

Lesson #1 Segregation, Independent Assortment, and Pedigrees

AGRO 315 Genetics

1. Match each term with the appropriate definition.

1. allele	7. heterozygous	13. monohybrid
2. dominant	8. homozygous	14. recessive
3. dihybrid	9. independent assortment	15. reciprocal cross
4. egg	10. gene	16. segregation
5. F1	11. genotype	17. sperm
6. F2	12. phenotype	18. zygote

_____ a. The particular traits of an individual resulting from both the individual's genetic makeup and environment. These could be appearance, taste, smell, sound, or any other trait which can be assessed.

_____ b. The offspring generated from crossing two individuals that vary by one trait.

_____ c. The genetic makeup of an individual with respect to the genes that control a particular trait.

_____ d. An alternative version of a particular gene

_____ e. A description of an individual that has two of the same versions of a particular gene in each of their somatic cells.

_____ f. A description of an individual that has one copy of one version of a gene, and one copy of an alternative version, in each of their somatic cells.

_____ g. Female gamete

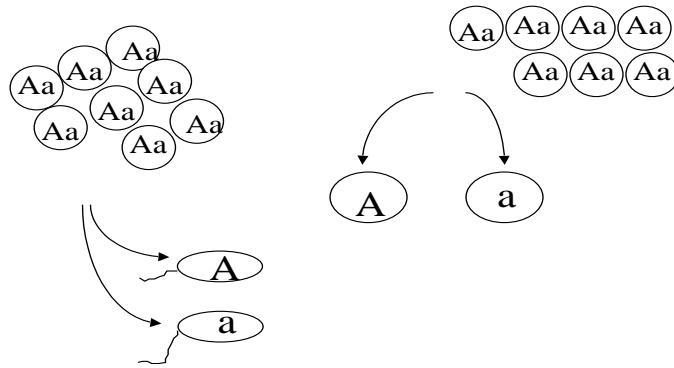
_____ h. Crossing two F1s produces this generation.

_____ i. The term used for the hereditary units first described by Mendel as, "Some type of particle that controls traits and maintains its identity as it is passed from parent to offspring."

_____ j. Crossing a true breeding belted male pig with a true breeding solid female to verify the results obtained from crossing a true breeding belted female and a true breeding solid male pig.

_____ k. When two parents that are true bred only differ by two traits, their offspring have this name.

_____ l. The genetic principle we are using every time we draw a Punnett Square. Draw two Punnett squares, one for each gene pair, to **explain this principle**.



2a. A _____ cell has all the genetic information to function (diploid).

b. A _____ has one copy of every gene (haploid).

c. The process by which alleles are separated in the formation of gametes (pictured above):

3. Refer to Mendel's Monohybrid cross data in your lecture notebook, lesson 1 or on Blackboard.

a. Draw a diagram to explain why Mendel got 6022 seeds with yellow cotyledons and 2001 seeds with green cotyledons in the F₂ of this experiment.

b. What is the probability that a yellow cotyledon F₂ seed will grow into a plant that will self and produce both yellow and green progeny?

4. Watch the presentation on fefe inheritance in the Vimeo site (<https://vimeo.com/57173166>) and complete the following questions.

****Password: GeNeTiCs**

a. Collect the phenotype data you collected on the 20 plants in the first row and combine your data above with the data that was already collected on 112 more plants in row 2-6

of F2 in the row with the fefe phenotype? 28 + _____ = _____

of F2 in the row with the normal phenotype? 84 + _____ = _____

b. Devise a simple genetic hypothesis to explain the genetic control of the fefe trait. What was the genotype of the F1 in your hypothesis?

c. Based on your hypothesis above, what is the number of the 132 F2 plants that you would predict would have the fefe phenotype? (check one)

100 99 61 33 32

e. When conducting an inheritance experiment, a geneticist will: (check one)

expect their results to always be a perfect fit to a ratio such as 3:1.

expect their results to be close to an expected ratio such as 3:1, but not a perfect fit because chance has an influence on the results.

f. List two advantages that a plant geneticist has in conducting an experiment compared with an animal geneticist.

g. Contrast two animals based on difficulty in conducting an inheritance study. Explain.

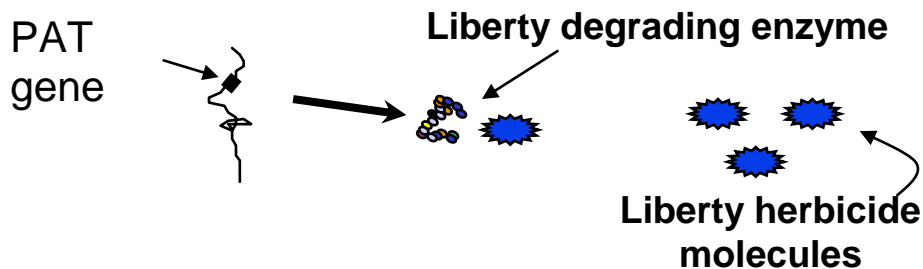
5a. Below is a data set obtained from a genetic experiment in which the only trait observed was corn kernel color (yellow vs. purple). Fill in the blanks in the genotype columns with the appropriate symbols. Use any letter you wish but use the upper case to represent the dominant allele.

Cross	Parent 1	genotype		Parent 2	genotype	# Purple Offspring	# Yellow Offspring
	yellow		X	yellow		0	492
purple		X	yellow		235	241	
purple		X	purple		452	139	

b. Which trait is the mutant trait in corn (purple or yellow seeds)? Explain why you came to this conclusion.

6. Corn plants grown in Nebraska now have traits derived from genetic engineering that were never found in corn before. These traits result from new genes being added to a chromosome in the corn plant. These new genes are called **transgenes** and the genetically engineered plants are **transgenic**. We will study this genetic engineering process in detail later in the course.

The PAT gene gives the corn plant resistance to a weed killing herbicide called “Liberty”, by telling the plant how to make an enzyme that chops up the herbicide molecule before the molecule damages the plant.



The genetic control of two of these traits is shown below.

G_ Glyphosate (Roundup) resistant
gg roundup damaged (destroyed)

L_ Liberty herbicide resistant
ll liberty damaged

c. A Nebraska farmer grows a hybrid with the genotype Gg Ll. Which cross or crosses below would generate this hybrid? (check one)

GGLL X ggll GGll X ggLL GGLL X GGLL

Volunteer corn is F2 plants (that grew from F2 seeds) made by the F1 hybrid. When a farmer is growing Soybean in a field that had **GgLI** corn plants the previous year, the volunteer corn becomes a problem weed. The farmer is motivated to remove the volunteer corn from this soybean field.

d. If the farmer attempts to remove the volunteer corn with a treatment of Glyphosate, what fraction of the volunteer corn will be destroyed? (NOTE Glyphosate herbicide kills plants in a different way than Liberty)

e. If the farmer attempts to remove the volunteer corn with a treatment of Liberty, what fraction of the volunteer corn will be destroyed?

f. List the genotypes of F2 volunteer plants that would resist BOTH Liberty and Glyphosate sprayed at the same time.

g. If the farmer attempts to remove the volunteer corn with a treatment of Glyphosate AND Liberty, what fraction of the volunteer corn will be destroyed? (**hint: answer is not 1/16**)

A corn breeder wants to develop a new hybrid for farmers to grow for the blue or purple corn chip market. They have these three true breeding lines of corn.

BBggll: True breeding for blue/purple corn, no herbicide resistance.

bbGGll: Yellow seed but Glyphosate resistant and not Liberty resistant

bbggLL: Yellow seed , not glyphosate resistant but does have Liberty resistance.

h. The breeder decides to cross BBggll X bbGGll. What is the ONE genotype produced from this cross?

i. They self these F1 plants and produce F2s, how many different F2 genotypes will be produced?

_____ 16 _____ 9 _____ 8 _____ 6 _____ 3

j. What fraction of ALL of the F2 seeds produced by the selfed F2 plants would have both the purple/blue seed color and Glyphosate resistance?

k. Assume that they select just the purple/blue F2 seeds and plant them. When these seeds grow into young seedling plants, they ruthlessly spray them with Glyphosate herbicide. What fraction of these F2 plants will survive?

l. Of those plants that survive the glyphosate treatment, what fraction will be the genotype **BBGGll** which is the type that they want for their plant breeding goal?

7a. Blood tests reveal a person's cholesterol levels. Having high levels of "bad cholesterol", or LDL, is a result of a person's: (circle one)

genotype

environment

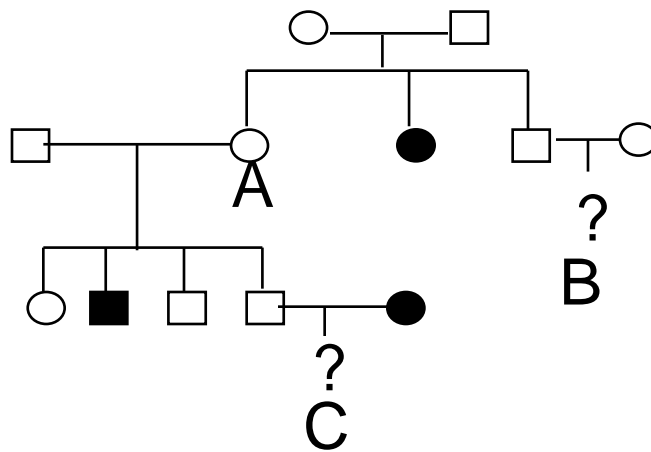
genotype and environment

b. Tangier disease is very rare. One reason is because the defective version of the ABC1 gene causing the disease is not very common. The other reason is that people will only have the disease if they lack the normal version of ABC1 in their cells. Therefore people with Tangier disease must be: (circle one)

homozygous

heterozygous

either homozygous or heterozygous



c. Assume the pedigree shows the occurrence of Tangier disease (filled symbols). What is the probability that 'C' will have Tangier disease?

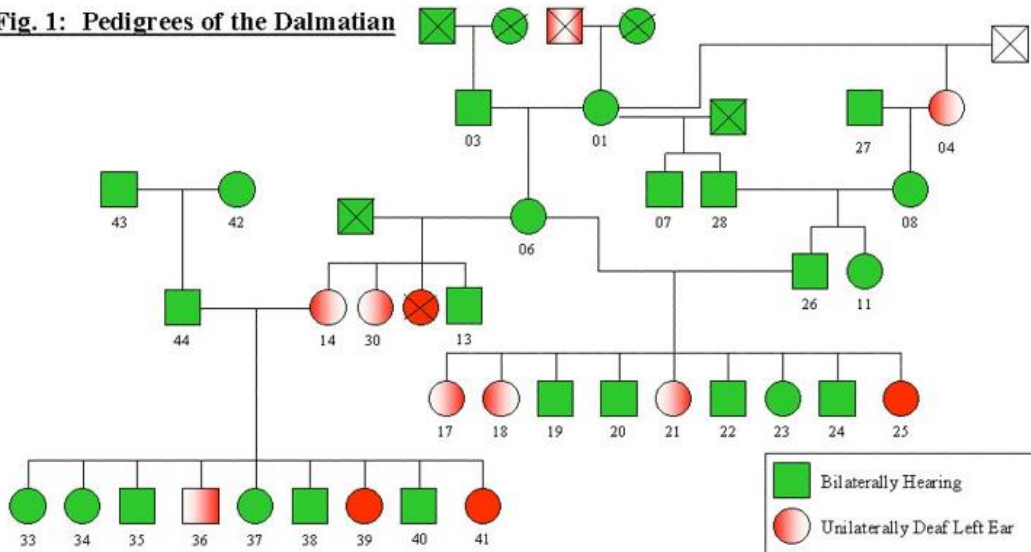
d. What is the probability that 'C' will be a carrier of the disease allele but be normal?

e. If 'C' has Tangier disease, what would be the chance of a sibling also having the disease?

f. If the female parent of 'B' is homozygous dominant, what is the chance that 'B' will have the disease?

8. Below is a pedigree from hearing phenotype data collected in one Dalmatian family.

Fig. 1: Pedigrees of the Dalmatian



To make analysis simpler, consider dogs to have the deaf phenotype (red) if they have hearing loss with either one or both ears. Consult the color pedigree linked to Blackboard.

a. Which of the crosses demonstrate that **deafness** is a recessive trait?

- ___ dog 06 X dog 26, both dogs can hear but must be Dd
- ___ dog 44 X dog 14, one dog is Dd the other is dd.

b. What is the genotype of dog 33?

- ___ DD ___ Dd ___ dd ___ could be DD or Dd

c. What is the genotype of dog 23?

- ___ DD ___ Dd ___ dd ___ could be DD or Dd