

Welcome AP Biology students. This is Mr. Lee and I'm looking forward to a great year with you all. This packet is designed to be a refresher from the concepts covered in biology taken here at Central Catholic.

Why the packet?

The reason why this is needed is we jump right into experimental design and evolution and these are in my opinion the two most critical pieces of the entire AP Biology course that every unit constantly bases its foundation on. To fully understand evolution, we need a refresher on these freshman level concepts of genetics and protein synthesis so we can fully dive in on day 1.

How am I going to learn this?

[Amoeba Sisters Biology Learning Playlist \(YouTube\)](#). The video lectures in this playlist will be an excellent refresher on concepts you should have learned in biology here. I have included guided notes with questions that I would like you to complete before the first day of class. These videos should give you the information to be able to perform the learning targets below. **There may be other videos that do not have a guided notes included in this packet that may help you. Please feel free to review those if you would like, but your focus should be on what is in this packet.**

Learning Targets: This is what I want you to know coming in on Day 1 of class

Scientific Method

- Be able to explain the process of the scientific method and the steps involved.
- Be able to design an experiment or recognize appropriate experimental design.

Vocabulary: Research Question, Hypothesis, Experiment, Conclusions Independent Variable (Manipulated), Dependent Variable (Responding), Control Variable (Constants), Control Group

Mendelian Genetics

- Basic vocabulary regarding Mendelian Genetics
- Be able to determine probabilities of genotypes and phenotypes using Punnett Squares

Vocabulary: Genes, Genotype, Phenotype, Alleles, homozygous (purebred/true-breeding), heterozygous (hybrid), Dominant, Recessive, Monohybrid Cross

DNA, RNA, & Protein Synthesis

- Explain how RNA differs from DNA and their roles in protein synthesis
- Describe the process of protein synthesis (transcription/translation) and be able to determine the amino acid sequence in a protein when given a starting DNA segment
- Explain the different types of mutations and the results of those specific types of mutations in terms of protein synthesis

Vocabulary: DNA, RNA, helix, sugar, phosphate, base, ribose, deoxyribose, A,T,C,G, U, Transcription, mRNA, ribosome, Translation, amino acids, protein, phenotype, mRNA, tRNA, codon, mutation, point mutation, substitution, insertion (point), deletion (point), chromosomal mutations, deletion (chromosomal), duplication, inversion, insertion (chromosomal), translocation

Incentive & Grading

- There will be an **extra credit multiple choice quiz** most likely on the first day of class.
 - Everyone will have to take it but this quiz can only help your overall grade and not hurt it.
- **The packet will be turned in as a separate graded assignment before the quiz.**
 - Please have a completed hard copy of the assignment to turn in.
 - Full credit will be given based on completion, effort, and general accuracy.

If you have any questions please email me at dlee@centralcatholichigh.org.

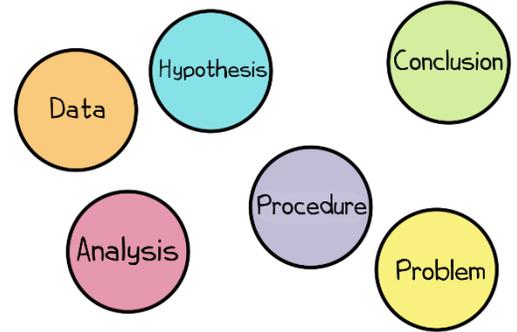


Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap: *Nature of Science* (Click)

1. What is the scientific method? Is there just one universal scientific method? Why or why not?



Reflect on what was discussed in the video. How would you complete these general sentence stems regarding the **nature of science**?



Note: It's important to remember that this video only mentions some components of the nature of science! The below sentence stems can contain more characteristics, which we encourage you to discuss and consider.

2. Science has a major goal of:

3. Science can lead to the development of:

4. It's important to know that science is:

5. Why is it important to verify the **credibility** of a source when researching a topic?



6. What does it mean if a science paper is **peer-reviewed** and why is this significant?





Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap: Nature of Science

7. **Observations** and **inferences** are important in science. How would you explain the difference between the two words?

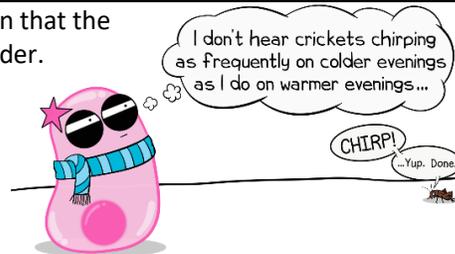
8. **Constants** (“controlled variables”) and a **control** are easily confused by students! How would you explain the difference between the two words?

9. Why is a **control group** generally very important in an experiment?

Data Collection: Pinky’s science fair project in junior high focused on an observation that the crickets outside her window chirped less frequently when the temperature was colder.

Fun Fact: There are free “cricket chirp calculators” online you can explore, which didn’t exist freely online when Pinky was in junior high.

Consider if data was collected consisting of the **average number of cricket chirps** at different **temperatures** in her backyard.



10. Which variable would be an **independent variable**? _____

11. Which variable would be a **dependent variable**? _____

12. Which variable (#10 or #11) would ideally be plotted on the X-axis of a graph? _____

13. In the collection of data, list at *least* 3 important **constants** (also known as “controlled variables”)?

14. Brainstorm and write at *least* 3 potential challenges or important points to consider when conducting the described data collection.

Example: *Repeated trials are not mentioned, and this would be important for optimal data collection.*

A)

B)

C)





Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap- DNA, Chromosomes, Genes, and Traits: An Intro to Heredity (Click)

The vocab below builds a foundation for understanding heredity! Complete the table using your own words and creativity.

Name	Illustrate!	Explain it in Your Own Words	What's its Significance? (Why does it Matter?)	Real Life Example
DNA	1.	2.	3.	DNA found in the body cell of a snake
Chromosome	4.	5.	Chromosomes allow the large amount of DNA to be compacted. One reason this is significant is in cell division as it makes it much easier for the cells to put these units into the new cells.	6.
Gene	7.	8.	9.	One of many genes that can code for a protein involved in eye pigment
Trait	10.	11.	12.	13.

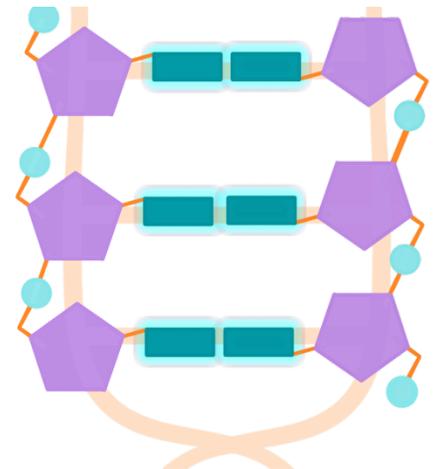
14. For the diagram at right, please label the following words on the diagram.

(A) Deoxyribose (sugar), (B) Phosphate, and (C) Nitrogenous Base.

15. Based on the definition, how many **nucleotides** do you see in this diagram? _____

16. What are the **four different types of bases** in DNA and how do they pair?

17. When studying **heredity**, what is the relationship of DNA **bases** and **traits**?





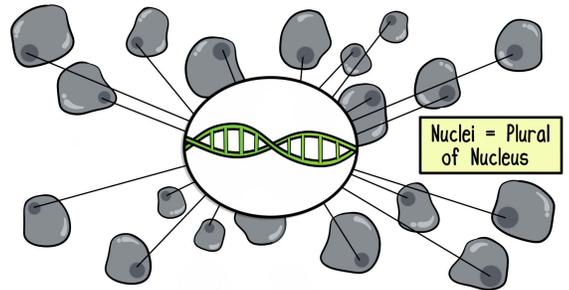
Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap- DNA, Chromosomes, Genes, and Traits: An Intro to Heredity

A Picture Says It!

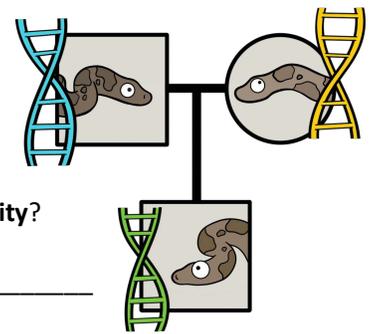
18. Explain what this image represents regarding where your entire DNA code can be found.



19. Apply Your Understanding

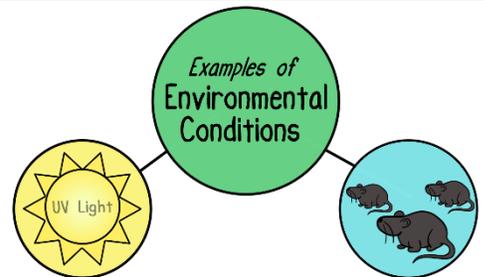
Spike is not a clone of his father. He inherited DNA from both of his parents.

Chromosomes are condensed units of DNA. If Spike has 36 chromosomes, you would expect that Spike would have inherited _____ chromosomes from his mother and _____ chromosomes from his father.



20. How did you determine the chromosome numbers and how does that relate to **heredity**?

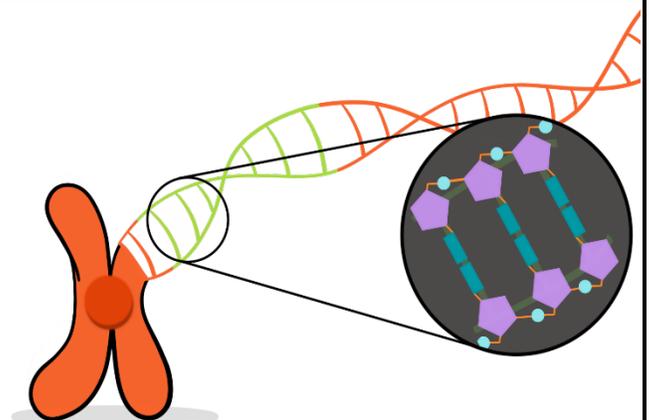
21. As mentioned in the video, the environment can also affect an organism's traits. The example of nourishment was used in the case for Spike, as this could affect his growth and size. This can also occur in humans. UV light was not mentioned in the video. How could UV light potentially affect an organism's trait? Provide one example.

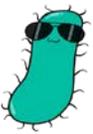


22. Recap the Vocab

Identify some of the vocabulary you worked with by labeling them on this illustration:

- DNA
- Gene
- Chromosome
- Nucleotide
- Phosphate
- Deoxyribose (sugar)
- Nitrogenous Base



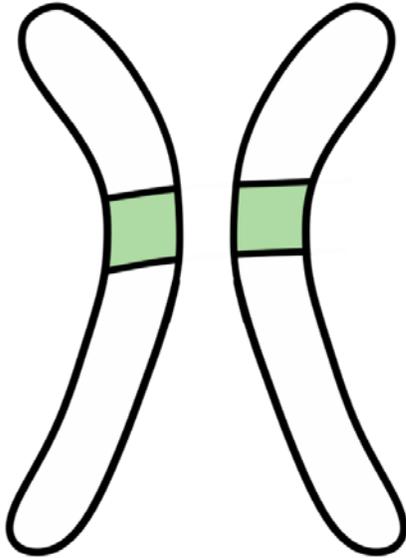


Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap: *Alleles and Genes* (Click)

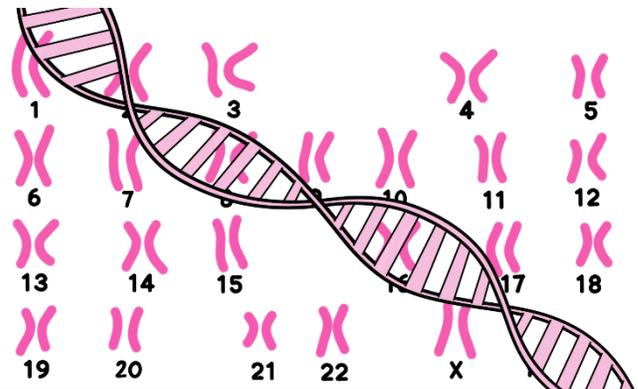
1. **Visualizing the Vocabulary:** For the following illustration, determine where you could label the following terms: **allele**, **gene locus**, and **chromosome**. Be sure to draw arrows to specify where you are labeling!



Analyzing Inheritance: A human's DNA code, found in nearly all body cells, can be condensed into **chromosomes**.

2. How many chromosomes do humans have total in *each* *body cell? _____
3. How many of those chromosomes in *each* human *body cell are from the mother? _____
4. How many of those chromosomes in *each* human *body cell are from their father? _____
5. How many *pairs* of chromosomes are there in *each* human *body cell? _____
6. *When looking at each pair*, how many chromosomes in each pair come from the mother? _____ Father? _____

**some exceptions*



7. **Working with the Vocabulary:** *In your own words*, explain how a person may taste the bitterness of PTC by using the following vocabulary words in your explanation (choose any order): **trait**, **gene**, **genotype**, **phenotype**, and **alleles**. Underline each word as you use it in your explanation. In this explanation, you can treat PTC taste sensitivity as a single-gene trait. [As mentioned in the video, it may be more complex than a single-gene trait.]







Amoeba Sisters | Video Recap

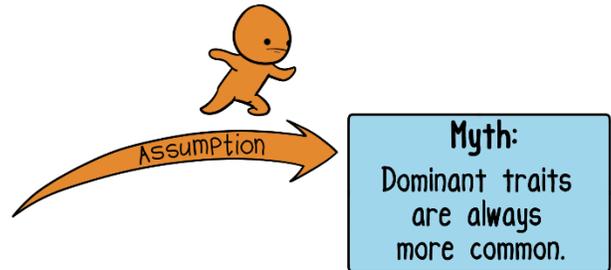
NAME: _____

Amoeba Sisters Video Recap: Alleles and Genes

8. **Deducing a Genotype:** If assuming PTC as a simple gene trait, what other genotype would you select to put in this missing genotype box that could result in this phenotype? Why?

PTC Taster (Dominant Trait)			
Phenotype	Genotype		
	<table border="1"> <tr> <td>TT</td> <td></td> </tr> </table>	TT	
TT			

9. **Relevant Scenario:** When explaining dominant and recessive traits to a younger family member, they respond, "Well chances are I can probably taste PTC, since dominant traits are more common." How might you address this misconception?

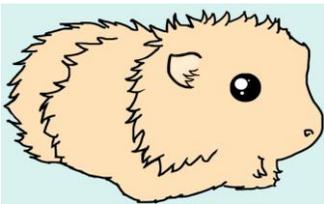
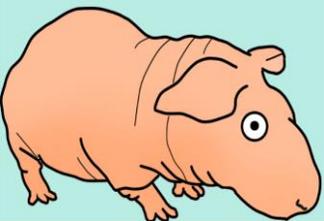


10. **Contrast:** Many times, students struggle with the difference between the terms **allele** and **gene**. How would you explain the difference of these two terms in a way that is memorable to you?



Amoeba Sisters Video Recap: **Monohybrid Crosses (Mendelian Inheritance)** (Click)

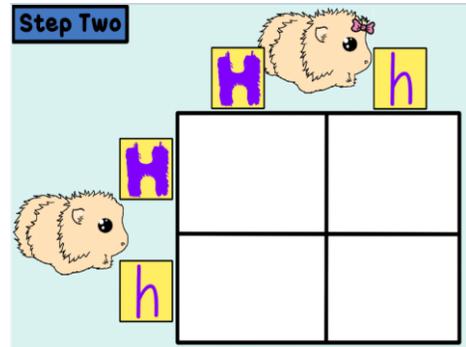
Vocabulary practice! Fill in missing boxes assuming that having hair for guinea pigs follows Mendelian inheritance, where the H dominant allele codes for hair and h codes for a lack of hair (hairless).

Image	Genotype	Heterozygous or Homozygous?	Phenotype
	HH	1.	2.
	3.	4.	Hairless
5.	6.	Heterozygous	7.

8. An **allele** is a form of a gene.

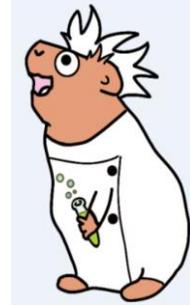
In the Punnett square on the right, how many H/h alleles does a baby guinea pig inherit from the **mother**? _____
 How many H/h alleles does a baby guinea pig inherit from the **father**? _____.

If a baby girl guinea pig looks almost identical to its mother, does this then mean that it inherited more alleles from its mother? Explain. (Hint: Think about the vocabulary words **dominant** and **recessive**.)



Mysterious Fred: A Guinea Pig Test Cross

There is a teacher from Texas that loves hairless guinea pigs. In guinea pigs, the dominant allele H codes for the trait of having hair and the allele h codes for the trait of being hairless. (Assume Mendelian inheritance). Let's say that this teacher receives her wish of finding a hairless guinea pig at a pet store and names her Genevieve. She finds another guinea pig at a store with hair that she names Fred.



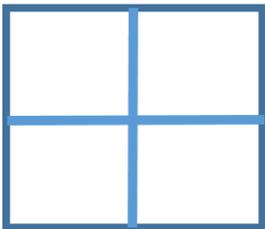
While she can be certain of Genevieve's genotype, how could she determine what genotype Fred is? She can do a **test cross**! A test cross involves breeding an organism with a dominant trait (like Fred) with an organism that exhibits a recessive trait (like Genevieve).

9. Genevieve has the genotype _____.

10. Fred's genotype could be _____ or _____.

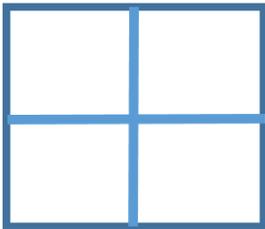
11. If Fred was genotype _____ and bred with Genevieve...

12. Please draw Punnett Square below to show prediction for offspring.



13. If Fred was genotype _____ and bred with Genevieve...

14. Please draw Punnett Square below to show prediction for offspring.



15. Explain in your own words how the offspring from the test cross could help determine Fred's genotype.

16. What could be some weaknesses with using a test cross to determine Fred's genotype?



Amoeba Sisters | Video Recap

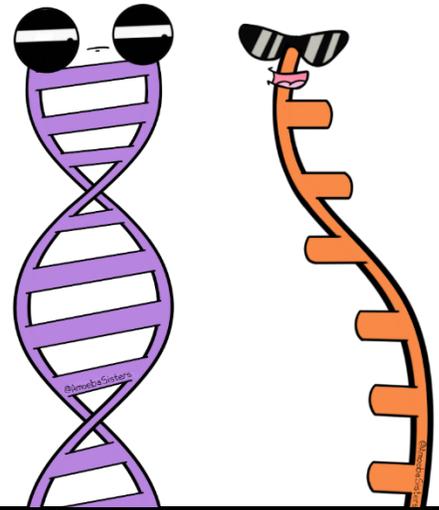
NAME: _____

Amoeba Sisters Video Recap: DNA vs. RNA & Protein Synthesis UPDATED

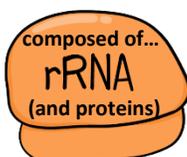
Whose Show Is This?

DNA shouldn't get all the credit! For this portion, check out the *Amoeba Sisters DNA vs. RNA* video. Then, write "D" if for DNA, "R" if for RNA, or "BOTH" if it pertains to both DNA and RNA.

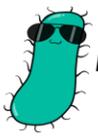
1. _____ I am a **nucleic acid**.
2. _____ I am usually **single-stranded**.
3. _____ I am generally found both inside and outside of the **nucleus** [in eukaryotic cells].
4. _____ I am arranged as a **double helix**, and my shape is often described as a "twisted ladder."
5. _____ I include bases **guanine, cytosine, and adenine**.
6. _____ Each of my nucleotides includes a **phosphate, sugar, and base**.
7. _____ I include the base **uracil**.
8. _____ I include the base **thymine**.
9. _____ I generally remain in the **nucleus** [in eukaryotic cells].
10. _____ I have the sugar **deoxyribose**.
11. _____ I am made up of **nucleotides**.
12. _____ I have the sugar **ribose**.



For the following discussed RNA types, complete the missing information in the boxes below. Some boxes have been filled in for you.

Type: <i>mRNA</i>	13. Type: _____	14. Type: _____
Stands for: 15. _____	Stands for: 16. _____	Stands for: Transfer RNA
Sketch to Help You Remember: 17.	Sketch to Help You Remember: 	Sketch to Help you Remember: 18.
General Function: 19. _____	General Function: 20. _____	General Function: <i>Transfers amino acids [to area of protein synthesis].</i>





Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap: DNA vs. RNA & Protein Synthesis UPDATED

Protein Synthesis Summary

Complete the missing information in the summary chart after watching the *Amoeba Sisters Protein Synthesis* video.

Process Name	Location (in eukaryotic cell)	Brief and General Description	End Result	DNA directly involved? (yes or no?)	List RNA type(s) involved (mRNA, rRNA, and/or tRNA?)
<p>Transcription</p>	21.	22.	23.	24.	mRNA only
<p>Translation</p>	25.	26.	27.	No	28.

29. Consider the illustration placed in the *transcription* box above. Identify and label on the illustration *if* any of the following are present: **DNA, mRNA, rRNA, tRNA, and/or amino acid.**

30. Consider the illustration placed in the *translation* box above. Identify and label on the illustration *if* any of the following are present: **DNA, mRNA, rRNA, tRNA, and/or amino acid.**





Amoeba Sisters | Video Recap

NAME: _____

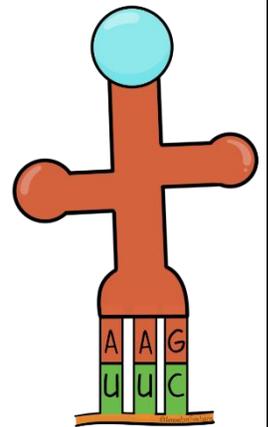
Amoeba Sisters Video Companion for *How to Read a Codon Chart*

Second Base

	U	C	A	G			
First Base	U	Phenylalanine	Serine	Tyrosine	Cysteine	U	
		Phenylalanine	Serine	Tyrosine	Cysteine		C
		Leucine	Serine	STOP	STOP		A
		Leucine	Serine	STOP	Tryptophan		G
	C	Leucine	Proline	Histidine	Arginine	U	
		Leucine	Proline	Histidine	Arginine		C
		Leucine	Proline	Glutamine	Arginine		A
		Leucine	Proline	Glutamine	Arginine		G
	A	Isoleucine	Threonine	Asparagine	Serine	U	
		Isoleucine	Threonine	Asparagine	Serine		C
		Isoleucine	Threonine	Lysine	Arginine		A
		Methionine	Threonine	Lysine	Arginine		G
	G	Valine	Alanine	Aspartic Acid	Glycine	U	
		Valine	Alanine	Aspartic Acid	Glycine		C
		Valine	Alanine	Glutamic Acid	Glycine		A
		Valine	Alanine	Glutamic Acid	Glycine		G

Third Base

1. Please *label* the following five words on the image below: **tRNA**, **mRNA**, **codon**, **amino acid**, and **anticodon**.



2. When reading a codon chart, *unless otherwise specified*, you generally use the three bases that are part of the: **CIRCLE ONE:** tRNA anticodon mRNA codon DNA codon DNA anticodon

3. The codon chart demonstrates that more than one codon can potentially code for the same amino acid. **CIRCLE ONE:** TRUE FALSE

4. The information in this rectangular codon chart could be represented in a different way (ex: circular codon chart). **CIRCLE ONE:** TRUE FALSE

5. How many different codon *combinations* are shown on this codon chart? _____

6. How many different *types* of amino acids are shown on this codon chart? _____

Codon Example 1 from Video

mRNA Codon:
AUG

tRNA Anticodon:
UAC

Amino Acid:
methionine

Codon Example 2 from Video
Try working through this before checking your answers in the video!

mRNA Codon:
CCA

tRNA Anticodon:
7. _____

Amino Acid:
8. _____

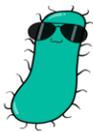
Codon Example 3 from Video
Try working through this before checking your answers in the video!

mRNA Codon:
GUC

tRNA Anticodon:
9. _____

Amino Acid:
10. _____





NAME: _____

Amoeba Sisters Video Companion for *How to Read a Codon Chart*

Second Base

		U	C	A	G	
First Base	U	Phenylalanine	Serine	Tyrosine	Cysteine	U
		Phenylalanine	Serine	Tyrosine	Cysteine	C
		Leucine	Serine	STOP	STOP	A
		Leucine	Serine	STOP	Tryptophan	G
	C	Leucine	Proline	Histidine	Arginine	U
		Leucine	Proline	Histidine	Arginine	C
		Leucine	Proline	Glutamine	Arginine	A
		Leucine	Proline	Glutamine	Arginine	G
	A	Isoleucine	Threonine	Asparagine	Serine	U
		Isoleucine	Threonine	Asparagine	Serine	C
		Isoleucine	Threonine	Lysine	Arginine	A
		Methionine	Threonine	Lysine	Arginine	G
	G	Valine	Alanine	Aspartic Acid	Glycine	U
		Valine	Alanine	Aspartic Acid	Glycine	C
		Valine	Alanine	Glutamic Acid	Glycine	A
		Valine	Alanine	Glutamic Acid	Glycine	G

Third Base

11. The video gave an example of identifying codons for an amino acid. Which six **mRNA codons** code for **leucine**?

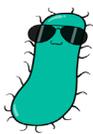
12. What would be the six **tRNA anticodons** for the above mRNA codons?

13. What would be the **DNA base triplets** on the DNA template strand that complement the mRNA? One example has been filled in for you!

 AAT _____

<p><i>TRUE or FALSE?</i></p> <p>14. _____ Changing one base letter on a mRNA codon will always change the amino acid it codes for.</p> <p>15. <i>Why or why not?</i> _____</p>	<p><i>TRUE or FALSE?</i></p> <p>18. _____ The mRNA codons GCU and GCC would share the <i>same tRNA anticodon</i>.</p> <p>19. <i>Why or why not?</i> _____</p>
<p><i>TRUE or FALSE?</i></p> <p>16. _____ The mRNA codon UGG is the only codon that codes for the amino acid tryptophan.</p> <p><i>TRUE or FALSE?</i></p> <p>17. _____ The mRNA codon UCU and AGU code for the same amino acid.</p>	<p>20. Stop codons can signal the end of a polypeptide. What are the three stop codons?</p> <p>_____</p> <p>21. AUG is generally a start codon. What is the amino acid that AUG codes for?</p> <p>_____</p>





Amoeba Sisters | Video Recap

NAME: _____

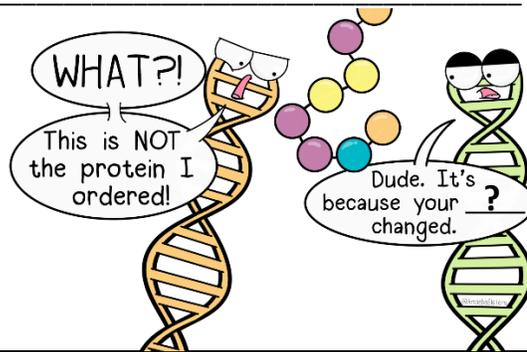
Amoeba Sisters Video Recap: *Mutations (Updated)*

1. What is a **mutation**?

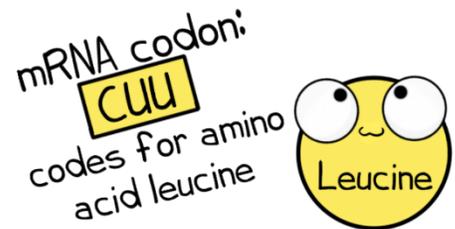
Mutations can be harmful, helpful, or neutral in their effect. A **silent mutation** tends to have a neutral effect as it does not result in coding for a different amino acid. Using your mRNA codon chart, give another mRNA codon that this CUU could mutate to and *still* code for leucine.

2. A specific part of a **nucleic acid** (such as DNA or RNA) experiences a mutation that could lead to a different protein produced. View the illustration below of DNA. Which part of the DNA experiences the mutation?

3. On the DNA illustration, draw an *arrow* to show *where* the answer to #2 could be located.

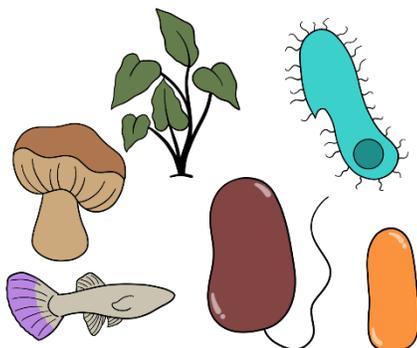


4. The mRNA codon CUU could mutate to **C_____** and *still* code for leucine, which would not change the amino acid.



5. Which type(s) of organism(s) can experience a mutation? Mark any that apply.

- _____ Animals (this includes humans)
- _____ Archaea
- _____ Bacteria
- _____ Fungi
- _____ Plants
- _____ Protists



6. Even a **gene mutation** that is a **point mutation**, meaning it affects one nucleotide base, can still make a major change

Consider the below information for normal hemoglobin:

PORTION OF HEMOGLOBIN DNA	GGA CTC CTC
MRNA	CCU GAG GAG
AMINO ACIDS	Proline-Glutamic Acid-Glutamic Acid

Sickle Cell Anemia is caused by a point mutation known as a **substitution**. Show what would occur *if* the *first* T ("thymine") DNA base in the portion shown above experienced a mutation with a substitution of A ("adenine").

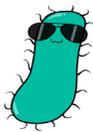
Sickle Cell Hemoglobin:

Portion of mutated hemoglobin DNA: _____

mRNA: _____

Amino Acids: _____





Amoeba Sisters | Video Recap

NAME: _____

Amoeba Sisters Video Recap: Mutations (Updated)

7. An **insertion or deletion** can result in a **frameshift mutation**. To demonstrate this, complete the following.

Note: You will need a codon chart.

Normal Strand:

DNA: GCA ATG CAC

mRNA: _____

Amino Acids: _____

Deletion (causing a frameshift):

Taking out the first "G" in the original DNA above results in:

DNA: CAA TGC AC

mRNA: _____

Amino Acids: _____

How did the frameshift change the amino acids?

8. Check your understanding! Mark any that are *correct*.

_____ Mutations are random.

_____ Mutations are mostly beneficial and useful for an organism.

_____ Mutations can occur in both DNA and RNA, which are **nucleic acids**.

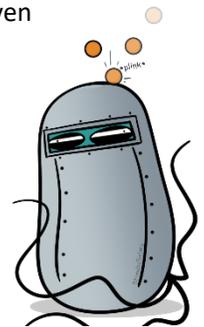
_____ Mutations can only occur during **interphase**.

_____ Not all genes code for proteins.

_____ Not all genes are "turned on" at a given time.

_____ **Substitution** mutations typically result in a **frameshift mutation**.

_____ Mutations can be **genetically inherited**.



Chromosome Mutations



Sketch It!

Create illustrations to show the following chromosome mutations. Note: Chromosomes exist in both prokaryotic and eukaryotic cells, but prokaryotic chromosome structure tends to be very different from eukaryotic chromosomes.

9. Duplication

10. Deletion

11. Inversion

12. Translocation

