Term Information

Effective Term	Autumn 2016

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: 2

Offering Information

Length Of Course	14 Week, 7 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	Completion of MOLGEN4500 (500) or MOLGEN4606 (606) with a minimum grade of C- or instructor permission.
Exclusions	Not open to students with credit for MolGen 5733

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0804
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

Attachments

- Human Genetics 4703 syllabus template.doc: Syllabus
  (Syllabus. Owner: Vaessin,Harald Emil Friedrich)
- Departmental Letter for MolGen 4703.pdf: Departmental Letter
  (Other Supporting Documentation. Owner: Vaessin,Harald Emil Friedrich)
- Concurrence Forms re Dept. of Pathology.pdf: Concurrence
  (Concurrence. Owner: Vankeerbergen,Bernadette Chantal)

Comments

- The current Human Genetics elective offering (MolGen 5733) is limited to senior undergraduates, and also serves graduate and postdoctoral students. It is thus not appropriate or accessible for many of our majors, or majors in other biological sciences. Many of the students in the biological sciences plan a career in healthcare, and thus have an interest in or need for coursework in Human Genetics. This new offering of Human Genetics will be an appropriate and attractive elective for advanced undergraduates across the biological sciences. This course request is being completed in tandem with a request to re-title the existing Human Genetics course (MOLGEN5733) as "Advanced Human Genetics" to more accurately describe its place in the curriculum and its appropriate audience. Concurrence for both changes has been sought from the Department of Biological Chemistry and Pharmacology, and the Department of Pathology, both of which house crosslisted versions of MOLGEN 5733. *(by Vaessin,Harald Emil Friedrich on 11/17/2015 03:38 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Vaessin,Harald Emil Friedrich	11/23/2015 09:00 AM	Submitted for Approval
Approved	Vaessin,Harald Emil Friedrich	11/23/2015 09:01 AM	Unit Approval
Approved	Fink,Steven Scott	11/23/2015 11:00 AM	College Approval
Pending Approval	Nolen,Dawn Vankeerbergen,Bernadette Chantal Hanlin,Deborah Kay Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole	11/23/2015 11:00 AM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

Department of Molecular Genetics

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November 20th, 2015

To Whom It May Concern:

The Department of Molecular Genetics is requesting the creation of a new course, to be titled "MOLGEN-4703, Human Genetics". This course will cover 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. This request is being submitted concurrently with a request to change the name of the existing Human Genetics course (MOLGEN 5733, crosslisted as MOLBIOC 5733 and PATHOL 5733) to "Advanced Human Genetics."

The rationale for these changes is that the current Human Genetics elective offering (MOLGEN5733) is limited to senior undergraduates, and also serves graduate and postdoctoral students. It is thus not appropriate or accessible for many of our majors, or majors in other biological sciences. Many of the students in the biological sciences plan a career in healthcare, and thus have an interest in or need for coursework in Human Genetics. This new offering of Human Genetics will be an appropriate and attractive elective for advanced undergraduates across the biological sciences. This course request is being completed in tandem with a request to re-title the existing Human Genetics course (MOLGEN5733) as "Advanced Human Genetics" to more accurately describe its place in the curriculum and its appropriate audience.

Sincerely,

Susan E Cole

Susan Cole, Ph.D.
Associate Chair of Molecular Genetics

HUMAN GENETICS
MOLGEN 4703
Autumn semester, Lecture course, 2 credits
Meeting Days and time
Meeting Locations

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

Office Hours
LIST TIMES

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 an prerequisite for registration. Be aware that we will do significant required reading, mostly from the primary scientific literature (ie real journal articles). This reading absolutely 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 required readings, which will be linked through the carmen website. All readings MUST be completed prior to the assigned class, and there will required online journal responses for each reading. Please BRING REQUIRED READINGS TO CLASS, either as printouts or as PDFs on a tablet or other reader.

Optional text:

Human Genetics 11th Edition by Ricki Lewis.
ISBN-13: 978-0073525365
ISBN-10: 0073525367
This text is not required, but may be useful for those who wish to review genetics concepts from previous classes

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 unexpected emergencies or illnesses, the lowest two journal article responses will be dropped from your grade.

If you miss a class meeting, you should get notes from a classmate, read the relevant chapter(s) in the book, 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 syllabus). 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: Each required reading will be accompanied by a few short questions or activities that must be completed prior to class, on carmen. 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 three grades in this category will be dropped. 5 points each for approximately 90 points total.

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 three grades in this category will be dropped. 3 points each for approximately 21 points total.

3 Module activities: Each module will close with an in-class activity worth 30 points for approximately 150 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 461 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 OSU Standard grade scheme, 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/."

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 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/."

TENTATIVE SCHEDULE (29 meetings total. Calendar is based on M/W class in AU 2016)

Wednesday 8/24 **Introductory Lecture**

Monday 8/29 **Introduction to, and practice with, relevant databases we will use throughout the semester**

Module 1: Mendelian inheritance of human diseases.
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	REQUIRED READING
Wednesday 8/31	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.
Monday 9/5	NO CLASS	
Wednesday 9/7	Mapping of the HD gene. Techniques for physical mapping and gene identification.	Gusella, J. F., et al. A polymorphic DNA marker genetically linked to Huntington's disease. Nature 306: 234-238, 1983.
Monday 9/12	Nature of HD mutation. Trinucleotide repeat expansions as a causal variant.	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.
Wednesday 9/14	Trinucleotide repeat expansions and anticipation. Introduction to genetic screening	Telenius H. et al. 1993. Molecular analysis of juvenile Huntington disease: The major influence on (CAG)n repeat length is the sex of the affected parent. Hum Mol Genet 2(10):1535–1540.

Monday 9/19: Module 1 in class activity
Students will work in small groups to read and briefly present several papers describing ethical issues related to genetic testing of HD. We will work through a case study related to some of these questions.

Module 2: Inheritance of sex-linked human diseases.
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	REQUIRED READING
Wednesday 9/21	Review of sex determination in mammals. Mechanisms underlying X-linked recessive inheritance. Intro to SCID-X1.	Gartler, S. M and Goldman, M. A. (2001). "X-Chromosome Inactivation". Encyclopedia of Life Sciences. www.els.net: Nature Publishing Group.
Monday 9/26	X-linked inheritance and X inactivation. What makes an X-linked trait recessive?	Conley, M. E., et al. Nonrandom X chromosome inactivation in B cells from carriers of X chromosome-linked severe combined immunodeficiency. Proc. Nat. Acad. Sci. 85: 3090-3094, 1988.
Wednesday 9/28	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.
Monday 10/3	Intro to gene therapy	Hacein-Bey-Abina, S., et al. (2003).A serious adverse event after successful gene therapy for X-linked severe combined immunodeficiency. (Letter) New Eng. J. Med. 348: 255-256.

Wednesday 10/5: Module 2 in class activity
Groups of students will examine the potential benefits and risks of different types of gene therapy, including potential issues with germ line therapy.

MIDTERM MONDAY 10/10
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	REQUIRED READING
Wednesday 10/12	Review of aneuploidy and nondisjunction. Intro to Down syndrome. Differentiation of translocation DS vs full trisomy 21. Idea of nondisjunction events in aneuploidy.	Hassold, T. et al. (2007). The origin of human aneuploidy: where we have been, where we are going *Hum. Mol. Genet. 16 (R2): R203-R208*
Monday, 10/17	Dosage imbalance vs specific gene effects. Overview of animal models	Korenberg, J. R., et al. Down syndrome phenotypes: the consequences of chromosomal imbalance. Proc. Nat. Acad. Sci. 91: 4997-5001, 1994.
Wednesday 10/19	Overview of animal models	links posted on carmen
Monday 10/24	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.

Wednesday 10/26 Module 3 in class activity
Students will work in groups 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.

Module 4 Multifactorial disorders

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!

DATE	FOCUS	REQUIRED READING
Monday, 10/31	Introduction to complex traits. Crohn Disease overview.	Hirschhorn JN and Daly MJ. (2005) Genome-wide association studies for common diseases and complex traits. Nat Rev Genet. 2005 Feb;6(2):95-108.
Wednesday 11/2	Tying complex traits to genetics through twin/sib studies	Satsangi, J., et al. (1996) Clinical patterns of familial inflammatory bowel disease. Gut 38: 738-741.
Monday 11/7	Identification of one 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.
Wednesday 11/9	Can mouse models recreate complex traits?	Maeda, S., et al. (2005) Nod2 mutation in Crohn's disease potentiates NF-kappa-B activity and IL-1-beta processing. Science 307: 734-738.
Monday 11/14	Genome-wide association studies to identify other susceptibility loci.	Libioulle C, et al. (2007) Novel Crohn disease locus identified by genome-wide association maps to a gene desert on 5p13.1 and modulates expression of PTGER4. PLoS Genet. 2007 Apr 20;3(4):e58

Wednesday 11/16: Module 4 in class activity

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.

Module 5 gene/environment interactions

Our exemplar will be Age Related Macular Degeneration (ARMD) and smoking. ARMD is a common complex disorder that is characterized by progressive degeneration of photoreceptors and the underlying retinal pigment epithelium. It is one of the major causes of blindness in the Western world. While numerous susceptibility genes have been identified we will focus on a specific genetic variant of the ARMS2 gene (ARMD8 OMIM #613778, http://omim.org/entry/613778).

DATE	FOCUS	REQUIRED READING
Monday 11/21	Introduction to gene/environment interactions. Identifying genetic susceptibilities	Rivera, A. et al. (2005). Hypothetical LOC387715 is a second major susceptibility gene for age-related macular degeneration, contributing independently of complement factor H to disease risk. Hum. Molec. Genet. 14: 3227-3236.
Wednesday 11/23	NO CLASS	
Monday 11/28	Interactions between genetic risk factors and environmental risk factors	Schmidt, S. et al. (2006) Cigarette smoking strongly modifies the association of LOC387715 and age-related macular degeneration. Am. J. Hum. Genet. 78: 852-864.
Wednesday 11/30	Towards mechanisms of susceptibility	Fritsche, L. G. et al. (2008) Age-related macular degeneration is associated with an unstable ARMS2 (LOC387715) mRNA. Nature Genet. 40: 892-896.
Monday 12/5	Towards personal genomics	Piermarocchi S, et al. (2015). Combined effects of genetic and non-genetic risk factors affect response to ranibizumab in exudative age-related macular degeneration. Acta Ophthalmol. 93(6):e451-7.

Wednesday 12/7: Module 5 in class activity

The reporting of genetic risks in the popular press are inherently problematic. Students will identify a recent scientific "discovery" related to genetic risk, and will work in class to determine how accurate (or inaccurate) the reporting is.

Final Exam:

Date as scheduled by OSU. 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.

The Ohio State University
College of the Arts and Sciences Concurrence Form

The purpose of this form is to provide a simple system of obtaining departmental reactions to course requests. **An e-mail may be substituted for this form.**

An academic unit initiating a request should complete Section A of this form and send a copy of the form, course request, and syllabus to each of the academic units that might have related interests in the course. Units should be allowed two weeks to respond to requests for concurrence.

Academic units receiving this form should respond to Section B and return the form to the initiating unit. Overlap of course content and other problems should be resolved by the academic units before this form and all other accompanying documentation may be forwarded to the Office of Academic Affairs.

A. Proposal to review

Molecular Genetics 5733 (MOLBIOC5733 PATHOL 5733 Advanced Human Genetics

Initiating Academic Unit | Course Number | Course Title

Change — 11-23-15

Type of Proposal (New, Change, Withdrawal, or other) | Date request sent

Pathology & Biological Chemistry and Pharmacology

Academic Unit Asked to Review | Date response needed

B. Response from the Academic Unit reviewing

Response: include a reaction to the proposal, including a statement of support or non-support (continued on the back of this form or a separate sheet, if necessary).

Signatures

	Name	Position	Unit	Date
1.	[signature]	Chair	Path	11/23/15
2.				
3.				

Revised 5/27/14

The Ohio State University
College of the Arts and Sciences Concurrence Form

The purpose of this form is to provide a simple system of obtaining departmental reactions to course requests. **An e-mail may be substituted for this form.**

An academic unit initiating a request should complete Section A of this form and send a copy of the form, course request, and syllabus to each of the academic units that might have related interests in the course. Units should be allowed two weeks to respond to requests for concurrence.

Academic units receiving this form should respond to Section B and return the form to the initiating unit. Overlap of course content and other problems should be resolved by the academic units before this form and all other accompanying documentation may be forwarded to the Office of Academic Affairs.

A. Proposal to review

Molecular Genetics 4703 Human Genetics

Initiating Academic Unit Course Number Course Title

New 11-23-15

Type of Proposal (New, Change, Withdrawal, or other) Date request sent

Pathology and Biological Chemistry and Pharmacology

Academic Unit Asked to Review Date response needed

B. Response from the Academic Unit reviewing

Response: include a reaction to the proposal, including a statement of support or non-support (continued on the back of this form or a separate sheet, if necessary).

Signatures:

1. Name [signature] Position Chair Pathology Unit 11/23/15 Date

2. Name Position Unit Date

3. Name Position Unit Date

Revised 5/27/14