Animals are the result of:

- Genetics
- Health
- Care and Management
- What they eat
  - all feeds come directly from plants
  - 2/3 of livestock feed is not suited to humans
  - 70% of cost of finishing cattle is feed
Types of Digestive Systems

- **Monogastric**
  - simple-stomach
  - humans, pigs, dog, monkey

- **Ruminants**
  - multiple stomachs
  - cattle, sheep, goat

- **Pseudo-Ruminants (Functional Cecum)**
  - horse, rabbit, hamster, guinea pig
Animal Classes based on type of feed eaten:

- **Herbivores**
  - vegetarians
  - eat only plants

- **Carnivores**
  - flesh eaters
  - eat mostly only other animals

- **Omnivores**
  - eat both plants and animals
What are Nutrients?

- Chemical substances found in feed materials that can be used, and are necessary for the maintenance, production, and health of animals.
- Nutrients are needed by animals in definite amounts varying with age, function, use etc.
Meeting the total nutritional requirements

Knowing the nutritional requirements and the nutritional value of the feeds
Nutrients

- Carbohydrates
- Fats
- Protein
- Minerals
- Vitamins
- Water
Energy Feeds

- Energy needed for all life processes
- Deficiency: slow or stunted growth, body tissue loss, lowered production of meat, milk, eggs, fiber
- Carbohydrates most important source of energy, than fats
Carbohydrates

- More abundant and cheaper
- Very easily digested and turned into body fat
- Easier storage than fats
Proteins

- Complex compounds made of amino acids
- In all plant and animal cells
- Nitrogen content multiplied by 6.25 tells the amount of protein
- Plants make their own protein
Amino Acids

- Some are created by the body, nonessential
- Others can’t be made fast enough, essential
  - must be furnished in the feed
- Poor Quality Protein Feeds:
  - insufficient amount of essential proteins
Source of Protein

- Animal Proteins are superior for monogastrics
  - better balanced in essential amino acids
- Milk and Eggs are abundant in essential amino acids
Essential Amino Acids

Most likely AA to be deficient are:

- Lysine, Methionine, and Tryptophan
- Cereal grains are low in these
- Rations with high amounts of cereal grains require supplements with proteins with higher levels of these amino acids
Minerals

- Minerals are the inorganic elements of animals and plants.

- Determined by burning off the organic matter and weighing the residue (called Ash).
Minerals

- 2 to 5% of animal are minerals (bones, teeth, part of blood, fluids)
- Regulate many vital processes
- 18 essential mineral elements
- Deficiency = loss of production
Minerals

- Free choice or in ration
- Supplement for deficiency only
- Trace minerals in areas where soil is deficient
Macrominerals

- Salt
- Calcium
- Phosphorus
- Magnesium
- Potassium
- Sulfer
Microminerals

- Chromium
- Cobalt
- Copper
- Fluorine
- Iodine
- Iron
- Manganese
- Molybdenum
- Selenium
- Silicon
- Zinc
Functions of Minerals

- Give strength to skeleton
- Part of protein
- Activate enzyme systems
- Control fluid balance
- Regulate acid-base balance
- Exert effects on nerves / muscles
- Engage in mineral-vitamin relation.
Vitamins

- Required in minute amounts for normal growth
- Specific functions
- Fat soluble or water soluble
Fat Soluble Vitamins

- Vitamin A, D, E, K
Water Soluble Vitamins

- Biotin
- Choline
- Folic Acid
- Inositol
- Niacin
- Pantothenic Acid (B-3)
- PABA
- Riboflavin (B-2)
- Thiamin (B-1)
- B-6
- B-12
- C
- All but C are from the B family
Water

- Most vital of all nutrients
- 40% of fat hog to 80% of newborn lamb
- Free access to Clean, Fresh Water at all times
What is a Feedstuff?

- any ingredient, or material, fed to animals for the purpose of sustaining them
- most provide one or more nutrients
- nonnutritives = flavor, color, palatability, adding bulk, preservatives
Feed Classifications

- Roughages
- Concentrates
- By-product feeds
- Protein Supplements
- Minerals
- Vitamins
- Special Feeds
- Additives, Implants, & Injections
Roughages

- Bulky feeds low in weight per unit
- Contain more than 18% crude fiber
- Low in Energy
- Natural feeds of ruminants
- Generally low in digestibility
- High in Ca, K, and trace minerals
- Higher in fat-soluble vitamins
- Protein varies
Roughages

- Pastures
- Hay
  - varies more than any other feed
  - harvest at optimum time
  - cure properly 20% moisture or less
- Crop Residues
  - left in field after harvest
  - straw, corn stalks, etc
  - fed to right class of animal & supplement
Roughages

- **Silage** = fermented forage plants
  - mostly corn or sorghum
  - 2 1/2 to 3# silage replaces 1# hay due to lower dry matter content of silage

- **Haylage** = low moisture silage
  - grass or legume wilted to 40-60% moisture before ensiling
  - more dry matter & feed value
Roughage

- **Green Chop (soilage)**
  - fresh plants cut and chopped in the field, transported and fed to animals in confinement
  - 50% more feed value
  - extra equipment required
  - harvest every day
Roughage

- Other Roughages
  - cottonseed hulls
  - corncobs
  - sawdust
  - beet tops
  - root crops
  - oat hulls
  - peanut hay
  - newspapers
Concentrates

- Feeds high in energy and low in fiber (under 18%)
- Availability and Price
- Need to substitute concentrates for each other as price changes
- Corn, Sorghum, barley, rye, oats, wheat, triticale
By-Product Feeds

- Feeds left over from animal and plant processing or industrial manufacturing
- Roughage and Concentrate
By-Product Feeds

- **Milling by-products from:**
  - cereal grains
  - oilseeds
  - root crops
  - dried beet pulp and tops
  - distillery and brewing
  - unused bakery products
  - fruits and nuts
By-Product Feeds

- Effective & Profitable Use:
  - price
  - composition be known
  - palatable and consumed
  - not adversely affect carcass quality
    - chemical residues
    - pesticides
Protein Supplements

More than 20% protein

Animal Protein Supplements

- inedible tissues from meat packing
- surplus milk products
- marine sources
- feather meal (85% protein) poor quality, must be hydrolized, less than 5% in hog ration
Protein Supplements

- Plant Protein Supplements
  - oilseed by-products
  - soybean meal
  - cottonseed meal
  - linseed meal
  - peanut meal
  - safflower meal
  - rapeseed meal
Protein Supplements

- **Plant Protein Supplements**
  - Hogs & Chickens usually fed some protein feeds of animal origin (essential amino acids)
  - Ruminants = protein quality is less important (& pseudoruminants)
  - Protein quality usually higher if variety of feeds is used
Protein Supplements

- **Nonprotein Nitrogen Sources (NPN)**
  - **Ruminants** - microorganisms (simple plants) in rumen convert nitrogen into protein
Nonprotein Nitrogen Sources (NPN)

- Urea - made from anhydrous ammonia
- Fertilizer, Feed Additive, Plastics
- Urea is the end product in nearly all mammals
- Urea = 281% protein
- Max Limits of use of Urea (25% of protein for pregnant cows)
Nonprotein Nitrogen Sources (NPN)

- Slow-release urea products
- Urea chemically bound to another compound
- Decreased solubility, slower release of ammonia
- More uniform ammonia level all day
- Less danger of Urea Toxicity
Nonprotein Nitrogen Sources (NPN)

- Single-celled protein (SCP)
- Protein from single-celled organisms: yeast, bacteria, fungi, algae
- Grown in: sewage, petroleum by-products, sawdust etc.
- Algae: can make 10 times as much protein as soybeans per acre
Vitamin Supplements

- Vitamins are destroyed by heat, sunlight, oxidation, mold growth
- Adult Ruminants: A, D, E
  - synthesize B, C, K vitamins
  - sunlight = Vit. D
- Hogs: need vitamin supplements
Colostrum: first milk given by mammals after parturition
- contains antibodies
- within 15 min to 4 hours
- surplus colostrum can be frozen for up to a year or more
- can feed cow colostrum to lambs etc., but some diseases are species specific
**Special Feeds**

- **Milk Replacers**
  - can’t replace colostrum
  - is fortified with vitamins, minerals & antibiotics
  - higher fat reduces diarrhea
Special Feeds

- **Fats and Oils**
  - acidulated soap stock, tallows, greases

- **Fat**
  - increases calories of ration (2 1/4 times energy of carbohydrates)
  - controls dust
    - animals don’t like dusty rations
  - lessons wear on feed mixing equip.
Special Feeds

- **Molasses**
  - by-product from sugar manufacture
  - 3/4 energy value of corn
  - appetizer
  - reduce dust, pellet binder
  - stimulate rumen activity
Additives, Implants, & Injections

- 80% of food animals get some drug during lifetime
- Chemicals that regulate growth, modify rumen activity, improve feed efficiency increase 15% each yr.
- Lower production costs
- Unsafe if used improperly
Feed Additives

- Abortifacients = induces abortion
  - feedlot heifers

- Antibiotics = produced by living organisms, bacteriostatic properties
  - growth stimulators
  - better feed efficiency
Antibiotics

- Low levels in feeds
- High (therapeutic) levels in feeds
Antioxidants

- Prevent oxidative rancidity of fats
- Other methods:
  - refrigeration
  - lack of light
  - lack of oxygen
Arsenicals

- Growth promotion in chickens, turkeys & swine
- Prevent coccidiosis in chickens
- Prevent dysentery in swine
Bloat Control Products

- “Bloat Guard”
- “Terramycin” or “Neoterramycin”
- “Enproal Bloat Blox”
- “Bovatec” & “Rumensin” inhibit gas formation and methane production in rumen
Buffers

- Lessen change in pH (antacids)
- Change in feed changes pH
- Upsets microbial activity in rumen
Chemotherapeutics

- Similar to antibiotics
- produced chemically instead of biologically
Copper

- Increased feed efficiency
- 175-200 ppm

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Electrolytes

Substance when dissolved in water enables solution to conduct electric current

Salts (saline)

Replenish fluids lost from:
- dehydration
- diarrhea
- hemorrhage
- vomiting
Electrolytes

- Give orally if possible
- Intraveneously if life threatening
- Subcutaneous possible
- Check with veterinarian
- 7-10% of body wt in 24 hrs
Flavoring Agents

- Increase palatability & feed intake
- Many additives taste or smell bad
Hormones

Chemicals released by a specific area of the body, transported to another, to bring about a physiological response.

- Increase growth, milk production, meat production.
Hormones

- **BST**: dairy cattle
  - naturally occurs in all milk
  - not a growth promotant
- **PST**: swine
  - similar to BST
- **MGA**: nonpregnant heifers
  - suppresses estrus
  - promotes growth
Implants

- Small pellet deposited under skin behind the ear
- Promote growth
- “Compudose”: steers any age or wt
- “Finaplex”: feedlot steers
- “Ralgro”: improves rate of gain
  - Not a hormone (anabolic agent)
  - Either sex, suckling, growing, finish
Implants

- “Synovex-S, Synovex-H, :sex specific implants
- Synovex-C” :calves 45 days
- “Steer-oid” & “Heifer-oid” :similar to Synovex-S and -H
Ionophores

- Feed additives that change the metabolism within the rumen by altering the rumen microorganisms
- “Bovatec” & “Rumensin”
- Lower feed intake, gain same
Other Additives

- Mold inhibitors
- Probiotics - microbial cultures
- Steriods - increase muscle mass & eliminate pain
- Tranquilizers - quieting & curbing activity
Feed Substitution

- Substituting feeds as price changes
- Feed composition be known
- Palatability & Quality
- Some require preparation (grinding or rolling)
Feed Processing: Mechanical

- **Dehulling:** removing the outer coat of grains, nuts, fruits (hulls are high in fiber, low in digest. for monogastrics)

- **Extruding:** pressed, pushed or protruded through constrictions under pressure (disrupts starch granules)
Feed Processing: Mechanical

- **Grinding:** reduced in size by impact or shearing (cheapest, most common)
- **Rolling:** compressed into flat particles by rollers
  - Dry: breaks hull or seed coat
  - Steam: keeps more intact
Feed Processing: Heat Treatments

- Heat can damage some nutrients
- Not done for monogastrics
- Dry Heat
  - Micronizing: microwave (sorghum)
  - Popping: rapid heat (sorghum)
  - Roasing: oven (corn & soybeans)
Feed Processing: Heat Treatments

- **Moist Heat**
- **Cooking:** potatoes, beans, soybeans for pigs
- **Exploding:** swelling caused by steaming under pressure (resembles puffed cereal)
Feed Processing: Heat Treatments

- **Flaking**: steam rolling, longer steaming period
- **Pelleting**: compacting and forcing through a die
  - mechanized feeding
  - eliminate dust
  - feed on ground
Feed Processing: Moisture Alterations

- **Bran Mash**: steamed wheat bran (horses) wheat bran in pail, add boiling water, cover, let stand
- **Drying (Dehydrating)**: <14%
- **Reconstituted Grain**: add water to grain (25-30%), stored in silo 15-21 days
Feed Processing: Moisture Alterations

- Watered Feeds:
  - Soaking: 12-24 hours
  - Liquid & Paste Feeding: slop hogs
Feed Processing

- Blocks: 30-50#
  - mineral, protein, energy
- Liquid Supplements: water, molasses, & urea, trace min & vit
- Fermenting: ensiling
- Hydroponics: sprouted grains
- Unprocessed corn: off cob
Forage Processing Methods

- **Chopping, Grinding, Shredding**
  - easier to handle
  - less storage area required
  - less waste
  - better production

- **Chopping**
  - cut down to 2”
  - dusty
  - leaf loss possible in field chopping
Forage Processing Methods

- Grinding
  - less than 1” lengths
  - more costly
  - swine and poultry
  - not desired for ruminants (pass through rumen to quickly)
  - add molasses to control dust
Forage Processing Methods

- **Shredding**
  - similar to chopping, stems cut longitudinally rather than crosswise
  - coarse forages (fodder, stover)
Forage Processing Methods

- Cubing (wafering)
  - compressing coarsely cut hay into cubes 1 1/4” square by 2” long
  - 30-32# per cubic foot
  - relatively coarse material
  - horses can choke on cubes
Forage Processing Methods

- **Drying**
  - hay taken from field, chopped, dried by heat
  - costly
  - swine and poultry
Forage Processing Methods

- Ensiling: moist forage stored in a silo in absence of air
- 2-3 weeks to cure
- Very versatile
- all forages
Forage Processing Methods

- Pelleting: ground forage forced through a steel die & compressing in round or rectangular mass & cut to length
- add binding agents
- requires fine grinding
- improves quality of poor forages
- easier handling
Miscellaneous Processing Methods

- Ammoniation: low nitrogen feeds
- Animal Waste Processing: chicken waste fed to ruminants
  - Deep Stacking: heat kills microbes
  - Ensiling: heat kills microbes
- Fat Added:
- Irradiation: ultraviolet light prevents richits (sun cured hay)
Miscellaneous Processing Methods

- Molasses added
- Preservatives:
  - Hay: organic acids (up to 28% moist)
  - Hay: anhydrous ammonia (30%)
Self-feeding Governors

- Bulky, fibrous feeds (inc. hay, less grain)
- Salt
- Fat content: animal eat until caloric intake level is reached
- Liquid Supplements: lick tank & ingredients
Treatment of High Cellulose Feeds

- Straw - open fibers to inc. digestion
- Alkali Treatment: sodium hydroxide
- High Pressure Steaming (wood)
  - digestibility up to 60%
  - high cost
Treatment of High Cellulose Feeds

- Ammoniation Treatment: air tight enclosure, add 3% Anhydrous Ammonia for 20 days
  - adds non-protein nitrogen (inc. CP 3-10%)
  - no residue left
  - inc. animal intake & prevents mold

- AA is dangerous (flammable, toxic to skin & eyes)
Cost Per Unit of Nutrients

- Soybean Meal (44% CP) sells for $9.88/cwt
- Linseed Meal (35% CP) sells for $6.25/cwt
- Which is the better deal?
- **SBM** = $0.225/lb protein
- **LSM** = $0.179/lb protein
Cost Per Unit of Nutrients

- **Corn (TDN = 91%)** = $3.63/cwt
- **Milo (TDN = 86%)** = $3.25/cwt

Which is the better deal?

- **Corn** = $3.99/lb TDN
- **Milo** = $3.78/lb TDN
Cost Per Unit of Nutrients

- Must consider:
  - platability
  - grade of feed
  - preparation required
  - quantities of each feed fed

- Cost per pound of production vs cost per pound of ration
Measuring Energy Values of Feeds

- Total Digestible Nutrients (TDN)
- Calorie System:
  - Gross Energy (GE)
  - Digestible Energy (DE)
  - Metabolized Energy (ME)
  - Net Energy (NE) (most used)
TDN System

- Most extensively used
- \[ \%\text{TDN} = \%\text{DCP} + \%\text{DCF} + \%\text{DNFE} + (\%\text{DEE} \times 2.25) \]
- Not very accurate
  - feed 100% fat = %TDN of 225%
Calorie System

- **Gross Energy**: does not describe usefulness of energy
  - 1# corn cob = 1# shelled corn

- **Digestible Energy**: energy not excreted in feces

- **Metabolized Energy**: gross energy not lost in feces, urine or gas
  - doesn’t account for energy lost in heat
Calorie System

- **Net Energy**: energy left after feces, urine, gas, & heat are deducted
  - growing in use
  - more complex to calculate
  - Net Energy (maintenance & gain)
Balancing a Ration

Pearson Square

Diagram:
- % Protein in Concentrate
- % Protein in Base
- Desired Protein in Ration
- Parts of Concentrate in Ration
- Parts of Base in Ration
Net Energy System

- How many calories would a 770# medium frame steer calf need to gain 2.6# per day?
- Calculate NEm and NEg values for a pound or ration (table)
### Ration For Finishing Cattle

<table>
<thead>
<tr>
<th></th>
<th>lb</th>
<th>NEm</th>
<th>NEg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelled Corn</td>
<td>68.6</td>
<td>59</td>
<td>40.47</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>4</td>
<td>3.16</td>
<td>2.12</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>27</td>
<td>14.04</td>
<td>7.56</td>
</tr>
<tr>
<td>Salt</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>76.2</td>
<td>50.15</td>
</tr>
</tbody>
</table>
Net Energy System

- Refer to Net Energy Requirements or animal

\[
\text{Mcal/day} \\
\text{NEm} \ldots \ldots \ldots \ldots \ldots \ldots \ldots 6.24 \\
\text{NEg} \ldots \ldots \ldots \ldots \ldots \ldots \ldots 5.50
\]

- Pounds of feed to meet the daily maintenance requirement

\[
6.24 \text{ Mcal} / .7620 \text{ Mcal} = 8.19 \text{ lbs}
\]
Pounds of feed to meet the requirement for 2.6 lb daily gain

- 5.50 Mcal / .5015 Mcal = 10.97 lb

Total pounds of feed that the steer calf must eat daily to gain 2.6 lb

- 8.19 + 10.97 = 19.16 lb
Net Energy System

- How many calories would a 770# medium frame steer calf need to gain 2# per day?
- Calculate NEm and NEg values for a pound or ration (table)
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<tr>
<td>Barley</td>
<td>70</td>
<td>54.6</td>
<td>36.4</td>
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<tr>
<td>Soybean meal</td>
<td>2.6</td>
<td>2.05</td>
<td>1.38</td>
</tr>
<tr>
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<td>14.04</td>
<td>7.56</td>
</tr>
<tr>
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<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>70.69</td>
<td>45.34</td>
</tr>
</tbody>
</table>
Net Energy System

Refer to Net Energy Requirements or animal

Mcal/day

NEm.....................6.24
NEg.....................4.29

Pounds of feed to meet the daily maintenance requirement

6.24 Mcal / .7069 Mcal = 8.83 lbs
Net Energy System

- Pounds of feed to meet the requirement for 2lb daily gain
  - \( \frac{4.29 \text{ Mcal}}{0.4534 \text{ Mcal}} = 9.46 \text{ lb} \)

- Total pounds of feed that the steer calf must eat daily to gain 2 lb
  - \( 8.83 + 9.46 = 18.29 \text{ lb} \)
Net Energy System: Predicting Gain

Predict daily gain of 770# steer eating 18# of ration

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</tbody>
</table>
Net Energy System: Predicting Gain

Pounds of feed to meet daily maintenance requirements

\[ \text{Mcal/day} \]

NEm..................6.24
NEg..................4.29

\[ \frac{6.24 \text{ Mcal}}{.7620 \text{ Mcal}} = 8.19 \text{ lb} \]
Net Energy System: Predicting Gain

Pounds of feed left for gain:
- 18 lb - 8.19 lb = 9.81 lb

Mcal of NEg supplied by remaining feed:
- 9.81 lb x .5015 Mcal = 4.92 Mcal

Daily gain expected:
- refer to tables:
- 2.4 lbs per day
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THANKS.....