forms of DNA. Whether you are studying a prokaryotic or eukaryotic cell, the genetic information of that organism can be found at specific loci. In other words, each coding segment of a chromosome is a gene, and each gene is found at a specific locus on the chromosome.

6 The information encoded on the genes is what gives organisms their specific traits. A slight difference in one nucleotide sequence of a gene can change the trait of the organism. For example, the gene for part of a hemoglobin molecule is found at a specific locus on the short arm of human chromosome number 11. There is one nucleotide sequence for normal, and another nucleotide sequence for sickle-cell hemoglobin. Both types of hemoglobin are produced by slightly different DNA sequences in the same gene at the same locus on the same chromosome, but the nucleotide sequence on the DNA strand is different by one single nucleotide at that locus. This produces a different trait. The person will have either normal blood hemoglobin, the sickle cell trait if the person inherits one copy of the faulty gene, or sickle cell anemia if the person inherits two copies of the faulty gene.

7 All three components together (the DNA, the chromosomes, and the genes) compose the entire genome of the organism. The genetic information is carried in the nucleotide sequence of the DNA. Each DNA molecule is condensed into separate chromosomes during reproduction, where the genetic information is passed from parent to offspring. The specific nucleotide sequences on the genes will determine the organism's unique traits.

8 As a final review, a DNA molecule carries the genetic code in a sequence of nucleotides along a strand. During replication and reproduction, the DNA molecule coils and condenses into a form known as a chromosome. The regions of the DNA that code for specific traits are known as genes. Each gene can be found at specific loci along the chromosomal form of the DNA molecule.

1 Review paragraph 4 to identify the similarities of DNA and chromosomes. Which of the statements below is true?

A DNA is found only in prokaryotic cells.

B Many chromosomes are found in prokaryotic cells.

C DNA and chromosomes perform different functions.

D A chromosome is a tightly coiled DNA strand.

---

2 What exactly is DNA?

A A DNA strand is a condensed version of a chromosome

B A specific location on a chromosome

C A double helix structure consisting of a nucleotide sequence

D A gene that codes for specific traits

3 What is the best definition of a chromosome?

A A specific locus that codes for traits

B A nucleotide sequence on the DNA strand

C A specific trait of an organism, such as blue eyes

D A highly coiled version of a DNA strand

---

4 A gene is the basic unit of heredity. What is the function of genes?

A Genes code for specific traits

B Genes determine the DNA sequence

C Genes create chromosomes

D Genes help with replication

5 Which of the following statements is true?

A DNA and chromosomes are found in different types of cells.

B The specific nucleotide sequences of the genes determine the individual characteristics of an organism.

C The coding segment of a chromosome is found in prokaryotic cells.

D Some living organisms do not have genetic material.

---

6 Which of the following statements is FALSE?

A DNA, chromosomes, and genes work together to determine heredity in organisms.

B Genes are found in chromosomes but not DNA.

C Differences between organisms are due to specific alterations in the nucleotide sequences.

D Chromosomes and genes allow the information encoded on the DNA strand to be copied and transferred.