MARCO LEARNING

AP Biology Insta-Review

Big Idea 3: Information Storage & Transmission

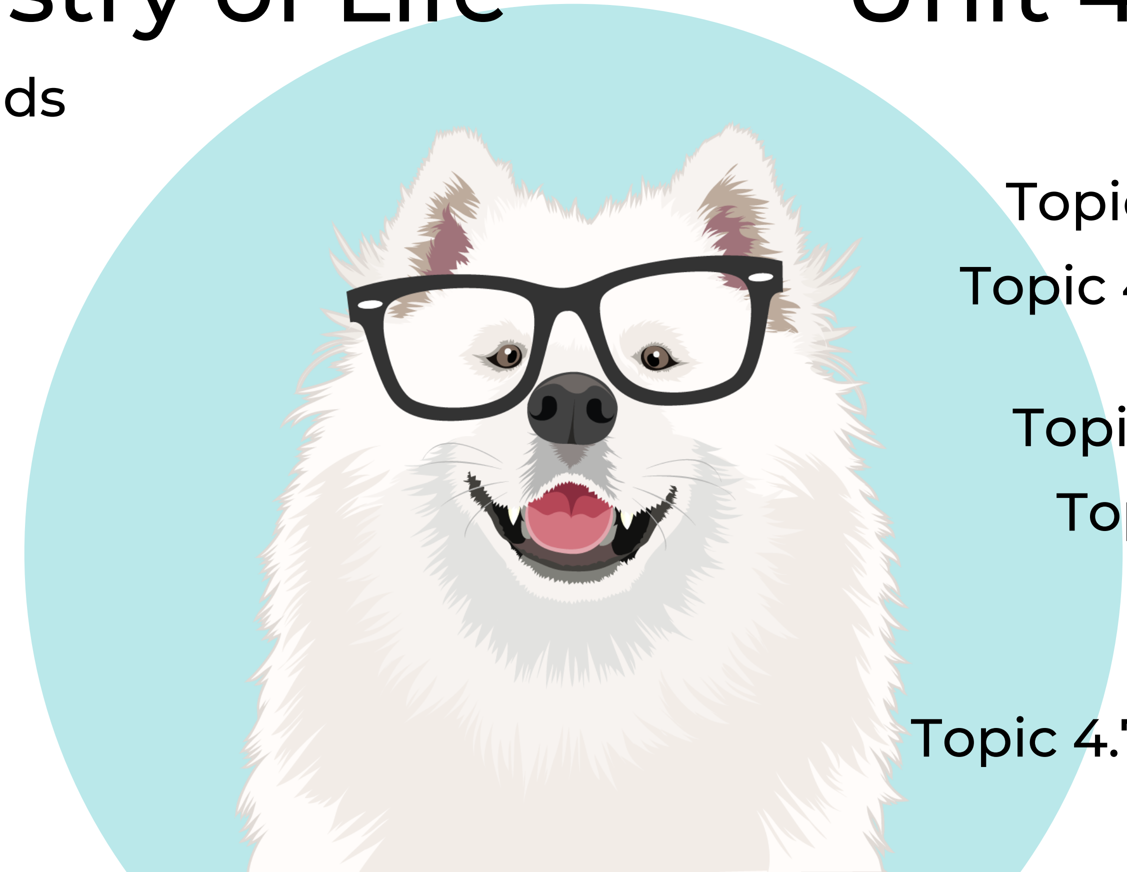
Tiffany Jones
@apbiopenguins

AP Biology students are penguins because they are Dressed for Success!
You are now an AP Bio Penguin!

Today’s Plan:

Unit 1: Chemistry of Life

Topic 1.6: Nucleic Acids



Unit 4: Cell Comm & Cell Cycle

Topic 4.1: Cell Communication

Topic 4.2: Introduction to Signal Transduction

Topic 4.3: Signal Transduction

Topic 4.4: Changes to Signal Transduction Pathway

Topic 4.6: Cell Cycle

Topic 4.7: Regulation of Cell Cycle

Today's Plan:

Unit 5: Heredity

Topic 5.1: Meiosis

Topic 5.2: Meiosis and Genetic Diversity

Topic 5.3: Mendelian Genetics

Topic 5.4: Non-Mendelian Genetics

Unit 8: Ecology

Topic 8.1: Responses to the Environment

Unit 6: Gene Exp & Regulation

Topic 6.1: DNA & RNA Structure

Topic 6.2: Replication

Topic 6.3: Transcription & RNA Processing

Topic 6.4: Translation

Topic 6.5: Regulation of Gene Expression

Topic 6.6 Gene Expression & Cell Specialization

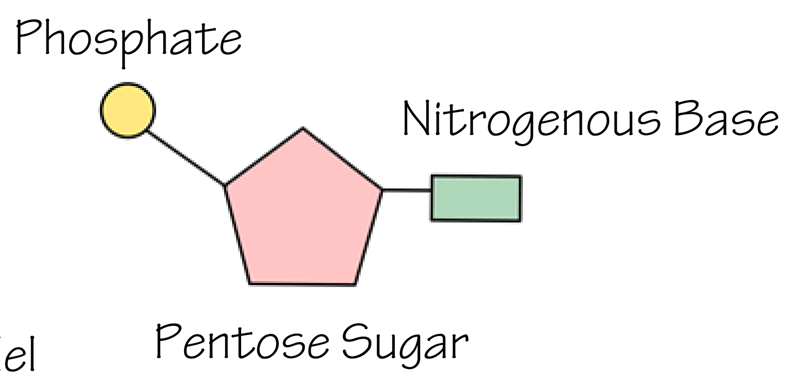
Topic 6.7 Mutations

Topic 6.8: BioTechnology

1.6: Nucleic Acids

Structure

- Composed of C, H, O, N, & P
- Monomer: Nucleotide
- Bond: Phosphodiester linkage (between phosphate and hydroxyl)
- Directionality: 5' → 3'; antiparallel



Nitrogenous Bases

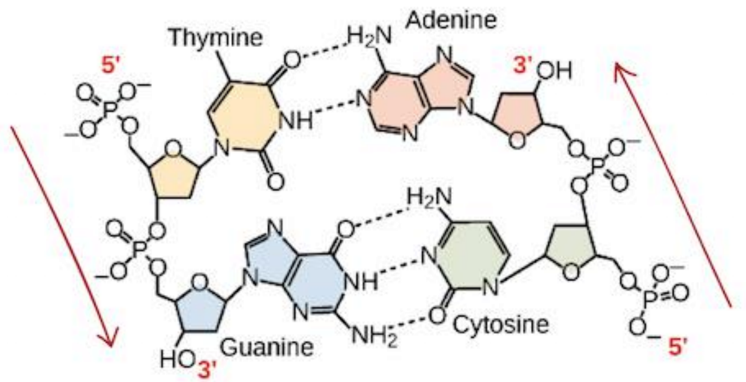
Purine:

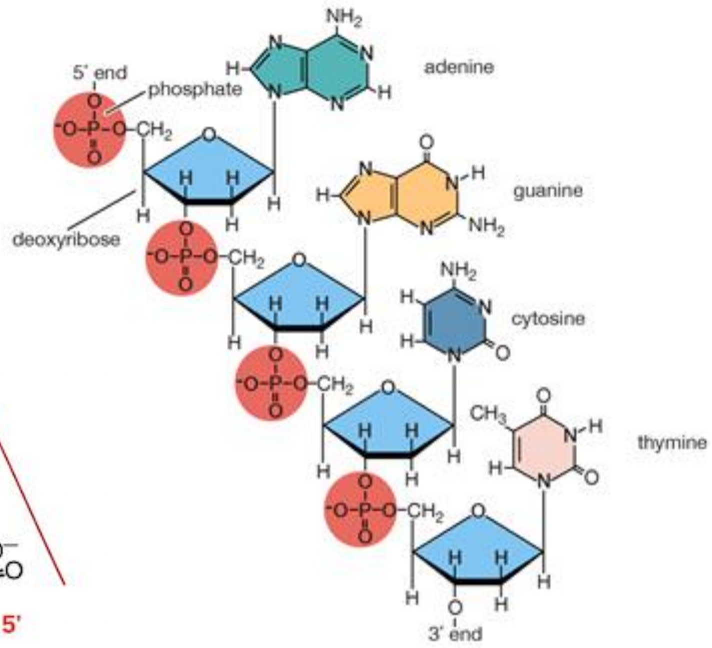
- Double Ring
- A & G

Pyrimidine:

- Single Ring
- C, U, T

Base Pairing	H bonds
A & T	2
C & G	3





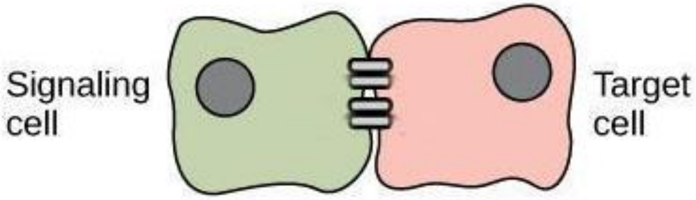
DNA vs. RNA

	DNA	RNA
Nitrogenous Bases	A, T, C, G	A, U, C, G
Sugar	Deoxyribose	Ribose
Strandedness	"double"	"single"

4.1 Cell Communication

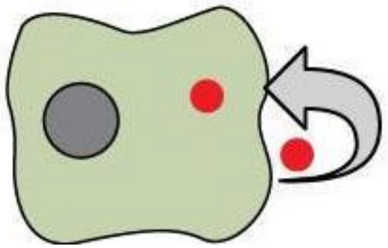
Cell-to-Cell Contact

- Cell communication where two cells are in direct contact with one another
- Example: Helper T cell binds to antigen presenting cell

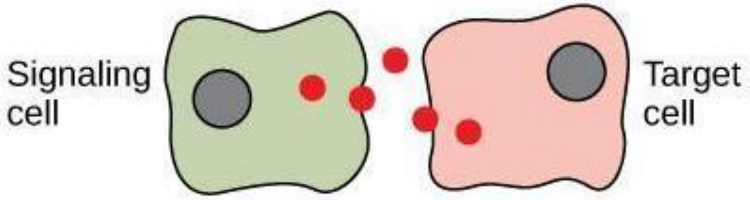


Autocrine Signaling

- Signaling to the same cell
- Example: Apoptosis



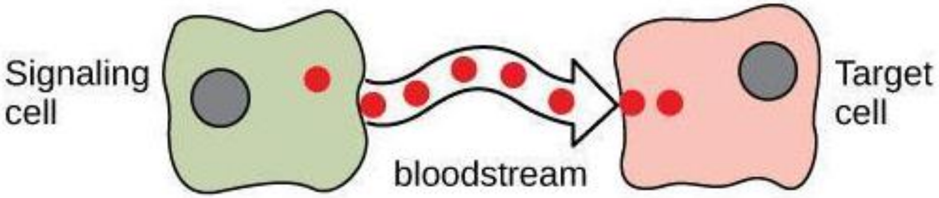
Paracrine Signaling

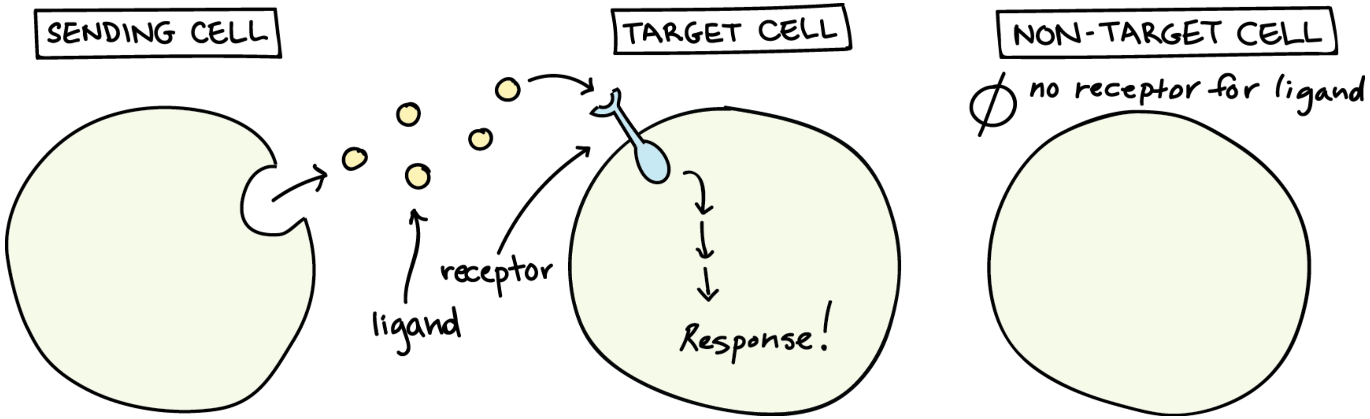


- Signaling molecule released into extracellular fluid and binds to nearby cell
- Example: Growth Factor

Endocrine Signaling

- Long distance signaling through bloodstream
- Example: Insulin released by pancreas and binds to body cells for glucose uptake





4.2/4.3 Signal Transduction

Reception

Ligand (signaling molecule) binds to receptor

Causes confirmational shape change

Ex: G protein coupled receptor

Steroid Hormone

Release: Simple Diffusion

Receptor: Intracellular

Example: Testosterone, Estrogen

Protein Hormone

Release: Exocytosis

Receptor: Extracellular

Example: Insulin

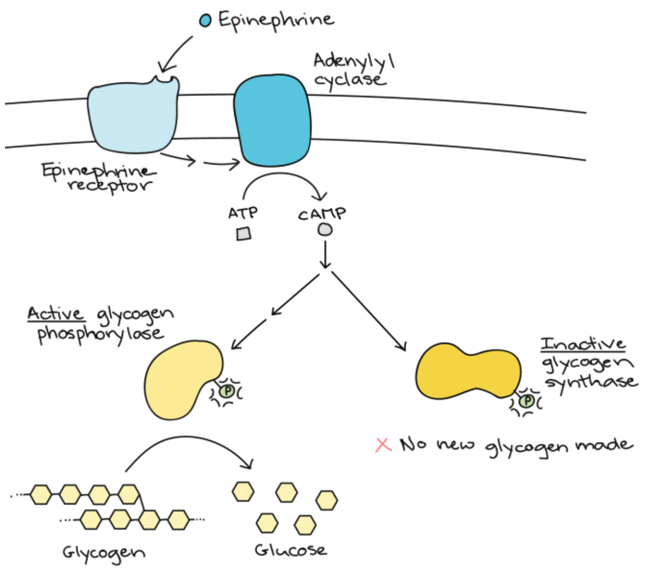
Response

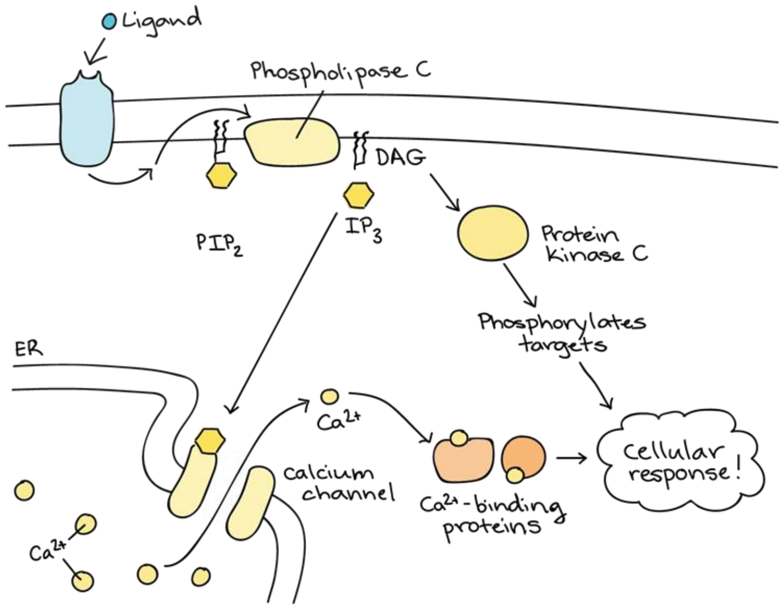
cell growth

secretion of molecules

gene expression

apoptosis





Transduction

Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals

Phosphorylation Cascade

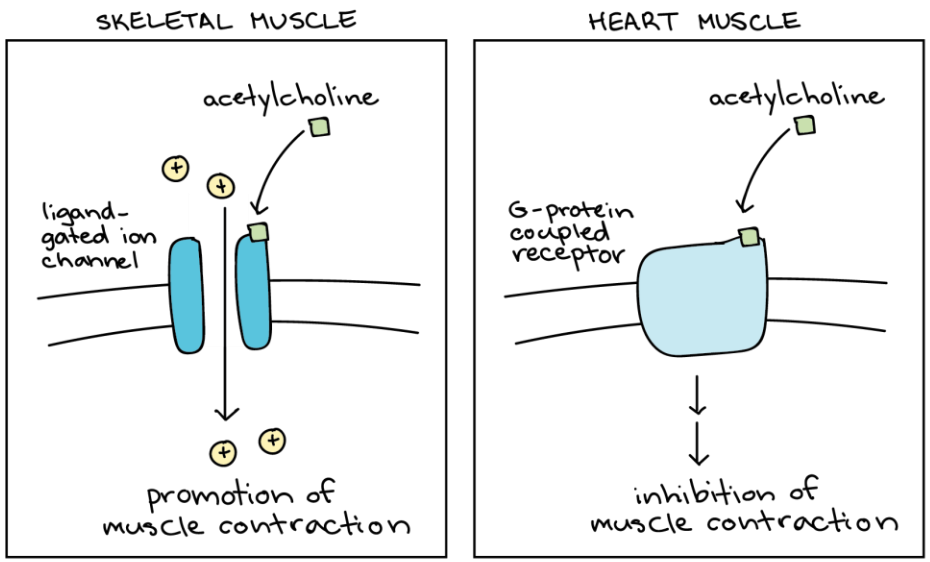
Protein Kinase

Phosphorylate relay molecules

Secondary Messengers

Ca^{2+}

cAMP

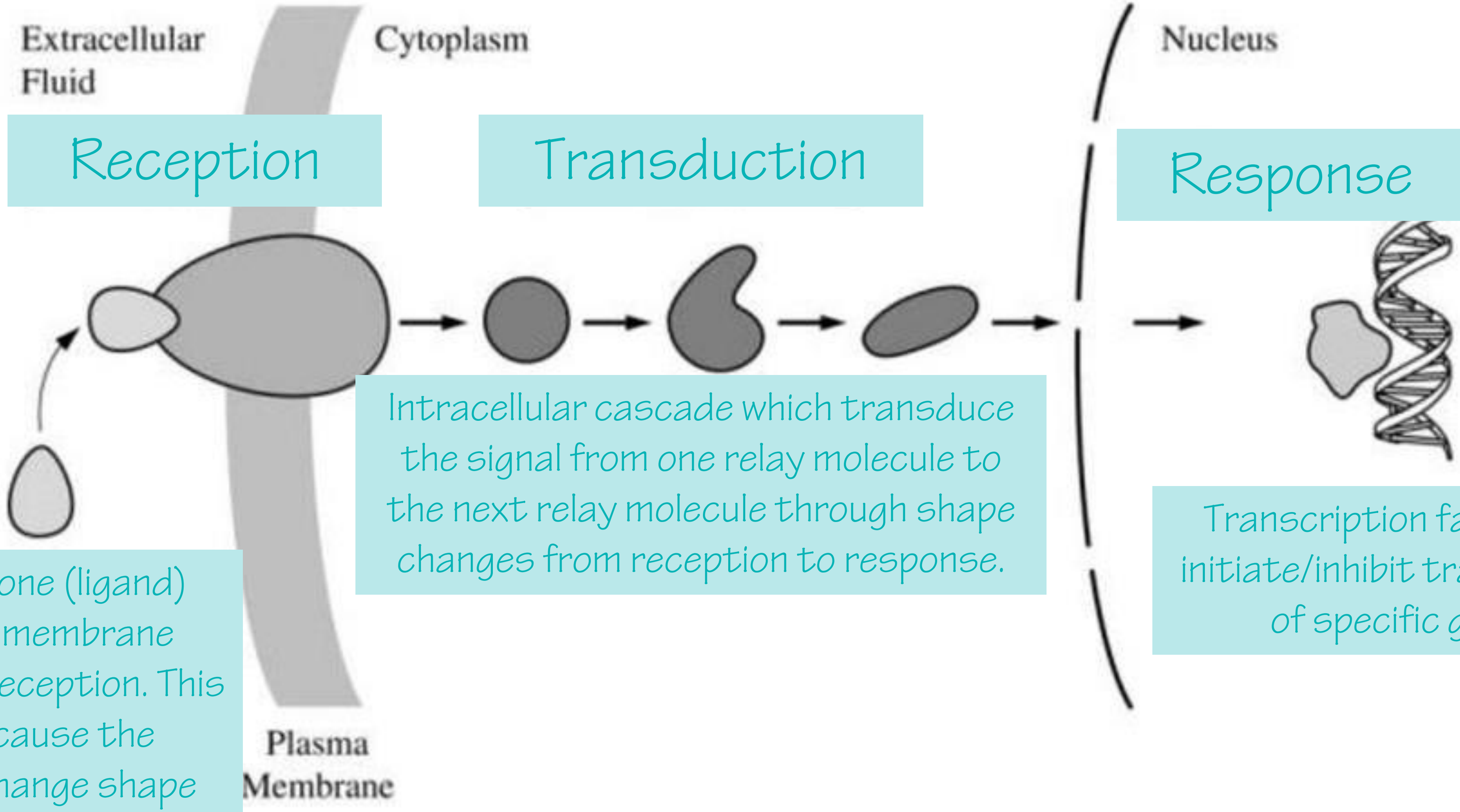


4.4 Changes in Signal Trans. Pathway

Mutations in any domain of the receptor protein or in any component of the signaling pathway may affect the downstream components by altering the subsequent transduction of the signal.

Chemicals that interfere with any component of the signaling pathway may activate or inhibit the pathway.

FRQ Example: 2013 #8



Reception

Protein hormone (ligand) binds to the membrane protein during reception. This binding will cause the receptor to change shape which initiates transduction.

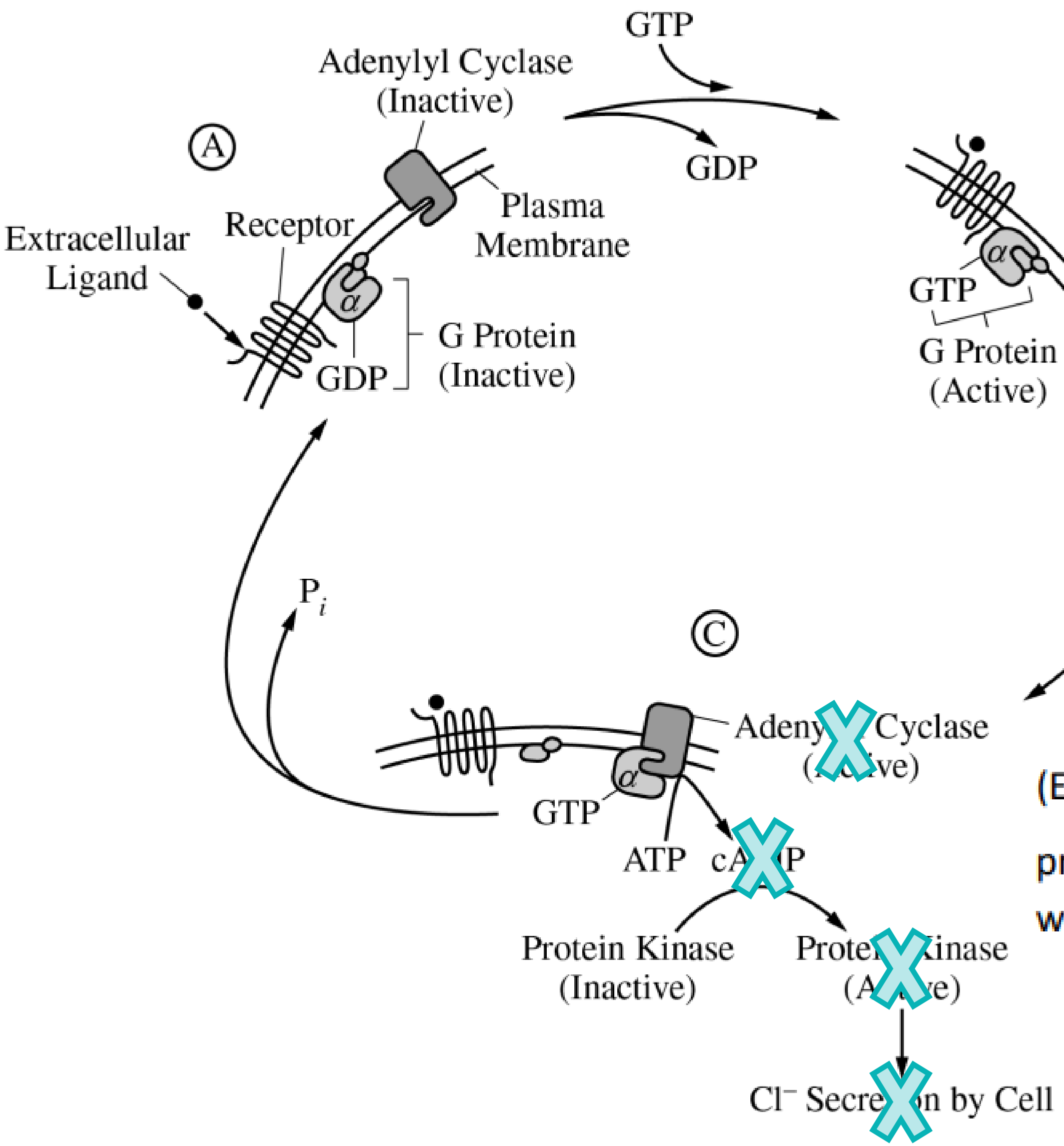
Transduction

Intracellular cascade which transduce the signal from one relay molecule to the next relay molecule through shape changes from reception to response.

Response

Transcription factors will initiate/inhibit transduction of specific genes.

FRQ Example: 2022 #1



In a separate experiment, scientists engineer a mutant adenylyl cyclase that cannot be activated by Gsa. The scientists claim that cholera toxin will not cause excessive water loss from whole intestinal cells that contain the mutant adenylyl cyclase. **Justify** this claim.

(Even in the presence of the toxin) cAMP will not be produced (by this pathway), the protein kinases will not be activated, and Cl^- ions will not be secreted (and less water will leave the intestinal cells).

FRQ Example: 2021 #1

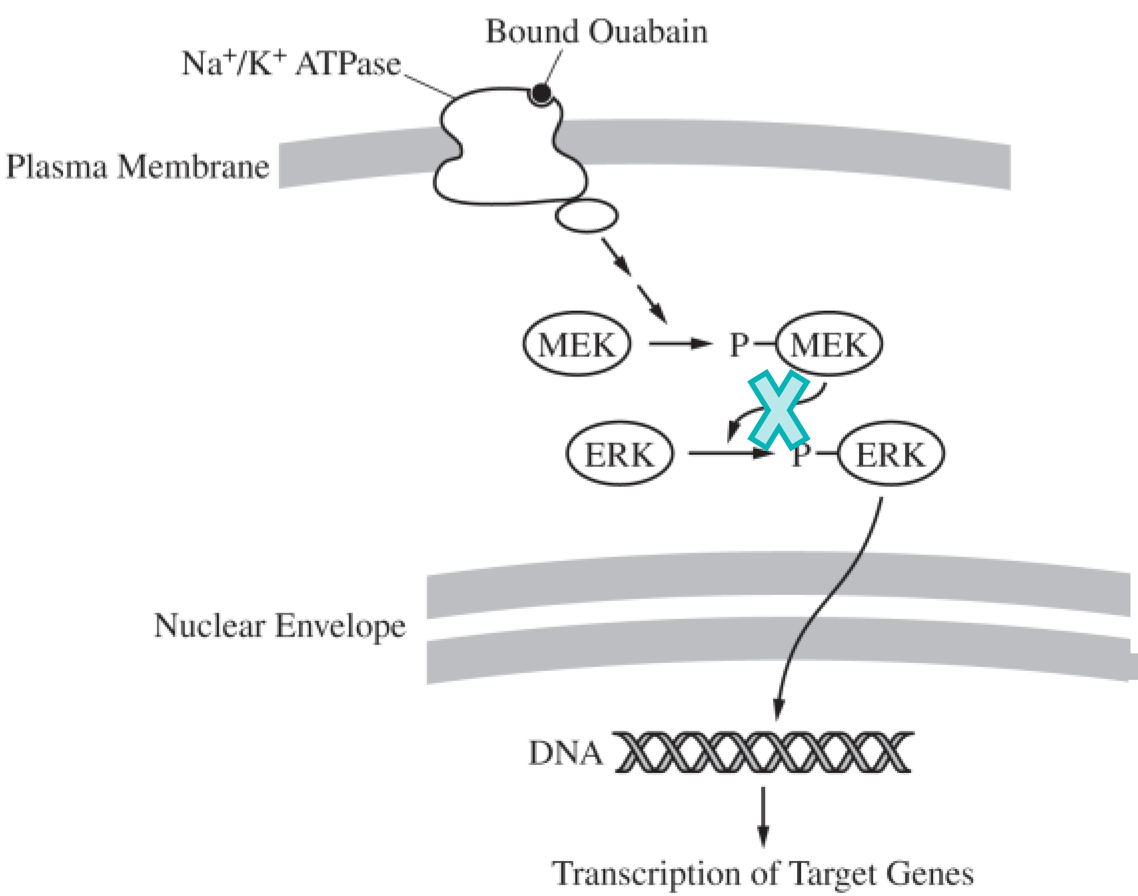


Figure 3. Signal transduction pathway hypothesized to play a role in the increased number o

In a third experiment, the scientists added an inhibitor of phosphorylated MEK (pMEK) to the PKD cells exposed to 10^4 ouabain. Based on Figure 3, **predict** the change in relative ratio of ERK to pERK in ouabain-treated PKD cells with the inhibitor compared with ouabain-treated PKD cells without the inhibitor. Provide reasoning to **justify** your prediction.

Accept one of the following:

- Option 1: The ratio of ERK to pERK will increase in the cells with the inhibitor.
- Option 2: The ratio of ERK to pERK will stay the same in the cells with the inhibitor.

- The justification must indicate that the pMEK inhibitor blocks further phosphorylation of ERK AND one of the following:

Option 1:

- The amount of pERK will not increase as it does in cells without the inhibitor.
- The amount of ERK will not decrease as it does in cells without the inhibitor.
- The cell continues to synthesize ERK.
- Phosphorylated ERK is being dephosphorylated to ERK.

Option 2:

- No additional ERK is synthesized/pERK is not being dephosphorylated.

FRQ Example: 2018 #2

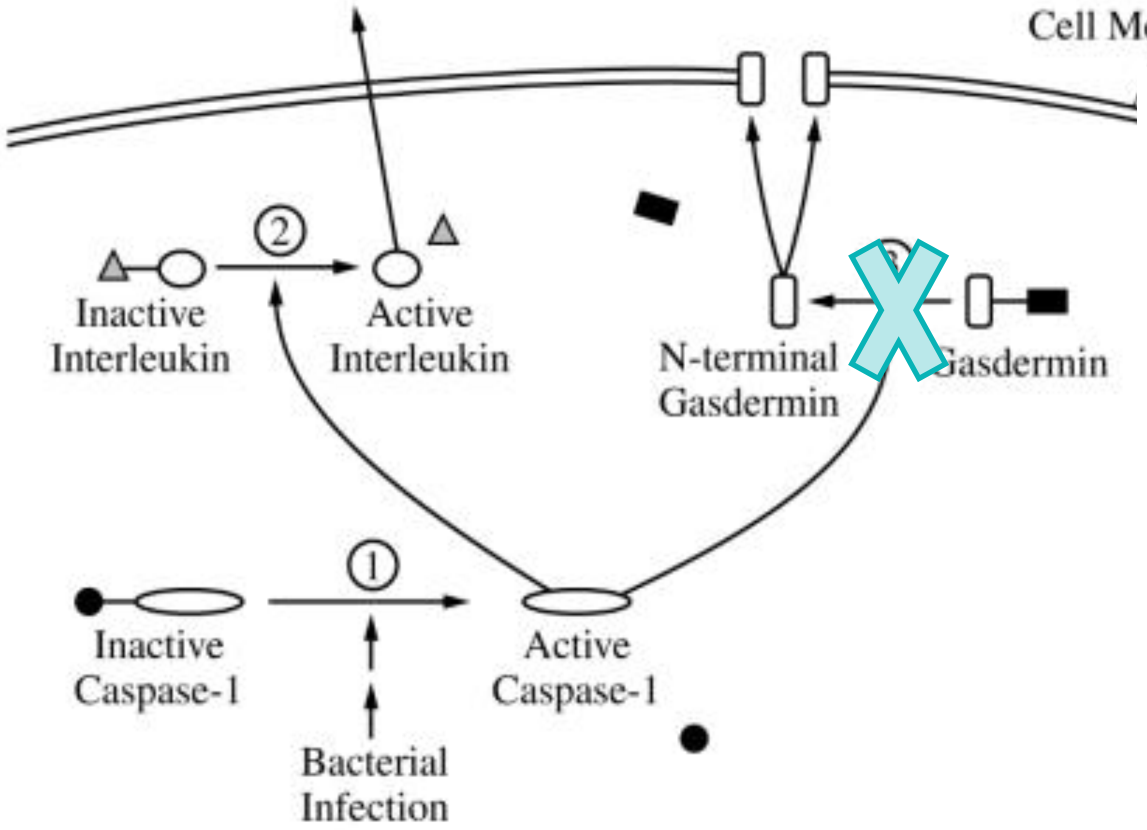


Figure 1. Cellular response to infection by pathogenic bacteria

In response to intracellular pathogens, the inactive caspase-1 is cleaved and forms an active caspase-1 (step 1). Active caspase-1 can cleave two other proteins. When caspase-1 cleaves an inactive interleukin (step 2), the active portion of the interleukin is released from the cell. An interleukin is a signaling molecule that can activate an immune response. When caspase-1 cleaves gasdermin (step 3), the N-terminal portions of several gasdermin proteins associate in the cell membrane to form large, nonspecific pores.

(a) **Describe** the effect of inhibiting step 3 on the formation of pores AND on the release of interleukin from the cell.

Description (2 points)

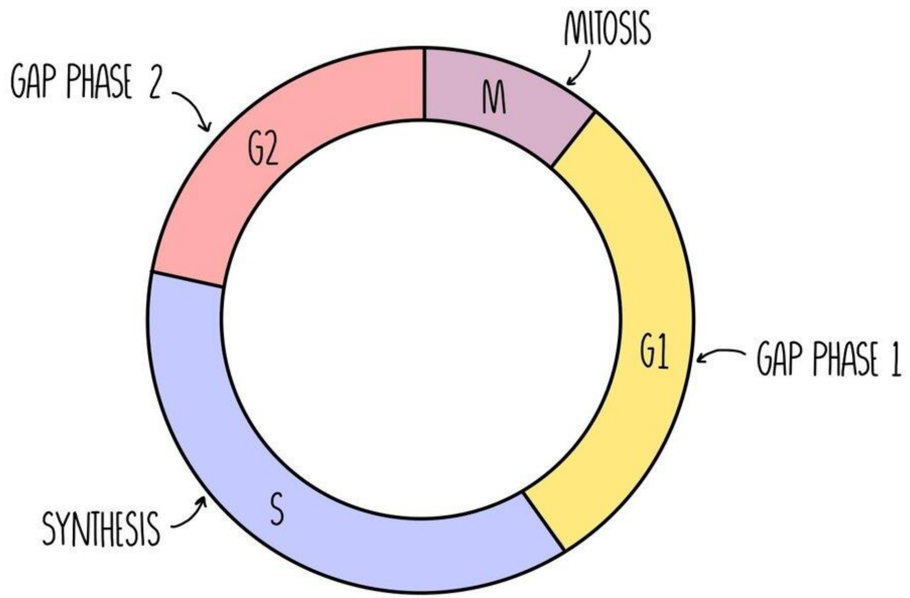
- Pores will not form.
- Interleukin release will not be affected/interleukin release continues.

G_1 | S | G_2

The cell grows through all the different phases of interphase

G_1	S	G_2
Duplication of cell organelles Synthesis of proteins, RNA, and building blocks	Replication of genetic material and centrosomes	Synthesis of proteins and RNA Makes organelles Reorganizes cellular contents

Interphase

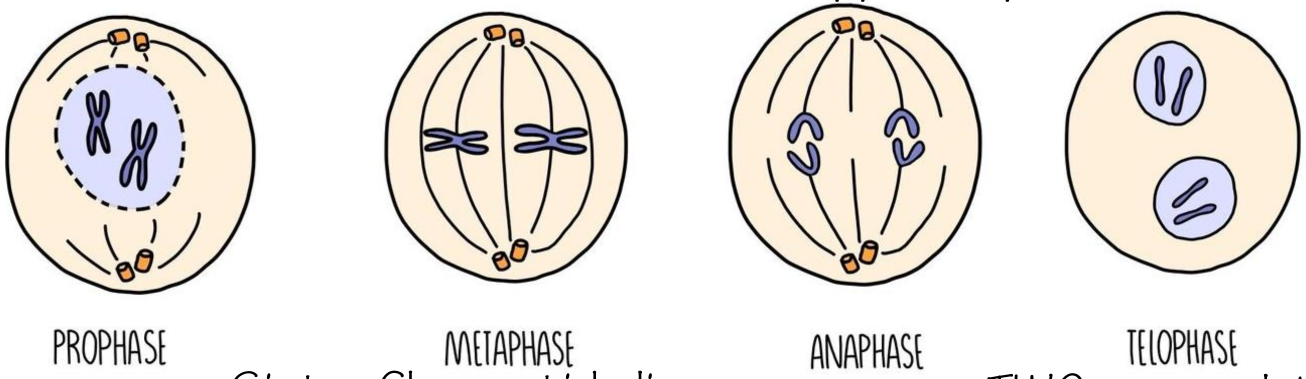


4.6 Cell Cycle

M

PREPARE to divide

Sister Chromatids pulled APART to opposite poles

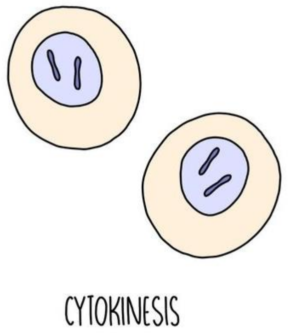


Sister Chromatids line up in the MIDDLE

TWO new nuclei are formed

Cytokinesis

Division of the cytoplasm



4.7 Regulation of Cell Cycle

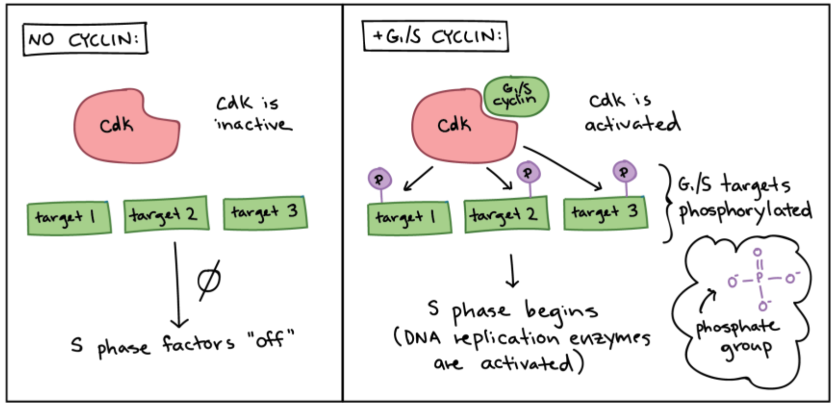
Checkpoints

G_1

During G_1, determines whether to complete the cell cycle

- Growth factor
- Adequate reserves
- Check for DNA damage

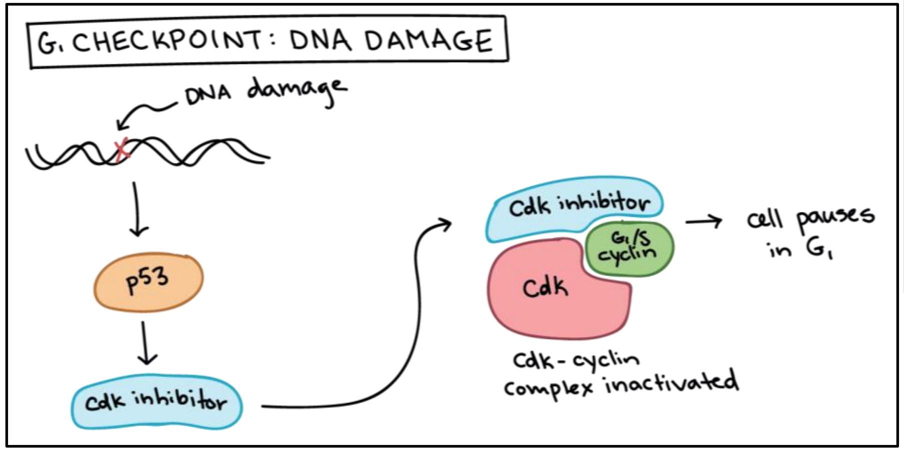
If do not pass, enter G_0 (nondividing state)



G_2

Check all DNA replicated and not damaged.

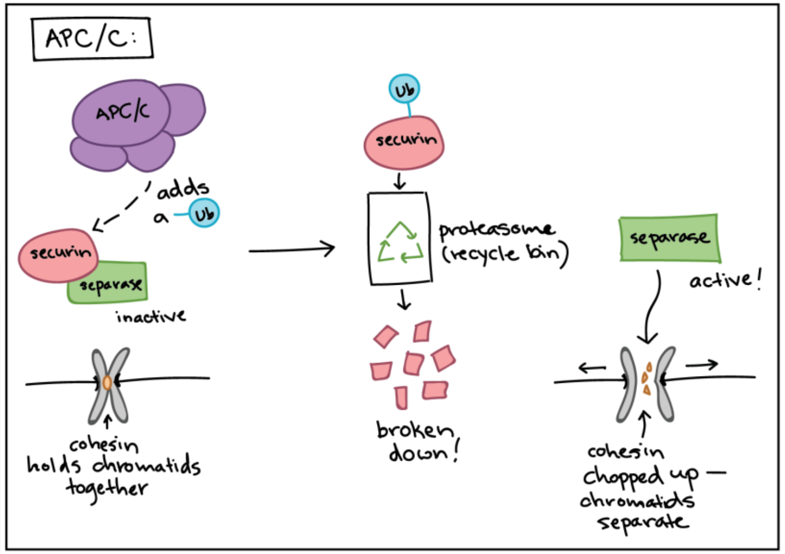
If detect problems with DNA, the cell cycle is halted, to complete DNA replication or repair the damaged DNA.



Checkpoints

M

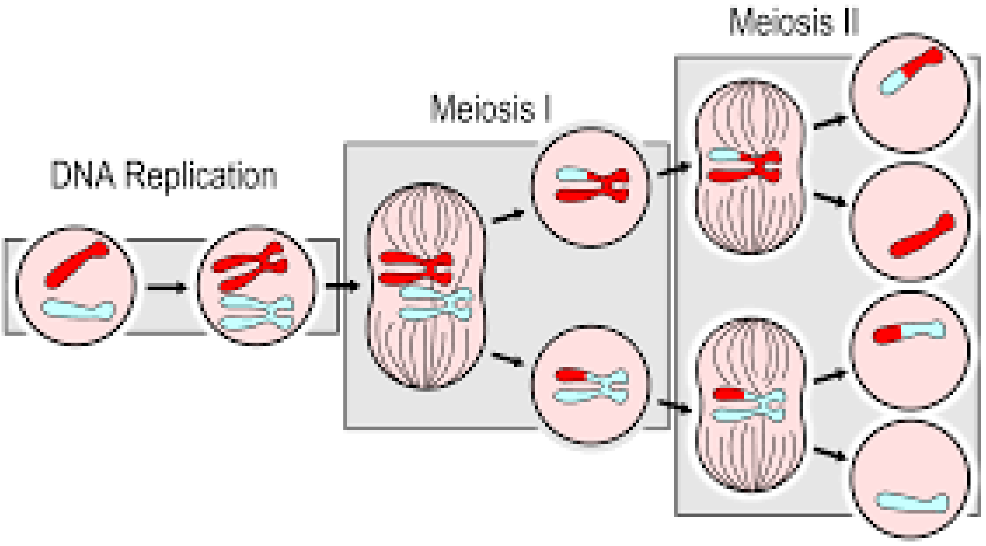
Check sister chromatids attached to the spindle microtubules



5.1 Meiosis

Function

Formation of HAPLOID gamete cells in sexually reproducing organisms



Result

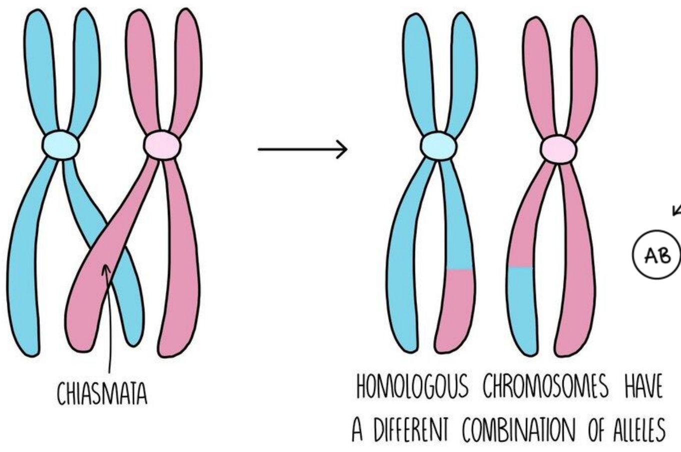
Daughter cells with half the number of chromosomes as parent cell

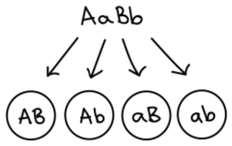
	Parent Cell Ploidy	Rounds of DNA Replication	Rounds of Nuclear Division	Daughter Cell Ploidy	Number of Daughter Cells
Mitosis	Diploid	1	1	Diploid	2
Meiosis	Diploid	1	2	Haploid	4

5.2 Meiosis & Genetic Diversity

Prophase I

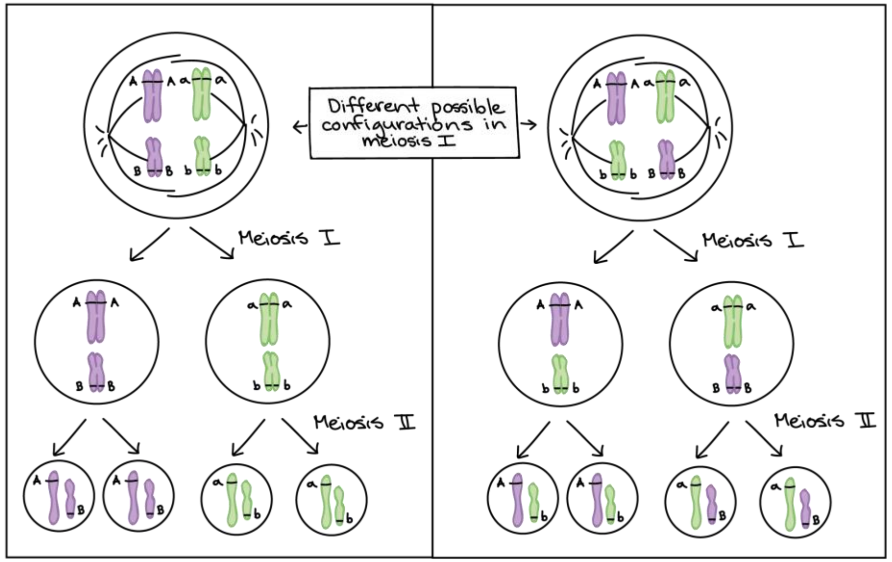
Chromatin condenses
Sister chromatids/
homologous chromosomes align
CROSSING OVER





Metaphase I

HOMOLOGOUS CHROMOSOMES
align on the metaphase plate
INDEPENDENT ASSORTMENT



Anaphase I

HOMOLOGOUS
CHROMOSOMES separate
to opposite poles

Telophase I

Nuclear envelope forms
around the HAPLOID
daughter cells

Meiosis I	Homologous Chromosomes
Meiosis II	Sister Chromatids

Prophase II

Chromatin condenses
Sister chromatids align

Metaphase II

SISTER CHROMATIDS align
on the metaphase plate

Anaphase II

SISTER CHROMATIDS
separate to opposite poles

Telophase I

Nuclear envelope forms
around the HAPLOID
daughter cells

	Parent Cell Ploidy	Rounds of DNA Replication	Rounds of Nuclear Division	Daughter Cell Ploidy	Number of Daughter Cells
Mitosis	Diploid	1	1	Diploid	2
Meiosis	Diploid	1	2	Haploid	4

Mitosis vs. Meiosis

	Compare to Parent Cell	Crossing Over	Independent Assortment
Mitosis	Identical	Does not occur	Does not occur
Meiosis	Genetically Distinct	Occurs in Prophase I	Occurs in Metaphase I

5.3 Mendelian Genetics

Complete Dominance

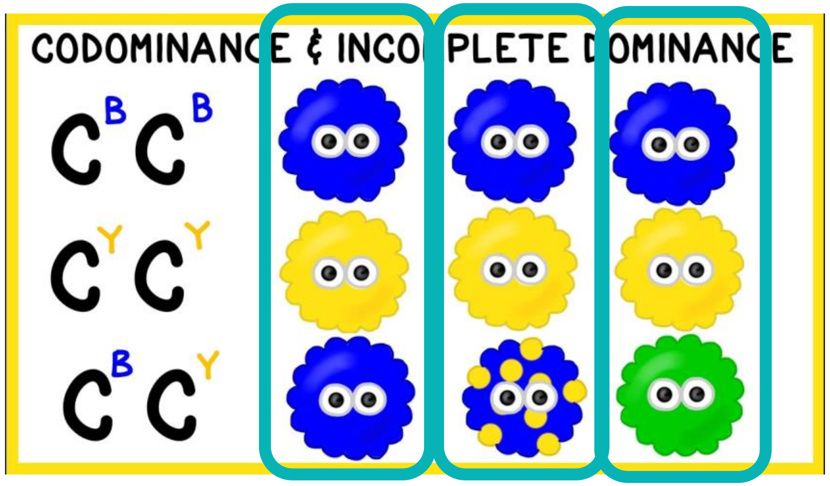
Homozygous dominant and heterozygous look the same

Codominance

Heterozygous is both dominant traits in organism

Incomplete Dominance

Heterozygous is a blend between the two dominant traits



Mendel's laws of segregation and independent assortment can be applied to genes on different chromosomes

	Y	y
Y	YY	Yy
y	Yy	yy

Yellow: ¾
Green: ¼

	R	r
R	RR	Rr
r	Rr	rr

Round: ¾
Wrinkled: ¼

Yellow & Round: ¾ x ¾ = 9/16
Yellow & Wrinkled: ¾ x ¼ = 3/16
Green & Round: ¼ x ¾ = 3/16
Green & Wrinkled: ¼ x ¼ = 1/16

RELEVANT EQUATION

Laws of Probability—

If A and B are mutually exclusive, then:

$P(A \text{ or } B) = P(A) + P(B)$

If A and B are independent, then:

$P(A \text{ and } B) = P(A) \times P(B)$

Monohybrid

Heterozygous for ONE trait
Complete Dominance:
3:1 ratio
Incomplete or Codominance:
1:2:1

Dihybrid

Heterozygous for TWO traits
Complete Dominance:
9:3:3:1 ratio
Incomplete or Codominance:
6:3:3:2:1:1

5.3 Mendelian Genetics

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

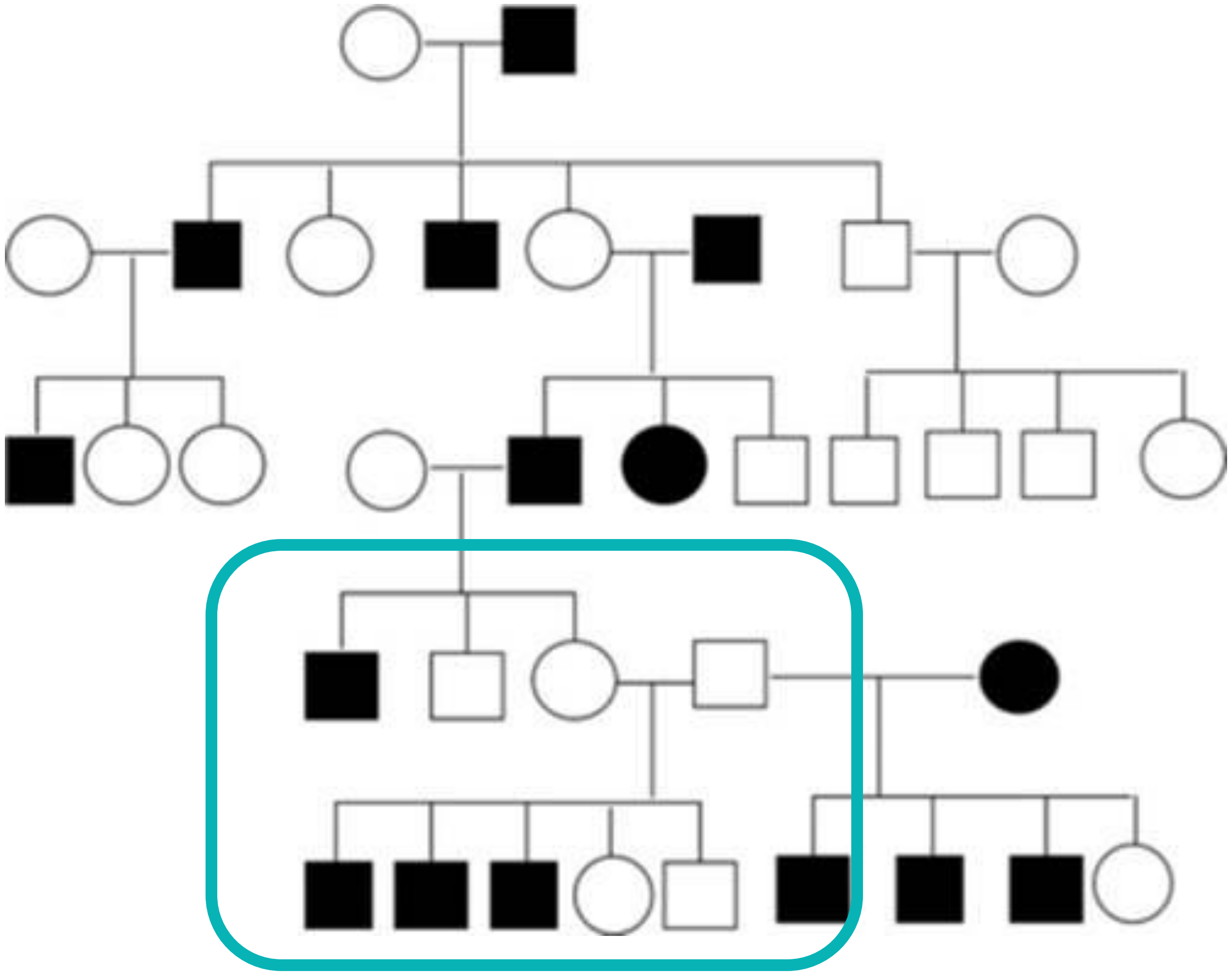
Allele is located on an allosome ("sex") chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together



Autosomal Recessive

5.4 Non-Mendelian Genetics

Autosomal Inheritance

Allele is located on an autosome (non-sex chromosome)

Sex-Linked

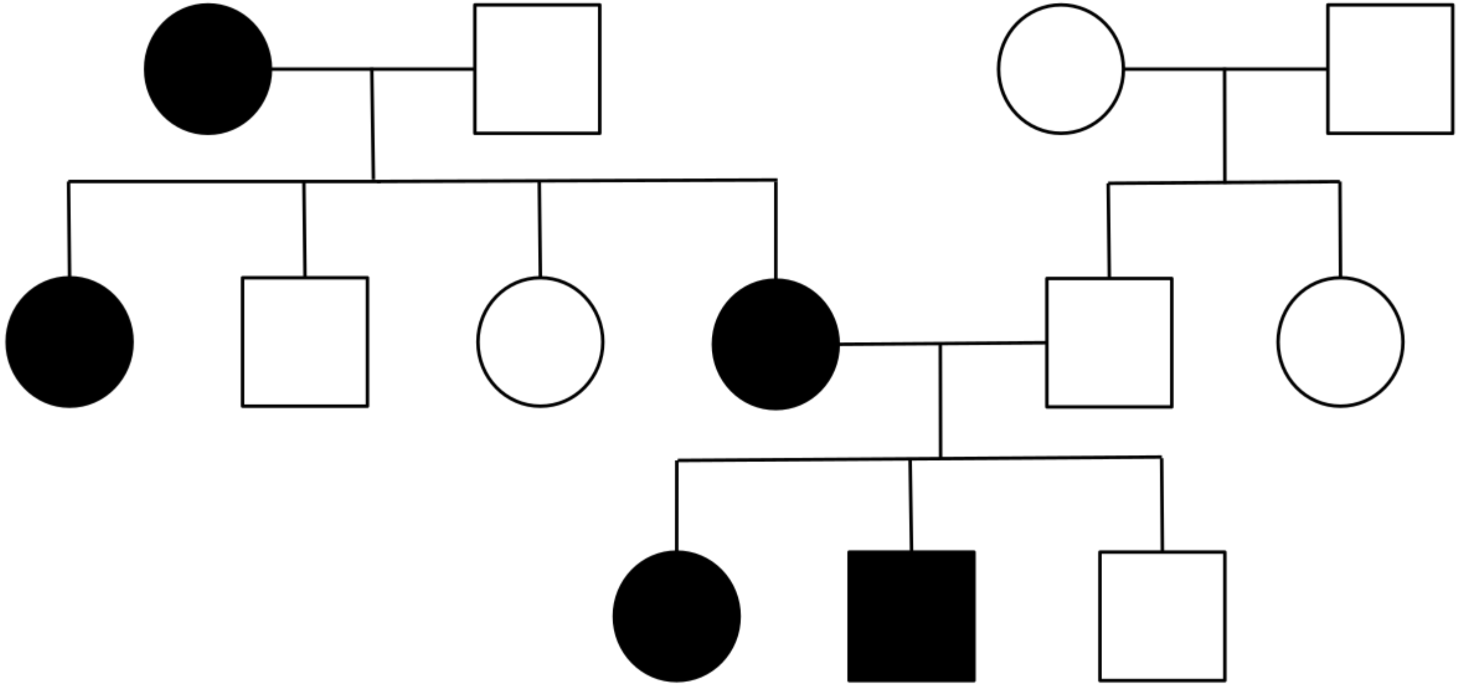
Allele is located on a sex chromosome

Maternal Inheritance

Allele is located on the DNA found in a mitochondrial or chloroplast

Linked Genes

Genes located on the same chromosome closely together



Autosomal Dominant

5.4 Non-Mendelian Genetics

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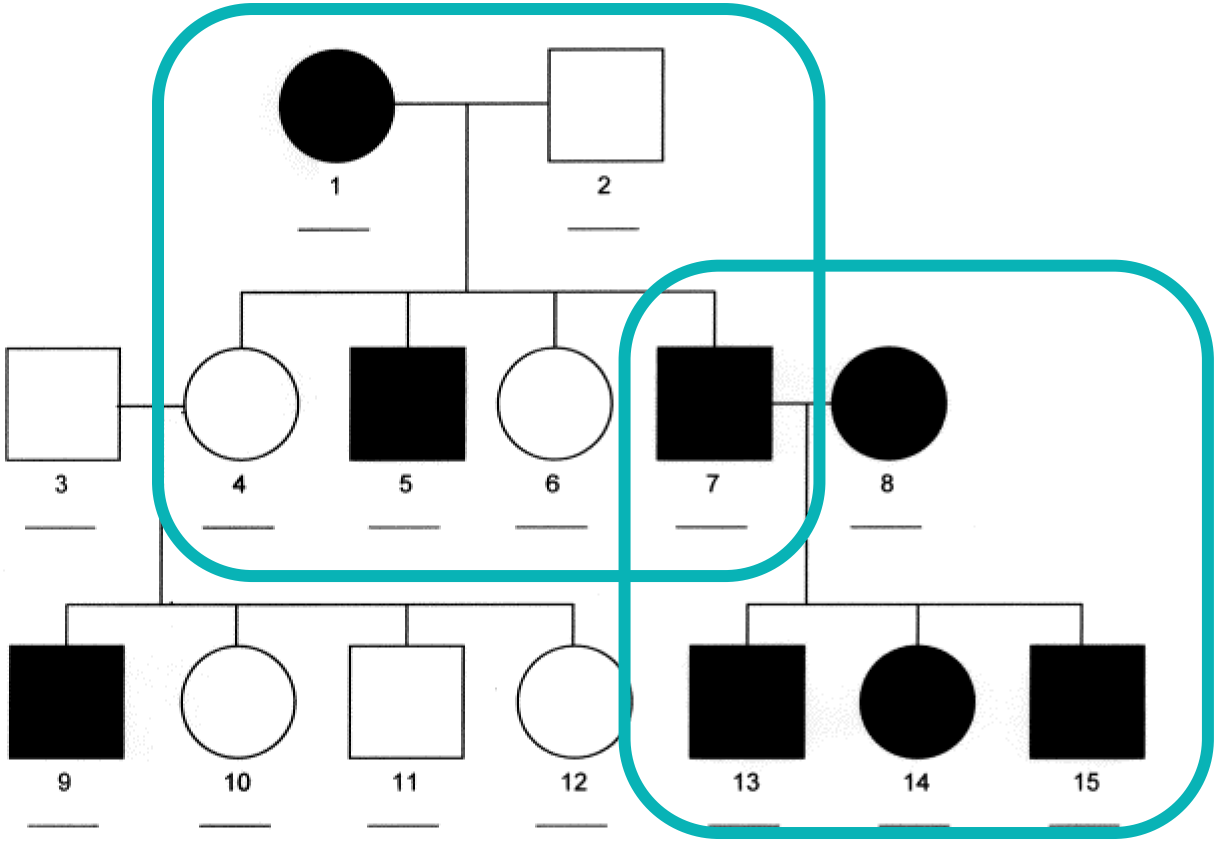

Sex-Linked Recessive

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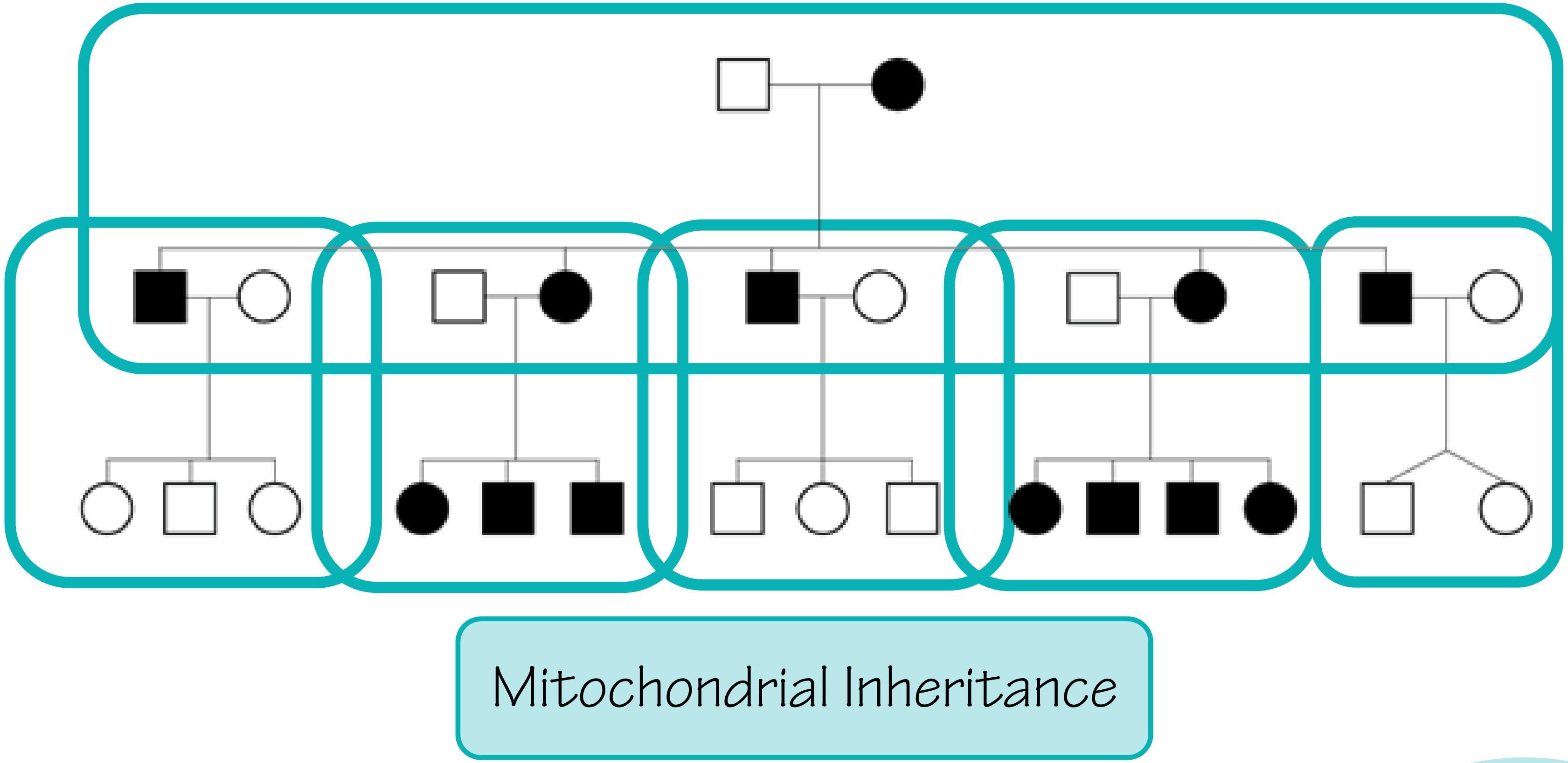


Genetic information (DNA/RNA) is passed to subsequent generations

Prokaryote

- Single DNA molecule
- Circular DNA molecule
- No introns

BOTH has plasmids (small extra-chromosomal, double stranded, circular DNA)

Eukaryote

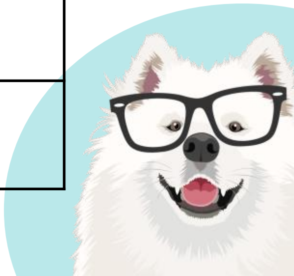
- Multiple DNA molecules
- Linear DNA molecules
- Introns

6.1: DNA & RNA Structure

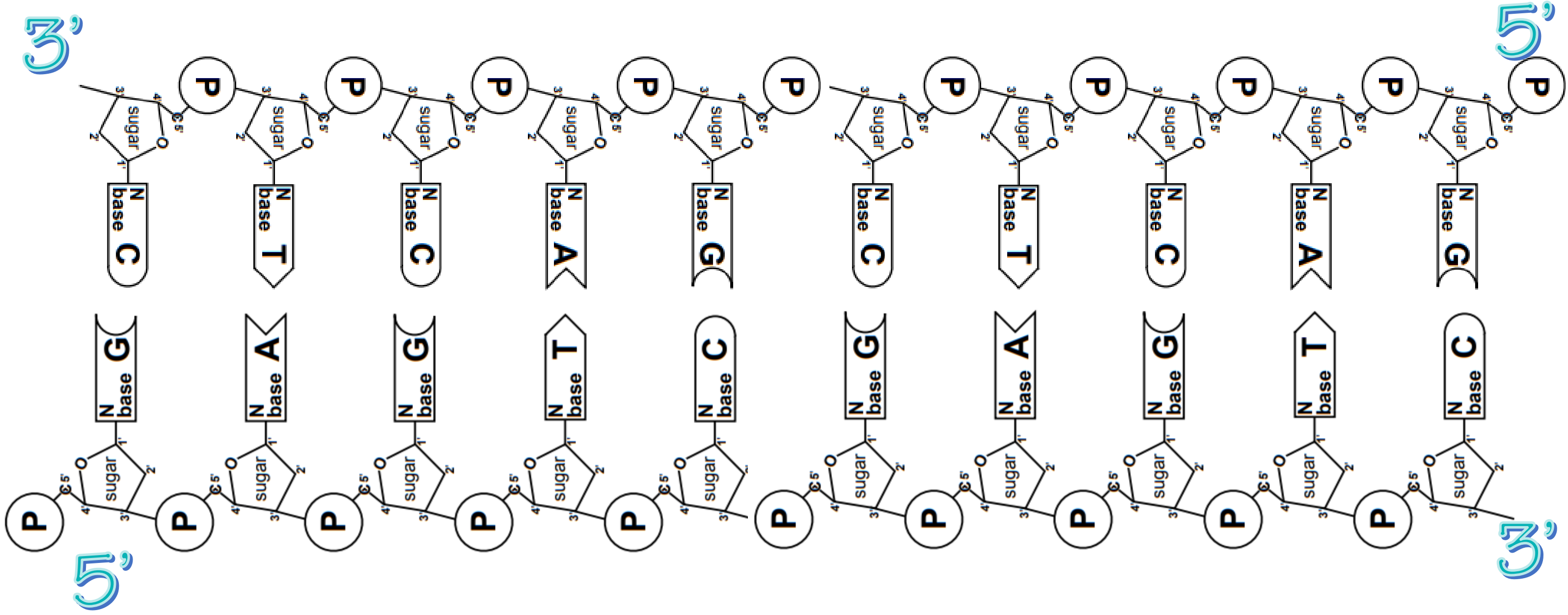
Base Pairing	H bonds
A & T/U	2
C & G	3

DNA vs. RNA

	DNA	RNA
Nitrogenous Bases	A, T, C, G	A, U, C, G
Sugar	Deoxyribose	Ribose
Strandedness	"double"	"single"



6.2 Replication



Location

- Eukaryotes: nucleus
- Prokaryotes: nucleoid

Structure

- Eukaryotes: multiple linear
- Prokaryotes: single circular

Reminders about DNA:

- DNA made up of:
  - nitrogenous base (A, T, C, G)
  - pentose sugar (deoxyribose)
  - phosphate group
- Purine (A/G) have a double ring structure
- Pyrimidine (C/T) have a single ring structure
- Base Pair Rules
  - A & T with 2 H bonds
  - C & G with 3 H bonds

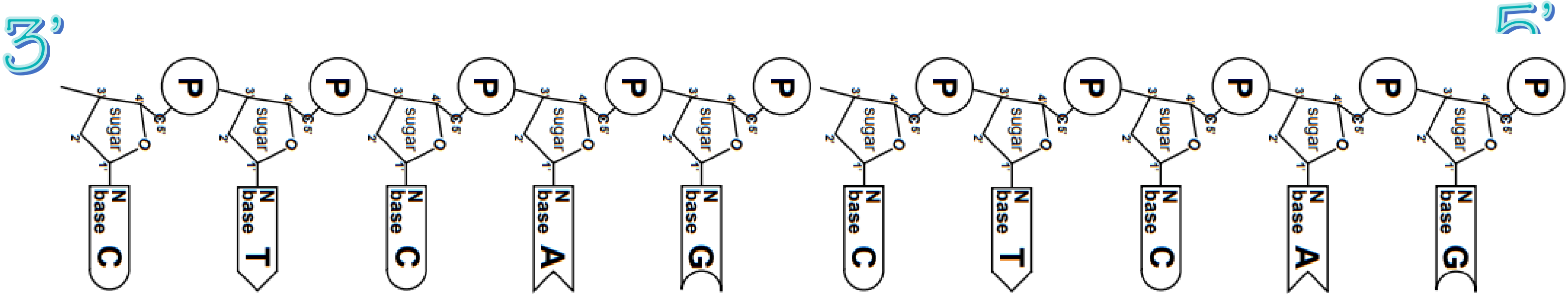
- Sidedness
  - 5' end: phosphate
  - 3' end: hydroxyl group
- Directionality
  - Read 3' to 5'
  - Synthesize 5' to 3'

(Remember ANTIPARALLEL)

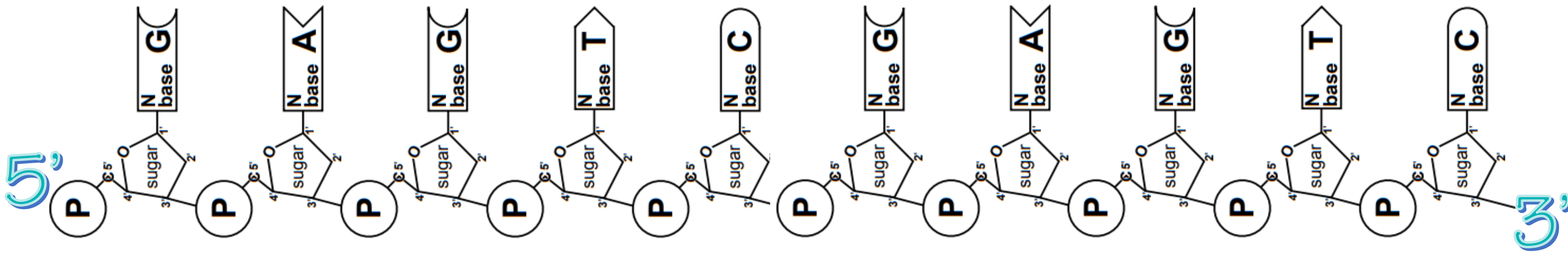
Replication

Important Enzymes

- Helicase unwinds the DNA strands
- Topoisomerase relaxes supercoiling in front of the replication fork.



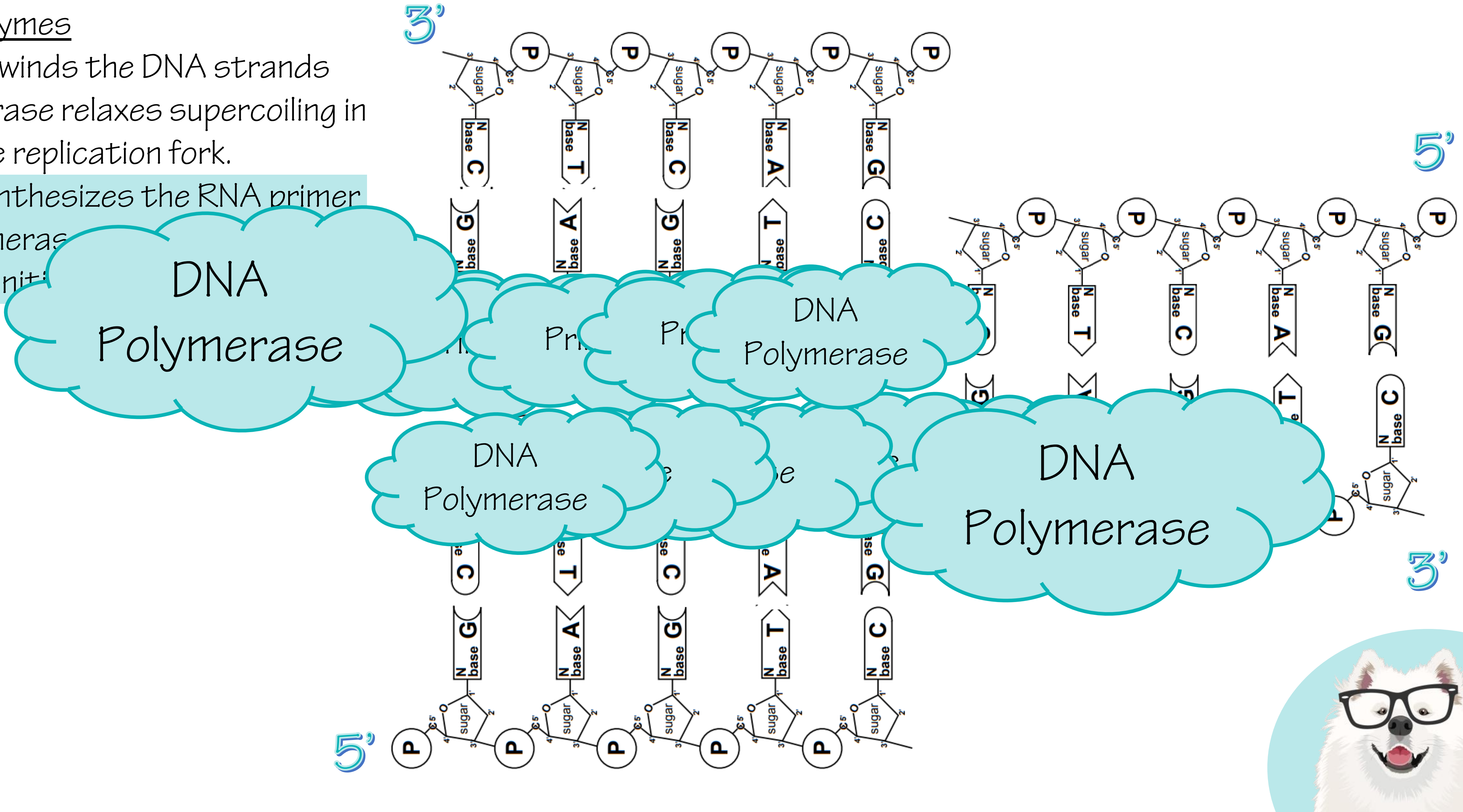
Helicase



6.2 Replication

Important Enzymes

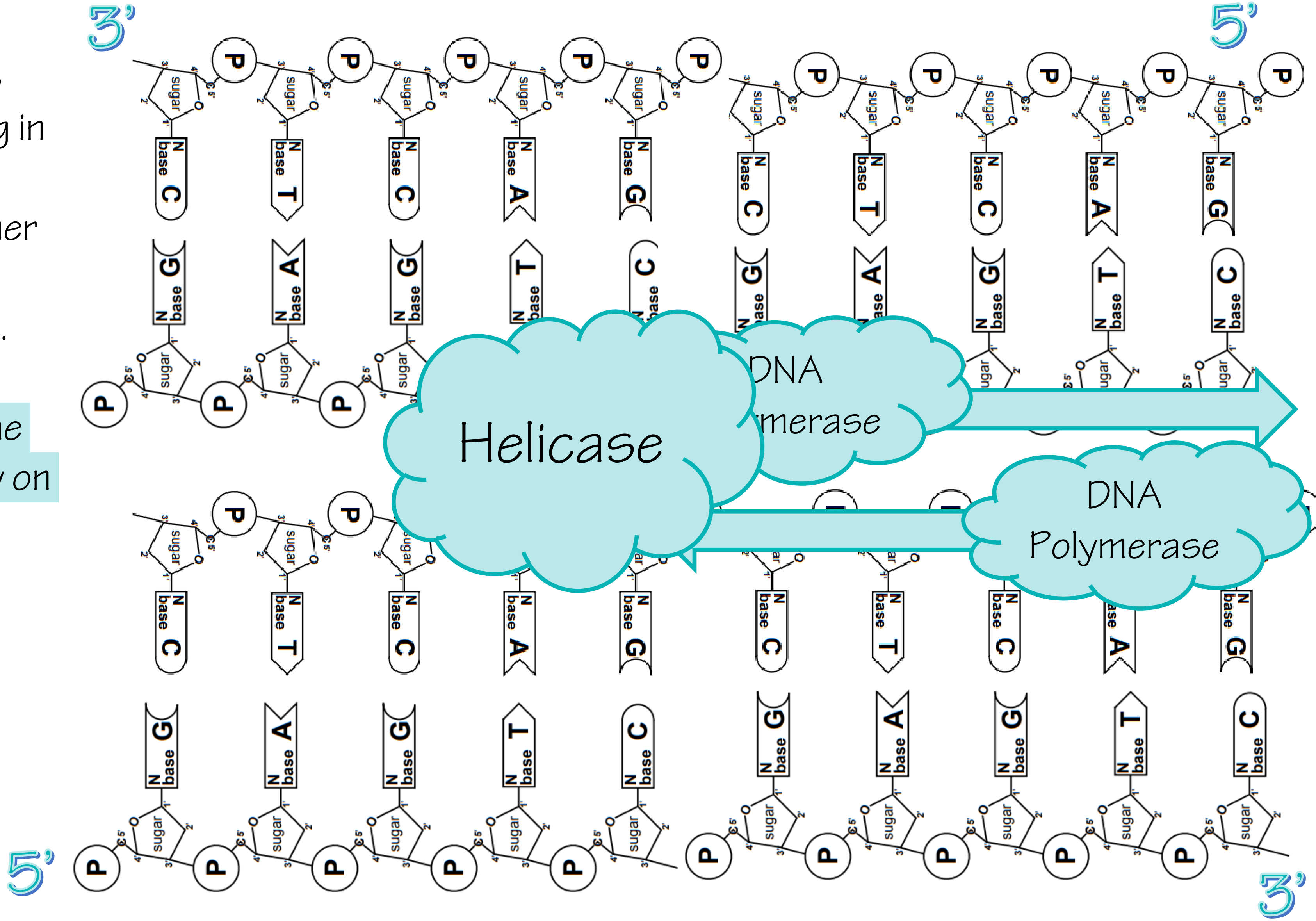
- Helicase unwinds the DNA strands
- Topoisomerase relaxes supercoiling in front of the replication fork.
- Primase synthesizes the RNA primer (DNA polymeras… primers to init…



6.2 Replication

Important Enzymes

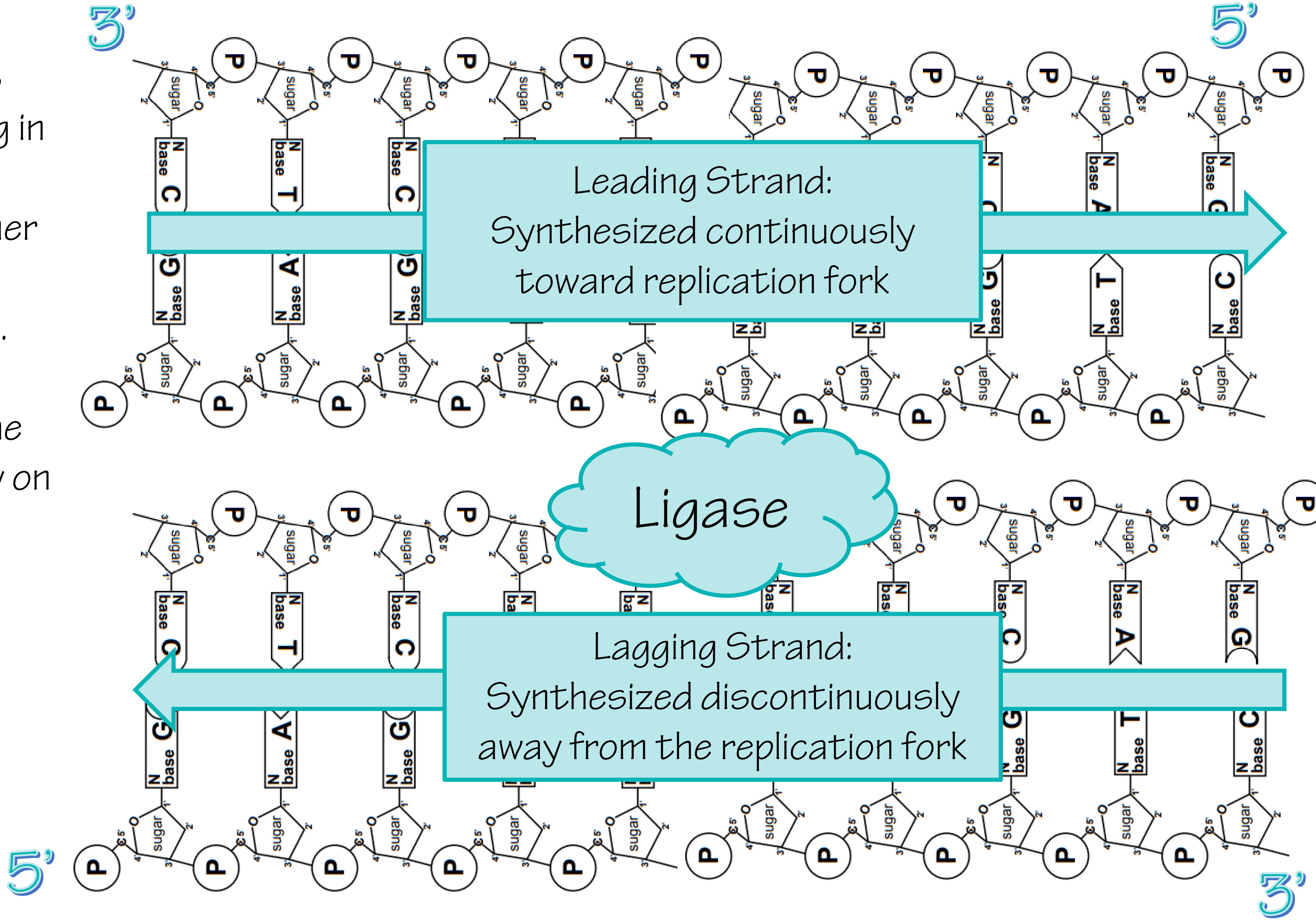
- Helicase unwinds the DNA strands
- Topoisomerase relaxes supercoiling in front of the replication fork.
- Primase synthesizes the RNA primer (DNA polymerase requires RNA primers to initiate DNA synthesis).
- DNA polymerase synthesizes new strands of DNA continuously on the leading strand and discontinuously on the lagging strand.



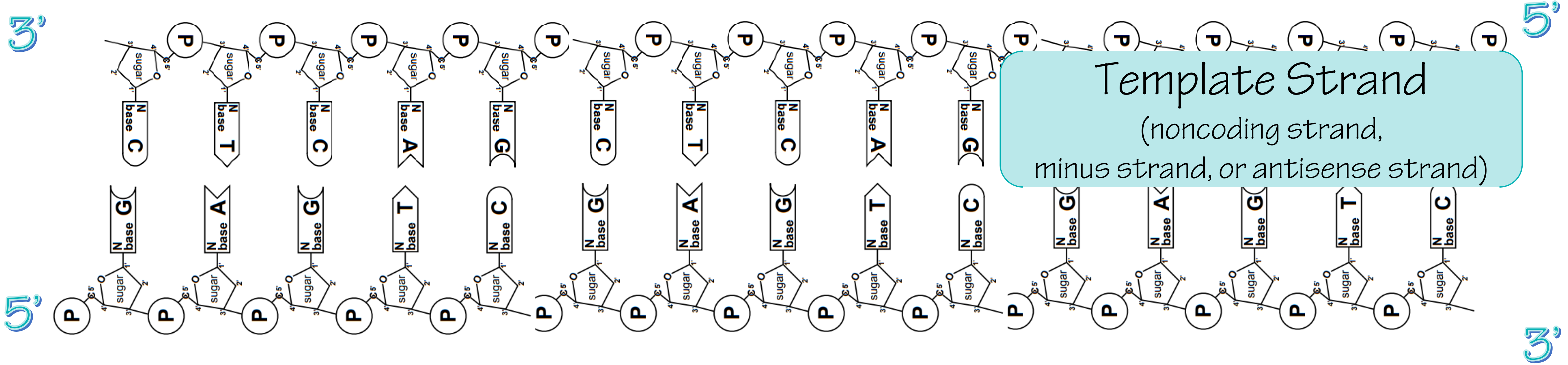
6.2 Replication

Important Enzymes

- Helicase unwinds the DNA strands
- Topoisomerase relaxes supercoiling in front of the replication fork.
- Primase synthesizes the RNA primer (DNA polymerase requires RNA primers to initiate DNA synthesis).
- DNA polymerase synthesizes new strands of DNA continuously on the leading strand and discontinuously on the lagging strand.
- Ligase joins the fragments on the lagging strand.



6.3 Transcription and RNA Processing



Template Strand

(noncoding strand,
minus strand, or antisense strand)

replication

DNA → RNA → Polypeptide

transcription → translation →

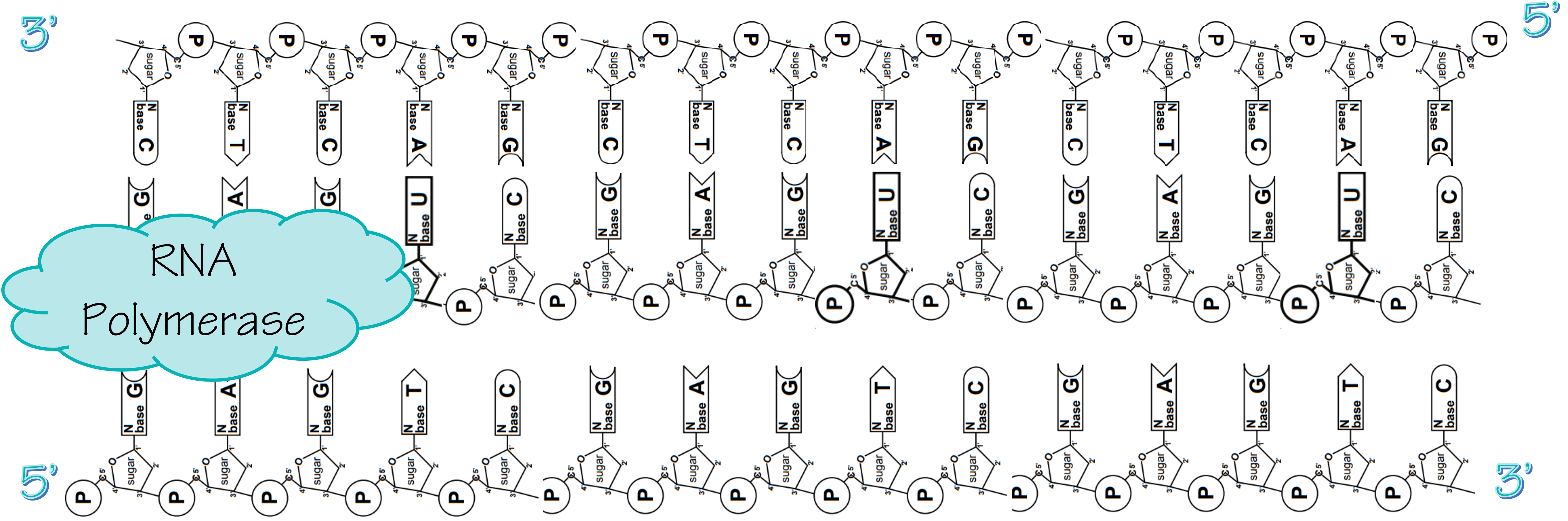
Location

- Eukaryotes: nucleus
- Prokaryotes: nucleoid (cytosol)

Types of RNA:

- mRNA: carry information from DNA to the ribosome
- tRNA bind to specific amino acid and have anticodon sequence that pairs with mRNA
  - used in translation to generate a primary peptide sequence based on mRNA
- rRNA are functional building blocks of ribosomes

6.3 Transcription and RNA Processing



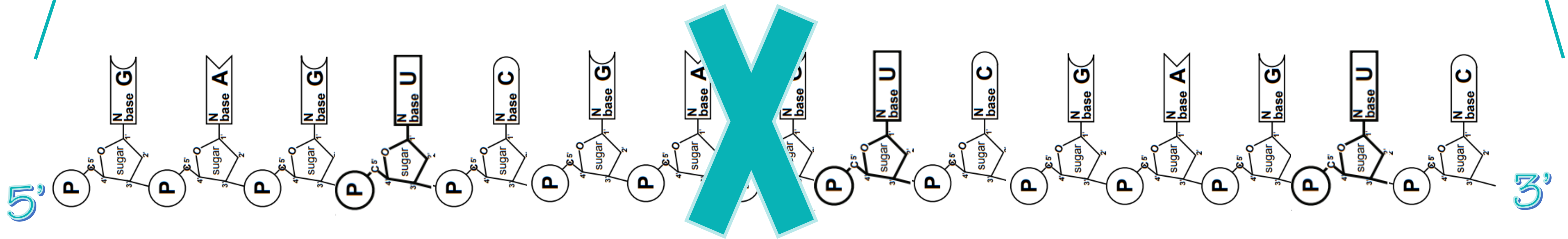
Important Enzyme & Components

- RNA polymerase synthesizes mRNA molecules in the 5' to 3' direction by reading the template DNA strand in the 3' to 5' direction.
- Promoter: site where RNA polymerase binds to start transcription
- Transcription Factors: activators/inhibitors to turn on/off gene expression

6.3 Transcription and RNA Processing

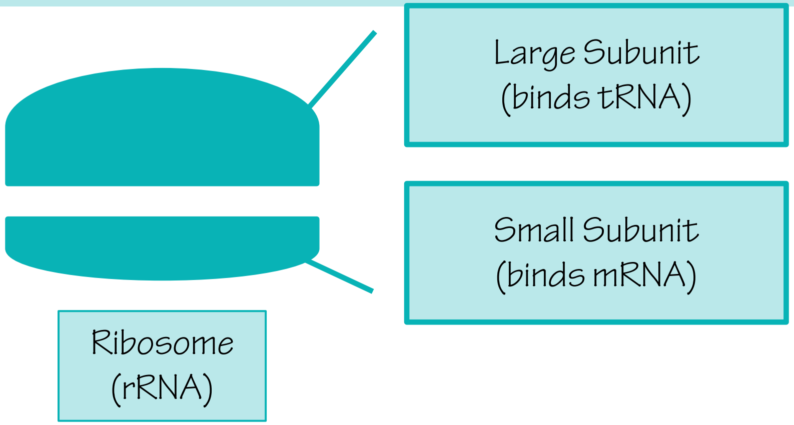
<u>5’ Guanine Cap</u>
- Signals the “start” of the mRNA transcript for ribosome to bind
- Facilitates export from nucleus

<u>Poly-A Tail</u>
- Inhibits degradation from hydrolytic enzymes in cytosol



<u>Splicing</u>
- Removal of introns from pre-mRNA transcript

6.4 Translation



<u>Location</u>
- Eukaryotes: cytosol/rough ER
- Prokaryotes: cytosol

<u>Steps of Translation</u>
- Initiation: start codon (AUG)
- Elongation: base pair between tRNA/mRNA with amino acid added
- Termination: stop codon (UAG, UAA, UGA)

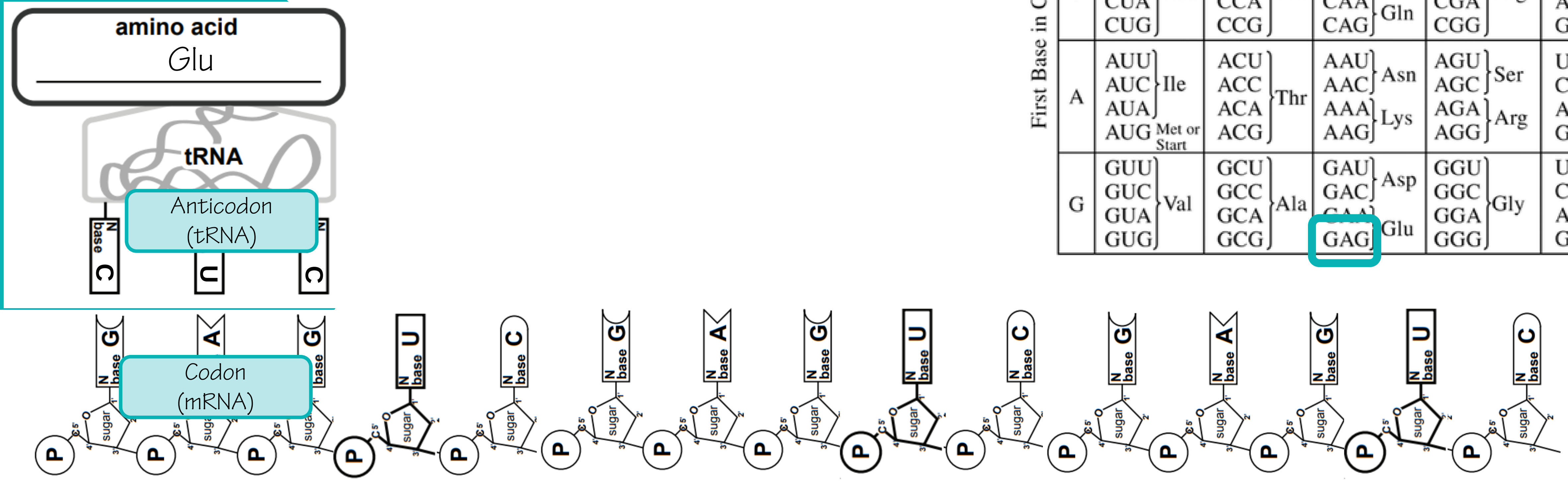
Second Base in Codon

First Base in Codon	U	C	A	G	Third Base in Codon
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 or Start	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

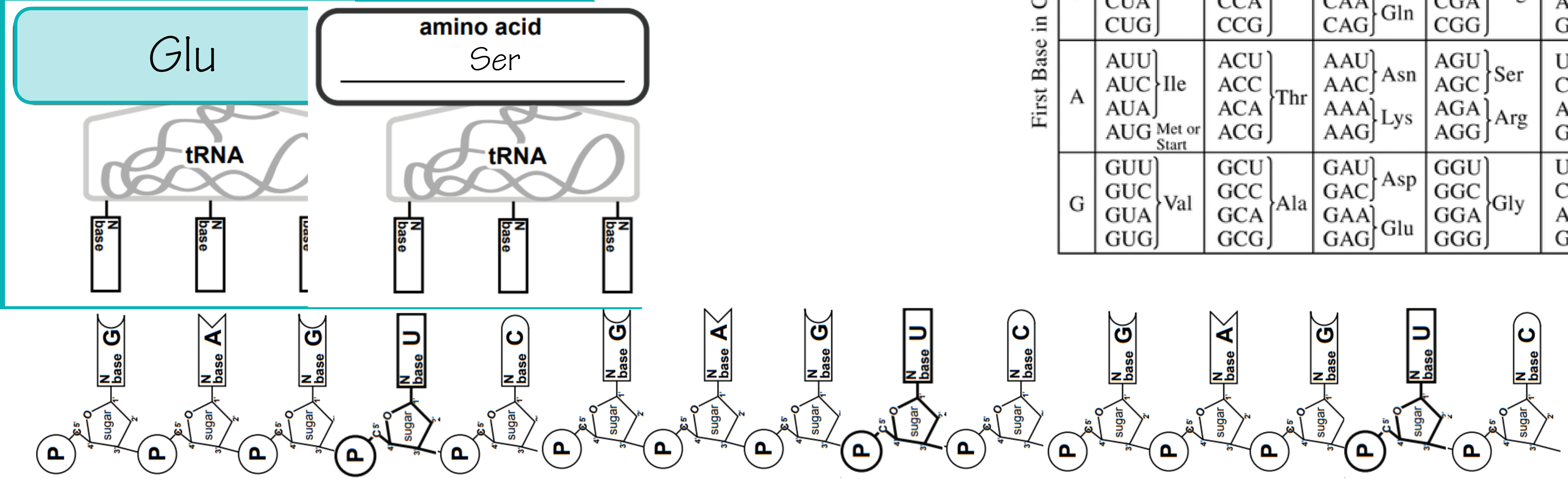
6.4 Translation

Second Base in Codon

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



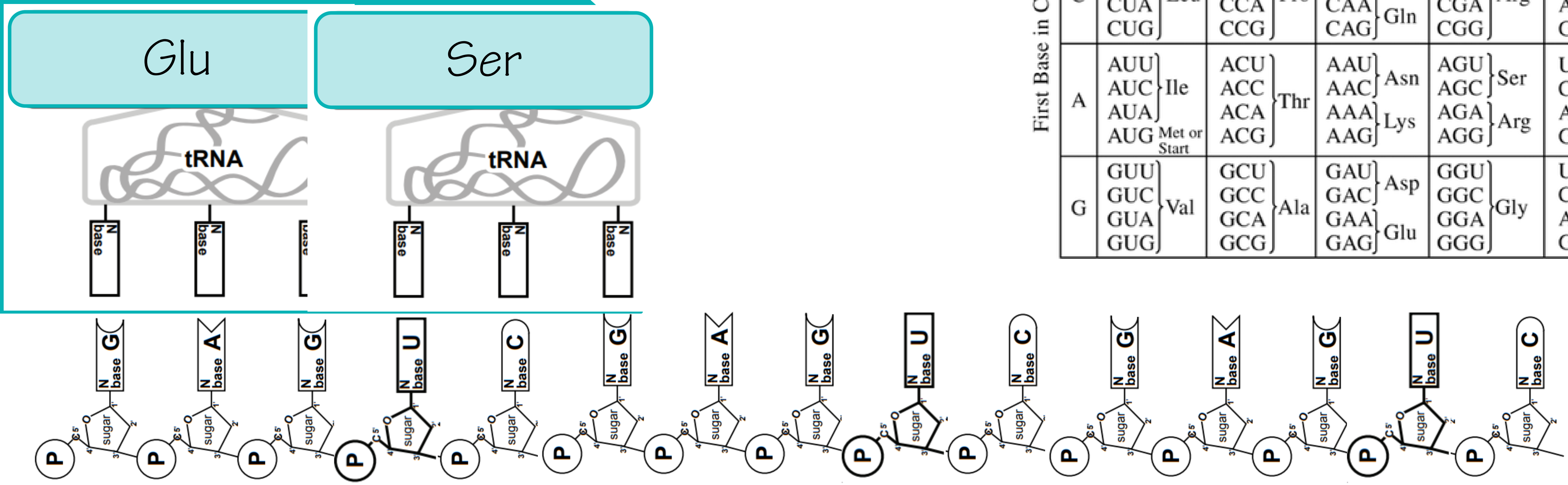
6.4 Translation



Second Base in Codon

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

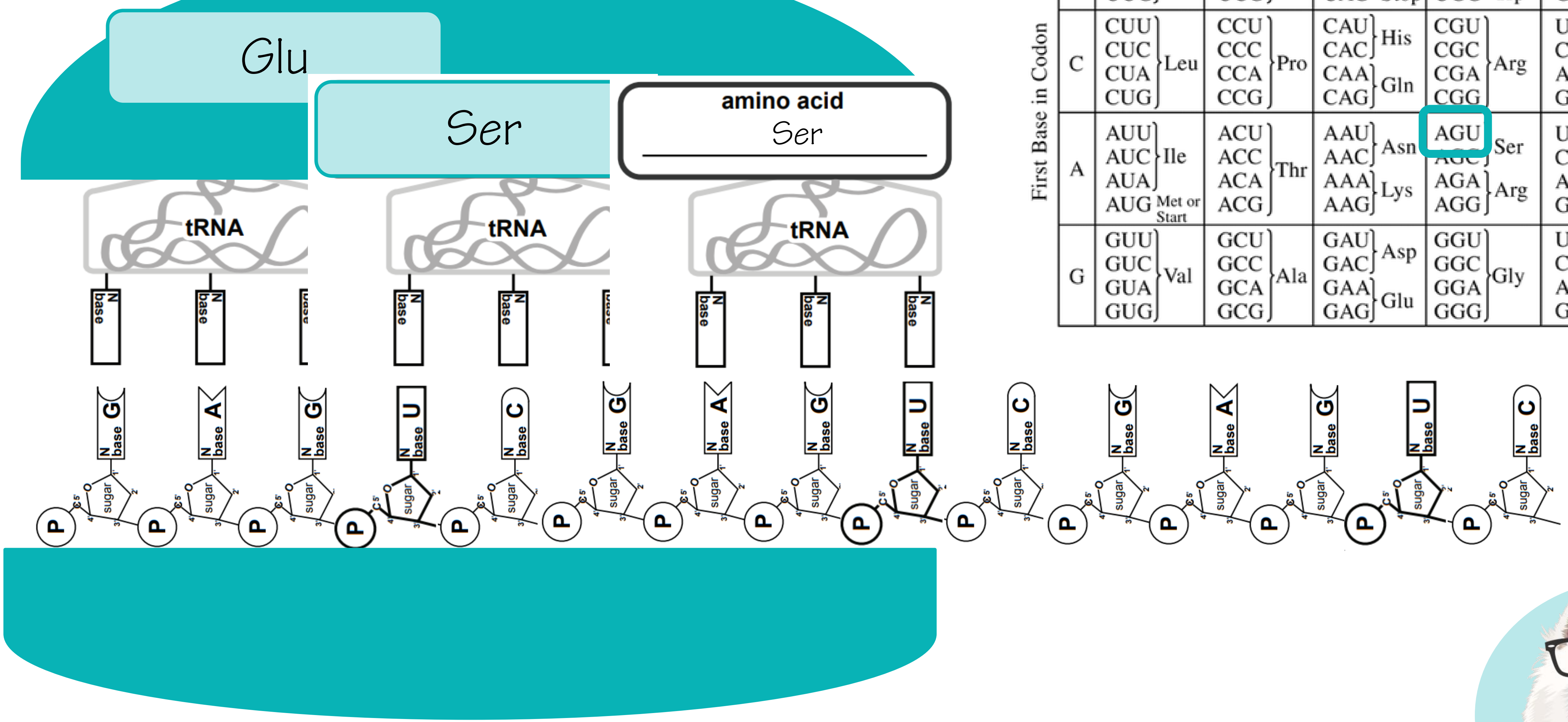
6.4 Translation



Second Base in Codon

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

6.4 Translation



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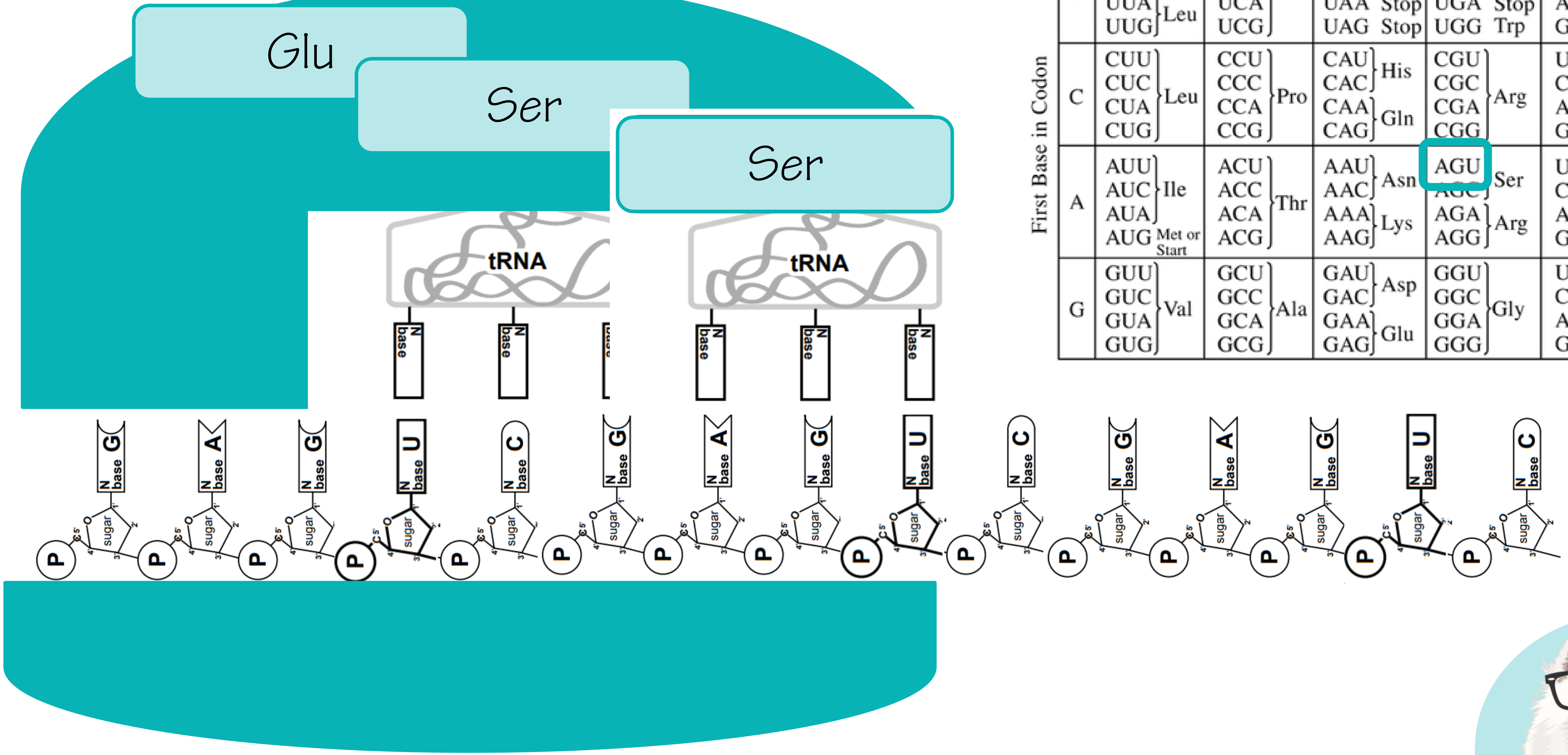
C	CUU, CUC, CUA, CUG Leu	CCU, CCC, CCA, CCG Pro	CAU, CAC His; CAA, CAG Gln	CGU, CGC, CGA, CGG Arg	U C A G
A	AUU, AUC, AUA Ile; AUG Met or Start	ACU, ACC, ACA, ACG Thr	AAU, AAC Asn; AAA, AAG Lys	AGU, AGC Ser; AGA, AGG Arg	U C A G
G	GUU, GUC, GUA, GUG Val	GCU, GCC, GCA, GCG Ala	GAU, GAC Asp; GAA, GAG Glu	GGU, GGC, GGA, GGG Gly	U C A G

6.4 Translation



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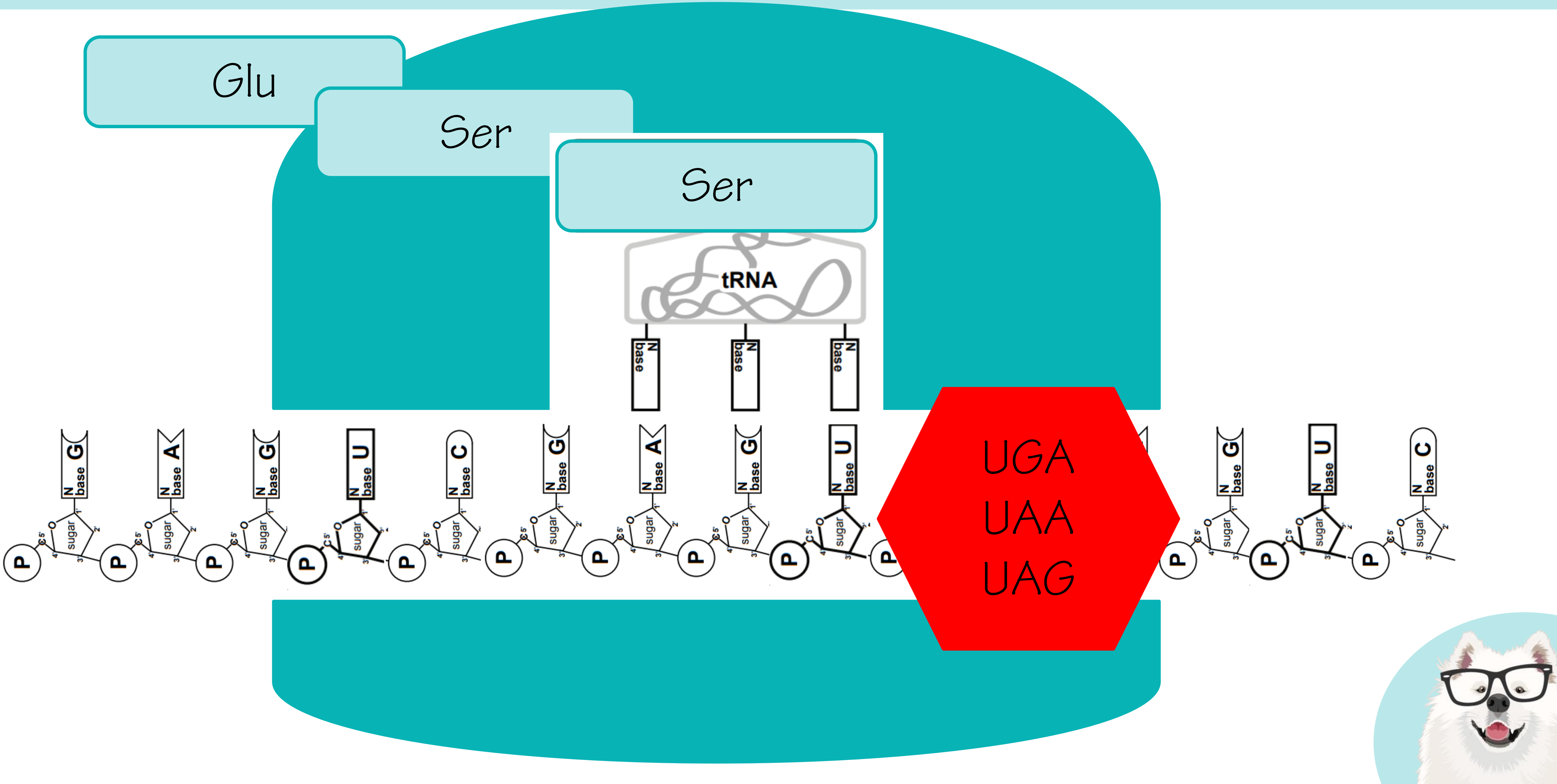
C	CUU, CUC, CUA, CUG Leu	CCU, CCC, CCA, CCG Pro	CAU, CAC His; CAA, CAG Gln	CGU, CGC, CGA, CGG Arg	U C A G
A	AUU, AUC, AUA Ile; AUG Met or Start	ACU, ACC, ACA, ACG Thr	AAU, AAC Asn; AAA, AAG Lys	AGU, AGC Ser; AGA, AGG Arg	U C A G
G	GUU, GUC, GUA, GUG Val	GCU, GCC, GCA, GCG Ala	GAU, GAC Asp; GAA, GAG Glu	GGU, GGC, GGA, GGG Gly	U C A G

6.4 Translation



6.5 Regulation of Gene Expression

Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription

Epigenetic changes can affect gene expression through reversible modifications of DNA or histones

- Methylation (DNA): inhibit
- Acetylation (histone): activate

The phenotype is determined by combination of genes expressed and the levels of expression—

- cell differentiation
- induction of transcription factors during development

Repressible Operon

Example: Trp Operon
synthesizes tryptophan

Starts: ON
Repressor: INACTIVE

If trp is present…
Trp binds to repressor to ACTIVATE
Repressor binds to operator to turn the operon OFF

Operon

Gene Regulation found in prokaryotes

Promoter
Site when RNA polymerase binds

Operator
Site when repressor binds

Genes
DNA

Inducible Operon

Example: Lac Operon
synthesizes enzymes to break down lactose

Starts: OFF
Repressor: ACTIVE

If lactose is present…
lactose binds to repressor to INACTIVATE
Repressor no longer binds to operator to turn the operon ON

6.7 Mutations

Point Mutations

Mutation at one nucleotide base pair

<u>Silent</u>

no change in
amino acid (AA)

<u>Missense</u>

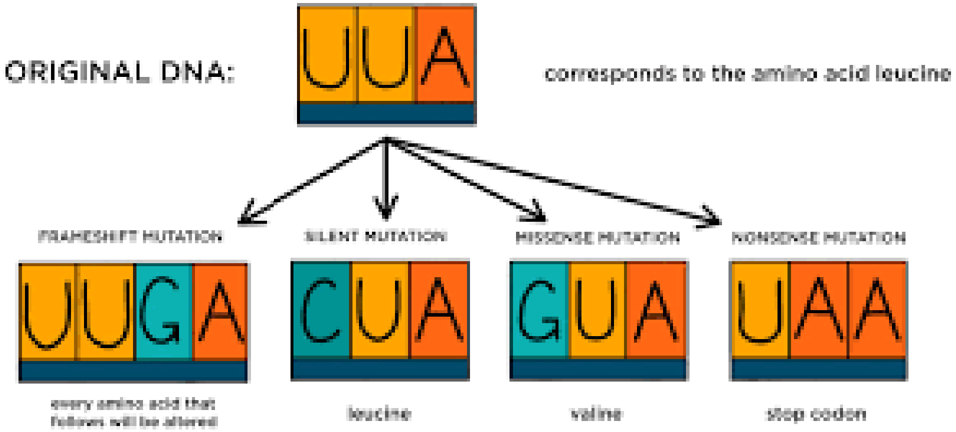
change from one AA
to another AA

<u>Nonsense</u>

change from AA
to STOP codon

<u>Frameshift</u>

insertion/deletion of 1 or 2
nucleotide base pairs
shifts the reading frame for
codons



Chromosomal Mutations

Rearrangement of chromosome parts
or changes in chromosome numbers

<u>Rearrangement</u>

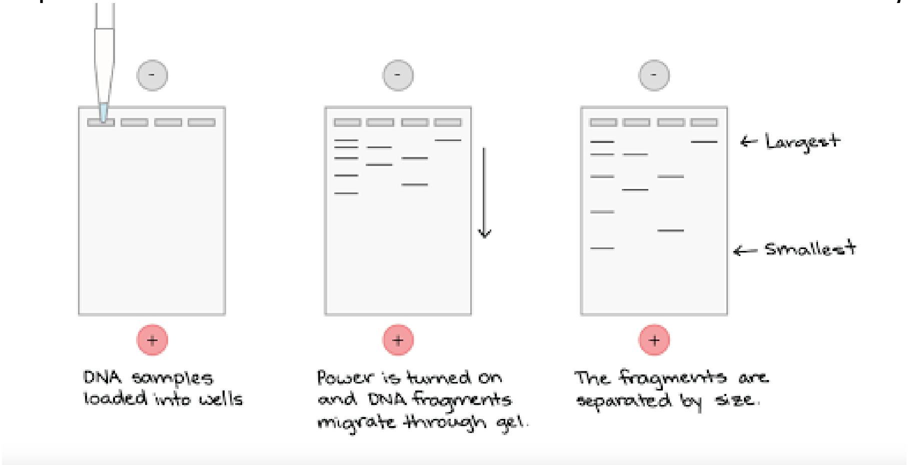
Insertion
Deletion
Duplication
Inversion
Translocation

<u>Changes in Chromosome Number</u>

Nondisjunction
Polyploidy

Gel Electrophoresis

Separate molecules based on size and charge

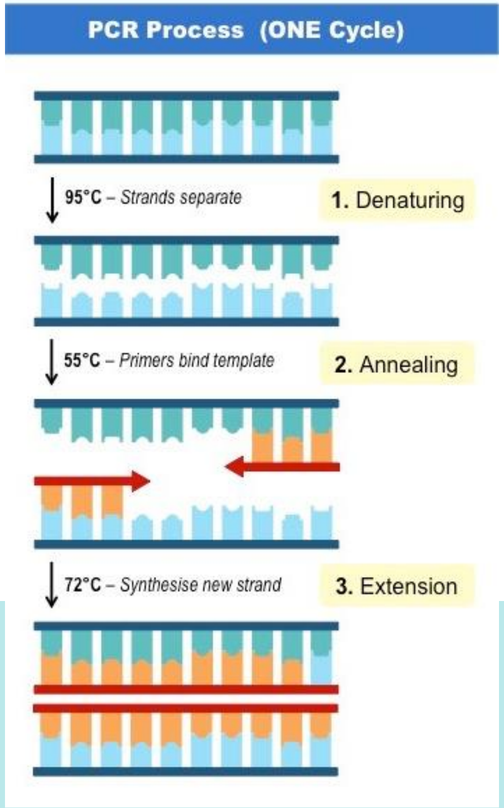


Polymerase Chain Reaction (PCR)

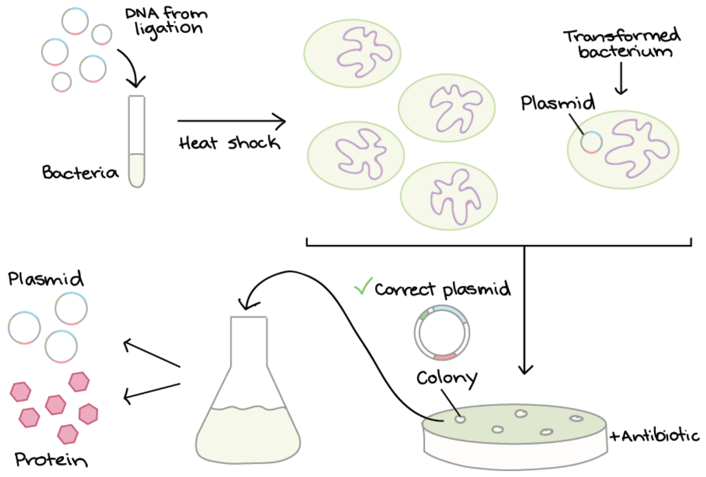
Makes multiple copies of DNA fragments

<u>Steps</u>

1. Heating
2. Cooling
3. Annealing



6.8 BioTechnology

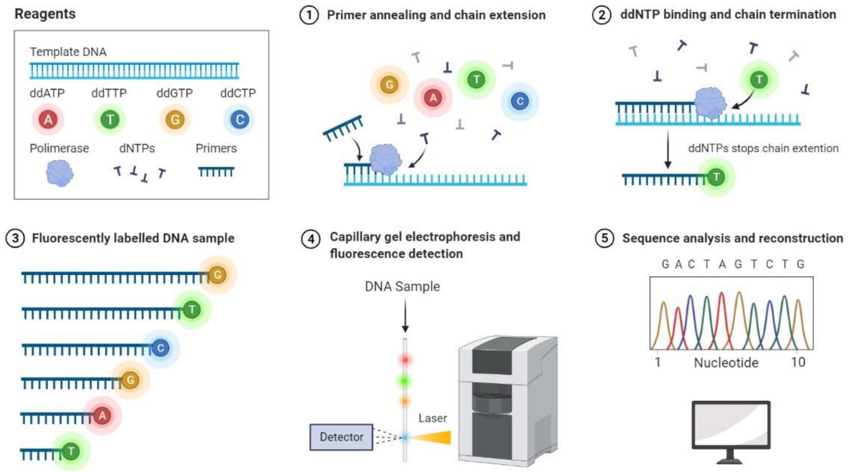


Bacterial Transformation

Introduce genetic material (plasmid) to bacteria

DNA Sequencing

Use radioactive nucleotides to determine the sequence of a DNA strand



8.1 Responses to Environment

Communication

Signaling allows for changes in behaviors of organisms to allow for differential reproductive success

Types of Communication:

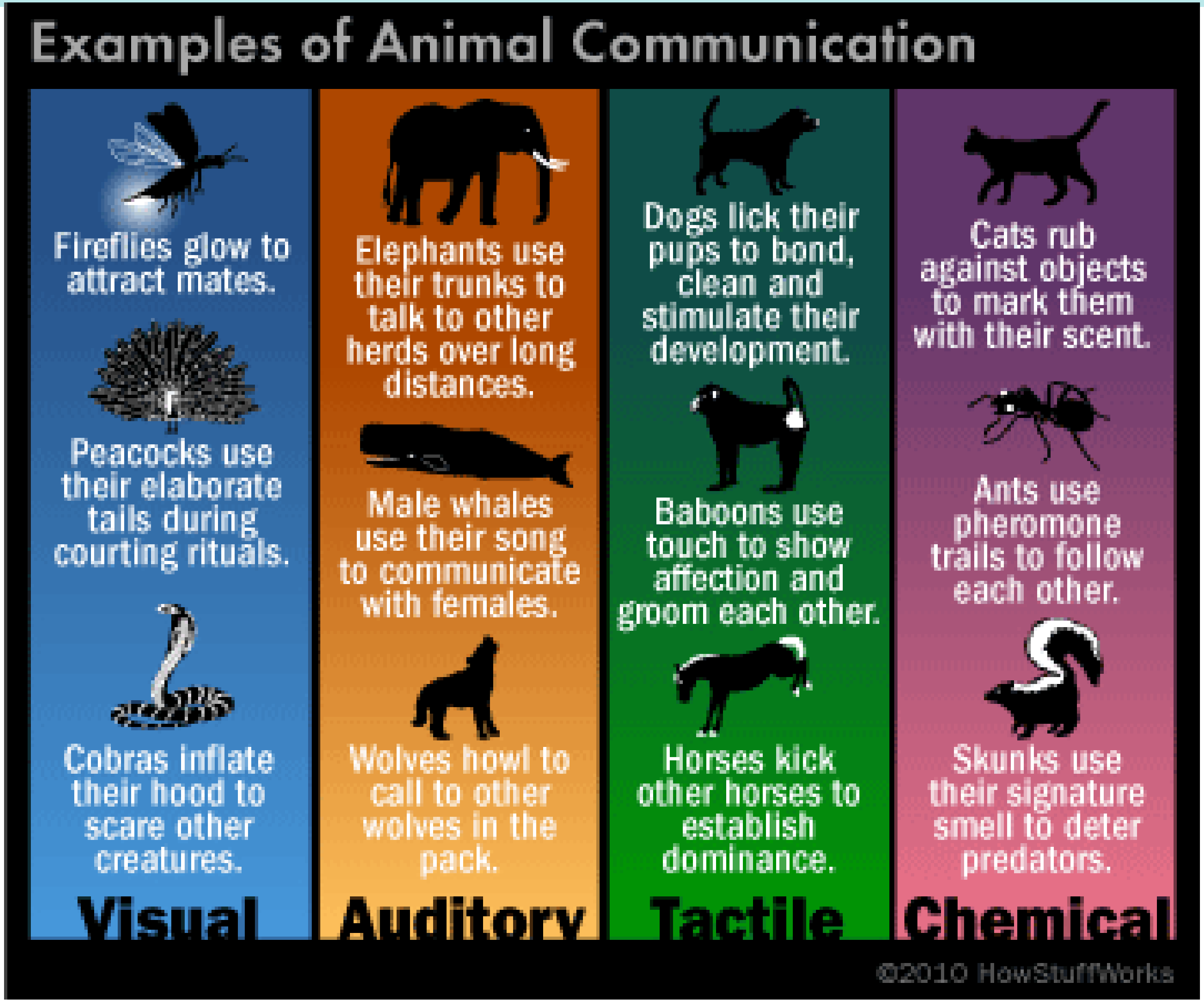
- Visual
- Auditory
- Electrical
- Chemical

Function:

- Indicate Dominance
- Foraging (Finding Food)
- Establish Territory
- Ensure Reproductive Success

Altruistic Behaviors

Reduces individual fitness but increases inclusive fitness.



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Signaling allows for changes in behaviors of organisms to allow for differential reproductive success

<u>Types of Communication:</u>

- Visual
- Auditory
- Electrical
- Chemical

<u>Function:</u>

- Indicate Dominance
- Foraging (Finding Food)
- Establish Territory
- Ensure Reproductive Success

Altruistic Behaviors

Reduces individual fitness but increases inclusive fitness.

Intersexual Selection

Reproductive behaviors to attract a mate
Individuals of one sex choose members of the opposite sex

<u>Examples</u>

- Blue Footed Booby – mating dance (visual)
- Frogs – croaking (auditory)
- Pheromones – (chemical)

Intrasexual Selection

Reproductive behaviors to indicate dominance and compete for access to mates

<u>Examples</u>

- Deer: antler size
- Horned Beetles: strength and size of "horn"

LEARNING

MC Practice

Phenotype	Number of Offspring
Gray body, long wings	42
Black body, apterous wings	41
Gray body, apterous wings	9
Black body, long wings	8

A student in a biology class crossed a male Drosophila melanogaster having a gray body and long wings with a female D. melanogaster having a black body and apterous wings. The following distribution of traits was observed in the offspring. Which of the following is supported by the data?

a. The alleles for gray body and long wings are dominant.

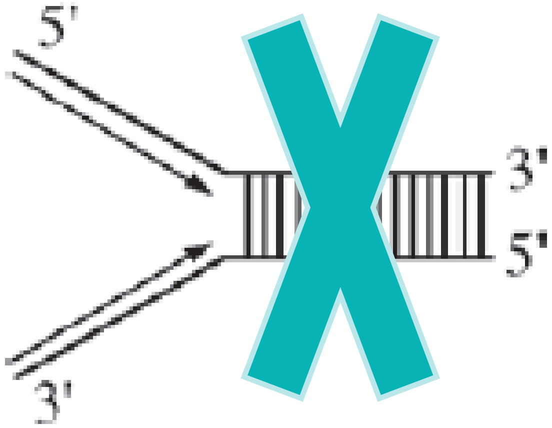
b. The alleles for gray body and long wings are recessive.

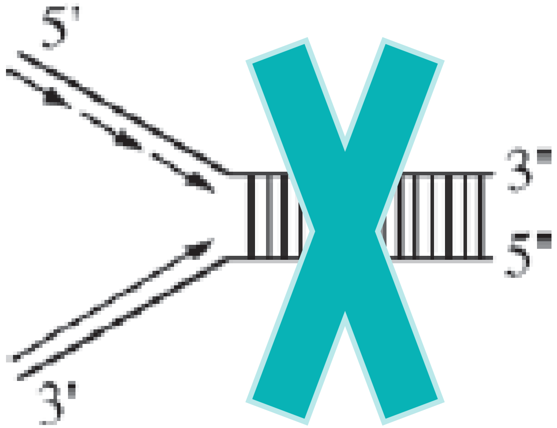
c. Genes for the two traits are located on two different chromosomes, and independent assortment occurred.

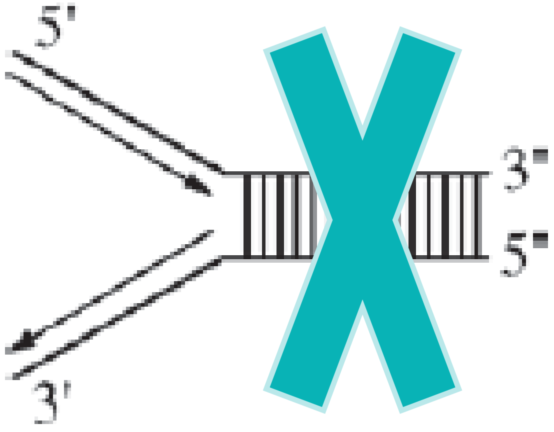
d. Genes for the two traits are located close together on the same chromosom and crossing over occurred between the two gene loci.

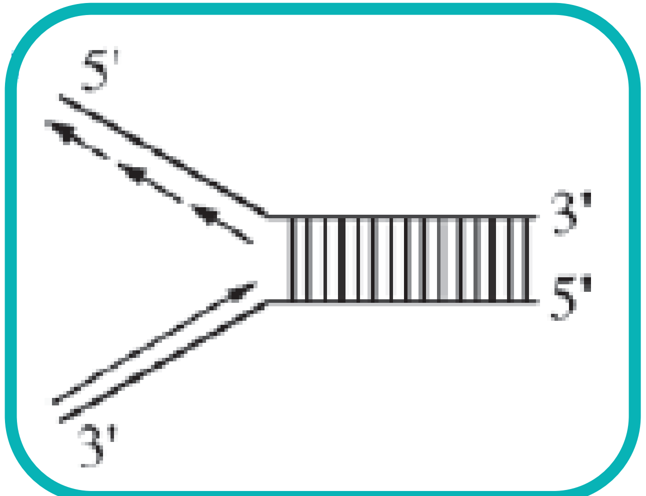
Multiple Choice Practice

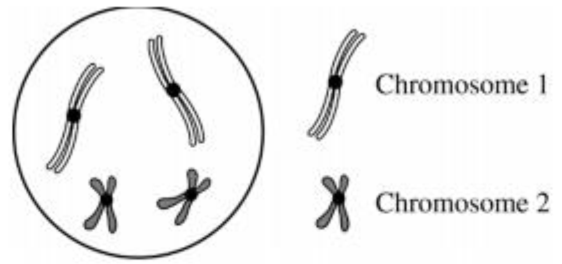
When DNA replicates, each strand of the original DNA molecule is used as a template for the synthesis of a second, complementary strand. Which of the following figures most accurately illustrates enzyme-mediated synthesis of new DNA at a replication fork?









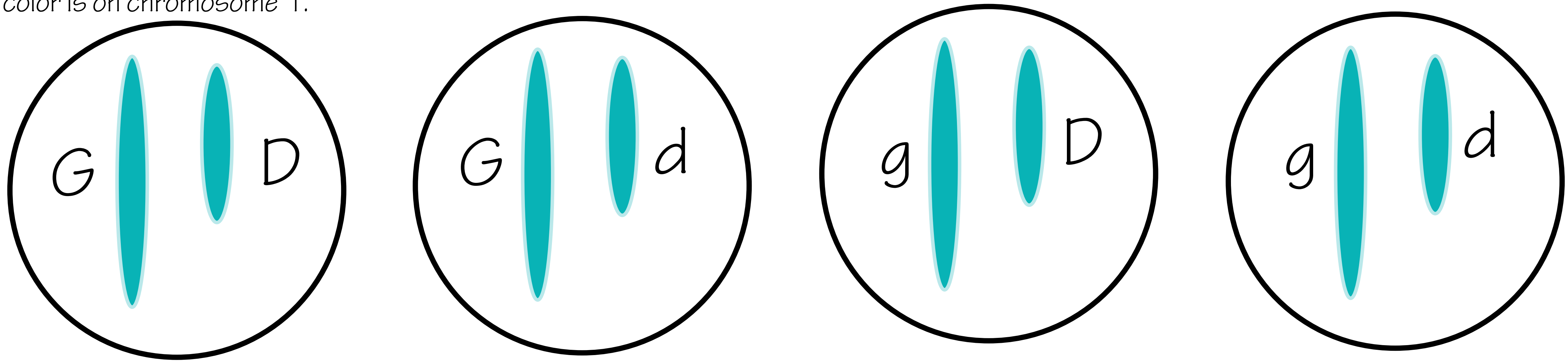


Free Response Practice:

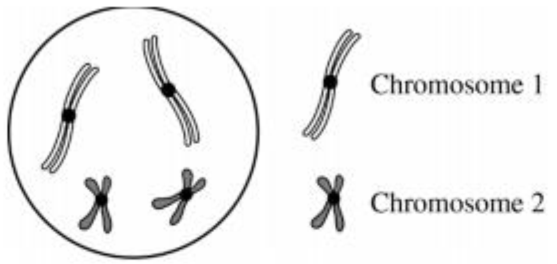
In a certain species of plant, the diploid number of chromosomes is 4 (2n = 4). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes GGDD and ggdd were crossed to produce F1 progeny.

F1 = GgDd

(a) Construct a diagram below to depict the four possible normal products of meiosis that would be produced by the F1 progeny. Show the chromosomes and the allele(s) they carry. Assume the genes are located on different chromosomes and the gene for flow color is on chromosome 1.



MARCO LEARNING



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Test Cross = GgDd x ggdd

(b) **Predict** the possible phenotypes and their ratios in the offspring of a testcross between an F_1 individual and a ggdd individual.

Gg	gg
Gg	gg

½ Green
½ Purple

Dd	dd
Dd	dd

½ Dwarf
½ Tall

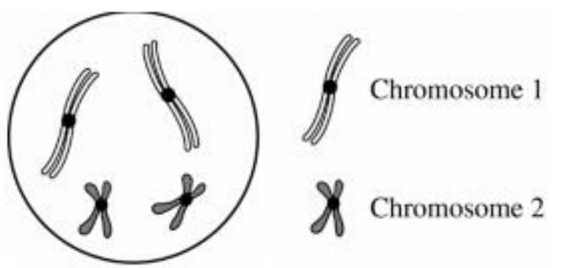
Gree
Gre

Prediction (1 point)

- 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall

¼

FRQ Practice (2016 #7)



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F1 = GgDd

(b) **Predict** the possible phenotypes and their ratios in the offspring of a testcross between an F_1 individual and a ggdd individual.

Prediction (1 point)

- 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall

(c) If the two genes were genetically linked, ***describe*** how the proportions of phenotypes of the resulting offspring would most likely differ from those of the testcross between an F_1 individual and a ggdd individual.

Identify difference (1 point)

- The majority/greater than 50 percent would have the parental plant phenotypes
- Greater than 25 percent would be green dwarf plants and greater than 25 percent would be purple tall plants
- Less than 25 percent would be green tall plants and less than 25 percent would be purple dwarf plants

Free Response Practice:

In humans, the gene that determines a particular condition has only two alleles, one of which (B) is completely dominant to the other (b). The phenotypes of three generations of a family with respect to the condition are shown in the pedigree in Figure 1. Individuals are numbered.

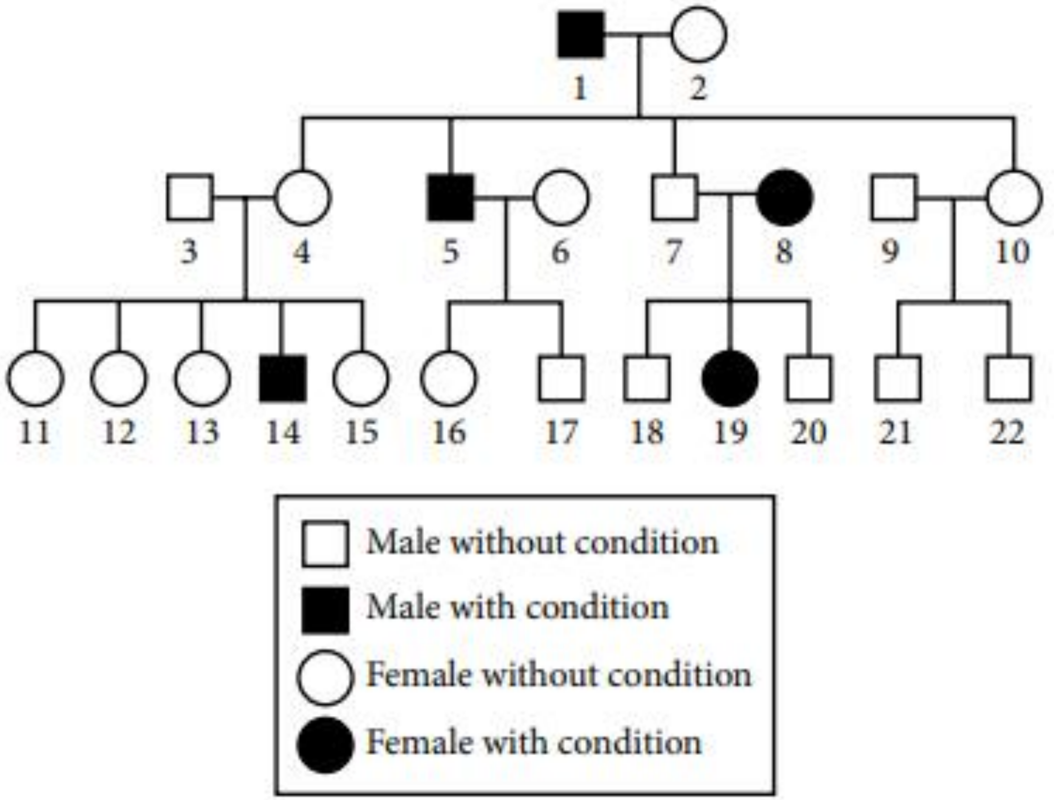


Figure 1. Inheritance of a particular condition over three generations of a family

Free Response Practice:

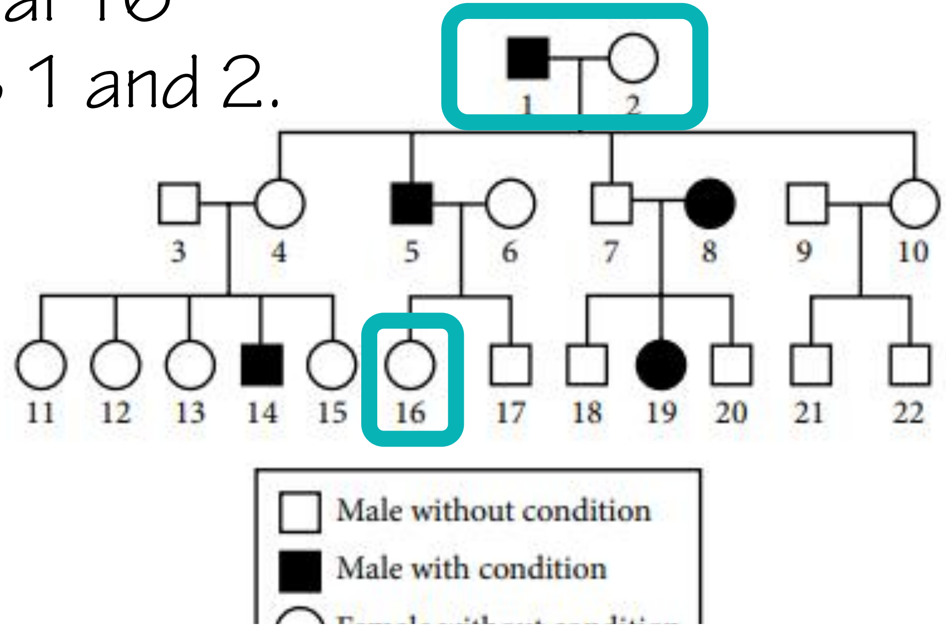
(a) **Describe** the process in eukaryotes that ensures that the number of chromosomes will not double from parent to offspring when gametes fuse during fertilization.

Describe the process in eukaryotes that ensures that the number of chromosomes will not double from parent to offspring when gametes fuse during fertilization.

- Homologous pairs of chromosomes separate in meiosis I, so the gametes are haploid (n), and each gamete receives only one member of each chromosome pair.

Free Response Practice:

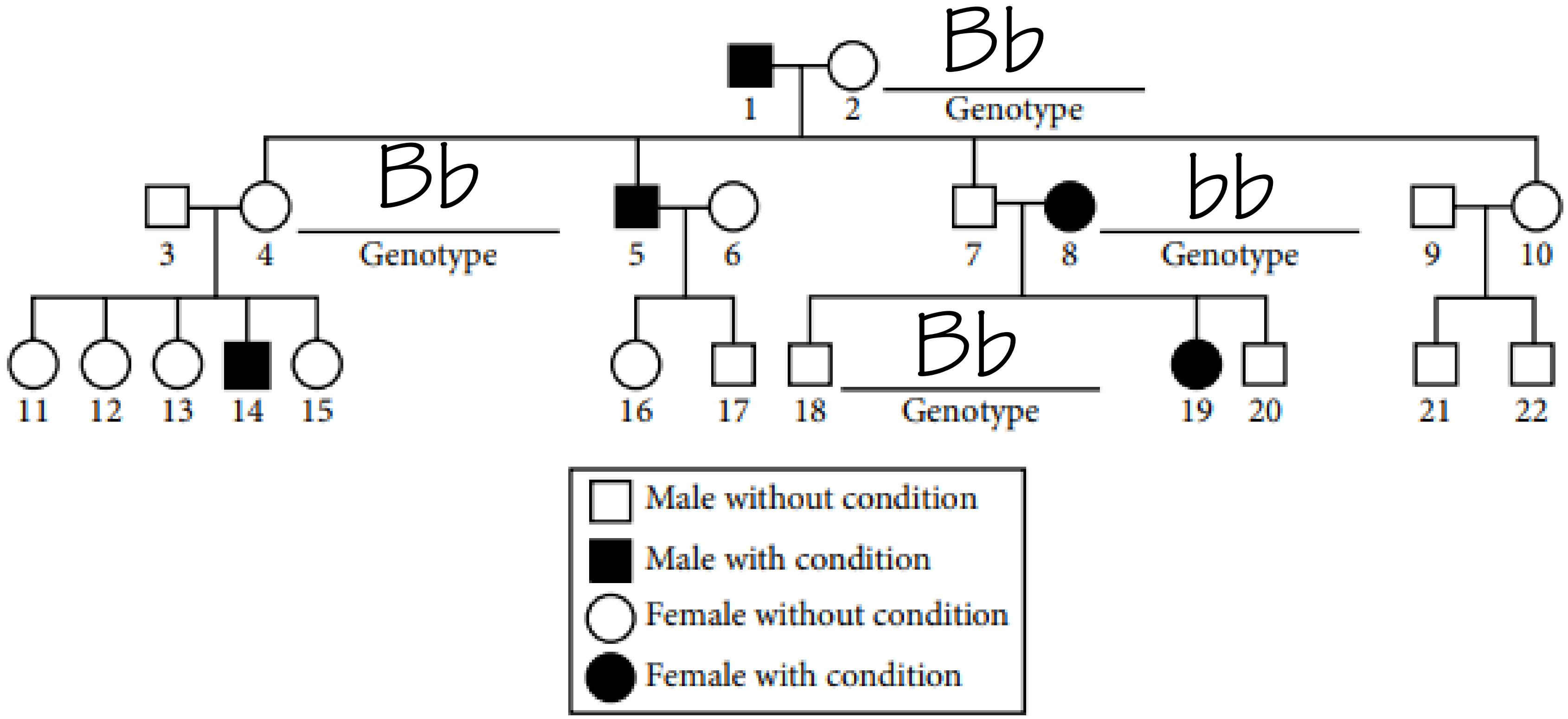
(b) **Explain** how any one chromosome in individual 16 contains DNA that came from **both** individuals 1 and 2.



Individual 5 inherited one member of each homologous pair of chromosomes from individuals 1 and 2. During gamete formation in individual 5, crossing over occurred between nonsister chromatids in each homologous pair. Thus each chromosome formed and passed on to individual 16 contains DNA from both 1 and 2.

Free Response Practice:

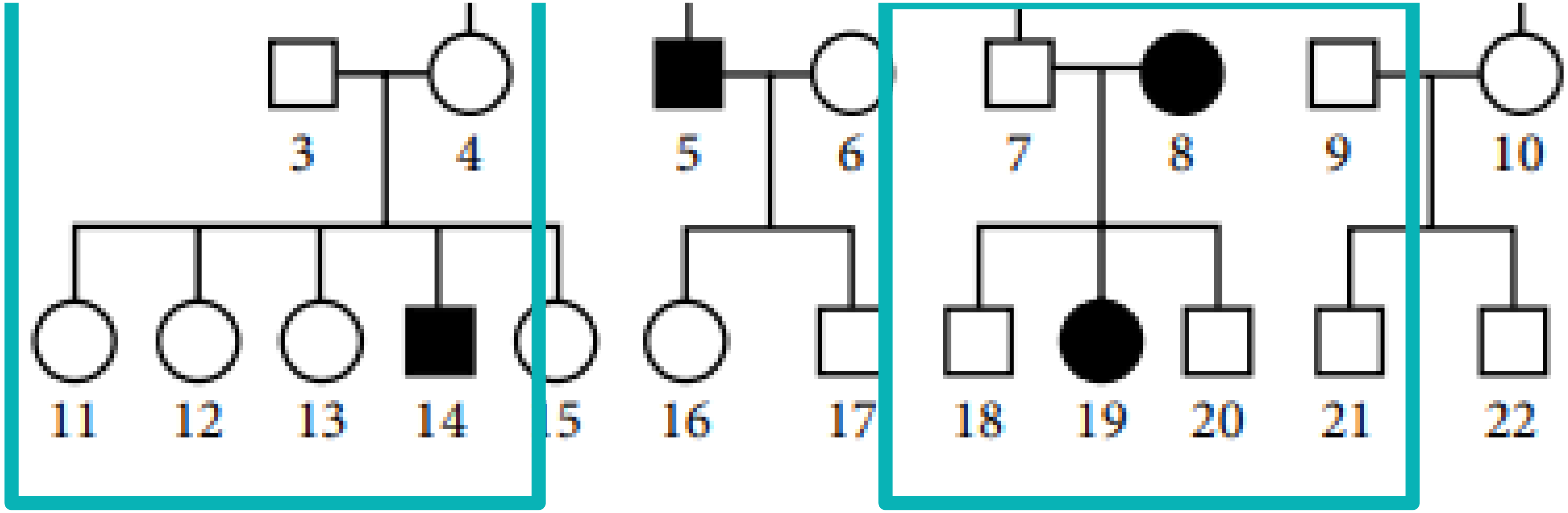
(c) **Use the template** figure of the pedigree and the allele designations B and b to **indicate** the genotypes of individuals 2, 4, 8, and 18.



Free Response Practice

(d) Based on the pedigree, explain whether the inheritance pattern of the condition is sex-linked or autosomal and dominant or recessive.

The disease phenotype is recessive and is autosomal/not sex-linked. It cannot be dominant because individuals 3 and 4 do not have it, but their offspring 14 does. It is not sex-linked because if it was Y-linked, all male offspring of males with the disease phenotype would have the trait, and they do not.



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