

## Lesson # 3

# Chicken Genetics and Reproduction

**Core Area:** Animal Science

**Unit:** Poultry Industry

**Lesson # 3:** Chicken Genetics and Reproduction

### California CTE Standards (Agriculture):

**C7.1** Differentiate between genotype and phenotype, and describe how dominant and recessive genes function.

**C7.2** Compare genetic characteristics among cattle, sheep, swine, and horse breeds.

**D4.5** Understand commonly used animal production breeding systems (e.g., purebred compared with crossbred) and reasons for their use.

**D5.1** Evaluate a group of animals for desired qualities and discern among them for breeding selection.

**D5.2** Understand how to use animal performance data in the selection and management of production animals.

**FS 5.3** Use critical thinking skills to make informed decisions and solve problems.

**Student Learning Objectives.** After completion of this unit, students should be able to:

1. Understand the shift from dual purpose to single purpose breeds of poultry through genetic selection.
2. Understand the measurement of performance data in genetic research.
3. Identify the effects of genetic selection on DNA.
4. Evaluate a group of laying hens to select desirable physical traits.

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

**Recommended Resources.** The following resource should be selected to accompany this lesson:

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

1. Aviagen Group — <http://www.aviagen.com/>
2. Cobb-Vantress — <http://www.cobb-vantress.com/>

3. <http://www.hyline.com/>

### List of Equipment, Tools, Supplies, and Facilities.

- Attached Handouts
- Power Point Presentation

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

- Poultry
- Domestication
- Single Purpose
- Dual Purpose
- Genetic Selection
- Clutch Length
- Growth Rate
- Resistance
- Quantify
- Heritability
- Breeding Stock
- Broiler Breeder
- Layer Breeder

### Interest Approach.

*Have students pick two of their favorite movie stars (one male and one female). The teacher will then go around the class and put the pairs onto the board. The teacher will then explain that if the two were to reproduce, they too would create handsome offspring. If each of the pairs were to produce offspring, a group of handsome people would be created. The teacher will then stress the idea that if only these actors were allowed to produce offspring, our world would be full of great handsome actors. Tie this concept into genetic selection in poultry.*

# SUMMARY OF CONTENT AND TEACHING STRATEGIES

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**Objective 1:** Understand the shift from dual purpose to single purpose breeds of poultry through genetic selection.

**Anticipated Problem:** What reasons are behind genetic selection? What are the possible advantages and disadvantages?

- A. Poultry — Domesticated Fowl that are valued for meat or eggs.
- B. **Domestication:** the process of taking a group of animals from the wild and, through a process of selection, causing them to become accustomed to human interaction.
  - 1. Domestication usually involves selecting for certain desirable characteristics by breeding two animals with the desirable characteristic.
- C. **Broiler** — Before modern production, a number of domesticated varieties of birds existed, each with their own unique qualities.
  - 1. The two most common traits that were selected for were egg production and meat production. In some cases, birds were better to eat, while others were better for producing eggs, but most birds were good for both egg and meat production.
    - a. Birds that were used for both egg and meat production were known as **dual purpose** breeds. Examples:
      - (1) Rhode Island
      - (2) Plymouth Rock
      - (3) New Hampshire
  - 2. Other birds were selected for different qualities. Examples include:
    - a. Different colored eggs
    - b. Feathers on their feet
    - c. Unique color
    - d. Unique comb shape
- D. Transition to **single purpose**
  - 1. Birds selected for either meat production or egg production, but not both.
  - 2. Traditional animal breeding programs were used to produce specialized birds for either meat or egg production.
  - 3. Selection of males and females to participate in breeding programs is largely based upon phenotypic traits.
    - a. Phenotypic traits are measurable and/or observable, and this allows for mating of males and females that both have high rates of gain or females that have high rates of egg lay.
    - b. Poultry breeding programs have resulted in tremendous improvements in animal performance and production efficiencies.

- (1) This has permitted chicken and eggs to be a very inexpensive source of protein.

**Teachers:** Use *handout 1* in order to familiarize students with terminology. Follow with the attached PowerPoint.

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**Objective 2:** Understand how production traits are used in genetic selection.

**Anticipated Problem:** What traits are used to determine which individuals should be selected?

1. Phenotypic traits of importance for genetic selection
  - A. Phenotypes are observable or measurable traits while genotype is the genetic make-up of the individual.
  - B. Phenotypes are a result of two contributing factors: environment and genotype.
    1. Environment can influence phenotype, so it is important to maintain environmental consistency in breeding programs and facilities.
    2. The genotype describes the genes that the animal possesses.
    3. Therefore, when selecting for a particular phenotype, one is also selecting for a specific set of genes that are associated with the phenotype.
    4. Consequently, using phenotypes to select for animals also results in genetic selection.
  - C. Phenotypic traits used to select for meat-type (broilers) birds and egg-type (layers) are very different.
  - D. Consequently, the genotype of broilers and layers is quite different from each other since certain traits selected for in one has not always been selected for in another.
    1. Egg layers
      - a. Clutch
        - (1) The amount of eggs laid consecutively without a break.
        - (2) A chicken can lay about one egg per day.
      - b. **Clutch length**
        - (1) The number of consecutive days a hen lays an egg before missing a day.
        - (2) Ability to lay a large number of eggs is a highly desirable trait.
      - c. Shell quality
        - (1) A strong shell is necessary for the egg to be transported from the farm to the store.
        - (2) Shells are made from calcium, so a bird's ability to absorb calcium and convert it into eggshell is a highly desirable trait.
      - d. Sexual maturity
        - (1) Chickens are only able to reproduce or produce eggs once they have reached sexual maturity.

- (2) With very early maturity, birds will produce eggs sooner in life, increasing a producer's profitability.
- e. Size
  - (1) Size of egg
    - (a) Consumers want mostly large eggs. If hens are producing medium or jumbo eggs, producers may not get paid as much.
  - (2) Size of the hen
    - (a) A large hen eats too much and a hen that is too small cannot produce large enough eggs.
- 2. Broilers
  - a. Growth rate
    - (1) The rate at which a meat bird gains body weight.
    - (2) Feed conversion (the rate in which consumed feed is converted to body weight gain) is an important trait since this relates to production efficiency.
  - b. Skeletal development
    - (1) A strong skeleton is very important to support body weight and muscle development.
    - (2) Bones are synthesized from calcium, so a bird's ability to absorb calcium and convert it into bone development is very important.
  - c. Resistance
    - (1) The ability of the bird to withstand disease.
- E. Heritability
  - 1. The ability of a trait to be passed on is known as **heritability**.
  - 2. Traits with high heritability are passed on easily and improve quickly in the population.
  - 3. Low rates of heritability take a much longer time to improve within the population.

**Teachers:** Display power point to obtain this objective.

**Objective 3:** Identify how genetic selection is used to improve populations.

**Anticipated Problem:** What is breeding stock?

- 1. Genetic Selection and DNA
  - A. **Breeding Stock**
    - 1. Sexually mature poultry of both sexes raised specifically to produce offspring.
    - 2. The genetic make-up of an individual is contained within the animal's DNA.
    - 3. In the same way that animals can be selected for phenotypic traits, animals can also be selected for genotypic traits.
      - a. Genotype is determined by sequencing DNA.

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- b. DNA is composed of nucleotides that are arranged in unique sequences.
  - c. DNA is packaged within chromosomes and chromosomes are located within the nucleus of every cell.
  - d. DNA provides the blueprint for the manufacturing of every protein within the cell.
  - e. By measuring genetic markers, or sequences of DNA, within an individual, identification of genes associated with desired production characteristics can be determined.
4. The breeding stock responsible for production of meat-type birds are known as broiler breeders:
    - a. **Broiler breeders** are selected for desired phenotypic and genotypic traits.
    - b. A relatively small number of broiler breeders are responsible for the production of millions of meat-type birds.
    - c. Broiler breeders are organized into a pyramid scheme that originates with an elite stock of birds.
      - (1) The elite stock is the most highly valued group of breeders since they contain the ideal genetics and are responsible for maintaining the genetic line.
      - (2) The parent stock consists of the breeders that produce either the meat or egg-type bird that is used in commercial production.
      - (3) Any desired phenotypic or genetic changes are made with the elite stock.
      - (4) It typically takes 5 years for a trait to be passed down from the elite stock to the commercial bird.
      - (5) Consequently, poultry breeders have to anticipate the needs and desires of commercial birds well in advance.

**Teachers:** Follow up with test.

**Review/Summary.** Focus the review of the lesson around the student learning objectives. Ask students to explain the content associated with each objective. Use their responses as the basis for determining any areas that need to be covered again.

**Application.** Application can involve student activity with the interest approach or another creative method outlined by individual instructors.

**Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as a written test. A sample test is attached.

## Answers to Sample Test:

### Part One: Matching

E	1. Poultry
I	2. Domestication
K	3. Single purpose
G	4. Dual purpose
A	5. Genetic selection
B	6. Clutch length
M	7. Growth rate
C	8. Resilience
D	9. Quantify
F	10. Heritability
J	11. Breeding stock
H	12. Broiler breeder
L	13. Layer breeder

### Part Two: T / F

1. T      6. F
2. T      7. T
3. T      8. T
4. T      9. T
5. F      10. T

# Handout # 1

## Poultry Genetic Terms

L F O A R C K Q Y F I T N A U Q O M H  
 Y G E D D O U B L E P U R P O S E A C  
 I U N H A J P A W S S N E H E Z T Q D  
 S N E Y D B X R L E W L Y K S W M A W  
 T W J B O R T E N I Q P K C O U Y V H  
 M E Z R V E I L T I F J H I P T T W E  
 C N B I P E A I E J N S O H R K I G L  
 O K C D D D R O M K O I C C U O L V I  
 C A U V S I T R P L I N L E P L I Y T  
 M H R I R N E B E I T V W H E K B F E  
 D R Q G E G F C R V A P M L L Y A P S  
 N W T O Y S S L A A C D W Y G S T R T  
 A D Y R A T C U M B I R I R N A I R O  
 W V W U L O B T E I T Q Z T I D R F C  
 T I N I G C F C N L S U R L S G E E K  
 T Q L W G K O H T I E T F U U X H D K  
 O V S Q E K V V P T M N P O G P F E N  
 L S T N Z D B A N Y O U W P G C R W C  
 Z K R E T S O O R M D Q Q O Y H F E X

Breeding Stock

Broiler

Chick

Clutch

DNA

Domestication

Double Purpose

Egg Layers

Elite Stock

Hen

Heritability

Hybrid Vigor

Livability

Poultry

Quantify

Rooster

Single Purpose

Temperament

Trait

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