

**DEPARTMENT OF ENVIRONMENTAL AND
RADIOLOGICAL HEALTH SCIENCES**

RADIOLOGY RESIDENCY PROGRAM

1. INTRODUCTION

The Department of Environmental and Radiological Health Sciences at Colorado State University offers a combined Residency/Master's program in Veterinary Diagnostic Imaging, with the objective of meeting the eligibility requirements of the American College of Veterinary Radiology to sit for the certifying board examination. The program offers clinical training in all aspects of diagnostic imaging under the guidance of six board certified faculty radiologists. Three to four residents are being trained who have started their programs one year apart. The radiology faculty has imaging expertise which encompasses large and small animal radiology, ultrasound, nuclear medicine, computed tomography, and magnetic resonance imaging.

The residency is a three year program combined with a Master's degree that typically begins in July. The Master's degree is earned in conjunction with the residency by completing a non-thesis graduate program of study. This program consists of 32 hours of graduate coursework, completion of both retrospective and prospective research projects, and successfully passing a final oral graduate examination. Results of these research projects are to be presented during resident seminars at CSU and one project will be presented at the annual ACVR scientific meeting.

The combined Residency/Master's degree program does not differ significantly from a standalone radiology residency program. The major content differences are the completion and submission of two manuscripts for publication and successful completion of an oral examination. Residents will also gain teaching experience by presenting a limited number of didactic lectures and seminars, but also more extensively through less formal clinical teaching sessions with veterinary students. A stipend is provided, tuition and fees are paid, and two weeks of vacation per year are allowed. There are no other fringe benefits.

II. Objectives

The residency training program is designed to provide supervised training in diagnostic imaging in an atmosphere conducive to learning clinical diagnostic imaging with an introduction to clinical investigation. The residency is also designed to prepare the trainee for certification by the American College of Veterinary Radiology. The residency is designed to provide thorough training in small and large animal radiology and ultrasound. More limited training is also provided in nuclear scintigraphy, computed tomography, and magnetic resonance imaging.

III. Training Period

The residency program requires 3 years (36 months) of training in veterinary diagnostic imaging of which at least 30 months is supervised clinical experience. See Appendix B for a schedule of clinical experience.

IV. Direction and Supervision

The program director has a 60% commitment to the diagnostic imaging service and is involved in radiology, CT, MRI, PET/CT, nuclear medicine and ultrasound. The program director is also involved in clinical instruction to residents as well as resident rounds, journal club, and known case conference. ACVR Diplomates are assigned to diagnostic radiology, ultrasound, nuclear medicine, CT, and MRI services at all times.

V. Faculty

The following faculty are involved in the residency training program. The primary clinical training responsibility is listed after each name.

Head, Department of Environmental and

Radiological Health Sciences:

J. Nickoloff, PhD

Residency Director

A. J. Marolf, Diplomate ACVR, DVM

R. D. Park, Diplomate ACVR, DVM, PhD, Radiology/CT, MRI, 35 yrs

S.L. Kraft, Diplomate ACVR, DVM, PhD, Radiology/MRI, CT, Radiation Therapy, 17 yrs

A. J. Marolf, Diplomate ACVR, DVM

D. S. Gibbons, Diplomate ACVR, DVM, M.S.

E. K. Randall, Diplomate ACVR, DVM, M.S.

A. Valdes-Martinez, ACVR, DVM

See Appendix A for abbreviated biographies that provide more detail on faculty in the residency training program.

Formal teaching of didactic lectures to professional veterinary students and graduate students are distributed equally among faculty. Radiology resident/graduate research projects are supervised primarily by one selected radiology faculty member, but the other radiologists serve on the graduate committee and thus play a supervisory role as well. Diagnostic imaging faculty equally share clinical rotations and resident lectures, clinical case rounds, known case conference rounds, and average 60% time on clinical duty, 30% time teaching and 10% time research.

Specialists in Veterinary Teaching Hospital include:

American College of Veterinary Radiology	7
American College of Veterinary Internal Medicine	20
American College of Veterinary Theriogenology	5
American College of Veterinary Surgery	17
American College of Veterinary Ophthalmology	2
American College of Veterinary Anesthesiology	4
American Association of Zoological Medicine	2
American College of Veterinary Emergency Critical Care	2
American College of Veterinary Pathology	12

VI. Affiliation Agreement

The residency program does not require affiliations with other institutions or training programs.

VII. Facilities

The facilities at the CSU Veterinary Teaching Hospital reflect state-of-the-art diagnostic imaging. Diagnostic imaging has the following assigned rooms:

Radiology:

Large Animal	1 Examination room
Small Animal	4 Examinations rooms
Ultrasound	3 Examination rooms
CT	1 Examination room, 1 control room, and 2 equipment rooms
MRI	1 Examination room, 1 control room, 1 reading room and 1 equipment room
Nuclear Medicine	2 Rooms Diagnostic, 2 wards, 1 radiopharmaceutical lab
I-131 Facility	1 ward, 1 ante-room

Small Animal Room 1:

800 mA Siemens Multix Top/Vertex Solitaire machine, with four way float top elevator table, Eklin RadipStart Clinical Digital Radiography System.
Dicom compliance achieved through interface with Philips iSite PACS and Fuji RIS.

Small animal Radiography/Fluoroscopy Room 2

800 mA multi-pulse high voltage waveform generator
Siemens Polydoros SX 65 generator with 150 kV X-ray tube
Siemens Sireskop CX ceiling free spot film device and permanently attached digital PC based imaging chain with tilting and floating table top. The spot film device has a front loading cassette arrangement with automatically programmed field subdivision.
An overhead suspended X-ray tube of 1509 kV capacity can interlock with a fine bucky grid.
Three photocells are available in the cassette holder to calculate and to terminate the exposures at a predetermined film density.
Dicom Compliance achieved with Siemens fluoroscopy software interfaced with Philips iSite PACS and Fuji RIS. Fluoroscopy Dicom compatibility to be achieved through an add on TIMS unit Fall 2010.

Small animal Radiography/fluoroscopy Room 3

Toshiba KXD-80F, 800 mA, 180 KW, microprocessor controlled generator
Ceiling free spot film device and permanently attached image
Intensifier television chain with a tilting and floating table top. The spot film device has a front loading cassette arrangement with automatically programmed field subdivision
An overhead suspended X-ray tube of 150 kV capacity interlocking capability with a fine bucky grid. Eklin RadieStart Clinical Digital Radiography System.
Fluoroscopy is incorporated with a digital imaging system (Infimed) Platinum RF fluoroscopic imaging computer.
TIMS live video recorder and CD/DVD burner.
Dicom Compliance achieved with addon TIMS and Infimed units interfaced with Philips iSite PACS and Fuji RIS.

Small Animal Special Procedure Room 4

Seimens Polydoros 805-80 KW generator
Camera mounted on a C (arcoscope arm) for fluoroscopy examinations and image intensification, and digital imaging X-ray tube mounted on a telescopic ceiling suspended crane for magnification studies
One pressure injector: Liebel-Flarsheim Angiomat 3000
Koordinate Kombi table with floating top
Fluoroscopy is incorporated with a (Infimed) Platinum One DSA digital system.
TIMS live video recorder and CD/DVD burner.
Dicom compliance achieved with addon TIMS and Infimed units interfaced with Philips iSite PACS and Fuji RIS.

Large Animal Examination Room

Two overhead ceiling-suspended longitudinal and transverse rail systems to support three telescoping cranes for high powered Philips X-ray tubes and a DR detector with interlocking capability at set distances and move as a unit or independently.
Eklin EDR3 Clinical Digital Radiography System with Cesium Iodide 17x17 active capture panel.
High powered ultra high heat capacity Philips X-ray tubes
Philips Super CP 100-100 kw generator
Specialized exam table for anesthetized (myelograms, pelvis exams,etc.)
Dicom compatibility as interfaced with Philips iSite PACS and Fuji RIS.

Combination teaching/research examination room:

Dell Medical/Simon DR 400MA/125KVP system
Dicom-

AGFA Computed Radiography System

Dicom Compliance achieved through interface with Philips iSite PACS

In addition:

Two Minray 80+port with Eklin Mark III Digital System
Dicom compatibility as integrated with Philips iSite PACS and Fuji RIS.

Ultrasound Room:

Siemens Antares Acuson
Dicom compliant with VEPRO server and integrated with Philips iSite PACS

Siemens Antares Sonoline,
Dicom complaint with Vepro server and integrated with Philips iSite PACS

Vepro Server
Dicom compliant

Computer Tomography/PET

Philips PET/CT
Extended Brilliance workstation

Magnetic Resonance

GE 1.5 Tesla 9.0 LX MRI scanner with Multinuclear spectroscopy
Advantage Windows workstation

Nuclear Medicine:

Digital Omega Gamma Camera with Mirage Acquisition/Processing Station for large animal.
Dicom compliance

GE Millenium SPECT system for small animal planar, whole body and SPECT imaging
Dicom compliance

Dark Room

Hand processor tanks, Kodak Processor x 2, X-ray film duplicator-subtraction unit

VIII. Clinical Resources

The diagnostic imaging service at the CSU VTH sees approximately 6,200 small animal radiology cases and 1,700 large animal radiology examinations per year, including exotic animals and food animal patients. Approximately 2,400 ultrasound, 400 CT, 300 MRI, 300 diagnostic nuclear medicine, and 40 I-131 cases are performed annually. The exotic animal service at the CSU VTH is run by 2 full time clinicians. The food animal program includes dairy, beef, and camelids. The equine and small animal clinics at the CSU VTH are staffed by a full complement of surgeons and other medical specialists.

DETAILED PLAN OF TRAINING YEARLY CASELOAD

The residency schedule is outlined in Appendix B. The average case load and resident case experience are as follows:

	Cases per year	Case load over 30 months for 3 residents	Case load over 30 months for single resident
Radiology Small Animal	6,200	15,500	5,200
Radiology Large Animal	1,700	4,250	1,420

	Cases per year	1 Year/Resident	Case load over 30 months for single resident
Ultrasound	2,400	2,400	5,000

	Cases per year	4 Months/Resident	Case load over 30 months for single resident
Computed Tomography	300	100	700
Magnetic Resonance Imaging	300	100	700
Nuclear Medicine (diagnostic)	300	100	300
Nuclear Medicine (I-131 patients)	40	15	100

Residents are assigned to diagnostic radiology for 12 months, ultrasound for 6 months, nuclear medicine for 4 months, CT/MRI for 4 months, and an elective rotation for 4 months. Rotations overlap; for example, a resident might be on ultrasound and radiology simultaneously.

Residents rotate through the Nuclear Medicine Service for one semester during which time approximately 1/3 of their effort is dedicated to diagnostic radiology. During their CT/MRI rotation (one semester) 4/5 of their time is in CT/MRI and 1/5 in diagnostic radiology.

While on diagnostic radiology rotations, residents spend approximately two-thirds of their time in small animal and one-third of their time in large animal radiology. Approximately 120 food animal cases (bovine, ovine, caprine, and camelids) are seen per year. In the small animal diagnostic radiology rotation, about 300 exotic animal species are radiographed. Eighty percent of these (exotic species) are avian (mostly raptors). The balance is evenly divided between reptiles and exotic mammal species.

IX. Training Content

Clinical training: Residents have clinical rotations in diagnostic radiology and ancillary imaging areas. A summary of the radiology resident Plan of Study is located in Appendix B. Under supervision of an assigned radiologist residents work with and dictate cases on a daily basis. All reports are reviewed orally in morning rounds and corrected with the supervising radiologist. Each resident keeps a personal log of all special procedures performed, so that deficiencies can be corrected before the residency is completed. Residents also have night and weekend radiology duty in the second and third years of training.

Clinical radiology rounds: Residents will attend radiology rounds each morning. Other imaging related discussion sessions are held weekly, including Known Case Conference and Journal Club. Assignments will be made to residents for participation in Known Case Conferences and the Journal Club. Residents are encouraged to attend pathology rounds each week. Radiographs may be presented by the resident at these rounds. Other medical, surgical and grand rounds within the VTH are available and should be attended when the schedule allows. Residents also attend weekly graduate seminars and present two seminars during their program.

Didactic classes: Residents enroll in graduate school during the course of their residency program. Both plan A (thesis) and plan B (non-thesis) MS degrees are offered. Residents in training programs pursuing an MS degree are required to enroll in a plan B program and to meet the minimum credit hour requirement listed below. Should an individual begin the combined resident/MS program and decide not to complete the residency, 32 credit hours would still be required to fulfill the MS requirements (Appendix C).

A resident with a pre-existing MS degree who decides he or she does not wish to pursue the MS degree must notify and make arrangements with his or her advisor/committee. In such cases, the resident will register for the minimum credit requirements to complete the outlined Residency Training Program approved by the American College of Veterinary Radiology.

Clinical teaching responsibilities: Residents participate in teaching diagnostic imaging to third and fourth year veterinary students. Presentation of at least 2 didactic lectures or seminars and participation in continuing education courses and/or anatomy instruction is also expected.

The following core courses are required:

<i>Course #</i>	<i>Credits</i>	<i>Course name</i>
STAT307	3	Introduction to Biostatistics or equivalent (only needed if no other statistics course has been taken)
ERHS550	5	Principles of Radiation Biology
ERHS701	VAR	Alternate Imaging (Offered in odd years, Spring semester)
ERHS711	VAR	Advanced Radiological Interpretation (Offered in even years, Spring semester)
ERHS712	3	Radiation Therapy Physics (Offered in odd years, Fall semester)
VS792	VAR	Seminar/Graduate
VS602	2	Critical Evaluation of Scientific Literature (Offered in Fall semester)
VS/ERHS 662	3	Applied Research: Planning, Design and Analysis (Offered in Spring semester)

The following Elective Courses are available:

<i>Course #</i>	<i>Credits</i>	<i>Course name</i>
ERHS400	3	Radioisotope Techniques (Offered in Fall semester)
ERHS721	(1-3)	Radiation Oncology
ERHS795	VAR	Independent Study
ERHS770	(1-3)	Radiation Biology Basic to Tumor Therapy
VS 660	3	Neurology and Neurosurgery (Offered in Spring semester)
VS701-704	VAR	Postgraduate Medicine I-IV (requires Residency Director approval)

The clinical imaging duties will comprise at least 30 months of the 36 month residency program, to be scheduled by the radiology resident director. Off clinic time will be distributed as follows: 10 days in the first year, approximately 18 days in the second year and approximately 43 days in the third year. Off clinic time is spent on clinical investigation projects, and board exam preparation. In addition, residents are allowed 10 days of vacation per year. Some of the vacation time may be assigned during Christmas and Thanksgiving breaks.

X. Research Environment

Two investigation projects are required. A retrospective study should be started during the first year of study and completed by September of the second year. A prospective study should be started during the second year of study and finished by December of the third year. Research projects must be reviewed and approved by the resident's advisor and graduate committee. A faculty person must be chosen by the resident to be a primary consultant on each investigational project. The results of these investigational projects will be presented in the Graduate Seminar Course, and one project should be presented at the annual ACVR meeting. Application for any research money must be made to the appropriate funding agency through the faculty consultant who assumes responsibility for performance of the work.

XI. Education Environment

An education environment is fostered in the training program. The residency program is combined with a Master's Degree. Courses required and the educational environment is detailed in the description of the training program.

XII. Evaluation

Residents will meet with the Radiology faculty and/or the director of the resident program at least yearly. At these annual reviews (usually conducted at 9, 21 and 33 months of the program), the following will be discussed:

- A summary of the resident's program to date; this must be provided in written form by the resident at least two weeks prior to the interview.
- Faculty evaluations of the resident's performance to date.
- Progress toward research and publication completion.

If progress towards completion of the Master's degree/Residency Program is deemed unsatisfactory by the Radiology faculty, a statement to this effect, including reasons for the unsatisfactory evaluation and suggested methods for correction of deficits will be provided to the resident, the resident's advisor, graduate committee, and to the Department Head. Deficiencies must be corrected within 3 months of the date of the statement of unsatisfactory progress. If deficiencies are not corrected, a recommendation to terminate the resident's program will be made.

Periodic Examinations/Evaluations

An examination is given to a resident at various times during the clinical training. The written examinations are given in six sections in the Summer Semester. Residents have to pass with a 70% score before passing on to the next test. These tests provide a self-assessment tool for the residents and also provide information for performance review.

First Year Resident

- Anatomy
- Radiobiology Radiation Physics
- Physics of Diagnostic Radiology

Second Year Resident

- Physics and Applications of Alternate Imaging
- Special Procedures
- Physiology/Pathophysiology

Graduate School

Examinations for the completion of the Master's program are determined by the Colorado State University Graduate School. Successful completion of the entire combined Residency/Master's program will fulfill the eligibility for examination by the American College of Veterinary Radiology. However, it must be re-emphasized that completion of anything short of the full three-year program (36 months) will prevent the resident from being credited with having completed an approved program.

XIII. Teaching File

Radiology, ultrasound, CT, MR, and nuclear medicine cases are available for resident training. These teaching files are kept current and updated regularly with material from the known case conference rounds. These contributions are provided by the supervising faculty radiologists (who share KCC responsibilities equally) and by the residents who have rotating duties towards finding KCC cases.

There is also a file of articles compiled for reading that are selected to assist knowledge of the ACVR objective list. This is kept up to date by the residents who contribute articles to the file.

XIV. Conferences

Radiology resident rounds are conducted daily. Known case conference and journal club are held weekly. Pathology rounds are available and held weekly. Clinical seminars are presented weekly for all clinical faculty and residents in the veterinary teaching hospital.

XV. Literature Resources

The Colorado State University Clinical Sciences Library is situated in the VTH building. This library is well stocked with books and journals covering both veterinary and human medicine. The main library on campus (1 mile north of the VTH) is also available. Internet access is available from several sites at the VTH. A journal article archive for radiology residents is also available at the VTH. This archive has been compiled and maintained by previous and current radiology residents

APPENDIX A

BIOGRAPHICAL SKETCHES

Faculty Radiologists

Richard D. Park

Susan L. Kraft

Angela J. Marolf

Elissa K. Randall

Alex Valdes-Martinez

BIOGRAPHICAL SKETCH

Give the following information for the key personnel and consultants and collaborators. Begin with the principal investigator/program director. Photocopy this page for each person.

NAME	POSITION		
Richard D. Park	Professor		
<i>EDUCATION (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	FIELD OF STUDY
Utah State University, Logan UT Colorado State University, Ft. Collins CO University of California, Davis CA Diplomate, American College of Veterinary Radiology	B.S. D.V.M. Ph.D.	1965 1968 1971 1971	Veterinary Medicine Veterinary Radiology

RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list, in chronological order, previous employment, experience, and honors. Key personnel include the principal investigator and any other individuals who participate in the scientific development or execution of the project. Key personnel typically will include all individuals with doctoral or other professional degrees, but in some projects will include individuals at the masters or baccalaureate level provided they contribute in a substantive way to the scientific development or execution of the project. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. **DO NOT EXCEED TWO PAGES.**

EMPLOYMENT/EXPERIENCE

- 1971-1974 Assistant Professor, Veterinary Clinical Medicine and Head, Radiology Section, University of Illinois, Urbana IL
- 1974-1975 Assistant Professor of Radiology, Department of Radiological Sciences, University of California, Davis CA
- 1975-1980 Associate Professor, Department of Radiology & Radiation Biology, Colorado State University, Fort Collins CO
- 1979-88,94-- Head, Radiology Section, Veterinary Teaching Hospital, Colorado State University, Fort Collins CO
- 1980-Date Professor, Department of Radiology and Radiation Biology, Colorado State University, Fort Collins CO

PROFESSIONAL SOCIETIES

Phi Zeta; Phi Kappa Phi; American Veterinary Medical Association; American College of Veterinary Radiology, Board Certified 1971; Sigma Xi; American Association of Veterinary Clinicians; International Veterinary Radiology Society

PUBLICATIONS - Selected

- Nyland TB, Park RD, Lattimer JC, Lebel JL, Miller CW: Gray-scale ultrasonography of the canine abdomen. Vet Rad 22:220-227. 1981.
- Park RD, Nyland TG, Lattimer JC, Miller CW, Lebel JL: B-mode gray-scale ultrasound: Imaging artifacts and interpretation principles. Vet Radiol 22.5:204-210. 1981.
- Park RD: Radiographic diagnosis of long bone neoplasms in the dog. Compendium on Continuing Education. 3:922-927. 1981.
- Nyland TG, Park RD: Real-time hepatic ultrasonography in the dog. Vet Rad 24:72-84. 1983.
- Kondo LJ, Wrigley RH, Park RD, Lebel JL: Sonographic appearance of renal neoplasia in the dog. Vet Rad 26:74-81. 1985.
- Weeks PM, Withrow SJ, Powers BE, Park RD: Closed biopsy for diagnosis of long bone tumors: accuracy and results. Jour Am Amin Hosp Assoc 21:489-494. 1985.
- Gillette EI, McChesney SL, Park RD: Relationship of functional changes and cardiomyopathy in dogs. Br. J. Cancer (Suppl). 53:192-195. 1986.

- Park RD, Nelson TR, Hoopes PJ: Magnetic resonance imaging of the normal equine digit and metacarpophalangeal joint. *Vet Radiol* 28:105-116. 1987.
- Postorino NC, Wheeler SL, Park RD, Powers BE, Withrow SJ. A syndrome resembling lymphomatoid granulomatosis in the dog. *Jour of Vet Internal Med* 3:15-19. 1989.
- Park RD. Radiographic examination of the equine foot. *Vet Clin N Am Eq Pract* 5:47-66. 1989.
- Gillette EL, Powers BE, McChesney SL, Park RD and Withrow SJ: Response of aorta and branch arteries to experimental intraoperative irradiation. *Int J Radiat Oncol Biol Phys.* 17:1247-1255. 1989.
- Park, RD. Diagnostic imaging of the spine. *Progress in Veterinary Neurology* 1:371-386. 1990.
- Finn ST, Park RD, Twedt DC, Curtis CR. Ultrasonographic assessment of sencalide-induced canine gallbladder emptying: An aid to the diagnosis of biliary obstruction. *Vet Radiol* 32:269-276. 1991.
- Park RD, Beck ER, LeCouteur RA. Comparison of computed tomography and radiology for detecting changes produced by malignant nasal neoplasia in dogs. *J Am Vet Med Assoc.* 201: 1720-1724. 1992.
- Finn-Bodner ST, Park RD, Twedt DC, Curtis CR. Sonographic volume determination of the in vitro and in vivo canine gallbladder. *Am J Vet Res* 54:832-835, 1993.
- Atwater SW, Powers BE, Park RD, Straw RC, Ogilvie GK, Withrow SJ: Thymoma in dogs: 23 cases (1980-1991). *J Am Vet Med Assoc.* 105:1007-13, 1994.
- Gamblin R. Straw RC, Powers BE, Park RD, Bunge MM, Withrow SJ: Primary osteosarcoma distal to the antebrachiocarpal joints in 9 dogs (1980-1992). *J Am Anim Hosp Assoc* 31:86-91, 1995.
- Ray CS, Baxter GM, McIlwraith CW, Trotter GW, Powers BE, Park RD, Steyn PF. Development of subchondral cystic lesions after articular cartilage and subchondral bone damage in young horses. *Eq Vet Journal* 28:225-232, 1996.
- Kenny DE, Cambre RC, Spraker TR, Stears JC, Park RD, Colter SB, de Lahunta A, Zuba JR. Leukoencephalomalacia in a neonatal female black rhinoceros (*Diceros bicornis*): Report of a fourth case. *Journal of Zoo and Wildlife Medicine* 27:259-265, 1996.
- Snaps FR, Balligand MH, Saunders JH, Park RD, Dondelinger RF. Comparison of radiography, magnetic resonance imaging and surgical findings in dogs with elbow dysplasia. *Am J of Vet Res* 58:1367, 1997.
- Snaps FR, Saunders JH, Park RD, Daenen B, Balligan MH, Dondelinger RF. Comparison of spin echo, gradient echo and fat saturation magnetic resonance imaging sequences for imaging the canine elbow. *Veterinary Radiology and Ultrasound* 39:518-523, 1998.
- Snaps FR, Park RD, Saunders JH, Balligand MH, Dondelinger RF. Magnetic resonance arthrography of the cubital joint in dogs affected with fragmented medial coronoid processes. *American Journal of Veterinary Research* 60:190-193, 1999.
- Frisbie DD, Trotter GW, Powers BE, Rodkey WG, Steadman JR, Howard RD, Park RD, McIlwraith CW. Arthroscopic subchondral bone plate microfracture technique augments healing of large chondral defects in the radial carpal bone and medial femoral condyle of horses. *Veterinary Surgery* 28:242-255, 1999.
- Kawcak CE, McIlwraith CW, Norrdin RW, Park RD, Steyn PS. Clinical effects of exercise on subchondral bone of carpal and metacarpophalangeal joints in horses. *Am. Jour. of Vet. Research* 61: 1252-1258. 2000.
- Morrow KL, Park RD, Spurgeon TL, Stashak TS, Arceneaux B. Computed tomographic imaging of the normal equine head. *Veterinary Radiology and Ultrasound* 41:491-497. 2000.
- Park RD. Optimal radiographic views for evaluating Thoroughbred yearlings—Quality control of the radiographic image. *AAEP Proceedings* 46:357-358. 2000.
- Becht JL, Park RD. A review of selected normal radiographic variations of the equine fetlock, carpus, tarsus and stifle. *AAEP Proceedings* 46:362-364. 2000.
- Kane AJ, McIlwraith CW, Park RD, Rantanen NW, Morehead JP, Bramlage LR. The prevalence of radiographic changes in Thoroughbred yearlings. *AAEP Proceedings* 46:365-369. 2000.
- Kane AJ, McIlwraith CW, Park RD, Rantanen NW, Morehead JP, Bramlage LR. The effect of radiographic changes in Thoroughbred yearlings on future racing performance. *AAEP Proceedings* 46: 370-374. 2000.
- Becht JL, Park RD, Kraft SL, Steyn PF, Wrigley RH. Radiographic interpretation of normal skeletal variations and pseudolesions in the equine foot. *Vet. Clinics of North America: Equine Practice* 17(1):1-18, 2001.

BIOGRAPHICAL SKETCH

NAME Susan L. Kraft	POSITION TITLE Associate Professor, Veterinary Radiology		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
University of Alaska, Anchorage AK Washington State University, Pullman WA Washington State University, Pullman WA	B.S. DVM Ph.D.	1981 1985 1991	Biology Veterinary Medicine Veterinary Sciences
<p>RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publications pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. PAGE LIMITATIONS APPLY. DO NOT EXCEED 4 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INDIVIDUAL.</p> <p><u>Positions and Employment</u></p> <p>1987 - 1991 Radiology resident and PhD graduate candidate, Washington State University 1991 – 1997 Assistant Professor Veterinary Radiology, Kansas State University 1997 – 1999 Associate Professor with tenure, Kansas State University 1999 – Present Associate Professor with tenure, Colorado State University</p> <p><u>Other Experience and Professional Memberships</u></p> <p>1993 Diplomate of American College of Veterinary Radiology, Diagnostic Imaging 1995-2001 Associate Editor Veterinary Radiology and Ultrasound Journal 1999 – Present Director Robert and Eva Knight MRI Facility, Animal Cancer Center 1999 – Present Member Animal Cancer Center, and ACC Research Committee, Colorado State University 2001 Diplomate of ACVR – Radiation Oncology 2001 Member, MRI Safety Committee, Colorado State University 2003 Member, International Society of Magnetic Resonance in Medicine 2004 Member, University of Colorado Cancer Consortium, Health Sciences Center, University of Colorado 2005 – present Co-Director Small Animal Imaging Core, University of Colorado Cancer Consortium, University of Colorado Health Sciences Center</p> <p><u>Honors</u></p> <p>1996, 1995 Sloan Fellowship Award, Kansas State University 1995 MSD Agvet Award for Creativity in Teaching, Kansas State University 2005 Innovative instructional methodology Award in Professional Veterinary Medical Education, College of Veterinary Medicine, Colorado State University</p>			

Selected peer-reviewed publications (in chronological order).

1. **Kraft SL**, Gavin PR, Wendling LR, Reddy VK: Canine Brain Anatomy on Magnetic Resonance Images. *Vet Radiol* 30 (4):147-158, 1989.
2. Gavin PR, **Kraft SL**, Wendling LR, D. Miller: Canine Spontaneous Brain Tumors - A Large Animal Model for BNCT, *Strahlentherapie und Onkologie* 165(2/3): 225-229, 1989.
3. **Kraft SL**, Gavin PR, Moore MP, Leathers CW, Richardson TE: Imaging Diagnosis, Canine Meningioma *Vet Radiol* 31(2): 65-67, 1990.
4. Frenier SL, **Kraft SL**, Moore MP, Gavin PR: A review of canine intracranial astrocytomas and comparison with the human counterpart. *Compend Cont Educ* 12(10): 1422-1436, 1990.
5. **Kraft SL**, Gavin PR, Leathers CW, Wendling LR, Frenier SL, Dorn RV. Diffuse cerebral and leptomeningeal astrocytoma in dogs: MR features. *JCAT* 14(4):555-560,1990.
6. Moore MP, Gavin PR, **Kraft SL**, De Haan CE, Leathers CW, Dorn RV. MR, CT and clinical features from dogs with nasal tumors involving the rostral cerebrum and nasal passages. *Vet Radiol* 32 (1): 19-25, 1991.
7. **Kraft SL**, Gavin PR, Leathers CW, DeHaan CE, Bauer WB, Miller DL, Dorn RV. Borocaptate sodium: A potential boron-carrying compound for Boron Neutron Capture Therapy. *Proceedings National Academy of Science, USA* 89:11973-11977, 1992.
8. Davidson H, **Kraft SL**. Imaging Diagnosis (MRI of a Canine Retrobulbar Lymphosarcoma). *Vet Radiol* 35(30), 1994.
9. DeHaan CE, **Kraft SL**, Gavin PR, Wendling LR, Griebenow ML. Normal variation in the lateral ventricles of the canine brain. *Vet Radiol* 35(2):83-87, 1994.
10. **Kraft SL**, Gavin PR, Leathers CW, DeHaan CE, Bauer WF, Dorn RV, Griebenow ML. Biodistribution of boron in dogs with spontaneous intracranial tumors following borocaptate sodium administration. *Cancer Research* 54:1259-1263, 1994.
11. **Kraft SL**, Gavin PR, DeHaan CE, Moore M, Wendling LR, Leathers CW. Retrospective evaluation of magnetic resonance imaging characteristics of 50 intracranial tumors. *J Vet Intern Med* 11:218-225, 1997.
12. Gavin PR, **Kraft SL**, Huiskamp R, Coderre JA. A review: CNS effects and normal tissue tolerance in dogs. *J Neurooncol* 33(1-2):71-80, 1997.
13. **Kraft SL**, Mussman J, Smith T, Biller DS. Magnetic resonance imaging of lumbosacral discospondylitis. *Vet Radiol*, 39(1):9-13, 1998.
14. Harkin K, Goggin JM, DeBey BM, **Kraft SL**, deLaHunta A. MRI of hereditary polioencephalomyelopathy in an Australian cattle dog. *JAVMA* 214(9):1342-1344, 1999.
15. **Kraft SL** and Gavin PR. MRI of Intracranial neoplasia. *Clinical Technique and Small Animal Practice*, 14(2):112-123, 1999.
16. Tucker DW, Olsen D, **Kraft SL**, Andrews GA, Gray AP. Primary hemangiosarcoma of the iliopsoas muscle eliciting a peripheral neuropathy. *JAAHA* 36(2):163-167, 2000.
17. **Kraft SL** and Gavin PR. Physical principles and technical considerations for equine computed tomography and magnetic resonance imaging. In *Advances in Equine Imaging* Veterinary Clinics of North America: Equine Practice (SL Kraft and GRoberts, eds.), W.B. Saunders, April 2001.
18. Kippenes H., Gavin P., **Kraft SL**, Sande R., Tucker R. Mensuration of the normal pituitary gland from magnetic resonance images in 96 dogs. *Vet Radiol and Ultrasound* 42:130-133, 2001.
19. Fish PH, Carpenter JW, **Kraft SL**. Diagnosis and treatment of a cerebral ischemic attack in a chimpanzee (*Pan troglodytes*), *J Zoo Wildlife Med*, 35:203-207, 2004.

20. Young B, Kraft SL. MRI diagnosis of a cervical foreign body. *Vet Radiol and Ultrasound*. 45(6): 538-541, 2004.
21. Huang Z, Haider MA, **Kraft S**, Chen Q, Blanc D, Wilson B, Hetzel F. Response of prostate gland to Pd-Bacteriopheophorbide (Tookad) photodynamic therapy monitored with magnetic resonance imaging. *Lasers in Surgery and Medicine*: 38:672-681, 2006.
22. Brennan G, Podell M, Wack R, **Kraft S**, Bielefeldt Ohmann H, VandeWoude S. Neurologic disease in Panthera leo with low titer lion lentivirus infection. *J Clin Microbiology*; Oct 11, 2006 (epub ahead of print).
23. **Kraft SL**, Ehrhart EJ, Gall D, Klopp L, Gavin P, Tucker R, Bagley R, Kippenes H, DeHaan C, Pedroia V, Partington B, Olby N. Magnetic Resonance Imaging Characteristics of 18 Peripheral Nerve Sheath Tumors of the Canine Brachial Plexus. *Vet Radiol and Ultrasound* 48(1):1-7, 2007.
24. **Kraft SL**, Randall E., Wilhelm M, Lana S. Development of a whole body MR imaging protocol in normal dogs and canine cancer patients. *Vet Radiol and Ultrasound* 48(3): 212-220, 2007.

Selected first-author book chapters (in chronological order).

1. **Kraft SL**, Gavin PR, DeHaan CE, Leathers CW, Bauer WF, Dorn RV III. The biodistribution of boron in canine spontaneous intracranial tumors following borocaptate sodium infusion. In Progress in Neutron Capture Therapy for Cancer (B.J. Allen, D.E. Moore, B. V. Harrington, eds.), Plenum Press, New York, 1992. pp. 537-541.
2. **Kraft SL**. Editorial comments on Magnetic Resonance Imaging in Veterinary Diagnosis. In *Advances in Small Animal Medicine & Surgery* (Rhea Morgan, ed.), W.B. Saunders, Dec, 1994.
3. **Kraft SL** and Gavin PR. MRI of canine intracranial tumors. *Clinical Techniques in Small Anim Pract*, 14(2): 112-122, May 1999.
4. **Kraft SL** and Gavin PR. Physical principles and technical considerations for equine computed tomography and magnetic resonance imaging. In *Advances in Equine Imaging Veterinary Clinics of North America: Equine Practice* (SL Kraft and G Roberts, eds.), W.B. Saunders, 17(1):115-130 April 2001.
5. **Kraft SL**. MRI for cancer imaging. In *Veterinary Clinical Magnetic Resonance Imaging* (Gavin PG, Tucker R, Bagley R, eds.), Blackwell Publishing, In press December 2007.
6. Serkova NJ, Hasebroock KM, **Kraft SL**. Magnetic resonance spectroscopy of living tissues, In *Methods in Molecular Biology: Tumor Marker Discovery* (Tainisky M ed), In press December 2007.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed for Form Page 2.
Follow the sample format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE		
Marolf, Angela J.	Assistant Professor of Radiology		
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
University of Colorado at Boulder	B.A.	1996	Biology
Colorado State University	D.V.M.	2002	Veterinary Medicine
University of Florida	Residency	2007	Diagnostic Imaging

A. Positions and Honors.

Positions and Employment

2002-2003 Rotating Small Animal Internship, University of Georgia Teaching Hospital, Athens, GA
 2003- Associate Veterinarian, Polo Springs Veterinary Hospital, Colorado Springs, CO
 2004-2006 Radiology and Diagnostic Imaging Resident, University of Florida Veterinary Medical Center, Gainesville, FL
 2006-2007 Radiology and Diagnostic Imaging Resident Transfer, Colorado State University, Fort Collins, CO
 2007- Associate Professor, Dept of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO

Professional Memberships

2007- American college of Veterinary Radiology, Diplomate
 American Veterinary Medical Association, Member
 Colorado Veterinary Medical Association, Member

Honors

1995 Phi Beta Kappa Honor Society
 2001 Phi Zeta National Honor Society

B. Selected peer-reviewed publications (in chronological order).

1. **Marolf A**, Blaik M, Ackerman N, et al. Comparison of Computed Radiography and Conventional Radiography in Detection of Small Volume Pneumoperitoneum. *Vet Radiol Ultrasound*. In Press.
2. **Marolf A**, Blaid M, Specht A. A Retrospective Study of the Relationship Between Tranceal Collapse and Bronchiectasis. *Vet Radiol Ultrasound*. May/June 2007; 48 (3): 199-203
3. **Marolf A**, Blaik M. Bronchiectasis. *Compend Contin Educ Pract Vet*. November 2006; 28 (11): 766-75
4. **Marolf A**, Specht A, Thompson M, et al. Imaging Diagnosis—Penile Hemangiosarcoma. *Vet Radiol Ultrasound*. September/October 2006; 47 (5):474-5
5. **Marolf A**, Kraft S, et al. Radiographic Diagnosis: Right Kidney Herniation. *Vet Radiol Ultrasound*. May/June 2002; 43 (3): 237-247.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed for Form Page 2.
Follow the sample format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE		
Randall, Elissa K	Assistant Professor, Diagnostic Imaging		
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
University of North Carolina, Chapel Hill	BA	1993	History, Minor in Chemistry
Virginia-Maryland Regional College of Veterinary Medicine , Blacksburg, VA	DVM	2001	Veterinary Medicine
Colorado State University, Fort Collins, CO	MS	2005	Environmental and Radiological Health Sciences

NOTE: The Biographical Sketch may not exceed four pages. Items A and B (together) may not exceed two of the four-page limit. Follow the formats and instructions on the attached sample.

A. Positions and Honors. List in chronological order previous positions, concluding with your present position. List any honors. Include present membership on any Federal Government public advisory committee.

Positions

2002-2005 Resident, Diagnostic Imaging, Colorado State University
2005-2008 Assistant Professor of Diagnostic Imaging, Michigan State University
2008-present Assistant Professor of Diagnostic Imaging, Colorado State University

Other Experience

2006 - 2008 Faculty Advisor, Michigan State University College of Veterinary Medicine Class of 2010
2006 - 2008 Committee on Student Admissions, Michigan State University CVM
2006 - 2008 Internship Committee, Michigan State University CVM
2006 - 2008 Residency Program Director, Diagnostic Imaging Section, MSU CVM
2007 – 2008 Principal Investigator/Radiation Safety Officer for Diagnostic Imaging

B. Selected peer-reviewed publications (in chronological order). Do not include publications submitted or in preparation.

Abstracts

Heffelman VL, **Randall EK**, Stanley B, Frtiz M, Hauptman J. Comparison of trans-splenic portography with trans-splenic portal scintigraphy in normal dogs. Proceedings, American College of Veterinary Radiology annual meeting, San Antonio, TX, October 2008.

Randall EK, Kraft SL, Lana S, Avery A, Olver C. Whole-body MRI: a prospective comparison to routine diagnostics in staging lymphoma in dogs. Proceedings, American College of Veterinary Radiology annual meeting, Chicago, IL, November 2005.

Randall EK, Kraft SL, Wilhelm M, Evolution and Evaluation of a whole body MRI protocol. Proceedings, American College of Veterinary Radiology annual meeting, Montreal, Canada, August 2004.

Manuscripts

Kraft SL, **Randall EK**, Wilhelm, M, Lana S. Development of a whole body magnetic resonance imaging protocol in normal dogs and canine cancer patients. *Vet Rad & US*, Vol. 48, No. 3, 2007, pp 212-220.

Meola S, Swiderski J, **Randall E**, Kraft S, Palmer R, What's your diagnosis? Spinal cord compression. *J Am Vet Med Assoc.* 2007 Jun 1;230(11):1629-30.

C. Research Support. List selected ongoing or completed (during the last three years) research projects (federal and non-federal support). Begin with the projects that are most relevant to the research proposed in this application. Briefly indicate the overall goals of the projects and your role (e.g. PI, Co-Investigator, Consultant) in the research project. Do not list award amounts or percent effort in projects.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed for Form Page 2.
Follow the sample format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME		POSITION TITLE	
Alex Valdés-Martínez		Assistant Professor	
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
Universidad Autónoma de Nuevo León	MVZ (DVM)	2000	Veterinary Medicine

NOTE: The Biographical Sketch may not exceed four pages. Items A and B (together) may not exceed two of the four-page limit. Follow the formats and instructions on the attached sample.

A. Positions and Honors. List in chronological order previous positions, concluding with your present position. List any honors. Include present membership on any Federal Government public advisory committee.

Positions and Employment

2001-2003 Equine Medicine and Surgery Internship, San Luis Rey Equine Hospital
2003-2004 Equine Medicine and Surgery Internship, Louisiana State University
2004-2005 Equine Medicine and Surgery clinical training, Louisiana State University
2005-2008 Radiology Residency, University of Pennsylvania
2008-Present Assistant Professor, Department of Environmental and Radiological Health Sciences, Colorado State University

Board Certification

American College of Veterinary Radiology (2008)

B. Selected peer-reviewed publications (in chronological order). Do not include publications submitted or in preparation.

Valdes-Martinez, A., Seiler, G., Mai, W., Bolt, D. M., Mudge, M., Dukti, S. A., Hubert, J. D. Quantitative analysis of scintigraphic findings in tibial stress fractures in racing Thoroughbreds. *AJVR*, Vol 69, No. 7, Jul 2008.

Valdes-Martinez, A., Cianciolo, R., Mai, W. Hypoechoic subcapsular thickening in feline kidneys: Association with lymphosarcoma. *Veterinary Radiology & Ultrasound*, Vol 48, No. 4, Jul-Aug 2007

Kinns, J., Mai, W., Seiler, G., Zwingenberger, A., Johnson, V., Caceres, A., **Valdes-Martinez, A.**, Schwarz, T. Radiographic sensitivity and negative predictive value for acute canine spinal trauma. *Veterinary Radiology & Ultrasound*, Vol 47, No. 6, Nov-Dec 2006

Valdes-Martinez, A., Strickland, K.N., Eades, S.C., Roberts, E.D. Echocardiographic evidence of an aortico-pulmonary septal defect in a Thoroughbred colt. *Veterinary Radiology & Ultrasound*, Vol 47, No. 3, Jan-Feb 2006

Valdes-Martinez, A., Waguespack, R.W. What is your diagnosis? Ultrasonographic diagnosis of a Cecocolic intussusception in a Thoroughbred yearling. *J Am Vet Med Assoc*, Vol 228, No. 6, March 15, 2006

Vidal, M.A., **Valdes-Martinez, A.**, Bueno, A. What is your diagnosis? Ultrasonographic diagnosis of a Superior check ligament desmitis. *J Am Vet Med Assoc*, Vol 228, No. 6, March 15, 2006

Valdes, A., Johnson, J.R. Septic pleuritis and abdominal abscess formation caused by *Rhodococcus equi* in a foal. *J Am Vet Med Assoc*, Vol 227, No. 6, September 15, 2005

Valdes-Martinez, A., Hdz-Vidal, G., Mora, F.A., Kawas, J.R., Ramirez, R., Davis, M.E., Jeffcott, L.B. Immunolocalization of cathepsin B in chondrocytes and osteoclasts in equine dyschondroplasia (osteochondrosis). *Vet. Méx.*, Vol 33, No. 4, 2002

APPENDIX B

RADIOLOGY RESIDENCY - PLAN OF STUDY

FIRST YEAR

Summer Trimester	Fall Trimester	Spring Trimester
<p>Technical training radiology (submit routine radiographic examinations for formal approval by radiologist, large and small animal)</p> <p>Clinical radiology rotation with a radiologist (4 Months Radiology)</p>	<p>Clinical radiology rotation with a radiologist</p> <p>STAT307 Introduction to Biostatistics or equivalent (if no previous statistics class)</p> <p>ERHS 721 Radiation Oncology (Elective)</p> <p>ERHS 712 Physics of Diagnostic Imaging (Odd # Years in Fall only)</p> <p>VS602 - Critical eval. of scientific literature (Fall only)</p> <p>ERHS 795O - US - independent study 2 credits (4 Months Radiology)</p>	<p>Clinical radiology rotation with a radiologist</p> <p>US rotation</p> <p>ERHS 701 - Alternate Imaging (Odd # years)</p> <p>ERHS 711- Advanced Radiological Interpretation (Even # years)</p> <p>VS/ ERHS 662 - Applied research</p> <p>Retrospective study proposal due (1 Month Rad., 2 Months US)</p>

SECOND YEAR

Summer Trimester	Fall Trimester	Spring Trimester
<p>VTH - clinical radiology rotation</p> <p>US rotation</p> <p>Retrospective study</p> <p>Finish retrospective study</p> <p>(2 Months Rad., 2 Months US)</p>	<p>VTH - clinical radiology rotation</p> <p>Computed Tomography/Magnetic Resonance Imaging rotation</p> <p>ERHS 721 Radiation oncology (Elective)</p> <p>ERHS 712 Physics of Diagnostic Imaging (Odd # years, Fall semester)</p> <p>Write proposal for prospective research project</p> <p>Complete paper for retrospective study (3 Months CT/MRI)</p>	<p>VTH - clinical radiology rotation</p> <p>ERHS 550 – Principles of Radiation biology</p> <p>ERHS 701 - Alternate Imaging (Odd # years)</p> <p>ERHS 711 – Advanced Radiological Interpretation (Even # years)</p> <p>Begin research prospective study</p> <p>(3 Month Rad.)</p> <p>Nuclear Medicine rotation</p>

THIRD YEAR

Summer Trimester	Fall Trimester	Spring Trimester
VTH - Clinical radiology Rotation	VTH - Clinical radiology rotation	VTH - Elective diagnostic imaging rotation
Nuclear medicine rotation	Ultrasound rotation	Masters oral exam
Continue research on prospective study	Radiation therapy rotation (2 weeks)	Study for ACVR board certifying examination (1 Month Rad., 2 Months Elective)
Submit application for ACVR examination by July 1 (2 Months Rad., 1 Month NM)	Finish prospective study	
Study for ACVR Preliminary Written Exam	Papers written for publication (1 Month Rad., 2 Months US)	
	Sit Written Exam	
	Seminar Presentation (VS 792)	

Months of Service Training

Year	Radiology	Ultrasound	CT/MRI	NM	Elective	Off Clinic + Vacation (days)
First	9	2	0	0	0	10 + 10
Second	5	2	3	0	0	18 + 10
Third	4	2	0	1	2	43 + 10
Total	18	6	3	1	2	

1. Additional Elective course may be added in consultation with Graduate Advisor (See accompanying list in syllabus)
2. Present cases in Known Case Conferences and review assigned journals in Journal Club

Proposed outline for guidance: Because of some courses being taught every other year and scheduling requirements in this hospital, the schedule above may need to be altered; however, the total content will be completed in the outlined 3 years.

APPENDIX C

COURSE OUTLINES

Required Courses:

STAT 307 03(3-0-0). Introduction to Biostatistics.

F, S. Prerequisite: M 121. Credit allowed for only one course: ST 301, ST 307/EH 307, ST 309, ST 311. Biostatistical methods: confidence intervals, hypothesis tests, simple correlation and regression, one-way analysis of variance. This course is only required if the resident has no prior statistics course.

ERHS 595B-K Var. Independent Study.

B) Large animal radiology. D) Radiation therapy. E) Radiation physics. F) Dosimetry. G) Radiation chemistry. H) Radiation biology. I) Radiological health. J) Radiation ecology. K) Micro-computer analysis.

ERHS 550 05(5-0-0). Principles of Radiation Biology.

S. Prerequisite: BY 310; R 300 or R 530. Dose-response relationships; physical, chemical, and biological modification of radiation damage; radiation oncology; radiation genetics and oncogenesis.

ERHS 701 Radiographic Techniques (Alternate Imaging)

S Prerequisite: VM 786A or B or C or D. Diagnosis and interpretation principles with ultrasound, nuclear scintigraphy, computed tomography and magnetic resonance imaging.

ERHS 711 Var. Radiographic Interpretation.

S Prerequisite: VM 786A or B or C or D. Radiographic interpretation of disease processes of all major systems in large and small animals including contrast examinations.

ERHS712 Physics of Diagnostic Imaging.

The physics of imaging with radiography, digital radiography, ultrasound, nuclear scintigraphy, computed tomography and magnetic resonance imaging. Offered Fall semester only of odd # years.

VS 792 Var. Seminar.

VS 602 02(1-0-1). Critical Evaluation of Scientific Literature.

F. Prerequisite: EH 307/ST 307 or ST 301. Method of evaluating scientific literature. Students present critiques of papers they have chosen.

Elective Courses:

ERHS 400 03(2-3-0). Radioisotope Techniques.

F, S. Prerequisite: C 112, PH 122. Properties of radioactivity and radiations, radiochemistry, radiobiology, dosimetry; use of radiotracers in experiments.

ERHS 721 Var [1-3]. Radiation Oncology.

F, S, SS. Management of spontaneous and experimental tumors with emphasis on radiation therapy.

ERHS 770 01(0-0-1). Radiation Biology Basic to Tumor Therapy.

F, S, SS. Prerequisite: Written consent of instructor. Current aspects of radiation biology pertinent to improvements in radiation therapy.

ERHS 795 Var. Independent Study.

D) Radiation Chemistry. E) Radiation Ecology. G) Health Physics. H) Exposure Assessment. I) Small animal radiology. J) Large animal radiology. K) Special techniques in radiology. L) Radiation therapy. M) Computed tomography. N)Magnetic resonance imaging. O) Ultrasound. P) Nuclear medicine.

VS 660 03(3-0-0). Neurology and Neurosurgery.

S. Diagnostic and surgical techniques for the nervous system.

VS 701 Var [1-3]. Postgraduate Medicine I.

F. Prerequisite: D.V.M. or written consent of department head. Comprehensive review, update of immunology, emergency medicine, dermatology, and endocrinology.

VS 702 Var [1-3]. Postgraduate Medicine II.

S. Prerequisite: D.V.M. or written consent of department head. Comprehensive review, update of neurology, gastroenterology, and ophthalmology.

VS 703 Var [1-3]. Postgraduate Medicine III.

F. Prerequisite: D.V.M. or written consent of department head. Comprehensive review, update of oncology, cardiology, reproduction, ophthalmology, and radiology.

VS 704 Var [1-3]. Postgraduate Medicine IV.

S. Prerequisite: D.V.M. or written consent of department head. Comprehensive review, update of hematology, nephrology, urology, respiratory, hepatic, and pancreatic.