NUTRITION

Basic and beyond

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FWRA 2011 symposium

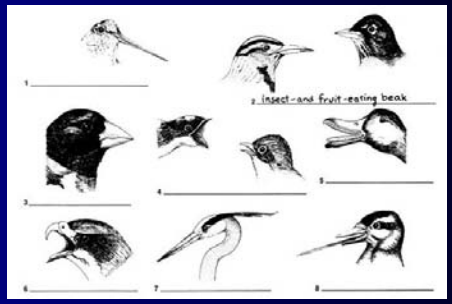
NUTRITION

- FOOD = ENERGY = LIFE
- Proper nutrition is a critical part of the rehabilitation process
  - Sometime the only one you need to provide
  - Raising orphaned animals
  - Preventing/restoring the loss of lean body mass
    - Body tissue except fat
    - Essential to successful wound healing
    - Overcoming viral and bacterial diseases
      - LBM loss of more then 20% will cease wound healing

NUTRITION

- **Balanced diet**
  - **Provides all required nutrients**
  - **In proper ratio**
- **Diet that does not contain enough energy components will not permit the animal's system to use the rest of the nutrients in the diet**
- **Missing one nutrient can effect the efficient digestion of the entire diet**
- **Surplus of a nutrient can cause the animal to avoid the diet altogether**
- **Surplus of certain nutrients can stop the absorption of another**
  - **Calcium/phosphorus**
  - **Zinc/Iron**
- **Enhance absorption**
  - **Vitamin C/ Iron**
  - **Vitamin D/ Calcium**

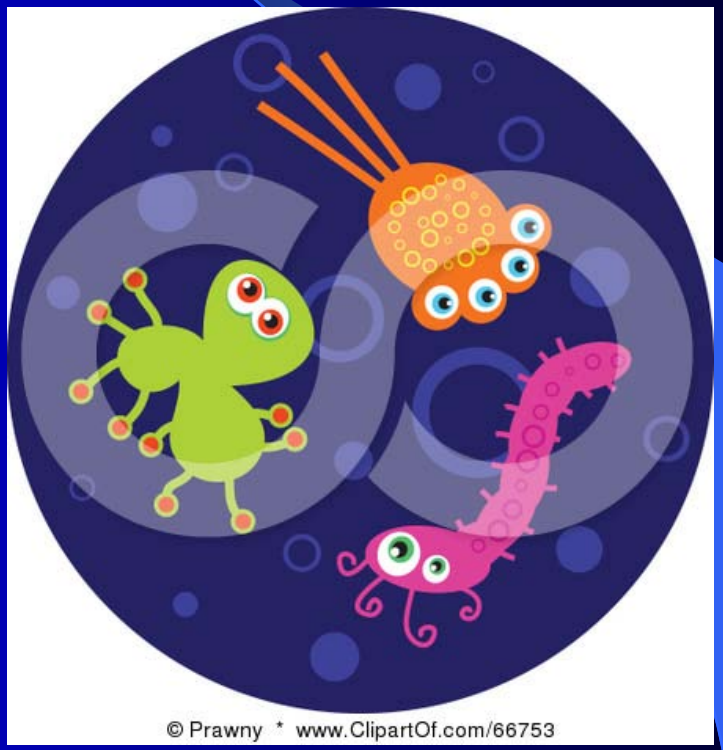
NUTRITION



- **Balanced diet**
  - **Sufficient amounts of all nutrients**
    - **Not specific ingredients**
- **Animals have unique foraging adaptations**
  - **The manner in which they eat and digest will differ**
  - **The manner in which it is absorbed and utilized will be the same**
- **The energy content of a diet is obtained from**
  - **Proteins**
  - **Carbohydrates**
  - **Fats**
- **Those nutrients are ingested digested absorbed and transported to cells**
  - **Generate energy**

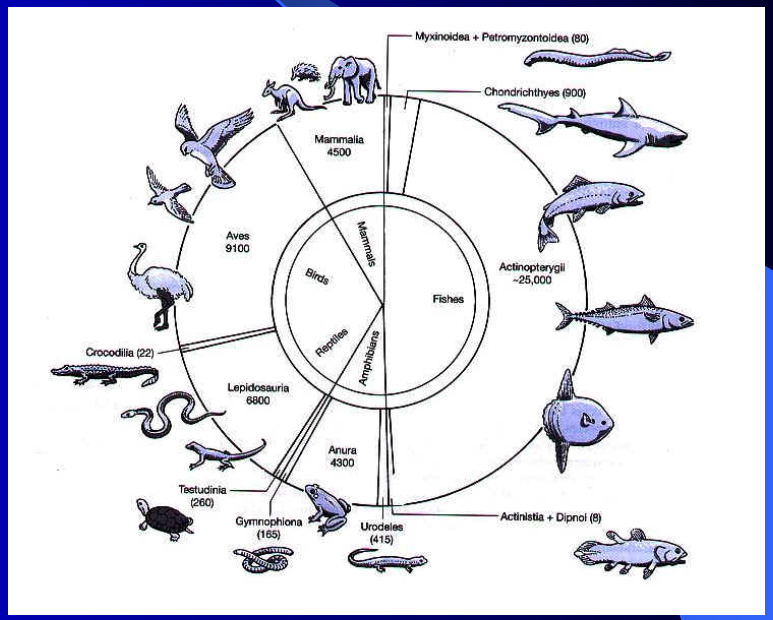
NUTRITION

- Diet needs to be
- Free of bacteria and toxins
  - Washing all fruits and vegetables
  - Reputable food source for fish and meat
  - Proper refrigerating
  - Proper thawing

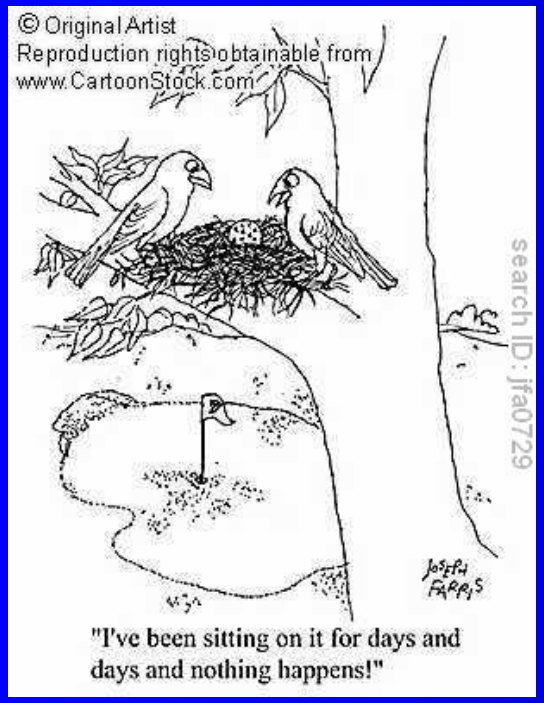


ENERGY REQUIREMENTS

- Energy requirements for native wildlife can be difficult to establish
  - Wide variations in nutritional and energy requirements
- Physiological conditions
  - Species
    - Birds
      - Over 9,998 species
    - Mammals
      - 5,490



ENERGY REQUIREMENTS



- **Physiological conditions**
  - **Age**
    - **Hatchlings and juveniles need extra protein**
      - **Insects**
  - **Size**
    - **A small bird will consume more food per body weight then a larger one**
  - **Sex**
    - **Calcium for egg production**
- **Environmental conditions**
  - **Weather**
    - **Food higher in fat and carbohydrate**
  - **Season - breeding**
    - **food higher in protein and carbohydrates**

ENERGY REQUIREMENTS

- **Energy expended is lowest when the animal is inactive and under thermoneutral conditions**
- **Energy expended is highest**
  - **During flight**
  - **Territory protection**
  - **Laying eggs**
  - **Feeding young**
  - **Obtaining food**
    - **Energy derived from the food needs to be higher then the energy spent finding or catching the food**

ENERGY REQUIREMENTS

- Food energy is measured in kilocalories
- Knowledge of energy requirements is necessary to determine how much food is needed for a specific animal in a specific situation

ENERGY REQUIREMENTS

- **BER- Basal Energy Requirement**
  - **Energy needed for healthy, awake, fasting animal in thermoneutral environment**
  - **Enough energy to maintain body function on a cellular level**
- **RER- Resting Energy Requirement**
  - **Healthy animal at rest, thermoneutral conditions**
  - **Sufficient energy for digestion, absorption, and metabolism of food**
- **MER- Maintenance Energy Requirement**
  - **Healthy, moderate active animal**
  - **BER plus energy for regulating body temperature and moderate activities**
- **DER – Daily Energy Requirement**
  - **Healthy, normal activity for the species**
  - **Energy sufficient to maintain normal body weight**
  - **Energy needed for work, growth, lactation, and gestation**

ENERGY REQUIREMENTS

- ***RER***
- **Placental animals**
  - **70(body weight in kg) $^{0.75}$** **70(BWkg)$^{0.75}$**
- **Marsupial mammals**
  - **49(body weight in kg) $^{0.75}$**
- **Reptiles**
  - **10(body weight in kg) $^{0.75}$**
- **Passerine birds**
  - **129(body weight in kg) $^{0.75}$**
- **Non-passerine birds**
  - **78(body weight in kg) $^{0.75}$**
- **Seabirds**
  - **90(body weight in kg) $^{0.75}$**

ENERGY REQUIREMENTS

- **DER**
  - **For sick, anorectic, or wounded animals**
    - **1.5 to 2 x RER**
  - **Cells need extra energy in order to heal/generate**
- **Healthy young**
    - **4 x RER**
  - Extra energy for new tissue growth and proper development
- **Sick orphans**
    - 5 x RER
  - Supply sufficient energy for new tissue growth and for fighting infections or healing injuries

ENERGY REQUIREMENT

- **Calculate RER for a specific animal**
- **Multiplied by an appropriate factor to find DER**
  - **The result will present the daily amount of Kcals/day**
  - **Not the mls/day**
- **Each supplement will have a different amount of Kcals/ml**

ENERGY REQUIREMENT

- Squirrel weighing 70 g
  - convert weight to kilograms
    - 70g ÷1000g/kg = 0.07 kg
  - Calculate RER
    - $70\ (0.07)^{0.75} = 9.5$ Kcal
  - Calculate DER
    - 4 x 9.5 = 38 Kcal/day
  - Zoologic milk matrix = 33/40 + 30/55
    - 1.7 Kcal/ml
  - Calculate ml/day
    - 38 Kcal ÷ 1.7 Kcal/ml = 22.3 ml per day

ENERGY REQUIREMENT

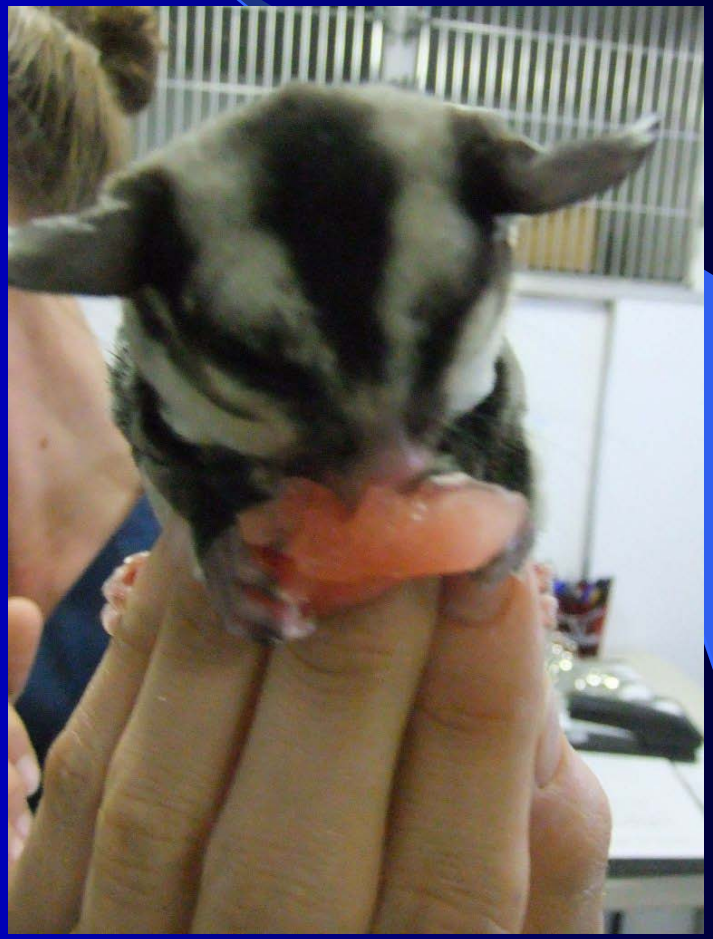
- Next consideration
  - Stomach capacity
    - Most mammals' stomach volume is 5% of the total body weight
    - Lagomorphs 10%
    - Most birds' stomach volume is 3 to 5% of body weight
- Squirrel
  - 70 g x 5% (stomach volume) = 3.5 ml per feeding
- 22.3 ml (per day) divide by 3.5 ml (per feeding) = about 6 feedings per day over 12 hours

ENERGY REQUIREMENT

- As the baby grows the DER decreases
  - **Healthy adult animal's DER should not be more then 2x RER**
- When reducing feeding and Kcal/day
  - Weigh babies on a daily basis
  - If losing weight
    - Put back to previous diet schedule and monitor closely for weight gain

NUTRITIONAL REQUIREMENT

- It is unrealistic to expect those equations to exactly calculate the specific energy of all species under all physiological conditions nor are they the only consideration in a sound diet plan



WATER

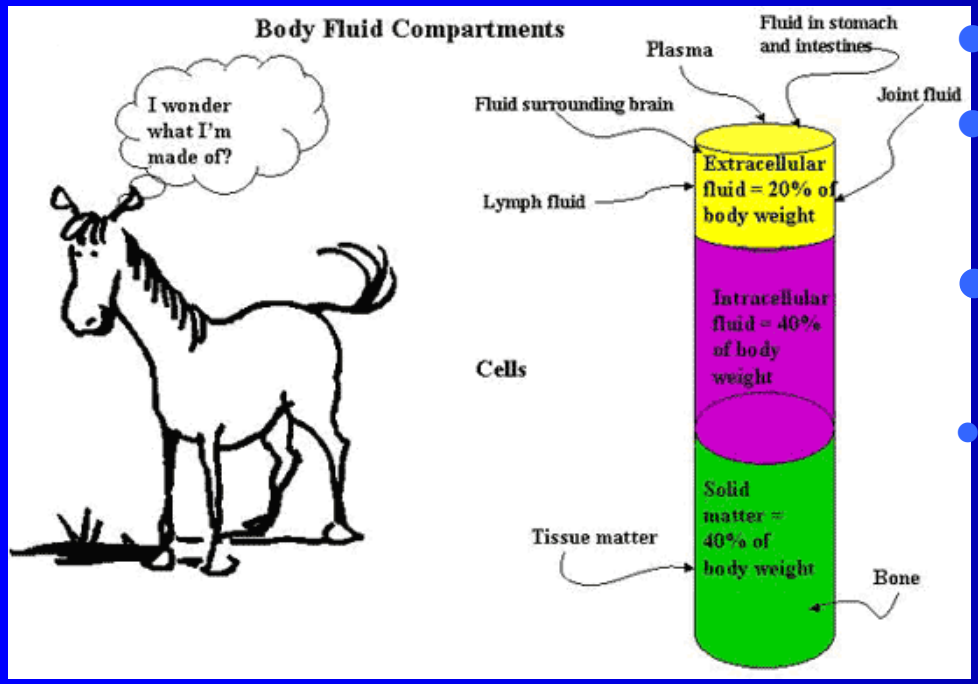
Life on earth is possible due to the presence of water

the most abundant component of the animal body in all stages of development

- **The first and most important element of a sound diet**

- **Medium for all chemical reactions in the body**
- **Transfers (blood = 80%)**
  - **oxygen to body tissues**
  - **carbon dioxide from the tissues**
- **Food carrier**
- **Aids in digestion and absorption**
- **Waste product removal**

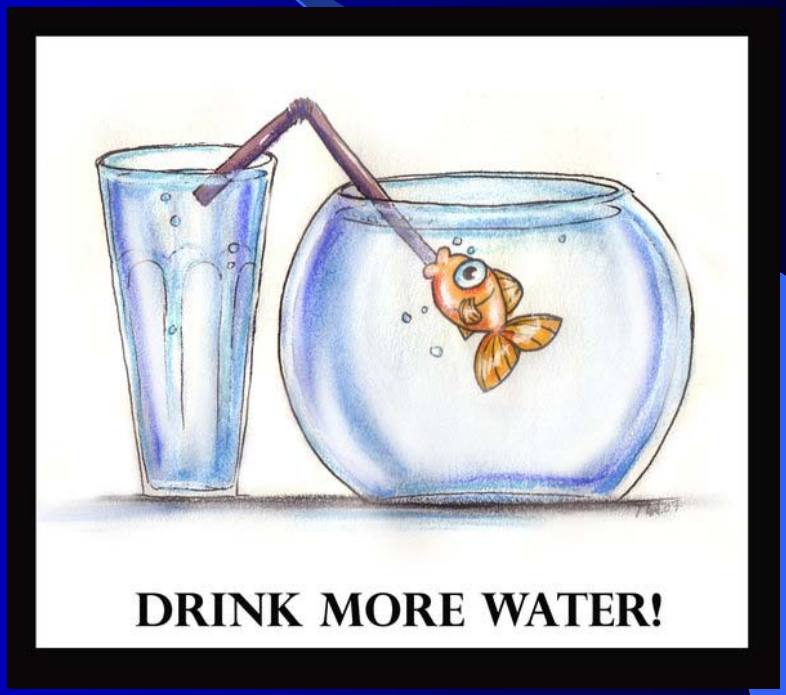
WATER



- Tissue building and repair
- Regulation of the body temperature
- Regulates pH of body fluids
- Animals may lose nearly all the fat and half the protein of the body and survive, but a loss of about one-tenth of the water from the body can be fatal
- Excess moisture in food can dilute the nutrients and energy in a diet

WATER

- Two water sources
  - Ingested water
    - Free drinking water
    - Water in food
      - Some food will contain more water then other
        - Fruits vs. Seeds
  - Metabolic water
    - Water created through metabolism
- Migratory birds rely solely on metabolic water production while making non-stop flights
  - Mostly from fat
- In mammals water production through metabolism of protein roughly equals the amount excreted



WATER

- **Check water dishes frequently – if it looks like you are not going to drink it – the animal will not drink it!**
- **Change and clean water and food dishes twice a day**

FLUIDS

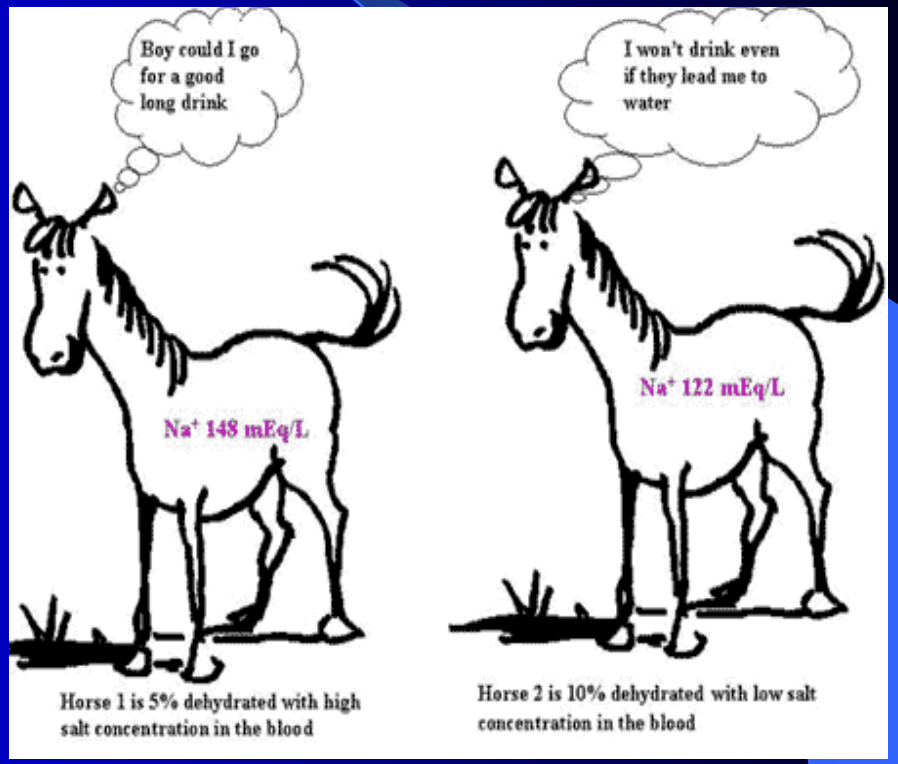
- **Most injured and orphaned animals will be in some state of dehydration and/or hypothermia**
  - **Must be corrected before feeding**
- **During the act of digesting food**
  - **fluid is pulled out from cells to aid in the process of digestion**
  - **If the animal is even mildly dehydrated**
    - **Feeding will worsen the problem**
  - **The processes of digestion and metabolism create heat**
    - **Hyperthermia**

FLUIDS

- **Always give fluids warmed**
  - **Fluid warmer**
  - **Heating pad**
- **Calculate % of dehydration (in decimal) x body weight in grams = amount of fluid replacement for next 48-72 hours**
- **Daily Maintenance**
  50ml/kg/day
  - **1-2% body weight per injection site**

FLUIDS

- 2 kg Pelican is estimated to be 10% dehydrated
- 0.10 x 2000 = 200mL
- 200mL / 48 hours
- Maintenance = 50 mL/kg/day
- 2 kg x 50 ml = 100mL
- 100mL / 24 hours
- First day
- 50% of deficit = 100ml
- 100% maintenance = 100ml to 200ml over first 24 hours
- Second and third day
- 25% of deficit = 50ml
- 100% of maintenance = 100ml to 125 ml/day
- 1 to 2% body weight per injection site

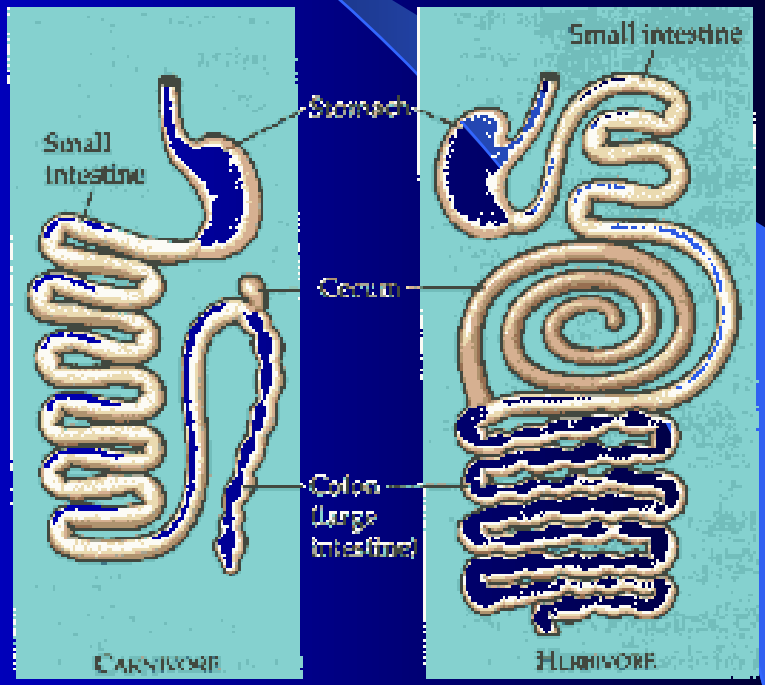


FLUIDS

- Fluids
- **Dehydration**
  - Mild
    - PO
  - Moderate
    - SQ
  - Severe
    - IV
      - Butterfly catheter
        - 25 G ½ " needle with 3.5" tube
        - Medial Metatarsal vein

LIPIDS

- **Diet high fat/ low carbs?**
  - **Deer**
    - **Eating grass**
  - **Eagle**
    - **Eating animals**
- **All animals diets are high in fat and low in carbohydrates**
  - **difference between herbivores and carnivores**
    - **Ability to change vegetable fiber into SCFA**
    - **Digested using fermentation by bacteria**

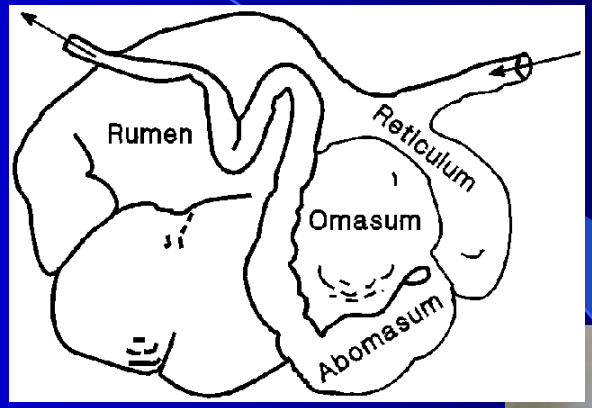


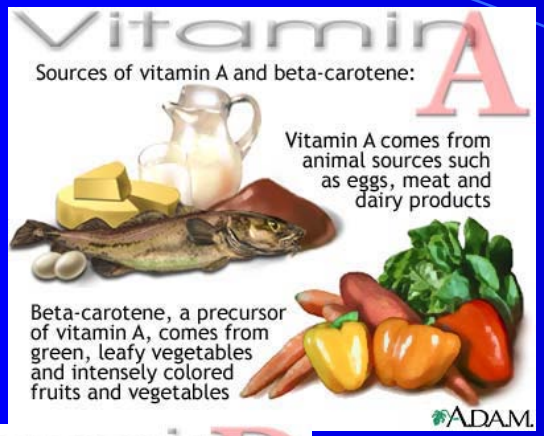
LIPIDS

- Hindgut digesters
  - Digest and absorb fat, proteins and carbohydrates
    - Through the stomach and small intestine
    - The undigested fiber passes to the cecum and colon
      - Vast amount of bacteria
    - Undigested carbohydrate is fermented
      - Produce SCFAs
        - Absorbed into the body
          - Used for energy

LIPIDS

- Foregut digesters
  - Ruminants
    - Subsist on fiber
  - Stomachs
    - Major organs of fermentation
  - Ferments fiber and available carbohydrates
    - Less carbohydrates to metabolize and absorb as glucose
    - SCFAs produce more than 70% of energy



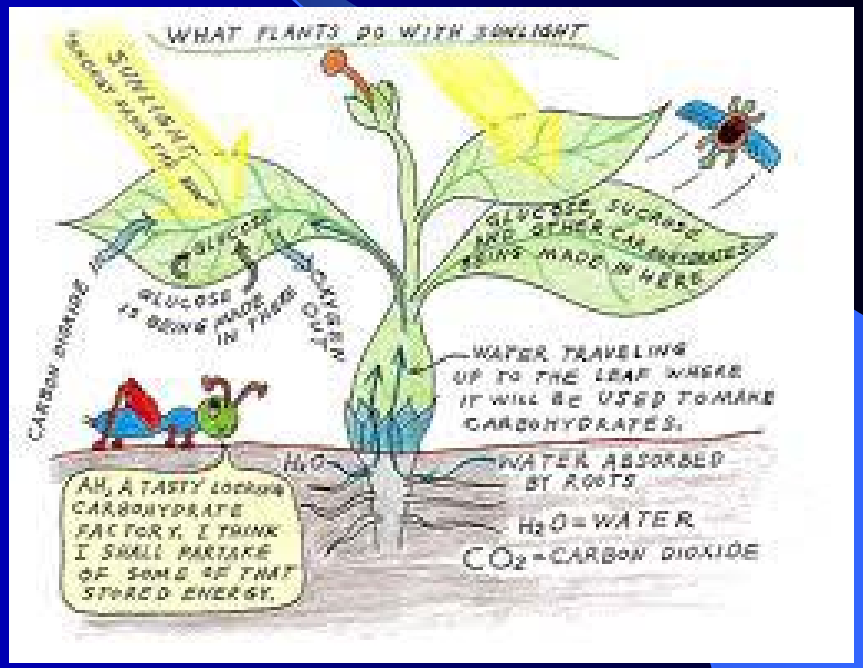


LIPIDS

- **Fat provides**
  - **2.25 more calories of energy per unit then metabolized protein**
    - **1gr of fat = 9 cal**
    - **1gr of protein/carb = 4 cal**
- **Allow for intestinal absorption of fat soluble vitamins**
  - **A - D - E - K**
- **Without fatty acids**
  - **Poor skin condition**
  - **Poor feather growth**
  - **Impaired growth in young**
  - **Accumulate fat in liver (fatty liver disease)**

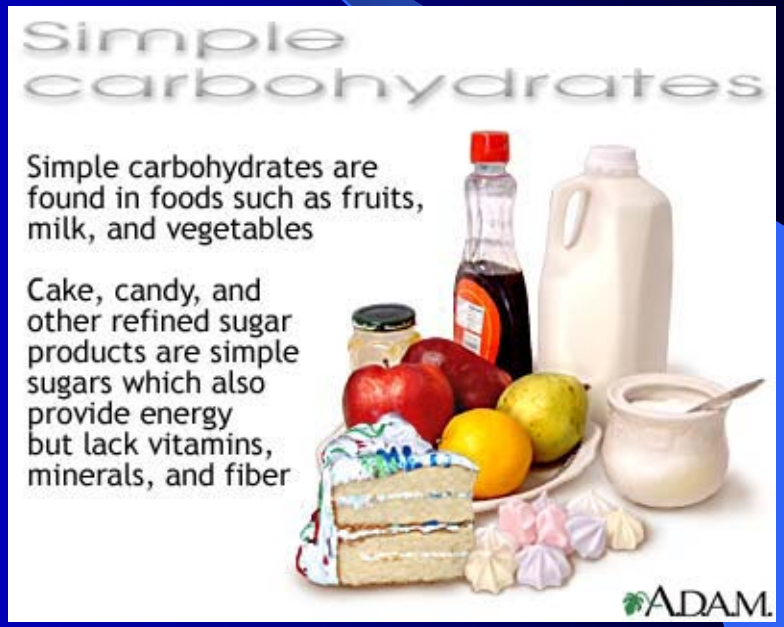
CARBOHYDRATES

- **Basic source of energy**
- **Carbohydrates take the form of sugar and starch**
- **Provides immediate fuel for physical performance**
  - **Carbohydrates are an excellent source of immediate energy boost**
- **The only source of energy for the brain**

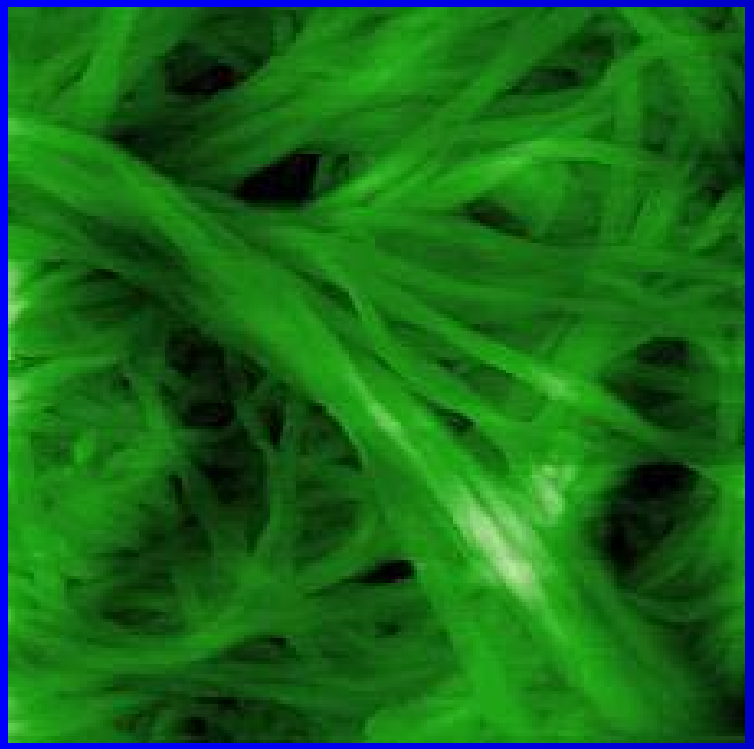


CARBOHYDRATES

- **Soluble carbohydrates**
  - **Simple sugars**
  - **Glucose**
    - **Simplest carbohydrate**
    - **Dose not need to be digested**
    - **Absorbed as is**
    - **Used instantly for energy without the need for any chemical changes on the way to the cell**
      - **Found in**
        - **Honey**
        - **Some fruits**
  - **Fructose**
    - **Found in honey, fruits and vegetables**

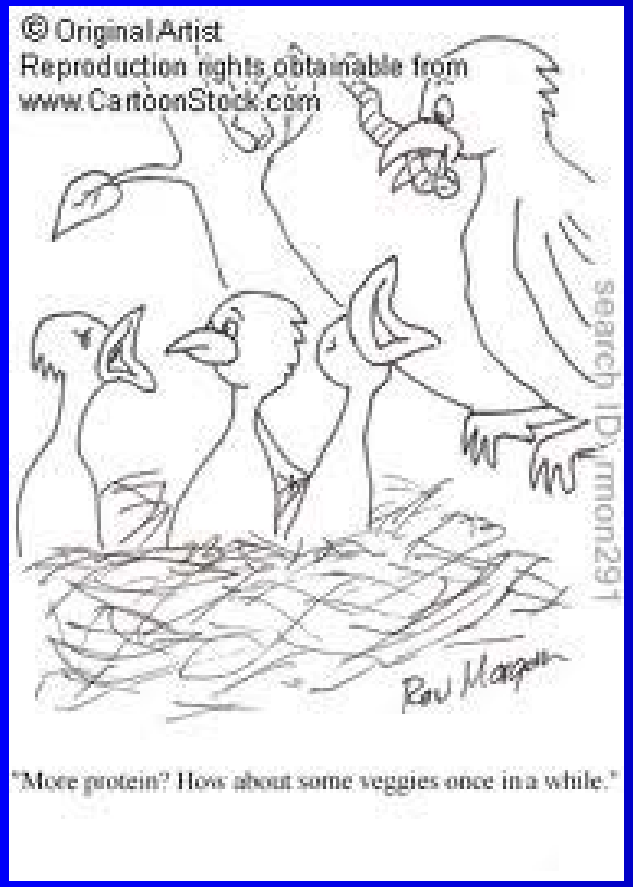


CARBOHYDRATES



- **Complex carbohydrates**
  - **Starch**
    - **Rice, beans, wheat, corn, potatoes**
  - **Glycogen**
    - **Used by animals to store energy**
      - **Liver and muscles**
  - Cellulose
    - Plant fiber

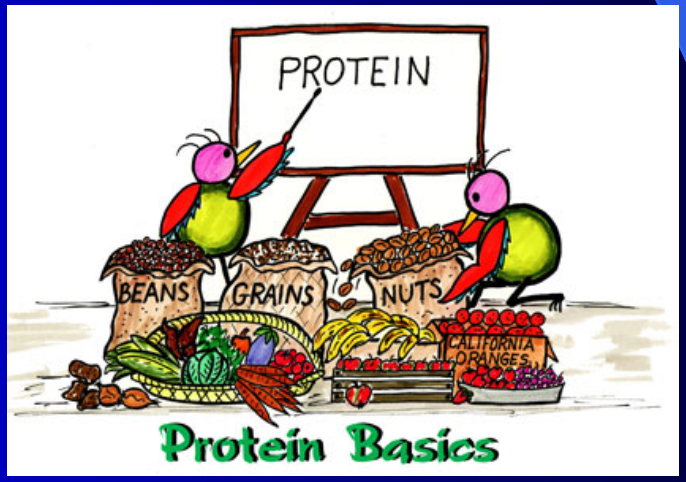
PROTEIN



- **Proteins are part of every cell, tissue, and organ in the body**
- **Play crucial role in all biological processes in the body**
- **Essential for growth, repair and maintaining healthy body tissues**
- **Muscle contraction, immune protection, transmission of nerve impulse**
- **Provides structural support to skin and bones**
- **Source of energy**

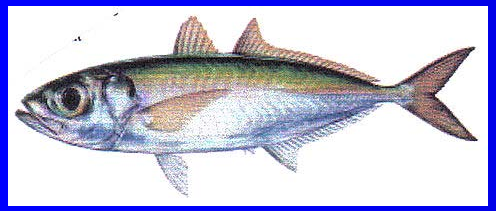
PROTEIN

- **Protein**
  - **Digested into amino acids**
  - **There are 22 different amino acid chains**
- **Some of these amino acids can not be made by the body**
  - **Known as essential amino acids**
    - **Must be provided in the diet**
- **Animal proteins contain a better balance of the essential amino acids than plant protein**
- **Dietary requirement for protein varies with age and physiological conditions**
  - **Young (altrecial >precocial)**
  - **Laying female**
  - **Molting**
  - **Geriatric**



PROTEIN

- Sources
  - Insects
  - Whole prey
  - Growing tips of leaves
  - Grains
  - Nuts
  - Seeds
  - Milk
    - Ideal proportions for greatest tissue synthesis
      - Species specific



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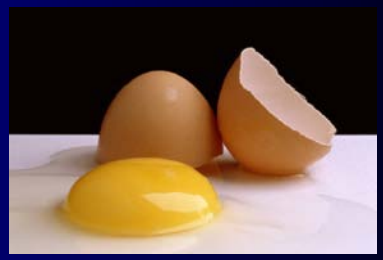
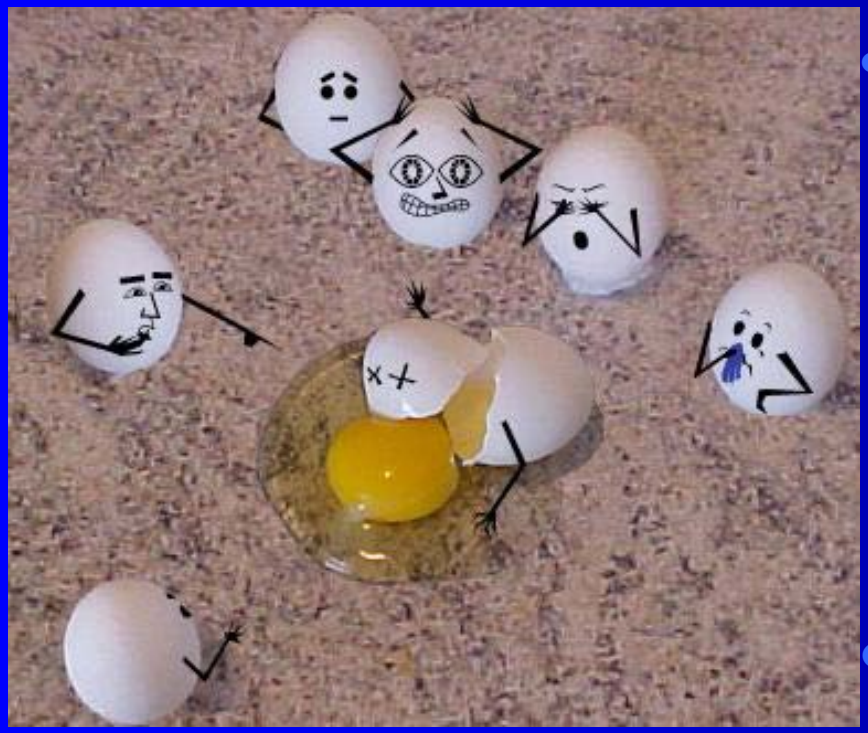


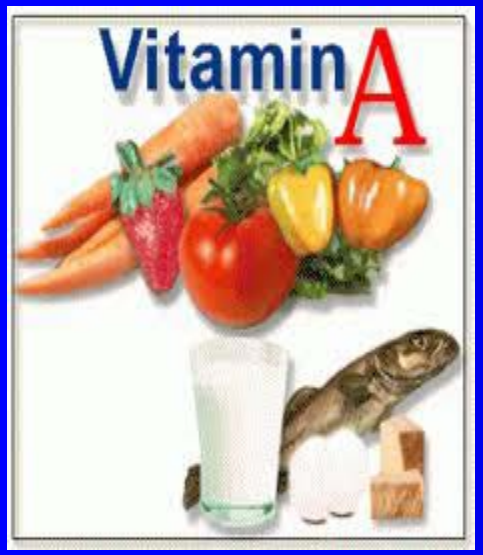


- Eggs
  - The perfect protein
- Raw egg white
  - Avidin
    - Renders biotin (B7) unavailable
      - Metabolism of fatty acids
  - Serpins
    - Inhibits trypcin action on protein
      - hydrolyses proteins
- Boiling the eggs
  - Destroys Avidin and trypcin inhibitor
    - Making protein available

MICRONUTRIENTS

- **Vitamins**
  - **Required in diet for proper body function**
- **Divided into 2 groups**
- **Fat soluble vitamins**
  - **A - animal origin**
  - **D**
  - **K**
  - **E**
    - **Stored in body fat and in the liver**
- **Water soluble vitamins**
  - **B complex**
  - **C**
    - **Are not stored in body**

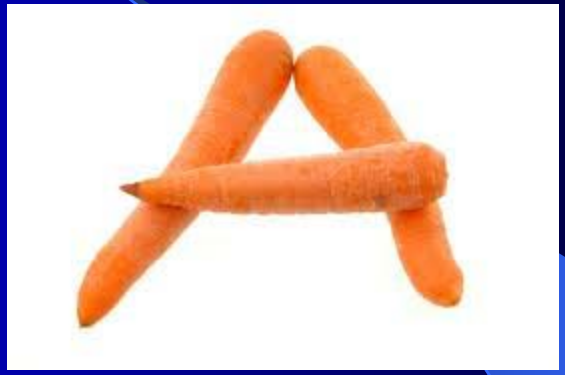
VITAMIN A



- **Vitamin A (beta carotene)**
  - **Vision, immunity, membrane integrity, growth, feathers, skin, resistance to infections (sinuses) and the maintenance of epithelial surfaces and linings of GI, respiratory & reproductive tracts**
- **Deficiencies/toxicity**
  - **Degeneration of eye structures**
  - **Prolonged deficiency will result in blindness**
  - **Loss of membrane integrity**
  - **Interfere with water retention**
  - **Poor feathering – unkempt appearance**
  - **Blunting of choanal papillae**
  - **Squamous cell metaplasia**
  - **Both deficiency and excess of dietary vitamin A suppress immune function**
- **Vitamin A levels are stored in liver tissue of animals**
  - **Carnivores usually do not suffer vitamin A deficiency**

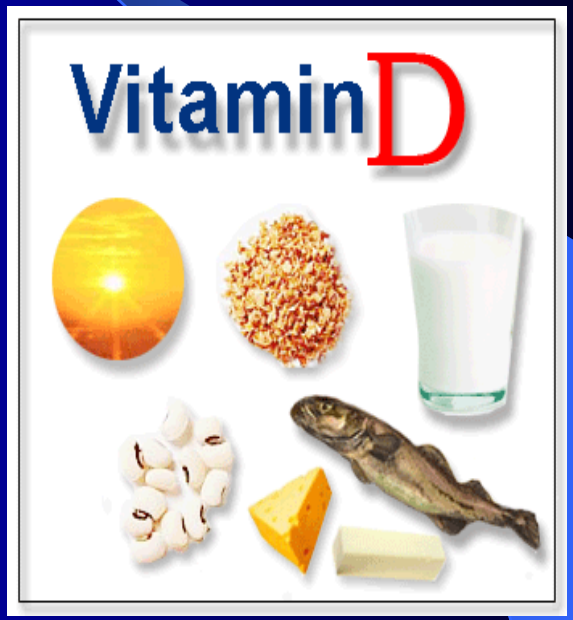
VITAMIN A

- Vitamin A levels in invertebrates are very low
- Fish store large amounts of vitamin A in their liver and fatty tissue
  - Cod liver oil, cooked liver
- Some fruits and vegetables can provide large quantities of vitamin A (carotenoids)
  - Orange fruits and vegetables
    - Apricots, cantaloupe, peaches, carrots, squash & sweet potatoes
  - Dark green leafy vegetables
  - Corn, squash, broccoli, and dandelion leaves
- Other sources
  - Egg yolk

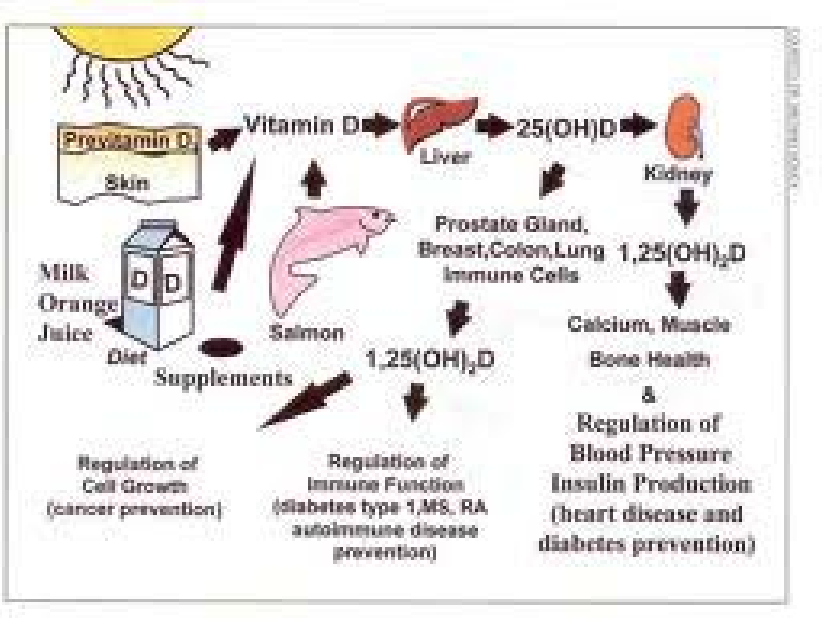


VITAMIN D

- **Vitamin D "sunlight vitamin"**
- **Calcium metabolism**
- **Normal mineralization of bone**
- **Bone growth and remodeling**
- **Prevention of MBD**
  - **Naturally presented in very few food items**
  - **Fish such as salmon, and tuna, fish liver oils**
- **Excess vitamin D retards bone growth and causes calcification of soft tissue**



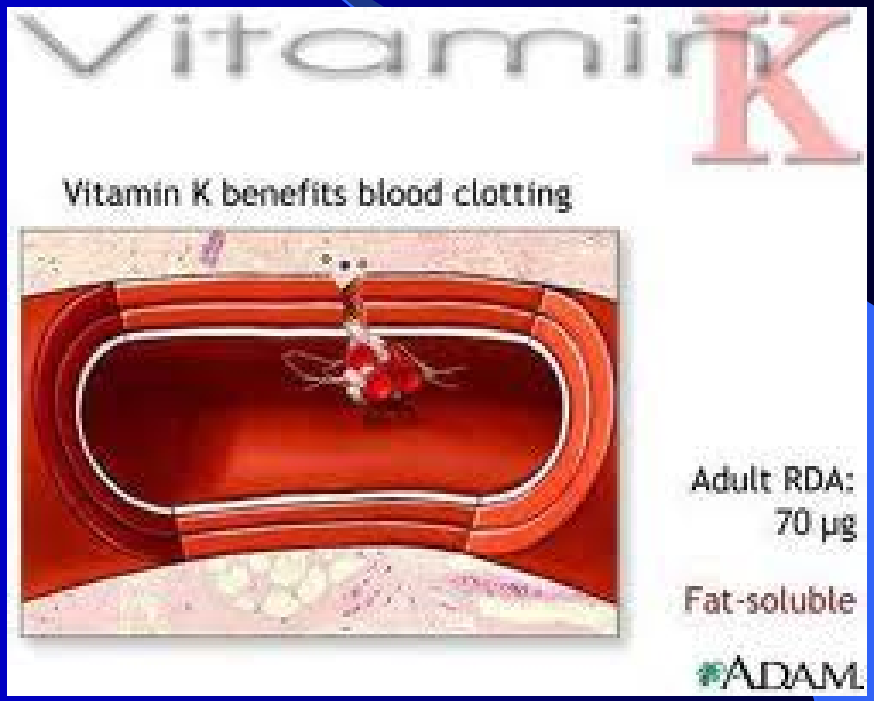
VITAMIN D



- **Deficiency**
  - **Dietary inadequacy**
    - **Increased requirement, or increased excretion**
  - **Prolonged indoor caging**
    - **Limited exposure to sunlight**
  - **Physiological impairments**
    - **Impaired absorption**
      - **Absorption of vitamin D from the digestive tract is inadequate**
    - **Kidneys cannot convert vitamin D to its active form**

VITAMIN K

- **Only known biological role is blood clotting**
- **Stops bleeding through clot formation**
- **Vital to proper liver function**
- **Body stores very little of it**
- **Stores are rapidly depleted without regular dietary intake**
- **Dietary source of vitamin K is generally green leafy vegetables**
  - **broccoli, peas, green beans**
- Hemophiliac animals
- **Rat poison**



VITAMIN E

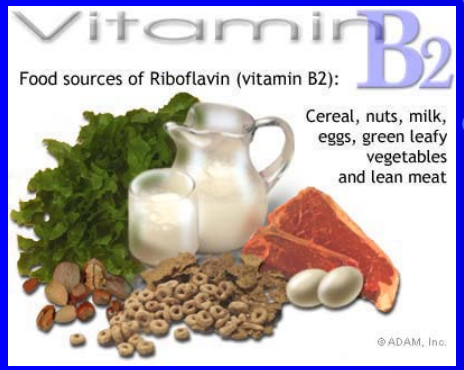
- Vitamin E is an antioxidant
- Prevents chemicals in the body from damaging cells
- Animals with a Vitamin E deficiency
  - Lack energy
  - Nervous system disorders (ataxia)
  - Vascular, and muscular disorders
  - Discoloration of body fat (orange or brownish yellow)
- Found in leafy green vegetables, walnuts, almonds, sunflower seeds, corn, vegetable oils
- Not very stable in storage
  - Fish diet in captivity

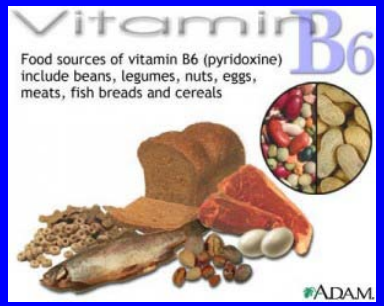
Need to be careful do not get deficiency

VITAMIN C

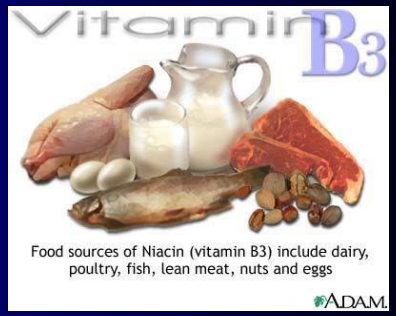
- **Water soluble**
  - **Not stored in the body**
- **A cofactor in development and repair of all body tissues**
  - **Important in wound-healing**
  - **Preventing bleeding from capillaries**
- **Can only be obtained from plant food sources**
  - **Orange, papaya, guava, ripe tomato, mango, strawberries, cantaloupe, watermelon, pears, kiwi, bananas**
  - **Dark leafy greens, green and red peppers, snow peas, broccoli, sweet potatoes**

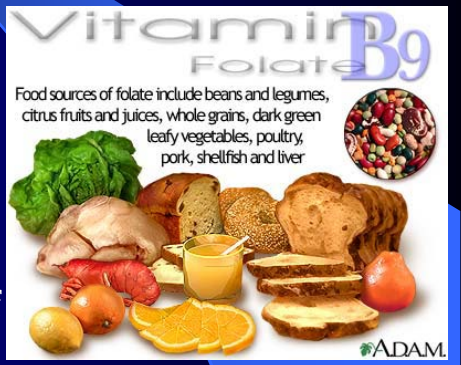
B COMPLEX

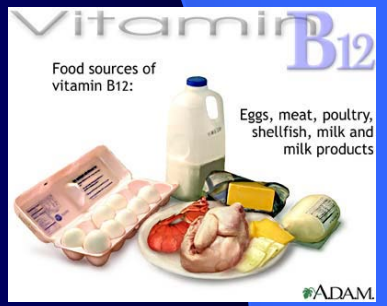




- B complex consists of eight water soluble vitamins
- Enhances metabolism of carbohydrates and proteins for available energy
- Boosts immune and nervous system
- Aids in cell growth, division and maintenance
- Important during breeding, molting, and rehabilitation process
  - Brewer's yeast is one of the best sources of the B vitamins
  - Whole, unrefined grains (such as cracked and whole wheat, brown rice, rye, and wheat germ), leafy vegetables, peanuts (B1), raisins, oranges (B1, B9)), almonds, pecans, broccoli (B2), sunflower seeds, peanut butter (B3, B7), bananas (B7, B9)
- Excesses are passed out in urine



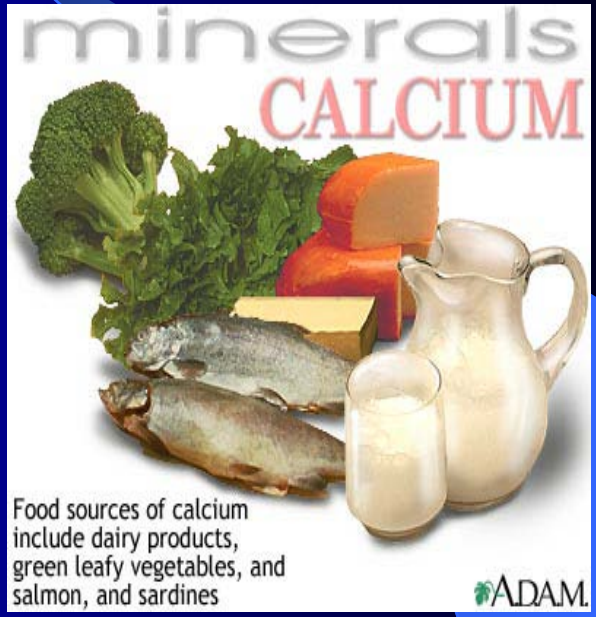




MINERALS

- **Macro minerals**
  - Sodium, potassium, chloride, calcium, magnesium, phosphorus, and sulfur
- **Calcium**
  - **Development of bones and muscles**
  - **Normal contractions of muscles**
    - **Heart**
  - **Blood coagulation**
  - **Egg formation (85% calcium)**
- **Calcium, phosphorus and vitamin D all connected**
  - **Poor calcium absorption is due to high phosphorus levels**

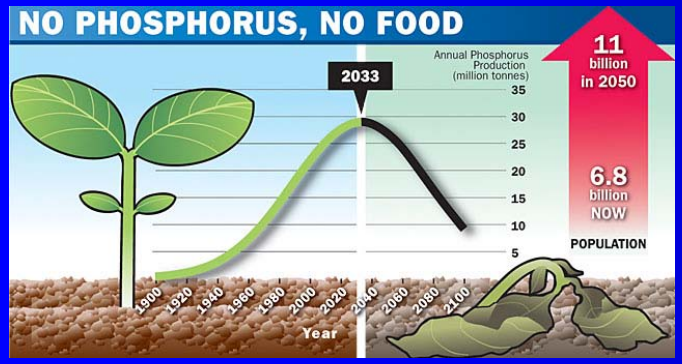
Calcium and Phosphorus must be balanced in diet (2:1)



CALCIUM

- **Mealworms are deficient in calcium and high in phosphorus**
  - **Raise and store in a nutritional media**
    - **Bran, wheat germ, mixed grain baby cereal, bone meal powder, vitamins**
    - **Feed mealworms every day**
    - **Thin slices of apple, carrots, greens**
- **What you feed your mealworms is the nutrition you are providing to the animal in your care**

PHOSPHORUS



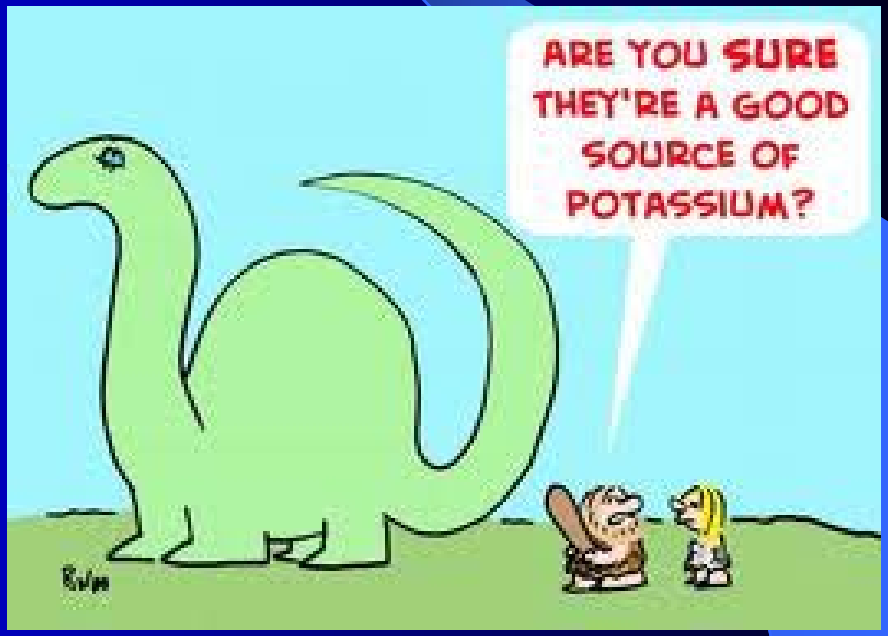
- Growth
- Maintenance of healthy system
- Repair of bone tissues
- Maintaining structure and function of bones
- Aids in conversion of protein, fats, and carbohydrates into energy

- Found in peanut butter, almonds, broccoli, lima beans, and animal food items
- Check all food for proper Ca/P ratio

POTASSIUM

- Regulates body fluids
- Function of nervous system
- Maintain normal contraction of muscles
- Aids in carbohydrate metabolism

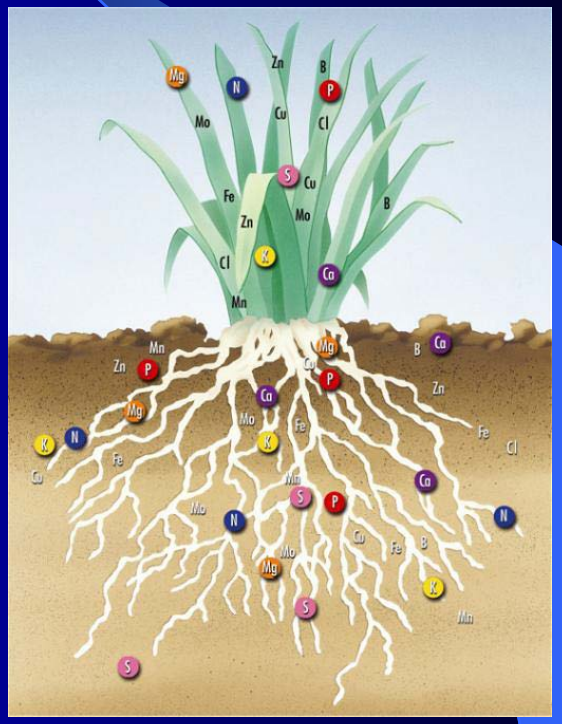
- **Found in bananas, apricots, oranges, cantaloupe, squashes, peanuts, and a variety of vegetables**



MICRO MINERALS

Trace minerals

- **Copper is a part of several proteins and enzymes**
  - **Required for blood, bone, tissue and skin construction**
- **Cobalt needed in very small amounts but very important**
  - **Building block for Vitamin B 12**
- **Iodine**
  - **Healthy thyroid function**
- **Zinc and Magnesium**
  - **Protein synthesis**
- **Selenium**
  - **Disease prevention, boosting of immune system**



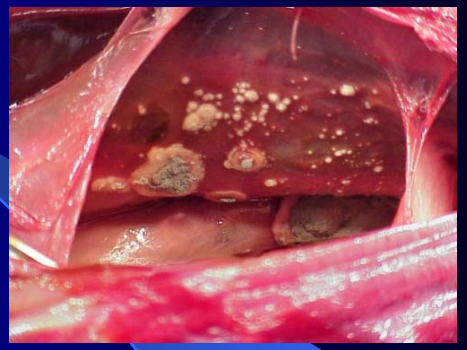
- The terms macro and micro do not reflect the significance of a mineral in maintaining health
  - deficiency of either can be as harmful

OTHER CONSIDERATIONS

- **Many factors of the animal's physical and physiological condition play an important role in the animal's systems and in their ability to use the nutrients you are providing**

MALNUTRITION

- Malnutrition
  - Inadequate intake of nutrients
- Animals can eat large amount of food
  - Unable to digest, absorb and/or convert food into energy
    - Parasites
    - Disease
      - Aspergillosis
      - Lead poisoning
    - Foreign body in GI
    - Food is insufficient in nutrients
      - Captivity (improper diet)
    - Stress
- A patient that consumes a sufficient amount of food
  - Not gaining weight
  - Loosing weight
    - Further investigation into cause is necessary



STRESS

- Energy demands increase
  - Fight/flight
    - Quickly depletes lean body mass protein stores

OTHER CONSIDERATIONS

- **Preparation of food**
- **Clean bowls every time you feed/water**
- **Wash fruits and vegetables before cutting**
  - **Bacteria can be found on the surface of fruits and vegetable**
  - **Once cut bacteria can multiply and spread to all food items in animal's dish**
- **Cut fruits and vegetables into appropriate size pieces**
- **Never add vitamin supplements to a commercially made formula**

OTHER CONSIDERATIONS

- **Presentation of food**
  - Important to learn the natural history and behavior of native species
  - Animals have diverse foraging techniques
    - Need to present food to mimic natural feeding behavior
- **Feeding smaller portions 3 to 4 times a day**
  - Promotes healthy appetite
  - Mimics natural behavior
  - Promotes psychological well being

OTHER CONSIDERATIONS

- Do not forget the greens!!!
  - Many of the vitamins required by animals come directly from leafy green plants
  - The meats from animals that ate the leafy, green plants
  - Fatty acids are manufactured by leafy green plants
    - Adds to presentation of diets
      - Chop on top of food

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