

# The Nutrients

Equine Nutrition #4

Created for Canadian Pony Club  
Education

By Lezah Williamson

# Nutrients

- Water
- Carbohydrates
- Protein
- Fats/oils
- Vitamins
- Minerals

Nutrients are necessary for repair of body, development, energy for work



# Food is composed of water and dry matter

- Water
- Dry matter:
  - Minerals
  - Vitamins
  - Protein
  - Lipids (fats)
  - Carbohydrates
    - Structural
    - Non-structural

# Energy

- Energy is not a nutrient
- Energy= calories
  - We measure horse calories in megajoules (MJ)
  - 1 MJ = 239 calories
- The horse gets energy from the content of its food
  - Primarily carbohydrates and lipids

# Groups of feeds by function

- **Nitrogenous**
  - **Proteins, fats, carbohydrates**
    - Build body tissue
    - Supply energy
- **Minerals**
  - Aid in building body tissue
- **Vitamins**
  - Allows body to utilize nutrients
- **Fibre**
  - Helps system utilize nutrients
  - Synthesis of B vitamins

# Water



# Water

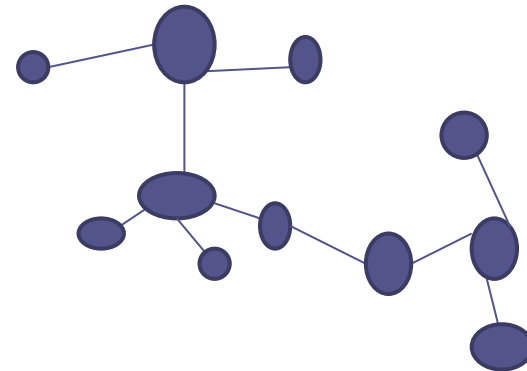
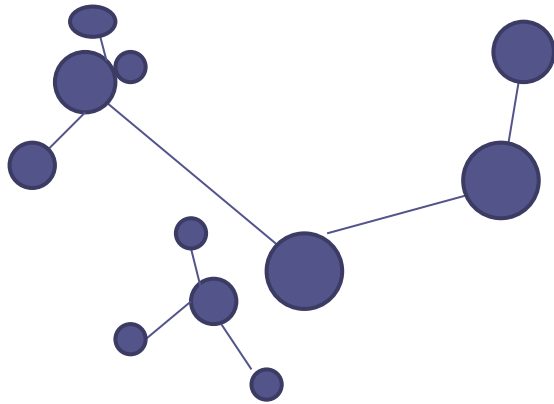
- Essential component
  - 80% of foal's body
  - 60-75% of a mature horse's body
- Necessary for:
  - Thermoregulation
  - Metabolism
  - Transportation of nutrients
  - Excretion
  - Digestion



# Factors affecting amount of water needed in diet

- Water should be available at all times
- Rate of consumption will vary, depending on:
  - Age of horse
  - Status of horse
    - lactating mares have a higher water requirement
  - Intensity level of exercise
  - Temperature/humidity
    - An idle horse will drink 28 L/day
    - In hot weather a horse may drink 80 L/day
    - Exercise will further increase this requirement
  - Type of feeds in diet
    - The more fibre in the diet, the more the horse will drink
    - Some feedstuffs have a high moisture content
    - Salt will increase thirst

# Amino Acids and Proteins



# Proteins

- Structural
  - Used for building and repairing muscle; skin; hair
- Produce enzymes
- Catalysts affect rates of reactions
- Hormones
- Transport compounds and nutrients around body

# Amino Acids

- Amino Acids are the building blocks of protein
- Essential Amino Acids
  - Need to be supplied in the diet
  - About 50% of amino acids are essential amino acids
- Non-essential Amino Acids
  - Synthesized in the body
  - Don't need to be supplied in the diet
- Lysine is the first limiting Amino Acid
  - Protein quality will be an indicator of how much Lysine is present
    - Methionine is another very important amino acid

# Protein breakdown

- Protein breakdown starts in the stomach
- Protein digestion and absorption occurs in the small intestine
- No/very little absorption happens in the large intestine
- Proteins associated with the plant cell wall are broken down in the large intestine
  - This supports microbial growth

# More on protein

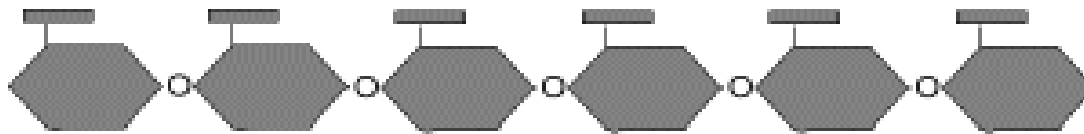
- Protein requirements increase as the workload increases
- Too much protein can be dangerous
  - Can cause body and mental stress (bad behaviour)
  - Overworks the kidneys

Lack of protein can have debilitating effects:

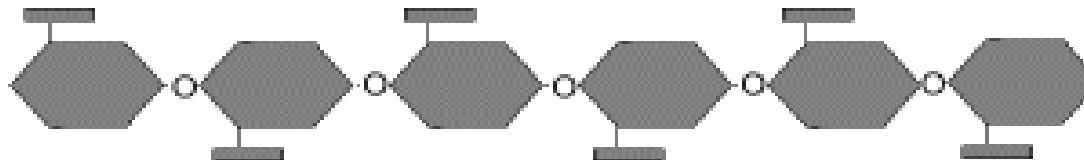
- poor growth
- poor performance
- lack of appetite
- poor condition

# Carbohydrates

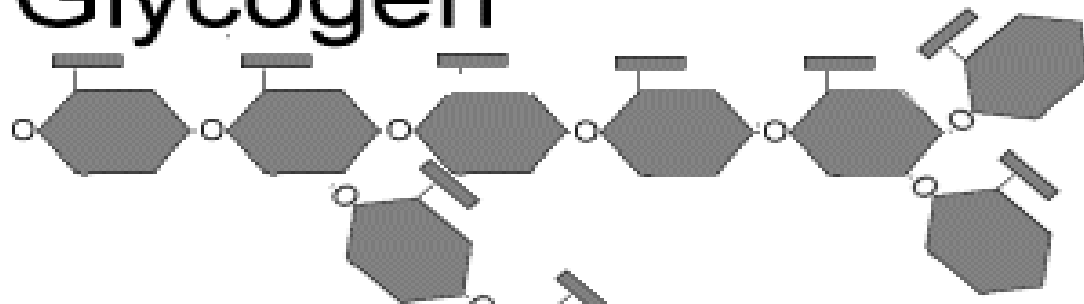
## Starch



## Cellulose



## Glycogen

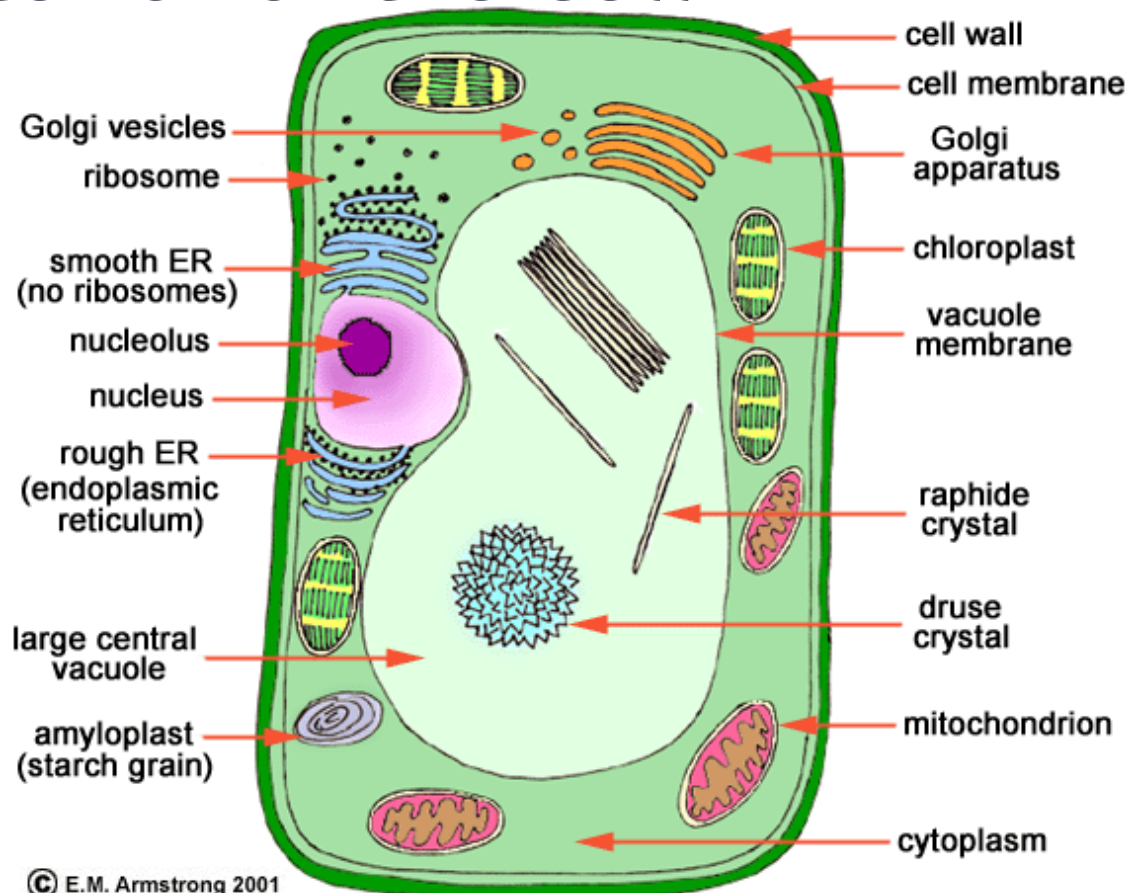


# Carbohydrates

- Collective term for starches, sugars, dietary fibre
- Primary energy source
- 2 main types:
  - **Structural**
    - Associated with plant cell wall (dietary fibre)
  - **Non-structural**
    - Associated with plant cell content
    - Simple sugars, starches and fructan



# Structural carbohydrates -cell wall; non-structural carbohydrates - from the interior of the cell





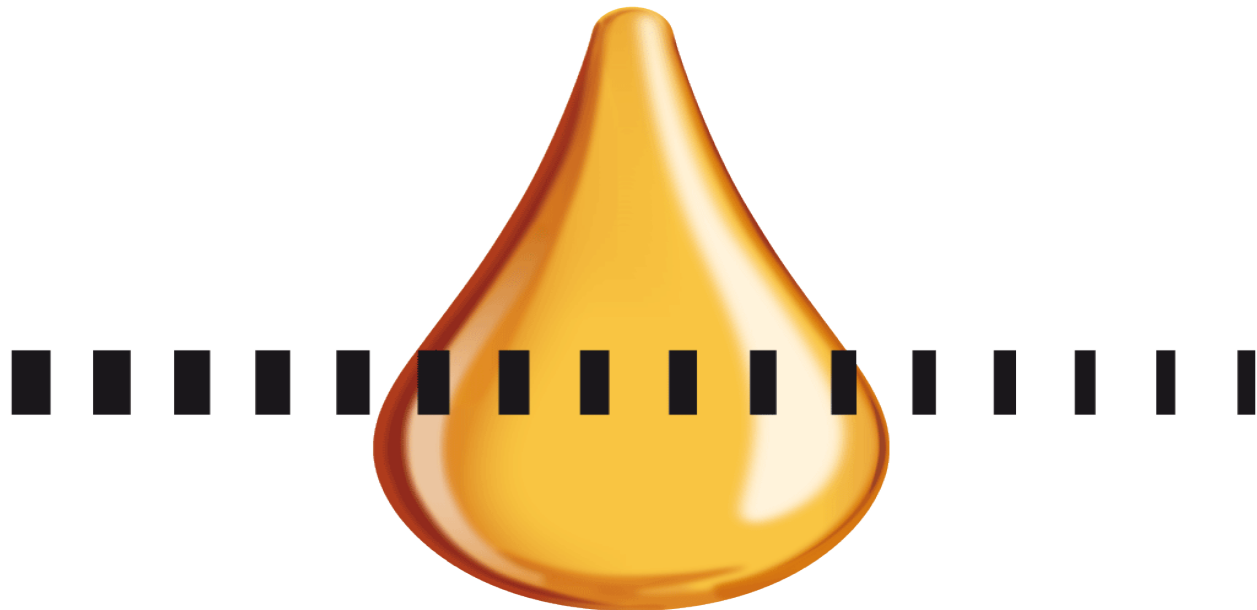
# Carbohydrate digestion

- Carbohydrates are degraded by microbes present in the GI tract
- Not digested in the small intestine
  - no enzymes present to break down these components
- Microbial population breaks down carbohydrates to produce volatile fatty acids:
  - Acetic Acid
  - Butyric Acid
  - Propanoic Acid

# Carbohydrates

- Other functions of carbohydrates include fuelling growth and body development, and warmth
- Excess carbohydrates can be stored in the form of fat
- Sources of carbohydrates include:
  - Grains (starch)
  - Grasses and hays (cellulose)
  - Molasses (sugar)

# Oils and Fats



**oils + fats**

# Fats and Oils

- Necessary for:
  - healthy skin
  - to improve appearance
  - for heat/warmth
- Provide 2 times (2X) the energy of carbohydrates
- Easily digestible
  - Well tolerated in the diet
- Large amounts can disrupt flora in the hindgut
  - Coats fibre, reducing access to fibre for microbes
- Feed in limited amounts
- Introduce to the diet gradually

## Fats and Oils (continued)

- Oil is fat in a liquid form
- Fats and oils provide a concentrated source of slow-acting energy
- Fats and oils have a protein sparing action
- Corn oil is the most commonly fed oil to put weight on
- Cod liver oil can be fed for vitamin value in winter
- Fats and oils can go rancid in hot weather

# Minerals

Periodic Table of the Elements

|   |  |  |  |  |   |   |  |  |   |  |  |   |   |   |   |   |  |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
|---|--|--|--|--|---|---|--|--|---|--|--|---|---|---|---|---|--|------------------------------------|--|--|--|--|--|--|------------------|------------------|----------------|-----------------|------------------|-------------------------------------|--|--|--|--|--|--|--|--|
| 1<br>1IA<br>11A                         |  |  |  |  |   |   |  |  |   |  |  |   |   |   |   |   |  |                                    |  |  |  |  |  |  |                  | 18<br>VIII<br>8A |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 1<br><b>H</b><br>Hydrogen<br>1.0079     | 2<br>IIA<br>2A                         |  |  |  |   |   |  |  |   |  |  |   |   |   |   |   |  |                                    |  |  |  |  |  |  | 13<br>IIIA<br>3A | 14<br>IVA<br>4A  | 15<br>VA<br>5A | 16<br>VIA<br>6A | 17<br>VIIA<br>7A | 2<br><b>He</b><br>Helium<br>4.00260 |  |  |  |  |  |  |  |  |
| 3<br><b>Li</b><br>Lithium<br>6.941      | 4<br><b>Be</b><br>Beryllium<br>9.01218 |  |  |  |   |   |  |  |   |  |  |   | 5<br><b>B</b><br>Boron<br>10.811          | 6<br><b>C</b><br>Carbon<br>12.011           | 7<br><b>N</b><br>Nitrogen<br>14.00574     | 8<br><b>O</b><br>Oxygen<br>15.9994          | 9<br><b>F</b><br>Fluorine<br>18.998403     | 10<br><b>Ne</b><br>Neon<br>20.1797 |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 11<br><b>Na</b><br>Sodium<br>22.989768  | 12<br><b>Mg</b><br>Magnesium<br>24.305 | 3<br>IIIB<br>3B                          | 4<br>IVB<br>4B                             | 5<br>VB<br>5B                                | 6<br>VIB<br>6B                          | 7<br>VIIB<br>7B                           | 8<br>VIII<br>8                           | 9<br>VIII<br>8                           | 10<br>VIII<br>8                           | 11<br>IB<br>1B                           | 12<br>IIB<br>2B                            | 13<br><b>Al</b><br>Aluminum<br>26.981539  | 14<br><b>Si</b><br>Silicon<br>28.0855     | 15<br><b>P</b><br>Phosphorus<br>30.973762   | 16<br><b>S</b><br>Sulfur<br>32.066        | 17<br><b>Cl</b><br>Chlorine<br>35.4527      | 18<br><b>Ar</b><br>Argon<br>39.948         |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 19<br><b>K</b><br>Potassium<br>39.0983  | 20<br><b>Ca</b><br>Calcium<br>40.078   | 21<br><b>Sc</b><br>Scandium<br>44.95591  | 22<br><b>Ti</b><br>Titanium<br>47.88       | 23<br><b>V</b><br>Vanadium<br>50.9415        | 24<br><b>Cr</b><br>Chromium<br>51.9961  | 25<br><b>Mn</b><br>Manganese<br>54.938    | 26<br><b>Fe</b><br>Iron<br>55.847        | 27<br><b>Co</b><br>Cobalt<br>58.9332     | 28<br><b>Ni</b><br>Nickel<br>58.6934      | 29<br><b>Cu</b><br>Copper<br>63.546      | 30<br><b>Zn</b><br>Zinc<br>65.39           | 31<br><b>Ga</b><br>Gallium<br>69.732      | 32<br><b>Ge</b><br>Germanium<br>72.64     | 33<br><b>As</b><br>Arsenic<br>74.92159      | 34<br><b>Se</b><br>Selenium<br>78.96      | 35<br><b>Br</b><br>Bromine<br>79.904        | 36<br><b>Kr</b><br>Krypton<br>83.80        |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 37<br><b>Rb</b><br>Rubidium<br>85.4678  | 38<br><b>Sr</b><br>Strontium<br>87.62  | 39<br><b>Y</b><br>Yttrium<br>88.90585    | 40<br><b>Zr</b><br>Zirconium<br>91.224     | 41<br><b>Nb</b><br>Niobium<br>92.90638       | 42<br><b>Mo</b><br>Molybdenum<br>95.94  | 43<br><b>Tc</b><br>Technetium<br>98.9072  | 44<br><b>Ru</b><br>Ruthenium<br>101.07   | 45<br><b>Rh</b><br>Rhodium<br>102.9055   | 46<br><b>Pd</b><br>Palladium<br>106.42    | 47<br><b>Ag</b><br>Silver<br>107.8682    | 48<br><b>Cd</b><br>Cadmium<br>112.411      | 49<br><b>In</b><br>Indium<br>114.818      | 50<br><b>Sn</b><br>Tin<br>118.71          | 51<br><b>Sb</b><br>Antimony<br>121.760      | 52<br><b>Te</b><br>Tellurium<br>127.6     | 53<br><b>I</b><br>Iodine<br>126.90447       | 54<br><b>Xe</b><br>Xenon<br>131.29         |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 55<br><b>Cs</b><br>Cesium<br>132.90543  | 56<br><b>Ba</b><br>Barium<br>137.327   | 57-71                                    | 72<br><b>Hf</b><br>Hafnium<br>178.49       | 73<br><b>Ta</b><br>Tantalum<br>180.9479      | 74<br><b>W</b><br>Tungsten<br>183.85    | 75<br><b>Re</b><br>Rhenium<br>186.207     | 76<br><b>Os</b><br>Osmium<br>190.23      | 77<br><b>Ir</b><br>Iridium<br>192.22     | 78<br><b>Pt</b><br>Platinum<br>195.08     | 79<br><b>Au</b><br>Gold<br>196.9665      | 80<br><b>Hg</b><br>Mercury<br>200.59       | 81<br><b>Tl</b><br>Thallium<br>204.3833   | 82<br><b>Pb</b><br>Lead<br>207.2          | 83<br><b>Bi</b><br>Bismuth<br>208.98037     | 84<br><b>Po</b><br>Polonium<br>[208.9824] | 85<br><b>At</b><br>Astatine<br>209.9871     | 86<br><b>Rn</b><br>Radon<br>222.0176       |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| 87<br><b>Fr</b><br>Francium<br>223.0197 | 88<br><b>Ra</b><br>Radium<br>226.0254  | 89-103                                   | 104<br><b>Rf</b><br>Rutherfordium<br>[261] | 105<br><b>Db</b><br>Dubnium<br>[262]         | 106<br><b>Sg</b><br>Seaborgium<br>[266] | 107<br><b>Bh</b><br>Bohrium<br>[264]      | 108<br><b>Hs</b><br>Hassium<br>[269]     | 109<br><b>Mt</b><br>Meitnerium<br>[268]  | 110<br><b>Ds</b><br>Darmstadtium<br>[269] | 111<br><b>Rg</b><br>Roentgenium<br>[272] | 112<br><b>Cn</b><br>Copernicium<br>[277]   | 113<br><b>Uut</b><br>Ununtrium<br>unknown | 114<br><b>Uuq</b><br>Ununquadium<br>[289] | 115<br><b>Uup</b><br>Ununpentium<br>unknown | 116<br><b>Uuh</b><br>Ununhexium<br>[288]  | 117<br><b>Uus</b><br>Ununseptium<br>unknown | 118<br><b>Uuo</b><br>Ununoctium<br>unknown |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| Lanthanide Series                       |  | 57<br><b>La</b><br>Lanthanum<br>138.9055 | 58<br><b>Ce</b><br>Cerium<br>140.115       | 59<br><b>Pr</b><br>Praseodymium<br>140.90765 | 60<br><b>Nd</b><br>Neodymium<br>144.24  | 61<br><b>Pm</b><br>Promethium<br>144.9127 | 62<br><b>Sm</b><br>Samarium<br>150.36    | 63<br><b>Eu</b><br>Europium<br>151.9655  | 64<br><b>Gd</b><br>Gadolinium<br>157.25   | 65<br><b>Tb</b><br>Terbium<br>158.92534  | 66<br><b>Dy</b><br>Dysprosium<br>162.50    | 67<br><b>Ho</b><br>Holmium<br>164.93032   | 68<br><b>Er</b><br>Erbium<br>167.26       | 69<br><b>Tm</b><br>Thulium<br>168.93421     | 70<br><b>Yb</b><br>Ytterbium<br>173.04    | 71<br><b>Lu</b><br>Lutetium<br>174.967      |  |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| Actinide Series                         |  | 89<br><b>Ac</b><br>Actinium<br>227.0278  | 90<br><b>Th</b><br>Thorium<br>232.0381     | 91<br><b>Pa</b><br>Protactinium<br>231.03688 | 92<br><b>U</b><br>Uranium<br>238.0289   | 93<br><b>Np</b><br>Neptunium<br>237.0482  | 94<br><b>Pu</b><br>Plutonium<br>244.0642 | 95<br><b>Am</b><br>Americium<br>243.0614 | 96<br><b>Cm</b><br>Curium<br>247.0703     | 97<br><b>Bk</b><br>Berkelium<br>247.0703 | 98<br><b>Cf</b><br>Californium<br>251.0798 | 99<br><b>Es</b><br>Einsteinium<br>[254]   | 100<br><b>Fm</b><br>Fermium<br>257.0951   | 101<br><b>Md</b><br>Mendelevium<br>258.1    | 102<br><b>No</b><br>Nobelium<br>259.1009  | 103<br><b>Lr</b><br>Lawrencium<br>[262]     |  |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |
| Alkali Metal                            | Alkaline Earth                         | Transition Metal                         | Basic Metal                                | Semimetals                                   | Nonmetals                               | Halogens                                  | Noble Gas                                | Lanthanides                              | Actinides                                 |  |  |   |   |   |   |   |  |                                    |  |  |  |  |  |  |                  |                  |                |                 |                  |                                     |  |  |  |  |  |  |  |  |



# Minerals

- Inorganic nutrients
  - Not carbon based
- Essential to life
  - Required for growth
    - Primary component in formation and upkeep of skeletal system
  - Cofactors of enzymes
  - Transport energy
  - Present in the fluid content of cells
  - Important for the function of the nervous system
  - Important in blood formation
- Comprise 7% of body weight
  - Referred to as 'ash content'
- Most minerals are absorbed in the small intestine

# Minerals can be divided into 2 types

## Macro-minerals

- Need larger amounts: grams/day
- Examples are:
  - Calcium
  - Phosphorous
  - Sulphur
  - Potassium
  - Magnesium
  - Chlorine
  - Sodium

## Micro-minerals

- Need small amounts: mg/day
- Examples are:
  - Copper
  - Cobalt
  - Zinc
  - Iron
  - Selenium
  - Chromium

# Mineral combinations

- Calcium:Phosphorous ratio
  - Combines with Vitamin D for bone development and maintenance
  - Present in the horse's body at 2:1
  - Feed the growing horse at 2:1
  - Feed the mature horse at 1.1-1.5:1
  - If physical or reproductive demands increase, the need for both of these can double
- Sodium and Chlorine combine to make common salt (*sodium chloride*)
  - Along with potassium, these three are referred to as 'tissue salts' (***electrolytes***)
  - Salt is extremely important to promote thirst, in the process of thermoregulation and for maintaining osmotic pressure
  - Large amounts of salt are lost through sweating and must be replaced
  - Other minerals can commonly be combined with salt:
    - Cobalt
    - Selenium
    - Iodine
    - Potassium (KCl – light salt)

# Vitamins



# Vitamins

- Vitamins are organic compounds
- They are needed in only small amounts
- They are essential to life
  - Needed for normal bodily functions
  - Essential to the body's well-being

# Vitamins: two types

## Water soluble

- These can be dissolved in water
- Excess excreted daily
- Deficiencies can occur
  - Vitamin B complex
    - Synthesized in large intestine
  - Vitamin C
    - Synthesized in liver

## Fat soluble

- These can be stored up to six months in fat and liver cells
- Deficiencies can occur, but so can excesses
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K

# Notable Vitamin and Mineral Combinations

- Cobalt and the B vitamins:
  - One of the B complex vitamins, cobalamin, can only be synthesized in the presence of cobalt
- Selenium and vitamin E
  - Selenium and vitamin E work together to help to prevent azoturia

# QUESTIONS

- 1. Name the 5 nutrients.
- 2. What is the function of protein?
- 3. What is the function of carbohydrates?
- 4. What is the function of water?
- 5. Name the fat soluble and water soluble vitamins.
- 6. What is the calcium phosphorous ratio?