

## **MCBA 741**

Molecular Methods of Biomedical Research I  
Fall 2024

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### **Description**

Molecular methods. Students will be introduced to and trained in molecular techniques that could be utilized in a proteomics or genomics laboratory, including cell culture, RNA isolation and quantification, cDNA synthesis, PCR (quantitative, real-time, and endpoint), in situ hybridization, and molecular cloning.

### **Prerequisites**

There is no prerequisites for this course.

### **Learning Outcomes**

After successful completion of this course, you will be able to:

1. Isolate and quantify RNA and synthesize cDNA.
2. Run endpoint, real-time, digital, and quantitative PCR.
3. Perform in situ hybridization.
4. Perform TA cloning.

### **Required Texts**

All required course materials and laboratory manuals will be provided on the first day of class.

### **Course Assignments and Grading**

#### **Laboratory Reports**

Students will be expected to submit a total of 2 laboratory reports during the semester. Report information will be based on lecture and lab results. Lab report 1 will be based on in-situ hybridization. Lab report 2 will be based on TA cloning.

#### **Quizzes**

Quizzes will be a combination of multiple choice and short-answer questions on lecture material from the previous week. If you are paying attention in lectures, and studying the

PowerPoints, the quizzes will be an excellent way to bolster your course grade. However, if you miss class or are tardy when the quiz is given, you cannot make it up later.

### **Evaluation and Grading Scale**

All graded materials will be promptly graded and returned. All grades will be posted on Blackboard. You are strongly encouraged to check your scores in Blackboard regularly. A final letter grade will be assigned based on percentages.

<b>Assignment Weights</b>	<b>Percent</b>
Lab Participation	22%
Quizzes	18%
Report 1	30%
Report 2	30%
Total	100%

Lab Participation (14 labs @ 10 points) = 140 points

Quizzes (12 quizzes @10 points) = 120

Report 1= 200 points

Report 2 = 200 points

**Total Points - 660 points**

### **Grading Scale**

89.5% - 100% = A

84.5% - 89.4% = B+

79.5% - 84.4% = B

74.5% - 79.4% = C+

69.5% - 74.4% = C

64.5% - 69.4% = D+

59.5% - 64.4% = D

0% - 59.4% = F

### **Course Policies and Procedures**

All graduate students are subject to the academic policies, regulations, and academic standards of both The Graduate School and the department, school and/or college in which enrolled.

[USC graduate bulletin](https://academicbulletins.sc.edu/graduate/policies-regulations/graduate-academic-regulations) (https://academicbulletins.sc.edu/graduate/policies-regulations/graduate-academic-regulations)

### **Attendance Policy**

When you miss class, you miss important information. If you are absent, you are responsible for learning material covered in class. If you have an [excused absence](https://academicbulletins.sc.edu/undergraduate/policies-regulations/undergraduate-academic-regulations) (<https://academicbulletins.sc.edu/undergraduate/policies-regulations/undergraduate-academic-regulations>), you will be permitted to make up coursework or complete an equivalent assignment agreed upon with me.

To arrange excuses for absences that can be anticipated at the start of the term, you should:

- Submit a request in writing (email is acceptable) stating the dates of the anticipated absence no later than the end of the second week of the course.
- Explain the reason for absence. In some cases, documentation may be required. Please [consult the policy](https://academicbulletins.sc.edu/undergraduate/policies-regulations/undergraduate-academic-regulations) (<https://academicbulletins.sc.edu/undergraduate/policies-regulations/undergraduate-academic-regulations>) for additional information.
- Include any request for make-up work.

To arrange excuses for absences that cannot be anticipated at the start of the term, (e.g. legal proceedings or illness), you should, at the first opportunity, submit in writing a request stating:

- The date of absence
- The reason for absence. In some cases, documentation may be required. Please [consult the policy](https://academicbulletins.sc.edu/undergraduate/policies-regulations/undergraduate-academic-regulations) for additional information.
- Any request for make-up work as soon as reasonably possible after you become aware of the need to be absent.

### **Academic Integrity**

As a partner in your learning, it is important to both of us that any assignment submission is a pure reflection of your work and understanding. The introduction of artificial intelligence options to complete academic work jeopardizes my ability to evaluate your understanding of our course content and robs you of the ability to master the subject matter.

Suspicious of use of artificial intelligence aids will be referred to the Office of Academic Integrity as alleged violations of Cheating, defined as “unauthorized assistance in connection with any academic work” and/or Falsification, which includes “Misrepresenting or misleading others with respect to academic work or misrepresenting facts for an academic advantage”.

You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation will result in a minimum academic penalty of your failing the assignment, and will result in additional disciplinary measures. This includes improper citation of sources, using another student's work, and any other form of academic misrepresentation.

The first tenet of the Carolinian Creed is, "I will practice personal and academic integrity."

Below are some websites for you to visit to learn more about University policies:

- [Carolinian Creed](http://www.sa.sc.edu/creed) (http://www.sa.sc.edu/creed)
- [Academic Responsibility](http://www.sc.edu/policies/staf625.pdf) (http://www.sc.edu/policies/staf625.pdf)
- [Office of Student Conduct and Academic Integrity](https://www.sa.sc.edu/academicintegrity/) (https://www.sa.sc.edu/academicintegrity/)
- [Information Security Policy and Standards](https://sc.edu/about/offices_and_divisions/division_of_information_technology/security/policy/universitypolicy/) (https://sc.edu/about/offices\_and\_divisions/division\_of\_information\_technology/security/policy/universitypolicy/)

## Disability Services

[Student Disability Resource Center](http://www.sa.sc.edu/sds/) (http://www.sa.sc.edu/sds/): The Student Disability Resource Center (SDRC) empowers students to manage challenges and limitations imposed by disabilities. Students with disabilities are encouraged to contact me to discuss the logistics of any accommodations needed to fulfill course requirements (within the first week of the semester). In order to receive reasonable accommodations from me, you must be registered with the Student Disability Resource Center (1705 College Street, Close-Hipp Suite 102, Columbia, SC 29208, 803-777-6142). Any student with a documented disability should contact the SDRC to make arrangements for appropriate accommodation.

## Mental Health

If stress is impacting you or getting in the way of your ability to do your schoolwork, maintain relationships, eat, sleep, or enjoy yourself, please reach out to any of our mental health resources. Most of these services are offered at no cost as they are covered by the Student Health Services tuition fee. For all available mental health resources, check out [Student Health Services Mental Health](https://www.sc.edu/about/offices_and_divisions/health_services/mental-health/index.php) (https://www.sc.edu/about/offices\_and\_divisions/health\_services/mental-health/index.php) and the quick reference list below.

- Wellness Coaching can help you improve in areas related to emotional and physical wellbeing (e.g., sleep, resiliency, balanced eating and more) – schedule an appointment at (803) 777-6518 or on [MyHealthSpace](https://myhealthspace.ushs.sc.edu/login_dualauthentication.aspx) (https://myhealthspace.ushs.sc.edu/login\_dualauthentication.aspx)
- Access virtual self-help modules via [Therapy Assistance Online \(TAO\)](https://us.taoconnect.org/register) (https://us.taoconnect.org/register) – see [TAO registration instructions](https://www.sc.edu/about/offices_and_divisions/health_services/medical-services/counseling-and-psychiatry/online-support/index.php) (https://www.sc.edu/about/offices\_and\_divisions/health\_services/medical-services/counseling-and-psychiatry/online-support/index.php).
- Access additional articles and videos on health and wellness topics on the Wellness Hub, [thriveatcarolina.com](http://thriveatcarolina.com), or by downloading the [CampusWell](https://www.campuswell.com/) (https://www.campuswell.com/) app and searching for University of South Carolina.

- Counseling & Psychiatry offers individual and group counseling and psychiatric services – schedule an appointment at (803) 777-5223 or on [MyHealthSpace](#) ([https://myhealthspace.ushs.sc.edu/login\\_dualauthentication.aspx](https://myhealthspace.ushs.sc.edu/login_dualauthentication.aspx)).
- Access the 24-hr Mental Health Support Line at (833) 664-2854.
- Access an anonymous [mental health screening program](#) (<https://www.uscscrining.org/welcome.cfm?access=website>)

## Course Schedule

### Week 1: August 28

#### Lecture:

1. Introduction to the IRF, Rules for use of IRF, Course Requirements (**Worden**)
2. Basic methods involved in Molecular Biology (**Potts**)
3. Basic calculations (**Junor**)

#### Lab:

1. Pipetting
2. Weighing and making buffers
3. Use of pH meter

### Week 2: September 4

#### Lecture – Labor Day

NO LECTURE

### Week 3: September 11

#### Lecture: (Potts)

1. RNA isolation and quantification
2. cDNA synthesis

#### Lab:

1. Basic cell culture practices and techniques

#### Lab:

1. RNA isolation and quantification
2. cDNA synthesis

### Week 4: September 18

#### Lecture: (Potts)

1. End-point and qPCR, PCR arrays (**Potts**)
2. Primer design for qPCR (**Potts**)

#### Lab:

1. End-point PCR (run PCR reaction on Monday)
2. Analysis of PCR products on agarose gel
3. Use of Gel Doc imaging system

**Week 5: September 25****Lecture: (Potts)**

1. RTPCR
2. Efficiency curves

**Lab:**

1. qPCR
2. Primer efficiency for PCR

**Week 5: October 2****Lecture: (Potts)**

3. Digital PCR

**Lab:**

2. Digital PCR

**Week 6: October 9****Lecture: (Potts)**

1. In Situ Hybridization

**Lab:**

1. In situ Hybridization – Making probes

**Week 7: October 16****Lecture: (Potts)**

1. Basic Molecular Cloning

**Lab:**

1. Run second gel
2. Make T7 probe
3. Quantification of T7 labeled probe

**Week 8: October 23****Lecture: (Altamare)**

1. Microarrays

**Lab:**

1. In situ Hybridization – Begin In situ protocol on embryos

**Week 10: October 30****Lecture:**

1. Epigenetics (**Kathrein**)

**Lab:**

1. Over-view of TA cloning labs (**Potts/Junor**)
2. Isolation of total RNA (using TRIzol) from zebrafish embryonic tissue
3. RNA quantification
4. cDNA synthesis

### **Week 11: November 6**

Lecture: (**Buckhaults**)

1. Next Gen Sequencing

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## -----MOLECULAR (TA) CLONING LABS-----

**Lab:**

1. TA cloning

### **Week 12: November 13**

Lecture: (**Kumar**)

1. DNA manipulation

**Lab:**

1. Genomic DNA extraction from chick embryo
2. End-point PCR

### **Week 13: November 20**

Lecture: (**Tan**)

1. Exosomes and use in medicine

**Lab:**

1. Agarose gel electrophoresis
2. Transfection of plasmids

### **Week 14: November 27**

Student Presentations

### **Week 15: December 4**

Lecture: (**Pujhari**)

1. Viral construction

**Lab:**

1. Finish Transformation
2. Agarose gel electrophoresis
3. Transfection of plasmids

### **Week 15: December 11**

Wrap up and final quiz