New Course Request

Indiana University

Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit □ Graduate credit ☑ Professional credit □

1. School/Division: Medicine/Graduate

2. Academic Subject Code: MGEN

3. Course Number: QB27 (must be cleared with University Enrollment Services)

4. Instructor: V. Thurston

5. Course Title: Fundamentals of Human Cytogenetics

Recommended Abbreviation (Optional) (Limited to 32 Characters including spaces)

6. First time this course is to be offered (Semester/Year): Fall 2008

7. Credit Hours: Fixed at 1 or Variable from _________ to _________

8. Is this course to be graded S-F (only)? Yes _____ No ☑

9. Is variable title approval being requested? Yes _____ No ☑

10. Course description (not to exceed 50 words) for Bulletin publication: An introduction to the principles of human cytogenetics with applications in basic genetics, including the clinical consequences of chromosomal abnormalities.

11. Lecture Contact Hours: Fixed at 1 or Variable from _________ to _________

12. Non-Lecture Contact Hours: Fixed at _________ or Variable from _________ to _________

13. Estimated enrollment: 3 of which 100 percent are expected to be graduate students.

14. Frequency of scheduling: Annually

Will this course be required for majors? Yes - PhD in IBMG Program

15. Justification for new course: Restructuring of program requirements because of IBMG open admission

16. Are the necessary reading materials currently available in the appropriate library? Yes

17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.

18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant. See attached

19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by:

[Signature]
Department Chairman/Division Director

Date 01/25/2008

Approved by:

[Signature]
Dean

Date 3/4/08

Chancellor/Vice-President

Date

Dean of Graduate School (when required)

University Enrollment Services

Date

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 724

University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White
New Course Request

I. Title: Fundamentals of Human Cytogenetics
   Course number: 
   Instructor: Virginia C. Thurston, Ph.D. course director
   Prerequisites: none

II. COURSE DESCRIPTION AND RATIONALE

   The establishment of the IBMG (Indiana University School of Medicine BioMedical Gateway) open admission Ph.D. graduate program beginning in the fall of 2007 necessitates a change in our Ph.D. graduate curriculum. Students no longer apply directly to our department for the Ph.D. degree, instead if accepted into the IBMG program take a common first year curriculum and declare a departmental affiliation for the PhD. degree at the end of the first academic year.

   Prior to the start of the open admission program, there were five 3-credit core courses required of Ph.D. students in Medical and Molecular Genetics (Q580 Basic Human Genetics, Q610 Clinical Genetics Practicum, Q612 Molecular and Biochemical Genetics, Q620 Human Cytogenetics, and Q630 Population Genetics). These five courses will remain for all of our M.S. students and clinical fellows. Masters students in the genetic counseling study track and the clinical fellows need these classes to be able to sit for the certification exams administered by the American Board of Genetic Counseling (ABGC) or the American Board of Medical Genetics (ABMG).

   Ph.D. students in the IBMG who choose Medical & Molecular Genetics (MMGE) will begin in Year 2 of their graduate studies after taking the new core courses for the open admission program, including G716 (Molecular Biology and Genetics). Some of the content in G716 overlaps with material in our existing 3-credit core courses. In addition in the spring semester of the first year of study, IBMG students declaring MMGE as a departmental affiliation may also have taken any of five new 1-credit elective courses (G724 Molecular Cancer Genetics, G725 Gene Therapy, G726 Developmental Genetics, G727 Animal Models in Disease, or G746 Chromosome Instability and Disease).

   Because of the additional coursework in the first year of the IBMG program and the inclusion of some of the basic content of our cores into G716, the department has chosen to modify and offer annual one credit introductory versions of four of the current three credit core courses listed above. [Ph.D. students from the IBMG program will no longer be required to take Q580 since they will have taken G716.] Our past students have reported that the department's broad focused training has served them well in positions after graduation. We intend to maintain this breadth by requiring all of our Ph.D. students to take as a minimum at least the 1-credit version of each of the four core course areas. We also recognize that the research focus in the field and department is including more on complex genetic disease, genes in development, animal models and advanced molecular techniques and applications. Our five new 1-credit elective modules, available to any of our graduate students, reflect this future shift. All new Ph.D. students now will be required to take at least 12 coursework hours in the department which include:
-G716 (3 credits)

-Each of the four 1-credit introductory core modules of the existing core courses for M.S. students. These new courses will be titled Introduction to Clinical Genetics (Q625), Fundamentals of Biochemical & Molecular Genetics (Qxxx), Fundamentals of Human Cytogenetics (Qxxx) and Fundamentals of Population Genetics (Qxxx). The content of the latter three core courses contains substantial overlap such that a student who has taken Biochemical & Molecular Genetics (Q612) may not enroll in Introduction to Biochemical & Molecular Genetics, a student who has taken Human Cytogenetics (Q620) may not enroll in Introduction to Human Cytogenetics, and a student who has taken Q630 (Population Genetics) may not enroll in Introduction to Population Genetics and vice versa.

-Any of the five 1-credit IBMG open admission modules or any other advanced course offerings in the department. [Note: If the student wishes to use the IBMG core courses as a Life Sciences Ph.D. minor, he/she cannot use G716 as counting towards the required departmental course hours.]

### Qxxx Fundamentals of Human Cytogenetics.

This one-credit course will contain much of the same general content as in our existing Human Cytogenetics (Q620, 3 cr.) but will be covered in a more focused manner. In Q620, a considerable portion of the course involves student presentations. In Fundamentals of Cytogenetics there will be only a single class day for student presentations. In G716, the open admission Ph.D. student will have received lectures on molecular genetics relative to replication (mitosis) and recombination (meiosis), but the focus in that class will differ from that presented in this course. Similarly, cancer will be covered in G716 from a molecular biology standpoint rather than with a cytogenetic focus. Cancer is only covered in one lecture in Fundamentals of Human Cytogenetics because additional offerings in cancer cytogenetics are available to our Ph.D. students (Q621, Q622, G724). Ph.D. students outside of Medical & Molecular Genetics who will have taken G716 through the IBMG program can take this course as an elective to obtain an overview of this subspecialty in Medical & Molecular Genetics. Ph.D. students outside of the IBMG program will be encouraged to take Q620 or the Fundamentals of Cytogenetics. The latter will be offered annually and provides an option for such students who do not want to take a more in-depth Human Cytogenetics class or time prevents them taking Q620 offered biannually. This course will be taught in two 1.5 hour sessions per week over a five-week period and is planned to be scheduled in the same time slot as two of the other new 1-credit core courses for our Ph.D. students, allowing a student to take any one or all three of the 1-credit core courses in the one semester. Q620 will be taught in the second third of the semester.

The objective of this course is to provide an introduction to human cytogenetics. A basic understanding of cytogenetics is an essential component in the broad education of medical genetics students. Cytogenetics plays an important role in the diagnosis and treatment of many disorders, both constitutional and neoplastic.

Thus, the major goal of this course will be to introduce all students to the basic principles of cytogenetics as they apply to basic and clinical genetics. The focus of the course will include chromosome structure and function, the underlying features of
cytogenetic disorders, as well as the common numerical and structural abnormalities involved in the diagnosis and evaluation of patients with a likely cytogenetic disorder, and the role of cytogenetics in cancer.

III. EDUCATIONAL OBJECTIVES

- **Describe the structure of the chromosome.** This would include basic chromosome structure as well as active chromatin, facultative chromatin, and epigenetic mechanisms.

- **List and describe the stages of mitosis and meiosis; including the synaptonemal complex, recombination and genetic control of meiosis.**

- **Describe the role of cytogenetics in medical genetics.** This would include listing the indications for requesting chromosome analysis, describing clinical findings in chromosomal disorders, discussing how these chromosomal abnormalities occurred, calculating risks to offspring of carriers with chromosomal rearrangements, determining the implications of chromosome rearrangements in cancer, and describing current and future methodologies.

IV. COURSE CONTENT:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic (Lecturer)</th>
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</thead>
</table>
| 1    | Mammalian chromosome structure and function (Thurston/Grimes)  
Human Cytogenetics: structure, function, associated proteins of the chromosome  
Human chromosomes  
Mouse chromosomes  
Telomere, centromere, replication origins  
Packaging into chromatin  
Histone code hypothesis - introduce  
Constitutive/ facultative heterochromatin – introduce |
| 1    | Chromatin status and chromosomal function (Grimes)  
Histone code hypothesis in detail: chromatin state can determine gene activity status (acetylation, methylation of histones, methylation of DNA at promoters)  
X inactivation – closing down a whole chromosome  
X inactivation center, Xist  
Escaping X inactivation  
Variation in expression levels of X linked genes in the population |
| 2    | Mitosis and Meiosis (Grimes)  
Describe and discuss the stages of mitosis and meiosis, polar body formation, gamete production.  
Identification and discussion of functional units including the synaptonemal complex, homologous pairing, recombination foci, crossover, cohesion, cell |
cycle control of replication and division.

Importance of the length of time in MI in mammals and relationship to non-
Disjunction

2 Methods and technology for chromosome analysis. (Thurston)
45 min lecture
45 min – visit clinical lab to observe G-banding, FISH procedure, image
capture. Demonstrate an example of clinical diagnosis based on FISH
analysis.

Brief introduction to SKY for detecting rearrangements.

Topics to be covered:
Identify different banding methodologies and associated nucleotide staining and
transcriptional activity of differentially-stained chromosome segments.

1. Understand the conventional cytogenetic methods for G-banded
preparations.

2. Understand fluorescence in situ hybridization methodology, and multiple
probe types and strategies used to identify chromosomes and gene loci.

3 Numerical chromosomal abnormalities (Thurston)
Aneuploidy: Abnormal number of chromosomes
Discuss the incidence of nondisjunction in meiosis and gametes
Identify causes of meiotic nondisjunction.
Describe mechanisms and current models of polyploid cell generation
Clinical syndromes associated with abnormal chromosome number

3 Structural chromosomal abnormalities – part 1 (Thurston)
Abnormal structure of chromosomes
Identify the forms of structural rearrangements of chromosomes and
associated structural variation of the human genome that may predispose to
the rearrangement.
Discuss copy number variants; segmental duplication, inversions and
translocations.
Discuss clinical syndromes due to autosomal deletions and duplications.

4 Structural abnormalities – part 2 (Thurston)
Dicentric chromosome generation and centromere inactivation
Robertsonian fusions
Abnormal centromere activation - neo centromeres.
Understanding the centromere – construction of de novo human artificial
chromosomes
Chromosomal copy number changes and rearrangements in cancer (Vance)
Recurring translocations – leukemia
Telomere failures result in fusions – model is dicentric chromosome
formation contributes to genomic instability
Rearrangements and aneuploidy in cancer – solid tumors
Use of SKY in diagnosis of changes in cancer

Guide students on choice of paper(s) to present

Student presentations on a topic of their choice from the course
If only 2-3 students, each student can present. If we have a larger number of
students they can work in groups. (1 hour; 3x20 min presentations).
Final 30 min: students will have an opportunity to review the course and ask
questions

V. REQUIRED AND RECOMMENDED TEXTS:

Gersen and Keagle. The Principles of Clinical Cytogenetics. 2nd ed. Humana Press. Totowa,

Thompson & Thompson Genetics in Medicine, 7th edition. Robert L. Nussbaum et al. eds. W.B.

Other books on reserve:

Miller O.J. and Therman, E. Human Chromosomes. Springer-Verlag. New York,

Gardner and Sutherland. Chromosome Abnormalities and Genetic Counseling.


VI. EVALUATION AND GRADING:

Student grades in the course will be determined by one final examination. The exam will
Exam will consist of short essays (for 1 hour) and one longer essay (30 min). Students
should provide a more in depth answer to the 30 min essay. Choices will be given for
both long and short essays.

Class grade will be based on:
30% for class presentation  
40% for short essay questions  
30% for long essay question

Grading Scale:

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A+</td>
<td>96-100</td>
</tr>
<tr>
<td>A</td>
<td>93-95.99</td>
</tr>
<tr>
<td>A-</td>
<td>90-92.99</td>
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<tr>
<td>B+</td>
<td>86-89.99</td>
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<tr>
<td>B</td>
<td>80-85.99</td>
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<tr>
<td>B-</td>
<td>75-75.99</td>
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<tr>
<td>C</td>
<td>60-74.99</td>
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<tr>
<td>D</td>
<td>50-59.99</td>
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<td>&lt;50</td>
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</tbody>
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Note that grades of C and lower are not passing grades in graduate level courses.

VII. CHEATING AND PLAGIARISM:

Students are instructed to make themselves aware of University regulations concerning plagiarism, the maintenance of academic honesty and the definitions of unacceptable behavior and cheating. Academic misconduct of any sort will not be tolerated and will be dealt with as outlined in the IU/IUPUI Code of Student Rights, Responsibilities, and Conduct, which can be viewed at: http://www.life.iupui.edu/help/docs/Part_3all.html

Examples of misconduct include but are not limited to:

1. Cheating
   A student must not use or attempt to use unauthorized assistance, materials, information, or study aids in any academic exercise

2. Fabrication
   A student must not falsify or invent any information or data in an academic exercise including, but not limited to, records or reports, laboratory results, and citations to the sources of information.

3. Plagiarism
   A student must not adopt or reproduce ideas, words, or statements of another person without appropriate acknowledgment. A student must give credit to the originality of others and acknowledge an indebtedness whenever he or she does any of the following:
   a. Quotes another person's actual words, either oral or written
   b. Paraphrases another person's words, either oral or written
   c. Uses another person's idea, opinion, or theory; or
d. Borrows facts, statistics, or other illustrative material, unless the information is common knowledge.

4. Interference
   a. A student must not steal, change, destroy, or impede another student's work.
   b. A student must not give or offer a bribe, promise favors, or make threats with the intention of affecting a grade or the evaluation of academic performance.

Potential consequences for academic misconduct:

If the instructor has information that one of his/her students committed an act of academic misconduct, the faculty member will hold an informal conference with the student. The conference will be prompt and private. If the faculty member concludes that the student is responsible for the misconduct, then the faculty member will impose an appropriate academic sanction (i.e., lower or failing grade on the assignment, assessing a lower or failing grade for the course).

VIII. AMERICANS WITH DISABILITIES ACT:

If you need any special accommodations due to a disability, please contact Adaptive Educational Services at (317)-274-3241. The office is located in CA 001E.