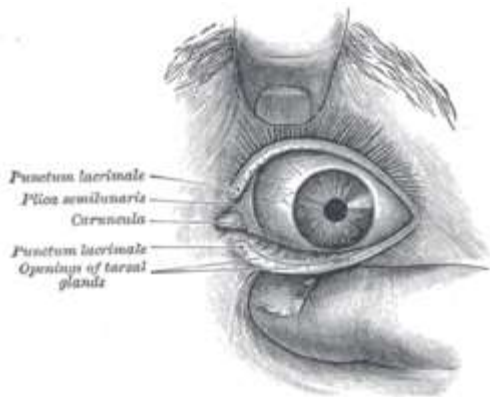


# PROTEIN SYNTHESIS

Or...how our bodies make  
proteins!



# What do these Chinese symbols say?

日

云

雨

Transcribe to English alphabet:

rì (\*nit)

yún (\*wən)

yǔ (\*wha?)

Translate to English words:

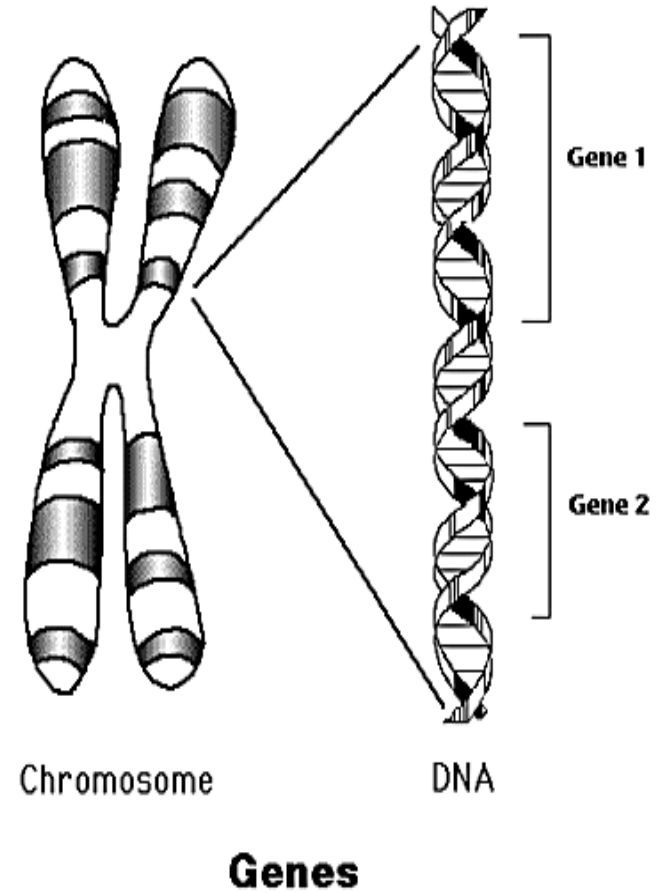
sun

cloud

rain

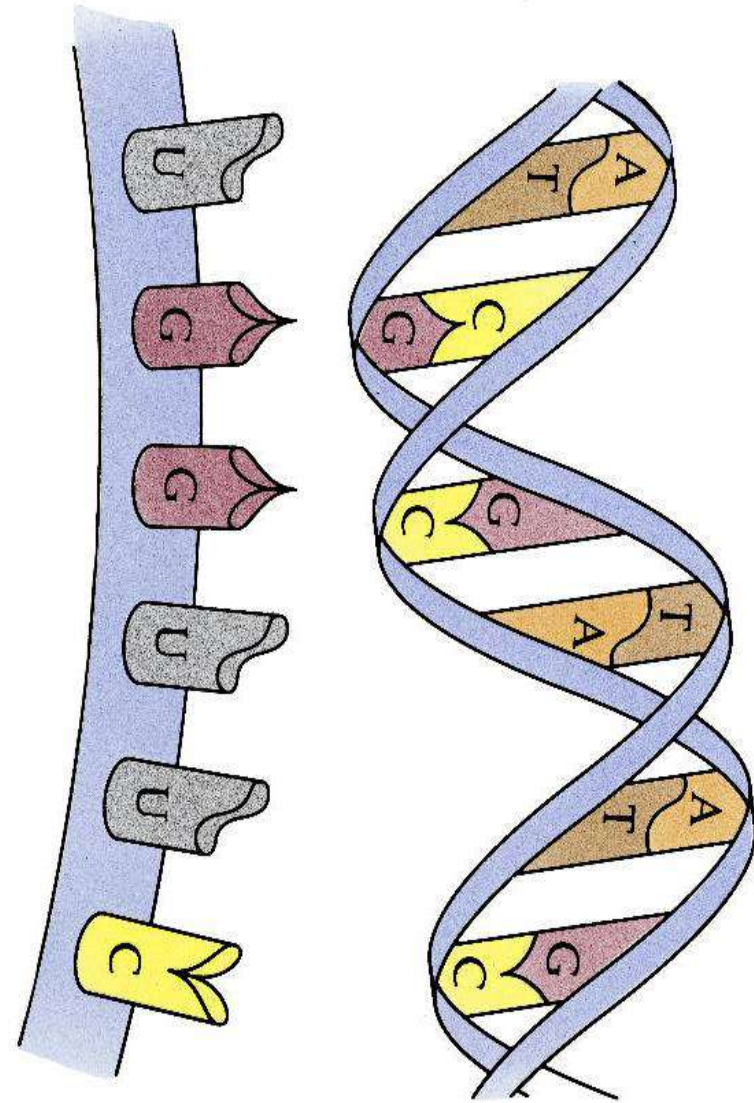
# The function of DNA

- The DNA molecule contains all your hereditary information in the form of genes
- A **gene** is a coded section of DNA; it tells our cells how to build specific proteins
- Genes code for **EVERYTHING** our body needs and does (saliva, bones, eye shape)
- Because DNA is so large, it is stuck inside the nucleus
- It needs a **messenger** to move the information from nucleus to protein production locations (ribosomes!)



# DNA needs RNA!

- RNA is a nucleic acid messenger between DNA and ribosomes
- 3 differences between DNA and RNA:
  - RNA has ribose sugar
  - RNA is single stranded
  - RNA contains a nitrogen base called **uracil (U)** instead of thymine.



## **DNA**

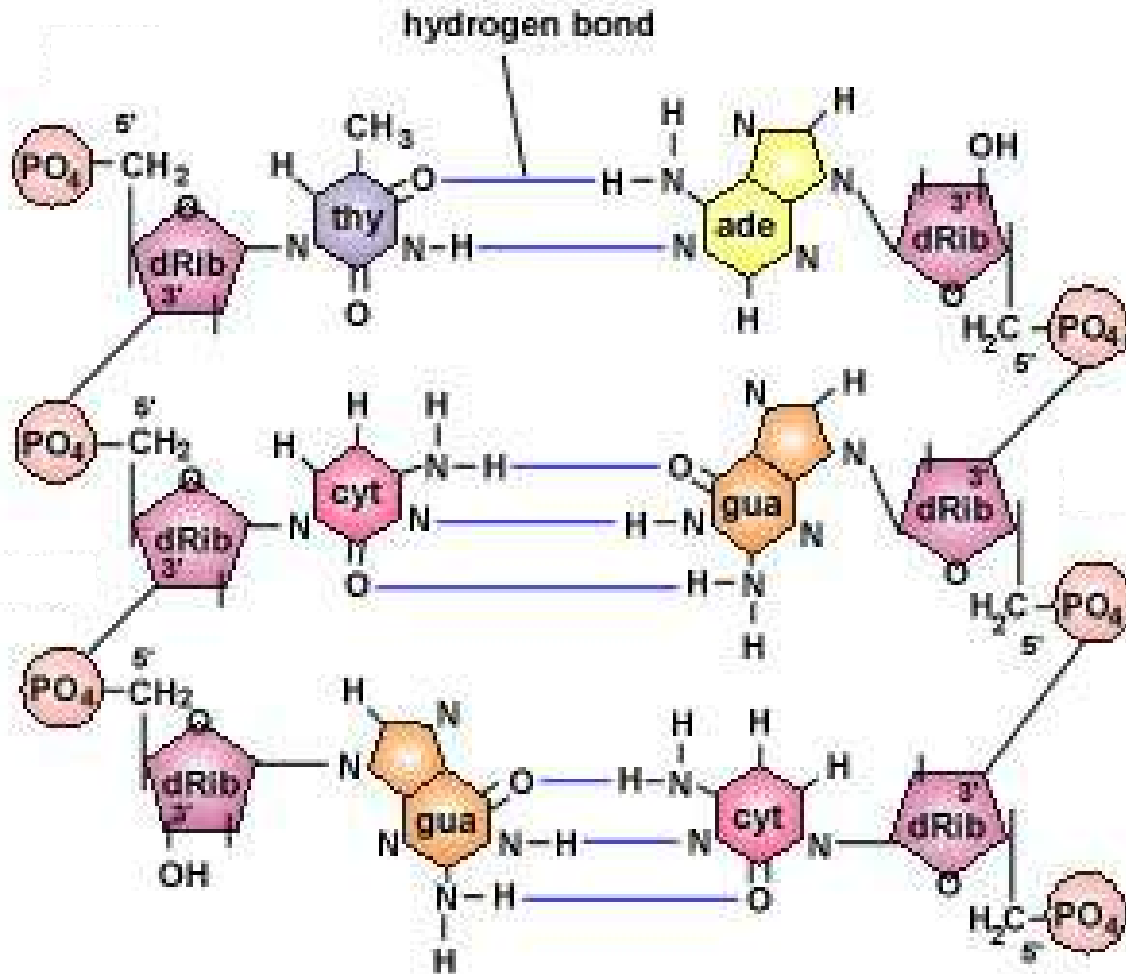
- Double stranded molecule
- Contains thymine
- Contains deoxyribose sugar
- Found only in nucleus

## **RNA**

- Single stranded molecule
- Contains uracil
- Contains ribose sugar
- Found in nucleus and cytoplasm

- Made of nucleotides
- Contain adenine, guanine, and cytosine

**Does this diagram represent DNA or RNA? ...how can you tell?**



**You are a**

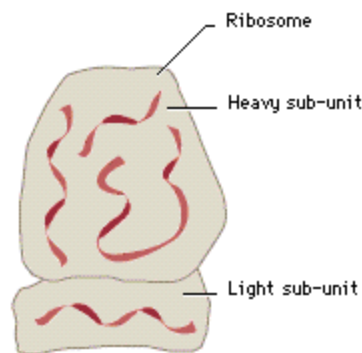


# 3 types of RNA

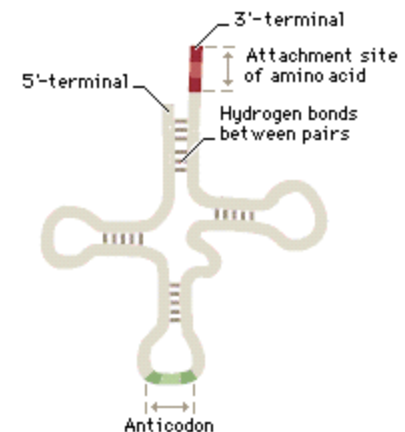
- Messenger RNA (mRNA):
  - copies DNA in the nucleus and carries the info to the ribosomes (in cytoplasm)
- Ribosomal RNA (rRNA):
  - makes up a large part of the ribosome; reads and decodes mRNA
- Transfer RNA (tRNA):
  - carries amino acids to the ribosome where they are joined to form proteins



**Messenger RNA**



**Ribosomal RNA**



**Transfer RNA**

# Protein synthesis

- **Protein synthesis** is the assembly of amino acids (by RNA) into proteins
- Involves two steps:
  - 1. Transcription – copying DNA code into mRNA
  - 2. Translation – reading the mRNA code and assembling amino acids into a polypeptide chain (protein)

# Transcription

- Performed in nucleus by mRNA
- mRNA “reads” single DNA strand and forms the complementary copy

日

云

雨

Chinese characters transcribed to English alphabet:

rì (\*nit)

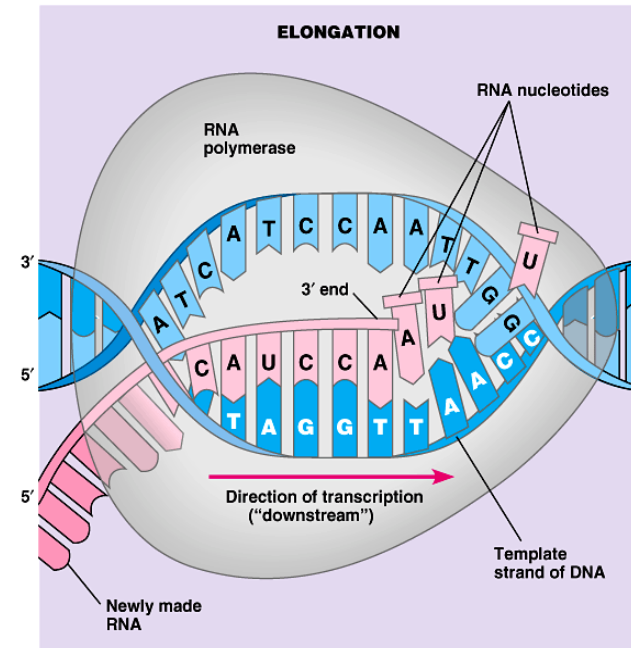
yún (\*wən)

yǔ (\*wha?)

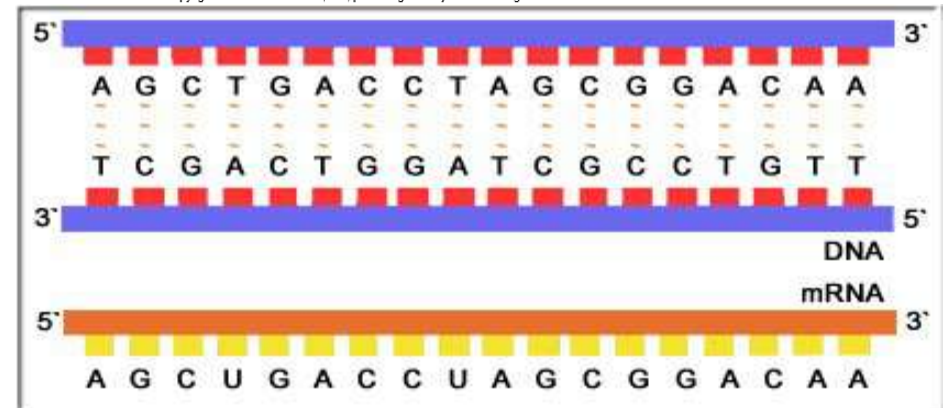
# How transcription works

1. DNA strand splits, exposing the active strand
2. Complementary mRNA nucleotides line up opposite the active strand, forming mRNA
3. mRNA leaves the nucleus

[Transcription demo](#)



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# Translation

- Translation occurs in ribosomes (in cytoplasm)
- All three types of RNA work together during translation to produce proteins

rì (\*nit)

yún (\*wən)

yǔ (\*wha?)

Transcribed Chinese words translated to English words:

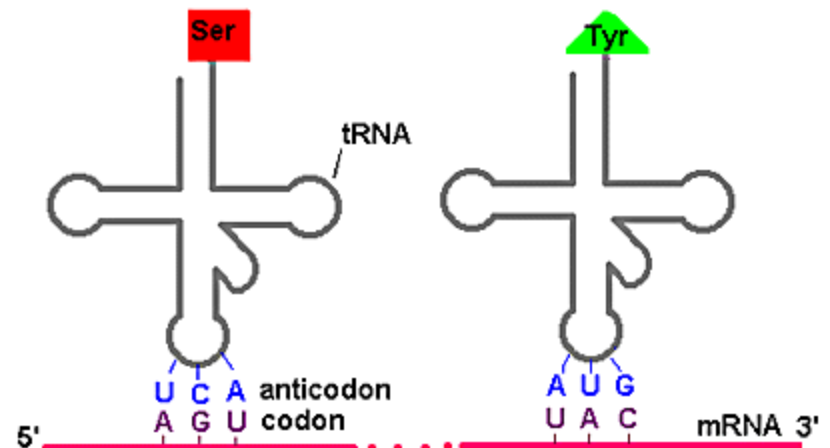
sun

cloud

rain

# Decoding mRNA (translation)

- The sequence of bases in an mRNA molecule serves as instructions for the order in which amino acids are joined to produce a polypeptide
- Ribosomes decode the instructions by using codons, sets of 3 bases that each code for 1 amino acid
- Each codon is matched to an anticodon, or complementary sequence on the tRNA to determine the order of the amino acids
- Translation demo

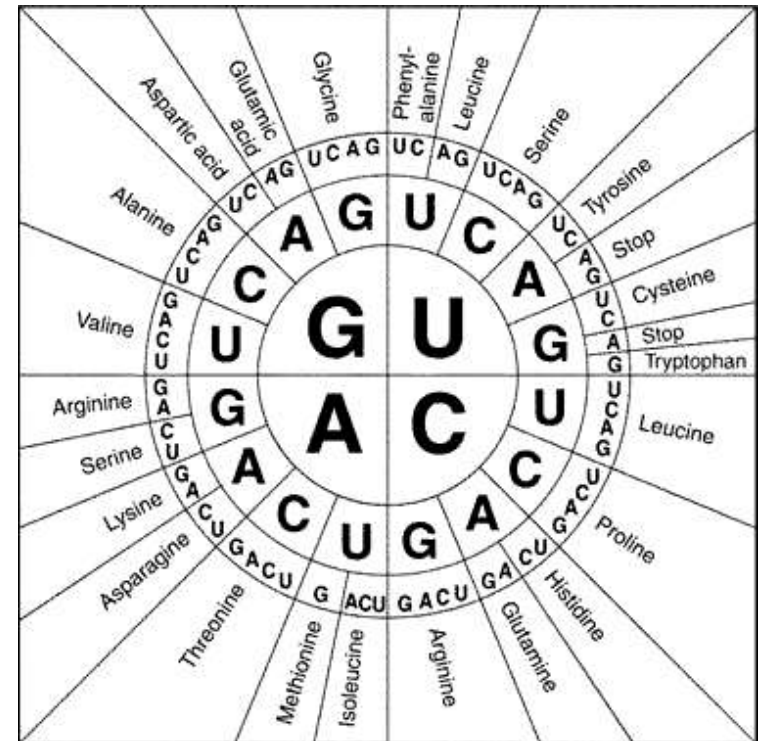


# Using a codon chart

- A codon chart is used to determine the sequence of the amino acids in the polypeptide
- The sets of 3 mRNA bases (codons) are used to find the amino acid

**Codons Found in Messenger RNA**

|            |   | Second Base              |                          |                            |                           |                  |
|------------|---|--------------------------|--------------------------|----------------------------|---------------------------|------------------|
|            |   | U                        | C                        | A                          | G                         |                  |
| First Base | U | Phe<br>Phe<br>Leu<br>Leu | Ser<br>Ser<br>Ser<br>Ser | Tyr<br>Tyr<br>Stop<br>Stop | Cys<br>Cys<br>Stop<br>Trp | U<br>C<br>A<br>G |
|            | C | Leu<br>Leu<br>Leu<br>Leu | Pro<br>Pro<br>Pro<br>Pro | His<br>His<br>Gln<br>Gln   | Arg<br>Arg<br>Arg<br>Arg  | U<br>C<br>A<br>G |
|            | A | Ile<br>Ile<br>Ile<br>Met | Thr<br>Thr<br>Thr<br>Thr | Asn<br>Asn<br>Lys<br>Lys   | Ser<br>Ser<br>Arg<br>Arg  | U<br>C<br>A<br>G |
|            | G | Val<br>Val<br>Val<br>Val | Ala<br>Ala<br>Ala<br>Ala | Asp<br>Asp<br>Glu<br>Glu   | Gly<br>Gly<br>Gly<br>Gly  | U<br>C<br>A<br>G |
|            |   |                          |                          |                            |                           | Third Base       |



# Decoding Practice

For the following DNA examples, first give the appropriate mRNA sequence, then identify the amino acid sequence (*remember: U replaces T in mRNA*)

## Example 1:

DNA: TAC GCA TGG AAT

mRNA: AUG CGU ACC UUA

Amino Acids: Met Arg Thr Leu

## Example 2:

DNA: CGT GGA GAT ATT

mRNA: GCA CCU CUA UAA

Amino Acids: Ala Pro Leu stop

## Codons Found in Messenger RNA

|            |   | Second Base |     |      |      |   |
|------------|---|-------------|-----|------|------|---|
|            |   | U           | C   | A    | G    |   |
| First Base | U | Phe         | Ser | Tyr  | Cys  | U |
|            |   | Phe         | Ser | Tyr  | Cys  | C |
|            |   | Leu         | Ser | Stop | Stop | A |
|            |   | Leu         | Ser | Stop | Trp  | G |
|            | C | Leu         | Pro | His  | Arg  | U |
|            |   | Leu         | Pro | His  | Arg  | C |
|            |   | Leu         | Pro | Gln  | Arg  | A |
|            |   | Leu         | Pro | Gln  | Arg  | G |
|            | A | Ile         | Thr | Asn  | Ser  | U |
|            |   | Ile         | Thr | Asn  | Ser  | C |
|            |   | Ile         | Thr | Lys  | Arg  | A |
|            |   | Met         | Thr | Lys  | Arg  | G |
|            | G | Val         | Ala | Asp  | Gly  | U |
|            |   | Val         | Ala | Asp  | Gly  | C |
|            |   | Val         | Ala | Glu  | Gly  | A |
|            |   | Val         | Ala | Glu  | Gly  | G |