CHAPTER
3

All In The Family

The following steps will help you execute the Chapter 3 Project. Use the hints and detailed instructions as you guide your students through the creating, predicting, and communicating of the inheritance of traits in their paper pets.

◆ Chapter Project Overview

◆ In the Chapter 3 Project, students will create a paper pet, cross it with a classmate's pet, and determine the offspring's traits.

◆ To introduce the project, discuss how the boxer puppies in the chapter opening photograph on pages 84–85 of the textbook look similar to each other and to their mother, as well as how they look different. Challenge students to explain how the puppies and their mother can look both similar and different.

◆ Have students read the description of the project in their text. Then distribute the Chapter 3 Project Overview on pages 70–71 and the Chapter 3 Project Scoring Rubric on page 74. After students have read these pages, answer their questions about the project and clarify what is expected of them. Note that students should choose their pet's traits without considering which alleles are dominant or recessive.

◆ Set a deadline for the project presentation and some interim dates for checkpoints. Students can fill in these dates on the Project Time Line on page 71 of the Overview.

◆ Distribute Chapter 3 Project Worksheet 1 on page 72. This worksheet provides instructions for how to create a paper pet.

◆ Materials and Preparation

◆ You will need blue and yellow construction paper for students to cut out their paper pets. Provide various materials for students to decorate their pets, such as markers, glitter, yarn, ribbon, sequins, feathers, buttons, and beads.

If you cannot provide these materials, suggest that students take their pets home and decorate them with materials available there. Students will also need scissors and glue.

◆ For Chapter 3 Project Worksheet 2, student pairs will need a coin to help them assign genotypes to their pets' offspring.

◆ For their presentations, students will need poster board or other large paper on which to mount their pet families.

◆ Check Your Progress— Section 1 Review

◆ Check students' pets to make sure they have correctly assigned pairs of alleles based on the traits of the pets. Explain that XX and XY are the symbols used in genetics to represent females and males, respectively. Students will learn more about the X and Y chromosomes in Chapter 4.

◆ Monitor the number of male and female pets so there is an equal number of each in the class. Make an extra pet if your class has an odd number of students.

◆ Check Your Progress— Section 3 Review

◆ Encourage students to use the terms *genotype* and *phenotype* as they carry out their crosses. Devise a method for students to find mates for their pets. You could have students choose the mates for their pets based on the phenotypes of their classmates' pets. Or you might draw names to set up the crosses randomly.

◆ Distribute Chapter 3 Project Worksheet 2 on page 73. Using this worksheet as a guide, student pairs can create the offspring from the cross between their pets. Students should determine the genotypes of the offspring by tossing a coin.

CHAPTER 3 PROJECT *(continued)*

◆ You might suggest to students that they determine the color of the offspring first and cut the pets out of colored paper. Then students can determine the genotypes of the other traits and write them directly on the back of the offspring.

◆ Check Your Progress— Section 4 Review

◆ Give students poster board or other large paper on which they can display their pet families.

◆ Make sure students correctly label the pet parents as the P generation and the offspring as the F_1 generation.

◆ Students should have one Punnett square for each of the five traits that correctly shows all of the possible genotypes of the offspring based on the genotypes of the parents.

◆ If students are unsure of how to mount their pets on the poster board, show them how to make a tape hinge on the left side of the pet so that the pet can be easily turned over and read like a page in a book.

◆ Present Your Project

◆ Allow class time for students to review all the pet families in the class. You could either set up the pet family posters around the room for students to look at, or you could have each pair of students present their pet family to the class.

◆ Encourage students to identify offspring that look identical to one or both parents or to other offspring. Also have students look for offspring that look like neither parent. Have students discuss these similarities and differences in the context of the results of the Punnett squares.

◆ Finally, ask students to evaluate in their journals how their pet models helped them learn and understand specific concepts in genetics. Encourage students to make suggestions about how their paper pets might help them understand other topics in genetics.

◆ Extensions

◆ Have students create an F_2 generation in their pet families by choosing two of the F_1 offspring as parents. Students should determine the genotypes and phenotypes of the F_2 offspring in the same manner as they did for the F_1 offspring.

◆ Challenge students to set up a breeding program in which they select paper pets that have one particular trait that is especially desirable in paper pets. Students can set up crosses that will produce offspring with the desirable trait. You could have students actually construct the paper pets as they did for this project, or simply have them construct the Punnett squares for the crosses.

CHAPTER 3 PROJECT   **OVERVIEW**

**CHAPTER
3**

All In The Family

Have you ever been surprised to see two people who looked alike but were not related? On the other hand, you're probably surprised when family members do not share the same physical characteristics. You may have wondered what causes people to look the way they do, or why offspring commonly look like their parents. These are questions that geneticists try to answer as they study the inheritance of traits.

In the Chapter 3 Project, you will explore how traits are passed from parent to offspring by creating a family of "paper pets." First, you will create your own "paper pet" by choosing its characteristics. Then you will find a mate for your pet and determine the characteristics of six offspring. Finally, you will present your pet family to the class.

◆ Project Rules

- ◆ Use Chapter 3 Project Worksheet 1 to help you create your paper pet. Cut out your pet from either blue or yellow construction paper. Then choose the other traits for your pet: gender, eye shape, nose shape, and teeth shape. Use any materials you wish to decorate your pet.

- ◆ On the back of your pet, write the alleles it has for each trait. Use XX for females and XY for males. For the other traits, the dominant alleles are for blue body color, round eyes, triangular nose, and pointed teeth. The recessive alleles are those for yellow body color, square eyes, oval nose, and square teeth.

- ◆ Find a mate for your pet and determine the alleles that each of six offspring will inherit from each parent by tossing a coin. Construct a paper pet for each of the offspring, showing their phenotypes. Write the genotypes on the back of each offspring.

- ◆ Make a display of your pet family in which you label the P generation and the F_1 generation. Construct a Punnett square for each trait to show all the possible allele combinations in your pet family.

- ◆ Present your pet family to the class. Explain why some offspring look like one or both of the parents and why some offspring do not.

◆ Project Hints

- ◆ Remember, if your original pet has a trait controlled by a dominant allele, you can choose whether your pet is homozygous or heterozygous for the trait.

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CHAPTER 3 PROJECT OVERVIEW *(continued)*

◆ Construct each of six offspring. Remember that each offspring must inherit its traits from the parents according to the laws of genetics. You will toss a coin to determine which allele each offspring inherits.

◆ Set up your display so that it is easy to turn over the pets and read their genotypes.

◆ Project Time Line

Task	Due Date
1. Complete Chapter 3 Project Worksheet 1	_____
2. Identify your pet's genotype	_____
3. Complete Chapter 3 Project Worksheet 2	_____
4. Construct Punnett squares for each trait	_____
5. Make a display of your pet family	_____
6. Present your display to the class	_____

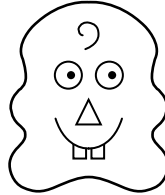**CHAPTER 3 PROJECT**   **WORKSHEET 1**

Making a Paper Pet

Follow the instructions to create your own paper pet with five different traits.

◆ Materials

blue or yellow construction paper
scissors
glue
markers
materials to decorate your pet, such as glitter,
    sequins, buttons, yarn, and beads

◆ Procedure

1. Cut out the outline of the paper pet below. Trace
the paper pet design onto either blue or yellow
construction paper and cut it out.

2. On the front of your paper pet, draw the other four
traits you have chosen for it. The table above lists
the possible choices and shows how
they should be drawn.

3. On the back of your paper pet, copy
the chart shown on the right, below.
Then write your pet's traits in the
phenotype column. Give your pet a
name, and write the name at the top
of the chart.

4. Fill in your pet's genotypes. Use XX
for a female and XY for a male. The
dominant alleles for the other four
traits are: *B* (blue skin), *R* (round
eyes), *T* (triangular nose), and *P*
(pointed teeth).

5. Decorate your paper pet with
materials of your choice.

Possible Traits		
Color	blue	yellow
Gender	female (curl)	male (no curl)
Eyes	square	round
Nose	triangular	oval
Teeth	square	pointed

Pet's Name

_____

Phenotype   *Genotype*

Color   _____   _____

Gender   _____   _____

Eyes   _____   _____

Nose   _____   _____

Teeth   _____   _____

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Making Paper Pet Offspring

Follow the instructions to make the offspring of your paper pet.

◆ Materials

scissors
blue and yellow construction paper
glue
markers
coin

◆ Procedure

1. Cut out the outline below of the paper pet offspring. Toss the coin to determine which alleles the first offspring will inherit for color from each parent. For example, "heads" could represent *B,* the allele for blue skin, and "tails" could represent *b,* the allele for yellow skin. Remember, blue is controlled by a dominant allele. Trace the outline of the offspring onto the appropriate color construction paper and cut it out.

2. On the back of the offspring, copy the chart for the phenotype and genotype of each trait. Write in the genotype and phenotype for color.

3. Toss the coin and record the results to determine the genotypes for the other four traits. Record the genotypes and phenotypes in the appropriate column. Remember, the traits controlled by dominant alleles are round eyes, triangular nose, and pointed teeth. A male has an X and a Y. A female has two Xs. Name each paper pet offspring, and write its name on the back.

4. On the front of the offspring, draw its traits according to the genotypes determined by the coin toss.

5. Repeat this procedure five times so that all together you have six offspring.

Pet's Name

_____

	Phenotype	*Genotype*
Color	_____	_____
Gender	_____	_____
Eyes	_____	_____
Nose	_____	_____
Teeth	_____	_____
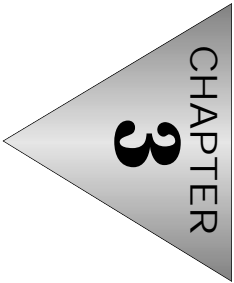
CHAPTER 3

All In The Family

In evaluating how well you complete the Chapter 3 Project, your teacher will judge your work in three categories. In each, a score of 4 is the best rating.

	4	3	2	1
Creating the Parent Paper Pet	The phenotypes and geno-types of all five traits are identified and drawn neatly and correctly on the parent paper pet.	All but one of the phenotypes and genotypes are identified and drawn neatly and correct-ly on the parent paper pet.	Some phenotypes and geno-types are correct, but two or more are identified and drawn incorrectly on the parent paper pet.	The phenotypes and geno-types are not completed, and/or few or none are cor-rectly identified and drawn on the parent paper pet.
Determining the Traits of the Offspring	The phenotypes for all five traits are correctly identified for all six offspring based on the results of the coin tosses to determine genotype.	Most phenotypes are cor-rectly identified for the off-spring based on the results of the coin tosses to deter-mine genotype.	Several phenotypes are incorrectly identified for the offspring based on the results of the coin tosses to determine genotype.	Phenotypes are incomplete, or few or none are correctly identified.
Presenting the Pet Family	Makes a thorough, interesting presentation that shows a complete understanding of the patterns of inheritance for each trait in the pet family.	Makes a thorough presenta-tion that shows an adequate understanding of the pat-terns of inheritance for each trait in the pet family.	Makes a presentation that shows an incomplete under-standing of inheritance pat-terns in the pet family.	Makes a presentation that shows a lack of understand-ing of inheritance patterns in the pet family.