

Equine Reproduction

2007 Edition

Laboratory



Animal Reproduction and Biotechnology Laboratory • Department of Biomedical Sciences



*Advancing Medicine for
Horses and Humans*

Colorado State University

COLLEGE OF VETERINARY MEDICINE
AND BIOMEDICAL SCIENCES

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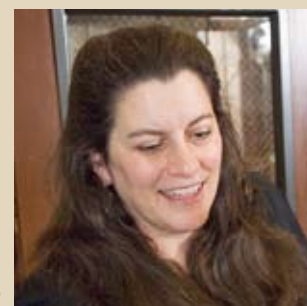
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Welcome from the Director...

My name is Gordon Woods and I am the new Director of the Equine Reproduction Laboratory and I also hold the John Alexander Chair in Large Animal Reproduction. At a time in my life when I thought things were pretty well in place (as did my wife), the opportunity to return to Colorado State University presented itself and I just couldn't resist the prospect of working with some of the world's most renowned experts in equine reproduction. It has proven to be a happy homecoming.

During my senior year in the Professional Veterinary Medical Program at Colorado State University, I still wasn't quite sure what my path would be when I graduated. That spring, I went to the Equine Reproduction Laboratory for a one-week rotation and found my life's work. Dr. Ed Squires' passion for equine medicine was infectious. I switched an elective rotation for a second rotation at the ERL, and then spent my spring break there as well. Dr. Squires went the extra mile, lining up mares for me to practice pregnancy palpations on, putting up with my incessant stream of questions, and making sure that I had every opportunity to experience first-hand cases in which he thought I might be interested.

After graduating from CSU in 1978, I went on to complete a residency in large animal reproduction from the University of Pennsylvania. On Dr. Squires' advice, I studied with Dr. O. J. Ginther at the University of Wisconsin. During that time,

and in the following years, I kept up with what was happening at the Equine Reproduction Laboratory and was constantly amazed at the string of breakthroughs advanced by the scientists here. When I returned in January to take on my current position, I couldn't believe how much the program had grown and how the caliber of the faculty and staff had somehow continued to improve beyond its already excellent reputation for cutting edge work in equine reproduction.

This notion of "One Medicine" is creating a whole new area of research for us where the work we do not only benefits horses, but people as well.

Today, we have Dr. Elaine Carnevale, who specializes in improving reproductive outcomes for aging mares through assisted reproductive techniques and research into reproductive hormones. Dr. Jason Bruemmer heads up the stallion division and his research focuses on semen preservation as well as understanding early pregnancy in the mare. Dr. Patrick McCue, our master teacher, focuses on reproductive pathology and embryo transfer, control of follicular development and ovulation, and also heads up the Clinical Reproduction Ser-



Dr. Gordon Woods with portrait of John Alexander.

vice. His extensive teaching activities include undergraduate, graduate and veterinary levels, and continuing education for practicing veterinarians and horse owners/farm managers. Dr. Ed Squires continues to conduct research in assisted reproduction and teach continuing education courses.

But our work doesn't stop there. We are establishing the horse as a model not only for reproduction problems in humans, but also for comparative oncology work. This notion of "One Medicine" is creating a whole new area of research for us where the work we do not only benefits horses, but people as well. To that end, we are collaborating with other institutions inside and outside of the University, including the College's own Animal Cancer Center, and look forward to a vigorous research program that will help bring about healthier lives for horses and the people who love them.

I hope you enjoy the first edition of the Equine Reproduction Laboratory magazine. I look forward to meeting each of you, our friends and benefactors who have supported this program with so much conviction and dedication for so many years. Thank you.

Gordon Woods, DVM, PhD
Director, Equine Reproduction
Laboratory
John Alexander Chair in Large Animal
Reproduction

Dr. Gordon Woods



Dr. Woods and Dr. Elaine Carnevale.

Connecting the Calcium Dots Led Researcher to New Paths

For most of his professional career, Dr. Gordon Woods has been an equine reproduction specialist. Known for ground-breaking research in equine cloning, his path seemed well defined – continue his research in equine reproduction at the University of Idaho, retire, and maybe do a little consulting on the side. But then, Dr. Woods had an “aha” moment

“We were getting very frustrated trying to produce in vitro-fertilized foals,” said Dr. Woods, who now is the Director of the Equine Reproduction Laboratory and holds the John Alexander Chair in

Dr. Woods with Dr. Lance Perryman, Dean, College of Veterinary Medicine and Biomedical Sciences.



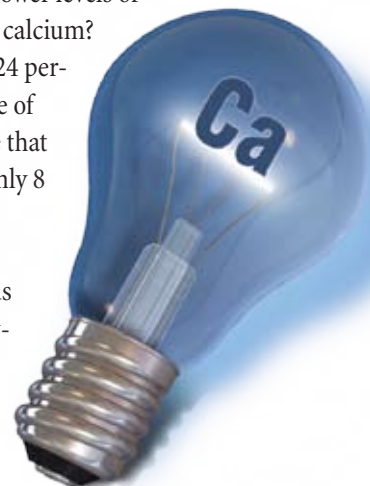
Large Animal Reproduction. The Equine Reproduction Laboratory is part of the Animal Reproduction and Biotechnology Laboratory, in the Department of Biomedical Sciences, College of Veterinary Medicine and Biomedical Sciences at Colorado State University. “The problem seemed to be that the embryonic horse cells were not dividing. There was something different with horse cells. I stepped back. I had three graduate students, and plenty of samples and we just started looking. When I was attending veterinary school here, Jim Voss (former CVMBS dean) told me that for every mistake you make for not knowing, you’ll make nine for not looking. Eventually, we found what we were looking for.”

What the research team found was a connection between calcium levels and cellular activity. In the horse, extracellular calcium (calcium levels outside of the cell) is high, higher than in humans, while intracellular levels are low. Once the team increased the calcium levels inside the cells, the success rate of transferred embryo cloning jumped. In 2003, the first cloned equine was born, Idaho Gem, fol-

lowed shortly after by Utah Pioneer and Idaho Star. While that made the headlines and garnered national attention, Dr. Woods’ focus was shifting to an intriguing possibility. Cancer cells and embryonic cells share some of the same traits that allow them to rapidly divide. If low calcium levels in embryonic cells resulted in low rates of cell division, wouldn’t it follow that high calcium levels would result in high rates of cell division, similar to what occurs in cancer?

“Horses have a much lower incidence of cancer than humans and even when they do get cancer, the tumors are normally benign,” said Dr. Woods. “We were wondering, might this have something to do with the lower levels of intracellular calcium? In humans, 24 percent of us die of cancer while that number is only 8 percent in horses.”

Dr. Woods looked at levels of pros-




tate specific antigen (PSA) in a study group. Those with higher PSA levels (which indicate a risk for prostate cancer) also had higher levels of intracellular calcium. Dr. Woods decided to try to find out why. Using venture capital, he helped to found a small biotech company, CancER2, which did basic studies on the chemical differences between stallion and man. When the ERL chair position opened up at Colorado State University, the opportunity to further develop his cancer studies and work with world-class programs in calcium channels, oncology and reproduction was one he couldn't pass up.

"The environment at Colorado State University is incredible for collaborative research," said Dr. Woods, who came to CSU in January 2007. "With the Animal Cancer Center, the Equine Reproduction Laboratory, all the work in calcium channels going on in the Department of Biomedical Sciences, and the Animal Reproduction and Biotechnology Laboratory, there are just an amazing number of extremely talented people here pushing toward common goals. I also plan to work with the Denver Medical Center, which will enable us to enhance our studies in human diseases using horse models."

Dr. Woods now has two research applications in progress. The first focuses on determining why reproductive performance is not optimal in horses today. His research team will develop the potential to identify horses with low intracellular calcium levels and investigate what regulates those levels, as well as best methods for correcting imbalances giving the horse the opportunity to optimize reproductive success. His second study is a continuation of the high PSA/high calcium connection in prostate cancer, particularly with regard to calcium regulation. +

John Alexander Chair

in Large Animal Reproduction



The John Alexander Chair in Large Animal Reproduction was created in 2001 to honor John Alexander, a member of the Professional Veterinary Medical Class of 2000, following his death in 1999 from a skiing accident. In January 2007, Dr. Gordon Woods accepted the Chair as well as the position of Director of the Equine Reproduction Laboratory.

"It has been a great privilege to accept the John Alexander Chair in Large Animal Reproduction," said Dr. Woods. "I know that the work that I do here at Colorado State University will honor the memory of John and the wishes of his family to recognize John's passion for equine medicine. In their time of great sorrow, they took it upon themselves to create something good out of tragedy and I commend them for their actions."

John Alexander was born and raised in Geneva, Illinois, and attended Taft School in Connecticut. Partially because of his love of the outdoors, and skiing and fishing, John moved to Colorado and attended the University of Colorado, graduating in 1994. While at CU, John made up his mind to pursue his interest in equine medicine and began his veterinary medical training at Colorado State University.

"He started out with an interest in architecture at CU, but decided that equine medicine was more to his liking," said Duncan Alexander, who was John's uncle. "He was especially interested in the reproductive side. He was fascinated by his veterinary studies, and had an intense interest in how and why things worked. John thought the world of his school and of his classmates and teachers. They were a very special group of people."

Duncan Alexander and his brothers Tom and John Sr., who is John's father, created the Chair with a joint contribution.

Dr. Tony Knight, who was head of the Department of Clinical Sciences at the time of John's death, said the loss devastated John's classmates and faculty, who knew him well. In his third year of the Professional Veterinary Medical program, John had become a natural leader and often was a spokesman for his class. He was an active member of the Class of 2000 who clearly enjoyed life to the fullest and had many friends.

With the John Alexander Chair in Large Animal Reproduction now occupied, John Alexander leaves two legacies that will fulfill for others the dreams that John and his family had for himself. The other is the John Alexander Memorial Scholarship, established by John's classmates after his death. Both the scholarship and the Chair will enable students and faculty interested in large animal reproduction to pursue careers and studies that John himself would have liked. +

A young brown foal with a white blaze on its forehead stands in a grassy field next to the lower legs and tail of a larger brown horse. The foal is looking towards the camera, and the larger horse's tail is visible on the right side of the frame. The background is a soft-focus green field.

*“Our goal is a
healthy pregnancy
and a healthy foal.”*



Dr. Elaine Carnevale with veterinary students and master's student Gretchen Lund, in the middle foreground, and resident veterinarian Joy Altermatt, on the far right, collecting an oocyte for a research project.

Dr. Elaine Carnevale

Giving Nature a High-Tech Helping Hand



Dr. Elaine Carnevale.

It's early morning in the "Princess Barn" and the residents are waking up, softly whinnying to each other while waiting for breakfast to be served. These ladies in waiting are treated like royalty and Dr. Elaine Carnevale makes no apologies for that. The mares are her charges and she wants to make sure they get only the very best.

The mares are at the Equine Reproduction Laboratory for reproductive assistance, whether to increase reproductive success in older or problem mares, or to obtain a pregnancy from a stallion with limited or poor quality sperm. Whatever the problem, Dr. Carnevale, an Assistant Professor in the Department of Biomedical Sciences, helps to find a solution to safeguard the mare's lineage and

ensure her valuable genetic material will be conserved.

"Fertility starts to decline in mares in their teen years," said Dr. Carnevale, who is a member of the research team at the Equine Reproduction Laboratory. "Many of our assisted reproduction techniques help prolong the reproductive life of the mare by using such technologies as oocyte transfer, embryo transfer, and sperm injection. We also are working to understand how aging affects reproduction. It's all about optimization."

When Dr. Carnevale came to Colorado State University in 1998, she began a clinical oocyte (egg) transfer program to obtain pregnancies from mares that were no longer able to get pregnant or provide

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Dr. Patrick McCue

From Dairy Farm to Horse Farm: A Love of Teaching and Clinical Work Come Together



Dr. Patrick McCue in the classroom.

Dr. Patrick McCue found the early influences for his career from the veterinarians who visited the family business.



Dr. McCue working with students at the ERL.

“I grew up on a family-operated dairy farm in northern New York State, and our lives revolved around farm chores and cattle,” said Dr. McCue, an Associate Professor in the Department of Clinical Sciences and a member of the Equine Reproduction Laboratory team. “Fortunately, my family also believed in the

value of taking time to enjoy life, so I was immersed in sports, fishing, and other outdoor activities. The life values and work ethic developed in my early years have stayed with me to this day.”

Dr. McCue received a bachelor’s degree in biology at the State University of New York in Potsdam and subsequently entered graduate school in zoology/wildlife biology at the University of Montana. He worked for several years for a company that studied endangered species in California. Eventually he felt the draw to return to a career goal that he had as a child, that of becoming a veterinarian.

“We routinely had veterinarians on the family farm and they were a role model to me,” said Dr. McCue. “They provided a service that was valuable to livestock owners and the community, and I respected that.”

He was accepted into the University of California, Davis, School of Veterinary Medicine and graduated as a DVM in 1986. It was in veterinary school that he fell in love with all aspects of equine medicine and health care. He completed

an internship at the University of Pennsylvania’s New Bolton Center in order to obtain further training in equine medicine and surgery. Dr. McCue then pursued advanced training in equine reproduction during a residency at UC-Davis. He subsequently received a PhD in comparative pathology and joined the faculty at Colorado State University in 1994.

“We are passionate about what we do at Colorado State University.”

“My initial position at CSU was as an equine ambulatory or field service clinician,” said Dr. McCue. “My specialty was still horse reproduction, but I developed a subspecialty in equine dentistry and was also involved with many aspects of general equine health care. My position was adjusted about 6 years ago and I have since been able to focus on equine reproduction almost exclusively. I coordinate a mare reproduction service, which includes breeding and foaling, and an embryo transfer program.”



Dr. McCue explaining a fine point to students.

Dr. McCue, in addition to being well known for his clinical work and research activities in equine reproduction, has also become renowned for his teaching skills, and has been called a “master teacher” by his colleagues. He is a recipient of the Carl J. Norden Distinguished Teacher Award and has twice received the American Association of Equine Practitioners Faculty Award for excellence in teaching. He brings an excitement to the classroom and clinic that is contagious to students and manages to turn almost every situation into a teaching opportunity for students and horse owners alike.

One of his favorite teaching techniques is to go to one of the dry-erase boards or laminated charts on horse reproduction scattered around the ERL or the James L. Voss Veterinary Teaching Hospital. He uses the charts and boards in an “impromptu lecture” to describe the particular clinical case at hand and to subsequently discuss the finer points of horse reproduction. He commands the attention of the horse owner and students with hastily drawn illustrations and lists of medical conditions and treatment options.

“Each group of students is assigned a pregnant mare and the objective is to be present when she foals”

His goal is to educate and he will use any clinical case or other opportunity to achieve that result. In his foaling class, a highlight each semester is the opportunity for every student to attend a live birth.

“Each group of students is assigned a pregnant mare and the objective is to be present when she foals,” said Dr. McCue. “Now, nature being what it is, that doesn’t always work out. Consequently, a back-up plan is to induce a mare’s labor in front of the entire class to make sure all students have a chance to witness the event.”

It is apparent that undergraduate, graduate and veterinary students all benefit greatly from the teaching and clinical programs at the Equine Reproduction Laboratory. They are able to have hands-on experiences that augment classroom lectures.

“We have had a very busy breeding season this year. The barns are always

full, and we will breed several hundred mares with either fresh, cooled, or frozen semen, foal out 30 to 40 mares and perform 100 to 150 embryo transfers,” said Dr. McCue. “The embryo transfer program allows us to maintain a herd of recipient or surrogate mares which our veterinary students use to learn how to perform reproductive examinations, such as palpation and ultrasound. With our stallions, students learn how to manage live-cover matings and to collect semen for artificial insemination. These are skills that require hands-on experience to develop. Clinical cases provide real-life examples that may be difficult to reproduce or describe in a classroom setting.”

Dr. McCue noted that one of the most valuable aspects of the diverse activities at the Equine Reproduction Laboratory is that it provides a multitude of opportunities for teaching. The busy clinical service provides rich and diverse educational experiences for equine sciences and veterinary students alike.

“We also do an outstanding job of education in our short courses,” said Dr. McCue. “It is gratifying to have veterinarians, owners, and farm employees come to CSU to learn reproductive management of the mare and stallion, and to have fun in the hands-on learning environment. We are passionate about what we do at Colorado State University.” +



Consulting on a case.



*Dr. Jason
Bruemmer*



Members of the CSU women's polo team.

Whether Advising the Polo Team or Examining Ways to Prevent Embryonic Loss, Researcher's Enthusiasm Is Infectious

It seems to be a relatively simple question. How does the female of a species “recognize” early on that she is pregnant? In humans, the embryo produces human chorionic gonadotropin (hCG, a peptide hormone) soon after conception, triggering a waterfall of physiological changes that allow the mother to maintain the pregnancy. In ruminants, the embryo secretes large quantities of a protein called interferon tau. But the horse is a mystery.

“Horses are one of the few species where we don’t understand how the female recognizes pregnancy,” said Dr. Jason Bruemmer, an Associate Professor of Animal Sciences and faculty member in the Animal Reproduction and Biotechnology Laboratory. “If we can figure that out, we might have a better chance of preventing early embryonic loss and enhancing reproductive outcomes.”

Understanding pregnancy recognition is just one area of equine reproduction in which Dr Bruemmer is focusing his research efforts. Early on in his career, and early means the age of 12, he worked at a thoroughbred breeding farm and veterinary clinic where his interest was piqued, though his start was modest.

“I had my first full-time job at the age of 12 working at the farm mowing the lawn and doing maintenance in the breeding shed,” said Dr. Bruemmer, who also was influenced by his grandfather, who played polo, and his mother, an avid

horsewoman who rode jumping horses. “I began to develop an interest in equine reproduction. It was a natural progression that led me to my field of study.”

Dr. Bruemmer, who has a joint appointment in the Department of Animal Sciences and the Department of Biomedical Sciences, graduated with a bachelor’s degree in animal science and his master’s degree in physiology of reproduction from Texas A&M University. He went on to receive his PhD in reproductive physiology from New Mexico State University. He joined Colorado State University in 1996 and has since developed a dual-focus research program: semen preservation of the stallion, and cell differentiation with regards to maternal recognition and maintenance of pregnancy in the mare.

Using equine genetics, Dr. Bruemmer and his team help to better understand the genetic changes that occur when a mare becomes pregnant. They are work-



Dr. Bruemmer in the laboratory with Paula Moffett, an ERL research associate.

ing to build the first equine gene chip to examine the 57,000 equine genes for up and down regulation, a first clue to genetic changes brought on by pregnancy. The project is funded through the Preservation for Equine Genetics Program (PEG).

“Conception itself is relatively efficient in mares, but a high number of embryos are lost in the first 18 days,” said Dr. Bruemmer. “Using ultrasound, at 12 days we can see the embryo. Ten days later, the foal is gone. For mares with great genetic value, those lost foals represent a significant reduction in their ability to produce offspring that will preserve their desirable genetic make-up.”

In his stallion work, Dr. Bruemmer is examining new ways to preserve semen including cryopreservation and the freezing of semen harvested from the epididymis. The techniques are particularly valuable when a stallion suffers a catastrophic injury or untimely death, or

early castration in some, and owners wish to preserve the stallion’s genetic material for future generations. For horse owners, Dr. Bruemmer’s clinical and research work is offering exciting new avenues of assisted reproduction that will enhance a horse’s reproductive success.

Dr. Bruemmer’s work also has impact on the human medicine side, using the horse as a model to explore genetics and human reproduction. His interest in this area developed during a sabbatical at Harvard Medical School three years ago where he focused on reproductive physiology. Working alongside human reproductive specialists allowed Dr. Bruemmer to develop new ideas about the horse model and see first-hand human reproductive challenges.

While his clinical and research work are fulfilling, Dr. Bruemmer also enjoys a full teaching load including an equine reproduction practicum, foaling class, an introduction to equine science and con-

tinuing education courses for veterinarians, farm managers, and horse owners. He also is the faculty advisor for Colorado State University’s national champion polo team, a sport he continues to enjoy with the same passion he found early on working as a 12-year-old at a neighbor’s horse farm. +



Dr. Bruemmer working with members of the ERL team.

Dr. Edward Squires

Love of Horses Brought Researcher to Life's Work

It was a tough, old cowboy who first started showing Ed Squires what it meant to be a horseman. As a young boy growing up in Morgantown, West Virginia, Squires worked for the horse dealer feeding and watering the horses that were being bought and sold. He learned how to catch a horse, tie a good knot, and overcome fear. At times, it was a rough and tumble childhood with sprains, cuts and sore muscles – all treated by the old cowboy using down-home horse medicine, most often a green liniment that seemed to be the cure-all for any and every ailment.

The result of that early equine imprinting was a passion for horses that has spanned six decades and shows no sign of abating. Dr. Squires, now a Professor in the Department of Biomedical Sciences, has enjoyed an illustrious career in equine reproduction that has brought advances in assisted technologies once unimaginable. His work continues today as a teacher, researcher, consultant, and advocate for the ongoing efforts of the Equine Reproduction Laboratory.

“That ranch owner was an excellent horseman who taught me a lot of practical lessons,” said Dr. Squires. “I continued working for him while I was getting my undergraduate degree, helping to break and train horses, and helping out as the ranch expanded to offer boarding and horse rentals. I was exposed to a great number of horses during those 10 years, and it was an important part of my education.”

Dr. Squires received his bachelor's degree in animal sciences and his mas-

ter's degree in reproductive physiology from West Virginia University before attending the University of Wisconsin where he studied under Dr. O. J. Ginther and received a PhD in endocrinology/reproductive physiology. He taught at the University of New Hampshire for two years before coming to Colorado State University in 1976 where he was assigned to the Equine Reproduction Laboratory.

“It was a much smaller facility then and I was mainly doing teaching and research, with a little bit of clinical work,” said Dr. Squires. “My previous work had been focused on the pregnant mare. Here, we started an embryo transfer program,

The Equine Reproduction Laboratory was the first in the United States to produce live foals from frozen-thawed embryos.

developing ways to recover and transfer equine embryos. We built a large program around this area of research, and began to offer commercial services in embryo transfer as well as teaching the techniques to veterinarians through continuing education classes.”

In 1985, the Equine Reproduction Laboratory was the first in the United States to produce live foals from frozen-thawed embryos. Dr. Squires' research work over the years, in addition to artificial insemination and embryo transfer, included estrous cycle control, endocrinology of the mare and stallion, and pres-

ervation of stallion semen. He also worked to establish relationships within the equine industry to garner private support for equine reproduction research at Colorado State University.

“My career has mainly been identifying problems in the horse/veterinary industry, solving the problem, and giving the answer right back to the industry as quickly as possible,” said Dr. Squires. “I've spent a lifetime developing answers to questions and establishing a rapport with people in the horse industry asking them to support our program. The majority of our research, about 90 percent, is supported through funding from private individuals and foundations. Their support has been critical to our success.”

Dr. Squires is the founder of the Preservation of Equine Genetics (PEG) program which focuses on developing reproductive techniques used to preserve genetic material. During the past five years, the laboratory has spent more than \$5 million on research and facilities development thanks in large part to fundraising through the PEG program.

While the work of the Equine Reproduction Laboratory primarily benefits horses, Dr. Squires said an interesting offshoot of the program has been application of the research to the preservation of endangered species and their genetic material. In addition, Dr. Squires has been able to travel to remote corners of the world to share assisted reproduction technology, including the polo fields of Argentina and the steppes of Mongolia, a long way from his early horse experiences in Morgantown. +





Dr. Carnevale looks on as Dr. Tae Kwang Suh, a special Assistant Professor in the Department of Clinical Sciences, injects an egg with a sperm (inset photo).

embryos. This evolved to include the collection of oocytes from the ovaries of valuable mares after they had died. Work done lately includes sperm injections (an assisted test-tube fertilization to obtain foals from subfertile stallions) where sperm is injected into the eggs of mares to improve conception rates.

Dr. Carnevale's clinical program is based on referrals so horses of all breeds come from across the United States (and some from other parts of the world) for treatment. The mares usually stay about six months out of the year, in the "Princess Barn," with the clinical team working to ensure the highest level of care and the best possible reproductive outcome. Dr. Carnevale works with mares of all ages, often as old as 25 years. The reason being, she notes, is that mares are limited in the number of foals they can produce, and their value may take a number of years to establish.

"The mare may be older by the time her value as a broodmare is recognized," said Dr. Carnevale. "We work with a lot of very good mares that are old and have compromised reproduction. Many horses will continue to perform in events, such as cutting, reining, racing, and jumping, until

they are older and their reproductive capacity is limited. Most of the mares in our program have proven their value as performers or producers, but they now have reproductive problems. Our goal is a healthy pregnancy and a healthy foal."

In her research program, Dr. Carnevale and her team continue to improve the science behind using sperm injections to artificially fertilize eggs. In another research project they are studying the egg and its interactions with the follicle. This would include the signals between the egg and follicle that result in egg maturation (preparation for fertilizations) and ovulation. An important component of the work is how these signals differ in old and young mares.

"One interesting aspect of our work with older mares is how it relates to fertility in humans," said Dr. Carnevale. "A lot of the same things that happen in the horse happen in the woman, including a long follicular phase, one ovulation, and a similar length of time for the egg to mature before ovulation. Some of the reproductive problems we see are also similar, as many women wait until they are older to have children. Mares will probably make an excellent model for

human reproductive studies and the information we gain can be used to benefit both species."

Dr. Carnevale, who is originally from Trinidad, Colorado, decided in the first grade that she wanted to be a horse doctor. She attended Colorado State University where she received her DVM and master's degree in equine reproduction. She spent a few years working in the breeding industries in New Zealand, Ireland, and Australia, before returning to the United States to the University of Wisconsin where she received her PhD in reproductive physiology. She studied with Dr. O.J. Ginther, internationally considered one of the leading authorities in equine reproduction.

Dr. Carnevale joined the faculty at Southern Illinois University, before returning to private practice for a year and then joining the faculty at Colorado State University. In addition to her research, Dr. Carnevale helps teach undergraduate, graduate, and veterinary students at the Equine Reproduction Laboratory. She also teaches short courses for veterinarians, horse owners and breeding farm managers. +



JoAnne Stokes, a research associate, working in assisted reproduction.

2007-2008

Equine Reproduction Short Courses

CSU Annual Reproduction Symposium

Topic: The Problem Mare and Stallion
Lecture \$450; September 30 - October 1, 2007

Courses specifically designed for the equine practitioner:

Basic Equine Reproductive Ultrasonography

Lecture and Lab \$500; October 2, 2007

Equine Embryo Transfer

Lecture and Lab \$1,450; October 3-5, 2007

Courses specifically designed for the horseman:

Reproductive Management & Artificial Insemination

Lecture and Lab \$1,000; November 1-4, 2007 & January 10-13, 2008

Techniques for Handling & Utilizing Cooled Semen

Lecture and Lab \$350 w/ AI, \$450 alone
November 5, 2007 & January 14, 2008

Techniques for Handling & Utilizing Frozen Semen

Lecture and Lab \$500; November 6, 2007 & January 15, 2008

Courses will fill quickly, so register today!



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Support Advances in Equine Medicine with a Gift to the ERL

Gifts to the Equine Reproduction Laboratory are used to support start-up and established research programs, and provide discretionary funds that are used where most needed. If you would like to make a donation in support of these needs and goals, please complete the form below and return with your gift. If you have any questions, please contact Paul Maffey, Development Director for the College of Veterinary Medicine and Biomedical Sciences at rpmaffey@colostate.edu or (970) 491-3932.

Colorado State University Equine Reproduction Laboratory

Enclosed is my/our check for a gift of:

\$50 \$100 \$200 Other \$ _____

(Payable to Colorado State University Foundation)

Name _____

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A matching gift form is enclosed.

Please apply this gift to the
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59563/V0801

Please return this form with your gift to: CSU Foundation, P.O. Box 1870, Fort Collins, CO 80522-1870



International Embryo Transfer Society Coming to Colorado in 2008

The 34th Annual Conference of the International Embryo Transfer Society (IETS) will be held Jan. 5-9, 2008, in Denver, Colorado. The conference brings together experts in embryo technologies from around the world. Faculty members from Colorado State University will attend the conference, present during conference proceedings, and are leading the local program committee, as well as making local arrangements.

The conference will include numerous symposia on embryo transfer topics and technologies, poster sessions, sessions with a practitioner's focus, as well as opening and closing ceremonies and a keynote address.

The International Embryo Transfer Society was formed in 1974 in Denver to serve as a professional forum for the exchange of information among practitioners, scientists, educators, regulatory officials, livestock breeders, suppliers of drugs and equipment, and students. The purpose of the IETS is to further the science of animal embryo transfer by promoting more effective research, disseminating scientific and educational information, fostering high standards of education, maintaining high standards of ethics, and cooperating with other organizations having similar objectives.

Members of the Society are engaged in the practice of embryo transfer in a variety of species, and in research on embryo production, transgenesis and cloning, on mechanisms regulating embryo development, and on development following embryo transfer. Species studied include domesticated and laboratory animals, and endangered species.

Registration information for the 34th Annual Conference of the International Embryo Transfer Society is available at the Society's Web site at www.iets.org. +



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