2. Anatomy and Physiology part 1

- Objectives in chapter 2.

- To get familiar with medical terminologies and accompanying concepts.
- Think of this as a reference.
- More reference terminologies in the additional reference book to be distributed.
- Will highlight most relevant words for students to remember.

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- Multimedia Resources for this chapter.
- We use Four Videos for this chapter.

- 1. Skeletal and tissues at Berkeley
- http://medical-education.blogspot.com/2006/11/video-anatomy-skeletal-system.html
- 2. Allen Weiner, U Washington, “Biology is Nanotech”
- http://www.uwtv.org/programs/displayevent.aspx?rID=2505&fID=497
- 3. A Biomimetics Video and an article in IEEE Sectrum, Mar. 2008 “Fly, Robot Fly”
- http://micro.seas.harvard.edu/

- 4. A Neuroscience for kid” Video
- http://www.uwtv.org/programs/displayevent.aspx?rID=4909

Contents

- anatomy : the internal and external structure of the body and their physical relationship
- physiology : the study of the function of those structures

Medical Terminology

- **Bacteria --** Back door of cafeteria
  Cat scan -- Searching for kitty
  Coma -- A punctuation mark
  Diarrhea -- Journal of daily events
  Dilate --
  Impotent -- Distinguished, well known
  Pelvis -- Cousin of Elvis
  Secretion -- Hiding anything
  Seizure -- Roman emperor
  Terminal illness --

anatomy

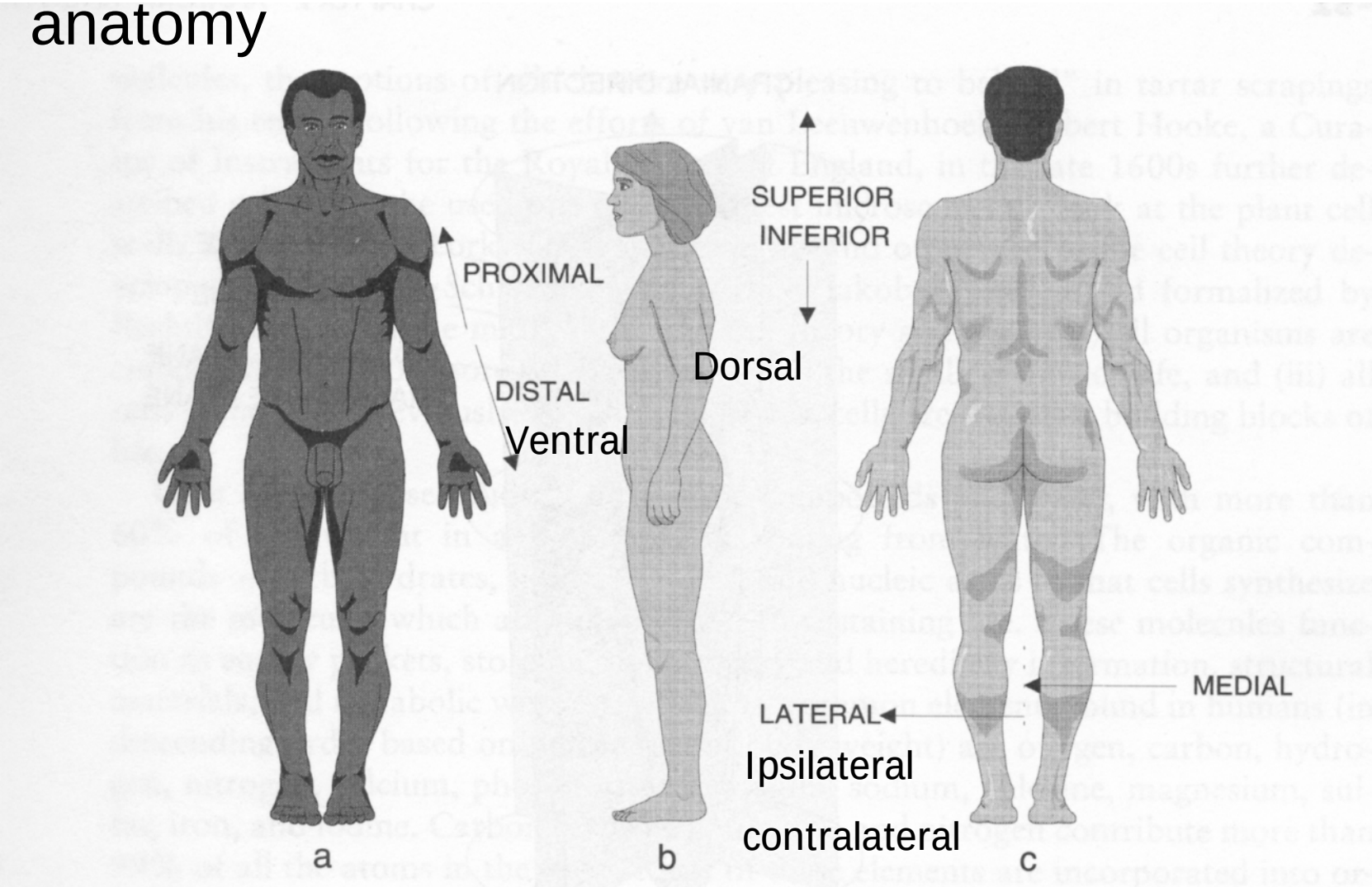


FIG 2.1. (a) anterior view of male body in anatomical position
(b) lateral view of female body
(c) posterior view of male body in anatomical position. Relative directions (proximal and distal, superior and inferior, and medial and lateral) are also shown.

planes

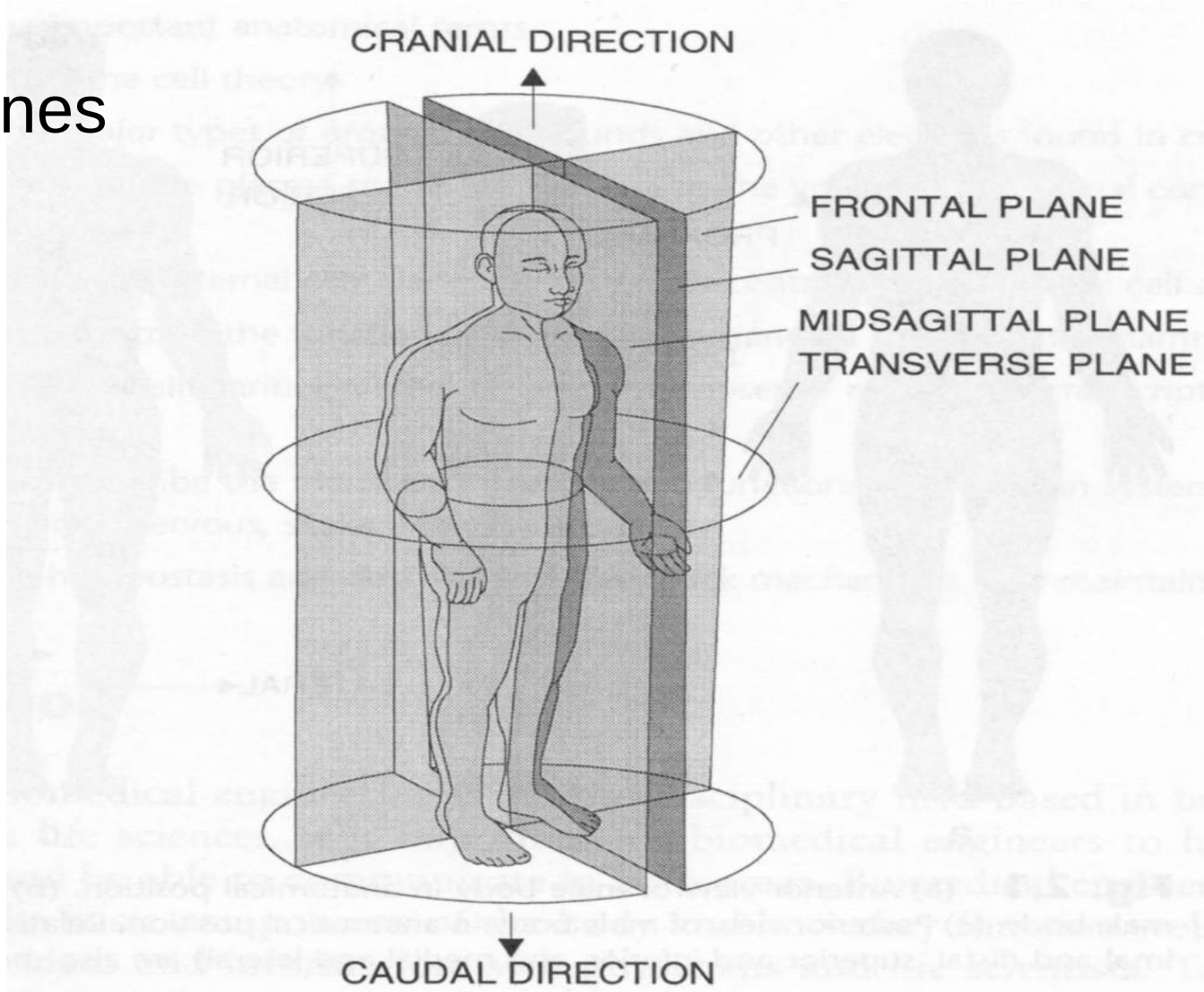


FIG 2.2.The body can be divided into sections by the frontal, sagittal, and transverse planes. The midsagittal plane goes through the midline of the body.

- anatomical division of **human body**
  - **axial part : head, neck, thorax, abdomen, pelvis**
    - **abdominal region divided into nine regions or four quadrants**
  - **appendicular part**
    - **upper extremities**
      - **(limbs: shoulders,upper arms,forearms.wrists,hands),**
    - **lower extremities**
      - **(hips,thighs,lower legs,ankles,feet)**

2. 2. CELLUAR ORGANIZATION

- cell theory

  -developed by Theodor Schwann and Matthias Jakob Schleiden

  - formalized by Rudolf Virchow in the mid-1800s.

(1) All organisms are composed of one or more cells

(2) **the cell is the smallest unit of life**

(3) **all cells come from previously existing cell**

Thus cells are the basic building blocks of life.

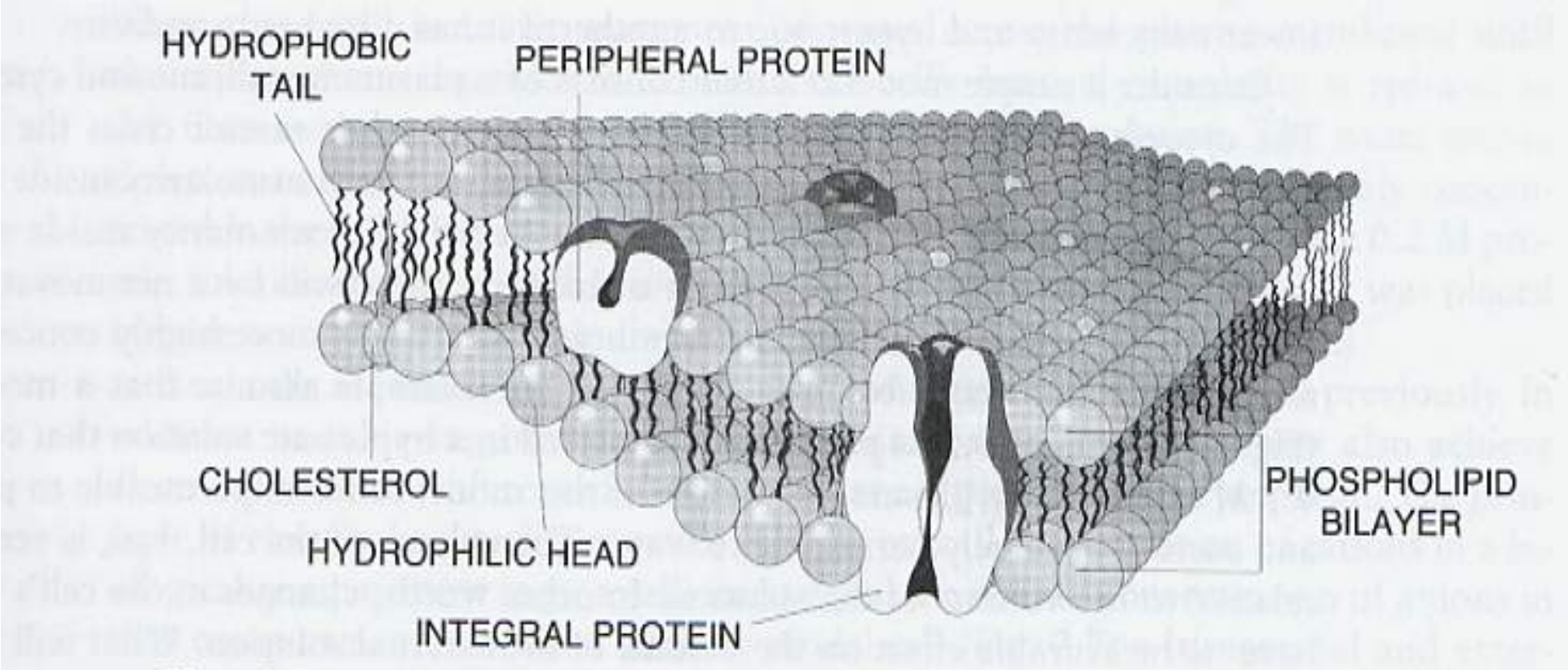


FIG 2.5. The plasma membrane surrounds all cells. It consists of a double layer of phospholipids interspersed with proteins and cholesterol.

Transport of large molecules

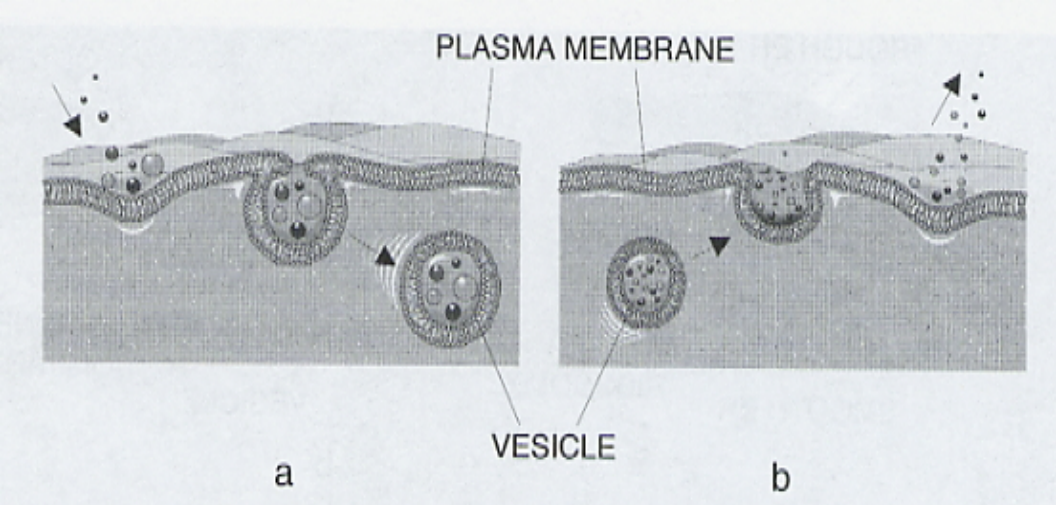


FIG.2.8. substances that are too large to pass through the integral proteins in the plasma membrane can be moved into the cell by means of endocytosis (a) and out of the cell by means of exocytosis (b)

- **Endocytosis : The outer materials move to inner cell with form of a vesicle. Material outside the cell is engulfed by a portion of the plasma membrane which encircles it to form a vesicle.The vesicle then pinches off from the plasma membrane and moves its contents to the inside of the cell.**
- **Exocytosis : The material within the cell is surrounded by a membrane to from a vesicle. The vesicle moves to the edge of the cell, then its membrane fuses with the plasma membrane and its contents are released.**

2.2.3. DNA and Gene Expression

DNA's are found in Chromosomes . Genes are functional parts of DNA molecules. DNA's consist of nucleotides.

- DNA: tightly coiled strands that are found in chromosomes.

- **Chromosomes: Human somatic cell has 46 chromosomes. Stretched out to be about 2nm wide and 2m long.**
- **Genes: segments of DNA.Each has a particular location in a specific chromosome and contains the code for producing one of the three forms of RNA**

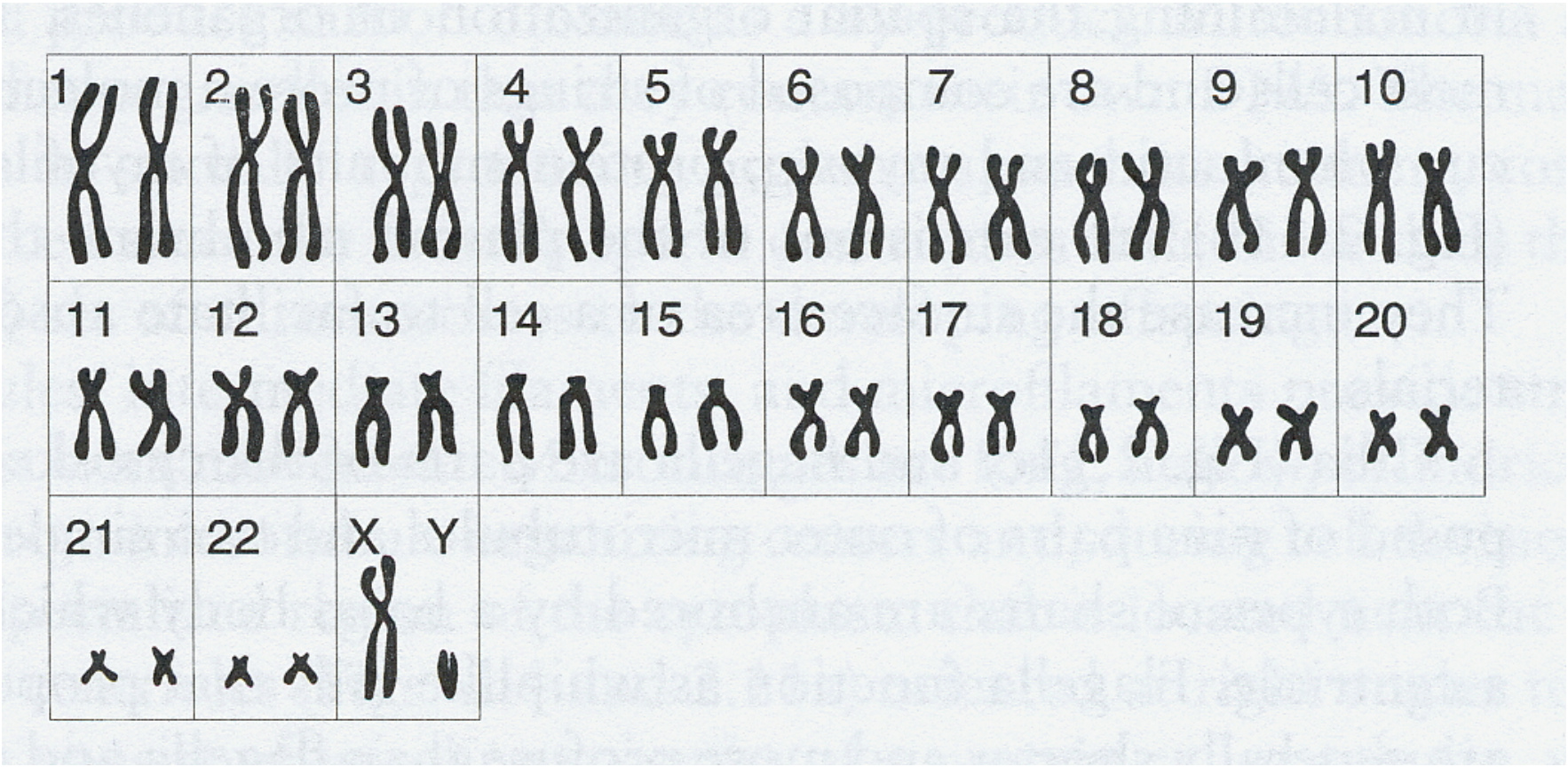


FIG 2.12. This karyotype of a normal human male shows the 22 pairs of autosomal chromosomes in descending order based on size, as well as the X and Y sex chromosomes.

▶ DNA

- contains information from both parents(the one in the mitochondria comes from mother)
- wrapped around protein spools (nucleosomes) in nucleus.
- organized into pairs of chromosomes
- each gene has a particular location in a specific chromosome and contains the code for producing one of the three forms of RNA
  - ribosomal RNA
  - messenger RNA
  - transfer RNA

▶ human Genome Project

- began in 1990, functional Genomics began in 2001 (originally planned for 15 years)
- First to identify the location of at least 3000 specific human genes
- Then to determine the sequence of nucleotides (about 3 billion) in a complete set of haploid human chromosomes

▶ DNA replication

- occur during cell division
- each strand of DNA is duplicated so that two double helices now exist.
- Each consists of one strand of the original DNA and one new strand.
- Some enzymes check for accuracy so that the error rate is reduced to approximately one per billion.

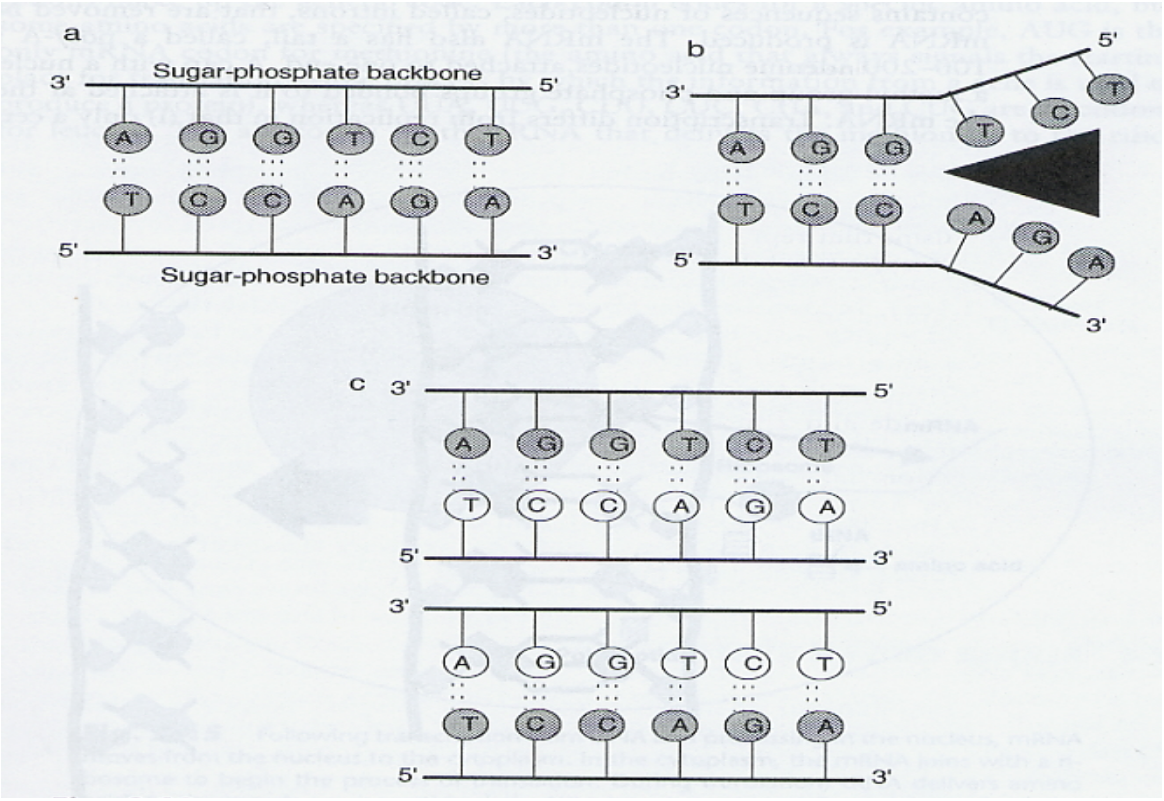


FIG 2.13. During replication, DNA helicase (shown as a black wedge in b) unzips the double helix (a).

Another enzyme, DNA polymerase, then copies each side of the unzipped chain in the 5' to 3' direction.

One side of the chain (5' to 3') can be copied continuously, whereas the opposite side (3' to 5') is copied in small chunks in the 5' to 3' direction that are bound together by another enzyme, DNA ligase.

Two identical double strands of DNA are produced as a result of replication.

▶ transcription

- DNA is in the nucleus and proteins are made on ribosomes outside of nucleus and in the cytoplasm—need to send message out.
- Sequence of nucleotides in a gene that codes for a protein is transferred to mRNA through complementary base pairing of the nucleotide sequence in the gene.
- Difference from replication
  - only a certain stretch of DNA acts as the template and not the whole strand
  - different enzymes are used
  - only a single strand is produced

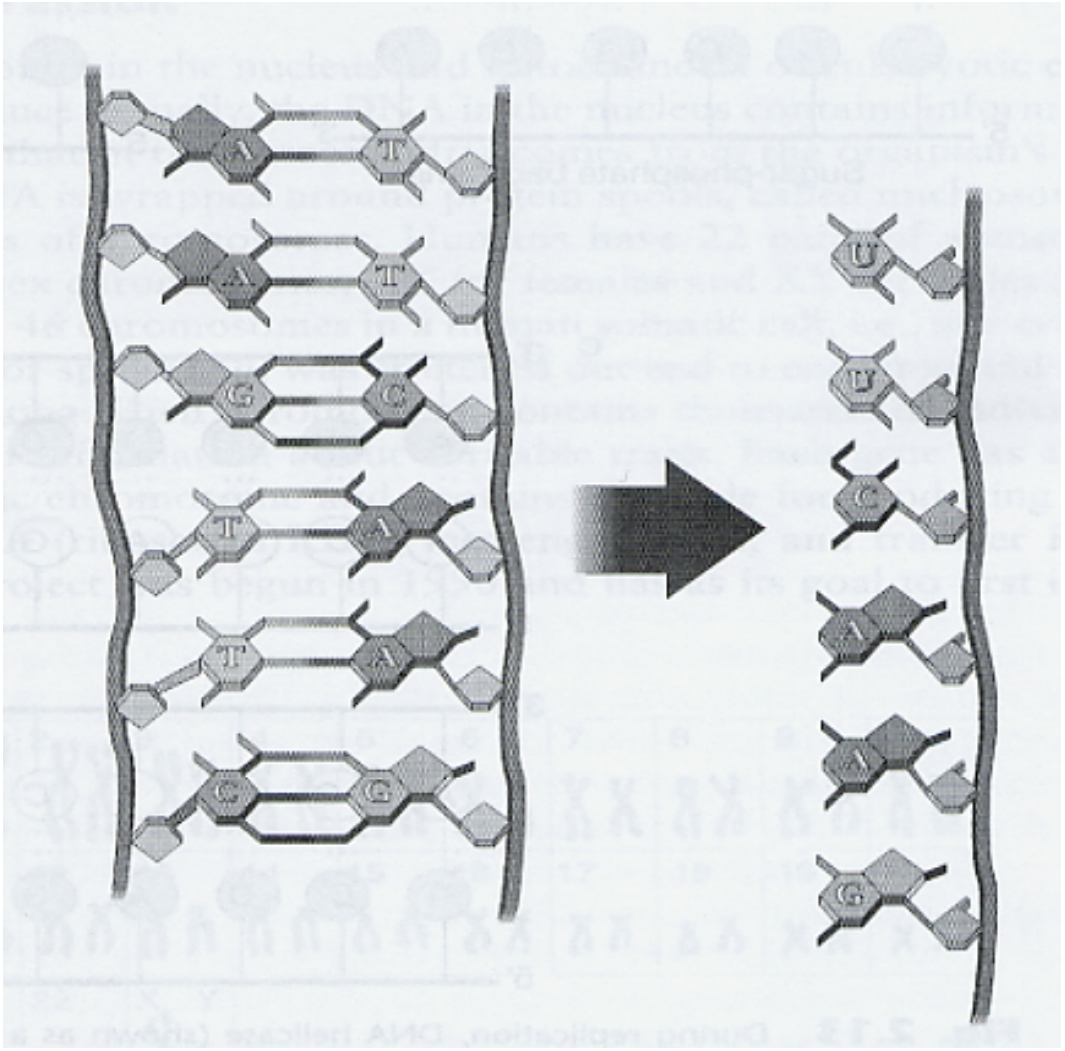
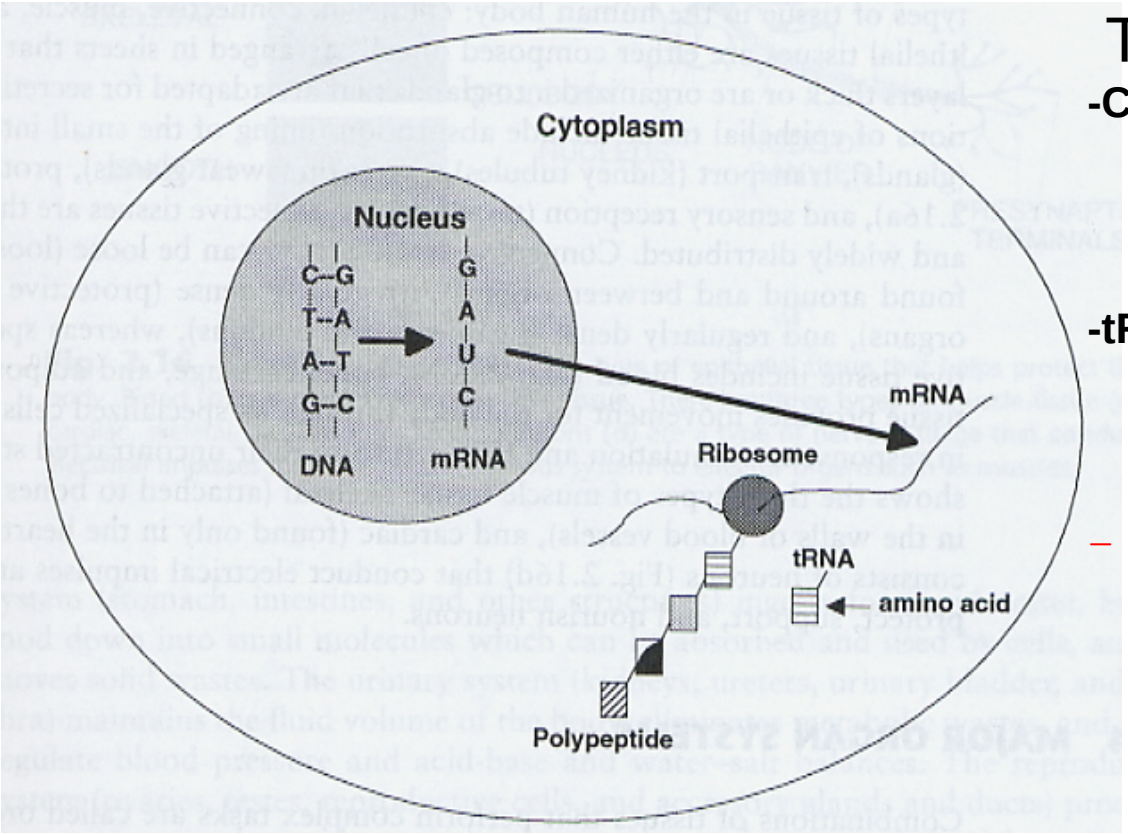


FIG 2.14. During transcription, RNA is formed from genes in the cell's DNA by complementary base pairing to one of the strands. RNA contains uracil(U) rather than thymine(T) so the T in the first two pairs of the DNA become Us in the single-stranded RNA.



Translation(after transription)

-Codon:a triplet in mRNA:coden(and anticoden) can organize 64(4^3) associations

for nucleotides(A,U,C,G) in each of the three places.

-tRNA contains an anticoden (3-base set), and binds at an area away from the triplet to an amino acid that is sprecific for that particular anticodon.

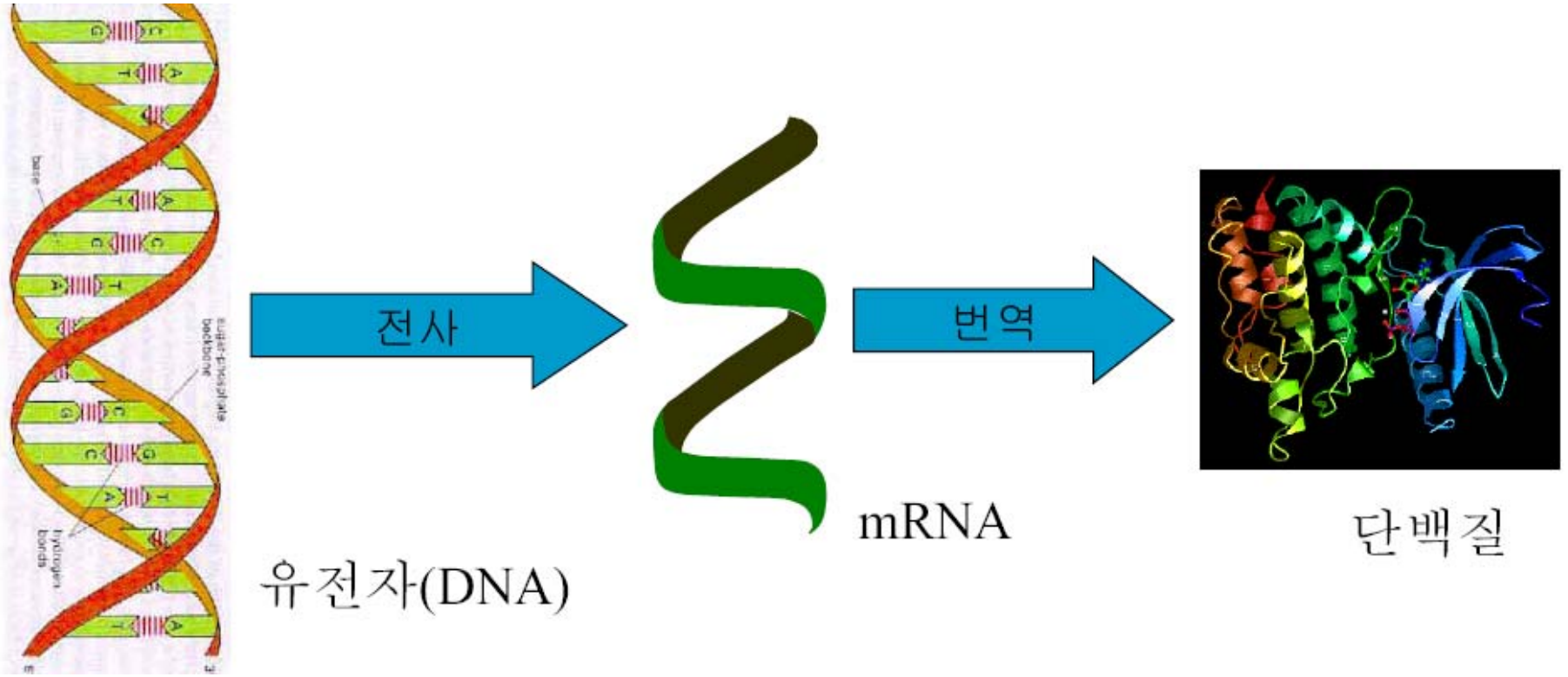
- DNA>mRNA>Codon>tRNA>Anticodon >specific_amino_acid>poly_peptide

FIG 2.15. Following transcription from DNA and processing in the nucleus, mRNA moves from the nucleus to the cytoplasm. In the cytoplasm, the mRNA joins with a ribosome to begin the process of translation.

During translation, tRNA delivers amino acids to the growing polypeptide chain. Which amino acid is delivered depends on the anticodon of a specific tRNA. Each tRNA binds to a particular amino acid at a site that is opposite the location of the anticodon.

For example, the codon CUG in mRNA is complementary to the anticodon GAC in the tRNA that carries leucine and will result in adding the amino acid leucine to the polypeptide chin.

- Central Dogma (Watson&Crick) 1955



- Each codon codes for a specific amino acid, but some amino acids are specified by more than one coden.

- Examples
- ▪ coden for metihionine : AUG
  ▪ codons for leucine : UUA, UUG, CUU, CUC, CUA, CUG

- ▪ anticodon on the tRNA that delivers the methionine to the ribosome : UAC
  ▪ tRNA with anticodons of AAU, AAC, GAA, GAG, GAU, GAC deliver leucine

▶ More on the **translation**

- mRNA binds to a ribosome and tRNA delivers amino acids to the growing polypeptide chain.
- Peptide bonds are formed between each new amino acid and the previous one.
- tRNA moves off into the cytoplasm where an amino acid joins with its anticodon.
- Process continues until a stop codon (UAA,UAG,or UGA) is reached on the mRNA
- The protein is then released into the cytoplasm (for transportation out of cell) or into the rough ER (for further modifications).