

INTRODUCTION TO PHARMACOLOGY

KEY TERMS

active ingredient	extract	paste
adverse drug reaction	extra-label use	precaution
ampule	formulary	proprietary name
caplets	gel caps	repository form
chemical name	generic equivalent	side effect
contraindication	generic name	single-dose vial
controlled substance	indication	solution
depot drug	inert ingredient	suspension
dose	injectable dosage form	sustained-release formulation
dosage	liniment	syrup
dosage form	lotion	tincture
dosage regimen	molded tablets	topical application
drug package insert	multidose vial	troche
elixir	nonproprietary name	trade name
emulsion	off-label use	warning
enteric-coated tablet	ointment	

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

- _____ liquid dose form in an alcohol solution administered PO
- _____ drug suspended within an oil or liquid fat
- _____ topically applied dose form; drug is dissolved in alcohol
- _____ drug made from processed animal organs (like pancreas, thyroid) or plants
- _____ solid (powered) dose form covered in gelatin
- _____ semi-solid dose form that liquifies at body temp
- _____ sucrose or other sugar-based liquid dose form taken PO
- _____ semi-solid dose form that does *not* melt at body temperature
- _____ PO dosage form formulated to dissolve slowly as moves through GI tract
- _____ drug form formulated to be protected against stomach acid
- _____ drug produced by companies other than the original developer
- _____ small, airtight glass containers containing drug; meant to be broken open to extract the drug; used only one time
- _____ type of drug that is meant to be absorbed over a prolonged period of time after it is injected into the animal; implants are an example of this type of drug
- _____ the ingredient of the drug formulation that includes preservatives, stabilizers, and liquid media into which the drug is dissolved or suspended
- _____ the term that means the *reason* or the *condition* for which the drug is to be used
- _____ any use of a drug in a manner other than that approved by the FDA
- _____ any effect of the drug other than the intended effect

18. In the line below from an article in a veterinary journal, identify the *proprietary name*.

“Notice: Cats should never be given Tylenol® or any acetaminophen product.”

Indicate whether each the statement is true or false

19. A *precaution* is a condition or situation in which a drug should NOT be given
20. 10 mg/lb every 6 hours for 3 days is an example of a *dose* and 250 mg is an example of a *dosage*
21. Extra-label drugs can be legally used by veterinarians in animals intended for use as human food
22. Suspensions must be shaken before administering; solutions do not need to be shaken.
23. Troches are commonly used with veterinary patients.
24. ® symbol indicates that the drug is restricted to use only by a veterinarian.
25. The AMDUCA gave veterinarians the authority to use approved animal drugs in an extra label manner.

PROCEDURES IN PHARMACOLOGY

KEY TERMS

antineoplastic drug
apothecary system
carcinogenic effect
compounding drugs
controlled substance / drug
cytotoxic drug
dosage range
household measuring system
material safety data sheet (MSDS)
metric system
mutagenic effect
OSHA
OTC
percentage solution
prescription drugs
Schedule drugs
teratogenic effect

SELF-ASSESSMENT REVIEW QUESTIONS

1. What is missing from this prescription? _____

Johnstown Veterinary Hospital, INC
3526 E. Caroline Ave SW
Johnstown, IA 74214-2441
(315) 521-2151

August 21st, 1998

*Mr. James Morrisi "Felix" (feline)
215 Boxwood Apt. 3a, Johnstown 523-4111*

R *Amoxitabs #24*

SIG: 1 tablet q12h PO for 12 days

Dr. Lucenda Morgenstine

Using the Key Terms, fill in the blank with the correct terminology

2. _____ This abbreviation means that the drug is available to be purchased without a prescription or without requiring a veterinarian's order.
3. _____ Which level of Controlled Substance (C-V though C-I) can not be prescribed by a veterinarian because it contains substance of high abuse with no approved medical purpose.
4. _____ This term means "poisonous to cells".
5. _____ What does MSDS stand for?
6. _____ What does OSHA stand for?
7. _____ The mixing of 2 drugs together create a "new" drug is called this.
8. _____ Type of dangerous drugs used to treat cancer.
9. _____ Which system of measurement includes tablespoon, pint, gallon, and pound?
10. _____ This term means capable of producing birth defects; often considered to be similar to the term teratogenic.

Indicate whether each the statement is true or false

11. The DEA typically requires maintaining the Controlled Substance logs for minimum of 5 years
12. Adding acepromazine tranquilizer to a bottle of ketamine would NOT be considered compounding as long as you didn't sell it to another practice.
13. If a drug is labeled as "store at room temperature" then it should be okay to keep in a refrigerator to keep it cool.
14. The use of non-child proof pill vial caps is illegal in veterinary medicine because they are not child-proof and they therefore violate the Poison Prevention Packaging Act of 1970.
15. C-III substances have a greater potential for abuse than C-V substances.
16. C-II drug prescriptions may not be refilled; a new prescription must be written for each treatment period.
17. Generally, a 3-ring notebook or spiral notebook is sufficient for maintaining a Controlled Substance log.

18. Make the following conversions:

- | | | | |
|----|------------|---|----------|
| A) | 2 g | = | _____ mg |
| B) | 5 mg | = | _____ g |
| C) | 14 lb | = | _____ kg |
| D) | 23 kg | = | _____ lb |
| E) | 83 kg | = | _____ mg |
| F) | 65 kg | = | _____ lb |
| G) | 0.4 kg | = | _____ g |
| H) | 0.003 lb | = | _____ mg |
| I) | 15 lb | = | _____ g |
| J) | 0.00043 kg | = | _____ mg |
| K) | 25,488 mg | = | _____ lb |
| L) | 0.0092 lb | = | _____ mg |
| M) | 25 ml | = | _____ L |
| N) | 43 cc | = | _____ ml |
| O) | 1.5 L | = | _____ ml |
| P) | 800 cc | = | _____ L |
| Q) | 0.055 L | = | _____ ml |
| R) | 0.25 ml | = | _____ L |

19. The doctor asks you to prepare a dose of ketamine sufficient to restrain a 15-lb cat. The drug formulary recommends using 15 mg/kg IV or IM. The concentration of ketamine in the vial is 100 mg/ml. What volume of ketamine is required for this cat?

20. The doctor asks you to fill a prescription for butorphanol for a coughing dog, dispensing sufficient tablets for 5 days of treatment. The dog weighs 55 lb. The recommended dose is 0.08 mg/kg. The tablets are available in 1-, 5-, and 10-mg sizes. The charge is \$.35 per tablet. How many tablets are required for a single dose? If the dosage specifies use q6h, how many tablets are required for each day of treatment? How many tablets should you dispense for the total 5 days of treatment? What is the charge for the dispensed medication?

21. The veterinarian wants to medicate a 16-lb Chihuahua, a 27-lb terrier, and a 66-lb collie. The recommended dosage is 3 to 5 mg/kg given once daily. You are to dispense enough medication to last each dog 180 days (6 months). The 50-mg tablets cost \$.03 each, the 100-mg tablets cost \$.05 each, and the 200-mg tablets cost \$.07 each. What are the minimum and the maximum daily doses (in mg) for each dog based on the recommended dosage range? How many tablets and what size are required for each dog each day? How much does the medication for the 180 days of treatment cost for each dog?

22. What is the concentration of drug (in mg/ml) in a 10% solution? In a 43% solution?

23. How many milligrams of drug are in 0.13 L of a 7.5% solution?

KEY TERMS

absorption	first-pass effect	passive diffusion
acid drug	free form of drug molecule	perfusion
acidic pH	gastric motility	perivascular injection
active transport	glomerulus	phagocytosis
active secretion (renal)	half-life of elimination	pharmacodynamics
aerosol administration	hepatic excretion	pharmacokinetics
agonist	hepatic portal system	pinocytosis
alkaline pH	hydrophilic	pKa
alkaline drug	induced	plasma (serum)
antagonist	biotransformation/metabolism	concentrations
aqueous	intestinal motility	PO per os
basic pH	ion trapping	prodrug
basic drug	IM	protein-bound drug
biliary excretion	intraarterial injection	proximal convoluted tubule
bioavailability	intradermal injection	reabsorption (renal)
biotransformation	intraperitoneal injection	receptor
blood:brain barrier	intrinsic activity	redistribution
Bowman's capsule	IV	renal excretion
chelator	IV bolus	route of administration
clearance	IV infusion	saturated (carrier)
collecting ducts (kidney)	lipophilic	subcutaneous (SC or SQ)
competitive, reversible	loading dose	steady state
antagonism	loop of Henle	subtherapeutic
concentration gradient	maintenance dose	surmountable, insurmountable
dissolution	maximum effective	antagonism
distal convoluted tubule	concentration	t-max
distribution	metabolism	therapeutic range / window
elimination	metabolite	tolerance to drug
enterohepatic circulation	minimum effective	topical administration
equilibrium	concentration	total daily dose
excretion	noncompetitive, irreversible	vasoconstriction /
extracellular fluid	antagonism	vasodilation
extravascular injection	nonreceptor mediated activity	volume of distribution (Vd)
facilitated diffusion	parenteral administration	weak acid/bases
fenestrations	partial agonist / partial	xenobiotics
filtration (renal)	antagonist	

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ Some PO administered drugs do not make it to systemic circulation because they are removed by the liver. What is this type of hepatic action called?
2. _____ In a dosage regimen, the instructions "b.i.d." would be what component?

3. _____ The movement of a drug molecule from an injection site to the systemic circulation is called this.
4. _____ The movement of a drug molecule into a compartment where it changes from a lipophilic state to a hydrophilic state and remains in that compartment is called this.
5. _____ Drugs move through fluid, like intercellular fluid, by this molecular process.
6. _____ This form of a drug molecule would NOT be able to readily penetrate a cell membrane.
7. _____ The movement of drug molecules across a cellular membrane using a carrier molecule but not requiring any energy expenditure by the cell is what process?
8. _____ Which type of *drug* (not drug molecule form) becomes more IONIZED as the environmental pH becomes more acidic.
9. _____ Which route of administration typically reaches a peak almost as quickly as the IV route of administration?
10. _____ After an initial, large dose of drug is injected, a smaller dose is administered to keep drug concentrations in the therapeutic range. What is this smaller dose called?
11. _____ The movement of a drug from systemic circulation out of the body is called what?
12. _____ Movement of a drug from the blood into the brain would be an example of this part of pharmacokinetics.
13. _____ The first pass effect occurs where?
14. _____ What is the conversion of a drug from active to inactive form by the liver called?
15. _____ The movement of drug from a tissue back to the blood and then to a second tissue is called this
16. _____ Movement of drug from the intestinal tract, to the liver, to the blood and tissue, back to the liver, to the intestinal tract, and then reabsorbed back from GI to the liver is called this.
17. _____ The point at which a t.i.d. administered drug achieves peak and trough concentrations that are the same from dose to dose is considered to be at this.
18. _____ Injection of a drug into the layers of the skin is what route of administration?
19. _____ If a drug combines with a receptor and causes that cell to produce some physiological change, the drug is called an:

20. The recommended total daily dose for a drug is 480 mg. What are the equivalent total daily doses for the following dosage intervals? From a practical point of view, which dosage schedule is the client most likely to follow (which schedule provides greatest chance for client compliance)?

_____ mg q12h _____ mg q8h _____ mg q4h
 _____ mg TID _____ mg q24h _____ mg QID

21. Which drug is absorbed in the greatest amount? (choose one)

- A. 100 mg of drug administered, bioavailability 0.7
- B. 150 mg of drug administered, bioavailability 0.5
- C. 200 mg of drug administered, bioavailability 0.4

D. 250 mg of drug administered, bioavailability 0.2

22. Rank the following injection routes in order of most superficial to most deep injection site:

intramuscular intradermal subcutaneous

23. If you were injecting a drug IP, in what body area would you inject it?

24. Drugs move through the body by a variety of mechanisms, including diffusion and active transport. Which mechanism of drug movement is described in the following?

- A) A local anesthetic injected SC produces a spreading feeling of numbness in the skin.
- B) Large drug molecules are taken up by macrophage “scavenger” cells in the alveoli of the lungs.
- C) The cells of the renal tubules accumulate concentrations of aminoglycoside antibiotic that greatly exceed drug concentrations in the plasma.
- D) A hydrophilic drug that moves down a concentration gradient into a cell.

25. Will the ionized molecules more readily dissolve in water or fat? Which passes through membranes better: ionized molecules or non-ionized molecules?

26. Which is the more acidic environment: a pH of 3 or a pH of 7?

27. Drug A is an “acid” drug. Is it more likely to be in the *lipophilic* or *hydrophilic* form when placed in a very acidic environment like the stomach?

28. Drug B exists in the ratios of Non-ionized molecules to Ionized molecules at the following pH environments shown below:

at pH=4 there is 1 nonionized molecule for every 100 ionized
at pH=5 there is 1 nonionized molecule for every 10 ionized
at pH=6 there is 1 nonionized molecule for every 1 ionized
at pH=7 there are 10 non ionized molecules for every 1 ionized

What is the pKa of Drug B?

Based on how Drug B exists as pHs become more alkaline (basic) or acidic, determine if Drug B is an acid drug or basic drug.

29. Indicate which of the following hypothetical drugs is most likely to have a predominance of drug molecules in the ionized form and which in the nonionized form:

- | | | | |
|----|---------------|----------|-------------------------------|
| A) | Acid drug | pKa of 3 | Placed in medium with pH of 6 |
| B) | Acid drug | pKa of 2 | Placed in medium with pH of 9 |
| C) | Acid drug | pKa of 5 | Placed in medium with pH of 2 |
| D) | Acid drug | pKa of 7 | Placed in medium with pH of 5 |
| E) | Acid drug | pKa of 7 | Placed in medium with pH of 7 |
| F) | Alkaline drug | pKa of 6 | Placed in medium with pH of 9 |
| G) | Alkaline drug | pKa of 9 | Placed in medium with pH of 8 |
| H) | Alkaline drug | pKa of 5 | Placed in medium with pH of 2 |
| I) | Alkaline drug | pKa of 5 | Placed in medium with pH of 8 |

30. You have four drugs given SQ. Rank the drugs in order from 1 to 4 where 1 = most rapidly absorbed to 4 = slowest to be absorbed from SQ tissue site which has a pH = 7.4. (4 pts total)

____ basic drug pKa = 5.4 ____ acid drug pKa = 8.4
____ acid drug pKa = 6.4 ____ basic drug pKa = 9.4

31. For each situation or condition below, state whether you would need to *increase* or *decrease* the dose to compensate for the condition and still achieve therapeutic concentrations in the body. (1 pt each)

- A) the half life for a drug is extended
- B) the metabolism of a drug has been accelerated by exposure to phenobarbital
- C) hypoproteinemic animal given a drug that is normally highly protein bound
- D) the volume of distribution for a drug is decreased

32. Here is some drug data. Answer the questions using this information.

Time after IV injection Drug concentration (plasma)

0 hrs.	-----
1 hr.	160 ug/mL
2 hrs.	100 ug/mL
3 hrs.	-----
4 hrs.	-----
5 hrs.	40 ug/mL
6 hrs.	-----
7 hrs.	-----

- A) What is the half life?
- B) What was the concentration at 4 hours?
- C) What was the concentration at 7 hours?
- D) What is the estimated peak concentration that occurred shortly after the IV bolus was given?
- E) How long would it take multiple maintenance doses to reach steady state for this drug?

33. Indicate whether each the statement is true or false

- A) If the metabolism of a drug has been induced, we should *decrease* the dose of the drug to compensate.
- B) Excretion of a drug by the liver is called biliary excretion.
- C) The neutralization of stomach acid by Tums® or Rolaids® is a non-receptor mediated action.
- D) An agonist would typically have little or no intrinsic activity on a receptor to which it binds.
- E) If the Vd of a drug increases, the concentration of the drug decreases.

34. If a drug is in hydrophilic form when given subcutaneously, how is it able to enter the capillaries? Can it exit capillaries also? Can it exit from all capillaries in the body?

GI DRUGS

KEY TERMS

acetylcholine	eructation	parasympathetic nervous system
adsorbents	fermentative digestion	prokinetic drugs
alpha adrenergic receptors	G-cells	prostaglandins
anticholinergic drugs	gastric	protectants
bloat (ruminal tympany)	gastric glands	ruminant
centrally or locally acting	gastrin	rumination
emetics	gastritis	serotonin antagonists
chemoreceptor trigger zone (CRTZ)	histamine	serotonin receptors
chief cells	monogastric	sympathetic nervous system
colonic	mucins	tenesmus
dopamine receptors	mucous cells	vagus nerve
emetic	narcotic (opioid) drugs	<u>vestibular apparatus</u>
emetic center	norepinephrine	
enterotoxins	parietal cells (oxyntic cells)	

GASTROINTESTINAL DRUG CATEGORIES AND NAMES

Emetics

Central acting emetics

apomorphine

xylazine

Locally acting emetics

Antiemetics

phenothiazine tranquilizers

acepromazine

chlorpromazine

prochlorperazine (Compazine®)

antihistamines

dimenhydrinate (Dramamine®)

diphenhydramine (Benadryl®)

anticholinergic drugs

aminopentamide

atropine

prokinetic drugs

metoclopramide (Reglan®)

cisapride

serotonin antagonists

ondansetron (Zofran®)

Antidiarrheals

anticholinergics

- aminopentamide (Centrine®)
- opioid narcotic drugs
 - diphenoxylate (Lomotil®)
 - loperamide (Imodium®)
- antinflammatories
 - bismuth subsalicylate (Pepto-bismol®, Kaopectate®)
 - flunixin meglumine (Banamine®)
 - sulfasalazine (Azulfidine®)
- adsorbents/protectants
 - activated charcoal
 - kaolin/pectin
 - bismuth

Laxatives and stool softeners

- emollient laxatives
 - mineral oil
 - cod liver oil
 - white petrolatum
 - glycerin
 - docusate sodium succinate (Colace®)
- bulk laxatives

Cathartics

- osmotic cathartics
 - hypertonic salts (milk of magnesia, Epsom salts)
 - lactulose
- irritant cathartics - castor oil

Antacid/antiulcer drugs

- nonsystemic antacids
 - magnesium products (Riopan®, Mylanta®)
 - aluminum products (Amphojel®)
 - combination magnesium and aluminum (Maalox®)
 - calcium products (Tums®, Rolaids®)
- systemic antacids or antiulcer drugs
 - H2 blockers
 - cimetidine (Tagamet®)
 - famotidine (Pepcid®)
 - ranitidine (Zantac®)
 - misoprostol (Cytotec®)
 - omeprazole
- sucralfate (Carafate®)

Ruminatorics and antibloat medications

- neostigmine
- dioctyl sodium succinate

Other GI drugs

- antimicrobials
 - metronidazole (Flagyl®)
 - sulfasalazine (Azulfidine®)
 - tylosin (Tylan®)

Oral electrolyte replacements
Pancreatic enzyme replacements
Corticosteroids

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ This term means “pertaining to or associated with the stomach”.
2. _____ This term means “pertaining to or associated with the intestine”
3. _____ This term means “pertaining to or associated with the colon”
4. _____ The neurotransmitter associated with the parasympathetic nervous system is this.
5. _____ Acid producing cells in the stomach (oxyntic or parietal cells) have receptors on them for histamine, acetylcholine, and what else?
6. _____ Cells in the stomach that produce hydrochloric acid are called:
7. _____ The cluster of neurons that coordinates the vomiting reflex is called:
8. _____ Straining to defecate is a called this.
9. _____ This nerve is mostly a parasympathetic nerve that innervates the GI tract and other organs in the abdominal cavity.
10. _____ “Fight or flight” part of the autonomic nervous system
11. _____ “Rest and restore” part of the autonomic nervous system
12. _____ These specialized neurons are sensors that detect substances in the blood and in the cerebral spinal fluid (CSF) and stimulates the emetic center to produce vomiting.
13. _____ Means “inflammation of the stomach”.
14. _____ Means “single stomached animal”.

Identify the drug each description describes from the list of Drug Names listed at the end of this chapter.

15. _____ This drug adheres to open ulceration sites; needs acidic environment to act; stimulates local production of prostaglandins.
16. _____ Adsorbent that turns stools a dark color.
17. _____ Decreases gastric acid by being antagonistic to stimulation of histamine receptors on the stomach cells that produce acid.
18. _____ Used in cattle with frothy bloat to break up bubbles or as a laxative drug (comes in clear pearls) that works by breaking down surface tension on dried fecal material allowing water to penetrate
19. _____ Antibiotic is used for treating giardiasis, a protozoa of the intestinal tract; known for producing neurologic side effects.
20. _____ This is given IV or as a tablet in the eye to produce emesis quickly in dogs by dopamine stimulation; less effective in cats than dogs.
21. _____ This injectable sedative is also an effective emetic in cats.
22. _____ Antiemetic that blocks dopamine receptors in CRTZ; also stimulates contractions and movement of the stomach in the “normal” direction; sometimes called a “pro-kinetic” agent.
23. _____ Antidiarrheal that increases resistance to feces movement by increasing the segmental contractions; also decreasing GI secretions

24. _____ Decreases acid production in the stomach by blocking the "pump" on the oxyntic (parietal) cell that pumps H⁺ ions into the stomach
25. _____ Antibiotic for treating colitis that derives more beneficial effect from its antiinflammatory effect than it's antimicrobial activity; is broken down into the antiinflammatory drug by the colonic bacteria.
26. _____ This drug increases blood flow to stomach, increases cell turnover, reduces stomach acid production; is a synthetic version of the natural compound that does this also.
27. _____ This is composed of lipase and proteinases.
28. _____ OTC antidiarrheal drug, turns stools dark like melena; decreases inflammation in the GI tract through "aspirin-like" activity.
29. _____ Decreases gastric acid by being antagonistic to stimulation of histamine (H₂) receptors on the stomach cells that produce acid.
30. _____ Phenothiazine *tranquilizer*; decreases stimulation of motion sickness receptors in dogs more than in cats

31. What effect does the parasympathetic nervous system have on GI motility, GI secretions, and blood flow to the GI tract ?

32. What type of enemas should be avoided for use in cats? (hint: its an electrolyte)

33. What effect do prostaglandins have on stomach mucus, stomach acid production, blood flow to stomach, and cell turnover.

34. Indicate whether or not induction of vomiting should be performed.

- A) Dog that has ingested strong alkali liquid cleanser 3 hours minutes ago.
- B) Cat that has ingested pelleted rat bait 40 minutes ago.
- C) Horse that has ingested insecticide contaminated feed 25 minutes ago.
- D) Dog that has ingested owner's heart medication and has been vomiting ever since.

35. Indicate whether each the statement is true or false

- A) Stimulation of dopamine receptors produces vomiting more frequently in cats than dogs.
- B) Histamine plays an important role in vomiting caused by motion.
- C) Prostaglandins decrease the sodium bicarbonate content found in the mucus on the stomach.
- D) Apomorphine works better in dogs when given PO than when given IV.
- E) Ruminatorics are drugs or compounds designed to break up frothy bloat.
- F) Cathartics are more aggressive than purgatives.
- G) Antihistamines are generally more effective anti-emetics in dogs than cats.
- H) Mast cell tumors can produce gastric ulcers because of the histamine they release and the gastric hyperacidity syndrome they cause

CARDIOVASCULAR SYSTEM

KEY TERMS

absolute refractory period	atrioventricular (AV) node
adrenergic drug, agonist, antagonist	automaticity
aldosterone	beta 1, beta 2 receptors
alpha 1 receptor	beta agonists, antagonists, blockers
angiotensin I and II	bradycardia
angiotensin-converting enzyme (ACE)	bundle branches
arrhythmia	cholinergic receptors
atrial fibrillation	down-regulation
atrioventricular (AV) block (1 st and 2 nd degree)	epinephrine

ectopic focus
muscarinic receptors
negative inotropic drug
nicotinic receptors
norepinephrine
pacemaker
paroxysm
P wave
PR interval
premature ventricular contraction (PVC)
Purkinje fibers

QRS complex
relative refractory period
renin-angiotensin system
repolarization
sinoatrial (SA) node
sodium potassium ATPase pump
supraventricular arrhythmia
tachycardia
up-regulation
ventricular flutter and fibrillation

CARDIOVASCULAR DRUG CATEGORIES AND NAMES

Antiarrhythmics

Sodium influx inhibitors

lidocaine
quinidine
procainamide
mexiletine

Beta -blockers

propranolol (Inderal)
atenolol

Calcium channel blockers

diltiazem

Positive inotropes

adrenergic drugs/catecholamines
norepinephrine/epinephrine
dobutamine
digoxin

Vasodilators

ACE inhibitors

enalapril (Enacard)
captopril
lisinopril
benazepril

hydralazine

prazosin
nitroglycerin

Diuretics

loop diuretics, furosemide (Lasix)
thiazide diuretics, chlorothiazide
potassium-sparing diuretics, spironolactone
osmotic diuretics, mannitol

Other drugs

aspirin

aminophylline, theophylline
sedatives, tranquilizers

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ This is the pacemaker of the heart.
2. _____ This delays the electrical impulses coming from the atria into the ventricles and allows the ventricles to fill with blood?
3. _____ What ion passes into the cardiac cell on depolarization?
4. _____ Stimulating what *specific* RECEPTOR increases the heart rate?
5. _____ Stimulating what *specific* RECEPTOR causes peripheral vasoconstriction?
6. _____ Stimulating what *specific* RECEPTOR causes bronchodilation?
7. _____ What part of the ECG represents movement of the depolarization wave through the AV node?
8. _____ What are the two types of cholinergic receptors?
9. _____ What neurotransmitter is associated with the sympathetic nervous system?
10. _____ The site from which the electrical activity of an arrhythmia originates is called this.

Identify the drug each description describes from the list of Drug Names listed at the end of this chapter.

11. _____ THE drug of choice for controlling ventricular arrhythmias (ectopic focus); it can *not* be given PO because of GI upset and 1st pass effect; cats are more sensitive to this drug than dogs
12. _____ Decreases arrhythmias by decreasing the stimulatory effect of the sympathetic nervous system on the heart
13. _____ THE most commonly used positive inotropic agent; narrow therapeutic index, toxicosis is common.
14. _____ Orally-administered, sodium-blocking antiarrhythmic used to control lidocaine responsive arrhythmias (not procainamide or quinidine)
15. _____ Positive inotropic drug; can only be used effectively for short periods of time before the heart muscle down regulates
16. _____ THE diuretic of choice; very effective; called a “loop diuretic” because of its site of action in the kidney.
17. _____ Potassium-sparing diuretic; not as effective as furosemide
18. _____ Currently THE vasodilator of choice; is called an ACE inhibitor
19. _____ This drug is used to decrease spontaneous clot formation
20. _____ This drug is a *topically applied* vasodilator; cream.
21. _____ This drug reverses 1st or 2nd degree heart block

22. Indicate whether each the statement is true or false

- A) The QRS complex on the ECG represents atrial depolarization
- B) “Up regulation” is the increased number of receptors produced by a cell that increases the sensitivity of the cell to a stimulus/drug.
- C) During the *absolute* refractory period, no amount of stimulus can cause the cell to depolarize again.
- D) *Hypokalemia* (low blood potassium) *increases* the risk for digoxin toxicosis.
- E) The early signs of digoxin toxicosis that the owner needs to be aware of (and watch for) are related to the GI tract (vomiting, diarrhea, anorexia).
- F) A positive inotropic drug is one that *decreases* the heart *rate*.
- G) Blood is pumped to the lungs from the *left ventricle*.
- H) The advantage of beta-blocker drugs over other antiarrhythmics is that if problems arise after several weeks of therapy, the drug can be safely stopped immediately.
- I) When switching from the liquid (PO) form of digoxin to the tablet form, the dose has to be *decreased* to provide an equivalent amount of drug.
- J) A rapid heart rate (240 bpm) caused by a problem in the atria would be classified as a *supraventricular tachycardia*.
- K) In severe digoxin toxicosis, we would expect to see a slow heart rate.

- L) Sympathetic nervous system stimulation of the heart would cause an increase in rate and force of the heart contraction.
- M) Acetylcholine is the neurotransmitter associated with parasympathetic nervous system effects.
- N) Angiotensin II is a potent vasodilator.
- O) Peripheral vasoconstriction causes an *increased* resistance to blood flow.
- P) Aldosterone is a hormone that causes sodium to be reabsorbed from the renal tubules.
- Q) 1st degree AV block with digoxin toxicosis is when the PR interval on the ECG lengthens.
- R) Non-specific beta blockers can cause *bronchodilation* as a side effect.

- 23. What kind of “non-cardiac” drugs do we use to help an animal that is experiencing aerophagia associated with congestive heart failure? _____
- 24. What drug slows the ventricular contraction rate in animals with atrial fibrillation without eliminating the atrial fibrillation itself? _____
- 25. What organ of the body eliminates digoxin? _____

RESPIRATORY DRUGS

KEY TERMS

aerosolization/aerosol therapy
alpha 1 receptor
beta 1 receptor
beta 2 receptor
bronchoconstriction
centrally/local acting antitussive
chronic obstructive pulmonary disease (COPD or heaves)
cor pulmonale

dyspnea
H1 receptors
inspissated
metered-dose inhalers (MDI)
mucociliary apparatus
nebulization
productive/nonproductive cough
opioid
serotonin

RESPIRATORY DRUG CATEGORIES AND NAMES

Antitussives

butorphanol (Torbutrol®)
hydrocodone (Hycodan®)
codeine
dextromethorphan

Mucolytics

acetylcysteine (Mucomyst®)
water (steam)

Expectorants

guaifenesin (glycerol guaiacolate)
saline expectorants
volatile oils (terpin hydrate, eucalyptus oil)

Bronchodilators

beta-2 adrenergics
terbutaline
albuterol
methylxanthines
theophylline
aminophylline

Other Respiratory Drugs

antimicrobials
corticosteroids
antihistamines
diuretics
oxygen

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ Administering a drug via a mist that is inhaled is called:
2. _____ What is the name of the mechanism that traps inhaled particles in a mucus layer and moves it up and out of the respiratory tree?
3. _____ Pulmonary disease that in turn causes cardiac disease is called:
4. _____ This *type* of drug (*not* a specific drug name) suppresses cough.
5. _____ This *type* of drug does not break apart mucus but increases *watery* secretions in the lungs.
6. _____ Name the *specific receptor* that, when stimulated, causes bronchodilation.
7. _____ What term means “difficult breathing”?
8. _____ What does “MDI” stand for?

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

9. _____ Expectorant; works by irritating the gastric lining
10. _____ Centrally-acting opioid antitussive; only FDA approved veterinary product for cough on the market.
11. _____ Same drug group as caffeine and theobromine in chocolate; this bronchodilator contains 80% active ingredient and 20% salt
12. _____ This drug is used in patients in which the inflammatory process itself is life threatening; not to be used with respiratory fungal disease; stabilizes cellular membranes more than antihistamines
13. _____ Mucolytic drug; breaks apart sulfhydryl (S-S) bonds
14. _____ Prophylactic anti-inflammatory; decreases inflammatory response only if the drug is at the site of inflammation before the inflammation starts
15. _____ Potent narcotic antitussive; human product, C-III drug
16. _____ Type of drug used to decrease pulmonary edema
17. _____ Common antitussive ingredient in the OTC cold preparations; not a controlled substance; not very effective in veterinary patients
18. _____ This drug is also used as an intravenously-administered muscle relaxant for equine patients.
19. _____ Which drug from the respiratory drug list is also used as an antidote in cats with Tylenol® (acetaminophen) toxicosis?
20. _____ The active ingredient of aminophylline.
21. _____ Used to dilate bronchioles by directly stimulating B2 receptor

22. Indicate whether each the statement is true or false

- A) Inflammation and migration of inflammatory cells (neutrophils, etc.) causes the mucus to become more “sticky” or viscous
- B) Rapid breathing is called dyspnea.
- C) Inspissated mucus means that the mucus is dried out.
- D) Use of a diuretic drug would decrease the efficiency of the mucociliary apparatus.
- E) Dextromethorphan is more effective than hydrocodone as an antitussive.
- F) In dehydrated animals the cough is usually nonproductive
- G) A common side effect of most direct bronchodilators on the heart is decreased heart rate and force of contraction.
- H) If an animal is in distress from bronchoconstriction, antihistamine drugs should be used to dilate the bronchioles.
- I) Decongestants primarily work by causing vasoconstriction in the nasal mucosa
- J) Prescribing dextromethorphan antitussive requires a controlled substance license or permit
- K) *Nebulization* describes the process by which macrophages move into the alveoli and clean up debris that made it down that far.
- L) Stimulation of the larynx produces a more forceful and gagging cough than bronchiolar irritation.
- M) Theophylline is the active ingredient and aminophylline is theophylline plus a salt.
- N) Stimulation of the parasympathetic nervous system in the bronchioles would cause bronchoconstriction.
- O) Centrally acting cough suppressants work better in veterinary patients than locally acting ones.
- P) Overdose of the opioid narcotic antitussives would be expected to cause respiratory depression.
- Q) Drugs that stimulate acetylcholine receptors in the respiratory tree would be expected to cause bronchodilation.

Endocrine Pancreatic Drugs

regular crystalline insulin
isophane (NPH) insulin
Lente insulin
Ultralente insulin
protamine zinc (PZI) insulin
recombinant human insulin
glipizide - sulfonylurea compound

Reproductive drugs

GnRH analogs
gonadotropins
 FSH, LH
 eCG
 HCG
progestins, progestagens, progestational hormones
 altrenogest (Regu-mate ®)
 medroxyprogesterone (Depo Provera ®)
 megestrol acetate (Ovaban ®)
estrogen
 estradiol cypionate ECP
 diethylstilbestrol DES
prostaglandins
 dinoprost tromethamine (Lutalyse®)
 cloprostenol (Estrumate®)
 fenprostalene
mibolerone
dopamine agonists
corticosteroids
oxytocin

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ What structures in the pancreas produce insulin?
2. _____ Hypothyroidism caused by a disease in the pituitary gland would be classified as what type of hypothyroidism?
3. _____ This term means the “state of being in heat”.
4. _____ Of the terms “exogenous” and “endogenous”, which is applied to drugs?
5. _____ Which part of the estrous cycle runs from the development of the follicle to lysis of the follicle?
6. _____ Which part of the estrous cycle is controlled by the corpus luteum?
7. _____ Which thyroid condition is caused by a lack of iodine and not a malfunction with the thyroid gland itself?
8. _____ This term refers to the muscular layer of the uterus.
9. _____ This is the creation of glucose from amino acids.
10. _____ This term means “can cause cancer”.

11. _____ Sulfonylurea compounds are used to treat what disease?
12. _____ The breakdown of glycogen stores in the liver is called this.

Identify the drug or hormone for each description from the list of Drug Names listed at the end of this chapter.

13. _____ This lyses the corpus luteum.
14. _____ Stimulates secretion of T3, T4.
15. _____ Hormone secreted by the developing follicles on the ovary.
16. _____ This hormone predisposes the uterus to pyometra (2 possible answers).
17. _____ This hormone causes development of cells that hold the ovum (egg).
18. _____ Side effects of this drug in the mare include bronchoconstriction, colic, and premature abortion
19. _____ Hormone drug used to treat urinary incontinence in spayed female dogs.
20. _____ This is a drug used to bring cattle in the luteal phase of estrous cycle back into estrus; not effective in the follicular phase.
21. _____ Hormone naturally produced by the corpus luteum.
22. _____ This hormone naturally lyses the mature follicle and releases the egg.
23. _____ This is the form of thyroid drug that is most commonly to treat hypothyroidism.
24. _____ The level of this hormone would be decrease in cats with primary hyperthyroidism.
25. _____ This is the drug of choice for maintaining control of diabetes mellitus in the dog; it is considered to be an intermediate acting insulin.
26. _____ Short term treatment of choice for hyperglycemia in dogs with uncontrolled diabetes mellitus; brings the glucose levels down quickly; given intravenously
27. _____ Hormone that maintains pregnant state of the uterus.
28. _____ Hormone associated with the behavioral signs of “heat”.
29. _____ Given to help a flaccid pregnant uterus contract during labor.
30. _____ This drug is given to transitional estrus mares over several days to imitate diestrus, then stopped to simulate the normal regression of the CL and hopefully initiate the follicular phase.
31. _____ Orally administered drug used to decrease hyperglycemic condition in some cats with diabetes.
32. _____ Drug sometimes given to mares to attempt to maintain pregnancy; rarely successful other than in mares that are lacking this hormone naturally.
33. _____ This hormone directly stimulates the thyroid to produce and release hormones.
34. _____ The thyroid hormone that actually causes the changes inside the cell.
35. _____ The thyroid hormone that allows local tissue regulation of its thyroid hormone need.
36. _____ This hormone causes release of FSH and LH to start the follicular phase.
37. _____ This hormone causes development of ovarian cells that produce estrogen.
38. _____ This hormone stimulates the development of the corpus luteum from follicular cells.
39. _____ This hormone is released by the pituitary when the fetus enters the birth canal and causes forceful uterine contractions.
40. _____ This hormone is released by the fetus to begin the steps leading to parturition.
41. _____ This drug is a control, not a cure for hyperthyroidism; keeps the thyroid from synthesizing thyroid hormones.

42. _____ This is the only compound on the list of hormones that actually destroys the feline thyroid tumor in feline hyperthyroidism.
43. _____ This drug is used to decrease the heart rate of a hyperthyroid cat but doesn't do anything about the excessive concentrations of T3 and T4.
44. _____ Drug that was used to prevent pregnancy in the dog by suppressing release of GnRH, FSH, and LH in the dog.
45. _____ Drug that prevents a mare from coming into foal heat by inhibiting the follicular phase of the estrous cycle; is a progestin.
46. _____ Use of this drug can cause open cervix pyometra in the dog 2-4weeks after administration; it can also cause aplastic anemia.
47. _____ Long lasting insulin.
48. _____ Used to synchronize estrus cycle of animals in *luteal* phase by terminating the luteal phase and bringing them back into the follicular phase; can cause abortion in pregnant humans who inject or spill it on themselves.
49. _____ Used to terminate pregnancy in mares; lots of species variation in its effectiveness; doesn't work well in dogs in early pregnancy; lots of side effects (GI colic signs, sweating)

50. Indicate whether each the statement is true or false

- A) An overdose of insulin will result in hypoglycemia.
- B) Compared to humans, dogs are very susceptible to thyrotoxicosis.
- C) As a general rule, cats need a longer acting insulin than dogs.

ANESTHESIA, ANALGESICS, TRANQUILIZERS

KEY TERMS

alpha 2 receptor	mixed agonists and antagonists
analgesic	modulation (of pain)
anesthesia	narcosis
apnea	narcotics
baroreceptors	neuroleptanalgesic
bradypnea	opiate
catalepsis	opioid
compound A	opioid receptors (mu, kappa, delta)
disinhibition	partial agonists and antagonists
dysphoria	sedative
euphoria	somatic pain
GABA	tachypnea
general/local anesthesia	transduction
hyperalgesia	tranquilizer
hypoproteinemia	visceral pain
minimum alveolar concentration	wind-up (pain)
mixed-function oxidase (MFO) enzyme system	

DRUG CATEGORIES AND NAMES

Analgesics

opioid analgesics

morphine

hydromorphone

fentanyl

butorphanol (Torbutrol®, Torbugesic®)

buprenorphine (Buprenex®)

other opioids (meperidine, codeine, oxycodone)

opioid antagonist

naloxone

Tranquilizers and Sedatives

acepromazine maleate

benzodiazepine tranquilizers

diazepam (Valium®)

zolazepam (Telazol®)

midazolam (Versed®)

clonazepam (Klonopin®)

benzodiazepine antagonist

flumazenil

alpha 2 agonists

xylazine (Rompun®)

detomidine (Dormosedan®)

medetomidine (Domitor®)

alpha 2 antagonists

yohimbine (Yobine®)

atipamezole (Antisedan®)

tolazoline (Priscoline®)

Anesthetics

barbiturates

thiopental (Pentothal®)

pentobarbital

phenobarbital

methohexital (Brevital®)

propofol

dissociative anesthetics

ketamine

tiletamine (Telazol®)

inhalant anesthetics

halothane

isoflurane

sevoflurane

other anesthetic gas agents

nitrous oxide

desflurane

CNS stimulants

methylxanthines

caffeine

theobromine

doxapram (Dopram®)

alpha 2 antagonists

yohimbine (Yobine®)

tolazoline

atipamezole (Antisedan®)

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ This is a type of drug that directly relieves the perception of pain without loss of other sensations.
2. _____ This is a type of drug that causes relaxation in the animal without a loss of consciousness; animal may be sleepy but is easily aroused.
3. _____ This is a type of drug that relieves anxiety, but produces no real analgesia, animal is relaxed but not necessarily sleepy.
4. _____ This is a type of drug that removes perception of touch, pain, temperature, and pressure.
5. _____ Pain associated with or originating from the organs or tissues inside the body.
6. _____ Pain associated with a specific location on the surface of the body.
7. _____ This is the translation of physical stimulus into depolarization of a receptor.
8. _____ This means “increased sensitivity to pain”.
9. _____ This term refers to the increased sensitivity the spinal cord acquires to pain as the result of pain signals being transmitted up the spinal cord.
10. _____ This group of analgesics is derived from poppy seeds.
11. _____ This group of drugs are chemically-synthesized, opiate-like drugs
12. _____ Pleasant hallucinogenic effects.
13. _____ Unpleasant hallucinogenic effects.
14. _____ This is a type of drug (not specific drug name) that produces some analgesic effect when it combines with an opioid receptor, but the effect isn't as strong as other opioid agonist drugs.
15. _____ This is a type of opioid drug that has activity at one type of opioid receptor and a blocking effect on another type of opioid receptor.
16. _____ Opioid drugs combined with tranquilizer or sedative drugs are called this.
17. _____ Stimulation of this catecholamine type receptor causes decreased release of norepinephrine from the neuron.
18. _____ This means “low blood protein”.
19. _____ Sevoflurane reacts with the carbon dioxide scavenger compounds commonly used in anesthetic machines (e.g., soda lime) producing this chemical that has been show to be nephrotoxic in rats.

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

20. _____ Injectable anesthetic agent; “ultrashort acting”; initial recovery is due to redistribution of the drug to less perfused tissues.
21. _____ This drug produces sedation by decreasing the release of norepinephrine.
22. _____ If a cow gets an overdose of xylazine, this is one of the drugs that can be used to reverse it.
23. _____ A barbiturate drug used in greyhounds because of its rapid metabolism.
24. _____ The fastest gas anesthetic for induction and recovery of veterinary patients.
25. _____ Tranquilizer with antiemetic properties; third eyelid comes up (prolapses) with this drug.
26. _____ Anesthetic gas usually used as an additional agent; don’t use in pneumothorax or bloated patients.
27. _____ A tranquilizer that has no inherent antiemetic properties of its own.
28. _____ Classified as a “short acting” barbiturate not as long in duration as phenobarbital injectable; adequate for short surgical procedures.
29. _____ Malignant hyperthermia is associated with this anesthetic agent.
30. _____ Dissociative anesthetic; visceral analgesia not as good as somatic analgesia; muscle relaxation is poor.
31. _____ Non-barbiturate injectable drug used for intubation; with weak anesthetic and analgesic properties; comes in a one-use ampule or vial.
32. _____ Which drugs appear to make animals hypersensitive to sound?
33. _____ Injectable anesthetic agent that produces a cataleptic state in cats; reflexes for swallowing stay intact; use ophthalmic ointment to keep eyes from drying out
34. _____ Which tranquilizer can produce penile prolapse and shouldn’t be used in hypotensive animals due to alpha 1 antagonist effect.
35. _____ This drug is a partial agonist / partial antagonist opioid narcotic; it is also the ingredient of a centrally acting cough medication approved for use in dogs.
36. _____ Strong opioid narcotic analgesic administered as a patch (Duragesic®)
37. _____ CNS stimulant found in chocolate.
38. _____ CNS stimulant used to reverse general respiratory depression such as might occur with inhalant anesthesia in pups in C-section; stimulates the brain stem in a general way.

39. Indicate whether each the statement is true or false

- A) The normal dose of barbiturates should be *decreased* in a dog with low plasma proteins
- B) Ketamine can result in dried corneas if the eyes are not medicated
- C) The two drugs in Telazol® are tiletamine and zolazepam.
- D) Typically the respiratory rate increases with opioid analgesic drugs.

40. What species is very sensitive to the effects of xylazine? _____

ANTICONVULSANTS AND BEHAVIOR DRUGS

KEY TERMS

anticonvulsant	ictus	polyuric
antidepressant	idiopathic epilepsy	postictal phase
antipsychotic	induced	preictal phase (aura)
anxiolytics	limbic system	seizure
convulsion	major tranquilizers	SSRIs
drug-induced hepatopathy	MAO inhibitors or MAOIs	status epilepticus
epilepsy	partial vs. generalized seizure	TCA's
GABA	polydipsic	
grain (measurement)	polyphagic	

DRUG CATEGORIES AND NAMES

Anticonvulsants

- phenobarbital
- diazepam (Valium®)
- potassium bromide (KBr)
- others
 - primidone
 - phenytoin (Dilantin®)
 - clonazepam (Klonopin®)
 - lorazepam
 - clorazepate

Behavior Modifying Drugs

- Antipsychotics (phenothiazine tranquilizers)
 - acepromazine
 - chlorpromazine
 - haloperidol
 - prochlorperazine
- Antidepressants
 - tricyclic antidepressants
 - amitriptyline (Elavil®)
 - clomipramine (Clomicalm®)
 - selective serotonin re-uptake inhibitors (SSRIs)
 - MAO inhibitors (MAOIs)
 - selegiline (deprenyl) (Anipryl®)
- Anxiolytics - benzodiazepines
 - diazepam
 - clonazepam
 - chlorazepate
 - lorazepam

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ This is a general term for a group of drugs that decreases the incidence or controls the onset of convulsions.
2. _____ Seizures that manifest themselves as muscle movement.
3. _____ Recurrent seizure activity (general term).
4. _____ Measurement of mass of some drugs like phenobarbital.
5. _____ Recurrent seizure activity of unknown origin.
6. _____ The state of being in a seizure or term used to describe the condition of an animal having prolonged seizure activity.
7. _____ Liver disease caused by a drug.
8. _____ Another term for seizure (not convulsion).
9. _____ Means “increased drinking”.
10. _____ Seizure that involves only localized muscle movement (e.g., one limb).
11. _____ This term means that the metabolism of the drug has been sped up.
12. _____ Means “increased appetite”.
13. _____ Seizure that produces convulsions that involve the whole body.
14. _____ The behavior changes that occur prior to the actual seizure.
15. _____ This part of the brain is associated with controlling and generating emotions.
16. _____ Mood elevating drugs that includes MAOIs, SSRIs, and TCAs.
17. _____ Group of drugs that decreases fear responses (“breaks apart” anxiety).
18. _____ Inhibitory neurotransmitter associated with the mechanism of action for diazepam and other benzodiazepine tranquilizers.

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

19. _____ The drug most commonly used and administered by the client for maintaining long term control of seizure activity.
20. _____ Drugs that work by blocking the removal of the 5-HT (serotonin) neurotransmitter from the synapse.
21. _____ The drug most commonly added to phenobarbital to enhance long-term control over persistent seizure activity.
22. _____ Approved for use in dogs to control seizures; primary metabolite is phenobarbital; implicated in drug-induced hepatopathy.
23. _____ The drug most commonly used for IV infusion control of status epilepticus.
24. _____ Antipsychotic drugs that act by blocking dopamine stimulation of the limbic system.
25. _____ Approved veterinary drug used to treat generalized anxiety and separation anxiety in dogs and cats; approved for obsessive-compulsive disorders in dogs.
26. _____ Human anticonvulsant poorly absorbed and rapidly metabolized by dogs (Dilantin®)
27. _____ Veterinary approved drug for use in treating Cushing’s disease and for “canine cognitive dysfunction” or old dog senility.

28. Indicate below whether the following statements are true or false.

- A) After a few weeks on phenobarbital to control seizures, the dose typically needs to be decreased to compensate for side effects that occur.
- B) Cats typically require a lower dose of phenobarbital than dogs do.
- C) The signs of polyuria and polydipsia in a dog on phenobarbital usually indicate potential serious kidney disease.
- D) The preferred route for administration of diazepam in the dog is PO.
- E) Potassium bromide has an advantage as an anticonvulsant because it reaches equilibrium in the body (steady state) after only 2 or 3 doses are given.
- F) Phenothiazine tranquilizer drugs may cause inappropriate aggressive behaviors of animals to emerge.
- G) Tricyclic antidepressants have an advantage over phenothiazine tranquilizers like acepromazine because they do not suppress overall behavior as much as phenothiazines do.
- H) Increased presence of dopamine neurotransmitter has been associated with a senility-like syndrome in dogs.
- I) Diazepam reduces anxiety by decreasing the amount of the neurotransmitter GABA.
- J) There is no simple “magic bullet” for behavior therapy.

ANTIMICROBIALS

KEY TERMS

aerobic	culture and sensitivity	myelosuppression
anaerobic	crystalluria	nephrotoxicosis
antibiotic	dermatophyte	ototoxic
antimicrobial	DNA gyrase	pathogens
bactericidal	Fanconi’s syndrome	penicillinase
bacteriostatic	fungicidal	pyogenic
beta-lactam ring	hypersensitivity	residue
beta-lactamase	keratoconjunctivitis sicca (KCS)	sensitive versus resistant
cephalosporinase	leukopenia	spectrum of activity
chelate	minimum inhibitory concentration (MIC)	superinfection, suprainfection
cross resistance		susceptibility
cross-reactivity		thrombocytopenia

ANTIMICROBIAL DRUG CATEGORIES AND NAMES

Penicillins

- Natural penicillins
 - penicillin G
- Aminopenicillins
 - ampicillin
 - amoxicillin
- Penicillinase-resistant
 - cloxacillin

dicloxacillin

oxacillin

Extended-spectrum

carbenicillin

ticarcillin

piperacillin

Penicillin adjuncts

clavulanic acid

sulbactam

benzathine

procaine

Cephalosporins

First-generation

cefadroxil (Cefa-Tabs®, Cefa-Drops®)

cephapirin (Cefa-Lak®, Cefa-Dri®)

cephalexin (Keflex®)

cephalothin (Keflin®)

Second-generation

cefoxitin (Mefoxin®)

Third-generation

ceftiofur (Naxcel®, Excenel®)

cefepodoxime (Simplicef®)

cefotaxime (Claforan®)

Aminoglycosides

amikacin

gentamicin

kanamycin

neomycin

streptomycin

tobramycin

Quinolones (Fluoroquinolones)

enrofloxacin (Baytril®)

marbofloxacin (Zeniquin®)

orbifloxacin (Orbax®)

difloxacin (Dicural®)

ciprofloxacin

Tetracyclines

tetracycline

oxytetracycline (LA-200®)

doxycycline

minocycline

Sulfonamides

sulfadiazine (Tribrissen®)

sulfadimethoxine (Primor®)

sulfamethoxazole (Septra®)

sulfachloropyridazine

sulfasalazine (Azulfidine®)

Sulfonamide potentiating compounds

trimethoprim

ormetoprim

Other antimicrobials

lincosamides

lincomycin
clindamycin (Antirobe®)
pirlimycin (Pirsue®)

macrolides

erythromycin
tylosin (Tylan®)
tilmicosin (Micotil®)
azithromycin (Zithromax®)

metronidazole (Flagyl®)

chloramphenicol

florfenicol

rifampin

bacitracin

Antifungals

amphotericin B

azoles - imidazole derivatives

ketoconazole

itraconazole

fluconazole

miconazole

clotrimazole

griseofulvin (Fulvicin®)

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ This drug concentration is the lower end of the therapeutic range for the antibiotic; this is the concentration of drug at which bacteria are inhibited;
2. _____ This term means a decrease in number of platelets.
3. _____ “Disease causing agents”.
4. _____ This is the range of bacteria that can be killed by a particular antimicrobial.
5. _____ This term means “kills bacteria”.
6. _____ When an antimicrobial drug is used, traces of the drug can be found in the tissue long after the drug has been stopped. This term refers to these traces of left over drug.
7. _____ This is the chemical structure found in penicillins and cephalosporins; it can be the site of action for some bacterial enzymes.
8. _____ If an animal has an allergic reaction to a drug, they are said to have this term.
9. _____ Refers to the process by which one compound binds to another compound causing the compounds to precipitate out of solution; occurs with tetracyclines and calcium.
10. _____ Means “toxic to the kidney”; occurs with aminoglycosides.
11. _____ Presence of crystals in the urine; crystals are typically precipitated drug molecules.
12. _____ Means “skin plant” and refers to fungal agents like “ringworm”.

13. _____ This term means that the bone marrow production of blood cells has been depressed or stopped; occurs with drugs like chloramphenicol.
14. _____ This enzyme is inhibited by quinolones and prevents the nuclear material inside the bacteria from being condensed so the bacteria can divide.
15. _____ This drug-induced condition results in glucosuria without hyperglycemia; associated most often with tetracyclines.
16. _____ This term means “keeps bacteria from growing or multiplying”.
17. _____ Means “decreased number of white blood cells”.
18. _____ This term indicates a bacteria that can be inhibited or killed by a particular drug.
19. _____ When an antibiotic is given by mouth, it may kill off beneficial bacteria in the GI tract allow pathogenic (disease causing) bacteria to proliferate producing this condition.
20. _____ Means “toxic to the ear”; occurs with aminoglycosides.
21. _____ Is a condition called “dry eye” due to the decreased function of the tear glands; is a condition that can result from the use of sulfonamide antibiotics.
22. _____ This is the process by which bacteria are isolated and their susceptibility to different antimicrobial drugs is determined.
23. _____ This refers to microbes that grow under conditions of little or no oxygen.
24. _____ Term that means, “produces pus”.
25. _____ Translates to “against life” and refers to drugs that kill pathogens; today this term applies mostly to antibacterial drugs.
26. _____ This term describes the resistance of bacteria to several related antimicrobial drugs.
27. _____ Enzyme produced by bacteria (especially *Staphylococci*) that can disable penicillins and cephalosporins.
28. _____ If a bacteria can not be killed by a particular drug, it is said to be this.
29. _____ This refers to microbes that require oxygen to grow.

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

30. _____ This group of antimicrobials can be rendered ineffective by the presence of pus; the nucleic acid in the debris of ruptured cells can bind to the drugs and prevent them from reaching the bacteria.
31. _____ Group of tetracyclines that is able to penetrate into the CNS through the blood-brain barrier, has a longer half life than the other tetracycline group, and has a slightly broader spectrum of activity.
32. _____ This group of antimicrobials works by inactivating key enzymes involved in the bacteria’s synthesis of folic acid, which the bacteria needs to function.
33. _____ Amino-type members of this group; greater spectrum of activity than the natural members of the group.
34. _____ First of the quinolones to be approved for use in the United State; indicated for use with cats and dogs; don’t use above 5 mg/kg in cats to decrease the risk for blindness.
35. _____ Beta-lactam antibiotics that are naturally resistant against penicillinase.
36. _____ These expired drugs can decompose to form a nephrotoxic compound that damages the proximal convoluted tubule of the kidney which prevents reabsorption of sugar from the urine and results in glucosuria; this is called Fanconi’s syndrome.

37. _____ This group of antibiotics is known for being very safe with the exception of hypersensitivity reactions that many animals seem to have with drugs of this group; hypersensitivity reactions can be life-threatening compared to the reactions seen with sulfonamide antibiotics.
38. _____ Antifungal used for deep mycoses; causes damage to the kidneys of the animal almost all of the time.
39. _____ These antimicrobials are readily chelated with calcium and magnesium; do not use orally in nursing animals, or allow animals to drink milk or eat dairy products while taking these drugs by mouth.
40. _____ Added to penicillin G to slow absorption and extend therapeutic concentrations for up to 3 days.
41. _____ Use of this drug in any animal intended for food is grounds for losing your license; can cause aplastic anemia in humans.
42. _____ Group of beta-lactam antimicrobials classified by “generations.”
43. _____ This group of antimicrobials are taken up with an active transport process that is oxygen dependent; hence this group of drugs is ineffective against anaerobes.
44. _____ This group of drugs works by binding to DNA gyrase and preventing the bacteria from replicating.
45. _____ Members of the penicillin group that have the greatest range of activity against bacteria.
46. _____ These drugs can cause adult teeth to turn yellow if these drugs were present in the body during the time when the enamel was being laid down on the developing adult teeth.
47. _____ Ototoxic and nephrotoxic.
48. _____ Group of antimicrobials indicated for use in prostatic infections because they can penetrate the blood-prostate barrier and accumulate within the prostate at concentrations higher than the surrounding plasma or blood.
49. _____ These antimicrobials work by interfering with the development of the bacterial cell wall.
50. _____ This sulfonamide drug is used for its antiinflammatory characteristics in the colon; this sulfa drug is metabolized in the colon to aminosalicic acid, and antiinflammatory drug.
51. _____ This group of antimicrobials is contraindicated in dogs who are in rapid growth phases because of the possibility of forming small bubble-like lesions in the joint cartilage.
52. _____ Like penicillins and cephalosporins, this drug group also causes hypersensitivity reactions; most of the reactions are in the skin and show up as pruritus, swelling of the face, and hives.
53. _____ Bacteriostatic antimicrobials; used most commonly for rickettsial diseases like Rocky Mountain spotted fever or Lyme disease; has two classes of drugs: one group is lipophilic and the other is hydrophilic.
54. _____ Early signs of toxicosis from this antimicrobial group is the presence of casts and increased protein in the urine.
55. _____ Used to treat superficial fungal infections (ringworm); teratogenic in cats and can produce cleft palates or other skeletal deformities.
56. _____ This is the most potentially nephrotoxic aminoglycoside.
57. _____ Water soluble tetracyclines; used in livestock to a great degree.
58. _____ These two groups of antibiotics are only effective against bacteria that are rapidly dividing.

59. _____ Intravenous injection of relative small doses of this drug in horses has resulted in arrhythmias, collapse and death; therefore, IV administration of this drug in horses is contraindicated.
60. _____ Added to sulfonamide antibiotics to increase their killing power.
61. _____ Added to penicillin G to slow its absorption and extend its action over 5 days.
62. _____ This group of antimicrobials is associated with KCS.
63. _____ Natural member of this group; beta lactam; don't give PO
64. _____ Lincosamide drug that works well against anaerobic bacteria and therefore is used to treat deep pyodermas, abscesses, and dental infections.
65. _____ This macrolide antibiotic is similar in its chemical structure as a compound called motilin; motilin and this macrolide antibiotic cause abdominal cramping, pain, and diarrhea.
66. _____ This macrolide antibiotic has produced deaths in people who have accidentally or intentionally injected themselves.
67. _____ Bactericidal antimicrobial that is effective against intestinal protozoa like *Giardia*; can cause neurological side effects even at normal doses.
68. _____ Drug has excellent ability to penetrate tissues; does not cause aplastic anemia like the other member of its group.
69. _____ Added with neomycin and polymyxin B to make a widely used antibiotic cream or ointment.
70. _____ This is added to amoxicillin to make amoxicillin resistant to the bacteria's beta-lactamase enzyme.
71. _____ This group of antifungals are the treatment of choice for deep mycoses; fewer side effects than amphotericin B.
72. _____ This group of otherwise safe antimicrobials is capable of causing superinfections in guinea pigs, ferrets, hamsters, and rabbits; should be used with caution in snakes, birds, turtles, and chinchillas.

73. Indicate whether each the statement is true or false

- A) Cloxacillin has a broader spectrum of activity than ampicillin.
 - B) If an animal has a reaction to penicillin G, amoxicillin should be safe to give because its formula is different enough from the formula of penicillin G.
 - C) Generally, 2nd and 3rd generation cephalosporins are more effective against gram negative bacteria than the 1st generation drugs.
 - D) With aminoglycosides, it is preferable to give the total daily dose divided among four doses (q.i.d.) instead of the total daily dose given once daily (s.i.d.).
 - E) Aminoglycosides readily penetrate cellular barriers.
 - G) Aminoglycosides are almost exclusively eliminated by the kidneys.
 - H) In aminoglycoside toxicosis, the BUN and serum creatinine concentrations go up before casts and protein begin to appear in the urine.
 - I) If an animal develops diarrhea while on oral tetracycline, it's okay to give them antacids, kaolin, or Pepto-Bismol®.
 - J) For susceptible bacteria in the liver or lungs, you would prefer a systemic sulfonamide as opposed to an enteric sulfonamide.
 - K) Amphotericin B begins to kill fungal organisms much quicker than ketoconazole or itraconazole.
 - L) When changing the griseofulvin dose form from microsized to ultramicrosized, we would probably have to increase the dose.
-

DISINFECTANTS AND ANTISEPTICS

KEY TERMS

antiseptics	germicides	scrubs vs solutions
bactericidal	halogens	spore form
biofilm	microbicidal	sporicidal
coagulum	microbiostatic	sterilizers
cytotoxic	naked virus	tinctures
disinfectants	nosocomial infections	vegetative form
enveloped virus	protozoacidal	virucidal
fungicidal	sanitizers	

DRUG CATEGORIES AND NAMES

alcohols
chlorine compounds
iodine and iodophors
chlorhexidine (biguanides)
glutaraldehyde
quaternary ammonium compounds
peroxides and oxidants
phenols - hexachlorophene
EDTA and Tris buffer
acetic acid

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ Chemical agents that kill or prevent growth of pathogens on living tissues.
2. _____ Antiseptics or disinfectants that reduce the number of microorganisms to a "safe" level
3. _____ Chemical agents that kill or prevent growth on inanimate objects.
4. _____ Means "kills microbial spores".
5. _____ This is an infection acquired during a period of hospitalization
6. _____ Means "kills protozoa".
7. _____ A glycocalyx coating over surgical implants that prevents antiseptics from reaching the bacteria.
8. _____ Means "kills viruses".
9. _____ Antiseptics or disinfectants that destroy all microorganisms
10. _____ Means that something is capable of killing cells.
11. _____ Type of virus that is difficult to kill with most antiseptics.
12. _____ Means "kills fungi".

13. _____ Antiseptic combined with a soap.
14. _____ Antiseptic (like iodine) dissolved in an alcohol solution.
15. _____ Means “kills bacteria”.

Identify the antiseptic or disinfectant compound for each description from the list of Drug Names listed at the end of this chapter.

16. _____ One of the most commonly used antiseptic/disinfectant in vet med; precipitates in hard water; should only be diluted with distilled water; can delay healing by inhibiting fibroblasts.
17. _____ Type of disinfectant commonly found in hand soaps, mouthwash, and Lysol®; members of this group have been reported to be neurotoxic and teratogenic in humans with prolonged contact (e.g. nurses).
18. _____ Common antiseptic found in most surgical scrubs; is inactivated by organic material but not to the extent of the chlorine compounds; exists also as a tincture and as solutions used as antiseptics.
19. _____ Effective against naked viruses (parvo virus); potent odor; corrosive.
20. _____ Virucidal against enveloped viruses, but *not* naked viruses like parvo virus; is inactivated by soaps; *benzalkonium chloride* is a member
21. _____ Must remain in contact with site for several minutes to produce bactericidal effect; not effective against parvo; forms a coagulum on top of oozing wounds that can trap bacteria; inexpensive.
22. _____ Active antiseptic ingredient is combined with a “carrier” like polyvinyl pyrrolidone that releases it over time.
23. _____ Sodium hypochlorite is the ingredient found in most household versions of this disinfectant.
24. _____ Disinfectant used to sterilize equipment that can’t be heat-sterilized because of its effectiveness against bacteria that produce biofilm.

25. Indicate below whether the following statements are true or false.

- A) “Color-fast” bleaches have chlorine as their active ingredient
 - B) It is appropriate to use a microbiostatic agent to disinfect the surgery table because these tend to be less corrosive than microbiocidal agents.
 - C) The vegetative form of bacteria is more susceptible to disinfectants and antiseptics than the spore form of bacteria.
 - D) Generally, it would be better to apply an antiseptic to a surgery site before cleaning the site of dirt and debris so the bacteria in the debris can be killed prior to cleaning.
 - E) Swabbing an injection site and then administering the injection doesn’t provide sufficient antiseptics.
 - F) Phenols are components of common household cleansers like Lysol®. Therefore, soaking a bird perch in a phenol compound or disinfecting a reptile cage with spray-on phenol disinfectant should be effective in controlling bacterial growth on these objects.
 - G) Hexachlorophene and chlorhexidine are similar compounds.
 - H) Ounce per ounce, iodophors tend to have less irritation and last longer than free iodine compounds, but they do not achieve as high a concentration of iodine at the disinfecting site in any given moment as iodine compounds in the free form.
-

ANTIPARASITICS

KEY TERMS

acetylcholine	endoparasites	monoamine oxidase (MAO)
acetylcholinesterase	gamma amino butyric acid (GABA)	muscarinic receptors
adulticide	glutamate	mydriasis
anthelmintic	hemoptysis	nicotinic receptors
anticestodal	IGRs	ovicidal
antinematodal	IDIs	P-glycoprotein
antiprotozoal	infective 3 rd stage larvae	proglottids
antitrematodal	insecticides	pruritus
cestocides	intima (arterial)	selective toxicity
coccidiostats	JHMs	SLUDDE
delayed neurotoxicity	macrocyclic ring	synergist
ectoparasites	microfilaricide	taeniocides
emboli	microfilaremia	vermicide
endectocides		vermifuge

DRUG CATEGORIES AND NAMES

Internal Parasite Drugs

antinematodals

avermectins and milbemycins
ivermectin (Heartgard®, Ivomec®, Eqvalan®)
selamectin (Revolution®)
doramectin (Dectomax®)
eprinomectin (Eprinex®)
milbemycin oxime (Interceptor®, Sentinel®)
moxidectin (Cydectin®, Quest®, ProHeart®)

benzimidazoles
thiabendazole
fenbendazole (Panacur®, Safe-Guard®)
oxibendazole (Anthelcide EQ®)
albendazole (Valbazen®)
oxfendazole (Benzelmin®)

pyrantel pamoate and pyrantel tartrate
piperazines
organophosphates

anticestodals

praziquantel
epsiprantel

heartworm medications

melarsomine (Immiticide®)
levamisole
ivermectin (HeartGard®)
milbemycin oxime (Interceptor®)
selamectin (Revolution®)
diethylcarbamazine (DEC)

antiprotozoals

amprolium
metronidazole
fenbendazole (Panacur®)
ponazuril (Marquis®)

External Parasite Drugs

organophosphates and carbamates
antidotes
 atropine
 glycopyrrolate
 pralidoxime (2-PAM)
pyrethrins and pyrethroids
piperonyl butoxide
amitraz
macrolides
 macrolides
 milbemycins
imidacloprid (Advantage®, Advantix®)
fipronil (Frontline®, Top Spot®)
nitenpyram (Capstar®)
lufenuron (Program®, Sentinel®)
methoprene
pyriproxyfen (Nylar®)
repellent – diethyltoluamide (DEET)

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ Inhibitory neurotransmitter involved with the effects of diazepam tranquilizers and originally thought to account for the majority of ivermectin's clinical signs until it was discovered that glutamate is the primary neurotransmitter that accounts for ivermectin effects.
2. _____ Tapeworm segments.

3. _____ Type of cholinergic receptors that, when stimulated, produce muscle tremors and eventually paralysis.
4. _____ Compounds that inhibit coccidia protozoa specifically.
5. _____ Means “dilated pupils”.
6. _____ Term used to describe compounds that kill flukes.
7. _____ Means that the drug expels the worms while they are still alive.
8. _____ Condition that occurs after recovery from acute organophosphate toxicosis.
9. _____ Type of cholinergic receptors that, when stimulated, produce the classic SLUDGE signs of organophosphate toxicosis.
10. _____ Anthelmintics that kill both internal and external parasites.
11. _____ Neurotransmitter associated with parasympathetic effects.
12. _____ General term used to describe compounds that kill a wide range of internal parasites.
13. _____ Molecule that is responsible for moving drugs like ivermectin from the CNS into the blood; is part of the blood-brain barrier functional mechanism.
14. _____ Term used to describe compounds that kill worms that are round in cross-section
15. _____ Inhibitory neurotransmitter thought now to account for the effects of ivermectin.
16. _____ This term refers something that floats along in the blood vessel until it lodges and causes obstruction; degenerating heartworm pieces obstructing pulmonary arteries would be an example.
17. _____ Type of drug that kills heartworm adult worms.
18. _____ Term used to describe compounds that kill protozoa
19. _____ Parasites that live on the outside of the animal’s body (e.g., fleas, ticks).
20. _____ Means “coughing up blood”.
21. _____ Means “kills parasite eggs”.
22. _____ Enzyme that destroys acetylcholine to terminate acetylcholine’s action
23. _____ Means “itching”.
24. _____ Term used to describe compounds that kill tapeworms.
25. _____ Compounds that kill the young produced by adult heartworms.
26. _____ Means that an insecticide is much more poisonous to the parasite than it is to the host animal.

27. Although it is preferable to remember the non-proprietary name for most drugs, many of the antiparasitic drugs are commonly referred to only by their trade names. Thus for this group of drugs, it is important for the veterinary technician to know which trade names are linked to which non-proprietary drug names. For each of the following trade names, identify the active ingredient.

- A) Advantage®
- B) Program®
- C) Immiticide®
- D) Revolution ®
- E) Interceptor ®
- F) Heartgard ®
- G) Sentinel®
- H) Panacur ®
- I) Strongid®, Nemex®
- J) Droncit ®
- K) Frontline®, Top Spot®
- L) Capstar®

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

29. _____ One of the safest group of the external insecticides; characterized by its quick knock down; made from chrysanthemum
30. _____ Group of internal and external antiparasitic drugs that works primarily by stimulation of the inhibitory neurotransmitter glutamate's receptors.
31. _____ Originally developed for demodicosis; extremely toxic if ingested; alpha 2 agonist.
32. _____ Toxicosis from this endectocide results in CNS depression and exhibited by ataxia, depression, blindness, and coma; toxicosis may last for several days.
33. _____ Safe, "round worm" medication found in grocery stores; "once-a-month" OTC dewormer; no effect on worms other than ascarids; vermifuge.
34. _____ Topically administered endectocide; used to control fleas and ticks, ear mites, sarcoptic mange, and as a heartworm preventative for dogs and cats; avermectin type drug.
35. _____ Antiprotozoal that is used primarily in calves and avian species; is similar in structure to thiamin and therefore acts by causing a thiamin deficiency.
36. _____ Arsenical adulticide against *Dirofilaria*; requires a deep IM injection.
37. _____ P-glycoprotein blocks these drugs from getting into the brain.
38. _____ This group of insecticides works by blocking acetylcholinesterase.
39. _____ A milbemycin type of antiparasitic approved for use in cattle and horses; was the active ingredient in the 6-month heartworm preventative, ProHeart®.
40. _____ Prototype drug for the benzimidazoles; attacks beta-tubulin in the parasite cells; has antiinflammatory and antifungal activity so is used in some ear medications.
41. _____ Antiprotozoal drug developed to be effective against the agent that causes equine protozoal myeloencephalitis (EPM)
42. _____ Microfilaricide most commonly used (not milbemycin).
43. _____ Benzimidazole anthelmintic; approved for use in dogs, horses, and livestock; must be given for 3 consecutive days in the dog to be effective; includes the trade named livestock medication Safe-Guard®.
44. _____ Antinematodal; considered very safe; effective against hookworms as well as ascarids; pleasant tasting liquid suspension administered PO; often combined with other anthelmintics like praziquantel or ivermectin.
45. _____ Toxic signs include SLUDGE signs or muscle tremors progressing to paralysis.
46. _____ Single-treatment tapeworm medication; effective against many different species of tapeworms including *Echinococcus*.
47. _____ Heartworm preventative avermectin approved for use in cats and dogs once a month as an oral medication; was the first canine heartworm preventative.
48. _____ Orally administered macrolide heartworm preventative but not an avermectin; also approved to control hookworm, ascarid, and whipworm infections.
49. _____ Topically applied flea insecticide; put between the shoulder blades; wide margin of safety; blocks nicotinic cholinergic receptor site for acetylcholine
50. _____ Flea tablet; inhibits chitin formation in larvae and egg; is an IDI
51. _____ Daily administered oral heartworm preventative medication; largely has been replaced by the monthly use of avermectins and milbemycins.
52. _____ Macrolide heartworm preventative for use in cats and dog that is similar in structure and mechanism of action as the avermectins; also approved to treat ear mites in cats.

53. _____ Antibacterial drug that is also antiprotozoal, especially against Giardia; has neurologic side effects at high doses.
54. _____ Injectable and pour-on avermectin type of drug approved for use in cattle and swine to treat several internal parasites, grubs, lice, and mange; has been reported to have caused “severe adverse reactions” in other species including fatalities in dogs.
55. _____ Insecticides associated with SLUDDE signs.
56. _____ Added to pyrethrins to increase their killing activity; a synergist drug.
57. _____ Topically applied insecticide; removes the inhibitory effect of GABA on the nervous system causing overstimulation of the insect and death; is very safe because the receptor site for this drug in insects is very different from the receptor site in mammals; can be toxic to some fish.
58. _____ THE antidote for organophosphate or carbamate toxicosis; readily available in most veterinary practices; blocks acetylcholine receptor.
59. _____ Oral tablet flea adulticide; rapid death of the fleas; nicotine type compound so stimulates muscle movement of the flea initially then paralyzes them; animals may have a transient period of increased itching after administration due to “seizure like” activity of the fleas as they die.
60. _____ Juvenile hormone mimic for fleas; larvae do not mature to adults; adulticide activity is minimal; similar to methoprene.
61. _____ Insect repellent; often used in human repellent products; can cause neurologic side effects.

62. Indicate below whether the following statements are true or false.

- A) Heartworm disease can be acquired from a blood transfusion taken from a heartworm positive dog that has circulating microfilaria.
- B) Cats should be treated for adult heartworms with melarsomine.
- C) The “L” in SLUDDE stands for “locomotion”.
- D) Glutamate is an excitatory neurotransmitter.
- E) Live ascarid worms may be expelled after administration of piperazine.

63. What dog breed is more susceptible to ivermectin toxicosis?

ANTIINFLAMMATORIES

KEY TERMS

Addison’s disease	corticotropin-releasing factor (CRF)	hypersensitivity reaction
adrenocorticotrophic hormone (ACTH)	cortex (of endocrine gland)	hypoadrenocorticism
aldosterone	Cushing’s syndrome	iatrogenic
alopecia	cyclooxygenase (COX)	leukotrienes
arachidonic acid pathway	eicosanoids	lipoxygenase (LOX)
atrophy	eosinopenia	lymphopenia
autoimmune reactions	glucocorticoids	mineralocorticoids
B-lymphocytes	gluconeogenesis	monocytopenia
catabolic effects	glycogenesis	neutrophilia
cell-mediated immunity	humoral immunity	phospholipid
	hyperadrenocorticism	phospholipase
		propionic acid

prostaglandins
renal papillary necrosis

T-lymphocytes
thromboxanes

DRUG CATEGORIES AND NAMES

corticosteroids (adrenocorticosteroids)

glucocorticoids

short acting

hydrocortisone

cortisone

intermediate acting

prednisone

prednisolone

triamcinolone

methylprednisolone

isoflupredone

long acting

dexamethasone

betamethasone

flumethasone

NSAIDs

cox 2 inhibitors

carprofen (Rimadyl®)

etodolac (EtoGesic®)

deracoxib (Deramaxx®)

meloxicam (Metacam®)

tepoxalin (Zubrin®)

phenylbutazone

aspirin (salicylates)

propionic acid derivatives

ibuprofen (Advil®, Motrin®)

ketoprofen (Ketofen®)

naproxen (Aleve®)

flunixin meglumine (Banamine®)

meclofenamic acid (Arquel®)

dimethyl sulfoxide (DMSO)

chondroprotective agents

polysulfated glycosaminoglycans (PSGAGs)

hyaluronic acid

glucosamine

chondroitin sulfate (Cosequin®)

acetaminophen

orgotein (superoxide dismutase)

gold salts

piroxicam

SELF-ASSESSMENT REVIEW QUESTIONS

Using the Key Terms, fill in the blank with the correct terminology

1. _____ The group of adrenocorticosteroids that are associated with the antiinflammatory response.
2. _____ These cyclooxygenase-produced eicosanoids cause platelets to adhere to each other and thus contribute to the clotting mechanism.
3. _____ This means “loss of hair” and is a clinical sign of Cushing’s disease.
4. _____ The type of immunity provided by antibodies.
5. _____ The combination of NSAID use plus arterial hypotension can produce this kidney condition that can result in kidney failure.
6. _____ Lipoxygenase produces this eicosanoid.
7. _____ These are diseases caused by the body’s own defense mechanisms turning against its own tissues; examples would be lupus or certain hemolytic anemias in which the RBCs are attacked by the body.
8. _____ Unlike the other cells in the CBC, the neutrophils increase in circulation under the effects of glucocorticoids. Increase in neutrophils is called this.
9. _____ This effect means that tissue is being destroyed or broken down; this effect is seen with steroids like corticosteroids.
10. _____ This type of cell produces antibodies against invading pathogens.
11. _____ This refers to the outer part of the adrenal gland (or any gland or organ that has an outer layer).
12. _____ Another name for hyperadrenocorticism.
13. _____ Enzyme that produces prostaglandins and thromboxanes.
14. _____ The collective term for all of the prostaglandins, leukotrienes, and thromboxanes produced by the arachidonic acid pathway.
15. _____ Means “low numbers of eosinophils”; can be seen on the CBC when some species of animals are given corticosteroids.
16. _____ This condition is characterized by clinical signs that are consistent with insufficient amounts of glucocorticoids.
17. _____ This is the production of glycogen in the liver.
18. _____ Hormone released from the hypothalamus that stimulates the pituitary to release ACTH.
19. _____ This means “decreased monocytes” and occurs in some species with the use of glucocorticoid drugs.
20. _____ This means “decreased size”; this is seen with the muscles and skin in animals with hyperadrenocorticism.
21. _____ Means that the animal has an elevated level of either natural cortisol of exogenous corticosteroids (drugs).
22. _____ This means the patient is exhibiting clinical signs consistent with low levels of corticosteroids.
23. _____ This means disease or condition “caused by the veterinarian”.
24. _____ This hormone is released by the adrenal gland and is a mineralocorticoid.
25. _____ Arachidonic acid is acted upon by cyclooxygenase and this enzyme to produce the eicosanoids.
26. _____ These group of adrenocorticosteroids affect mainly the electrolytes (sodium, potassium) and water balance in the body with little or no antiinflammatory effect.
27. _____ This is the creation of glucose from amino acids (which come from catabolism of protein).

28. _____ Suppression of lymphocytes by glucocorticoids results in this condition which is a “decrease of lymphocytes in circulation”.
29. _____ Ibuprofen, ketoprofen, naproxen all belong to the same group of compounds characterized by this chemical structure.
30. _____ Type of body defense mechanism characterized by cells that attack pathogens or foreign proteins (as opposed to the antibody response)
31. _____ Thromboxanes and these inflammatory mediators (eicosanoids) are produced by cyclooxygenase.
32. _____ This series of enzymes results in the production of eicosanoids after an injury.
33. _____ These cells are involved in the cell-mediated immunity; they do not produce antibodies.
34. _____ This hormone is released by the pituitary gland and stimulates the adrenal gland to produce corticosteroids.

Identify the drug for each description from the list of Drug Names listed at the end of this chapter.

35. _____ NSAID comes in a rapidly-disintegrating tablet; not a selective COX-2 inhibitor; called a “dual pathway NSAID because it blocks lipoxigenase also.
36. _____ Chondroprotective agent that is a component of the joint synovial fluid; acts as a lubricant and increases the viscosity of the fluid; may also suppress production of prostaglandins and scavenge free radicals.
37. _____ The intermediate-acting glucocorticoid that is not a “pred”.
38. _____ Older NSAID commonly used in equine medicine for relief of inflammation associated with the musculoskeletal system; 99% protein bound; bone marrow suppression has been reported in dogs.
39. _____ First COX-2 selective inhibitor released for veterinary medical use in the United States.
40. _____ Intermediate-acting corticosteroid; is in the active form (doesn’t have to be metabolized to become active)
41. _____ Antiinflammatory that works differently from NSAIDs or glucocorticoids; scavenges superoxide radicals; stinks.
42. _____ Short-acting glucocorticoid; applied topically.
43. _____ Besides carprofen, what are the other three COX-2 selective inhibitors used in veterinary medicine?
44. _____ Long-acting glucocorticoid that comes in aqueous solution, alcohol form, and suspension form.
45. _____ Prototype drug for the salicylates; commonly available OTC drug; non-specific for its cyclooxygenase activity (hits both COX-1 and COX-2); used to reduce the risk for spontaneous clot formation.
46. _____ Derivatives of propionic acid; OTC drugs; high incidence of gastric ulcers when given by owner to their pet dogs.
47. _____ NSAID used primarily in horses for relief from colic; has more analgesic effect than phenylbutazone; thought to provide some protection against endotoxins.
48. _____ Chondroprotective agent that mimics the components of normal joint cartilage; traps water molecules and helps provide springy characteristic that allows the cartilage to tolerate impact; inhibits degrading enzymes in the joint fluid.

49. _____ Intermediate-acting corticosteroid; must pass through liver in order to be converted to its active form prednisolone.
50. _____ Nutraceutical chondroprotective agents; are precursors for PSGAGs; appear to increase the efficiency with which cartilage repairs itself.
51. _____ Human OTC drug used to relieve discomfort from pain but isn't an NSAID; very toxic to cats; rarely used in dogs.

52. Indicate below whether the following statements are true or false.

- A) A long-acting glucocorticoid drug combined with acetate, diacetate, pivalate, or valerate would identify it as an aqueous solution.
- B) We shouldn't give vaccines to a dog that has been on prednisone for allergic skin reactions because the immune system won't be able to adequately respond.
- C) In hypoalbuminemic animals (low blood protein) we may have to increase the dose of NSAIDs to achieve the same effect on the tissues.
- D) The two most common target organs for NSAID toxicity are the liver and the kidney.
- E) NSAIDs should be able to provide enough analgesia to allow an animal with a broken leg to be positioned for a radiograph of the leg without using anesthesia.

53. Indicate which of the following are associated with glucocorticoid effects:

- A) increased retention of sodium
- B) maintain integrity of capillaries
- C) decrease fibroblast activity
- D) decrease T-lymphocyte activity
- E) decrease scar tissue formation
- F) increase B-lymphocyte activity
- G) Lymphocytosis
- H) Increased eosinophils and monocytes
- I) Increased neutrophils.
- J) Muscle wasting and atrophy.

54. What effect do NSAIDs have on the following: stomach and intestinal mucus production, production of sodium bicarbonate by the GI tract wall, and repair of the GI epithelial cells.

ANSWERS TO SELF-ASSESSMENT REVIEW QUESTIONS AND APPLICATION QUESTIONS

CHAPTER 1

Self Assessment Review Questions

1. elixir
2. emulsion
3. tincture
4. extract
5. gel cap or capsule
6. ointment or cream (not paste)

7. syrup
8. paste
9. sustained release medication
10. enteric coated
11. generic drug
12. ampule
13. repository or depot drug
14. inert ingredients
15. indication
16. extra-label or off-label
17. side effect or adverse effect
18. Tylenol® is the proprietary name (capitalized like a proper noun)
19. FALSE. That would be a contraindication.
20. FALSE. These are reversed. A dose is given one time.
21. TRUE. They must follow the guidelines for their use, however.
22. TRUE
23. FALSE. These are lozenges to be held in the mouth. Veterinary patients won't do this.
24. FALSE. The ® is a indication for a copyrighted logo or drug name.
25. TRUE

CHAPTER 2

Self Assessment Review Questions

1. The strength (concentration) of the tablets is missing. There are 24 amoxicillin tablets (Amoxitab® is a trade name) required, but we don't know if they are the 50 mg, 100 mg, 200 mg or 400 mg size.
2. OTC
3. C-I. C-I (Roman numeral 1) is the highest level of potential abuse and C-V (Roman numeral 5) is the group with the least amount of abuse potential.
4. cytotoxic
5. material safety data sheet
6. occupational health and safety administration
7. compounding
8. antineoplastic agents or drugs
9. household
10. mutagenic, which means capable of producing mutations
11. FALSE. 2 years is the typical recommended minimum
12. FALSE. Mixing two drugs in a syringe, bottle, or container is considered compounding because you are then administering these as a "new" combined drug with physical and pharmacological interactions.
13. FALSE. "Room temperature" is 59-86 degrees F while a refrigerator would keep drugs in the "cool" (46-59 degrees F) to "cold" (not exceeding 46 degrees F) range. "Warm" and "excessive heat" also describe specific ranges of temperature.
14. FALSE. The Poison Prevention Packaging Act does not apply to veterinarians. However, there is an ethical obligation to warn pet owners of the risk of accidental ingestion of medication in non-child proof containers and to emphasize keeping the medication out of reach of children.
15. TRUE. The smaller the Roman numeral, the more potential for abuse.
16. TRUE. C-II drugs are the most potentially abusive drugs veterinarians are legally allowed to prescribe.
17. FALSE. Although not a regulation, it is recommended that the log be kept in a bound notebook of sequentially numbered pages to reduce the risk of a page being removed and replaced by another page with adjusted inventory information to hide diversion of abuse substances.

- | | | | |
|------------------|---------------|--------------|--------------|
| 18 A) 2000 mg | B) 0.05 grams | C) 6.36 kg | D) 50.6 lbs |
| E) 83,000,000 mg | F) 143 lbs | G) 400 grams | H) 1363.6 mg |
| I) 6818.2 grams | J) 430 mg | K) 0.056 lbs | L) 4181.8 mg |
| M) 0.025 L | N) 43 mL | O) 1500 mL | P) 0.8 L |
| Q) 55 mL | R) 0.00025 L | | |

19. Convert 15 pounds to kilograms first: $15 \text{ pound} \times 1 \text{ kg}/2.2 \text{ pounds} = 6.82 \text{ kg}$. Now determine how much drug you will need for this sized cat: $6.82 \text{ kg} \times 15 \text{ mg/kg} = 102.3 \text{ mg}$ of drug needed. Now determine how much physical drug you'll need to inject: $102.3 \text{ mg} \times 1 \text{ mL}/100 \text{ mg} = 1.02 \text{ mL}$. Note that when multiplying the dose times the concentration in the bottle, the problem has to be set up so the "mg" in the numerator and denominator cancel each other out leaving "mL" by itself on top. The 1.02 mL is rounded to the nearest $1/10^{\text{th}}$ mL = 1.0 mL.

20. First convert the dog's weight to kg: $55 \text{ lbs} \times 1 \text{ kg}/2.2 \text{ pounds} = 25 \text{ kg}$. Now determine how much drug a 25 kg dog will need: $25 \text{ kg} \times 0.08 \text{ mg/kg} = 2 \text{ mg}$ of drug needed. Now select the tablet size keeping in mind that you don't want to break a tablet into anything smaller than $1/2$ tablet. If we use the 1 mg tablet size then we need: $2 \text{ mg} \times 1 \text{ tablet}/1 \text{ mg} = 2 \text{ tablets}$ per dose. If we use 5 mg tablet size, it comes out to: $2 \text{ mg} \times 1 \text{ tablet}/5 \text{ mg} = 0.4 \text{ tablet}$ per dose which we would round to 0.5 tablet per dose. This isn't as accurate as using the two 1 mg tablets, but it's close enough if this drug is safe. Now determine how many tablets you are going to need for 5 days of treatment if the drug is to be given q6h (which "every 6 hours" which is FOUR times daily, not six). For the two 1 mg tablet dose, we would need: $2 \text{ tablets/dose} \times 4 \text{ doses/day} \times 5 \text{ days} = 2 \times 4 \times 5 = 40 \text{ tablets}$ for the five day period. For the $1/2$ tablet of the 5 mg strength tablets: $0.5 \text{ tablet/dose} \times 4 \text{ doses/day} \times 5 \text{ days} = 0.5 \times 4 \times 5 = 10$ total for the five day period. Cost of the medication: $40 \text{ tablets (1 mg tablets)} \times \$0.35/\text{tablet} = \$14.00$ or $10 \text{ tablets (5 mg size)} \times \$0.35/\text{tablet} = \$3.50$.

21. 16 lb Chihuahua = 7.27 kg = dose range of 21.8 mg to 36.4 mg; so use $1/2$ of a 50 mg tablet. $1/2 \text{ tablet/dose} \times 1 \text{ dose/day} \times 180 \text{ days} = 90$ of the 50 mg tablets needed. 90 tablets at \$0.03 per tablet = \$2.70 for the 180 days. 27 lb Terrier-X = 12.3 kg = dose range of 36.8 mg to 61.4 mg; so use 1 whole 50 mg tablet per dose. $1 \text{ tablet/dose} \times 1 \text{ dose/day} \times 180 \text{ days} = 180 \text{ tablets}$. 180 tablets x \$0.03 per tablet = \$5.40 for the 180 days worth of medication. 66 lb Collie = 30 kg = dose range of 90 to 150 mg; so use either 1 of the 100 mg tablets, 1 and $1/2$ of the 100 mg tablets, or $1/2$ of the 200 mg tablets; costs would be respectively \$9.00, \$13.50, or \$6.30.

22. 10% solution = 10 grams/100 mL = 10000 mg/100 mL = 100 mg/mL. 43% = 43 grams/100 mL = 43000 mg/100 mL = 430 mg/mL.

23. 7.5% solution = 7.5 grams/100 mL = 7500 mg/100 mL = 75 mg/mL. If there is 75 mg/mL, we want to know how many are in 0.13 L or 130 mL. $130 \text{ mL} \times 75 \text{ mg/mL} = 9750 \text{ mg}$ in 130 mL of solution.

CHAPTER 3

Self Assessment Review Questions

1. first pass effect
2. dose interval
3. absorption
4. ion trapping
5. passive diffusion
6. ionized or hydrophilic
7. facilitated diffusion (not active transport)
8. alkaline or basic drug

9. IM
10. maintenance dose
11. elimination or excretion
12. distribution
13. liver
14. metabolism or biotransformation
15. redistribution (distribution is going from blood to tissue)
16. enterohepatic circulation
17. steady state
18. intradermal
19. agonist
20. 240 mg q12h; 160 mg q8h; 80 mg q4h (6x a day); 160 mg TID; 480 q24h; 120 mg QID
21. C is the correct answer. Choice A = $100 \text{ mg} \times 0.7 = 70 \text{ mg}$. Choice B = $150 \text{ mg} \times 0.5 = 75 \text{ mg}$. Choice C = $200 \text{ mg} \times 0.4 = 80 \text{ mg}$. Choice D = $250 \text{ mg} \times 0.2 = 50 \text{ mg}$.
22. Most superficial = intradermal (within the layers of the skin), then subcutaneous (below the skin), then intramuscular would be the deepest.
23. Into the abdominal or peritoneal cavity (IP = intraperitoneal)
24. A) passive diffusion through extracellular fluid between cells. B) phagocytosis or pinocytosis since it is a large molecule. C) active transport – is able to accumulate drug in spite of the concentration gradient. D) facilitated diffusion – moves along a concentration gradient so no cellular energy is being expended, and because it's hydrophilic it's not likely to passively diffuse through the lipid cellular membrane; thus it needs a carrier to get through the membrane.
25. Ionized molecules dissolve in water. Non-ionized molecules pass through membranes.
26. pH of 3.
27. Acid drugs in acidic environments are more likely NON-ionized and therefore lipophilic.
28. $pK_a = 6$. This drug becomes more ionized in more acidic environments and more non-ionized in alkaline environments. That would make the drug an alkaline or basic drug.
29. A) ionized B) ionized C) non-ionized D) non-ionized E) $\frac{1}{2}$ in ionized form and $\frac{1}{2}$ in the non-ionized form F) non-ionized G) ionized H) ionized I) non-ionized
30. This is SQ so drug most in ionized (hydrophilic) state will most rapidly diffuse to capillary and enter systemic circulation (absorption). Fastest (#1) = basic drug pK_a 9.4 (100 ionized molecules for every 1 non-ionized). #2 = acid drug pK_a 6.4 (10 ionized molecules for every 1 non-ionized). #3 = acid drug pK_a 8.4 (1 ionized molecule for every 10 non-ionized molecules). #4 = basic drug pK_a 5.4 (1 ionized molecule for every 100 non-ionized molecules).
31. A) decrease dose – it takes longer for the drug concentrations to drop by $\frac{1}{2}$. B) increase dose – the drug is being converted to a metabolite (presumably an inactive metabolite) at a quicker rate. C) decrease dose – less protein in the blood for binding means more drug molecules in the free form and available to distribute to tissues to produce a greater effect. D) decrease dose – with the drug distributed to fewer tissues and hence less diluted by the volume of tissue fluid, the amounts of drug in the tissues will become more concentrated. Decrease dose to prevent concentration from exceeding therapeutic range.
32. A) Always look for two concentrations that are $\frac{1}{2}$ or $\frac{1}{4}$ of each other. In this problem there is 160 ug/mL at 1 hour post dose and 40 ug/mL at 5 hours post dose. 160 divided by 2 = 80 and 80 divided by 2 = 40. Thus, the concentrations went through two half lives to go from 160 to 40 ug/mL. How long did it take to drop from 160 to 40 ug/mL? 160 was at 1 hour post dose and 40 was at 5 hours post dose. The elapsed interval between these two samples was $5-1 = 4$ hours. Thus, if 4 hours = 2 half lives, then 1 half life must be 2 hours. Therefore, no matter at what concentration we start on this dose curve, 2 hours later the concentration will be $\frac{1}{2}$ of what it was.
B) If the half life is 2 hours and the concentration at 2 hours post injection is shown as 100 ug/mL, then 2 hours later at 4 hours post injection the concentration will be $\frac{1}{2}$. At 4 hours post injection the concentration will be 100 divided by 2 = 50 ug/mL.

C) 40 ug/mL at 5 hours post injection will be $\frac{1}{2}$ again 2 hours later at 7 hours post injection. At 7 hours post injection the concentration will be 20 ug/mL.

D) The estimated peak concentration occurring immediately after the completion of the IV bolus push should theoretically be double (twice) what it is at 2 hours post injection since this drug has a 2 hour half life. Thus, we would estimate that the peak concentration at 0 hr post injection is $100 \text{ ug/mL} \times 2 = 200 \text{ ug/mL}$.

E) Steady state = 5 x the half life. $5 \times 2 \text{ hours} = 10 \text{ hours}$ to reach steady state.

33. A) FALSE. If metabolism has been induced, it means it has been sped up. The drug is being broken down quicker and therefore inactivated more rapidly. The dose needs to be increased. This is the explanation for why tolerance develops to drugs like barbiturates, alcohol, and opioid/narcotics. B)

TRUE. C) TRUE. D) FALSE. An ANTAGONIST is a drug molecule that occupies a receptor site without producing an effect. In so doing, the antagonist blocks the agonist from occupying the receptor site and therefore “reverses” the agonist’s effect. E) TRUE. If V_d increases there is more volume of fluid into which the drug is dissolved and therefore the drug is more diluted.

34. Capillaries have openings called fenestrations through which drug molecules can enter. Drug molecules can leave through fenestrations to go from systemic circulation to tissues (distribution). The capillaries in the brain, prostate, and globe of the eye do not have fenestrations and therefore the only way a drug can get into these areas from systemic circulation is if the drug is in a lipophilic (non-ionized) state.

CHAPTER 4

Self Assessment Review Questions

1. gastric
2. enteric
3. colonic
4. acetylcholine
5. gastrin
6. parietal or oxyntic cells
7. emetic center
8. tenesmus
9. vagus nerve
10. sympathetic nervous system
11. parasympathetic nervous system
12. CRTZ chemoreceptor trigger zone
13. gastritis
14. monogastric
15. sucralfate (Carafate®)
16. bismuth
17. dimenhydrinate, diphenhydramine
18. DSS dioctyl sodium succinate
19. metronidazole
20. apomorphine
21. xylazine
22. metoclopramide (Reglan®)
23. loperamide, diphenoxylate
24. omeprazole
25. sulfasalazine (Azulfidine®)
26. misoprostol (“prost” suggests a prostaglandin)
27. pancreatic enzyme supplements
28. bismuth subsalicylate (Pepto-Bismol®, Kaopectate®)

29. cimetidine (Tagamet®), ranitidine (Zantac®), famotidine (Pepcid®)
30. acepromazine
31. The parasympathetic nervous system (rest and restore system) would do everything to increase digestion. Therefore, GI motility increases, GI secretions increase, and blood flow the GI tract increases.
32. Phosphate.
33. Prostaglandins in the stomach will help protect the stomach from acid and enhance the ability of the stomach to repair itself. Therefore, stomach mucus will be increased, stomach acid production will be decreased, and blood flow and cell turnover will both be increased to assist in repair and health of the tissue.
34. A) No – corrosive substance. B) Yes. C) No – horses don't vomit D) No – dog is already vomiting.
35. A) True.
B) True.
C) False. Prostaglandins would increase the sodium bicarbonate as a means of protecting the stomach lining by neutralizing stomach acid.
D) False. When given IV or in the sulcus of the eye, the drug achieves high concentrations in the blood very quickly. This stimulates the CRTZ which stimulates the emetic center and produces vomiting. With the PO administration, the concentrations of apomorphine in the blood rise slowly allowing time for the apomorphine to pass through the blood:brain barrier and enter the brain itself where it suppresses the activity in the brain stem including the emetic center. Thus, as the concentration gradually rises in the blood to stimulate the CRTZ, it is also rising in the brainstem where it will depress the emetic center.
E) False. Ruminatorics stimulate contraction of the rumen. They aren't used to relieve bloat.
F) False. Purgatives are more aggressive generally than cathartics. Both are more aggressive than most laxatives.
G) True.
H) True.

CHAPTER 5

Self Assessment Review Questions

1. SA node.
2. AV node
3. Sodium (Na⁺)
4. Beta 1 (β₁)
5. Alpha 1 (α₁)
6. Beta 2 (β₂)
7. P-R Interval (end of P wave to beginning of large R wave in QRS complex)
8. Muscarinic and nicotinic.
9. Norepinephrine, epinephrine (catecholamines)
10. Ectopic focus
11. lidocaine
12. beta-blocker antiarrhythmics like atenolol and propranolol
13. digoxin
14. mexiletine
15. dobutamine (catecholamine)
16. furosemide
17. spironolactone
18. enalapril
19. aspirin
20. nitroglycerin

21. atropine

22. A) False. QRS is the ventricles depolarizing. The P wave is atria depolarizing.

B) True.

C) True

D) True

E) True

F) False. Positive inotropic drugs *increase the force of contraction*. Negative inotropic drugs decrease the force of contraction. A positive inotropic drug would increase the heart rate, and a negative inotropic drug would decrease the heart rate.

G) False. The left ventricle, being the larger of the two ventricles, pumps the blood to the rest of the body. The smaller right ventricle pumps the blood the relatively short distance to the lungs and then back to the left atrium.

H) False. Stopping the beta blockers suddenly can put the animal at great risk for an increase in arrhythmias and possibly death. When the beta blocker drugs are used, the catecholamine neurotransmitters (epinephrine and norepinephrine) can't reach the beta 1 receptors on the heart. In response to this, over time the heart cells begin to "sprout" new beta 1 receptors allowing the heart muscle to regain its responsiveness to the catecholamines and prompting an increase in beta blocker dose. This is the process of up-regulation and it refers to the increase in number of new receptors to the beta adrenergic agonists. If all of the beta blocker drug molecules are allowed to disappear by stopping the beta blocking drug, then you have all of the original beta 1 receptors as well as the new up-regulated beta 1 receptors available to respond to the catecholamine neurotransmitters. This means in response to a mild release of norepinephrine with excitement or exercise, the heart muscle is going to respond with greater force of contraction and the conduction system is going to conduct the depolarization wave through quicker. An ectopic focus could also fire more readily giving rise to arrhythmias. Beta 1 blocker antiarrhythmic drugs should be tapered off over time and never stopped "cold turkey".

I) False. Tablets typically have a lower bioavailability than liquids. We know that digoxin tablets have a 60% bioavailability and the elixir typically has around a 75% bioavailability. Thus, if we are giving 2 mg of elixir, we are getting 75% of that, or 1.50 mg ($0.75 \times 2 \text{ mg} = 1.50 \text{ mg}$) of digoxin, actually into systemic circulation. Because the tablets are absorbed to a lesser degree (only 60% bioavailability compared to 75% for the elixir) then only 1.20 mg of a 2 mg of tablet dose ($0.60 \times 2 \text{ mg} = 1.20 \text{ mg}$) is going to reach the systemic circulation. In order to give enough tablet dose to equal the 1.50 mg absorbed after 2 mg of elixir, we would have to give more of the tablet form of the drug. In other words, the dose of the tablet would have to be more than the dose of the elixir in order to achieve 1.50 mg of drug actually reaching systemic circulation. The actual amount needed for the equivalent tablet dose is shown below:

$$\text{Dose tablet} \times 0.60 = \text{Dose elixir} \times 0.75$$

$$\text{Dose tablet} \times 0.60 = 2 \text{ mg elixir dose} \times 0.75$$

$$\text{Dose tablet} \times 0.60 = 1.50 \text{ mg (amount of drug that is absorbed into systemic circulation)}$$

$$\text{Dose tablet} = 1.50 \text{ mg} / 0.60 = 2.50 \text{ mg}$$

Dose tablet = 2.50 mg tablet dose needed to achieve the same systemic concentration of drug as the 2.0 mg elixir.

J) True. The origin of the problem is "above" the ventricles in the atria and the heart rate is increased.

K) True. The dominance of the parasympathetic effect of digoxin on the SA and AV node slows the overall rate of contraction as well as increases the delay of the impulse passing through the AV node.

L) True.

M) True.

N) False. Angiotensin II is the body's most potent vasoconstrictor. It is released as a result of a drop in arterial blood pressure and thus it causes vasoconstriction at the point where the arteries dump blood into the capillaries essentially squeezing the terminal opening of the arteries. The arterial blood pressure increases in response to the vasoconstriction in the same way that squeezing the one end of a rubber tube while blowing into the opposite end would cause air pressure to increase inside the rubber tube.

O) True

P) True

Q) True.

R) False. Beta 2 receptors on the bronchioles cause bronchodilation when stimulated. Beta blocker (antagonist) drugs that block beta 2 receptors will block this bronchodilating effect and allow the bronchoconstricting effect from parasympathetic (acetylcholine) stimulation or histamine stimulation to dominate. The net effect is the potential for bronchoconstriction.

23. Sedatives or tranquilizers are often given to animals with aerophagia (“eating air” or gasping for breath) to relieve the fear that comes with struggling to breathe. By reducing the fear, we reduce the sympathetic nervous system stimulation on the heart slowing it down, but also allowing the heart to beat more efficiently with fewer beats and reducing the work of the heart. Reducing the work on the heart means less need for oxygen. Reducing the fear also reduces other muscle movement (pacing, panting, anxious behavior) and therefore also reduces the need for more oxygen.

24. Digoxin. Digoxin slows conduction through the AV node thus reducing the number of impulses that reach the ventricles and thus reducing the ventricular heart rate. Digoxin slows the SA node, but the SA node is not in control anyway in animals with atrial fibrillation. Thus, digoxin doesn’t really reduce the atrial fibrillation, it only reduces the ventricular rate.

25. Kidney.

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CHAPTER 6

Self Assessment Review Questions

1. nebulization or aerosol therapy
2. mucociliary apparatus
3. cor pulmonale
4. antitussive
5. expectorant (a mucolytic breaks apart the mucus)
6. beta 2
7. dyspnea
8. metered dose inhaler
9. guaifenesin
10. butorphanol
11. aminophylline (theophylline is the active ingredient)
12. glucocorticoids, corticosteroids
13. acetylcysteine
14. antihistamine
15. hydrocodone (codeine is less potent)
16. diuretic
17. dextromethorphan
18. guaifenesin
19. acetylcysteine
20. theophylline
21. albuterol, terbutaline

22. A) True
 B) False. Dyspnea is difficult breathing. Rapid breathing is tachypnea.
 C) True
 D) False. Drying out the mucus makes it more sticky and is harder for the cilia to move.
 E) False. Hydrocodone is much more potent. Dextromethorphan is the OTC antitussive and doesn't work very well in veterinary patients.
 F) True.
 G) True. They stimulate catecholamine alpha 1 receptors to cause vasoconstriction and typically have some ability to stimulate beta 1 receptors to cause an increased heart rate.
 H) False. Antihistamines only work before the histamine is released. Antihistamines are competitive antagonists for histamine at the H1 receptor. If bronchoconstriction has occurred, the H1 receptor has most likely already been stimulated by histamine and other chemical mediators that stimulate bronchoconstriction. You would need a direct bronchodilator like a beta 2 agonist drug.
 I) True.
 J) False. It 's an over-the-counter (OTC) drug requiring no prescription. Note that some over-the-counter decongestants like pseudoephedrine are now more tightly regulated because of their use in "cooking" methamphetamine.
 K) False. Nebulization, or aerosol therapy, is the delivery of drug in a mist that is inhaled.
 L) True
 M) True
 N) True
 O) True
 P) True
 Q) True
 R) True
 S) True

23. sympathetic nervous system
 24. alpha 1
 25. they stimulate the central nervous system
 26. acetylcholine
 27. histamine
 28. productive cough
 29. expectorant ("expectorate" means "to spit")

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CHAPTER 7

Self Assessment Review Questions

1. Beta cells
2. Secondary hypothyroidism. Hypothyroidism caused by diseases of the thyroid is primary hypothyroidism and hypothyroidism from a problem with the hypothalamus and lack of TRH would be tertiary hypothyroidism.
3. estrus (the noun), not estrous (the adjective).
4. Drugs are exogenous compounds meaning that they are from outside of the body.
5. follicular phase.
6. luteal phase.
7. goiter
8. myometrium

9. gluconeogenesis
10. carcinogenic
11. They are oral medications used to lower blood glucose in diabetic animals and people.
12. glycogenolysis
13. prostaglandin
14. TSH
15. estrogen
16. progesterone directly, estrogen by increasing the sensitivity of the uterus to progesterone.
17. FSH
18. dinoprost tromethamine, cloprostenol, or fenprostalene (the prostaglandins)
19. diethylstilbestrol (DES)
20. dinoprost tromethamine (Lutalyse)
21. progesterone
22. LH
23. levothyroxine, (T4, tetraiodothyronine, thyroxine)
24. TSH and TRH due to the excessive amounts of T3 and T4 generated by the cancerous thyroid gland.
25. NPH insulin
26. Regular or crystalline insulin
27. progesterone
28. estrogen
29. oxytocin
30. altrenogest (progestins, progestogens)
31. glipizide – sulfonylurea compound
32. progesterone compounds
33. TSH from the pituitary
34. T3 – triiodothyronine
35. T4 – tetraiodothyronine, thyroxine
36. GnRH
37. FSH
38. LH
39. oxytocin
40. ACTH
41. methimazole
42. I-131
43. propranolol
44. megestrol acetate
45. altrenogest
46. estrogens (ECG, DES)
47. Ultralente, PZI insulin
48. dinoprost tromethamine (prostaglandin F2 alpha)
49. dinoprost tromethamine
50. A) True. Insulin moves glucose from the blood into the cells.
B) False. Humans are much more sensitive to thyrotoxicosis than dogs.
C) True.

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CHAPTER 8

Self Assessment Review Questions

1. analgesics
2. sedative (a narcotic produces more profound sleep – narcosis)
3. tranquilizer
4. anesthetic
5. visceral pain
6. somatic pain
7. transduction
8. hyperalgesia
9. wind up
10. opiates
11. opioids
12. euphoria
13. dysphoria
14. partial agonist/partial antagonist
15. mixed agonist/antagonist
16. neuroleptanalgesic
17. alpha 2
18. hypoproteinemic
19. compound A
20. thiopental
21. xylazine, detomidine, medetomidine
22. yohimbine, tolazoline, atipamezole
23. methohexital
24. sevoflurane
25. acepromazine
26. nitrous oxide
27. diazepam or other benzodiazepine tranquilizers
28. pentobarbital
29. halothane
30. ketamine, tiletamine
31. propofol
32. opioids
33. ketamine, tiletamine (dissociatives)
34. acepromazine
35. butorphanol
36. fentanyl
37. theobromine
38. doxapram

39. A) True.
B) True.
C) True.
D) False. Opioids depress the brain stem where the respiratory center is located. This is the reason why opioids are used for cough suppression.

40. Cattle. 10x more sensitive than equine patients.

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CHAPTER 9

Self Assessment Review Questions

1. anticonvulsant
2. convulsions
3. epilepsy
4. grain
5. idiopathic epilepsy
6. status epilepticus
7. drug induced hepatopathy
8. ictus
9. polydipsia
10. partial seizure
11. induced
12. polyphagia
13. generalized seizures
14. preictal phase or aura
15. limbic system
16. antidepressants
17. anxiolytic
18. GABA (gamma amino butyric acid)
19. phenobarbital
20. SSRI (selective serotonin re-uptake inhibitor) antidepressant
21. potassium bromide (KBr)
22. primidone
23. diazepam
24. phenothiazine tranquilizers (acepromazine, etc.)
25. clomipramine (Clomicalm®)
26. phenytoin
27. selegiline (deprenyl) (Anipryl®)

28. A) False. Phenobarbital induces its own metabolism, thus the rate at which the drug is converted to a less active form is sped up. The concentrations of phenobarbital drop quicker with induced metabolism, thus more drug would have to be given to compensate. The dose would need to be increased, not decreased.

B) True. They metabolize phenobarbital slower than dogs so need a smaller “mg per pound” dose.

C) False. This is a normal side effect of phenobarbital with many dogs.

D) False. PO administered diazepam is largely removed by the liver before it gets a chance to reach systemic circulation (first pass effect), therefore, the PO route of administration is not very effective compared to the IV route of administration.

E) False. Potassium bromide has a very long half life of 21-24 days. Thus, the time to reach steady state for potassium bromide is around 3-4 months (steady state = five times the half life).

F) True. Phenothiazine tranquilizers may remove learned behaviors that control aggression allowing the natural aggressive behavior to show itself.

G) True.

H) False. Decreased dopamine is associated with senility-like syndrome in dogs and therefore drugs that increase the amount or effect of dopamine tend to reverse some of the signs associated with this syndrome.

I) True.

J) True. Behavior modification is a complex process for which drugs may help but typically are not the sole component of successful modification.

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CHAPTER 10

Self Assessment Review Questions

1. minimum inhibitory concentration (MIC)
2. thrombocytopenia
3. pathogens
4. spectrum of activity
5. bactericidal
6. residue
7. beta-lactam ring
8. hypersensitivity
9. chelate
10. nephrotoxicosis
11. crystalluria
12. dermatophyte
13. myelosuppression
14. DNA gyrase
15. Fanconi's syndrome
16. bacteriostatic
17. leukopenia
18. sensitive
19. superinfection, suprainfection
20. ototoxic
21. keratoconjunctivitis sicca (KCS)
22. culture and sensitivity
23. anaerobic
24. pyogenic
25. antibiotic
26. cross resistance
27. beta-lactamase
28. resistant
29. aerobic
30. aminoglycosides
31. doxycycline and minocycline
32. sulfonamides
33. amoxicillin, ampicillin
34. enrofloxacin
35. cloxacillin, dicloxacillin, oxacillin
36. tetracycline or oxytetracycline
37. penicillins
38. amphotericin B
39. tetracycline and oxytetracycline
40. procaine
41. chloramphenicol
42. cephalosporins
43. aminoglycosides
44. quinolones
45. carbenicillin, ticarcillin, piperacillin

46. tetracycline and oxytetracycline
47. aminoglycosides: amikacin, gentamicin, neomycin, kanamycin, tobramycin and netilmicin
48. quinolones – enrofloxacin (Baytril®)
49. penicillins and cephalosporins
50. sulfasalazine (Azulfidine®)
51. quinolones – enrofloxacin (Baytril®)
52. sulfonamides
53. tetracyclines
54. aminoglycosides
55. griseofulvin
56. neomycin
57. tetracycline and oxytetracycline
58. penicillins and cephalosporins
59. doxycycline
60. trimethoprim and ormetoprim
61. benzathine
62. sulfonamides
63. penicillin G
64. clindamycin (Antirobe®)
65. erythromycin
66. tilmicosin (Micotil®)
67. metronidazole (Flagyl®)
68. florfenicol (Nuflor®)
69. bacitracin
70. clavulanic acid or sulbactam
71. imidazoles: ketoconazole, itraconazole, fluconazole, miconazole, clotrimazole
72. penicillins

73. A) False. Although cloxacillin is effective against beta-lactamase producing bacteria, it's overall spectrum of activity is actually narrower (less organisms) than the aminopenicillins like ampicillin and amoxicillin.

B) False. Cross reactivity between all members of penicillin is too strong. A similar reaction is likely to occur with all members of the penicillin group.

C) True.

D) False. The key to safety with aminoglycosides is allowing enough time between doses for the drug concentration to drop well below the therapeutic range. Giving the drug in small doses frequently doesn't allow concentrations to get as high as a single dose once daily, and it doesn't allow for enough time between doses for the trough concentration (lowest concentration) to get very low before the next dose is given. Once daily doses of aminoglycosides have largely replaced the t.i.d. and even b.i.d. dosing of the drug.

F) False. Aminoglycosides are ionized at body pH therefore they are not lipophilic and do not readily penetrate cellular membranes like the blood-brain barrier or prostate barrier.

G) True. This is why renal disease or poorly functioning kidneys results in a greater risk for aminoglycoside toxicosis.

H) False. Casts and protein reflect inflammation and injury to the renal tubules. BUN and creatinine do not begin to go up until at least 75% of the kidney function or renal tubule function has been eliminated.

I) False. The magnesium in antacids, the kaolin, or the bismuth in Pepto Bismol® will chelate with the orally administered tetracycline.

J) True. Systemic sulfonamides are absorbed into the body; orally administered enteric sulfonamides stay in the GI tract.

K) True.

- L) False. Ultramicrosized is smaller and therefore better absorbed than the microsized formulation. Because of that, you would have to use a smaller dose when switching from the microsized to the smaller ultramicrosized.

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CHAPTER 11

Self Assessment Review Questions

1. Antiseptics
 2. Sanitizers
 3. Disinfectants
 4. Sporicidal
 5. Nosocomial infection.
 6. Protozoacidal
 7. Biofilm
 8. Virucidal
 9. Sterilizers
 10. Cytotoxic
 11. Naked virus. Enveloped viruses are easier to kill by disrupting the lipid envelope.
 12. Fungicidal
 13. Scrub
 14. Tincture
 15. Bactericidal
 16. chlorhexidine
 17. phenols
 18. iodine
 19. chlorine
 20. quaternary ammonium compound
 21. alcohol
 22. iodine
 23. chlorine
 24. glutaraldehyde
25. A) False. Color-fast bleaches have no chlorine, despite the “bleach” designation. Color-fast bleaches tend to be peroxide-based compounds (like hydrogen peroxide).
- B) False. “Static” agents only inhibit the pathogen or microorganism without actually killing it. To kill it requires the action of the immune system. Inanimate objects like a surgery table do not have an immune system, thus the disease-causing agents wouldn’t be killed. Disinfectants need to be microbicidal.
- C) True.
- D) False. “Organic material”, such as dirt, secretions, feces, blood, etc., often react with many antiseptic or disinfectants and reduce their effectiveness. Thus, it is much better to scrub a site with a soap or soap/antiseptic combination to reduce the amount of organic material present prior to applying the antiseptic agent itself. This is why at least three cleanings of a surgical site with a surgical scrub compound are recommended.
- E) True. It takes several seconds or even a few minutes for the alcohol to produce a bactericidal effect. In addition, if there is dirt or organic debris at the site, most of the alcohol may be inactivated.

- F) True for the use of phenols to control gram-positive bacteria (less effective against gram-negatives). But, because the phenol residue can irritate the animal's skin with prolonged contact, the bird perch or reptile cage would have to be thoroughly rinsed of any phenol to avoid dermal irritation or ulceration.
- G) False. These two terms are often confused because they both have "hex" and "chloro" in their names. Hexachlorophene is a phenol and has a history of neurotoxicity. Chlorhexidine is a biguanide and is widely and safely used in veterinary medicine as a disinfectant and antiseptic.
- H) True. The longer acting effect of iodophors is due to slow release of iodine over time. This is less irritating, lasts longer, but won't achieve as high of concentration of iodine as the same amount of free iodine compounds because the iodophor stretches out its release of iodine over a longer period of time.

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CHAPTER 12

Self Assessment Review Questions

1. gamma amino butyric acid (GABA)
2. proglottids
3. nicotinic receptors
4. coccidiostats
5. mydriasis
6. antitrepatodal
7. vermifuge
8. delayed neurotoxicity
9. muscarinic receptors
10. endectocides
11. acetylcholine
12. anthelmintic
13. P-glycoprotein
14. antinematodal
15. glutamate
16. emboli
17. adulticide
18. antiprotozoal
19. ectoparasites
20. hemoptysis
21. ovicidal
22. acetylcholinesterase
23. pruritus
24. anticestodal, cestocides, or taeniocides
25. microfilaricide
26. selective toxicity

27. A) imidacloprid
B) lufenuron
C) melarsomine
D) selamectin
E) milbemycin oxime
F) ivermectin
G) milbemycin oxime + lufenuron
H) fenbendazole
I) pyrantel

- J) praziquantel
- K) fipronil
- L) nitenpyram

- 29. pyrethrins
- 30. macrolides (avermectins and milbemycins)
- 31. amitraz
- 32. ivermectin
- 33. piperazine
- 34. selamectin
- 35. amprolium
- 36. melarsomine (Immiticide®)
- 37. macrolides (avermectins and milbemycins)
- 38. organophosphates and carbamates
- 39. moxidectin (Cydectin® in cattle, Quest® in horses)
- 40. thiabendazole
- 41. ponazuril (Marquis®)
- 42. ivermectin
- 43. fenbendazole
- 44. pyrantel
- 45. organophosphate
- 46. praziquantel
- 47. ivermectin
- 48. milbemycin oxime
- 49. imidacloprid (Advantage®)
- 50. lufenuron
- 51. diethylcarbamazine (DEC)
- 52. milbemycin
- 53. metronidazole
- 54. doramectin
- 55. organophosphates and carbamates
- 56. piperonyl butoxide
- 57. fipronil (Frontline®, Top Spot®)
- 58. atropine
- 59. nitenpyram (Capstar®)
- 60. pyriproxyfen (Nylar®)
- 61. DEET (diethyltoluamide)

62. A) False. Microfilaria are not capable of developing into adult heartworms until they are picked up by the mosquito and molt within the mosquito. The infective larvae injected into another animal by the mosquito migrate through tissue and spend a relative small amount of time in the blood. Also, because there are very few migrating infective larvae in the body, the chances of the infective larvae being in the blood and being taken up in a transfusion are very, very slim.

B) False. Cats with adult heartworms are not treated with adulticides as the risk of fatal emboli and lung inflammatory reactions are too great. Thus, the adult heartworms are allowed to die naturally one at a time and any inflammatory reaction treated with corticosteroids or other medications.

C) False. Lacrimation (tear production).

D) False. It is an inhibitory neurotransmitter. Stimulation of the glutamate receptor inhibits the nervous system and blocking glutamate's effect allows domination of excitatory neurotransmitters.

E) True.

63. Collie

CHAPTER 13

Self Assessment Review Questions

1. glucocorticoids
2. thromboxanes
3. alopecia
4. humoral immunity
5. renal papillary necrosis
6. leukotrienes
7. autoimmune reactions
8. neutrophilia
9. catabolic effects
10. B-lymphocytes
11. cortex
12. Cushing's syndrome
13. cyclooxygenase (COX)
14. eicosanoids
15. eosinopenia
16. Addison's disease
17. glycogenesis
18. corticotropin-releasing factor (CRF)
19. monocytopenia
20. atrophy
21. hyperadrenocorticism
22. hypoadrenocorticism
23. iatrogenic
24. aldosterone
25. lipoxygenase
26. mineralocorticoids
27. gluconeogenesis
28. lymphopenia
29. propionic acid
30. cell mediated immunity
31. prostaglandins
32. arachidonic acid pathway
33. T-lymphocytes
34. ACTH (adrenocorticotropin hormone)
35. tepoxalin (Zubrin®)
36. hyaluronic acid
37. triamcinolone
38. phenylbutazone
39. carprofen (Rimadyl®)
40. prednisolone, methylprednisolone, triamcinolone
41. DMSO
42. hydrocortisone
43. etodolac (EtoGesic®), deracoxib (Deramaxx®), and meloxicam (Metacam®)
44. dexamethasone
45. aspirin
46. ibuprofen, ketoprofen, naproxen

- 47. flunixin meglumine
- 48. polysulfated glycosaminoglycans (PSGAGs)
- 49. prednisone
- 50. glucosamine and chondroitin sulfate
- 51. acetaminophen

52. A) False. Acetate, diacetate, pivalate, or valerate esters on drugs like dexamethasone identify it as suspension formulation. While an aqueous solution drug can be given IV, a suspension must never be given IV.

B) False. B-lymphocyte responses are not suppressed by normal doses of glucocorticoids. B-lymphocytes are responsible for producing antibodies.

C) False. Less blood protein means less protein for the NSAIDs to bind to in the blood. Thus, more of the NSAID molecules are available in the free form to distribute to the tissues. If anything, the dose would have to be decreased to compensate for a greater percentage of the drug being able to get to the target tissues. See the pharmacokinetic chapter of this text for more information on protein binding effects on distribution.

D) False. Kidney (renal papillary necrosis) and GI tract (ulcerations). Although the liver is listed as a target organ for some COX-2 selective toxicities, these are fairly rare incidences.

E) False. NSAIDs are not true analgesics in that they do not reduce the perception of pain at the brain level to any great degree. You would need to use an opioid analgesic for this type of procedure.

53. A) No. That would be a mineralocorticoid effect

B) Yes

C) Yes

D) Yes. This is why fungal diseases and other pathogens normally killed or suppressed by cell-mediated immunity can get worse when on glucocorticoid drugs.

E) Yes. Decreased fibroblasts decreases the amount of scar tissue laid down.

F) No. It affects primarily T-lymphocyte activity and cell mediated immunity; much less so antibody formation.

G) Lymphocytosis is an increased number of lymphocytes. Glucocorticoids cause a lymphopenia.

H) No. Glucocorticoids cause an eosinopenia and monocytopenia.

I) Yes.

J) Yes.

54. Prostaglandins increase mucus production, increase sodium bicarbonate secretion and increase the rate at which GI epithelial cells turnover and the GI tract wall repairs itself, thus NSAIDs that block these prostaglandins will DECREASE mucus and bicarbonate secretion and SLOW healing of the GI tract wall. This is what predisposes the GI tract to ulcers when non-selective COX inhibiting NSAIDs are used.