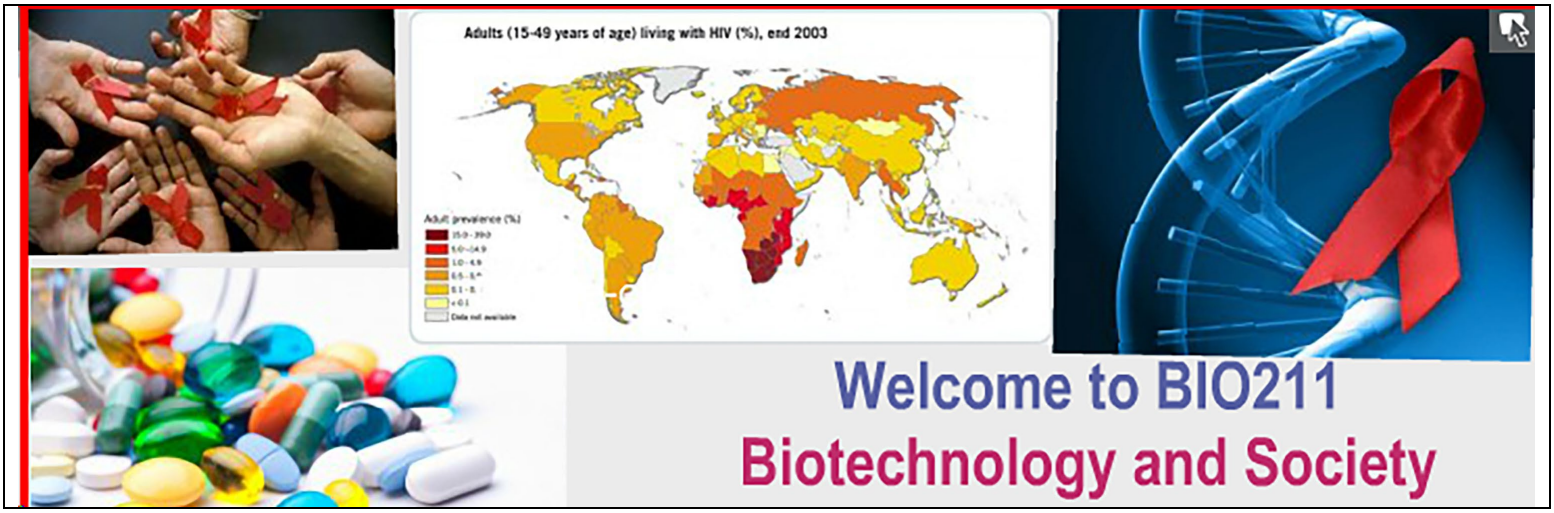
BIO211: Biotechnology and Society (36005)
Biology Department Name
Medgar Evers College

Instructor:	Dr. Shiraz Mujtaba, PhD	**Term:**	**Spring 2025**
Office:	403D	**Class Meeting Days:**	**Mondays**
Phone:	718-270-6191 (Email Preferred)	**Class Meeting Hours:**	**4:00 -6:30 PM**
E-Mail:	smujtaba@mec.cuny.edu	**Class Location:**	**AB1 and L09**
Office Hours:	Mondays & Wednesdays	**Lab Location:**	**Not required**
	6:35 PM-7:35 PM	**Face to Face**	**X___**
Course Credits:	3 of credits	**Online Full**	
		Online-Hybrid	**___**
		Online Platform	**Brightspace LMS**
			https://brightspace.cuny.edu/d2l/home/670056
		Pre-requisite/s:	BIO 101or PHS 101 or permission of the department Chair
		Co-requisite/s:	**Not required**

I. Welcome!

Classrooms are one of the most dynamic places on the planet - I welcome you all! I look forward to interacting with each of you and continuing to teach and learn from your questions and ideas. This course builds on the fundamental knowledge of biology. However, it quickly pivots into the applied aspects of Biology (Biotechnology). I hope you will agree that in the current times, it's technology rather than the human brain that is driving society. In the middle of this



busy life, improving the environmental and overall health of living organisms is one of the critical determinants of scientists and the government. In this course, we learn how biotechnology impacts society and an individual. We will talk more. Good luck with the semester.

II. University Course Catalog Description

Paste the description from the online catalog.

III. Course Overview

This course fulfills the following General Education (Pathways) Requirements: X ☐ Yes ☐ No
(If yes, respond to Section III. If not, go to Section IV.)

Biotechnology and Society is a course designed to introduce students to the field of biotechnology and to the applications and the impact of modern biotechnology on society. The history of biotechnology and the biotech discoveries in DNA science that influence the field will be presented. Basic concepts of DNA, the Central Dogma, and molecular genetics will be introduced as a foundation to understand the techniques of modern biotechnology. The use of biotechnology in areas such as medicine, agriculture, bioremediation, food processing, forensics, and energy production will be presented. Students will examine the ethical, legal, and social implications of selected topics in biotechnology.

☐ Foundation Cluster ☐ Required Core ☐ General Knowledge Cluster **X** ☐ Flexible Core

Required Common Core:

- ☐ English Composition I or II
- ☐ Mathematics and Quantitative Reasoning
- ☐ Life and Physical Sciences

Flexible Common Core:

- ☐ World Cultures and Global Studies
- ☐ US Experiences in Its Diversity
- ☐ Creative Expression
- ☐ Individual and Society
- ☐ Scientific World
- ☐ Additional Flexible Common Core

College Option:

- ☐ Socio-cultural
- ☐ Humanities
- ☐ Natural Sciences & Mathematics
- ☐ Social and Behavioral Sciences

MEC General Education/CUNY Pathways Requirement

Biotechnology and Society, BIOL 211, is an elected general education course of the Medgar Evers College General Education Program, Cluster II – General Knowledge Cluster. This course also satisfies the Scientific World Flexible Core general education requirement of the CUNY Pathways 30-credit transfer policy.

GEP Essential Learning Outcomes Addressed

ELO 1: Knowledge of Human Cultures and the Physical and Natural World
ELO 2: Intellectual and Practical Skills
ELO 3: Personal and Social Responsibility

IV. Student Learning Outcomes (SLOs)

What will they know, what will they be able to do, what will they value, and what will they create as they progress through the course? This can be under bullets, listing, and outlines, as detailed as you would like. Objectives should be specific rather than general, speaking to skills and performance rather than knowledge. Objectives should also be clearly measurable. Often, objectives use the phrasing "by the end of this course, students will be able to…"

Students will:

1. Discuss the definition of biotechnology, the history, and the fundamentals of modern biotechnology.
2. Demonstrate knowledge of the basic biology of the prokaryotic and eukaryotic cells, the macromolecules of life, structure and function of DNA, and the Central Dogma.
3. Discuss and identify the basic principles and common terms and techniques of recombinant DNA and technology.
4. Discuss recent advances in modern biotechnology and some of the applications and challenges to society in the areas of agriculture, industry, medicine, and/or forensics.
5. Demonstrate knowledge of the positive impacts of biotechnology on society.
6. Discuss the main issues related to biotechnology regulation and patents.
7. Demonstrate understanding and ability to identify and evaluate current issues of biotechnology in making informed personal and societal choices as citizens in the twenty-first century.
8. Apply critical thinking to current societal problems or issues as they appear in the public media that require knowledge and application of biotechnological principles.
9. To insert a writing intensive assignment as a part of the course

V. Required Texts and Materials

Sharon Walker. 2007. Biotechnology Demystified. McGraw Hill, New York

References

- Ellyn Daugherty. 2007. Biotechnology –Science for the new millennium. Paradigm Publishing, Inc., St.
- Paul, MN.Bitton, G. 2010. Pollution Control Biotechnology, in Wastewater Microbiology, Fourth Edition, John Wiley & Sons, Inc., Hoboken, NJ, USA. doi: 10.1002/9780470901243.ch16
- Rajiv K. Sinha, Dalsukh Valani, Shweta Sinha. 2010. Environmental biotechnologies for bioremediation of contaminated lands and soil by microbes, plants and earthworms. Nova Science Publishers.
- Susan R. Barnum 2006. Biotechnology – an introduction. Brooks/Cole, Belmont, CA 94002.
- William J. Thieman & Michael A. Palladino. 2013. Introduction to Biotechnology 3rd Ed. Benjamin Cummings, USA.

Assigned Readings (during the teaching of the course through the semester Students will be assigned selected readings from the list below.):

1. Sean Poulter, "**Human Genes in Your Food: Rice crops to be genetically modified with human DNA,** "*Daily Mail,* March 6, 2007.
2. Christopher Reeve, **Congressional Testimony on Cloning**, 7 March 2002.
3. **How Science Can Build a Better You,** David Ewing Duncan, *New York Times* November 3, 2012
4. **New Shade of Green: Stark Shift for Onetime Foe of Genetic Engineering in Crops**, Andrew Revkin, *New York Times*, January 4, 2013.
5. **Hidden Treasures in Junk DNA**, *Scientific American Magazine*, September 18, 2012 –By Stephen S. Hall
6. **New DNA Analysis Shows Ancient Humans Interbred with Denisovans**, *Scientific American Magazine,* August 30, 2012 – News by Katherine Harmon
7. **Custom-Designed Proteins Could Counteract Chemical Weapons**, I*nnovation NewsDaily,* February 07, 2012 – *TechMediaNetwork* By Charles Q. Choi,
8. **Green Fluorescent Protein Makes for Living Lasers**, *Scientific American Magazine,* June 13, 2011 – News By John Matson
9. Dr. Zeba F. Alam. 2013. **Biotechnology 4u.** www.biotechnology4u.com
10. Nina V. Fedoroff, Engineering **Food for All**, *New York Times*, August 18, 2011
11. **Genetically Modified Crop on the Loose and Evolving in U.S. Midwest**, *Scientific American Magazine*, August 06, 2010 – News By David Biello
12. **Scientists Tweak Photosynthesis in Pursuit of a Better Biofuel**, *Scientific American Magazine* , January 13, 2012 –By David Biello
13. **California fails to pass genetically modified foods labeling initiative, *CNNHealth.com*,** Nov. 8, 2012
14. **Long-term study finds no negative effects from GM food -** *Western Farm Press,* MAR 21, 2012

15. **Transgenic Goat's Milk Kicks Up Immunity**, *Scientific American Magazine,* August 04, 2006 – News By Karen Schrock
16. **Algal Biofuel Sustainability Review Highlights Concerns about Water Supply**, *Climatewire,* October 25, 2012 –By Tiffany Stecker.
17. **Scientists Engineer Bacteria to Make Fuel from CO2**, *Climatewire,* August 23, 2012 –By Umair Irfan.
18. **Fuel Cell Treats Wastewater and Harvests Energy**, *Scientific American Magazine*, July 16, 2012 – News By Katherine Tweed
19. **Slick Solution: How Microbes Will Clean Up the Deepwater Horizon Oil Spill**, *Scientific American Magazine* May 25, 2010 – Features By David Biello
20. **Environmental Biotechnology for Bioconversion of Agricultural and Forestry Wastes into Nutritive Biomass,** Marian Petre and Violeta Petre http://dx.doi.org/10.5772/55204
21. **Artificial Jellyfish Built from Rat Cells**, *Nature magazine,* July 23, 2012 – News By Ed Yong,
22. **Can Algae Feed the World and Fuel the Planet?** *Scientific American Magazine*, **A Q with Craig Venter**, November 11, 2011 – Features By David Biello
23. **Supreme Court Ensures Funding of Research Using Human Embryonic Stem Cells**, *Nature magazine*, January 08, 2013 – News By Meredith Wadman
24. **Diseases in a Dish: Stem Cells for Drug Discovery**, *Scientific American Magazine,* February 16, 2011 –By Stephen S. Hall
25. **Brain Cells Made from Urine**, *Nature magazine,* December 10, 2012 – News By Monya Baker,
26. **Fetal Cells Return as a Parkinson's Cure**, *Scientific American Magazine,* January 11, 2010 By M. A. Woodbury
27. **Francis Collins, Lawmakers Debate Stem Cell Merits**, *Scientific American Magazine,* September 18, 2010 – News By Katherine Harmon
28. **Hormone-Producing Thyroid Grown from Embryonic Stem Cells**, Nature *magazine,* October 11, 2012 – News By Dan Jones,
29. **Safety of Induced Stem Cells Gets a Boost**, Nature *magazine,* January 10, 2013 – News By Monya Baker.
30. **Outsmarting Dengue Fever by Vaccinating Mosquitoes** April 08, 2011, *Scientific American Magazine* By Rebecca Coffey
31. **Europe Nears First Approval for Gene Therapy Treatment**, Nature *magazine* ,July 23, 2012 – News By Daniel Cressey,
32. **Test-Tube Babies May Face Greater Health Risks Than Naturally Conceived**, *Scientific American Magazine,* February 23, 2010 – News By Katie Moisse
33. **Trio of Genome-Sequencing Studies Offers a Broader View of Lung Cancer**. *Nature magazine,* September 13, 2012 – News By Monya Baker,
34. **Gene Therapy Restores Sight to Three Patients**, *Scientific American Magazine,* April 01, 2012 –By Ferris Jabr
35. **Portrait in DNA: Can forensic analysis yield police-style sketches of suspects?** *Scientific American Magazine,* May 11, 2010 –By Christine Soares
36. **Gene Therapies Will Cure Many a Disease**, *Scientific American Magazine,* January 06, 2013 –By Ricki Lewis
37. **Gene-Therapy Successes Spur Hope for Embattled Field**, *Nature Magazine*, August 25, 2011 – News By Erika Check Hayden
38. **Tomorrow's Medicine**, *Scientific American Magazine,* May 02, 2012 By The Editors, Nancy Shute, Ferris Jabr, Katherine Harmon
39. **DNA-Swap Technology Almost Ready for Fertility Clinic**, *Nature magazine,* October 24, 2012 – News By David Cyranoski,
40. **Vaccinomics: Scientists Are Devising Your Personal Vaccine**, *Scientific American Magazine,* June 24, 2010 – Features By Melinda Wenner Moyer
41. Lee, S. Y. (2012), **Editorial: State-of-the-art reviews in industrial biotechnology**. *Biotechnology Journal,* 7: 166–167. doi: 10.1002/biot.201100507
42. Erickson, B., Nelson, J. E., Winters, P., **Perspective on opportunities in industrial biotechnology in renewable chemicals**. *Biotechnol. J.* 2012, **7**, 176–185.
43. Jang, Y. S., Lee, J., Malaviya, A., Seung, D. Y. et al., **Butanol production from renewable biomass: Rediscovery of metabolic pathways and metabolic engineering**. *Biotechnol. J.* 2012, 7, 186–198.

44. Cimini, D., De Rosa, M., Schiraldi, C., **Production of glucuronic acid-based polysaccharides by microbial fermentation for biomedical applications**. *Biotechnol. J.* 2012, **7**, 237–250.
45. Gonçalves, G. A. L., Bower, D. M., Prazeres, D. M. F., Monteiro, G. A., Prather, K. L. J., **Rational engineering of Escherichia coli strains for plasmid biopharmaceutical manufacturing**. *Biotechnol. J.* 2012, **7**, 251–261
46. **Tissue-Engineered Leather Could be Mass-Produced by 2017**, *Scientific American Magazine,* September 18, 2012 – News By Michael Keller, Txchnologist
47. **Bacteria Transformed into Biofuel Refineries**, *Scientific American Magazine,* January 27, 2010 – News By David Biello
48. **Genetically Engineered Stomach Microbe Converts Seaweed into Ethanol**, *Scientific American Magazine*, January 19, 2012 – News by David Biello
49. **Supreme Court Considers GM Crop Patent Case -** *Western Farm Press,* APR 5, 2012
50. **Defending the Body Corporate: Appeals Court Puts Gene Patents on the Stand**, Scientific *American Magazine,* April 07, 2011 – News By Larry Greenemeier
51. **Human-Rights Court to Rule on Fertility-Treatment Ban**, *Nature magazine,* 2012-By Michele Catanzaro.
52. **Court Reaffirms Right of Myriad Genetics to Patent Genes, New** *York Times,* August 16, 2012,
53. Diamond vs. Chakrabarty, 447 U.S. 303. (Lexis-Nexis, enter case number or names "get a cast").
54. The failure of liberal bioethics, *New York Times*, August 17, 2011.
55. www.ornl.gov/sci/techresources

VI. Supplementary (Optional) Texts and Materials

Full-text citations of any supplementary materials

VII. Basis for Final Grade

Assessment	Percent of Final Grade
Quizzes	10%
Midterm	15%
Homework	20%
Class Assignments	20%
Term paper	15%
Final Exam	20%
	100%

College Grading Scale:

Grading Scale (%)	
97 - 100	A+
93 - 96.9	A
90 - 92.9	A-
87.1 - 89.9	B+
83 - 87	B
80 - 82.9	B-

77 - 77.9	C+
70 - 76.9	C
67.1 - 69.9	D+
63 - 67	D
60 - 62.9	D-
0 - 59.9	F

VIII. Grade Dissemination:

Explain where grades will be posted for assignments and assessments.

Note: The Schedule is subject to revision

IX. Assignment Description/s

- All assignments must be submitted on Brightspace before the deadline.
- None of the assignments should be emailed to me.
- All assignments are required to be handwritten
- Missing assignments will be accepted with either a doctor's note or if you have a jury duty.

X. Rubrics: **Insert or attach rubrics related to the assessment of SLOs.**

XI. Course Policies: Grades

Late Work Policy: Offer specifics about your policy on late work.

Example:

There is no make-up for in-class writing, quizzes, midterms, or final exams.

Essays turned in late will be assessed as a penalty: a half-letter grade if it is one day late or a full-letter grade for 2-3 days late. Essays will not be accepted if they are overdue by more than 3 days.

Extra Credit Policy: Offer specifics about your policy on extra credit.

Grades of "Incomplete": Offer specifics about your policy on incomplete grades.

An "INC" is a temporary grade for a student who is doing passing work during a semester and who, for some justifiable reason, has not been able to complete a particular assignment. The student must finish all the assignments as defined by the instructor, or in their absence, by the Departmental Chairperson before the end of the subsequent semester, the summer being excluded. If the necessary assignment is not completed during this period, the student shall receive a "FIN" automatically. To change the grade of "INC" the lower portion of the Grade Change Form shall be used by the instructor or the Departmental Chairperson, as the case may be. "FIN" is converted from an "INC" grade when the student does not complete assignments by the end of the subsequent semester. Credits are counted towards the GPA (Grade Point Average) Index.

Assignment Revision Policy: Offer specifics about your policy on revisions and resubmissions.

Group Work Policy: Offer specifics about your policy on group work.

XII. Course Policies: Technology and Media

Email: how it will be used, who will communicate with whom, who answers technology questions, expected response time, will you check it on weekends, etc.

Laptop / Smartphone Usage: Describe your policies for using laptops throughout your course. Whether you dislike the use of laptops during your lecture or whether you encourage using a laptop during discussion, feel free to state it here.

Classroom Devices: Describe your policies for using calculators, tape recorders, and other audio & technology devices for your course.

XIII. Course Policies: Student Expectations

Disability Accommodations: Federal law prohibits discrimination based on a disability. Under the guidelines of the Americans with Disabilities Act, the College will provide reasonable accommodations to persons with documented disabilities. Therefore, if you need or have any questions regarding accommodation or services, please contact Mr. Anthony Phifer, Director, Office of Accessibility and Accommodation Services (Bedford Building Room 1020) at 718-270-5027 or aphifer@mec.cuny.edu. Any information provided to the office will be confidential and will not be released without your permission. https://youtu.be/6d9lVLZ9g2M
Office of Accessibility and Accommodations Services - Medgar Evers College

Participation Policy: All students are responsible for participating fully in the work of each course. The Department may determine additional regulations. Offer specifics about your expectations for participation in online or in-person courses. Will students get points for participation? You may also describe the expectations of online and face-to-face etiquette.

Professionalism Policy: Offer specifics about your expectations for appropriate classroom behaviors.
Academic Conduct Policy: Academic dishonesty is prohibited at The City University of New York. Penalties for academic dishonesty include academic sanctions, such as failing or otherwise reduced grades, and/or disciplinary sanctions, including suspension or expulsion. Familiarize yourself with CUNY policies regarding dishonorable conduct and follow them. Academic Integrity Policy – The City University of New York (cuny.edu)
If you are using a plagiarism-detection service, you should state so on the syllabus.
CUNY Policy on Religious Accommodations: Under New York State Education Law 224-A, and according to CUNY's religious accommodation policy, students can request religious accommodations for any scheduled academic activities that may conflict with their religious observances. To discuss accommodation due to religious observance for the upcoming holidays or any other religious observance throughout the academic year, please talk to your professor or someone at your Office of Student Life.
https://www.cuny.edu/about/administration/offices/transformation/diversity-equity-and-inclusion-hub/religious-accommodations/

XIV. Student Resources

Learning Center: The mission of the Learning Center is to assist our students to become independent learners, so they can use their skills to decipher, appreciate and manipulate related and advanced levels of various subject areas, and use their knowledge to negotiate real-life circumstances. Learning Center - Medgar Evers College (cuny.edu)

Writing Center
Our tutors serve as writing coaches and are trained to help students improve their writing skills across all disciplines. If your professor recommends Writing Tutoring/Coaching or you want to improve your 0writing skills, please schedule an appointment with one of our Tutors at 718-804-6953 or click the link below. The Writing Center is open 6 days weekly and is located in the Bedford Building Charles E. Inniss Memorial Library (in the back corner of the first floor), Room: B-1045A. http://mecwritingcenter.weebly.com/

Counseling Services
Many students find balancing their academic, personal, and professional lives challenging and sometimes overwhelming. If you or a peer experience this, Counseling and Psychological Services and Interfaith Services are here to help. Email CAP@mec.cuny.edu, and a Counselor will contact you. You can also contact the Campus Chaplain, Father Ralph Rivera, at RRiveraSJ@mec.cuny.edu. In addition, peer support groups are available via the college's Center for Women's Development and Male Development and Empowerment Center. Students can contact staff in the centers at Levelyn@mec.cuny.edu or Anbrereton@mec.cuny.edu, respectively." The office is located in the Bedford Building, Room: B-1005. Counseling & Psychological Services - Medgar Evers College (cuny.edu)

Computing Labs: Computer Labs are available for you to complete and print your papers in each building.

These resources are located below:
Bedford Building Computing Labs:
Monday – Friday, 7 a.m. – 10 p.m.
Saturday 8 a.m. – 10. p.m.
Sunday, 11 a.m. to 8 p.m.
Carroll Street Technology Lounge:
Monday – Friday, 9:00 a.m. – 7 p.m.
Academic Building 1:
Reserved Computing Labs
It contains two labs, C05 and C07. Other labs include the Department of Mathematics—Lab C12 and the Department of Physical, Environmental and Chemistry Lab C09.
For usage and schedules check with individual departments.

Library Resources
Offer information about access and expectations. The Charles Evans Inniss Memorial Library entrance is on the first floor of the Bedford Building. There are also computers and printers available in the library for you. For reference help, you can email or use the chat box for live help during library hours. Ask_A_Librarian@mec.cuny.edu

The Ella Baker/Charles Romain Child Development Center
The Ella Baker /Charles Romain Child Development Center (EB/CR CDC) of Medgar Evers College provides both a Pre-School and an Afterschool Program, which meets the needs of student parents and their children. The center is open from 7:45 a.m. to 10:00 p.m. Mondays - Thursdays and until 3:00 p.m. on Fridays. Weekend services are available on Saturdays from 8:00 a.m. – 4:00 p.m.

XV. Important Dates to Remember

Add a short statement that describes all the dates, and assignments are tentative and can be changed at the college and/or professor's discretion.

Last Day to Add/Drop Classes: Please refer to the MEC administrative calendar
Grade Forgiveness Deadline: Please refer to the MEC administrative calendar
Mid–Term Examination: Professor will announce
Withdrawal Deadline: Please refer to the MEC administrative calendar
Spring Break: Please refer to the MEC administrative calendar
Final Examination: Please refer to the MEC administrative calendar

XVI. Class Schedule

Date/Week	Student Learning Outcomes	Chapters to be Discussed in Class	Topics to be Discussed in Class	Assignments or Learning Activities	Assessment Methods used to evaluate students' performance
	List the student learning objective	The chapter covered during this class period.	Topic covered during this class period.	Assignments must support the attainment of the SLOs.	Assessment must align with SLOs
Week 1-3	SLO 1	• **Review syllabus.** • What is Biotechnology? Biotechnology - historical development of an old science with powerful new	• Introduce biotechnology and modern biology discoveries • Understand atoms and molecular forces • Distinguish ionic	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment	1. Classwork 2. Homework 3. Quiz

		technologies. Biotechnology- a multidisciplinary science. • Career prospects in biotechnology field. • Macromolecules of life	from covalent bonds • Explain why water is polar • Describe the 4 basic types of biomolecules, including proteins, carbohydrates, lipids and nucleic acids. • Difference between DNA and RNA	• Survey	
Week 4-5	SLO 1 and 2	**Cellular basis of life** • Organization of prokaryotic and eukaryotic cells. • Cell communication • Eukaryotic cell cycle and mitosis • Meiosis and sexual reproduction	• Compare prokaryotes to Eukaryotes • Know the function of the basic cell organelles • Know the physiochemical properties of the cell membrane • Explain what catalysis is, mitochondria and vacuoles • Explain and compare the steps of DNA replication, mitosis and meiosis	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	1. Classwork 2. Homework 3. Quiz
Week 6	SLO 1 and 2	**An overview of DNA structure, transcription and translation.** • Biological information flows within a cell from DNA to Protein. • Mutation in the DNA- causes and consequences	• Explain how information in DNA is translated into proteins Know • what transcription and translation are, and which enzymes are involved in each process • **Scientific literacy** • Article 5 • Article 6	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	1. Classwork 2. Homework 3. Quiz
Week 7	SLO 1 and 2	**Pattern of Inheritance** • Mendelian inheritance. • Sex-linked	• Understand the difference between genotype and phenotype • Understand how		

		inheritance	to use the principles of Mendelian Genetics to predict the genotype and phenotype of genetic crosses • Understand the difference between dominant traits and recessive traits • Understand the difference between dominance and incomplete dominance • Understand the difference between sex-linked traits and sex-influenced traits disorders • Explain what a chromosomal disorder is and how many chromosomes people normally have. • Explain what epigenetic changes are and give an example of an epigenetic change		
Week 8	SLO 1, 2 and 3	**<u>Molecular cloning techniques:</u>** • Splicing and joining DNA. • Separating DNA fragments. • Cloning vectors • Cell transformation • Construction and screening DNA libraries • Polymerase chain reaction revolutionized DNA technology	• Explain what cloning of a gene means • Explain what cDNA is • Explain what a plasmid is and why it is used in cloning • Explain why PCR is useful	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	1. Midterm 2. Classwork 3. Homework
Week 9	SLO 1, 2, 3 and 4	**<u>Protein biotechnology:</u>** • Protein structures • Protein engineering • Protein as biotechnology	• Explain how the function of a protein is dependent on the shape assumed by complex molecules • Explain structure of proteins • Understand that	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	1. Quiz 2. Classwork 3. Homework

		products	the shape of a protein depends not only on the protein's chemical structure but also on the action of other molecules present in the cell. • **Scientific literacy** • Article 7, 8		
Week 10	SLO 1, 2, 3, 4 and 5	**Biotechnology in agriculture**: • Plant tissue culture and applications. • Gene transfer in plants • GM plants with beneficial traits • Transgenic plants as bioreactors • GM plants and public concerns	**Scientific literacy** • Articles 4, 10, 11, 12, 13, 14, 16	• Scientific Article • Group discussion • Group assignments	
Week 10	SLO 1, 2, 3, 4 and 5	**Animal biotechnology:** • Animal cell culture • Gene transfer in animals • Bioengineered animals for beneficial traits/products • Bioethics in animal biotechnology	**Scientific literacy** Articles 15, 21, 38-40	• Scientific Article • Group discussion • Group assignments	
Week11	SLO 1, 2, 3, 4 and 5	**Biotechnology and Environment:** • Use of biotechnology in reducing the use of chemical pesticides, herbicides and fertilizers • Biosensors. • Restoration of degraded lands	• Bioremediation • Genetically engineered bacteria • Bioaugmentation • Biosensors to detect environmental pollutants • Articles, 17, 18, 20, 22	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	
Week 11	SLO 1, 2, 3, 4 and 5	**Aquaculture biotech:** • Transgenic fish • Economics of aquaculture • Medical applications • Public concerns	• Role of biotechnology in waterborne lives • Role of fishes in research and development • Role of aquatic lives	• Scientific Article • Group discussion • Group assignments	

		and issues	in nutrition and health		
Week 12	SLO 1, 2, 3, 4 and 5	**Stem cell technology:** • Types of stem cells • Cloning stem cells • Application of Stem cells • Controversy and legal issues	• Define embryonic stem cell and adult stem cell, • Explain how an adult stem cell • Explain at which stage of embryonic development form *in vitro* fertilization can you obtain embryonic stem cells? • Describe somatic cell nuclear transfer. • Articles 23, 24, 25, 26, 27	• Slides • Lecture • Recording • YouTube • Qs and As • Formative assessment • Survey	1. Quiz 2. Classwork 3. Homework
Week 12	SLO 1, 2, 3, 4 and 5	**Biotechnology in medicine:** • Disease diagnosis • Gene therapy • Vaccines and therapeutics • Regenerative medicine • Ribozyme application • Genetic testing and reproductive technology. • Human genome and its importance • Public concerns and issues	• Explain What does Diagnosis means. • Explain Why Gene Therapy is Powerful but so difficult • Explain Ribozyme • Similarly, Vaccines • Articles 30-35		
Week 13	SLO 1, 2, 3, 4, 5 and 6	**Forensics and DNA profiling** • Public concerns and DNA profiling • Industrial biotechnology • Industrial fermentation • Biotechnology products and processes • Bioconversions	•	• Scientific Article • Group discussion • Group assignments	
Week 13	SLO 1, 2, 3, 4, 5 and 6	**Biotechnology and Society:** • Regulations Patents and	• Explain patenting and regulation • Explain trademark • Discuss positive	• Slides • Lecture • Recording • YouTube	

		biotechnology Trade secret and trademark	and negatives of patenting	• Qs and As • Formative assessment Survey	
Week 14	SLO 1, 2, 3, 4, 5, 7 and 8	**<u>Biotechnology- moral and ethical perspectives:</u>** • Biotechnology and Nature • Safety and ethical ssues on reproductive echnology • Ethics and policies or human cloning	Scientific literacy • Article 3, 25, 26, 27, 38-40	• Scientific Article • Group discussion • Group assignments	**Final Exam** **Term paper**