NEBRASKA AGRICULTURE IN THE CLASSROOM
NEBRASKA FARM BUREAU FOUNDATION

Lesson Four: Inheritance and Traits

Level: High School

PURPOSE

Students will communicate the evidence of the inheritance and variation of traits by developing a model to build their own pig.

NEBRASKA STATE EDUCATION CONTENT STANDARDS CONNECTION

SC.HS.9.4 Gather, analyze, and communicate evidence of the inheritance and variation of traits.

SC.HS.9.4.c Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

AFNR.HS.2.4.c Apply scientific principles to breed animals.

ESTIMATED TIME

50 minutes

MATERIALS NEEDED

- Design a Pig Worksheet
- Coins – 1 per group of 2 students
- Swine Breed PDF
- Colored Pencils

VOCABULARY

Average Daily Gain: The weight gain of an animal per day.

Thickness: A measure of the amount of backfat a pig has. It is measured at the tenth rib.

Carcass Length: An indicator of the overall length of a pig's carcass.

Consumer: Someone who consumes (eats) an agricultural product, such as pork.

Corn: A yellow, starchy grain fed to pigs primarily to give them energy.

Feed Conversion: The ability pigs have to turn feed into muscle.

Heritability: The proportion of differences among animals due to differences in breeding values. This can be attributed more to genetics than the environment.

Loin Eye Area: A measurement of the meat that makes up a pork chop.

Market Weight: The weight at which a pig may be marketed or sold to be processed into pork products. This weight is achieved at 250 – 280 pounds.

Producer: Someone who raises an agricultural product, like pigs, to be processed into food or other goods.

Soybean Meal: A brown, powdery feed fed to pigs primarily to meet their protein needs. It is made from ground up soybeans.

BACKGROUND INFORMATION

Read or summarize the following information for students prior to the lesson:

After pigs are weaned and raised from approximately 13-55 pounds in a nursery, they are transferred to a new barn, called the finishing barn. Finishing barns are similar to farrowing barns and nurseries in that they are climate-controlled and allow pigs easy access to water and food.

In this growth/finishing phase of production, pigs will grow from approximately 55-280 pounds. This is accomplished through a primarily corn and soybean meal diet. During the finishing phase, pigs eat about 6-10 pounds of feed per day. When pigs have grown to weigh between 250-280 pounds, hogs are moved from the finishing barn and taken to market. In the moving process, pork producers use large sorting boards to help direct the pigs where to go. They also try to move only a few at a time down the alleyway to help the pigs stay as calm as possible.

After pigs are sold, they are processed into pork products for consumers to enjoy. Examples of pork products include loin chops, ham, bacon, tenderloin, sausage, and 'picnic' roasts. Through the entire pig production process, careful measures are taken to ensure that pigs remain well-cared for and healthy; safe pork comes from healthy pigs.

Throughout the life and growth of pigs, differences can be observed, depending on the pigs' genetics and their environment. Examples of traits observed include color, litter birth weight, loin eye area, and backfat thickness. Some of these traits have a higher heritability, meaning the differences we observe among pigs can be attributed more to the pigs' genetics than their environment. Many of the highly heritable traits are of great importance when it comes to finishing pigs, as they directly impact the pig's ability to grow, and later - the quality and quantity of the pig's meat. Highly heritable traits include: carcass length, backfat thickness, lean percentage, loin eye area, average daily gain, and feed conversion. Through careful selection of boars and breeding programs, producers can work to provide the consumer with the highest quality meat at the lowest price.

Part One: Learning Activity

INTEREST APPROACH

Ask the class, "How many pounds do you think a pig weighs before it goes to market to be processed into pork products?" Explain that pigs weigh between 250-280 pounds when they go to the market.

CONDUCT ACTIVITY

1. Show the class the *Swine Breed PDF*.
2. Explain to students that it is the decision of the pig farmer which breed of pigs he or she raises. The characteristics of the pigs are dependent upon breed characteristics and the genetics of each specific mother pig (sow) and father pig (boar.)

3. Have each individual student select a breed from the poster of pig breeds.
    - Based upon the breed students pick, pass out a *Design a Pig Worksheet* to each student.
    - If they have selected *Chester White, Duroc, Landrace, Poland China, Spotted Swine*, they need a "droopy ear" worksheet
    - If they have selected *Berkshire, Hampshire, Yorkshire*, they need an "upright ear" worksheet.
4. Divide students into groups of 2. Pass out one coin to each group. Students will be completing the activity individually but will share a coin.
5. Explain that pigs exhibit differences that can be observed, depending on the pigs' genetics and their environment. Examples of traits observed include color, litter birth weight, loin eye area, and backfat thickness. Some of these traits are more dependent upon genetics than the environment, meaning they are more heritable. Each student will be "designing" their market pig based upon the traits that are more heritable.
6. Students complete worksheet, following the instructions for each of the 3 parts.
7. Collect coins.

FOLLOW UP QUESTIONS

1. At the conclusion of the activity, show students the swine breeds poster again. Explain that while students designed their market pig in comparison to the rest of the herd (within their same breed), there are some breeds that naturally possess positive carcass traits. Discuss breeds on chart. Ask students:
    - If you had to do this again and pick a different breed, which would you pick to ensure higher carcass quality?

1. Look at the heritability estimates chart. What trends do you notice in the types of traits that are highly heritable vs. less heritable? Why do you think this is?
    - Heritable traits are related to muscle and leanness. Less heritable traits include survivability factors like "number weaned" and "survival to weaning" which are more related to the environment of the newborn piglet.
2. How would a producer utilize this information of heritable traits in managing market pigs or breeding programs?
    - A producer should recognize that desirable traits in terms of meat production can be managed and select breeding pigs accordingly.
3. Show students the most recent weekly pork price summary and discuss. *www.pork.org/blog/category/weekly-pork-price-summary*
    - Pick a few specific primal and sub-primal cuts to discuss. How has the price changed since last week? Since a year ago? Why might this be? How do these cuts compare to a different sub-primal?

- Why might this be?
  - Answers will vary.
- What primals and sub-primals appear to be the most valuable on a pig carcass?
  - Answers will vary.
- How do the heritable traits we discussed today play into this chart and pig prices?
  - Answers will vary.

Part 2 (Optional): Attend a Virtual Field Trip

Biosecurity is a procedure to protect animals against disease. Farmers limit travel to their pig barns by practicing biosecurity. This ensures they can raise their pigs in a safe and healthy environment.

Virtual Field Trips allow farmers to open their barn doors to show students what happens inside. The farmer uses a tablet to connect with classrooms to be a part of a live, video-chat allowing students to have their questions answered in real time.

Visit the Nebraska Farm Bureau Foundation website, *www.nefbfoundation.org/educators/get-involved/virtual-field-trips*, to see a list of upcoming Virtual Field Trips and to sign up for a time to attend. If you have questions, please contact Nebraska Farm Bureau Foundation at *foundationforag@nefb.org* or (402) 421-4747.

SOURCES UTILIZED

Pork Checkoff
www.pork.org/blog/category/weekly-pork-price-summary
www.pork.org/facts/pig-farming/life-cycle-of-a-market-pig

Purdue University Cooperative Extension Service
www.nsif.com/factsheets/nsif3.pdf

NATIONAL AGRICULTURAL LITERACY OUTCOMES

Plants and Animals for Food, Fiber, & Energy

T2.9-12.a Compare and contrast the difference between nature's plant and animal life cycles with agricultural systems (e.g. producers manage the lifecycle of plants and animals to produce a product for consumption.)

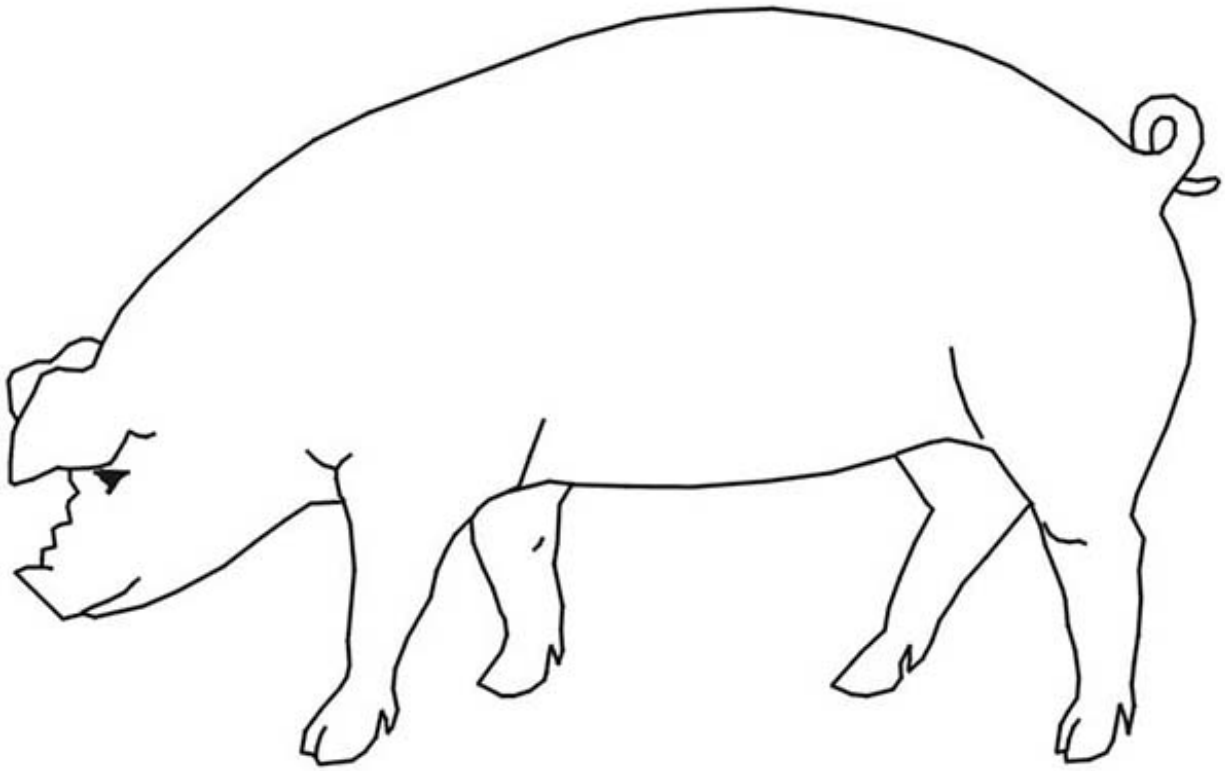
Name: KEY _____ Period: _____ Date: _____ Due: _____

DESIGN A PIG: DROOPY EAR

Droopy Ears (Chester White, Duroc, Landrace, Poland China, Spotted Swine)

Part One: Select Breed

Instructions: Based upon the breed you selected, color your pig with the appropriate markings. Use the Major Swine Breeds poster as a reference.



Part Two: Trait Differences

*Instructions: After analyzing Table 1. "Heritability estimates of some traits of interest to swine seedstock producers," select 5 traits relating to market pigs that have relatively high heritability. For each heritable trait you select, flip a coin. The coin is meant to act as a predictor of the traits your pig will inherit. If the coin is heads, this is an indicator your pig has a value that is **higher** than the breed average. Mark a '+' in the appropriate column. If tails is flipped, this indicates your pig has a value that is **lower** than the breed average. Mark a '-' in the appropriate column. Finally, indicate whether this selection is desirable or not and your rationale.*

Table 1. Heritability estimates of some traits of interest to swine seedstock producers.

Trait	Heritability
Conception rate	.30
Litter size	.10
Litter birth weight	.30
21-day litter weight	.17
Number weaned	.07
Survival to weaning	.05
Rebreeding interval	.35
Sperm quantity	.37
Sperm motility	.17
Average daily gain	.30
Feed conversion	.30
Days to 230 lb.	.25
Backfat thickness	.50
Loin eye area	.45
Carcass length	.55
Lean percentage	.48
Ultimate pH	.21
Color	.28
Drip loss	.16
Tenderness	.26

Trait of Importance	Heritability Value	HEADS (+ Breed Average)	TAILS (- Breed Average)	Desirable Selection?	Rationale
Example: Carcass length	.55	+		Yes	A longer carcass could indicate larger size and thus more muscle/meat
1. Answers will vary					
2. Answers will vary					
3. Answers will vary					
4. Answers will vary					
5. Answers will vary					

Part Three: Describe Your Pig

Instructions: Based upon your findings on the previous chart and your knowledge of market pigs, answer the following questions in complete sentences.

1. Which breed did you select? Why did you select it?
   Answers will vary.
2. What things do you think pig farmers think about when they pick their pig breeds?
   Behavior tendencies of different breeds, growth traits, or farmer preference.
3. Why might pig producers be concerned with these heritable traits that relate to carcass quality?
   Answers will vary, although in general, it would be advantageous to have all traits be higher, with the exception of back fat. The higher these traits are, the faster growing, higher meat producing pigs the producer has.
4. Why do you think the loin eye area important?
   This is an indicator of the size of the muscle that makes up the pork chop. More muscle means more meat for the consumer to enjoy.
5. In which traits does your pig have values that are higher than the herd average? How might this impact the final market weight of your pig?
   Answers will vary.
6. In which traits does your pig have values that are lower than the herd average? How would this impact the final market weight of your pig?
   Answers will vary.
7. How might all of these traits relate to the price of pigs?
   Pork is sold by the pound, so the more lean meat that is sold, the more money a pig will sell for.

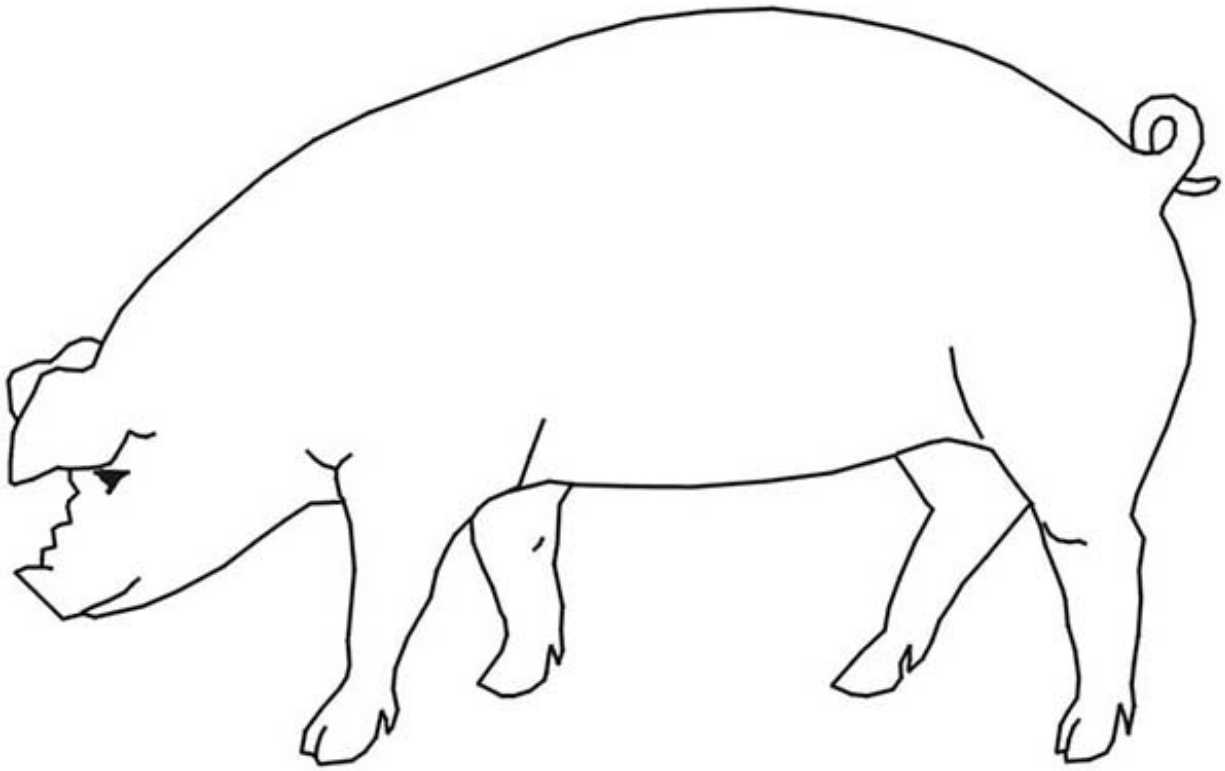
Name: _____ Period: _____ Date: _____ Due: _____

DESIGN A PIG: DROOPY EAR

Droopy Ears (Chester White, Duroc, Landrace, Poland China, Spotted Swine)

Part One: Select Breed

Instructions: Based upon the breed you selected, color your pig with the appropriate markings. Use the Major Swine Breeds poster as a reference.



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Feed conversion	.30
Days to 230 lb.	.25
Backfat thickness	.50
Loin eye area	.45
Carcass length	.55
Lean percentage	.48
Ultimate pH	.21
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Trait of Importance	Heritability Value	HEADS (+ Breed Average)	TAILS (- Breed Average)	Desirable Selection?	Rationale
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Part Three: Describe Your Pig

Instructions: Based upon your findings on the previous chart and your knowledge of market pigs, answer the following questions in complete sentences.

1. Which breed did you select? Why did you select it?

2. What things do you think pig farmers think about when they pick their pig breeds?

3. Why might pig producers be concerned with these heritable traits that relate to carcass quality?

4. Why do you think the loin eye area important?

5. In which traits does your pig have values that are higher than the herd average? How might this impact the final market weight of your pig?

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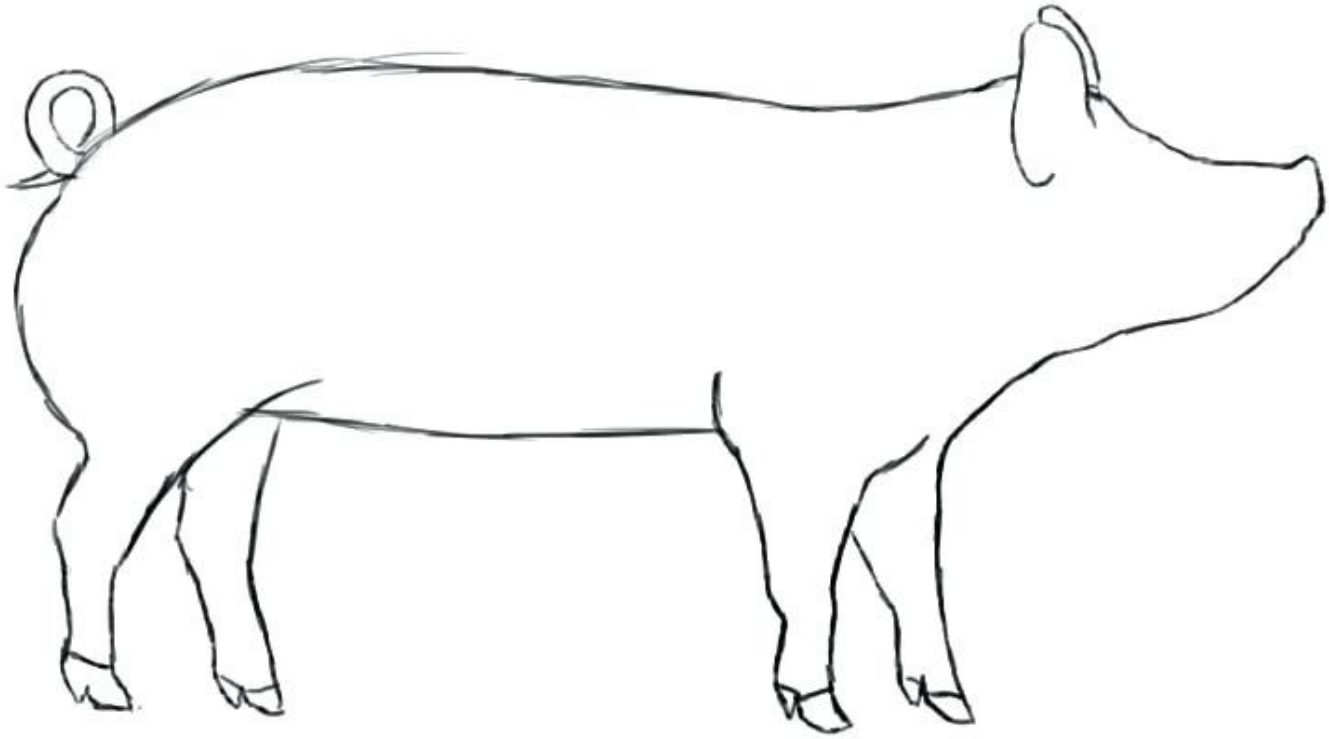
DESIGN A PIG: STRAIGHT EAR

Upright Ears (Berkshire, Hampshire, Yorkshire)

Part One: Select Breed

Instructions: Based upon the breed you selected, color your pig with the appropriate markings. Use the Major Swine Breeds poster as a reference.



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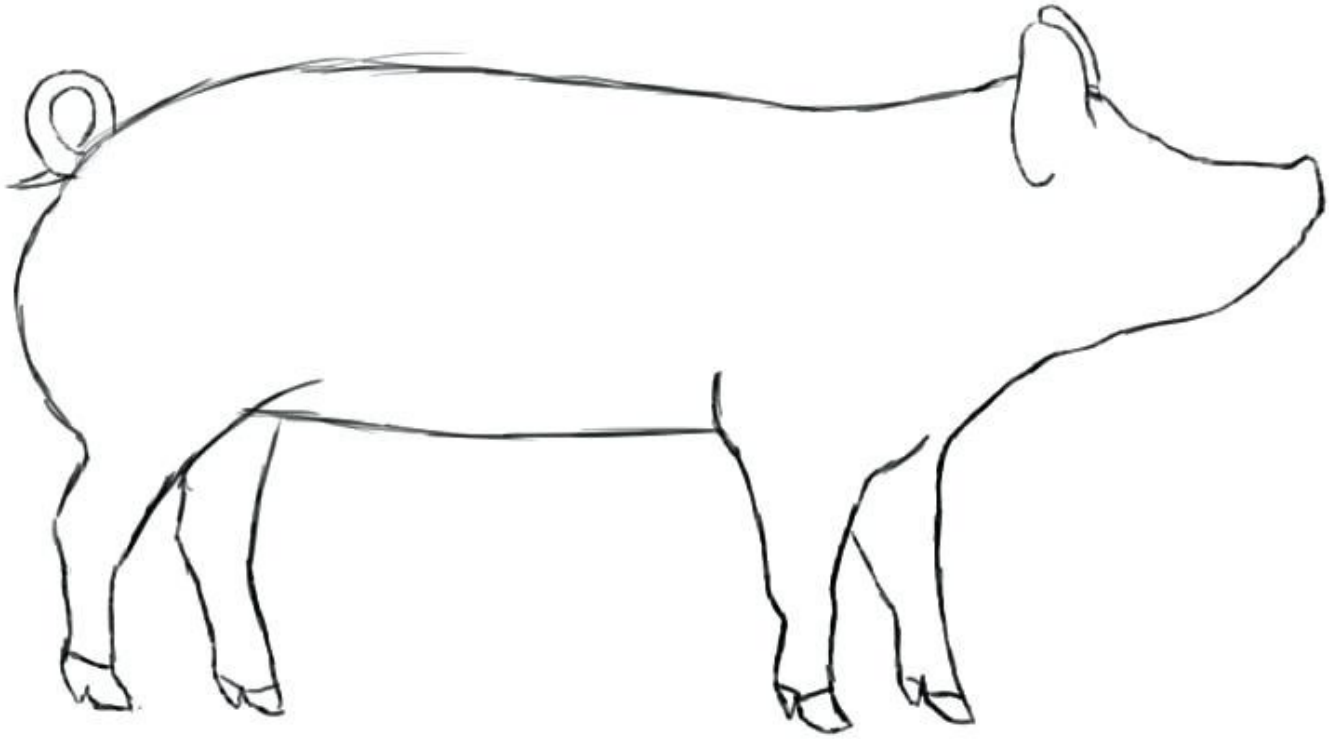

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Major Swine Breeds

Duroc

The second-most recorded breed of swine in the United States, the red pigs with the drooping ears are valued for their product quality, carcass yield, fast growth and lean-gain efficiency. They also add value through their prolificacy and longevity in the female line. Much of the U.S. breed improvement has occurred in Ohio, Kentucky, Illinois, Indiana, Iowa and Nebraska.

Berkshire

The third-most recorded breed of swine in the United States, Berkshires are known for fast and efficient growth, reproductive efficiency, cleanness and meat flavor and value. The first U.S. meeting of Berkshire breeders and importers was held in 1875, with the American Berkshire Association formed shortly after – making it the oldest swine registry in the world.

Yorkshire

The most-recorded breed of swine in North America, Yorkshires are white with erect ears. They are found in almost every state, with the highest populations being in Illinois, Indiana, Iowa, Nebraska and Ohio. Yorkshires are known for their muscle, with a high proportion of lean meat and low backfat. Soundness and durability are additional strengths.

Spotted

The Spotted swine breed is characterized by large, black-and-white spots. Many breeders in central Indiana specialized in breeding Spotted hogs through the years. Today, Spots are known for their feed efficiency, rate of gain and carcass quality. In addition, commercial producers appreciate Spotted females for their productivity, docility and durability.

Landrace

White hogs with droopy ears, Landrace are the fifth-most recorded breed of swine in the United States. Known as “America’s Sowherd,” Landrace females are heavy milkers and often farrow large pigs. Crossing well with other breeds, Landrace often possess length of body, a high percentage of carcass weight in the ham and loin and the ideal amount of finish.

Poland China

In the early 1800s, Poland China hogs originated in Ohio. Today, Poland China hogs are known for their large frame, length of body, leanness and muscle. They also are excellent feeders, gaining well under good care and management. They also are quiet in their disposition.

Hampshire

The hogs with “the belt,” Hampshires are the fourth-most recorded breed in the United States. Most popular in the Corn Belt, Hampshires are known for producing lean muscle, high carcass quality, minimal backfat and large loin eyes. Females also are known for their mothering ability, with longevity in the sow herd.

Chester White

Chester Whites originated in Chester County, Pa., from which their name was formed. These white hogs with droopy, medium-sized ears are known for their mothering ability, durability and soundness. Packers also tout their muscle quality.

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