

Program Description: HeartQuest is part of the Edwards Lifesciences Foundation Cardiovascular Innovation & Research Center (CIRC) in the School of Engineering and is an intensive nine-day program that immerses motivated high school students in the science and practice of cardiovascular research. Most students begin research without formal training in what it means to do research, what is expected from them, or how to conduct research. To address this need, HeartQuest blends university-level instruction and ‘choose your own adventure’ style research projects to teach how the heart, blood vessels, and blood sustain life while building technical, analytical, and communication skills essential for research. By the end of the program, students will 1) understand core cardiovascular physiology through the lens of an engineer, 2) learn fundamental laboratory techniques and practice analyzing and interpreting data, 3) critically evaluate primary literature and communicate their findings, and 4) develop a clear roadmap for pursuing research in college. This curriculum was designed to build the skills that UC Irvine faculty value when onboarding new undergraduate researchers.

Overview: In the first half of HeartQuest, students will develop the fundamental skills to find and critically read scientific journal articles, while learning to analyze and interpret data from core laboratory techniques. In the second half of the course, students will apply this knowledge in a course-based research project while learning about advanced topics in cardiovascular engineering. Students will also gain training in the philosophy of what it means to be a researcher. These objectives will be accomplished through the following modules.

Module 1 – Research Professionalism and Ethics

Learning Objective: Identify the roles, responsibilities, and expectations for researchers conducting biomedical research. Students learn the professional standards that govern research, including laboratory safety, responsible conduct, data integrity, authorship, reproducibility, and rigorous documentation. Students will learn how to find the right research environment for themselves and what it means to be a researcher.

Module 2 – Biomedical Literature Review

Learning Objective: Students will learn how to navigate biomedical databases, recognize the structure of a research paper, and distinguish between review and primary research articles. Through guided reading, figure dissection, and small-group discussions, they will practice extracting key information from complex papers, connecting experimental data to broader concepts in cardiovascular physiology. Students will be able to summarize a paper in their own words, ask informed questions about study design, and use literature to motivate and refine their own research ideas.

Module 3 – Fundamental Laboratory Techniques

Learning Objective: Analyze data from real research experiments to make and defend claims, using appropriate statistics and publication-style figures, and stating assumptions and limitations. Through this module, students will learn about standard molecular biology techniques used in the laboratory, including Western blot, polymerase chain reaction, and immunofluorescence. They will also learn how to use FIJI to analyze data and GraphPad Prism to visualize and statistically test data.

Module 4 – Cell Culture Foundations

Learning Objective: Perform aseptic cell culture and troubleshoot common problems to maintain healthy, contamination-free cultures. Students gain hands-on experience in aseptic technique, biosafety cabinet workflow, and seeding, passaging, and maintaining cell culture.

Module 5 – Topics in Cardiovascular Engineering

Learning Objective: Learn how different biomedical engineering labs investigate cardiovascular health and evaluate how engineering approaches (e.g., computational modeling, mechanobiology, biosensing) are used to study cardiovascular function. Through lab tours and research overviews, students will connect laboratory methods to cardiovascular questions and identify areas of research they want to contribute to in the future.

Module 6 – Course-Based Research Experience

Learning Objective: Develop and evaluate a testable hypothesis for a biomedical problem, justify key design and analysis choices, and communicate evidence-based conclusions. Students will be presented with an experimental problem and will make decisions that affect the research results, data analysis, and conclusions. Unlike traditional teaching labs, students will engage in open-ended research, asking questions with unclear answers, providing an authentic and guided research experience.

Week 1 Program Overview

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
GMT-07 8 AM								
9 AM		Arrival Time						
10 AM	Homework • Get UCINetID • Complete biosafety training • Download Prism and Fiji	Program Overview	Building on the Research of Others	Biomedical Engineering Laboratory Tours I	Responsible Conduct of Research	Biomedical Engineering Laboratory Tours II		
11 AM		How to Find Research Opportunities	Biomedical Literature Search 101	Journal Club Western Blot	Journal Club Immunofluorescence	Course-Based Research Experiment		
12 PM		Lunch	Lunch	Lunch	Lunch	Lunch		
1 PM		PPE Fitting / Lab Safety / CIRC Tour	Technical Training: Western blot	Technical Training: RT-PCR	Technical Training: Immunofluorescence	Cell Culture Training: Aseptic Technique + Lab		
2 PM		Departure Time						
3 PM						Homework • Choose PVAT for research project		
4 PM								
5 PM								
6 PM								
7 PM								

Week 2 Program Overview

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
GMT-07 8 AM								
9 AM		Arrival Time						
10 AM		Presentation 101	Biomedical Engineering Laboratory Tours III	Becoming a Researcher	Finding the Right Research Position for You	Holiday / No Class July 3, July 17, August 7		
11 AM		Course-Based Research Experiment	Course-Based Research Experiment	Course-Based Research Experiment	Course-Based Research Experiment Presentations			
12 PM		Lunch	Lunch	Lunch	Lunch			
1 PM		Cell Culture Training: Working in a BSC	Cell Culture Training: Cell Counting / Seeding	Cell Culture Training: Passaging	How to Find Research Opportunities (Part II; Reflection)			
2 PM					Award Ceremony (Certificates)			
3 PM		Departure Time						
4 PM		Homework • Choose TNFa Dose for research project	Homework • Choose smooth muscle cell assays for research project	Homework Prepare Presentation				
5 PM								
6 PM								
7 PM								

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| <ul style="list-style-type: none"> Module 1 – Research Professionalism and Ethics Module 2 – Biomedical Literature Review Module 3 – Fundamental Laboratory Techniques | <ul style="list-style-type: none"> Module 4 – Cell Culture Foundations Module 5 – Topics in Cardiovascular Engineering Module 6 – Course-Based Research Experience |
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