

The Laboratory Cat

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Acknowledgements



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- Sue Spray and Tim Baker – Scripps Institute

Disclaimer



- This is not an ACLAM sanctioned presentation
- All information is deemed reliable and correct
– No warranty for accuracy
- No information presented is known to be specifically included on the ACLAM Board Certification Exam

Domestic Cat Taxonomy



Animalia
Chordata
Mammalia
Order
Family
Felis
Felis catus

Contributions to Biomedical Research



- **22,687 cats used in research in FY 07**
– 2.2% of regulated animal usage
http://www.aphis.usda.gov/publications/animal_welfare/content/cvrttable_version/2007_AC_Report.pdf
- **Uses include:**
 - Experimental neurology
 - Ophthalmology
 - Retrovirus research
 - Inherited diseases
 - Immunodeficiency diseases

Inherited Disease Models



- >200 heritable genetic defects identified; many homologous to human inborn errors
http://home.roslin.ac.uk/roslin/Comparative_Genomics/Genome/Genetic/Species.html
- 38 chromosomes
<http://www.colostate.edu/faculty/genetics/med/genetics/species.html>
- NCI Laboratory of Genomic Diversity provides genetic map with comparisons to human chromosomal locations
- LAM, 2nd ed., p. 461, Table I

What's Your Diagnosis?



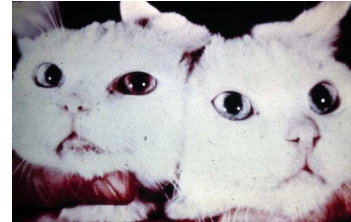
<http://animal-world.com>

- Coat color
- Mode of inheritance
- Chromosomal abnormality if ♂
- Condition

Inherited Disease Models

Waardenburg syndrome

- Characterized by hearing loss and changes in skin and hair pigmentation
- Heterochromic eyes
- PAX3 gene



What's Your Diagnosis?



Where's the mouse?



Inherited Disease Models

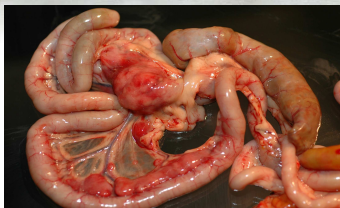
Porphyria

- Defect in porphyrin metabolism

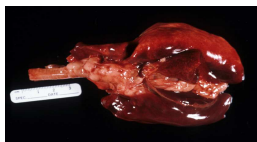


<http://dtdemine.com>

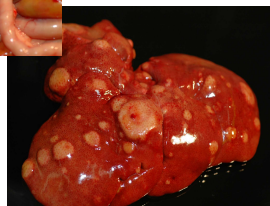
What's Your Diagnosis?



- Likely diagnosis
- Incidence
- Viral etiology



Kim Newkirk, DVM, PhD, DACVP

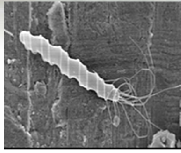


Infectious Disease Models

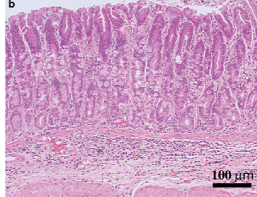
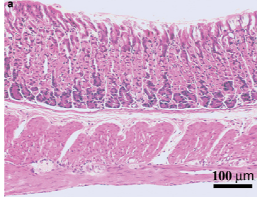
Feline immunodeficiency virus

- Single stranded RNA virus, Retroviridae, Lentivirinae
- Morphologically similar to HIV, antigenically distinct
- Similar pathogenesis and clinical signs
- Transmission
- ELISA, Western blot

Infectious Disease Models



<http://microbiology.comped.ucdavis.edu>



Laboratory Investigation (2005) 85, 1104–1117. doi:10.1038/labinvest.3700305; published online 20 June 2005

- Tissue
- Pathogen
- Significance



Infectious Disease Control



American Association of Feline Practitioners 2006 Vaccination Guidelines

- **Core**
 - FVRCP
 - Rabies
- **Non-core**
 - FeLV
 - FIV
 - *Chlamydomydia felis*
 - *Bordetella bronchiseptica*
- **Not Generally Recommended**
 - FIP
 - Feline *Giardia*
- LAM, 2nd ed., p. 463, Table II

Housing According to the AWRs...



- Spot-cleaning frequency for hard surfaces in contact with cats
- Manner of food and bedding storage relative to floors and walls
- Minimum ambient temperature for cats not acclimated to lower temperatures, except as approved by AV

Housing According to the AWRs...



- When cats are present, ambient temperature must not fall below ____ for > ____ h and must not rise above ____ for > ____ h
- Ambient temperature at which auxiliary ventilation must be provided

Housing According to the AWRs...



- Minimum height of 1^o enclosure
- Minimum floor space for cats ≤ 8.8 lbs (4 kg)
- Minimum floor space for cats > 8.8 lbs

Housing According to the AWRs...



- For queens with nursing kittens, if floor space for each kitten is less than ____% of the minimum requirement for the queen, housing must be approved by the ____
- **T or F** The litter pan may not be considered part of the required floor space
- Maximum number of adult nonconditioned cats that may be housed in the same 1^o enclosure

Housing According to the AWRs...



- **T or F** A receptacle containing sufficient clean litter must be provided in all 1° enclosures
- **T or F** Resting surfaces must be large enough to hold all occupants of the 1° enclosure at the same time comfortably
- **T or F** Low resting surfaces that do not allow the space under them to be comfortable occupied by the animal will be counted as part of the floor space

Housing According to the AWRs...



- **T or F** When an entire group or room of cats is known to have been exposed to an infectious agent, the group may be separated during the process of diagnosis, treatment, and control
- Frequency at which cats must be fed
- Unless restricted by the AV, frequency and interval at which cats must be offered water

Social Behavior



- **Predacious**
- **Social**
 - Hierarchy
 - Affiliative behavior
 - Maternal behavior
 - ♂ aggressive behavior
 - Urine spraying/fighting
- **Dominance/submission signals**
 - Vocalization
 - Visual cues
 - Scent marking



<http://farm3.static.flickr.com>

Reproduction



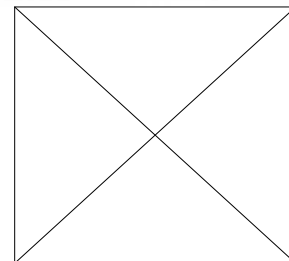
- **Queen**
 - First estrous generally between 5-9 mo; ≥ 2 kg BW
 - Peak sexual activity between 1.5-7 y
 - 2-3 litters/y; 3-4 kittens/litter
- **Tom**
 - Puberty between 8-13 mo
 - Peak performance between 2-8 y
- **Seasonally polyestrous**
- **Sensitive to photoperiod**

Estrous Cycle



- **Proestrus** $\frac{1}{2}$ -3 d
 - Ovarian follicular growth; estrogen synthesis
- **Estrus** 4-7 d
 - Follicular phase; \uparrow estradiol
 - May experience during pregnancy
- **Interestrus** 1-3 w
 - Baseline estradiol
- **Diestrus** 45-50 d
 - Formation of corpora lutea; progesterone
- **Anestrus** Oct-Jan
 - Baseline estradiol/progesterone

Mating Sequence

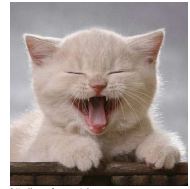


Reproduction

- **Induced ovulators**
- **Gestation 65-66 d**
- **Pregnancy detection**
 - Relaxin ↑20-30 d post mating, remains elevated
 - Palpation
 - 17 d discrete nodules
 - 25 d uteromegaly
 - 45 d fetal heads
 - Calcification of fetal skeletons 38-43 d
 - Ultrasonographic evidence 11-14 d; fetal heartbeat 3.5-4 w

Neonatal Care

- Passive immunity from translactational Ig transfer
- Maternal antibodies wane at 9-14 wk
- For orphans, use commercially designed kitten milk replacement formula
- Birth weight 100 ± 10 g
- Weaned 6 wk, 550-600 g BW
- **LAM, 2nd ed., p. 471, Table IV**



What's Your Diagnosis?



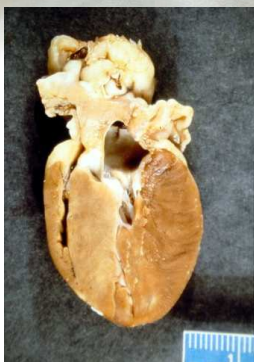
Other developmental defects in kittens

- One of the most common according to LAM, 2nd ed.
- Atresia ani

Nutrition

- **Obligate carnivores**
- Diets ↑in protein, fat; ↓ carbohydrate
- **Lack ability to synthesize sufficient quantities of**
 - Taurine
 - Arginine
 - Vitamin A
 - Niacin
 - Arachidonic acid
- **Short GI tract relative to dog**

Dietary deficiency in which of the following has been associated with the depicted condition?



- Arginine
- Niacin
- Taurine
- Vitamin A

Nutrition

- AAFCO approved diets
- Closed formula vs open/fixed formula vs semipurified
- Adult maintenance energy requirement 60-80 kcal/kg BW/d
- Queens increase energy requirements by 25-30% mid-gestation
- Kittens require 250 kcal/kg BW/d

Effects of Gamma Irradiation and Pasteurization on the Nutritive Composition of Commercially Available Animal Diets
Caulfield et al. (2008) *JAALAS*, (47)6, 61-66



- Diet sterilization methods
 - Pasteurization
 - partial sterilization
 - exposure to 107°C for 15-20 min in autoclave
 - Gamma irradiation
 - extensively destroys microbes
 - doses ≥ 10 KGy inactivate Salmonella, Campylobacter, and microbes responsible for spoilage
 - 20-30 KGy used to treat SPF diets
 - 40-50 kGy recommended for gnotobiotic or germ-free diets
 - D value energy required to kill 90% of the microbial population

Effects of Gamma Irradiation and Pasteurization on the Nutritive Composition of Commercially Available Animal Diets
Caulfield et al. (2008) *JAALAS*, (47)6, 61-66



- Nutrient requirements for dogs/cats described in *AAFCO Dog and Cat Food Nutrient Profiles*
 - Association of American Feed Content Officials
- Objective to investigate if gamma irradiation or pasteurization of animal foods altered their nutritive composition
- Results confirmed gamma irradiation has effects on vitamin A and peroxide content of dry cat food; pasteurization has only modest effect

Effects of Gamma Irradiation and Pasteurization on the Nutritive Composition of Commercially Available Animal Diets
Caulfield et al. (2008) *JAALAS*, (47)6, 61-66

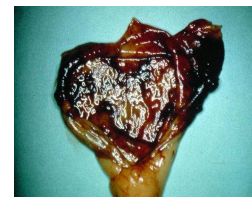


- Vitamin A deficiency associated with impaired growth, visual deficits, \downarrow reproduction, \downarrow disease resistance, altered bone growth, and neurologic disease
- Vitamin A deficiency implicated in ataxic syndrome in some large felids
- Vitamin A deficiency suspected to be involved in development of leukoencephalomyelopathy in SPF cats

Feline Lower Urinary Tract Disease



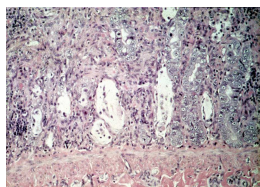
- Diet may contribute
- ♂ urethral obstruction
- Magnesium ammonium phosphate crystal (struvite) formation complication factor
- Most important factor in development of struvite urolithiasis



What's Your Diagnosis?



- Morphologic diagnosis
- Likely differential
- Etiology
- Prevention



What's Your Diagnosis?



- Morphologic diagnosis
- Likely differential



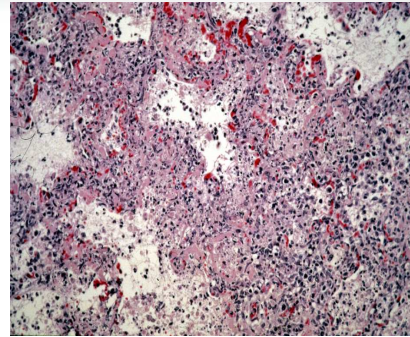
What's Your Diagnosis?



- Morphologic Diagnosis
- Differentials

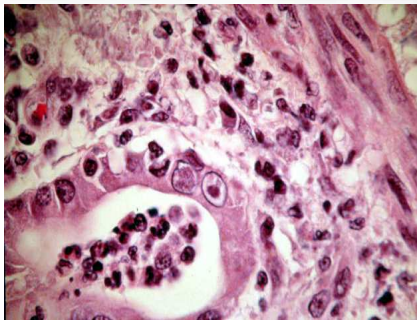
<http://www.familyvet.com>

What's Your Diagnosis? Kitten with respiratory distress



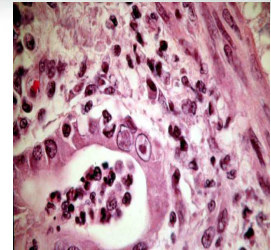
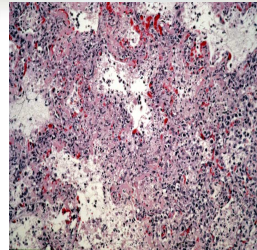
Slide 1 of 2

What's Your Diagnosis? Kitten with respiratory distress



Slide 2 of 2

What's Your Diagnosis? Kitten with respiratory distress



- Disease
- Etiologic agent

Upper Respiratory Infection



- FHV-1 and FCV 1° etiologic agents in 80% of URI
- Others include:
 - *Chlamydia*→conjunctivitis
 - *Mycoplasma*→conjunctivitis
 - Reovirus
 - *Bordetella*→acute bronchitis and pneumonia
- FHV-1→conjunctivitis, keratitis
- FCV→oral, lingual ulcerations

FHV-1 and FCV



- Environmental persistence
 - FHV-1, 1-2 d
 - FCV, 8-10 d
- Transmission via direct contact, fomites
- 80% of recovered FHV-1 cats become carriers
- Vaccines do not offer complete protection
- Modified live intranasal vaccines produce local immunity within 2-4 d

What's Your Diagnosis?

•Disease

•Etiologic agent



Kim Newkirk, DVM, PhD, DACVP

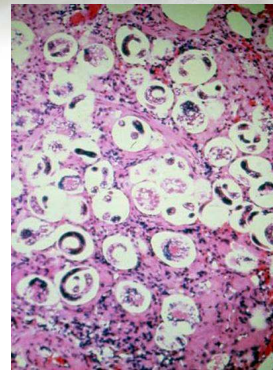
Feline Coronaviruses

- Feline coronaviruses
 - FECV
 - FIPV
- Antigenically and morphologically indistinguishable
- FECV
 - Ubiquitous
 - Subclinical or self-limiting GI signs
 - Fecal-oral transmission
 - Binds to and kills enterocytes
 - Humeral immunity stimulated as virus taken up by mesenteric LN

Feline Coronaviruses

- FIPV capable of replicating in macrophages; macrophages migrate peripherally
- Systemic antibodies not protective
 - May enhance disease due increased macrophage uptake
- Most common in young <18 m and old >13 y
- May manifest as acute vasculitis w/ pleural/peritoneal effusions or as pyogranulomatous disease

What's Your Diagnosis?



NCSU-CVM Parasitology Group

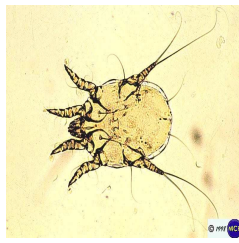
Cat lung

•Etiologic agent

- Trematode found in lung parenchyma

Of the following, which is the most common cause of otitis externa in the cat?

- Ctenocephalides felis*
- Lynxacarus radovski*
- Notedres cati*
- Octodectes cynotis*



<http://www.ict.usp.br/~marcelcp/imagens/can/38.jpg>

External Parasites

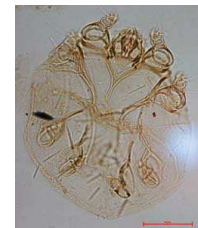


Ctenocephalides felis



40 mag.

JRDF-CVM-NCSU



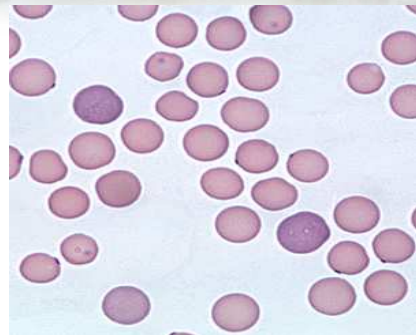
Notedres cati

What's Your Diagnosis?



Slide 1 of 3

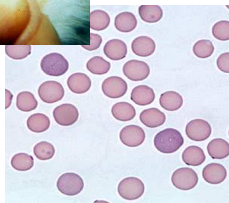
What's Your Diagnosis?



<http://diaglab.vet.cornell.edu>

Slide 2 of 3

What's Your Diagnosis?

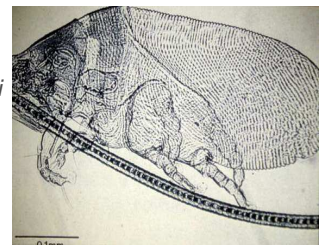


- Disease
- Etiologic agent
- Vector

Slide 3 of 3

The depicted organism was removed from the pelage of a cat. Identify.

- a. *Cheyletiella blakei*
- b. *Demodex cati*
- c. *Lynxacarus radovski*
- d. *Sarcoptes scabiei*



External Parasites



400 mag.

JOEF-CVM-NCMU

<http://www.wormsandgermsblog.com>



Cheyletiella sp.

NCMU-CVM Parasitology Group



100 mag.

JOEF-CVM-NCMU

What's Your Diagnosis?



1000 mag.

JOEF-CVM-NCMU

NCMU-CVM Parasitology Group

- Etiologic diagnosis
- Etiologic agent

What's Your Diagnosis



- Disease
- Etiologic agent
- Vector

<http://img.fid.com/mosby/thumb/500063-tx13.jpg>



<http://pathmicro.med.sc.edu>

P26-based Serodiagnosis for Bartonella spp. Infection in Cats Werner et al. (2008) JAALAS, (58)4, 375-380

- Intracellular bacterial pathogen
- Cat adapted species
 - *B. henselae* seroprevalence 4-80%
 - *B. clarridgeiae* seroprevalence 0-36%
- *B. koehlerae* rarely identified in cats
- Cats usually asymptomatic

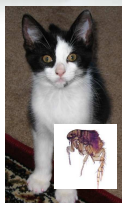
P26-based Serodiagnosis for Bartonella spp. Infection in Cats Werner et al. (2008) JAALAS, (58)4, 375-380

- Immunocompetent humans
 - papule→regional lymphadenopathy
 - fever, malaise, fatigue, myalgia, arthralgia, weight loss, splenomegaly (5 to 14%)
- Immunocompromised humans
 - bacillary angiomatosis, bacillary peliosis
- *B. henselae* and *B. koehlerae* implicated in culture-negative endocarditis

P26-based Serodiagnosis for Bartonella spp. Infection in Cats Werner et al. (2008) JAALAS, (58)4, 375-380

- Culture definitive diagnostic assay, as long as 45 d for growth
- IFA most common serologic assay
- Objective to evaluate *B. henselae* rP26 protein for serodiagnosis of *Bartonella* infection in cats
- Results suggested that rP26-based serology can serve as a useful adjunct tool for diagnosis of *B. henselae* and *B. clarridgeiae*

Bartonellosis Cat to Cat Transmission



Bacteremic Cat

1) Flea ingests *Bartonella* with cat blood during feeding

2) Amplification of *Bartonella* in flea's hindgut



4) Flea bites cat, feces with *Bartonella* infects bite wounds, cat becomes bacteremic



3) *Bartonella* excreted in flea feces for at least 9 days; lands on new cat

Marcy Souza, DVM, MPH, DABVP (Avian)

Bartonellosis Cat to Human Transmission



Bacteremic Cat

Cat scratches person
(or bites)



Infected cat blood in claws contaminate person's wound

Flea feces in claws contaminate wound and spread *Bartonella* to person

Marcy Souza, DVM, MPH, DABVP (Avian)

What's Your Diagnosis?



<http://img.webmd.com>

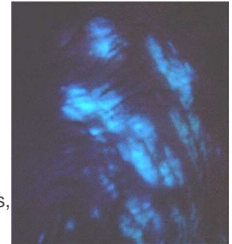
- Disease
- Most likely etiologic agent



<http://www.magazine.ayurvedicure.com>

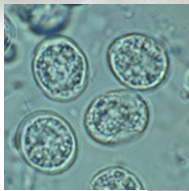
Dermatophytosis

- *Microsporum canis*
- *Trichophyton mentagrophytes*
- Generally restricted to cornified nonliving keratin layer of skin
- Transmission via direct contact infected cats or humans, carriers, or fomites
- Diagnosis via fungal culture or Wood's lamp



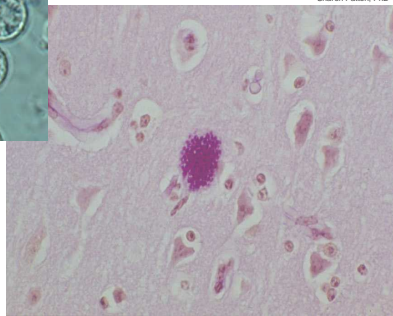
<http://images.rescuergroups.org>

What's Your Diagnosis



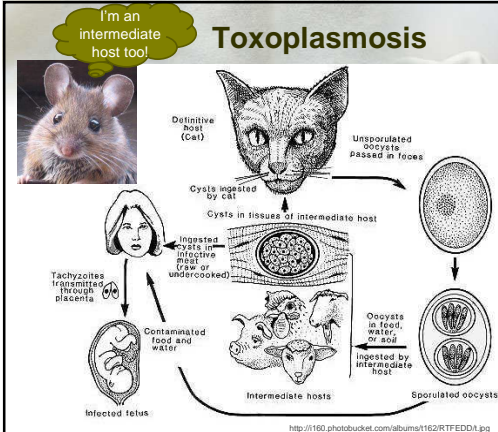
<http://www.cdc.gov>

Etiologic agent



Sharon Patton, PhD

Toxoplasmosis



Allergens

- *Fel d 1* major cat allergen
- Produced in the sebaceous glands of skin; coats hair shafts
- Male cats might shed more than female

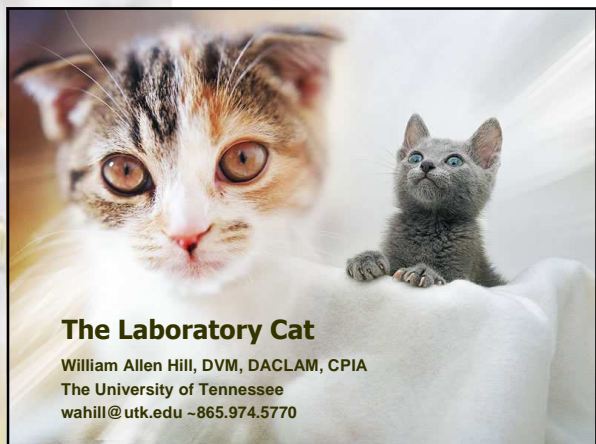
Quimby et al. (2009) *JAALAS* 48(4), 402-404



You intend to stick that WHERE?!



<http://www.bmcs.com>



The Laboratory Cat

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