Lesson C3–2

Exploring Genetics

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 3. Understanding Cells, Genetics, and Reproduction

Lesson 2. Exploring Genetics

New Mexico Content Standard:

Pathway Strand: Animal Systems

Standard: **IV:** Know the factors that influence an animal's reproductive cycle to explain species response.

Benchmark: **IV-B:** Discuss reproductive cycles to show how they differ from species to species.

Performance Standard: **2.** Discuss the implications of genetic variation.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe how the gender of offspring is determined.
2. Explain how genotype and phenotype are different.
3. Distinguish between qualitative and quantitative inheritance

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Baker, MeeCee and Robert E. Mikesell. *Animal Science Biology & Technology.* Danville, Illinois: Interstate Publishers, Inc., 1996. (Textbook, Chapter 2)

Other Resources. The following resources will be useful to students and teachers:

Ensminger, M.E. *Animal Science.* Danville, Illinois: Interstate Publishers, Inc., 1991 (Textbook, Chapter 3)

Lee, Jasper S., et al. *Introduction to Livestock and Companion Animals,* Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2000. (Textbook, Chapter 8)

Lee, Jasper S. and Diana L. Turner. *AgriScience,* Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook, Chapter 5)

Mader, Sylvia S., *Biology*. Dubuques, Iowa: Wm. C. Brown Publishers, 1993. (Textbook, Chapter 5)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheets

Terms. The following terms are presented in this lesson (shown in bold italics):

Alleles
Codominance
Dominant
Gametes
Genes
Genotype
Gregor Mendel
Heterozygous
Homozygous
Incomplete dominance
Phenotype
Qualitative traits
Quantitative traits
Recessive

Sex chromosomes
Zygote

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have students count the number of students who have brown eyes, blue eyes, and green eyes. Then ask the eye color of each student's parents. Discuss the relationship between parents' eye color and students' eye color.

Summary of Content and Teaching Strategies

Objective 1: Describe how the gender of offspring is determined.

Anticipated Problem: What determines the gender of offspring?

I. The study of genetics is concerned with the transfer of traits. ***Gregor Mendel*** discovered that these traits are inherited through units called ***genes***. Mendel further discovered that genes were found in pairs and half of the inherited traits come from the father and half from the mother.

   A. ***Gametes*** or sex cells, known as the sperm from the male and egg from the female, meet in fertilization and mix genetic material from both. The resulting ***zygote*** contains ***genes*** from both mother and father, and displays characteristics from both.

   B. Determination of the sex of zygote depends on the ***sex chromosomes***. Male sex chromosomes are either X or Y. A zygote that receives a Y chromosome from sperm will be male. A zygote that receives an X chromosome from sperm will be female. The male makes sex determination as all eggs from female receive an X chromosome. Therefore, a female zygote will have two X chromosomes (XX) while a male zygote will have one X and one Y chromosome (XY).

Use TM: C3–2A to discuss with students how sex of the resulting zygote is determined. Chapter 6 in Animal Science Biology and Technology is recommended to assist your students in mastering this information.

Objective 2: Explain how genotype and phenotype are different.

Anticipated Problem: How are genotype and phenotype different?

II. Resulting offspring of reproduction have both genotype and phenotype heredity.

   A. ***Genotype*** is the actual genetic code. It controls physical and performance traits. The genotype of an organism cannot be changed by environmental factors.

B. ***Phenotype*** is the organism's physical or outward appearance. This is the part of the genotype the organism expresses or shows. In some instances, phenotype may be altered by the organism's environment.

C. A ***homozygous*** organism is one having similar ***alleles*** or genes on the DNA molecule for a particular trait. While a ***heterozygous*** organism is one having different alleles for a particular trait.

A variety of techniques can be used to help students master this objective. Students need text material to help understand the difference between genotype and phenotype. Chapter 6 in Animal Science Biology and Technology is recommended to assist your students in mastering this information.

Objective 3: Distinguish between qualitative and quantitative inheritance.

Anticipated Problem: What is the difference between qualitative and quantitative traits?

III. The genes contained in an organism control traits of that organism. Some traits are controlled by only one pair of genes, while others require several pairs.

A. ***Qualitative traits*** are traits controlled only by a single pair of genes and cannot be altered by the environment. Their phenotype is either one thing or the other. These traits most easily show how genes are inherited. An example is coat color.

B. ***Quantitative traits*** are traits controlled by several pairs of genes. These traits are expressed across a range. These traits can also be altered by environment. Examples include rate of gain, growth rate, backfat depth, etc.

C. Not all traits contained within an organism are expressed. ***Dominant*** traits cover up or mask the alleles for ***recessive*** traits. In some organisms there are cases of ***codominance*** of traits in which both dominant and recessive genes are expressed. ***Incomplete dominance*** may also occur. This happens when a blending of the allele pair is expressed.

Several different methods and techniques may be used to aid students in learning this material. Students need text materials to help understand how traits are transferred and expressed in organisms. Chapter 6 in Animal Science Biology and Technology is a recommended reference. Also use TM: C3–2B and C3–2C to discuss this material with your students. Also incorporate LS: C3–2A to show students the Punnett Square method.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

Application. Application can involve the following student activity using the attached lab sheet:

LS: C3–2A: PUNNETT SQUARE

Answers to Sample Test:

Part One: Matching

1=c,2=a,3=d,4=g,5=f,6=b,7=i,8=c,9=h

Part Two: Completion

10. Gregor Mendel
11. sex chromosomes
12. phenotype
13. Dominant, recessive
14. genetics

Part Three: Short Answer

Pp	Pp
Pp	Pp

15. Pp
16. 0:4:0 (homozygous dominant: heterozygous: homozygous recessive)
17. 4:0 (dominant: recessive)

Sample Test Name_____

Test

Lesson C3–2: Exploring Genetics

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. alleles	d. genotype	g. phenotype
b. codominance	e. genetics	h. heterozygous
c. homozygous	f. qualitative traits	i. incomplete dominance

_____ 1. Study of heredity.

_____ 2. Two genes that contain information for the same trait.

_____ 3. The genetic code of the organism.

_____ 4. The expressed part of the genetic code.

_____ 5. Traits which are controlled by a single pair of genes.

_____ 6. Trait in which both genes in the pair are expressed.

_____ 7. Trait in which a blending of the genes is expressed.

_____ 8. Allele made of two identical genes.

_____ 9. Allele made of one of both possible genes for a certain trait.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

10. _____ _____ discovered that traits are inherited through units called genes.
11. Determination of the sex of zygote depends on the _____ _____.
12. _____ is the organism's physical or outward appearance.
13. _____ traits cover up or mask the alleles for _____ traits.
14. The study of _____ is concerned with the transfer of traits.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

Use the Punnett Square method to estimate the possible gene combinations for the following situation. Mating a polled cow (PP) to a horned bull (pp).

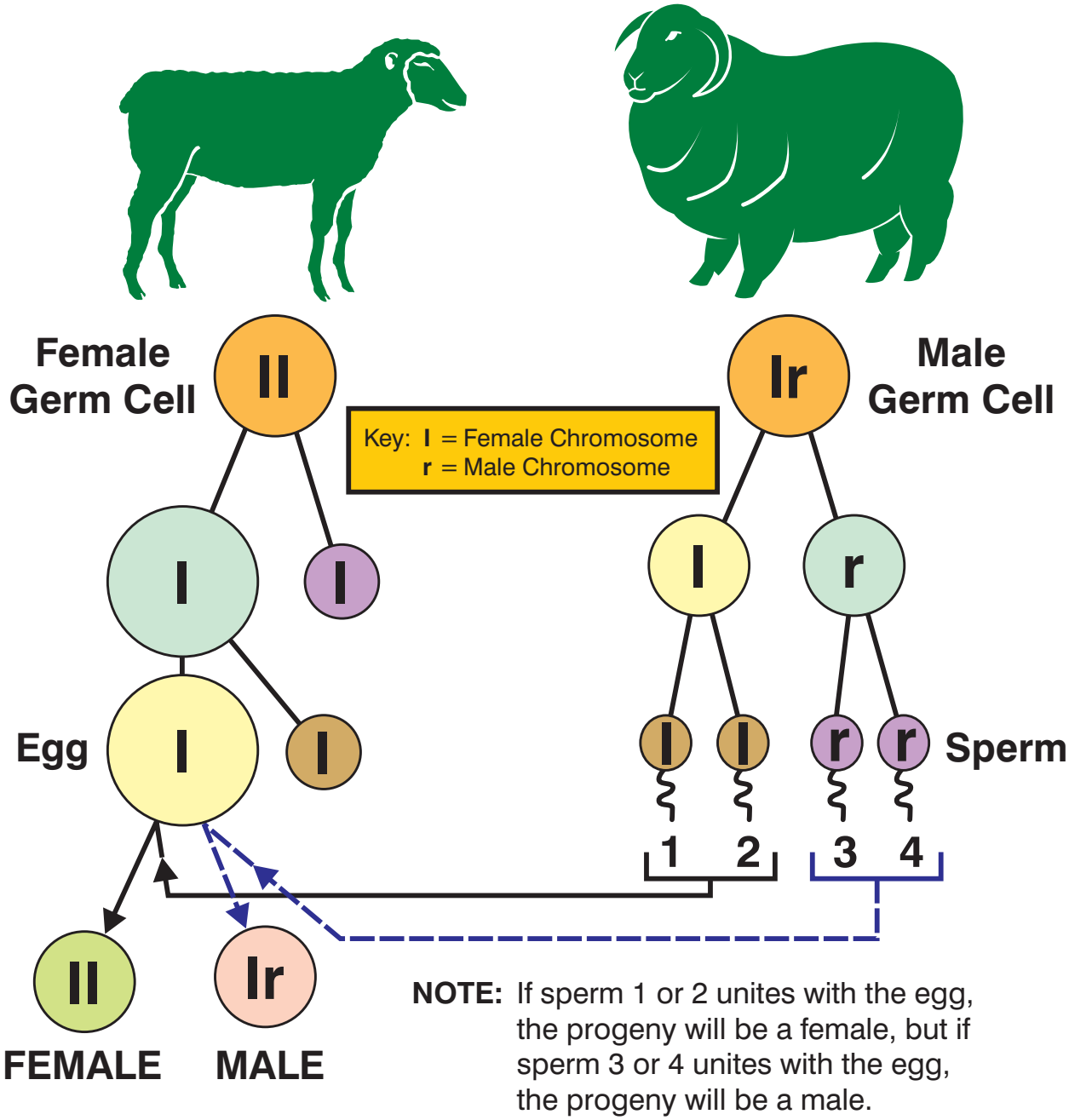
15. What would be the offspring's gene combination?

16. What would the genotype ratio be?

17. What would the phenotype ratio be?

TM: C3–2A

Chromosome Combinations Determine Sex



NOTE: If sperm 1 or 2 unites with the egg, the progeny will be a female, but if sperm 3 or 4 unites with the egg, the progeny will be a male.

TM: C3–2B

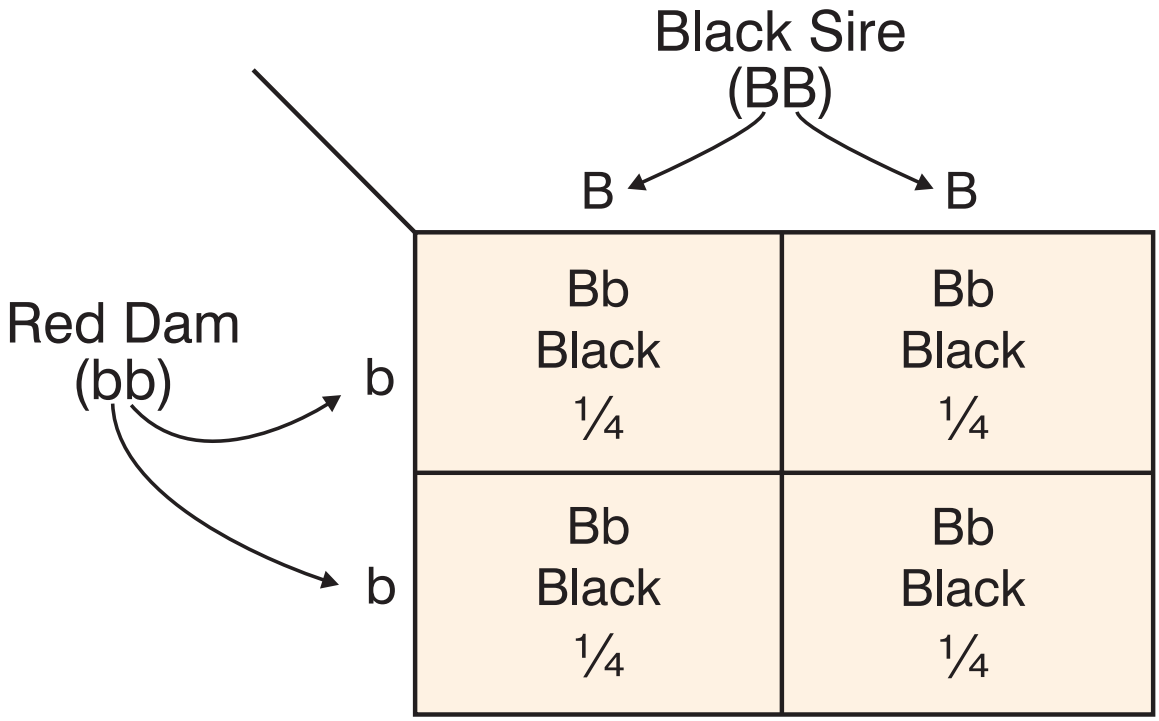
Red Sire
(RR)

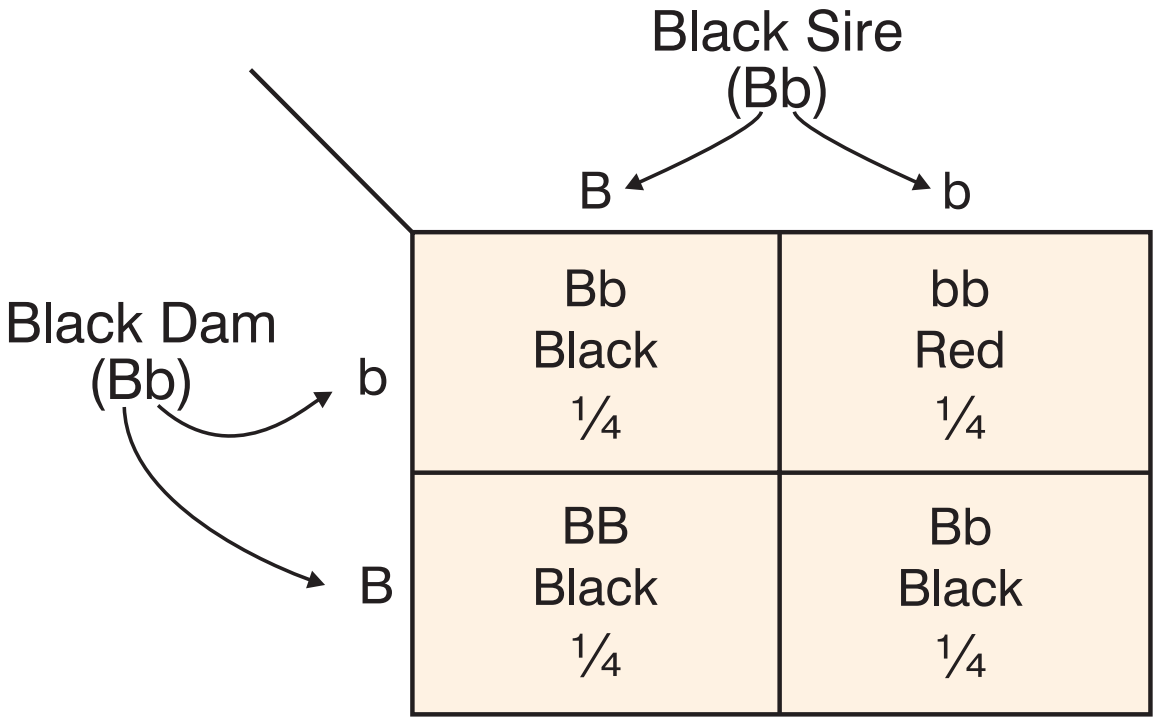
White Dam (rr)	R	R
r	Rr Roan ¼	Rr Roan ¼
r	Rr Roan ¼	Rr Roan ¼

Roan Sire
(Rr)

White Dam (rr)	R	r
r	Rr Roan ¼	rr White ¼
r	Rr Roan ¼	rr White ¼

TM: C3–2C


Black Sire
(BB)
B
B
Red Dam
(bb)
b
b
Bb
Black
¼
Bb
Black
¼
Bb
Black
¼
Bb
Black
¼


Black Sire
(Bb)
B
b
Black Dam
(Bb)
b
B
Bb
Black
¼
bb
Red
¼
BB
Black
¼
Bb
Black
¼

Name _____

Lab Sheet

Punnett Square

Instructions:

Use the Punnett Square method to estimate the possible gene combinations. Write the required information in the squares.

1. Mating a female, which is heterozygous for horns (Pp) to a horned bull (pp).

   a. What would be the genotype ratio? _____

   b. What would be the phenotype ratio? _____

2. Mating a corn plant that is heterozygous for green leaf color (Gg) with a corn plant that is homozygous for the recessive white leaf color (gg).

   a. What would be the genotype ratio? _____

   b. What would be the phenotype ratio? _____

3. Mating a plant carrying a heterozygous gene for height (Tt) with another heterozygous plant. (T = tall, t = short)

c. What would be the genotype ratio? _____

d. What would be the phenotype ratio? _____

4. Mate a polled, black cow (PpBb) with a polled, black bull (PpBb) P = polled; p = horned; B = black; b = red.

a. How many phenotypes are possible? _____

b. List each phenotype and the number of offspring with that phenotype.

_____

_____

_____

_____

_____