From the Teacher: J. Haut
Class: Enhanced Biology & Enhanced SEA Biology
Period: 2, 4, and 5
Assignment: Week 3

If turning in paper packet and work, make sure to include this header information on all pages!

From the Student: Student Name
Teacher Name
Name of class
Period #
Assignment #

Patterns of Inheritance

The work in this packet is due 5/15/2020. If working online, you may turn in work digitally before the deadline. I encourage you to turn work in as you complete it. If completing paper packets, attach all work to packet before turning packet in on May 15th. You can also take a picture of paper packet work and email images to me. Make sure to have the proper heading on each page to ensure that I receive all of your work. I have broken the work down into daily tasks to help you manage your time.

My office hours are 10AM-12PM, M-F. You can email me at jhaut@tusd.net, post a question in Teams, or call me at (209) 625-9540 with questions. Please continue to check your email regularly.

Wk3:Day 1 (turn in by 5/15/20): Review how DNA is structured, the human life cycle, and how meiosis creates haploid gametes.

1. Review the structure of DNA: figure 3.29 on p. 50 in your textbook and figure 8.5 on p. 124.
2. Review the human life cycle: Read page 131.
3. Review meiosis: Read pgs. 132-133 in your textbook.
4. Write 1-2 thoughtful paragraphs about what you now understand about a) meiosis, the human life cycle, and the structure of DNA, b) what still confuses you, and c) what new questions you have.

Wk3: Days 2 & 3 (turn in by 5/15/20)

Read the following passage and answer the questions that follow. Pages 144-148 in Ch. 9 can also be helpful.

The Chromosomal Basis of Segregation

Diploid cells contain two sets of **homologous chromosomes**. One set, or one member of each pair, comes from each parent. Each pair of homologous chromosomes carries **genes** that govern the same traits. For example, in pea plants, flower color is determined by a single gene *F*, which can have two different forms, *F* or *f*, called **alleles**. Every cell in the diploid plant has two copies of the gene, one on each member of a homologous pair of chromosomes. These two versions of the same gene may be alike (**homozygous**) or different (**heterozygous**). The genetic makeup of the cell is known as its **genotype**. In this example, a cell with two *F* alleles would have the genotype *FF*. A cell with two *f* alleles would have the genotype *ff*. If the cell has one *F* and one *f*, its genotype is *Ff*. The genotypes *FF* and *ff* are homozygous, and the genotype *Ff* is heterozygous. All the cells of the plant should have the same genetic composition.

In pea plants, the *F* allele is **dominant** over *f*: When one *F* is present it masks the *f* allele. The *f* allele is called **recessive**. A capital letter is used to denote the dominant allele. A pea plant having either the *FF* or *Ff* genotype has the **phenotype**, or outward appearance, of purple flowers. The phenotype that results from the *ff* genotype is white flowers.

Genetic traits are passed from one generation to the next by reproduction. When animal cells undergo meiosis they produce **gametes**, which are haploid. When plant cells undergo meiosis they produce **spores**, which then become the plants that produce gametes.

Activity A: Genotypes and Phenotypes

A gene *R* codes for the tongue-rolling ability in humans. The allele *R*, which gives a person this ability, is dominant over *r*.

1. What is the phenotype of an individual whose genotype is RR? _____
2. What is the phenotype of an individual whose genotype is Rr? _____

3. What is the phenotype of an individual whose genotype is rr? _____

4. What are your phenotype and genotype? _____

After meiosis, each resultant gamete will have only one member of each homologous pair of chromosomes. Therefore, each gamete will have only one allele for tongue-rolling.

The distribution of alleles during the formation of gametes was one of the principles described by Gregor Mendel. It is called the **principle of segregation**: The two alleles of a gene segregate, or separate, from each other so that each one ends up in a different gamete. Mendel, however, did not know about the existence of chromosomes or meiosis. Not until decades after his death was the chromosomal basis of Mendel's law discovered.

5. If a person's genotype is RR, what are the genotypes of the resulting gametes? _____

6. If the person's genotype is rr, what are the genotypes of the resulting gametes? _____

7. If the person's genotype is Rr, what are the genotypes of the resulting gametes? _____

Activity B: Predicting the Outcome of a Monohybrid Cross. Refer to pages 145-146

When the genotypes of the parents are known, we may determine what gametes the parents can make and in what proportion the gametes will occur. This information allows us to predict the genotypes and phenotypes of the offspring. The prediction is simply a matter of listing all of the possible combinations of gametes. In this section you will be doing **monohybrid** crosses: Only one trait is followed.

By convention, the parental generation is called P. The first generation of offspring is called F_1. F stands for filial, which refers to a son or daughter, so F_1 is the first filial generation. If members of the F_1 generation are crossed, their offspring are called the F_2 generation, and so on. Predict the results of the following cross (using R to denote tongue rolling ability.):

Predict the results of the following cross: P generation: RR X RR

1. What genotype(s) will be found in the F_1 generation? _____

2. What phenotype(s) will be found in the F_1 generation? _____

3. Explain why you made these predictions.

_____

_____

_____

Predict the results of the following cross:
P generation: RR X rr

4. What genotype(s) will be found in the F_1 generation? _____

5. What phenotype(s) will be found in the F_1 generation? _____

6. Explain why you made these predictions.

_____

_____

_____

In the examples given so far, each parent has only been able to produce one type of gamete, so the outcomes of the crosses are fairly simple. The **Punnett** square was devised to keep track of all possible combinations of genotypes when more than one type of gamete can be produced. Fill out the Punnett square in Figure 9.2 for the F_2 generation by crossing offspring of the previous cross (Rr X Rr).

7. What are the possible genotypes in the F_2 generation?

   _____

8. What is the phenotype of each genotype in the F_2 generation?

   _____

9. What is the phenotypic ratio for this cross?

   _____

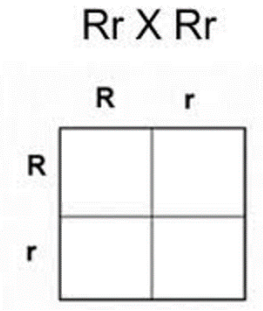


Figure 9.2
Punnet square for monohybrid cross

<u>Activity C: The Chromosomal Basis of Independent Assortment. Refer to pages 148-149 in Ch 9 of textbook.</u>
Genes that are located on the same chromosome are **linked** with each other. If genes are located on separate, nonhomologous chromosomes they are not linked, or unlinked. Unlinked genes separate independently during meiosis. For example, consider the allelic pair R and r and a second allelic pair A and a. If the R gene and the A gene are not linked, their alleles can be found in any combination in the gametes. That is, the R allele can be in the same gamete as either A or a. This is Mendel's **principle of independent assortment**. The word assortment in this case refers to the distribution, or sorting, of alleles into gametes.

In Figure 9.3 below is a cell that represents the following conditions: diploid; two homologous pairs of chromosomes; two unlinked genes called R and A; cell is heterozygous for both genes.

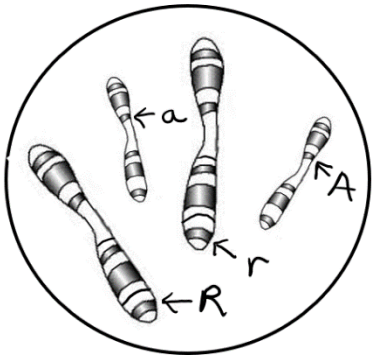


Figure 9.3

R is the gene for tongue-rolling, as used in the previous examples. A determines arch characteristics. A person who has the dominant allele has normal arches. An individual who is homozygous recessive has flat feet.

1. What is the genotype of this cell? _____
2. What is the phenotype of the individual represented by the cell in Figure 9.3?

   _____

3. Recall that when this cell undergoes meiosis, each gamete receives one member of each homologous pair. List the possible combinations of alleles that will be found in the gametes.

   _____

4. In what proportion would you expect these gametes to occur?

   _____

Wk3: Days 4 & 5 (turn in by 5/15/20)

Scientists at Bikini Bottoms have been investigating the genetic makeup of the organisms in this community. Use the information provided and your knowledge of genetics to answer each question.

1. **For each genotype below, indicate whether it is a heterozygous (He) OR homozygous (Ho).**

   TT _____ Bb _____ DD _____ Ff _____ tt _____ dd _____

   Dd _____ ff _____ Tt _____ bb _____ BB _____ FF _____

   Which of the genotypes in #1 would be considered purebred? _____

   Which of the genotypes in #1 would be hybrids? _____

2. **Determine the phenotype for each genotype using the information provided about SpongeBob.**

   Yellow body color is dominant to blue.

   YY _____ Yy _____ yy _____

   Square shape is dominant to round.

   SS _____ Ss _____ ss _____

3. **For each phenotype, give the genotypes that are possible for Patrick.**

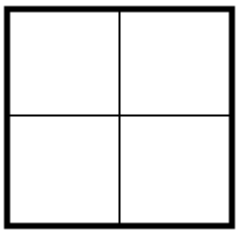
   A tall head (T) is dominant to short (t).

   Tall = _____ Short = _____

   Pink body color (P) is dominant to yellow (p).

   Pink body =_____ Yellow body = _____

4. **SpongeBob SquarePants recently met SpongeSusie Roundpants at a dance. SpongeBob is heterozygous for his square shape, but SpongeSusie is round. Create a Punnett square to show the possibilities that would result if SpongeBob and SpongeSusie had children. HINT: Read question #2!**



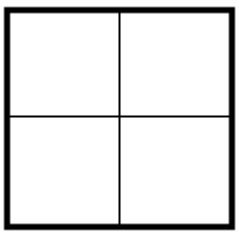
   A. List the possible genotypes and phenotypes for their children.

   _____

   B. What are the chances of a child with a square shape? ____ out of ____ or ____%

   C. What are the chances of a child with a round shape? ____ out of ____ or ____%

5. **Patrick met Patti at the dance. Both of them are heterozygous for their pink body color, which is dominant over a yellow body color. Create a Punnett square to show the possibilities that would result if Patrick and Patti had children. HINT: Read question #3!**



   A. List the possible genotypes and phenotypes for their children.

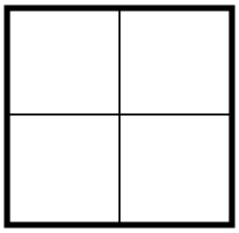
   _____

   B. What are the chances of a child with a pink body? ____ out of ____ or ____%

   C. What are the chances of a child with a yellow body? ____ out of ____ or ____%

6. **Everyone in Squidward's family has light blue skin, which is the dominant trait for body color in his hometown of Squid Valley. His family brags that they are a "purebred" line. He recently married a nice girl who has light green skin, which is a recessive trait. Create a Punnett square to show the possibilities that would result if Squidward and his new bride had children. Use B to represent the dominant gene and b to represent the recessive gene.**

   A. List the possible genotypes and phenotypes for their children.



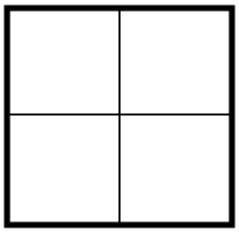
   B. What are the chances of a child with light blue skin? ____%

   C. What are the chances of a child with light green skin? ____%

   D. Would Squidward's children still be considered purebreds? Explain!

7. **Mr. Krabbs and his wife recently had a Lil' Krabby, but it has not been a happy occasion for them. Mrs. Krabbs has been upset since she first saw her new baby who had short eyeballs. She claims that the hospital goofed and mixed up her baby with someone else's baby. Mr. Krabbs is homozygous for his tall eyeballs, while his wife is heterozygous for her tall eyeballs. Some members of her family have short eyes, which is the recessive trait. Create a Punnett square using T for the dominant gene and t for the recessive one.**

   A. List the possible genotypes and phenotypes for their children.



   B. Did the hospital make a mistake? Explain your answer

Chapter 9
Patterns of Inheritance

Ms. Haut

Modern Theory of Heredity

- Based on Gregor Mendel's fundamental principles of heredity
  - Parents pass on discrete inheritable factors (genes) to their offspring
  - These factors remain as separate factors from one generation to the next

Experimental genetics

- Began with Gregor Mendel's quantitative experiments with pea plants
  - These plants are easily manipulated.
  - These plants can self-fertilize.

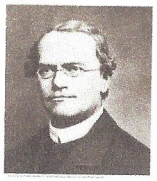


Figure 9.2

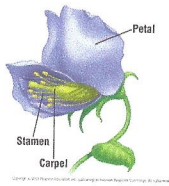


Figure 9.3

Mendel's Discoveries

- Developed true-breeding lines—populations that always produce offspring with the same traits as the parents when parents are self-fertilized
- Mendel then crossed two different true-breeding varieties.
- Counted his results and kept statistical notes on experimental crosses

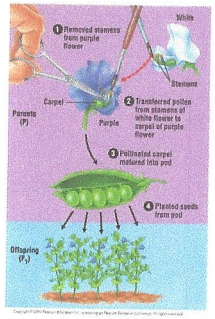


Figure 9.4

Mendel's Law of Segregation

- Mendel performed many experiments.
- 1st Law of genetics
  - The two members of an allele pair segregate (separate) from each other during the production of gametes.

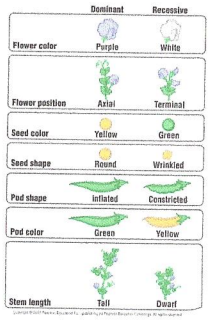


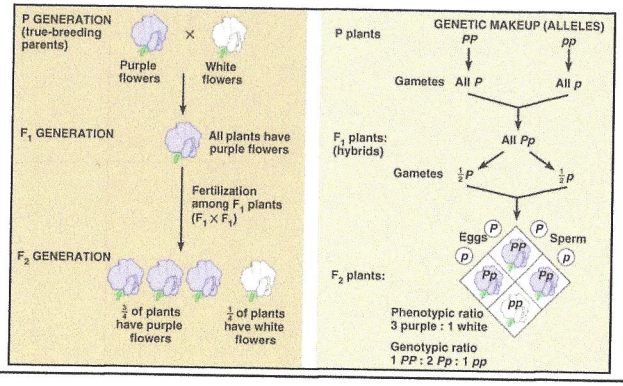
Figure 9.5

- Based on Mendel, we've developed four hypotheses from the monohybrid cross:
  - There are alternative forms of genes, called alleles.
  - For each characteristic, an organism inherits two alleles, one from each parent.
  - If 2 alleles differ, one is fully expressed (dominant allele); the other is completely masked (recessive allele)
  - Gametes carry only one allele for each inherited characteristic.
    - 2 alleles for each trait segregate during gamete production

Useful Genetic Vocabulary

- Homozygous—having 2 identical alleles for a given trait (PP or pp)
- Heterozygous—having 2 different alleles for a trait (Pp); ½ gametes carry one allele (P) and ½ gametes carry the other allele (p)
- Phenotype—an organism's expressed traits (purple or white flowers)
- Genotype—an organism's genetic makeup (PP, Pp, or pp)

Monohybrid Crosses

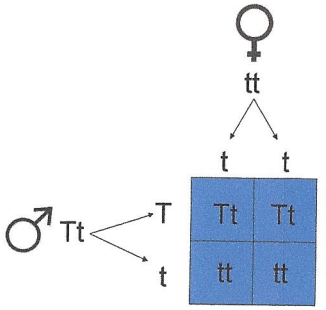


				Ratio	
FLOWER COLOR	Purple	x	White	3.15:1	
FLOWER POSITION	Axial	x	Terminal	3.14:1	
SEED COLOR	Yellow	x	Green	3.01:1	
SEED SHAPE	Round	x	Wrinkled	2.96:1	3:1
POD SHAPE	Inflated	x	Constricted	2.95:1	
POD COLOR	Green	x	Yellow	2.82:1	
STEM LENGTH	Tall	x	Dwart	2.84:1	

Punnett Square

- Cross a heterozygous tall pea plant with a dwarf pea plant.
- T = tall, t = dwarf

♂ Tt x tt ♀



The Testcross

- The cross of an individual displaying the dominant phenotype to a homozygous recessive parent
- Used to determine if the individual is homozygous dominant or heterozygous

CAUTION:

Must perform many, many crosses to be statistically significant

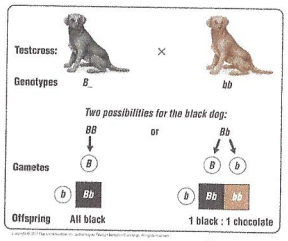


Figure 9.10

Genetic Alleles and Homologous Chromosomes

- Homologous chromosomes
  - Have genes at specific loci.
  - Have alleles of a gene at the same locus.

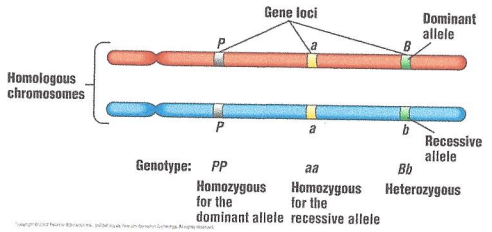


Figure 9.7

Mendel's Law of Independent Assortment

- During gamete formation, the segregation of the alleles of one allelic pair is independent of the segregation of another allelic pair
  - Law discovered by following segregation of 2 genes (dihybrid cross)

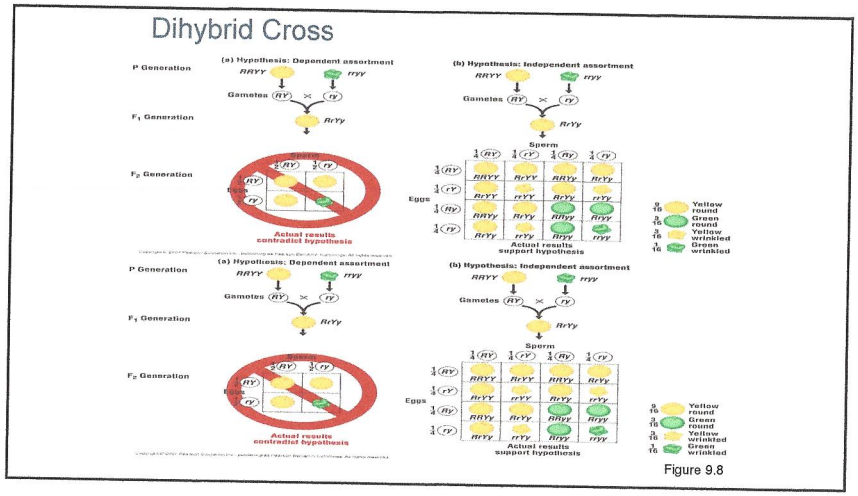


Figure 9.8

Gamete formation

AaBb

AB
Ab
aB
ab

AABb

AB
Ab
AB
Ab

AaBbCc

ABC aBC
ABc aBc
AbC abC
Abc abc