

Unit 4 - Inheritance and Variation in Traits https://quizlet.com/_2xc3d

1. What happens in each stage of the [cell cycle](#).

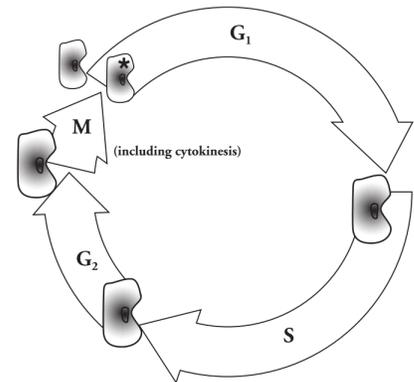
G1: Cellular growth, organelle synthesis.

S: DNA is replicated or copied

G2: Further cellular growth, DNA checks for errors

M: Mitosis: The nucleus is divided through the phases (prophase, metaphase, anaphase and telophase).

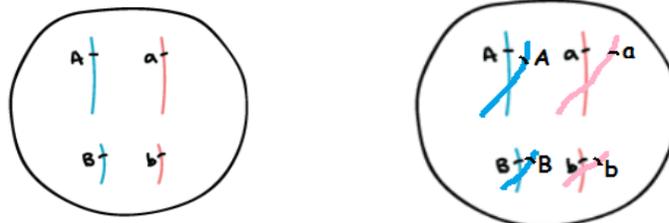
C: Cytokinesis: Cell splits into two each with its own identical nuclei.



A gene for bone growth causes Achondroplasia (a common type of dwarfism). A gene for blood cells can cause leukemia (white blood cell cancer). Use the key to answer the questions and sketch a model.

Gene Function	Genotype or Gene Symbol (version of the gene)	Phenotype or appearance
Bone growth	AA or Aa	Dwarfism (short height)
	aa	average height
White Blood Cell Reproduction	BB or Bb	Healthy white blood cell count
	bb	Leukemia

View the following chromosomes with their genotypes. Sketch what the chromosomes would look in prophase of mitosis (**after each chromosome duplicates**).



2. What would be the phenotype of the cell above? **Dwarfism, Healthy white blood cell count**

3. Write the genotype of a person with average height and leukemia. **aabb**

4. If a skin cell had a genotype of AaBb, what would the daughter cell have? **AaBb**

5. Using the data below, calculate the **mitotic index** of the tissue. SHOW WORK.

Lung Tissue Sample:

Stage	Number of cells
Interphase	462
Prophase	23
Metaphase	24
Anaphase	4
Telophase	16

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

$$23+24+4+16 = 67 \text{ cells in mitosis}$$

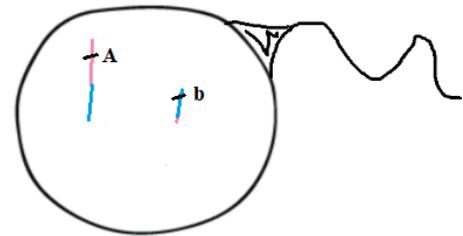
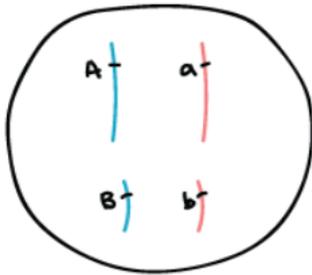
$$67+462 = 529 \text{ total cells}$$

$$(67/529) \times 100 = 12.7\% \text{ Mitotic index}$$

6. If Cell A represented a skin cell and Cell B represented a sperm cell in the same person what would the chromosomes look like in cell B?

Cell A

Cell B (other combinations possible: aB, AB, ab)

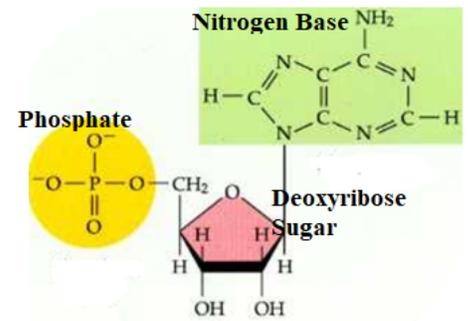


7. Which cell type would be a result of meiosis vs. mitosis? What is the difference?

Cell A would be the result of mitosis because the chromosome number is diploid (in pairs). Cell B would be the result of meiosis because the chromosomes are haploid (single chromosomes) in the production of sperm or egg cells. Another difference is that crossing-over or DNA exchange occurs in meiotic cell chromosomes.

8. What three molecules make up a nucleotide? Label the diagram to the right with the terms: Nitrogen base, phosphate and sugar.

The three molecules are deoxyribose sugar, nitrogen base (ATCG) and phosphate.



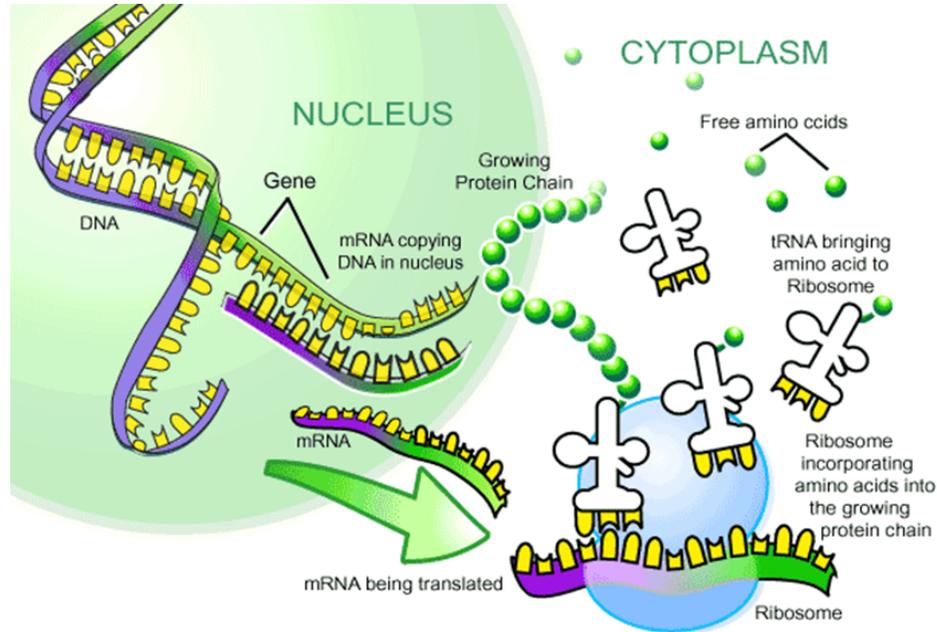
9. How do nucleotides form the double helix?

Nucleotides bind together in opposite directions to form DNA. A covalent bond holds the phosphates and the deoxyribose sugars together along the outer strands and a weaker hydrogen bond holds the nitrogenous bases together.

10. How does base pairing work?

A binds with T

C binds with G



11. Using the diagram below highlight and add to the description of the major events in DNA [transcription](#) and [translation](#) on the next page.

Transcription and Translation Steps

Step 1: DNA unzips at a particular gene along the hydrogen bonds between the nitrogen bases using enzymes.

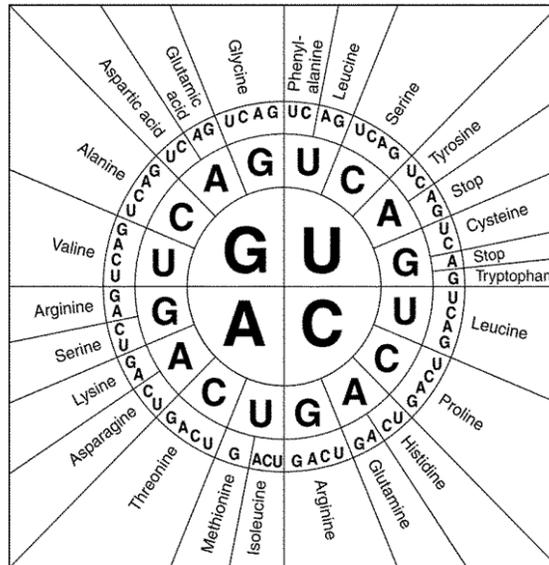
Step 2: RNA nucleotides bind to the template strand transcribing the DNA. The mRNA (message RNA) detaches and leaves the nucleus. DNA zips bonding the nitrogen bases once again reforming the double helix.

Step 3: A ribosome attaches to the mRNA and exposes a codon (three letters of mRNA). The ribosome continues to expose codons as it translates the mRNA.

Step 4: tRNA (transfer RNA) anti-codons bond to each codon. Each tRNA has a specific amino acid associated with the molecule.

Step 5: The amino acids link together through peptide bonds. Eventually the amino acids are processed and finally result in a protein product.

12. Transcription/Translation Table: Fill in the following table, use the chart to determine the amino acid from the codon.



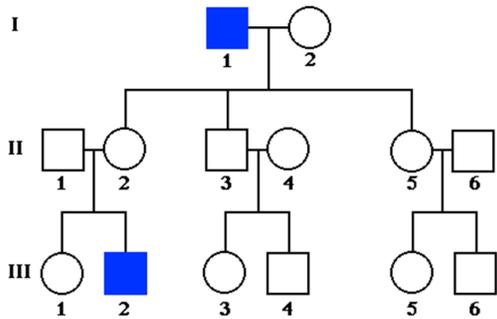
DNA Code	mRNA Codon	tRNA Anticodon	Amino Acid (1st 3 Letters Only)
GAG	CUC	GAG	Leu
AGG	UCC	AGG	Ser
GAC	CUG	GAC	Leu
TCC	AGG	UCC	Arg
CCA	GGU	CCA	Gly
AAA	UUU	AAA	Phe
CGC	GCG	CGC	Ala
TTC	AAG	UUC	Lys

13. What are the [different types of mutations](#) and their effects on the amino acids/protein produced?

Mutation Type	DNA Change (single letter substitution, insertion, deletion)	Effect on Amino Acid(s)
Nonsense	Single letter substitution	Premature STOP codon
Missense	Single letter substitution	Change in a single amino acid
Silent	Single letter substitution	No change in amino acids
Frameshift	Insertion or deletion	Many changes in amino acids as reading frame shifts over one.

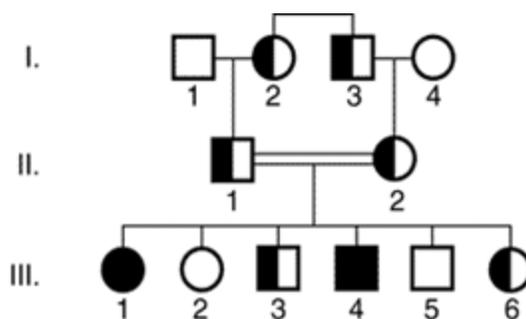
14. What is the type of inheritance pattern seen in the pedigrees below? How do you know?

Pedigree A



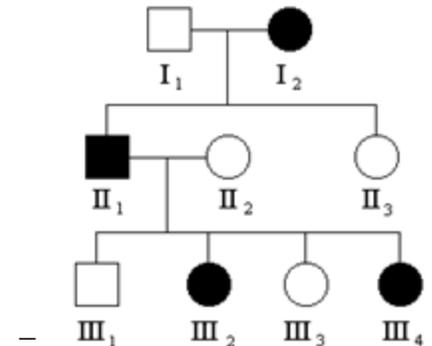
X-linked Recessive
 Only males are affected
 Affected males connected through
 Carrier females

Pedigree B



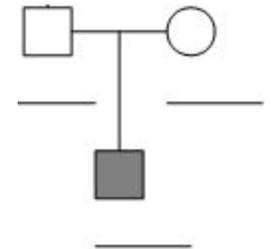
Autosomal Recessive
 Both males and females affected
 Only one generation affected
 Parents are related

Pedigree C



Autosomal Dominant
 Both males and females affected
 Each generation affected

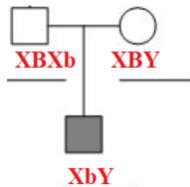
A woman comes to a genetic counselor with concerns about her son who has an unknown genetic disorder. A family history is taken to the right.



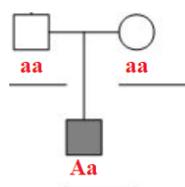
a. What are the possible patterns of inheritance? Explain.

Could be any of the patterns: X-linked recessive because only male affected, Autosomal dominant because it could be caused by a new mutation, Autosomal Recessive because both parents could be carriers.

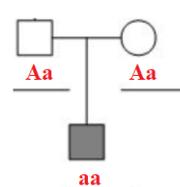
b. Write the possible genotypes on the pedigree. [Depends on type of inheritance]



(if x-linked)



(if autosomal dominant)



(if autosomal recessive)

c. What suggestions do you have for the genetic counselor to have more certainty?

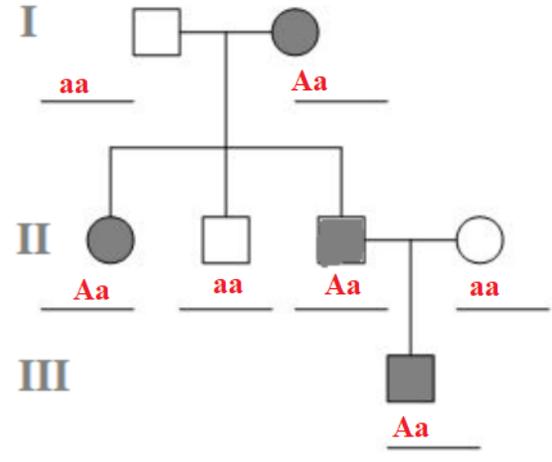
The genetic counselor should take at a minimum a three generation pedigree to include more family members. The health of all family members should be discussed as well. If more information is obtained an observable pattern may be more apparent.

The genetic counselor meets with the family again and is able to obtain more information. Answer the questions based on the updated family history.

a. What is the likely pattern of inheritance now? Based on what newly obtained evidence?

The family history now clearly shows an autosomal dominant pattern of inheritance. There are males and females affected and the disease affects each generation.

b. Write in the genotypes of the individuals in the pedigree.



c. What would be the chance for I-1 and I-2 to have another affected child? Show work in punnett square.

	a	a
A	Aa	Aa
a	aa	aa

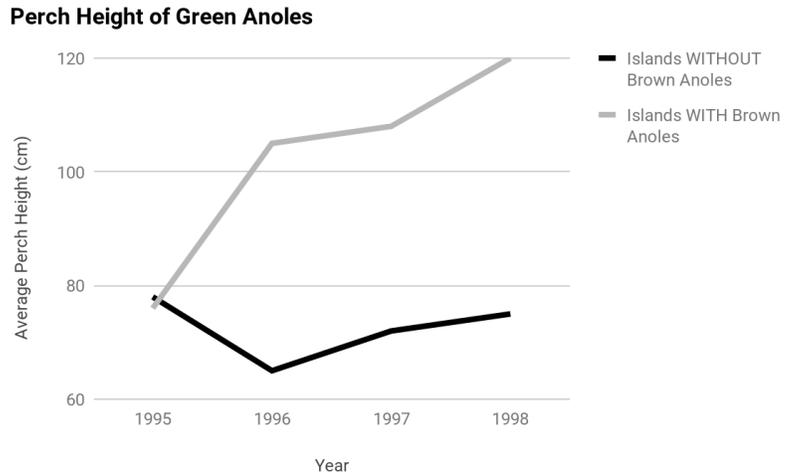
There would be a 50% chance to have an affected child (Aa).

Unit 5 Evolution

The green anole is a type of lizard that live in trees in Florida. In the 1950s, a similar species of lizard called the brown anole invaded Florida from Cuba. We know two things about the two species of anoles:

- They live in similar habitats and eat similar food.
- They are known to eat the newly hatched lizards of the other species.

Scientists conducted two investigations to determine whether or not the population of green anoles was evolving due to the invasion of brown anoles. First, they introduced brown anoles to three islands and left three islands alone. Then they measured the average height green anoles could be found in the trees (perch height) before and after introducing the invasive brown anoles. Here is a graph of the data they collected on perch height:

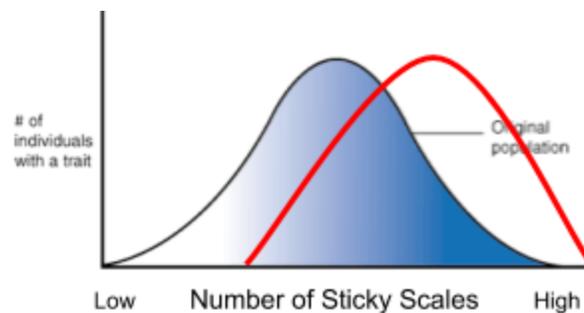


Next, scientists knew that living higher in the trees was associated with larger footpads and more sticky scales on the anoles' feet. So in 2010, the scientists collected data on the populations of green anoles that had been invaded by brown anoles and those that had not been invaded to investigate whether or not the population of green anoles adapted because of the invasion. Below is a summary of the data the scientists collected:



	Green Anoles on an Island WITHOUT Brown Anoles	Green Anoles on an Island WITH Brown Anoles
Average Perch Height in Trees	70 cm	120 cm
Average Size of the Toe Pads (Standardized for body size)	1.27 cm	1.33 cm (4.5% increase)
Average Number of Sticky Scales on the Feet (Standardized for body size)	51 Sticky Scales	54 Sticky Scales (6.5% increase)

- What pattern do you see in the perch height data? Support with evidence.
 - Green anole perch higher when brown aloes are present.
 - In 1998 the green anole perch height was 120cm on the island with brown anole and ~75cm on island the island without brown anole.
- When the brown anoles invaded, scientists noted that they ate similar food and lived in similar habitats as the green anoles, why does this matter for the survival of the green anoles?
 - There would be competition for food and space between the green and brown anole.
- Why might being able to go higher in trees be an advantage for survival?
 - They can get to a food source and have access to space that the brown anole cannot get to. This will decrease competition and decrease the number of young being eaten by the other species.
- On the following graph using the evidence provided **add a line** to show how selection has driven change in the population of green anoles on the islands with brown anoles.



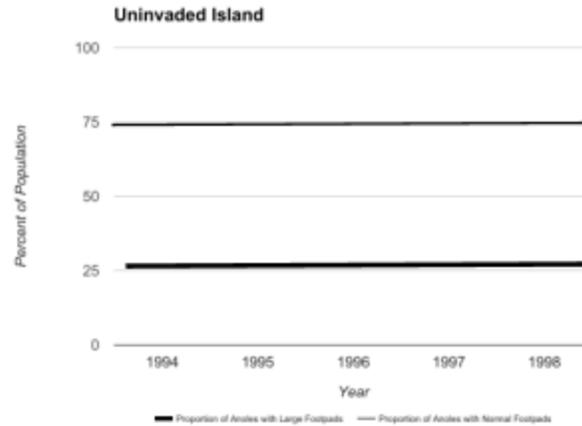
- What type of selection would you identify this as?
 - Stabilizing
 - Directional**
 - Disruptive
- For each of Darwin's observations and inferences describe how they relate to the green anole.

Variation	The toe pad size varies average 1.27 cm without brown anole and 1.33 cm with. The number of sticky scales on feet also varies with the average being 51 when brown anoles are not present and 54 when brown anoles are present.
Heritability	The trait for toe pad size and the number of sticky scales is passed from parent to offspring.
Overproduction	More anoles will be produced than can survive to ensure that some will survive and pass on genes.
Struggle for Existence	There will be competition for food, space and mates due to overproduction.
Survival of the Fittest	The anoles with the most favorable traits will survive and pass on their their genes. In this case the green anoles with the traits that help them perch higher in trees such as larger toe pad size and higher number of sticky scales on feet.

7. Write an explanation for how [natural selection](#) led to the adaptation of the population of green anoles when the brown anoles invaded their habitats in Florida.
- When brown anoles invaded the island there was competition for food and space. The green anoles with larger food pads and more sticky scales had less competition for food and space because they could perch higher. Therefore they were more likely to survive and reproduce and pass on those traits.
8. Complete the graphs below showing how you think the proportion of green anoles with larger foot pads in the population changed over time on the invaded and uninvaded islands.

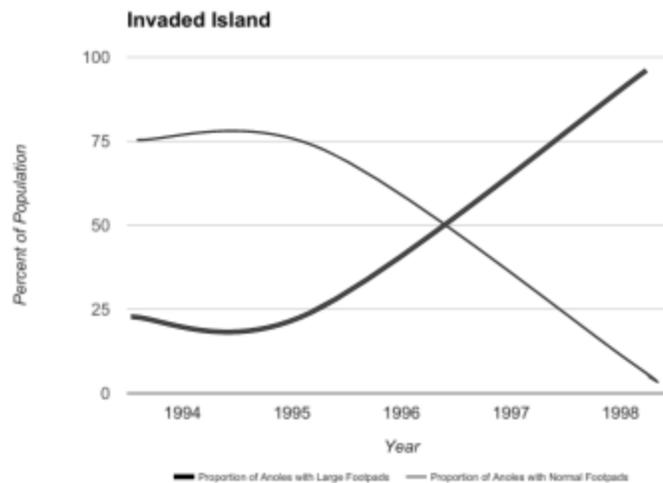
***There is more than one correct answer for this question

- The percent of the proportion of each phenotype (large footpads and normal footpads) should equal 100. You might not have started with 75 and 25.
- The proportion numbers should stay the same over time because there was no selection pressure from brown anoles on the uninvaded island.



***There is more than one correct answer for this question

- The percent of the proportion of each phenotype (large footpads and normal footpads) should equal 100. You might not have started with 75 and 25.
- As large footpads increases the normal sized decreases. Selection towards large foot pads on green anoles when the brown anole is present.

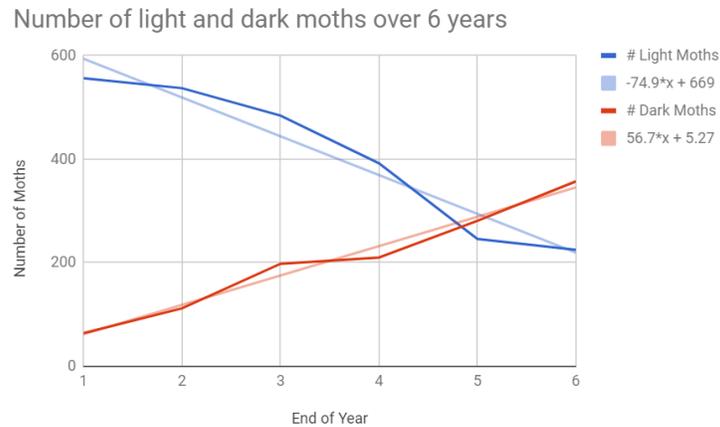


9. Students posed the question: Are green anoles more closely related to the brown anole or the cuban green anole? Listed below are the different types of [evidence](#) students collected to answer the question. Rank each piece of evidence by placing a check in the appropriate column.

	Most Helpful (Only 1)	Helpful	Least Helpful
Anatomical Structures		X	
DNA Similarity	X		
Embryological Development		X	
Behavior			X
Fossil Record		X	
Diet			X

Peppered Moths - Simulation

The economic changes known as the industrial revolution began in the middle of the eighteenth century. Since then, tons of soot have been deposited on the countryside around industrial areas. The soot discoloured and generally darkened the surfaces of trees and rocks. In 1848, a dark-coloured moth was first recorded. Today, in some areas, 90% or more of the peppered moths are dark in colour. More than 70 species of moth in England have undergone a change from light to dark. Similar observations have been made in other industrial nations, including the United States. Below is data collected over six years.



- Given the data and information above:
 - What pattern do you notice?
 - As the number of light moths decrease the number of dark moths increase. The evidence that supports this is from year 1 to year 5 the number of light moths decreased from ~580 to ~220. During the time the number of dark moths increased from ~50 to ~280.
 - Identify a cause and effect relationship to explain the pattern.
 - Cause - Soot deposited on the countryside and industrial areas from the industrial revolution caused the surfaces of trees and rocks to darken. The dark moths were better camouflage and were more likely to survive predators, reproduce and pass on the trait for dark color.
- What evidence presented supports that variation is present in the peppered moth population?
 - Light and dark colored moths were present.
- What are sources of variation in the population of peppered moths?
 - Sexual Reproduction (mixing and mom and dad's genes)
 - Mutations (random changes in DNA)
 - Meiosis (process of crossing over)
- If the trendline equation for light moths is $Y = -74.9X + 669$. What would you expect the number of moths to be at the end of year 7?
 - $Y = -74.9(7) + 669$
 - $Y = 145$
 - The number of light moths continues to decline.
- If the trendline equation for dark moths is $Y = 56.7X + 5.27$. What would you expect the number of moths to be at the end of year 7?
 - $Y = 56.7(7) + 5.27$
 - $Y = 402$
 - The number of dark moths continues to increase.