VITAMINS

Equine Nutrition #9

Created for Canadian Pony Club Education by Lezah Williamson

Vitamins

- Vitamins are organic compounds
  - They are required as vital nutrient
  - Needed in limited amounts
  - Have diverse biomechanical functions
- Are classified by biological and chemical activity, not structure

Purpose of Vitamins

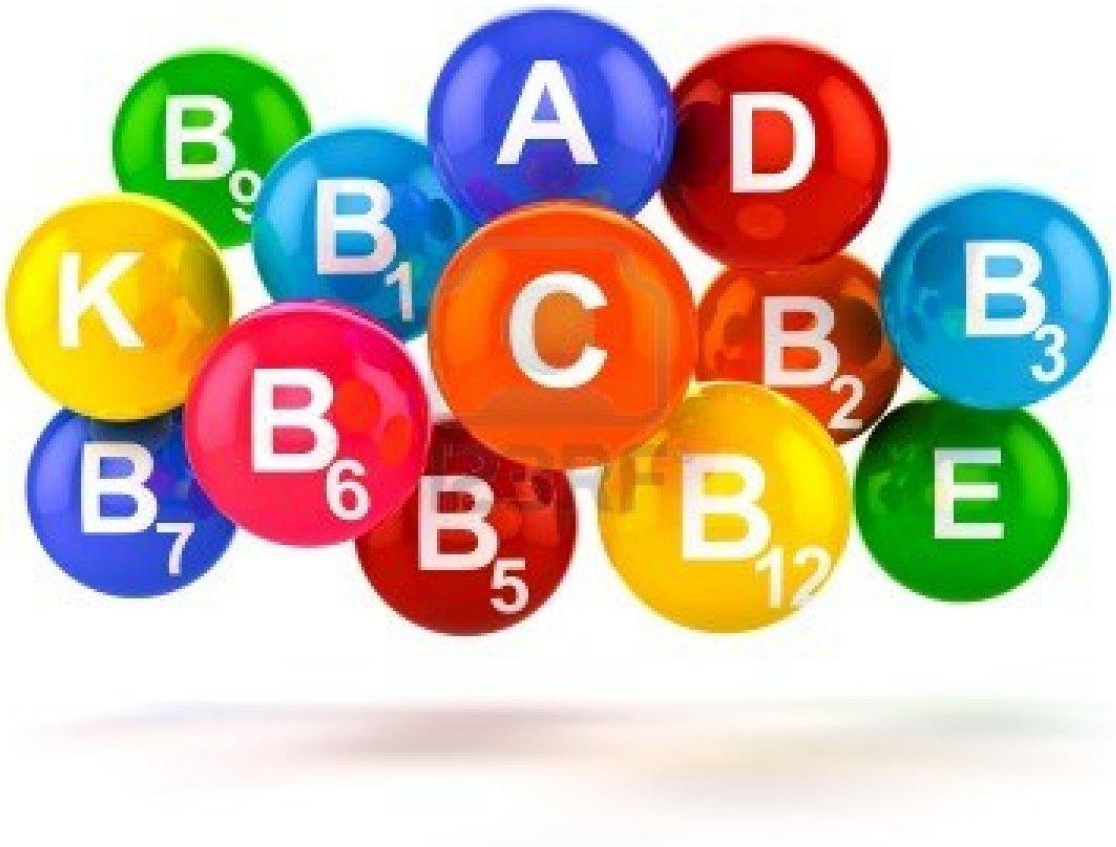
Some have hormone-like functions as regulators in mineral metabolism

- Regulate cell and tissue growth and differentiation
- Antioxidants
- Precursors for enzyme cofactors
  - Help enzymes work as catalysts for metabolism
  - May be bound to enzyme as part of prosthetic groups
- Coenzymes: detachable molecules that function to carry chemical groups or electrons between molecules

A Brief History of Vitamins

- Vitamins were not discovered until the 20th Century
- The first vitamin to be discovered was vitamin A in 1913
- Scientists attempted to create a framework to organize the vitamins by

The Vitamins



List of Vitamins

- A – retinol, 4 carotenoids, including beta carotene
- B1 – thiamine
- B2 – riboflavin
- B3 – niacin
- B5 – pantothenic acid
- B6 – pyroxidine, pyridoxial, pyridoxamine
- B7 – Biotin
- B9 – Folic Acid, folicin
- B12 – Cobalamin
- C – Ascorbin Acid
- D – Calciferol
- E – Tocopherol
- K - Phylloqinone

Water Soluble vs. Fat Soluble

- Water soluble vitamins can be dissolved in water
- Excesses are expelled daily
- Deficiencies can occur
- Vitamin B complex and Vitamin C are the water soluble vitamins

- Fat soluble vitamins can be stored in fat
- Surplus amounts can be stored for up to 6 months in fat and liver cells
- Excesses are possible
- Vitamins A, D, E and K are the fat soluble vitamins

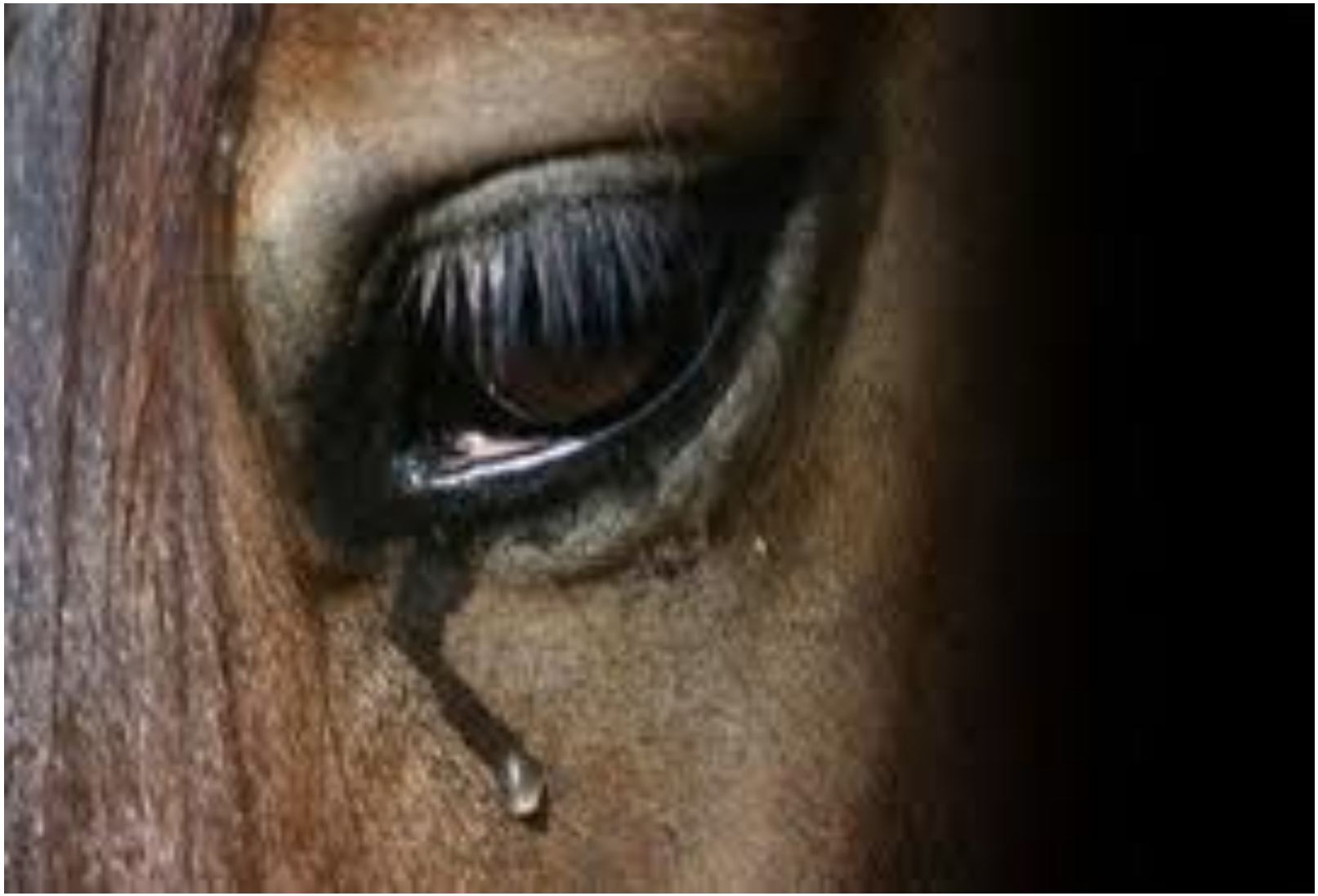
Vitamin A

- Converted from dietary carotene
- Produced by the horse's own metabolism
- Sources
  - Green pastures
  - High quality hays
- Functions
  - Maintaining soundness of epithelial tissues in:
    - Respiratory system
    - Digestive tracts
    - Reproductive tracts
  - Important for eye function, healthy skin and hooves
  - Regulates bone remodeling

Vitamin A Deficiency

- Deficiencies:
- Can be found in stabled horses
- Night blindness; excessive tears; photophobia
- Progressive weakness; decreased growth
- Prolonged shedding; rough, dry hair coat
- Impaired intestinal absorption; impaired deposition of mineral into bone
- Susceptibility to pneumonia and respiratory infections

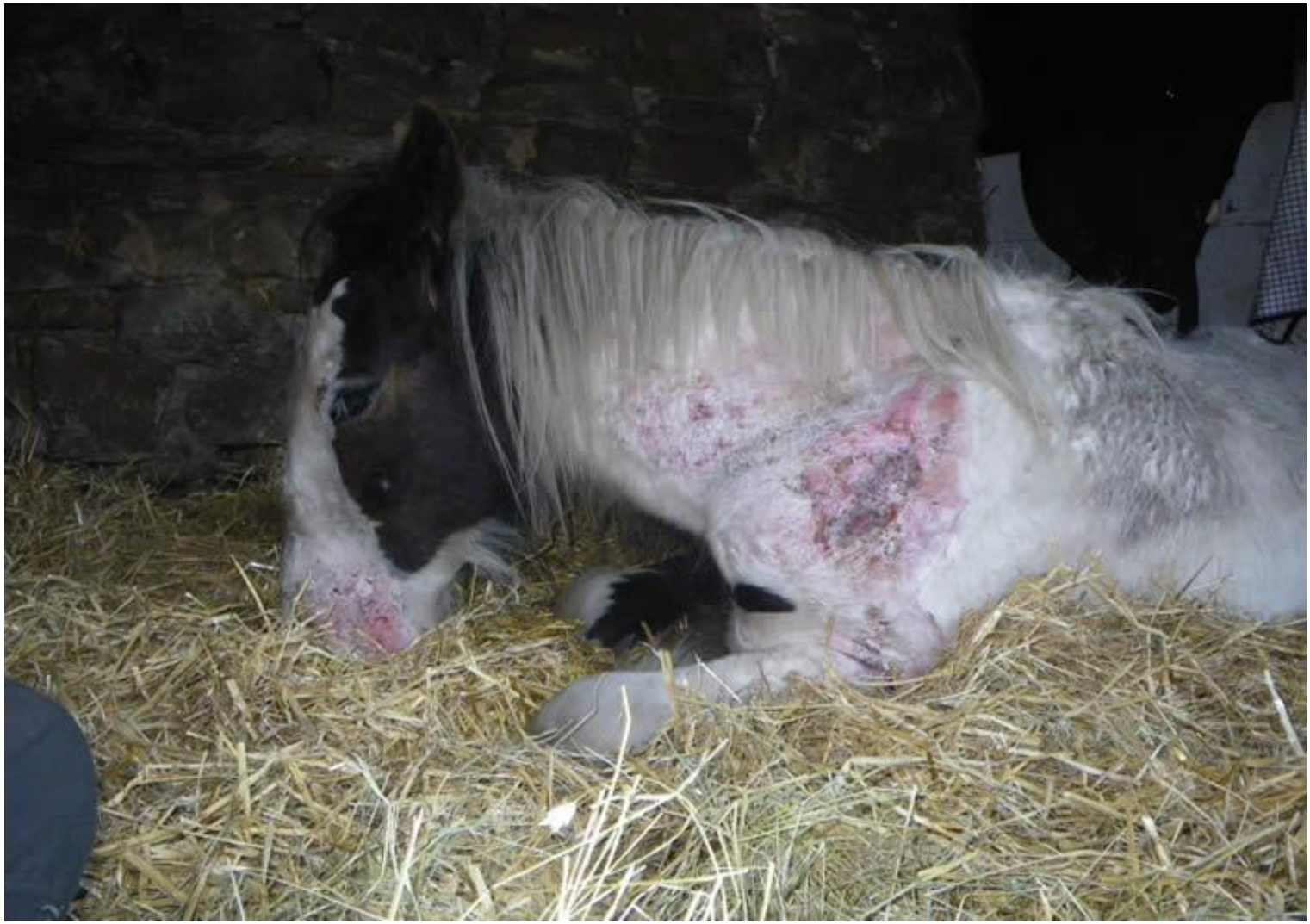
Vitamin A deficiency can cause excessive tearing and other eye issues



Vitamin A Toxicity

- Bone fragility
- Abnormal bone growth
- Unthriftiness; depression
- Poor muscle tone; in-coordination
- Rough hair coat; hair loss; sloughing off of epithelial tissues on both inner and outer body surfaces

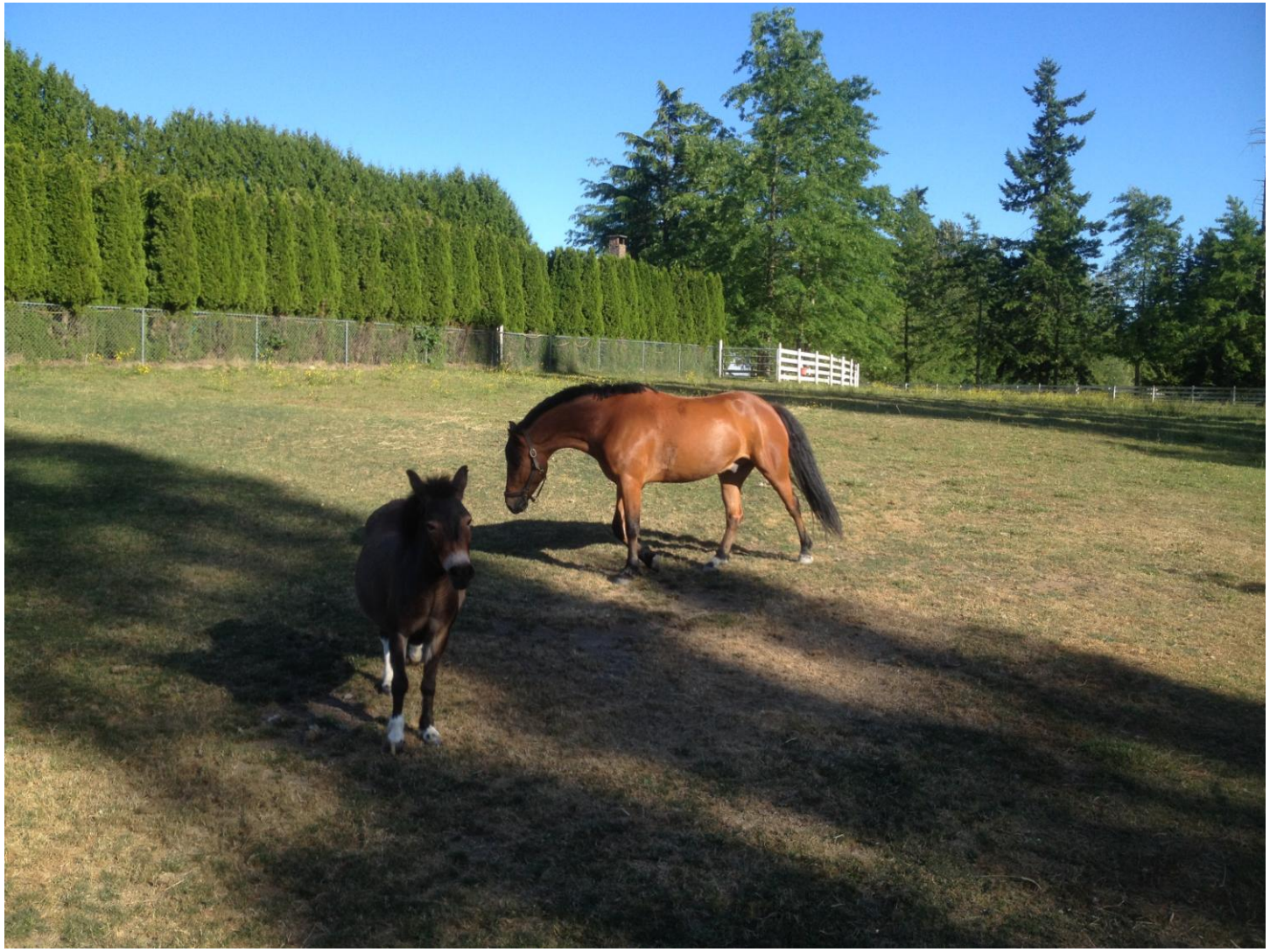
Vitamin A toxicity can cause skin sloughing and rough hair coat



The B complex

- The B Complex vitamins function as coenzymes
  - Responsible for the metabolism of carbohydrates, fats and proteins
  - Produced in the large intestines
  - Any disruption in the large intestine can disrupt the production of B vitamins

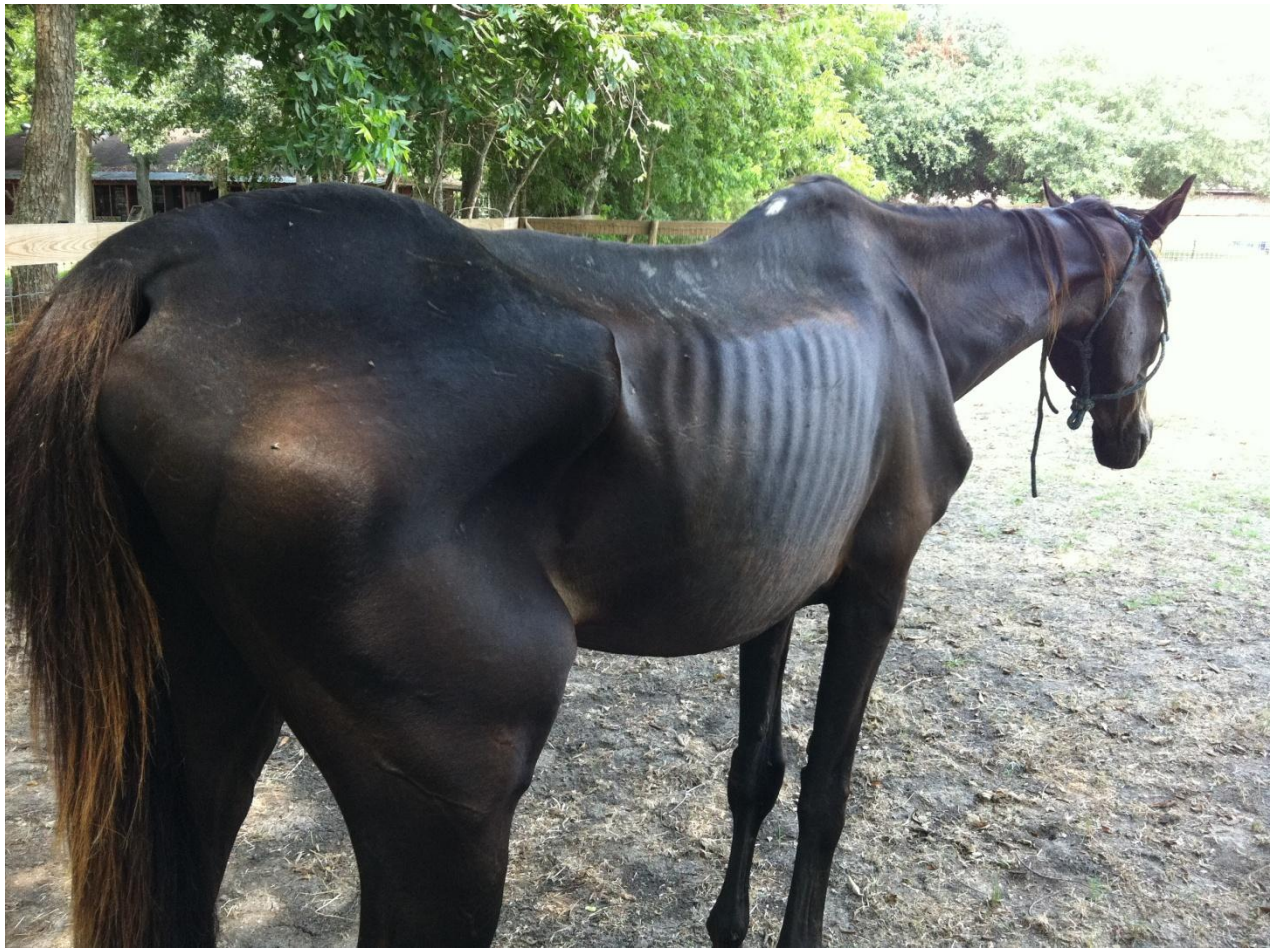
B-Complex: found in hay/pasture



B1 - Thiamine

- Functions:
  - Carbohydrate metabolism
    - Helps carbohydrates release energy
  - Proper functioning of the nervous system
- Source:
  - Good pasture and high quality green leafy hay
  - Brewer's yeast
- Deficiency:
  - Bradycardia (slow heart rate) and arrhythmia
  - Ataxia and localized muscular contractions
  - Appetite loss and weight loss
- Toxicity:
  - Very unlikely

B1 deficiency can cause loss of appetite and weight loss



B2 - Riboflavin

- Functions:
  - Essential for energy metabolism
  - Essential for nervous system function
- Source:
  - Green leafy hay (particularly legume) and pasture
- Deficiency:
  - Rough hair coat; atrophy of skin and hair; dermatitis
  - Conjunctivitis
  - Photophobia and excessive tears
- Toxicity:
  - Very unlikely; can consume 20X the recommended requirement without issue

B3 – Pantothenic Acid

- Function:
  - Constituents of several important coenzymes
  - Plays a part in protein, carbohydrate and fat utilization
- Sources:
  - Microbial synthesis
- Deficiency:
  - Unlikely if horse has access to high quality hay or pasture
- Toxicity:
  - Has never been documented

B6 - Pyroxidine

- If deficient in B6, tryptophan (and essential amino acid) cannot be utilized

Choline

- Functions:
  - Transportation and metabolism of fats
  - Builds and maintains structure of cells
  - Transmits nervous impulses
  - Related to the level of methionine (essential A/A)
- Sources:
  - All natural fats contain choline
- Deficiency/Toxicity:
  - Has not been documented

Biotin (aka Vitamin H)

- Functions:
  - Works as a coenzyme in metabolism of carbohydrates, fats and proteins
  - Can improve hoof growth or tensile strength
- Source:
  - Supplements
- Deficiency/Toxicity:
  - Has never been documented
  - Moldy feed can 'tie up' this vitamin and make it less accessible

Tensile strength of hoof wall can be improved with biotin

Folacin (aka Vitamin M)

- Folacin molecules contain para-amino-benzoic acid (PABA)
- Functions:
  - Cell metabolism
  - Red blood formation
  - Acts as a coenzyme for several enzymes involved in metabolism
- Sources:
  - Synthesized in cecum and large intestine
  - Green leafy hay or pasture
- Deficiency/Toxicity:
  - Has not been documented

B12 - cobalamin

- Functions:
  - Assist in production of red blood cells
    - Helps prevent anemia
  - Utilization of carbohydrates, fats, and proteins
  - Assists in conversion of propionic acid (VFA)
- Source:
  - The only B vitamin not produced by plants
  - Synthesized in the cecum and colon, in conjunction with cobalt (a mineral)
- Deficiency/Toxicity:
  - Has not been documented

Vitamin C

- Functions:
  - Proper formation of collagen and lysine (AA)
  - Interacts with iron and B-complex vitamins
- Sources:
  - Synthesized in the liver and other body cells
- Deficiency/Toxicity:
  - not reported in horses

Vitamin D

- Functions:
  - Promotion of proper absorption, transportation, and metabolism of calcium and phosphorous
- Sources:
  - Sunlight
  - Sun-cured hay
  - Found in plants only AFTER they have been cut and exposed to sunlight

Vitamin D Deficiencies and Toxicity

- Deficiency:
  - Deficiencies are highly unlikely and have only been observed under experimental conditions
  - Reduced growth, reduced mineralization of bone, high amounts of Calcium excreted with feces
- Toxicity:
  - Calcium deposition in soft tissues
  - Loss of joint function
  - Enlargement of head
  - Calcification of soft tissues

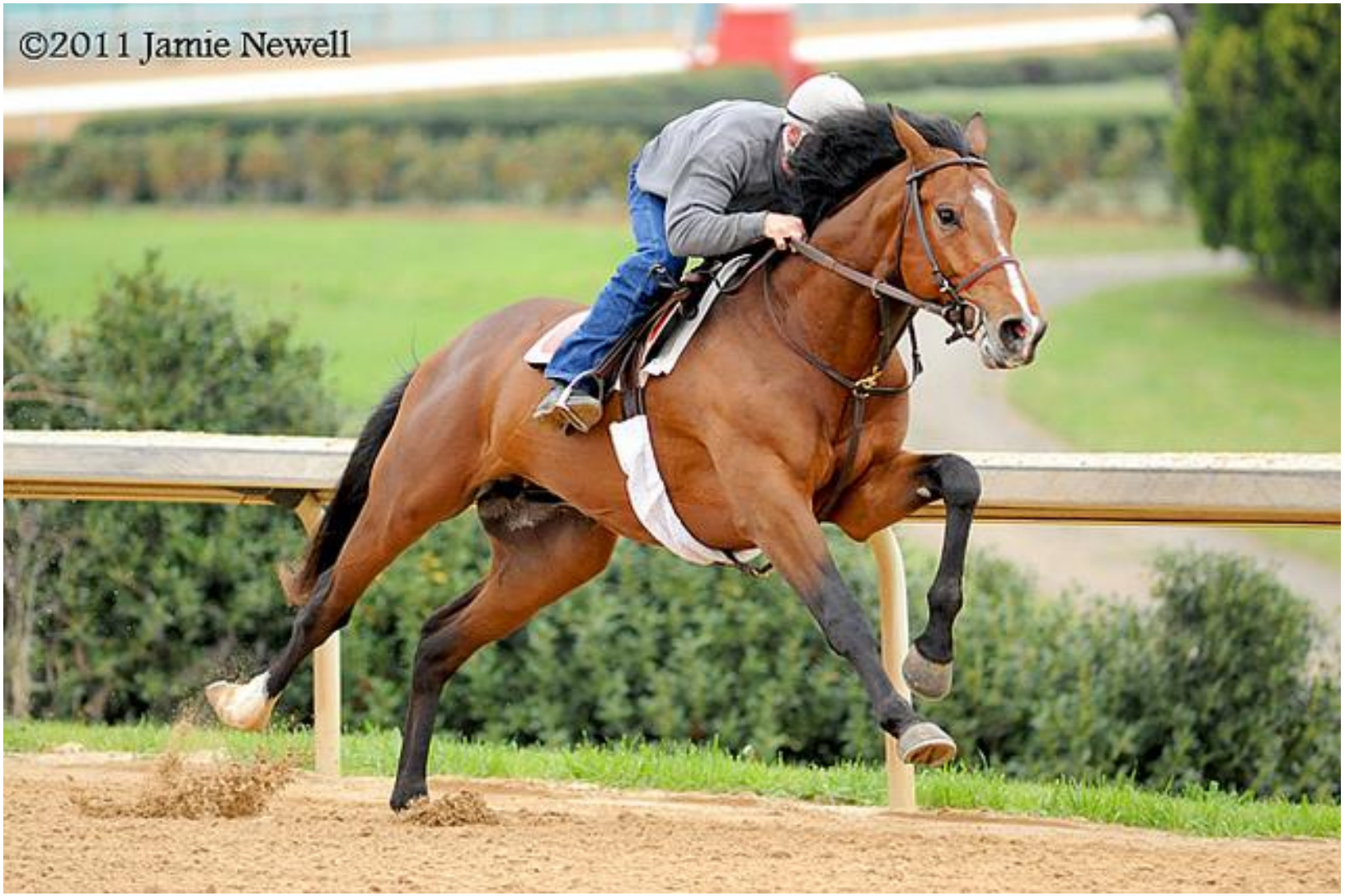
Vitamin E

- Function:
  - Required for normal cell structure
  - An antioxidant
  - Growth and muscle development
  - Oxygen transport
  - Red blood cell stability
- Sources:
  - Green growing forages
  - Good quality hay
  - Cereal grains
  - Wheat germ oil
  - Legume hays

Vitamin E and its role in exercise

- Role in exercise:
  - During intense exercise, large amounts of oxides are produced in skeletal and cardiac muscles
  - Vitamin E combines with oxygen to act as an antioxidant
  - This protects all cells and red blood cells, which are very susceptible
  - Acts as a vasodilator
    - Opens up blood vessels, allowing blood to move more freely
  - Works in conjunction with selenium to remove peroxide from body

Vitamin E plays a critical role in intense work



Vitamin E Deficiencies and Toxicity

- Deficiency:
  - Swollen joints
  - Fragmentation of muscle tissue
  - Ataxia
  - White Muscle Disease
  - Linked to a form of Wobbler's Syndrome
    - Very similar to selenium deficiency
- Toxicity:
  - Has never occurred

Vitamin K

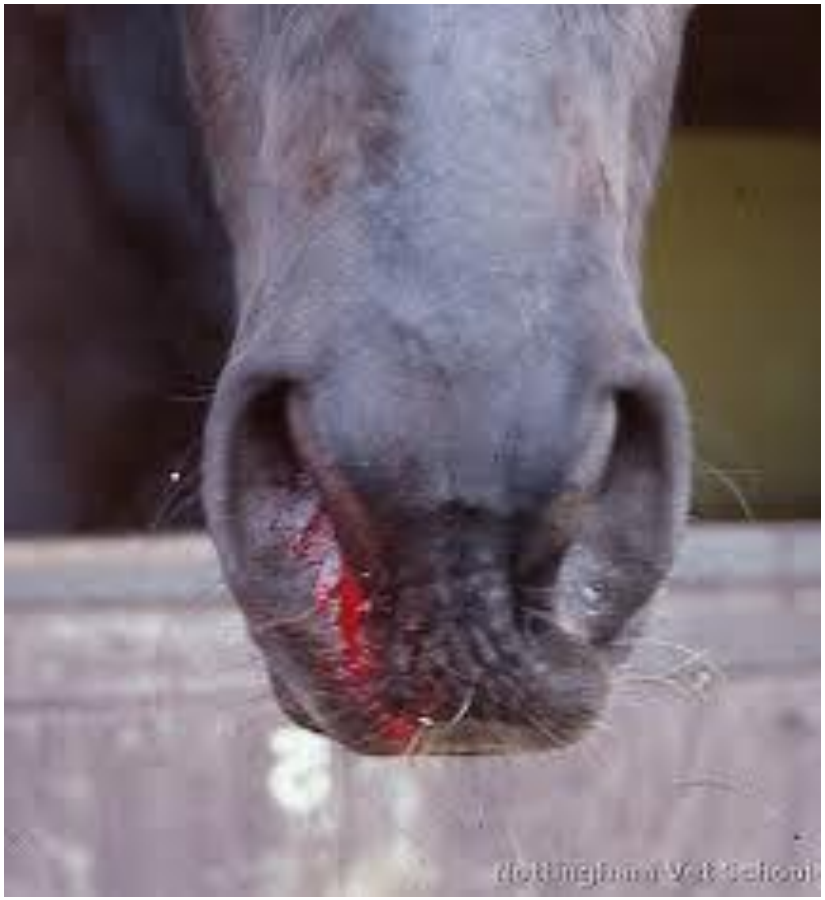
- Functions:
  - Promotion of normal blood coagulation
  - Prevention of hemorrhage
  - Required for growth
- Sources:
  - Phylloquinone from green, leafy plants
  - Flora in the hindgut

Vitamin K Deficiency and Toxicity

- Deficiencies:
  - Not frequently seen
  - Low thrombin levels
  - Increased clotting time
  - Hemorrhage more easily
- Toxicity:
  - Very unlikely

Vitamin K promotes coagulation

Nosebleed



Hemorrhage

Questions

- 1. What are vitamins?
- 2. Where do vitamins come from?
- 3. Compare and contrast water soluble versus fat soluble vitamins.
- 4. Which vitamin needs cobalt as a part of its structure?
- 5. Which vitamin works closely with selenium?
- 6. What are the symptoms of a vitamin A deficiency?
- 7. Which vitamin helps with blood clotting?
- 8. Which vitamin helps with calcium absorption?