Chicken a la Coin Flip

Standards of Learning
LS.12.b) the function of genes and chromosomes
LS.12.c) genotypes and phenotype

Objective
Students will:

- Be able to determine the phenotype of a trait based on the genotype in a monogenetic simple cross

Materials

- "Chicken a la Coin Flip" Student Sheet
- "Chicken a la Coin Flip" Trait Key, coins
- "Punnett Practice Problems" Student Sheet

Background Knowledge
This lesson is designed to provide students with the knowledge of and experience with genetics and to teach students how to use the tools used by breeders such as the Punnett Square. By the end of this lesson, students will be able to correctly identify the parentage of a pullet or cockerel as demonstrated by the completion of at least two Punnett Squares which predict the observed traits.

As you learn more about and compare breeds of chickens, you will notice many different characteristics which are a result of genetic variation within the domestic chicken species. Skin color, feather color, feather patterns and textures, body size, and egg shell color are all characteristics you can see. These are known as phenotypes. Some genetic characteristics you cannot see by simply looking at a chicken, but you can measure these traits by keeping good records. Examples include rate of growth and egg production. These characteristics are particularly important to poultry farmers. Farmers research the genetic characteristics of chicken breeds and choose the best breed or breeds for their farm.

Procedure

1. Hand out one penny and one copy of "Chicken a la Coin Flip Student Sheet" to each student group.
2. Hand out one copy of "Chicken a la Coin Flip Trait Key" to each group. This sheet will need to be printed in color.
3. Have students complete the "Chicken a la Coin Flip" activity. This activity features a list of single allele dominant/recessive traits in chickens. Students each flip a coin to signify one set of alleles. Heads represents the dominant allele, tails represents the recessive allele. By combining their flips with another student, students will have a list of genotypes. Students are then to illustrate the phenotype of their cross on the "Blank Chicken Coloring Sheet." Students can then compare their cross with other crosses in the class and notice the variety of offspring which can originate from one set of parents.
4. Once a student is done drawing and coloring their "chicken," have them hang it on a board or wall which has been designated the "chicken coop."
5. Hang two copies of the "Chicken a la Coin Flip Parents" above the "Chicken Coop." Have students reflect and discuss the diversity of the offspring coming from the same two parents. I.e. "Do any two chickens (who aren't from the same partnership) have the exact same set of traits?"

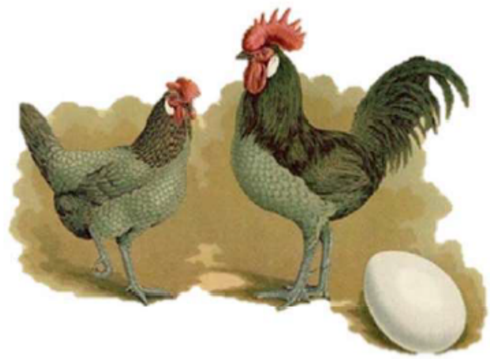
6. Have students complete the “Punnett Practice Problems” sheet. This sheet requires students to complete various parts of Punnett Squares. These squares are based on crosses from Reginald Punnett’s work.

Credit

Chris Kniesly, Virginia Agriculture in the Classroom 2019 Teacher of the Year

Name: ____ Period: ________________

Chicken a la Coin Flip



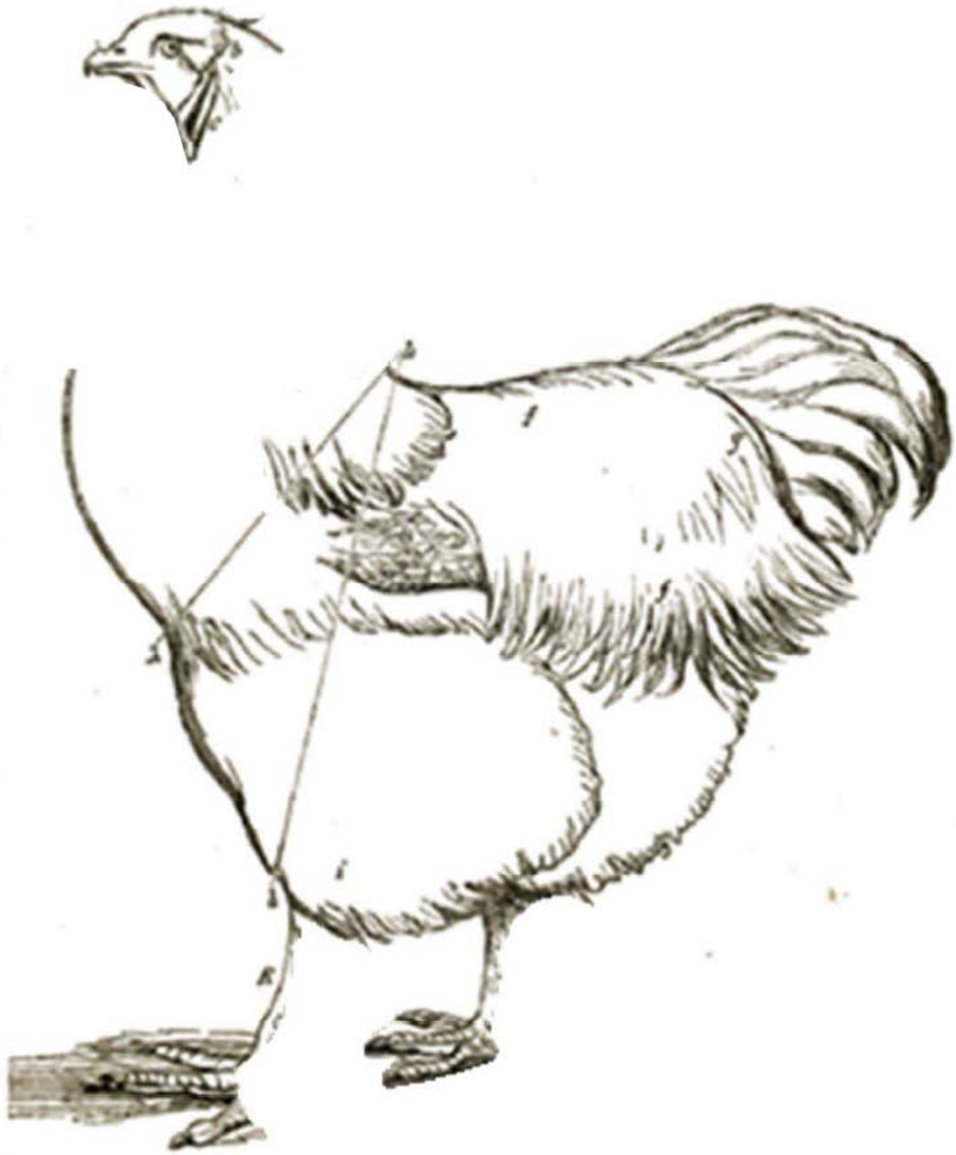
Background: In Mendelian genetics, a hybrid cross is a cross where both parents have identical phenotypes as a result of identical genotypes which are heterozygous for each trait. Hybrid crosses were used by Gregor Mendel, and later by Bateson and Saunders, to demonstrate that some traits were dominant over others. The number of possible outcomes in a multiple-trait hybrid cross is part of the reason for the diversity of living things.

Directions: For each of the listed traits, flip two coins, one coin for each parent. On the chart below, record the number of "heads" and the number of "tails." Then determine what traits your chicken would have if "heads" were dominant genes and "tails" were recessive genes.

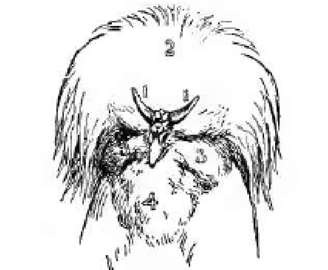
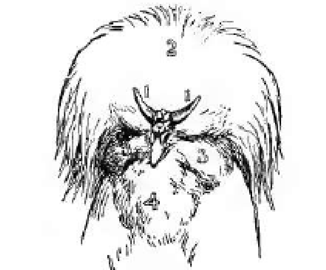
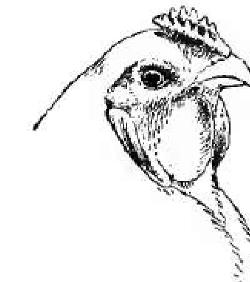
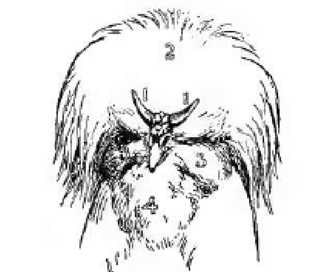
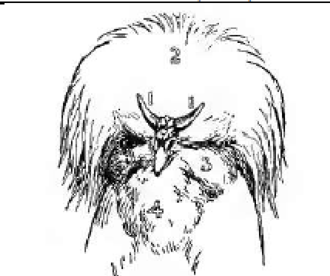
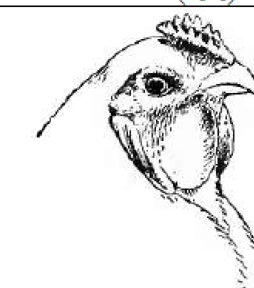
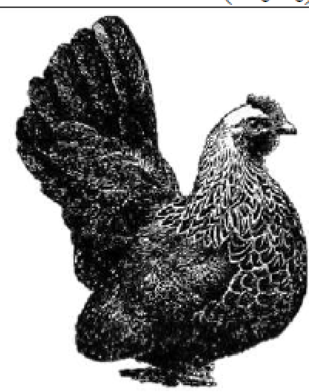
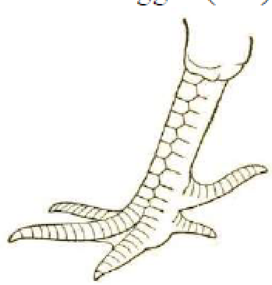
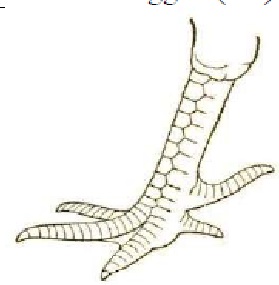
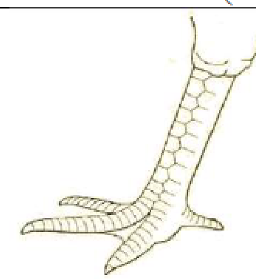
Trait	**Coin 1 (Mother)**	**Coin 2 (Father)**	**Genotype of Offspring**	**Phenotype of Offspring**
Crest				
Muffs and Beard				
Vulture Hocks				
Polydactyl				
Frizzled				
Neck Feathering				
Fibromelanosis				
Comb Type				
Feather Color				

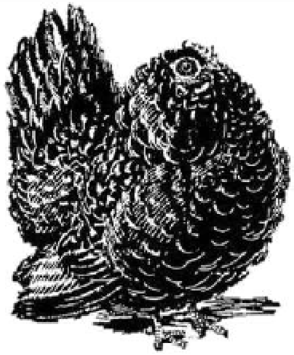
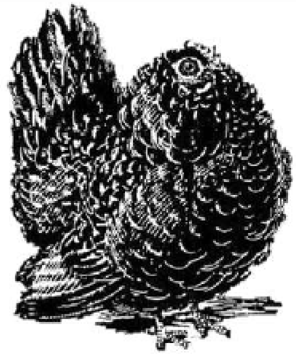
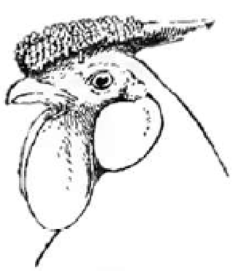
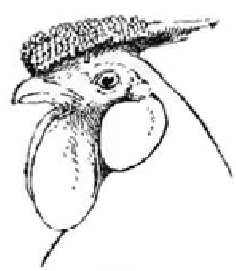
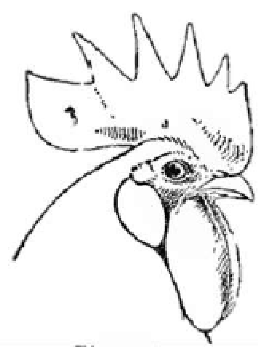
Directions: On the back of this sheet, use the "Chicken Template" to illustrate and color your chicken.

Chicken Template



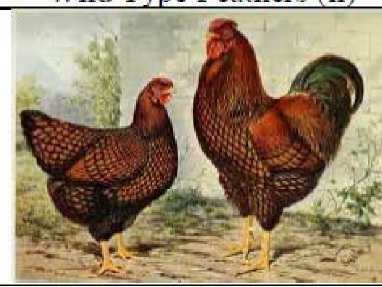
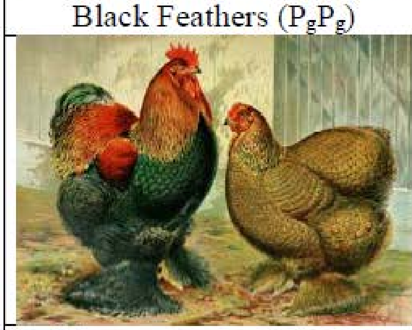
Chicken a la Coin Flip Trait Key

Homozygous Dominant	Heterozygous	Homozygous Recessive
 Figure 10. Sultan's Head, Male (Ideal). 1-1, V-shaped Comb; 2, Crest; 3, 3, Muffs; 4. Beard.	 Figure 10. Sultan's Head, Male (Ideal). 1-1, V-shaped Comb; 2, Crest; 3, 3, Muffs; 4. Beard.	 Figure 8. Pea Comb, Profile (Ideal).
Crested (C_rC_r)	Crested (C_rc_r)	No Crest (c_rc_r)
 Figure 10. Sultan's Head, Male (Ideal). 1-1, V-shaped Comb; 2, Crest; 3, 3, Muffs; 4. Beard.	 Figure 10. Sultan's Head, Male (Ideal). 1-1, V-shaped Comb; 2, Crest; 3, 3, Muffs; 4. Beard.	 Figure 8. Pea Comb, Profile (Ideal).
Muffs and Beard (M_bM_b)	Muffs and Beard (M_bm_b)	Clean Faced (m_bm_b)
		
Clean Legged (VV)	Clean Legged (Vv)	Vulture Hocks (vv)
		
Polydactyl, 5 toes (P_oP_o)	Polydactyl, 5 toes (P_op_o)	Standard, 4 toes (p_op_o)

Homozygous Dominant	Heterozygous	Homozygous Recessive
		
Frizzled (FF)	Frizzled (Ff)	Standard Feathering (ff)
		
Naked Neck (N_aN_a)	Naked Neck (N_an_a)	Standard Feathering (n_an_a)
		
Fibromelanosis (F_MF_M)	Fibromelanosis (F_Mf_M)	Standard Pigmentation (f_Mf_M)
		
Rose Comb (RR)	Rose Comb (Rr)	Single Comb (rr)

<u>Feather Color</u>

There are many genes in chickens which affect feather color. To simplify this complex process, the effect of four monogenetic color traits are shown below. Select <u>*one*</u> and use it to determine your "chicken's" feather color.

Homozygous Dominant	Heterozygous	Homozygous Recessive
		
White Feathers (II)	White Feathers (Ii)	Wild Type Feathers (ii)
		
Silver Feathers (SS)	Silver Feathers (Ss)	Gold Feathers (ss)
		
Black Feathers (P_gP_g)	Blue Feathers (P_gp_g)	Splash Feathers (p_gp_g)
		
Wild Type Feathers (LAVLAV)	Wild Type Feathers (LAVlAV)	Buff Feathers (lAVlAV)

Name: ____ Period: __________

Punnett Poultry Problems

Background: William Bateson, Edith Rebecca Saunders, and Reginald C. Punnett were pioneers in the field genetics and heredity. Their work help popularize the earlier work of an Austrian botanist named Gregor Mendel, who developed principles of heredity by hybridizing garden peas. Bateson, Saunders, and Punnett worked with peas as well, however a vast majority of their work and discoveries dealt with the domestic chicken.

Directions: Use Punnett Squares to solve the problems below. Be sure t write the genotypic and phenotypic ratios.

"By crossing two forms exhibiting antagonistic characters, crossbreds were produced. … (The crossbred's) inability to transmit both of the antagonistic characters, is the central fact proved by Mendel's work. … The zygote formed by the union of a pair of opposite allelomorphic gametes we shall call a heterozygote." - Bateson and Saunders, 1902

Repeat one of Mendel's crosses by crossing a purebred tall plant (TT) w a purebred short plant (tt) to create heterozygotes.

__________ X __________

________ TT: ________ Tt: ________ tt

________ Tall: ________ Short

Next cross two of the offspring from your last cross to create the "F_1" generation of Mendel's experiment.

__________ X __________

________ TT: ________ Tt: ________ tt

________ Tall: ________ Short
