WEST VIRGINIA UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR MEDICINE

BMM 753- MOLECULAR MECHANISMS OF HUMAN DISEASES

FALL, 2026

Credit Hours:	3 credit hours
Class Days/Times	Tuesdays and Thursdays, 10:00 to 11:30 AM.
Class Location:	**Robert C. Byrd Health Sciences Center, Erma Byrd 101**
Instructors:	Saravanan Kolandaivelu, Ph.D. (Course coordinator)
	Marieta Gencheva, Ph.D.
	Scott Weed, Ph.D.
	Visvanathan Ramamurthy, Ph.D.
	Shian Liu, Ph.D.
Office Hours:	Flexible: contact each instructor as needed
Contact Information:	(SK): kolandaivelus@hsc.wvu.edu
	(MG): mgencheva@hsc.wvu.edu
	(SW): scweed@hsc.wvu.edu
	(VR): ramamurthyv@hsc.wvu.edu
	(SL): shian.liu@hsc.wvu.edu

Course Pre or Co-Requisites: Completion of the first-year graduate curriculum in biomedical sciences.

COURSE DESCRIPTION:

The course will be divided into four modules, each representing one disease area.

1. Cancer (Dr. Weed)

In this module, Dr. Weed will focus on cancer, a group of related hyperproliferative diseases. First, the general characteristics of selected cancer types will be compared to identify common and unique features, including incidence, metastatic frequency, and survival rates following diagnosis. Mechanisms involving 3–4 classic oncogenes and tumor suppressor genes will be discussed. In-depth aspects of the molecular basis of tumor invasion and metastasis with the tumor microenvironment will be emphasized. Therapeutic approaches will be examined, including mechanisms of drug action and resistance. The module will conclude with a discussion between students and a physician on the clinical aspects of pancreatic cancer as a case study.

2. Neurodegeneration (Dr. Kolandaivelu)

In this module, Dr. Kolandaivelu will begin with an introduction to brain structure and function, including the organization of neural circuits, synaptic communication, and the role of neurotransmitters in neuronal signaling. The module will then focus on the cellular and molecular mechanisms that lead to neuronal dysfunction and death, ultimately contributing to major neurodegenerative and neurological disorders such as Alzheimer's disease, Parkinson's disease, epilepsy, and amyotrophic lateral sclerosis (ALS). Key topics will include protein aggregation, oxidative stress, mitochondrial dysfunction, neuroinflammation, excitotoxicity, and defects in cellular metabolism and synaptic function. The module will also examine how advances in our understanding of disease mechanisms have led to the development of innovative therapeutic strategies, including neuroprotective approaches, gene- and cell-based therapies, and targeted pharmacological interventions. The broader implications of these emerging therapies for the treatment of neurodegenerative diseases will be discussed. The module will conclude with an interactive discussion between students and a physician focusing on the clinical presentation, diagnosis, and treatment challenges associated with these disorders.

3. Metabolic disease (Dr. Gencheva).

In this module, Dr. Gencheva will focus on the molecular and physiological basis of metabolic diseases, with emphasis on obesity and type II diabetes. The module will begin with an overview of metabolic homeostasis, including carbohydrate and lipid metabolism, insulin signaling, cellular energetics, and the roles of major metabolic organs in maintaining energy balance. Dr. Gencheva will then discuss the pathogenesis of obesity and diabetes, highlighting the contributions of insulin resistance, chronic inflammation, and genetic factors. Current strategies for disease prevention and treatment will also be examined. The module will conclude with a discussion between students and a physician on the clinical aspects of metabolic diseases.

4. Therapeutic Application and Translation Medicine (Drs. Ramamurthy and Liu)

In this module, the principles of therapeutic development and translational medicine will be explored using major human diseases, including cancer, neurodegenerative disorders, obesity, and type II diabetes as model systems. The module will focus on how discoveries in basic and molecular research are translated into clinical therapies and precision medicine approaches. Key topics will include target identification, biomarker discovery, drug development, gene and cell-based therapies, protein therapeutics, immunotherapy, and mechanisms of therapeutic resistance. Challenges in translating laboratory discoveries into effective clinical treatments, including disease heterogeneity, patient variability, and clinical trial design, will also be discussed. Experts in the field, Dr. Ramamurthy (Translational Medicine) and Dr. Liu (Drug Development and Protein Therapeutics), will lead and discuss this module. The module will conclude with case-based discussions involving students, instructors, pharmaceutical scientists, and/or physicians, focusing on drug development strategies, clinical translation, and future directions in therapeutic innovation.

COURSE FORMAT/METHOD OF INSTRUCTION

Within each module, the course will combine *conventional*, *active learning, and clinician-day* format sessions. The goal is to use a balanced portfolio (i.e., approximately 50% each) of these two modalities for an optimal learning experience.

For both types of sessions, students should bring their laptops to class (for quizzes, polling or other activities). Computers will be active when the instructor requires them—i.e., the default state will be "computers off".

Conventional is defined as instructor-led lectures accompanied by PowerPoint presentations. The instructors will incorporate as much student interactivity as possible during these sessions.

Active Learning. At the end of each class, students will get reading assignments, including a review of lecture slides, a set of questions to research at home, or review articles or sections of reviews to read. These will be discussed in the subsequent class section. The assigned at-home readings will generally cover new material that will clarify important points and/or offer a different perspective. Additionally, instructors will engage students in in-class problem solving to apply the principles they've learned to novel cellular or clinical issues.

Clinician day. For each module, a clinician/scientist with relevant expertise will conduct the final class session. The clinician will present a short workshop on cutting-edge issues about their disease of interest (20-30 minutes). Students will participate in discussions with the clinicians about the application of basic disease mechanisms addressed in the course to the disease pathology.

REQUIRED TEXTS AND READINGS

All reading materials will be posted on SOLE.

ASSIGNMENTS AND ASSESSMENT

Your grade for this course will be based on the required assignments and point values listed below:

CLASS PARTICIPATION

The key to success in an active learning format is reading and understanding content prior to the class, followed by regular, active, and insightful participation in class. Thus, increased responsibility falls to each student to structure their preparation time and participation in ways that optimize their contribution to the intellectual environment of the course. Accordingly, a significant fraction of your grade (20%) will be based on class participation. One essential aspect of class participation is engagement in discussions, even when you aren't the primary presenter. Participation in discussions with each clinician will be expected.

QUIZZES

A 10-question quiz will be administered in class in the next-to-last session of each module, either incorporated in the lecture slides or via SOLE. Quizzes will test understanding of concepts and connections discussed in each current module.

TEAM PRESENTATION

Student teams will develop and deliver a short PowerPoint presentation (10–15 minutes per team, depending on class size) during the final class sessions. Each team member is expected to contribute equally and present an equal portion of the presentation.

Presentation topics will focus on mechanistic links between disease processes and therapeutic translation. Specifically, Team 1 will present on the connections between neurodegeneration and therapeutic applications/translational medicine; Team 2 will focus on cancer and therapeutic applications/translational medicine; and Team 3 will focus on metabolic disease and therapeutic applications/translational medicine. Presentations will be evaluated according to the criteria outlined in the grading rubric table below.

	Fair	Good	Excellent
Background	Narrow and shallow background introducing only the most obvious aspects. Poor organization, difficult to follow	Hits the major points but misses some details. Decent organization with obvious effort. Makes the obvious connections but misses some subtle ones	Broad and deep background providing information on all aspects of the questions. Discusses relevance/significance. Very well organized and easy to understand. Connections are very clear.
Content	Minimal content. Covers the question in a superficial way. Narrow and shallow.	Comprehensive but has some areas that are unbalanced. Some focus but wanders at points	Addresses different aspects of the question in depth. Balanced coverage of all aspects of the question (breadth).
Discuss tie-ins to block	Only the most obvious tie ins are discussed	Makes some connections mostly to past blocks, some diversity but not comprehensive in scope	Multiple connections to different lectures are presented. (later on connections to lectures in different blocks)
Answer questions	"Yes" "no" "I don't know" (If you don't know an answer it is important to admit you don't know, rather than guess)	Some questions answered well, others not or only partially answered	Demonstrate mastery of your presentation by providing a detailed answer providing additional material that you didn't present.
Time management	Way too long, way too short. Frequently wanders far off topic	One or two not in sync with the rest, talk falls 5 min too short or long	Presentation completed in proper time. Balanced time for different components/individuals

GRADES

- Class attendance and participation: 30 points
- Completion of quizzes: 10 points each = 40 pts
- Team presentation (one presentation, at the end of module 4): 30 points

Final Grade Determination

The final course grade will be based on cumulative assessments from all course instructors. Each instructor will evaluate and submit grades for their respective course modules, including class attendance and participation, quizzes, and the team presentation. The course coordinator will compile these assessments, calculate the final grade for each student, and submit the final course grades.

The grading scale for this course is as follows:

A (Excellent, 90-100%)

B (Good, 80-90%)

C (Fair, 70-80%)

D (Poor, 60-70%)

F (Failure<60%)

Attendance: You are expected to attend all class sessions. In the event of personal issues that prevent you from attending, you must inform Dr. Kolandaivelu and the course instructors at least 24 hours in advance of your absence from class. Uninformed absences will result in a loss of points from your grade.

For extreme circumstances that necessitate your short-term absence, such as a death in the family or hospitalization, contact the Office of Campus and Community Life at 304-293-5611. The Office of Campus and Community Life will notify your instructors of imminent absence in situations if you are unable to do so.

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 accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (304-293-6700).

ACADEMIC INTEGRITY

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, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. 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 Catalog at http://catalog.wvu.edu/underl/coursecreditstermsclassification/#academicintegritytext. 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 me before the assignment is due to discuss the matter.

Plagiarized material in any assignment automatically results in a grade of “F” for the assignment. It is your responsibility to inform him/herself of the definition of plagiarism. Not knowing the definition cannot excuse instances of plagiarism. It is your responsibility to make sure that the final paper submitted for an assignment is the final version of his/her paper (and not a previous draft). See the academic integrity/dishonesty policy below for further information.

INCOMPLETE GRADES

A grade of I (Incomplete) is a temporary grade assignment used when unforeseen, non-academic circumstances arise that prohibit you from completing the last course assignments or examinations at the end of the semester. The grade of Incomplete is typically assigned because of an excused absence from the final examination or because assignments are unavoidably incomplete, as determined by the instructor. Those who are failing a course (exclusive of the incomplete work) may not request an Incomplete.

If you want to be considered for an Incomplete, you must apply to the instructor before the end of the term. If the instructor agrees, the instructor and you must negotiate the conditions under which the grade of I will be changed to a letter grade and sign a contract. The date to submit the incomplete work should not be set beyond the last day of class of the following semester. If don’t complete the terms of the contract, then the

instructor should submit a grade of F. All incomplete contracts must be filed with the department and the Dean's Office.

To remove the grade of I, you don't need to register for the course again.

If the Incomplete grade is not changed by the end of the next major term (excluding summer), the I grade will be replaced with an IF.

SEXUAL MISCONDUCT

West Virginia University (WVU) does not tolerate sexual misconduct, including harassment, stalking, sexual assault, sexual exploitation, or relationship violence [BOG Policy 44]. It is important for you to know that there are resources available if you or someone you know needs assistance. You may speak to a member of university administration, faculty, or staff, but keep in mind that they have an obligation to report the incident to the Title IX Coordinator. If you want to speak to someone who is permitted to keep your disclosure confidential, please seek assistance from the Carruth Center, 304-293-9355 or 304-293-4431 (24-hour hotline), and locally within the community at the Rape and Domestic Violence Information Center (RDVIC), 304292-5100 or 304-292-4431 (24-hour hotline).

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.

The link to all the general WVU academic policies and syllabus statements is available, which includes things like weather, appropriate use of technology, AI, campus firearm, mental health ect.

https://facultysenate.wvu.edu/resources/syllabus-policies-and-statements?utm

Fall Semester 2026

- August 17 - General Registration
- August 18 - On-Campus First Day of Classes
- August 24 - Last Day to Register, Add New Courses, Make Section Changes, Change Pass/Fail and Audit
- September 7 - Labor Day Recess (University Closed)
- October 7 - Mid-Check Grades Due by Noon
- October 9 - Fall Break
- November 3 - General Election Day (University Closed)
- November 20 - Last Day to Drop a Class and Last Day to Withdraw from the University
- November 21-29 – Fall and Thanksgiving Recess
- December 4 - Last Day of Classes
- December 7-11 - Final Exam Week
- December 12 - Commencement
- December 12 - Winter Recess Begins

- December 14 – Grades Due by noon
- December 14-January 1 - Winter Intersession

Tuesdays and Thursdays, 10:00-11:30 AM

Robert C. Byrd Health Sciences Center, Erma Byrd 101

Date	Topic	Lecturer	
Aug 25, 27	Cancer	Dr. Weed	Pre-test Aug 25
Sept 1, 3	Cancer	Dr. Weed	
Sept 8, 10	Cancer	Dr. Weed	Quiz #1 Sept 10
Sept 15	Cancer	Dr. Weed	Clinical session
Sept 17	Neurodegeneration	Dr. Kolandaivelu	
Sept 22, 24	Neurodegeneration	Dr. Kolandaivelu	
Sept 29, Oct 1	Neurodegeneration	Dr. Kolandaivelu	Quiz #2 Oct 1
Oct. 6	Neurodegeneration	Dr. Kolandaivelu	Clinical session
Oct. 8	Metabolic diseases	Dr. Gencheva	
Oct 13, 15	Metabolic diseases	Dr. Gencheva	
Oct 20, 22	Metabolic diseases	Dr. Gencheva	Quiz #3 Oct 22
Oct 27, 29	Metabolic diseases	Dr. Gencheva	Clinical session (Oct. 29)
Nov 5	Therapeutic application and translation medicine	Drs. Ramamurthy/ Liu	
Nov 10, 12	Therapeutic application and translation medicine	Drs. Ramamurthy/ Liu	
Nov 17, 19	Therapeutic application and translation medicine	Drs. Ramamurthy/ Liu	Quiz #4 Nov 19
Dec. 1	Therapeutic application and translation medicine	Drs. Ramamurthy/ Liu	Expert in drug development/ and or Clinical session
Dec 3	Team presentations, summary discussion	Gencheva, Weed, Ramamurthy, Liu, and Kolandaivelu	Post-test

Note: Depending on the availability of clinicians and experts in drug development and therapeutic approaches, instructors may adjust the dates and sequence of topics within their respective modules.