



ANEQ 334 – Principles of Equine Genetics

[Prerequisites – ANEQ 102; ANEQ 328, BZ 350 or SOCR 330; STAT 301 or 307]

Course Description: The objectives of this course are focused on the application genetic principles for the understanding of important quantitative and qualitative traits in horses. The goal is an increased understanding of equine biology and the principles of selection and genetic improvement.

Course Dates: January 18th, 2017 through May 5th, 2017
Course Times: Monday, Wednesday, Friday – 8:00am to 8:50am
Course Location: Clark A102

Instructor: Stephen Coleman MS Ph.D.
Office: Animal Sciences 10
Phone: (970) 491-2681
E-mail: stephen.coleman@colostate.edu (the best way to reach me)
Office Hours: Mondays, Wednesdays and Fridays from 9:00am to 10:00am

What does this mean? – unless I state otherwise in class, if you need to ask me a question (or you have something else you need or want to talk about) you should be able to find me in my office during these times.

What it does not mean – These are not the only times you can meet with me. I have an open-door policy – if the door is open, please come in! If you need to talk with me, come see me. If you'd like some guarantee that I'll be in my office when you need me, please make an appointment (by e-mail or by phone).

Teaching Assistants: Isabelle Kunz
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Miranda Culbertson
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Office Hours: Thursdays 9:30-10:30am Animal Science Rm 63

Kristin Klohonatz
E-mail: kristin.klohonatz@colostate.edu
Office Hours: by appointment

References:

There are no required text books for this class. Required material will be presented in class, though I may also provide/assign readings that I think will support what we are learning in class through Canvas. The following books may be useful references to supplement in class materials:

Horse Genetics, Bailey and Brooks, ISBN 978-1-84593-675-4

Equine Genomics, Chowdhary, ISBN 978-0-8138-1563-3

Molecular and Quantitative Animal Genetics, Khatib, ISBN 978-1-118-67740-7

Understanding Animal Breeding, Bourdon, ISBN 0-13-096449-2

All the above books are available through the CSU libraries. Two of them – Equine Genomics and Molecular & Quantitative Animal Genetics – are available electronically. I own all 4 of these books and I'm happy to have you come by my office to look at them (and perhaps borrow them briefly).

Course Materials:

Course material and messages will be hosted on the Canvas e-learning management site (<http://info.canvas.colostate.edu/login.aspx> - Course ID = 2017SP-ANEQ-334-001). Unless otherwise indicated, all assignments and assessments will be completed or submitted through Canvas. If you cannot access the course through Canvas, please contact me immediately so that we can get the issue resolved.

When possible, lecture notes will be posted on Canvas prior to class. I will also be posting suggested resources which I believe will help you understand the lecture materials. It is my intent to make many of the lecture periods more interactive – as such, material from these lectures will be posted after class.

Course Objectives:

Objective #1 – You should be able to accurately communicate knowledge of equine genetics.

Being able to communicate effectively is one of the most important life skills and its importance is often overlooked. In order to communicate effectively and accurately you have to really know what you are talking about. My objective for this course is that we equip you with skills needed to talk about equine genetics with your classmates, your parents, as well as horse producers and professionals.

Objective #2 – You should be able to think critically about the role of genetics in equine biology.

Genetics, at its core, is a science concerned with how things work and to some degree is involved in every aspect of horse physiology and disease pathology. It's important, therefore, that you can apply the principles of equine genetics to observe, interpret and critically assess data.

Objective #3 – You should become familiar with important single and multi-gene traits in the horse.

By the end of class, you should be able to distinguish between quantitative and qualitative traits and discuss the relationship between a trait of interest and its associated genotype and phenotype. Most important, by the end of class you should be able to apply your knowledge of inheritance to understand the impact of these traits on the horse and how you can use that understanding to effect genetic change in the horse.

Objective #4 – You should gain an understanding of the concepts and terminology of quantitative genetics including how to apply those concepts for genetic improvement.

Most of the traits of interest in horses (and other livestock species) are quantitative in nature. In order to select and breed high performing animals, we need to understand the nature of multi-gene quantitative traits and how their related phenotypes are transmitted between generations. It is important to understand the key components affecting the rate of genetic change in a population and specific strategies for imposing selection on quantitative traits.

Objective #5 – You should gain an understanding of the molecular basis underlying the genetic variation observed in horses.

Changes that we observe in a horse's appearance and performance can all be traced back to changes in the DNA. Understanding the nature of these changes and what effects they have on equine biology is important for understanding how and why the phenotypes for a trait of interest are transmitted from generation to generation. Appreciating the molecular basis of the phenotype (the genotype) helps us to be more accurate with the outcomes of selection.

Academic Integrity: I take academic integrity very seriously. Acts of academic dishonesty and misconduct destroy the possibility of meaningful learning and discussion. We all must do and take credit for our own work.

Here is **what you can expect from me:**

- I will attend every class period and arrive on time. I will make every effort to inform of any exceptions to this.
- I will come to class with a good attitude, this means:
 - o I will be respectful of your ideas and the diversity you bring to the classroom.
 - o I will be open to ideas and dialogue that challenge me.
 - o I will answer any appropriate questions that you have (in class or in office hours).

- I will do my best to make sure that each student is given an equal opportunity to succeed in my course:
 - o I will provide the course material presented in class for all students on Canvas.
 - o I will do my best to minimize disruptions and distractions in the classroom.
 - o I will consistently apply grade adjustments (should any be required) for all students.
 - o I will not tolerate cheating of any form in the classroom (this includes acts of plagiarism, using unauthorized sources of information on exams or assignments, unauthorized possession or distribution of academic materials, or the facilitation of academic dishonesty by any students).
- I will try to be reasonable, fair and understanding when circumstances beyond your control impact your academic performance in my course.

Here is **what I expect from you**:

- I expect that you show up to class and work hard in my class. You are entirely responsible for the grade you earn at the end of the semester.
- I expect you to complete the assignments and participate actively in class.
- I expect you to be respectful of me, yourself and your classmates.
- I expect you to be honest both in how you interact with me and the work you turn in.
- I expect you to maintain a high level of academic integrity and adhere to the Colorado State University General Catalog Academic Integrity Policy and Student Conduct Code (<http://www.catalog.colostate.edu/>).

Grading Policy:

The grade distribution for ANEQ 334 is as follows (points are approximate):

<i>Homework Assignments</i>	45%	(~325 points*)
<i>Exams</i>	45%	(450 points*)
<i>Attendance/Participation</i>	10%	(50 points*)

<i>Total</i>	100%	

There will be 4 exams during the semester. They are (tentatively) scheduled as follows:

- Exam 1** **Friday, February 10th, 2017 @ 8-8:50am (in class)**
- Exam 2** **Friday, March 10th, 2017 @ 8-8:50am (in class)**
- Exam 3** **Friday, April 12th, 2017 @ 8-8:50am (in class)**
- Final Exam** **Wednesday, May 10th, 2017 @ 11:50am-1:50pm (Clark A102)**

The final exam will be comprehensive. The mid-term exams will focus primarily on the material presented in class in during the period (~4-5 weeks) preceding that exam. However, as the concepts in genetics build on each other and are inter-related, students can expect certain topics to appear (or reappear) on more than one exam.

I understand that circumstances (planned and unplanned) may prevent everyone from taking the exams at the scheduled times. If you have a university excused absence requiring you to miss an exam, you must inform me of the absence at least 1 week before the scheduled date and take the exam before the excused absence occurs. Students with planned un-excused absences also need to inform me of the absence at least 1 week in advance and take the exam prior to the absence. For unplanned and un-excused absences (life happens – I get that), I need you to let me know of the absence within 24 hours of the scheduled exam time (so within a day of the exam occurring). We will then discuss the possibility of a make-up exam (documentation for the absence will be necessary). I want to be reasonable, fair and understanding when life gets in the way of school, but please, don't interpret that to mean you have any expectation of me granting a make-up exam. If you want to guarantee yourself a grade for each exam, show up at the scheduled exam time.

Homework assignments will be described and scheduled in class then posted on Canvas. Assignments are due at 2pm (before class) on the assigned due date. Late homework assignments will be penalized 10% per day late.

Questions on returned exams/assignments should be submitted in writing within 1 week of the exam/assignment being returned. I will not negotiate grades at the end of the semester. If you are concerned about your grade, please come see me during the semester and we can discuss what you can do about it.

The grading scale is as follows. You will be guaranteed at least those letter grades in you have those percentages.

<u>Grade</u>	<u>Percentage</u>
A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	Below 60%

Attendance:

Regular attendance in lecture has a positive correlation with student success, both in terms of the grade you earn and your understanding of the course material. There are several practical reasons to consider as well: (1) You'll learn what you need to know, but also what you don't need to know. In other words, attending lecture can help you decide where to focus your energy for the course, (2) It's where the answers are – more importantly it's an easy place to get clarification from me if you have questions, and (3) Bottom line, it's expensive to pay and not go. Showing up to class helps you get the most out of the investment you are making in yourself.

I place a high value on attendance. The grade distribution is set up to reward attendance and participation (10% of your final grade). Consider it this way, the best way to turn a B into an A is to have good attendance. Conversely, the best way to make your A into a B is if I never see you. Attendance will be recorded with unannounced in class quizzes (1 or 2 questions over recent material). If you are present to take the quizzes you will receive credit (whether or not you answer the questions correctly). These quizzes will be administered during the first few minutes of class – if you are more than 5 minutes late for class you will not get credit. If you know you will be late in advance (ex – preceding class is at the foothills campus), you must let me know in advance and come see me at the end of the class period (and we'll try to work something out).

Phones/Laptops: Technology (cell phones, laptops, tablets, etc) is a part of daily life. Used properly these it can enhance your learning and your lecture experience. It can, unfortunately, also become a distraction that gets in the way of learning. My preference is that these devices are not used in class, however, as adults I leave that decision to you. I understand (with phones particularly) that you may need to remain connected to the world outside of class (we all get important phone calls from time to time). The policy in the class room is this – the consequence of disrupting the course (anything that breaks my train of thought or prevents your classmates from learning) is that you will be responsible for presenting part of a subsequent lecture on a topic of my choosing.

Accommodations: Any student eligible for academic adjustments because of a learning disability or medical condition should contact the Office of Resources for Disabled Students for development of appropriate accommodations. I can only make accommodations after receiving appropriate documentation from the Office of Resources for Disabled Students (<http://www.rds.colostate.edu/>).

Assignments: Homework assignments are designed to review, reinforce and apply the principles of genetics learned in class. The points come from a variety of sources, described here:

Week-in-Review Quizzes (50 points) – these weekly (most of the time) review quizzes are designed as formative assessment. The goal is to allow you to review (and test yourself on) recent material so that you can assess what you “know” and what you “don’t know”. They will also allow me to identify areas from the instruction that might need additional review. Points will be earned for these quizzes simply by completing them.

Homework Assignments (150 points) – these assignments will be used to review and reinforce concepts presented in class. Students will have 1 to 2 weeks to complete each individual assignment. There are 5 or 6 planned assignments, the lowest homework grade will be dropped.

Equine Genetic Disease Study Guide (25 points) – a 1- or 2-page infographic explaining the symptoms/clinical signs of the selected disease, normal function of the gene and gene product including associated genotypes (affected/unaffected), genetic testing if available, and breeding schemes to avoid affected animals.

Equine Coat Color Study Guide (25 points) – a 1- or 2-page infographic describing the selected phenotype, normal function of the associated gene and how function is altered, the genotype/phenotype relationships, genetic testing information, and breeding schemes to produce desired phenotypes.

Term Paper (100 points) – a 4 to 5-page report describing a quantitative trait or equine disease (hopefully of some interest to them). The report should include background on the trait/disease, the current understanding of it with a focus on genetics, and future directions for investigating it. The final report will be due approximately 2 weeks before the end of the semester.

Course Outline:

Principles of Equine Genetics will (tentatively) cover the following topics:

- Review of basic genetics
- Variation (phenotypic and genotypic)
- The equine genome
 - o Summary/Sequencing/Structure and Function
 - o Contents (Annotation and features/Gene functions/Regulation)
- Causes of Genetic Variation
 - o Mutations
 - o Recombination/Re-assortment/Linkage
- Maintenance of Genetic Variation
 - o Selection and Fitness
 - o Allele and Genotype Frequencies
 - o Development of breeds
- Genetic Variation and Reproduction
 - o Enhancing variation versus Loss of variation
- Central Dogma of Molecular Biology/Genetic Equation
 - o Relationship of genotype and phenotype
 - o Simple inheritance ($P=G+E$)
 - o Role of the environment
- Mechanisms of Gene Action – Simply-inherited traits (diseases)
 - o Gene function and normal phenotype
 - o Impact of mutations
 - o Dominant and Recessive modes of inheritance
 - o Additive and Non-additive gene action
- Mechanisms of Gene Action – Gene interactions
 - o Coat color as a system of interacting genetics
 - o Epistasis and Pleiotropy
 - o Phenotypes/Genotypes
 - o Molecular basis of alleles and gene function
 - o Putting it all together – expression of coat color phenotype
- Equine genetic testing
 - o Parentage, disease, phenotype
- Selection of simply-inherited traits
- Complex traits/complex phenotypes
 - o What defines a complex trait?
 - o Describing a complex phenotype – how does that relate to genotype?
- Examples: reproductive traits, behavior, conformation and performance
- Selection and change
 - o Variance, heritability, repeatability
 - o Components of genetic change
 - o Genetic prediction
- Mating strategies/Genetic preservation
 - o Mating decisions/breeding goals
 - o Artificial reproductive technologies (ART)
- Equine breeds/evolution