Studies at California State Polytechnic University

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Maximum Efficiency

Steve Wickler, DVM, PhD, university veterinarian, director of lab facilities, and associate director of equine sciences in the Department of Animal and Veterinary Sciences at California State Polytechnic University in Pomona, Calif., has done a number of studies to evaluate what makes the equine locomotor system so efficient.

"We've looked at two different aspects," Wickler says. "One project, started by my colleague Don Hoyt, PhD, director of the Minority Biomedical Research Support Program, special assistant to Provost for Research, and professor of biological sciences in the Department of Biological Sciences, looked at the metabolism of different animals and how they move. Don measured the preferred speed at the walk, trot, and canter, using ponies, to find their behaviorally chosen speed," he says.

"Don measured the metabolism of the ponies and calculated the costs of locomotion--the amount of energy it takes to move a given distance," he continues. "He found that if the animals walked slower than their preferred speed, the costs went up. If they walked faster, the costs also went up. The minimum metabolic cost coincided with the speed the animals chose. When they are roaming free, they'll walk at a certain speed, and when they go to a trot they go directly to their preferred speed--which turns out to be right in the middle of their trotting range.

"We repeated the study with horses and found the same thing; the speed they walked was the most economical and so was their preferred trotting speed," he continues.

Even if a horse is bred to trot, it becomes metabolically expensive to do an extended trot. At a certain point, it is more economical to switch to a canter rather than trot faster. Horses also tend to change gaits in order to reduce concussion forces.

"We've also been doing some incline studies, looking at the effect of grade--how trotting uphill or downhill makes a difference in metabolism," says Wickler. "If you weight the animal with 20% of its body weight (200 pounds of rider and tack on a 1,000-pound horse), its metabolic rate goes up by 20%. If you take the same animal and
make it trot up a 10% grade (a 10-foot rise in 100 feet of distance), the 10% grade elevates the horse's metabolism 250%.

If the horse is working 2.5 times harder, this factor must be taken into consideration when conditioning him. The metabolic rate of horses in research trials is determined by measuring oxygen consumption. The animals are all trained to wear oxygen consumption masks while doing the various activities, says Wickler.

"One of our studies has been looking at the shifts in force production on various grades," he says. "On the level, most of the forces are taken by the front legs. When the horse goes up a 10% incline, however, there must be more thrust from the hind leg