# DNA

# Characteristics of Life

- Cellular organization
- Reproduction
- Homeostasis
- Heredity
- Responsiveness
- Growth and Development
- Complex Chemistry (Biomolecules)

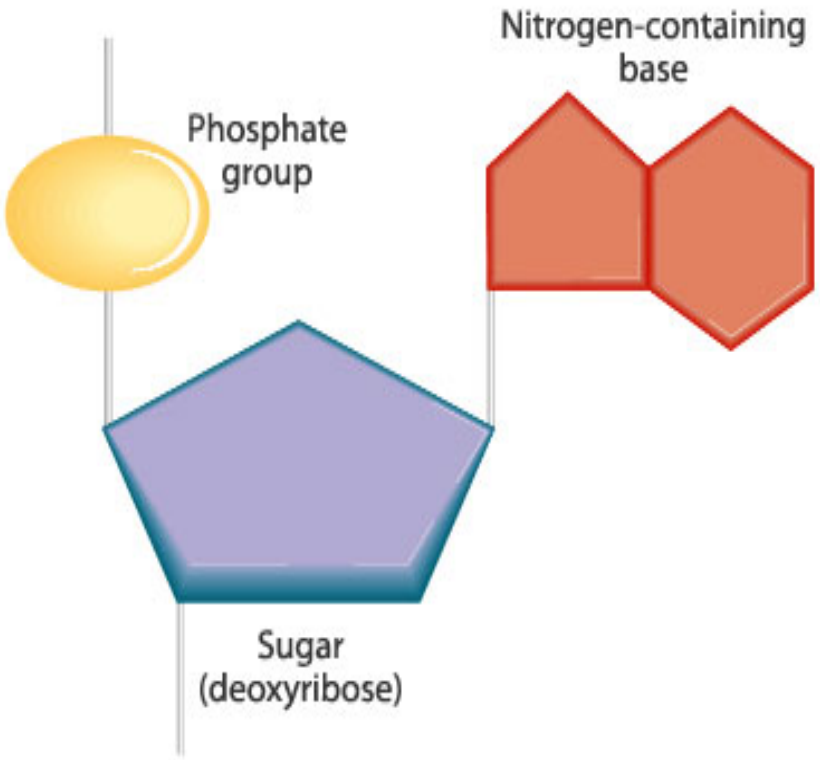
# Biomolecules

| Biomolecule | Proteins | Carbohydrates | Lipids | Nucleic Acids |
|---|---|---|---|---|
| Element | C, H, O, N, S | C, H, O | C, H, O, P | C, H, O, P, N |
| Examples | Enzymes, muscle fibers, antibodies | Sugar, glucose, starch, glycogen, | cellulose Fats, oils, waxes, steroids, phospholipids in membranes | DNA, RNA |
| Monomers (subunits) | Animo Acids | Monosaccharaides (simple sugars | Fatty Acid | Nucleotides |

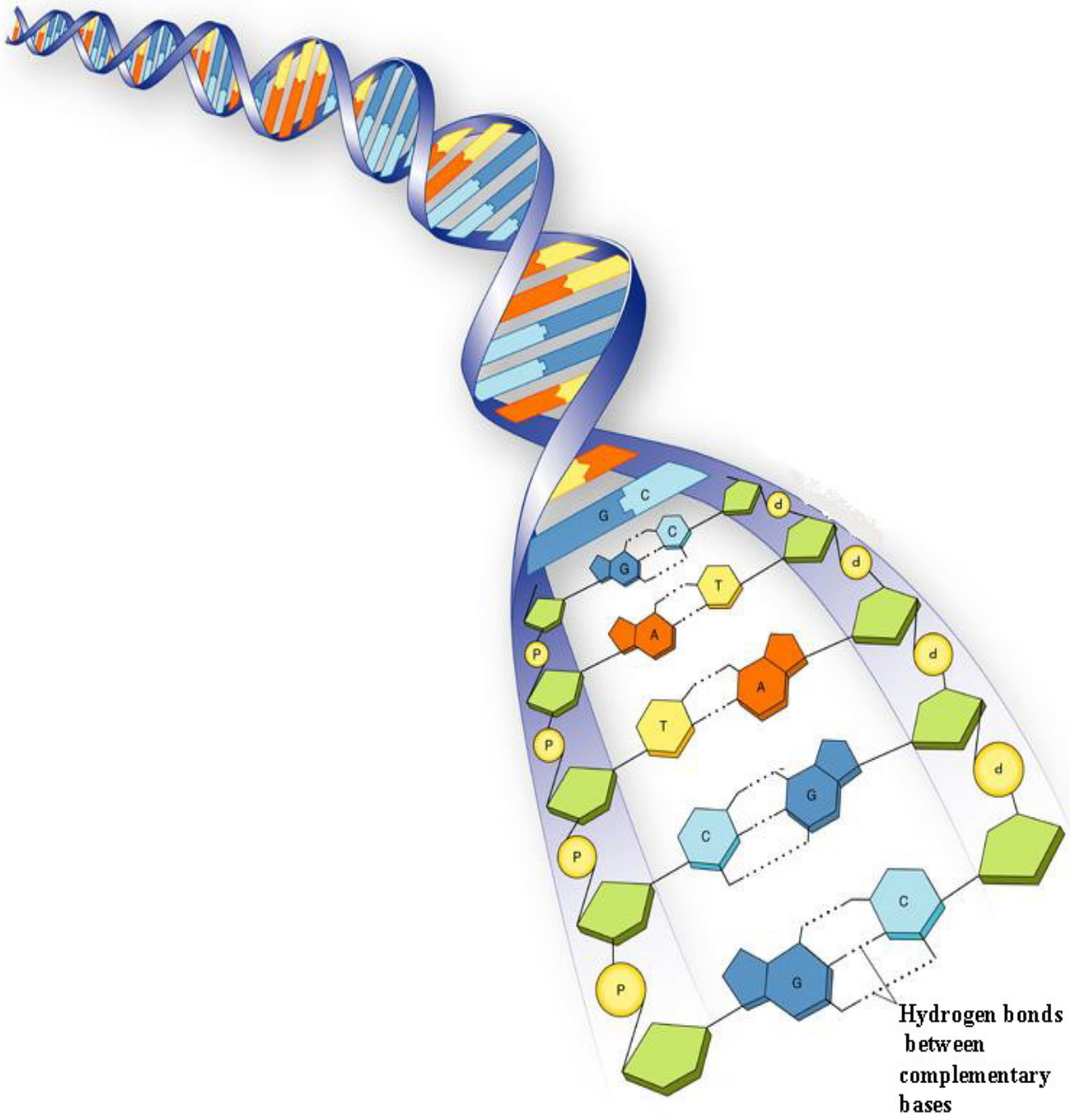
# DNA Double Helix
## February 28, 1953…


- Watson and Crick created a model of DNA by using Franklin's and Wilkins's DNA diffraction X-ray

# Nucleotides:
## building blocks of DNA (and RNA)



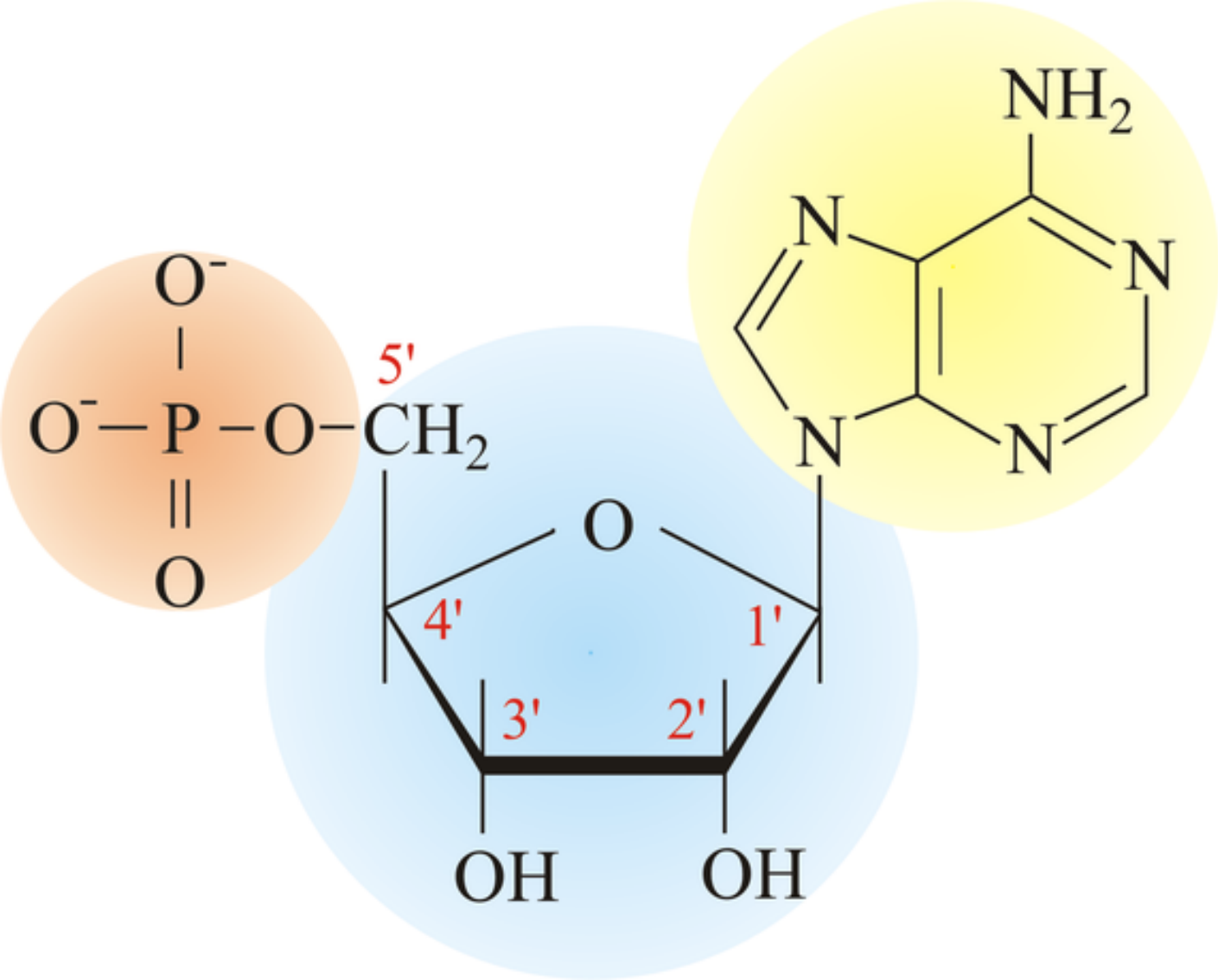

- A DNA **nucleotide**
  - a 5-carbon **deoxyribose** sugar
  - a phosphate group
  - one of four **nitrogenous bases**: adenine (A), guanine (G), cytosine (C), or thymine (T).

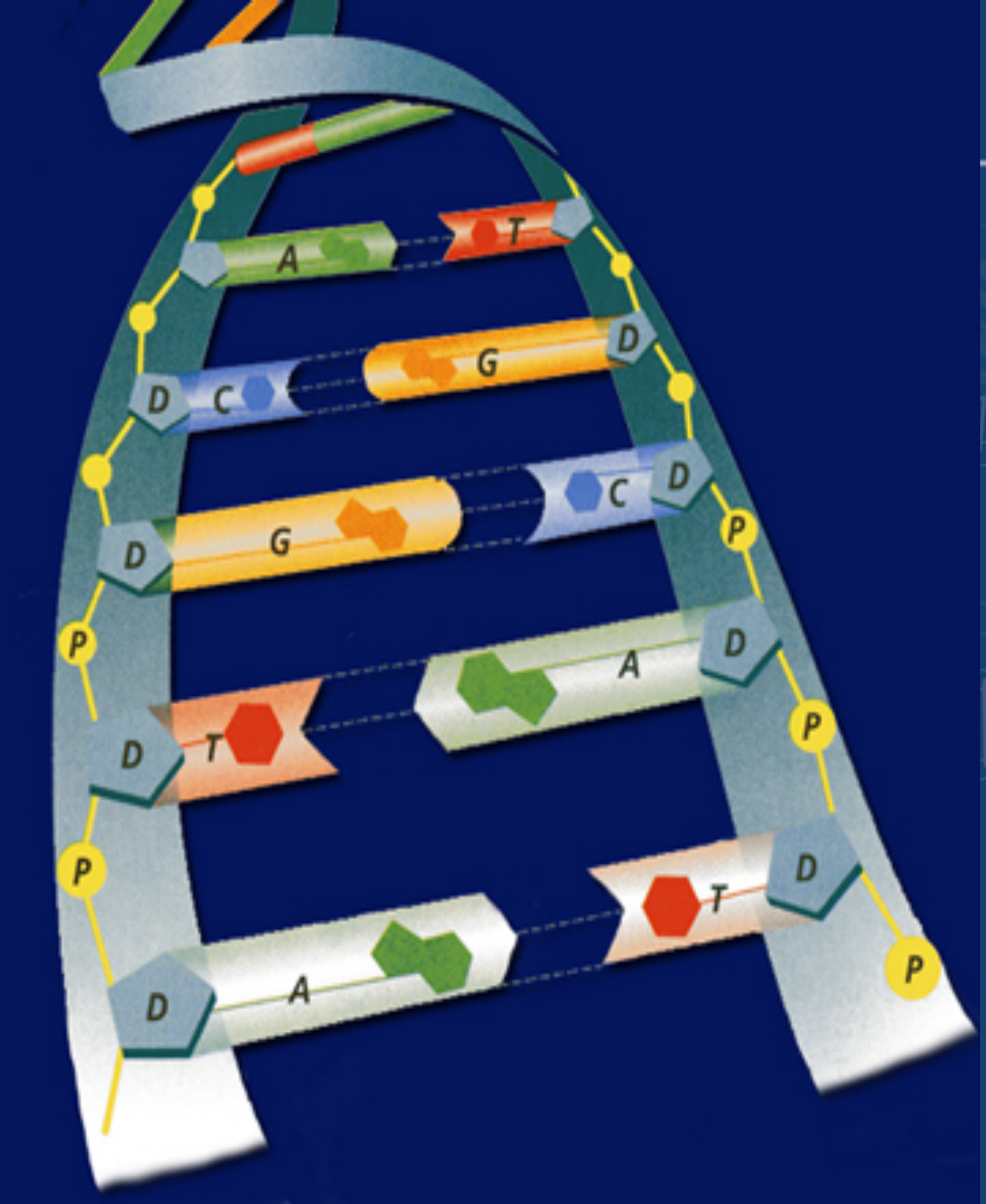



DNA is in a Double-Helix Structure

This structure provides Protection and takes up minimal space in the Nucleus

# List the Parts of a Nucleotide






- Complementary Base Pair Rules
  - A—T
  - T—A
  - G—C
  - C—G

# Practice…

- Strand A

ATGCTAGCTATTC

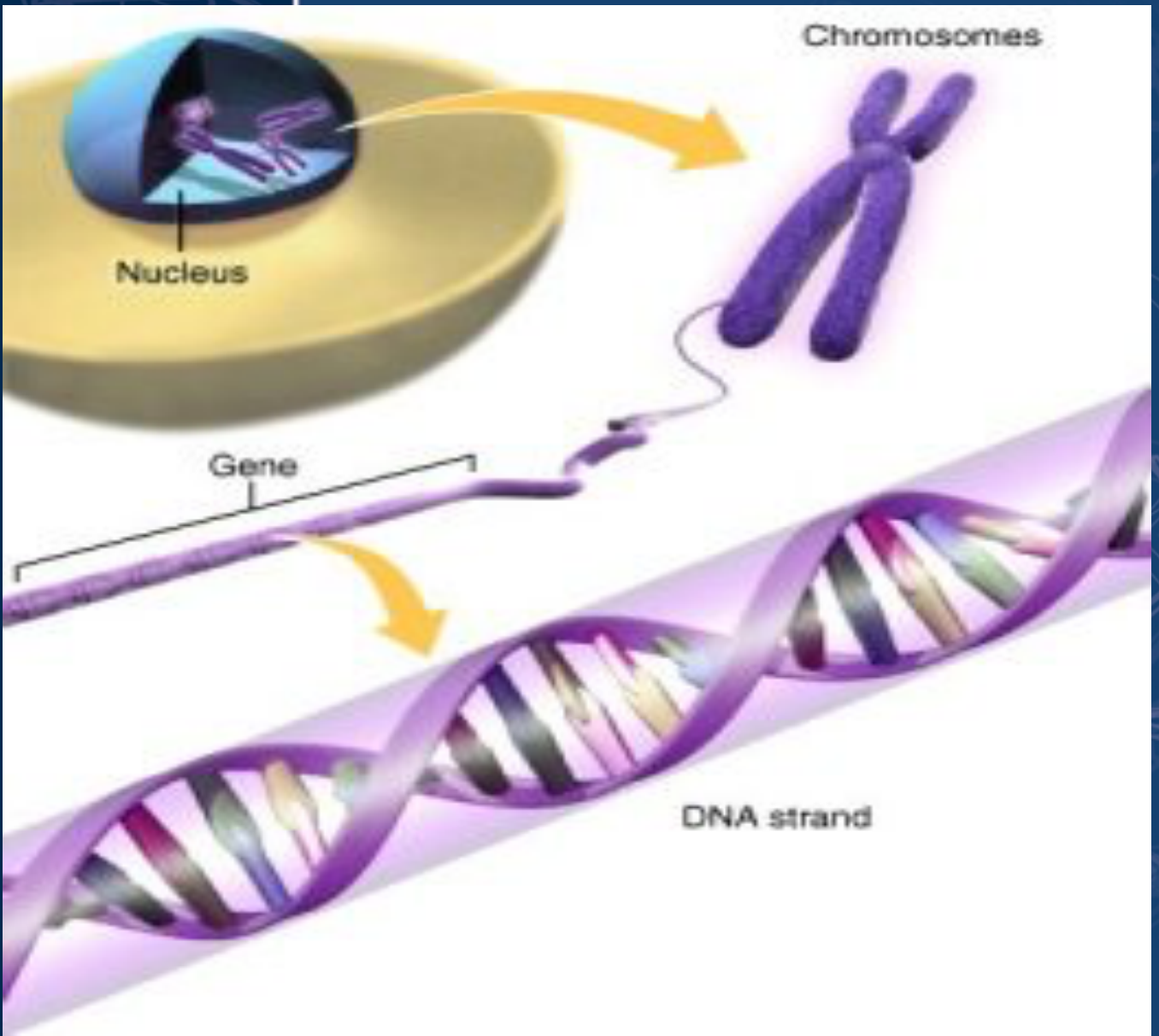
- Strand B? (compliment)

TACGATCGATAAG

# DNA Functions

- DNA contains all the information for developing all proteins in the body.
  - Primary function is to create proteins
- Proteins make up the structures and carry out the functions of the organism.
- DNA is located in the nucleus of all cells.

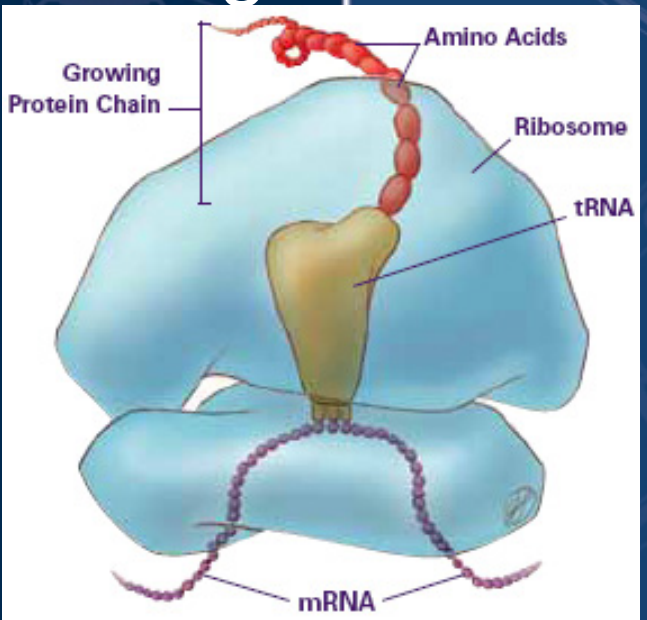
# Genes

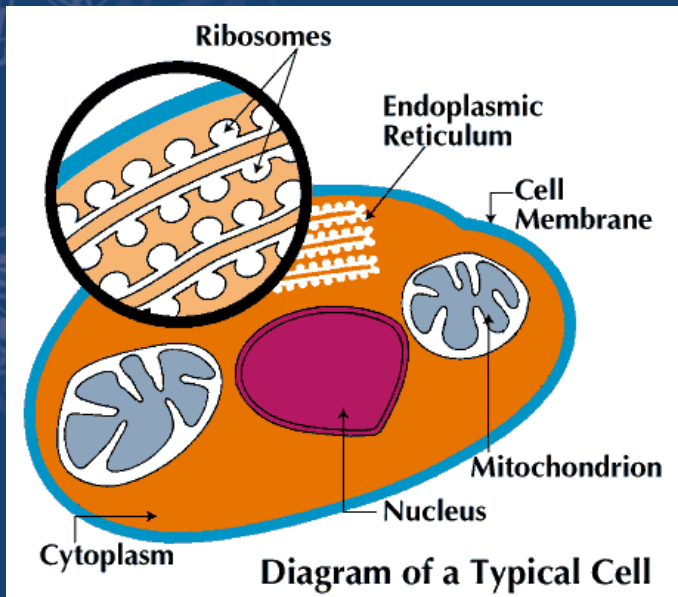



- DNA is segmented into parts called genes.
- Genes are responsible for coding different traits (skin, eye, hair color)

# DNA in the Nucleus

- DNA is found in the nucleus and is too big to leave the nucleus.
- DNA's main function is to create Proteins.
- Proteins are made outside of the nucleus on organelles called Ribosomes.

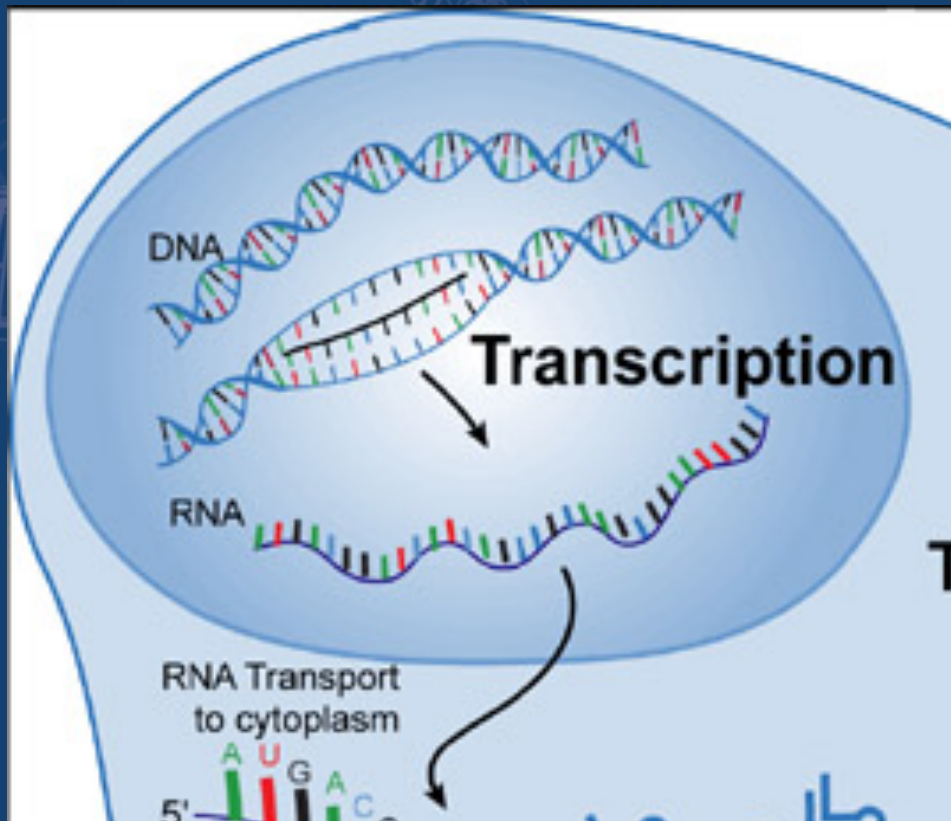


# How does the information to make the proteins get to the ribosomes?

- RNA

- DNA makes RNA <u>inside of the nucleus</u> through the process of <u>Transcription.</u>



# DNA or RNA

DNA

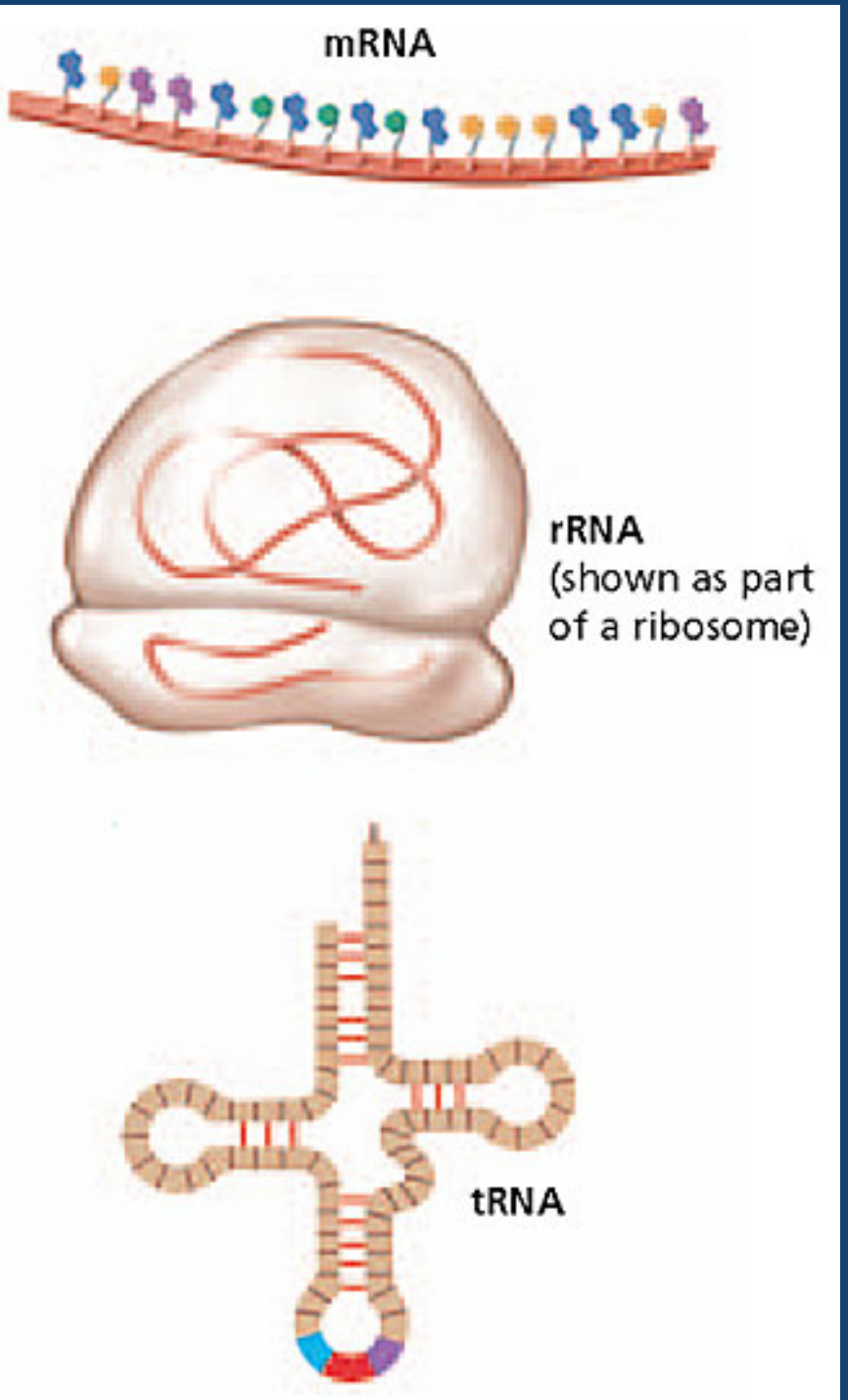
- Double Stranded
- CGAT
- Deoxyribose Sugar
- Too big to move from nucleus

RNA

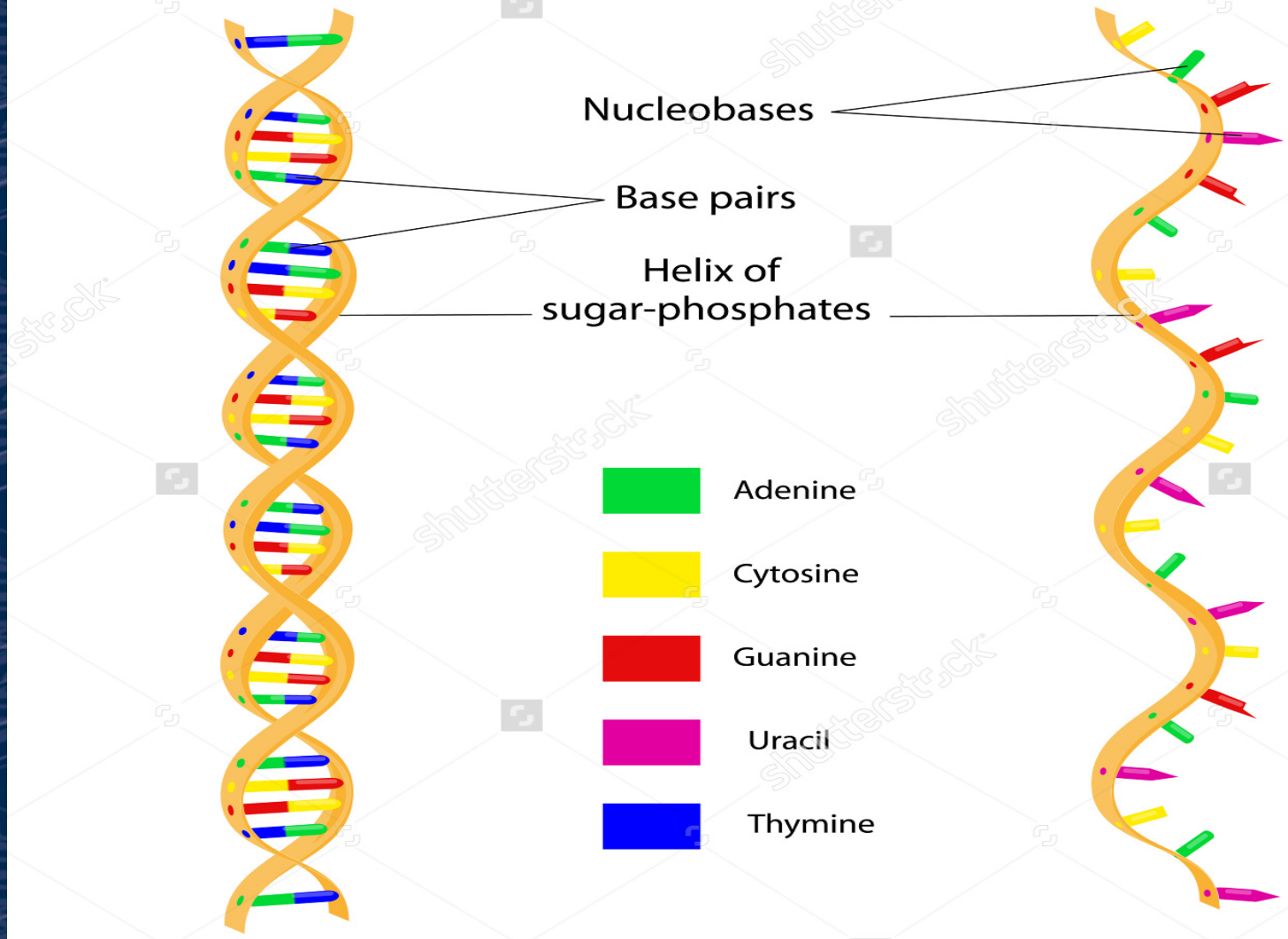
- Single Stranded
- CGAU
- Ribose Sugar
- Small and Transferable
- 3 types (mRNA, tRNA, rRNA)

# Types of RNA

- **Types of RNA**
  - Cells have three major types of RNA:
    - **messenger RNA (mRNA)**
    - **ribosomal RNA (rRNA)**
    - **transfer RNA (tRNA)**



# Structure of DNA & RNA



# RNA to Protein

- RNA takes the information from DNA to the ribosome to build proteins by coding for amino acids.

- The building of proteins is called translation.

ESSENTIAL FOR LIFE!!!!

- Proteins are used to create all the different types of organelles, cells, organs as well as perform their functions

# MAJOR TYPES OF PROTEINS

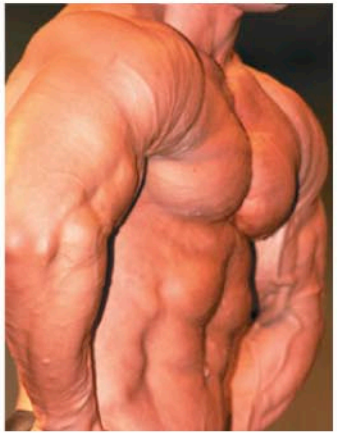
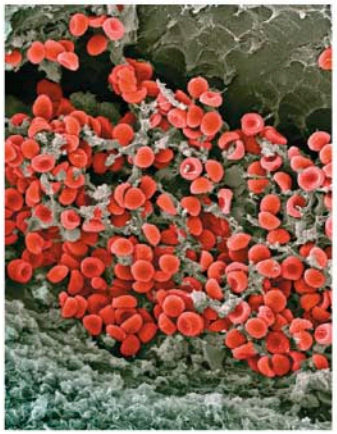
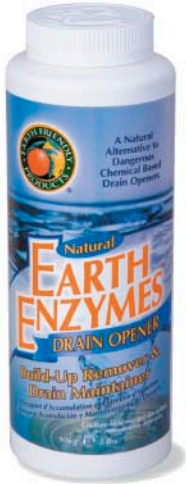
| Structural Proteins | Storage Proteins | Contractile Proteins | Transport Proteins | Enzymes |
|---|---|---|---|---|
|  |  |  |  |   |



Figure 3.15

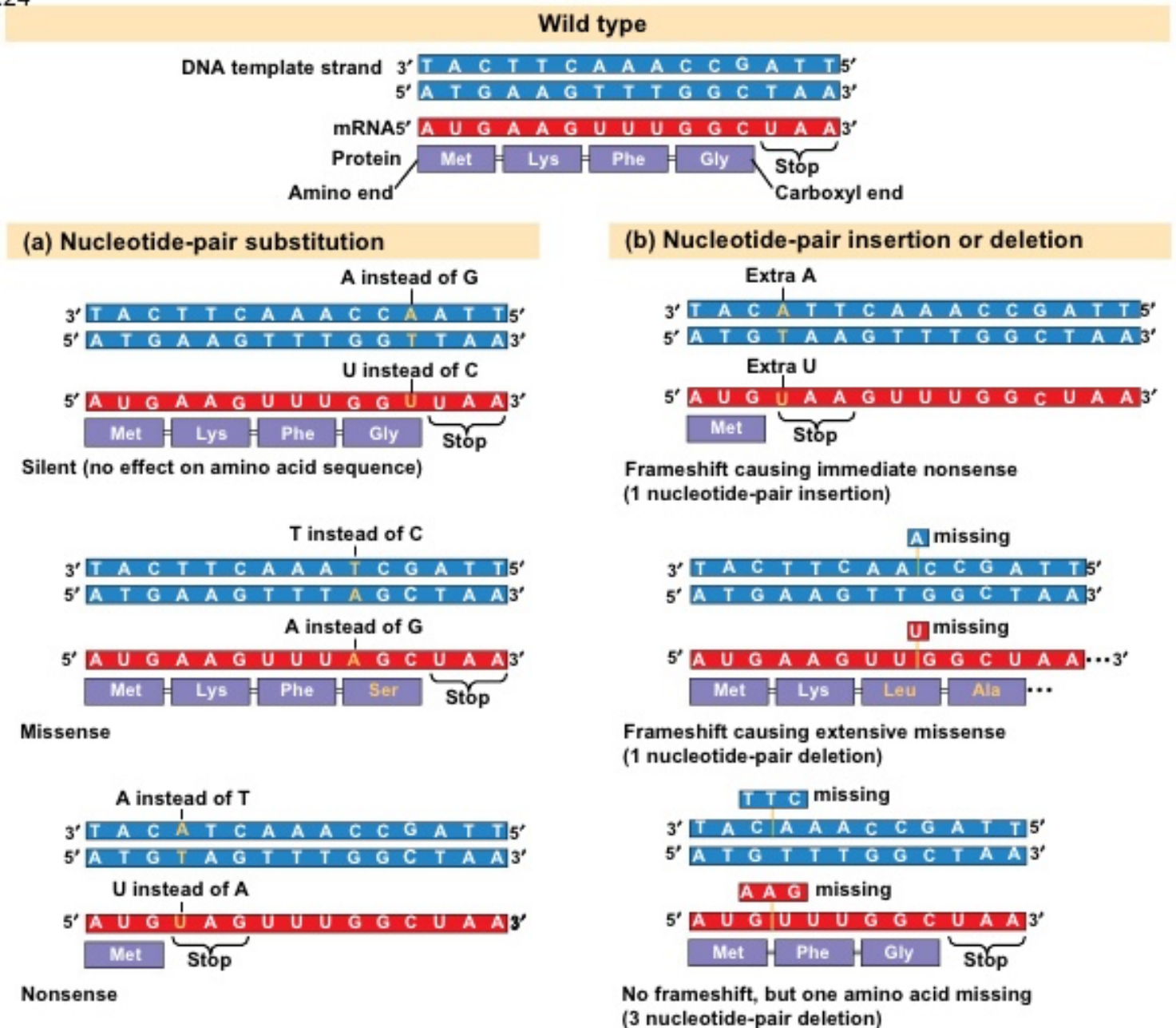
# What if something goes WRONG!!!

- The proper function of many proteins is essential for the function of a cell.
- Genes (DNA) affects the protein functions, which in turn affects all bodily functions

- Mutation – an error (change) in the DNA sequence.
  - Can have major, little, or no affect
  - A mutation that alters the way a protein is made could change the function of a whole organ system.

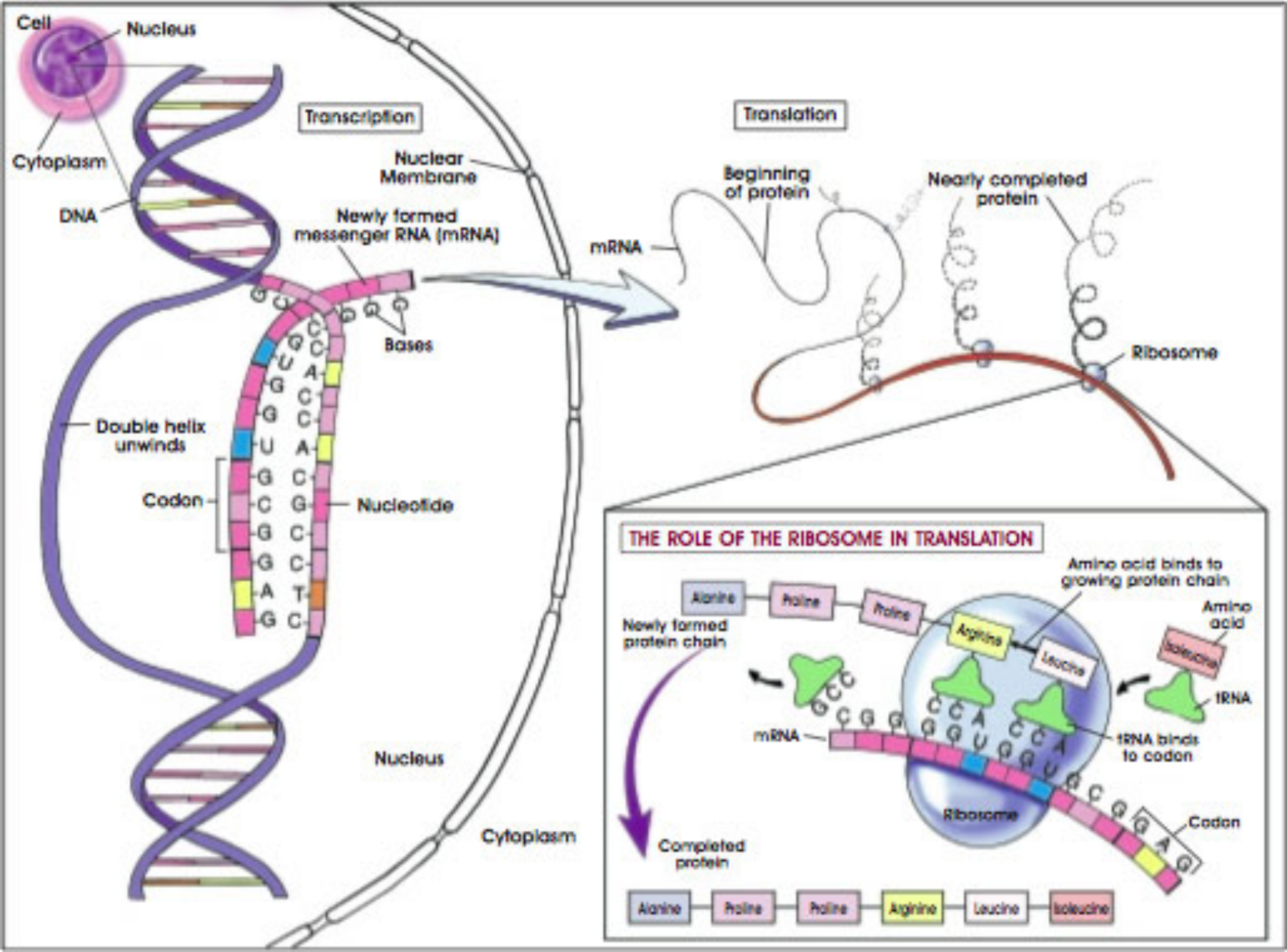
# Mutation in a DNA Sequence

Figure 17.24



# In Review: Flow of Genetic Information

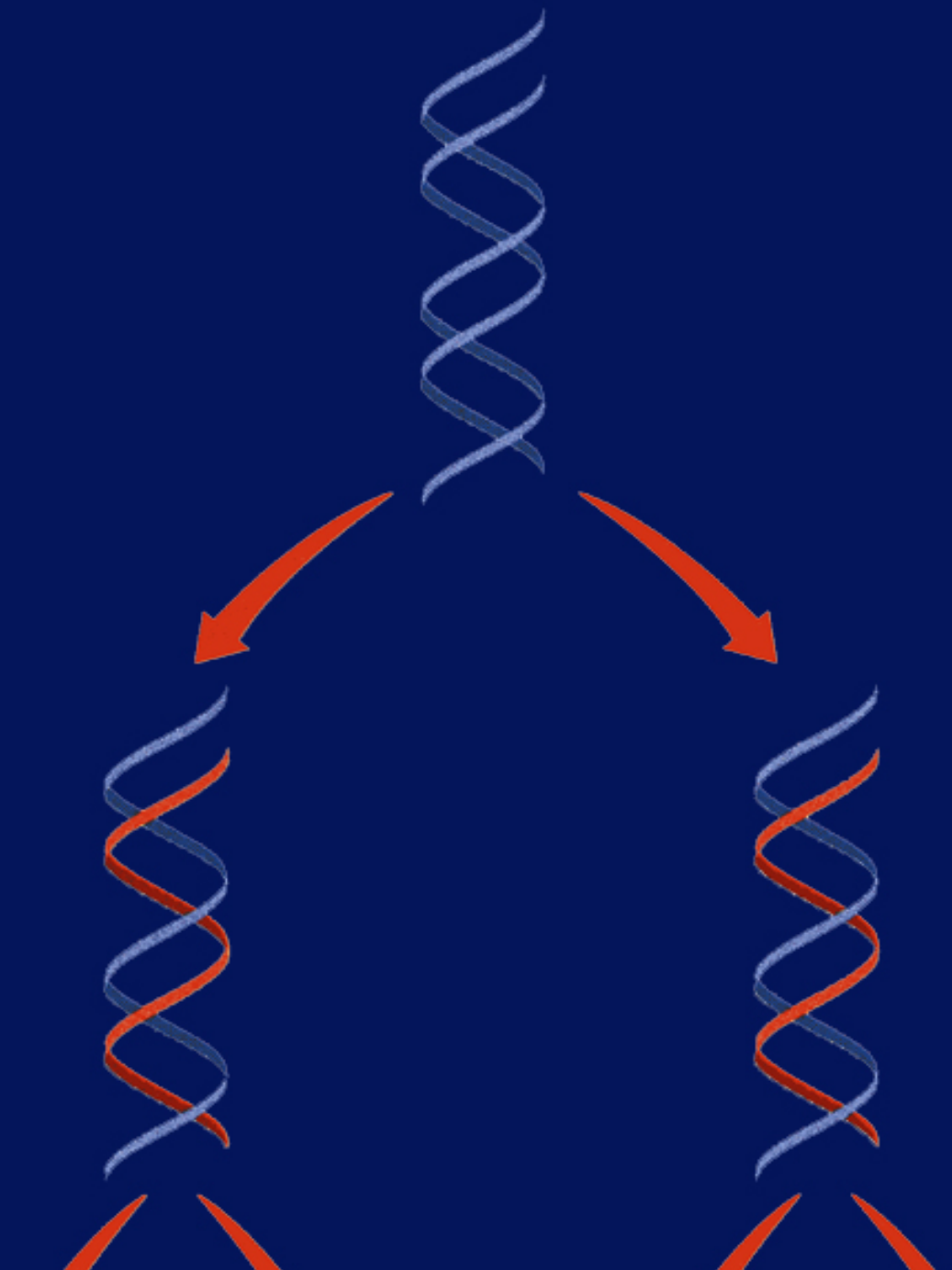
- The flow of genetic information can be symbolized as DNA→RNA→Protein.
- The sequence of nucleotides in DNA contain information.
- This information is put to work through the production of proteins.
- Proteins fold into complex, 3-D shapes to become key cell structures and regulators of cell functions.


Cell
Nucleus
Cytoplasm
DNA
Transcription
Nuclear Membrane
Newly formed messenger RNA (mRNA)
Bases
Double helix unwinds
Codon
Nucleotide
Nucleus
Cytoplasm
Translation
mRNA
Beginning of protein
Nearly completed protein
Ribosome
THE ROLE OF THE RIBOSOME IN TRANSLATION
Amino acid binds to growing protein chain
Alanine
Proline
Proline
Arginine
Leucine
Isoleucine
Amino acid
Newly formed protein chain
tRNA
mRNA
tRNA binds to codon
Ribosome
Codon
Completed protein
Alanine
Proline
Proline
Arginine
Leucine
Isoleucine

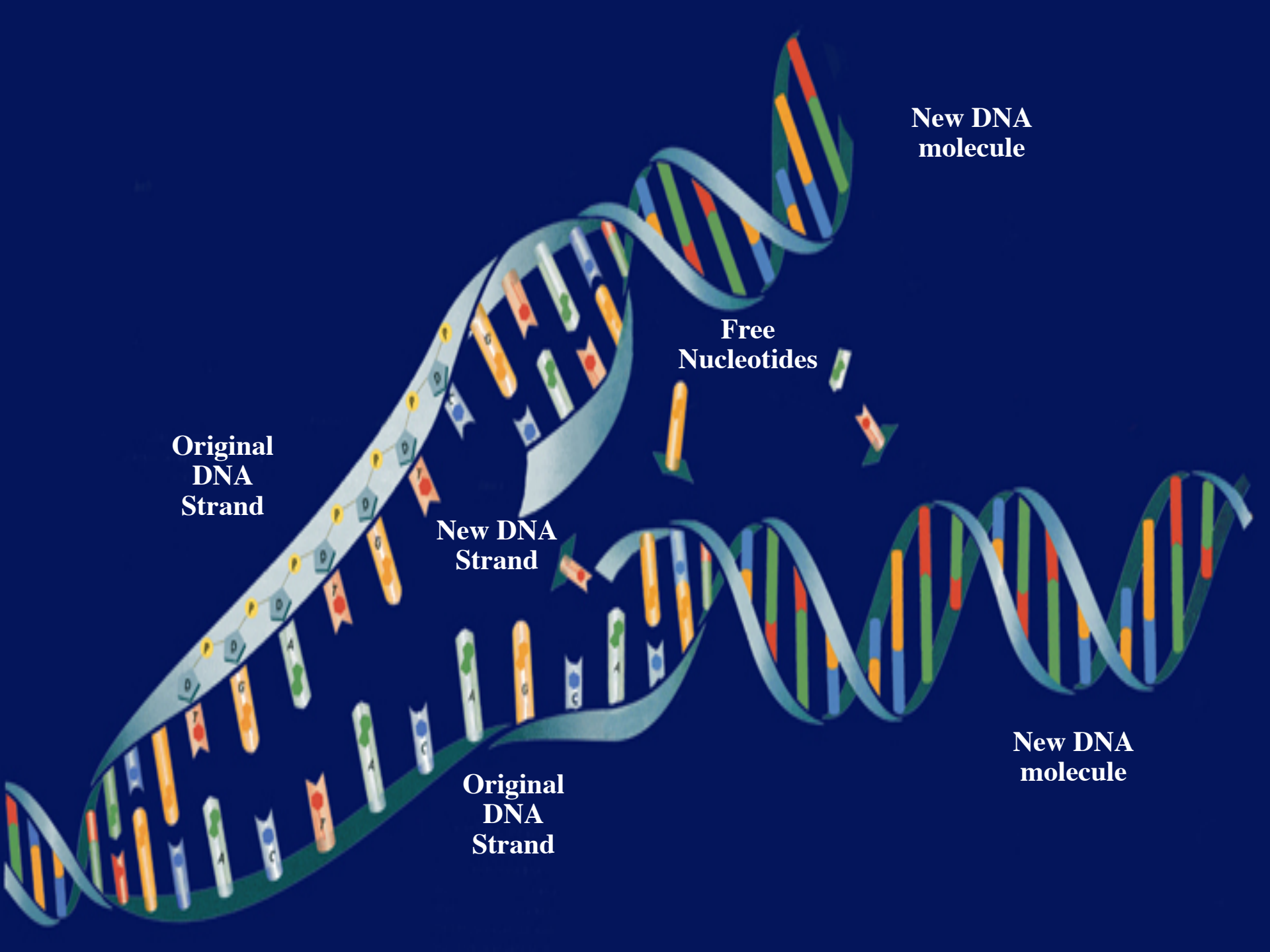
# What's the difference between the DNA in your skin cells and the DNA in your muscle cells?

- NOTHING!
- Your DNA is the same all of your somatic (body) cells.
- How does this DNA get to every cell?

# DNA Replication



- Each new DNA molecule is made of one strand of nucleotides from the original DNA molecule and one new strand.

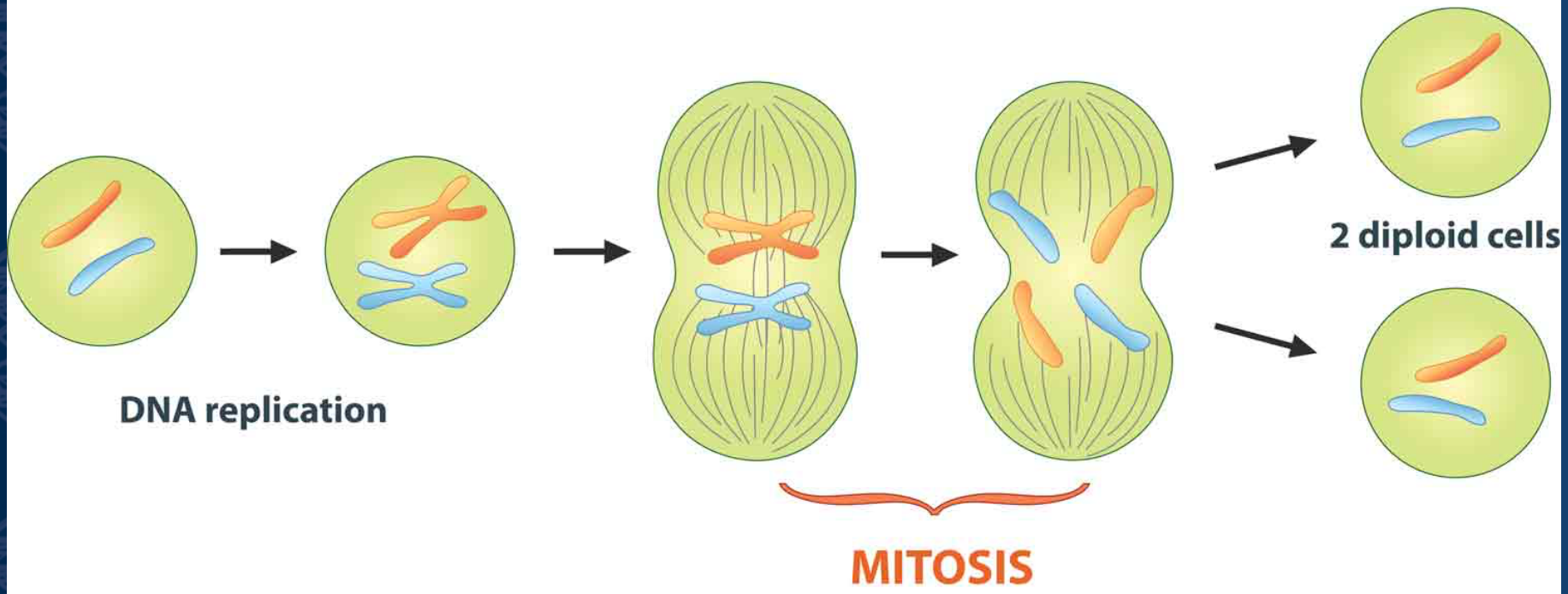

New DNA molecule
Free Nucleotides
Original DNA Strand
New DNA Strand
Original DNA Strand
New DNA molecule

# Mitosis

- process by which DNA is copied in a cell before a cell divides in Mitosis

- Mitosis – is the process in which cells divide with the same genetic material
  - The original (parent cell) splits into two genetically identical daughter cells.

# Mitosis



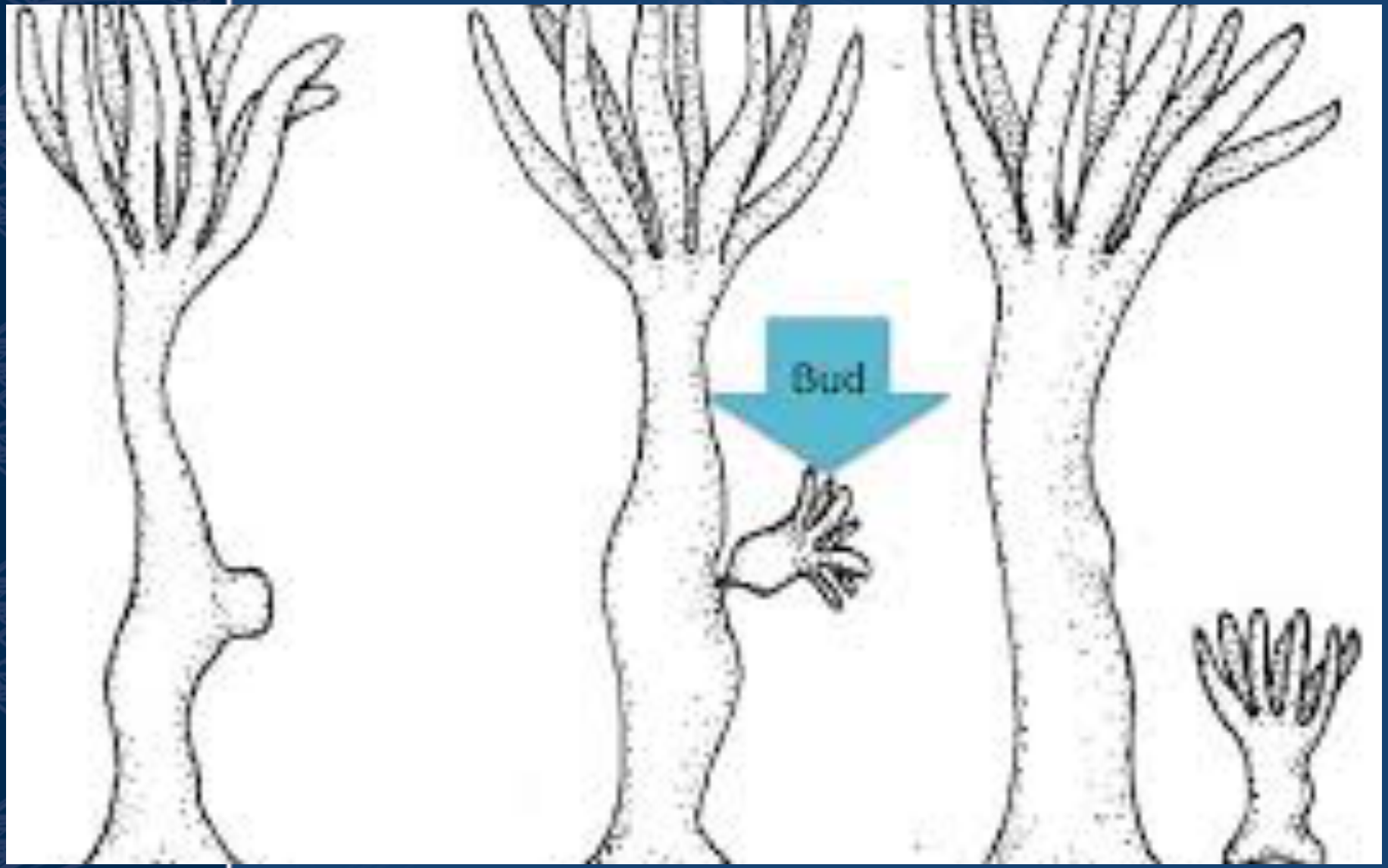
# Mitosis (cont.)

- Mitosis is important for sexual and asexual organisms.

Sexual
- Growth
- Repairing Tissues
- Cellular Differentiation

Asexual
- How the organism reproduces

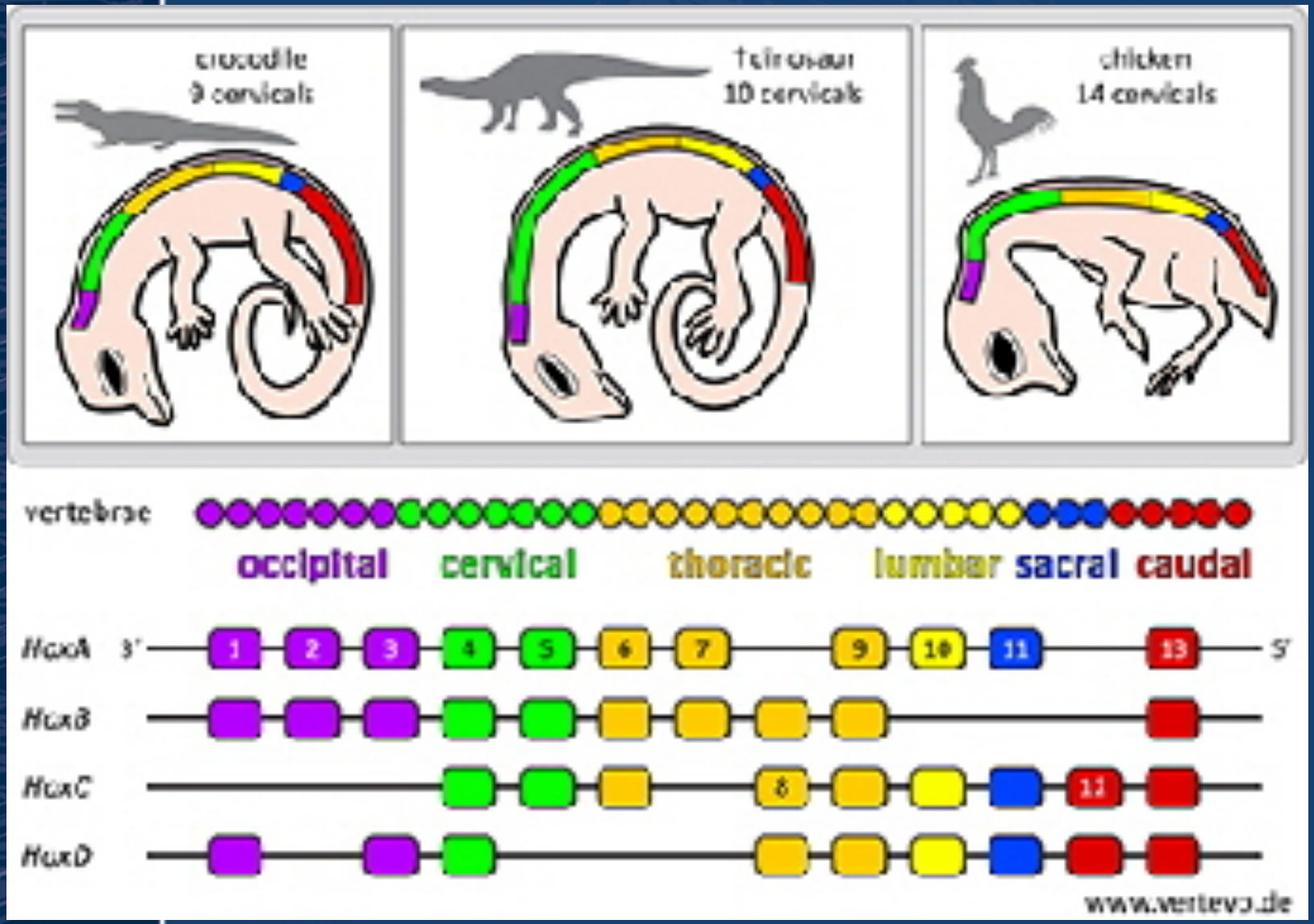
# Asexual Reproduction (Budding)



# Cellular Differentiation

- Just because all of your cells contain the same DNA does not mean all of your cells are the same.
- Differences between different cell types (bone,muscle,skin) are due to gene expression.
- This is not an result of different genes(DNA)
- THIS IS NOT A RESULT OF MUTATION!

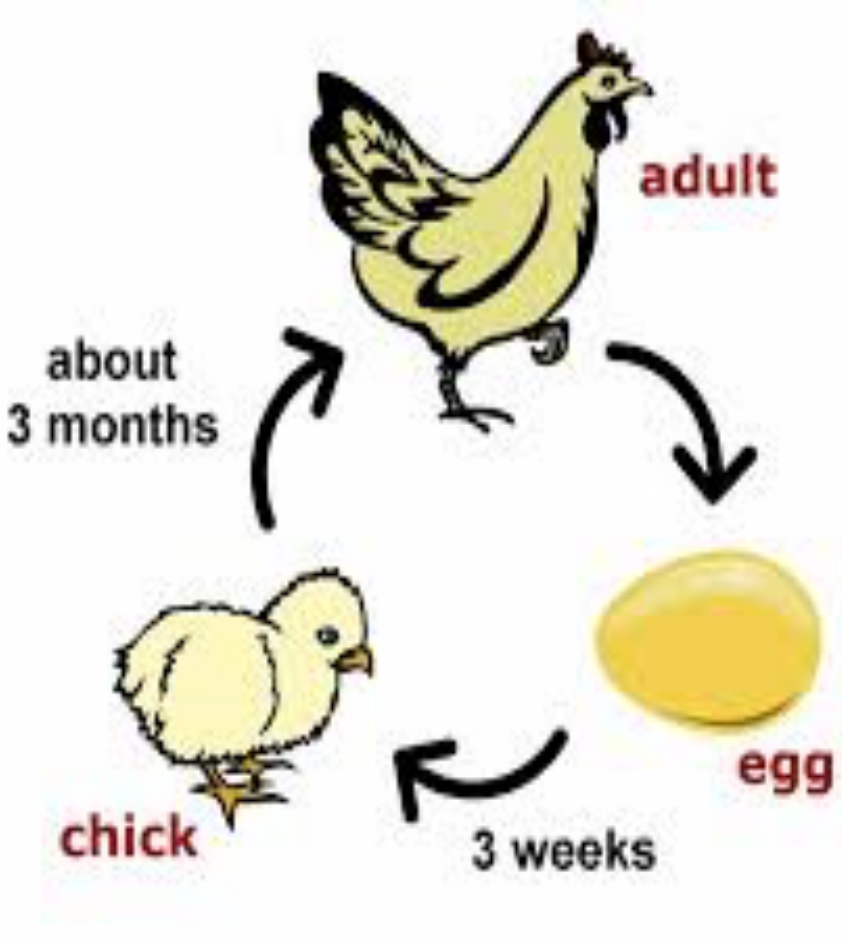
# Cellular Differentiation

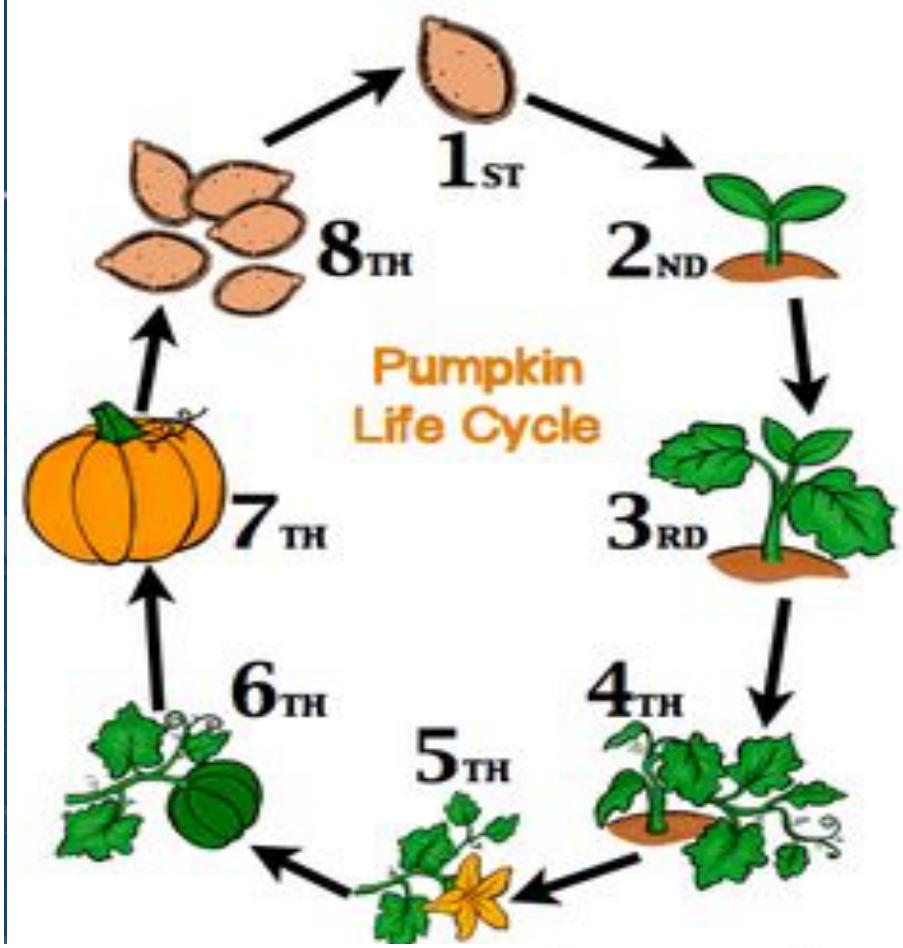


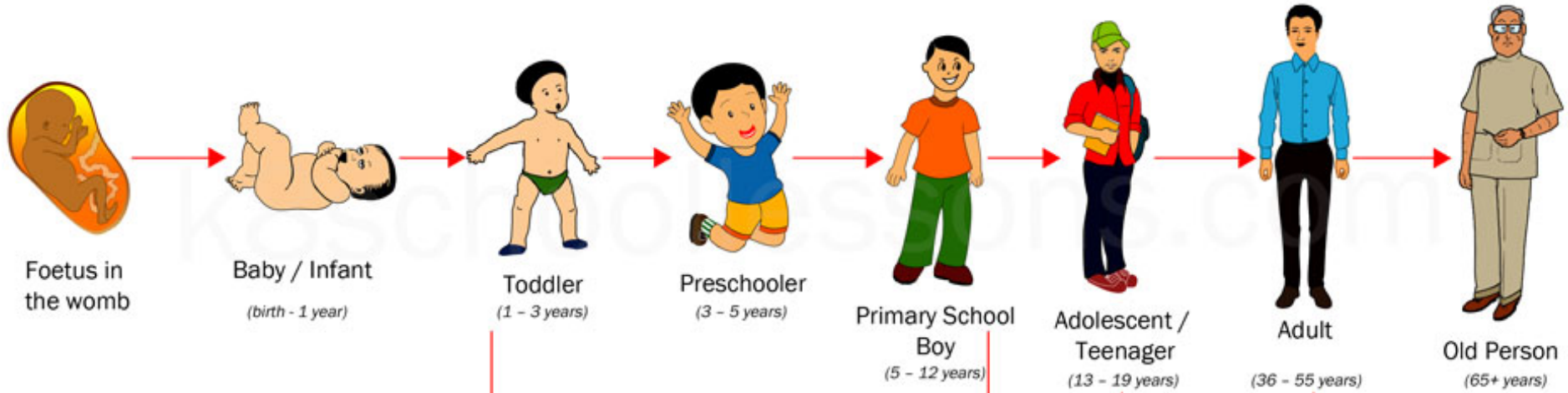
# Gene Expression

Transcription + Translation = Gene Expression

- The proteins that are produced determine what is express (shown) in an organism.
- Not all DNA is used(expressed) in every cell
- You express different genes at different stages of development.
- Zygote, Embryo, Baby, Adolescence, Adult
- Egg, larva, pupae, Chrysalis, Butterfly
- Egg, Tadpole, Froglet, Frog


adult
about
3 months
egg
chick
3 weeks


Pumpkin
Life Cycle
1ST
2ND
3RD
4TH
5TH
6TH
7TH
8TH


Foetus in the womb
Baby / Infant
(birth - 1 year)
Toddler
(1 – 3 years)
Preschooler
(3 – 5 years)
Primary School Boy
(5 – 12 years)
Adolescent / Teenager
(13 – 19 years)
Adult
(36 – 55 years)
Old Person
(65+ years)