Genetics

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Objectives

- Describe the structure of genetic material
- Describe the replication and expression of genetic material
- Discuss the role of biotechnology in the animal industries
- Describe the process of selection for convenience traits
A Science

Genetics
- Study of inheritance (heredity)
  - Inherited genetics
  - How characteristics are passed from generation to generation
- Study of genetic codes of body cells
  - Molecular genetics

Heredity
- Transmission of characteristics from parent to offspring
- By means of genes on chromosomes in nucleus of body cells
- Controlled by genes (DNA)
IN A CELL, A CHROMOSOME PAIR CARRYING A GENE PAIR WITH DIFFERENT ALLELES (A,a) FOR A SPECIFIC TRAIT.

GENOTYPES AND PHENOTYPES
HOMOLOGOUS CHROMOSOMES CARRY THE SAME GENES, BUT MAY HAVE THE DOMINANT OR RECESSIVE FORM. MAMMALIAN CHROMOSOMES CARRY APPROXIMATELY 3000 GENES.
Chromosomes

- Occur in pairs
  - One from paternal parent
  - One from maternal parent
- Made of DNA with a strand of 4 nucleotide bases
Genes (Traits)

- Occur in pairs on chromosome pairs
  - One from each parent
- Stores information on chromosomes
  - Tells cell how to build protein (good or bad)
- Proteins made are coded by specific genes
  - Genetic code of nucleotide bases
Alleles

- Alternative copy of same gene
  - Dominant or recessive
  - Protein construction slightly different
  - Function slightly different

- Different forms
  - Co-dominant
  - Co-recessive
  - One dominant and one recessive

- Recessive genes expressed if no dominant genes
  - May be good or bad
Genetic Code

- Combination and order of nucleotide bases
  - In DNA of chromosomes in nucleus of body cells
- Ordered by genes to build proteins
Nucleotide Bases

- Found in DNA of chromosomes
- Bind on pairs of chromosome strands
- Building blocks of genetic code

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Adenine --- Thymine</td>
<td></td>
</tr>
<tr>
<td>Thymine --- Adenine</td>
<td></td>
</tr>
<tr>
<td>Cytosine --- Guanine</td>
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<tr>
<td>Guanine --- Cytosine</td>
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Transcription

- To make protein from nucleotide code of RNA copy of chromosome DNA
  - RNA strand copy binds with DNA strand
  - Messenger RNA (mRNA)
    - Leaves nucleus
    - Shuttles between nucleus and cytoplasm of cell

<table>
<thead>
<tr>
<th>DNA</th>
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<tbody>
<tr>
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<td>Uracil</td>
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<tr>
<td>Thymine</td>
<td>Adenine</td>
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<tr>
<td>Cytosine</td>
<td>Guanine</td>
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<tr>
<td>Guanine</td>
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Translation

- Process of protein synthesis from the code on mRNA
- Ribosome in cytoplasm bind to mRNA to read code
- Produces strand of amino acids = protein
- Code of 3 nucleotide bases = codon
The start codon is AUG. Methionine is the only amino acid specified by just one codon, AUG.

The stop codons are UAA, UAG, and UGA. They encode no amino acid. The ribosome pauses and falls off the mRNA.
GAG   TTT   TAT   ATC   ACT   TAC   GAC   TAA   CAG   TTA   ACA   CTT   TCG   GAC   CTT   CAA   AAT   GCT   ACT   CUC   AAA   AUA   UAG   UGA   AUG   CUG   AUU   GUC   AAU   UGU   GAA   AGC   CUG   GAA   GUU   UUA   CGA   UGA
Body Cells Divide

- Mitosis – 2 cells with copies of chromosome pairs (diploid)
- Meiosis- 4 cells with copies of chromosome singles (haploid)
Reproduction

- Transfer of haploids from both parents’ (gametes) to form embryo (diploid)

- Phenotype
  - A particular trait that is observed

- Genotype
  - Genetic makeup of a single trait
  - Not visible
Expression of Genes (Phenotype)

- **Homozygous**
  - Genes are alike
    - Dominant alleles
      - PP
    - Recessive alleles
      - pp

- **Heterozygous**
  - Genes are different
    - One dominant and one recessive alleles
      - Pp
  - Carriers
**F_1 CROSS**

**PHENOTYPE:**
- POLLED $\times$ POLLED

**GENOTYPE:**
- Pp $\times$ Pp

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<tbody>
<tr>
<td>P</td>
<td>1/4 POLLED PP</td>
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<tr>
<td>p</td>
<td>1/4 POLLED Pp</td>
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3/4 POLLED (1/4 HOMOZYGOUS 1/2 HETEROZYGOUS)

1/4 HORNED (HOMOZYGOUS)
AA x AA
Black x Black

<table>
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<table>
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<tbody>
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<tr>
<td></td>
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All black
AA x AA

AA

AA

AA

AA

AA

AA
AA x aa
Black x Red

Sire

A

A

a

a

A a

Black

A a

Black

A a

Black

A a

Black

All black
AA x aa

AA

aa

Aa

Aa

Aa

Aa
Aa x Aa
Black x Black

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- A A A: Black
- A a: Black
- A a: Black
- a a: Red

3/4 Black
1/4 Red
Aa x aa
Black x Red

A  a
a  a

A  a
a  a

Black  Black
Red  Red

½ Black  ½ Black
½ Red  ½ Red
Aa x aa

Aa

Aa  Aa

aa  aa
Biotechnology

- A science study of techniques
- Genetic Engineering (Biotechnology)
  - Gene mapping
  - Recombinant DNA processes – produces vaccines, hormones, tests
  - Gene deletion – produces vaccines
  - Gene transfer – produces improved production and resistance
  - Nuclear transfer – produces cloning (twinning)