Practice Test

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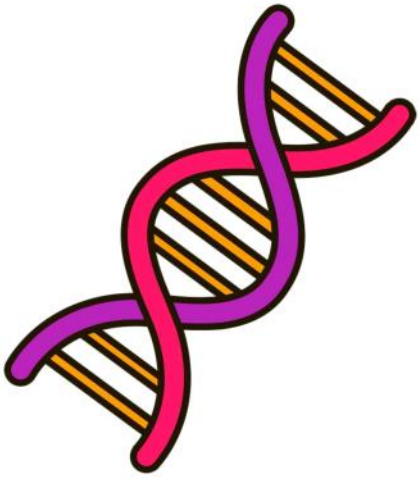
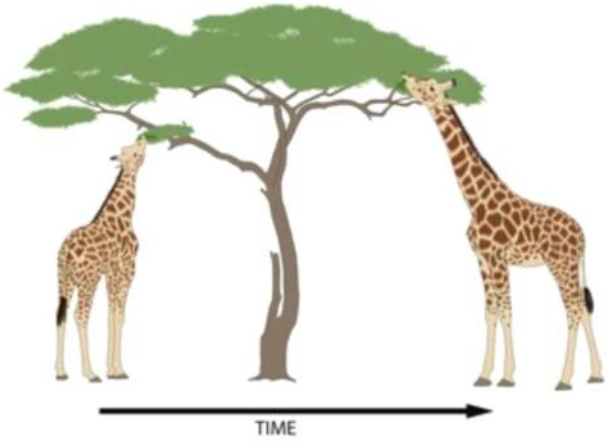
Unit 3: Biology REVIEW

"Practice Test"

Science 10





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Part I: Vocabulary

Referring to your notes and textbook, define each of the following vocabulary terms in a complete sentence:

1. Adaptation	The process which causes organisms to fit successfully in their 'job' (niche) within the environment. Adaptation is caused by natural selection.
2. Adaptive Radiation	When a single ancestral species evolves to fill a variety of niches in an ecosystem.
3. Allele	One of the different versions of a particular gene. Eg. The *gene* is for eye color, the *allele* is the specific color (blue, brown, hazel, etc.)
4. Artificial Selection	The process by which humans select only those organisms with traits that they choose to reproduce *(desired traits)*, leading to an increase in the abundance of their chosen traits (alleles) in populations of organisms.
5. Carcinogen	Any agent which causes cancer, usually these are mutagens which damage the structure of DNA.
6. Chromosome	Separate strands of DNA found inside the nucleus of the cell, packed into dense structures during cell division. Humans have 23 pairs of chromosomes, all of which are identical except for the sex chromosomes (which are XY in males). The same gene is found in the same position on each chromosome of the pair, but they may be different alleles.
7. Co-dominance	A relationship between alleles in which ***neither allele is dominant*** over the other, will result in a hybrid organism *(heterozygous genotype)* that expresses a new trait *(new phenotype)* which is partly one trait and partly the other. Eg. Black Chicken + White Chicken = offspring with black AND white feathers, BOTH traits are shown.
8. Complementary Base Pairing	The nitrogen-containing bases (guanine, cytosine, adenine, thymine) found in DNA always pair in a specific way: guanine always pairs with cytosine and adenine always pairs with thymine.
9. Complete Dominance	A relationship between alleles in which one allele is dominant over the recessive allele, with the result that a *hybrid (heterozygous genotype)* organism expresses just the trait of the dominant allele *(phenotype shoes the dominant trait only)*.
10. DNA	Deoxyribonucleic Acid. The hereditary molecule which stores the information for making proteins as a series of genes.
11. Dominant	An allele of a gene whose phenotype overwrites the expression of a recessive allele. If an organism is a heterozygote (eg. Bb) the dominant trait is shown in the phenotype (eg. Bb = brown eye color, if brown = B and blue = b)
12. Extinction	The complete loss of a species. Unsuccessful alleles do not get inherited, as over time, these organisms do not reproduce and pass on genes. If an organism is not reproducing, and making more of it's species it can lead to loss of that species.

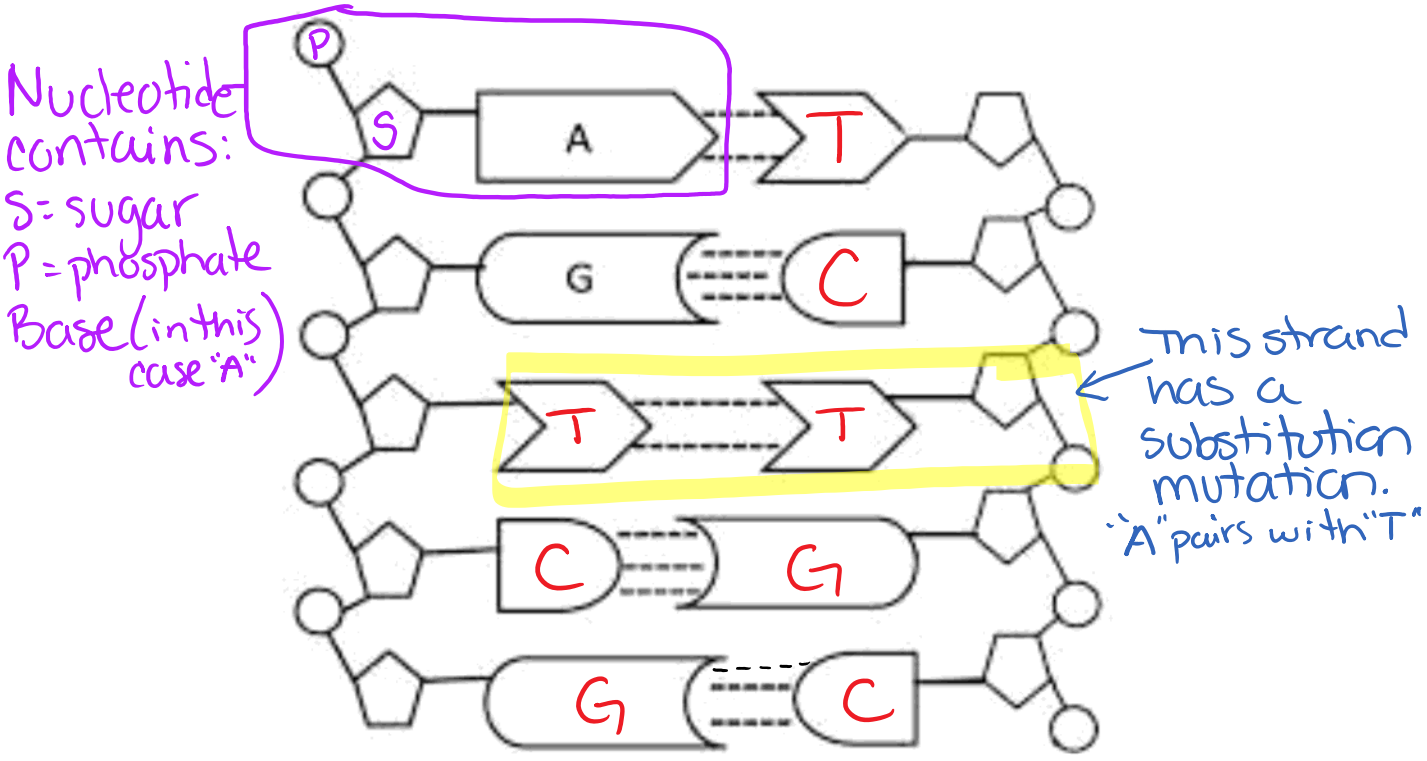
13. Gene	A region of DNA which contains the instructions for building a specific protein. Genes are found on chromosome. *(link: alleles are the different versions of the gene)*
14. Genetic Engineering	*Not covered in this course. But FYI: The technologies that allow scientists to change the DNA of organisms by modifying genes or by transferring genes from other organisms.*
15. Incomplete Dominance	A relationship between alleles in which **neither allele is dominant** over the other, with the result that a heterozygote (hybrid) organism expresses a new trait which is a combination of the traits of both alleles. Eg. Red flowers + white flowers = pink flowers
16. Mendelian Genetics	A form of inheritance described by Gregor Mendel in which the genes show complete dominance. Meaning a trait will show dominance OR recessive, not any combinations.
17. Mutagen	Any agent which causes mutations, changes in the base pair sequence of DNA molecules, including radiation, chemicals, heavy metals, and viruses.
18. Mutation	Random changes to the structure of genes which create new alleles. Mutations create new versions of the gene…this leads to genetic variation within a species.
19. Natural Selection	The process by which successful organisms are more likely to reproduce, leading to an increase in the abundance of their successful traits (alleles) in populations of organisms. Natural selection is the important process that drives evolution.
20. Selection Pressure	Any agent in the environment which affects the survival of organisms in a population, thus applying the 'pressure' that drives natural selection. Selection pressures include agents such as competition between organisms or between predators and prey, environmental factors and changes, disease, introduction of an invasive species
21. Protein	A complex, three-dimensional molecule whose shape allows it to perform a specific function within living cells. Genes provide the instructions for the assembly of specific proteins.
22. Punnett Square	A technique which allows scientists to predict the alleles inherited by offspring. This involves 1) determining the genetics of the parents, 2) writing their alleles around a 2x2 grid, and 3) filling in the grid by combining the alleles from the parents.
23. Recessive	An allele of a gene whose phenotype is concealed by the presence of a dominant allele. A recessive trait will only be present in a homozygous organism. *Eg. Blue eyes = bb, BOTH recessive alleles must be present*
24. Sex-Linked Inheritance	A form of inheritance in which the gene is found on either the X or the Y of chromosome pair 23, which means that it is inherited differently in females than males.
25. Transcription	the process of making an RNA copy of a gene sequence. This copy, called a messenger RNA (mRNA) molecule, leaves the cell nucleus and enters the cytoplasm, where it directs the synthesis of the protein
26. Translation	The process where ribosomes in the cytoplasm read the mRNA codon sequence (3-nucleotide code) and a tRNA molecule bring the corresponding amino acid to assemble the growing polypeptide chain. This chain with then become part of a larger protein molecule.

Part II: Knowledge Answer each of the following questions in complete sentences.

1. What does DNA stand for?

   Deoxyribonucleic acid

2. Use the diagram and follow the instructions carefully. Be clear with your labeling
   i. Complete the complementary base pairing
   ii. Circle ONE nucleotide.
   iii. In the nucleotide you circled, label the THREE parts of a nucleotide.



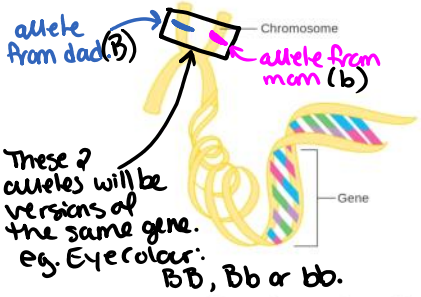
3. What type of bonds connect the two DNA strands?

   Hydrogen bonds connect the complimentary base pairs nucleic acids (bases). A pairs to T with 2 hydrogen bonds, which G pairs to C with 3 hydrogen bonds

4. What shape does a double-stranded DNA molecule take?

   The double stranded DNA molecule forms a **DOUBLE HELIX** shape.

5. Distinguish between ***genes and alleles.***
(you may wish to use the diagram to help support your answer)



A **gene** is a section of the DNA strand *(the nucleotide sequence ATGC...etc.)*that codes for the production of a specific protein in the organism.
An **allele** is the different versions of that specific gene.
For example, in chickens there is a gene for feather color, and the different allele might represent, brown, black, white, etc.
An organism will inherit one allele from their mom and one allele from their dad. The combination of these alleles and the type of inheritance *(complete dominance, incomplete dominance, co-dominance, sex-linked)* will determine the organisms **phenotype**.

6. You have been given the template strand of DNA from a gene. ***Transcribe and translate*** it:

Remember DNA is double stranded.

DNA Template Strand	T A C C C G A A T T A G G C T A T C
DNA Coding Strand (the one mRNA is made from)	A T G G G C T T A A T C C G A T A G
mRNA "codon" (3 base sequence)	U A C C C G A A U U A G G C U A U C
tRNA ← contains "u" not "T"	A T G G G C U U A A U C C G A U A G
Amino Acid Sequence	Tyr - Pro - Asn - STOP (not made after "stop") (Ala) - (Ile)

remember the amino acid chain is based on the mRNA codon.

i. What type of molecule contains the codons?

The mRNA molecule (strand) contains the 3-base sequence called a ***codon.***

ii. How many codons are there?

In the molecule shown above, there are 6 codons shown (18 bases in total)

iii. What type of molecule contains the anticodons?

The tRNA molecule contains the ***anticodon.*** This is complementary to the mRNA strand and carries the amino acids to be added to the growing peptide chain (will be added to a protein)

iv. How many anticodons are there?

In the molecule shown above there are 6 anticodons (although only 3 would be used because then a stop codon is reached so no tRNA molecule would be bringing another amino acid.

v. How many amino acids are in the polypeptide made from this DNA sequence?

Only 3 amino acids would be made in this DNA sequence. Once a "stop" code is reached, the ribosome detaches and the peptide strand stops being added to. (ie: no more amino acids are added)

7. The following is an mRNA strand.

i. Translate it.

ACU UAG UCC GUU CGA UUU GAU

Thr	STOP	Ser	Val	Arg	Phe	Asp

not added to peptide chain

ii. How many amino acids would be in the polypeptide?

There is only 1 amino acid in this polypeptide. Once a STOP codon is reached (UAG = STOP) the ribosome will detach from the mRNA strand and no more amino acids are added

8. Describe one of Mendel's experiments on peas.

Gregor Mendel experimented with the genetics of peas. He began by creating true-breeding varieties: peas whose offspring were always the same. For example, he had true-breeding peas with purple flowers and true-breeding peas with white flowers. When he crossed purple and white-flowered parents together, he found that all the offspring resembled the purple parent but not white parent. When he crossed these purple offspring with themselves, he found that the offspring were 76% purple flowers and 24% white flowers (very close to a 3:1 ratio). These results demonstrated to Mendel that each parent passes on a single element (gene) to its offspring, and that organisms must possess a pair of elements (one from each parent).

**remember "true-breeding" means "pure-bred" so homozygous for a particular trait*

9. Explain the two 'laws' resulting from Mendel's experiments.

First, Mendel demonstrated that organisms have two alleles for each gene, because they are located on both chromosomes of the pair. When organisms perform sexual reproduction, the chromosomes are randomly separated into the gametes (eggs or sperm cells) so that each receives just on allele. When the egg and sperm fertilise each other to create the offspring, the chromosomes are combined to create a new pair. In other words, we inherit one chromosome from each pair from each of our parents.

Second, Mendel coined the terms "dominant" and "recessive" to describe how the traits of one allele can mask or cover the traits of another allele. This is, of course, not the only way which alleles can interact (see the next question), but the peas that Mendel were studying showed complete dominance.

10. Explain the difference between ***complete dominance, co-dominance, and incomplete dominance*** using examples from videos shown in class or notes.

Complete dominance, co-dominance, and incomplete dominance are all different ways in which alleles can interact with each other if they are present on two chromosomes of a chromosome pair.

The simplest of these is **complete dominance***(mendellian inheritance)*, in which the dominant allele completely covers the expression of the recessive allele. This means that there can only be two different traits: dominant or recessive. For example, if having the ability to roll your tongue is created by a dominant allele (T), and lacking the ability is a recessive allele (t), then a child that inherits both dominant alleles (TT) will be able to roll their tongue, a child with one of each allele (heterozygous, Tt) will express the dominant trait and have the ability to roll their tongue. The only way the recessive phenotype (not being able to roll your tongue) is show is if an individual inherits BOTH alleles for the recessive trait, ie: they are homozygous recessive.

Co-dominance is a form of *NON-mendellian inheritance* and results from two alleles which are not dominant over the other, so they are both dominant and neither allele covers the expression of the other. Instead, the combination of both alleles results in a third trait which combines the original traits of both. For example, if the brown hair allele (B) in cows is co-dominant with the white hair allele (W), then a cow that inherits one of each allele (BW-a heterozygote) will express both traits (a new phenotype) and have a mixture of brown and white hair, or the "roan" coat colour.

Incomplete dominance is also a form of *NON-mendellian inheritance* results from two alleles which are dominant over the other, so they are both dominant and neither allele covers the expression of the other. In this case, the combination of both alleles results in a NEW third trait (new phenotype) which **BLENDS** the traits of both (instead of allowing the original traits to mix like co-dominance). For example, if the red flower allele (R) is incompletely dominant with the white flower allele (W), then a flower that inherits one of each allele (RW) will express both traits and have PINK flower petals.

11. A single gene controls the hair texture of guinea pigs. The allele for straight hair (H) is completely dominant over the allele for curly hair (h). If a breeder was to cross two hybrid guinea pigs that had both alleles, what is the probability of their offspring having curly hair? Show all your work.

Hybrid = heterozygous.

There is a 25% probability that their offspring will have curly hair.

	H	h
H	HH	Hh
h	Hh	hh

$\frac{1}{4} = 25\%$.

genotype	phenotype
HH	straight hair
Hh	straight hair
hh	curly hair

12. In snapdragons, flower color is controlled by incomplete dominance. The two alleles are red (R) and white (W). The hybrid trait (RW) is expressed as pink flowers. If a plant breeder was to cross a white plant with a pink plant, what is the probability that their offspring would have pink flowers? Show all your work.

There is a 50% probability that their offspring will have pink flowers.

	W	W
R	RW	RW
W	WW	WW

genotype	phenotype
RW	pink 50%
WW	white 50%

13. Human blood types are determined by co-dominant alleles (A and B). If a man with BB blood had children with a woman with AB blood, what is the chance that their children would have AA blood? Show all your work.

There is a 0% probability that their offspring will have AA blood.

this means $I^A I^A$, so 2 copies of the "A" allele. (no possible, given the parents)

	I^B	I^B
I^A	$I^A I^B$	$I^A I^B$
I^B	$I^B I^B$	$I^B I^B$

genotype	phenotype
$I^A I^B$	type-AB
$I^B I^B$	type-B

14. Distinguish between ***positive, negative, and neutral mutations***. *(provide examples to support your answer)*

Each type of mutation results from a change in the base pair sequence of a DNA molecule. The difference between them is the effect that they have on the protein created by the gene. ***Positive mutations*** modify the gene so that it creates a protein with ***better function*** than the original protein. *For example bacteria that develop antibiotic resistance. The bacteria that are able to survive and reproduce after being treated with antibiotics have a mutation which makes them resistant to the effects of the antibiotic, therefore they survive which is an improved function.*

Negative mutations modify the gene so that it creates a protein with ***worse function*** than the original (or perhaps even no function). *For example individuals with sickle cell anemia have a mutated form of the gene for a protein which affects their red blood cells. It changes the shape of the cell and impairs it's function in the body.*

Neutral mutations modify the gene but do not alter the protein, resulting in ***identical function*** to the original. *For example the Kermode Bear is a black bear with different fur color. NOT albino, just a different allele for the fur color gene*

15. What are the **3 Requirements for Natural Selection?**

i. The **population must show variation in the gene**, meaning there must be different versions of the gene (alleles) present in the population. *Eg. 2 different colors of Peppered Moths (light + dark)*

ii. **The trait/characteristic must be heritable**. Meaning it must be a genetic trait that is inherited by offspring such that the trait is able to be passed onto the next generation.

iii. The **environment must favor a particular variation of the gene**. That is to say that there must be a selection pressure which causes a version of the gene to be more successful than the other version, so that gene is "selected for" when members of the species survive, reproduce, and pass that gene along to their offspring.

16. Explain how **natural selection** results in the increasing abundance of selected alleles.

Natural selection results from differences in the survival and reproduction of organisms in a population as a result of a variety of selection pressures. Successful organisms, that is organisms whose combinations of alleles are 'selected' to give them any advantage over other members of their species, are more likely to survive and live long enough to reproduce. This means that their offspring are more likely to become part of the population, and the alleles that made them successful are more likely to be part of the next generation. Over time, generation after generation, this results in selected alleles becoming more and more common, while other alleles become less and less common.

17. Compare and contrast *(similarities and differences)* ***natural and artificial selection.***

Natural and artificial selection are both processes which result in genetic change in populations over time. That is, 'selected' alleles are successful and become more abundant within the population from each generation to the next. The difference between these processes comes from what selection pressures determine 'success.' **In natural selection, it is selection pressures** such as: environmental factors, disease, competition for food, mates and habitat which applies selection pressure to organisms, and results in populations which are well adapted for their particular environment. **In artificial selection, it is human choice** such as desire for particular colours of hair or size of fruits which applies selection pressure to organisms, and results in populations which are modified for a particular human purpose.

18. What are some of the **risks** of modern agricultural practices?

Modern agriculture emphasizes efficiency over other considerations, and as a result has become extremely productive. Most modern agriculture utilizes **monoculture** meaning that large numbers of the same crop or animal (often genetically identical or similar) is grown in as little space as possible. Some of the risks associated with this approach, however, include a reliance on monocultures of plants and animals with low genetic diversity that are vulnerable to same diseases, foods that are chosen for their productivity rather than their nutritional value, and a lack of consideration for the welfare (happiness, safety, and health) of food plants and animals.