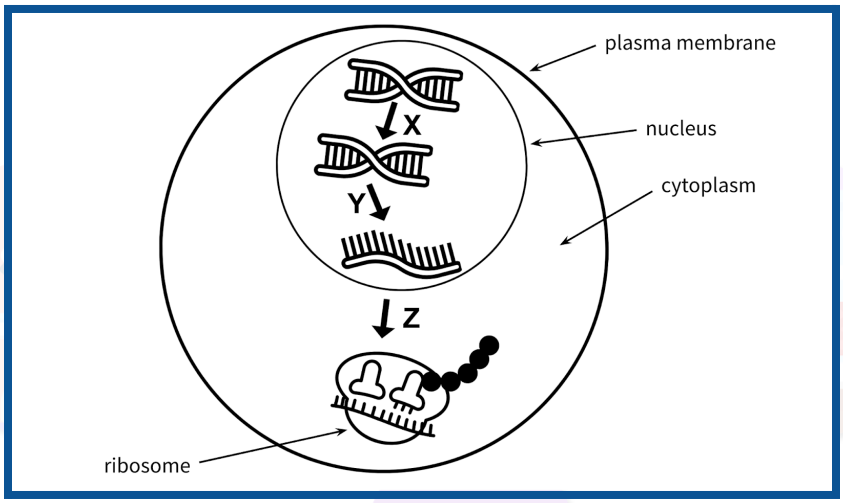
Summative #3

SB2, SB3. Genetics Unit

NAME: **DATE:** **BLOCK:**

1. (SB2a) Examine the provided cell diagram and use it to answer the following questions.



Which table correctly identifies the genetic processes labeled X, Y, and Z?

A.

Letter	Process
X	transcription
Y	translation
Z	replication

B.

Letter	Process
X	translation
Y	transcription
Z	replication

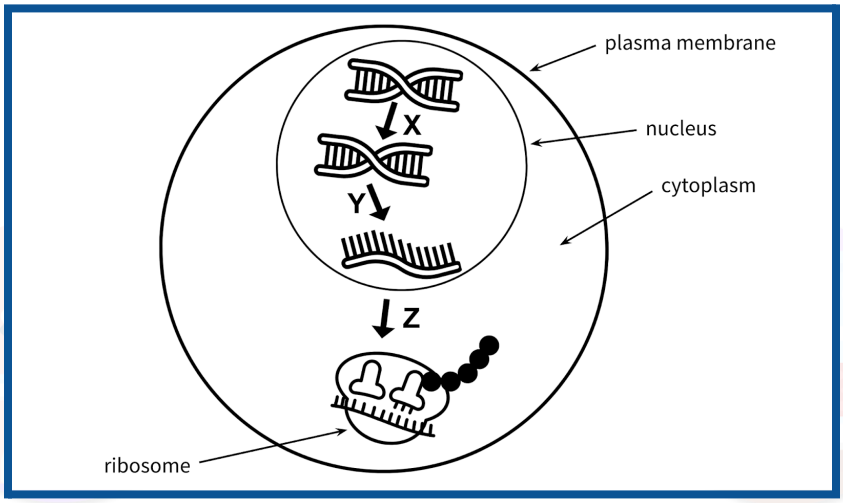
C.

Letter	Process
X	transcription
Y	replication
Z	translation

D.

Letter	Process
X	replication
Y	transcription
Z	translation

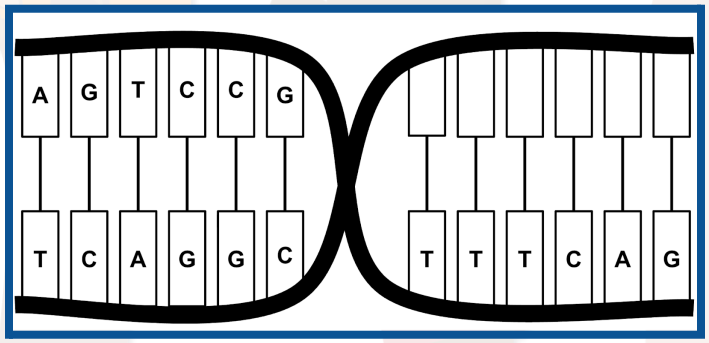
2. (SB2a) Examine the provided cell diagram and use it to answer the following questions.



In the diagram, processes X and Y both occur in the nucleus but have different roles. What is the main difference between process X and process Y?

A. Process X produces RNA, while process Y produces protein.
B. Process X produces DNA, while process Y produces RNA.
C. Process X produces RNA, while process Y produces DNA.
D. Process X produces protein, while process Y produces RNA.

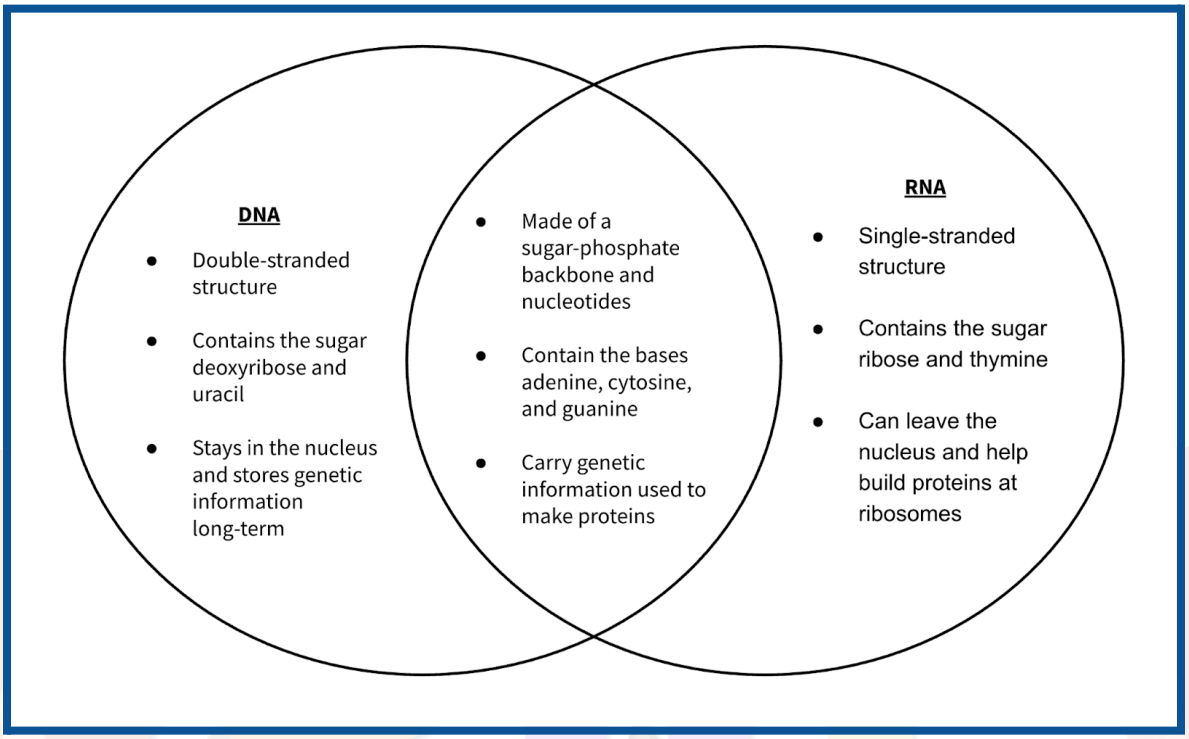
3. (SB2a) The DNA molecule shown is missing several base pairs on its complementary strand.



Which sequence correctly completes the complementary strand according to complementary base-pairing rules?

A. AAAGUC
B. TTTCAG
C. AAAGTC
D. UUUCAG

4. (SB2a) Kelci created the Venn diagram to compare DNA and RNA. After reviewing it, her teacher told her that one statement is incorrect.



Which statement in the Venn diagram is incorrect and needs to be fixed?

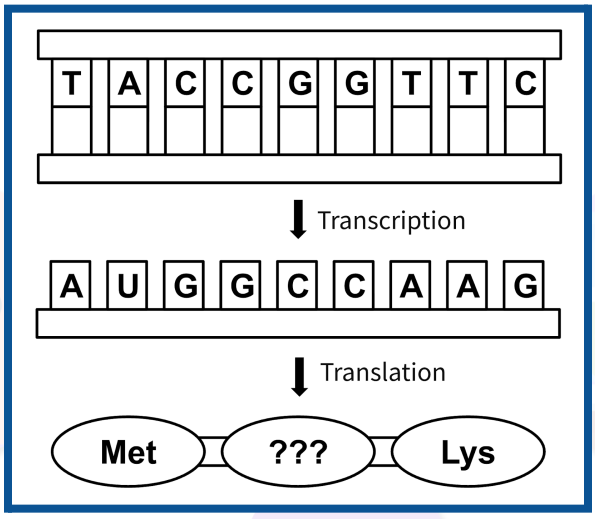
A. DNA is double-stranded, while RNA is single-stranded.
B. DNA stays in the nucleus and stores genetic information long-term.
C. RNA contains the sugar ribose and the base thymine.
D. Both DNA and RNA contain adenine, cytosine, and guanine.

5. (SB2a) By the early 1950s, scientists knew that DNA carried genetic information, but its structure was unknown. James Watson and Francis Crick developed a model of DNA using chemical evidence and data from other researchers, including X-ray diffraction images produced by Rosalind Franklin, which suggested that DNA had a helical shape. By combining this evidence with knowledge of base pairing, Watson and Crick proposed the double-helix model, which explained how DNA could store genetic information and replicate accurately.

Why was Franklin's X-ray diffraction evidence important to the discovery of DNA's structure?

A. It provided evidence that DNA has a helical shape.
B. It revealed the exact order of DNA bases.
C. It explained how DNA mutations occur during replication.
D. It proved that DNA is found only in the nucleus.

6. (SB2a) A scientist is studying how genetic information is used to build proteins. The diagram shows a DNA sequence being transcribed into mRNA and then translated into amino acids.

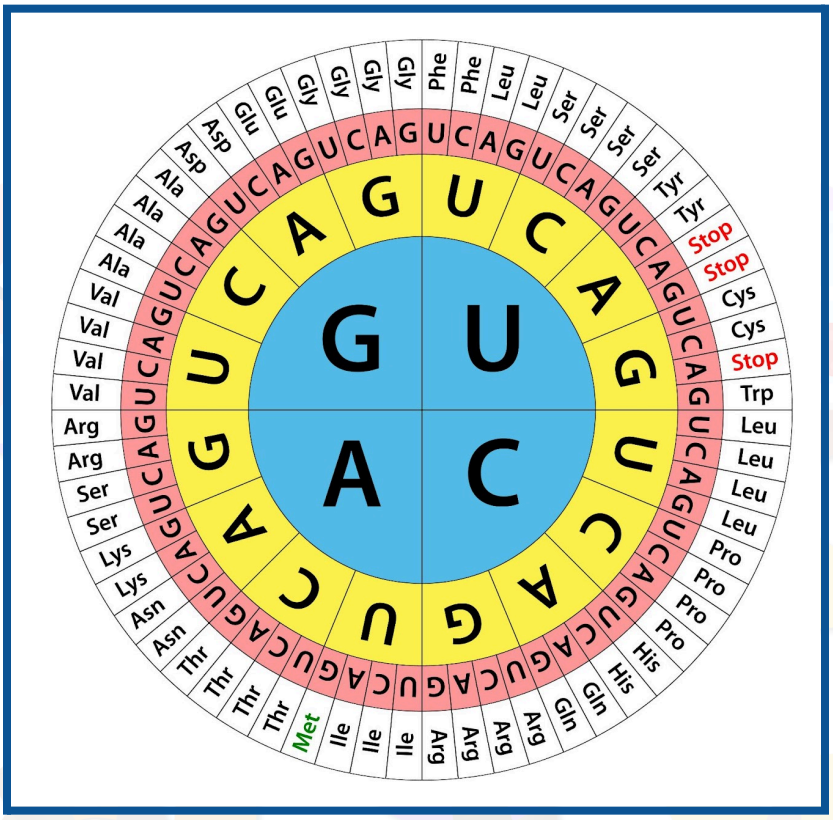


Which amino acid correctly completes the protein sequence? Use the codon chart below.

First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
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

A. Lysine
B. Leucine
C. Valine
D. Alanine

7. (SB2a) The genetic code determines how mRNA codons are translated into amino acids during protein synthesis.



Use the codon chart above to identify which codons produce the amino acid serine. Select all that apply.

A. UCU
B. AGU
C. UCC
D. UAU
E. AGC
F. UGG

8. (SB2a) Trabian is observing a cell in which a ribosome in the cytoplasm is reading an mRNA strand while tRNA molecules deliver amino acids to form a protein chain. Which process is occurring in the cell?

A. Replication is occurring.
B. Transcription is occurring.
C. Translation is occurring.
D. Mutations are occurring.

9. (SB2a) During protein synthesis, a strand of mRNA is formed using a DNA template inside the nucleus. Which statement best explains what is happening during this process?

A. DNA is copied to produce two identical DNA molecules.
B. DNA directs the formation of mRNA through complementary base pairing.
C. mRNA directs the assembly of amino acids at the ribosome.
D. tRNA copies DNA to produce a protein sequence.

10. (SB2a) Three students, Khloe, Navina, and Delvin, are determining the correct amino acid sequence produced from the DNA template strand TAC AGA CCT AAA.

- Khloe predicts the amino acid sequence will be Met – Ser – Gly – Phe.
- Navina predicts the amino acid sequence will be Met – Leu – Gly – Phe.
- Delvin predicts the amino acid sequence will be Met – Ser – Ala – Phe.

Using the codon chart provided, which student correctly identified the amino acid sequence?

First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
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

A. Khloe
B. Navina
C. Delvin
D. None of the students are correct

11. (SB2b) Israel examines a section of a gene shown below.

- Original DNA Template Strand: TAC GAA CTT AGC

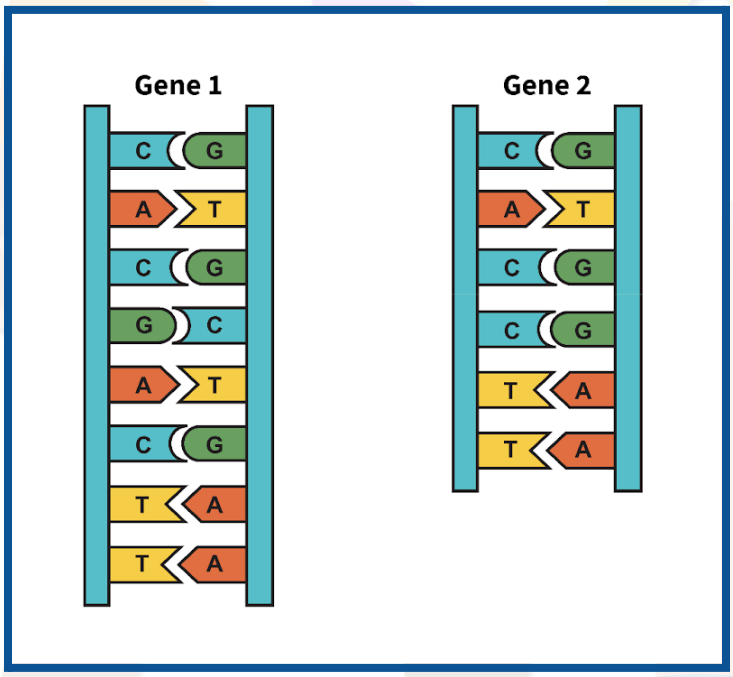
After DNA replication, a mutation occurs and the DNA template strand changes to:

- Mutated DNA Template Strand: TAC GTA CTT AGC

What best explains the effect of the mutation Israel observed?

A. The mutation changes one amino acid in the protein because a different mRNA codon is produced.
B. The mutation causes a frameshift, changing every amino acid after the mutation.
C. The mutation prevents transcription from occurring.
D. The mutation produces the same amino acid sequence because the genetic code is universal.

12. (SB2b) The diagrams below show portions of a gene that controls fur color in two rabbits of the same species. Gene 1 was taken from a rabbit with typical brown fur, and Gene 2 was taken from a rabbit with an unusual light fur color.



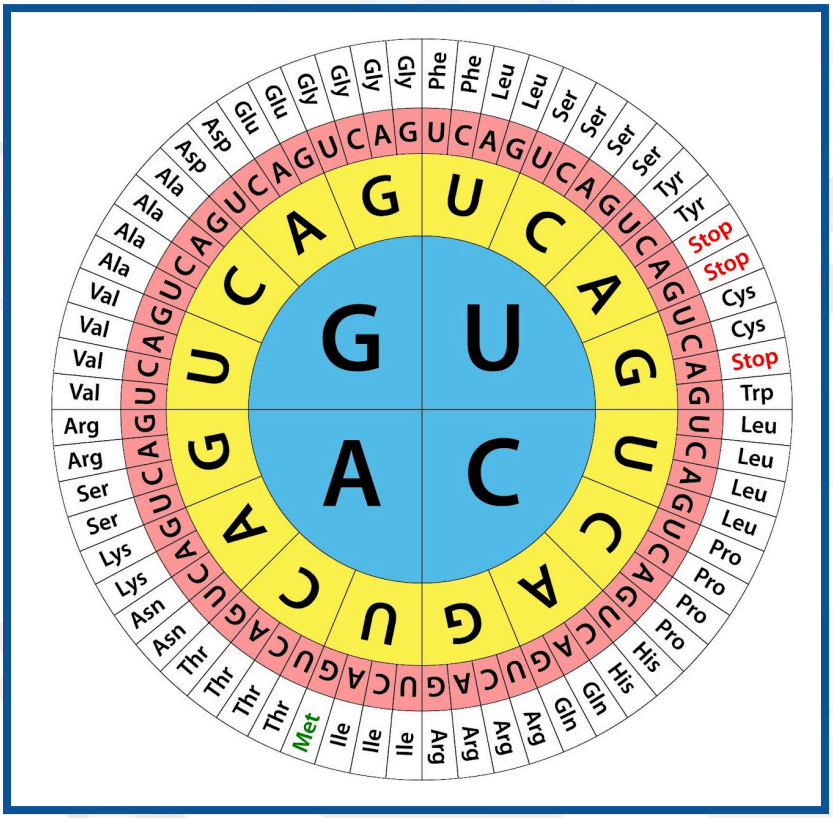
The difference in fur color is most likely the result of

A. an frameshift insertion
B. a point substitution
C. a frameshift deletion
D. normal DNA replication

13. (SB2b) The following DNA template strand is transcribed and translated to produce a protein:

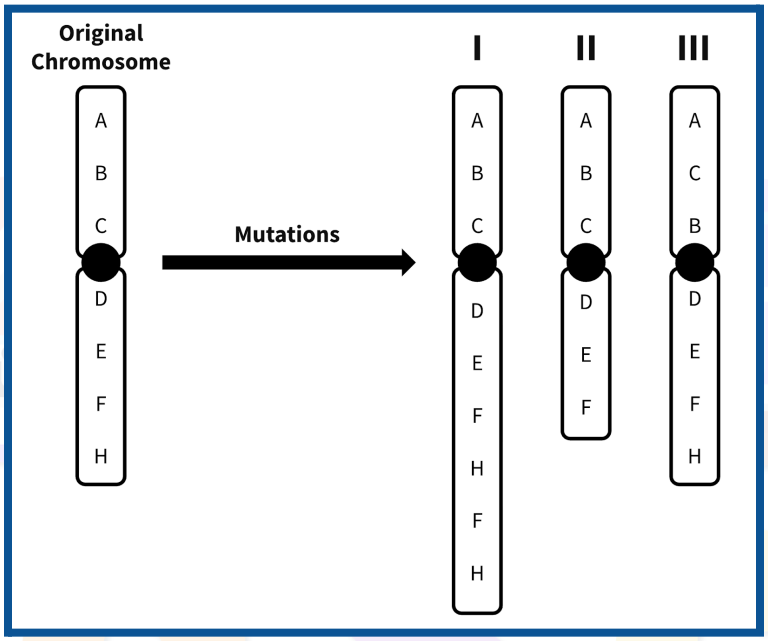
TAC TTT AAA

Using the codon chart below, determine which TWO point substitutions in the DNA template strand would result in a silent mutation.



A. TAC TAT AAA
B. TAC TTT ATA
C. TAC TTT AAG
D. TAC TTT AAC
E. TAC TTC AAA
F. TAC TTT AAT

14. (SB2b) The diagram below illustrates a chromosome undergoing three distinct mutations, each leading to a unique structural rearrangement.



Which type of chromosomal mutation is represented in Mutation II?

A. translocation
B. duplication
C. deletion
D. inversion

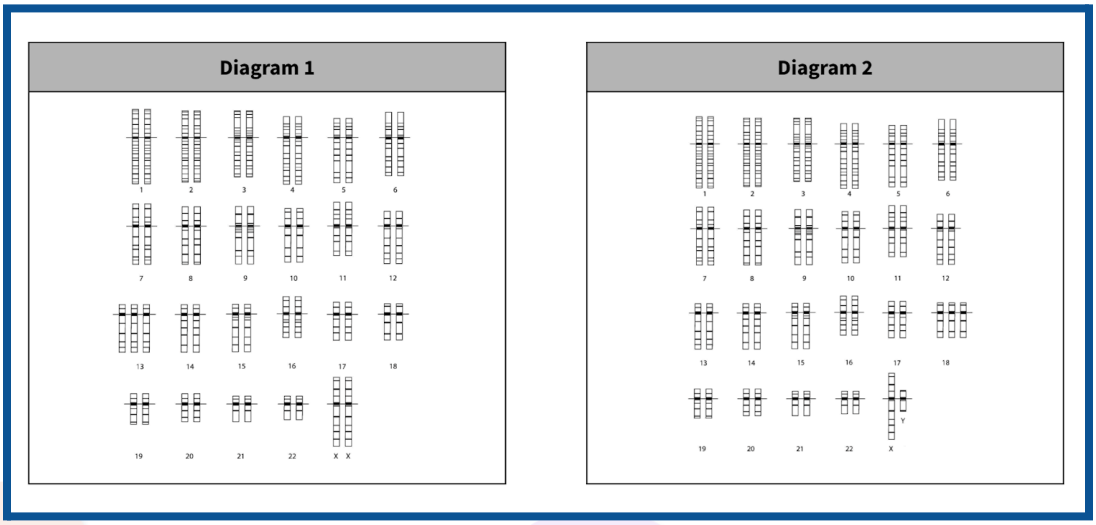
15. (SB2b) A research team is studying frogs living near an industrial area. Scientists discovered that chemicals released into the nearby water supply can damage DNA in developing frog embryos. These chemicals are known as environmental mutagens because they can change DNA sequences.

Scientists compared the DNA of frogs living in clean water with frogs living near the industrial site. Frogs exposed to the chemicals showed several changes in their DNA sequences, which sometimes led to physical differences such as abnormal limb development or changes in skin color.

Which statement best explains how environmental mutagens can cause these physical changes in frogs?

A. Mutagens change DNA sequences, which can alter proteins that control traits.
B. Mutagens prevent cells from undergoing cellular respiration.
C. Mutagens cause organisms to intentionally adapt to their environment.
D. Mutagens only affect adult organisms and cannot affect developing embryos.

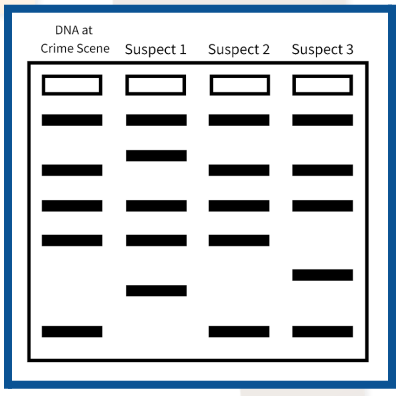
16. (SB2c) The diagrams show the karyotypes of two different individuals.



How can Diagram 1 be identified?

A. Male with Trisomy 18
B. Female with Trisomy 18
C. Male with Trisomy 13
D. Female with Trisomy 13

17. (SB2c) Investigators collected DNA evidence from a crime scene and compared it to DNA samples from three suspects using gel electrophoresis. The results are shown in the diagram.



Based on the banding patterns shown, which suspect is most likely linked to the crime scene?

A. Suspect 1
B. Suspect 2
C. Suspect 3
D. None of the suspects

18. (SB3a) Who was Gregor Mendel?

A. A scientist who discovered the structure of DNA
B. A monk who studied inheritance patterns in pea plants
C. A chemist who developed the first microscope
D. A physician who created the first vaccine

19. (SB3a) According to Mendel's Law of Independent Assortment, which gametes can be produced by an organism with the genotype CcDd? Select all that apply.

A. CD
B. Cc
C. Cd
D. cD
E. cd
F. DD

20. (SB3a) An organism has two different alleles for the same trait, one dominant and one recessive. The organism shows only the dominant trait. Which statement best explains why the recessive trait is not observed?

A. The dominant allele prevents the recessive allele from being expressed.
B. The recessive allele is removed from the organism's DNA.
C. The dominant allele changes into the recessive allele.
D. The recessive allele is only expressed during reproduction.

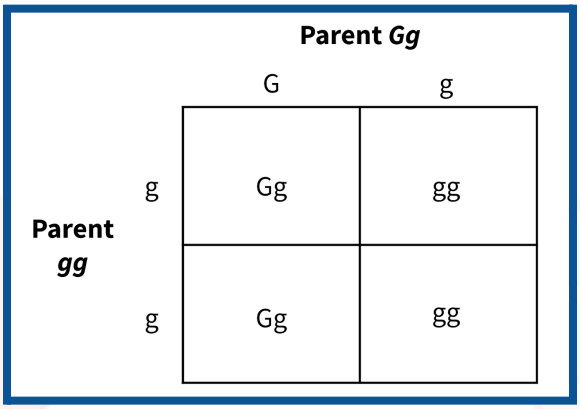
21. (SB3b) The Punnett square above shows that all four offspring have the genotype Pp.

Pp	Pp
Pp	Pp

Based on this information, what are the most likely genotypes of the two parent organisms?

A. PP × pp
B. Pp × Pp
C. PP × Pp
D. pp × pp

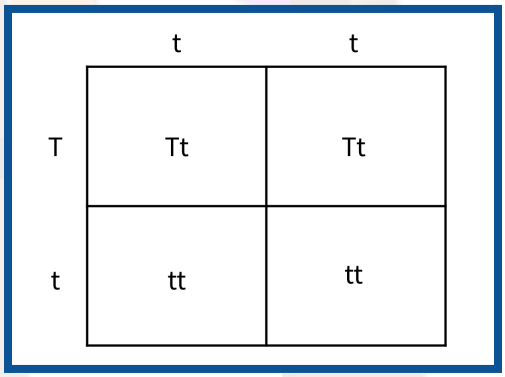
22. (SB3b) In a certain species of bioluminescent jellyfish, glowing tentacles (G) are dominant to non-glowing tentacles (g).



According to the Punnett square, what is the probability that an offspring will have glowing tentacles?

A. 100%
B. 25%
C. 75%
D. 50%

23. (SB3b) In pea plants, tall (T) is dominant over short (t). A heterozygous tall plant is crossed with a short plant. The Punnett square below shows the possible offspring:



Select THREE statements that are true about the Punnett square.

A. 50% of the offspring will be tall.
B. 50% of the offspring will be short.
C. All offspring will have the homozygous recessive genotype.
D. Half of the offspring will have the homozygous recessive genotype.
E. All offspring will show the dominant trait.
F. The cross results in a 3:1 genotype ratio.

24. (SB3b) The table lists the eye color and genotype of six individuals where brown eyes are dominant over blue eyes. Use the table to answer the question that follows.

Name	Eye Color	Alleles
Aliyah	brown	homozygous
Mateo	blue	homozygous
Priya	brown	heterozygous
Diego	brown	heterozygous
Nia	blue	homozygous
Nathan	brown	heterozygous

If Aaliyah and Mateo had four children together, what eye color would the children most likely have?

A. All 4 of the children would have blue eyes.
B. Only 3 of the children would have brown eyes, and 1 child would have blue eyes.
C. Only 2 of the children would have brown eyes, and 2 of the children would have blue eyes.
D. All 4 of the children would have brown eyes.

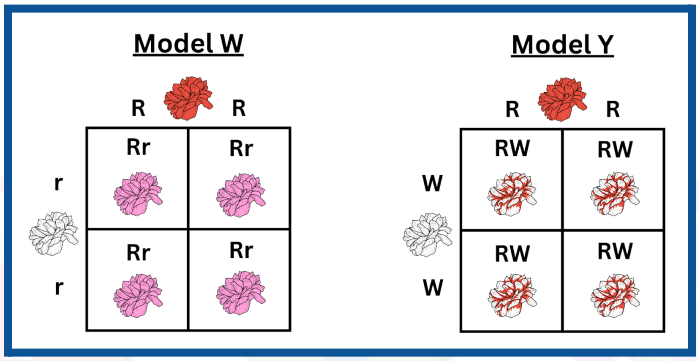
25. (SB3b) In pea plants, purple flowers (P) are dominant over white flowers (p), and tall stems (T) are dominant over short stems (t). Two plants that are heterozygous for both traits are crossed. The Punnett square below is partially completed.

	PT	**Pt**	**pT**	**pt**
PT	PPTT	PPTt	PpTT	PpTt
Pt	PPTt	PPtt	PpTt	Pptt
pT	PpTT	PpTt	ppTT	ppTt
pt	PpTt	Pptt	ppTt	?

What is the genotype and phenotype of the missing offspring?

A. PpTt — purple flowers and tall stems
B. pptt — white flowers and short stems
C. ppTt — white flowers and tall stems
D. Pptt — purple flowers and short stems

26. (SB3b) The diagrams illustrate two different genetic models for flower color inheritance resulting from plant crosses.



Which model, W or Y, shows an incomplete dominance pattern of inheritance?

A. Model W, because the heterozygous offspring display a blended phenotype that is different from both parents.
B. Model W, because one allele completely masks the other in the heterozygous offspring.
C. Model Y, because the heterozygous offspring show the same phenotype as one of the parent plants.
D. Model Y, because both alleles are expressed equally and separately in the heterozygous offspring.

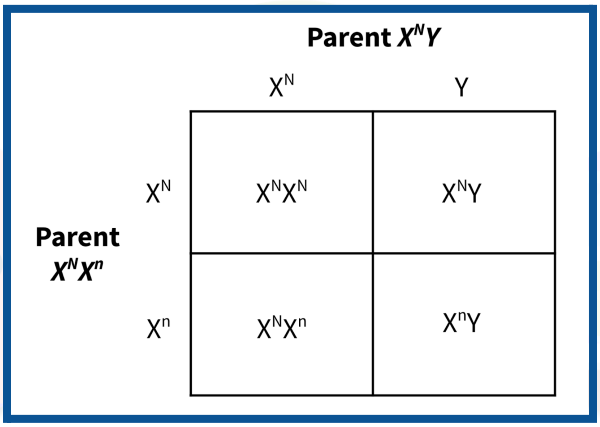
27. (SB3b) The chart shows how human blood type is inherited.

Blood Type Inheritance: A, B, AB, or O	
Genotype	**Phenotype**
AA	A
AB	AB
AO	A
AB	AB
BB	B
BO	B
OO	O

A mother is homozygous for type A blood and a father is heterozygous for type B blood. Based on the possible combinations of alleles, which blood types could their children have?

A. Type A only
B. Type B only
C. Type A or Type AB
D. Type A, Type B, Type AB, or Type O

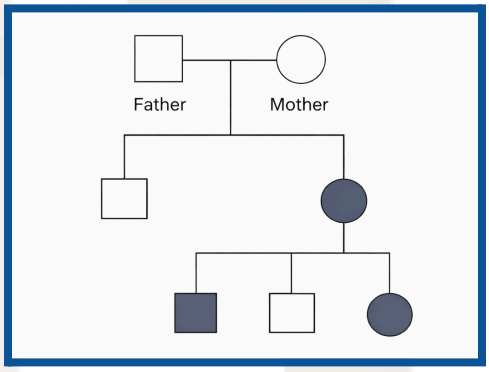
28. (SB3b) A trait for red-green color blindness is sex-linked and carried on the X chromosome. The allele for normal vision (X^N) is dominant, and the allele for color blindness (X^n) is recessive. A mother who is a carrier for color blindness and a father with normal vision have children.



Based on the Punnett square, what conclusion can be made about the likelihood of color blindness in the children?

A. All daughters will have color blindness.
B. Half of the sons are expected to have color blindness.
C. Half of all children will have color blindness.
D. Only daughters can inherit color blindness.

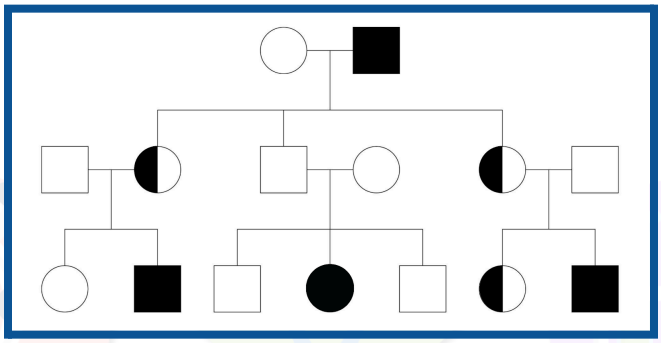
29. (SB3b) The pedigree diagram shows a trait appearing in both males and females. Two unaffected parents have an affected child. The trait skips one generation and then reappears.



Which conclusion is best supported by the pedigree?

A. The trait is autosomal dominant because it appears in both males and females.
B. The trait is autosomal recessive because unaffected parents can have affected offspring.
C. The trait is sex-linked dominant because it skips generations.
D. The trait is mitochondrial because it reappears in later generations.

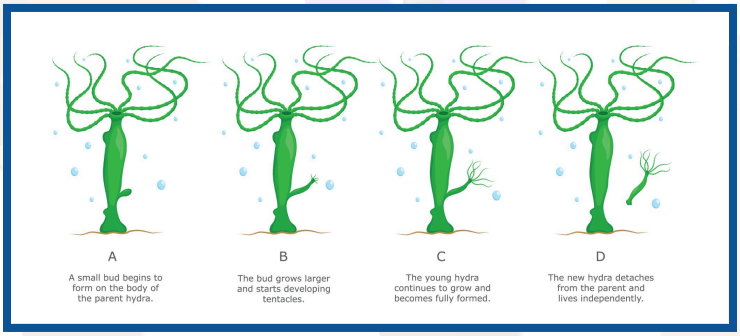
30. (SB3b) Zion is studying pedigrees in biology and created a pedigree diagram to track the inheritance of a specific genetic trait in his family.



Based on the information shown in the pedigree, what is the most likely genotype of individual III-4?

A. AA
B. Aa
C. aa
D. A_

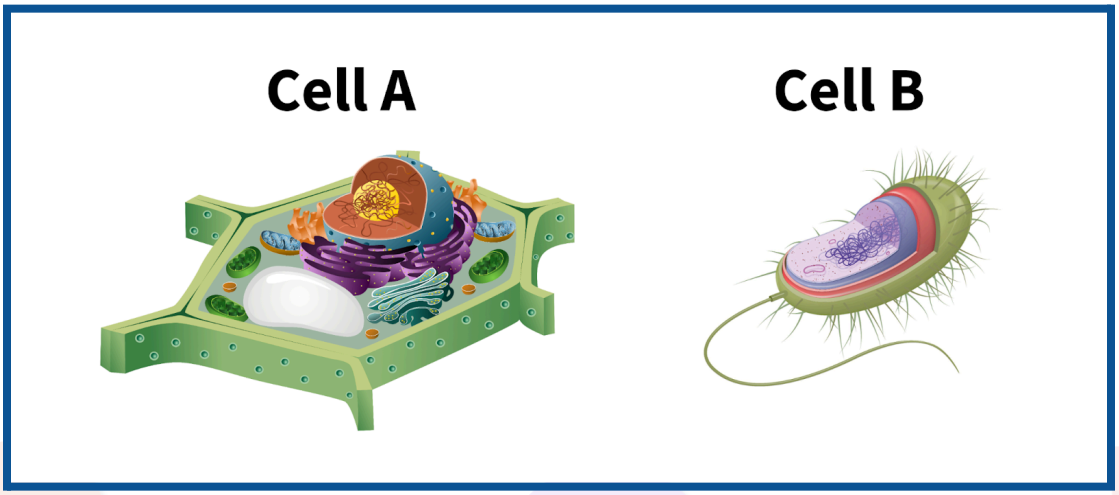
31. (SB3c) The diagram shows the stages of hydra budding, beginning with a small bud forming on the parent, growing tentacles, and eventually detaching to live independently.



Based on the process shown in the diagram, which conclusion about the type of reproduction occurring in hydra is most accurate?

A. The process is sexual reproduction because two parent organisms are required to produce a new hydra.
B. The process is asexual reproduction because the new hydra develops from one parent and is genetically identical to it.
C. The process is sexual reproduction because the new hydra forms specialized reproductive cells before detaching.
D. The process is asexual reproduction because the offspring contains a combination of genetic material from two parents.

32. (SB1a) Two different types of cells are shown above, each with unique structures that help them function and survive.



Select all the characteristics that Cell A and Cell B both have in common.

A. Presence of a cell membrane
B. Presence of ribosomes
C. DNA that stores genetic information
D. Presence of cytoplasm
E. Complex and advanced structure
F. Presence of membrane-bound organelles

33. (SB1b) A scientist observes two different types of cell division.

- In Process 1, the cell divides once and produces two identical daughter cells.
- In Process 2, the cell divides twice and produces four cells that are genetically different from each other.

Which statement correctly identifies each process?

A. Process 1 is meiosis because it produces identical cells; Process 2 is mitosis because it produces four cells.
B. Process 1 is meiosis because it occurs in body cells; Process 2 is mitosis because it produces gametes.
C. Process 1 is mitosis because it reduces the chromosome number by half; Process 2 is meiosis because it maintains the chromosome number.
D. Process 1 is mitosis because it produces identical cells; Process 2 is meiosis because it produces genetically different cells.

34. (SB1c) A student investigates how temperature affects the activity of an enzyme and records the following data:

Temperature (°C)	Reaction Rate
10	Very slow
37	Highest rate
60	Very low (does not recover after cooling)

Which explanation best accounts for these results?

A. The enzyme stops working at high temperatures because all substrates are permanently used up.
B. The enzyme becomes more efficient at high temperatures but runs out of energy.
C. The enzyme denatures at high temperatures, preventing the substrate from binding properly.
D. The enzyme increases activation energy at high temperatures, slowing the reaction.

35. (SB1d) A cell is placed in a solution with a higher concentration of salt outside the cell than inside the cell. After 30 minutes, the cell shrinks. Which statement best explains what happened?

A. Water moved into the cell by diffusion, causing it to swell.
B. Water moved out of the cell by osmosis, causing it to shrink.
C. Salt moved into the cell by active transport, causing it to shrink.
D. Salt moved out of the cell by diffusion, causing it to shrink.

36. (SB5a) A marine ecosystem includes sea stars that feed on mussels. When the sea star population declines significantly, the mussel population rapidly increases and outcompetes other species for space and resources.

Based on this scenario, what is the most likely impact of removing a keystone species from an ecosystem?

A. The ecosystem becomes more stable because one predator is removed.
B. Biodiversity increases because prey species reproduce more.
C. The balance of the ecosystem is disrupted, leading to decreased biodiversity.
D. Energy flow stops completely within the ecosystem.

37. (SB5b) Cierra wanted to draw a marine food web. The table shows marine organisms and what they eat.

Organisms	What They Eat
Phytoplankton	Make their own food
Small Fish	Zooplankton
Sharks	Tuna, Small Fish, Jellyfish
Jellyfish	Small Fish, Zooplankton
Tuna	Zooplankton, Jellyfish, Small Fish
Zooplankton	Phytoplankton

Select TWO food chains that are consistent with the feeding relationships shown in the table.

A. Small Fish → Zooplankton → Tuna → Shark
B. Phytoplankton → Zooplankton → Jellyfish → Shark
C. Zooplankton → Phytoplankton → Small Fish → Tuna
D. Phytoplankton → Zooplankton → Small Fish → Shark
E. Phytoplankton → Small Fish → Jellyfish → Tuna

38. (SB5c) A volcanic eruption completely covered a small island with lava. After the lava cooled, scientists observed that no soil, plants, or animals remained. Over time, lichens began to grow on the bare rock. As the lichens broke down the rock, small amounts of soil began to form. Grasses and small plants later grew in the new soil, followed by shrubs and eventually trees. Many years later, the island supported a stable forest ecosystem with a variety of animal species.

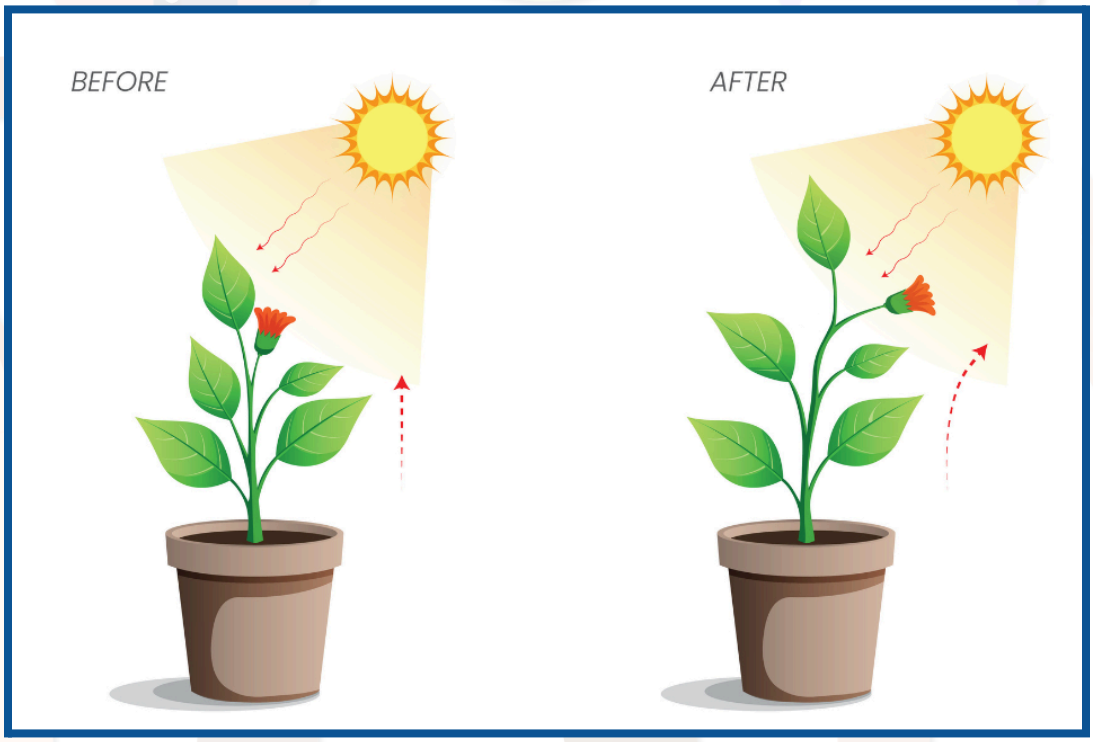
Based on the information in the scenario, which type of ecological succession occurred on the island?

A. Primary succession, because the ecosystem began on bare rock with no existing soil.
B. Secondary succession, because soil was already present when plants began to grow.
C. Primary succession, because animals returned before plants.
D. Secondary succession, because the ecosystem recovered quickly after a disturbance.

39. (SB5d) Over the past several decades, scientists have recorded a steady increase in atmospheric carbon dioxide levels due to expanded industrial activity, increased vehicle emissions, and the burning of fossil fuels. Based on this information, what is the most likely environmental result of rising atmospheric carbon dioxide levels?

A. A decrease in global temperatures due to reduced sunlight
B. An increase in global temperatures due to the greenhouse effect
C. A decrease in ocean temperatures and sea levels
D. A reduction in weather-related natural disasters

40. (SB5e) A student places a potted plant near a window. After several days, the stem of the plant bends toward the light coming through the window.



Which statement best explains this response?

A. The plant is performing photosynthesis more quickly on one side.
B. The plant is showing phototropism by growing toward a light source.
C. The plant is undergoing geotropism because gravity is pulling it sideways.
D. The plant is absorbing more water on the side facing the window.