Goal (learning objective)
Youth will:

- Learn the difference between a purebred and crossbred animal.
- Learn the reasons for each breeding method.
- Learn benefits of crossbreeding and the several different types of crossbreeding systems for each species.

Supplies
- Copies of Handout 1 “Purebred vs Crossbred” (make enough copies for group)
- Paper
- Colored Pencils

Pre-lesson preparation
- Make photocopies of Handout 1 – enough for group
- Read/Review lesson
- Read/review handout
- Using either the Resource Handbooks or your own drawings, be ready to walk youth through drawing their own examples of crossbreeding systems

Lesson directions and outline
Share the following information with the youth:

Heredity is the passing on of traits from parents to offspring. Most plants and animals have two of every kind of gene, one from their mother and one from their father. Only one gene from each parent is passed to each offspring for a particular trait. There are different forms of a gene that are referred to as alleles. Alleles are forms of the same gene with small differences in their DNA sequence. These small differences contribute to each organism’s unique physical features. These physical features are called “phenotypes.”

Some alleles are dominant, while others are recessive. Dominant alleles overpower recessive alleles and are always expressed in offspring. Recessive alleles are only expressed in offspring if both parents contribute a recessive allele. In human eye color, the allele for brown eyes is dominant, and the allele for blue eyes is recessive. Therefore, if the offspring receives a brown eye allele from either parent, the offspring will have brown eyes. The offspring would have to receive a blue eye allele from each parent to have blue eyes.

Purebred breeding is done to maintain genetics or characteristics for specific breed purposes. For example, Angus cattle are used for carcass characteristics and hide color and those two characteristics want to be maintained.

Crossbred breeding is done for marketability, with the intent of combining several desirable characteristics from two different breeds. For example, Angus cattle bred to Herefords which are characteristically good mothers that produce higher weaning weight calves. Offspring of these two will have several desirable characteristics appealing to the market.
Conducting the activity (DO)

1. Ask for a volunteer to distribute Handout 1
2. Cover the following terms with the group:
   a. Outbreeding
   b. Inbreeding
   c. Linebreeding
   d. Grading up
   e. New breed formation
   f. Systematic crossbreeding
   g. Two-breed terminal cross
   h. Three-breed terminal cross
   i. Backcross
   j. Three-breed rotational cross
3. Ask: How does cross breeding help cattle and swine?
4. Ask: What is your animal's breed/breeding? If youth are aware of their animal's breed have them try and draw out that breeding system.
   a. For example, if they have a brockle-faced, black steer the parents could be a black Angus bull bred to a Hereford cow or if they have a red pig with a white belt the parents could have been a Hampshire boar bred to a Duroc gilt.

What did we learn? (REFLECT)

- Ask: What is the difference between a purebred and crossbred animal?
- Ask: What is the purpose for each breeding type?
- Ask: What are some of the crossbreeding systems?

Why is that important? (APPLY)

- Ask: How does purebred breeding influence the industry? What does it provide?
- Ask: How is crossbreeding beneficial?
REPRODUCTION: PUREBRED VS CROSSBRED – HANDOUT 1

Terminology –
- Pure breeding (straight breeding): the mating of two animals of the same breed; several types
- Crossbreeding: mating two different breeds to combine desirable traits of two or more different breeds and produce superior offspring (the superiority of the offspring is known as heterosis or “hybrid vigor”); several types
- Outbreeding: the continuous use of unrelated animals. Allows one offspring to get the maximum amount of heterozygosity in a flock
- Inbreeding: mating of a male and female that have one (or more) common ancestor(s). Examples include daughter/sire matings and dam/son matings. Inbreeding increases the number of dominant and recessive genes (homozygosity) and may result in lowered reproductive performance and decreased fleece weights (in sheep)
- Linebreeding: kind of inbreeding which concentrates on continued matings of decedents of a certain animal
- Grading up: the repeated use of males of a single breed on a set of females and their daughters
- New breed formation: the development of a new breed from crossbreeding existing breeds
- Systemic crossbreeding: involves crossing males and females of certain breeds or crosses to get specific types of offspring. Examples: two-breed terminal crossing, three-breed rotational cross, roto-terminal cross, etc. Purpose of crossbreeding is to increase both individual and maternal heterosis

Crossbreeding Systems –
- Two-breed terminal cross: system in which straight bred females are bred to a bull of another breed. The cross ends with the calves. The replacement females are kept with the straight breeds. Therefore, part of the herd must remain straight bred or replacements must be purchased. The producer benefits only from the individual heterosis in the calf (no maternal heterosis).
- Three-breed terminal cross: system in which a two-breed cross female, called the “F1”, is bred to a male of a third breed. This three-way cross gives the maximum amount of heterosis in both the female (maternal heterosis) and offspring (individual heterosis). The producer either raises the F1 females or purchases them. Breeds used in the cross for the females should be based on maternal characteristics (fertility, birth ease, milking ability, etc.). The breed chosen for the terminal male should compliment the female breeds by excelling in fertility level, growth rate, and carcass characteristics. All of the offspring from this cross are marketed, no replacements are selected from this three-way cross typically.
- Crisscross/backcross: system in which two breeds are used. Female replacements are saved from the crossbred offspring to breed back to one of the parent breeds. From then on, the replacement females are bred to males of the opposite breed of their own sire. Two separate herds must be kept. The only purchases that must be made are males. Though you do not get the maximum heterosis from this cross, the big advantage is that one can raise all their own replacement females.
- Three-breed rotational cross: system that includes the use of three breeds of sires in a rotation with the females kept from these crosses. Three breeds are chosen, and each breed is used for two or three years in a row. The females are bred to the breed of males to which they are least related. In this system, 87% of the heterosis possible is obtained.
Crossbreeding Benefits –

- Crossbreeding combines the desirable characteristics of two or more breeds because if selected properly, the strong points of one breed can compliment the weak points of another breed.
- Heterosis (hybrid vigor), a phenomenon that causes crossbreds to out-produce the average of their straight bred parents.
  - Traits that are low in heritability are the ones that best respond to heterosis, and include reproductive phase through weaning traits. Generally, lower heritable traits, such as fertility, are enhanced through systematic crossbreeding. ‘
  - Highly heritable traits, such as yearling weight and carcass characteristics, are enhanced by individual selection. Much of the advantage in heterosis in traits of low heritability is obtained using the crossbred female. Cross breeding provides commercial producers the chance to increase the total production of meat per animal in the breeding herd.
- In the swine industry, the crossbred female is the basis for more than 95% of the commercial swine produced in the US. Crossbred females will normally produce more pigs at birth with greater livability and produce more milk, which equals heavier weaning weights.
- Crossbred offspring grow faster to market weight as a result of heterosis.