**BMM445: MOLECULAR MECHANISMS OF AGE-RELATED DISEASES**

**Spring, 2025**

*Instructors:*

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*Introduction*

Meeting times: Mondays and Wednesdays, 3:00-4:30

Credits: 3 Credits

Pre-requisites: BIOC235/BMM235 either BIOC 339 or AGBI 410, or agreement from course coordinator.

Brief summary of course goals.

The association of chronic diseases -- such as cancer, Alzheimer’s disease, diabetes and cardiovascular disease – with aging is well established. Relatively recently, some cell biologic and molecular mechanisms that drive the aging program have been elucidated. Excitingly, intervention with these mechanisms in the experimental or clinical setting can prolong lifespan as well as prevent the onset of multiple chronic diseases. The new field driving these advances, called geroscience, promises to identify unified, general mechanisms that underly our increasing predisposition to chronic diseases accompanying aging.

This course is organized to provide relevant background in the molecular pathogenesis as well as therapeutic approaches and challenges in cancer (first module) and neurodegenerative diseases (second module). In the third module, the burgeoning field of geroscience – a field less than 20 years old—will be discussed, focusing on cell biology, molecular biology and biochemistry. Finally, we will discuss how concepts from geroscience impact upon our understanding of two classes of chronic diseases, namely, cancer and neurodegenerative diseases, thus connecting course content meaningfully.

The course will combine didactic lectures with active learning approaches (discussions, presentations) to promote a deeper understanding of the biological concepts.

Learning outcomes.

--Discuss the evidence that aging results from the interactions of the environment with a biological program that consists of a networked set of “subprograms”

--Analyze the interplay of cellular and physiologic metabolism, immunity and inflammation, epigenetics and cell senescence in the programming of aging vs. longevity, neurodegenerative diseases and cancer.

--Outline mechanistically how interventions including drugs, diet, exercise affect the program and subprograms of aging and the onset of chronic diseases.

--Recognize the common factors between aging, cognitive decline and neurodegeneration in the nervous system.

--Determine how the specialized morphology and cell biology of neurons are impacted by disease mechanisms related to Alzheimer disease, Parkinson Disease, amyotrophic lateral sclerosis and age-related macular degeneration.

--Describe multiple cellular aspects altered by cancer cells and how these contribute to continued propagation of the neoplastic phenotype.

--Explain how different extrinsic factors impact the genome to cause cancer and to drive tumor progression in patients

*Instructional Materials*

Lectures will be delivered through Powerpoint and the files will be posted on the Health Sciences Center SOLE site. All additional materials required for class will also be posted on SOLE.

*Student presentations*

The class will be divided into three groups. In the first module of the course (see below), groups 1, 2 and 3 each will present a group powerpoint discussion regarding cancer focus areas 1, 2 or 3 (respectively). The three topics will be released to the class at the end of week 1 of the module. Students will specify their first and second choices of topics and accommodated as possible. The three group presentations will occur on the last session of the module.

The neurodegeneration and aging group modules will have analogous group presentations.

Each topic will focus on one family of proteins or one pathway. Each topic assignment will be accompanied by a list of papers (including research articles and review articles) that the group should minimally cover (although additional papers are welcome). This 30-minute presentation (including 10 minutes of open discussion with class) should be prepared through a cooperative effort of all members of the group, who will meet in person or virtually outside of class. If the group wishes to obtain feedback from the instructor prior to the presentation, they may do so by sharing their powerpoint at least one week in advance. More specific guidance about these presentations will be distributed in class.

Presentations will be graded according to the following rubric:

|  |  |  |  |
| --- | --- | --- | --- |
| Criteria | Needs Improvement | Satisfactory | Excellent |
| Subject knowledge | Limited understanding of the material discussed. | Mastery of the key concepts of the discussed material and ability to make connections between them. | In-depth knowledge of the material, ability to integrate knowledge, suggestion of alternative explanations or perspectives on an issue. |
| Quality of presentation | Slides have key details missing or irrelevant information. | Slides have appropriate information and are well organized. | Slides are logically arranged, illustrate key points, are easy to follow, and prompt discussion. |
| Supporting materials | Insufficient sources or sources with poor validity. | Sources were sufficient and reputable. | Sources provided different viewpoints and broadened the understanding of the topic discussed. |

*Quizzes*

There will be two 10-question quizzes in class per module; quizzes will be a mix of multiple choice and short answer questions. Students should bring their laptops to class in order to take the quizzes on the SOLE website.

*Class participation*

Students are expected to contribute to class discussion when reviewing the learning material and/or relevant manuscripts and video recordings. Reading materials and research questions will be assigned occasionally prior to class and will be provided on SOLE. Participation in discussions will be graded at the end of each block using the rubric below. Student participation in the discussions accompanying the group presentations will carry particular weight.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criteria | Needs Improvement | Satisfactory | Good | Excellent |
| Frequency and quality of participation | Needs prompting to participate, not engaged, answers show minimal effort. | Participates occasionally, provides comments related to the discussion, asks questions. | Participates often, asks relevant questions, provides answers and examples for clarification. | Participates often, able to answer questions and make connections between ideas, prompts further discussion and expands the understanding of all participants. |
| Command of material | Shows gaps in knowledge. | Displays good grasp of the material discussed. | Demonstrates mastery of the material, able to summarize the material and connect ideas. | Statements, questions and opinions show in-depth understanding of key concepts and provide insight and perspective. |

*Grading*

Final grades will be based on percentage points as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Points per unit | Total points |  |
| Quizzes (6) | 10 | 60 |  |
| Presentations (3) | 10 | 30 |  |
| Class participation (3) | 3.3 | 10 |  |
| Total |  | 100 |  |

Final grades will be assigned using the following general scale for percentage of total points:

Letter grade Percent of Total points

A 100-90%

B 89-80%

C 79-70%

D 69-55% F <55%

(Final grades may deviate slightly from the scale above depending upon the need for curvature)

*Tips to ensure success in this course*

Students will be expected to read course materials, manuscripts, or watch videos prior to some of the classes. Getting familiar with the assignments will make discussion in class easier. Students are expected to contact the instructors in the class with any question or concern about the material taught or the manner in which the class is conducted – by email or in person. Students are also encouraged to communicate with their peers and classmates when they don’t understand a specific concept or topic, to ask for peer input on their presentations, or just to study together, when feasible. Taking notes in class will help the majority of students and is also highly encouraged although not required for grading.

*Course and Institutional Policies*

Attendance Policy

Students are expected to attend classes. Absences without legitimate reason will result in decrease of the participation grade and 0 points on quizzes. Students with a legitimate reason to miss a class should inform the instructors in advance and work with them to make up the assignments.

Late Assignment and Missed Exam Policy

Students who miss class will only be able to make up a quiz if they have informed the instructor about the absence in advance. The projects will be presented in class and there will be no possibility for makeup. Students who have a legitimate reason to miss the class presentation will have the possibility to complete an additional assignment for extra credit. Assignments missed without informing the instructor about the absence in advance or with no legitimate reason will result in 0 points or decrease in the participation grade for the respective module.

Inclusivity Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in your classes, please advise your instructors and make appropriate arrangements with the Office of Accessibility Services.

More information is available at the Division of Diversity, Equity, and Inclusion website as well.

Academic Integrity Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University Academic Standards Policy. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter.

Mental Health Statement

Mental health concerns or stressful events can adversely affect your academic performance, social relationships and quality of life. WVU’s BeWell office offers free, confidential counseling services to assist you with addressing these and other concerns that you may be experiencing. You can schedule an appointment in the HSC BeWell clinic by calling 304-293-1292 or 304-293-1353. You can also email the BeWell Coordinator, Layne Hitchcock, at layne.kehl@mail.wvu.edu or request an appointment online at health.wvu.edu/bewell.

BeWell is an extension of the Carruth Center for Counseling and Psychological Services, and you can learn more about mental health resources on their website at carruth.wvu.edu.

If you are in need of crisis services, call the Carruth Center’s main number 24/7: (304) 293-4431. You can also text WVU to 741741.

Spring Semester 2025

* January 10  - General Registration
* January 13 - On-Campus First Day of Classes
* January 17 - Last Day to Register, Add New Courses, Make Section Changes, Change Pass/Fail and Audit
* January 20 - Martin Luther King, Jr. Day Recess (University Closed)
* February 28 - Mid–Check Grades Due
* March 14 - Last Day to Apply for May Graduation
* March 15-23 - Spring Recess
* April 18 - Spring Holiday (University Closed)
* April 21 - Last Day to Drop a Class and Last Day to Withdraw from the University
* May 2  - Last Day of Classes
* May 5-9 - Final Exams
* May 12-30 - Maymester
* May 16-18 – Commencement

Classes meet Mon-Wed 3-4:30, room 201 Erma Byrd Biomed Research Building

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| Date | Course Module | Topic |
|  | Cancer (Dr. Weed) |  |
| Jan. 13,15 |  | Intro to cancer and aging, genomic instability in cancer |
| Jan.22,Jan.27 |  | Oncogenes and tumor suppressors, epigenetics |
| Jan.29, Feb. 3 |  | Quiz 1 and Chronic inflammation in cancer;tumor microenvironment |
| Feb.5,10 |  | Cell senescence and proliferation; intestinal dysbiosis; quiz 2 |
| Feb. 12 |  | Group presentations |
|  | Neurodegeneration (Dr. Robichaux) |  |
| Feb. 17, 19 |  | Neurobiology review, neuroinflammation |
| Feb. 26, March 3 |  | Alzheimer’s disease |
| March 5,10 |  | Parkinson’s disease |
| March 12, 24 |  | ALS, Age-related macular degeneration (AMD) 1 |
| March 26,31 |  | AMD 2,Group presentations |
|  | Aging mechanisms (Dr. Frisch) |  |
| April 2 |  | Is aging programmed? |
| April 7,9 |  | Metabolism, mitochondrial aspects of aging |
| April 14,16 |  | Cell senescence, epigenetics-1 |
| April 21,23 |  | Epigenetics-2, Immunity |
| April 28, 30 |  | Circadian control, Group presentations |
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