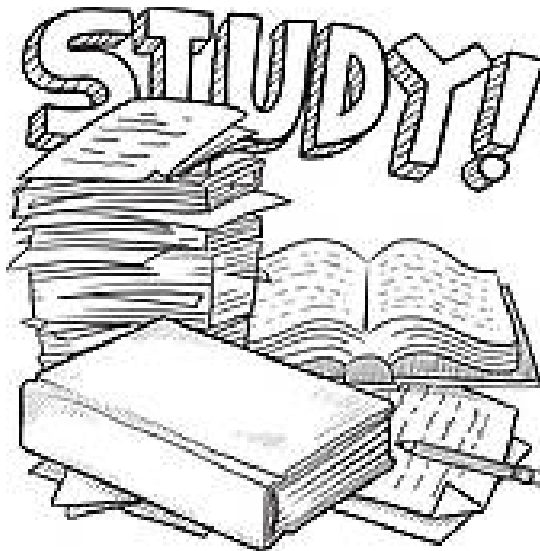


SCIENCE 10

FINAL EXAM REVIEW BOOK 2



DNA IS THE FOUNDATION FOR THE UNITY AND DIVERSITY OF LIVING THINGS

NAME: _____

BLOCK: _____

Study Checklist

This review booklet is by no means a "practice final". It is a collection of practice questions on each unit, meant to guide your final exam studying and prepare you for the types of questions you are likely to see. DO NOT treat this booklet as a practice test. If you're stuck on a question, look it up and ask for help! DO NOT go straight to the answer key when you come across a question you cannot remember how to do. Difficult questions SHOULD guide your study! Always look up a concept in your class notes if you are stuck, then attempt the question again.

BEFORE beginning this booklet you should:

- read through your class notes booklet on *each topic*
- make your own "quick summary page" of important formulas & key concepts for the unit
- review quizzes & tests from the unit to recall strengths & weaknesses (*a great study method would be to re-do old quizzes & tests on a separate piece of paper*)

WHILE working through this booklet you should:

- look up concepts & example problems in your class notes when you come across a problem you are stuck on
- make a list of "questions to ask my teacher" so you can come to class and use your time efficiently.

Questions I'm having difficulty with:

Page	Question Number #	Topic

Biology Summary

ESSENTIAL QUESTION How is DNA the foundation for unity and diversity of living things?

TOPIC 1.1:

How does an understanding of DNA help us investigate living things?

- The variation in living things we see around us is due to DNA.
- DNA is made of many nucleotides linked together in a specific order.
- DNA exists in chromosomes, which contain thousands of genes.
- The structure of DNA is important to passing on genetic information.
- The different genetic make-up of organisms is reflected in the diversity of life.

Key Terms

DNA	nucleotide
protein	chromatin
chromosome	gene
allele	karyotype
species	population
nitrogenous bases	
complementary bases	
homologous chromosome	



TOPIC 1.2:

How is hereditary information passed from one generation to the next?

- Genes pass on inherited traits from parent to offspring.
- Punnett squares show the probability of offspring inheriting specific traits.
- Both alleles are expressed in codominance.
- In incomplete dominance, alleles are neither dominant nor recessive.
- Some inherited traits are due to alleles on the sex chromosomes.

Key Terms

genetics	traits	dominant
recessive	phenotype	genotype
homozygous	heterozygous	codominance
incomplete dominance		sex-linked traits



TOPIC 1.3:

How can natural and artificial selection influence changes in populations?

- DNA mutations produce genetic diversity within a population.
- Natural selection favours traits that make an organism better suited to its environment.
- Natural selection can lead to the formation of new species.
- Environmental factors can cause mutations.
- Humans select desired characteristics in organisms to be passed on to the next generation.

Key Terms

mutation	selective advantage	natural selection
adaptation	adaptive radiation	extinction
mutagen	carcinogen	artificial selection
monoculture		

TOPIC 1.4:

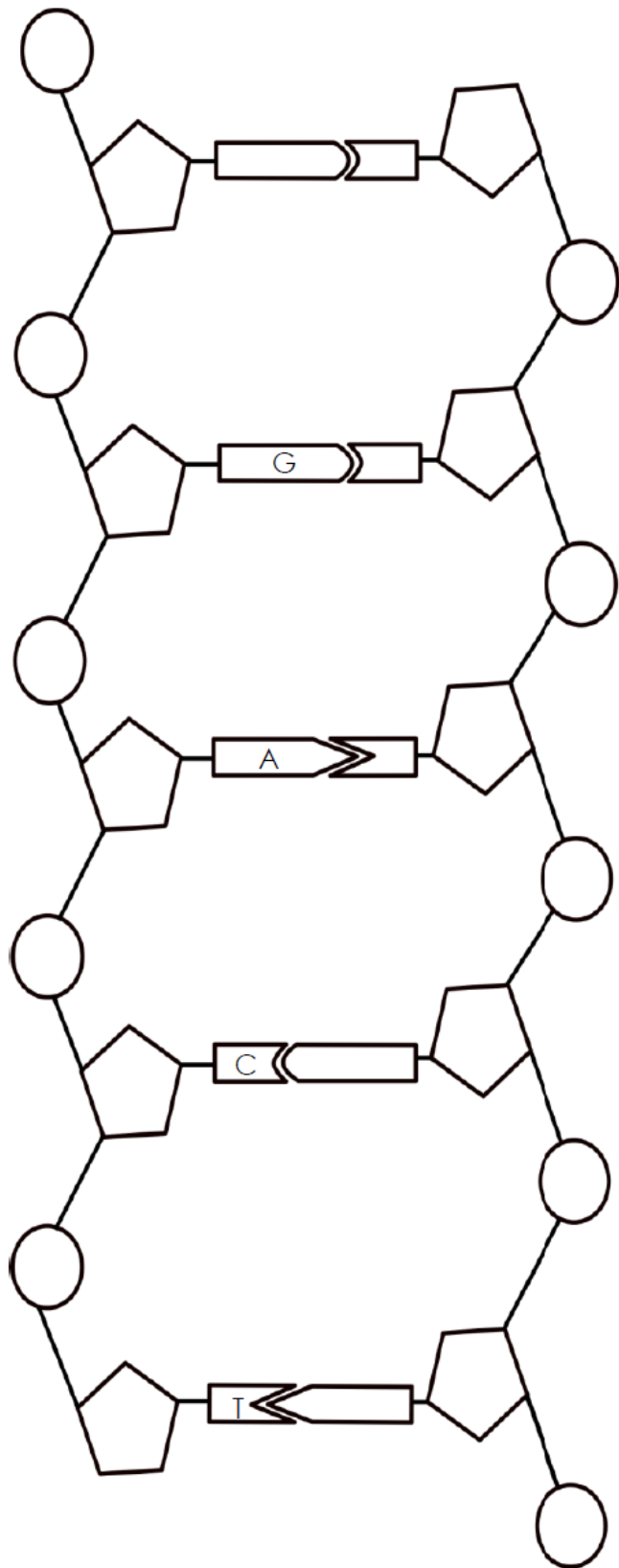
How and why are the genes of organisms manipulated?

- DNA of a living cell can be copied, modified, and inserted into another organism.
- DNA technology has many uses.
- The use of biotechnology has some risks and raises some ethical issues.

Key Terms

biotechnology	cloning
gene cloning	recombinant DNA
artificial insemination	in vitro fertilization (IVF)
gene therapy	

The Structure of DNA



1. Complete the following tasks using the DNA illustration.

- Color all of the phosphate groups pink.
- Color the deoxyribose sugars purple.
- Draw a square around a nucleotide.
- Draw a circle around a base pair.
- Color each adenine green and label it with an A.
- Color each thymine orange and label it with a T.
- Color each cytosine blue and label it with a C.
- Color each guanine yellow and label it with a G.

2. Circle the full name of DNA.

Deoxyribonucleic acid
Ribonucleic acid
Mononucleic acid

3. Draw a line through the part below that is NOT one of the 3 parts of a nucleotide.

Deoxyribose
Ribose
Phosphate group
Nitrogenous base

4. Circle one word from each column that best describes the shape of DNA.

<u>First Word</u>	<u>Second Word</u>
Single	Helix
Double	Line

5. Circle the part(s) of the nucleotide that make up the sides of a DNA molecule.

Sugar Phosphate group Nitrogen base

6. Circle the part(s) of the nucleotide that make up the center of a DNA molecule.

Sugar Phosphate group Nitrogen base

7. Complete the base pairing rules.

A pairs with _____.
C pairs with _____.

Directions: Read the statements below. Determine if the statement is true or false. If the statement is true, write a T in the space provided. If the statement is false, write an F in the space provided and explain why it is false.

____ 8. Cells will always have the same amount of cytosine and guanine bases in the DNA molecule.

____ 9. Cells will always have the same amount of cytosine and adenine bases in the DNA molecule.

____ 10. Cells will always have the same amount of cytosine and thymine bases in the DNA molecule.

11. One side of a DNA molecule contains the following sequences of bases. Write the complementary sequence of each DNA strand in the space provided.

A	T	C	G	G	T

G	C	C	A	A	T

C	C	A	T	G	A

CHALLENGE

Consider the bases that make up a DNA molecule. If 10% of the bases are thymine, what percentage of the bases would be adenine? Circle your answer.

- 10%
- 20%
- 40%
- 80%

Consider a different DNA molecule. If 15% of the bases are cytosine, what percentage of the bases would be adenine? Circle your answer.

- 15%
- 30%
- 35%
- 70%

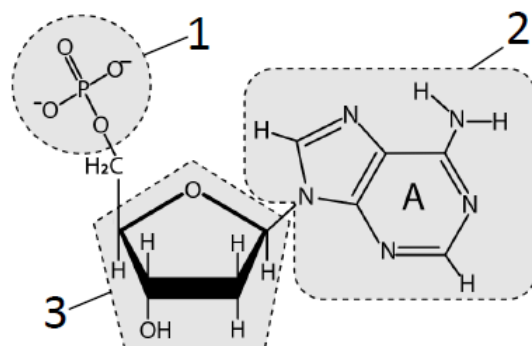
DNA STRUCTURE

TASK 1: Fill in the Blanks

- Purines are made up of a _____ ring.
- Adenine and guanine are both _____.
- The _____ groove occurs where the two sugar-phosphate backbones are further apart.
- Guanine forms _____ hydrogen bonds with its complementary nitrogenous base.
- _____ is a nitrogenous base found in RNA but not DNA.
- Guanine bonds to _____.
- The "A" in DNA stands for _____.
- The sugar found in DNA is _____.
- Thymine and _____ both can bond with adenine.
- The 3-D shape of DNA is a _____.
- A single-ringed sugar with five carbons is called a _____ sugar.
- Thymine bonds to _____.
- Nitrogenous bases that bond with one another are considered _____.
- _____ bonds link nucleotides together.

TASK 2: Diagram Analysis

Analyse the diagram to answer the questions below.

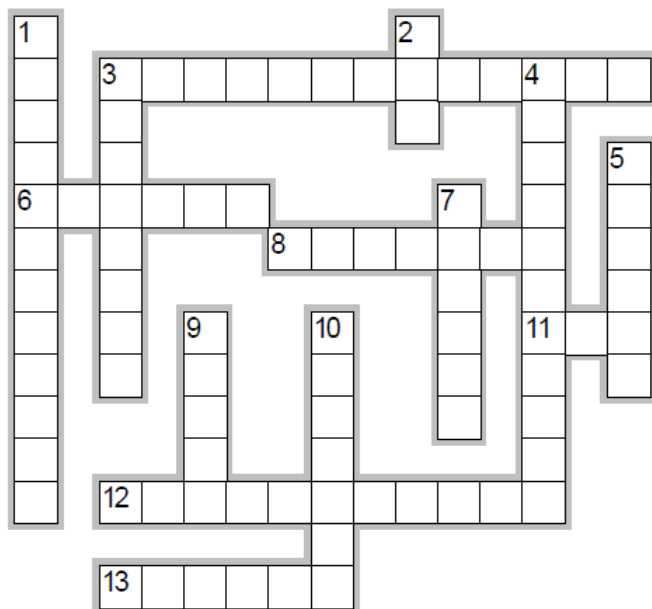


- Is the nucleotide above a DNA or RNA nucleotide, and how do you know? _____

- Label 1, 2 and 3 in the diagram above.
 1 _____
 2 _____
 3 _____
- Is the base a purine or a pyrimidine and why?

- Which carbon is the phosphate group attached to? _____
- Which carbon is the nitrogenous base attached to? _____

TASK 3: Crossword



ACROSS

- The chemical bonds between nitrogenous bases.
- A nitrogenous base with two rings.
- Cytosine bonds with this nitrogenous base.
- Adenine forms _____ hydrogen bonds with its complementary base.
- Cytosine and thymine.
- Pyrimidines have a _____ ring.

DOWN

- The orientation of the two DNA strands in a double helix.
- The molecule that encodes hereditary information.
- The functional group attached to the 3' carbon of the sugar.
- These units join together to form strands of DNA and RNA.
- _____ and Crick are the two scientists who discovered the 3D structure of the DNA molecule.
- The sugar found in RNA.
- The _____ groove occurs where the two sugar-phosphate backbones are close together.
- This nitrogenous base bonds to adenine.

Intro to Genetics & DNA

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

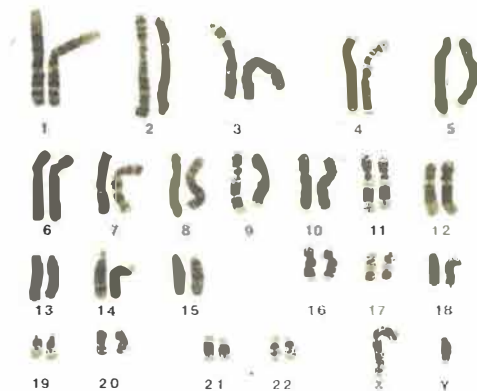
1. Think about a time you have seen a flock of Canada geese flying overhead. If you could examine the geese closely, would they look identical? Would they be genetically identical? Explain your answers. **PA C**
2. Describe the structure of DNA. **C**
3. What is the role of DNA in cells? **C**
4. Suppose a section of DNA has 27 percent thymine (T). **PA**
 - a) What percentage of cytosine (C) does it have?
 - b) What percentage of adenine (A) does it have?
 - c) What percentage of guanine (G) does it have?
5. What is a genome? **PA**
6. Using a diagram or flowchart, illustrate the relationships among nucleotide, DNA, gene, allele, chromatin, and chromosome. **C**
7. Why is the word *homologous* used to describe chromosome pairs, rather than the word *identical*? **PA**
8. How are homologous chromosomes alike? How are they different? Make a diagram to help explain your answer. **PA C**
9. Draw and label a karyotype for an organism that has three pairs of homologous chromosomes. **PA C**
10. Why are the X and Y chromosomes commonly referred to as the sex chromosomes? **PA**
11. How does DNA replication ensure that daughter cells can produce the same proteins? **PA**

Connecting Ideas

12. Use a graphic organizer to show the relationships among the terms *biodiversity*, *genetic diversity*, *species diversity*, and *ecosystem diversity*. **PA C**
13. What is the difference between a gene and an allele? How is each related to diversity among living things? **PA**

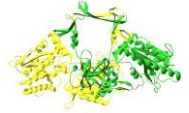
Making New Connections

14. The human genome contains about 3.0×10^9 pairs of bases. Humans have approximately 21 000 genes, and a typical gene has 3000 base pairs. Suppose that the genome is a railway track and each base pair is a railway tie. If each railway tie is 1 m from the next, how many kilometres long is the track? Given this information, how much of the human genome consists of DNA that does not code for proteins? **AI**
15. The image below shows chromosomes in a human cell. **PA**
 - a) What is this representation called and how is it prepared?
 - b) Identify the sex of the individual.
 - c) Does this individual have the correct number of chromosomes? How do you know?





Protein Synthesis Practice



I can statements for Protein Synthesis

- I can **model** the structure of DNA and **describe** the importance of it within our cells.
- I can **construct an explanation** of how genes code for proteins.

(____ points)

1. Here is one half of a DNA strand. Complete the other half by writing the **complementary base pairs**.

A-T-G-C-C-A-T-A-T-G-G-G-T-A-A

2. You just wrote in the template strand of DNA. Use the template strand to transcribe a strand of **mRNA**.

3. Write down the **tRNA anti-codons** that pair with the mRNA strand.

4. Use your codon wheel to write down the correct **amino acid sequence** from the mRNA strand you created.

5. How can there be so many proteins when there are only 20 amino acids?

6. What are the stop codons? What do these tell us? Be **specific**.

7. What is the start codon? What does this mean? Be **specific**.

8. What is a codon? What strand do you find a codon on? Give an **example** of a codon.

9. What is an anticodon? On what strand can you find an anticodon?

10. What is the goal of transcription?

11. Where does transcription occur within the cell?

12. What is the goal of translation?

13. Where does translation occur within the cell?

14. Amino acids are put together by _____ bonds and form a(n) _____.

15. What strand do you look at in order to write down your amino acid sequence?

16. DNA: CAT CCA ACC ATA CCC CTA TAC CCA TAT CCT CCC ATT AAA CCG

mRNA: _____

A.A.: _____

17. DNA: AGATAA AGA CCA GCA ACA TAATAC CTC TTA ACA CTC CTC CGA TGA ACT

mRNA: _____

A.A.: _____

18. DNA: TACCTTGGGGAATATCTTCGATGAATCCGTACACGCTGGACGGTACTCGCC ATC

mRNA: _____

A.A.: _____

19. DNA: TAA ACT CGG TAC TAG ATC TAA CTA GCT TTA CCC ATC

mRNA: _____

A.A.: _____

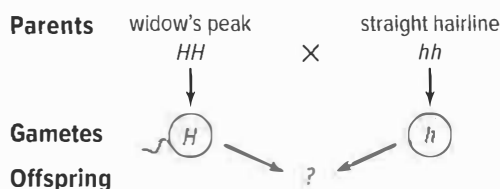
20. What would happen to the protein above if the sequence of DNA **changed by one base**?
Provide an **example** of how the protein would change using the above strand.

Genes & Inheritance

Questioning and Predicting Planning and Conducting Processing and Analyzing Evaluating
Applying and Innovating Communicating

Understanding Key Ideas

1. Explain how Mendel used selective breeding to learn more about heredity.
2. In terms of experimental design, why was it important that Mendel used true-breeding plants to explore patterns of inheritance?
3. Explain the differences between the following sets of terms and give an example of each term:
 - a) dominant and recessive
 - b) genotype and phenotype
 - c) homozygous and heterozygous
4. The diagram below represents the genotypes of two parents and one gamete from each parent.



- a) What is the genotype of the offspring?
 - b) What is the phenotype of the offspring? Explain your reasoning.
5. Suppose that two siblings both have attached earlobes, and their parents have unattached earlobes. Unattached earlobes are represented as E , and attached earlobes are represented by e . What are the genotypes of the parents? Explain your reasoning.
 6. Copy the Punnett square into your notebook. The ability of a person to roll his or her tongue is dominant (T), and the inability is recessive (t). Fill in the blank genotypes and describe the phenotypes for each.

	T	t
t	Tt	
t	Tt	

7. In pigeons, the checker pattern of feathers (F) is dominant to the non-checker pattern (f). Suppose a checkered pigeon with the genotype Ff mates with a non-checkered pigeon. Draw a Punnett square to predict the genotypes of their offspring.
8. A white-flowered plant is crossed with a red-flowered plant. What is the likely mode of inheritance if the offspring produced are
 - a) plants with pink flowers?
 - b) plants with red flowers?
9. How does sex-linked inheritance occur?

Connecting Ideas

10. The Punnett square shows the genotype of the female parent and the genotypes of the offspring.

	?	?
X^b	X^bX^b	X^bY
X^b	X^bX^b	X^bY

X^B = Normal

X^b = Red-green colour vision deficiency

Y = Y chromosome

- a) What is the genotype of the male parent?
- b) What is the phenotype of the male parent?

Making New Connections

11. Sometimes breeders of plants and animals need to know if a plant or animal that has a dominant phenotype has a genotype that is homozygous dominant or heterozygous. One way to determine this is by doing a test cross. A test cross involves
 - mating the individual of unknown genotype with an individual who is homozygous recessive for the trait
 - analyzing the phenotypes of the offspring.
 Explain how this helps breeders identify the unknown genotype. Use a Punnett square to work through possible crosses.

SHOW what you KNOW PUNNETT SQUARES

Name: _____

Date: _____

1. Fill in the missing parts of the Punnett Square.

	B	B
B	BB	
b		Bb

	B	B
b		
b		

	B	b
	BB	Bb
	Bb	bb

Answer the following questions.

2. If an individual has genotype Dd, they are ____ ?

- a. heterozygous dominant
- b. homozygous dominant
- c. heterozygous recessive
- d. homozygous recessive

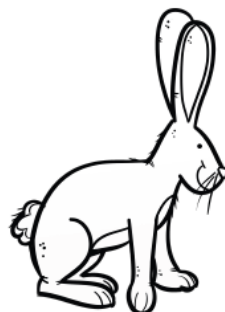
3. An organism's genetic makeup (alleles) is known as its _____.

4. An organism's physical appearance is known as its _____.

5. In a certain pepper plant, hot flavor is dominant (H) to mild (h) flavor. If you cross two heterozygous dominant plants, what percentage of the offspring will have hot flavor?



6. Brown fur (B) is dominant over white fur (b) in rabbits. What is the probability of brown fur in offspring between a heterozygous dominant brown rabbit and a homozygous recessive white rabbit?



Genetics Packet ~ Punnett Square Practice

Basics

1. The following pairs of letters represent alleles of different genotypes. Indicate which pairs are **Heterozygous** and which are **Homozygous**. Also indicate whether the homozygous pairs are **Dominant** or **Recessive** (*note **heterozygous** pairs don't need either dominant nor recessive labels.)

A. BB = _____

D. gg = _____

B. Bb = _____

E. aa = _____

C. Gg = _____

F. Ee = _____

2. In humans, brown eye color (B), is dominant over blue eye color (b). What are the **phenotypes** of the following genotypes?

A. Bb = _____

B. BB = _____

C. bb = _____

Monohybrid Crosses with Complete Dominance

3. A heterozygous smooth pea pod plant is crossed with a wrinkled pea pod plant. *There are two alleles for pea pod, smooth and wrinkled. Use R for seed texture. Predict the offspring from this cross.*

a. What is the genotype of the parents? _____

b. Set up a Punnett square with possible gametes.

c. Fill in the Punnett square for the resultant offspring.

d. What is the predicted genotypic ratio for the offspring? _____

e. What is the predicted phenotypic ratio for the offspring? _____

f. If this cross produced 50 seeds how many would you predict to have a wrinkled pod?

4. In humans, achondroplasia “dwarfism” (D) is dominant over normal (d).

A homozygous dominant (DD) person dies before the age of one.

A heterozygous (Dd) person is dwarfed. A homozygous recessive individual is normal.

A heterozygous dwarf man marries a heterozygous dwarf woman...

a. What is the probability of having a normal child? _____

b. What is the probability that the next child will **also** be normal? _____

c. What is the probability of having a child that is a dwarf? _____

d. What is the probability of having a child that dies at one from this disorder? _____

5. In humans, free earlobes (F) is dominant over attached earlobes (f). If one parent is homozygous dominant for free earlobes, while the other has attached earlobes, can they produce any children with attached earlobes?

6. In humans widow's peak (W) is dominant over straight hairline (w). A heterozygous man for this trait marries a woman who is also heterozygous.

a. List possible genotypes of their offspring.

b. List the phenotypic ratio for their children.

Incomplete Dominance

12. Cross two pink Four o'clock flowers (incomplete dominance). Use R = red, W = white.

a. Complete a Punnett square for this cross.

b. What is the predicted genotypic ratio for the offspring?

c. What is the predicted phenotypic ratio for the offspring?

13. In humans straight hair (SS) and curly hair (CC) are incompletely dominant, that result in hybrids who have wavy hair (SC). Cross a curly hair female with a wavy haired male.

a. Complete a Punnett square for this cross.

b. What are the chances of having a curly haired child? _____

c. What genotype(s) would you need to produce a curly haired child?

Codominance

14. A black chicken (BB) is crossed with a speckled chicken (BW). a. Show the Punnett square for the cross.

b. What is the predicted genotypic ratio for offspring? _____

c. What are the chances of having a white chick? _____

Codominance & Multiple Alleles

15. Human blood types:

a. What possible genotypes will produce B type blood?

b. What possible genotypes will produce A type blood?

c. What is the only genotype that will produce O type of blood?

d. What is the only genotype that will produce AB type of blood?

16. You are blood type O and you marry a person with blood type AB.

a. Complete a Punnett square for this cross.

b. List the possible blood types (phenotypes) of your offspring.

17. In the 1950's a young woman sued film star/director Charlie Chaplin for parental support of her illegitimate child. Charlie Chaplin's blood type was already on record as type AB. The mother of the child had type A (AO) and her son had type O blood (OO).

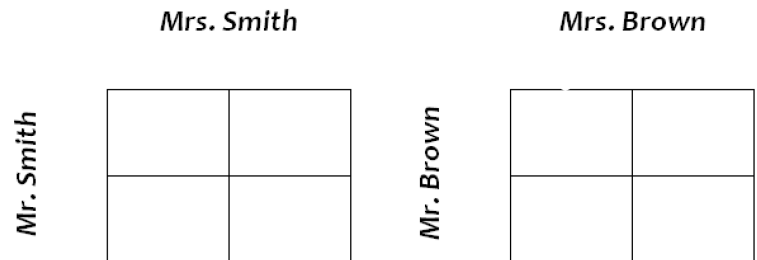
a. Complete a Punnett square for the possible cross of Charlie and the mother.

b. The judge ruled in favor of the mother and ordered Charlie Chaplin to pay child support costs of the child. Was the judge correct in his decision based on blood typing evidence? Explain why or why not. **refer to any Punnett squares to support your answer.*

18. Suppose two newborn babies were accidentally mixed up in the hospital. In an effort to determine the parents of each baby, the blood types of the babies and the parents were determined.

Baby 1 had type O, Mrs. Brown had type B, Mrs. Smith had type B, Baby 2 had type A, Mr. Brown had type AB, and Mr. Smith had type B.

a. Draw Punnett squares for each couple (you may need to do more than 1 square/ couple)



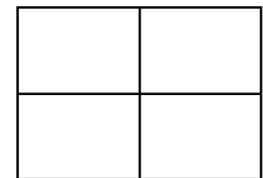
b. To which parents does baby #1 belong? Why? Hint you may want to refer to your Punnett squares.

Sex-Linked Traits

19. Hemophilia is a sex-linked trait. A person with hemophilia is lacking certain proteins that are necessary for normal blood clotting. Hemophilia is caused by a recessive allele so use “N” for normal and “n” for hemophilia. Since hemophilia is sex-linked, remember a woman will have two alleles (NN or Nn or nn) but a man will have only one allele (N or n). A woman who is heterozygous (a carrier) for hemophilia marries a normal man:

a. What are the genotypes of the parents?

b. Make a Punnett square for the above cross.



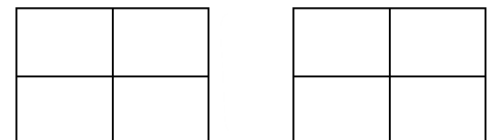
c. What is the probability that a male offspring will have hemophilia?

d. What is the probability of having a hemophiliac female offspring?

20. Can a color blind female have a son that has normal vision?

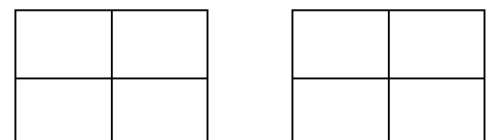
Color blindness is caused by a sex-linked recessive allele.

Do the Punnett square. *use N = normal vision and n = color blind



21. Muscular dystrophy is a sex-linked trait.

What **parental genotypes** could produce a female with muscular dystrophy? Do the Punnett square. *use M = normal muscles, and m = muscles missing dystrophin protein



NAME _____

Mutations Practice

(staff.fcps.net/einman/biology/MutationsWS.doc)



Deletion, Insertion & Substitution

There are several types of mutation:

- **Frameshift: DELETION** (a base is lost/deleted)
- **Frameshift: INSERTION** (an extra base is added/inserted)
 - Deletion & insertion may cause what's called a **FRAMESHIFT** mutation, meaning the **reading "frame"** changes, thus changing the amino acid sequence from this point forward
- **POINT MUTATION/SUBSTITUTION** (one base is substituted for another)
 - If a substitution **changes** the amino acid, it's called a **MISSENSE** mutation
 - If a substitution **does not change** the amino acid, it's called a **SILENT** mutation
 - If a substitution **changes the amino acid to a "stop,"** it's called a **NONSENSE** mutation



Complete the boxes below. Classify each as **Frameshift (Deletion or Insertion)** or **Substitution**.
(Hint: Deletion & Insertion will always be frameshift).

Original DNA Sequence: T A C A C C T T G G C G A C G A C T ...

mRNA Sequence: _____

Amino Acid Sequence: _____

Mutated DNA **Sequence #1** T A C A T C T T G G C G A C G A C T ...

What's the **mRNA** sequence? _____ (Circle the change)

What will be the **amino acid** sequence? _____

Will there likely be effects? _____ What type of mutation is this? _____

Mutated DNA **Sequence #2** T A C G A C C T T G G C G A C G A C T ...

What's the **mRNA** sequence? _____ (Circle the change)

What will be the **amino acid** sequence? _____

Will there likely be effects? _____ What type of mutation is this? _____

Mutated DNA **Sequence #3** T A C A C C T T A G C G A C G A C T ...

What's the **mRNA** sequence? _____ (Circle the change)

What will be the **amino acid** sequence? _____

Will there likely be effects? _____ What type of mutation is this? _____

Mutated DNA **Sequence #4** T A C A C C T T G G C G A C T A C T ...

What's the **mRNA** sequence? _____ (Circle the change)

What will be the **amino acid** sequence? _____

Will there likely be effects? _____ What type of mutation is this? _____

Original DNA Sequence: T A C A C C T T G G C G A C G A C T ...

mRNA Sequence: _____

Amino Acid Sequence: _____

Mutated DNA Sequence #5 T A C A C C T T G G G A C G A C T ...

What's the mRNA sequence? _____ (Circle the change)

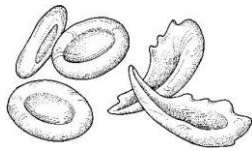
What will be the amino acid sequence? _____

Will there likely be effects? _____ What type of mutation is this? _____

1. Which type of mutation is responsible for **new variations** of a trait? _____

2. Which type of mutation does **not** result in an abnormal amino acid sequence? _____

3. Which type of mutation stops the **translation** of an mRNA molecule? _____



Sickle Cell Anemia

Sickle cell anemia is the result of a type of mutation in the gene that codes for part of the **hemoglobin** molecule. Recall that hemoglobin carries **oxygen** in your **red blood cells**. The mutation causes these red blood cells to become stiff & sickle-shaped when they release their oxygen. The sickled cells tend to get stuck in blood vessels, causing pain and increased risk of stroke, blindness, damage to the heart & lungs, and other conditions.

--- Analyze the DNA strands below to determine what amino acid is changed **AND** what type of mutation occurred

Normal hemoglobin DNA

C A C G T A G A C T G A G G A C T C ...

Normal hemoglobin mRNA

Normal hemoglobin AA sequence

Sickle cell hemoglobin DNA

C A C G T A G A C T G A G G A C A C ...

Sickle cell hemoglobin mRNA

Sickle cell hemoglobin AA sequence

4. What type of mutation is this? Please explain why.

Natural & Artificial Selection

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

1. Explain how mutations are a source of new alleles. PA
2. In a population of sparrows, most birds have a beak that is about 10 mm long. Some birds, however, have beaks that are slightly longer or slightly shorter than the average. Explain why this variation within the population is important in terms of survival of individual sparrows. PA C
3. Why does genetic variation make it possible for changes in populations to occur through natural selection? Explain your answer. E C
4. How does natural selection influence adaptation? PA
5. Explain how the ability of a population of insects to withstand the effects of an insecticide is an example of natural selection. C
6. Severe flooding results in a river changing course. Explain how a species of mouse that now lives on both sides of the river might eventually become two different species. What about a species of bird that now lives on both sides of the river? Explain. QP C
7. The Greater Antilles is a group of islands in the Caribbean. These islands include Cuba, the Dominican Republic, Haiti, Jamaica, and Puerto Rico. Each island is home to many lizard species that look very similar. DNA analysis shows that the similar-looking lizards from different islands are not alike genetically. Explain this. E C
8. Use a graphic organizer of your choice to identify and describe different types of mutagens and examples of each. C
9. Give an example of how people have used selective breeding to create a new variety of plant. Describe two possible consequences of the new variety. PA C

Connecting Ideas

10. Many antibacterial soaps and sprays are available without a prescription. Why might your doctor suggest that you avoid using (or restrict your use of) these products? AI

Making New Connections

11. The medium ground finches (*Geospiza fortis*) of the Galapagos Islands use their strong beaks to crush seeds. They prefer the small seeds that are abundant during wet years. During dry years, fewer small seeds are produced. Therefore, the finches also have to eat larger seeds, which are more difficult to crush. Researchers have measured the depth (dimension from top to bottom) of the finches' beaks, which relates to strength. The deeper the beak, the stronger it is. Use the graph to answer these questions. PA E
 - a) Years 1, 4, and 6 were drought years. Year 8 was wet. What do you notice about the average beak depth in the finch population during dry years compared with wet years?
 - b) How do the data relate to selective pressure and natural selection?

Changes in Beak Depth of *Geospiza fortis* over Eight Years



Biology Review

What Do You Know?

Connecting to Concepts

Visualizing Ideas

1. Study the photo here. How does DNA account for both the similarities and differences among the different varieties of apples?



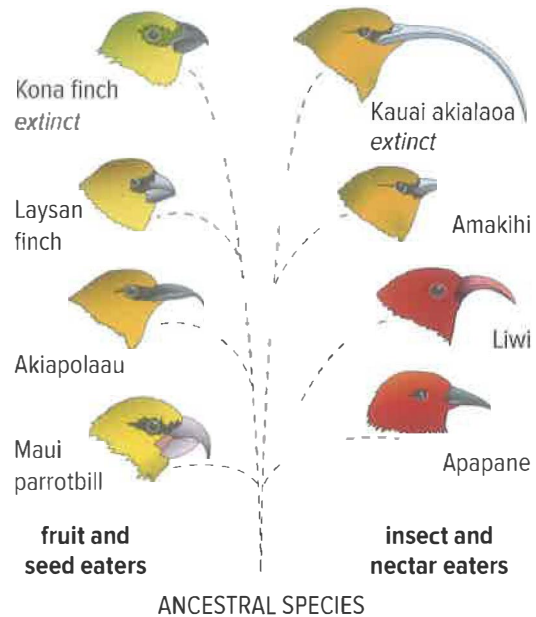
2. Suppose you have to explain the concept of homologous chromosomes to a Grade 6 class. How could you use the diagram on the right as part of your explanation? What labels would you add?



3. The diagram below shows the results of two crosses. Explain the results and the genetic principle that is illustrated.



4. The image at the top of the next column shows what happened over time to a group of birds called honeycreepers after an ancestral species reached the Hawaiian Islands. Each island has different biotic and abiotic conditions. Identify and describe the concepts shown.



Using Key Terms

5. Create a table with three columns. In the first column, list all the key terms from this unit. In the second column, record a definition for each term, written in your own words. In the third column, sketch or draw a small picture that can help you remember the term and its meaning.
6. In a format of your choice, show how the term *DNA* relates to following terms from this unit:
 - gene
 - species
 - population
 - traits
 - mutation
 - natural selection
 - adaptation
 - adaptive radiation
 - artificial selection
 - monoculture
 - biotechnology

Communicating Concepts

7. Scientists often describe the structure of DNA by comparing it to a ladder. Draw a DNA molecule and use the drawing to explain how DNA is similar to a ladder. Then explain the limitations of this comparison.

- 8.** DNA sequences in a genome are compared to letters strung together in a book. Develop another analogy for how DNA, chromosomes, genes, and nucleotides are related.
- 9.** Sketch a small section of DNA. Use the sketch to describe how DNA's complementary nature enables accurate replication.
- 10.** "The sex chromosomes in a human are a homologous pair." Do you agree or disagree with this statement? Explain why.
- 11.** Distinguish between the following pairs of terms using a definition and an example.
- homozygous and heterozygous
 - dominant and recessive
- 12.** Given the phenotype of an individual, can you determine its genotype? Explain.
- 13.** Since Mendel performed his experiments with pea plants, scientists have discovered that there are more complex patterns of inheritance. Use examples and diagrams to illustrate the differences among the following mechanisms:
- dominance
 - incomplete dominance
 - codominance
 - sex-linked inheritance
- 14.** In a Venn diagram, compare and contrast natural selection and artificial selection.
- 15.** Evolution is the process of biological change over time based on the relationships between species and their environments. Summarize how genetic variation is involved in biological change over time.
- 16.** Make a table to show three examples of transgenic organisms and describe their practical application.
- 17.** Make a flowchart to show the steps involved in gene cloning.
- 18.** There are many benefits to biotechnology, but there are also ethical concerns. Use a concept map to illustrate some of the benefits and concerns that are associated with the biotechnology topics discussed in this unit.

What Do You Know?

Connecting to Competencies

Developing Skills

- 19.** A female fruit fly that is homozygous dominant for red eyes is crossed with a white-eyed male fruit fly. Use a Punnett square to predict the genotype(s) and phenotype(s) of their offspring.
- 20.** Explain why there are varieties of houseflies that are not killed by a popular insecticide. Under what conditions is such resistance considered to be a selective advantage?
- 21.** Outline a breeding program that would help you develop a cow that produces more milk.
- 22.** Choose a species of animal, and describe two of its traits. Explain the adaptive value of both traits. Include a sketch with your explanation.
- 23.** Research a drug or other form of medical treatment that was developed using recombinant DNA technology. Describe what it is, its use, and any risks or controversies that are associated with its use.

Thinking Critically and Creatively

- 24.** Describe an experimental approach to determine which of two alleles for a gene is recessive.
- 25.** Develop a plot for a movie or play that involves the use of gene therapy. Ensure that your ideas are scientifically plausible.

Biology Review *(continued)*

26. In radishes, colour is controlled by two alleles, one for red colour and one for white colour. Inheritance of these alleles shows incomplete dominance. The photographs below show the phenotype for each possible colour: red, purple, and white. What phenotypic ratio would you expect from crossing two heterozygous radish plants?



27. State whether each of the following examples demonstrates artificial selection. Explain why or why not.
- A person breeds long-furred Persian cats.
 - A farmer increases the variability in the fat content of different plant species.
 - Over time, plants develop chemical defences that deter herbivores.
 - Crops are bred to be pest-resistant.

Understanding Big Ideas

Making New Connections

28. Imagine that you are a journalist writing an article for the magazine *Ethics in a Changing World*. You have been asked to research and explain the social and environmental implications of current genetics research. Suggested topics include gene cloning, transgenic crops to reduce hunger, in vitro fertilization, and gene therapy. Choose one topic and write an article on what you find.

Applying Your Understanding

29. A black-haired true-breeding guinea pig is crossed with a white-haired true-breeding guinea pig. All the offspring have black hair.
- Which hair colour is dominant?
 - What are the genotypes and phenotypes of the parents?
 - What are the genotypes and phenotypes of the offspring?
30. A yellow-haired rat is mated with a black-haired rat. Over time, the rats produce 45 black offspring and 52 yellow offspring. From these results, determine the *probable* genotypes of the parents and offspring. How could you determine the dominant allele?
31. Sickle cell anemia is an autosomal recessive disorder that results in the formation of abnormally shaped red blood cells. Write the genotypes for the following individuals:
- a person with sickle cell anemia
 - a person carrying the sickle cell allele
 - a homozygous person with a normal phenotype
32. Hemophilia is a disease that is due to an X-linked recessive allele. A man and woman who do not have hemophilia have a son who does have hemophilia. Explain how this can occur. If they have a daughter, could she have hemophilia? Explain.

Thinking Critically and Creatively

33. Sea stars eat clams by pulling apart the two halves of a clam's shell. Create a sequence of drawings to show how this could result in natural selection of muscle size in clams.
34. Adaptive radiation often occurs on islands. Would you expect to find more adaptive radiation on islands that are remote from the mainland, like small Pacific islands, or islands that are close to the mainland, like Vancouver Island? Explain your answer.

- 35.** Explain the following observations from a scientific research study that involved finches (*Geospiza fortis*) on the Galapagos Islands.
- During a drought in 1977, a large percentage of *Geospiza fortis* finches died of starvation on the Galapagos island Daphne Major.
 - The 90 bird survivors in 1978 had a beak depth from about 9.4 mm to about 10.2 mm, which was greater than the beak depth of the finches that did not survive.
- 36.** Scientists at the University of Guelph produced genetically modified pigs. These pigs were given the name Enviropig™ because they were genetically altered so that less phosphorus was excreted in their waste. High levels of phosphorus in animal waste can enter streams and lakes and act as a pollutant.
- a) What is one advantage of developing these pigs?
 - b) What is a potential risk of these pigs being produced?
 - c) These pigs were being considered as a source of food. Should genetically modified food that is to be consumed by people be labelled as such? Provide a supporting statement for your opinion.
- 38.** Indoor tanning beds work by exposing people to artificial ultraviolet light. Researcher have found that this increases a person's risk of developing a deadly form of skin cancer, called melanoma, by 20%.
- a) What do you know about the link between ultraviolet light and cancer?
 - b) Several countries have passed laws to restrict the use of tanning beds by teenagers. What are the regulations in British Columbia for the use of indoor tanning beds? Do you think these regulations are strict enough, too strict, or not strict enough? Why?
- 39.** Write a paragraph that summarizes how you think society has been affected by biotechnology and what the impact has been to date. In your paragraph be sure to include examples and information that support your opinion.
- 40.** Choose a crop plant that is grown in British Columbia that has been genetically modified to be more resistant to disease. Research the economic and environmental impacts that growing this crop has had in B.C. Give your opinion as to whether the crop should continue to be grown in B.C. or not. Use evidence from your research to support your opinion.

Connect to Self and Society

- 37.** In Canada, individual grizzly bears and populations of grizzly bears are being isolated as humans expand their use of land that was previously used by the bears.
- a) If the grizzly bear were to become extinct, what might some of the economic, political, and social implications be for Canada?
 - b) How might wildlife corridors help the situation? (Wildlife corridors are routes designed to help animals cross busy highways safely in mountain parks.)
- 41.** With modern technologies, scientists can retrieve DNA from 5000 year old bones found in archeological digs. Recently some First Nations people have shared their DNA with scientists to see if there are connections with the DNA of people who lived in the same area thousands of years before. The results of these studies often show direct links between contemporary First Nations and their ancestors. In what ways does this research help to bring together Indigenous scientific knowledge and Western science?