Using the scientific inquiry method in the Equestrian Science program at William Woods University

Karen Pautz
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The study
Determine the efficacy and palatability of the new product known as Horse Quencher (http://horsequencher.com/).

Introduction
Maintaining proper hydration in a horse is crucial to his physical well-being. Many major health issues, notably colic, can arise from dehydration. But there's literal truth to the old saw "you can lead a horse to water, but you can't make him drink." The only way to force fluid into a horse is via nasogastric intubation or intravenous catheterization. Horsemen for centuries have been trying to find tricks to make horses drink: everything from adding salt to the horse's diet to increase the thirst response, flavoring the water (powdered Gatorade is a current favorite) to mask unusual water tastes, to wetting down his hay and grain into sloppy mashes.

Recently a product has arrived on the equine market that purports to encourage horses to drink water. Horse Quencher (HQ) is a sweet-feed-like additive that's added to a bucket of water. The company claims a "99% acceptance rate, and 100% guaranteed." The WWU EQS department has tried the product with a handful of horses with some success, but it's important that students understand that weak anecdotal evidence is not sufficient for decision-making with a scientific basis.

Purpose of the study as an educational tool
While it would be beneficial to find a reliable method of increasing water intake in horses, the study is more important as a method of introducing students to the informal use of the scientific method in the horse industry. Students will learn to ask questions, develop hypotheses, test them, and most importantly, they'll learn to recognize all the confounding variables that arise in any real-world test involving horses. In addition, they'll be introduced to critical thinking and learn about confirmation bias, and will learn to compare commercial marketing claims to real data.

The experiment
William Woods currently has 157 horses on campus. This large number is excellent for a research project. However, the cost of the product itself ($2.50 for a single serving) will by

necessity limit the trial to fewer horses. However, we can still choose a large sampling from horses of each representative discipline, breed and gender to obtain statistically significant results.

The experiment will involve offering a bucket of HQ water to the selected sample of school horses for seven days. Students will record each horse's reaction to the water and note if/how much of the HQ water each horse drinks.

Cautions and contraindications
The main concern when introducing the scientific inquiry method to students is that the study must in no way be deleterious to the horses used as test subjects. That limits our research options, as does the lack of sensitive scientific instruments which would allow us to perform more details biomechanical studies. This particular study will be safe, because horses will not be denied non-HQ water. Instead, the additive will be administered to the horses in an additional water bucket. If the horses choose not to drink from their HQ buckets, they'll still have access to their normal clean, fresh water.

Equipment and supplies
- 40 new 5-gallon water buckets with measuring marks
- appropriate wall attachments for buckets
- Horse Quencher with accurate measurement systems
- group-accessible spreadsheet or database where information can be recorded and analyzed

Confounding issues
- It will be difficult to come up with a truly random sampling of horses -- it will be most practical in terms of physical labor to test a group of horses who are stabled together.
- It is difficult to monitor water intake of non-HQ buckets -- we normally refill buckets several times per day, and many horses have automatic waterers in their stalls. Monitoring would require the students involved in the study to be the only ones watering the horses, and this isn't currently practical. However, it will not be difficult to control the water in the research buckets, as signs can be placed on them saying that they must not be handled by students other than those in the study.
- There's a need to have a control group of horses, who ideally would receive non-HQ water in a third bucket.
- Weather plays a large part in any horse's water consumption. Ideally, the study would take place during the weather swings (usually a rapid drop in temperatures) that cause horses to reduce their water intake. Ideally, the study would be replicated during several different weather patterns.

The lesson
During an initial meeting with the students, I'll explain the purpose of the study. We'll discuss, as a group, the best way to test our hypothesis that horses are more likely to drink the HQ-water. I'll work with them to develop the data set that they think will clearly test the hypothesis.

Throughout the discussions, I'll remind them that we want to know *how* to know the horses will drink more. It's this "how we know" that is the basis of the scientific inquiry method.

In the discussion about being sure not to harm the horses in the study, I'll help the students come to the realization that it's best to add an additional water bucket with the HQ, rather than replacing existing buckets.

We'll discuss how to administer the HQ, and I'll hope the students will decide on a standard time of day to empty the bucket of the last day's HQ-water and refill with a new HQ dose.

We'll discuss the practical application of the study: the signs required to prevent riders from automatically dumping and refilling the study buckets, the selection of the horses based on location and discipline. We'll discuss the desirability of having a control group of horses against which to base the HQ-horses' responses.

In the discussion about measuring the horse's response to the HQ, I'll hope the students discuss measuring the water volume at the beginning and end of each day. They might also realize that the horse's initial reaction to the water (drinking immediately, sniffing or lipping the water, curling upper lip, no reaction) is worthy of being recorded.

We'll talk about a probable missing element to the study, that of being able to compare the horse's ingestion of HQ-water in relation to non-HQ water. Due to the number of people handling the test-subject horses daily, and because we don't want to limit non-HQ water, we probably won't record non-HQ water volume intake. That will limit our study results to learning whether the horses will drink the HQ water, but it will not clearly demonstrate the horse's preference for HQ-water over regular water.

We'll discuss the data recording process, and I'll ask students to determine the information they want to record. We'll talk about the different water needs of horses based on size and activity, and I'll hope they also realize that environmental conditions (temperature and humidity outside and in the barn) will affect the horses' reactions. From this discussion, we'll develop a publicly-editable spreadsheet or database on which to record test results. By placing the spreadsheet on a wiki, or by using cloud-based databases, all students will have access to the information, and can update quickly for real-time results.

We'll discuss what results we can expect, and how they might confirm or disprove our hypothesis.

At the beginning of the week, I'll ask each student to predict the outcome of the study, with explanations for her decision. I'll ask her to back up her prediction with previous studies, marketing literature, and/or personal anecdotes. At the end of the week, I'll again discuss the study with the students. We'll talk about whether our study design was sufficient for our needs. We'll talk about whether the results of the study were predicted at the beginning of the week, and how confirmation bias makes it difficult for students to not fudge the results somewhat, or to look for explanations for the possible failure of their prediction.

Web 2.0 applications for collaboration

At minimum, the study can use a wiki-based spreadsheet which will be editable by all students involved in the study. A Google Docs spreadsheet would be sufficient for this work. However, a more robust application would be a cloud-based database such as Zoho Creator, which would

allow for real-time analytics and the development of a variety of reports. The information collected would be the same in either application, but the database would allow for greater manipulation of the data. Zoho Creator is mobile-device friendly, so students could enter their data on their smartphones while standing in front of the horse.

Further depth of study could be added with the addition of a digital video clip of each horse's reaction to the HQ additive. The videos could be easily taken with student smartphones, and added to the database or stored on a shared network drive.

Using the information:
At the end of the study, I'll ask students to make a recommendation to the EQS department regarding the administration of HQ. I'll ask them to develop a cost analysis, and compare that to the cost of treating a horse for impaction colic resulting from dehydration.

I'll ask them how the study they undertook can help them to develop other lines of inquiry. For instance, I might ask them how to determine whether a particular feedstuff (hay or grain) is causing an allergic reaction in a horse. Or I might pose the conundrum of how to find the best method of feeding a horse a bitter-tasting feed additive/medication. The students' experience with the first research study should help them more easily develop other studies.

I'll encourage them, too, to look for alternatives to HQ, which appears on the surface to be a simple combination of horse feeds known to the industry as a "sweet feed." If the ingredients are similar, would it be possible to simply add a handful of our regular feed to the bucket of water? What if a flavoring such as peppermint oil were used instead? If students begin to develop these new research options and hypotheses, then we'll begin the lesson discussion anew.

Web 2.0 Resources

Google Docs
http://www.google.com/drive/about.html?usp=ad_search&gclid=CMq7s9L73bkCFe9aMgod6yMA1Q

Zoho Creator
http://www.zoho.com/creator/

Critical thinking: confirmation bias web resources

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