

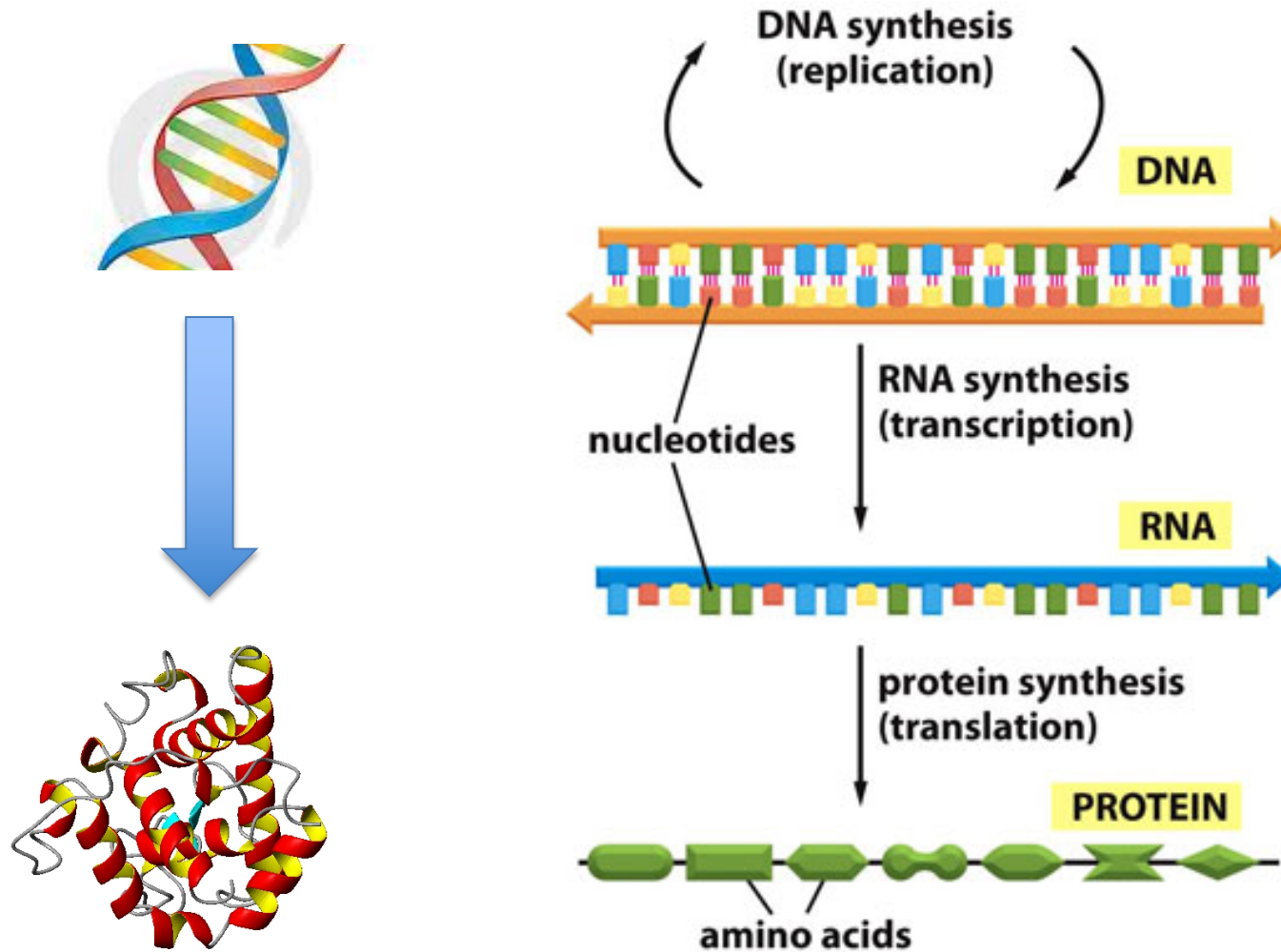
Lecture 2: Biology Basics Continued

Spring 2020

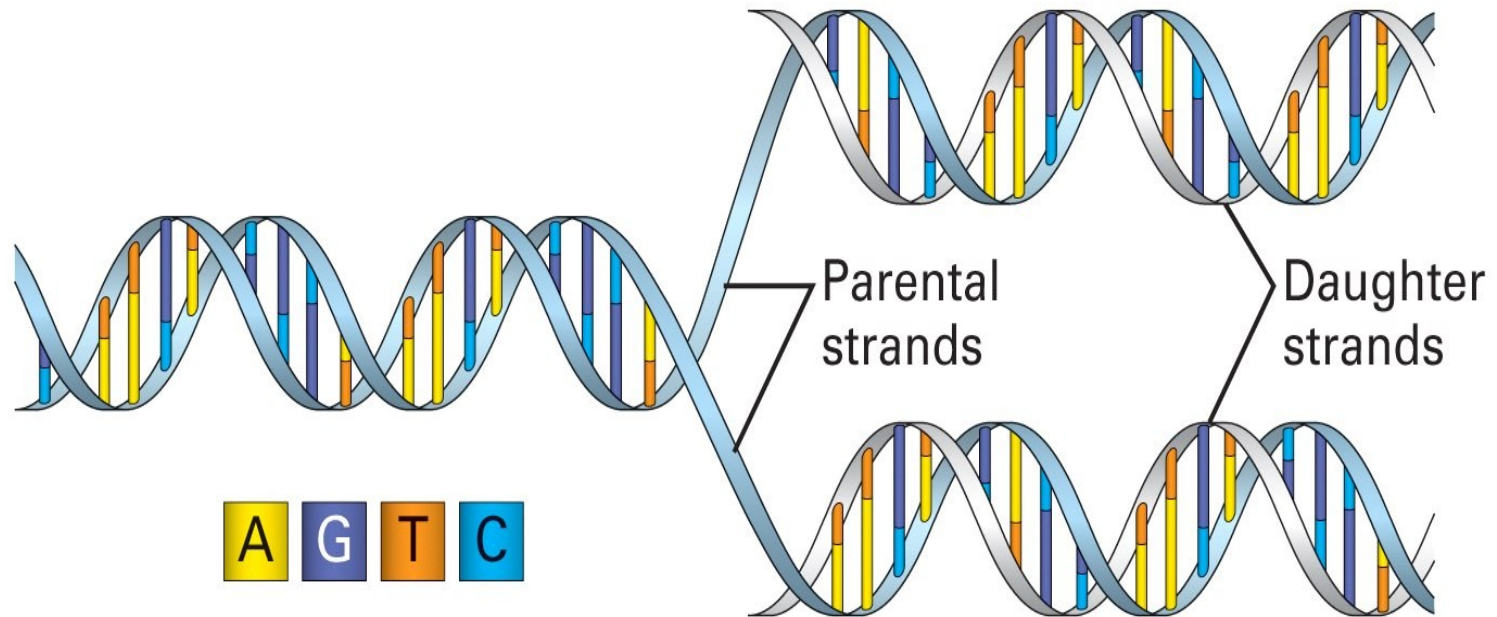
January 23, 2020

Genetic Material for Life

Central Dogma

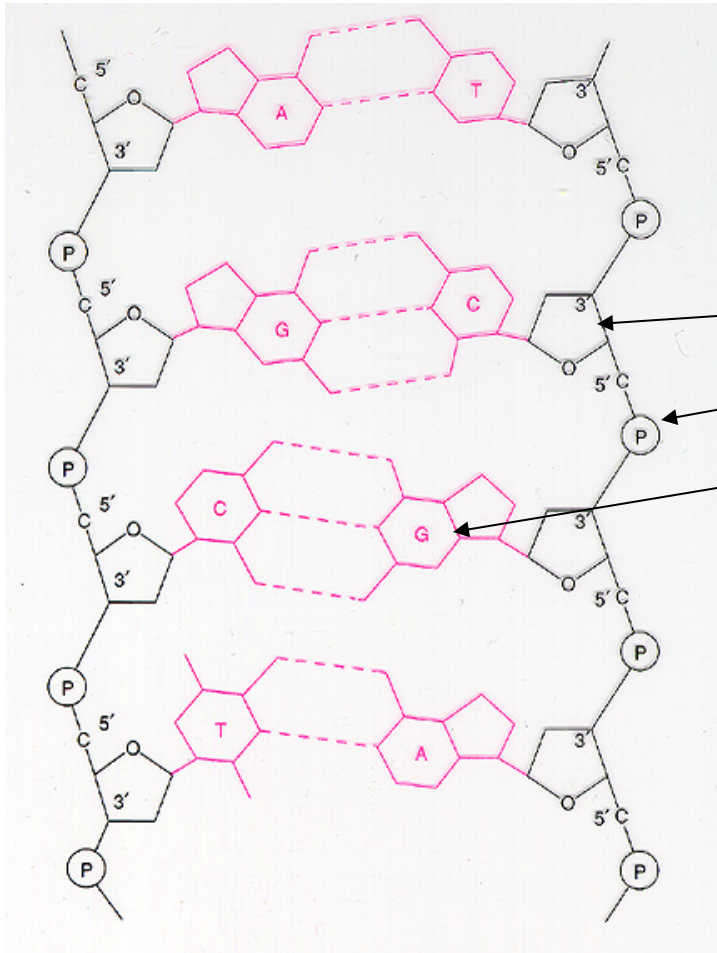


DNA: The Code of Life



- 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.

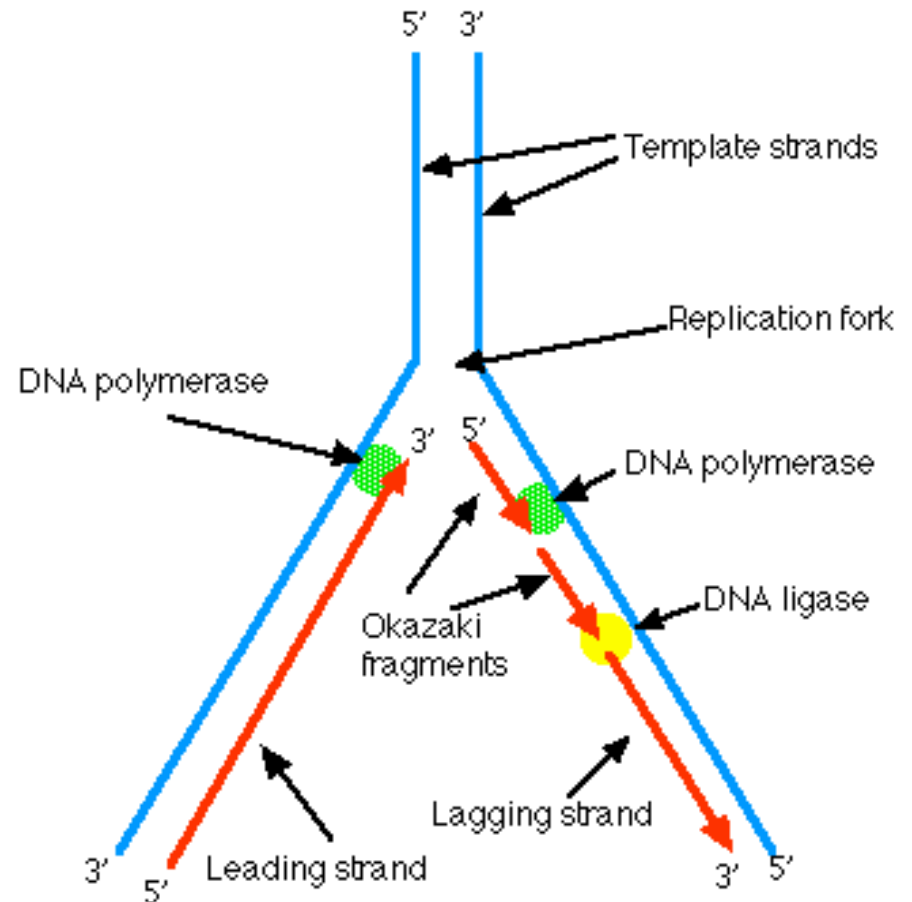
DNA: The Code of Life



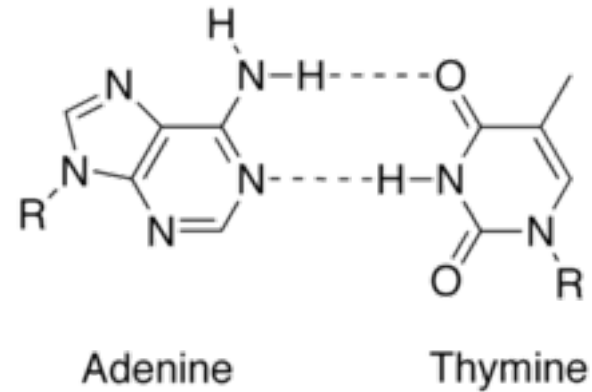
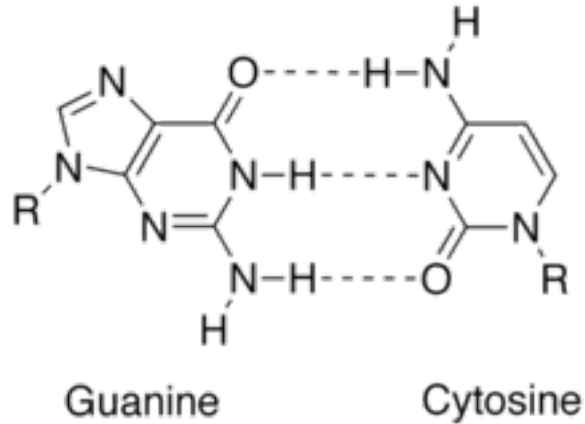
- DNA has a double helical structure which is composed of
 - sugar molecule
 - phosphate group
 - and a base (A,C,G,T)
- DNA always reads from 5' end to 3' end for transcription and replication

DNA Replication

- DNA can replicate by splitting, and rebuilding each strand.
- Note that the rebuilding of each strand uses slightly different mechanisms due to the 5' 3' asymmetry, but each daughter strand is an exact replica of the original strand.

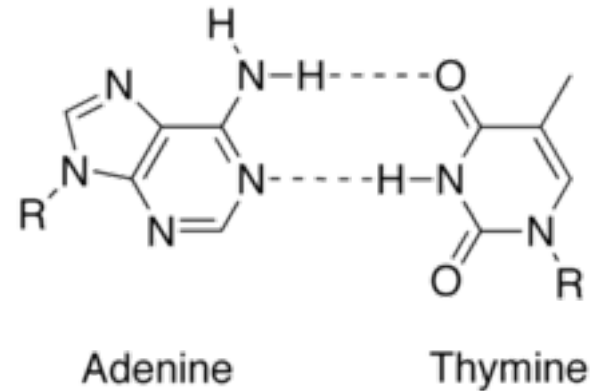
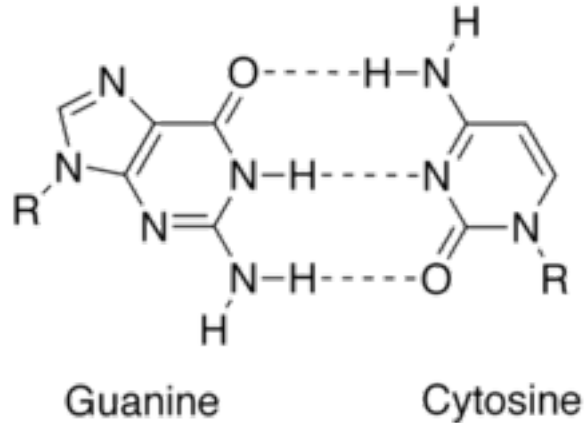


Reverse Complement of DNA



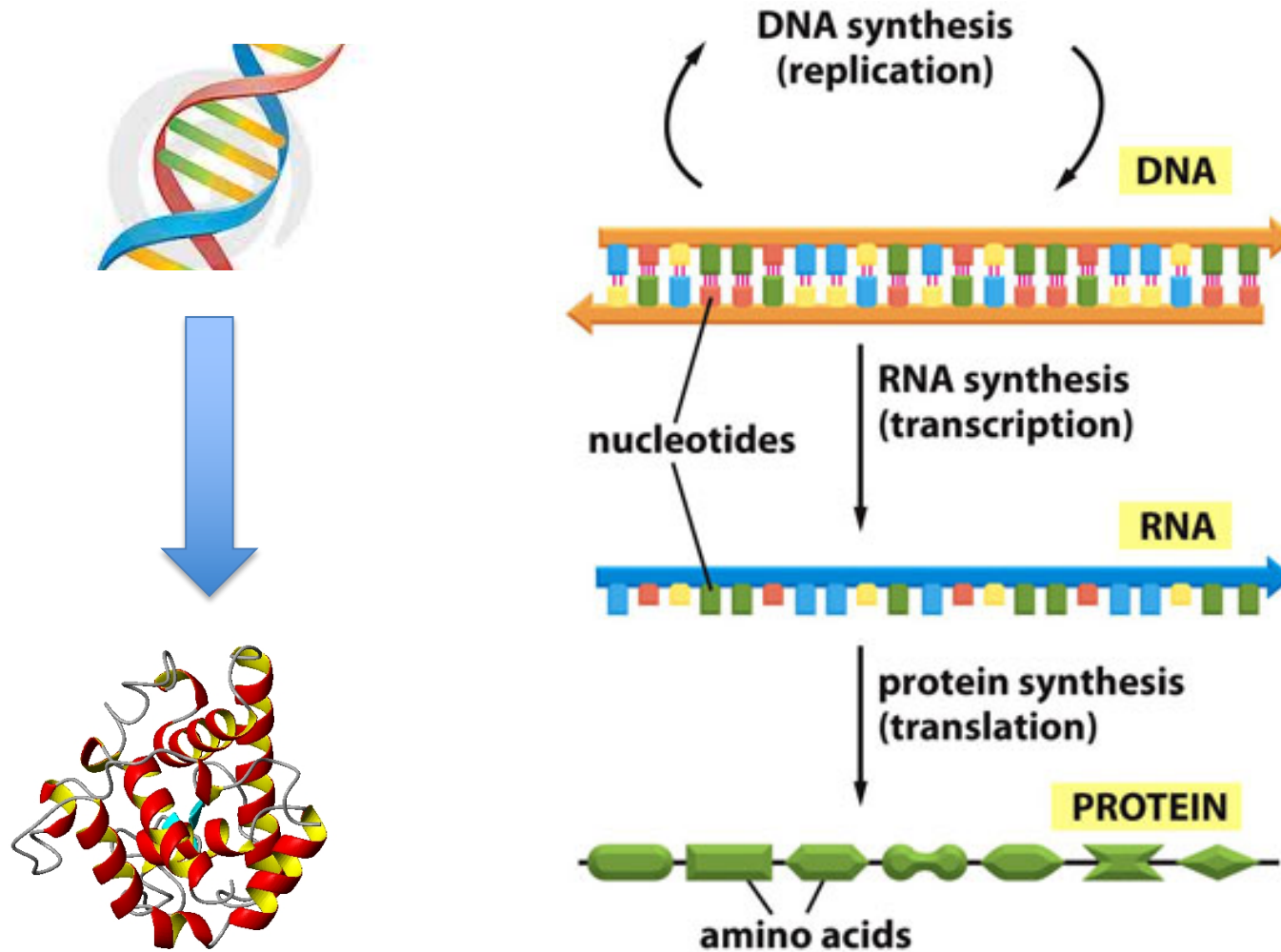
What is the reverse complement sequence of TATAGCCCG?

Reverse Complement of DNA

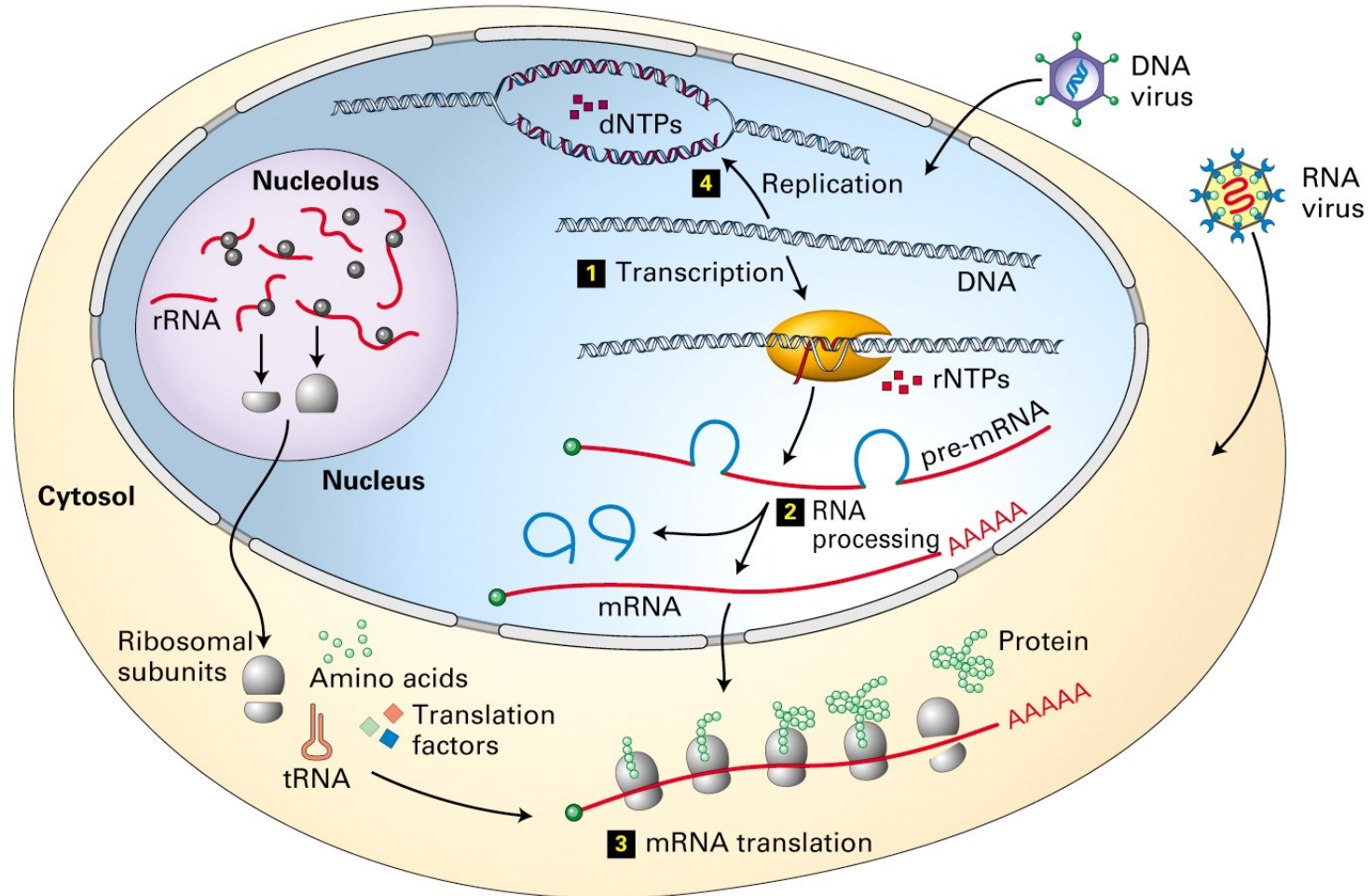


What is the reverse complement sequence of TATAGCCCG? **CGGGCTATA**

Central Dogma



Transcription and Post-transcriptional Modifications

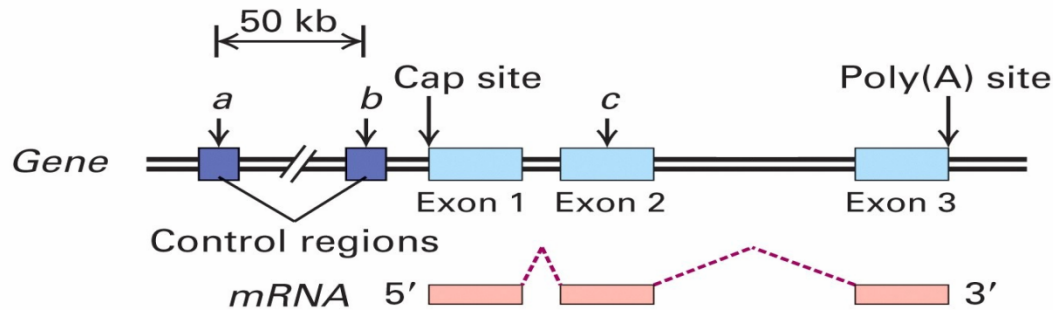


DNA to Proteins

Youtube video

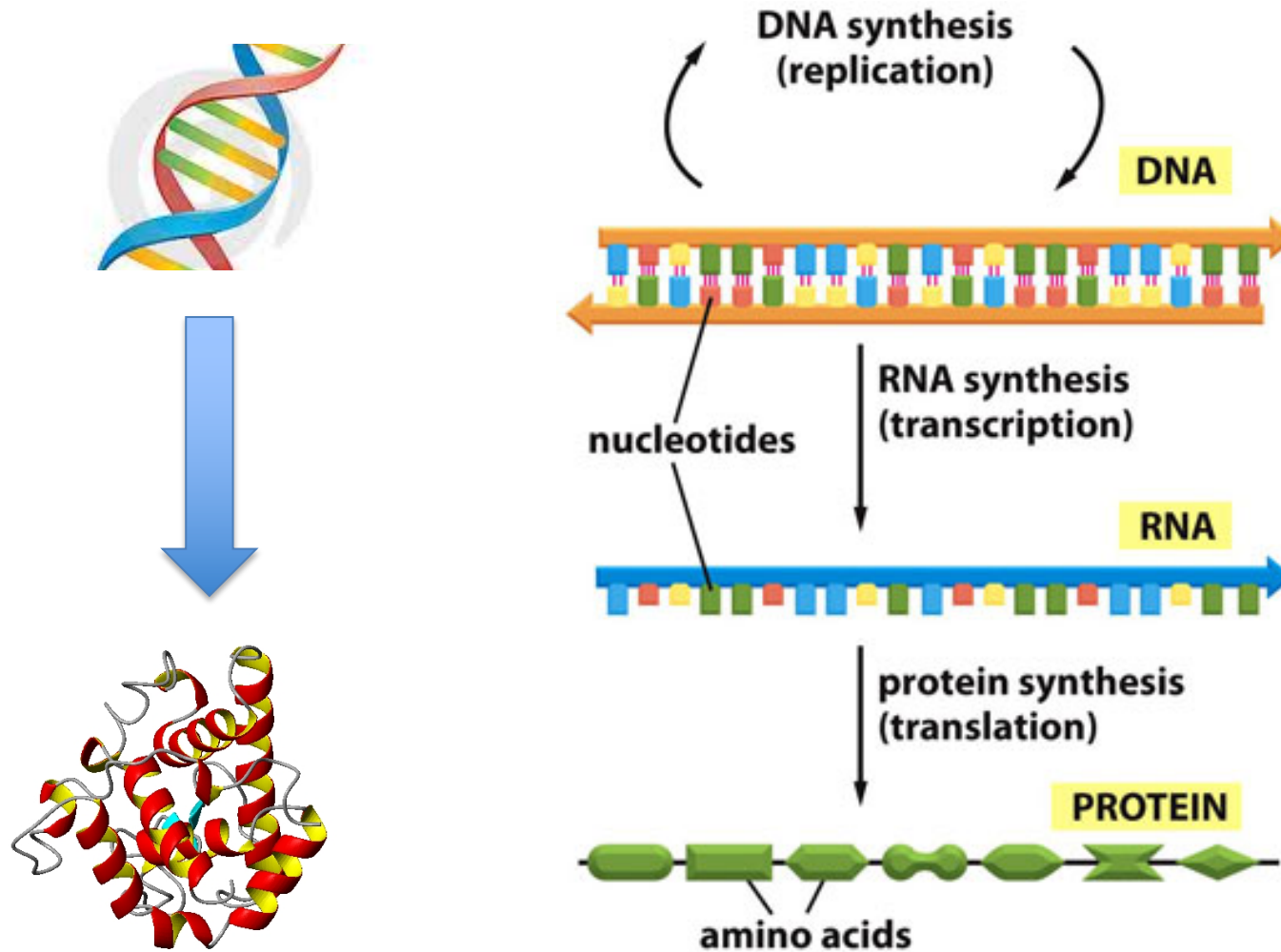
<https://www.youtube.com/watch?v=D3fOXt4MrOM>

Transcription Control

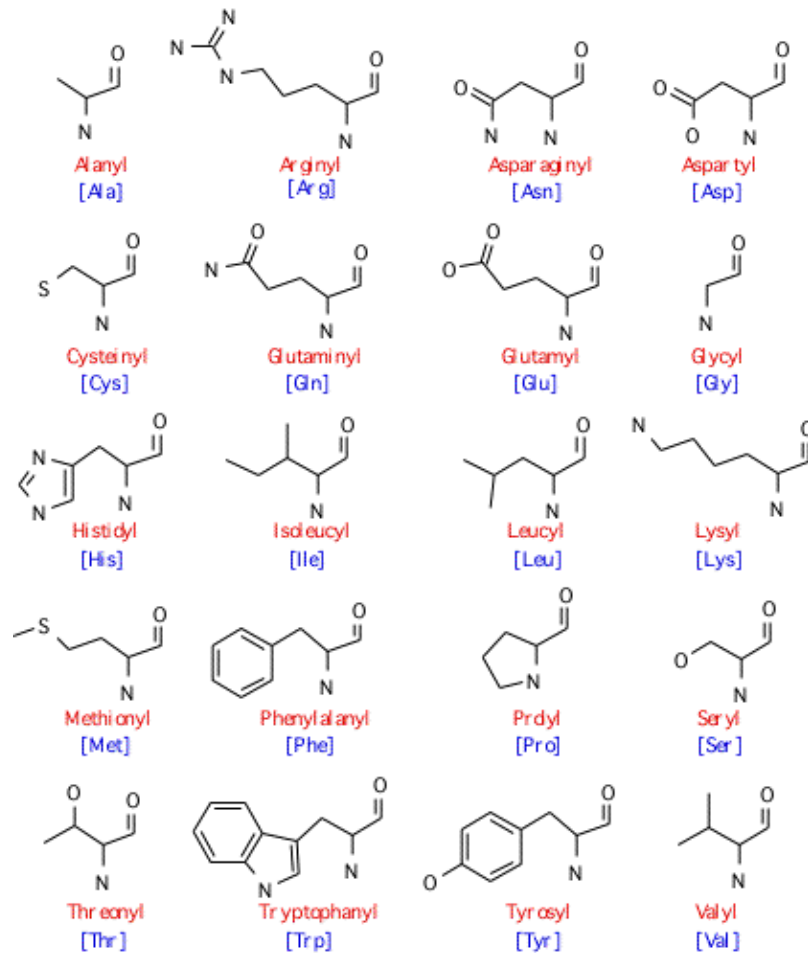


- Regulatory regions: up to 50 kb upstream of +1 site
- Exons: protein coding and untranslated regions (UTR)
1 to 178 exons per gene (mean 8.8)
8 bp to 17 kb per exon (mean 145 bp)
- Introns: splice acceptor and donor sites, junk DNA
average 1 kb – 50 kb per intron
- Gene size: Largest – 2.4 Mb (Dystrophin). Mean – 27 kb.

Central Dogma



Naturally Occurring Amino Acids



Translation: Code Book of Life

		Second letter				
		U	C	A	G	
First letter	U	UUU Phenylalanine UUC UUA Leucine UUG	UCU UCC Serine UCA UCG	UAU Tyrosine UAC UAA Stop codon UAG Stop codon	UGU Cysteine UGC UGA Stop codon UGG Tryptophan	U C A G
	C	CUU Leucine CUC CUA CUG	CCU Proline CCC CCA CCG	CAU Histidine CAC CAA Glutamine CAG	CGU Arginine CGC CGA CGG	U C A G
	A	AUU Isoleucine AUC AUA AUG Methionine; start codon	ACU Threonine ACC ACA ACG	AAU Asparagine AAC AAA Lysine AAG	AGU Serine AGC AGA Arginine AGG	U C A G
	G	GUU Valine GUC GUA GUG	GCU Alanine GCC GCA GCG	GAU Aspartic acid GAC GAA Glutamic acid GAG	GGU Glycine GGC GGA GGG	U C A G

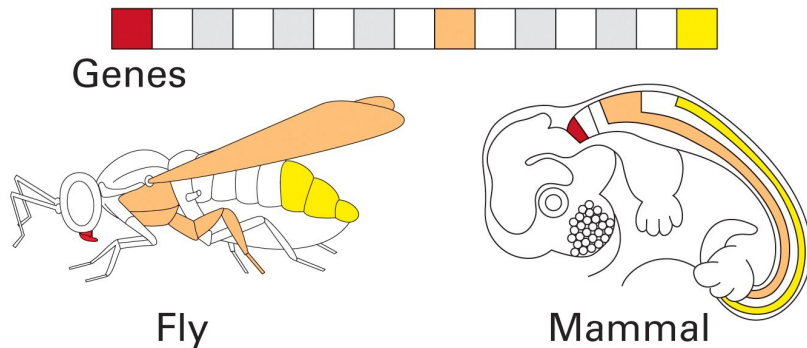
Genes and Proteins

- One gene encodes one protein and begins with start codon (e.g. ATG), then each three code one amino acid. Then a stop codon (e.g. TGA) signifies end of the gene.
- In the middle of a (eukaryotic) gene, there are segments that are spliced out during transcription.
 - Introns: segments that are spliced out
 - Exons: segments that are kept.
- Detecting the introns and exons is a task for gene finding.

Genotype/Phenotype

- To prevent confusion between **genes** (which are inherited) and **developmental outcomes** (which are not), geneticists make a distinction between the **genotype** and the **phenotype** of an organism
 - **Genotype**: complete set of genes inherited by an individual
 - **Phenotype**: all aspects of the individual's physiology, behavior, and ecological relationships

DNA the Genetics Makeup



- Genes are inherited and are expressed
- **genotype** (genetic makeup)
- **phenotype** (physical expression)

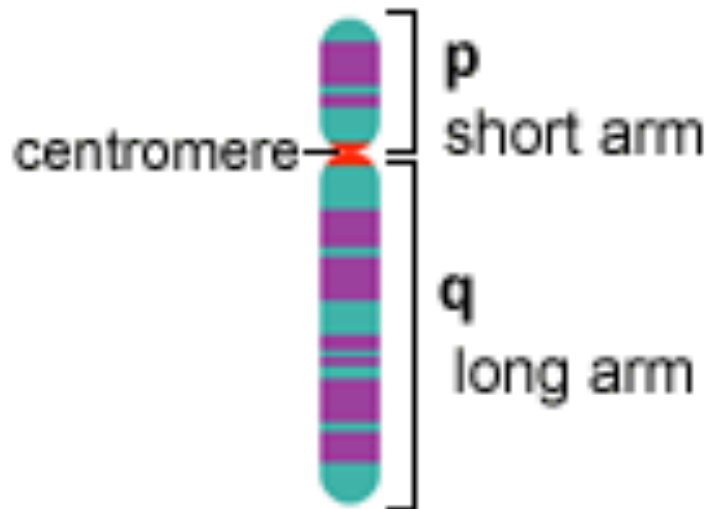


On the left, is the eye's phenotypes of green and black eye genes.

- Two organisms whose genes differ at one **locus** are said to have different genotypes.
- A locus (loci for plural) is the specific location of a gene or a DNA sequence on a chromosome.
- A variant of the DNA sequence at a given location is called an **allele**.
- The ordered list of loci known for a particular genome is called a **genetic map**.

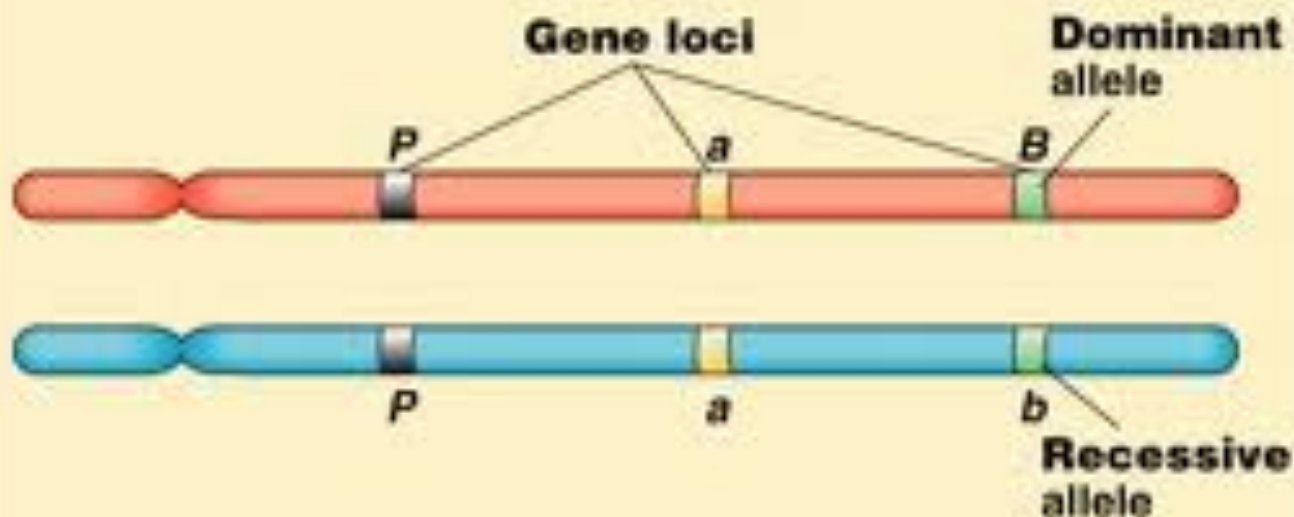
Diploid and polyploid cells whose chromosomes have the same allele of a given gene at some locus are called **homozygous**, with respect to that gene (otherwise, it is **heterozygous**).

Short and Long Arms of a Chromosome



The chromosomal locus of a gene might be written "6p21.3"

- **6**: chromosome number
- **p**: position on the chromosome's short arm ("p") or long arm ("q")
- **21.3**: the position on the arm: region 2, band 1, sub-band 3. The bands are visible under a microscope when the chromosome is stained.



Genotype:	<i>PP</i>	<i>aa</i>	<i>Bb</i>
	Homozygous for the dominant allele	Homozygous for the recessive allele	Heterozygous