Structure of dna and rna pdf book download pdf file

DNA stands for deoxyribonucleic acid, while RNA is ribonucleic acid. Although DNA and RNA both carry genetic information, there are quite a few differences between them. This is a comparison of the differences between DNA versus RNA, including a quick summary and a detailed table of the differences. DNA contains the sugar deoxyribose, while RNA contains the sugar ribose. The only difference between ribose and deoxyribose is that ribose has one more -OH group than deoxyribose, which has -H attached to the second (2') carbon in the ring. DNA is a double-stranded molecule, while RNA is a single-stranded molecule. DNA is stable under alkaline conditions, while RNA is not stable. DNA and RNA perform different functions in humans. DNA is responsible for storing and transferring genetic information, while RNA directly codes for amino acids and acts as a messenger between DNA and ribosomes to make proteins. DNA and RNA base pairing is slightly different since DNA uses the bases adenine, thymine, cytosine, and guanine; RNA uses adenine, uracil, cytosine, and guanine. Uracil differs from thymine in that it lacks a methyl group on its ring. While both DNA and RNA are used to store genetic information, there are clear differences between them. This table summarizes the key points: Main Differences Between DNA and RNA Comparison DNA RNA Name DeoxyriboNucleic Acid RiboNucleic Acid Function Long-term storage of genetic information; transmission of genetic information to make other cells and new organisms. Used to transfer the genetic code from the nucleus to the ribosomes to make proteins. RNA is used to transmit genetic information in some organisms and may have been the molecule used to store genetic blueprints in primitive organisms. Structural Features B-form double helix. DNA is a double-stranded molecule consisting of a long chain of nucleotides. A-form helix. RNA usually is a single-strand helix consisting of shorter chains of nucleotides. Composition of Bases and Sugars deoxyribose sugarphosphate backboneadenine, guanine, cytosine, thymine bases ribose sugarphosphate backboneadenine, guanine, cytosine, uracil bases Propagation DNA is self-replicating. RNA is synthesized from DNA on an as-needed basis. Base Pairing AT (adenine-thymine)GC (guanine-cytosine) AU (adenine-uracil)GC (guanine-cytosine) Reactivity The C-H bonds in DNA make it fairly stable, plus the body destroys enzymes that would attack DNA. The small grooves in the helix also serve as protection, providing minimal space for enzymes to attach. The O-H bond in the ribose of RNA makes the molecule more reactive, compared with DNA. RNA is not stable under alkaline conditions, plus the large grooves in the molecule make it susceptible to enzyme attack. RNA is constantly produced, used, degraded, and recycled. Ultraviolet Damage DNA is susceptible to UV damage. Compared with DNA, RNA is relatively resistant to UV damage. There is some evidence DNA may have occurred first, but most scientists believe RNA evolved before DNA. RNA has a simpler structure and is needed in order for DNA to function. Also, RNA is found in prokaryotes, which are believed to precede eukaryotes. RNA on its own can act as a catalyst for certain chemical reactions. The real question is why DNA evolved if RNA existed. The most likely answer for this is that having a double-stranded molecule helps protect the genetic code from damage. If one strand is broken, the other strand can serve as a template for repair. Proteins surrounding DNA also confer additional protection against enzymatic attack. While the most common form of DNA is a double helix. there is evidence for rare cases of branched DNA, quadruplex DNA, and molecules made from triple strands. Scientists have found DNA in which arsenic substitutes for phosphorus. Double-stranded RNA (dsRNA) sometimes occurs. It is similar to DNA, except thymine is replaced by uracil. This type of RNA is found in some viruses. When these viruses infect eukaryotic cells, the dsRNA can interfere with normal RNA function and stimulate an interferon response. Circular single-strand RNA (circRNA) has been found in both animals and plants. At present, the function of this type of RNA is unknown. Burge S, Parkinson GN, Hazel P, Todd AK, Neidle S (2006). "Quadruplex DNA: sequence, topology and structure". Nucleic Acids Research. 34 (19): 5402–15. doi:10.1093/nar/gkl655 Whitehead KA, Dahlman JE, Langer RS, Anderson DG (2011). "Silencing or stimulation? siRNA delivery and the immune system". Annual Review of Chemical and Biomolecular Engineering. 2: 77–96. doi:10.1146/annurev-chembioeng-061010-114133 DNA and RNA vaccines have the same goal as traditional vaccines, but they work slightly differently.Instead of injecting a weakened form of a virus or bacteria into the body as with a traditional vaccine, DNA and RNA vaccines use part of the virus' own genetic code to stimulate an immune response.The mRNA vaccine for COVID-19 co-developed by Pfizer and BioNTech was the first of its kind authorized for emergency use in the United States. On December 11, 2021 the Food and Drug Administration granted emergency use authorization for the messenger RNA (mRNA) vaccine for COVID-19 co-developed by Pfizer and BioNTech. The emergency use vaccine is approved for people ages 5 and older. This article explains what exactly mRNA vaccines are and how they work. It also discusses how RNA vaccines are different from another advancement in disease prevention—DNA vaccines—along with the pros and cons of each type. Traditional vaccines, which expose the body to proteins made by a virus or bacteria, are often made by using weakened or inactive versions of that virus or bacteria. That's how popular vaccines, like the measles, mumps, and rubella (MMR) vaccine and pneumococcal vaccine, work. When you get the MMR vaccine, for example, your body is introduced to weakened forms of the measles, mumps, and rubella viruses that do not cause disease. This triggers an immune response and causes your body to make antibodies like it would with a natural infection. The antibodies in traditional vaccines like these help your body recognize and fight the virus should you be exposed to it later on, preventing you from getting sick. A DNA or RNA vaccine has the same goal as traditional vaccines, but they work slightly differently. Instead of injecting a weakened form of a virus or bacteria into the body, DNA and RNA vaccines use part of the virus' own genes to stimulate an immune response. In other words, they carry the genetic instructions for the host's cells to make antigens. "Both DNA and RNA vaccines deliver the message to the cell to create the desired protein so the immune system creates a response against this protein," Angelica Cifuentes Kottkamp, MD, an infectious diseases doctor at NYU Langone's Vaccine Center, tells Verywell. "[Then the body] is ready to fight it once it sees it again." Research published in 2019 in the medical journal Frontiers in Immunology reports that "preclinical and clinical trials have shown that mRNA vaccines provide a safe and long-lasting immune response in animal models and humans." "So far, there's been no mass production of vaccines based on DNA or RNA," Maria Gennaro, MD, a professor of medicine at the Rutgers New Jersey Medical School, tells Verywell. "So this is kind of new." Unlike traditional vaccines that contain a weak or inactive form of a virus, messenger RNA (mRNA) vaccines instruct cells in your body to build a protein similar to the virus. Your body responds to the protein with an immune response, which prepares your body to fight the actual virus if you encounter it. DNA and RNA vaccines work the same way as each other, but have some differences. With a DNA vaccine, the virus' genetic information "is transmitted to another molecule that is called the messenger RNA (mRNA)," Gennaro says. This means with an RNA or mRNA vaccine, you're one step ahead of a DNA vaccine. Vaccines are evaluated for their effectiveness in what are called vaccine effectiveness studies. No vaccines are 100% effective in preventing disease. But data from these studies shows that the mRNA vaccines developed by Pfizer-BioNTech and Moderna reduce the risk of COVID-19 by 90% or more in people who are full vaccinated. "The mRNA goes into the cell, and the cell translates it into proteins…which are the ones that the organism sees and induces the immune response," Gennaro says. Another difference between a DNA and RNA vaccine is that a DNA vaccine delivers the message via a small electrical pulse, which "literally pushes the message into the cell," Cifuentes-Kottkamp says. "The advantage is that this vaccine is very stable at higher temperatures. The disadvantage is that it requires a special device that provides the electrical pulse," she says. DNA and RNA vaccines are touted for their cost effectiveness and ability to be developed more quickly than traditional, protein vaccines. Traditional vaccines often rely on actual viruses or viral proteins grown in eggs or cells, and can take years and years to develop. DNA and RNA vaccines, on the other hand, can be made more readily available because they rely on genetic code—not a live virus or bacteria. This also makes them cheaper to produce. "The advantage over protein vaccines—in principle, not necessarily in practice—is that if you know what protein you want to end up expressing in the body, it's very easy to synthesize a messenger RNA and then inject it into people," Gennaro says. "Proteins are a little more finicky as molecules, whereas the nucleic acid [DNA and RNA] is a much simpler structure." But with any health advancement comes potential risk. Gennaro says that with a DNA vaccine, there is always a risk it can cause a permanent change to the cell's natural DNA sequence. "Usually, there are ways in which DNA vaccines are made that try to minimize this risk, but it's a potential risk," she says. "Instead, if you inject mRNA, it cannot get integrated into the genetic material of a cell. It is also ready to be translated into protein." Because no DNA vaccine is currently approved for human use, there is still much to learn about their effectiveness. With two mRNA vaccines approved for emergency use, they are much closer to full approval and licensing by the FDA. DNA and RNA vaccines both instruct cells in your body to produce a protein that induces an immune response. Unlike RNA vaccines, DNA vaccines require an electrical impulse to push the genetic message into the cell. And while mRNA vaccines cannot affect your genes, this is a potential risk with DNA vaccines. DNA and RNA vaccines contain genetic information that instructs cells in your body to produce a protein with a similar structure to that of the virus. This tricks your body into building an immune response to the protein that prepares your body to fight the real virus if you encounter it. Unlike traditional vaccines, neither RNA or DNA vaccines contain a live virus. For this reason they are more cost effective and can be produced more quickly than traditional vaccines. RNA and DNA vaccines induce a similar immune response, but DNA vaccines require an electrical pulse to reach the cell. Frequently Asked Questions Are mRNA vaccines for COVID-19 safe even though they were developed so quickly? The mRNA vaccines went through all the necessary steps to ensure they are safe and effective, including three phases of clinical trials, FDA authorization and approval, and intense safety monitoring. Do mRNA vaccines alter your DNA? No, mRNA vaccines deliver instructions (messenger RNA) to your cells to build protection against the virus that causes COVID-19. The messenger RNA never enters the nucleus of the cell, which is where your DNA is located. When COVID-19 hit, a tremendous amount of funding and attention poured into mRNA vaccine development. As a result, the highly effective mRNA COVID-19 vaccines became the first of their kind to gain FDA approval and authorization. Messenger RNA vaccines are an important, life-saving advancement that has opened the door to a promising new era in disease prevention. The information in this article is current as of the date listed, which means newer information may be available when you read this. For the most recent updates on COVID-19, visit our coronavirus news page.

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