Term Information

Effective Term	Spring 2021
Previous Value	*Autumn 2016*

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

We propose moving the class from 2 credits to three credits

What is the rationale for the proposed change(s)?

1) Students spend more time on the class than expected of a 2 credit hour class. The class requires reading multiple papers from the primary literature for most meetings. For many students reading a single journal article can take more that two hours. In the last two offerings, multiple students have indicated on their SEIs that they spend more that 5 hours per week outside of class working on this class, which suggests that the workload is too heavy for a 2 credit hour course

2) Extra time in class will facilitate more active learning techniques. The syllabus indicates that in class activities will be used, but over the first few offerings, I found that I rarely had time to work them into class given the need to also convey some content. By increasing class times from twice a week for 55 minutes to twice a week for 80 minutes, I will be able to better use active learning techniques, and the group discussions that close each module will be able to happen in greater depth.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

None anticipated. The class serves as an elective for the Molecular Genetics and several other biology-based major, and we anticipate that a three credit hour elective will likely be viewed as beneficial by most students

Is approval of the requrest contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Molecular Genetics
Fiscal Unit/Academic Org	Molecular Genetics - D0340
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	4703
Course Title	Human Genetics
Transcript Abbreviation	Human Genetics
Course Description	This course covers principles of human genetics, including mapping and identification of disease genes, animal models, genetic testing and gene therapy, with a focus on reading the primary scientific literature.
Semester Credit Hours/Units	Fixed: 3
Previous Value	*Fixed: 2*

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade

Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: Completion of 4500 (500) or 4606 (606) with a minimum grade of C-; or instructor permission.
Exclusions	Not open to students with credit for 5733.
Electronically Enforced	Yes
Previous Value	**No**

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0806
Subsidy Level	Baccalaureate Course
Intended Rank	Junior, Senior

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Upon completion of this course students will be able to:

  • Understand how the principles of gene transmission and gene action in humans provide a basis to understand genetic diseases and disorders
- •Understand current approaches to the treatment and prevention of genetic disorders, and discuss ethical implications of these treatments
- •Understand recent advances in genetic and genome research and their implications for our understanding of human health
- •Understand the scientific techniques that allow researchers to identify and study human variants that influence health
- •Understand how genetic and environmental factors interact in the development of human characteristics.
- •Effectively read and interpret human genetics related papers from the primary literature

Content Topic List

- 1. Introduction to Mendelian disorders.
- 2. Techniques for mapping and gene identification.
- 3. Inheritance of sex-linked human diseases.
- 4. Aneuploidy
- 5. Multifactorial disorders
- 6. Gene/Environment interactions
- 7. Towards personal genomics

Sought Concurrence
No
Previous Value
Yes

Attachments

- MG4703 3 cr syllabus.docx: syllabus for 3 credits

(Syllabus. Owner: Cole,Susan Elizabeth)

Comments

- Concurrence was sought and received at initial course creation. These changes are not expected to require additional concurrence *(by Cole,Susan Elizabeth on 09/10/2019 06:09 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Cole,Susan Elizabeth	09/10/2019 06:09 PM	Submitted for Approval
Approved	Cole,Susan Elizabeth	09/10/2019 06:10 PM	Unit Approval
Approved	Haddad,Deborah Moore	09/10/2019 06:41 PM	College Approval
Pending Approval	Vankeerbergen,Bernadette Chantal Oldroyd,Shelby Quinn Hanlin,Deborah Kay Jenkins,Mary Ellen Bigler	09/10/2019 06:41 PM	ASCCAO Approval

HUMAN GENETICS
MOLGEN 4703
Spring semester, Lecture course, 3 credits
TBA
TBA

Instructor

Susan Cole
282 Biological Sciences Building
phone: 614-292-3276
email: cole.354@osu.edu

Office Hours

Office hours: Monday 11:30-12:30 and Thursday 2:00-3:00, 282 Biosci
If you have a conflict with posted office hours, you are welcome to make individual appointments: email me with your request and a list of 3 or 4 times that it would be convenient for you to come by my office.

Course Description

The completion of the Human Genome project and the subsequent ability to sequence individual genomes for relatively little cost have created an avalanche of information about how our genes influence our health. This Human Genetics course will provide students with a basic foundation in human genetics starting with phenotypes that are inherited in classical Mendelian patterns and extending to non-Mendelian diseases, complex traits, and the interplay between genes and the environment.

Instead of flooding you with lists of traits and diseases to memorize, we will use one disease as an exemplar of each type of expression or inheritance, and follow that disease or trait from its description to the identification of a causal genetic variant. Each module will close with a specific special topic, including issues such as ethical questions related to human genetics, the methods and importance of genetic testing or genetic therapy, the molecular basis of how gene variants influence phenotypes, and the use of animal models to better understand human disease.

This course is intended for upper level majors in any biological science. The completion of a general genetics course (MOLGEN 4500 or MOLGEN 4606) is a prerequisite. Be aware that we will do significant required reading, mostly from the primary scientific literature (ie real journal articles). This reading MUST be done prior to the assigned class!

Learning Outcomes

Upon completion of this course students will be able to:

- Understand how the principles of gene transmission and gene action in humans provide a basis to understand genetic diseases and disorders
- Understand current approaches to the treatment and prevention of genetic disorders, and discuss ethical implications of these treatments
- Understand recent advances in genetic and genome research and their implications for our understanding of human health
- Understand the scientific techniques that allow researchers to identify and study human variants that influence health
- Understand how genetic and environmental factors interact in the development of human characteristics.
- Effectively read and interpret human genetics related papers from the primary literature

Readings

Primary literature
Required reading will be largely from the primary literature. Ohio State has subscriptions to sources for all readings, which will be linked through the carmen website. Readings should be completed prior to class. There will journal responses assigned for a subset of meetings, (designated as "response required" on the syllabus and carmen. Responses are due BEFORE class on the day the reading is assigned. Please BRING READINGS TO CLASS, either as printouts or as PDFs on a tablet or other reader.

OPTIONAL text:
Genetics and Genomics in Medicine by Tom Strachan, Judith Goodship, Patrick Chinnery
ISBN 9780815344803. This text is NOT REQUIRED and there will not be assigned readings in this text. However, the text may be useful for those who wish to review genetics concepts from previous classes. Realistically, any edition of this text or any text you have kept from a previous genetics course would serve the same purpose.

Course website

https://carmen.osu.edu Notes and supplemental materials will be available on this website.
Note packets including major figures used during lectures will be posted prior to lectures. You are encouraged to print these out and bring them to class or access them as PDFs on an eReader.
Required readings will be posted or linked prior to class. You are encouraged to print these out and bring them to class or access them as PDFs on an eReader.

Attendance

If you know you must miss a class meeting, you may still submit any required journal article responses PRIOR to the class meeting. To account for an unexpected emergency or illness, the lowest journal article response will be dropped from your grade.

If you miss a class meeting, you should get notes from a classmate, read the relevant materials, and then you may make an appointment with the instructor to go over any material you need assistance with.

Many required activities will take place during lectures and each module will culminate in a required, in class activity that counts towards your final grade (see grading information). If you must miss a scheduled in-class activity due to documented illness or participation in a University-approved activity, you will be provided with an alternative activity to earn the missed points.

Grading information

Your course grade will be based on the following components:

1) Journal article responses: Readings with a required response will be accompanied by a few short questions or activities that must be completed and turned in on carmen BEFORE class. These are not intended to be sources of high stress, but instead to help you keep up with the reading. Early in the semester, these readings may take more time than you expect, but should become easier as the semester progresses. Note that most bioscience careers are going to require you to do this kind of reading, so you might as well start getting used to it now! To allow for unexpected emergencies and illnesses the lowest grade in this category will be dropped. 10 points each for approximately 70 points total after dropping lowest grade.

2) In class activities: These are short, unannounced activities designed to increase your engagement and understanding. To allow for unexpected emergencies and illnesses the lowest two grades in this category will be dropped. 3 points each for approximately 30 points total after dropping lowest grades.

3) Scheduled in class activities: Four scheduled in class discussion activities will be held. These will include one component that must be completed PRIOR to the day of the activity, as well as a component that will be completed in class on that day. Each scheduled activity is worth 20 points for approximately 80 total points.

4) Exams: There will be one midterm and one final exam. Each will have an in class and a take home component, and will be worth 100 points each.

Total course points: Approximately 380 points.

Grading scale

Final grades will be based on your final percentage [(points accumulated/ total points for the course) x 100)]. Generally, the final grades assigned will reflect the following grade scheme:

93-100 = A; 90-92 = A-; 87-89 = B+; 83-86 = B; 80-82 = B-; 77-79 = C+; 73-76 = C; 70-72 = C-; 67-69 = D+; 63-66 = D; 60-62 = D-; 0-59 = F

However, the instructor reserves the right to adjust the lower limits for each grade category downwards if justified by overall class performance (i.e., a 90 % is guaranteed to receive an A-, but in some cases an A- may be assigned for a performance below 90%).

Statement on Academic Misconduct

"It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/."

The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the University's Code of Student Conduct. Ignorance of the University's Code of Student Conduct is never considered an "excuse" for academic misconduct. Suspected cases of academic misconduct will be reported to the Committee on Academic Misconduct. If COAM determines that you have violated the University's Code of Student Conduct, the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact the instructor

PLEASE TAKE CARE OF YOURSELF:
As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you are or someone you know is suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting **ccs.osu.edu** or calling 614--292--5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766.

If you are thinking of harming yourself or need a safe, non-judgmental place to talk, or if you are worried about someone else and need advice about what to do, 24 hour emergency help is also available through the Suicide Prevention Hotline (Columbus: 614-221-5445 / National: 800-273-8255); or text (4hope to 741741); or at suicidepreventionlifeline.org

Student Accommodations

"Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 098 Baker Hall, 113 W 12th Ave;
614-292-3307 Office / 614-429-1334 VRS / 614-292-4190 Fax
Web: slds.osu.edu."

TENTATIVE SCHEDULE
Day 1 **Introductory Lecture**

Module 1: Mendelian inheritance of human traits.
Our exemplar will be Huntington's disease (OMIM #143100 , http://omim.org/entry/143100). This is an autosomal dominant, late onset, fatal, neurodegenerative disorder, characterized by selective loss of neurons in the caudate and putamen. It was first formally described in 1872, and the causal mutation was identified in 1993. These is, as yet, no treatment, though genetic testing is available.

DATE	FOCUS	READING
Day 2	Intro to Mendelian disorders and HD. Techniques for mapping and gene identification	Huntington, G. (1872). "On Chorea". Medical and Surgical Reporter of Philadelphia **26** (15): 317–321. **RESPONSE REQUIRED**
Day 3	Techniques for mapping and gene identification	Packet on mapping techniques
Day 4	Mapping of the HD gene. Techniques for physical mapping and gene identification.	Gusella, J. F., et al. (1983) A polymorphic DNA marker genetically linked to Huntington's disease. Nature 306: 234-238. **RESPONSE REQUIRED**
Day 5	More physical mapping techniques	Packet on physical mapping techniques
Day 6	Mechanisms of dominant/recessive alleles. Nature of HD mutation. Anticipation.	Huntington's Disease Collaborative Research Group. 1993. A novel gene containing a trinucleotide repeat that is expanded and unstable on Huntington's disease chromosomes. Cell 72: 971-983. **RESPONSE REQUIRED**
Day 7	Introduction to and practice with relevant databases	BRING A LAPTOP IF POSSIBLE
Day 8	Trinucleotide repeat expansions as a cause of disease. Introduction to genetic screening	Budworth and McMurray (2013). A Brief History of Triplet Repeat Diseases. Methods in Molecular Biology, vol. 1010.

Day 9: Module 1 in class activity (Bring a laptop if possible)
Students will read papers describing ethical issues related to genetic testing of HD prior to class. We will discuss the scientific and ethical issues and work through a case study related to some of these questions.

You will need to read the following, and submit your responses to the posted questions on carmen **PRIOR** to the class -- the pre-class article responses will be part of the module activity grade.

IN ADDITION to online submission, <u>bring a copy of your responses with you to class.</u>

1) Lindblad AN. (2001) To test or not to test: an ethical conflict with presymptomatic testing of individuals at 25% risk for Huntington's disorder. Clin Genet. 60:442-6.
2) Millan FA et al. (1989) Prenatal exclusion testing for Huntington's disease: a problem of too much information. J Med Genet. 26:83-5.

Module 2: Inheritance of sex-linked human traits.
Our exemplar will be X-linked Severe Combined Immunodeficiency (SCID-X1) (OMIM #300400, http://omim.org/entry/300400). This is a, X-linked variety of severe immunodeficiency syndrome (people who are affected are sometimes called "bubble children"). It was recognized as a distinct, X-linked disorder in the 1960s, and a casual mutation was identified in 1993. Some children are successfully treated with bone marrow transplants. SCID-X1 was one of the first diseases to be treated with gene therapy, but as we will discuss, the outcomes have been mixed.

DATE	FOCUS	READING
Day 10	Review of sex determination in mammals. Mechanisms underlying X-linked recessive inheritance. Intro to SCID-X1.	1) Wing, J. & O'Connor, C. (2008) Sex chromosomes in mammals: X inactivation. Nature Education 1(1):221 2) Ahn, J. & Lee, J. (2008) X chromosome: X inactivation. Nature Education 1(1):24
Day 11	X-linked inheritance and X inactivation. What makes an X-linked trait recessive?	Puck J.M. et al. (1987) Carrier detection in X-linked severe combined immunodeficiency based on patterns of X chromosome inactivation. J Clin Invest. 79:1395-400 **RESPONSE REQUIRED**
Day 12	Mapping and identification of SCID X1 gene.	Noguchi, M., et al. Interleukin-2 receptor gamma chain mutation results in X-linked severe combined immunodeficiency in humans. Cell 73: 147-157, 1993.
Day 13	Intro to gene therapy	1) Hacein-Bey-Abina, S., et al. (2003). A serious adverse event after successful gene therapy for X-linked severe combined immunodeficiency. New Eng. J. Med. 348: 255-256. 2) Noguchi, P. (2003) Risks and benefits of gene therapy. Risks and benefits of gene therapy N Engl J Med. 348:193-4

Day 14**: Module 2 in class activity (Bring a laptop if possible)**
Students will examine the methods and potential benefits and risks of different types of gene therapy, including potential issues with germ line therapy.

You will need to poke around at http://learn.genetics.utah.edu/content/genetherapy/, and submit your responses to the posted questions on carmen **PRIOR** to the class -- the pre-class article responses will be part of the module activity grade.
IN ADDITION to online submission, bring a copy of your responses with you to class

MIDTERM Day 15
NOTE! A take home component will need to be completed PRIOR to the midterm date. Information and data from the take home component will apply to the in class exam

Module 3: Aneuploidy.
Our exemplar will be Down syndrome (OMIM # #190685, http://omim.org/entry/190685), which is most commonly caused by inheritance of a third copy of human chromosome 21 (trisomy 21). It was originally described in 1866. Much research has gone into attempts to work out why having three copies of perfectly normal genes causes the phenotypes. Mouse models have been used to identify the causes of specific phenotypes, and even to propose possible treatments.

DATE	FOCUS	READING
Day 16	Review of aneuploidy and nondisjunction. Why is aneuploidy a problem? Intro to DS.	O'Connor, C. (2008) Chromosomal abnormalities: Aneuploidies. Nature Education 1:172
Day 17	Dosage imbalance vs specific gene effects. Other aneuploid conditions	Korenberg, J. R., et al. Down syndrome phenotypes: the consequences of chromosomal imbalance. Proc. Nat. Acad. Sci. 91: 4997-5001, 1994. **RESPONSE REQUIRED**
Day 18	Overview of animal models	Strachan and Read (2011) "Genetic Manipulation of Animals for Modeling Disease and Investigating Gene Functions" from Human Molecular Genetics, 4th ed.
Day 19	Overview of animal models continued	Strachan and Read (2011) "Genetic Manipulation of Animals for Modeling Disease and Investigating Gene Functions" from Human Molecular Genetics, 4th ed.
Day 20	Use of animal models in DS.	Roper, R. J.et al. Defective cerebellar response to mitogenic Hedgehog signaling in Down's syndrome mice. Proc. Nat. Acad. Sci. 103: 1452-1456, 2006. **RESPONSE REQUIRED**

Day 21 **Module 3 in class activity (Bring a laptop if possible)**
Students will work to design a potential animal model for a human disease based on information provided in class. This exercise will provide practice using online databases including OMIM and the UCSC genome database.

You will need to do some work online, and submit your responses to the posted questions on carmen **PRIOR** to the class -- the pre-class article responses will be part of the module activity grade.

IN ADDITION to online submission, bring a copy of your responses with you to class

Module 4 Multifactorial disorders and Gene/Environment interactions
Our exemplar will be Crohn Disease (Also called Inflammatory Bowel Disease 1, OMIM #266600, http://omim.org/entry/266600), a chronic, relapsing form of intestinal inflammation. While it is clear that there are genetic influences, Crohn Disease is not a simple, single gene disorder. Instead, genetic variants at numerous gene loci influence whether any given individual will be diagnosed. To date, over 150 genetic loci that influence inheritance of IBD have been identified!

Module 4.1 Identifying and analyzing risk factors for multigenic disorders

DATE	FOCUS	READING
Day 22	Introduction to complex traits. Techniques for gene identification in complex traits. Intro to IBD.	1) Strachan and Read. (2011) Mapping complex traits. From Human Molecular Genetics, 4th ed. 2) Hendy and Hart (2013) A review of Crohn's Disease. EMJ Gastroenterol. 1:116-123
Day 23	Identification of a Crohn susceptibility locus.	Hugot, J.-P., et al. (2001) Association of NOD2 leucine-rich repeat variants with susceptibility to Crohn's disease. Nature 411: 599-603, 2001. **RESPONSE REQUIRED**
Day 24	Genome-wide association studies to identify other susceptibility loci.	Hampe J et al. (2007) A genome-wide association scan of nonsynonymous SNPs identifies a susceptibility variant for Crohn disease in ATG16L1. Nat Genet. 39:207-11.
Day 25	Functional analyses of risk mutations	Cadwell K et al. (2008) A key role for autophagy and the autophagy gene Atg16l1 in mouse and human intestinal Paneth cells. Nature 456:259-63 **RESPONSE REQUIRED**
Day 26	Introduction to gene/environment interactions.	Craig, J. (2008) Complex diseases: Research and applications. Nature Education 1(1):184
Day 27	Interactions between genetic risk factors and environmental risk factors	Cadwell, K. et al. (2010). Virus-Plus-Susceptibility Gene Interaction Determines Crohn's Disease Gene Atg16L1 Phenotypes in Intestine

Day 28**: Module 4 in class activity (Bring a laptop if possible)**
Complex traits pose special problems for genetic counseling and diagnosis. Groups of students will work together to discuss these issues and issues related to commercial DNA analysis and incidental findings through DNA sequencing.

You will need to read the following, and submit your responses to the posted questions on carmen **PRIOR** to the class -- the pre-class article responses will be part of the module activity grade.

IN ADDITION to online submission, bring a copy of your responses with you to class.

1) ACMG recommendations for reporting of incidental findings in clinical exome and genome sequencing. Green RC, Berg JS, Grody WW, Kalia SS, Korf BR, Martin CL, McGuire AL, Nussbaum RL, O'Daniel JM, Ormond KE, Rehm HL, Watson MS, Williams MS, Biesecker LG; American College of Medical Genetics and Genomics. *Genet Med.* 2013 Jul;15(7):565-74. doi: 10.1038/gim.2013.73.

2) ACMG policy statement: updated recommendations regarding analysis and reporting of secondary findings in clinical genome-scale sequencing. ACMG Board of Directors. *Genet Med.* 2015 Jan;17(1):68-9. doi: 10.1038/gim.2014.151.

Final Exam:
As scheduled by the registrar

NOTE! A take home component will need to be completed PRIOR to the exam date. Information and data from the take home component will apply to the in class exam. Do NOT make travel plans that conflict with the scheduled exam date, as NO alternative dates will be permitted.