PM401
Basic Microbiology

Applied Microbial Genetics

(2015)

Applied Genetics

1. Learn the DNA language

Ramy K. Aziz, PhD

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Before we start

- Your last instructor of the season:

  Ramy K. Aziz, PhD

- Contact:

  Email: ramy.aziz@pharma.cu.edu.eg (best way)

  Twitter: @azizrk (*if necessary*)

- Course information page:

  http://www.egybio.net/courses/FOPCU/pm401

Why Learn the DNA language?

It’s the language of the future

Sup? cu…
4get’t… ^_^
My <3 is broken
LOL LMAO

2015

It’s the language of the future

ATATAGCACGCAACAGAGTGACCA
CATGCTCGAATGGCATGCTACTAG

2025

It’s the language of the future

ATATAGCACGCAACAGAGTGACCA
CATGCTCGAATGGCATGCTACTAG
= **I . HATE . PHARMACY .**

2025

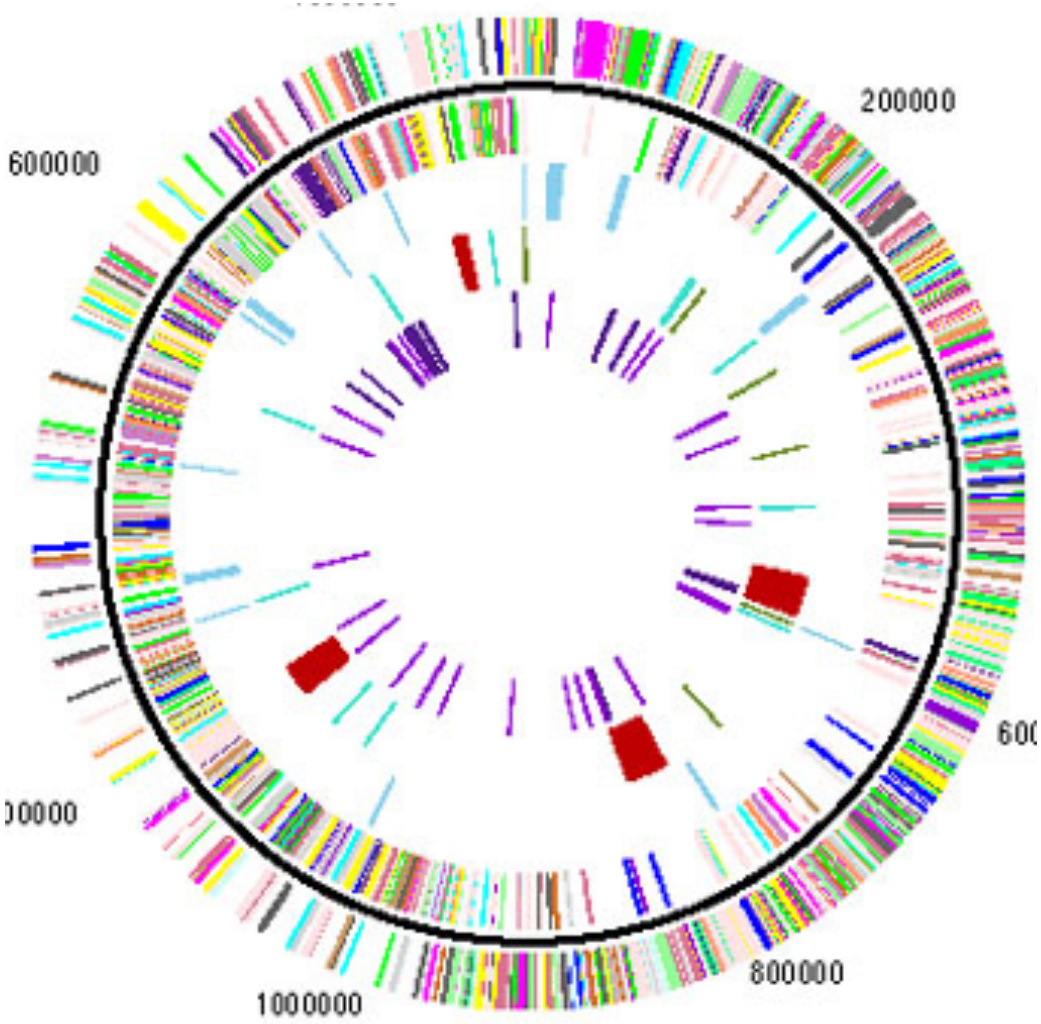
Quick Questionnaire

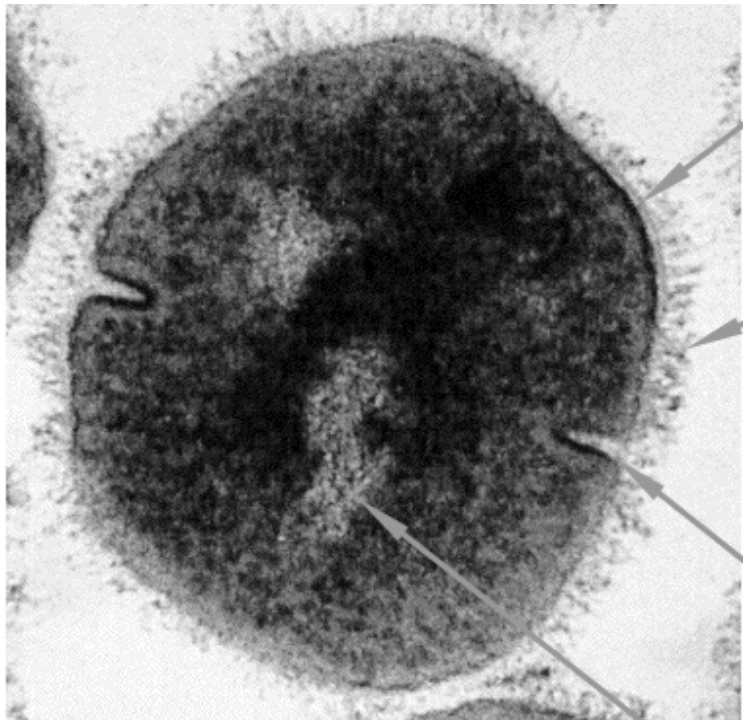
- Do cells in your tongue and lung have the same genes?
- Do cells in your toes and nose have the same proteins?
- How many letters exist in the human genetic code?
- How many codons exist in the human genetic code?
- Is it possible to transform a protein into a gene?

Some Terminology

- **Gene: a discrete unit of hereditary information located on the chromosomes and consisting of DNA.**
- **Genome: an organism's genetic material**
- **Genotype: The genetic makeup of an organism**
- **Phenotype: the physical expressed traits of an organism**
- **Nucleic acid: Biological molecules (RNA and DNA) that allow organisms to reproduce.**

Genotype → phenotype





Credit: V. Fischetti

GENOME

LIVING CELL

Some Terminology

- The **genome** is an organism's complete set of DNA.
  - a bacteria contains about 600,000 DNA base pairs
  - human and mouse genomes have some 3 billion.
- human genome has 24 distinct chromosomes.
  - Each chromosome contains many **genes**.
- **Gene**
  - basic physical and functional units of heredity.
  - specific sequences of DNA bases that encode instructions on how to make **proteins**.
- **Proteins**
  - Make up the cellular structure
  - large, complex molecules made up of smaller subunits called **amino acids.**

DNA sequence looks like…

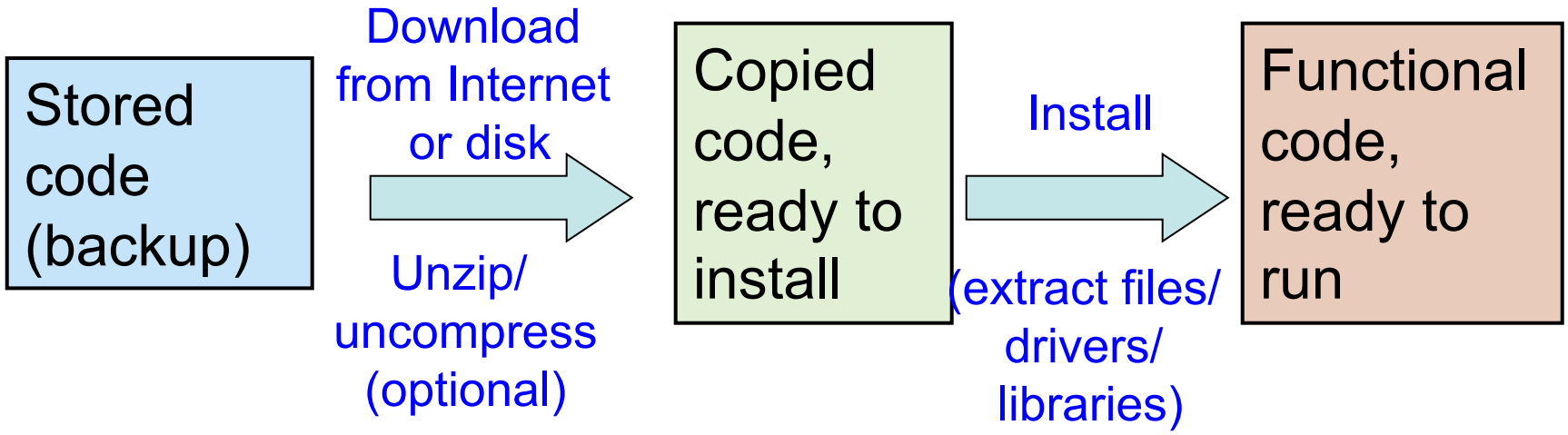
```
.....acctc ctgtgcaaga acatgaaaca cctgtggttc ttccttctcc
tggtggcagc tcccagatgg gtcctgtccc aggtgcacct gcaggagtcg
ggcccaggac tggggaagcc tccagagctc aaaaccccac ttggtgacac
aactcacaca tgcccacggt gcccagagcc caaatcttgt gacacacctc
ccccgtgccc acggtgccca gagcccaaat cttgtgacac acctccccca
tgcccacggt gcccagagcc caaatcttgt gacacacctc ccccgtgccc
ccggtgccca gcacctgaac tcttgggagg accgtcagtc ttcctcttcc
ccccaaaacc caaggatacc cttatgattt cccggacccc tgaggtcacg
tgcgtggtgg tggacgtgag ccacgaagac cccgaggtcc agttcaagtg
gtacgtggac ggcgtggagg tgcataatgc caagacaaag ctgcgggagg
agcagtacaa cagcacgttc cgtgtggtca gcgtcctcac cgtcctgcac
caggactggc tgaacggcaa ggagtacaag tgcaaggtct ccaacaaagc
aaccaagtca gcctgacctg cctggtcaaa ggcttctacc ccagcgacat
cgccgtggag tgggagagca atgggcagcc ggagaacaac tacaacacca
cgcctcccat gctggactcc gacggctcct tcttcctcta cagcaagctc
accgtggaca agagcaggtg gcagcagggg aacatcttct catgctccgt
gatgcatgag gctctgcaca accgctacac gcagaagagc ctctc.....
```

The Flow of Information In a Computer

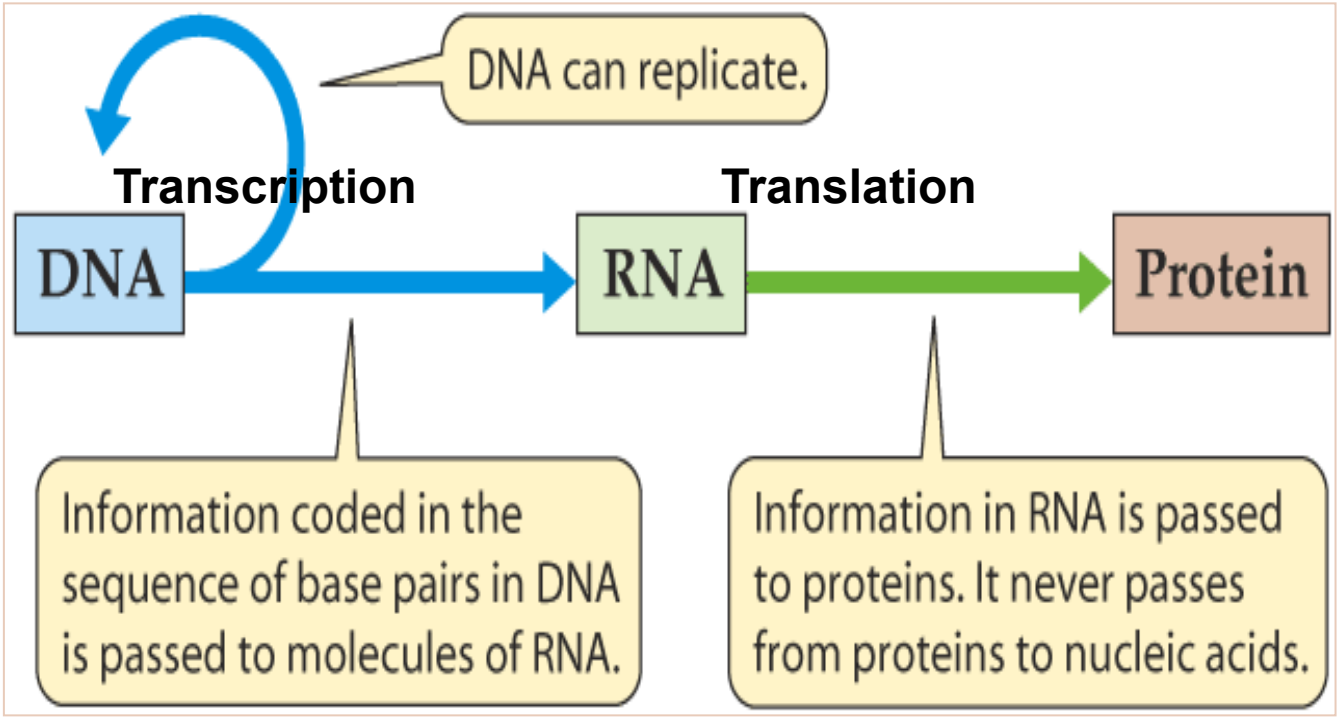
Can you just copy an installed program to make it run on another computer?

in most cases, NO!

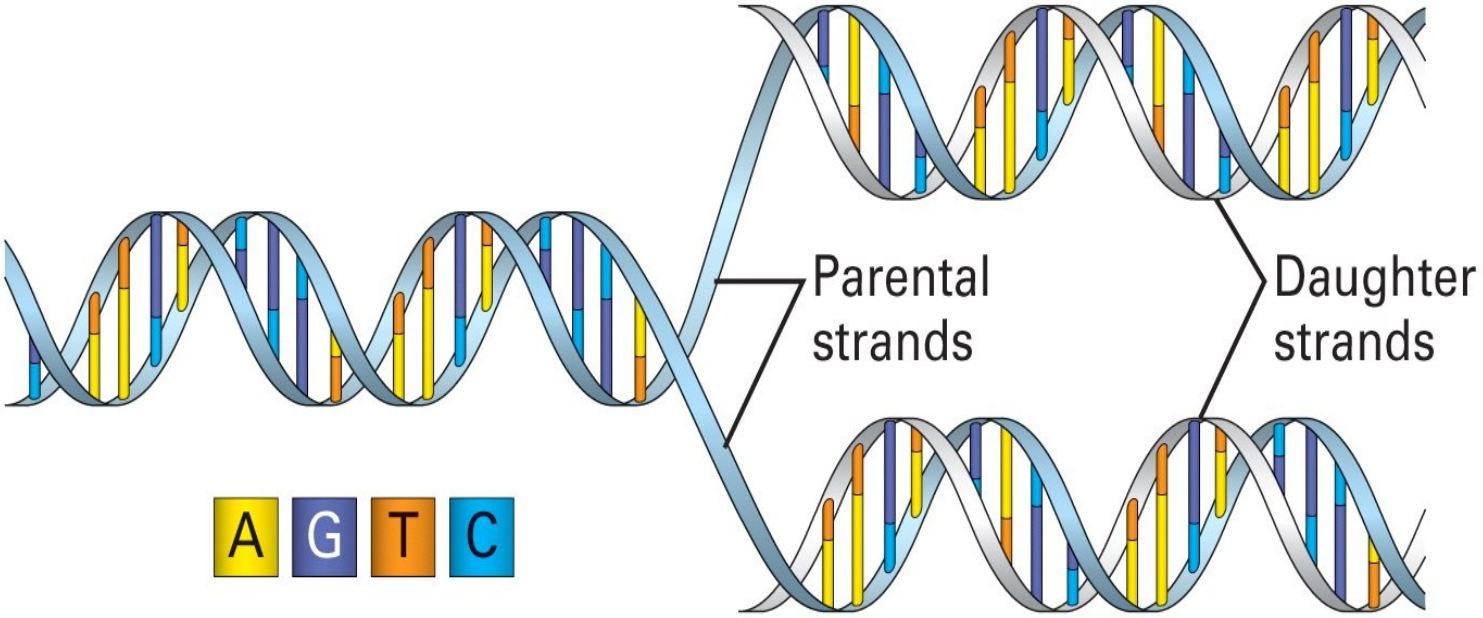
The Flow of Information In a Computer



The Flow of Information In The Cell

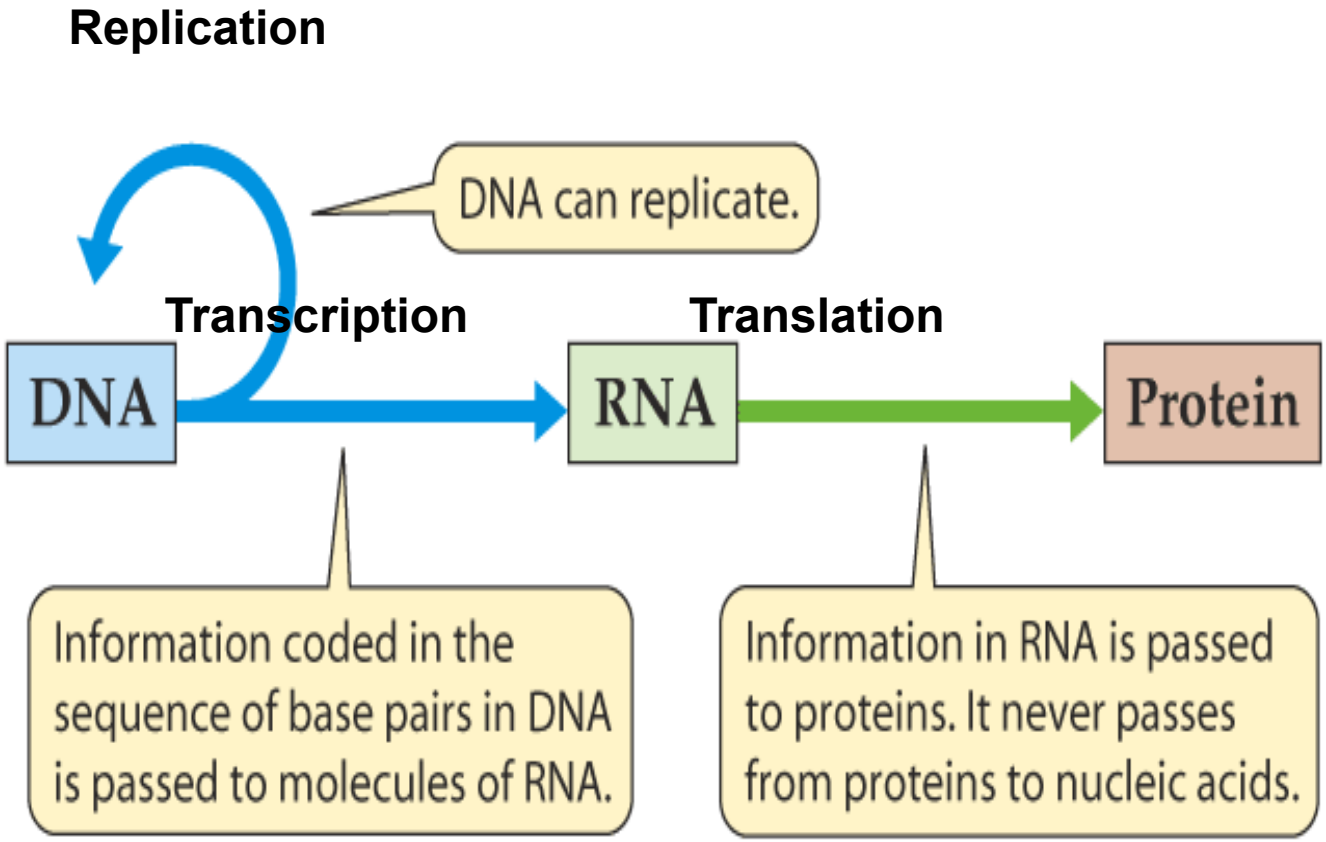


DNA: The Code of Life

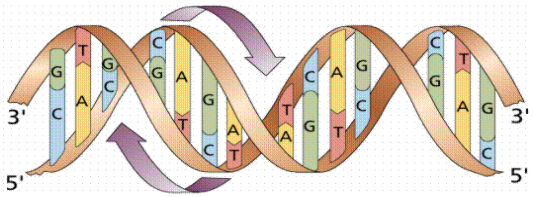


- The structure and the four genomic letters code for all living organisms
- Adenine, Guanine, Thymine, and Cytosine which pair A-T and C-G on complimentary strands.

DNA, RNA, and the Flow of Information



A gene codes for a protein



DNA

transcription

mRNA

translation

Protein

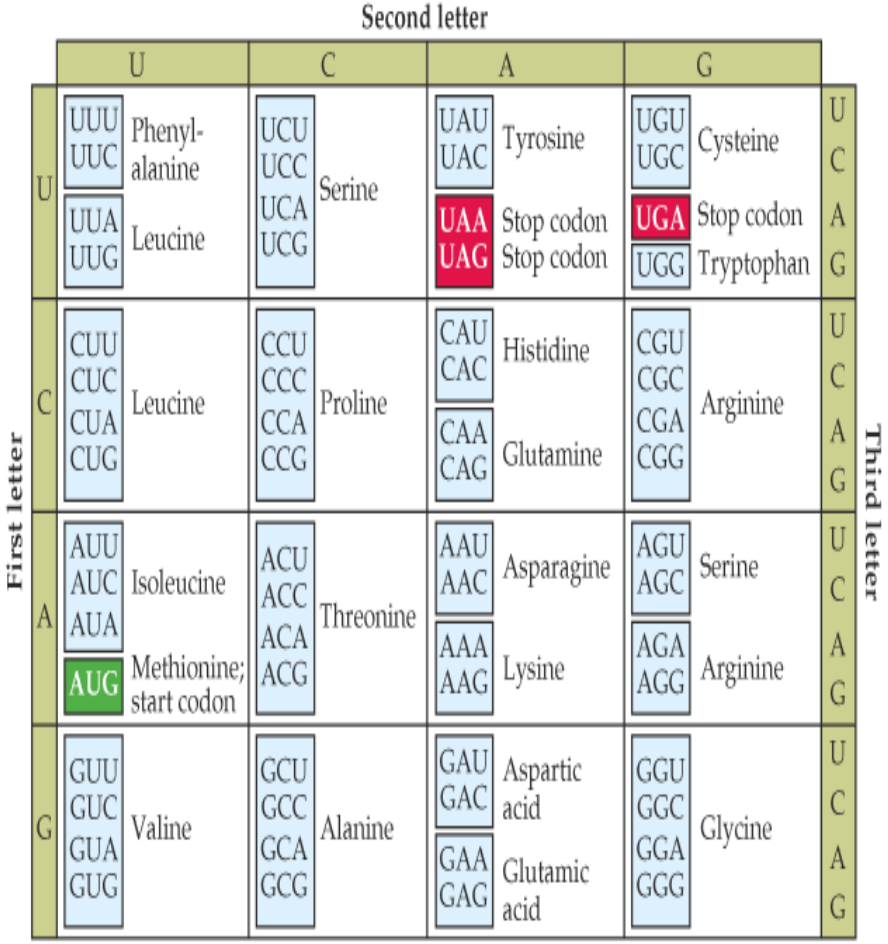
CCTGAGCCAACTATTGATGAA

CCUGAGCCAACUAUUGAUGAA

PEPTIDE

Cell Information: Instruction book of Life

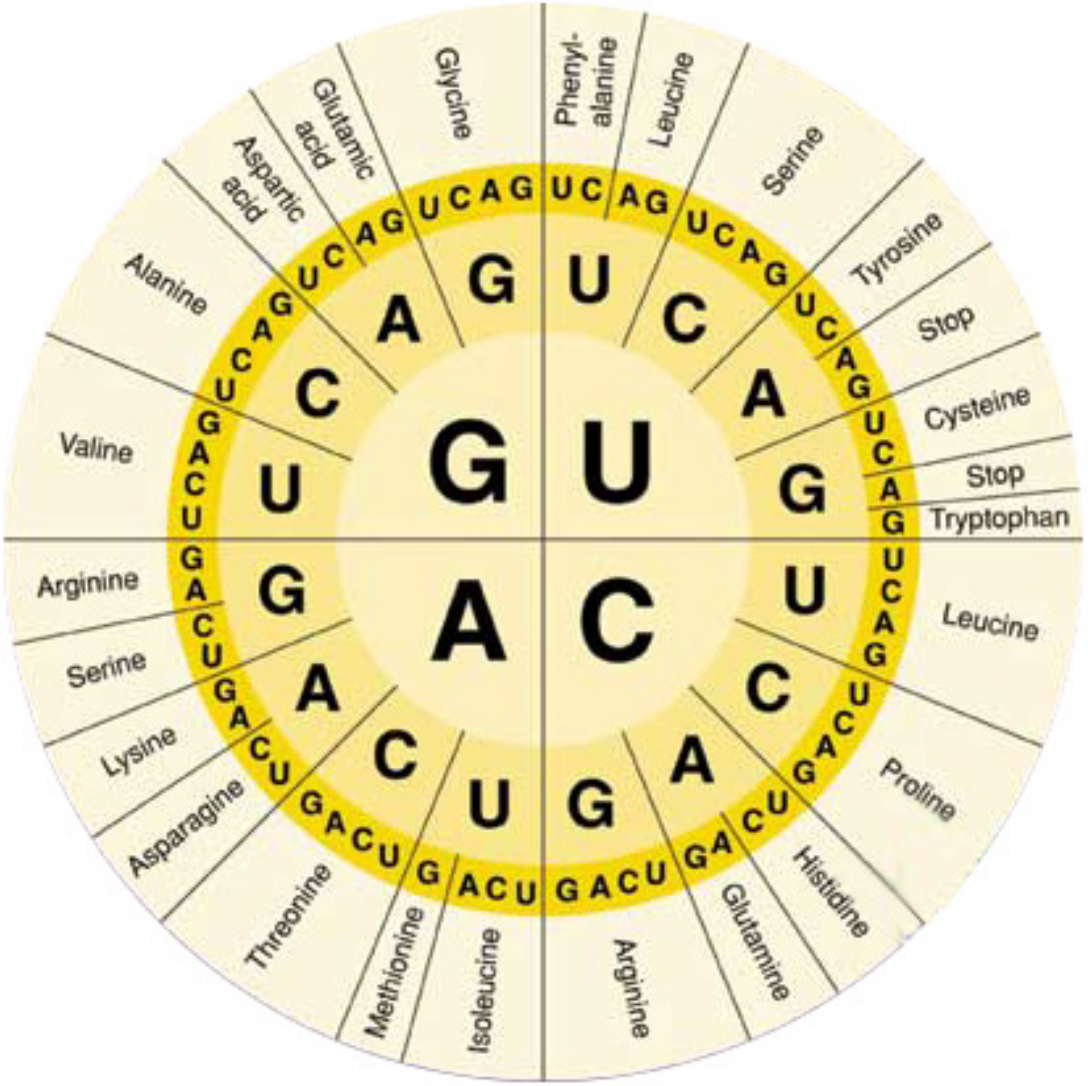
- DNA, RNA, and Proteins are examples of strings written in either the four-letter nucleotide of DNA and RNA (A C G T/U)
- or the twenty-letter amino acid of proteins. Each amino acid is coded by 3 nucleotides called codon. (Leu, Arg, Met, etc.)



The Genetic Code

Amino Acid	SLC	DNA Codons
Isoleucine	I	ATT, ATC, ATA
Leucine	L	CTT, CTC, CTA, CTG, TTA, TTG
Valine	V	GTT, GTC, GTA, GTG
Phenylalanine	F	TTT, TTC
Methionine	M	ATG
Cysteine	C	TGT, TGC
Alanine	A	GCT, GCC, GCA, GCG
Glycine	G	GGT, GGC, GGA, GGG
Proline	P	CCT, CCC, CCA, CCG
Threonine	T	ACT, ACC, ACA, ACG
Serine	S	TCT, TCC, TCA, TCG, AGT, AGC
Tyrosine	Y	TAT, TAC
Tryptophan	W	TGG
Glutamine	Q	CAA, CAG
Asparagine	N	AAT, AAC
Histidine	H	CAT, CAC
Glutamic acid	E	GAA, GAG
Aspartic acid	D	GAT, GAC
Lysine	K	AAA, AAG
Arginine	R	CGT, CGC, CGA, CGG, AGA, AGG
Stop codons	Stop	TAA, TAG, TGA

The Genetic Code



Do You Speak the DNA language?

- What is the reverse, the complement, the reverse complement, and the message of: AAGGCCTTGCTTCG
- What is the amino acid encoded by: CUG
- Translate:
  AGC ATG ATT CTG GAA TAG CTA G
- Reverse translate these peptides:
  PHARMACY, HAPPY
- Write your name using the genetic code (ignore non-applicable letters)

Only for the curious!

- **Go to:**
  http://web.expasy.org/translate/
  and translate some of the proteins you want
- **For the more curious !!**
  - Google “Reverse translate protein to DNA
  - Select one of the found programs
  - Start writing your name and other words in DNA code

Thank you
for your attention.

Questions??