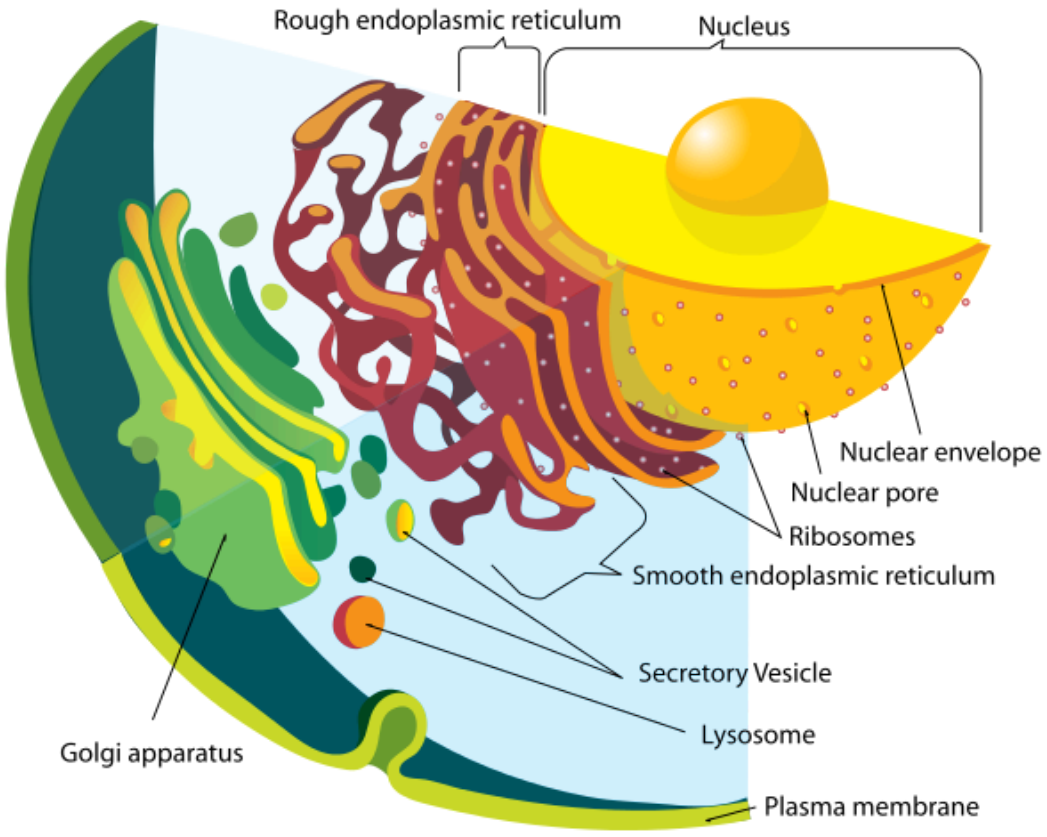
4.1

CELL STRUCTURES

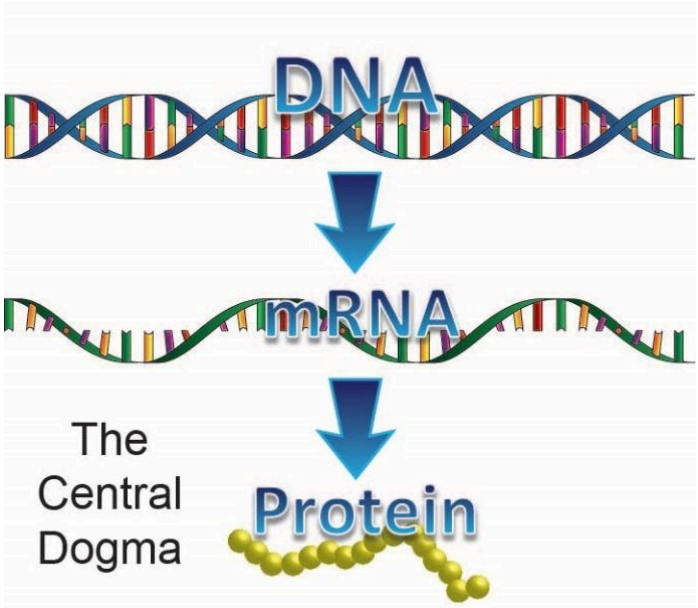
An Interactive Image that allows you to explore the anatomy of a cell has been added to help you. You can see images of many of the bolded terms below. Be prepared to know where these fundamental cell parts are and what they do. As technology progressed to the point of peering deeper and deeper into the world of the cell, it became apparent that the cell cytoplasm, when viewed under a light microscope, was full of even smaller intracellular structures. The structures are collectively called cellular organelles. This introduction will identify these organelles briefly, and subsequent sections will add details.

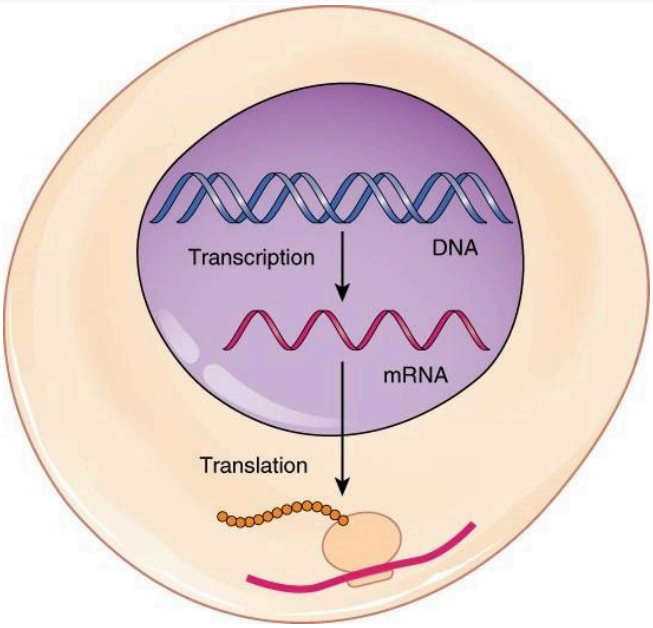
To help illustrate the function of many of these organelles, let us consider the secretion of insulin by beta cells in the pancreas. In order to secrete insulin, the cell must first make it. This process starts in the cell **nucleus**. The nucleus houses the genetic material (DNA) of a human cell and provides a location for **DNA transcription** (the copying of DNA). Importantly, the nucleus is surrounded by two distinct lipid bilayer membranes. The outer membrane belongs to the **endomembrane system** (made up of the nuclear envelope, the endoplasmic reticulum, the golgi apparatus, lysosomes, the plasma membrane, and most vacuoles and vesicles).



Endomembrane System Diagram. Title: File: Endomembrane system diagram en.svg; Mariana Ruiz LadyofHats;Site: http://en.wikipedia.org/wiki/File:Endomembrane_system_diagram_en.svg; License: Public Domain.

The production and secretion of insulin helps illustrate the coordinated efforts of the organelles in this system. Within the nucleus, the insulin gene (located on chromosome 11) is transcribed from DNA to RNA and then further processed into messenger RNA or mRNA. This mRNA is then transported out of the nucleus to **ribosomes** docked to the surface of the **endoplasmic reticulum** (ER). The ER is actually divided into two components: the rough ER and the smooth ER. The rough ER is named "rough" because it is studded with ribosomes, which create a bumpy surface when viewed under an electron microscope. The function of the ribosome is to perform **translation** (the use of mRNA as a template to synthesize protein). The ribosome is specifically suited to interpret the mRNA nucleotide acid code (a series of adenosines, uracils, guanidines, and cytosines—abbreviated A, U, G, and C respectively) and assign the appropriate amino acid in the creation of a polypeptide chain. This is the first step of making a protein. The process of DNA to RNA to protein is called the **central dogma** of biology.





Central Dogma of Biology - DNA Transcription to Translation. File:0328 Transcription-translation Summary.jpg;Author: OpenStax College; Site:http://commons.wikimedia.org/wiki/File:0328_Transcription-translation_Summary.jpg;License:

Within the rough ER, the nascent (immature) insulin protein is folded into primary, secondary, and teriary structures. It is then transported to the **Golgi apparatus**. The Golgi apparatus is the location for processing and sorting (think of a giant UPS mail warehouse). Within the Golgi, the nascent insulin is further processed into mature (functional) insulin and packaged into secretory vesicles. These vesicles (now full of insulin) bud off of the Golgi and are transported, via microtubules, to the **plasma membrane** where they await the proper signal for secretion. Secretion occurs as the vesicle fuses with the **plasma membrane**, expelling its contents into the extracellular space in a process known as exocytosis. Now that you understand the process of how cells can create and secrete insulin let us now examine the roles of each of these organelles in greater detail.