Equine Guelph
Research Update

Fall 2010

helping horses for life

In Step With Industry Issues

The race is on for an adequate drug test

As purses increase in the horse racing industry, the stakes for winning get higher…driving some participants to use performance-enhancing drugs. The diversity of these substances is making adequate drug testing and fair racing more difficult to ensure.

Erythropoietin (EPO) is one such drug. It's a naturally occurring hormone in mammals, which stimulates red blood cell production. Red blood cells contain haemoglobin which carries oxygen from the lungs to body tissues.

Injecting extra EPO means the bone marrow produces more red blood cells thus making more oxygen available for strenuous physical activity. This, in turn, can improve athletic performance.

Increased efforts are now in place to detect illicit use of EPO. This is difficult because it comes in many forms. Prof. Dorothee Bienzle, Department of Pathobiology, is performing a number of pre- and post-race tests to hone in on the exact levels of blood haemoglobin that indicate EPO drug use.

"We're developing a test that will prevent horses treated with any form of EPO from competing," she says Bienzle.

The Ontario Racing Commission is serious about getting drugs out of the racing sector. ORC is proposing horses found to have been injected with EPO be banned from racing. They believe this intent to punish will reduce the likelihood of its use.

"Not only is the use of EPO illegal from a racing standpoint, it can also be dangerous," says Bienzle.

Prof. Dorothee Bienzle is performing a number of pre- and post-race tests to hone in on the exact levels of blood haemoglobin that indicate EPO drug use. "We're developing a test that will prevent horses treated with any form of EPO from competing," she says.

"When used in excess, clumping of blood cells can occur, causing strokes, heart attacks or even death."

Bienzle's test, along with the heavy fines for EPO use, will help to maintain the integrity of the horse racing industry, she says.

Research funding has been provided by Equine Guelph, the Ontario Racing Commission and the Canada Research Chairs program.

- Vanessa Perkins

"The very positive response from the industry to last year's Fall newsletter with a focus on research encouraged us to repeat the exercise this year. We present a survey of the progress made in the past 12 months by researchers who were showcased last year, and introduce the new projects that were funded earlier in the year and which are getting up to speed. In a special article, we ask design engineer Dr. John Runciman, "What is the attraction for you working with vets on issues of equine health? We hope the whole package gives you an informative snapshot of the current status of research being funded with the help of the industry partners of Equine Guelph."

Dr. Jeff Thomason, Co-Chair,
Equine Guelph Research Committee

UNIVERSITY of GUELPH

INSIDE **Volume 7, Number 2**

Capturing the whole picture

The Ontario Veterinary College (OVC) is one of only two facilities in Canada that has extensive imaging capabilities, with x-ray and ultrasound technology, computed tomography (CT), magnetic resonance imaging (MRI) and nuclear medicine. "The CT and MRI technologies are generating never before seen pictures of horse anatomy," says Nykamp. "This will be helpful for owners, industry professionals and veterinary students to better understand their animals."

Rapid injury diagnosis is a key step in injury treatment, and high-tech imaging machines often help. The Ontario Veterinary College (OVC) - which holds x-ray and ultrasound technology, computed tomography (CT), magnetic resonance imaging (MRI) and nuclear medicine - is one of only two facilities in Canada that has all five diagnostic tools. This makes the OVC a sought-after locale for injury diagnosis.

Stephanie Nykamp, a certified radiologist at OVC, is using this equipment to its full potential. She's working with Equine Guelph to develop three-dimensional models and images of a horse's anatomical features. These enhanced images could help veterinarians and researchers with injury diagnosis, and serve as educational materials when teaching equine anatomy to OVC students or other graduate students.

"We can create interactive files with images that the students can rotate into any orientation they would like," says Nykamp.

Stephanie is combining images taken with CT and MRI technologies to create these three-dimensional models of a horse's legs, head and neck, for example. These enhanced images will provide a closer and more detailed look at the bones, joints, ligaments and muscles in each limb.

"The CT and MRI technologies are generating never before seen pictures of horse anatomy," says Nykamp. "This will be helpful for owners, industry professionals and veterinary students to better understand their animals."

When the CT scans and MRI photos are taken, they will be compiled into interactive teaching tools as well as videos that show the limb rotating, so anatomical features can be viewed from different angles.

Nykamp says this perspective of horse anatomy will add value to Equine Guelph's educational programs.

This research has been funded through the Equine Guelph Research Fund.

- Carol Moore

2009 RESEARCH PROJECT UPDATE

Excellent Embryos

Embryo freezing in horses has been mostly ineffective, as the capsule around the embryo remains impermeable to many widely used freezing chemicals, called cryoprotectants. University of Guelph researchers are looking to determine if novel types of cryoprotectants may be more successfully metabolized by horse embryos.

"Right now, there is only a very narrow window in which we are able to freeze embryos effectively – only very early embryos, at about five and one-half to six days old," says leading researcher Prof. Tracey Chenier from the Department of Clinical Studies. "For these frozen embryos to be commercially viable worldwide, we need to be able to freeze embryos at day seven or eight."

This spring, Chenier and her colleagues have begun flushing mares to collect embryos. Then, they will use a chemical process known as gas chromatography to determine how much of the cryoprotectant is able to penetrate the embryo's outer capsule and reach the embryonic fluid inside.

Chenier and her colleagues hosted former Guelph researcher Dr. Stanley Leibo, a world renowned cryobiologist, and assisted with the project this past summer.

- Alycia Moore

EVENTS
Mark your calendar!

September 25 - October 10
EquiMania! at the Alltech FEI World Equestrian Games, Kentucky

November 05 - 14
EquiMania! at the Royal Agricultural Winter Fair, Toronto

Anyone wishing to excerpt Equine Guelph should contact:
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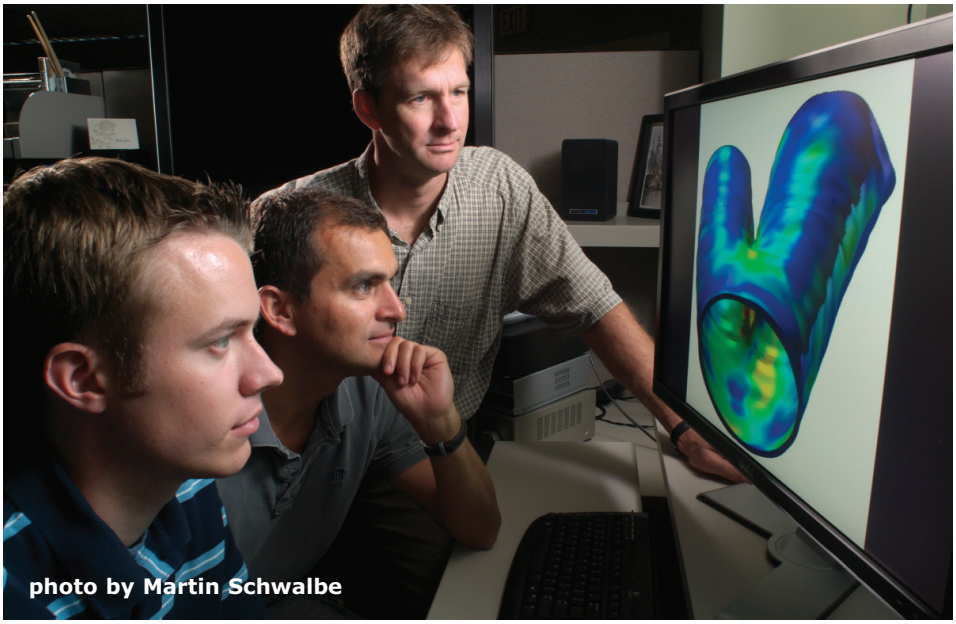
Bioengineer Collaborating with Vets



Stressed regions of a horse's pulmonary artery are examined by (from left) undergraduate student Matt Teeter, Prof. Luis Arroyo and Prof. John Runciman.

Dr. John Runciman joined the faculty at University of Guelph's School of Engineering eleven years ago with an impressive background in mechanical and bioengineering. Runciman never would have guessed his interest in disassembling mechanical objects and analyzing how they function would lead him to researching pulmonary artery calcification in alliance with veterinary researchers. He declares "The rules of engineering still apply to the animal side but are more complicated, interrelated and optimized."

Runciman shifted his focus from gears to tissue after a professor raised his interest in orthopedic research and its clinical applications. He furthered his Masters in Mechanical Engineering at Queen's University with a Ph.D. in Bioengineering at University of Strathclyde, Glasgow, Scotland and returned to Queen's in Kingston for a postdoctoral Fellowship in the Department of Physiology. Runciman became involved in research areas including: the biomechanics and design of orthopedic implants, design of assistive devices and waterskiing biomechanics and equipment design.

One year after signing on at the University of Guelph, Runciman's mechanical engineering skills were sourced to assess a knee impact measuring tool for Dr. Jim Dickey (human biomechanics) and Dr. Mark Hurtig (veterinary orthopaedics). Runciman has worked with half a dozen large animal veterinary faculty and students since then. He attests "Expanding areas of research is best when collaboration combines strengths". Runciman is quick to praise the quality of equipment and staff at the University of Guelph. Some of the greatest challenges he has faced while researching projects with vets concerns funding. By the time serious financial backing materializes, a young vet in the DVSc program may have graduated. Funding from the equine industry made available through Equine Guelph has often helped to alleviate this problem.

Runciman is currently working with veterinary researchers Dr. Luis Arroyo and Dr. Laurent Viel in the department of Clinical Studies, researching pulmonary artery calcification which is a condition linked to premature death in young, athletic, race horses. Runciman has facilitated the groundwork with 3-D models in the test lab. There are many challenges when working with complicated systems involving heart and lungs together. The next significant stride will be made this summer, taking the static lab work; which looks at one functional unit in isolation and using these findings to move forward and study live functioning of the cardiopulmonary system during exercise.

Runciman enjoys the research resulting from his involvement with vets. He says it staves off complacency, as he picks up a book off his desk and states he is never sure what is coming up next. "If you had told me I would be researching aerodynamics to understand fluid flow in animals a few years ago, I would not have believed it!" Runciman proclaims: "I am attracted to the challenge of working on animals. They are more complex than the most complicated machinery ever built."

Funding for Runciman's equine research was provided by Equine Guelph.

- Jackie Bellamy

2009 RESEARCH PROJECT UPDATE
Working in the Field

Routine anaesthetic and analgesic methods today only allow practitioners a very short window in which to complete surgeries such as castrations before additional doses of anaesthetic drugs are required. To eliminate this problem and optimize surgery time and analgesia, University of Guelph researchers are looking at the effectiveness of systemic lidocaine as an additional method in equine field surgeries, compared to more standard techniques.

Prof. Melissa Sinclair and her colleagues from the Department of Clinical Studies began performing the first half of their study this spring when most field castrations are performed. So far, the response to their work from private practitioners and area clients has been overwhelmingly positive, helping the researchers in their ongoing data collection with surrounding clinics and farms.

The remaining data will be collected in late summer and fall during the next wave of castrations.

"So far we're thrilled at the very positive response from private practitioners and farm owners who have been eager to participate," says Sinclair.

- Alycia Moore

Respiration Restoration

Researchers in many fields aim to clear up common respiratory conditions

At a metre and a half in length, horses have one of the longest mammalian airways — three times longer than a human's. These airways help them obtain the oxygen they need when running…but racehorses and companion horses alike suffer from a myriad of respiratory diseases. To help lead the way to clearer airways, University of Guelph researchers are using a variety of approaches to combat respiratory conditions.

One such condition is exercise induced pulmonary haemorrhage (EIPH), which plagues about 80 per cent of racehorses. It occurs after intense activity, when within seconds a horse's heart rate more than quadruples to over 200 beats per minute. The huge increase in blood pressure can cause the capillaries in the lung to burst, resulting in nose bleeds and in some cases, potentially fatal haemorrhaging.

Dr. Luis Arroyo and Prof. Laurent Viel, Department of Clinical Studies, and Prof. John Runciman, Department of Engineering, are examining the relationship between EIPH and calcified lesions in the pulmonary artery, which are also found in about 80 per cent of racehorses (the body deposits calcium as an ultimate repair mechanism in an attempt to reinforce tissue weakened by injury or stress).

The main trunk of a horse's pulmonary artery is four to six centimetres in diameter and responsible for carrying more than 250 litres of blood per minute from the heart to the lungs for oxygenation.

Researchers used MRI and CT scans to build a 3-D image computer model that calculated the stress that this huge volume of blood can cause on arterial walls. They also examined the spatial location of the calcified lesions.

If the research finds that calcium deposits are linked to EIPH, then more resources can go towards understanding and preventing them.

"From our models, we found that the highest stresses were right where the artery branches, and this is also where the calcification always starts," says Runciman. "The blood flow in racing horses is tortuous; it almost becomes their Achilles' heel."

photo by David Landry

Arteries will stretch to accommodate each pulse of blood from the heart and contract to move the blood along, thereby acting as shock absorbers so the blood pressure in the smallest arteries is minimal, avoiding rupture. A calcified artery is less elastic, losing its shock-absorbing role, which results in a larger, faster pulse wave that has greater impact when it reaches the lungs. Researchers believe this pressure spike is what bursts lung capillaries and causes EIPH.

Their research is taking a new twist. This summer, Arroyo, Runciman and Viel will put catheters in the pulmonary arteries of ex-racers and young, healthy horses to perform inside-out ultrasounds that monitor the animal's blood flow and pulse wave.

"This is the first time we'll be looking at live animals," says Arroyo. "We can examine them both resting and exercising, to see firsthand if and how the calcified lesions affect arterial stiffness and parameters like pulse wave."

In many cases, existing EIPH seems to be associated with — and perhaps a contributor to — a respiratory condition found in young racehorses called inflammatory airway disease (IAD). This condition concurrently studied by

Viel is similar to asthma in humans, where the airways become overly sensitive to allergens resulting in bronchial constriction, or closure of the airways.

On the racetrack, horses with IAD struggle to get enough oxygen. In an oxygen deprived state, the body's natural response is to constrict blood vessels. During intense exercise, blood vessels must dilate to accommodate increased blood flow. These counteracting mechanisms could result in the damage and bleeding associated with EIPH.

That's where research by Viel and graduate student Modest Vengust comes in. They examined the effect of the drug furosemide on the lung. Known commercially as Lasix, it is used on many racehorses and believed to treat EIPH; specifically, fluid in the lung.

Before high blood pressure causes the lung's small blood vessels to rupture, some of the fluid in the capillaries will be forced out into the lung in an attempt to reduce pressure. Lasix was thought to prevent this accumulation of fluid, called pulmonary oedema, reducing excessive small artery blood pressure.

However, when the researchers put Lasix treated horses on a treadmill to increase their heart rate and blood pressure to racetrack levels, they found that it had no effect on reducing fluid build-up.

Lasix also has many side effects, including dehydration and blood electrolyte imbalance.

"We wanted to know if Lasix treated or somehow prevented EIPH," says Viel. "We found that it does neither. Therefore, it becomes questionable if Lasix has any preventative effect at all, meaning the debate should continue as to whether Lasix is a valid pre-racing medication. In my opinion, it would be a great welfare benefit to the horse in treating them for IAD, as we treat asthmatics with a simple bronchodilator that opens up their airways to their normal, healthy level. Many of these drugs are approved for use in horses and would offer a safer, more effective solution."

Some veterinarians also believe that effectively treating IAD early on, could prevent the onset of recurrent airway obstruction (RAO), or "heaves", amore advanced respiratory illness of older animals.

RAO is commonly found in hunter-jumpers, ponies, dressage and companion horses. The condition causes frequent allergic respiratory responses which include performance disruptive coughing and animal discomfort. It's especially prevalent in colder countries like Canada where horses must be stabled for a portion of the year, since mouldy hay and dusty stable conditions are known to induce symptoms.

Prof. Dorothee Bienzle, Department of Pathobiology, is studying Clara cells, the cells that line most of the bronchi in the lung, to understand how the disease progresses. Clara cells produce a protein – Clara cell secretory protein (CCSP) – which reduces the inflammation caused by inhaling harmful dust and fungal spores.

Bienzle found that years of continuous exposure to poor quality air eventually exhausts the Clara cells, which means lower CCSP levels and less ability to limit the inflammatory allergic response. Older horses with advanced RAO produce very little CCSP.

Researchers can measure CCSP levels in the respiratory tract with lung washes, where water is flushed into and then collected from the lung. From these tests, researchers have determined the amount of protein present in normal horses compared to those with severe RAO. This allows them to tell how advanced the disease is based on CCSP levels. They also found that CCSP leaks into the blood of animals with inflamed lungs.

"We'd like to develop a CCSP test for blood, which might be a very good indicator of how severe the disease is," says Bienzle. "This would allow us to simply take a blood sample and be able to give the animal's owner an accurate prognosis."

Over the summer, Bienzle and her team performed lung washes on horses from several nearby farms. The hope was to obtain realistic data by testing animals that are housed in conditions typical to Ontario stables.

Previous studies by Bienzle have identified three types of fungal agents that may be responsible for RAO cases throughout Ontario. She will examine the fungal agents found in the lung washes as well as CCSP levels and the different types of inflammatory cells present in horses with and without RAO.

Research funding has been provided through the funding agencies of Equine Guelph and the Natural Sciences and Engineering Research Council.

- Natalie Osborne

Our research writers belong to the unique U of G training program, SPARKS (Students Promoting Awareness of Research Knowledge).

Researchers Look to Discover Unknown Forms of Bacteria Causing Colitis


photo by Jacquie Labatt

Faeces-contaminated environments, such as transport trailers and stables, can spell trouble for horses. These are locations where deadly colitis-causing Clostridium bacteria can sometimes thrive.

Colitis occurs when the horses' colon becomes rapidly inflamed through infection from clostridia or other bacteria. This leads to severe diarrhoea that often results in a swift, painful death from dehydration and toxaemia.

Treating colitis-afflicted horses is especially difficult, since owners and veterinarians have only a small window of time for early emergency medical treatment.

On top of this, scientists only know of three colitis-causing bacteria – Clostridium difficile, Neorickettsia risticii, and Salmonella. Together, they cause roughly 40 per cent of colitis cases, while the causes of the other 60 per cent are unknown.

University of Guelph researchers are beginning a two-year study to find out what other bacteria might be responsible for some of these unknown causes.

Profs. John Prescott, Department of Pathobiology, and Luis Arroyo, Clinical Studies, suspect that previously unrecognized strains of Clostridium perfringens — the fastest growing bacterium known — may be responsible for causing colitis in horses.

Among other approaches, they plan to construct a genomic sequence of an isolate from a colitis-affected horse that is not infected with the known causes of colitis. Then, they will compare this isolate to the genome sequence of known and fully sequenced Clostridium perfringens strains involved in other types of disease in animals and humans.

If they are able to spot variations between the genomic sequences, they can then begin looking at the genetic differences and particularly for variants of toxin genes known to be important for serious disease in Clostridium bacteria. This could indicate a different strain of this bacterium, and be a key start to developing vaccines or therapeutic control strategies.

"Once we know specifically what we're dealing with, we can take action and make a dent in that 60 per cent of cases for which we don't know the cause," says Prescott. "It's the not knowing and not being able to provide targeted treatments – that's the problem."

This study receives support from Equine Guelph.

- Joey Sabljic

The researchers are hoping to start striking back against the 60 per cent of colitis cases caused by previously unknown Clostridium perfringens strains.

Monitoring Study Moves On To Thoroughbreds

Some horses are born with heart abnormalities that may go undetected until they begin their racing career. Sudden death due to heart complications are rare…but disastrous for all concerned.

Two years ago, University of Guelph researchers Peter Physick-Sheard and Kim McGurrin conducted a study on Standardbred horses to explore how racing affects their heart rate.

Now, the researchers have decided to take their study to the next step and explore the actual cardiac function of Thoroughbred horses' hearts during races.

Physick-Sheard and McGurrin found that a horse experiences different psychological and physical stimuli during a competition, such as sensing the physical presence of other horses and understanding that they are in a competitive race. This elicits a greater heart rate than while training or during treadmill exercise.

"We wanted to see what a horse's heart rate and heart rhythm responses were

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Taking the Next Step in Regenerative Medicine


photo by Martin Schwalbe

Stem cell research is becoming a popular and important part of regenerative medicine in both equine and human medicine. Joint cartilage cannot regenerate on its own (in either horses or humans) and current treatment options lead to repair by fibrocartilage with inferior mechanical properties compared to normal healthy cartilage.

Researchers, veterinarians, orthopedic surgeons as well as engineers are working together to discover an innovative approach to use stem cells when repairing damaged cartilage and tissue in horses with the hope that favourable results can translate into better treatment options for humans as well.

Thomas Koch, a Guelph Ph.D. graduate and adjunct faculty member of the Department of Biomedical Sciences, have been collaborating with researchers in Denmark and Canada on pioneering stem cell research since 2005. A well recognized problem in cartilage repair is the ability to retain the cells at the injury site and prevent the cells from "falling" into joint space.

Koch is studying the utility of synthetic, bio-degradable hydrogels for retaining the cells at the injury site as well as more commonly used matrixes such as fibrin and platelet rich plasma derived from the patient or individual.

Koch's research group was recently strengthened by the addition of Post-Doctoral Fellow Younes Leysi-Derilou, who has a strong background in human stem cell research and biochemical engineering. Leysi-Derilou's work is centered on producing cartilage exhibiting mechanical properties mimicking that of normal cartilage.

He will be investigating the mechanical stimulation needed to engineer tissue constructs ex vivo. The successful application of these constructs in horses suffering from cartilage defects could be of great interest in human medicine, since the horse is one of the best animal models of cartilage repair due to similar cartilage thickness between horses and humans.

Koch is employed by the Orthopedic Research Lab at Aarhus University in Denmark and funded by the Danish Research Agency for Technology, Production and Innovation. Additional operating funds are provided through the Equine Guelph Research Fund, the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Grayson Research Foundation of Lexington, Kentucky.

- Johnny Roberts

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like during actual competition," says McGurrin. "Getting a better handle on the heart rate of Thoroughbred race horses can provide insight into the psychological and physiological experiences a horse goes through, from the time prior to the race until they cross the finish line."

Their previous Standardbred study established normal parameters, enabling them to gather information and data required to inform the Thoroughbred study. McGurrin says they used their previous results as benchmark comparisons when trying to identify any horses with potential abnormalities.

Funding for this research is provided through Equine Guelph. The Thoroughbred study will be conducted in cooperation with the Woodbine Entertainment Group in Toronto.

Assisting Physick-Sheard and McGurrin are undergraduate students Eva Hirmer and Jordan Cook.

- Johnny Roberts

"We wanted to see what a horse's heart rate and heart rhythm responses were like during actual competition," says McGurrin. "Getting a better handle on the heart rate of Thoroughbred race horses can provide insight into the psychological and physiological experiences a horse goes through, from the time prior to the race until they cross the finish line."

The researchers, including Thomas Koch, are focusing on the utility of synthetic, bio-degradable hydrogels for cartilage repair. Their goal is to produce cartilage that exhibits the mechanical properties of normal cartilage. The successful application of these constructs in horses suffering from cartilage defects could be of great interest in human medicine, since the horse is one of the best animal models of cartilage repair due to similar cartilage thickness between horses and humans.

EquiMania! Road Trip From Lexington to Toronto

photo by Henrietta Coole

The fall schedule for Equine Guelph's youth program, EquiMania!, is an extemely busy one this year – starting at the Alltech FEI World Equestrian Games in Kentucky in September and ending at The Royal Agricultural Winter Fair in November.

"It's a bit of a road trip this fall – and it's worth every mile," exclaims Gayle Ecker, director of Equine Guelph.

A small army of Equine Guelph staff and volunteers from Canada are in Kentucky from September 25 until October 10 manning the EquiMania! education centre, the anchor tenant of the Kids Zone at the Alltech FEI World Equestrian Games.

As soon as the 5,500 lb. exhibit is unloaded from the truck from Kentucky, it will be time to pack up again for The Royal Agricultural Winter Fair in Toronto from November 5 to 14.

EquiMania! has become one of the most popular attractions at The Royal for 'horse crazy' kids. This year, EquiMania! will be located on the main floor near the President's Choice® SuperDogs Theatre.

As always, EquiMania! will be chock full of unique educational displays, activities and quizzes to engage youth about horse health care and safety. Kids of all ages will learn: how to braid a tail, about potential careers in the horse industry, how to tell the age of a horse by its teeth, horse farm and rider safety, to identify horse bones, why horses can sleep standing up, equine nutrition, how to wrap legs and what parasites look like.

To learn more about EquiMania!, visit **www.EquiMania.ca.**

Take a Journey Through Your Horse's Joints

Pfizer Equine Division

Equine Guelph's Journey through the Joints, sponsored by Pfizer, is an online tool designed to take horse people on an interactive journey from a healthy joint to an inflamed, arthritic joint.

One of the biggest health challenges facing both horses and humans is arthritis. We all know that it hurts, but don't really understand what is happening in the joints.

Currently, there is no effective long-term treatment to repair a cartilage injury in the joint, one of the leading causes of early retirement in horses. The tissue from the cartilage heals extremely slowly and the damaged (or missing) tissue is often irreplaceable, usually leading to osteoarthritis.

The goal of the Journey through the Joints tool is to educate caretakers on the different stages of joint degeneration and explain exactly what arthritis is – what it means and how to prevent and care for horses with arthritis. The interactive tool also challenges participants' knowledge with user-friendly activities on the anatomy of a joint, featuring a 360 degree tour of an actual horse joint.

"We think it's really important to teach horse people about the basics on joints," says Dr. Cathy Rae, manager of equine technical services for Pfizer Animal Health. "It is critical to have a basic knowledge of joints before grasping an understanding of causes and care of lameness."

To check out this new tool, go to **www.EquineGuelph.ca.**


educating horsepeople


funding industry research


promoting health & performance

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