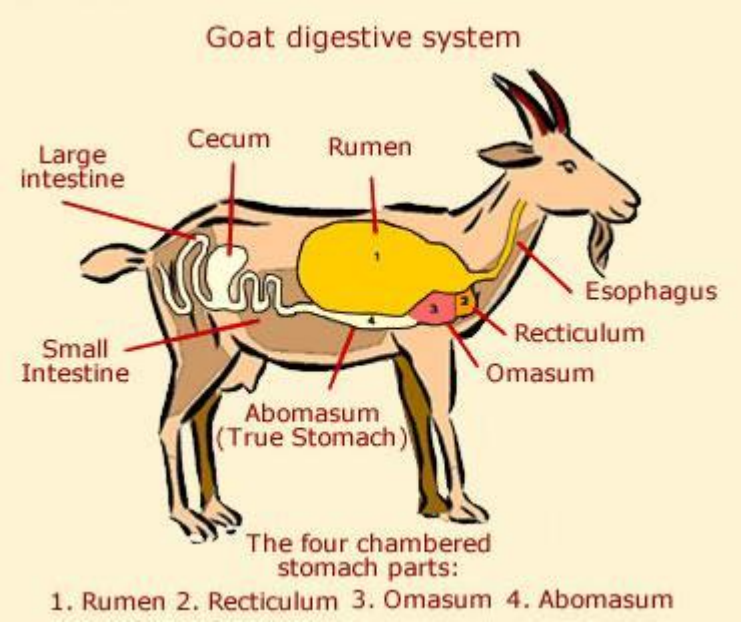
Science of Veterinary Medicine



Digestion Unit Handouts

Name: _____ Date: _____ Period: _____

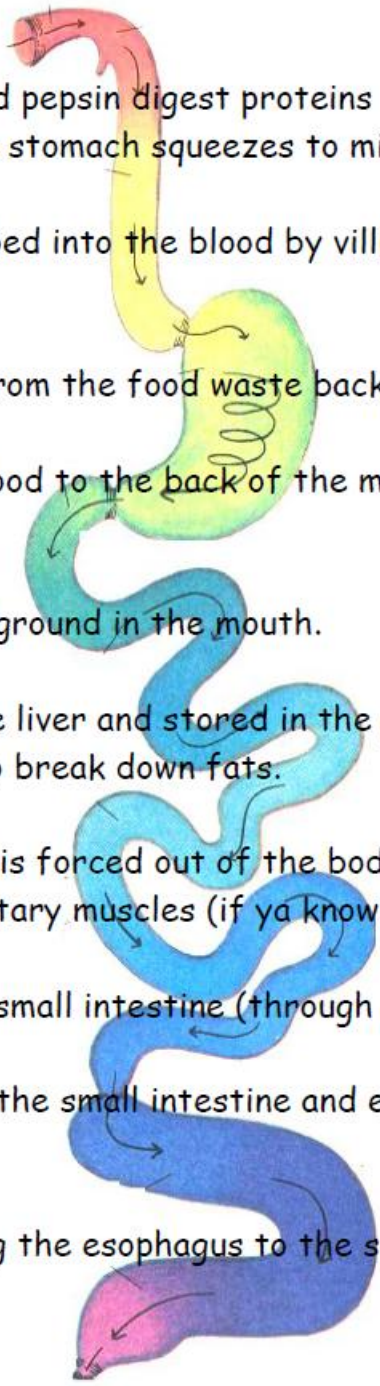
Digestive System

S A E R C N A P M E S L D S F R R J K Q P R E N C
T T Z L J X S R P U M S H M B W E F T K S T M O H
V A K I K W R K S S E E N K I R V O S M A O E I E
I H S N J Y C I I G N L C U E S I B S T R N T T M
L P N T G B N G Z R M I I H H S L L I L S C A I I
L R G H E Z P Y Z S A Z E A A C A G G P P M B R C
I W G T V U R I D D U M F T R N R L E W U F O T A
E N I T S E T N I L L A M S O U I R Y L K D L U L
S A B S O R P T I O N A J L G R I C U M U S I N G
R U M I N A N T S X T D A E H S P C A O A R S X S
S L G I U Q K A H S K R R T T K I O D L H E M G A
J L C A T O L W E R G Z U A A T K E C S J F O E G
J I T H H I J G H E K O L X E W N R S U B F M L Z
T Z T I V P I H I D M I B R U U W E F F M U A J C
D Q Y A E D O N U D C F U H M W Z O B V S B S U G
N W V R B D T S P A W C T E K Z L Y N R R R U M L
P K W A B E R M E L A C B C C X C C X A I A M Q Q
F F R Y S J S N R B I B P X N C G P W B T H Q M M
N O I T S E G I D L P P O M U C E C M W V E C I O
O J I S J O J W Q L T A A M J E J U N U M L Q E S
O N T L G H D Y Y A R N J S A I R F N R W N F W Q
E I R W O X B Y E G X Z M P E S U Y W Y L E U N W
L O R J S Z J V B C P H E Q U U U Q E E N X F Z A
D R I U N O V F W B B N G L O D C M R U M E N Z Z
I N A I Z P R U S M H M C B O T J N R H F Q T E U

Abomasum
Absorption
Amylase
Buffers
Cecum
Chemical
Digesta
Digestion
Duodenum
Esophagus
Gallbladder
Ileum
Jejunum
Large Intestine
Lipase
Liver
Mechanical
Metabolism
Mouth
Mucoproteins
Nutrition
Omasum
Pancreas
Peristalic
Regurgitate
Reticulum
Rumen
Ruminants
Saliva
Small Intestine
Taste
Villi

Write these steps of digestion in their proper order. They are all messed up here.

Summary of Digestion



- Hydrochloric acid and pepsin digest proteins in the stomach. The stomach squeezes to mix food.
- Nutrients are absorbed into the blood by villi in the small intestine.
- Water is absorbed from the food waste back into the body.
- The tongue pushes food to the back of the mouth where it is swallowed.
- Food is chopped and ground in the mouth.
- Bile (produced by the liver and stored in the gallbladder) enters the small intestine to break down fats.
- Solid waste material is forced out of the body by action of both voluntary and involuntary muscles (if ya know what I mean).
- "Food" moves to the small intestine (through the duodenum).
- Waste (food) leaves the small intestine and enters the large intestine.
- The food moves along the esophagus to the stomach.

The Digestive System is a Giant Food Processor

Mechanical Digestion

Food is chopped and ground into small pieces in the mouth.

Chemical Digestion

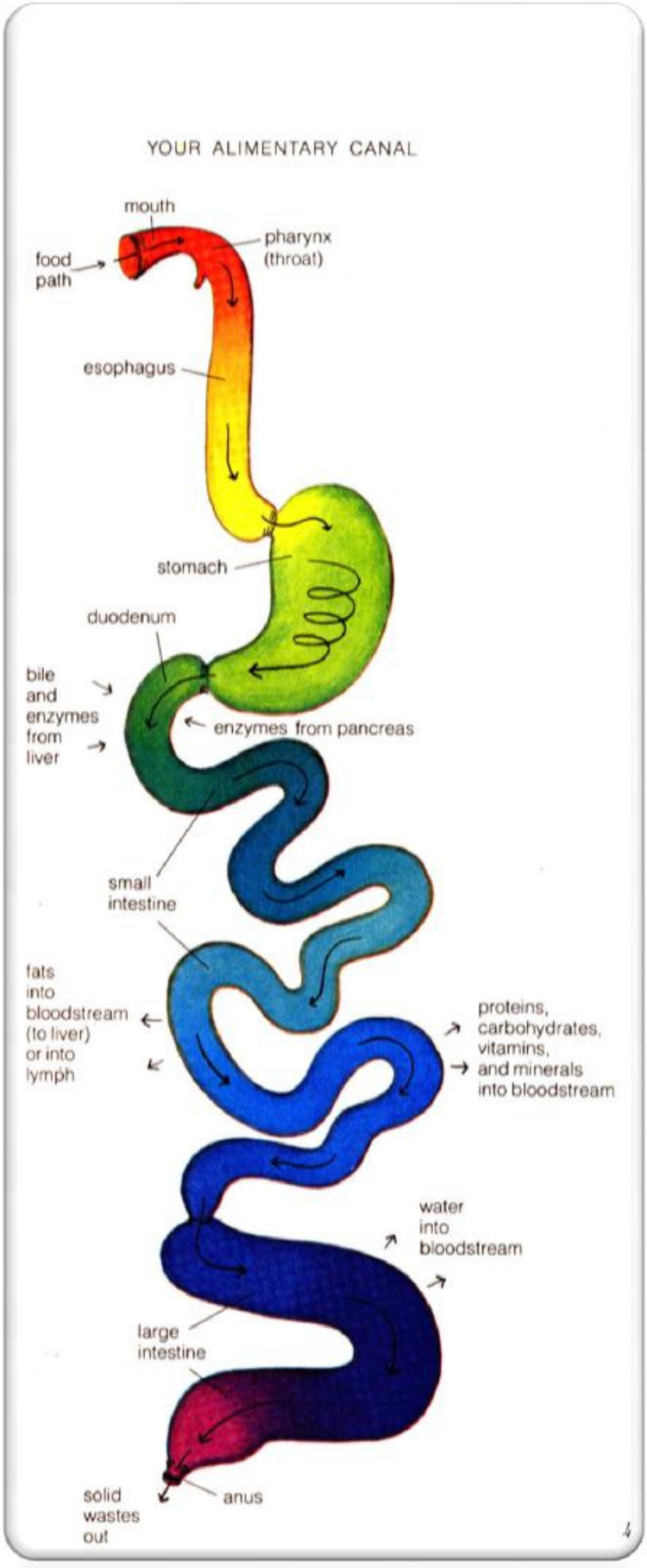
Food is broken down into simple nutrients by the chemical action of enzymes.

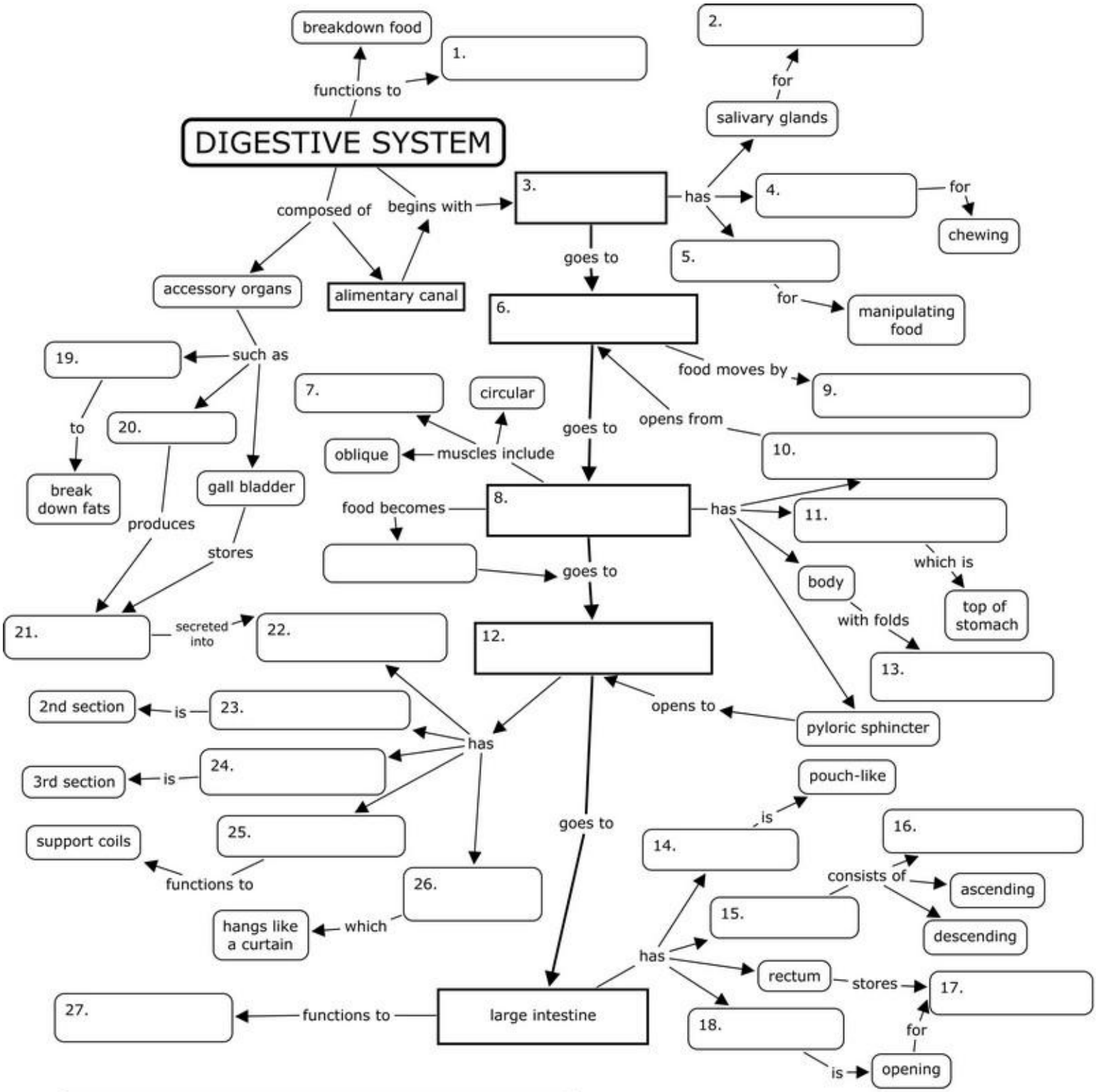
Nutrients

Carbohydrates are broken down into simple sugars (glucose) which is used by the cells for energy.

Proteins are broken down into amino acids (the building blocks of cells) which are used to repair old cells and build new cells (skin, blood, muscle, bone and nerve).

Fats are stored for future use. They contain vitamins.





WORD BANK

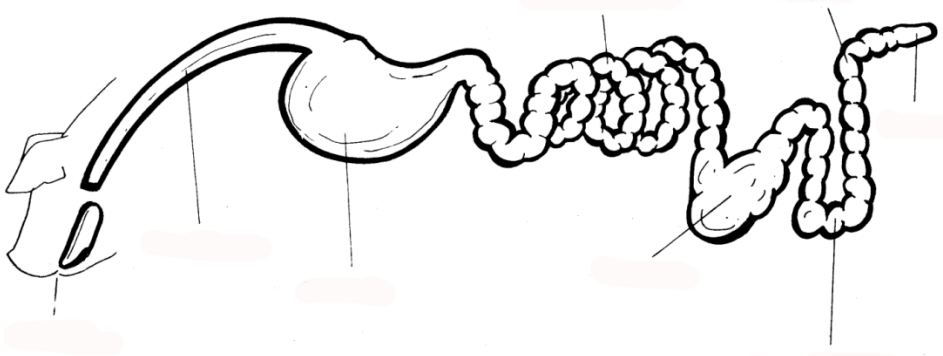
esophagus | longitudinal | jejunum | waste | pancreas | ileum
producing amylase | cardiac sphincter | mesentery | cecum | anus
mouth | rugae | peristalsis | tongue | transverse | small intestine
teeth | absorb nutrients | stomach | greater omentum | bile
fundus | duodenum | chyme | absorb water | colon | liver

Name: _____ Date: _____ Period: _____

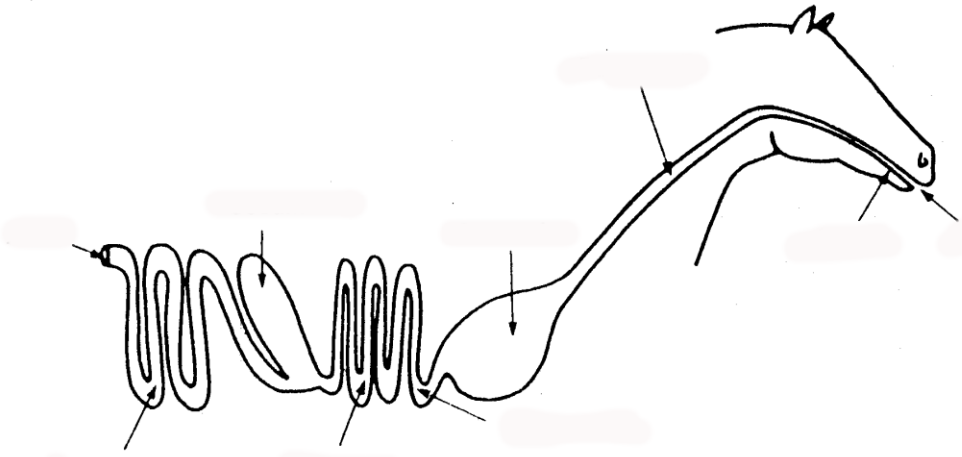
Digestive System Comparisons

Procedures: Using your notes, textbook, internet, or other resources; label the structures indicated on each diagram

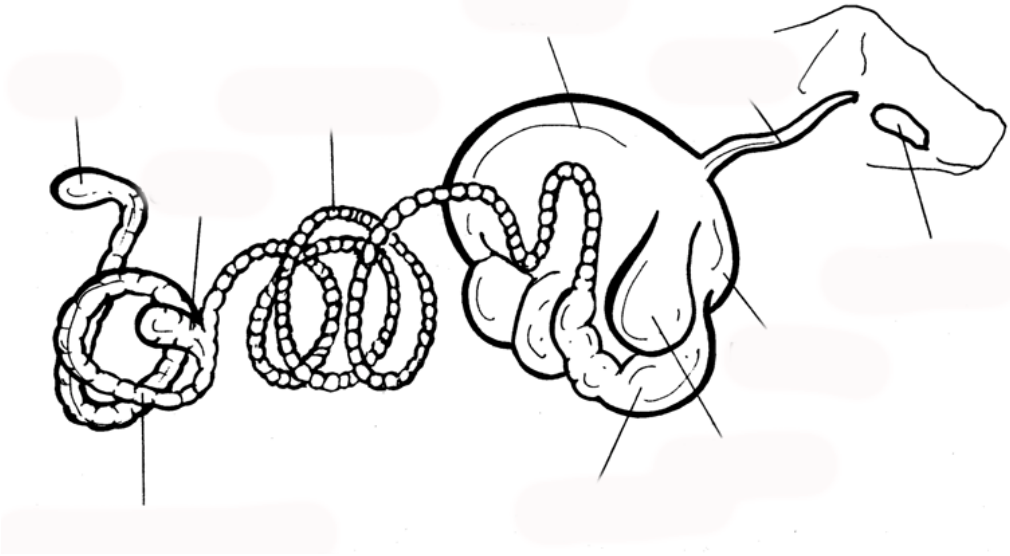
Simple Monogastric Digestion System



Digestive System of a Horse



Ruminant Digestion System



Number the organs in the correct order and briefly describe the primary function of each structure.

_____ Mouth: _____

_____ Cecum: _____

_____ Small Intestine: _____

_____ Esophagus: _____

_____ Large Intestine: _____

_____ Stomach: _____

_____ Rectum: _____

_____ Colon: _____

_____ Rumen: _____

_____ Omasum: _____

_____ Abomasum: _____

_____ Reticulum: _____

Name: _____ Hour_____Date: _____

Ruminant Digestive Disorders

by Craig Kohn, based on Hoard's Dairyman's *Feeding Guide*, by Mike Hutjens, as well as *World of Dairy Cattle Nutrition* by Dr. Knowlton and Jill Nelson of the Holstein Foundation.

Metabolic disorders in dairy cows occur at varying rates on different farms, but all result in lost profitability. Ration adjustments, daily animal inspections, and a good VCPR (Veterinary Client Professional Relationship) can prevent many of these problems, but these problems can never be completely eliminated. The overall goal is to *minimize* the occurrence of these disorders as much as possible.

The following represent the most common feed-related health problems in dairy cattle. Remember that most metabolic disorders of a cow occur near or around calving. The weeks prior to calving to a month or two after represent the greatest risk and cows in these time frames should be monitored extra carefully.

Acidosis - *AKA: SARA (Subacute Rumen Acidosis)*

Description: when the pH (acidity) of the rumen drops below 6 for an extended period of time. The cow's feed intake will decline, and her manure will be runny and very stinky (like spoiled raw chicken). Her milk fat percentage will drop below the milk protein percentage. Acidosis can be designated as *Subclinical* or *Clinical*. *Subclinical* is a pH between 5 and 5.5; *Clinical Acidosis* is more severe, and occurs when the pH is below 5. If the pH drops below 5, the cows will become dehydrated with sunken eyes. In this case, immediate veterinary care is needed.

Prevention: avoid including too much high energy feeds, too large of feed particles, and adding unsaturated oils. Adding sodium bicarbonate (baking soda) to the diet can raise the rumen pH. Increasing the amount of long forages (fiber) to increase saliva production can also help, as the saliva works as a buffer in the rumen. Do not practice slug feeding (feeding 5+ lbs. of grain per meal).

Laminitis - *AKA*: Acidosis-Laminitis; Lameness; Founder

Description: laminitis occurs when the blood vessels in the tissue of the hoof become inflamed and dilate. It can be caused by environmental and/or dietary factors. In dietary cases, if a) VFA production exceeds absorption, b) if rumen pH falls below 5.5, or c) if the blood vessels become inflamed due to a blood poisoning, the bone inside the hoof will swell. Because the hoof cannot expand, but the bone can, a cow can experience intense pain from this situation. Laminitis can be either *Clinical* or *Subclinical*; subclinical will be less serious but occur over a months-long period. Clinical laminitis will be severe and will occur abruptly, usually because of grain overload. Grain-overload usually also causes acidosis; as such acidosis and laminitis can be linked in some cases depending on the cause.

Prevention: same as rumen acidosis; also additions of zinc and copper to the diet can help, as deficiencies in these minerals can also cause lameness. Finally, the B Vitamin Biotin can work as a preventative measure.

Bloat

Description: gases routinely build up in the rumen due to fermentation, requiring the cow to belch frequently to release the gas. If gas is trapped in the rumen due to compaction, formation of foam, or an inability to belch (lack of eructation), the animal will become bloated and distended. Her left side will balloon, her breathing will be shallow and difficult, and death can occur in serious cases. A tube through the mouth into the rumen will evacuate the gases; mineral oil or other anti-foaming agents (such as propylene glycol) can eliminate the foam that traps gases.

Prevention: Legume-based pastures (e.g. soybeans and alfalfa) can increase the production of gaseous foam, in part due to the low saliva production that results from this diet. Slug feeding can also create gaseous foam (feeding 5^{+} lbs. of grain per meal). If legume-based bloat occurs, gradually introduce animals to lush pasture. To minimize grain bloat, keep the grain consumed per serving to less than 5 lbs. Seek a veterinarian immediately for severe bloat. Some animals may develop chronic bloat (lifelong reoccurring bloat); culling should be considered in these cases.

Displaced Abomasum - *AKA*: Twisted Stomach, DA

Description: in up to 90% of these cases, the abomasum (fourth stomach chamber; the one most like our own stomach) will become inflated with gas and will move from the lower right side of the cow to the left side. In rare cases, the stomach will twist to the right, causing the stomach to completely twist and block the flow of food and blood. Immediate veterinary surgery is needed in this case. DA's normally occur in the first month of lactation. A cow with a DA will have reduced feed and water intake, appears to be in pain or in discomfort, and may have dark streaks in their feces (which will be reduced). DA's can be identified by 'pinging' the rib cage of a cow with a stethoscope. A normal cow will have a deep thudding sound, while a DA will produce a banjo-ish noise that can be heard with the stethoscope.

Prevention: keep the cow's rumen full of feed by allowing constant access to forage. Avoid sudden increases in grain to avoid gas formation in the abomasum. In addition, hypocalcemia (milk fever) can reduce stomach movements, increasing the risk of a DA; calcium supplementation can help prevent hypocalcemia. Finally, a DA can be occur if there is nothing in the abomasum to digest; monitor cows that go off feed closely for a DA.

Ketosis - *AKA*: Acetonemia

Description: in a nutshell, ketosis is when high energy demands force a cow to break down bodily stores of fat too quickly. If too much fat is needed, the digestive tract will not be able to break it down efficiently, causing a byproduct called a ketone to form in the blood. These ketones will cause a cow's breath to smell like nail-polish remover. The cow will appear thin, and milk production will drop. Ketosis can result from other conditions; this is called *Secondary Ketosis* and results when other disorders force a cow to utilize her reserves of fat. For example, if a cow had a DA and her feed intake dropped off during peak milk production, her body would have to break down fat to compensate for lowered energy intake. *Primary Ketosis* is when ketosis occurs only because of an increased breakdown of fat.

Prevention: cows with a high BCS are at the greatest risk for ketosis. As such, ensure that cows are not over-conditioned at the time of calving. Avoiding sudden feed ration changes and feeding the highest quality forage to newly calved cows will also help.

Hypocalcemia - *AKA*: Milk Fever, Parturient Paresis

Description: Hypocalcemia is simply when the bodily calcium levels of a cow drop too low. Calcium is needed for muscles to contract, and when there isn't enough calcium, a cow will experience partial paralysis. This is simply due to the fact that her muscles cannot contract, not because of any nerve damage. Calcium levels in the body can drop rapidly before, during, and immediately after calving due to the increased bodily demands for the nutrient. Initially, a cow with low calcium will stagger or stumble, but as the situation progresses, she may not be able to stand up at all and will have a dopy, drugged appearance. Hypocalcemia can make a cow more susceptible to a DA due to reduced stomach contractions. Ketosis can also be an issue if a cow is off her feed. Despite the seriousness of this disease, which can end in death, it is very easy to treat; a simple IV of calcium will cause a complete turn-around in the cow's health.

Prevention: avoid feeding excessive calcium during a cow's dry period. If a cow has limited access to calcium before calving, her body will become better at utilizing the stores of calcium in her bones. Supplement large amounts of Vitamin D for three days before calving to help her body utilize calcium more efficiently. Feed a balanced mineral ration designed by a nutritionist that focuses on magnesium, potassium, phosphorus, and of course calcium. Adding anionic salts will reduce rates of milk fever as it helps a cow stores and utilize calcium more efficiently.

Grass Tetany - *AKA*: Hypomagnesia

Description: an animal that walks stiffly, appears disoriented, and/or convulses may have Grass Tetany, or low levels of bodily magnesium. Frequent urination and loss of appetite are other common symptoms. Treatment requires an injection of magnesium sulfate or Epsom salts under the skin.

Prevention: spring pastures are often low in magnesium. This is most common in wheat and rye that is heavily fertilized. Adding inorganic magnesium or supplying legumes such as alfalfa or soybeans will help as well.

Hardware Disease

Description: this is simply the consumption of a piece of metal such as a wire or nail. This material will settle into the reticulum due to its low location. Sharp metal objects can pierce the wall of the reticulum causing irritation and fluid leakage. Animals with this condition will stop eating and hunch their back to try to ease the pressure of the object. Body temperature may increase due to infection. Heart rate and breathing may be affected depending on where the puncture occurs and ends. The cow's manure may have tarry streaks if internal bleeding occurs. She will not respond to a withers pinch due to the pain in her abdomen. If a cow has not received one already, she can be treated with an orally-given magnet, which will trap metal objects and prevent them from migrating into the rest of the digestive tract.

Prevention: efforts to keep metal out of feed troughs are of vital importance. A magnetic bar in feed processing equipment can also aid in prevention.

Excessive Fiber - *AKA*: Poopin' Bricks

Description: see AKA. Basically a cow consumes too much fiber, causing her feces to lose its normal consistency. This can result in anal blockage (compacted bowels) and digestive obstruction. A suppository or stool softener can help her pass her feces.

Prevention: work with a nutritionist in order to avoid diets that are too high in fiber.

Johnne's Disease (*pronounced YO-neez*) - *AKA*: Chronic Enteritis

Description: Infection and swelling of the intestinal tract prevents the absorption of water and nutrients into the blood. A cow slowly starves to death with a stomach full of food. Johnne's is spread by manure-contamination of food and water. The feces of the cow will look like green-ish brown hot water. This disease is can be thought of as highly severe diarrhea with no cure.

Prevention: remove all infected cows asap. Prevent the introduction of fecal matter into feed and water. Separate calves from cows within 24 hours of birth.

Answer the following questions:

1. Define acidosis: _____

   _____

2. What is the difference between clinical and subclinical acidosis? _____

   _____

3. What type of actions can make acidosis more likely to occur? _____

   _____

4. What is slug feeding? _____

5. What is laminitis? _____

6. What is the difference between clinical and subclinical laminitis? _____

_____

7. Which is more likely to be linked to acidosis, clinical or subclinical laminitis? Why? _____

_____

8. What is bloat? _____

9. What causes bloat? _____

_____

10. What are three ways in which an animal with bloat can be treated? _____

_____

11. What is an abomasum? _____

12. What is a Displaced Abomasum (DA)? _____

_____

13. What causes a DA? _____

_____

14. How do you identify a DA? _____

_____

15. Why would a cow that is off feed be more prone to a DA? _____

_____

16. What is ketosis? _____

_____

17. What is the underlying cause of ketosis? _____

_____

18. What is the difference between primary and secondary ketosis? _____

_____

19. How can ketosis be prevented? _____

_____

20. What is hypocalcemia? _____

_____

21. How does a nutritional disorder cause partial paralysis in a cow? Isn't paralysis related to the nervous system?

_____

_____

22. Why are DAs and ketosis more common when a cow has hypocalcemia? _____

_____

23. What are four things that a producer could do to prevent hypocalcemia? (2 pts)

_____

_____

_____

24. What is grass tentany? _____

_____

25. How is grass tetany similar to milk fever? _____

_____

26. What is hardware disease? _____

_____

27. What is the treatment for hardware disease? _____

28. Excess fiber in the diet can cause what problem? _____

29. What is Johnne's Disease? _____

_____

30. Why would a cow with Johnne's look like they are starving if they have been eating constantly? _____

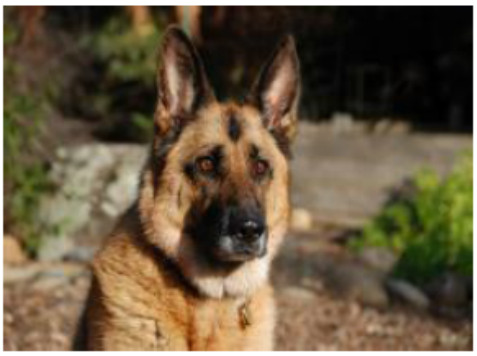
_____

31. A cow is brought to you with a high temperature, a pinging abomasum, breath that smells like nail-polish remover, and she does not respond to a withers pinch. Her manure is streaked but solid, she is responsive, and she is able to stand and move but with noticeable pain and discomfort. What is your diagnosis or diagnoses?

_____

_____

Bloat: Is Your Dog at Risk?



Gastric Dilatation and Volvulus (GDV) or "bloat" is an emergency situation that may be difficult for dog-owners to recognize. Dogs are in severe pain while suffering from bloat, and without prompt and aggressive treatment, the condition is usually fatal.

Who is Most at Risk?

Large and giant dog breeds, such as Great Danes, Saint Bernards, Weimaraners, Golden Retrievers, German Shepherd Dogs, Wolfhounds and Bloodhounds, are most at risk for bloat due to a deep and narrow chest. The incidence increases with age. Additionally, there is a familial association with this condition (it tends to run in families), and it is likely to happen again in the same pet if definitive treatment (surgery) is not performed.

Ingestion of a large amount of food or air is also a risk factor for bloat. This might result from:

- eating fast
- eating from an elevated food bowl
- eating one large meal each day
- stress (from pain or anxiety) that causes panting

Dry food eaters and those without access to adequate water seem to be most at risk. Exercise after eating has long been accused of causing bloat, but clinical studies do not support this.

Preventing Bloat

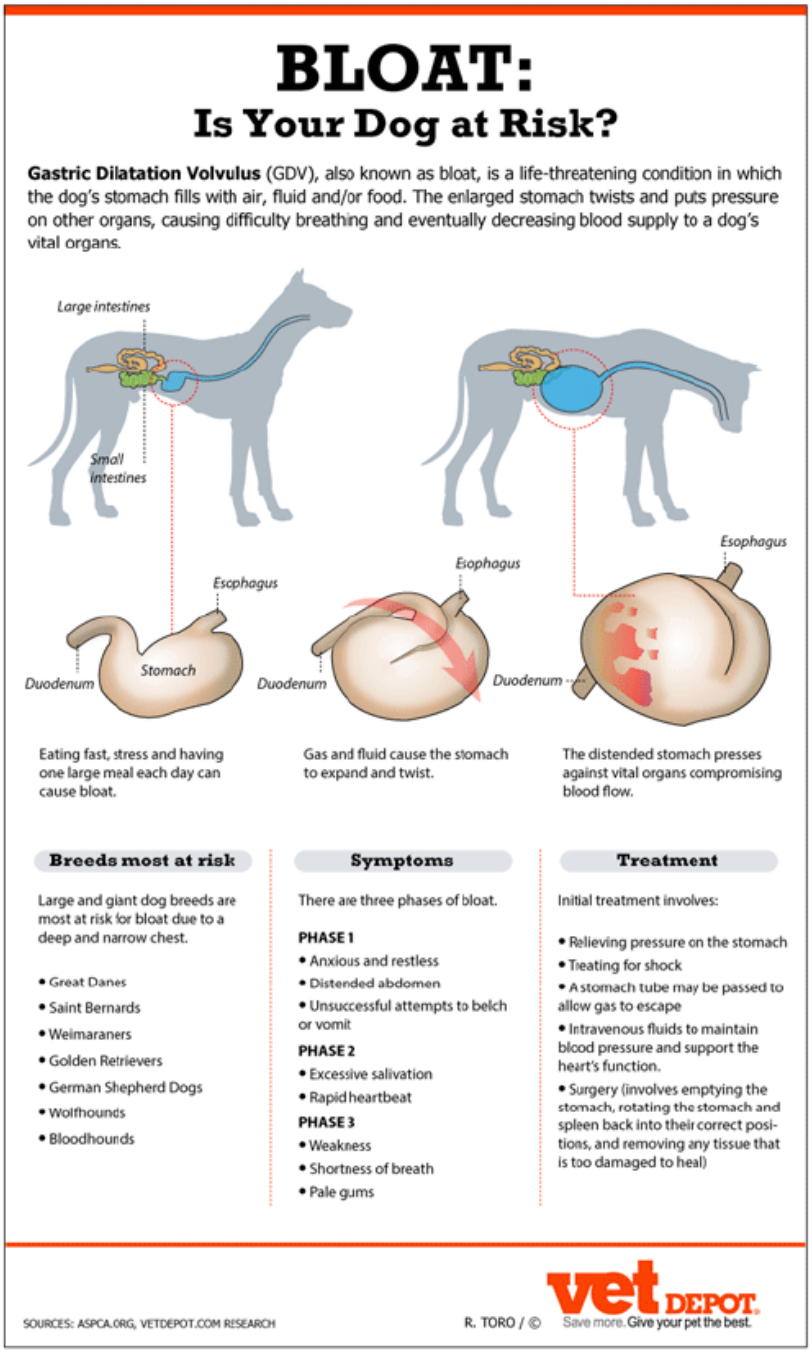
Owners have many tools available to help reduce the chances that their dogs will develop bloat:

1. Feed several small meals each day
2. Do not feed from an elevated food bowl
3. Offer water at all times
4. Do not breed dogs with a history of bloat or their direct family members
5. Try to reduce stress especially around feeding time
6. Consider having a "gastropexy" performed as a preventive measure

What is Bloat and Why is It So Serious?

Recent research has implicated two anatomical differences in dogs at risk for bloat that may contribute to the syndrome:

1. loose stomach ligaments that allow for stretching of the stomach with gas and/or food
2. delayed emptying of the stomach allowing for more pressure to build



Once the stomach is distended and ligaments are stretched, the stomach can rotate and flip over, which prevents food and gas from escaping. Because the spleen is attached to the stomach by ligaments, it too can rotate and flip over, compromising its own blood flow.

The distended stomach presses on the caudal vena cava (one of the main veins that return blood to the heart). This can lead to reduced cardiac output, arrhythmias, shock, and ultimately death. Pressure on the diaphragm can restrict lung expansion and severely impair the ability to breathe. Increased pressure on the lining of the stomach can lead to sloughing of the tissue and ulceration with life-threatening infections as a result.

Symptoms of Bloat

Dogs suffering from bloat will usually attempt to vomit, but are unable to bring anything up. They are nauseous and salivate excessively. They have a very distended, painful abdomen and are extremely restless. Their heartbeat may be irregular. As the disease progresses, blood pressure will drop, shock will develop, abnormal blood clotting may occur, and death is imminent without treatment.

"Dogs are in severe pain while suffering from bloat, and without prompt and aggressive treatment, the condition is usually fatal."

Diagnosing and Treating Bloat in Dogs

Diagnosis is fairly straightforward: breed, history, symptoms, and physical exam findings often lead to a tentative diagnosis of bloat. An abdominal x-ray can confirm the diagnosis, but the patient should be stabilized before time is taken to obtain an x-ray. This usually involves relieving pressure from within the stomach and intravenous fluid therapy.

Initial treatment involves relieving pressure on the stomach and treating for shock. A stomach tube may be passed to allow gas to escape; however, in many cases the stomach is twisted and a tube cannot be passed. If this is the case, a large bore needle is placed directly into the stomach through the dog's abdominal wall. After the stomach is partially decompressed, a stomach tube can be passed to relieve more pressure.

Intravenous fluids are administered through at least one catheter in a leg to maintain blood pressure and support the heart's function. Once the dog is stable, the veterinarian will take an abdominal x-ray if it he or she hasn't done so already, run blood work and an electrocardiogram (ECG) to evaluate the dog's overall condition, determine appropriate supportive care, and prepare for surgery.

Surgery involves emptying the stomach, rotating the stomach and spleen back into their correct positions, and removing any tissue that is too damaged to heal. If any portion of the stomach has undergone necrosis (cell death due to lack of blood supply), this area must be removed or it could slough, leading to a life-threatening infection. If the spleen has evidence of necrosis (or lost blood supply), it is usually removed, a procedure known as a "splenectomy".

The surgeon should also perform a "gastropexy" during which the stomach is sutured to the right abdominal wall. A permanent adhesion should form, preventing future episodes of bloat. It will not prevent gas distention, but it will prevent the rotation of the stomach.

Post-Operative Complications

There are many complications that can occur at the time of surgery or shortly thereafter. Arrhythmias can occur during any anesthetic procedure, but are especially common with bloat due poor oxygen delivery to cardiac muscle and other factors that allow superoxide radicals (toxins) to be released into the blood supply. Additionally, arrhythmias occur in approximately 20-25% of splenectomies regardless of the underlying disorder.

Regurgitation and aspiration pneumonia (stomach material entering the lungs) can also occur due to the esophagus being distended. Special precautions during and after surgery must be taken to reduce this risk. Infections are also relatively common after bloat surgery. They can come from ulceration of the digestive tract or contamination during the procedure.Antibiotics are often administered to prevent and/or treat infections.

Other life-threatening complications are also possible. The veterinarian should discuss the pet's prognosis with the owner at the onset of treatment.

Prognosis

Plasma lactate (a blood test) can be used as an indicator of prognosis. Traditionally, high levels (above 6.0 mmol/L) have been associated with increased mortality. However, a 2011 study disputes the value of this measurement. The study goes on to show that a decrease in plasma lactate concentrations = 50% within 12 hours may be a good indicator for survival. It is, therefore, prudent to measure lactate levels at the onset of treatment and continue to monitor these levels to keep owners informed of the prognosis as treatment continues.

Overall mortality rates have been reported from 15-30% of affected animals. Those dogs requiring removal of portions of the stomach have higher mortality rates. If dogs are treated within six hours after the onset of symptoms, they have a much greater chance of surviving. Therefore, owners should veterinary care as soon as possible when a dog develops symptoms consistent with bloat.