

# Animal Breeding & Genetics

## B. A. Reiling



# Brief History of Genetics

- ✓ 1866 - Gregor Mendel & his "garden peas"
  - Sought to understand
    - Why were the peas consistent within lines,
    - but different between lines?
  - Helped **define the rules of inheritance**
    - Dominance vs. Recessiveness
- ✓ Late 1800's, Johann Friedrich Miescher
  - Isolated the "genetic blueprint" → DNA
- ✓ 1953 - Watson & Crick
  - Describe the chemical structure of DNA
    - **Double-helix**; tied together with nucleotides



# DNA, Chromosomes, & Genes

- ✓ 4 nucleotides (bases) for mammalian genome
  - Adenine, Cytosine, Guanine, & Thymine
- ✓ Mammalian DNA varies in length & organization
  - Dependent on species
    - The human genome: 3.3 billion base pairs
    - The swine genome: 2.8 billion base pairs
    - The cattle genome: 3.0 billion base pairs
    - The canine genome: 2.4 billion base pairs

# DNA, Chromosomes, & Genes

- ✓ Bases divided into thread-like structures
  - **Chromosomes**
- ✓ Number & size of chromosomes differ by species
  - **Humans: 23 pairs of chromosomes**
    - 22 pairs of autosomes & 1 pair of sex chromosomes
  - **Pigs - 19 pairs; Cattle - 30 pairs; Dogs - 39 pairs.**
- ✓ Chromosomes organized into functional subunits
  - **Genes**, that consist of specific base sequences
    - Base sequences → “instructions” → proteins → phenotype
  - **Alleles** - alternative forms of the gene

# Genotype vs. Phenotype

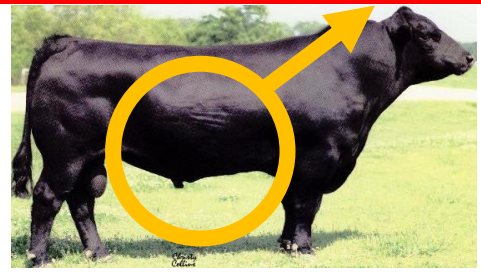
- ✓ **Genotype** = genetic makeup of a trait
  - "BB" vs "Bb" vs "bb"
- ✓ **Phenotype** = expressed characteristics
  - Influenced by BOTH **Genetics** & **Environment**

# Qualitative Traits

- ✓ Primarily determined by the genotype
  - Small number of genes involved
- ✓ Minimal environmental influence
- ✓ Often detected by visual observation
  - Examples
    - hair color; eye color;
    - horned vs. polled;
    - erect vs. floppy ears

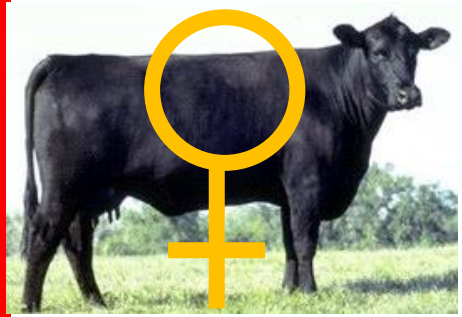


# Punnett Square:



**B**

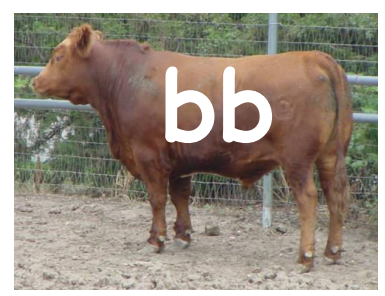
**b**



**B**



**b**



# Codominance

- ✓ When each type of allele is inherited,
  - **BOTH** are expressed!
- ✓ Classic Example - Shorthorn Cattle
  - **R = Red; W = White**
  - **RW = Roan**





# Multiple Alleles

More than 2 allelic possibilities

Classical example is Human Blood Type

✓ 3 allelic possibilities; A, B, O

➤ But each human can only have two

➤ A & B are co-dominant; O is recessive

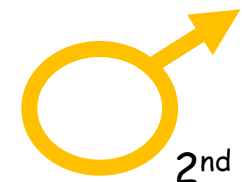
- AA or AO = produce antigen A
- BB or BO produce antigen B
- AB produce both antigens A & B (universal recipient)
- OO produce neither antigen (universal donor)

# Determination of Possible Blood Type Outcomes - Punnett Square

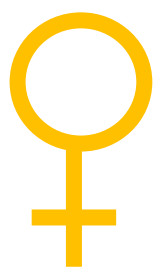
✓ When you don't know the 2<sup>nd</sup> Allele

✓ Example 1

- Father = Type A
- Mother = Type B
- Genotypic possibilities
  - A, B, AB, O



2<sup>nd</sup> allele could be either



2<sup>nd</sup> allele could be either

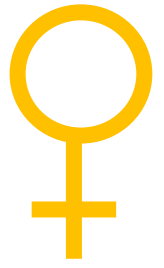
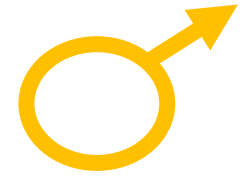
		A	A	O
B		AB	AB	BO
B		AB	AB	BO
O		AO	AO	OO

# Determination of Possible Blood Type Outcomes - Punnett Square

✓ When you don't know the 2<sup>nd</sup> Allele

✓ Example 2

- Father = Type AB
- Mother = Type B
- Genotypic possibilities
  - A, B, AB



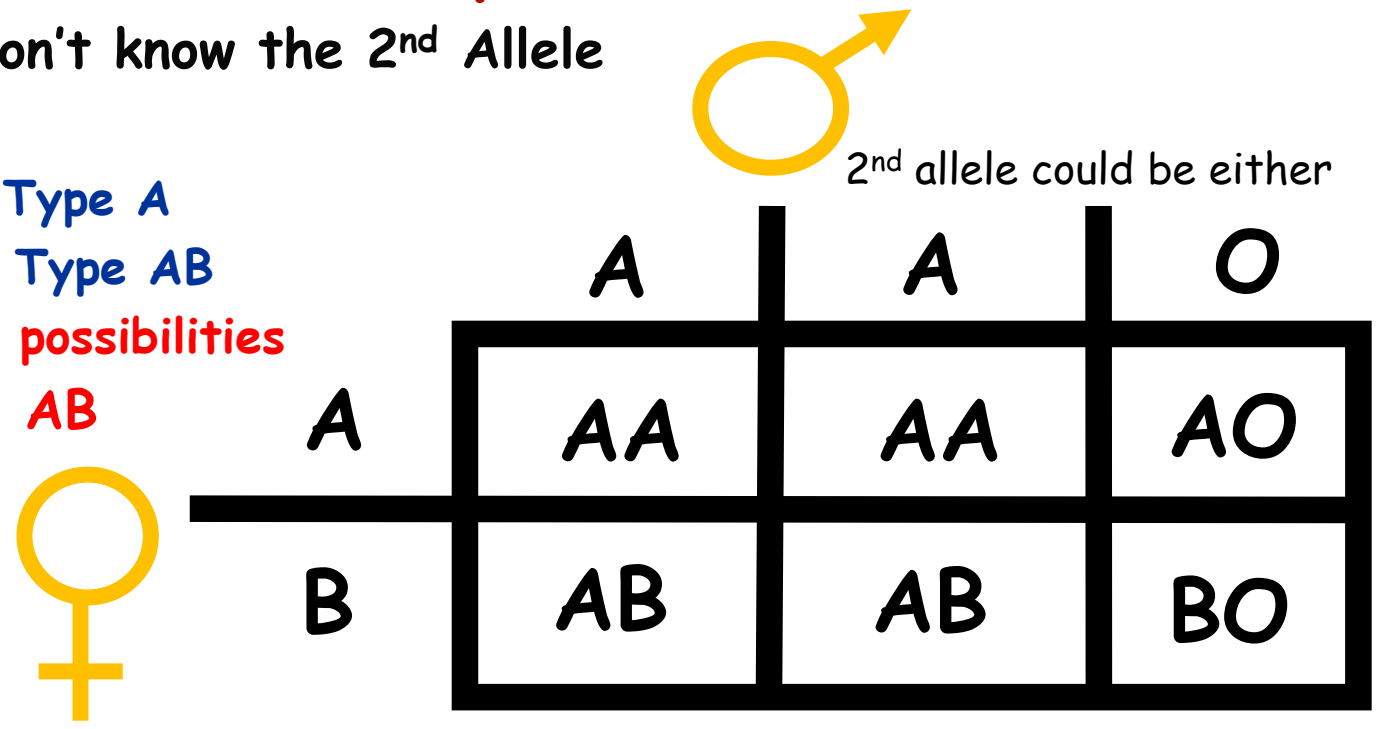
2<sup>nd</sup> allele could be either

	A	B
B	AB	BB
B	AB	BB
O	AO	BO

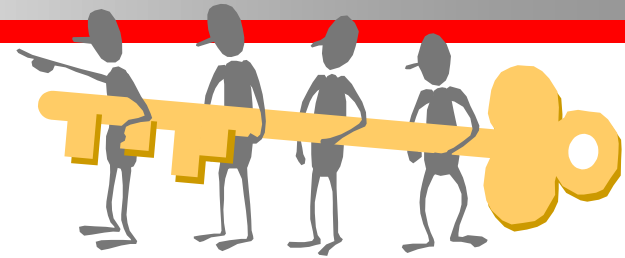
# Determination of Possible Blood Type Outcomes - Punnett Square

- ✓ When you don't know the 2<sup>nd</sup> Allele
- ✓ Example 3

- Father = Type A
- Mother = Type AB
- Genotypic possibilities
  - A, B, AB



# Key Points: Genetics



- ✓ What is DNA? Describe the structure.
  - ✓ Chromosomes → Genes → Proteins → Trait
  - ✓ Qualitative Trait Characteristics
  - ✓ Dominant vs. Recessive (Punnett Square)
  - ✓ Codominance
  - ✓ Multiple Alleles
- Related to  
Blood Typing

Extension is a Division of the Institute of Agriculture and Natural Resources at the University of Nebraska-Lincoln cooperating with the Counties and the United States Department of Agriculture.

The Youth Development program abides with the nondiscrimination policies of the University of Nebraska-Lincoln and the United States Department of Agriculture.