

# Syllabus

## I. General Information

|                           |  |
|---------------------------|--|
| Instructor:               | Dr. Piotr Filipczak  |
| Phone/Email:              | 505-925-8876 / <a href="mailto:pfilipczak@unm.edu">pfilipczak@unm.edu</a>  |
| Office Hours (in-person): | Monday and Wednesday, 10:30 am to 12:00 am<br>Tuesday and Thursday, 1:00 pm to 2:00 pm   |
| Office Hours (online):    | Tuesday and Thursday, 2:00 pm to 2:30 pm<br><a href="https://unm.zoom.us/j/99097010790">https://unm.zoom.us/j/99097010790</a><br>Meeting ID: 990 9701 0790 |
| Office Number:            | VAAS 132A  |
| Course Section:           | 501  |
| Meeting Room:             | VAHS 110   |
| Meeting Time:             | Tuesday and Thursday (9:00 am to 12:45 pm)   |

## II. Course Description

Prerequisite: Biol 2710

The goal of this course is to provide theory and experience with protocols used to characterize and manipulate nucleic acids. This course will reinforce and build upon techniques learned in Biotechnology I. Techniques include DNA isolation and quantification, PCR, qPCR, gel electrophoresis, recombinant DNA technology, cloning, DNA sequencing, site-directed mutagenesis, tissue culture, and basic bioinformatics skills. Current issues and topics related to biotechnology will be explored.

## III. Resources

*Canvas (learning management system for communication, grades entry, resources navigation and selected assignments).*

## IV. Student Learning Outcomes

### **Outcome #1: Perform phenol-chloroform DNA isolation. Components:**

- Perform phenol-chloroform DNA isolation.
- Describe the function of the four basic steps of phenol-chloroform DNA isolation.
- Identify important technical considerations associated with working with DNA.

**Outcome #2: Analyze the quantity and quality of DNA in a sample. Components:**

- a. Describe how a spectrophotometer works.
- b. Utilize a spectrophotometer to quantify DNA samples.
- c. Interpret data provided by a spectrophotometer.
- d. Utilize an agarose gel to verify the quality of a DNA sample.

**Outcome #3: Utilize the polymerase chain reaction (PCR) to amplify and analyze genetic sequences. Components:**

- a. Explain the uses of the polymerase chain reaction and its importance in Biotechnology.
- b. Identify the essential components of a PCR reaction and technical consideration associated with their use.
- c. Explain the importance of primer design to the success of a PCR reaction.
- d. Describe the three steps of the PCR reaction e. Perform multiple PCR- based experiments and identify how PCR is used differently in those experiments.

**Outcome #4: Utilize real-time polymerase chain reaction (qPCR) to amplify and quantify a genetic sequence. Components:**

- a. Explain the fundamental principle underlying real-time PCR.
- b. Describe the applications of real-time PCR.
- c. Explain similarities and differences in real-time versus traditional PCR.
- d. Describe the different types of reporter methods used in real-time PCR.
- e. Conduct a real-time PCR experiment and interpret results.
- f. Explain the use of and interpret results from a Melt Curve Analysis.

**Outcome #5: Demonstrate the procedures required to determine the DNA sequence of a gene. Components:**

- a. Explain how the dideoxy or chain termination method of DNA sequencing works, both in manual and automated (i.e. dye terminator) sequencing reactions.
- b. Describe technical considerations associated with sequencing.
- c. Perform a sequencing reaction using fluorescently labeled dideoxynucleotides.
- d. Interpret a sequencing gel.
- e. Discuss goals and benefits of genome sequencing including the Human Genome Project.
- f. Describe the three steps of genome sequencing: preliminary sequencing, finishing and annotating.
- g. Describe "next generation" high-through put sequencing methods.

**Outcome #6: Perform the techniques required to clone a gene. Components:**

- a. Describe the process used to clone a gene.
- b. Identify the characteristics of a cloning vector.
- c. Perform a variety of previously learned techniques in order to clone a gene, including:
  - Ligation • bacterial transformation • antibiotic screening • mini-preps • restriction enzyme digestion
- d. Perform a variety of new techniques in order to clone a gene, including:
  - TA Cloning method • Blue-white screening.

**Outcome #7: Perform a PCR-based site-directed mutagenesis protocol. Components:**

- a. Define site-directed mutagenesis and explain the theory underlying PCR-based site-directed mutagenesis.
- b. Describe the uses of site-directed mutagenesis and its importance in biotechnology.
- c. Outline the function of the three steps utilized in PCR-based site-directed mutagenesis.
- d. Discuss technical considerations associated with site-directed mutagenesis, particularly primer design.
- e. Perform a site-directed mutagenesis experiment and interpret results.

**Outcome #8: Discuss techniques involved in DNA forensics and conduct a DNA fingerprinting protocol. Components:**

- a. Describe the basic premise underlying DNA forensics.
- b. Explain the uses of DNA forensics, including emerging uses.
- c. Explain what short-tandem repeat (STR) analysis is and why it is currently the forensic DNA technique of choice.
- d. Perform a basic DNA fingerprinting experiment (STR analysis) and interpret results.

**Outcome #9: Utilize online resources to perform basic bioinformatics tasks. Components:**

- a. Utilize Genbank to search for genomic sequences using gene name or accession number; interpret data found in Genbank entry and link to related entries.
- b. Utilize BLAST to compare genomic sequences, find unknown genomic sequences, and find homologous genes in different species; interpret data from BLAST search and link to related entries.
- c. Utilize on-line primer design software to design and evaluate PCR primers for a given genomic sequence.

**Outcome #10: Analyze scientific literature related to in-lab experiments. Components:**

- a. Explain aims and methods of assigned scientific papers.
- b. Interpret and critically analyze results and conclusions from scientific papers.
- c. Relate material found in literature to in-class experiments.

**Outcome #11: Discuss current topics of importance in Biotechnology. Components:**

Genetically Modified Organisms:

- a. Describe the impact of biotechnology and GM crops on the agricultural industry, both in the US and worldwide.
- b. Outline the pros and cons of GM crops, including environmental, societal, and health concerns.
- c. Identify GM crops currently available on the market, and those in production.
- d. Describe the role of the USDA and/or EPA in regulating genetically modified crops.
- e. Describe current regulations for labelling of biotechnology products.
- f. Describe methods used to identify GM crops including ELISA and PCR.

Gene therapy:

- a. Define gene therapy.
- b. Explain different methods used in gene therapy.
- c. Explain the history of gene therapy, including the current state of gene therapy in the U.S.
- d. Describe obstacles to using gene therapy in research and/or therapies.
- e. Outline ethical concerns associated with gene therapy.

**V. Course Requirements**

**Attendance:** In-person participation is required in this course. Student who missed 15% of a class time (which stands for 5 meetings) may be dropped by the instructor with a W, F or D (depending on the stage of the course).

**Technology & Computer Requirements:**

- Dependable computer
- Reliable internet connection
- Computer speakers
- Reliable web browser
- Microsoft Suite (PowerPoint and Word)
- Adobe Flash Player

## VI. Students Evaluation Criteria

| Type of Assignment:      | Points per Assignment: | Total Points in this Category: | Percentage of the Final Grade: |
|--------------------------|------------------------|--------------------------------|--------------------------------|
| Quizzes (6x)             | 10 pts                 | 60 pts                         | 20.0%                          |
| Lab Reports (10x)        | 10 pts                 | 100 pts                        | 33.4%                          |
| Oral Presentations (4x)  | 10 pts                 | 40 pts                         | 13.3%                          |
| Poster presentation (1x) | 30 pts                 | 40 pts                         | 13.3%                          |
| Final Exam               | 40 pts                 | 60 pts                         | 20.0%                          |
| <b>Total</b>             | <b>NA</b>              | <b>300 pts</b>                 | <b>100.0%</b>                  |

- **Quizzes:** Taken in class. One lowest score will be dropped from the final grade.
- **Lab Reports:** Completed digitally based on experimental procedures performed in class and submitted via Canvas.
- **Oral Presentations:** Given individually in class using a slide format.
- **Poster Presentation:** Created with a lab partner and presented at the UNM Valenica Research Symposium at the end of April 2025.
- **Final Exam:** To be completed in class during the final week of the course.

### Grading scale:

- 100 or higher: A+
- 94-99.99: A
- 90-93.99: A-
- 87-89.99: B+
- 83-86.99: B
- 80-82.99: B-
- 77-79.99: C+
- 73-76.99: C
- 70-72.99: C-
- 60-69.99: D
- below 60: F

## VII. Course Policies

**Academic Integrity:** All homework, quizzes and exams in this course must be completed by students as their original and individual work. No group work is allowed when it comes to completing these assignments. While taking quizzes and exams, only resources listed by the instructor (such as non-graphing calculator, scratch paper, periodic table etc.) are allowed. Use of any other resources such as (but not limited to) textbooks, smartphones and other electronics are forbidden. Plagiarism or cheating is not tolerated. Any instance of this will result in a grade of zero for that assignment. For more

details on academic integrity violation examples, please see the UNM Academic Dishonesty Policy: <https://policy.unm.edu/regents-policies/section-4/4-8.html>.

**Communication:** Email is the best way to contact your instructor. My typical response time is less than 24 hours during the workweek and less than 48 hours during the weekend. A summary of the most important information about the course will be posted every Monday via Canvas course shell. Small changes to the original schedule and course design are possible and will be announced by the instructor in a timely manner via Canvas or UNM-associated email.

**Accommodations:** UNM is committed to providing equitable access to learning opportunities for students with documented disabilities. As your instructor, it is my objective to facilitate an inclusive classroom setting, in which students have full access and opportunity to participate. To engage in a confidential conversation about the process for requesting reasonable accommodations for this class and/or program, please contact Accessibility Resource Center at [arcsrvs@unm.edu](mailto:arcsrvs@unm.edu) or 505-277-3506.

**UAP 2720 and 2740.** Our classroom and university should foster mutual respect, kindness, and support. If you have concerns about discrimination, harassment, or violence, please seek support and report incidents. Find confidential services at LoboRESPECT Advocacy Center, the Women's Resource Center, and the LGBTQ Resource Center. UNM prohibits discrimination on the basis of sex (including gender, sex stereotyping, gender expression, and gender identity). All instructors are "responsible employees" who must communicate reports of sexual harassment, sexual misconduct and sexual violence to Compliance, Ethics and Equal Opportunity. For more information, please see UAP 2720 and UAP 2740.

**Credit-hour statement:** This is a three-credit-hour course. Class meets for three 50-minute sessions/two 75-minute sessions of direct instruction for fifteen weeks during the Fall 2025 semester. Please plan for a minimum of six hours of out-of-class work (or homework, study, assignment completion, and class preparation) each week.

**Respectful Conduct Expectations:** I am committed to building with you a positive classroom environment in which everyone can learn. I reserve the right to intervene and enforce standards of respectful behavior when classroom conduct is inconsistent with University expectations [and/or classroom community agreements]. Interventions and enforcement may include but are not limited to required meetings to discuss classroom expectations, written notification of expectations, and/or removal from a class meeting. Removal from a class meeting will result in an unexcused absence. [Insert number] or more unexcused absences may result in permanent removal and a drop from the course (see attendance policy). The University of New Mexico ensures freedom of academic inquiry, free expression and open debate, and a respectful campus through adherence to the following policies: D75: Classroom Conduct, Student Code of Conduct, University Policy 2240 – Respectful Campus, University Policy 2210 – Campus Violence.

**Responsible Learning and Academic Honesty:** Cheating and plagiarism (academic dishonesty) are often driven by lack of time, desperation, or lack of

knowledge about how to identify a source. Communicate with me and ask for help, even at the last minute, rather than risking your academic career by committing academic dishonesty. Academic dishonesty involves claiming that work created by another source is your own original work. It is a Student Code of Conduct violation that can lead to a disciplinary procedure. When you use a resource in work submitted for this class, document how you used it and distinguish clearly between your original work and the material taken from the resource.

**Thriving and Finding Support:** Students are especially successful at UNM when they take advantage of support and get involved in campus and academic life. Your MyUNM login page provides direct links to wellbeing resources, including financial capability, mental health, food, jobs, and resource centers. MyUNM will help you identify academic resources like peer tutoring and opportunities like study abroad. You can contact academic advisors and resource advisors for information and guidance via Student Hub on MyUNM. I look forward to providing you with information about academic opportunities related to our class and to helping you find support resources.

VIII. Course Schedule

| Week | Meating Date                             | Topic  | Assignment |
|------|--|--|------------|
| 1    | 1/20<br>1/22                             | Course introduction.<br>Genomic DNA isolation and measurement.                     |            |
| 2    | 1/27<br>1/29                             | Designing primers for specific amplification of genomic DNA sequences.             | Quiz #1    |
| 3    | 2/3<br>2/5                               | Sequencing analysis of amplified DNA fragments.                                    |            |
| 4    | 2/10<br>2/12                             | Post-transcriptional silencing of gene expression using siRNA.                     | Quiz #2    |
| 5    | 2/17<br>2/19                             | Total RNA isolation, quantification and cDNA synthesis.                            |            |
| 6    | 2/24<br>2/26                             | Quantitative assessment of transcript levels using RT-qPCR.                        | Quiz #3    |
| 7    | 3/3<br>3/5                               | Research Project (i)   | Quiz #4    |
| 8    | 3/10<br>3/12                             | Research Project (ii)  |            |
| 9    | 3/17<br>3/19                             | <b>Spring Break – No Meetings</b>  |            |
| 10   | 3/24<br>3/26                             | Research Project (iii)   |            |
| 11   | 3/31<br>4/2                              | Research Project (iv)  |            |
| 12   | 4/7<br>4/9                               | Performing a site-directed mutagenesis via PCR amplification.                      |            |
| 13   | 4/14<br>4/16                             | Using RT-qPCR for comparative analysis of number of copies of genes.               | Quiz #5    |
| 14   | 4/21<br>4/23                             | Preparation of posters for the UNM-Valenica Undergraduate Research Symposium 2025. | Quiz #6    |
| 15   | 4/28<br>4/30                             | Immunodetection and quantification of protein levels using Western blot (i)        |            |
| 16   | 5/5<br>5/7                               | Immunodetection and quantification of protein levels using Western blot (ii)       | Quiz #7    |
| 17   | <b>Tuesday, 5/12<br/>9:00 – 11:00 am</b> | <b>Final Exam</b>  |            |