2017학년도 1학기 [세포유전학] 강의계획서

◆ 수업정보 ◆

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교과목명	세포유전학 (**Cellular Genetics)**

[수업정보]

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◆ 학습계획 ◆

[과목개요]

KFBT271 Cellular Genetics course will examine the **central dogma** of molecular biology which is the logical explanation of the flow of genetic information within a biological system, and thus discuss DNA, RNA, and protein, and how their synthesis, such as DNA replication, transcription, RNA processing, and translation, is regulated as the fundamental architecture of the course.

[학습목표]

After taking this **KFBT271 Cellular Genetics** class, you should know **the key concepts of the central dogma of molecular biology**, including the composition of genomes and the basic mechanisms of replication, transcription, RNA processing, translation and RNA turnover, and how the complexes that perform these activities identify their targets, carry out their function and can be regulated to meet cellular needs. In addition, you should have **a basic understanding of the experimental approaches and deductions** that have shaped, and continues to shape, our understanding of these concepts.

[주차별 학습내용]

차시	주제	내용 요약	해당 주차의 강의자료 파일명
1	DNA: The genetic material	You probably answered "DNA." Today, it is commonly known that DNA is the genetic material. For a long time, scientists knew such molecules existed. They were aware that genetic information was contained within organic molecules. However, they didn't know which type of molecules play this role. In fact, for many decades, scientists thought that proteins were the molecules that carry genetic information. In this section, you will learn how scientists discovered that DNA carries the code of life.	01
2	Proof that DNA is genetic material	In 1928, Frederick Griffith was able to transform harmless bacteria into virulent pathogens with an extract that Oswald Avery proved, in 1944, to be DNA. In 1952, Martha Chase and Alfred Hershey used radioactively labeled virus DNA to infect bacteria, proving the same point. These important experiments established that DNA is the genetic material.	02
3	Central dogma	The classic view of the central dogma of biology states that "the coded genetic information hard-wired into DNA is transcribed into individual transportable cassettes, composed of messenger RNA (mRNA); each mRNA cassette contains the program for synthesis of a particular protein (or small number of proteins)."	03
4	DNA replication	DNA replication is the process of producing two identical replicas from one original DNA molecule. This biological process occurs in all living organisms and is the basis for biological inheritance. DNA is made up of two strands and each strand of the original DNA molecule serves as a template for the production of the complementary strand, a process referred to as semiconservative replication. Cellular proofreading and error-checking mechanisms ensure near perfect fidelity for DNA replication.	04
5	DNA polymerase & replication	The DNA polymerases are enzymes that create DNA molecules by assembling nucleotides, the building blocks of DNA. These enzymes are essential to DNA replication and usually work in pairs to create two identical DNA strands from one original DNA molecule. During this process, DNA polymerase "reads" the existing DNA strands to create two new strands that match the existing ones.	05
6	Process of DNA replication	DNA replication begins when the enzyme helicase "unwinds" a small portion of the DNA helix, separating the two strands. This point of separation is called the replication fork. The two	06

		strands are kept separated by single stranded binding proteins (SSB) which bind onto each of the strands. A group of enzymes called the DNA polymerases are responsible for creating the new DNA strand, however they cannot start the new strand off, only extend the end of a pre-existing strand. Therefore, before the DNA polymerases can start synthesizing the new strand, the enzyme primase attaches a short (~60 nucleotides) sequence of RNA called a primer. The DNA polymerases then extend this primer, moving along each strand from the 3′ end to the 5′ end and adding nucleotides to the 3′ hydroxyl group of the previous nucleotide base. The order of nucleotides is retained by matching complementary nucleotides on the template strand.	
7	RNA transcription	The DNA contains the master plan for the creation of the proteins and other molecules and systems of the cell, but the carrying out of the plan involves transfer of the relevant information to RNA in a process called transcription. The RNA to which the information is transcribed is messenger RNA (mRNA).	07
8	Process of transcription	The process associated with RNA polymerase is to unwind the DNA and build a strand of mRNA by placing on the growing mRNA molecule the base complementary to that on the template strand of the DNA. In the mRNA, Uracil is substituted for thymine as the base complementary to adenine. Since the other strand of the DNA has bases complementary to the template strand, the mRNA has the same sequence of bases at the upper strand of DNA shown above (with U substituted for T) , which is called the coding strand. According to Karp, the RNA polymerase is capable of adding 20 to 50 nucleotides per second to the growing mRNA chain. Electron microscope images suggest that there can be over a hundred RNA polymerases operating simultaneously.	08
9	Regulation of transcription	The regulation of transcription is a vital process in all living organisms. It is orchestrated by transcription factors and other proteins working in concert to finely tune the amount of RNA being produced through a variety of mechanisms. Prokaryotic organisms and eukaryotic organisms have very different strategies of accomplishing control over transcription, but some important features remain conserved between the two. Most importantly is the idea of combinatorial control, which is that any given gene is likely controlled by a specific combination of factors to control transcription.	09
10	Translation	Translation is the process by which a protein is synthesized from the information contained in a molecule of messenger	10

		RNA (mRNA). During translation, an mRNA sequence is read using the genetic code, which is a set of rules that defines how an mRNA sequence is to be translated into the 20-letter code of amino acids, which are the building blocks of proteins. The genetic code is a set of three-letter combinations of nucleotides called codons, each of which corresponds with a specific amino acid or stop signal. Translation occurs in a structure called the ribosome, which is a factory for the synthesis of proteins.	
11	DNA repair I	Because DNA is the repository of genetic information in each living cell, its integrity and stability are essential to life. DNA, however, is not inert; rather, it is a chemical entity subject to assault from the environment, and any resulting damage, if not repaired, will lead to mutation and possibly disease. Perhaps the best-known example of the link between environmental-induced DNA damage and disease is that of skin cancer, which can be caused by excessive exposure to UV radiation in the form of sunlight (and, to a lesser degree, tanning beds). Another example is the damage caused by tobacco smoke, which can lead to mutations in lung cells and subsequent cancer of the lung. Beyond environmental agents, DNA is also subject to oxidative damage from byproducts of metabolism, such as free radicals. In fact, it has been estimated that an individual cell can suffer up to one million DNA changes per day.	11
12	DNA repair II	DNA repair processes exist in both prokaryotic and eukaryotic organisms, and many of the proteins involved have been highly conserved throughout evolution. In fact, cells have evolved a number of mechanisms to detect and repair the various types of damage that can occur to DNA, no matter whether this damage is caused by the environment or by errors in replication.	12