

Problem Solving Lab – Chapter 11.3
What Type of Mutation Results in Sickle-Cell Anemia?

A condition called sickle-cell anemia results from a genetic change in the base sequence of DNA. Red blood cells in patients with sickle-cell anemia have molecules of hemoglobin that are misshapen. As a result of this change in protein shape, sickled blood cells clog capillaries and prevent normal flow of blood to body tissues, causing severe pain.

ANALYSIS: The table below shows the sequence of bases in a short segment of the DNA that controls the order of amino acids in the protein, hemoglobin.

DNA BASE SEQUENCE:

Normal Hemoglobin	GGG CTT CTT TTT
Sickled Hemoglobin	GGG CAT CTT TTT

THINKING CRITICALLY:

1. Use an amino acid table to transcribe and translate the DNA base sequence for normal hemoglobin and for sickled hemoglobin into amino acids. Remember that the table lists mRNA codons, not DNA base sequences.
2. Does this genetic change illustrate a point mutation or frameshift mutation? Explain your answer.
3. Explain why the correct sequence of DNA bases is important to normal development of proteins.
4. Assume that the base sequence reads GGG CTT CTT AAA instead of the normal sequence for hemoglobin. Would this result in sickled hemoglobin? Explain your answer.

Problem Solving 11.3
Gene Mutations and Proteins

Gene mutations often have serious effects on proteins. In this activity, you will demonstrate how such mutations affect protein synthesis.

PROCEDURE:

1. Use the following base sequence of one strand of an imaginary DNA molecule:

AATGCCAGTGGTTCGCAC

2. Write the base sequence for an mRNA strand that would be transcribed from the given DNA sequence.

3. Use the amino acid table to determine the sequence of amino acids in the resulting protein fragment.

4. If the fourth base in the original DNA strand were changed from G to C, how would this affect the resulting protein fragment?

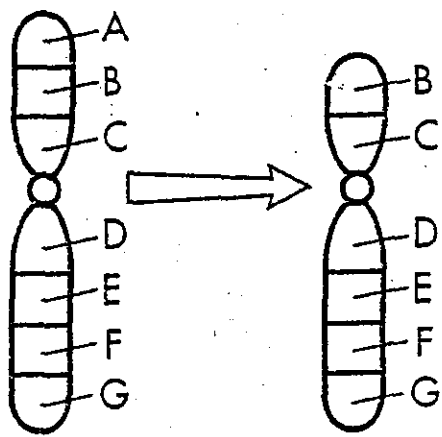
5. If a G were added to the original DNA strand after the third base, what would the resulting mRNA look like? How would this addition affect the protein?

ANALYSIS:

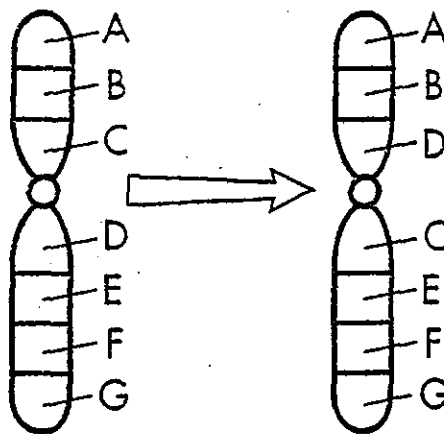
1. Which change in DNA was a point mutation? Which was a frameshift mutation?

2. In what way did the point mutation affect the protein?

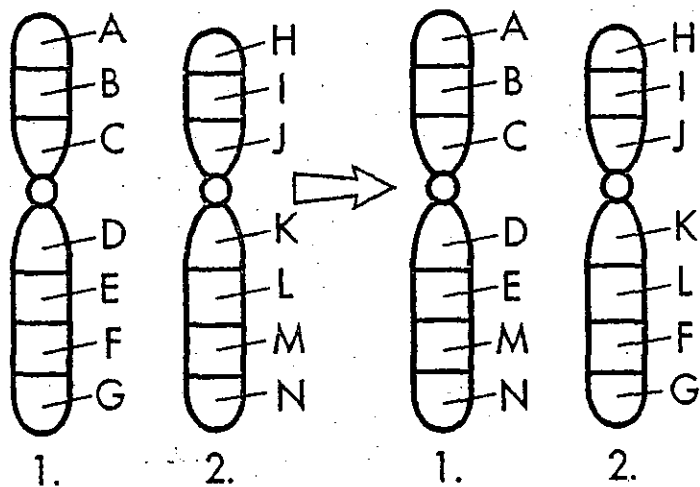
3. How did the frameshift mutation affect the protein?



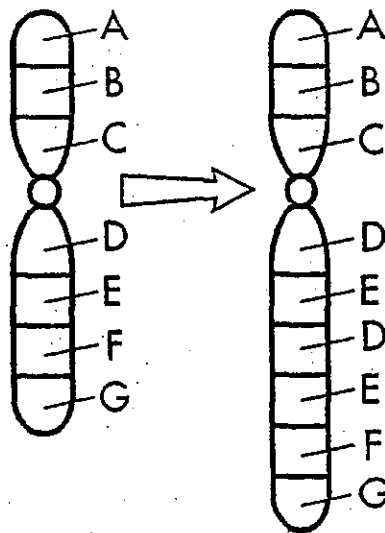
Deletion ☆



Inversion ☆



Translocation ☆



Duplication ☆

Chromosomal Alterations

- Gene A
- Gene B
- Gene C
- Gene D
- Gene E

- Gene F
- Gene G
- Gene H
- Gene I
- Gene J

- Gene K
- Gene L
- Gene M
- Gene N

Karyotyping Activity

Purpose

This lab will give you the opportunity to explore WHY an amniocentesis is done to check for chromosomal abnormalities.

Materials

Activity Sheets
Pen
Glue or tape
scissors

Procedure

1. You have been hired by a genetic testing lab. A lab report comes to you with an amniotic fluid sample taken from a pregnant woman. The physician suspects the fetus may have a birth defect due to a chromosomal abnormality. She states the following as basis for this hypothesis:

- The father's family has a history of children born with defects.
- The mother is 39 years old.
- The mother is known to have used the medication Accutane during this pregnancy.

1. If the karyotype analysis from the amniotic fluid is normal, then the physician may prescribe a sonogram to detect any physical deformities in the fetus. While it may not be possible to detect physical defects caused by Accutane, the mother's use of this drug puts the child at risk for a birth disorder. This is the first time you have performed the amniocentesis.

2. You now have received the chromosome scatter sheet and you prepare to make the karyotype. Record the letter on the scatter sheet for future reference.

3. Carefully cut out the key (normal chromosomal scatter) and paste each chromosome in the appropriate numbered box. Carefully cut out each of the chromosomes in the scatter worksheet you have been given. Save the large capital letter in the bottom right hand corner. Rearrange the chromosomes into matched pairs, using your karyotype reference sheet as a guide. When searching for the mate of each chromosome, remember to consider the length of the "arms" and the placement of the centromere (the point where the chromatids of the chromosomes are joined.)

4. Copy the large letter that you found on the lower right hand corner of your scatter sheet. Write it at the top of your karyotype layout sheet.

5. After all the chromosome pairs are matched, glue the matched pairs onto the karyotype layout worksheet, arranging the pairs in order from longest to shortest.

Human Birth Defects Resulting From Chromosomal Disorders

Total Number of Chromosomes	Affected Chromosome Pair	Birth Defects	Estimated Frequency	Main Characteristics	Treatment Options
47	21	Down Syndrome	1/700	Short, broad hands with simian palmir crease, short stature, hyperflexibility of joints, mental retardation, broad head with round face, open mouth with large tongue, slanting eyes.	None
47	13	Phenylketonuria	1/5000	Mental deficiency and deafness, minor muscle seizures, cleft lip and/or palate, polydactyly, corneal abnormalities, posterior leg protrusions.	None
47	18	Edward's Trisomy	1/4000 to 1/10000	Congenital malformations of many organs; low-set, malformed ears; receding mandible, small mouth and nose with general edema appearance; double kidney, short sternum, 90% die in first 6 months	None
45	23 (0 X)	Turner Syndrome	1/5000 1/3000 Live born girls	Female with retarded sexual development, usually sterile; short stature, webbed skin in neck region, cardiovascular abnormalities, hearing impairment	Correction of the ovaries; surgery to correct; Estrogen to start cycle; Still infertile
47 48 48 40 50	23 (+X) 23 (+XX) 23 (+XY) 23 (+XXY) 23 (+XXY)	Klinefelter's Syndrome	1/500 Male births	Male, infertile with small testes, developed breasts, feminine pitched voice, mental deficiency, long limbs, knocked knees, stumbling gait/awkwardness, frequent early death.	Hormones for secondary sex characteristics; Mastectomy to reduce psychological stress
47	23 (+X)	Triple X	1/1000	Female with underdeveloped genitalia and limited fertility; Frequent neuromotor delay	None
46	23 (XY) 23 (XX) Damaged X chromosome	Fragile X		Retardation; severe to mild, anxiety, panic attacks excessive shyness, long fingers, arms, legs, testicles Women not as affected as men. Male: long narrow face, prominent ears, hoarse, jointedness	Special Education, living skills

Karyotyping Scatter Sheet

Partner Names _____

Scatter _____

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22		23	

Condition and Treatment

Sex of child

K5

TDS

KARYOTYPING ANALYSIS QUESTIONS

Karyotype Letter: _____

Refer to your karyotype to answer the following questions.

1. How many chromosomes are present in the karyotype you completed?
 2. List the sex chromosomes present.
 3. What is the sex of this individual?
How do you know?
 4. Is this karyotype normal or abnormal?
Explain.
 5. Describe the abnormality and identify the associated condition.(if present)
 6. How might karyotypes be used in medicine?
 7. How do chromosome mutations occur?
-
8. Explain the benefits of chromosome mutations.
 9. Why are some chromosome mutations harmful?



STUDENT WORKSHEET
FOR
MICROSLIDE™ LESSON SET 245
CANCER

STUDENT'S NAME _____ CLASS _____ DATE _____

INTRODUCTION

In this unit you will learn something about Cancer and how it can be detected and prevented. You will use the Micro-Slide-Viewer, Microslide and Text Folder.

Read and follow the directions for use of the Micro-Slide-Viewer and Microslide on the envelope attached to the text folder holding the slide.

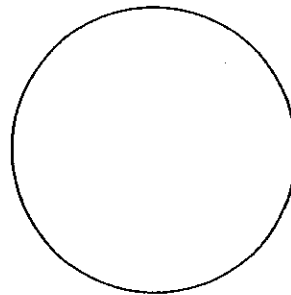
Examine each slide and study the description in the text folder. After studying each slide and printed text, answer the questions for that slide on this worksheet. If you don't know the answer, go to the next slide and question. You may find the answer as you learn more about the subject. When requested, draw what you see in the space provided.

INTRODUCTION

- a) Cancer is (a single disease) (more than 100 different diseases). CIRCLE YOUR CHOICE.
- b) What do all cancer diseases have in common? _____
- c) A cancer-causing agent or chemical in the environment is called a _____.
- d) What percent of cancers is caused by factors present in the environment? _____
- e) Are any cancers preventable? YES or NO? CIRCLE YOUR CHOICE.

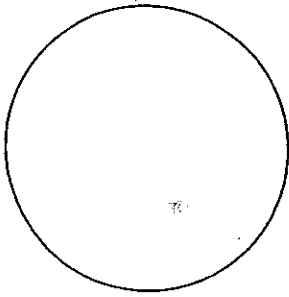
SLIDE 1. -HEALTHY SKIN

- a) Draw what you see in this slide.
- b) There are _____ cells in the human body.
- c) True or false: New cells are being made by your body all of the time. CIRCLE YOUR CHOICE.
- d) Normal cells and tissue are characterized by _____ and _____.



SLIDE 2. -CANCEROUS SKIN

- a) Draw what you see in this slide. Label some of the cancerous cells.
- b) Cancer cells continue to _____ and _____ even when they should not.
- c) Starting with 1 cancerous cell, how many cancer cells will there be after 6 generations? _____
- d) Cancer cells have lost the ability to _____.
- e) True or false: Metastasized cells are non-cancerous. CIRCLE YOUR CHOICE.



SLIDE 3. -TUMOR

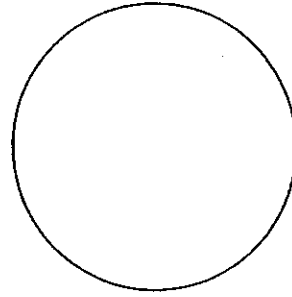
- a) Non-cancerous growths are called (malignant) (benign). CIRCLE YOUR CHOICE.
- b) Cancer cells continue to grow and divide as long as _____.

SLIDE 4. -LUNG - NORMAL AND CANCEROUS

- a) Lung cancer is (the most common) (a rare) disease. CIRCLE YOUR CHOICE.
- b) What is the most significant cause of lung cancer? _____
- c) Are most lung cancer deaths preventable? YES or NO? CIRCLE YOUR CHOICE.
- d) True or false: Second-hand smoke is also carcinogenic. CIRCLE YOUR CHOICE.
- e) Why do many people find it hard to stop smoking? _____.

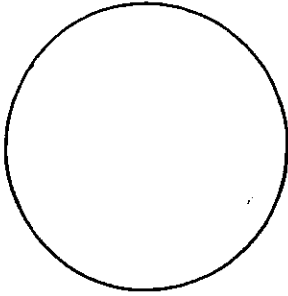
SLIDE 5. -MELANOMA/BASAL CELL CARCINOMA

- a) Draw what you see in the slide.
- b) List 4 warning signs of a melanoma: _____.
- c) Which is more dangerous - long, gradual exposure to sun or a severe sunburn? _____
- d) True or false: Skin damage from solar radiation is irreversible. CIRCLE YOUR CHOICE.
- e) List two ways to protect yourself from skin cancers. _____

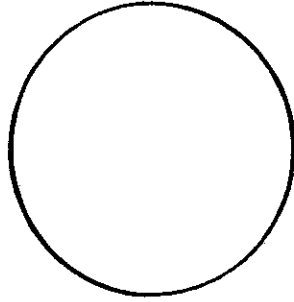
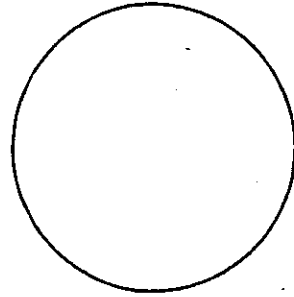


SLIDE 6. - COLON / NORMAL AND CANCEROUS

- a. (Diet) (Exercise) plays a role in digestive system cancers. CIRCLE YOUR CHOICE.
- b) Limiting _____ and increasing _____ might decrease your chance of contracting colon cancer.
- c) List three foods that may help protect against colon cancer: _____



- a) _____ is the most common cancer among North American women.
- b) (Early detection) (avoiding the sun) is the key to preventing deaths from breast cancer. CIRCLE YOUR CHOICE.
- c) Who finds most breast cancers? (Doctors) (Women, through self-examination). CIRCLE YOUR CHOICE.



SLIDE 7. - BREAST / NORMAL AND CANCEROUS
SLIDE 8. - TESTES / CANCER - CERVIX / CANCER

- a) True or False: Cancers of the reproductive system are common in young adults. CIRCLE YOUR CHOICE.
- b) Testicular cancer occurs most often in men in their _____.
- c) Testicular cancer can be treated if (caught early) (allowed to progress at its own rate.) CIRCLE YOUR CHOICE.
- d) A Pap test helps find what kind of cancer? _____

Step #1 Determine symbols to represent the alleles. Write them on your paper.

Step #2 Determine the genotype of the parents; represent them with the appropriate symbols. Write them down.

Step #3 Determine possible gametes from each parent. Write them down.
(Don't break the law of segregation!!)

Step #4 Draw a Punnett square. Place the gametes from one parent on the top of the square and the gametes from the other parent along the left side of the square. Fill in the boxes.

Step #5 Reread the question. Write a complete sentence in which you clearly state the answer to the question asked in the problem.

Example: In certain flowers, blue flower color is dominant to purple flower color. Give the genotypic ratio among the offspring resulting from a cross between a plant with purple flowers and a plant heterozygous for blue flowers. What percent would be blue?

1) B = gene for blue flowers;

b = gene for purple flowers

2) bb (purple flower's genotype);

Bb (blue flower's genotype)

3) bb → b or b Bb → B or b

4)

	B	b
b	Bb	bb
b	Bb	bb

5) The genotypic ratio among the offspring is 1 Bb: 1 bb. Fifty percent would be blue

Work out questions 1 - 4 on a separate sheet of paper. Show all work neatly

1. Curly hair is dominant over having straight hair. A man has straight hair and a woman is heterozygous for curly hair. What percentage of their children should have straight hair?

2. Having wide feet is dominant to having thin feet. A woman and a man each are heterozygous for wide feet. What fraction of their children should have wide feet?

3. In fruit flies, long wing is dominant to short wing. Two long wing flies produce 49 short wing and 148 long wing offspring. What are the probable genotypes of the parents? Use a Punnett square to determine what fraction of the long wing offspring should be heterozygous.

Note: You will need to do steps 1 and 2 for problems 4 and 5; no Punnett square is needed.

4. Assume dark eyes are dominant to blue eyes. A blue eyed man marries a dark eyed woman. They have one child who is blue-eyed. The man's parents have dark eyes; the woman's father has dark eyes, but her mother has blue-eyes. What are the most probable genotypes of all of the individuals mentioned? Hint: you may want to do a "family tree."

5. In cattle, the hornless (polled) condition is dominant; the horned condition is recessive. A certain polled bull is bred to three cows.

Cow A has horns and bears a polled calf.

Cow B is polled and produces a polled calf.

Cow C is polled and bears a horned calf.

Use logic to determine the genotypes of the four parents and the calves. Indicate whether each animal is homozygous or heterozygous. You may not be able to fill in all the blanks!!

Bull: ___ ___ Cow A: ___ ___ her calf: ___ ___
 Cow B: ___ ___ her calf: ___ ___
 Cow C: ___ ___ her calf: ___ ___

**PUNNETT SQUARES—
CROSSES INVOLVING ONE TRAIT**

In a certain species of animal, black fur (B) is dominant over brown fur (b). Using the following Punnett square, predict the genotypes and phenotypes of the offspring whose parents are both Bb or have heterozygous black fur.

	B	b
B		
b		

Genotypes: _____% homozygous black fur (BB)
 _____% heterozygous black fur (Bb)
 _____% homozygous brown fur (bb)

Phenotypes: _____% black fur
 _____% brown fur

Now do the same when one parent is homozygous black and the other is homozygous brown.

Genotypes: _____% homozygous black fur (BB)
 _____% heterozygous black fur (Bb)
 _____% homozygous brown fur (bb)

Phenotypes: _____% black fur
 _____% brown fur

Repeat this process again when one parent is heterozygous black and the other is homozygous brown.

Genotypes: _____% homozygous black fur (BB)
 _____% heterozygous black fur (Bb)
 _____% homozygous brown fur (bb)

Phenotypes: _____% black fur
 _____% brown fur

**PUNNETT SQUARES—
CROSSES INVOLVING TWO TRAITS**

In a dihybrid cross, when two traits are considered, the number of possible combinations in the offspring increases. Suppose that black hair (B) is dominant over blonde hair (b) and brown eyes (E) are dominant over blue eyes (e). What percent of offspring could be expected to have blonde hair and blue eyes if:

1. The father has black hair (heterozygous) and brown eyes (heterozygous) and the mother has blonde hair and blue eyes.

Genotype of father—BbEe
 Genotype of mother—bb ee
 In the Punnett square below, complete the remaining gametes of the father. Then, fill in the boxes below.

	BE	Be	
be			

2. Both parents have black hair (heterozygous) and brown eyes (heterozygous).

Genotype of father—
 Genotype of Mother—
 Complete the Punnett square below.

In each dihybrid cross, the phenotype ratio of individuals with brown hair and brown eyes, brown hair and blue eyes, blonde hair and brown eyes and blonde hair and blue eyes is _____.

Activity: Genetic Variation

Gene Number	Dominant Trait	Genotype (if the trait is present)	Genotype (if the trait is absent)
1	Freckles	FF or Ff	ff
2	Mid-digital hair	DD or Dd	dd
3	Can roll tongue	RR or Rr	rr
4	PTC taster	TT or Tt	tt
5	Bent little finger	BB or Bb	bb
6	Widow's Peak	PP or Pp	pp
7	Free ear lobe	EE or Ee	ee
8	Interlocking fingers w/ left thumb on top	LL or Ll	ll

DIRECTIONS:

- Complete Table 1. Use the symbols in the table above to record your genotype for each trait. Research the presence or absence of the trait in your parents and siblings to determine if you are homozygous dominant or heterozygous. In the last column record your phenotype for each trait.

Genetic Self-Analysis - (Table 1)

Genetic # & Trait	Genotype	Homozygous or Heterozygous	Phenotype
Freckles			
Mid-digital hair			
Can roll tongue			
PTC taster			
Bent little finger			
Widow's Peak			
Free Ear Lobes			
Left thumb on top			

- Prepare your chromosomes as instructed by your teacher.

- Randomly select a chromosome from the class gene pool and complete Table 2.

Genetic Analysis of Offspring- (Table 2)

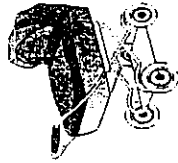
Genetic # & Trait	Your allele	Donor allele	Homozygous or Heterozygous	Phenotype
Freckles				
Mid-digital hair				
Can roll tongue				
PTC taster				
Bent little finger				
Widow's Peak				
Free Ear Lobes				
Left thumb on top				

Analysis:

- What is the gender of the offspring in your cross?
- Why must each offspring have an X chromosome?
- Define and give an example of a DOMINANT allele.
- Define and give an example of a RECESSIVE allele.
- Define and give an example of GENOTYPE.
- Define and give an example of PHENOTYPE.
- Define HOMOZYGOUS. List ALL the traits in the offspring that are homozygous.
- Define HETEROZYGOUS. List ALL the traits in the offspring that are heterozygous.
- What alleles does the offspring have for the trait- bent little finger?
- How many alleles are there for each trait?
- How many alleles does each chromosome have?
- How many alleles does each offspring have?
- What is the genotype of the offspring for the trait- bent little finger?
- What is the phenotype of the offspring for the trait- bent little finger?

GENO-PHENO

Introduction: You are a genetic engineer responsible for studying "ziggies." Ziggies live deep within the redwood forests of Northern California. Ziggies are an endangered species, and you are responsible for mating two parent ziggies to create a baby ziggly. You will use your knowledge of genetics to complete this task.



Procedure:

- 1) Obtain ziggly parent chromosomes. Ziggies have 2 chromosomes, with a total of 9 genes. Record the genotype of your ziggly parents on the space provided on your "Geno-Pheno Rummy" data sheet.
- 2) Given the genotype of the parent ziggies, complete the appropriate Punnet square (on back of data table) for each of the genes.
- 3) Raise your hand to have your Punnet squares checked by teacher. Obtain a "geno-pheno" dice.
- 4) To determine which genotype your baby ziggly inherits, you will roll the "geno-pheno" dice. If you do not have the genotype that is rolled on the dice in your Punnet square roll the dice again, until you roll and genotype that you have.
- 5) Once you have rolled the genotype for your ziggly, circle it in the Punnet square and fill in this section of the "Geno-Pheno Rummy" data sheet;
- 6) Check your results with the teacher. Obtain a "Geno-Pheno Decoder Key." Determine the phenotype of your baby ziggly.
- 7) Obtain poster paper from the teacher and accurately draw your baby ziggly. Draw your baby ziggly in color and as instructed by the phenotype you determined. If you want, you may give your baby ziggly an appropriate name.
- 8) Turn your baby ziggly and parent chromosomes into the "Ziggly Nursery" in the front.
- 9) Return to your seat and answer the "Geno-Pheno Analysis Questions."

GENO-PHENO "DECODER KEY"

Gene	Genotype	Phenotype	Trait
A	• AA • Aa • aa	• green hair • blue hair • orange hair	Hair color
B	• BB • Bb • bb	• curly hair • spikey hair • straight hair	Hair type
D	• DD • Dd • dd	• 8 legs • 4 legs • 2 legs	Number of legs
E	• EE • Ee • ee	• 2 tails • 1 tail • no tail	Tail
G	• GG • Gg • gg	• 3 eyes • 2 eyes • 1 eye	Number of eyes
H	• HH • Hh • hh	• oval shaped head • triangular shaped head • circular shaped head	Head shape
J	• JJ • Jj • jj	• solid body color • striped body • spotted body	Body color
Q	• QQ • Qq • qq	• 2 wings • 2 wings • no wings	Wings
R	• RR • Rr • rr	• "pig" nose • "human" nose • "clown" nose	Nose style

GENO-PHENO "PUNNET SQUARES"

Name: _____ Partner's Name: _____ Period: _____

GENO-PHENO "DATA SHEET"

Mother Ziggly Genotype: _____

Father Ziggly Genotype: _____

Gene A

Gene B

Gene D

Gene E

Gene G

Gene H

Gene J

Gene Q

Gene R

Gene	Genotype	Heterozygous/Homozygous (Recessive/Dominant)	Phenotype
A			
B			
D			
E			
G			
H			
J			
Q			
R			

GENO-PHENO

"ANALYSIS QUESTIONS"

Directions: Answer the following questions to the best of your ability. Copy the question and answer all questions in complete sentences.

- 1) What is the genotype of your baby ziggly?
- 2) Describe the phenotype of your baby ziggly.
- 3) Where did the genetic information to create the baby ziggly come from?
- 4) Does your baby ziggly differ genetically from the mother ziggly? If so, how was this genetic variation created?
- 5) What genotype does your ziggly have for body number of eyes? What is the resulting phenotype?
- 6) What genotype does your father ziggly have for hair type? Does your baby ziggly and father ziggly have the same phenotypic hair type?
- 7) What does Mendel's law of segregation state? How does this law apply to the creation of a baby ziggly?
- 8) What does Mendel's law of independent assortment state? How does this law apply to the creation of a baby ziggly?
- 9) What would be the probability that a baby ziggly would be homozygous recessive for nose style if two zigglys ($Rr \times Rr$) were crossed? (show punnet square)
- 10) What is the genotypic ratio for hair color in your potential baby ziggly?
- 11) What is the phenotypic ratio for body color in your potential baby ziggly?

Activity: Human Face Variation

Face # 1

Trait	P1 Allele	P2 Allele	Genotype	Phenotype
Gender				
Face shape				
Chin Shape 1				
Chin Shape 2				
Cleft Chin				
Skin Color				
Hair type				
Widows Peak				
Eyebrows 1				
Eyebrows 2				
Color of eyebrows				
Eye distance apart				
Eye size				
Eye Shape				
Eye slant				
Eyelashes				
Eye color				
Mouth size				
Protruding lower lip				
Lips				
Dimples				
Nose size				
Nose shape				
Nostril Shape				
Earlobe attachment				
Freckles				
Hair Color				

Face # 2

Trait	P1 Allele	P2 Allele	Genotype	Phenotype
Gender				
Face shape				
Chin Shape 1				
Chin Shape 2				
Cleft Chin				
Skin Color				
Hair type				
Widows Peak				
Eyebrows 1				
Eyebrows 2				
Color of eyebrows				
Eye distance apart				
Eye size				
Eye Shape				
Eye slant				
Eyelashes				
Eye color				
Mouth size				
Protruding lower lip				
Lips				
Dimples				
Nose size				
Nose shape				
Nostril Shape				
Earlobe attachment				
Freckles				
Hair Color				

QUESTIONS

- Define the following terms:
 - Dominant _____
 - Recessive _____
 - Incomplete dominance _____
 - Homozygous _____
 - Heterozygous _____
- If a trait is recessive, how can it be seen in the offspring? _____
- What does phenotype mean? _____
- If a particular trait is heterozygous, will a dominant trait be seen or not be seen in the offspring? _____
- In your experiment, which traits show incomplete dominance? _____
- What does genotype mean? _____
- Under what conditions would two offspring have the same genotype and phenotype? _____
- In this experiment you were asked to collect data on two children. Did your first child look exactly like your second child? Why? _____
- What does polygenic inheritance mean? _____
- Which traits in your experiment were controlled by polygenic inheritance? _____
- How does chance play a role in inheritance? _____
- What does probability mean? _____

K16

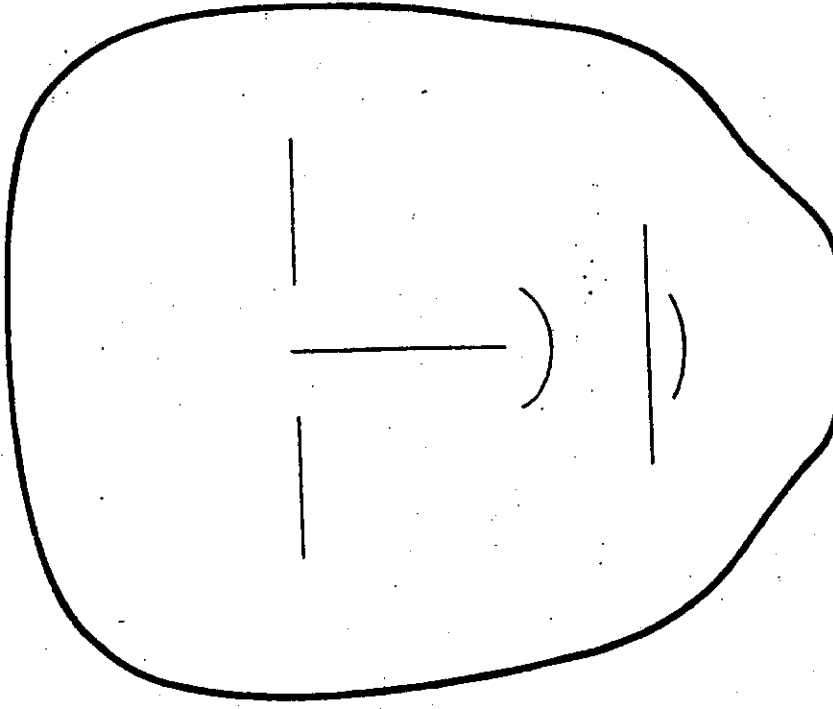
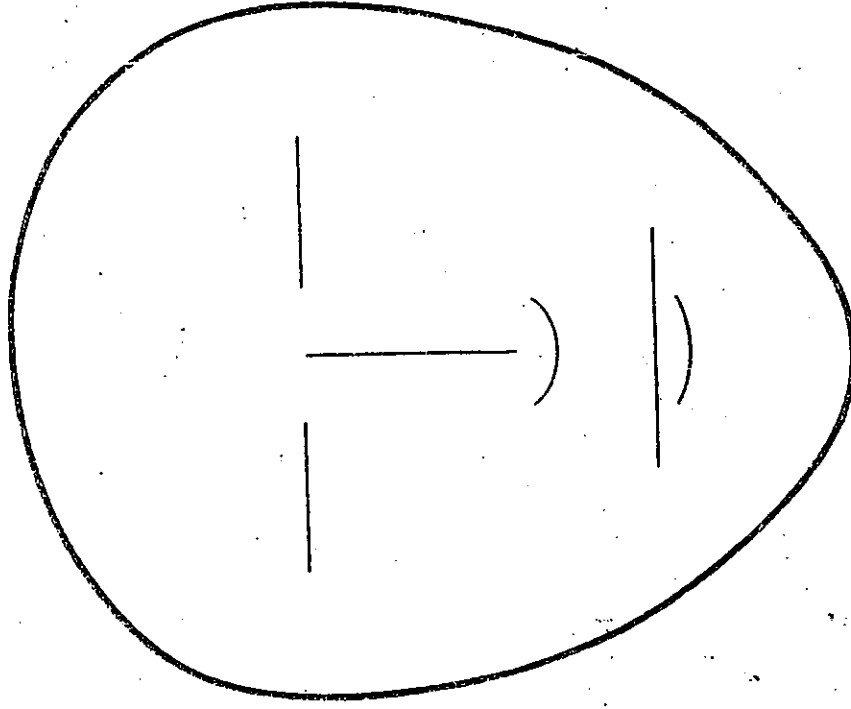
GENOCABULARY

From the following list, select the word defined in each description. Place the BLOCKED letter on the matching line at the bottom of the page to spell out the name of someone important in the field of genetics.

allele	genetics	inheritance	recessive	sprain
dominant	heredity	pollination	redundant	strain
gene	homologous	pure	segregation	zygote

- Short segment of DNA that controls a trait: 1
- Organisms pure breeding for a specific trait: 2
- Chromosomes having the same appearance: 3
- Allele that masks the presence of another allele for the same trait: 4
- Allele that is masked by the presence of another allele for the same trait: 5
- Offspring receiving traits from parents: 6
- Contrasting forms of a gene: 7
- The cell resulting from the fusion of gametes: 8
- The way in which traits are inherited: 9
- Traits passing from parents to offspring: 10
- Separation of genes during gamete formation: 11
- Always produces offspring with a certain trait: 12

G 1 2 3 4 5 6 7 8 9 10 11 12



Two Trait Crosses

In Humans, PTC tasting is dominant to not tasting, having freckles is dominant over no freckles, an unattached (free) ear lobe is dominant over attached ear lobes, 6 fingers (poly-dactylism) is dominant over 5 fingers.

1. A PTC taster, unattached ear lobe man marries a non-taster, unattached ear lobe woman. Their first child is a non-taster and has attached ear lobes. What are the genotypes of the parents and the child?
2. A normal fingered, unattached ear lobe man married a polydactyl, unattached ear lobe woman. They had a child who attached ear lobes and 5 fingers. What are the genotypes of the parents and the child? What is the probability that their only child would have unattached ear lobes and 6 fingers?
3. A non-taster man who has freckles married a taster woman who has no freckles. They had six children. Two were non-tasters without freckles: one was a non-taster with freckles; two of the taster children had freckles. The sixth child was a taster with no freckles. Give the genotypes of the parents and the children.
- In Guinea pigs, brown hair is dominant over white hair and short hair is dominant over long hair.*
 4. If a homozygous brown, long hair pig is crossed with a white, homozygous short hair pig, what is the probability of getting a brown short hair pig?
 5. If a white, heterozygous short hair pig is crossed with a homozygous brown, heterozygous short hair pig, what is the probability of getting a white, short hair pig?

Show your work!!!!!!!

Incomplete Dominance Practice Questions

1. A pure red flower and a pure white flower produce all pink flowers.
 - a. What is the genotype of the red flower? _____
 - b. What is the genotype of the white flower? _____
 - c. What is the genotype of the pink flowers? _____
2. In northeast Kansas there is a creature known as a wildcat. It comes in three colors, blue, red, and purple. This trait is controlled by a single locus gene with incomplete dominance. A homozygous (BB) individual is blue, a homozygous (bb) individual is red, and a heterozygous (Bb) individual is purple.
 - a. What would be the genotypes and phenotypes of the offspring if a blue wildcat were crossed with a red one? (create a Punnett square)
3. A cross between a blue blablah bird & a white blablah bird produces offspring that are silver. The color of blablah birds is determined by just two alleles.
 - a) What are the genotypes of the parent blablah birds in the original cross?
 - b) What is/are the genotype(s) of the silver offspring?
 - c) What would be the phenotypic ratios of offspring produced by two silver blablah birds? (create a Punnett square)
4. The color of fruit for plant "X" is determined by two alleles. When two plants with orange fruits are crossed the following phenotypic ratios are present in the offspring: 25% red fruit, 50% orange fruit, 25% yellow fruit. What are the genotypes of the parent orange-fruited plants?
 1. Predict the phenotypic ratios of offspring when a homozygous white cow is crossed with a roan bull. (create a Punnett square)
 2. What should the genotypes & phenotypes for parent cattle be if a farmer wanted only cattle with red fur?
 3. A cross between a black cat & a tan cat produces a tabby pattern (black & tan fur together).
 - a) What pattern of inheritance does this illustrate?
 - b) What percent of kittens would have tan fur if a tabby cat is crossed with a black cat? (create a Punnett square)

Sex Determination/Sex linked Inheritance

1. What is an autosome?
2. How many pairs of autosomes do humans have?
3. How many pairs of sex chromosomes do humans have?
4. Which parent determines the sex of the offspring? Why?

In fruit flies eye color is a sex linked trait. Red eyes are dominant over white eyes.

5. A white eyed female fruit fly is crossed with a red eyed male. What are the genotypes of the females? of the males? What would be the phenotypes of all offspring?

6. Determine the genotypic and phenotypic ratios from the following crosses:

- a) A carrier female and a red eyed male.
- b) A carrier female and a white eyed male.

In humans, color vision is sex linked. Normal color vision is dominant over red green color-blindness.

7. A woman(her father was colorblind) with normal color vision marries a man of normal vision.
 - a) What type of vision can be expected in their offspring?
 - b) Suppose the man's father was colorblind. Would this affect the couples children? Explain.

In humans, Hemophilia(blood does not clot) is sex linked recessive.

8. A woman without hemophilia marries a man without hemophilia. Their first child has hemophilia. How is this possible? What is the probability their next child will be normal?

Multiple Alleles

1. What are multiple alleles?
2. Explain how 4 blood types are possible when there are only 3 alleles for blood type?
3. Henry is type O, so is his mother. What blood types may his father have?
4. A woman with type b blood has a type O child. What are the genotypes of mother and child? Which genotypes could the father not be?
5. On Jerry Springer show, a woman with type A blood is claiming Mr. X(type AB blood) is the father of her child. The child has type B blood. Is Mr. X guilty, innocent, or are you unsure?
6. What is the probability of a type O mother and a type AB father producing a child with type A blood?
7. If a man with type A blood marries a woman with type B blood(both of their mothers have type O), what are the possible blood types their children might have?

8. Two babies are mixed up in the hospital. From the following info determine which baby belongs to which parents.

Individual	Blood Type	Genotype
Baby 1	O	
Baby 2	A	
Mrs. Brown	B	
Mr. Brown	AB	
Mrs. Smith	B	
Mr. Smith	B	

9. Complete the following table by writing yes or no in each box if it is possible. There will be more than one yes for parent 2.

Parent 1	Child	Parent 2 A	Parent 2 B	Parent 2 AB	Parent 2 O
O	B				
A	AB				
B	O				
AB	AB				

World of Genetics

Name _____

- Adenine
- Allele
- Amino acids
- Blood Types
- Cell reproduction
- Chromosomes
- Cloning
- Codominant
- Colorblindness
- Cross-pollination
- Cystic fibrosis
- Cytosine
- Daughter cells
- Deoxyribonucleic acid
- DNA
- Dominant
- Down Syndrome
- Ethics
- Family tree
- Genes
- Genetic code
- Genetics
- Genotype
- Guanine
- Heredity
- Heterozygous
- Homozygous
- Hybrid
- Incomplete dominance
- Inherited
- Karyotype
- Meiosis
- Mitosis
- Mutagens
- Mutation
- Nitrogen bases
- Nondisjunction
- Parents
- Pea plants
- Phenotype
- Plasmid
- Probability
- Proteins
- Punnett square
- Purebred
- Recessive
- Recombinant DNA
- Replication
- Ribonucleic acid
- RNA
- Self-pollination
- Sex chromosomes
- Sex-linked traits
- Sickle cell anemia
- Thymine
- Traits
- X chromosome
- Y chromosome

G L D N R N C K P C V D H U C C E K J P C M T W R R X C U K M Y
 R E I O I S O O R H Y O O G P N H Y U L E P T L V U U R X
 N P N W T E N L G O A A M K H M E R O I A V O I Y D D
 A C E E K N R X D O I B R M I O A E J R U E N O R J K Q V B
 V G T Y T E S O C I R N A G I N Z R N G E T B I S E P M O K
 T Q H I W I D Y G H S B C B A N A Y Y O E D A R N I N K T D
 P E I R I A C T N E R J L O I F O N G O T N I T E G S T I P
 F M C X L L P C R D N O U I M L F A T O T Y E T I D T C S U
 U T S O K L M V O A R B M N N P I X C C U Y P T Y O A Z A R
 F T M S I E G Z B D I O A O C D L T C I O S P E I C N N O V
 O I F G N L I V O S E T M S S T N E Y H D D E E I C D M A D
 B X T J S E N S O E Q C S E E O I E T E R S O E O T S V Z G
 U A I D W R B Q H X C R O S S M O S E G O L M N P J F X S
 Q G K C G V C W A C H Y B R I D E N S D C M A I E F A O L
 S R T R A I T S Q Q C P D D H G L M S N U O N O R N S L C F
 I I W A T S O N L K L P K B J N P R O N J I M A S E A L R W
 C B P Z B E U J U V R R G E N E S I O S B S U I M O N N S W
 K O B V O H E O S P U G S E L F T B I M L Q S O N O M E T C
 L N C L F P M B J G N Y X X C I S O L S U S K I A P E D R
 E U M W R R E P T V G I G J U R O C E T O O N T E Y N E R I
 C C R T Z Y N D D C N V H D O X B R R E C T G M O A M T E T C E C
 E L P H X R J E N A R S R O I E E N Z R T I S O R R T I N E S
 L E L Y R J E N C L S E N P E F N T N O H A L O O T E N S I P N E
 L A M N C I N I E D C I H U R C N P M L Y H A S L Y E N S
 A C S I P C I N I E R W I S G P E F I E O B L N L E K T G I J R
 N A M N O S I E R W I S G P E F I E O B L N L E K T G I J R
 E C I E O N T L L T O U W T V L R R S I I P C N O A N F O O
 M I D T A O L T S T A U E M L W H Y M H A E A N T E G D T V
 I D I U R E Z Y Y D P H F O A C B A H E R R E U D T D J E N
 A M G P C K C C E Z Q T P Z Y K F K P B F G M A M V H P H F

Challenge:

The puzzle includes the last names of six people who have made contributions to the field of genetics. Who are they?

BLOOD TYPE AND INHERITANCE

In blood typing, the gene for type A and the gene for type B are codominant. The gene for type O is recessive. Using Punnett squares, determine the possible blood types of the offspring when:

- Father is type O, Mother is type O

_____ % O
 _____ % A
 _____ % B
 _____ % AB
- Father is type A, homozygous; Mother is type B, homozygous

_____ % O
 _____ % A
 _____ % B
 _____ % AB
- Father is type A, heterozygous; Mother is type B, heterozygous

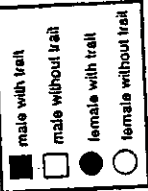
_____ % O
 _____ % A
 _____ % B
 _____ % AB
- Father is type O, Mother is type AB

_____ % O
 _____ % A
 _____ % B
 _____ % AB
- Father and Mother are both type AB

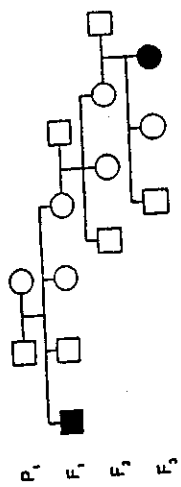
_____ % O
 _____ % A
 _____ % B
 _____ % AB

HUMAN PEDIGREES

By studying a human pedigree, you can determine whether a trait is dominant or recessive. To interpret the three pedigrees below, use the same key shown at the right. Of course, the individual with the trait could be homozygous dominant or heterozygous dominant.

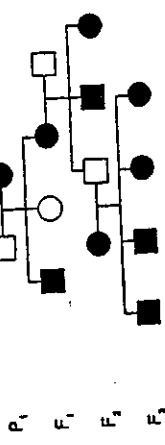


A. The pedigree shows the inheritance of attached earlobes for four generations.



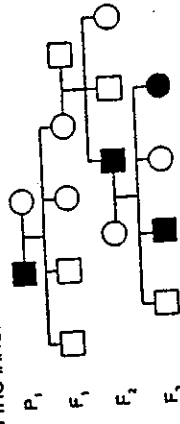
Is the trait for attached earlobes, versus free earlobes, dominant or recessive? _____ How do you know? _____

B. The pedigree shows the inheritance of tongue rolling.



Is this trait dominant or recessive? _____ Explain. _____

C. This pedigree shows the inheritance of colorblindness, a sex-linked trait.



Is this trait dominant or recessive? _____ Is the mother of the colorblind girl in the F₃ generation colorblind, a carrier, or a person with normal color vision? _____ Explain. _____

TRACING A GENETIC DISORDER IN A FAMILY

Genetic Disorders are conditions that are inherited from parents. Sometimes parents have children who show a genetic disorder trait even though the parents themselves do not show the trait for the disorder. Persons who do not show the disorder trait but are capable of passing it to their children are called carriers. Study the family history below to find out how a child gets a genetic disorder.

Mr. and Mrs. Gearhart have a son, William, who has cystic fibrosis. Cystic fibrosis is a genetic disorder that causes large amounts of mucus to be made the lungs and near the pancreas. This makes breathing and digestion difficult. Mr. Gearhart told a genetic counselor that he had a cousin who had cystic fibrosis. Mrs. Gearhart cannot remember anyone in her family having this disorder. Persons with cystic fibrosis are known to be pure recessive for the disorder.

Set up a Punnett square to show the gene types for each of William's parents and for William. Use F for the dominant gene and f for the recessive gene. Then, answer the questions.

1. What is the genotype for Mr. Gearhart? _____ For Mrs. Gearhart? _____
What is William's genotype? _____ Explain your results.

	Mother	
Father		

2. The Gearhart's doctor told them that they have a chance of having another child with cystic fibrosis. Is this true? Explain.

	Mother	
Father		

3. Suppose one parent was a heterozygous and the other was pure dominant for the cystic fibrosis. Make a Punnett square to explain whether they would have children with cystic fibrosis or children who would be carriers of the disorder. Explain your results.

	Mother	
Father		

COULD THE TAYLOR'S SON BE COLOR BLIND?

A Genetic counselor had several appointments every morning. Today Taylor's son is going to take driving lessons. He had been having trouble seeing road signs clearly. The Taylor's want to know if their son is color blind. They have several color blind relatives who see red and green objects in shades of gray. The counselor asked some questions and drew Punnett squares.

Use the information that follows to hypothesize what the counselor will say.

Mr. Taylor is not color blind. His father and his brother are color blind for red and green. His mother and his sister can see red and green. Mrs. Taylor and her relatives can see red and green. They are not color blind.

Analyzing the Problem

1. Would you hypothesize that the gene for color blindness might be on a sex chromosome? Why?
2. If the color vision gene is on the X chromosome, how many genes for color vision does a woman inherit? _____ From whom?
3. If the color vision gene is on the X chromosome, how many genes for the color vision does a man inherit? _____ From whom?

Solving the Problem

1. Use the Punnett squares below to show the genes for color vision in Mrs. Taylor's family. Call the gene for color vision C and its color blind form c.

	Her Father			His Mother			His Father	
Her Mother	C	Y		C	c		-c	Y
C								
c								

2. From which parent could Mr. Taylor's brother and sister inherit a C or c gene _____
3. How can Mr. Taylor have normal color vision while his brothers cannot see red and green?
4. Is it likely that the Taylor's son is color blind? Explain

Tech Prep Applications

Use with Chapter 12: Patterns of Heredity and Human Genetics

Activity Tracking a High-Cholesterol Gene

Familial hypercholesterolemia, or FH, is a potentially lethal, inherited disorder characterized by an extremely high blood cholesterol level—500 milligrams per deciliter or more compared to the under 200 milligrams per deciliter that physicians prefer to see. People with high cholesterol are unusually prone to atherosclerosis, the condition in which cholesterol and other substances build up on

artery walls, eventually blocking the artery and often causing a heart attack or stroke. By some estimates, FH affects about a half million people in the United States, and each has a 50-50 chance of passing the disorder on to offspring. In this activity, you'll analyze the inheritance pattern of FH and learn how scientists track the family history of FH to save lives.

Part A: The Inheritance Pattern of FH

1. Scientists have discovered that the cause of FH is a defect in cells that prevents them from extracting LDLs (low-density lipoproteins, the so-called bad cholesterol) from the bloodstream. As a result, circulating cholesterol particles are free to accumulate within blood vessels. Individuals homozygous for the defective allele, LL' , have six times the normal cholesterol level. When they mate with individuals having normal cholesterol levels, LL , the F_1 offspring are heterozygous, LL' , showing an intermediate condition of twice the normal blood cholesterol level (Figure 1). What pattern of inheritance does this illustrate?

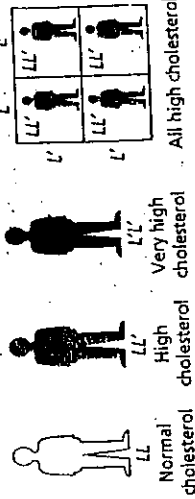


Figure 1

2. What are the expected genotypic and phenotypic ratios of F_2 offspring from a mating between heterozygous individuals? Use the Punnett square to find your answer.

Genotypic ratio _____
Phenotypic ratio _____

3. What phenotypic and genotypic ratios could you expect from a mating between a heterozygous individual and a normal homozygous individual (a)? Between a heterozygous individual and an individual homozygous for the defective allele (b)? Use the Punnett squares to find your answers.

a.

Genotypic ratio _____
Phenotypic ratio _____

b.

Genotypic ratio _____
Phenotypic ratio _____

Tech Prep Applications

Tracking a High-Cholesterol Gene

Part B: Tracking the Family History of FH
Because individuals with familial hypercholesterolemia have a 50 percent chance of passing the disorder on to offspring, scientists have recently launched an extensive campaign to track down and alert relatives of people with FH. To show the transmission of a trait through several generations of a family, scientists construct a pedigree of the family. Study the key and the pedigree diagram in Figure 2 to learn the symbols.

- Key**
- = Female with normal cholesterol
 - ◐ = Female with high cholesterol
 - = Female with very high cholesterol
 - = Male with normal cholesterol
 - ◑ = Male with high cholesterol
 - ◓ = Male with very high cholesterol

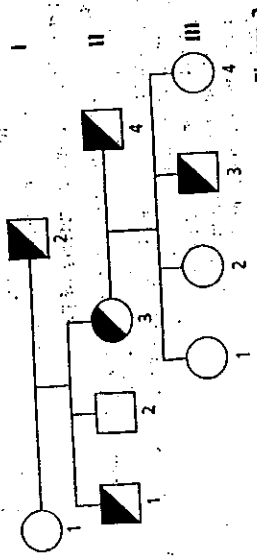


Figure 2

1. What are the benefits of being able to see the transmission of a trait over the history of a family?
2. Refer to the pedigree diagram in Figure 2. What is the probability of individuals II-3 and II-4 having a child with very high cholesterol?

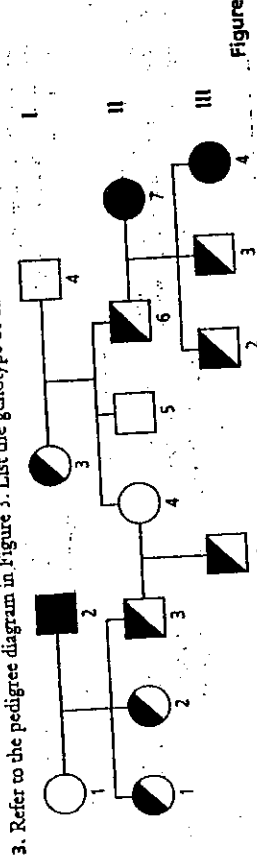


Figure 3

3. Refer to the pedigree diagram in Figure 3. List the genotype of each individual marked with a number.
4. In the pedigree in Figure 3, if individuals II-6 and II-7 have another child, what is the chance that he or she will have very high cholesterol? Complete the Punnett square to support your answer.
