

# Honors Genetics

## AGR 3303: Spring 2020

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Office Hours: Monday, 10:00 am to 12:00 am; Tuesday, 1:30 pm to 3:30 pm\*

TA:  
Office:  
E-Mail:  
Office Hours:

\*These office hours are specifically when I will be available in the office for questions. If a student needs to come by at other times, it is wise to schedule an appointment (call or send an e-mail) to make sure someone is available.

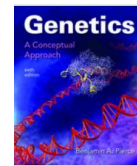
### Course Description:

AGR 3303, Genetics, will present a comprehensive coverage of the principles, theory and applications of genetics. Topics will provide an understanding of heredity material, gene expression, and the inheritance of traits. Upon completion of AGR 3303 students will be prepared for more advanced courses in genetics, plant and animal breeding, biochemistry, biotechnology, and molecular genetics.

**Location:** L007 Turlington: M, W, F; Period 2, 8:30 am to 9:20 am

### Course Resources:

A. **Textbook:** Genetics, A Conceptual Approach, Benjamin Pierce, 6th Edition.



B. **Online Resources and Electronic Textbook:**

SaplingPlus is an online assignments and tutorial system from the textbook publisher and is required for AGR 3303. SaplingPlus can be purchased from the publisher or through the UF bookstore.

#### Order from the Publisher:

1. Go to: [macmillanlearning.com/sapling](http://macmillanlearning.com/sapling)
2. Next create or log in. You have to create an account before you can find your instructors course.
3. Once you have an account and log in, you are given prompts to find your instructors course by school-dept-instructor.

#### Purchase from the bookstore:

1. You will be given a code.

#### Once you have a code:

1. Log in to Genetics on Canvas
2. Click on Assignment
3. Click on SaplingPlus
4. Click on the link that indicates SaplingPlus will open in a new window
5. Log in or create an account
6. Once SaplingPlus is open click on the payment link
7. Enter your code

### Grades:

Minus grades will not be given for this course

Exams: Three 100-point exams will be given over lecture material. Exams will be multiple choice with 50 questions. An optional 100-point comprehensive final exam will be available for those that want to replace their lowest exam grade.

\*\*There will be no make-up exams given. If you miss an exam you can take the comprehensive final to replace the missed exam.

The three exam grades will be worth 75% of your final grade.

**\*\*Programmable calculators and phones are not allowed for use during exams.**

Homework: Homework will be delivered through the SaplingPlus. Homework assignments and due dates will coincide with each lecture. Your average homework grade at the end of the semester will be worth 5% of your final grade.

A	89.76%
B+	84.76% to 89.75%
B	79.76% to 84.75%
C+	74.76% to 79.75%
C	69.76% to 74.75%
D+	64.76% to 69.75%
D	59.76% to 64.75%
E	< 59.76%

### **Seminar Reports (20% of final grade)**

Honors students are required to attend 8 genetics related seminars during the semester and to turn in written summaries of the seminars. These can be graduate or faculty given seminars. Suggested sources of seminars are the Agronomy Department, Horticultural Sciences Department, Environmental Horticulture Department, Plant Molecular and Cell Biology (PMCB) Program, Forestry, Botany, Animal Sciences, The Vet School, Animal Molecular and Cellular Biology (AMCB) Program, and the Genetics Institute. Other sources may be suggested by the student. The student must identify and get approval of all seminar topics. Each report is worth 12.5 points for a total of 100 points.

UF Grading Policy: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

UF Attendance Policy: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

### **Bonus:**

At random 1 to 4 -point bonus questions will be given during class periods. You will have five minutes to turn in your answer. Missing the question will not count against your final grade. If the question is correctly answered, the points will be added to your total points at the end of the semester. At times there may be more than one bonus opportunity per exam.

**\*\*Once bonus points are posted you have two weeks to discuss a discrepancy. Two weeks after posting, bonus points will not be re-evaluated.**

### **Services for Students with Disabilities:**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **Online Course Evaluation Process:**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### **Academic Honesty:**

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report

any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class

### **Software Use:**

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

### **Campus Resources:**

#### Health and Wellness

*U Matter, We Care:* If you or someone you know is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu), 352-392-1575, or visit <https://umatter.ufl.edu/> to refer or report a concern and a team member will reach out to the student in distress.

*Counseling and Wellness Center:* Visit <https://counseling.ufl.edu/> or call 352-392-1575 for information on crisis services as well as non-crisis services.

*Student Health Care Center:* Call 352-392-1161 for 24/7 information to help you find the care you need, or visit <https://shcc.ufl.edu/>.

*University Police Department:* Visit <https://police.ufl.edu/> or call 352-392-1111 (or 9-1-1 for emergencies).

*UF Health Shands Emergency Room / Trauma Center:* For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; <https://ufhealth.org/emergency-room-trauma-center>

#### Academic Resources

*E-learning technical support:* Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at <http://helpdesk.ufl.edu/>.

*Career Connections Center:* Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services <https://career.ufl.edu/>.

*Library Support:* <https://cms.uflib.ufl.edu/ask> various ways to receive assistance with respect to using the libraries or finding resources.

*Teaching Center:* Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>

*Writing Studio:* 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>

*Student Complaints On-Campus:* <https://sccr.dso.ufl.edu/policies/student-honor-%20code-student-conduct-code/>

*On-Line Students Complaints:* <https://distance.ufl.edu/student-complaint-process/>

**Office Address:**

2005 SW 23<sup>rd</sup> St  
Building 345



Map for Kenworthy's office.



Building 345, room 103  
Building 350, Room

## COURSE MATERIAL

### \*Topics

### CHAPTER : Sections

1. History of genetics and genetic material	1.1, 1.2, 1.3, 10.2
2. DNA and RNA Structure	1.3, 10.1, 10.2, 10.3, 10.4
3. DNA Replication	12.1, 12.2, 12.3, 12.4
4. Chromosomes	2.1, 2.2, 11.1, 11.2, 11.3, 11.4
5. Cell division	2.2, 2.3
6. Bacterial and Viral Genetics	9.1, 9.2, 9.3, 9.4
7. Chromosomal Variations, parts 1 & 2	8.1, 8.2, 8.3, 8.4

### Exam 1

**Wednesday, Feb. 5**

**\*\*No Class: Feb. 7**

8. Genetic Segregation, part 1	3.1, 3.2
9. Genetic Segregation, part 2	3.3, 3.4
10. Modification of Mendelian Ratios	5.1, 5.2, 5.3
11. Sex Determination, linkage and pedigrees	4.1, 4.2, 6.1, 6.2, 6.3

**No Class Mar 2-6 (Spring Break)**

12. Gene Linkage	7.1, 7.2, 7.3,
13. Quantitative Traits	24.1, 24.2, 24.3

### Exam 2

**Wednesday, March 18**

**\*\* No Class: Mar 20**

14. Genes	
15. Transcription	13.1, 13.2, 13.3, 13.4
16. RNA Processing-Translation	14.2, 15.1, 15.3
17. Prokaryotic Gene Expression	Chapter 16
18. Eukaryotic Gene Expression	Chapter 17
19. Mutations	18.1, 18.2, 18.3
20. Transposable Elements	18.4
21. DNA Repair	18.5
22. Cancer	23.1, 23.4, 23.5
23. Developmental Genetics	22.1, 22.2,
24. Biotechnology	19.1, 19.2, 20.1, 20.2, 20.3
25. Population Genetics	25.1, 25.2, 25.3, 25.4

### Exam 3

**Monday, April 20**

**Classes End**

**Wednesday, April 22**

**Final**

**Friday, May 1; 7:30 am to 9:30 am**

\*We will attempt to maintain the exam schedule; however, material may be altered for any given exam depending on time.

\*\*Tentative dates: confirm before assuming no class. If class occurs on these dates then Exam dates may be moved up.

**Class Notes:** Lectures will be given as Powerpoint presentations. The presentations will be available for downloading at <http://ss.at.ufl.edu/>. Log-in to Canvas E-Learning Systems using your GatorLink username and password. You must have an active GatorLink ID for access. If you do not have a GatorLink ID go to <http://gatorlink.ufl.edu> or to the CIRCA Help Desk: CSE520D, 392-HELP for assistance. You are responsible for bringing the printouts to class. Lectures are posted in the Files tab.

**NOTE: The instructor reserves the right to change any and all information contained in this and other handouts in this course**

## 2017 Exam 1 Study Guide

### Lectures 1 – 2. History and RNA & DNA Structure

- Understand the major milestones and individuals involved in the field of genetics.
  - Darwin; Mendel; Griffith; Avery, MacLeod and McCarty; Hershey and Chase; Watson and Crick
    - Know what they are credited with discovering/determining
- When was DNA first discovered?
- When was DNA proven to be the genetic material?
- When was the structure of DNA determined?
- How did Rosalind Franklin and Maurice Wilkins contribute to determining the structure of DNA?
- Understand/describe the methodology from experiments that proved DNA (and for some viruses RNA) is the genetic material.
- Know the characteristics of functional DNA.
- Be able to know the components and differentiate cell structures: Prokaryotes vs. Eukaryotes.
- Know which organelles contain DNA.
- Be familiar with nucleotides.
  - What differs between the pentose sugars of RNA and DNA?
  - Double ringed purines: Adenine and Guanine
  - Single ringed pyrimidines: Cytosine, thymine (DNA only), and Uracil (RNA only)
- Know the components and structure of DNA and RNA.
- Know the physical and chemical properties of nucleic acids.
- Know that guanine and cytosine pair and that adenine and thymine pair
- How was it determined that RNA is the genetic material in some viruses?
- Know that nucleic acids are read from 5' to 3'.

### Lecture 3. DNA Replication

- Know that nucleic acids are read from 5' to 3'.
- Understand semi-conservative replication and the associated experiments.
- Know the components and procedures involving the synthesis of leading and lagging strands.
  - Initiation, unwinding, elongation and termination
  - Be familiar with the various enzymes involved in DNA replication (prokaryotic and eukaryotic) and their functions.
- Why is a primer needed for DNA polymerase?
- What is a nuclease? Why is this activity useful in DNA replication?
- How does telomerase function to maintain the length of a chromosome?
- What are the differences between rolling circle and Theta replication?

### Lecture 4. Chromosomes

- Be familiar with the metaphase shapes and parts of chromosomes.
- Where do spindle fibers attach to pull apart sister chromatids?
- Euchromatin versus heterochromatin
- Be familiar with types of DNA sequences.
- Understand and differentiate sister chromatids and homologous chromosomes.

### Lecture 5. Cell division

- Cell cycle – G1, S, G2, M – mitosis and meiosis – their phases – what are the products?
  - Know mitosis vs. meiosis.
- The result of DNA synthesis (replication) – produces sister chromatids
  - What is synapsis – homologous pairing.
  - What is crossing over between non-sister chromatids in a homologous pair (tetrad).
- Genetic Diversity
  - Number of chromosomal combinations from meiosis =  $2^n$ , where n is the haploid number.
  - Understand what is meant by random assortment of chromosomes.

- How does crossing over influence genetic diversity?
- How does non-disjunction influence genetic diversity?
- Gamete maturation
  - Animals – Be familiar with the processes of Oogenesis and Spermatogenesis.
  - Plants – Be familiar with the process of Megasporogenesis, Microsporogenesis, and Double Fertilization.

### Lecture 6. Bacterial and Viral Genetics

- What are plasmids? Their functions?
- Be familiar with the methods of gene transfer in bacteria.
- What is the F Plasmid and its role?
- Be familiar with some unique features of viral genetics (types of viruses, retrovirus, reverse transcription, overlapping genes encoded in the same DNA)

### Lecture 7. Chromosomal Variations

- Chromosomal Aberrations
  - Deletions
  - Duplications
  - Inversions
  - Translocations
- Aneuploids
  - Monosomy
  - Trisomy
    - Inheritance – nondisjunction – Be able to determine the products of a non-disjunction event.
- Polyploidy
  - Understand the basic chromosome number (x)
  - Be able to determine an organism's ploidy level based on total chromosome number and its basic chromosome number.
  - Be able to determine an organism's basic chromosome number based on its total chromosomal number and its ploidy level.
  - Be familiar with Autopolyploid and Allopolyploids – meaning of terms, how do they form, and how they differ.
  - Understand why triploids are sterile and their value.

What are these chromosome re-arrangements? How do they occur? What are pairing and crossing over problems? What are their consequences?

## Exam 2 Study Guide

### Lectures 8 and 9

#### Terminology:

Locus	Heterogenous
Allele	Heterozygous
Phenotype	True-breeding
Genotype	Qualitative Trait
Monohybrid, dihybrid, and trihybrid	Testcross
Heterozygous	Reciprocal cross
Homozygous	Complete Dominance
Dominant allele	Incomplete Dominance
Recessive allele	Codominance
Homologous Chromosomes	
Gametes	
Somatic Cells	

- Who is Gregor Mendel?
  - What are his laws/theories/principles of inheritance?
- Be able to determine the possible gametes from a parent or organism.
- Be able to determine parental genotypes through analysis of progeny genotypes and phenotypes.
- Be able to use the Punnet square and/or forked line method to determine progeny genotypes and phenotypes.
- Use the product and sum laws or the binomial distribution to determine genetic probabilities.
- Be able to determine progeny ratios for monohybrid crosses, dihybrid crosses, and testcrosses.
  - Monohybrid cross – one trait – occur in fourths
  - Dihybrid cross – two traits – occur in sixteenths
- Be able to use Chi-Square ( $X^2$ ) analysis to determine if observed data fits an expected ratio. (You will be given a chi-square chart.)

### Lecture 10 and 11

#### Non-Mendelian inheritance patterns

- Recognize those ratios related to epistasis and know that two genes are involved even though you are only following one expressed trait.
  - Monohybrid cross – one trait – occur in fourths
  - Dihybrid cross – two traits – occur in sixteenths
  - When epistasis is involved – one trait, two genes – occur in sixteenths
- Evaluate a given progeny ratio or progeny distribution (given in numbers) and determine the type of gene interaction involved – complete or incomplete dominance, codominance, or epistasis.
- Sex-linked inheritance - Understand why male and female ratios differ.
  - illustrate and describe this type of inheritance
  - predict progeny given parental genotypes and phenotypes
- Understand and determine sex influenced vs. sex limited
- Understand and determine penetrance and expressivity values
- Cytoplasmic inheritance - Involves the chloroplast and mitochondrial genomes.
  - Know that progeny receive their mitochondria and chloroplast from the female parent.
  - Know that cytoplasmic inheritance is related to the fact that the male gamete cell is much smaller than the female gametic cell and; therefore, contributes little cytoplasm to the zygote compared to the female.
  - Understand Male sterile cytoplasm – How this relates to hybrid development/production of plants.



- Know the corn blight epidemic resulted from multiple corn varieties sharing a common genetic background.

## Lecture 12

### Gene Linkage and Genetic Mapping

- Why some genes are linked and others are not?
- Know various linkage symbolism and phases (coupling and repulsion).
- What is recombination?
- Be familiar with T.H. Morgan.
- Know map distances: 1 map unit = 1 centiMorgan = 1 % recombination frequency
- What is the maximum amount of recombination that can occur between any two linked genes?
- Be able to construct a map based on the results of a three point cross (following three genes).

## Lecture 13

### Quantitative Genetics

- Difference between qualitative traits and quantitative traits.
- Complete problems – Determine the number of genes involved, and the number of additive alleles resulting in a phenotype.
- What are sources of phenotypic variation?
- Be able to explain genotype X environment interaction.
- Be familiar with heritability – use, importance & calculations (Broad and Narrow-sense)
- Be familiar with concordance – monozygotic and dizygotic twins

## Exam 3 Study Guide

### Genes and Transcription

- Be familiar with the arrangement of gene components: Prokaryotes vs. Eukaryotes
- Functions of various gene components.

### Transcription

- Be familiar with the Central Dogma of genetics
- Understand how codons stipulate amino acid sequence
- Understand the role of transcription in gene expression.
- How does transcription occur in prokaryotic and eukaryotic organisms?
  - Be familiar with the roles and functions of promoters, enhancers, and transcription factors
- How is RNA Polymerase involved?
- Be able to differentiate between RNA molecules and Polymerases.
- What is the product of transcription?
- Be familiar with mRNA structure

### RNA Processing

- Know how pre-mRNA is processed
  - What is the 5' cap? How is it added?
  - What is the 3' poly A tail? How is it added?
  - RNA splicing
  - Spliceosome mechanism
  - Alternative Splicing

### Translation

- How do amino acids bind to tRNA?
- What is aminoacyl-tRNA synthetase?
- How is translation initiated?
- How are initiation factors involved?
- What is the function and assembly of a Ribosome?
  - E, P, A site functions
- Understand the processes of elongation and termination.

### Gene Regulation

- What are the different levels of gene regulation
- Understand structural gene vs a regulatory gene vs a regulatory element

### Prokaryotic Gene Regulation

- Operon structural arrangement
- What role does the regulator gene and regulatory protein play in gene expression?
- Know the roles of promoter and operators.
- Determine negative or positive control
  - Inducible vs. Repressible (decipher how a given operon is regulated)
- Understand the arrangement and regulation of the lac Operon.
  - Negative inducible
  - How does lactose induce expression
  - Why is it under negative control
  - cAMP-CAP regulation related to glucose presence
- Understand the arrangement and regulation of the trp Operon
  - Why is it negative?
  - Why is it repressible?
  - Understand the process of attenuation of the trp Operon. What does it mean to attenuate?
- What are different ways that RNA molecules can affect gene expression?

### Eukaryotic Gene Regulation

- How does chromatin structure serves as the on/off switch
- What are enhancers and how do they affect gene expression

- How transcriptional activator proteins affect gene expression?

### Mutations

- What are the implications of inheritance of somatic or germ line mutations.
  - Spontaneous vs. induced
- Be familiar with base substitutions
  - transitions and transversions
- Be familiar with insertions and deletions
  - What is a frame shift?
- Understand the Ames test and how to use it to determine if compounds are mutagenic.

### Biotechnology

- What is the benefit of cloning genes?
- Know the difference between targeted versus random approaches to gene cloning
- What is recombinant DNA?
- How do restriction enzymes work?
- Understand how to cut two different DNA strands with the same restriction enzyme followed by joining them together (sticky ends) to create recombinant DNA.
- What is a vector and how do you create one?
- Be familiar with screening procedures to recognize recombinant molecules.
  - antibiotic resistance
  - color of the growing colony
- Be familiar with the Polymerase Chain Reaction
- How does Sanger sequencing differ today from the original methods?
- Agrobacterium and Gene Gun mediated Plant transformation
  - Know *Agrobacterium tumefaciens* and its natural infection process.
  - Understand the process of plant transformation using Agrobacterium.
- Be familiar with map-based cloning/sequencing versus whole-genome shotgun cloning/sequencing