9B Crazy Traits

What role does chance play in an organism's heredity?

Your traits are determined by the genes you inherit from your parents. For each gene, you get at least one allele from your mother and one allele from your father. The alleles you end up with are determined by two factors: (1) the genotypes of your parents; and (2) the allele from each parent you inherit. The alleles you inherit from each parent are determined by chance. In this investigation, you will play a game that will help you learn about inheritance.

Materials

- Crazy Traits game
- Name tags
- Markers

1 Determining the genotype

1. The first trait you will flip for is gender. Choose the male sex chromosome coin (***X*** on one side and ***Y*** on the other) and the female sex chromosome coin (***X*** on both sides). Place both coins in the plastic cup and shake. Toss the coins onto the table and record your results in Table 1.
2. Next, flip coins to determine the allele for each of the other traits your creature inherits from each parent. In this activity, we will assume that both parents have the same genotype for all traits (***Tt***). You will need a blue (egg) coin with a capital ***T*** on one side and a lower case ***t*** on the other side. You will also a green (sperm) coin with a capital ***T*** on one side and a lower case ***t*** on the other side.
3. Flip the coins for the next trait—skin color. Place the coins in the plastic cup. Shake the cup and toss the two coins onto the lab table. The side that lands up on each coin represents the sperm and egg that unite during fertilization. Record the allele from each parent and genotype in columns 2, 3, and 4 of the first row of Table 1.
4. Repeat this procedure for traits 2 through 14.

2 Stop and Think

a. What information do the letters on the sperm and egg coins indicate: alleles, genotype, or phenotype?

_____

b. For the sperm coin, what are the chances of getting a ***T*** or getting a ***t***? State your answer as a fraction and a percent.

_____

c. For the egg coin, what are the chances of getting a ***T*** or getting a ***t***? State your answer as a fraction or a percent.

_____

d. When both coins are flipped at once, what are your chances of getting each of the following combinations: ***TT***, ***Tt***, or ***tt***? State your answer for each as a fraction and a percent.

Table 1: Genotypes and phenotypes

Trait	Allele from mother	Allele from father	Genotype	Phenotype
1. Gender				
2. Skin color				
3. Leg				
4. Foot				
5. Arms				
6. Hands				
7. Eye color				
8. Eyebrows				
9. Beak				
10. Ears				
11. Antenna				
12. Antenna shape				
13. Tail				
14. Wings				

3 Building your creature

1. Once you have completed columns 2 through 4 of Table 1, use Table 2 (next page) to look up the phenotype for each trait. Record the phenotype for each trait in column 5 of Table 1.
2. Once you have completed Table 1, select the correct body parts to build your creature.
3. Carefully assemble your creature.
4. Give your creature a name and make it a name tag. Write the sex of your creature on the name tag.
5. Place your creature on the table at the front of your classroom.

4 Thinking about what you observed

a. Examine the creatures. Do any of them look exactly alike? Why or why not?

b. How does this investigation explain why siblings may resemble each other, but never look exactly alike (unless they are identical twins)?

c. Count the number of males and number of females. Does the number of each match the chances of getting a male or female in the game? Why or why not?

d. Which trait(s) are examples of complete dominance?

e. Which trait(s) are examples of incomplete dominance?

f. Which trait(s) are examples of codominance?

Table 2: Genotypes and phenotypes

Trait	Genotypes and phenotypes
1. Gender	***XX*** - female ***XY*** - male
2. Skin color	***TT*** - red ***Tt*** - purple ***tt*** - blue
3. Leg	***TT*** - short ***Tt*** - short ***tt*** - long
4. Foot	***TT*** - webbed ***Tt*** - webbed ***tt*** - talons
5. Arms	***TT*** - long ***Tt*** - long ***tt*** - short
6. Hands	***TT*** - paws ***Tt*** - paws ***tt*** - claws
7. Eye color	***TT*** - red ***Tt*** - one red and one green ***tt*** - green
8. Eyebrows	***TT*** - unibrow ***Tt*** - unibrow ***tt*** - separate
9. Beak	***TT*** - trumpet ***Tt*** - trumpet ***tt*** - crusher
10. Ears	***TT*** - elephant ***Tt*** - elephant ***tt*** - mouse
11. Antenna	***TT*** - long ***Tt*** - long ***tt*** - short
12. Antenna shape	***TT*** - knob ***Tt*** - knob ***tt*** - star
13. Tail	***TT*** - long ***Tt*** - short ***tt*** - none
14. Wings	***TT*** - no wings ***Tt*** - no wings ***tt*** - wings

5 Exploring on your own

If time permits, work with another group whose creature is the opposite gender. Follow the steps below to create offspring of the couple:

1. Record the genotypes of each parent in the first column of Table 3 on the next page.
2. First, toss for gender using the male and female sex chromosome coins.
3. For each trait, you'll need to use the correct egg and sperm coins for each parent. Use the data in Table 1 to find the parents' genotype for each trait. Then, select the egg and sperm coin that has the same alleles as the genotype. For example, if the father's genotype for skin color is ***TT***, choose the sperm coin that has a capital ***T*** on both sides of the coin. If the mother's genotype for skin color is ***tt***, place the egg coin that has a lower case ***t*** on both sides of the coin.
4. Place both coins in the plastic cup, shake, and toss out onto the table. Record your results in the fourth column of Table 3.
5. Use Table 2 to look up the phenotypes. Record the phenotypes of the offspring in the last column of Table 3.

Table 3: Offspring genotypes and phenotypes

Trait and genotypes of parents	Genotype of mother for the trait	Genotype of father for the trait	Genotype of offspring (after flipping)	Phenotype of offspring
1. Gender				
2. Skin color				
3. Leg				
4. Foot				
5. Arms				
6. Hands				
7. Eye color				
8. Eyebrows				
9. Beak				
10. Ears				
11. Antenna				
12. Antenna shape				
13. Tail				
14. Wings				

6 Applying what you learned

a. Which parent does your offspring share the most traits with, the mother, father, or both equally?

b. Why do you need to choose different egg and sperm coins for each trait and for each parent?

c. What is the process that flipping the sex cell coins represents? Why is this process important?

d. There is always a 50% chance of having a male offspring. Explain why this statement is true. You may use a diagram to help explain.

e. In part 1, you started off with both parents having identical genotypes for all traits. Use what you have learned in the investigation to explain why this is unrealistic in nature.

f. CHALLENGE! Make punnett squares to show possible genotypes and phenotypes for each trait you flipped for in Part 5. For each, list the chances for each phenotype as a ratio and as a percent.