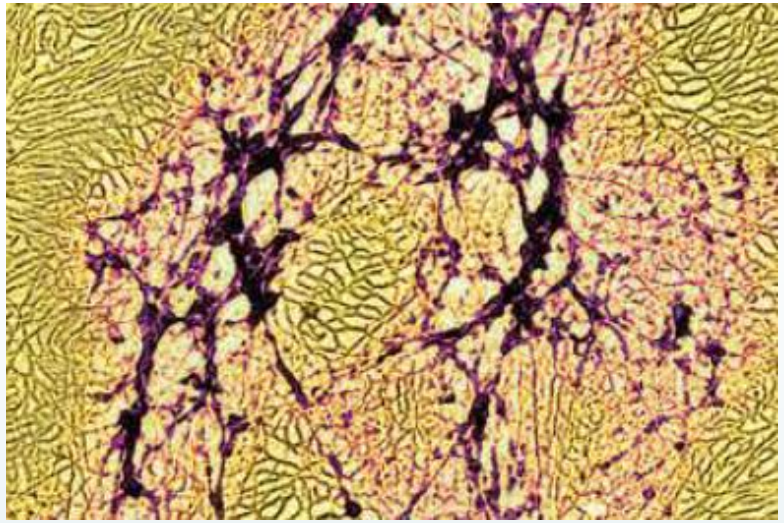
1-1: How does an understanding of DNA help us investigate living things?

Image credits: singularityhub.com

Any uncredited images throughout this powerpoint are from Science Connections 10 textbook or publisher's powerpoint.

Big Ideas



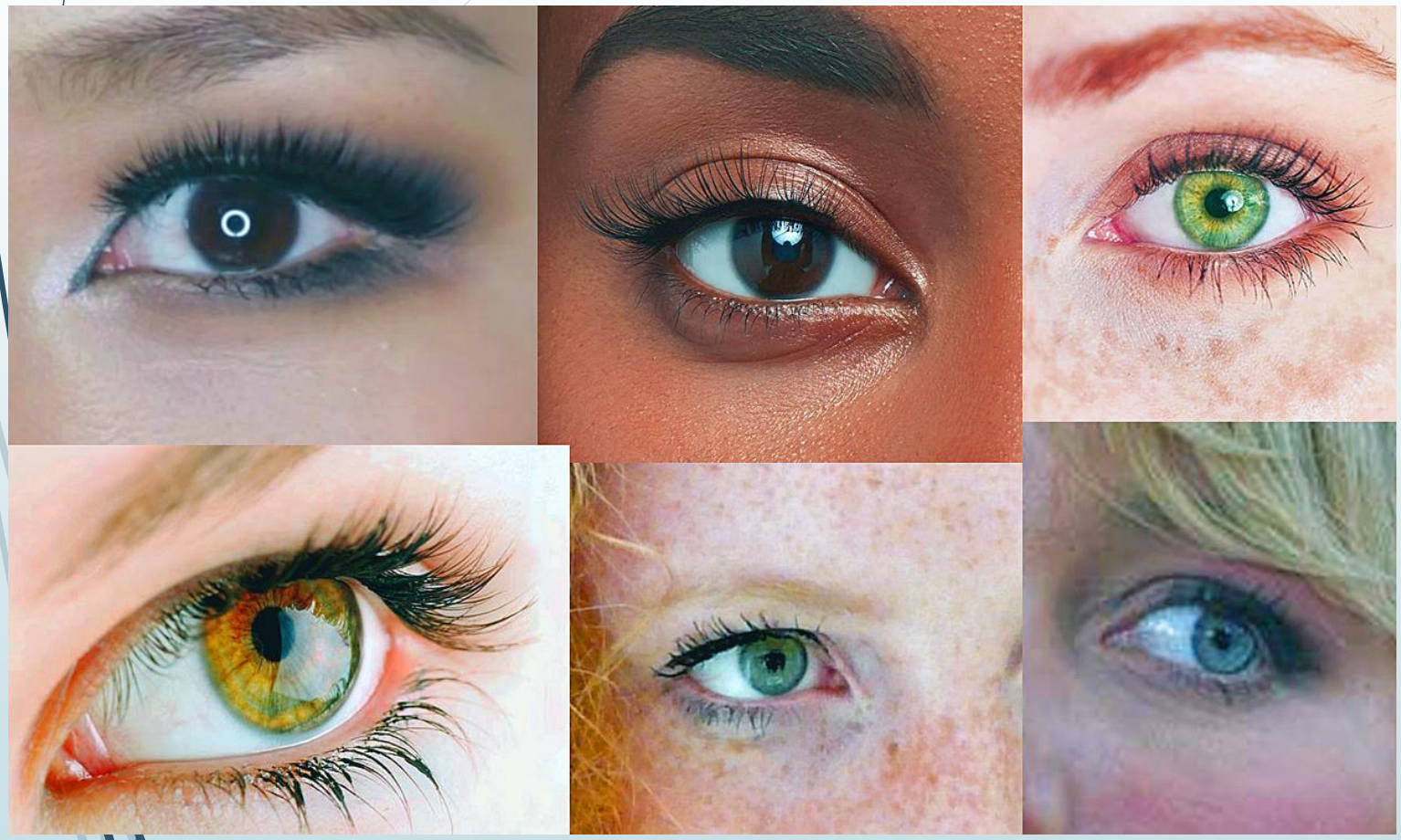
- The variation in living things we see around us is due to DNA.
- DNA is made of many nucleotides linked together in a specific order.
- DNA exists in chromosomes, which contain thousands of genes.
- The structure of DNA is important to passing on information.
- The different genetic make-up of organisms is reflected in the diversity of living things.

3

Variation is when living things have characteristics that are different from each other.

4

Variation is when living things have characteristics that are different from each other.



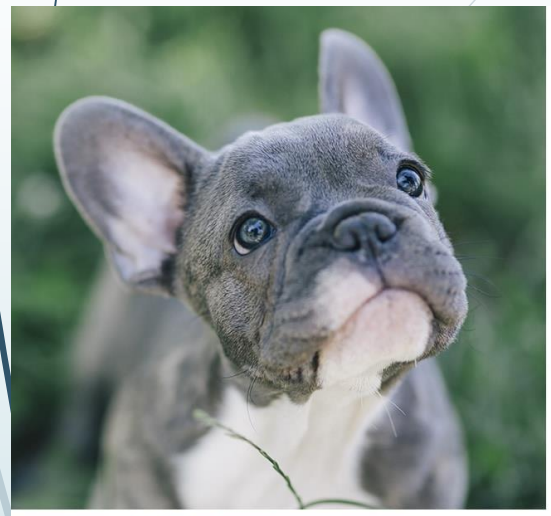
5

There is variation between species…

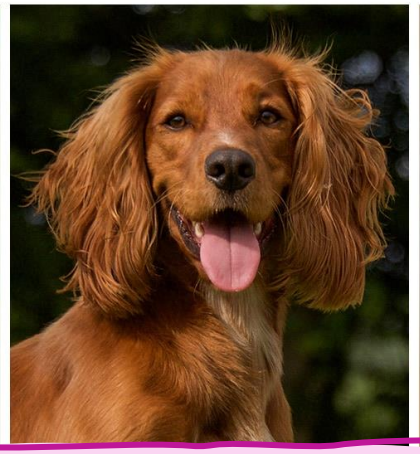
Discussion: Why is variation between species important?

6

…and there is variation within species (DNA, appearance, behaviour, etc.)






Discussion: Why is variation within a species important?

Concept 1: The variation in living things we see around us is due to DNA.

DNA is like a secret family recipe:

- Contains instructions for how to make something important
- Stored somewhere safe, in a compact way
- Passed on through generations (is 'inherited'), sometimes with slight modifications

Instructions for Life

Every living thing has a set of instructions or genetic information that tells its cells what to do (e.g. how to look, behave, get energy, live, reproduce, etc.)

The **genome** is an organism's complete set of genetic information.

- Is stored as **DNA (or RNA)** in the cell nucleus
- Is **inherited** (passed on to offspring)
- Is responsible for **variation** in living things

Example 1: Hair Colour

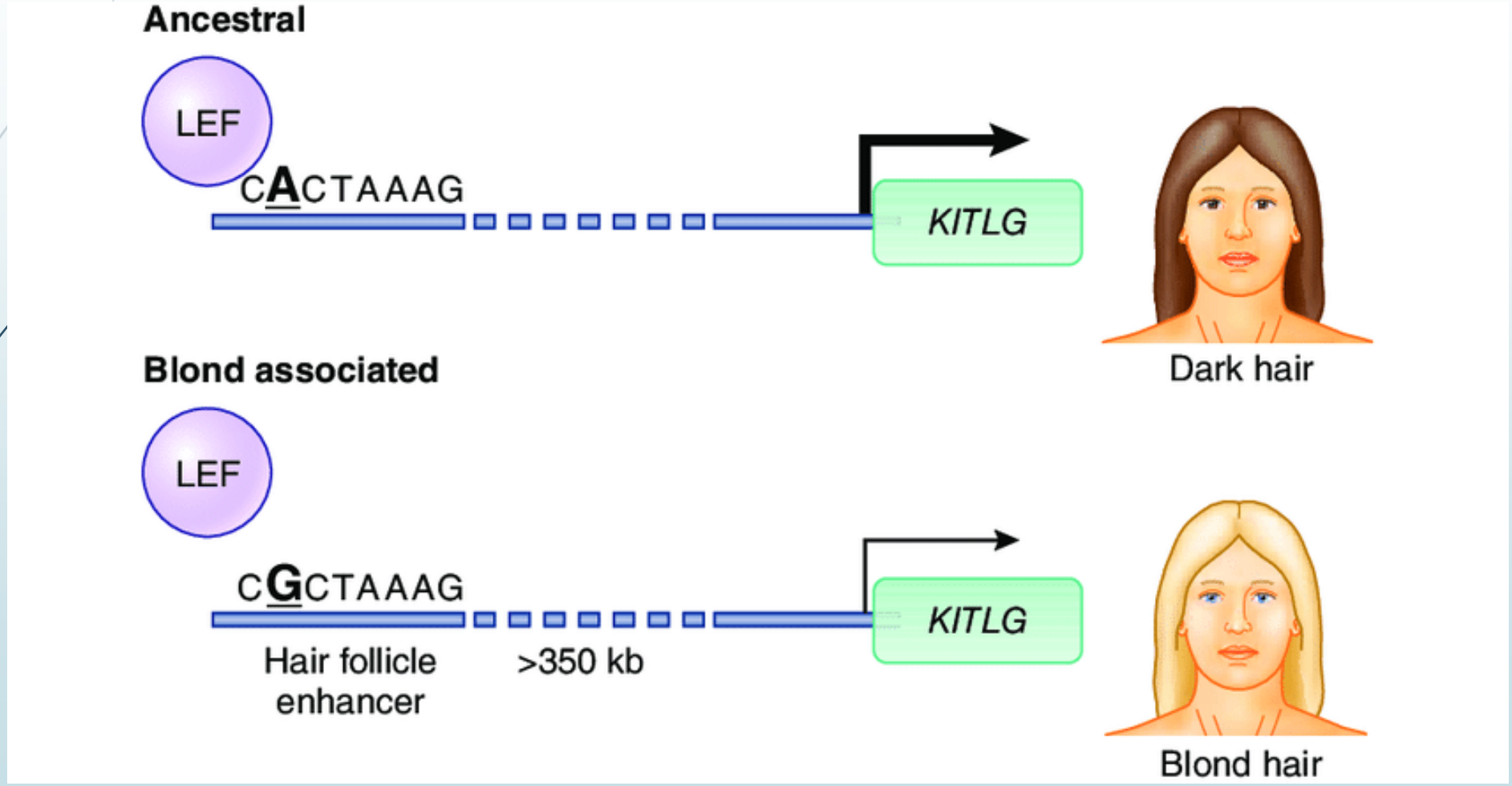
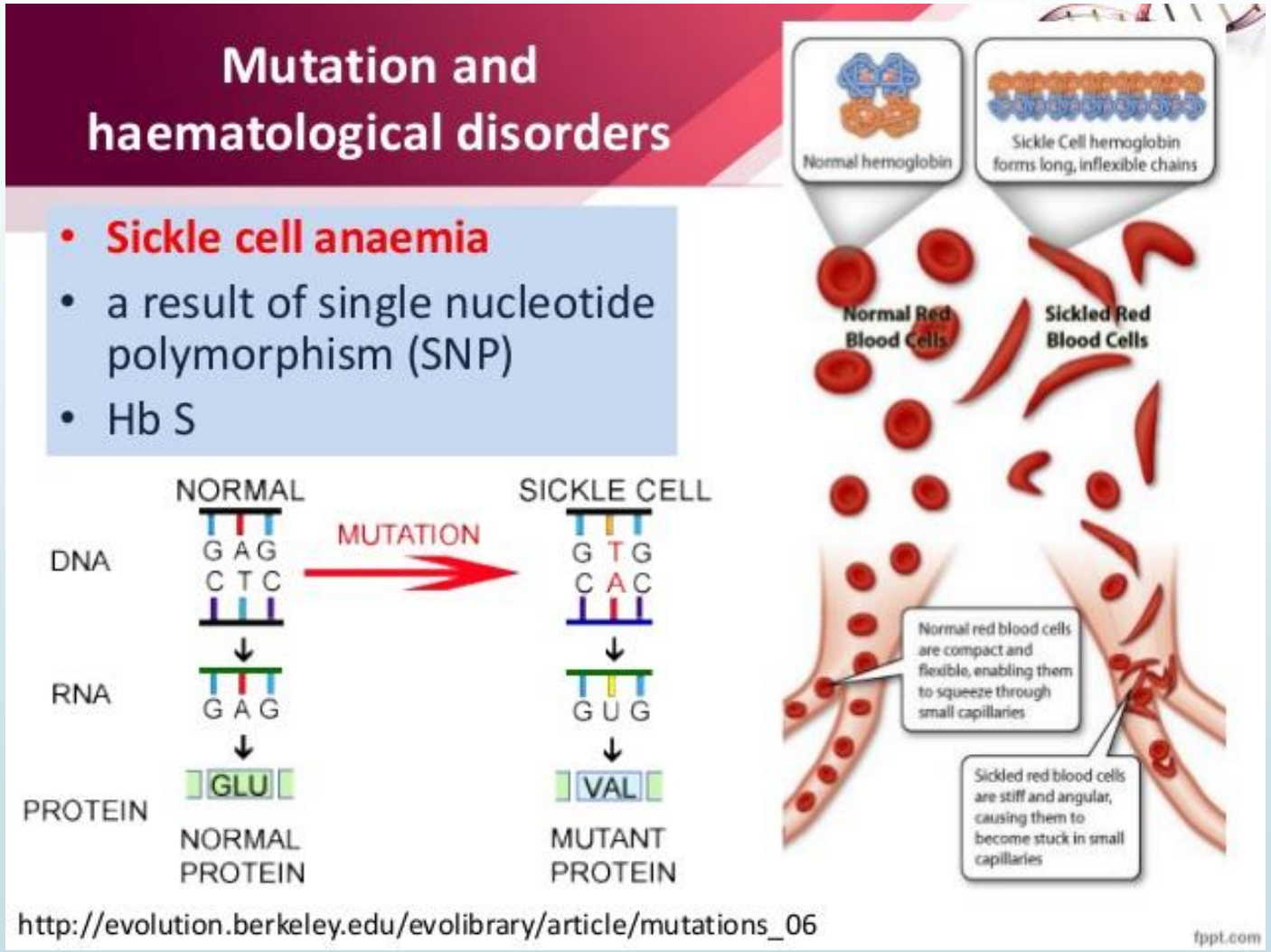


Image from: https://www.researchgate.net/publication/263431247_The_secret_of_a_natural_blond

Example 2: Sickle Cell Anemia



Slide from https://www.slideshare.net/ThetSuWin/mutation-and-dna-repair-53021983

Discussion Questions

1. Why is there variation among organisms on Earth?

2. Choose one group of organisms in Figure 1.1 and describe some of the similarities and differences between species in that group. Use examples not already listed in the text.

Concept 2: DNA structure

Concept 2: DNA is made of many nucleotides linked together in a specific order.

There are two types of **nucleic acids**:

1) **DNA** (deoxyribonucleic acid)
2) **RNA** (ribonucleic acid)

Nucleotides are the basic building blocks of nucleic acids.

(Slight differences between DNA and RNA: we will learn about DNA nucleotides.)

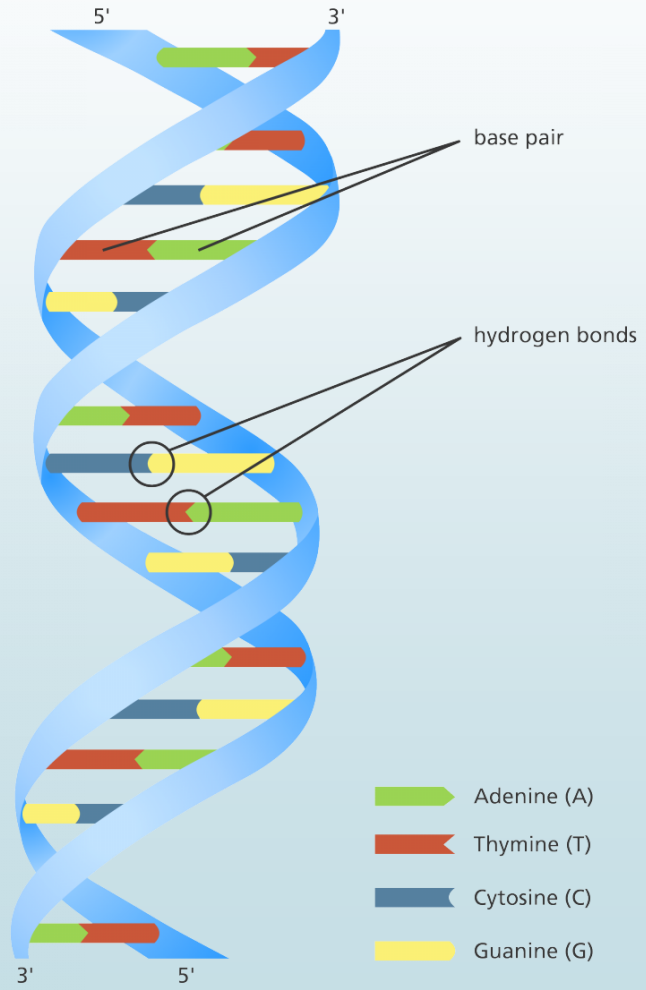
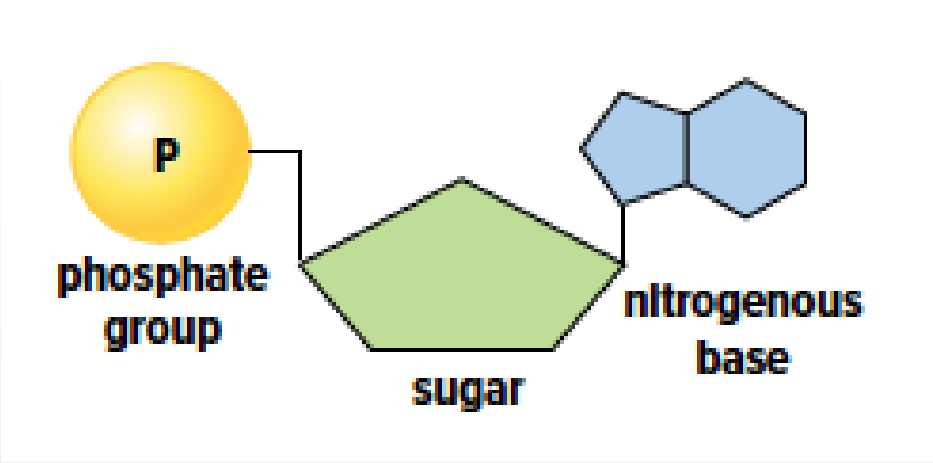


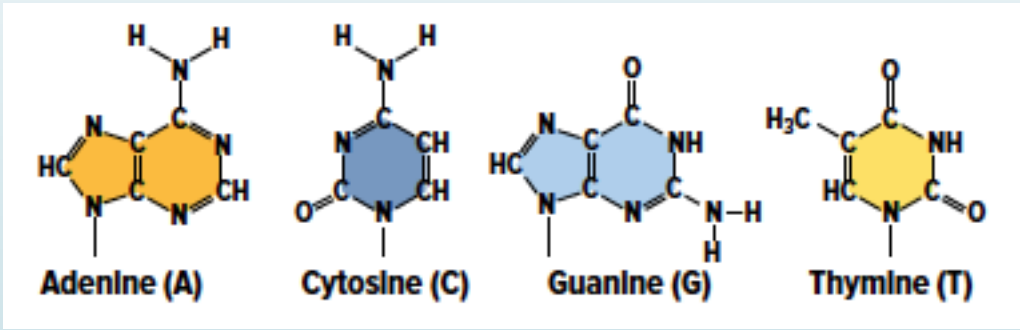
Image credits: yourgenome.org

The Structure of DNA

Each **nucleotide** has three parts:

1) a **phosphate** group
2) a **sugar**
3) a **nitrogenous base**
   - **Adenine (A)**
   - **Guanine (G)**
   - **Thymine (T)**
   - **Cytosine (C)**





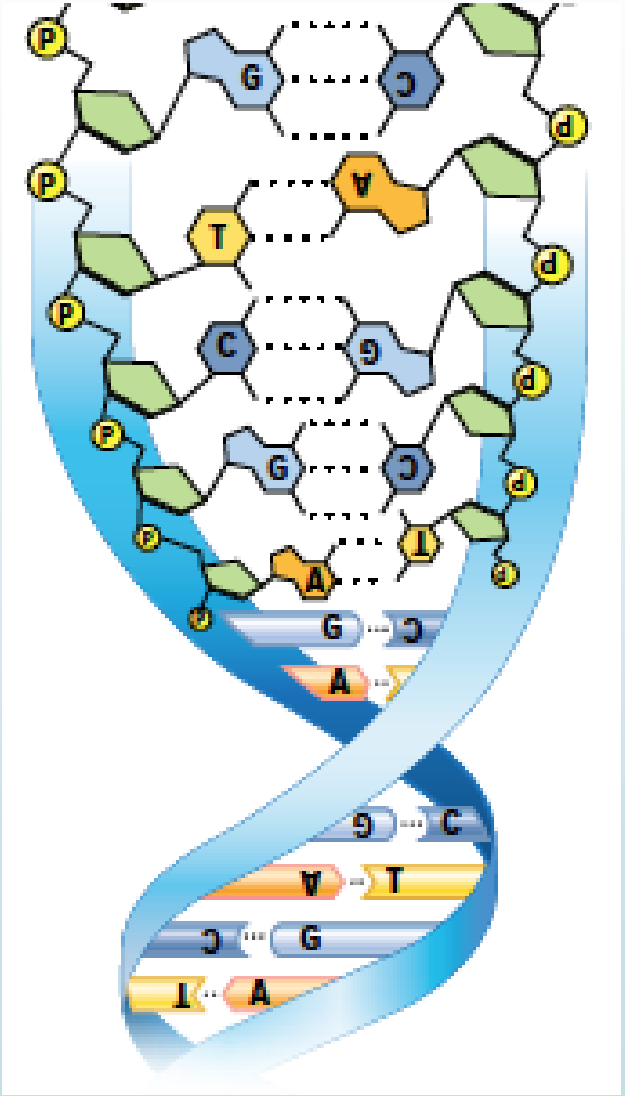
Because there are 4 types of nitrogenous bases, there are four types of nucleotides (A, G, C, T). The sequence of nucleotides in a nucleic acid is how it stores genetic information!

The Structure of DNA (cont'd)

Nitrogenous bases that pair together are **complementary bases:**

- adenine (A) and thymine (T)
- cytosine (C) and guanine (G)

Remember:
Apples in a **T**ree; **C**ar in a **G**arage
; **C**hips and **G**uacamole

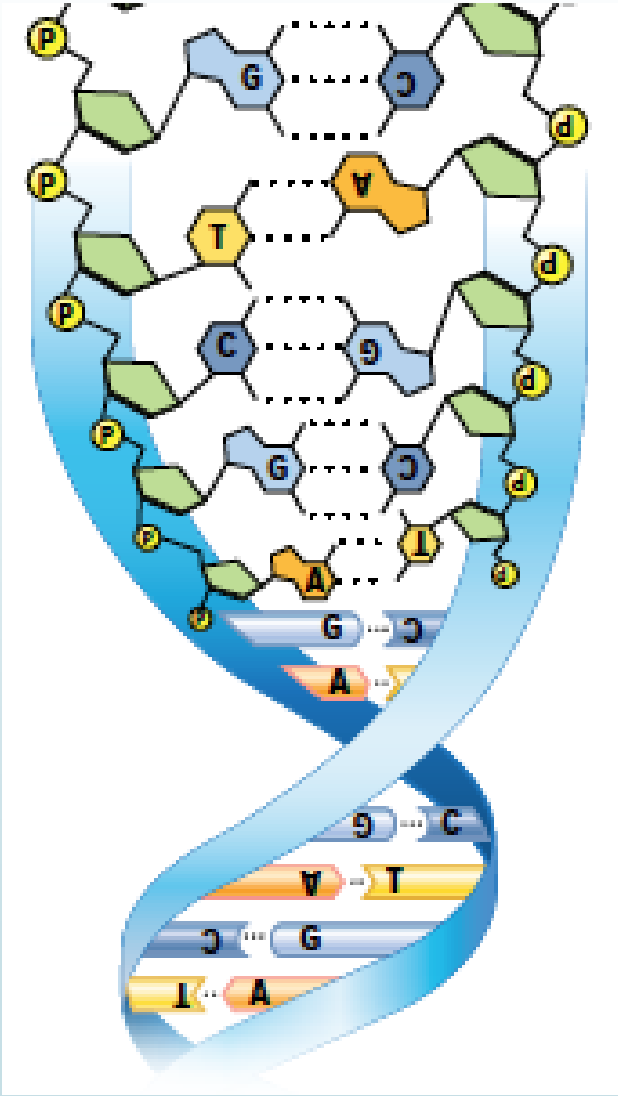


The Structure of DNA (cont'd)

DNA is double-stranded (made of two strings of nucleotides)

DNA has a **double helix** (twisted ladder) shape:

- Sides of ladder: sugar and phosphate
- Steps of ladder: pairs of nitrogenous bases held together by **hydrogen bonds**



Discussion Questions

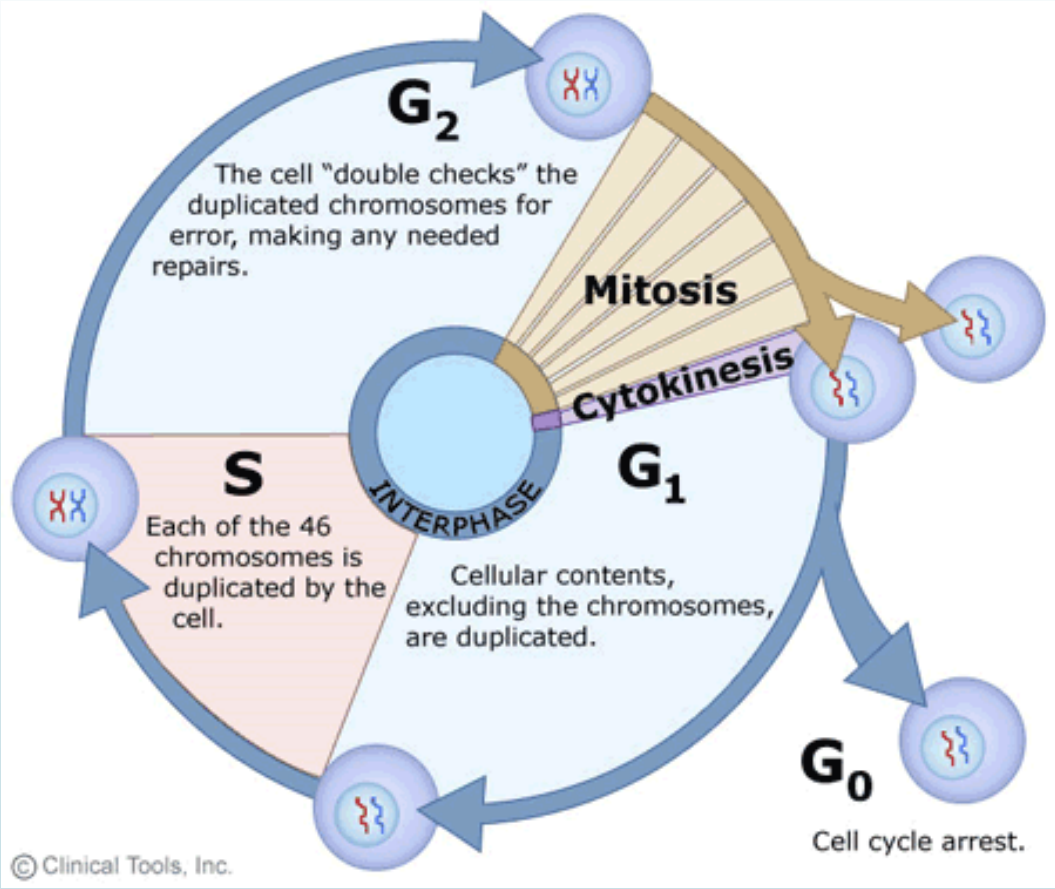
1. If the bases on one strand of DNA are ATGGGCTA, what is the sequence of complementary bases on the other strand of DNA?

2. Think of an analogy to describe base pairs. Share it with a classmate.

Concept 4: DNA Replication and Protein Synthesis Overview

Concept 4: The structure of DNA is important to passing on genetic information.

- A cell replicates its DNA once in the cell cycle.
- During cell division, one copy of DNA is passed on to each daughter cell



https://www2.le.ac.uk/projects/vgec/highereducation/topics/cellcycle-mitosis-meiosis

Do not memorize!

Concept 4: The structure of DNA is important to passing on genetic information.

Cell Cycle Review

G_1:

- Growth
- Performs regular cell functions

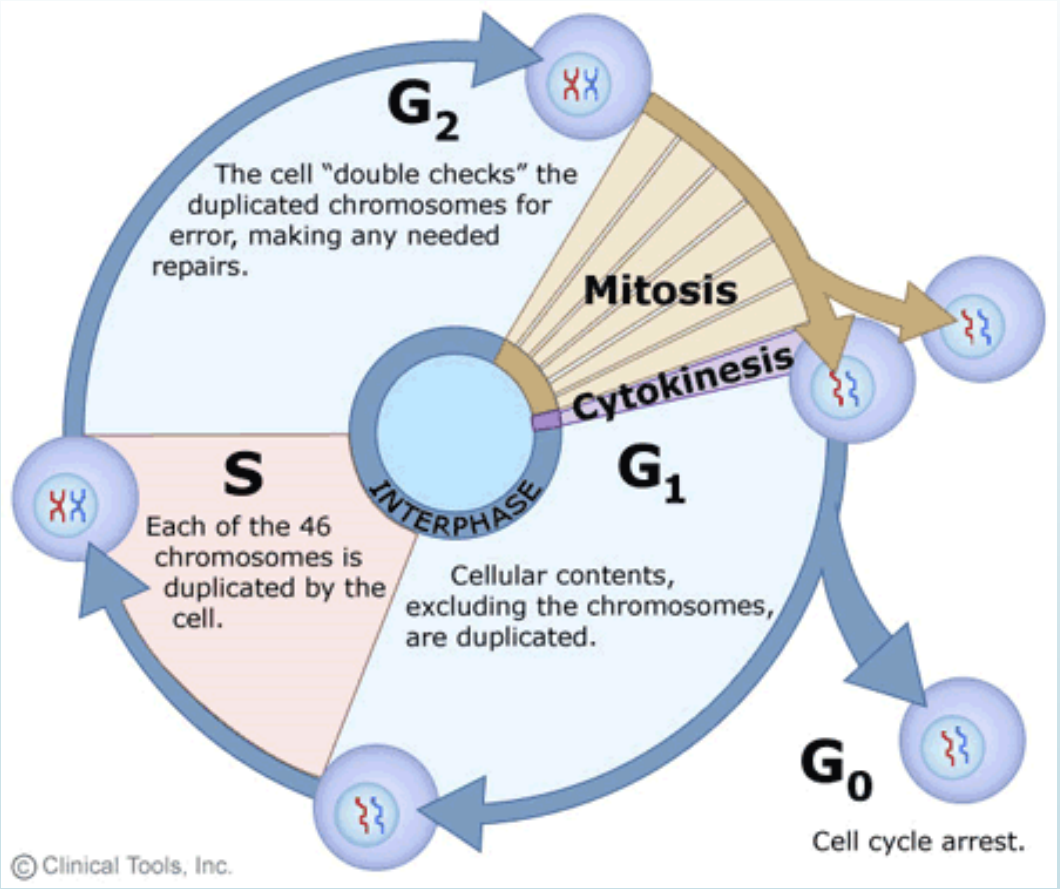
S: DNA replication

- DNA replicated: one → two sister chromatids per chromosome

G_2:

- Double-checking

Mitosis/cytokinesis: cell divides



https://www2.le.ac.uk/projects/vgec/highereducation/topics/cellcycle-mitosis-meiosis

DNA Replication

Replication: a process that makes identical copies of a DNA molecule for use in cell division

- Hydrogen bonds between nitrogenous bases are 'unzipped'
- New nucleotides form a new strand: C-G; A-T
- Each new DNA molecule consists of an original strand and a new strand.

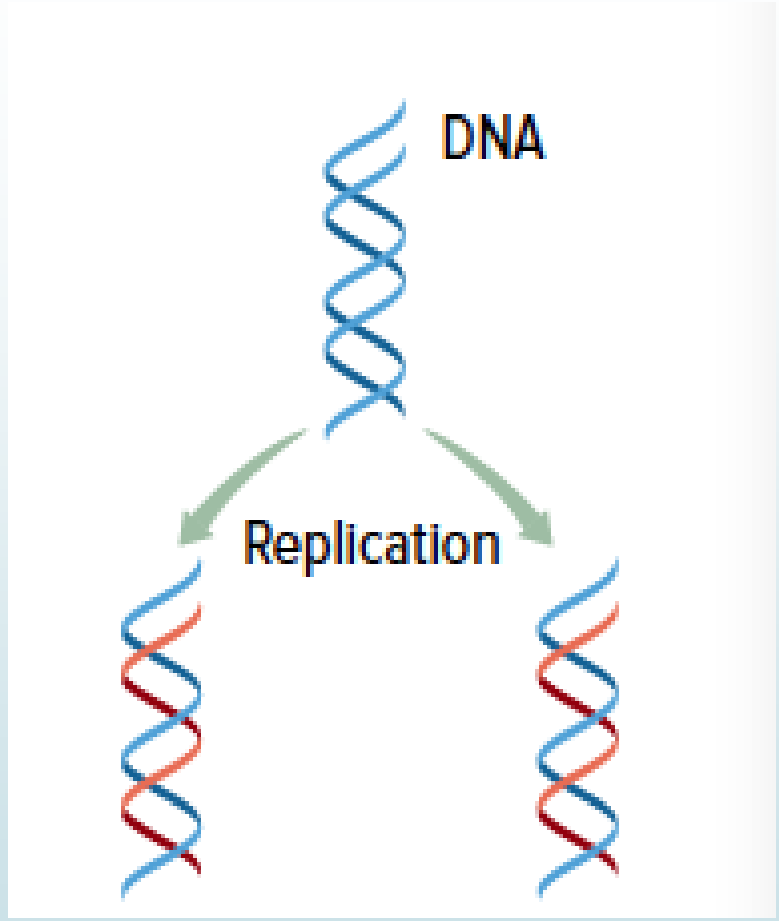


Figure 1.7: During DNA replication, two molecules of DNA are made from one. The resulting new molecules are identical to the original. Each new molecule contains one original strand of DNA (shown here in blue) and one new strand (shown in red).

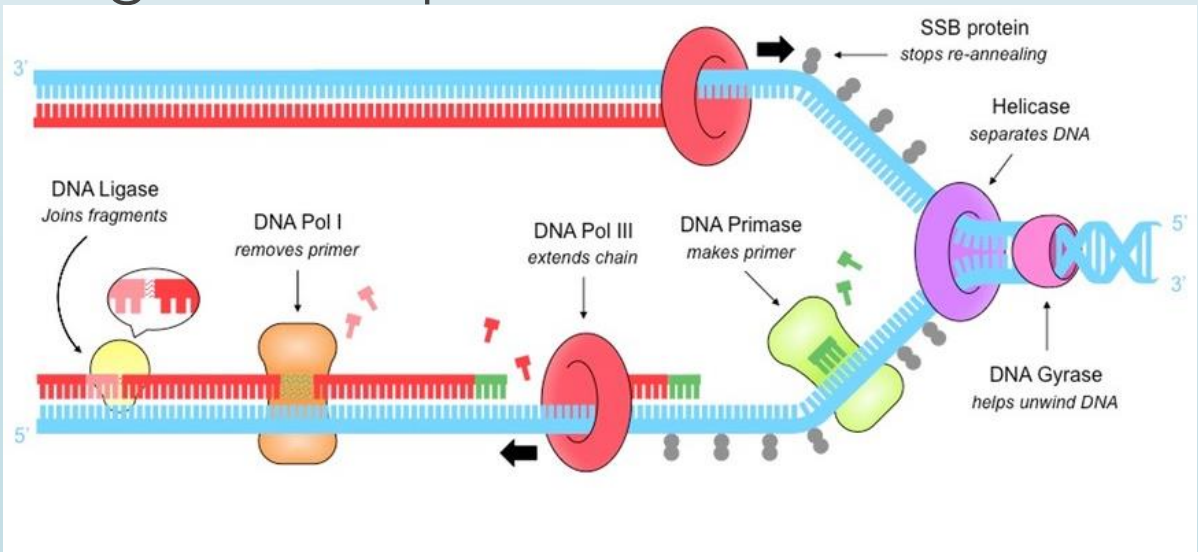
Do not memorize!

Concept 4: The structure of DNA is important to passing on genetic information.

DNA Replication (cont'd)

DNA replication is complex, involving many enzymes (proteins!), such as:

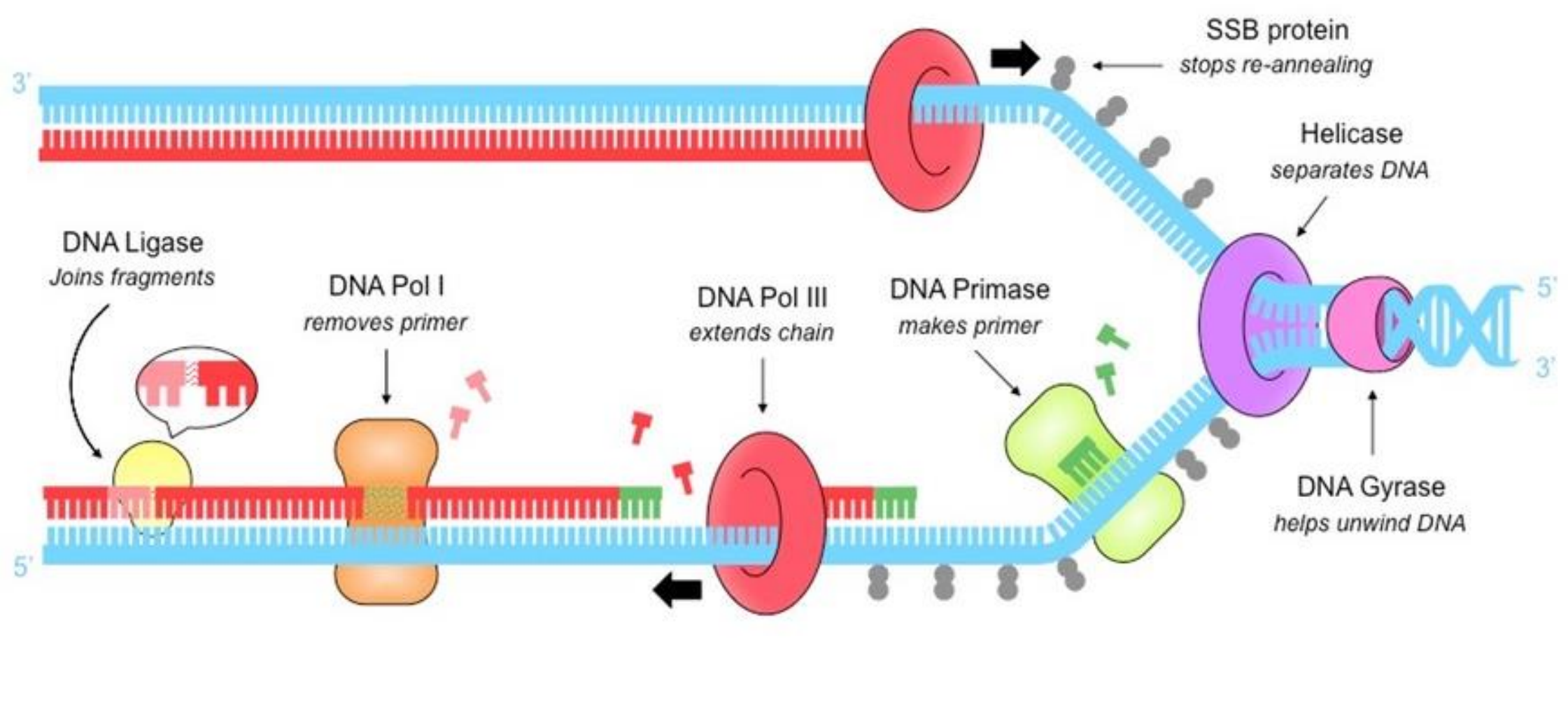
- Helicase: unwinds, unzips DNA strand
- DNA Polymerases: complementary base pairing, double-checking
- DNA Ligases: rezips DNA strand



Do not memorize!

Concept 4: The structure of DNA is important to passing on genetic information.

DNA Replication (cont'd)



DNA is Used to Make Proteins
(more details to follow)

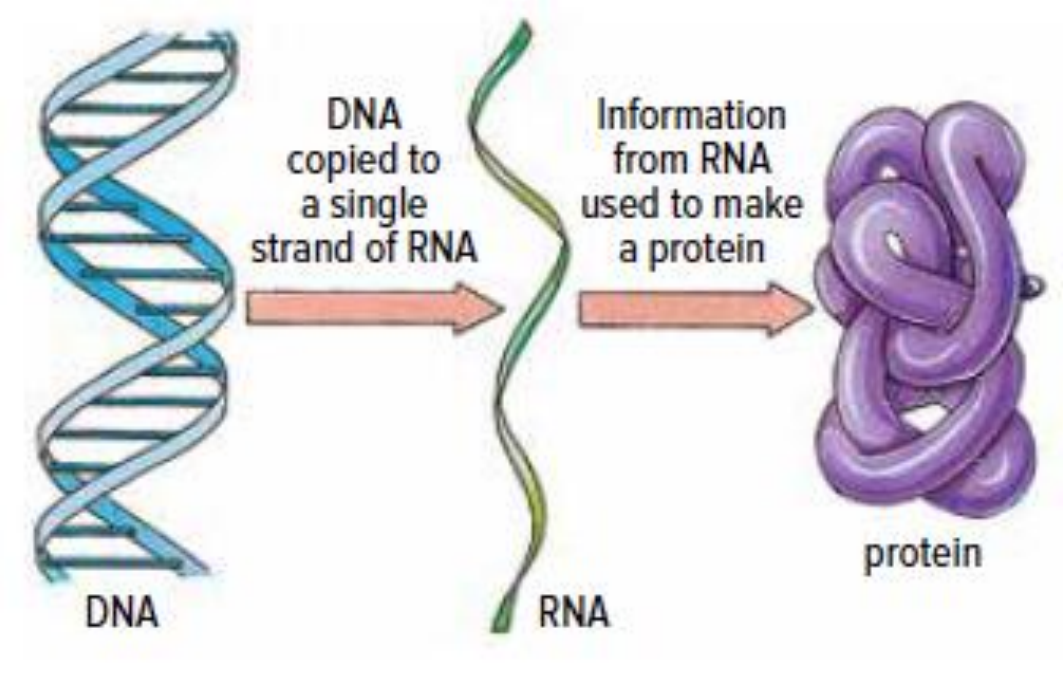


Figure 1.8: Genetic information passes from the genes (DNA) to an RNA copy of the gene, and the RNA copy directs the sequential assembly of a chain of amino acids to produce a protein.

- Each cell has one copy of DNA in the nucleus.
- Sections of DNA are copied into RNA
  - RNA is disposable, can exit nucleus
- Ribosomes 'read' RNA and make proteins.
- The sequence of bases in the DNA molecule determines the specific sequence of amino acids in the protein molecule.

Discussion Questions

1. Explain how the structure of DNA is related to how genetic material is passed from one generation to the next.

2. How are genes involved in the production of proteins?

The Function of DNA

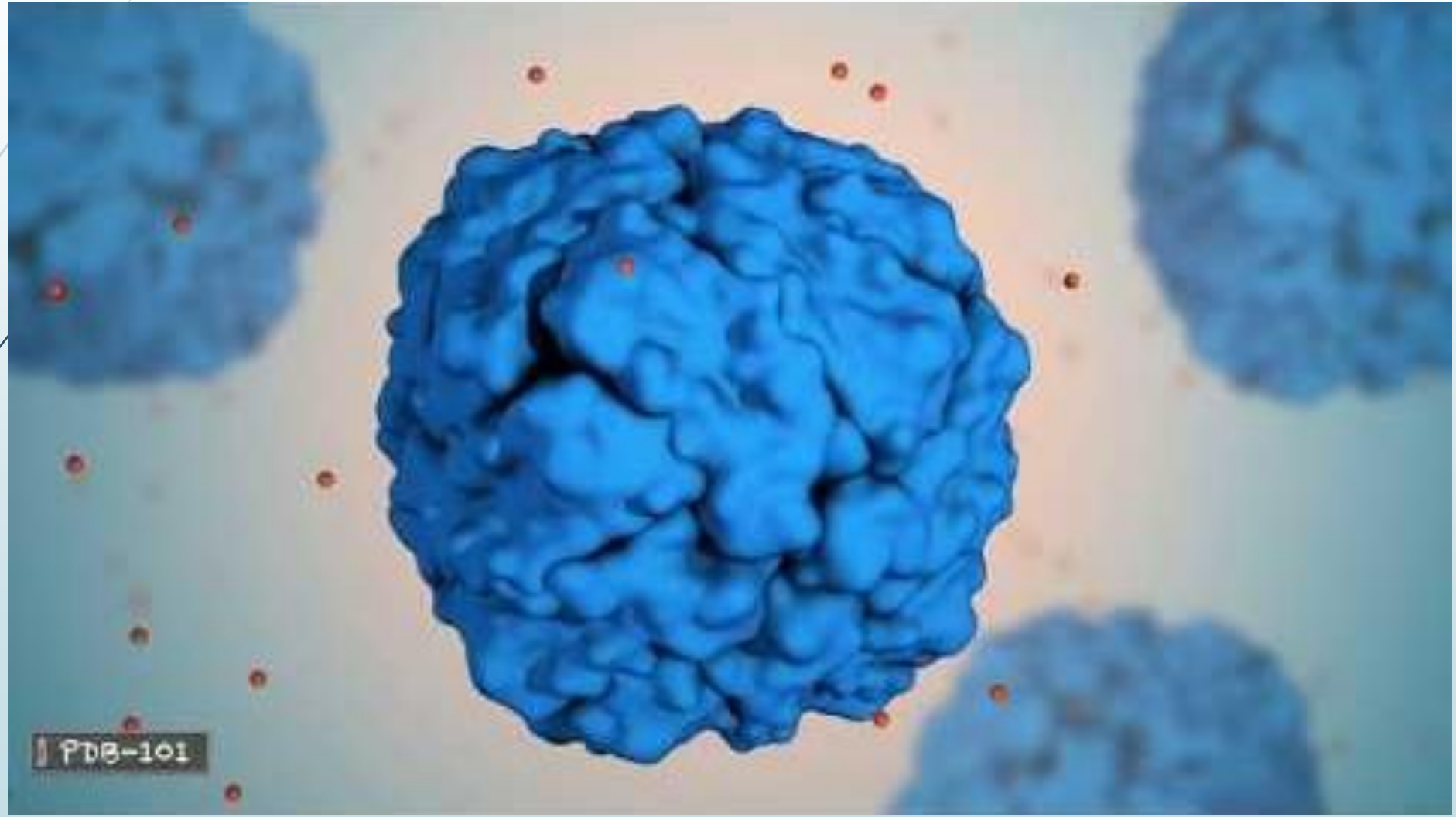
DNA stores genetic information.

- The sequence of nucleotides in DNA is how genetic information is stored.
- Parents pass their DNA on to their offspring; DNA is inherited.

DNA contains instructions to make **proteins…**

Answer the following questions in this video:

1. What are proteins made of?
2. List three proteins in the body and describe what they do.



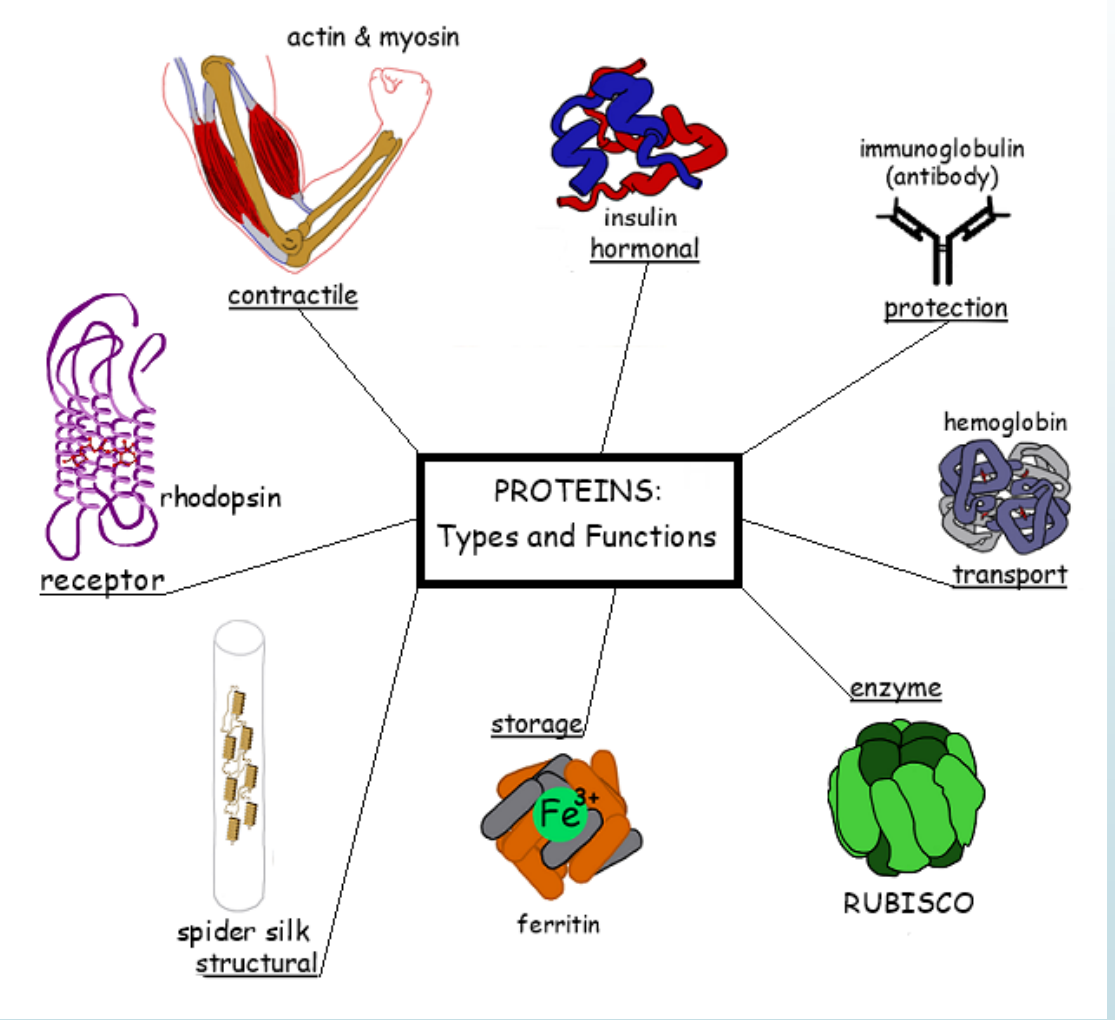
https://www.youtube.com/watch?v=wvTv8TqWC48&ab_channel=RCSBProteinDataBank

Proteins: what are they?

Proteins do everything that a cell (and thus, a living thing) needs to function, grow, and reproduce.

Examples:

- Structure
- Growth and repair
- Signaling
- Speeding up chemical reactions
- Transporting substances

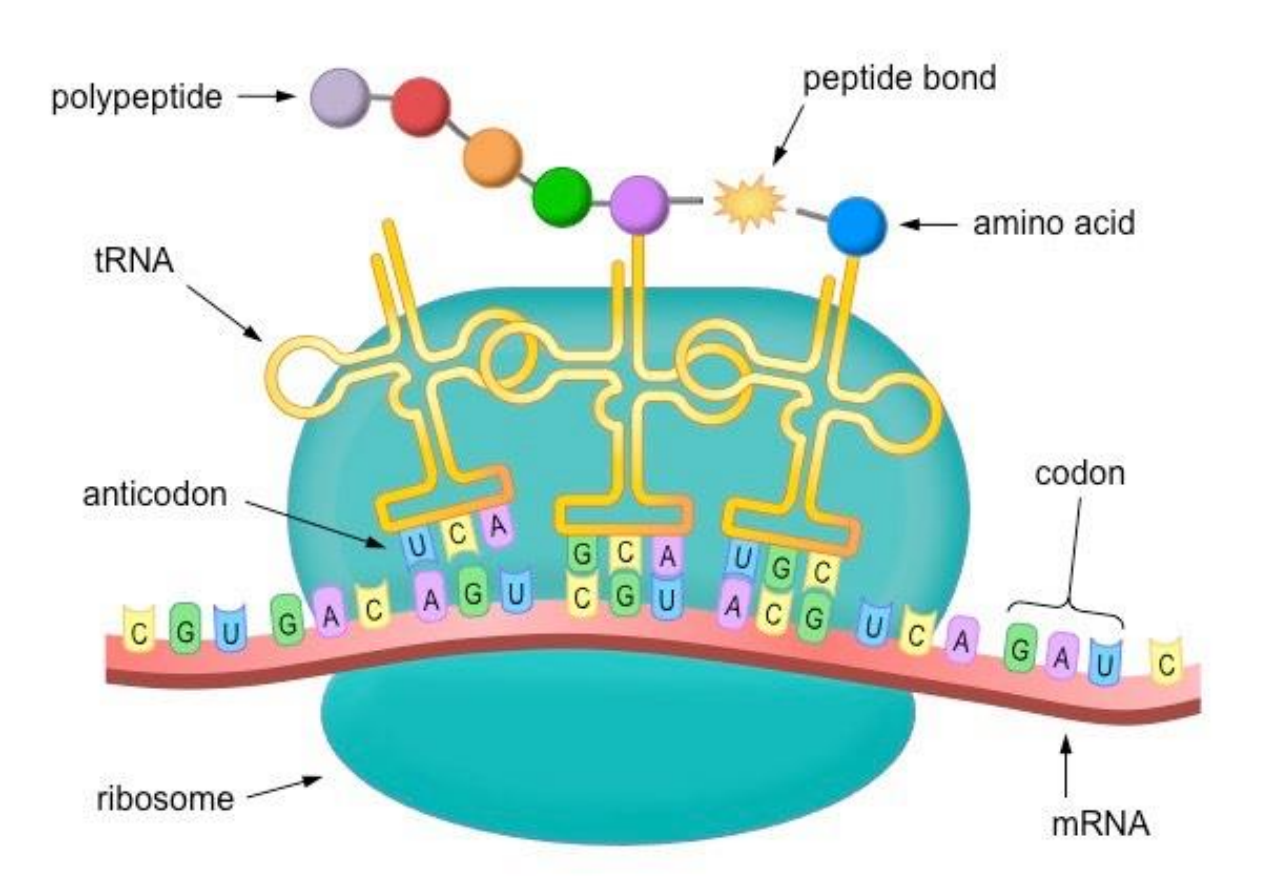


Proteins: examples (do not memorize)

Protein type or name	Function
Sonic Hedgehog (SHH)	Controls stem cell growth in limbs
Keratin	Structural: makes up hair, feathers
Myosin	Contraction of muscle fibers
Clock proteins	Detects light; establish circadian cycle
Antibodies	Bind to harmful pathogens; help neutralize or tag for destruction
Hemoglobin	In red blood cells, stores oxygen or carbon dioxide
ATP synthase	A 'turbine' that harnesses proton gradient to make ATP

ATP synthase video: https://www.youtube.com/watch?v=XI8m6o0gXDY&ab_channel=DiscoveryScience

Proteins: what are they?



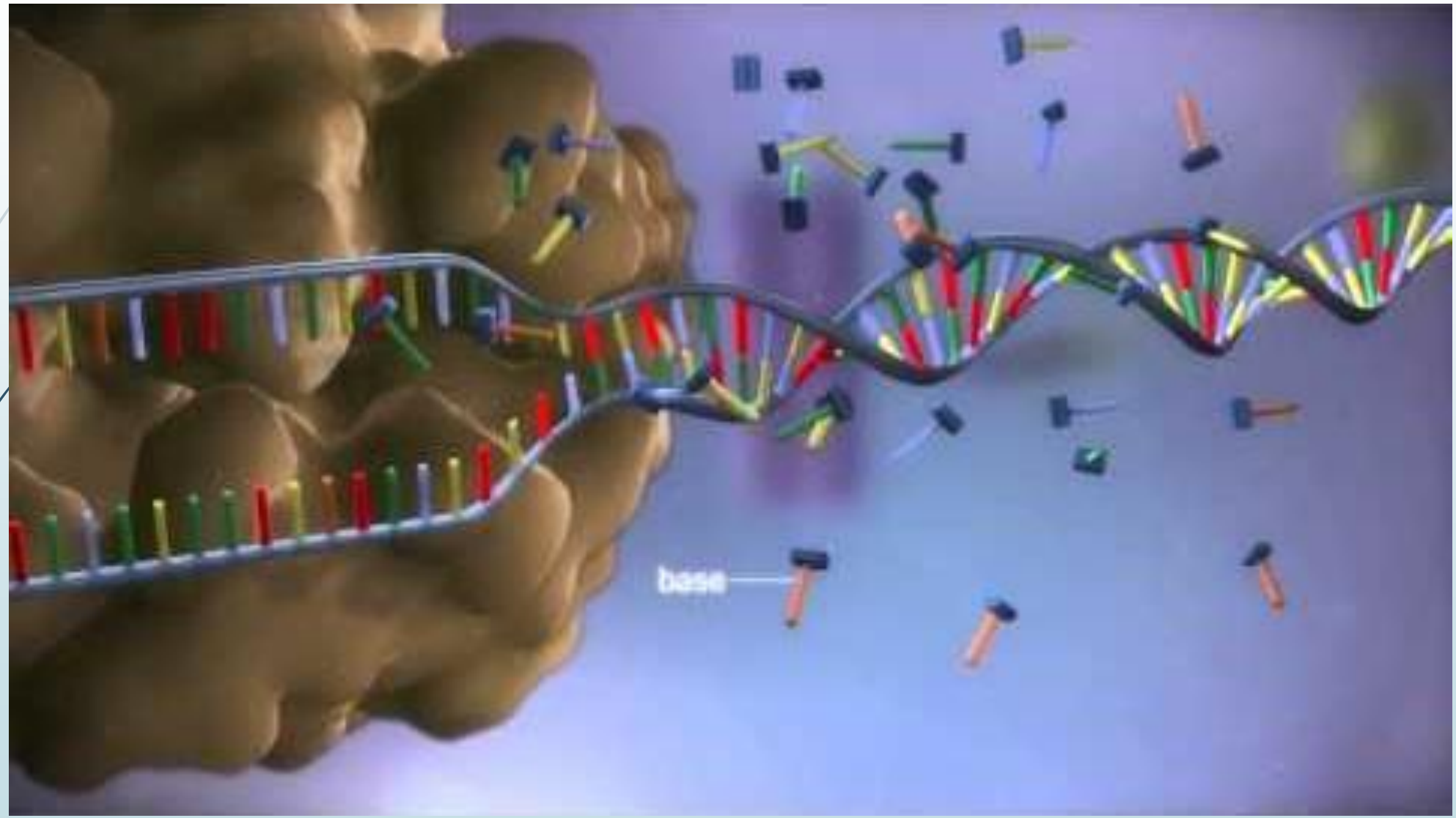
Amino acids are the building blocks of proteins.

The sequence of amino acids in a protein is determined by the sequence of nucleotides in DNA.

(This is how DNA contains all the instructions for life: by containing the instructions for proteins!)

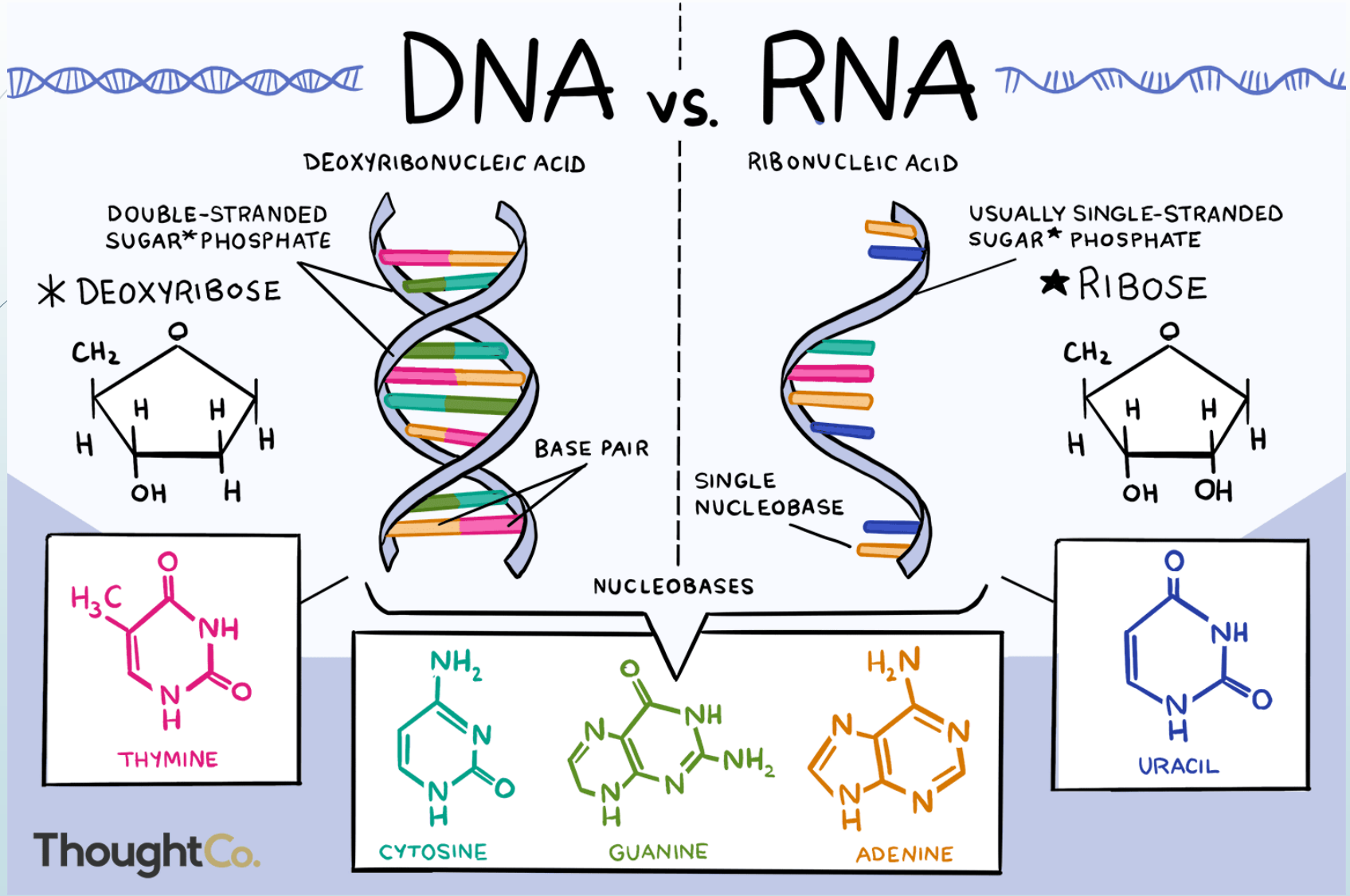
Protein Synthesis (not in textbook)

How are proteins made from DNA?

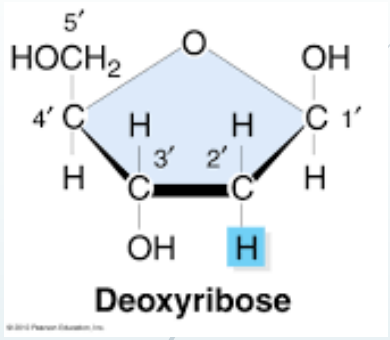


https://www.youtube.com/watch?v=gG7uCskUOrA&ab_channel=yourgenome

Nucleic Acid Comparison



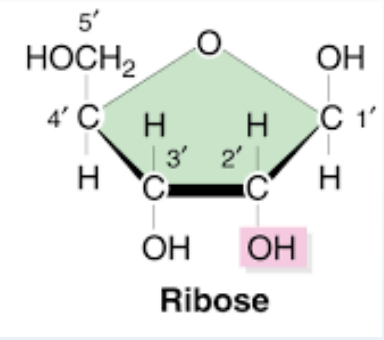
Nucleic Acid Comparison



DNA

- Deoxyribonucleic acid
- Nucleotides:
  - Deoxyribose sugar
  - Adenine, cytosine, guanine, thymine
- Double-stranded, double helix
- Single copy of DNA per cell; only copied (DNA replication) when preparing for cell division

RNA

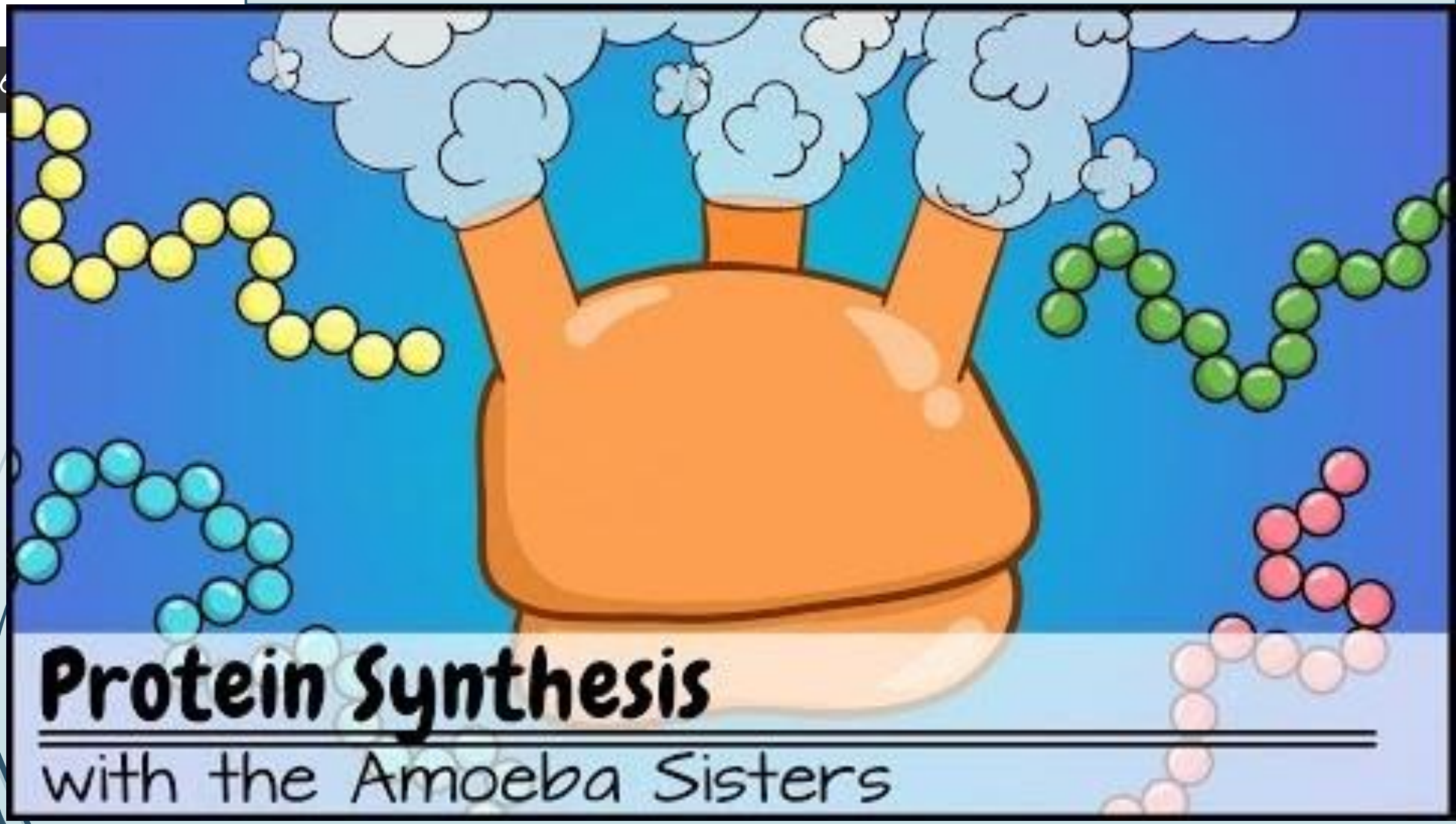


- Ribonucleic acid
- Nucleotides:
  - Ribose sugar
  - Adenine, cytosine, guanine, uracil
- Single-stranded
- Many RNA molecules per cell; constantly being made, used, recycled

Significance of DNA and RNA

- RNA nucleotides can hydrogen-bond with DNA nucleotides
- RNA made from DNA; DNA made from DNA
- RNA required for DNA to make proteins

Concept 2: DNA is made of many nucleotides linked together in a specific order.



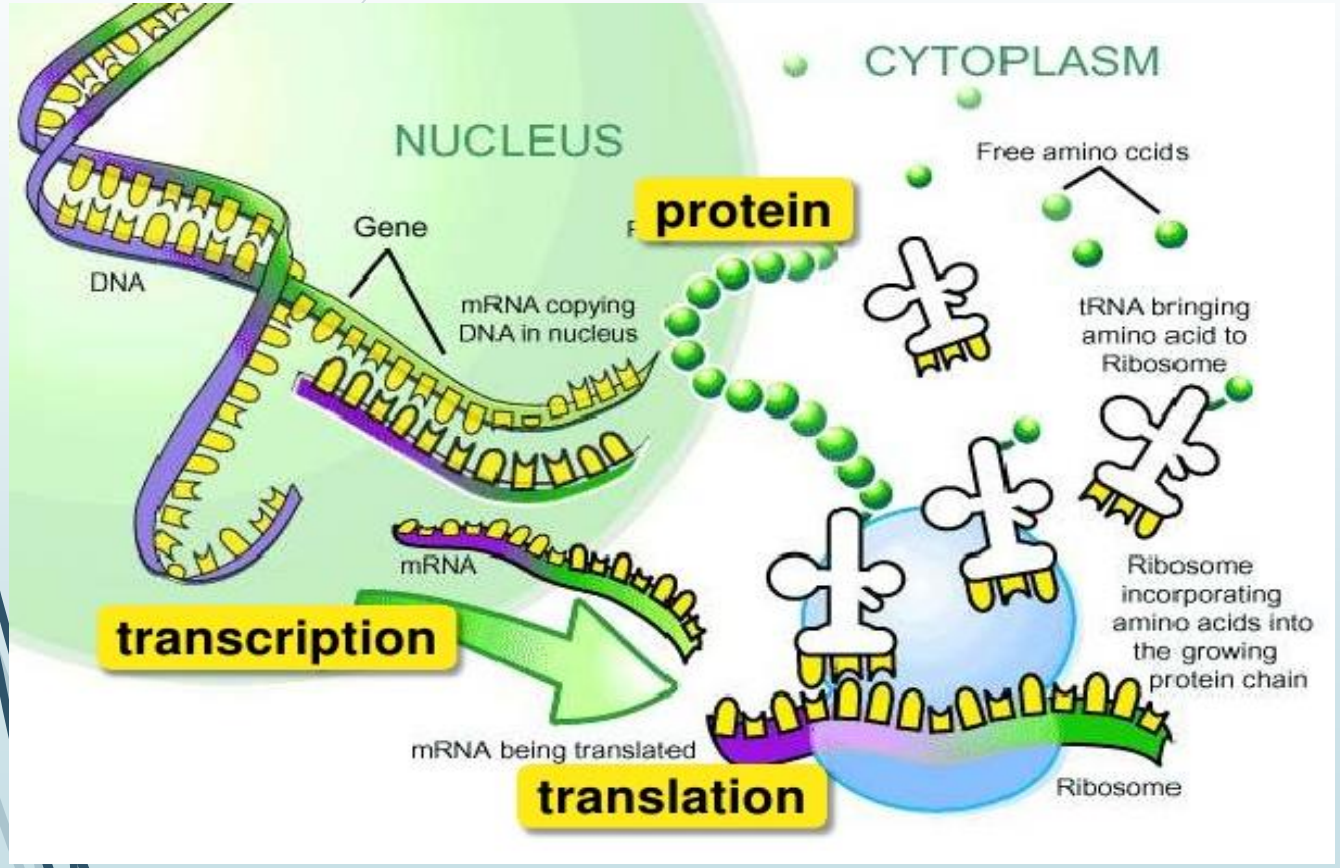
https://www.youtube.com/watch?v=oefAI2x2CQM

Post-video Questions

1) Why can't proteins be made directly from the DNA? Why is mRNA necessary?
2) Where do transcription and translation occur?
3) What is the role of tRNA?

https://www.youtube.com/watch?v=oefAI2x2CQM

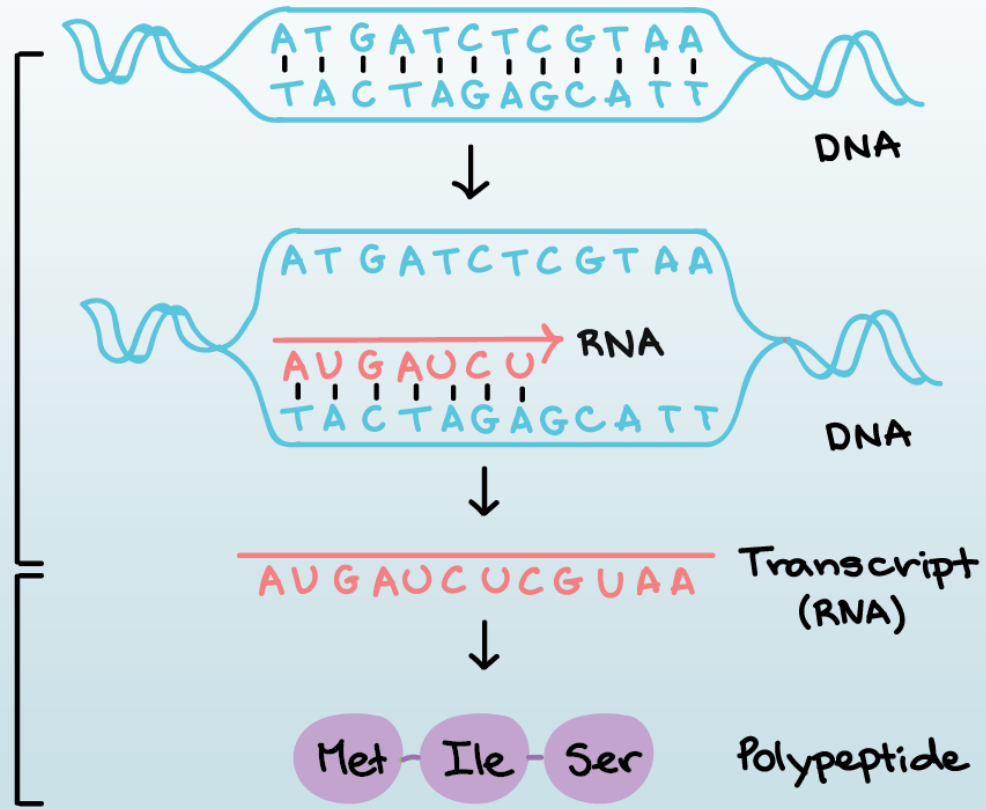
Protein Synthesis: Summary



1. **Transcription**:
   - DNA is transcribed into mRNA
2. **Translation**:
   - Ribosome reads mRNA
   - mRNA is translated into an amino acid sequence through tRNA
3. **End result: protein!**

Protein Synthesis: Transcription

1. **Transcription**:
   - Part of DNA is copied into messenger RNA (**mRNA**) transcript
   - RNA base pairs:
     - adenine – **uracil** (*not* thymine)
     - guanine – cytosine
   - Occurs in nucleus
   - **Codon**: 3-base-pair sequence in mRNA



https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription

Protein Synthesis: Transcription

Practice:

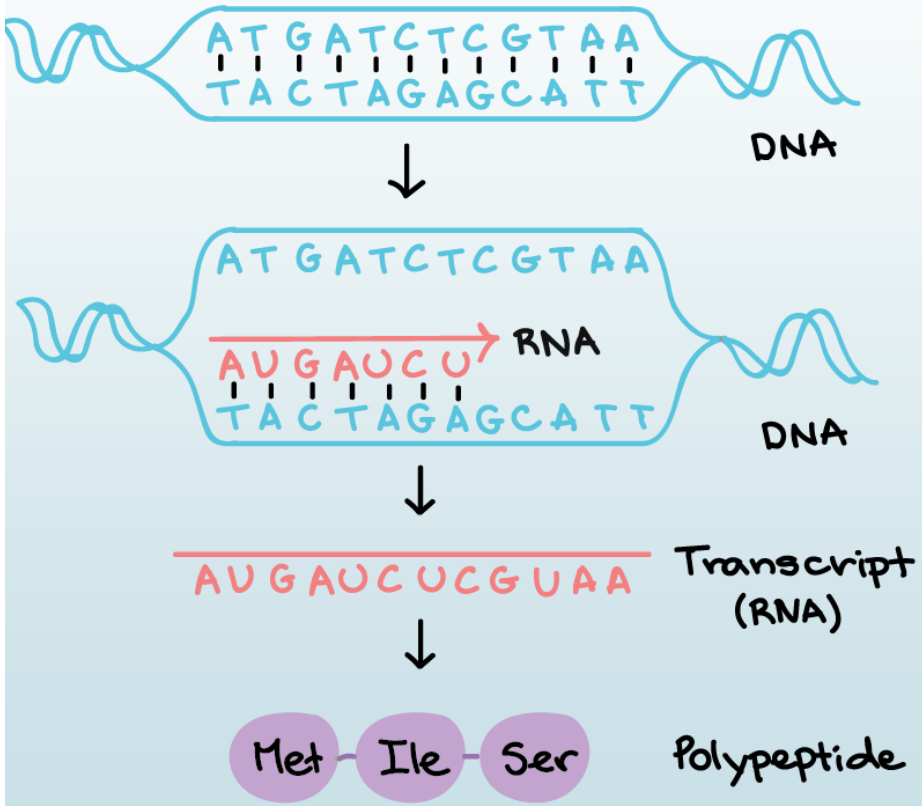
For the DNA sequences below, write the corresponding mRNA sequence.

a) TAC CAT TAA CAG TAC GGG (DNA)

AUG GUA AUU GUC AUG CCC (mRNA)

b) TAC ATG GCA ATA CGC GAA (DNA)

AUG UAC CGU UAU GCG CUU (mRNA)

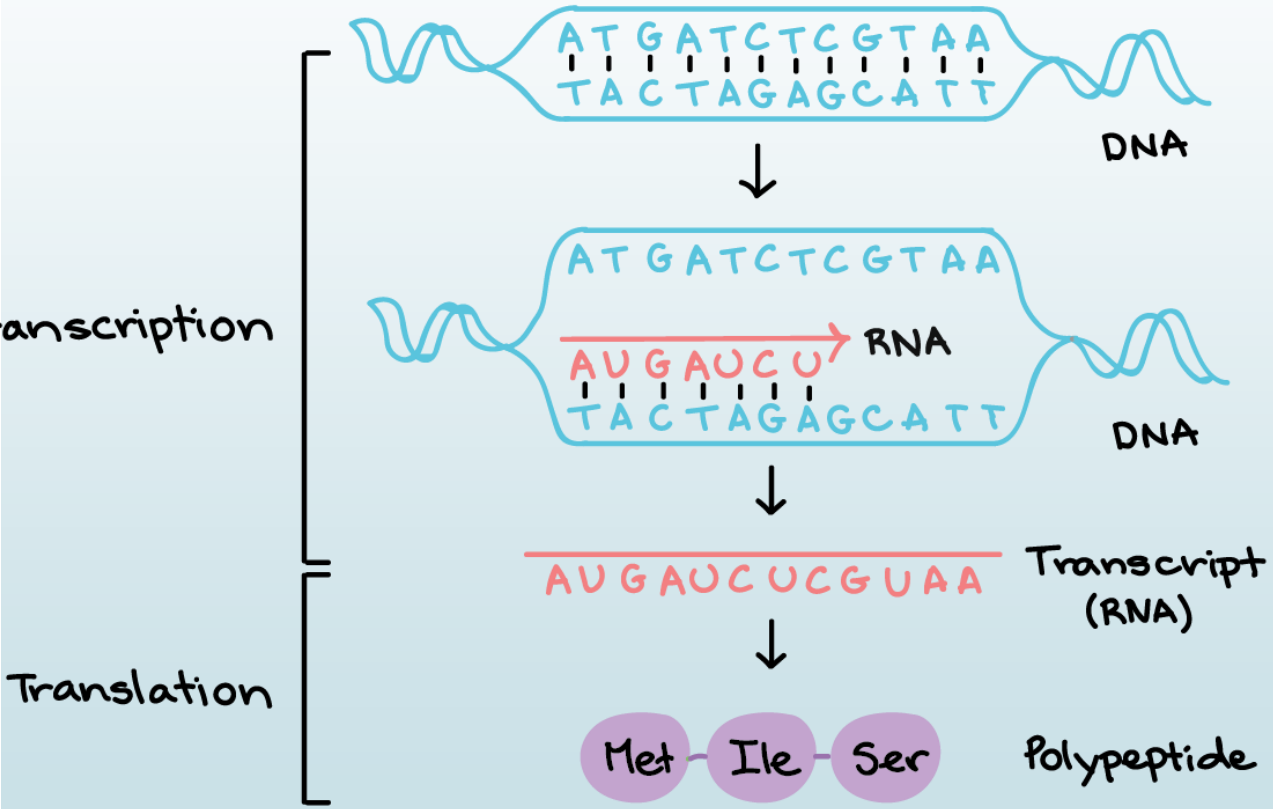


https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription

Protein Synthesis: Translation

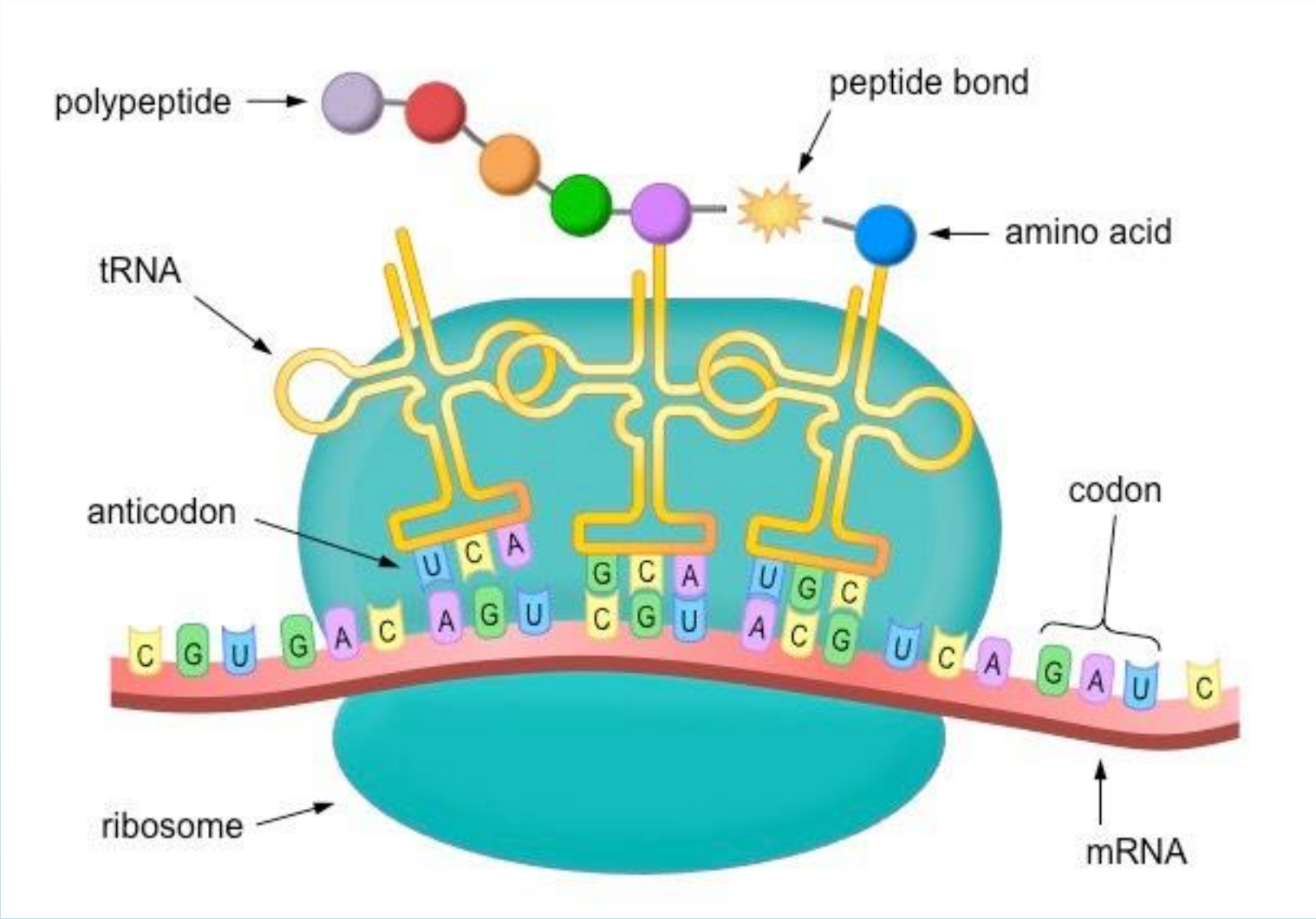
2. Translation:

- mRNA leaves nucleus, is 'read' by ribosome
- Transfer RNA (**tRNA**) has matching **anticodon** and **amino acid**
- Result: amino acid chain = protein (basically!)



https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription

Protein Synthesis: Translation

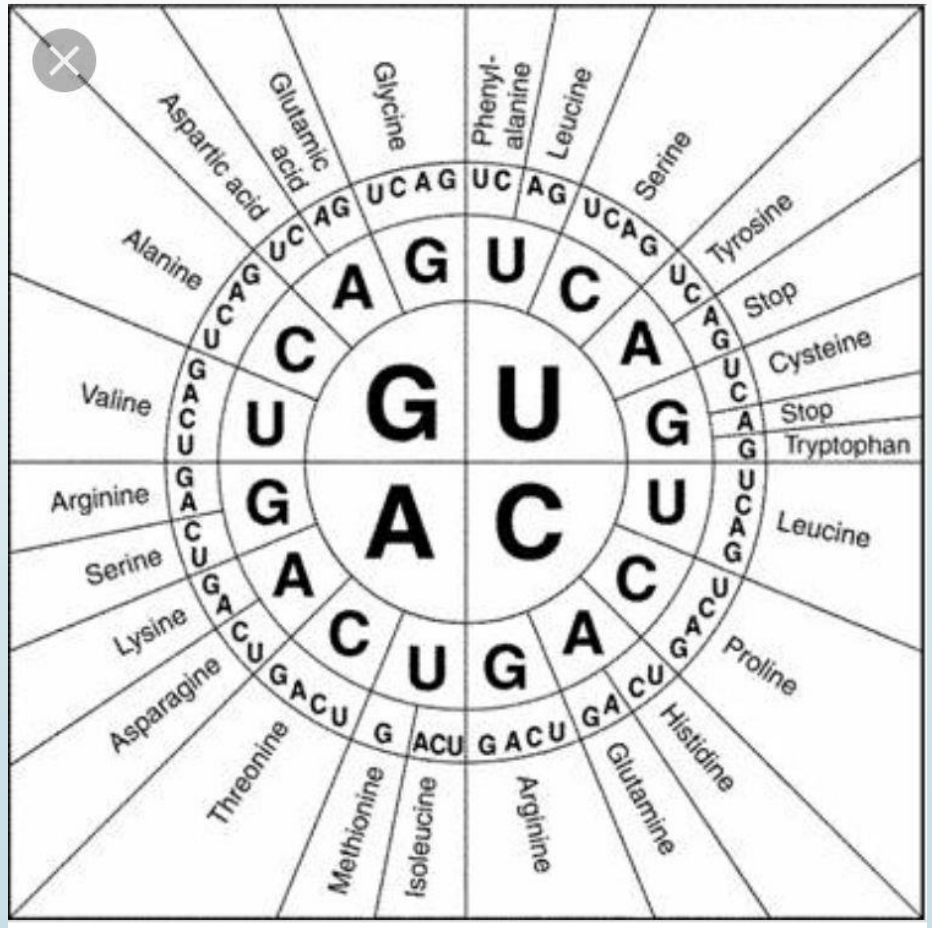


Protein Synthesis: Translation

Charts can help us determine the corresponding amino acids for mRNA codons.

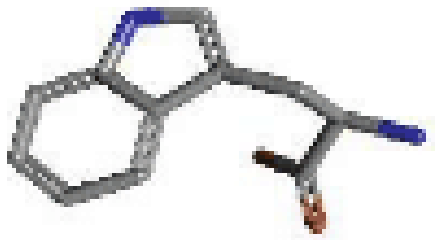
Second Position

First Position (5' end)	U	C	A	G	Third Position (3' end)
U	UUU Phe UUC UUA Leu UUG	UCU UCC UCA Ser UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G
C	CUU CUC CUA Leu CUG	CCU CCC CCA Pro CCG	CAU His CAC CAA Gln CAG	CGU CGC CGA Arg CGG	U C A G
A	AUU AUC Ile AUA AUG Met	ACU ACC ACA Thr ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G
G	GUU GUC GUA Val GUG	GCU GCC GCA Ala GCG	GAU Asp GAC GAA Glu GAG	GGU GGC GGA Gly GGG	U C A G



Protein Synthesis: Translation

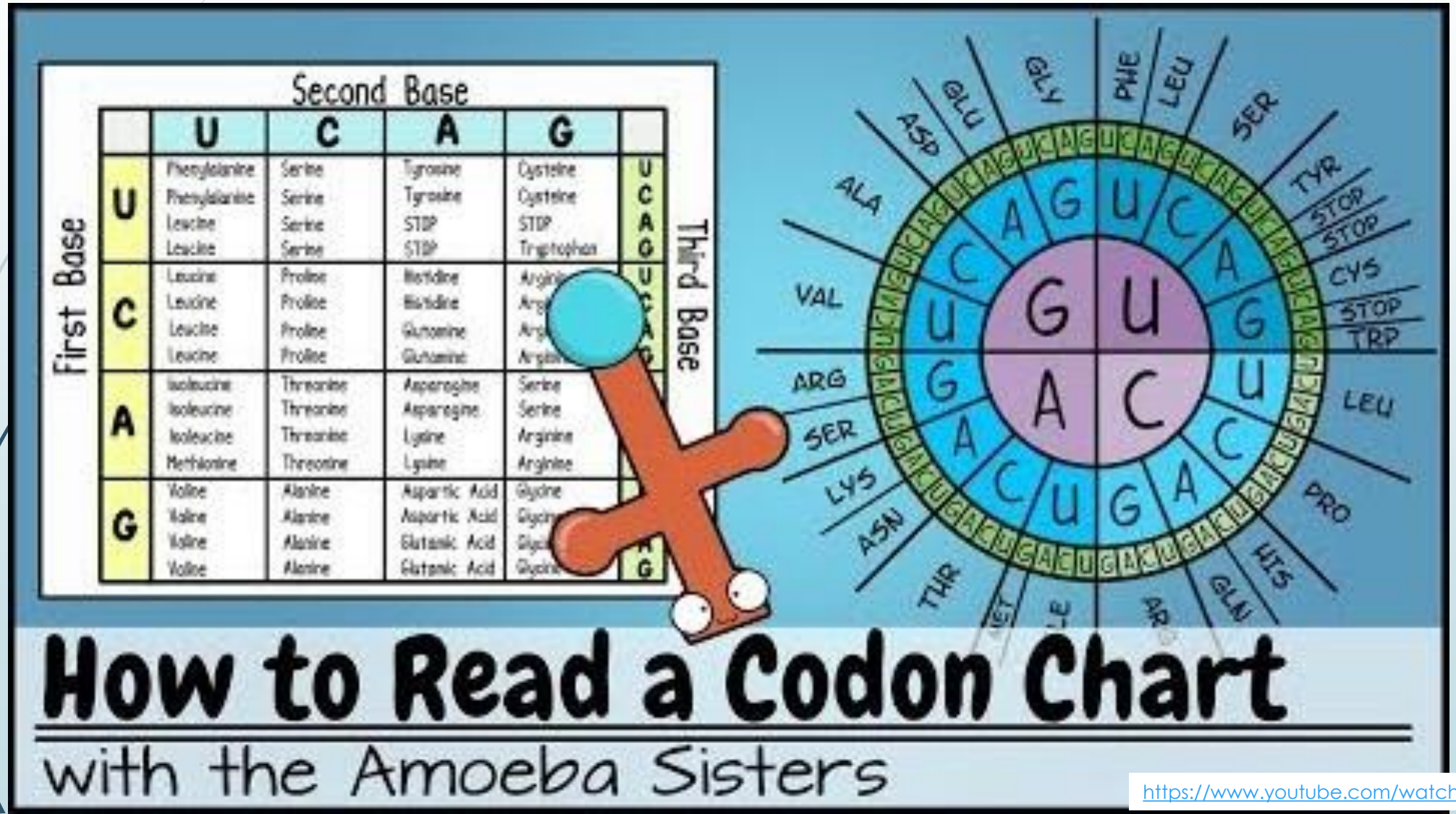
Charts can help us determine the corresponding amino acids for mRNA codons.

What most people see when they see UGG	
What I see when I see UGG	 Tryptophan

https://me.me/i/what-most-people-see-when-they-see-ugg-what-i-9e36c5de02174c5fb431e414cab6398a

Protein Synthesis: Translation

Charts can help us determine the corresponding amino acids for mRNA codons.



https://www.youtube.com/watch?v=LsEYgwuP6ko

Protein Synthesis: Translation

Practice:

For the mRNA sequences below, write the corresponding amino acid sequence.

a) AUG GUA AUU GUC ACA CCC (mRNA)

b) AUG UAC CGU UAU GCG CUU (mRNA)

Second Position

First Position (5' end)	U	C	A	G	Third Position (3' end)
U	UUU Phe UUC Phe UUA Leu UUG Leu	UCU Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA Stop UAG Stop	UGU Cys UGC Cys UGA Stop UGG Trp	U C A G
C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CCG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg	U C A G
A	AUU Ile AUC Ile AUA Ile AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU Ser AGC Ser AGA Arg AGG Arg	U C A G
G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GGC Gly GGA Gly GGG Gly	U C A G

Question: Why might both these mRNA sequences start with AUG?

https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription

Protein Synthesis: Translation

Practice:

For the mRNA sequences below, write the corresponding amino acid sequence.

a) AUG GUA AUU GUC ACA CCC (mRNA)
methionine – valine – isoleucine – valine – threonine – proline (met-val-ile-val-thr-pro)

b) AUG UAC CGU UAU GCG CUU (mRNA)
methionine – tyrosine – arginine – tyrosine – alanine – leucine (met-tyr-arg-tyr-ala-leu)

Second Position

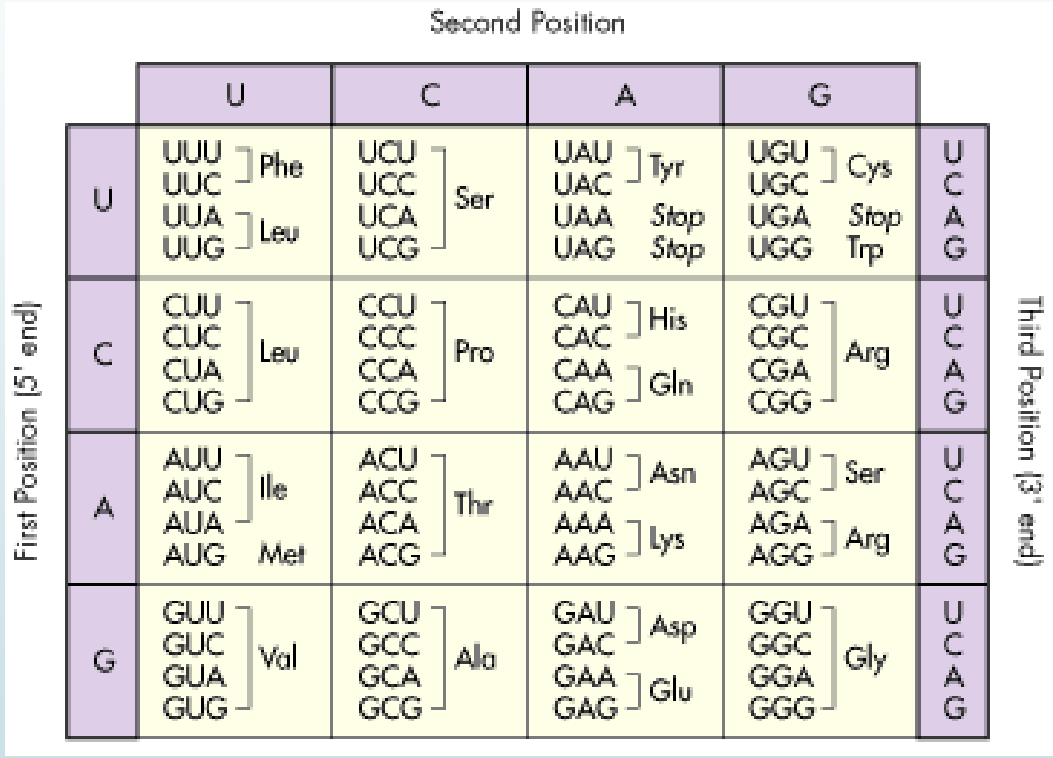
First Position (5' end)	U	C	A	G	Third Position (3' end)
U	UUU Phe UUC Phe UUA Leu UUG Leu	UCU Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA Stop UAG Stop	UGU Cys UGC Cys UGA Stop UGG Trp	U C A G
C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CCG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg	U C A G
A	AUU Ile AUC Ile AUA Ile AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU Ser AGC Ser AGA Arg AGG Arg	U C A G
G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GGC Gly GGA Gly GGG Gly	U C A G

Question: Why might both these mRNA sequences start with AUG?

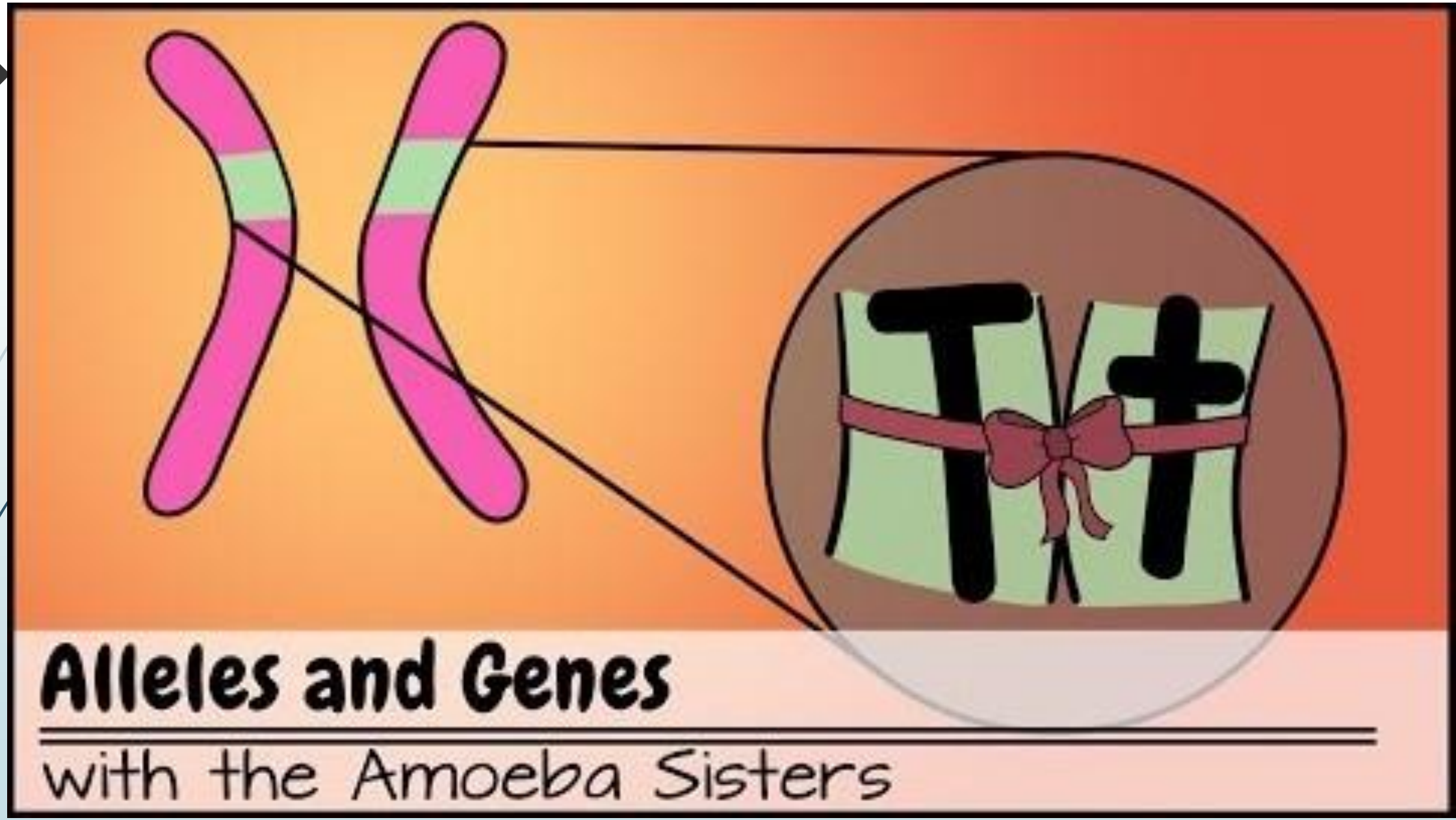
https://www.khanacademy.org/science/biology/gene-expression-central-dogma/transcription-of-dna-into-rna/a/overview-of-transcription

Protein Synthesis Summary (copy down)

Step	Code	Extra Notes
DNA	TAC GAT	Complementary DNA strand (the one not used to make mRNA here) would be ATG CTA
mRNA	AUG CUA	U instead of T; codon
tRNA	UAC GAU	Complementary to mRNA; anti-codon
Amino acid	Met – Leu (Methionine – Leucine)	Based off mRNA **codon**



Concept 3: DNA exists in chromosomes, which contain thousands of genes.



https://www.youtube.com/watch?v=pv3Kj0UjiLE (stop at 4:35)

Alleles are Different Versions of Genes

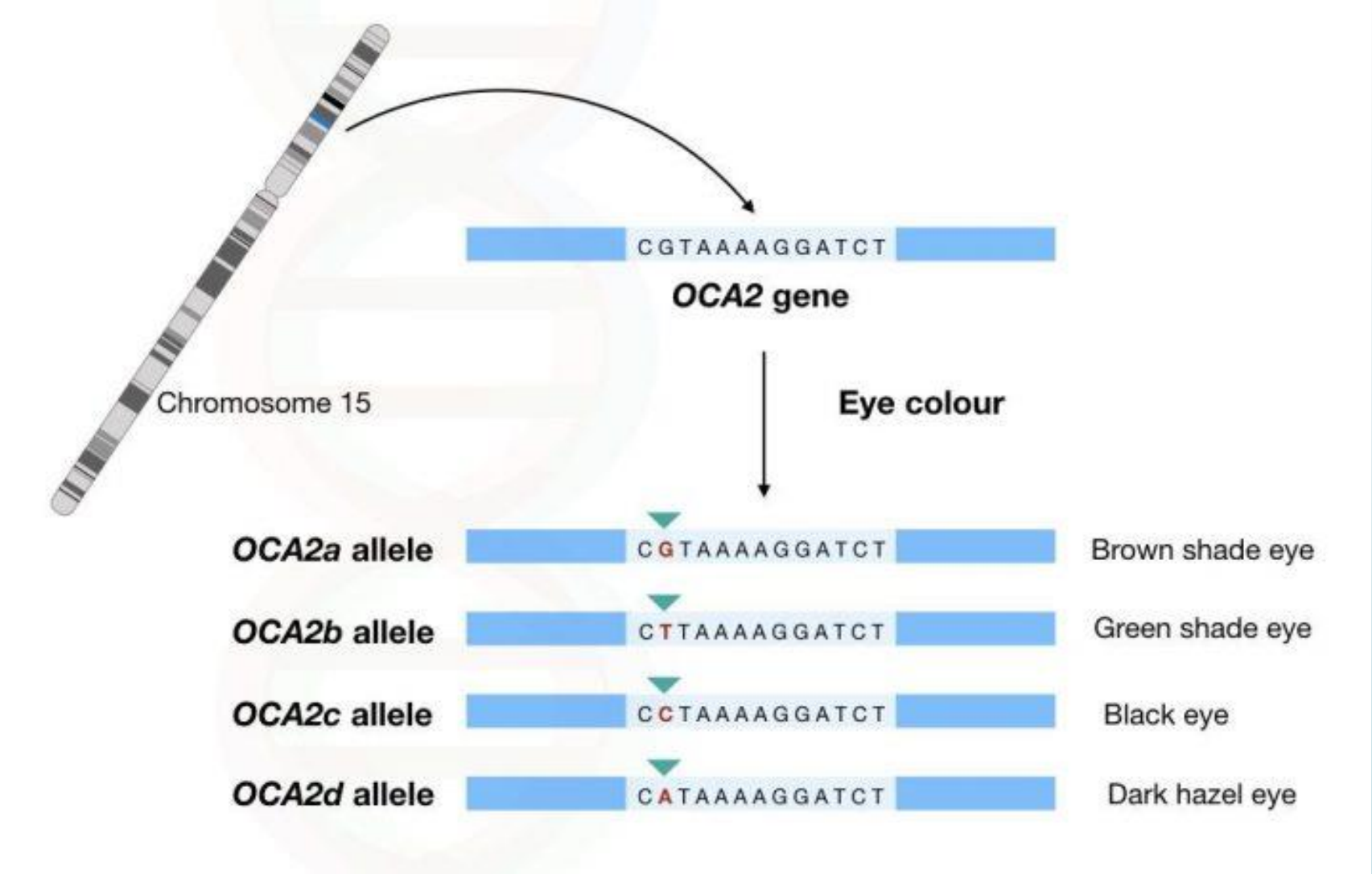
Gene: a part of a chromosome that is responsible for a **trait** (a characteristic that is genetically determined) (1 gene → 1 protein)

Allele: one of multiple different forms of the same gene; usually represented by capital/lowercase letters

Gene/Trait Examples	Allele Examples
Blondeness	Brown hair, blonde hair
Eye colour	Blue eyes, brown eyes
Lactose tolerance	Lactose tolerant, lactose intolerant

Extra reading: https://www.technologynetworks.com/neuroscience/articles/gene-vs-allele-definition-difference-and-comparison-331835

Alleles are Different Versions of Genes



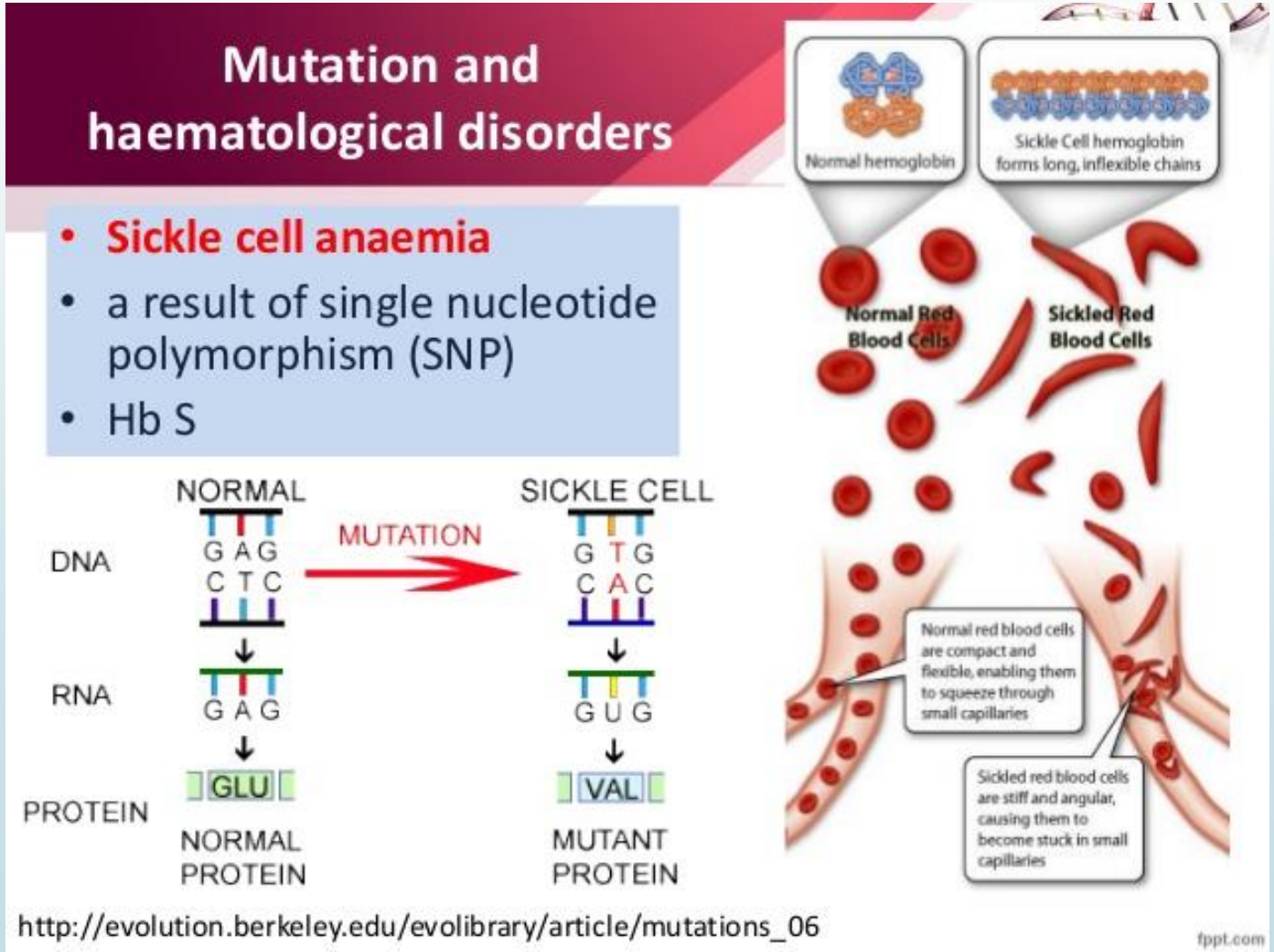
https://geneticeducation.co.in/comparison-between-gene-vs-allele/

Putting it All Together: DNA, Genes, Proteins, Traits

*Many traits do exist that are influenced by many genes. But this framework is still a useful way of thinking about most genes.

Do not memorize!

Putting it All Together: DNA, Genes, Proteins, Traits



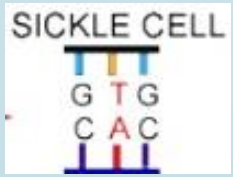
Do not memorize!

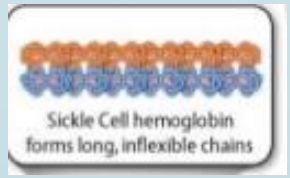
Putting it All Together: DNA, Genes, Proteins, Traits

HBB gene → makes → hemoglobin → determines → red blood cell type

HBB allele 1 → makes → normal hemoglobin → causes → normal red blood cells

HBB allele 2 → makes → mutated hemoglobin → causes → sickle cell anemia



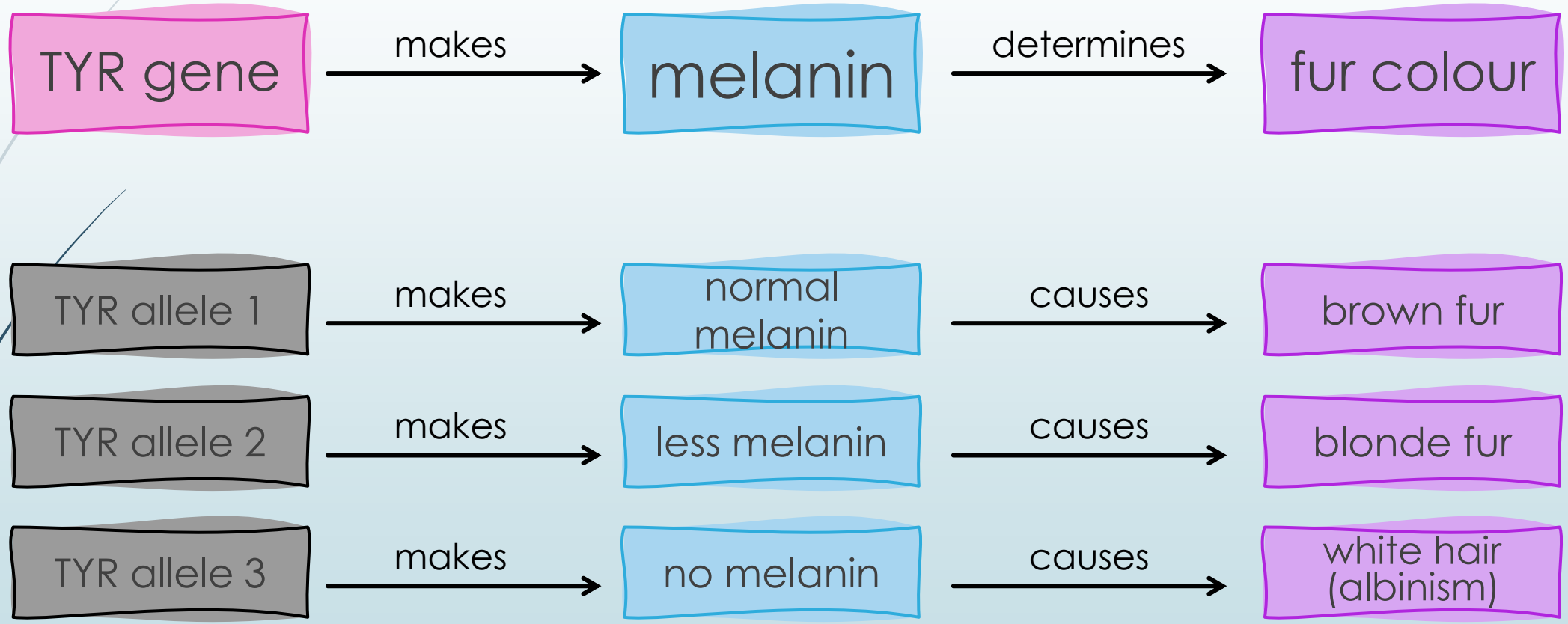


Do not memorize!

Putting it All Together: DNA, Genes, Proteins, Traits

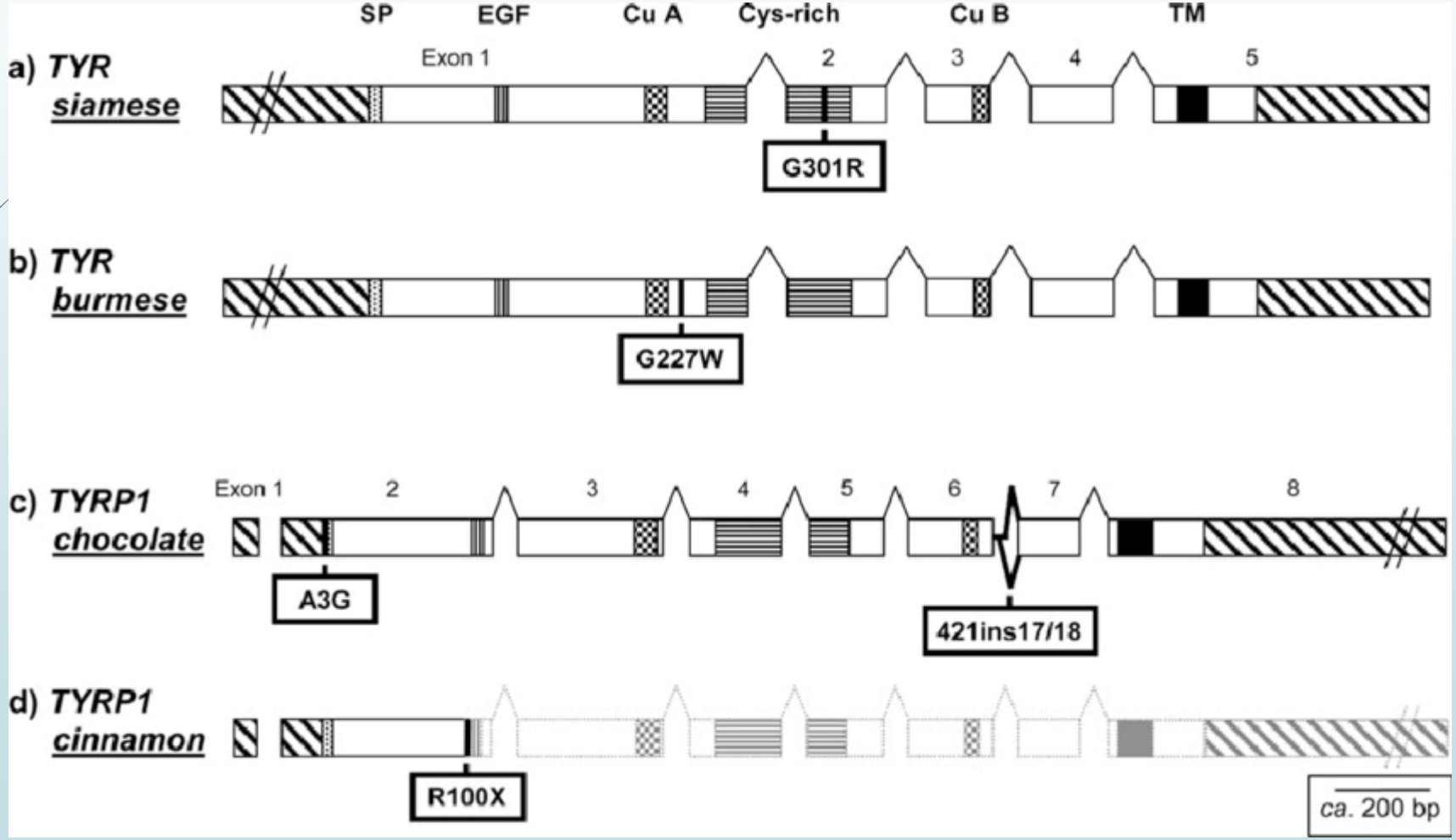
Do not memorize!

Putting it All Together: DNA, Genes, Proteins, Traits



Do not memorize!

Putting it All Together: DNA, Genes, Proteins, Traits



Concept 3: DNA organization and packaging

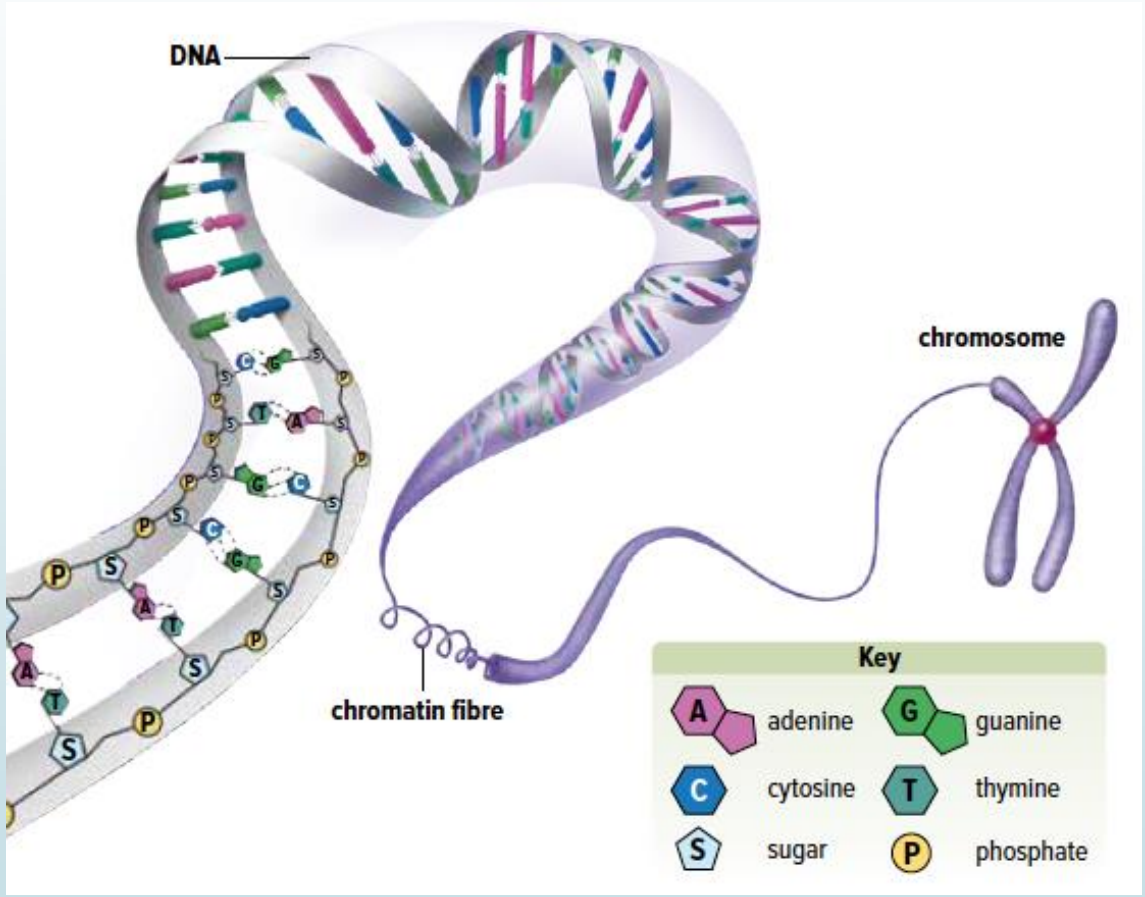
Warm-up Activity

You have been given 3 meters of string.

1. How tightly can you package this string? Can you fit it into:
   - Your fist?
   - The small container you have been given?
   - The cap of a marker?
2. How would a homologous chromosome look, compared to your chromosome?
3. Review: ***When*** is DNA packaged tightly? ***Why***?

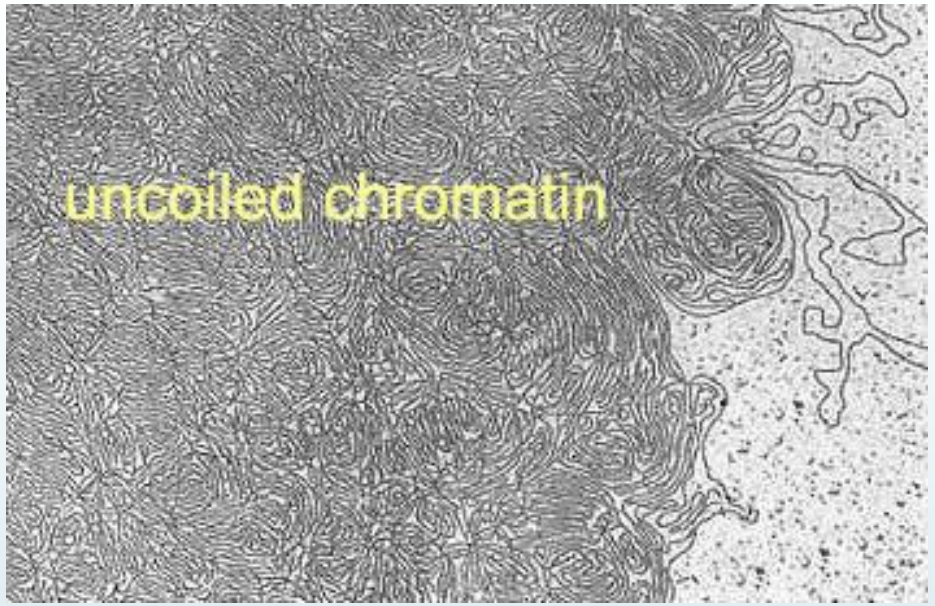
Concept 3: DNA exists in chromosomes, which contain thousands of genes.

DNA can be found as **chromosomes** or as **chromatin**, depending on the stage of the cell cycle



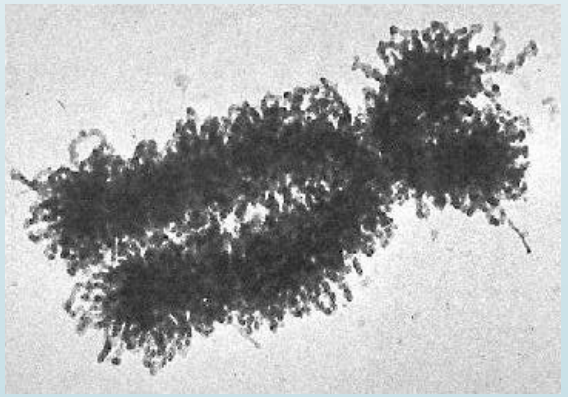
For most of the cell cycle, DNA exists as semi-condensed fibers called **chromatin.**

- Easy access to genes (sections of DNA), to make proteins



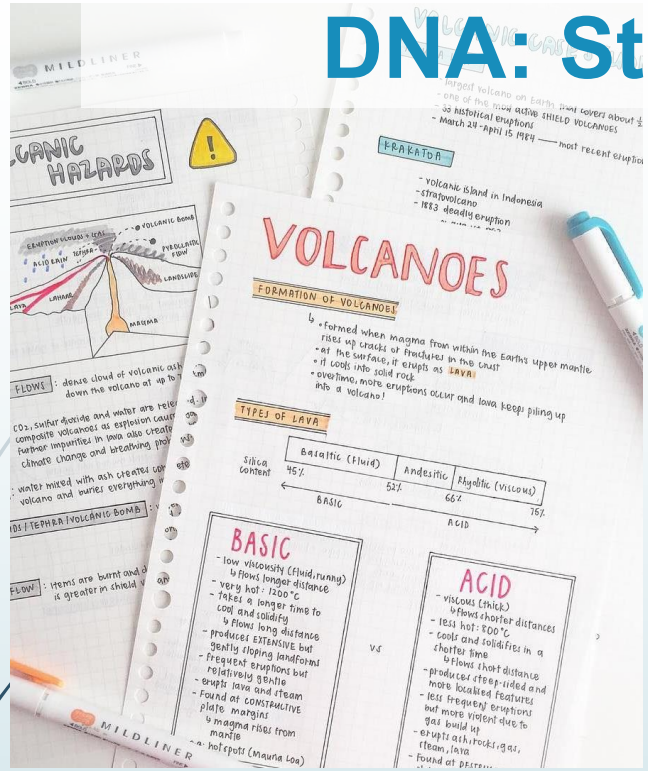
When cells prepare to divide (mitosis/meiosis), DNA condenses further into **chromosomes.**

- Easy to transport to new cells
- Can pair with homologous chromosome



https://newscenter.lbl.gov/2002/11/15/unraveling-the-secrets-of-gene-regulation/ https://www.sciencelearn.org.nz/images/1632-electron-micrograph-of-a-human-chromosome

DNA: Structure and Function



Nucleotides are like the words on pieces of paper. To 'study', you can only look at one page at a time. Cells uncoil DNA fully when they use nucleotide sequences to code proteins.

Chromatin is like organized stacks of paper. When needed, specific pieces of DNA can be accessed.

Chromosomes are like moving boxes filled with paper. You are much less likely to 'leave DNA behind' when packaged this way.

https://www.pinterest.fr/pin/348466089910768826/

https://sossimple.organizedsolutions.com/a-strategy-for-paper-piles/

https://blog.padmapper.com/2010/07/22/how-to-find-free-moving-boxes/

/end testable content

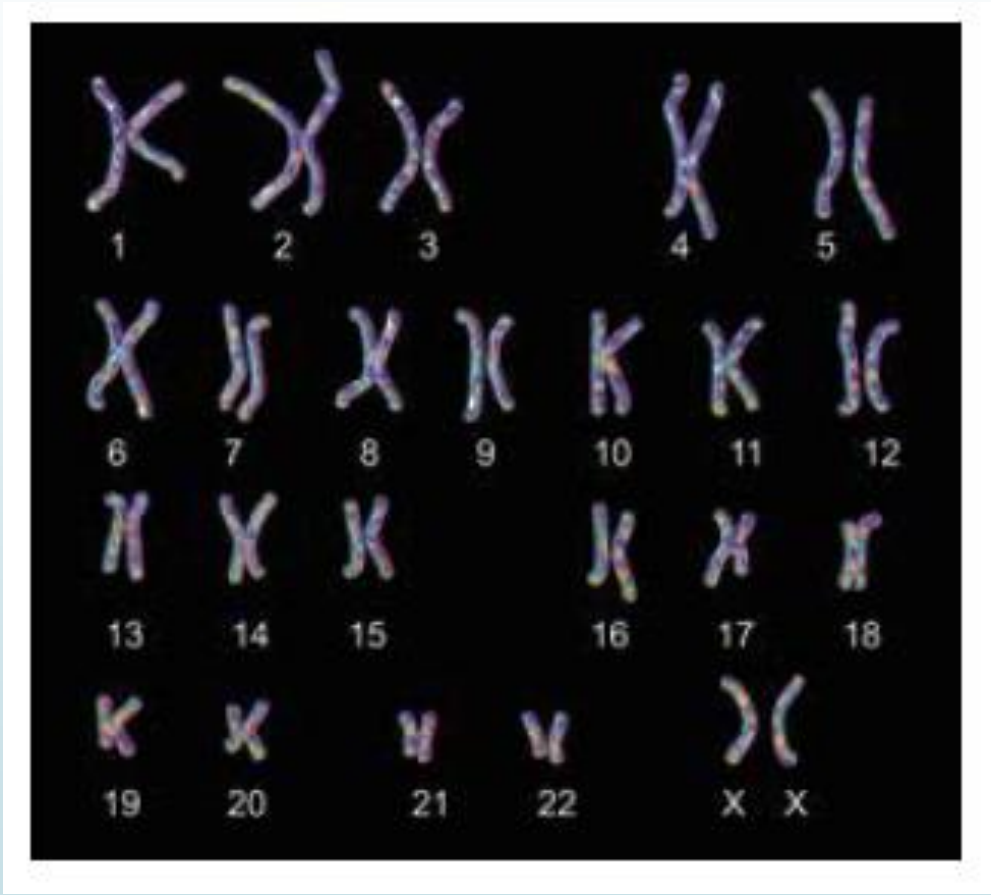
Slides after this point are a ‘bridge’ or introduction to the next section but will not be on the 1.1 test.

The Karyotype

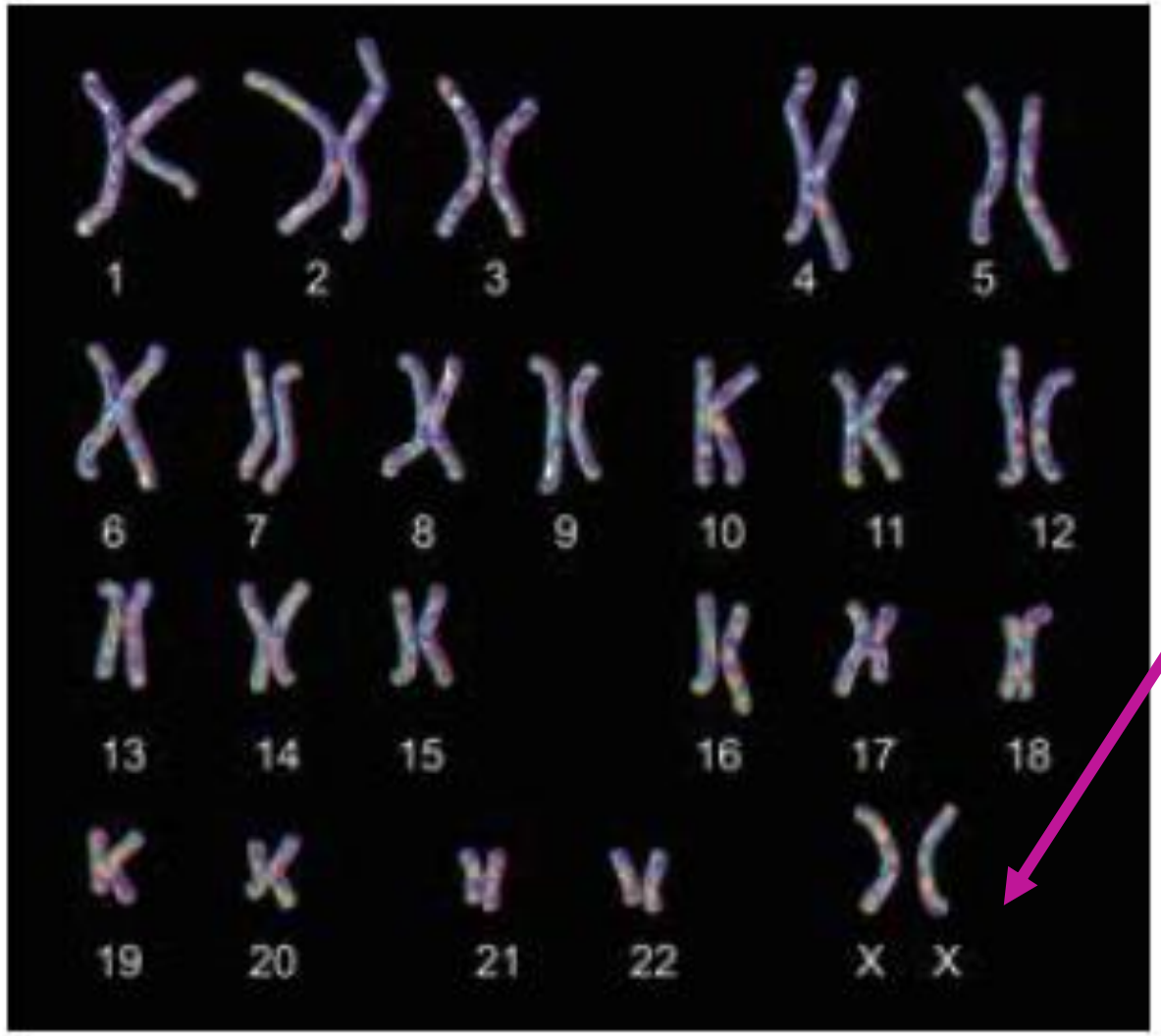
(Review: **genome** is an organism's complete set of genetic instructions.)

Karyotype: a photograph of pairs of homologous chromosomes in a cell

- 46 chromosomes in most human cells (paired)
- 23 chromosomes in sperm/egg cells (not paired)



Homologous Chromosomes

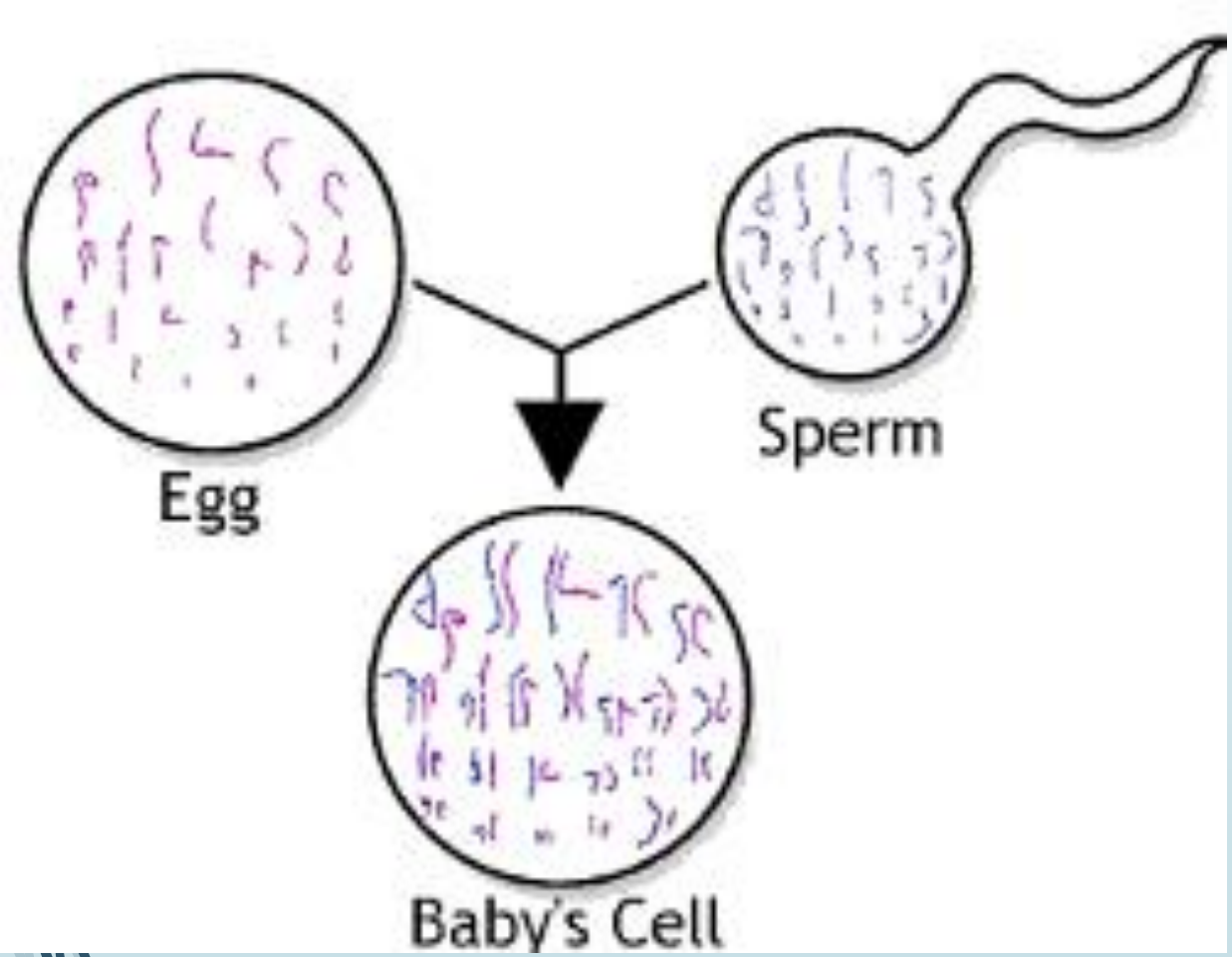


In a regular body cell, there are 23 pairs of chromosomes:

- One pair: *sex chromosomes*
  - X and Y: genetic male
  - X and X: genetic female
- Pairs 1-22: *autosomes*

Discussion: How are chromosomes paired? Why are they paired?

Homologous Chromosomes



Sperm and egg cells each have one set of 23 chromosomes. During fertilization, they combine to make a zygote with a complete set of 46 chromosomes (two sets of chromosomes that are homologous). These then divide to form you!

Most of your body cells are made of 46 (23 pairs) chromosomes. In each pair, one chromosome was from mom, and one from dad!

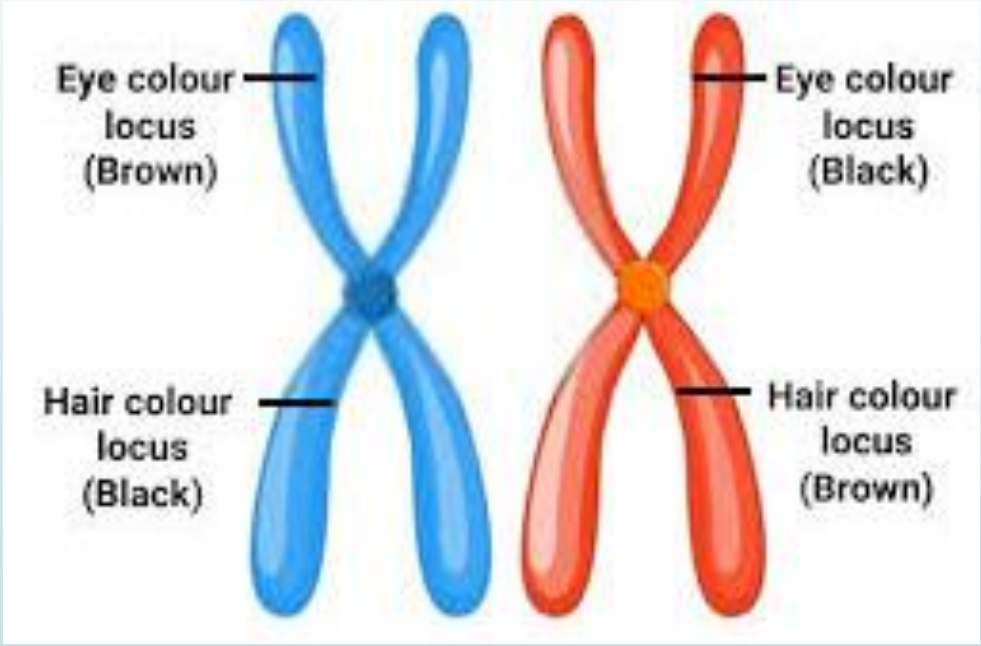
Homologous Chromosomes

Homologous chromosomes: pairs of chromosomes with *similar* DNA sequences

- One chromosome inherited from each parent (one from mom, one from dad)

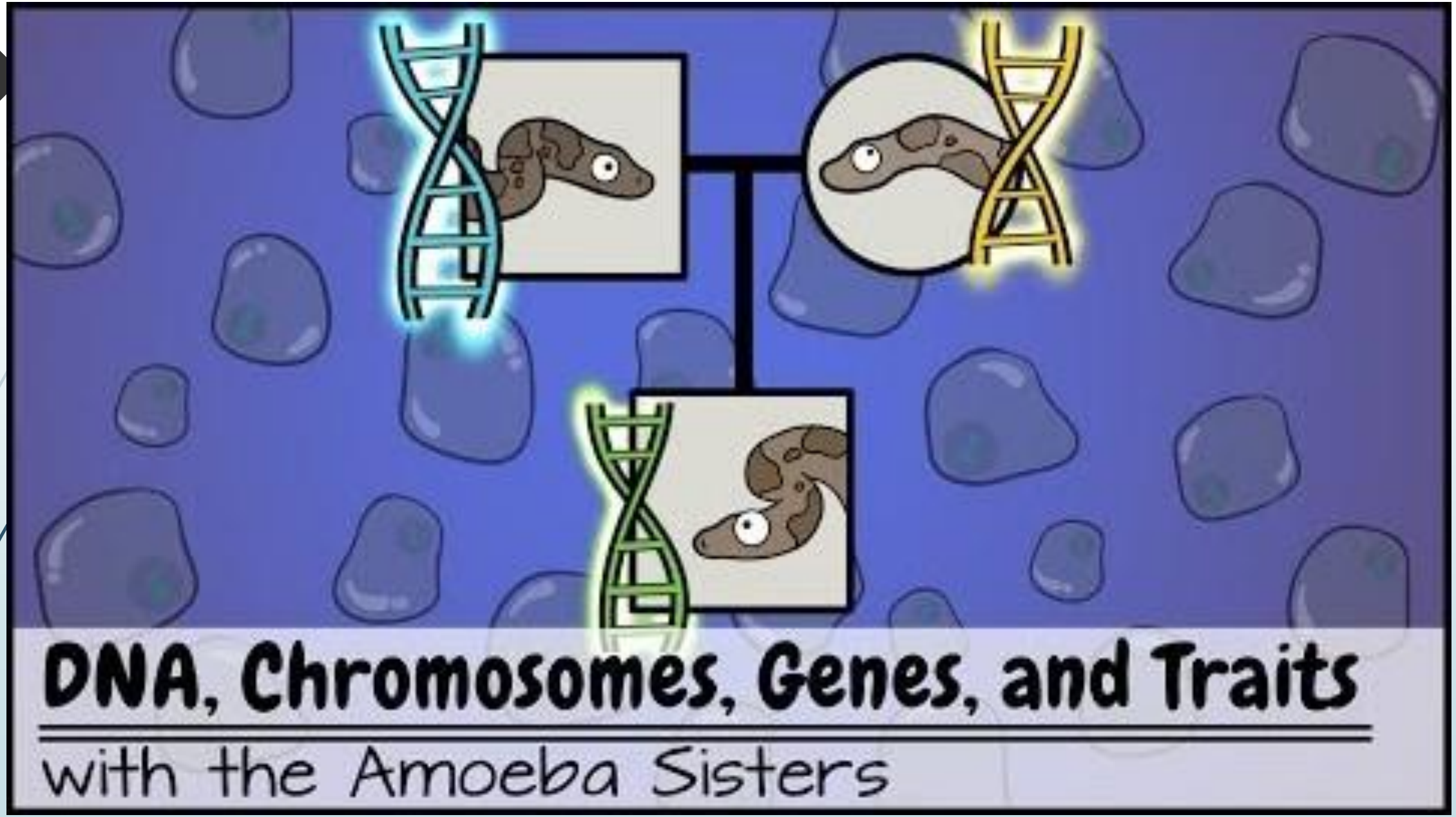
Homologous chromosomes have the *same*:

- Length
- Centromere location
- Genes (type, location, sequence)



Note: homologous chromosomes *are not identical*. For each gene, alleles may be same or different.

Concept 3: DNA exists in chromosomes, which contain thousands of genes.



https://www.youtube.com/watch?v=8m6hHRlKwxY

The Big Picture Summary

The **genome** is DNA that is split into **chromosomes** (46 for humans).

- During most of the cell cycle, this DNA is packaged loosely as **chromatin**. **DNA replication** occurs during this time. When the cell prepares to divide, it is condensed into chromosomes.

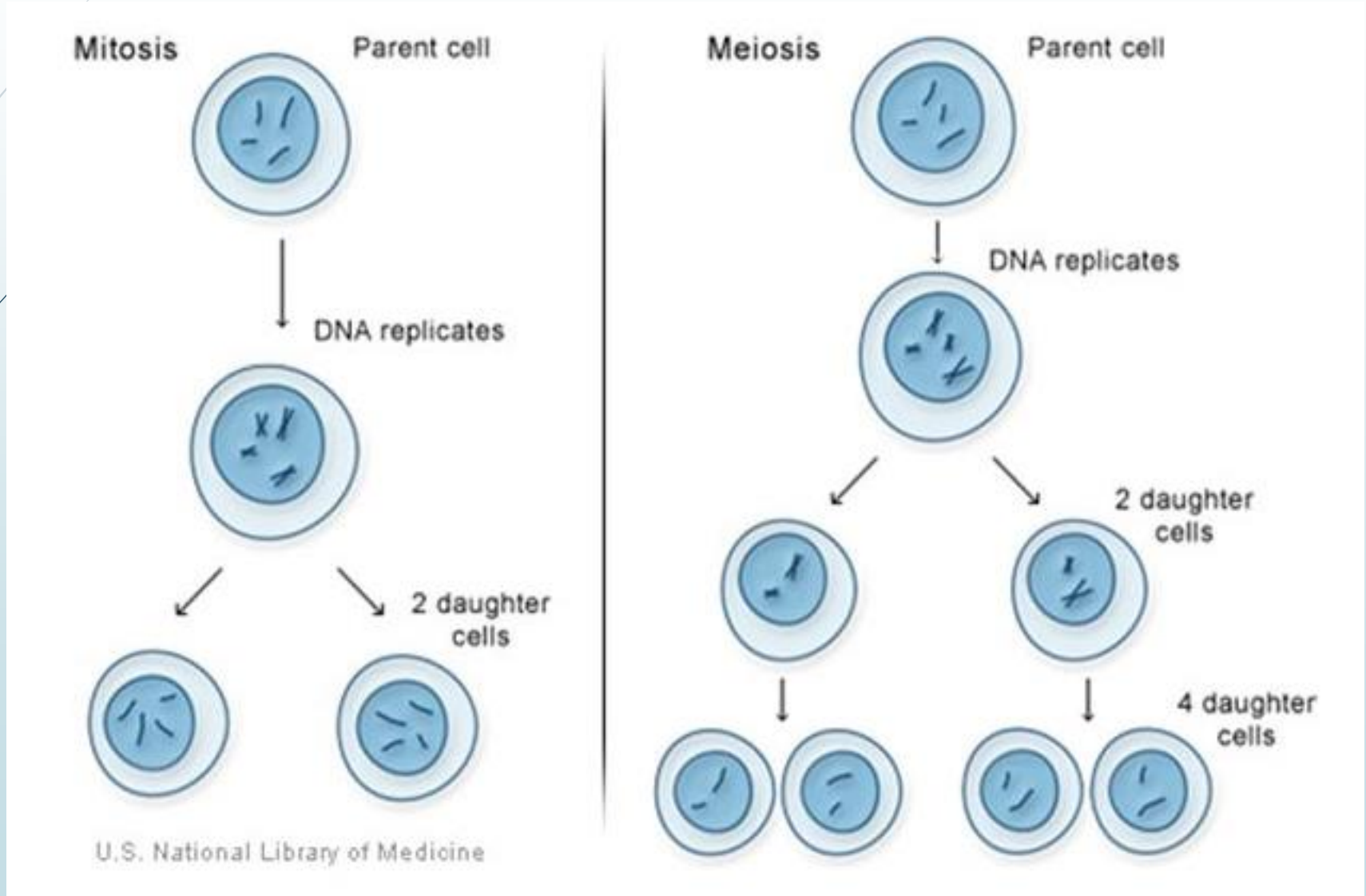
Each chromosome is made of DNA. Some is useful, some is not.

Sections of useful DNA are called **genes**. Each gene is responsible for a **trait** by making a **protein**.

- A trait is a characteristic (e.g. hair colour, eye colour, height).
- Proteins are complex molecules with various functions.
- The process of producing a protein from DNA involves **transcription** and **translation**.

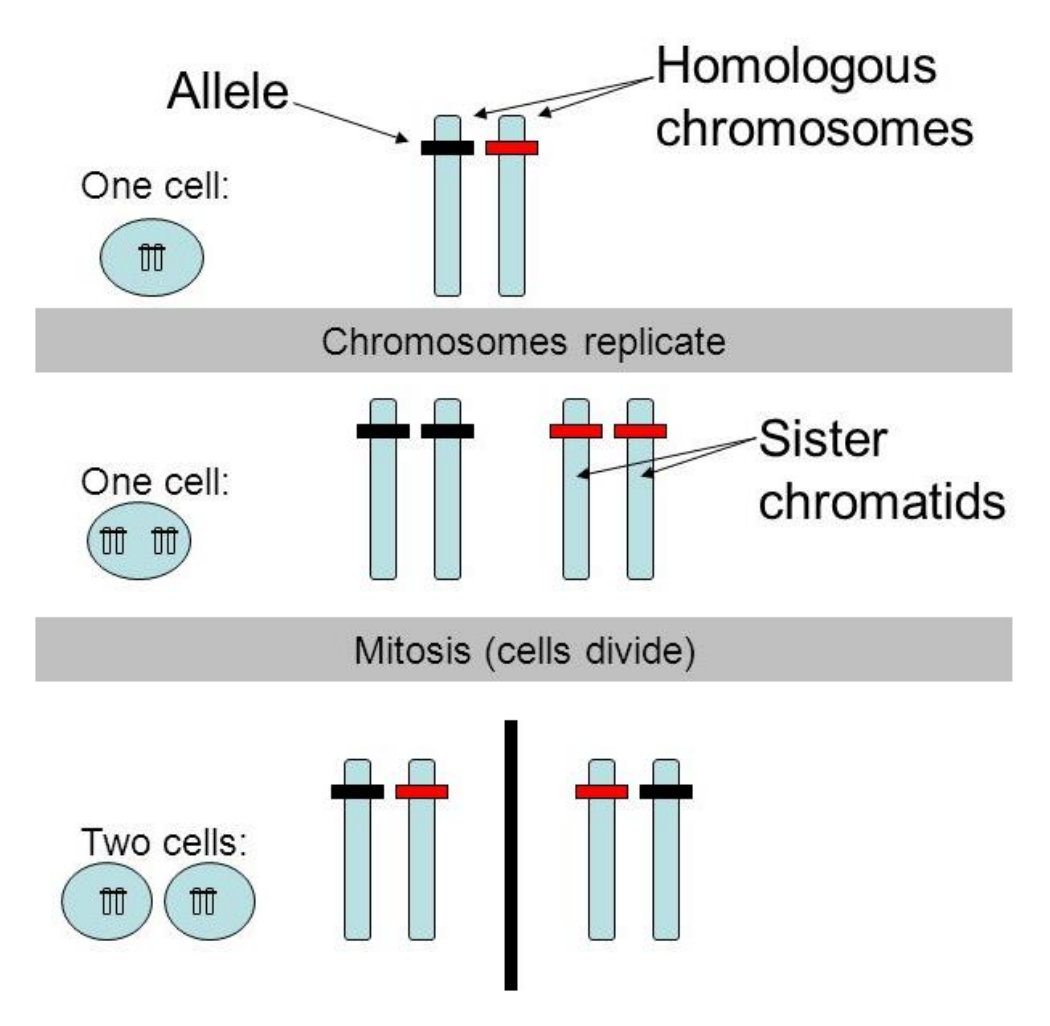
Small differences in DNA sequences of genes can affect the proteins and traits they code for. Different versions of genes are called **alleles**.

Review: mitosis and meiosis



Review: mitosis

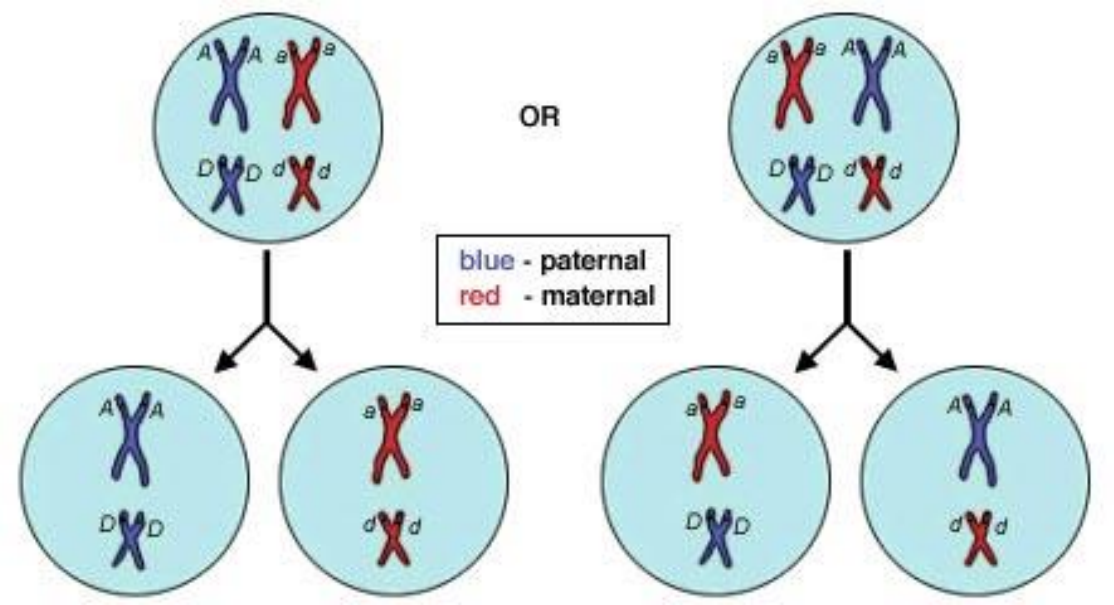
- 1x DNA replication; 1x cell division
- Final cells are identical
- Chromosome number is conserved; all DNA is the same as original cell



Source: https://slideplayer.com/slide/4787428/

Review: meiosis + sexual reproduction

- 1x DNA replication; 2x cell divisions
- Homologous pairs split up; chromosome number halved in sperm or egg cell
- Fertilization: one sperm and one egg combine → proper number of chromosomes



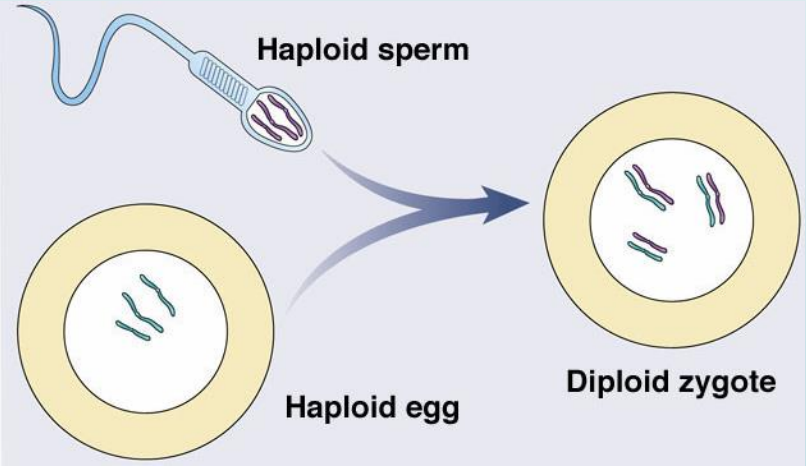
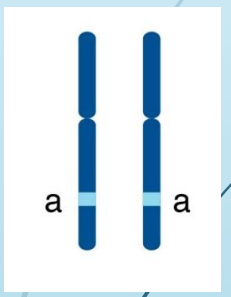
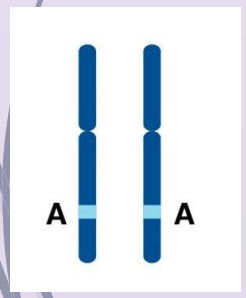
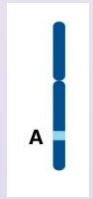
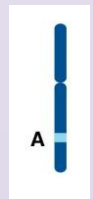
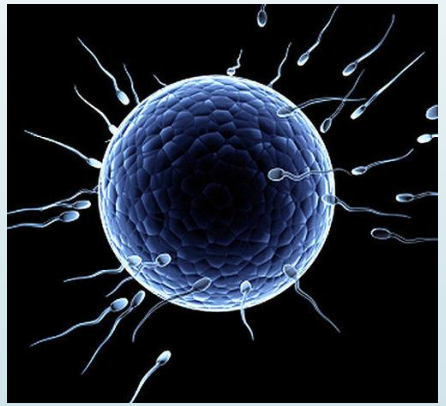


Image: https://www.mrgscience.com/topic-33-meiosis.html

Preview: meiosis + sexual reproduction

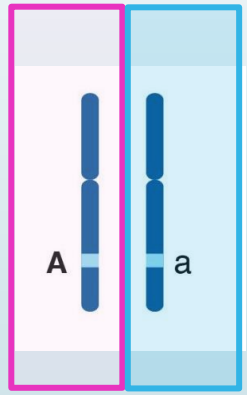
Parental DNA	Meiosis	Gametes
Biological father 	100% chance of allele "*a*"	 
Biological mother 	100% chance of allele "*A*"	 

Fertilization
(one chromosome from each parent)



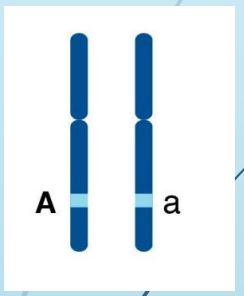
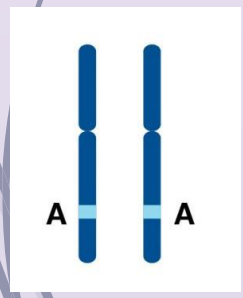
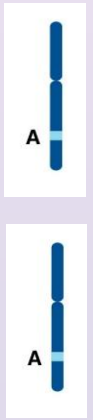
Offspring DNA

100%

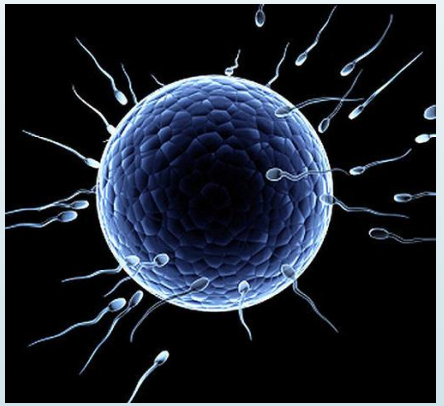


Images: https://www.thoughtco.com/allele-a-genetics-definition-373460; https://www.cbsnews.com/pictures/human-eggs-9-fascinating-facts/

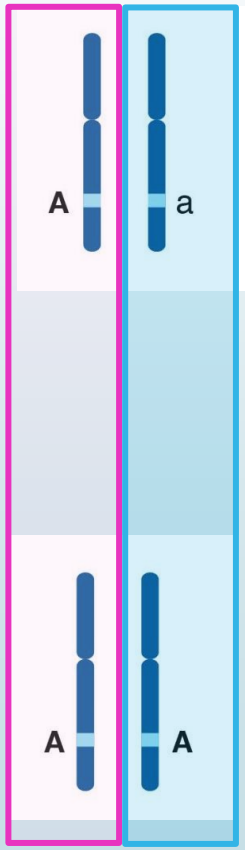
Preview: meiosis + sexual reproduction

Parental DNA	Meiosis	Gametes
Biological father 	50% chance of allele "A"; 50% of allele "*a*"	
Biological mother 	100% chance of allele "*A*"	

Fertilization
(one chromosome from each parent)



Offspring DNA

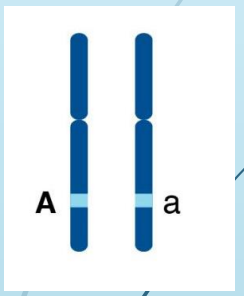
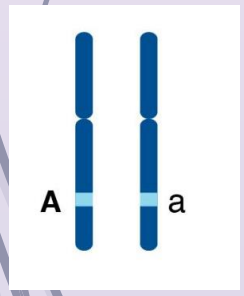


50%

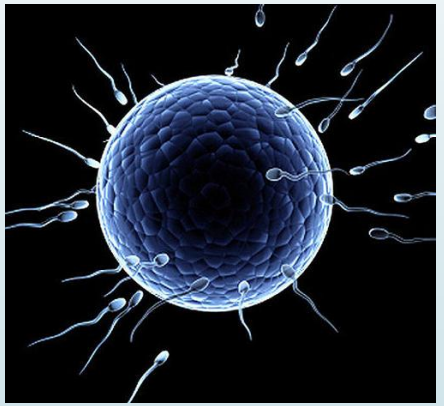
50%

Images: https://www.thoughtco.com/allele-a-genetics-definition-373460; https://www.cbsnews.com/pictures/human-eggs-9-fascinating-facts/

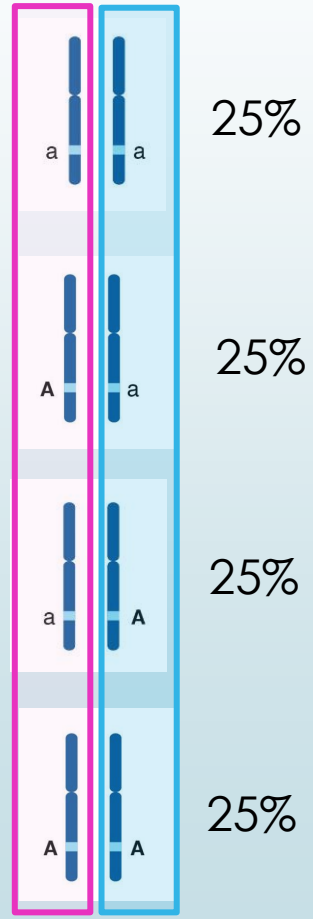
Preview: meiosis + sexual reproduction

Parental DNA	Meiosis	Gametes
Biological father 	50% chance of allele "A"; 50% of allele "*a*"	
Biological mother 	50% chance of allele "A"; 50% of allele "*a*"	

Fertilization
(one chromosome from each parent)



Offspring DNA



Images: https://www.thoughtco.com/allele-a-genetics-definition-373460; https://www.cbsnews.com/pictures/human-eggs-9-fascinating-facts/

Discussion Questions

1. Describe the relationships among chromatin, a chromosome, DNA, and a gene.

2. Make an analogy that helps explain homologous chromosomes.

Concept 5: Types of Biodiversity

Concept 5: The different genetic make-up of organisms is reflected in the diversity of life.

- Biodiversity exists at three different levels:
  1) species diversity
  2) genetic diversity
  3) ecosystem diversity

NOTE: Concept 5 is FYI only: not testable!

Species Diversity

Species diversity: variety and abundance of species in a given area

- **Species:** group of organisms that can interbreed in nature and produce fertile offspring

Genetic Diversity

Genetic diversity: variety of inherited traits within a species; is due to mutations in genes.

- **Gene pool:** genetic diversity within a population
- **Population:** members of the same species living in the same geographical area at the same time

Ecosystem Diversity

Ecosystem diversity: variety of ecosystems in the biosphere

- Ecosystems are made up of biotic (living) factors and abiotic (non-living) factors.

Discussion Questions

1. Describe the differences among the three types of biodiversity.

2. Explain how variation in genes is related to all three types of biodiversity.