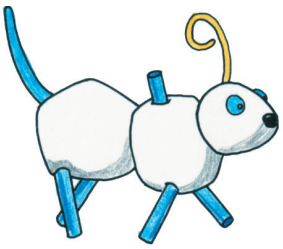
9 Breeding Critters—More Traits

INVESTIGATION

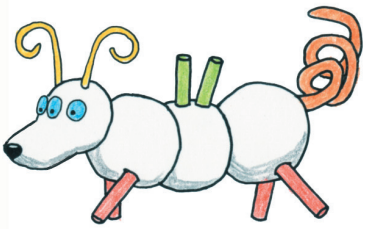
JOE HAS BEEN *thinking about all of the other ways he and his brother and sister resemble each other and their parents, and all of the ways they are different. Joe has their father's sense of humor, his brother has their mother's smile and laugh, and nobody can figure out where his sister got her musical talent. Joe is beginning to realize that many genes and the environment contribute to each person's unique traits.*

When you considered Skye and Poppy's breeding, you focused on just one characteristic—tail color. Critter tail-color inheritance followed the same pattern described by Mendel in his experiments with pea plants. One gene, for which there are two alleles, determines each characteristic. Each characteristic has two versions, or traits. For the characteristic of tail color, the traits are blue and orange, and the alleles of the tail-color gene are referred to as **T** and **t**. One trait is completely dominant over the other (recessive) trait. In this case, blue tail color (**T**) is dominant over orange (**t**).

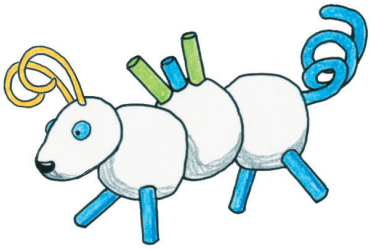
In fact, Skye and Poppy have a variety of traits. Some of them follow the pattern of inheritance that was described by Mendel. Others are inherited in a different pattern. In this activity, you will look at some other traits and investigate how they are inherited.



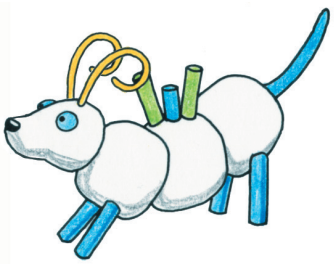
Skye



Poppy



Lucy



Ocean

GUIDING QUESTION

What causes variation between offspring of the same parents?

MATERIALS

For each group of four students

1 plastic cup
colored pencils

For each pair of students

1 Student Sheet 9.1, "Critter Breeding Worksheet"
2 pennies
critter "parts"

THE MODEL

The table below shows Skye's and Poppy's traits. It also shows the traits of all their offspring. In this activity, you will look at more traits in the third-generation offspring, which are produced when the second-generation offspring mate with each other. Lucy, a female, and Ocean, a male, are the second-generation critters who will mate.

First and Second Generation Traits

	GENERATION ONE		GENERATION TWO
CHARACTERISTIC	SKYE	POPPY	100 OFFSPRING (SUCH AS LUCY AND OCEAN) *
Body segments (number)	2	3	3
Leg color	blue	red	blue
Eyes (number)	2	3	2
Nose length	short	long	medium
Tail color	blue	orange	blue
Tail style	straight	curly	48 curly, 52 straight
Antennae (number)	1	2	2
Spikes (color and number)	1 short blue	2 long green	1 short blue + 2 long green
Calling behavior	whistles	clicks	whistles
Sex	male	female	53 female, 47 male

** Results indicate all 100 offspring unless otherwise noted.*

PROCEDURE

1. Work in pairs. Place Student Sheet 9.1, "Critter Breeding Worksheet," between you and your partner. The person sitting on the left side will toss a penny for Ocean while the person on the right will toss a penny for Lucy.
2. For each toss, each partner should
   - hold a penny in cupped hands.
   - shake it to the count of five.
   - allow it to drop from a height of about 20–40 cm (8–16 inches) onto the desk.

Critter Code

CHARACTERISTIC	ALLELES	TRAIT
Body segments (number)	**BB** **Bb** **bb**	3 3 2
Leg color	**LL** **Ll** **ll**	blue blue red
Eyes (number)	**EE** **Ee** **ee**	2 2 3
Nose length	**NN** **Nn** **nn**	long medium short
Tail color	**TT** **Tt** **tt**	blue blue orange
Tail style	**SS** **Ss** **ss**	curly *curly or straight straight
Antennae (number)	**AA** **Aa** **aa**	2 2 1
Spikes (color and number)	**GG** **HH** **GH**	1 short blue 2 long green 1 short blue + 2 long green
Calling behavior	**WW** **Ww** **ww**	whistles whistles clicks

** To find out if an **Ss** critter's tail is curly or straight, toss a coin. If it shows heads, the critter's diet contains "crittric" acid, causing the critter to develop a curly tail. If the coin shows tails, the critter's diet does not contain crittric acid, causing it to develop a straight tail.*

3. The partner on the left tosses a penny to determine which allele for number of body segments Ocean gives to his offspring. If the penny shows heads, write **B** in the column titled "From Ocean" on Student Sheet 9.1. If the penny shows tails, write **b**. The other partner tosses a penny to determine the allele that Lucy gives. Write the letter for that allele in the column titled "From Lucy."
4. Determine the offspring's phenotype for number of body segments. Look at the alleles you wrote under "From Ocean" and "From Lucy." Compare these alleles with the Critter Code on the previous page (or with the information in the first column of Student Sheet 9.1). Then write the appropriate trait in the next column. For example, if you wrote **Bb** for the alleles, the trait is "3 segments."
5. Continue tossing coins and filling in Student Sheet 9.1 until you have completed the table. Use the Critter Code to determine the phenotype for each characteristic based on the genotype of the offspring. Note the special instructions for tail style.
6. Find out if your critter is male or female by determining its sex chromosomes as follows:
   a. Ocean is an XY male. The partner representing Ocean tosses a penny. If it shows heads, Ocean donates an X chromosome to the offspring. If the penny shows tails, Ocean donates a Y chromosome to the offspring.
   b. Lucy is an XX female. The partner representing Lucy does not need to toss a penny. Lucy can donate only an X chromosome to the offspring.

   Write the sex (male or female) of the offspring in the appropriate space.
7. Use the materials provided by your teacher and listed in the table on the next page to make your critter.

8. Draw your critter and color in the body parts.

Critter Characteristics

CHARACTERISTIC	REPRESENTED BY
Body segments	Large foam balls connected by toothpicks
Heads	Small foam balls
Legs	Pieces of red or blue drinking straws
Eyes	Blue thumbtacks
Nose	Brass fastener, adjust length
Tail	Blue or orange chenille stem
Antennae	Yellow paper clip
Spikes	Pieces of blue or green drinking straws
Calling	Speech bubble sticky note

ANALYSIS

1. Look at the other critters made by your classmates. They are all siblings (brothers and sisters).

   a. What are their similarities and differences?

   b. Use the ideas you have learned in this unit and the model you used in this activity to explain to Joe why some siblings look a lot alike, while others look very different from each other.

2. Which characteristics show a simple dominant/recessive pattern like tail color? List them in a table, and indicate which version is dominant and which is recessive for each trait.

   Hint: Look at the "First and Second Generation Traits" table to see which traits have this pattern.

   Some traits do not show a simple dominant versus recessive pattern. Look at the "First and Second Generation Traits" table to help you answer Questions 3–5.

3. For which characteristic do some offspring have traits in between Skye's and Poppy's traits? Explain. (For example, in some plants, a cross between a red- and white-flowered plant will give

pink-flowered offspring. This is called *incomplete dominance*.)

4. For which characteristic do some offspring have both Skye's and Poppy's traits? Explain. (For example, in humans, a person with type A blood and a person with type B blood can have a child with type AB blood. This is called *co-dominance*, as both traits appear in the offspring.)
5. Which critter trait is affected by an environmental factor, such as light, temperature, or diet? Explain.
6. Consider the pattern for sex determination.
   a. How is a critter's sex determined?
   b. Whose genetic contribution—Ocean's or Lucy's—determines the sex of the offspring?
7. Draw a model and use it to describe why asexual reproduction leads to identical offspring and sexual reproduction leads to variation. You can use the offspring of the cross between Ocean and Lucy as your example. Be sure to include the following:
   - a diagram or other model that shows the inheritance of a chromosome pair and alleles for a characteristic like tail color
   - an explanation of how inheritance of two characteristics (for example, tail color and number of body segments in critters) would lead to more variation in critter offspring
   - what would happen if there were more pairs of chromosomes and more genes shown
8. Consider Joe's story. Joe's friend says he thinks Joe doesn't have Marfan syndrome because he has hair and eyes like his father's and acts more like his father, and his father doesn't have Marfan syndrome. Based on what you have learned so far, do you agree with Joe's friend that he's unlikely to have Marfan syndrome? Explain in terms of what you know about inheritance of genes and chromosomes.