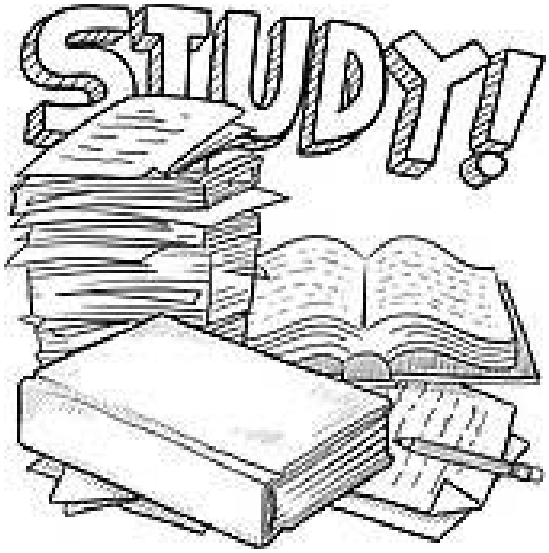
SCIENCE 10

FINAL EXAM REVIEW BOOK 2



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

NAME: Key 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 specifc 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:

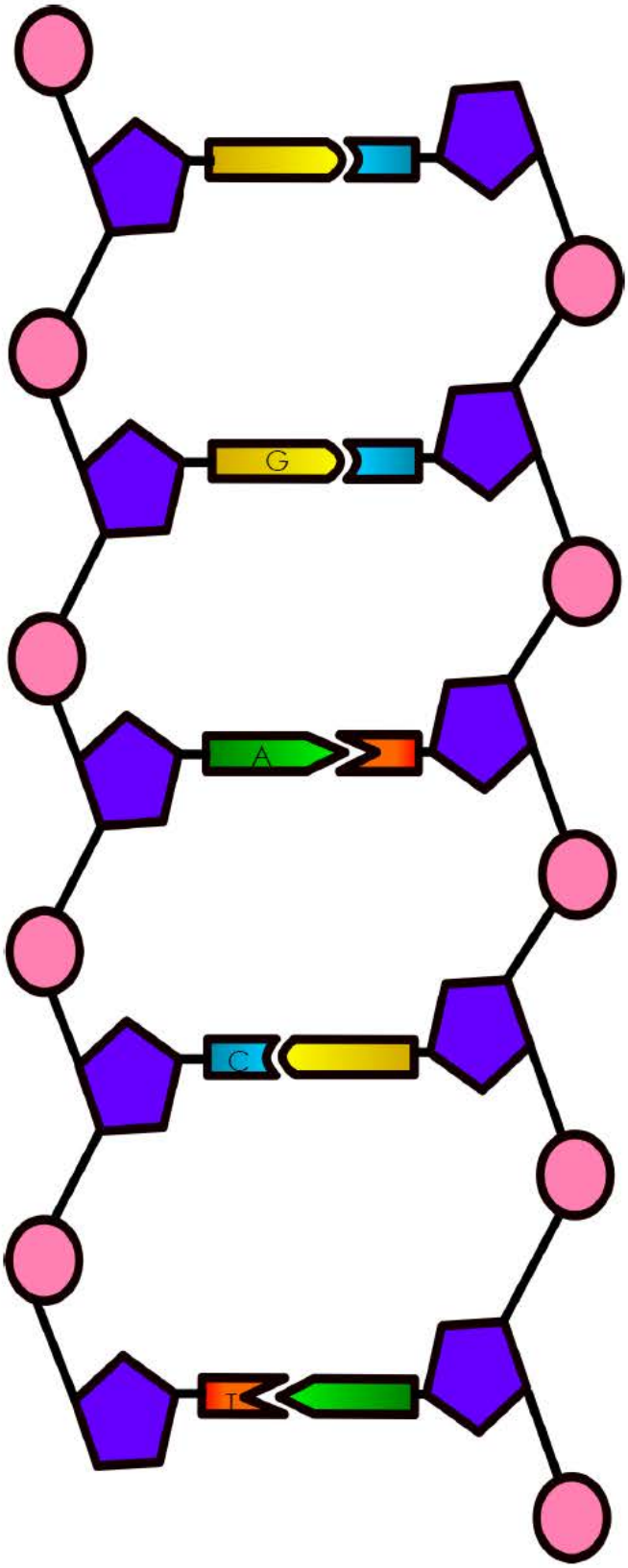
How and why are the genes of organisms manipulated?

- 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. Write the full name of DNA.

Deoxyribonucleic acid

3. List the 3 parts of a nucleotide.

Sugar
Phosphate group
Nitrogenous base

4. Use two words to describe the shape of a DNA molecule.

Double helix

5. List the two parts of a nucleotide that make up the sides of a DNA molecule.

Sugar
Phosphate group

6. Name the part of a nucleotide that makes up the center of a DNA molecule.

Nitrogenous base

7. List the base pairing rules.

A—T
C—G

8. Based on the DNA base pairing rules, would cells always have the same amount of cytosine and guanine molecules? Explain your answer.

Yes, because cytosine makes a pair with guanine. Therefore if you have a cytosine, you will also have a guanine.

9. Based on the DNA base pairing rules, would cells always have the same amount of cytosine and adenine molecules? Explain your answer.

No, because they do not pair with each other.

10. Based on the DNA base pairing rules, would cells always have the same amount of cytosine and thymine molecules? Explain your answer.

No, because they do not pair with each other.

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
T	A	G	C	C	A

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

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

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?

T = 10%
A = 10%
} 20%

C = 40%
G = 40%
} 80%

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

T = 35%
A = 35%
} 70%

C = 15%
G = 15%
} 30%

DNA STRUCTURE

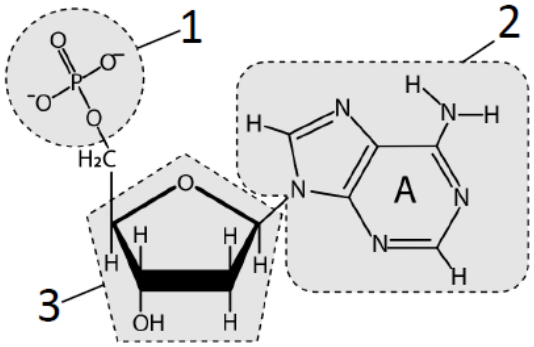
ANSWER KEY

TASK 1: Fill in the Blanks

1. Purines are made up of a DOUBLE ring.
2. Adenine and guanine are both PURINES.
3. The MAJOR groove occurs where the two sugar-phosphate backbones are further apart.
4. Guanine forms THREE hydrogen bonds with its complementary nitrogenous base.
5. URACIL is a nitrogenous base found in RNA but not DNA.
6. Guanine bonds to CYTOSINE.
7. The "A" in DNA stands for ACID.
8. The sugar found in DNA is DEOXYRIBOSE.
9. Thymine and URACIL both can bond with adenine.
10. The 3-D shape of DNA is a DOUBLE HELIX.
11. A single-ringed sugar with five carbons is called a PENTOSE sugar.
12. Thymine bonds to ADENINE.
13. Nitrogenous bases that bond with one another are considered COMPLEMENTARY.
14. PHOSPHODIESTER bonds link nucleotides together.

TASK 2: Diagram Analysis

Analyse the diagram to answer the questions below.



1. Is the nucleotide above a DNA or RNA nucleotide, and how do you know? It is a DNA nucleotide because there is a hydrogen bond instead of a hydroxyl attached to the 2' carbon.
2. Label 1, 2 and 3 in the diagram above.
   1 phosphate
   2 nitrogenous base / adenine / purine
   3 pentose sugar / deoxyribose
3. Is the base a purine or a pyrimidine and why? It's a purine because it has a double ring.
4. Which carbon is the phosphate group attached to? 5'
5. Which carbon is the nitrogenous base attached to? 1'

TASK 3: Crossword

ACROSS

3. The chemical bonds between nitrogenous bases.
6. A nitrogenous base with two rings.
8. Cytosine bonds with this nitrogenous base.
11. Adenine forms ___ hydrogen bonds with its complementary base.
12. Cytosine and thymine.
13. Pyrimidines have a ___ ring.

DOWN

1. The orientation of the two DNA strands in a double helix.
2. The molecule that encodes hereditary information.
3. The functional group attached to the 3' carbon of the sugar.
4. These units join together to form strands of DNA and RNA.
5. ___ and Crick are the two scientists who discovered the 3D structure of the DNA molecule.
7. The sugar found in RNA.
9. The ___ groove occurs where the two sugar-phosphate backbones are close together.
10. 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

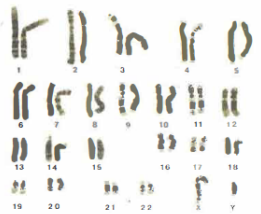
1. Think about a time you have seen a flock of Canada geese flying overhead. If you could examine the geese closely, would they look identical? Would they be genetically identical? Explain your answers. PA C
2. Describe the structure of DNA. C
3. What is the role of DNA in cells? C
4. Suppose a section 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?



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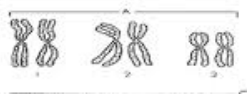
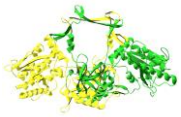
ANSWER KEY Intro to Genetics and DNA

1. No they wouldn't look identical. No the flock would not be genetically identical as they are the result of sexual reproduction.
2. DNA structure: double helix, two strands, like a ladder with a backbone made up of alternating sugar/phosphate and the rungs are the nitrogenous bases. 4 different bases adenine, thymine, cytosine, guanine, which form complementary pairs AT and CG. DNA is antiparallel.
3. DNA contains the instructions for the development and function of living things.
4. a) 23% b) 27% c) 23%
5. A genome is an organism's complete set of DNA, including all of its genes.
6. A nucleotide is a building block or subunit of DNA → a section of DNA that codes for a specific protein is called a gene → an allele is one of two or more alternative forms of a gene → chromatin is what we call DNA that is wrapped together with a protein called histone → tightly coiled chromatin is called a chromosome
7. One chromosome of each homologous pair comes from the mother (called a maternal chromosome) and one comes from the father (paternal chromosome). Homologous chromosomes are similar but not identical. Each carries the same genes in the same order, but the alleles for each trait may not be the same.
8. Alike - carries same genes in same order Different - one comes from father, one comes from mother, alleles for each trait may not be the same
9. → see diagram to the right



10. As they determine the sex of an individual, for ex. XX is a female and XY is a male
11. As it ensures that each copy of a cell has the same genetic information as the original cell.
12. OMIT
13. A gene is a specific section of DNA that codes for a particular protein. An allele is a different form of a gene. They are related to diversity of living things as there are variations in alleles that are then expressed as differences in individuals.
14. OMIT
15. a) A karyotype. Scientists take a picture of the chromosomes from one cell, cut them out, and arrange them using size, banding pattern and centromere position as guides. b) XY - male c) Yes as they have 23 pairs of chromosomes.

Protein Synthesis Practice



I <u>can</u> 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
T-A-C-G-G-T-A-T-A-C-C-C-A-T-T

2. You just wrote in the template strand of DNA. Use the template strand to transcribe a strand of **mRNA**. A-U-G-C-C-A-U-A-U-G-G-G-U-A-A

3. Write down the **tRNA anti-codons** that pair with the mRNA strand.
U-A-C-G-G-U-A-U-A-C-C-C-A-T-T

4. Use your codon wheel to write down the correct **amino acid sequence** from the mRNA strand you created.
Methionine-Proline-Tyrosine-Glycine-Stop

5. How can there be so many proteins when there are only 20 amino acids? The reason there are so many different types of proteins when there are only 20 amino acids is because, the amino acids can sequence themselves in different patterns, creating a different protein. This is kind of like letters in the alphabet forming many words.
6. What are the stop codons? What do these tell us? Be **specific**. The stop codons are: UGA,UAA, UAG. They tell us when the mRNA is done being transcribed from DNA.
7. What is the start codon? What does this mean? Be **specific**. AUG is the start codon. This tells the RNA polymerase when to start adding nucleotides to build the mRNA molecule to pair with the complementary strand of DNA.
8. What is a codon? What strand do you find a codon on? Give an **example** of a codon. A codon is a sequence of three bases (letters) found on the mRNA strand. An example of a codon is GUU. This codes for the amino acid Valine.
9. What is an anticodon? On what strand can you find an anticodon? An anticodon is a sequence of three bases (letters) found on the tRNA strand. This pairs with the codon sequence found on the mRNA strand.

10. What is the goal of transcription? The goal of transcription is to build a strand of mRNA from the complementary DNA template strand.

11. Where does transcription occur within the cell? Transcription occurs within the nucleus of the cell.
12. What is the goal of translation? The goal of translation is to build a protein.

13. Where does translation occur within the cell? Translation occurs in the cytoplasm of the cell.
14. Amino acids are put together by peptide bonds and form a(n) protein.

15. What strand do you look at in order to write down your amino acid sequence? In order to write down the amino acid sequence, you look at the mRNA strand to get the codons which code for the amino acids that build the protein.

16. DNA: CAT CCA ACC ATA CCC CTA TAC CCA TAT CCT CCC ATT AAA CCG
mRNA: GUA GGU UGG UAU GGG GAU AUG GGU AUA GGA GGG UAA UUU GGC
A.A.: Val-Gly-Tryp-Tyro-Gly-Asp-Meth-Gly-Iso-Gly-Gly-Stop

17. DNA: AGA TAA AGA CCA GCA ACA TAA TAC CTC TTA ACA CTC CTC CGA TGA
mRNA UCU AUU UCU GGU CGU UGU AUU AUG GAG AAU UGU GAG GAG GCU ACU
A.A. Ser-Iso-Ser-Gly-Arg-Cys-Iso-Meth-Glu-Asp-Cys-Glu-Glu-Ala-Thr

18. DNA TAC CTT GGG GAA TAT CTT CGA TGA ATC CGT ACA CGC TGG ACG GTA
mRNA AUG GAA CCC CUU AUA GAA GCU ACU UAG GCA UGU GCG ACC UGC CAU
A.A. Meth-Glu-Pro-Leu-Iso-Glu-Ala-Thr-STOP

19. DNA TAA ACT CGG TAC TAG ATC TAA CTA GCT TTA CCC ATC
mRNA AUU UGA GCC AUG AUC UAG AUU GAU CGA AAU GGG UAG
A.A. Iso-STOP

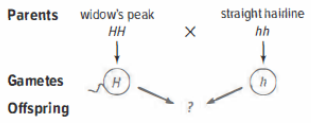
20. What would happen to the protein above if the sequence of DNA **changed by one base**? Provide an **example** of how the protein would change using the above strand.
Answers will vary here. If the amino acid sequence above changed by one base pair, the entire protein could change. For example, if a base was substituted for another base, it could change the amino acid sequence, changing the protein formed. If a base was added or deleted, there would be a shift in the sequence, and the majority of the sequence would change, changing the protein dramatically. Also, there is a chance nothing would change with the protein. For example, if AUU changed to AUC, it codes for the same exact amino acid and the protein would not change.

Genes & Inheritance

KI Questioning and Predicting | PS Planning and Conducting | AN Processing and Analyzing | EV Evaluating
AI Applying and Innovating | CO Communicating

Understanding Key Ideas

1. Explain how Mendel used selective breeding to learn more about heredity. KI
2. In terms of experimental design, why was it important that Mendel used true-breeding plants to explore patterns of inheritance? PS
3. Explain the differences between the following sets of terms and give an example of each term: AN K
   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. AI C



   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. AI C
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. AI C

	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. CO
8. A white-flowered plant is crossed with a red-flowered plant. What is the likely mode of inheritance if the offspring produced are PA
   a) plants with pink flowers?
   b) plants with red flowers?
9. How does sex-linked inheritance occur? C

Connecting Ideas

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

	?	?
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. AI C

ANSWER KEY: Genes and Inheritance

1. He selectively breed pea plants with one another to study how traits were passed on from generation to generation.
2. True breeding plants are plants that will, when self fertilized, only produce offspring with the same traits. It was important he used this type of plant in his experiments so he knew what the genotype of the parent plants were before cross breeding further. This allowed him to better understand the processes at work from generation to generation.
3. a) A dominant allele produces a dominant phenotype in individuals who have one copy of the allele, which can come from just one parent. For a recessive allele to produce a recessive phenotype, the individual must have two copies, one from each parent. b) The genotype is the genetic information which is responsible for a particular trait. The phenotype is the physical expression, or characteristics, of that trait. c) Homozygous is when there are two copies of same allele (ex. HH = homozygous dominant or hh = homozygous recessive) and heterozygous is when there are two different alleles (Hh).
4. a) Hh b) widow's peak - dominant trait will be seen
5. The parents would need to have the genotype Ee as they both need to carry the recessive trait for it to potentially appear in the next generation.
6. genotypes: tt, tt phenotypes: inability to roll tongue
7. See diagram to the right

	F	f
f	Ff	ff
f	Ff	ff

8. a) incomplete dominance b) simple inheritance
9. Sex linked inheritance is when genetic information contained within the X or Y chromosome is passed on to the next generation.
10. a) X^bY b) red-green colour vision deficiency
11. By mating animals with a homozygous recessive animal you can use the resulting offspring to help figure out what the other parent contributed. For example if all of the animals in the next generation have the recessive trait then it is likely the other parent was also hh, if all of the offspring in the next generation have the dominant trait then it is likely that the parent is HH and if there is a mix of dominant and recessive animals then it is likely the parent is Hh.

SHOW what you KNOW

PUNNETT SQUARES

Name: Date:

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

	B	B
B	BB	BB
b	Bb	Bb

	B	B
b	Bb	Bb
b	Bb	Bb

	B	b
B	BB	Bb
b	Bb	bb

Answer the following questions.

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

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

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

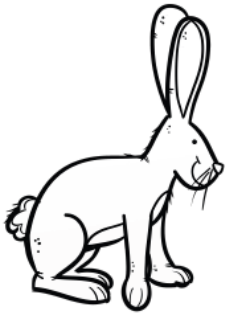
4. An organism's physical appearance is known as its ____phenotype____.

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?

	H	h
H	HH	Hh
h	Hh	hh

75%

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?



50%

	B	b
b	Bb	bb
b	Bb	bb

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 = __Homozygous dominant__

B. Bb = __Heterozygous__

C. Gg = __Heterozygous__

D. gg = _Homozygous recessive__

E. aa = _Homozygous recessive__

F. Ee = _Heterozygous_

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

A. Bb = __Brown eyes__

B. BB = __Brown eyes__

C. bb __blue eyes__

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? _Rr x rr____

b. Set up a Punnett square with possible gametes.

	R	r
r	Rr	rr
r	Rr	rr

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

d. What is the predicted genotypic ratio for the offspring? ___1 Rr : 1 rr__

e. What is the predicted phenotypic ratio for the offspring? ___1 smooth : 1 wrinkled___

f. If this cross produced 50 seeds how many would you predict to have a wrinkled pod? __25__

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…

	D	d
D	~~DD~~	Dd
d	Dd	dd

a.What is the probability of having a normal child? __1/3… 33.3%__

b.What is the probability that the next child will **also** be normal? __1/3… 33.3%__

each child is a new shot at the same punnett square!

c.What is the probability of having a child that is a dwarf? __2/3… 66.6%_____

d.What is the probability of having a child that dies at one from this disorder? __25%__

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?

No, the homozygous parent will give a dominant allele to each child keeping it from expressing the attached earlobe trait.

	F	F
r	Ff	Ff
r	Ff	Ff

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.

	W	w
W	WW	Ww
w	Ww	ww

a. List possible genotypes of their offspring.
WW, Ww, and ww

b. List the phenotypic ratio for their children.
Widow's peak and straight hairline

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.

	R	W
R	RR	RW
W	RW	WW

b. What is the predicted genotypic ratio for the offspring?
1RR : 2RW : 1 WW

c. What is the predicted phenotypic ratio for the offspring?
1 Red : 2 Pink : 1 White

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 wavyh aired male.

a. Complete a Punnett square for this cross.

	C	C
C	CC	CC
S	CS	CS

b. What are the chances of having a curly haired child? _50%__

c. What genotype(s) would you need to produce a curly haired child? __CC with CS or CC with CC__

Codominance

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

	B	B
B	BB	BB
W	BW	BW

b. What is the predicted genotypic ratio for offspring? ___1 BB : 1 BW____

c. What are the chances of having a white chick? __0%__

Codominance & Multiple Alleles

15. Human blood types:

a. What possible genotypes will produce B type blood? I^Bi (heterozygous) OR I^BI^B (homozygous dominant)

b. What possible genotypes will produce A type blood? I^Ai (heterozygous) OR I^AI^A (homozygous dominant)

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

d. What is the only genotype that will produce AB type of blood? I^AI^B

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

a. Complete a Punnett square for this cross.

	i	i
I^A	I^Ai	I^Ai
I^B	I^Bi	I^Bi

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

Type A or Type B

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.

	I^A	I^B
I^A	I^AI^A	I^AI^B
i	I^Ai	I^Bi

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.*

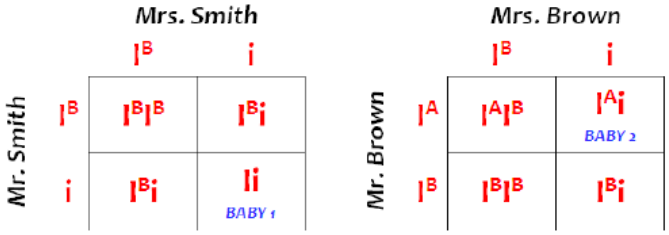
The judge was wrong!!

There is NO way Charlie Chaplin fathered the child in question because he doesn't have a recessive (i) allele to contribute to the child to make the child have type O blood.

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)
Baby 2 MUST belong to the Browns because Mr. Brown is the only parent with an A allele to contribute… then the rest works out as follows:



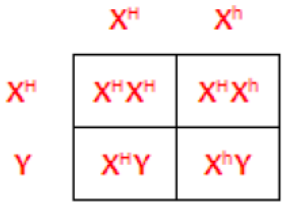
b. To which parents does baby #1 belong? Why? *Hint you may want to refer to your Punnett squares.*
Baby 1 must belong to the Smiths, because they are the only ones with the possibility of EACH having a recessive allele to pass down to the baby, Mr. Brown has type AB blood and therefore only has the dominant A and dominant B alleles – no recessive allele possible.

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? X^HX^h x X^HY

b. Make a Punnett square for the above cross.



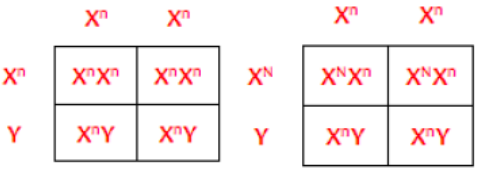
c. What is the probability that a male offspring will have hemophilia? 50%

d. What is the probability of having a hemophiliac female offspring? 0%

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

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

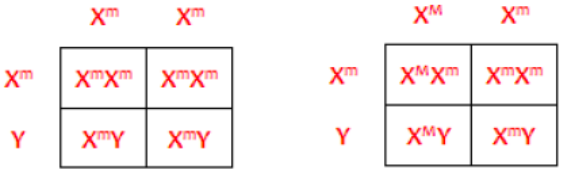
Do the Punnett square. ***use N = normal vision and n = color blind***



NO, if the mother has an affected X for colorblindness, she will pass that X chromosome on to her son, the son will receive a Y from his father so the only place he gets an X is from mom and that X will be affected if she is colorblind.

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***



Mom has to have at least one recessive allele and dad must HAVE muscular dystrophy (and therefore one recessive allele)

NAME _____ **Mutations Practice**

*(staff.fcps.net/**einman**/biology/**Mutations**WS.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: A U G U G G A A C C G C U G C U G A

Amino Acid Sequence: METHIONINE -TRYPTOPHAN - ASPARAGINE - ARGININE- CYSTEINE - (STOP)

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? A U G U A G A A C C G C U G C U G A (Circle the change)

What will be the amino acid sequence? METHIONINE -(STOP)

Will there likely be effects? YES What kind of mutation is this? SUBSTITUTION - NONSENSE

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? A U G C U G G A A C C G C U G C U G A (Circle the change)

What will be the amino acid sequence? METHIONINE - LEUCINE -GLUTAMIC ACID – PROLINE

Will there likely be effects? YES What kind of mutation is this? INSERTION - FRAME SHIFT

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? A U G U G G A A U C G C U G C U G A (Circle the change)

What will be the amino acid sequence? METHIONINE-TRYPTOPHAN-ASPARAGINE- ARGININE- (STOP)

Will there likely be effects? NO What kind of mutation is this? SUBSTITUTION – SILENT MUTATION

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? A U G U G G A A C C G C U G A U G A (Circle the change)

What will be the amino acid sequence? METHIONINE-TRYPTOPHAN-ASPARAGINE- (STOP)

Will there likely be effects? YES What kind of mutation is this? SUBSITUTION - NONSENSE

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

mRNA Sequence: A U G U G G A A C C G C U G C U G A

Amino Acid Sequence: METHIONINE-TRYPTOPHAN-ASPARAGINE-ARGININE-CYSTEINE- (STOP)

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

What will be the corresponding mRNA sequence? A U G U G G A A C C C U G C U G A

What will be the amino acid sequence? METHIONINE-TRYPTOPHAN-ASPARAGINE- PROLINE - ALANINE

Will there likely be effects? YES What kind of mutation is this? DELETION – FRAME SHIFT

1. Which type of mutation is responsible for new variations of a trait? FRAME SHIFT AND MISSENSE
2. Which type of mutation results in abnormal amino acid sequence? FRAME SHIFT, NONSENSE, AND MISSENSE
3. Which type of mutation stops the translation of the mRNA? NONSENSE

Sickle Cell Anemia

Sickel 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 bloods cells. The mutation causes the red blood cells to become stiff and 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 and 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 G G A C T G A G G A C T C C T C

Normal hemoglobin mRNA G U G C A C C U G A C U C C U G A G G A G

Normal hemoglobin A.A. sequence VALINE-HISTIDINE-LEUCINE-THREONINE-PROLINE-GLUTAMIC ACID-GLUTAMIC ACID

Sickle cell hemoglobin DNA C A C G T G G A C T G A G G A C A C C T C

Sickle cell hemoglobin mRNA G U G C A C C U G A C U C C U G U G G A G

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

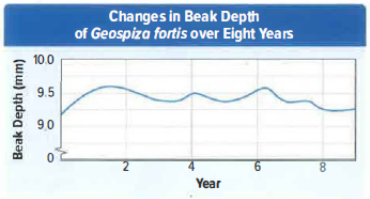
1. Explain how mutations are a source of new alleles. PA
2. In a population of sparrows, most birds have a beak that is about 10 mm long. Some birds, however, have beaks that are slightly longer or slightly shorter than the average. Explain why this variation within the population is important in terms 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?



ANSWER KEY: Natural Selection and Artificial Selection

1. Mutations, random changes in the sequence of the DNA code can result in new alleles if the mutations happen on sections of DNA that are genes (code for a specific protein)
2. It is important in terms of individual survival as birds with different beak lengths are able to access different resources and then they aren't all competing for the same resource.
3. Genetic variation makes it possible for populations to change through natural selection if certain individuals with different traits are better able to survive and reproduce and pass their traits on to the next generation.
4. Natural selection influences adaptation as over time organisms that are better able to survive and reproduce will pass their traits on to the next generation. Over time we will see populations that are well adapted to the current environmental conditions.
5. The insects that are better able to survive and reproduce will pass their traits onto the next generation.
6. As the mice are geographically isolated from one another they will no longer be able to interbreed. Over time the two populations might change so much that they are no longer able to produce fertile offspring and will be considered separate species. For birds they are not geographically isolated as they can fly and will still have the ability to interbreed so it is unlikely they will become separate species.
7. They look similar as they have evolved characteristics that enable them to survive and reproduce in similar environments.
8. Physical mutagens - causes physical changes to structure of DNA - ex. X-ray, uv radiation, etc. Chemical mutagens - can enter a nucleus and react with DNA ex. Nitrites, gasoline fumes
9. Corn - selectively bred for larger, juicier kernels. Loss of genetic diversity if this is the only variety that is continued to be bred. Potential for susceptibility to pests/poor weather/etc. If there is a lack of genetic variation.
10. May lead to natural selection of bacterial populations and an increase in resistant strains.
11. a) during drought years longer beak depths b) there is a selective advantage during drought years for birds with longer beak depths as they are better able to access food, survive and reproduce.

Biology Review

What Do You Know?

Connecting to Concepts

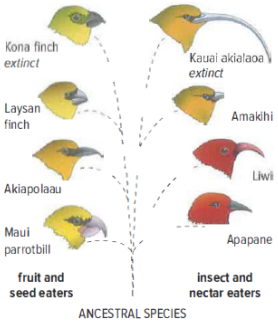
Visualizing Ideas

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:

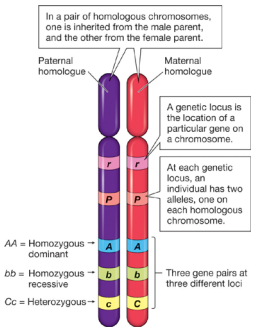
- gene
- species
- population
- traits
- mutation
- natural selection
- adaptation
- adaptive radiation
- artificial selection
- monoculture
- biotechnology

Communicating Concepts

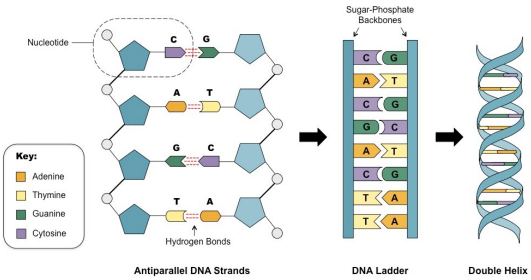
7. Scientists often describe the structure of DNA by comparing it to a ladder. Draw a DNA molecule and use the drawing to explain how DNA is similar to a ladder. Then explain the limitations of this comparison.

ANSWER KEY: Biology Review

1. DNA accounts for the similarities and differences between these apples as they share DNA that is similar and codes for things like the apple's shape, size etc. that make it apple like the sections of DNA that are different account for unique colours, flavours, textures etc.
2. Homologous chromosomes are chromosome pairs (one from each parent) that are similar in length, gene position, and centromere location. The position of the genes on each homologous chromosome is the same, however, the genes may contain different alleles



3. In the first generation we see that the dominant trait is 100% expressed (the lighter colour) and in the second generation we can see the recessive trait is 25% expressed as the parents that were crossed from the F_1 generation carried both a dominant and recessive allele (Cc x Cc).
4. The concept illustration is called adaptive radiation. This is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches.
5. OMIT
6. gene - section of DNA that codes for a specific protein species - contain sections of DNA unique to organisms within the same species population - within a population there is variation in DNA traits - are the result of DNA mutation - occurs in DNA natural selection - variation in DNA → better survival rates/reproduces and passes genetic info on to next generation adaptation - variations in DNA lead to natural selection and populations that are better adapted to their environment artificial selection - selecting organisms with desired traits and ensuring their DNA is passed on to the next generation monoculture - decreased genetic variety, less variation in DNA biotechnology - altering of DNA using technology
7. See diagram below. Limitation - doesn't show the helix structure (twisting)



8. Nucleotides are like the individual
letters, genes are like the sentences and chromosomes are like the entire bound book.
9. See diagram above as well. Complementary nature only allows certain base pairs to occur so it ensures the correct sequence.
10. If this pair is made up of an X and Y chromosome, then the pair of chromosomes is not homologous because their size and gene content differ greatly.
11. a) Homozygous is a word that refers to a particular gene that has identical alleles on both homologous chromosomes, for example TT or tt. Heterozygous refers to a particular gene that has different alleles on both homologous chromosomes for example Tt. b) A dominant allele produces a dominant phenotype in individuals who have one copy of the allele, which can come from just one parent. For a recessive allele to produce a recessive phenotype, the individual must have two copies, one from each parent.
12. It depends on the phenotype that they are displaying. If it is a recessive phenotype then yes you know that there genotype would have two recessive alleles (like tt) but if they display the dominant phenotype you will not know their genotype, it could be Tt or TT for example.
13. Dominance - where one trait is completely dominant over another for example if you crossbred red and white flowers and the first generation was all red Incomplete dominance - is where neither trait is dominant so again if you crossbred red and white flowers the result would be pink flowers Codominance - is where both traits are dominant for example if you crossbred red flowers and white flowers you would have flowers with both and red and white on them Sex-linked inheritance is when the genetic information for a specific traits is carried on a sex chromosome
14. Artificial selection - human involvement as organisms with desirable traits are used to create new organisms or selectively bred Natural selection - involves random mutations that enable an organism to better survive and reproduce in an environment and then those traits are then passed on to the next generation.
15. Genetic variation is involved in biological change over time as it is the genetic variation that may provide an organism with a trait that allows it to better survive and eventually reproduce in an environment. If there is an environmental change then organisms that can survive better in the new environment will pass on their traits to the next generation over time there can be a shift in the biology of the organism.
16. Transgenic organisms - examples: Golden rice: modified rice that produces beta-carotene, the precursor to vitamin A. Vitamin A deficiency is a public health problem for millions of people around the world, particularly in Africa and Southeast Asia. Goats that produce important proteins in their milk: goats modified to produce FDA-approved human antithrombin (ATryn), which is used to treat a rare blood clotting disorder in humans. Goats have also been genetically modified to produce spider silk, one of the strongest materials known to man, in their milk. Proposed uses for this recombinant spider silk range from artificial tendons to bulletproof vests. Vaccine producing bananas: genetically engineered bananas that contain a vaccine. Bananas provide an easy means for delivering a vaccine (especially to children) without the need for a medical professional that is trained in giving shots. Edible vaccines are still in development.
17. OMIT
18. OMIT
19. Genotypes of offspring: Rr (100%) Phenotypes of offspring: Red eyes (100%)
20. They had some sort of genetic variation that enabled them to survive the insecticide and then they were able to reproduce and pass on the traits to the next generation. It is a selective advantage when members of the population are better able to survive and reproduce so the resistance to the chemical is a selective advantage for that fruit fly population.
21. Take a cows that are producing more milk than the rest of the herd and breed them. From the next generation do the same and continue the process over successive generations.
22. Answers will vary.

23. Answers will vary.
24. Answers will vary.
25. Answers will vary.
26. Crossing two heterozygous (RW) radishes would results in the genotypes of RR (1:4), RW (2:4) and WW (1:4) and the phenotypic ratios of red (1:4), purple (2:4), white (1:4).
27. a) yes - as Persian cats with long fur are being selectively bred over many generations. b) yes - as the farmer is selecting which plant species to breed together to achieve desired traits. c) no - assuming there is no human intervention/ involvement in breeding and this has occurred naturally over time d) yes - as it says crop we can assume that plants that are insect resistant are being selectively bred over time.
28. OMIT
29. a) black hair b) parent 1: phenotype - black haired, genotype - BB parent 2: phenotype: - white haired, genotype - bb c) offspring: phenotype - black haired, genotype - Bb
30. OMIT
31. a) they would carry two recessive alleles, rr b) they would carry one dominant and one recessive allele, Rr c) homozygous person with a normal phenotype, RR
32. The mother was a carrier of the recessive allele. If they have a daughter she wouldn't have hemophilia but she could be a carrier.
33. Clams with greater muscle size might avoid predation, survive, reproduce and pass the traits on to the next generation and the process would continue.
34. You would expect to see more adaptive radiation on remote islands as the populations of species are more isolated from each other and less likely to interbreed.
35. Birds with greater beak depths survived due to their ability to extract resources that birds with shorter beaks could not access.
36. a) less pollution from the pig's waste enters the environment b) the may have health problems, or reduced lifespans c) Answers will vary.
37. a) Economic - loss of tourism to view grizzly bears and visit areas they inhabit, political - reflects poorly on the ability of the government to manage habitat and resources, social - loss of species is a loss of diversity and will have an influence on the local ecosystem and people who inhabit it b) wildlife corridors will encourage movement of the bears so that they can access food and water, as well as other populations to breed with.
38. a)Exposure to UV radiation is the main factor that causes skin cells to become cancer cells. Almost all skin cancers (approximately 99% of non-melanoma skin cancers and 95% of melanoma) are caused by too much UV radiation from the sun or other sources such as solaria (solariums, sunbeds, and sun lamps). b) B.C. Tanning Bed Ban. Regulation ban people under the age of 18 (minors) from using tanning equipment, to reduce the chances of developing skin cancer later in life.
39. OMIT
40. OMIT
41. OMIT