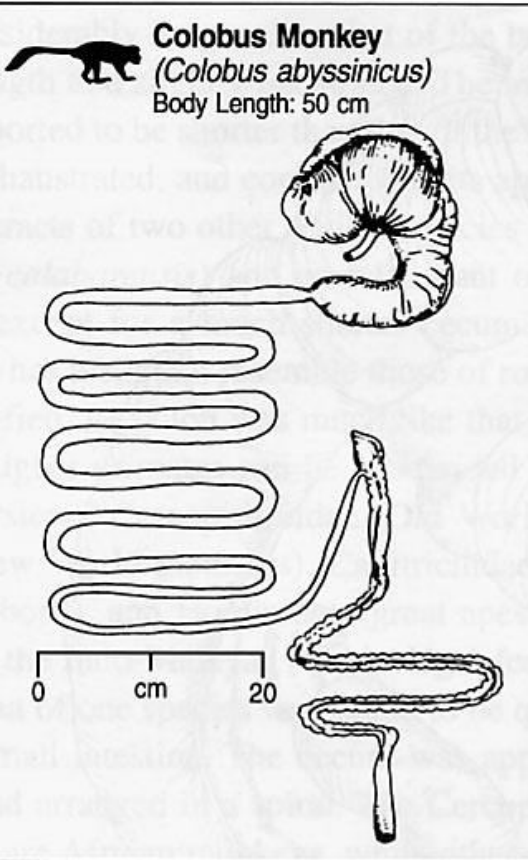


Nutrition and Feeding of Equine

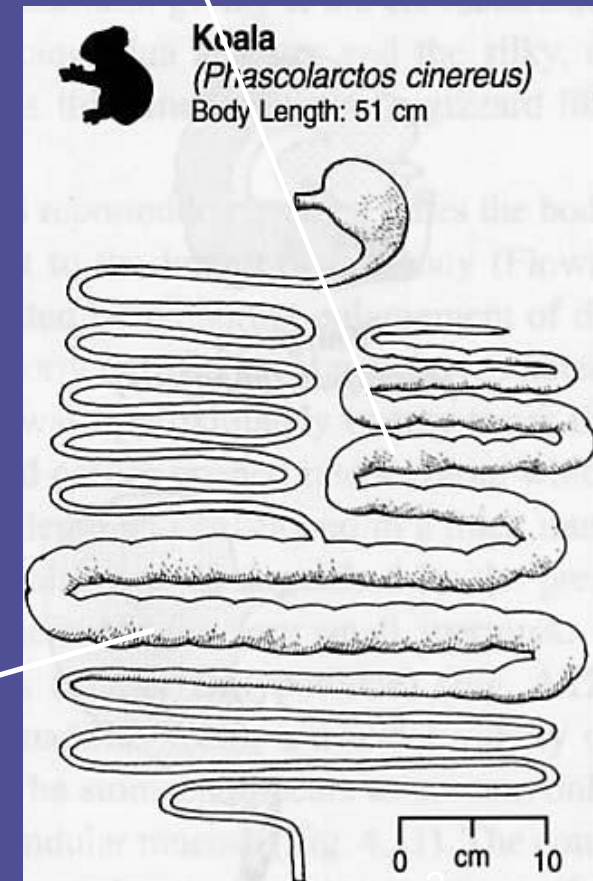


In foregut fermenters the fermentation chamber is located in an oral position (before) relative to the small intestine.

In hindgut fermenters the fermentation chamber is located in an aboral (after) position relative to the small intestine.

This anatomical difference has profound physiological and ecological consequences.

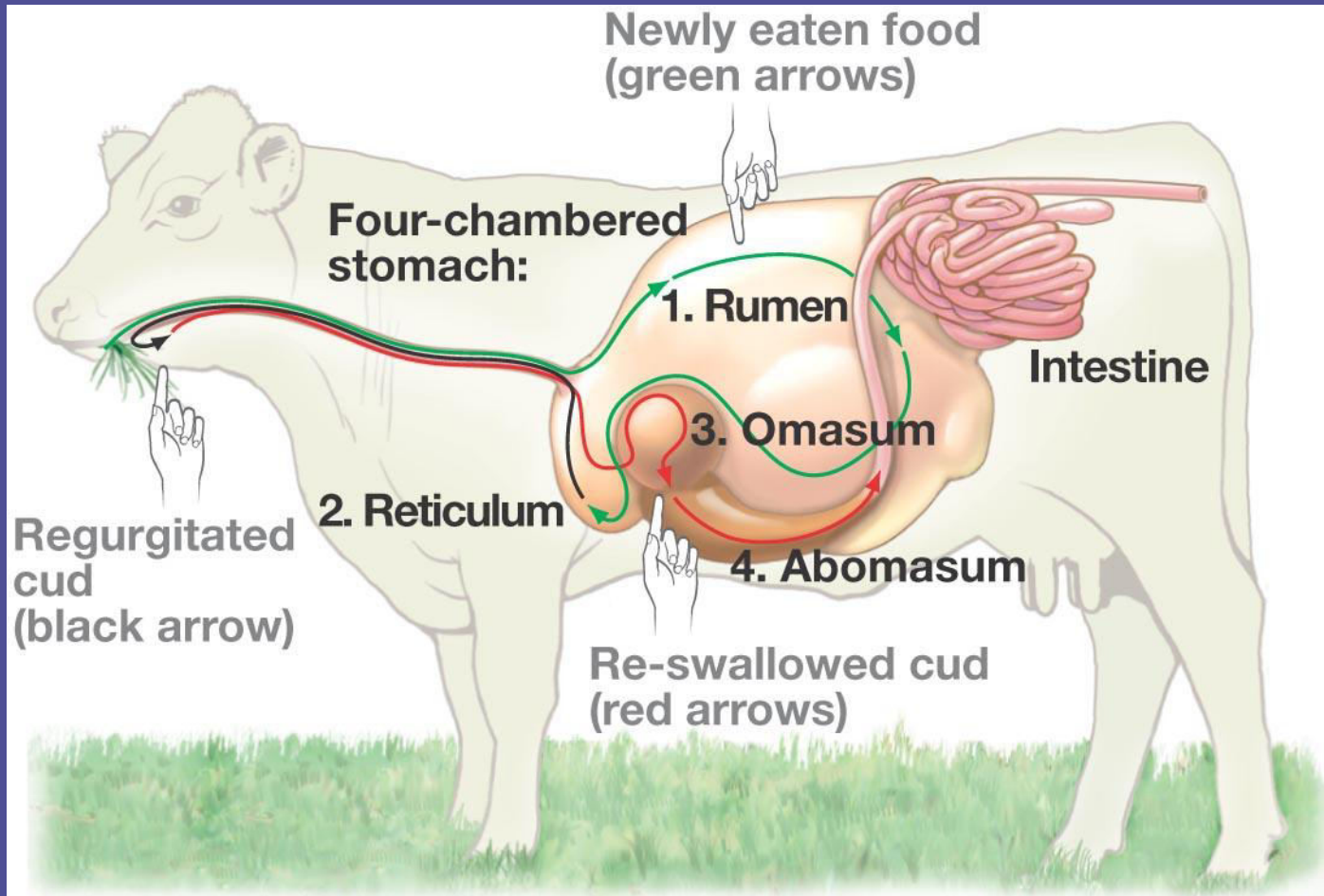
Cecum



Colon

Hindgut=Cecum+Colon

Cows are foregut fermenters



Copyright © 2008 Pearson Benjamin Cummings. All rights reserved.

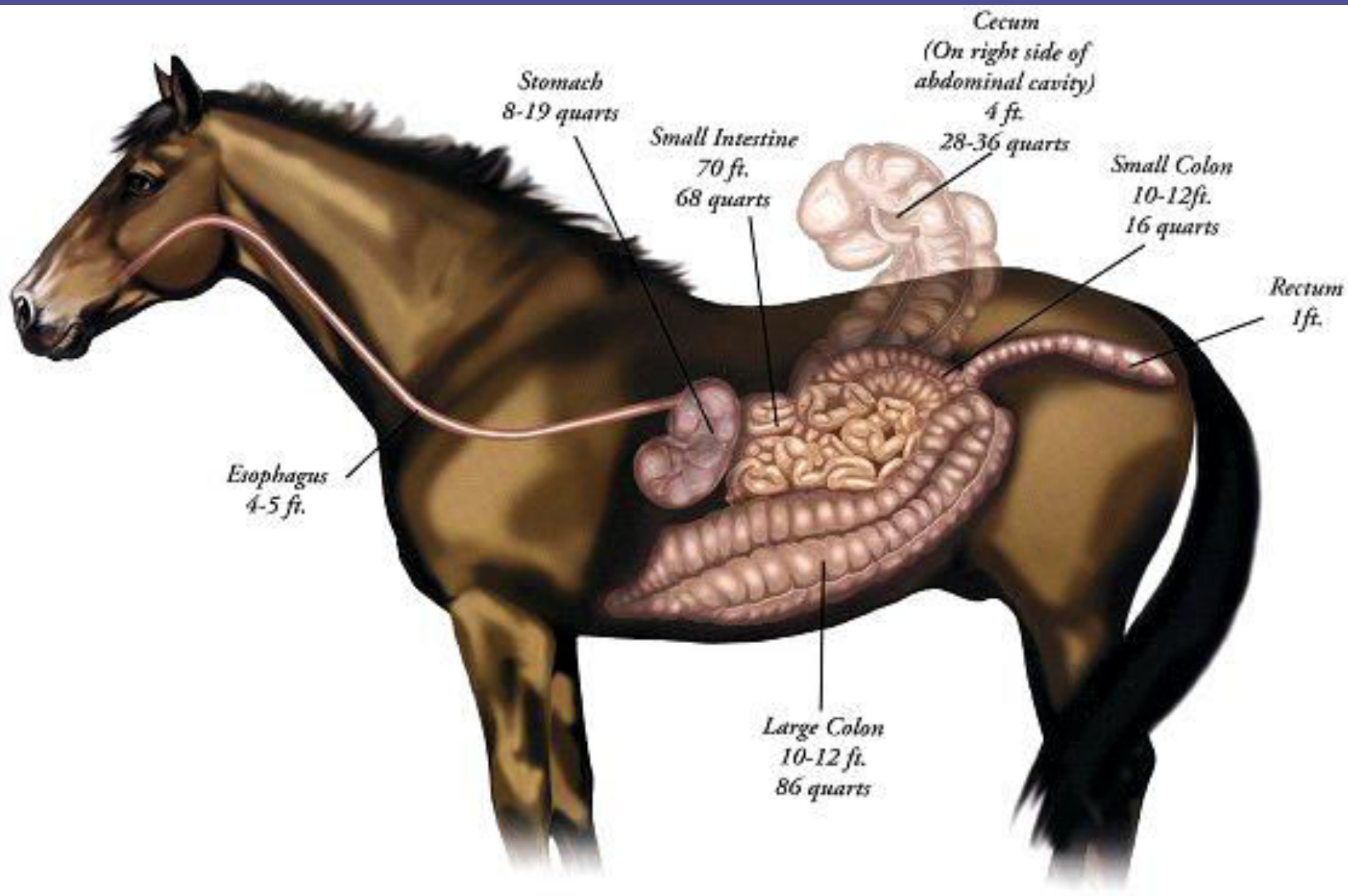
Horses are hindgut fermenters



Consider the horse

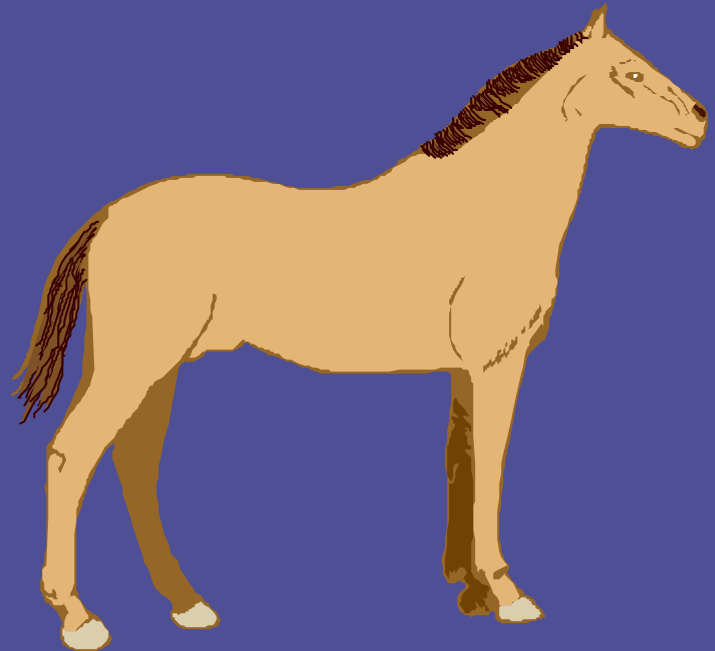
Grazing animal
Trickle feeders / nibblers
12 – 16 hours grazing
They are not cows



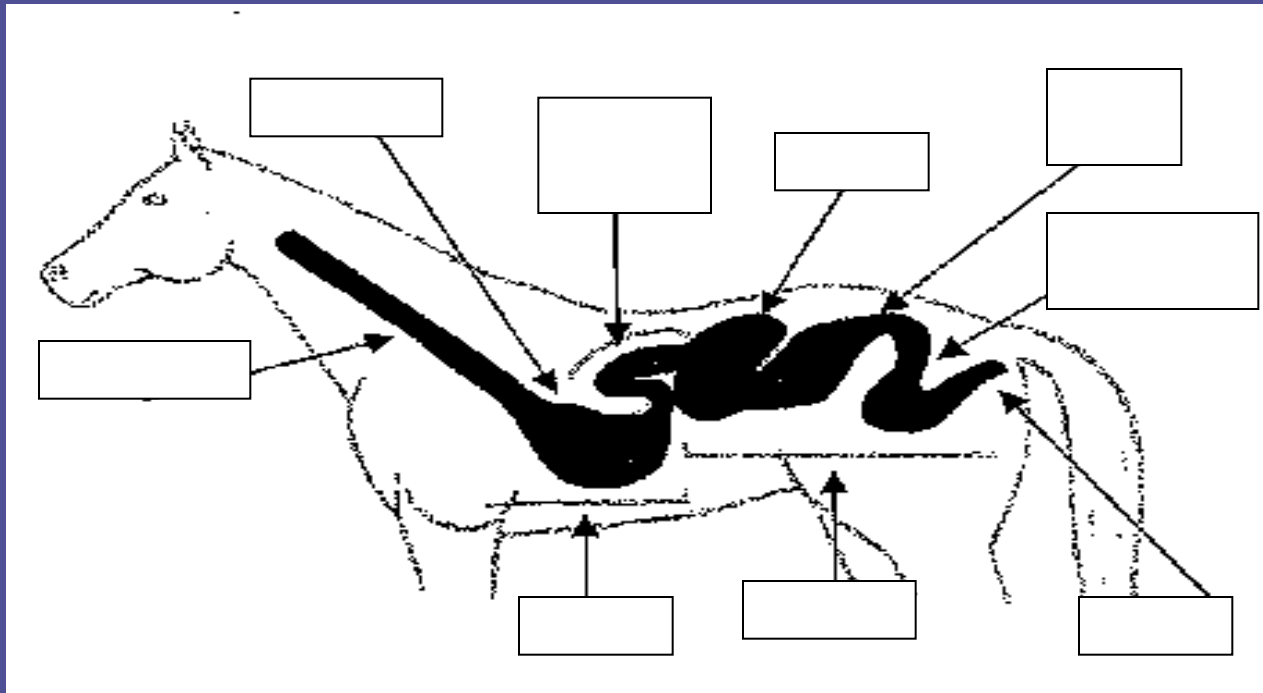


Do you know the nutrient requirements of your horse?

- Stage of Production
 - Maintenance
 - Work
 - Lactation
 - Pregnancy
 - Early growth
- Mature Size
- Activity Level

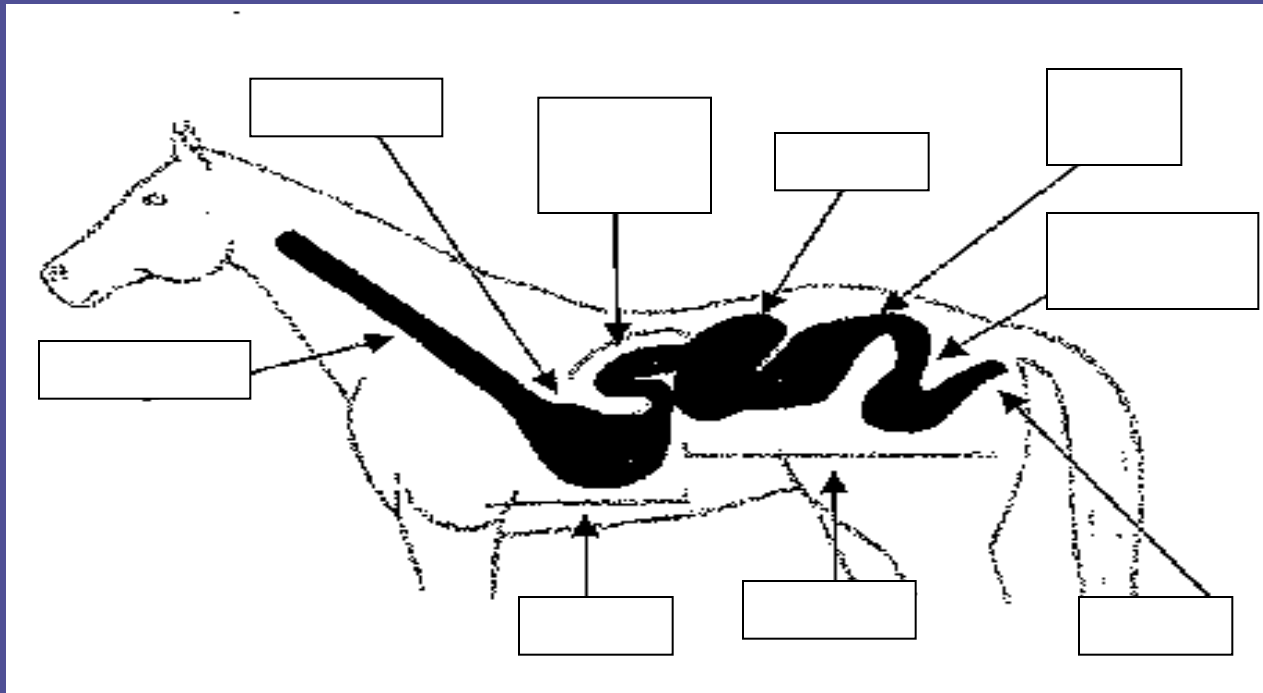


Equine Digestive System



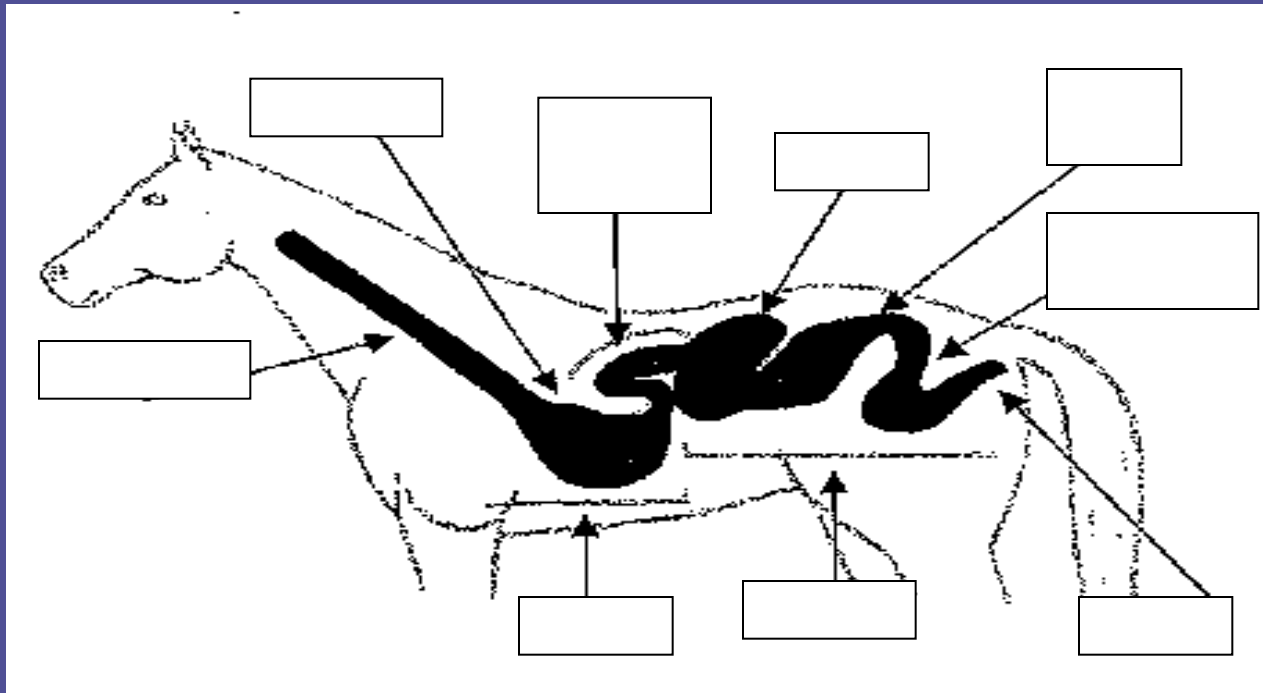
- Mouth to anus = 100ft

Equine Digestive System



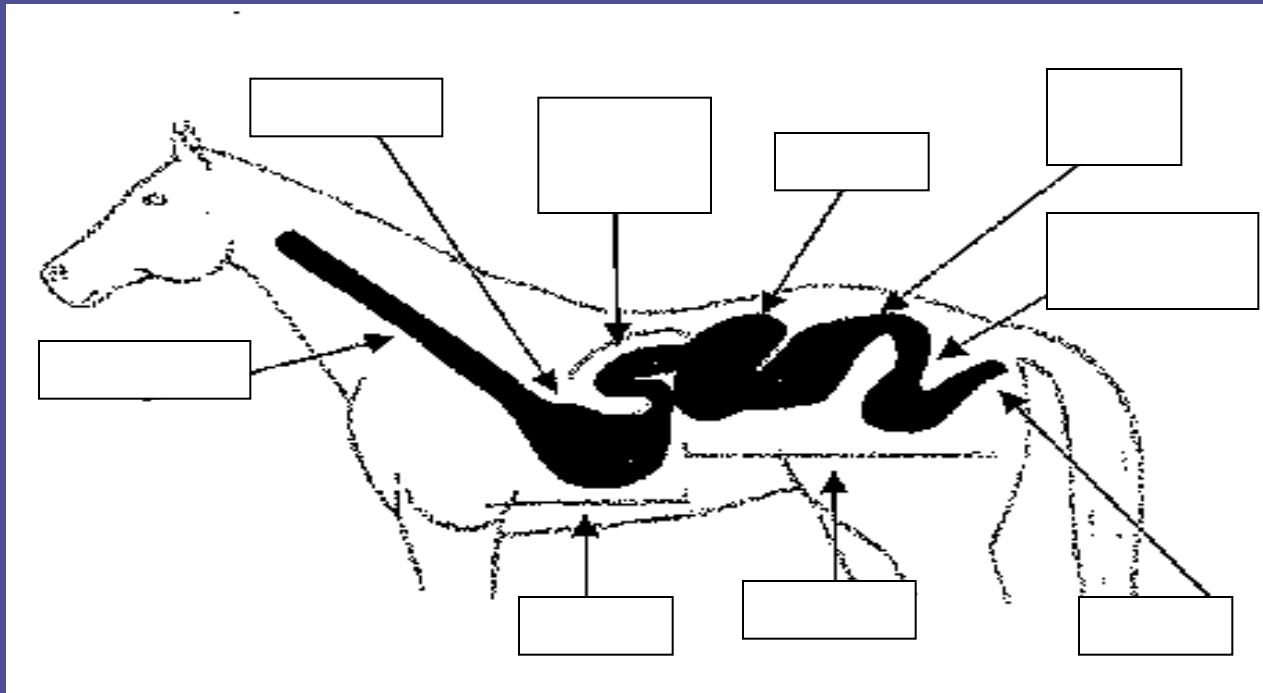
- Mouth, esophagus, stomach = 3-4 feet
- Stomach Capacity = 8-15 quarts

Equine Digestive System



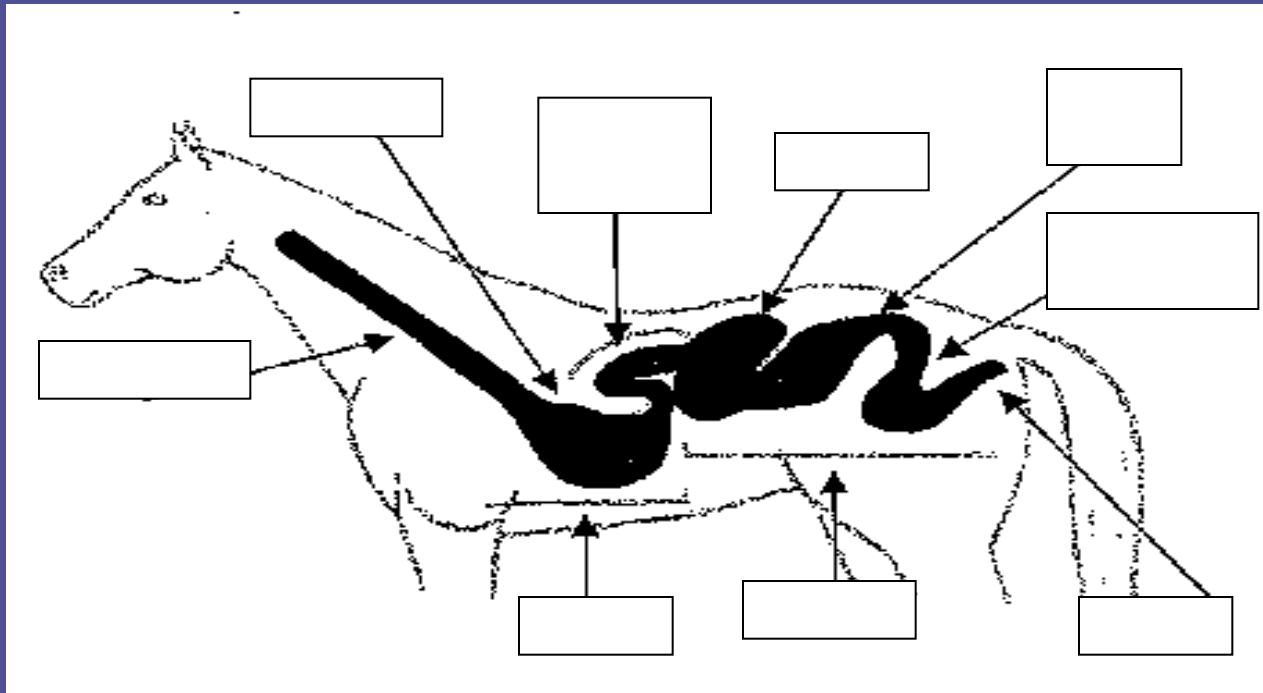
- Small intestine = 70 feet long
- Small intestine capacity = 48 quarts

Equine Digestive System



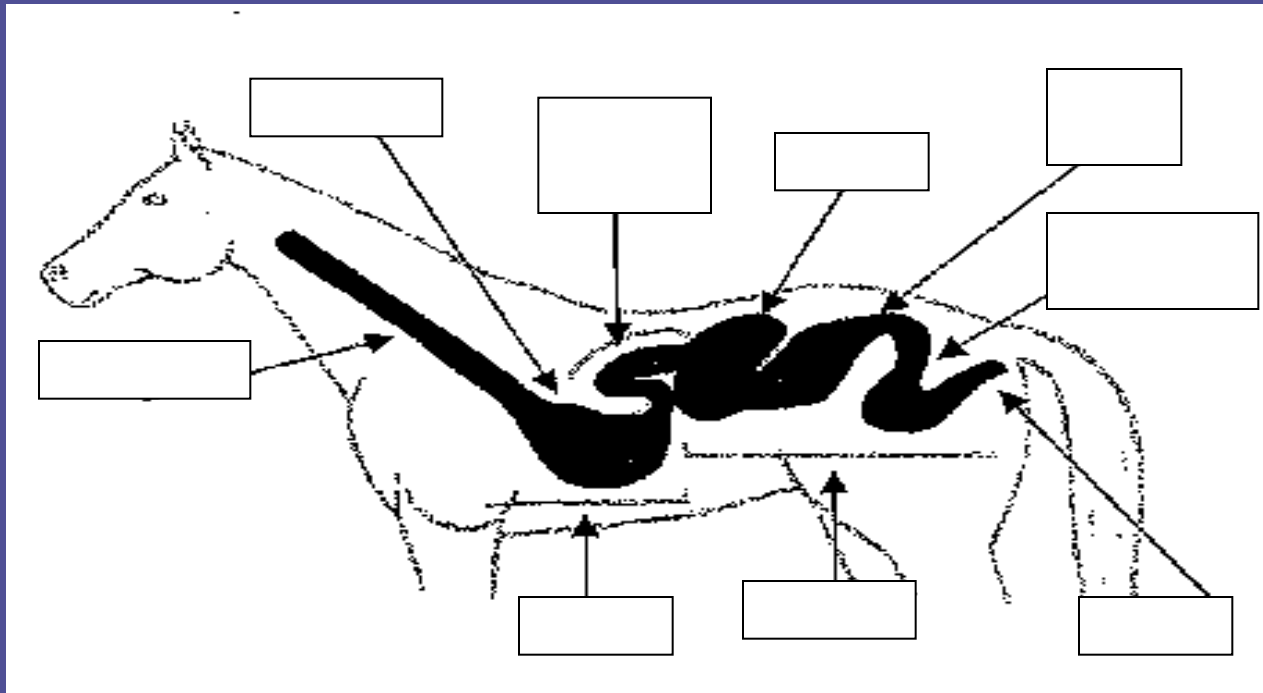
- Large intestine = 20 feet long
- Large intestine capacity = 130 quarts

Equine Digestive System



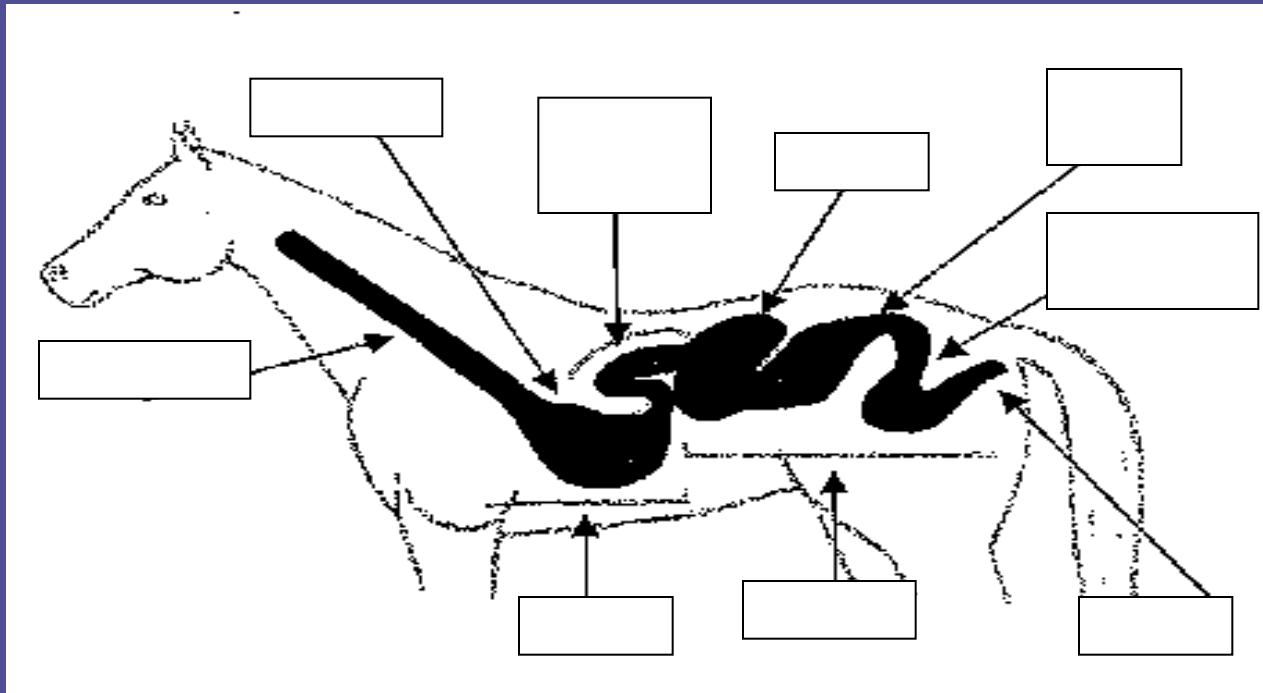
- Mouth breaks down food
- Wets feed with saliva--3 gallons per day

Equine Digestive System



- Stomach has 10% of the digestive system capacity
- Therefore horses are constant grazers

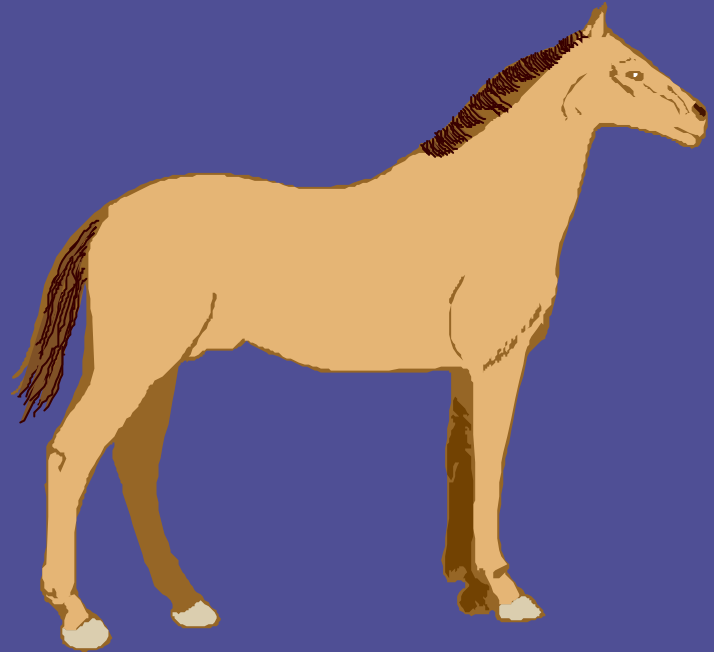
Equine Digestive System



- In the small intestine : break down carbohydrates to glucose, proteins to amino acids, fats to free fatty acids, and add bicarbonate.

DIGESTION

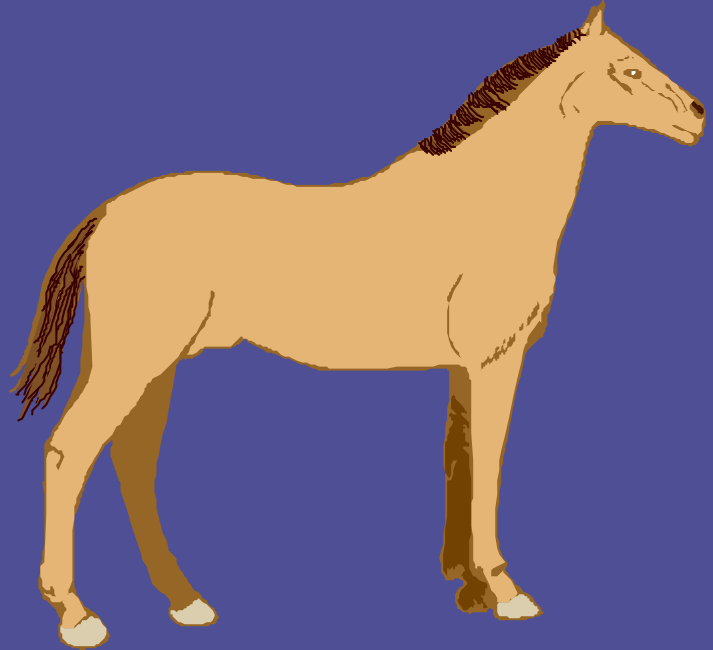
- Total process = 65 hours
- 15 minutes in the stomach
- 1 hour in small intestine
- 63 hours in large intestine



DIGESTION

NUTRIENT REQUIREMENTS

- Maintenance
- Work
- Lactation
- Pregnancy
- Early growth



Based on 1100 lb. horse

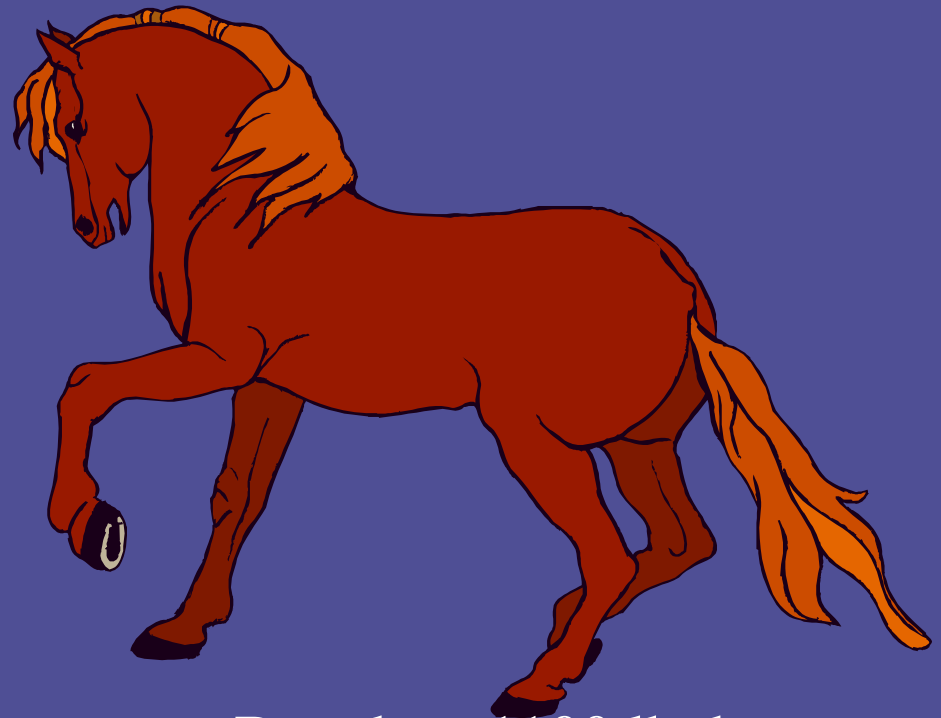
Maintenance Requirements

Mcal/day

•16.4

Protein/day

•1.4 pounds



Based on 1100 lb. horse

WORKING REQUIREMENTS

Mcal/day

- 28-30

Protein/day

- 2.8 lbs.



NURSING REQUIREMENTS

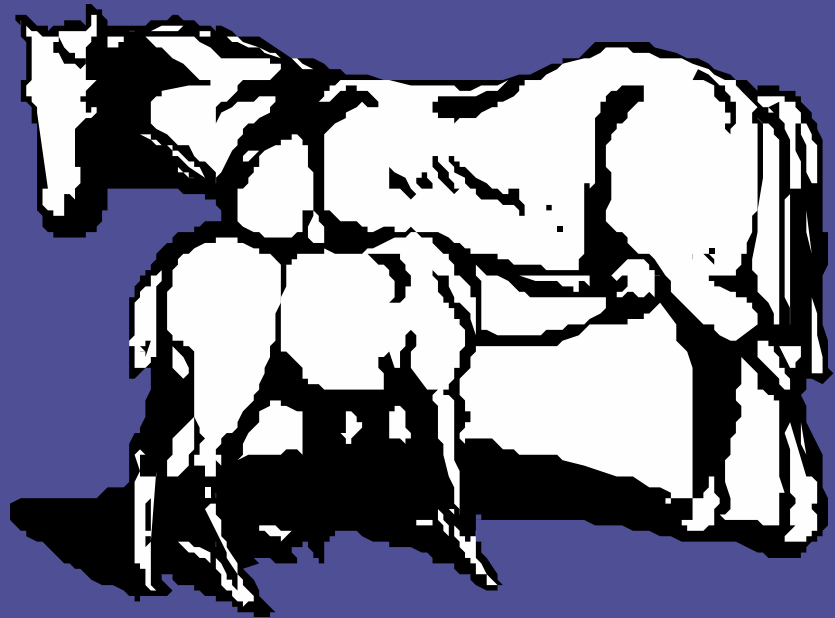
Mcal/day

- 28

Protein/day

- 12.5 %

- 3 lbs.



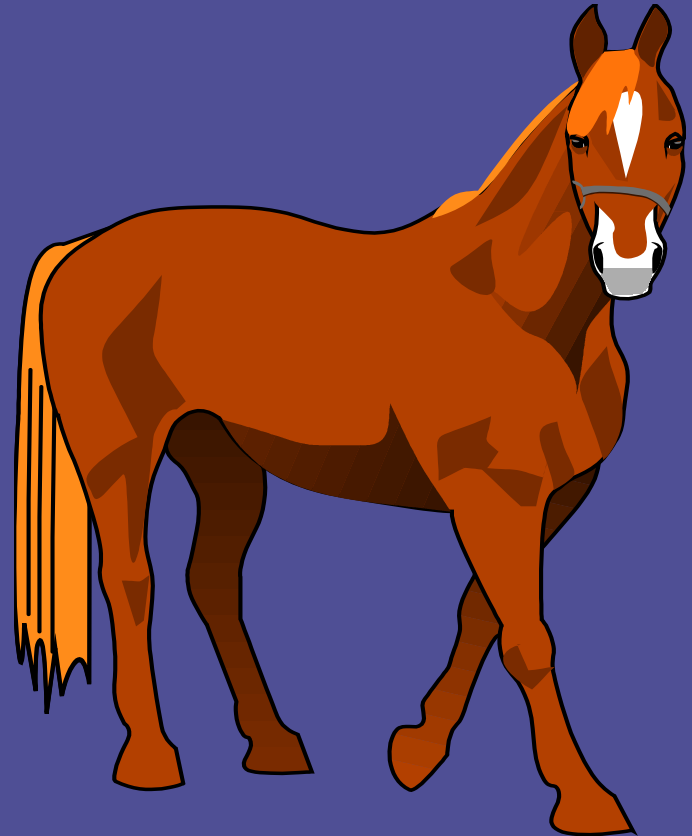
Pregnancy Requirements

Mcal/day

- 18.4 last 3 months
- 1 lb./day fetal growth

Protein/day

- 1.5 lbs. first 8 months
- 2 lbs.. Last 3 months



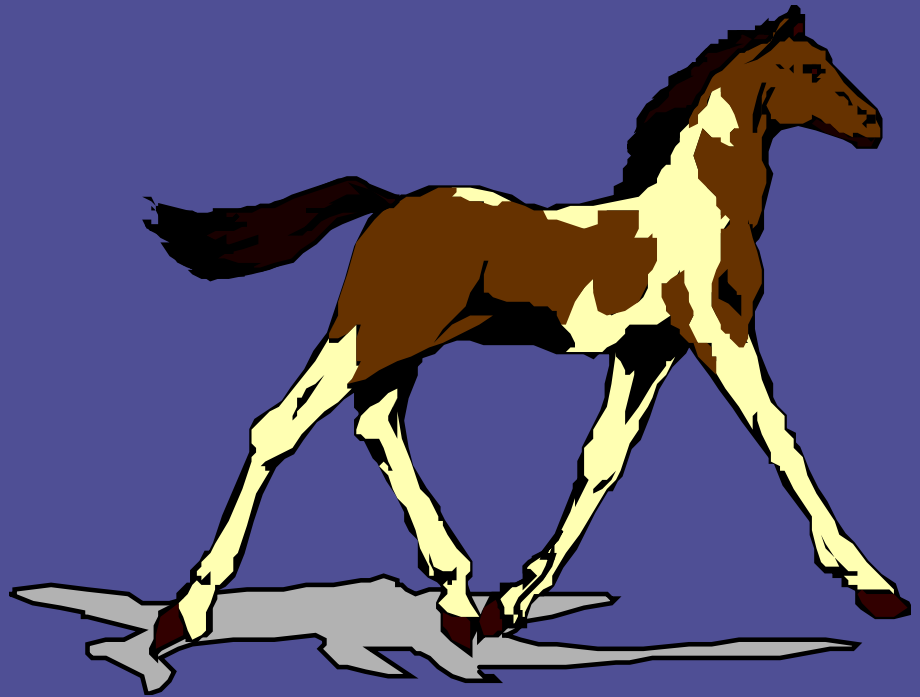
Growing Horse Requirements

Mcal/day

- Yearling-19
- 2 yr. old-22

Protein/day

- Yearling-14 %
- 2 yr. old 10 %



Meeting Requirements

Forage primary source

Where is feed digested

Quality of ingredients

Total nutrient requirement





Five Nutrients Needed for Normal Function

1. Energy is supplied by carbohydrates and fats in units called calories. A Kilocalorie (Kcal) is 1,000 calories and mega calorie (Mcal) is 1,000 kilocalories.

- Feed manufacturers formulate rations based on digestible energy (DE). Digestible energy is the gross energy of the feed minus the energy lost in the feces.
- Net energy (NE) refers to the actual energy used by the horse for production and maintenance.

2. Protein is 80% of the animal's structure on a fat-free, moisture free basis.

- Amino acids, the building blocks of protein are the major components of muscle
- The quality and digestibility of the protein are the major components of muscle enzymes and many hormones.

3. Minerals are important for development and maintenance of a strong skeletal system. Also, they are needed by equine because they are important parts of hormones amino acids and used in the regulation of body functions.
 - A. Many minerals are obtained from roughage (pasture and hay) and grain.

- B. Calcium/phosphorus intake and ratio are important because if phosphorous intake exceeds calcium intake, calcium may not be absorbed even though the feedstuff meets the calcium requirement.
1. Calcium and phosphorus are important for bone structure and many energy transfer reactions
 2. Sodium and chloride in salt play many roles including the maintenance of fluid balance, acid-base balance normal flow of nerve impulses and muscular movements

4. Vitamins are needed by horses in exceedingly small amounts as catalysts for many transformations and reactions in the body tissues as part of the enzyme complex.
 - Fat-soluble vitamins include vitamin A, D, E, and K. These vitamins are stored by the body in the fat cells and the liver. Vitamin A and E are the only fat-soluble vitamins that may need to be added to the diet as a supplement.

- Water soluble vitamins include B, complex (10 vitamins) and vitamin C. Water-soluble vitamins cannot be stored in the body so they must be ingested and synthesized daily.
- Water soluble vitamins and vitamin K are synthesized by cecal microbes.

5. Water is required by horses to regulate body temperature and assist in softening feedstuff for ingestion.
 - Under normal environmental conditions a horse needs 10-12 gallons of fresh drinking water daily (1 gallon/100 lbs. Of body weight).
 - Restricted water intake can result in reduced feed intake.

A. Five major factors that regulate nutrient Requirements

1. Maintenance refers to the nutrient intake required to maintain a constant body weight during normal activities of a non-working horse.
 - Generally, digestible protein and energy requirement for maintenance increase as the horse's weight increases.
 - However, horses larger than 1,300 pounds require less energy for maintenance because they are usually less active.

2. The growth of the horse has a major impact on the nutrient requirement.

- Protein and energy intakes are the major nutrient factor influencing the growth of young horses.
- A young horse needs more protein and energy for their active growth and restricted intake of protein and energy will restrict their growth rate.

3. Reproduction factors that regulate the nutrient requirements of a horse include breeding and gestation.

a) At breeding, nutrient requirements vary.

- 1) Mares gaining weight at the same time of breeding are twice as likely to conceive as thin mares maintaining weight; hence, the energy intake may need to be 10-15% above normal
- 2) Protein requirements at breeding time are similar to the protein requirement for maintenance.

- b. During gestation energy and protein requirements increase dramatically during the last three months of pregnancy.
 - 1) 60-65% of fetal development occurs in the last trimester.

4. Lactation is another major factor that affects nutrient requirements. The level of milk production depends on the energy and protein intake.
5. Working horses require more energy and protein than required for maintenance.
 - a. The amount of increased energy and protein intake varies with work conditions.
 - b. Increasing the maintenance requirement for energy by 10% for each hour of field work is a reasonable guide.

B. Other factors affecting nutrient requirements

1. Individuality of the horse (Body composition, metabolism, temperament, ect.)
2. Environmental factors (temperature, humidity, parasite control, ect.)
3. Weight and ability of the rider.

1. Forage (roughage), concentrates and supplements are the three major feed categories fed to equine.
2. Most equine receive their daily ration as forage and concentrates.

B. Forage

1. Forage is high in fiber, but relatively low in energy.
2. Adequate forage in the ration may be helpful for several reasons. Forage may:
 - a. Decrease the risk of colic and laminitis,

- b. Help keep calcium levels higher than phosphorus,
 - c. Discourage vices such as wood chewing because forage occupies the equine for longer periods of time than grain.
- 3. The most common forages used for equine include hay and pasture.

C. Hay is the most common form of forage given to the horse kept in confinement

1. Legumes and grass plants are common hay ingredients and a legume/grass mixture is preferred for equine in lactation, late pregnancy and during growth.

- a. Most important consideration once a high quality hay has been harvested is that the hay be free of dust and mold which can harm an equine.
 - 1) Moldy hay most often occurs when hay is baled at too high moisture levels (20% or more), with out a preservative added.
 - 2) First cut hay also often leads to moldy hay.

- b. Legume hay is higher in protein, energy, calcium, magnesium, and Vitamin A than grass hay.
- c. Rule of Thumb: Feed 1.5 or 1.75% of the body weight as forage. Mature, idle equine may need twice as much hay per day if not fed grain with it.

2. Some types of hay:

- a. Oat hay- an excellent feed but may be low in protein, unless harvested at the soft dough stage.
- b. Alfalfa hay- is one of the finest hay for horses because of high palatability and nutritious content.

- d. Bermuda grass hay is made from coastal Bermuda grass.
- e. Legumes (clover) are mixed with cool season grasses to improve hay quality, but one never mixes clover with Bermuda (warm season grasses).
- f. NEVER feed sudangrass and sorghum-sudangrass hybrids to equine: they cause muscle weakness, urinary problems, and may cause death if cut or grazed after a drought or frost.

3. Things to look for when selecting high quality hay:

- a. The MOST important selection criteria for any good quality hay is the stage of maturity or stem to leaf ratio.
 - 1) Hay should be free of mature seed head or plants in full bloom since their presence indicates that the plant has reached the reproductive stage of growth and is too mature. (hay in the reproductive state has less protein content, is harder to digest, and is palatable.)

- 2) Hay should have a high proportion of leaves relative to stems in order to have increased digestibility and quality.
- b. Bright green color- a minimal amount of vitamin a loss from sun bleaching
- c. Good clean smell free from moldy or dusty smell.
- d. Hay with no foreign matter or weeds that reduce digestibility and palatability to the equine.

D. Pasture is the main source of roughage for equine maintained in paddocks.

1. Natural feeds for equine, and when grown under good conditions, provide many minerals and vitamins lacking in other feeds.
2. Pasture provides succulence in the ration, reduces feed cost, and can reduce stable vices caused by boredom and mineral deficiencies.
3. Rule of Thumb: Allow 2 acres per horse for rotational grazing. More intensive grazing systems, if properly managed, can allow higher stocking rates (less acreage required per animal)

A. Concentrates in the ration.

1. Oats are the most popular grain that horsemen feed horses because they are highly palatable and a fibrous grain with less risk of nutritional diseases.
 - a. Oats have a higher fiber content than corn or barley which means oats have more bulk per nutrient content.

- b. The higher bulk of oats makes it more difficult for the horse to over eat and get colic or founder.
- c. Horses may eat oats whole or processed, but crimping, rolling, or crushing the kernel increases digestibility.

2. Barley is lower in fiber than oats and has greater energy density.
 - a. Substitute barley for oats if the cost per unit of energy is less.
 - b. Barley has a harder kernel than oats and should be processed before using as horse feed.
 - c. Crushed or ground barley can cause colic in horses and needs to be mixed with a more fibrous feedstuff as a preventative measure.

3. Corn is the most energy-dense farm grain and is referred to as a “hot feed”
 - a. Corn has about 2 times the amount of energy as oats.
 - b. Corn contains large amounts of carbohydrates (starch) and should contain less than 14% moisture to prevent mycotoxin formation and toxicity.
 - c. Cracked corn increases digestibility but rolled or crushed corn may ferment quickly in the digestive tract leading to colic.

C. Additive

1. Molasses is a feed additive often added to concentrates to increase palatability.
 - a. Equine like the flavor.
 - b. Molasses reduces dust in the feed and adds energy.
 - c. Molasses should be added at the rate of 3-10%. Greater amounts have a laxative affect.

D. Supplements

- Are used to increase the nutritional value of a ration.
- 1. Supplements may be used to add protein, vitamins, minerals, or a combination of the three.
- 2. The need for supplements is determined by the quality of feedstuff and the requirements of the individual equine.

E. Types of Supplements

1. Protein supplements

- a. Equine that need protein are those young growing equine, milking mares, performance equine in high-stress situations, or equine being fed poor quality roughages like late cut grass.

- b. Soybean meal is the preferred plant protein supplement for equine because it has 42-50 percent protein, and a better balance of amino acids than other plant protein source supplements.
- c. Other protein supplements include linseed meal, cottonseed meal, meat meals, milk protein, alfalfa meal, and commercial protein supplements.

- d. Commercial protein supplements are convenient for those who do not wish to formulate their own rations but they can be expensive.
- e. Milk protein supplements have the best distribution of amino acids but are only fed to foals because of cost and digestibility.

2. Vitamin supplements.

- a. Vitamin supplementation is most needed from the time equine are newborn foals through the 12 month yearling and anytime equine are fed poor quality forage. However, the commercial feed should contain them in premix.
 - 1) Vitamin A and D are required for calcium and phosphorus absorption, but when fed in excess over a period of time can cause problems such as fragile or thick bones, flaking skin, calcification of blood vessels, the heart and other soft tissues, etc.

- 2) Equine synthesize B vitamins, vitamin C, and Vitamin K in their body and do not need them added to their diet unless they are fed poor quality forages or low levels of good quality forages.
- 3) Equine who have 12 hours access to good quality pasture or those receiving good quality hay (preferably half legumes) probably need no vitamin supplements

3. Mineral supplements

- a. Mineral supplements added to the concentrate mix are often used to balance the mineral content of rations.
 - 1) Choice of mineral supplements will depend on availability and cost.
 - 2) Calcium and phosphorus are the most commonly deficient macro minerals.
 - 3) Copper and zinc are the most commonly deficient trace minerals.
 - 4) Rations are balanced so there is always 1.5 to 2.5 times more calcium than phosphorus.

- b. Calcium may be supplied by ground limestone or oyster shell flour; while monosodium phosphate will supply phosphorus; and, both, calcium and phosphorus are supplied by steamed bone meal and dicalcium phosphate.
 - 1) Must be mixed with a more palatable feed source.
 - 2) Trace-mineralized salt mixed with limestone or dicalcium phosphate satisfies the natural craving of equine for salt, while supplying sodium chloride, calcium, and potassium.

- c. A trace mineralized salt block should be provided for the equine “free access”.
- d. If selenium is added to the trace mineralize salt it is a mineral mix.

A. Selecting the Right Ration

1. A ration must be balanced.
 - a. Balanced rations consist of a single feed or mixture of feeds to supply energy, protein, minerals, and vitamins for work, growth, lactation, pregnancy, and maintenance.

- b. Balanced rations meet the equine's nutrient requirement for the day.
 - c. Amount of nutrients needed depends on the equine's size and production status.
- 2. A ration must be palatable (taste good and have good digestion qualities) or the equine will not eat it regardless of the nutritional value.

3. All rations should contain minimal energy content per unit weight to fuel various body processes.
 - a. Cost per energy unit is a primary concern for feed costs

- b. Energy is the first concern when formulating a ration for all equine. Grain is added to the equines ration to supply the necessary energy.
- c. Energy sources must be digestible and provide fuel efficiency in the form of carbohydrates and fats.
- d. Energy intake above the amount need to fuel the body for maintenance, production, and growth will be deposited as body fat.

B. Figuring feed consumption

1. Feeding consumption is proportional to a equine's body weight, level of activity, and the equine's health and state of being.
 - a. Lactating mares require more nutrients and they need both extra energy and protein.
 - b. Mature equine of larger weight require more energy to maintain their bodies than smaller equine.

2. It is cheaper to maintain a moderate to fleshy condition on a pregnant mare than try to increase the body fat content of a thin mare during the breeding season .

3. While growing foals need high-energy rations, the major concern for any growing equine is adequate protein, minerals, and vitamins.
 - a. The growing foal needs higher levels of energy and protein than any other elements.
 - b. Equine rations are typically limited to the amino acid lysine and used for growth and reproduction.
 - c. Growing equine need .6 percent lysine while horses in production need .3-.4 percent lysine in the total ration.

C. Feeding practices

1. Equine have individualistic eating habits and do not group feed concentrate very well.
 - a. Each equine should have its own concentrate mix feeder and feeders should be a minimum of 50 feet apart.
 - b. Extra feeders need to be provided for a third equine to have a place to feed when they are displaced from other feeders.

2. Hay can be fed in a number of ways.
 - a. Hay fed on the ground may be contaminated with dirt, feces and urine and may be scattered or walked on. Increased levels of dirt consumed with the hay may cause colic.

- b. Hay fed on a feeder placed too high may lead to eye irritation from hay particles or foreign materials.
- c. Hay allowed accumulating, molding and spoiling in troughs and mangers can cause severe digestive disorders, including colic and death.

3. Equine may form bad eating habits such as eating to fast if they are not fed at regular intervals.
 - a. Equine need to eat at the same time every day.
 - b. Even with the mature-idle equine, it is preferred to feed them at least twice a day, approximately 12 hours apart.

4. Ration changes should be don't gradually over a period of 7–10 days.
 - a. 25% of the old ration is replaced with the new ration every two days.

- b. Equine should be introduced to pasture gradually with a initial turn out of 30 minutes, increased daily up to the preferred grazing time within 10 days.
- c. When introducing equine to pasture, feed their normal ration before turning them out.

5. Special feeding problems:

- a. Obesity is a common problem and is caused by overfeeding and a lack of exercise.
- b. Equine in close confinement crave unnatural feedstuff and may chew on wood, eat their hair or dirt.
- c. Equine that graze pastures on light, sandy soils are prone to sand colic.

6. Parasite control is an important part of feeding management.
 - a. Internal parasites decrease digestive efficiency and cause digestive problems.
 - b. External parasites annoy the equine and cause equine to spend extra energy.

12.02-01

Ingredient	Foal Creep Ration	Weanling Ration	Yearling, 2yr old, late pregnancy &lactating mare	Adult equine , early pregnancy, late 2yr old
Oats(crimped or crushed)	880	880	880	1000
Corn(coarsely cracked)	440	540	680	780
Soybean meal (44%)	480	380	260	60
Molasses (liquid)	140	150	140	130
Dicalcium Phosphate	30	20	10	10
Limestone	20	20	20	4
Salt (trace mineralized)	10	10	10	10
Vitamins A,E, & D	----	-----	----	----
Total Pounds	2000	2000	2000	2000

12.02-02 nutrient content of feedstuff(as fed basis)

Type of feed	Dry matter (%)	Digestible energy Mcal/lb	Crude Protein lb/lb	Calcium g/lb	Phosphorus g/lb	Vitamin A (1,000 IU/lb)
Alfalfa-early bloom	90.5	1.02	0.180	5.81	0.86	23.00
Fescue- full bloom	91.9	0.86	0.1181	0.81	1.32	8.73
Barley	88.6	1.49	0.117	0.23	1.54	0.37
Corn	88.0	1.54	0.091	0.23	1.27	0.98
Oats	89.2	1.30	0.118	0.36	1.54	0.02
Soybean meal	89.1	1.43	0.445	1.59	2.86	-----
Linseed meal	90.2	1.25	0.346	1.77	3.63	-----
Blackstrap Molasses	74.3	1.18	0.043	3.36	0.36	-----
Limestone	100	-----	-----	178.67	0.18	-----
Dicalcium Phosphate	97	-----	-----	96.81	83.73	-----

B. Formulating a ration

1. The ration to be formulated will be a single ration used for maintenance of an 1100-pound gelding. The ration is considered maintenance because the gelding is not being ridden. Since this ration is for maintenance, a roughage of alfalfa hay (hay, sun cured, and early bloom) will be considered as the sole ingredient of the ration.

Contents of Alfalfa Hay

Dry Matter	90.5%
Digestible Energy	2.48 Mcal/kg or 1.13Mcal/lb
Crude Protein	19.9%
Calcium	1.41%
Phosphorus	0.21%



Forage intake estimates

Hay

Minimum = 1% body weight

Typical = 1.5 – 2.0 % body weight

Upper limits = 2.5 – 3% body weight

Total intake will reflect forage quality



Forage intake estimates

Pasture

1.5 – 3.1 % body weight per 24 hours



Concentrate use

Fed for many reasons

balance forage nutrients

meet specific nutrient requirements

the owner wants to

Concerns

over feeding

fat horses with issues



Concentrate use

Starch

controlled intakes

2 -3 grams per kg body weight / meal

Grain meal = 5 lbs per meal

Meals no closer than 5 hrs



Feeding Management

Forage primary nutrient source

Quality forage

NO MOLD

Concentrate as required

Change feeds gradually

21 -28 day adaptation



Feeding Programs for Horses

Maintenance

Reproduction

Growth

Performance

Aging

foals

Maintenance Horses

Mature, non working horses that are not pregnant or nursing

May need supplements depending on pasture and forages in the diet

Good quality pasture in summer and hay in winter Adequate forages will deter many abnormal behaviors

Reproduction

Increased Calcium and Phosphorus

**Make sure they have an acceptable body
condition score**

**Gradual increase in intake around 6 months
and by 8-10 months, 20% increase**

**Maintain BCS 5-7, moderate, fleshy condition
but not obese**

**Ca and P needs increase in last trimester
and during lactation**

**Prenatal nutrition- Cu to foal in utero reduces
DOD**

Development Orthopedic Disease

The term "DOD" describes a variety of orthopedic disorders in growing horses.

Contracted tendons, wobblers, phystis, osteochondritis, osteochondrosis dissecans (OCD) and angular limb deformities are all considered Development Orthopedic Disease.

Growth

Critical in avoiding DOD

Use of creep feed

**Accelerated is bad for bone and joint
formation**

Performance

Anaerobic activity- build up reserves of glycogen for easily accessible energy

Aerobic- utilizes fatty acids and stores glycogen Ergogenic aids

Additives

Metabolites

Enhances performance

Sodium bicarb milkshake prevents lactic acid build up, given before the race BANNED

Aging Horses

Small amounts at a time of a highly digestible feed

Teeth are extremely important, owner must pay attention to them

Senior pelleted diets are complete but for optimum GI health, they need forages

Breeding

Meet the requirement of the mare and the foal Nutritional needs change during gestation Early gestation, late gestation or lactation Body condition scoring is essential

First 8 months of gestation nutritional requirements are similar to maintenance

Last 3-4 months of pregnancy must increase protein, energy, vitamins and minerals

Foaling/lactation consume between 2-3 % of body weight

Stallion Nutrition

Maintenance until breeding season (protein requirements are higher than mare maintenance)

Assess body condition prior to breeding season Thin stallions can have reduced libido and fertility

Aged Horse Nutrition

Genetics and lifestyle determine when a horse is classified as aged

Many older horses have dental problems which can lead to severe nutritional problems

Motility of the digestive tract can also decrease with age

Processed feeds may lead to better absorption

Normal Foal Nutrition

Must receive colostrum within the first 18 hours of birth

May need an enema to pass meconium

The mares diet should provide all the required nutrients so her milk will lead to optimal growth in the foal

Coprophagy will actually benefit the foal by providing the GI tract with necessary microbes

Orphan foals need a nurse mare, nurse goat or milk replacer

Coprophagy

Normal foal behavior, possibly due to pheromones, it should not be discouraged

Innoculates the GI tract with necessary bacteria, and vitamins

Starts as early as the first week of life, especially during the first two months, utilizing the feces of the mare

Nutritional supplements for foals

If foals are unable to feed, they must be supported by enteral or parenteral feeding

Delayed feeding of the foal can lead to problems

won't get colostrum which is necessary for the foals immune system

Reduction in intestinal villi height

Decreased weight of stomach, pancreas and small intestine

Increased risk of necrotizing enterocolitis

Donkey Feeding and Nutrition

Higher forage digestibility

Very adaptable, easy keeper

Energy- low resting metabolism

Can utilize straw

Water- don't need to drink as much because they don't waste as much energy, and don't sweat as much

Major problems: over feeding leading to obesity Like short grass

Utilize protein very efficiently

Hay

VS.

Haylage



Biotin





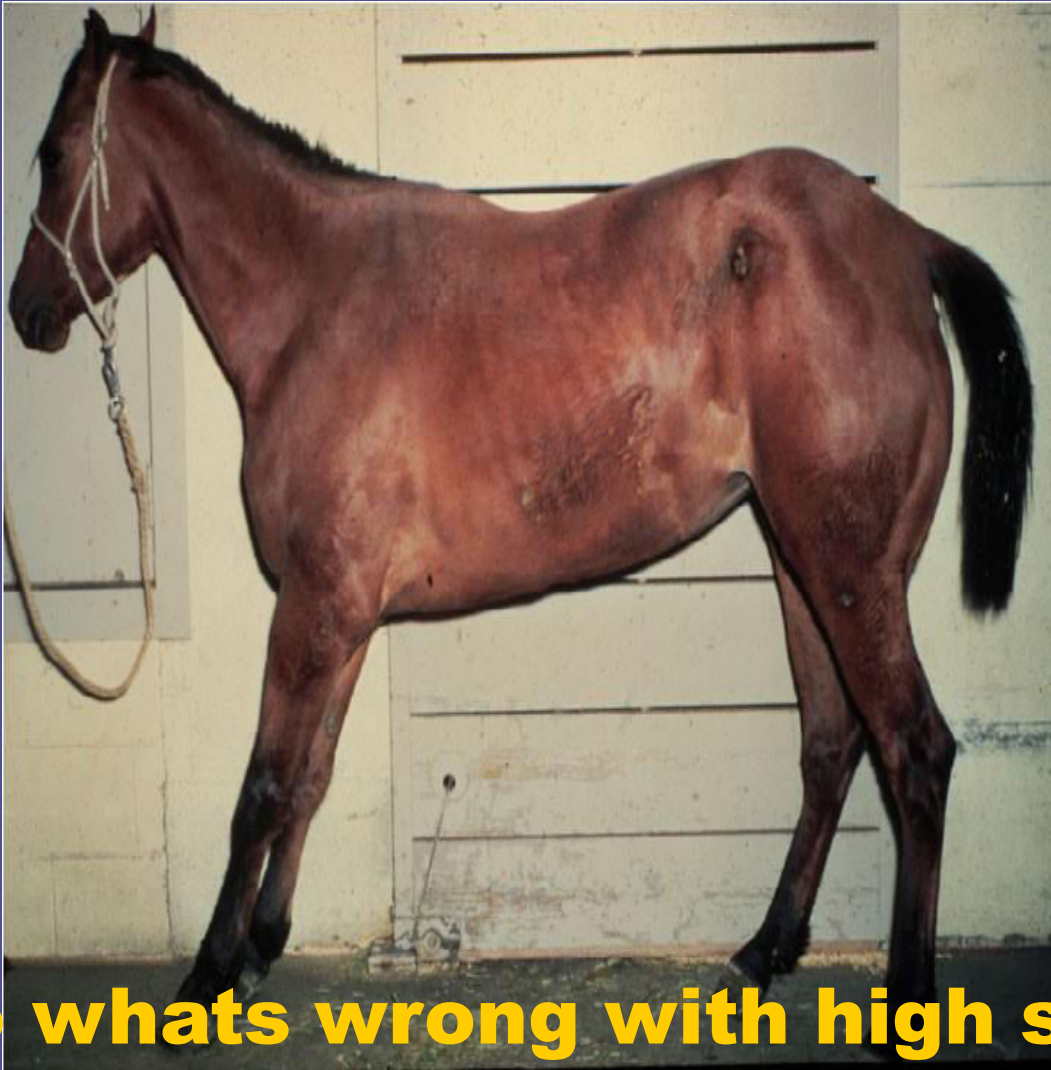
10-20 km travel per day

Diet: high fibre, high in minerals, low protein. Energy mainly from volatile fatty acids not glucose.



Is Modern Pasture OK For Modern Horses?

NO! Modern pasture is designed for ruminants(cows).
Thoroughbreds are more adapted to glucose, but the average horse is not modern.
Lower fibre, high soluble carbs are good for cows, meat and milk production, not for horses



So whats wrong with high soluble carbs/low fibre?

Digestive disturbances, rapid fermentation
Metabolic disorders, behavioural problems
Acidosis, increased risk of laminitis and colic

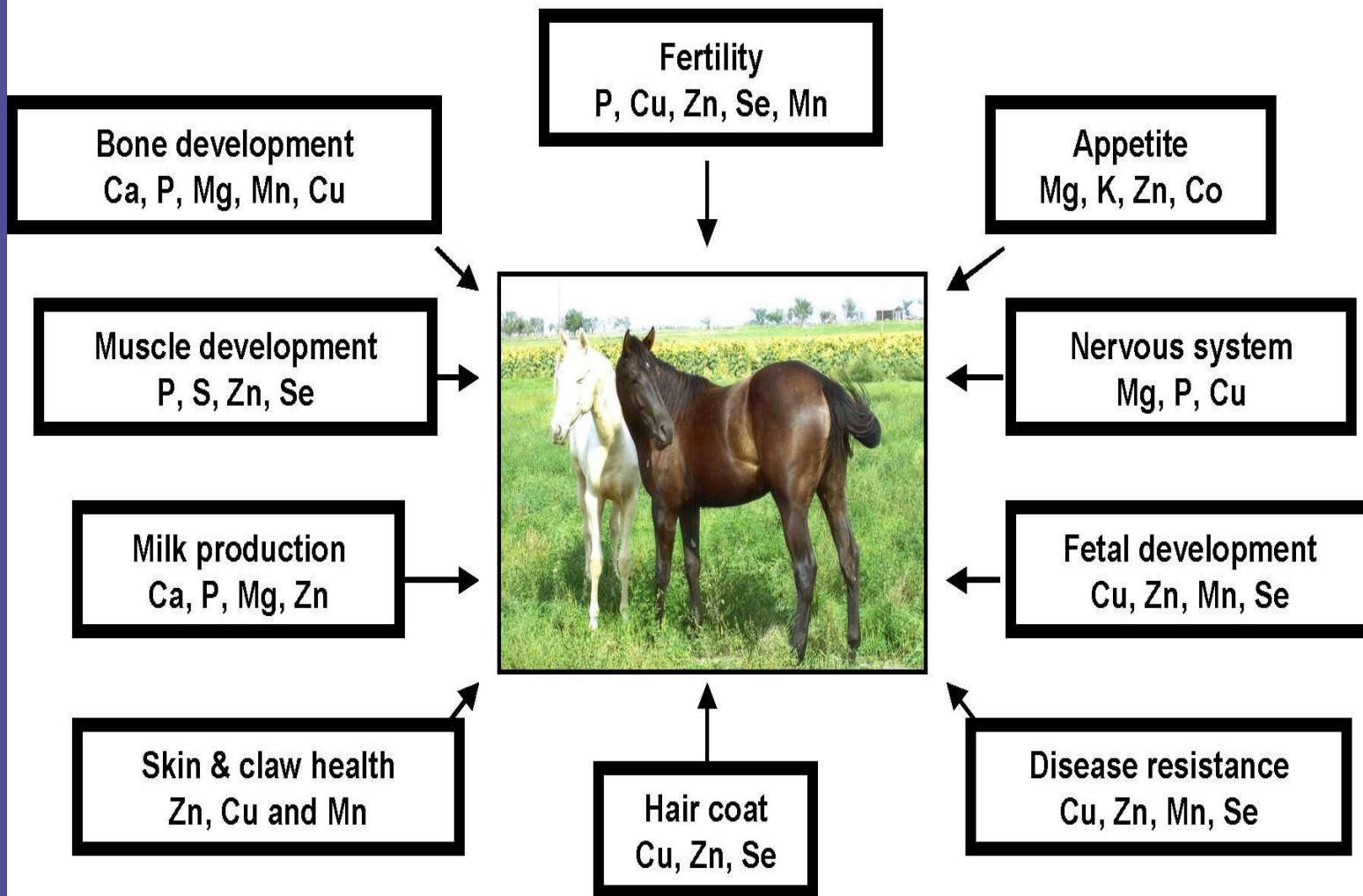


Can Pasture be a sole diet?

It can be too good!

It can provide enough energy and protein

But what about vitamins and minerals?

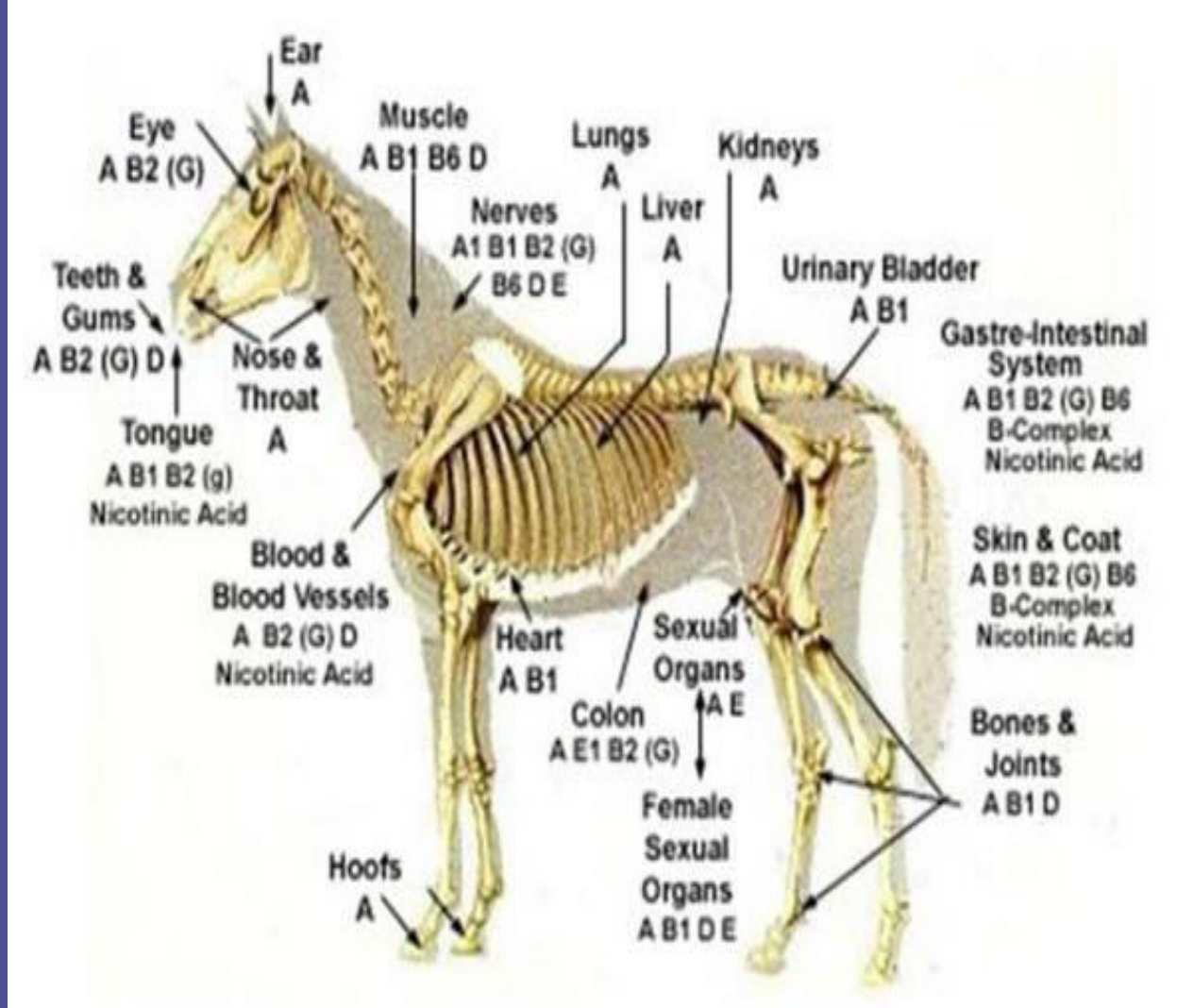


Minerals

Spring pasture low in Magnesium

Kikuyu has low Ca:P (do not feed only Kikuyu)

NZ low in Copper, Selenium, and Cobalt



Vitamins

Fat Soluble Vitamins high in fresh forage

Vitamin B & K synthesised by hindgut deficiencies may occur with low fibre pasture.

Vitamin D – need the sun– its good to take the cover off on sunny days



How much work is your horse doing?

Feeding should be tailored to requirements

No work = No carb supplements, just high fibre and minerals

Working out every day = carbs + protein + minerals + fibre

Energy Requirements for Performance Horses

Performance horses have unique nutritional needs imposed on their body. Exercise can create a change in requirements for all types of nutrients. When feeding a performance horse it is important to realize that horses like people, are different, therefore it is important to know your horse and it's nutrient needs.

Types of exercise

- Exercise can be classified into two different categories:
- aerobic-typical of low intensity, long duration performance in which the horse's heart rate stays below the range of 150 beats per minute
- anaerobic- high intensity, short duration performance in which the horses heart rates are above 150 beats per minute

Aerobic exercise

- During aerobic exercise, energy is supplied in part to the muscle by energy pathways that use oxygen to assist nutrient breakdown.

Anaerobic exercise

- During anaerobic exercise, the intense demands for energy overwhelm the nutrient breakdown pathways which use oxygen; so non- oxygen using pathways must supply energy to the muscle.

Compounds that contain energy

- Energy containing compounds that are produced through nutrient breakdown include glucose and fatty acids
- Glucose can be broken down aerobically and anaerobically
- Fatty acids rely on aerobic pathways
- Energy is supplied to the body through the breakdown of protein, carbohydrates, fat, and fiber

Carbohydrates

- Carbohydrates are versatile energy sources for the performance horse
- horses break down starch into glucose in the small intestine, where it is absorbed into the blood
- once in the blood these glucose units can be catabolized aerobically or anaerobically to produce ATP immediately

Fats

- Fat is a less versatile energy source than starch since it can only be oxidized aerobically to produce energy or stored as body fat
- Fatty acids cannot be converted to glucose or used to synthesize glycogen
- Feeding fat does, however, alter blood glucose and insulin response to feeding and exercise

Fats cont'd

- Fats do supply fatty acids and are found mainly in grain and grain by products

Protein

- If the protein intake of a performance horse exceeds its requirement, then the extra protein can be used as a source of energy
- The amino acids from this extra protein are broken down by the liver, and the nitrogen from the protein is excreted as ammonia
- The carbon skeletons that are left can be oxidized to produce ATP or used to

Proteins

- Excessive proteins should be avoided in the exercised horse for a number of reasons:
- expensive energy source
- water requirements increase with increased protein intake
- urea levels increase in blood
- increased nitrogen excretion in the urine

Fiber

- Supplied in large amounts by forages
- processed by the microbes in the horse's large intestine to produce volatile fatty acids
- VFA are absorbed through the large intestine of the body and are used in various energy pathways in the body

Fiber

- Fiber is not considered a source to supply large amounts of energy for quick replenishment for exercise depletion
- It is an important contributor of energy throughout the day and has added benefits of assisting in proper flow of digesta through the digestive tract

Use of energy containing compounds

- Horses in a net negative energy load are not receiving adequate dietary replacement of energy losses resulting from exercise.
- When this happens horses will mobilize body fat to supply energy to the heart, kidney, and muscles.

- During highly aerobic exercise such as walking, fat and carbohydrates supply the majority of needed energy.
- As intensity of exercise increases, the ability of the body to use fat as energy becomes limited because of the overwhelming of the oxygen dependent pathways.

- The intensity of exercise which causes the oxygen using pathways to become overwhelmed varies among horses and with the specific condition the horse.
- As the horse becomes more fit, the time the horse becomes anaerobic is delayed, allowing for more efficient use of energy

Analyzing rations of energy containing feedstuffs

- Feedstuffs not only differ in energy concentrations, but also in the concentration of starch, fat , and fiber.
- Example:
 - corn is expected to contain about 1.6 Mcal De/lb., 70% starch and 3% fiber while oats are expected to contain around 1.3 Mcal De/lb., 45% starch and 10% fiber

Example

- The oats and hay ration is lower in amount of starch fed per day as compared with the oat-corn ration.
- More of the energy in this ration would be in the form of fiber which is a slower digested energy substrate as compared with fat and starch.

- This provides some basis for the subjective evidence that horses on oats and hay do not perform well during heavy conditioning or intense physical exertion
- Not only does this ration require the most pounds per day of consumption to meet a specific energy need, but the lower starch level might delay replenishing of glucose containing compounds in the muscle.

- Combining a mixed feed with hay such as the second ration increases the starch content of the diet by about a pound per day.
- Adding fat decreases the amount of starch fed per day and increases the amount of fat

- Both fat and starch can be efficiently used as energy, but the ability of each to replenish different fuels for muscular exercise is specific. The added fat diet has the benefit of supplying larger amounts, thus aiding as a guard against weight loss from net negative energy load during intense conditioning programs.

Feeding energy

- There are several considerations for supplying energy to exercising horses:
- ideal body weight
- body condition
- colic and founder

Concerns for feeding exercising horses

- How nutrients are supplied to the horse can be more of a factor to success than what is being fed. Some special concerns for exercising horses include:
 - starch overload
 - timing of feeding

- Body weight regulation

- water

- quality of feedstuffs

- The most important thing to remember when feeding performance horses is that as activity or exercise increases you need to increase only the amount of energy fed.
- Rule of thumb- provide $\frac{3}{4}$ - 1 $\frac{1}{2}$ lb. of grain/100lb of body weight in addition to liberal amounts of good quality hay

- Ration should contain at least 50 % of forage intake
- remember that horses are individuals and vary greatly in their requirements for feed

- Exercise can have a dramatic effect on the nutrient requirements of horses. Nutrition is but one part of athletic performance. It may be the easiest to control but it will not overcome poor genetics or conditioning programs.

- The basic force behind every type of equine performance is the conversion of chemically bound energy from feed into mechanical energy for movement. Energy is the dietary factor most affected by exercise. It is our responsibility as horsemen to make sure our horses receive adequate amounts of feed to meet their needs.

Older Horse Nutrition



When is “old” ?

- Individual variation
- Breed dependant
- Previous use

No tests to confirm.....!!

When is “old” ?

16 ½ years !!!!

What is ageing ?

- Changes in composition, physical strength & physiological function

DIRECT : factors assoc with age-ing

INDIRECT: physical inactivity & degenerative disease

Signs of Ageing

- Loss of mobility
- Failure to maintain body weight
- Loss of teeth / chewing ability
- Deepened hollows over eyes
- Dropping of back
- Greying of hair coat
- Rough, dull coat
- Slow shedding of hair coat
- 'pot – bellied' appearance
- Increase in general infections

Why are horses living longer?

- Better nutrition
- Parasite control
- Veterinary intervention
- Increased owner commitment



Old Horse Conditions

- Pituitary tumours (Cushings)
- Other tumours
- Choke
- Colic
- Eye lesions
- Heart conditions
- Lung disease
- Liver disease
- Tendon / ligament damage
- Increased mortality under GA
(multi factorial)

Older Horse Nutrition

- Ageing is gradual & individual
- Do not change to veteran diet when horse / pony reaches a certain age
- Let your eye, horse condition & performance tell you

Common problems - 1

- Worn, loose or no teeth
- Can no longer chew long length fibres – balling up and falling out of mouth
- Piles of balled up forage around floor under haynet or outside stable door
- Increased risk of colic & digestive problems
- Alternative fibre source may be required

Common problems - 2

- Pain in joints of neck / front feet
- Reduced ambulation & grazing
- Reduced appetite



Common problems - 3

- Heavy worm burdens
- Less resistance to parasites
- Previous worm damage
- Reduced digestive efficiency



Common problems - 4

- Environmental factors
- Live out 24 hours
- Compete with field companions / bullying
- Less resistance to cold weather
- *?perception of acceptance of age & low body weight*

Older Horse Nutrition

- 4 Categories

1. Young at heart

- Maintain weight on balanced diet
- Clinically normal
- Old in years but 'young' in self
- Active & clinically normal

2. Middle-aged spread

- Clinically normal
- Gaining weight
- Old in years – functioning normally
- Reduced level of physical activity
- Tendancy to gain weight

3. The poor doer

- Common
- Clinically normal
- Difficult to maintain weight
- Reduced intake / digestion



4. The golden oldie

- Horse pony over 25 years old
- True geriatric
- One or more physical / metabolic abnormalities as well as old age



Feeding Guidelines

- Clinically healthy older horse



Water

- More prone to impaction type colics
- Clean water buckets
- Ensure not frozen in winter
- Bullying at water troughs



Energy

- Individual requirements
- Usually just Maintenance
- If native – generally hold weight well
- Monitor body weight – especially when “hairy”

Protein

- Protein digestion reduces with age
- Likely have higher requirement for quality protein
- Look for **12 – 14% crude protein**
- *TWICE* that needed for younger animals

Fibre

- Essential component for optimum digestive health
- 50%+ of diet should be fibre
- Slow release energy, gut-fill, warmth in large intestine fermentation, retain water & electrolytes
- Use digestible long fibre sources – good meadow hay or haylage

Fibre cont'd

- Dentition dependant
- Is prehension possible?
- Loose incisors – very painful
- Check fibre particle in droppings – should be smaller than 50p piece
- Observe horse when grazing & feeding from ground

Fibre cont'd

- Haylage can be easier than hay
- Increased moisture in haylage can be good or can be bad
- Need to feed plenty of it
- Usually greater nutritional value

Remember water content (2)



Fibre cont'd

- If long fibre sources too much for individual dentition – short chops next option
- “Dengie Hi-Fi” range can be fed ad-lib as complete hay replacers
- Other factors determine which one most suitable (eg – laminitis)

Short Chop Length Fibres



Fibre cont'd

Common problem with short chops :-

UNDER – FEEDING

- Weigh very little
- Follow instructions to feed adequate amounts

Fibre cont'd

- When short chops too difficult – pelleted fibre feeds are next step.
- Often need mashing
- Faster transit time, but better than no fibre
- Slow consumption by adding small quantity of short



Pelleted Fibre Feeds



Fibre cont'd

Dentition

Good

Moderate

Poor

Fibre Source

Soft hay / haylage

Chopped Fibre

Pelleted / complete
feeds

“Fibre Checklist”

1. Watch horse feeding from ground & grazing
2. Examine fibre particles in droppings
3. “Palm test” on hay

1) Watch Horse Feeding



2) Examine Droppings



3) Palm Test on Hay



Oil

- 2 ½ times energy of cereals
- Useful for weight gain
- Look for feeds **>4% oil**
- **OR** – supplement oil
- Add gradually – fresh vegetable oils
- The '100 Rule'

Oil

100ml oil

Per

100kg bodyweight

With

100 i.u. Vitamin E

Minerals

- If on forage only diets, a good broad spec vit / min supplement needed
- Supplement B-vitamins
- Unfit / Full coat / Cushings => sweating



Antioxidants

- Role in horses less well defined
- High intakes may have a protective effect
- Vits E & C
- Selenium

Joint Support

- Little scientific evidence (yet)
- Response may be individual in nature
- Glucosamine / possibly chondroitin

Purchased feeds

- Veteran diets
- Balanced
- Highly palatable
- Soft mixes
- Consistent
- Process often increases digestibility

Choke

- Chopped & pelleted feeds
- Pre-soak in water
- If 'bolting' by greedy animals – add chopped fibre



Management Considerations

- Regular dental care
- Monitor bodyweight
- Regular foot trimming
- Good worming programme
- Diet selection
- Choose field companions carefully
- Choose a flat field / paddock
- Attention to respiratory health

Management Considerations

- Extra feeds in individual corrals
- Raise feed buckets
- Pain relief
- Soaking feeds

Information Development

Much effort and time was devoted to:

- developing accurate/current information
- incorporating appropriate pictures/graphics
- providing proper credit of pictures/graphics
- obtaining user/educational permission

Any and/or all errors, omissions, etc. are purely unintentional and/or accidental.

This presentation was developed for use as resource and is provided as an educational service. User and/or purchase fees are not associated with this presentation.

Feeding Management

- Feed at the same time each day
- Feed horses on an individual basis
- Feed horses at least twice daily or if confined, allow access to hay throughout the day
- Horses need some amount of fiber in their diet daily (minimum of 1% of body weight in hay)
- Feed horses grain only if needed - growing, hard working or lactating horses
- Change diets gradually: over at least 4-5 days

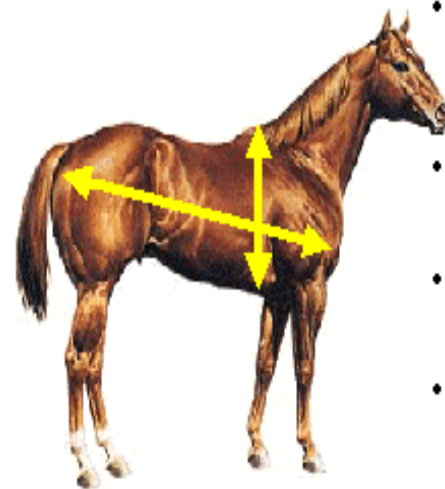
Practical Feed Management

- Determine the activity- Make A Plan!
- Determine the horse's Condition Score
- Determine the horse's fitness level
- Determine the increase in feed needed for the activity level
- Increase workload and feed gradually
- It takes about 6 wks or more to go from an unfit state to a fit and functional state

Body Condition Score

- Body Condition Score is based upon how much fat the horse is carrying
- The scoring system uses a scale of 1 to 9
- Useful to group horses for feeding management

Equine Weight Estimates



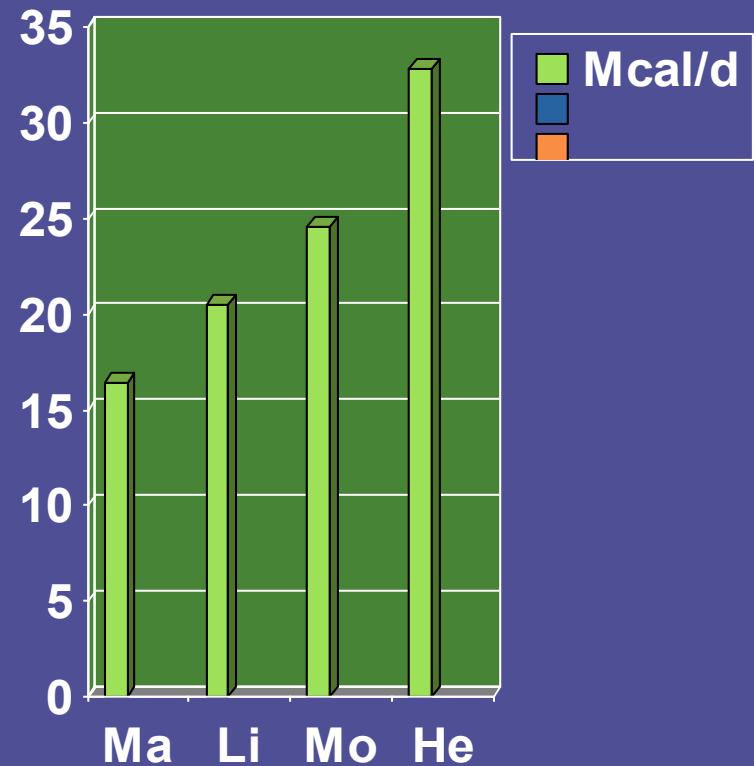
- Measure horse from point of chest to point of croup in inches = length
- Measure horse's heartgirth or circumference in inches
- $(\text{heartgirth} \times \text{heartgirth} \times \text{length} / 300) + 50 = \text{weight}$
- $(((70" \times 70")65")/300)+50] = 1,111 \text{ lbs. } (+/- 3\%)$

Feeds & Nutrition - Ensminger & Olentine

members.aol.com/CRTtrust/PONYSEX.html

Energy Requirements

- **Maintenance:**
Rest, No Work/Use, etc.
- **Light Work:**
Pleasure, Trail, etc.
- **Moderate Work:**
Longer and/or Harder Rides,
Light Ranch Work, etc.
- **Heavy (Intense) Work:**
Heavy Ranch Work, Racing,
Polo, etc.



Nutrients

- Water
- Protein
- Vitamins
- Minerals
- Energy Yielding Nutrients
 - Carbohydrates
 - Fats

Water

- The most important nutrient
- Important for nutrient digestion, nutrient absorption, and temperature regulation
- Obtained by drinking and from feeds
- Consumption varies according to need
 - Maintenance: 4-10 gallons/day
 - Heavy Work: 20 gallons/day

Protein

- Protein is commonly measured in the diet in the form of Crude Protein (CP)
- Protein commonly makes up 7-20% of the horse's diet
- Protein is required in a greater amount for young and growing animals
- Provides amino acids for building and maintenance of muscle, bone, enzymes, and hormones

Protein

- Amino acids in protein are required in the diet (essential) or can be made from other amino acids supplied by protein (non-essential)
- Lysine is considered to be the first limiting amino acid- young growing animals need adequate lysine
- High concentration of protein in legumes (alfalfa, soybeans) and seeds (especially oil seeds)
- Protein is expensive - therefore we balance rations to not overfeed protein

Vitamins: General Principles

- Vitamins are generally needed in small amounts
- Vitamins are important factors and/or co-factors for chemical reactions in the body
- Horses receive vitamins from high-quality hays and grains....however, hays stored over 1 year usually lose a great deal of vitamin activity
- Vitamins are fat -soluble (A,D,E,K) or water-soluble (B vitamins and C)
- Fat soluble vitamins can be stored in fat or liver; water soluble are not stored in the body

Vitamins: Specific Aspects

- Vitamin A (essential for vision): usually present in high-quality leafy forages or through grazing; can be stored
- Vitamin D (essential for Ca absorption & bone growth): can be obtained through sunlight or UV light exposure and feeds
- Vitamin E (important for its antioxidant properties - to keep cell membranes healthy): found in high quality hays and grains

Vitamins: Specific Aspects

- Vitamin K (important for blood clotting): found in high quality forages and intestinal bacteria, can be synthesized
- B vitamins: usually supplied in adequate amounts in good quality feeds; B 12 is synthesized by bacteria in cecum and colon
- THIAMIN: the only B-vitamin that may need supplementation
- Vitamin C: not considered dietary essential because it can be made by the horse

Minerals

- Required in very small amounts (ppm)
- Inorganic elements required by the body for chemical reactions and structure/foundation (bones and teeth)
- Macrominerals (required in greater amounts)
 - Ca, P, Mg, Na, Cl, S, K
- Microminerals (required in smaller amounts) -
 - Cu, Zn, I, Fe, Mn, Se

Minerals

- Calcium & Phosphorus - important in bones and teeth plus metabolic functions (i.e. muscle contraction)
- We balance rations for Ca and P
- Ca is present in moderate/high levels in hays/forages
- P is present in moderate levels in grains
- The absolute amount as well as the ratio of Ca:P is important in horse diets
- Normal dietary requirements of Ca:P is about 1.43:1
- The Ca:P ratio should never be less than 1:1; or over 3:1 in young horses, 6:1 in mature horses

Minerals

- Sodium (Na) and Chloride “salt” (important in osmotic balance): not enough present in normal feeds (supplementation); usually add .5% - 1% to horses diet or free-choice
- Magnesium (important for bones and metabolism): found in normal feedstuffs
- Sulfur - usually not a problem; horses tend to get enough S from S-containing amino acids
- Potassium (important in intracellular action): potassium is relatively high in forages

Minerals

- Cu, Zn (important for connective tissue and skin integrity): need to watch levels in growing horses; too much Zn can cause Cu deficiency
- I (essential for T3 and T4 that control basal metabolism): usually adequate in feed with iodized salt - can be over-fed!
- Fe (component of hemoglobin): usually adequate in feedstuffs
- Se (detoxification of substances that are toxic to cell membranes): can be toxic in soils in some areas, can also be deficient
 - Req: 0.1 mg/kg of diet
 - Toxic: 2.0 mg/kg of diet!

Energy Providing Nutrients

- Carbohydrates & Fats
- Carbohydrates are typically the most common source of energy for horses
- Energy is the fuel for all body functions
- Grains are considered a high energy source
- There has been some work with feeding additional fat to horses (up to 12% of ration)

Choosing Grains & Hays

Grains:

- Corn, Oats, Barley, Sorghum, Wheat
- Clean, Plump
- No Fines
- No Dust, Mold or Foreign Objects

Hays:

- Legume or Grass
- Leafy, Green, Small Stems
- No Mold
- Minimal Dust or Foreign Objects

Hay: Quality & Nutrition

Photos: Unknown Source

Stems



Mature



Good



Suckling Foals and Weanlings

- Suckling foals 3 to 4 months old need usually need no supplementation
- After 4 months start foals on type of concentrate they will be fed as weanling
- Foals should consume 6 to 8 pounds of concentrate per day and 1 pound of hay per 100 body weight at weaning time

Yearlings and Two Year Olds

- .5 to 1 pound of grain per 100 pounds of body weight
- 1 to 1.5 pounds of hay per 100 pounds of body weight
- Feed for desired condition and workload

Mature Horse

- Idle---1.5 to 1.75 pounds of hay per 100 pounds of body weight, requires 0.5 to 0.75 pounds of high protein supplement
- High Work Load---0.5 to 1.75 pounds of grain and 1 to 1.5 pounds of hay per 100 pounds of body weight

Pregnant and Lactating Mares

- First Half---1.5 to 2 pounds of hay per 100 pounds of body weight and 0.5 to 0.75 pounds of high protein supplement
- Last Half---0.5 to 1 pound of grain and 1 to 1.5 pounds of hay per 100 pounds of body weight
- Lactating---1 to 1.5 pounds of grain and 1 to 1.5 pounds of hay per 100 pounds of body weight.

Horse Nutrition:

Summary

- Feed according to body condition
- Feed according to work performed
- Feed twice a day
- Need a minimum of 1% of weight in hay
- Water should always be clear and cool preferably given before feeding
- Feed changes should be gradual

Muscle Disorders

- Equine rhabdomyolysis syndrome
- Polysaccharide storage myopathy

PSSM

- Any age, breed, gender
- Sign: partial or complete inability to move, profuse sweating, and elevated respiratory rates during or after exercise
- PSSM is identified by an accumulation of phosphorylated glucose, glycogen, and an abnormal polysaccharides in the skeletal muscles. Horses will often show signs of PSSM at a young age,

Laminitis

Founder or lameness, especially of the forefeet

Genetic differences in susceptibility

Exposure to black walnut

Inflammation of the sensitive laminae of hoof

Nutritional etiology- carbohydrate overload of hindgut

Grain or lush pasture (overloading)

Grain with low pre-cecal digestibility

Microbial growth increases lactate and microbial toxins

Laminitis (con't)

**Preventative nutritional intervention
includes:**

**Avoid sudden exposure to lush pasture or
grain**

**Maintain susceptible animals on dry feed
such as grass hay**

**If grain mix is used, factor in pre-cecal
digestibility and glycemic index**

**If grain is fed, feed using Virginiamycin as an
additive**

Azoturia

Characterized by dark, sweet-smelling urine, myoglobinuria, severe muscle cramping (tying up), animal is stiff and sore and in great pain

A genetic condition may predispose horses to this condition (improper use of glycogen)

Associated with hard exercise and forced immobility

Vit E and Se deficiency and electrolyte imbalance may predispose horses to it

Azoturia nutritional intervention

Feed balanced ration in small meals to avoid excess glycogen storage

Feed a low – energy diet with added fat and avoid grain

Feed high-quality alfalfa hay but make sure to balance for Ca and P

Starvation and Neglect

Detrimental effects on the immune system, digestive tract health, healing and body score

Feeding a starved, neglected horse (Stull, 2003)

Days 1-3 one pound of leafy alfalfa every 4 hours

Days 4-10 increase amount of alfalfa to four pounds every 8 hours by day 6

Day 10 to several months feed as much alfalfa as the horse will eat twice a day. Provide a salt block. Do not feed grains or supplements until the horse maintains a normal body score

Colic

Generic term for abdominal pain caused by distension of the gastrointestinal tract

Many causes of colic are related to the diet
Impaction

Due to reduced water intake

Poorly digestible feeds

Ingestion of sand

Sudden diet changes

Poisonous plants

Colic (cont)

Gas- from fermentation

Consumption of lush green forage or grain

**Sudden change to a much lower nutritional
plant**

**Irritation of gastrointestinal tract or
alteration of motility**

Poisonous plants

Blister beetles in hay

Possible Causes of Colic

**Feeding unwholesome feeds Horses bolt
their feed Overfeeding**

**Irregular feeding schedule One large meal
per day**

**Diet changes without a transition period
Inability to vomit**

Vitamin deficiencies

Se and Vit E

White muscle disease and steatitis in foals

Reproductive failure and azoturia in adults

**Equine motor neuron disease due to low
plasma vit E White Muscle Disease**

stiff, stilted gait, hopping in rear legs

**Necropsy shows mottled white patches of
gritty feeling muscle**

Selenium deficiency

In presence of adequate vitamin E

Generalized steatitis

**Subcutaneous fat is grossly tan and appears
necrotic**

- **Biotin deficiency**

Hoof wall problems

Low in grains

**corn and soybean meal > oats > wheat, barley and
milo**

Bacteria in gut generates avidin which binds biotin

Foal Diarrhea

Foal diarrhea is most common during the first 2 wk of life, when foal immune systems are weak and foals are susceptible to dehydration caused by the diarrhea.

Treatment is frequently expensive, so a dietary supplement that could significantly reduce the occurrence or severity of foal diarrhea would be highly practical.