



Dublin City Schools
Biomedical Research Academy
Framework
2026

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Academy Framework**

BIOMEDICAL RESEARCH ACADEMY

Overview

The Biomedical Research Academy is an integrated immersion in biology, research, anatomy, physiology, and art. The program is designed for students with a strong interest in pursuing careers in medicine, nursing, research, or other allied health science fields. Through an inquiry and problem-based approach, students build a solid foundation in the biomedical sciences applied by professionals in the field. They explore career pathways through hands-on experiences, laboratory simulations, guest speakers, field trips, and professional networking. Each student designs, conducts, and presents a year-long biomedical research study on a topic of personal interest.

The Biomedical Research Academy explores the following ideas:

- Structure determines function in living systems from molecules to organisms.
- Homeostasis and regulation are essential for survival and health.
- Scientific inquiry drives discovery, requiring curiosity, evidence, and revision.
- Human health is interconnected with genetics, environment, and behavior.
- Technology transforms medicine, from microscopy to biomedical engineering.
- Data informs decisions in research, diagnosis, and treatment.
- Innovation solves real problems in healthcare and biology.
- Communication is essential for scientists, clinicians, and researchers.
- Ethics guide biomedical advancement and patient care decisions.
- Reflection deepens understanding of science and the human experience.

This Academy includes a robust laboratory experience for students related to the course goals.

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Molecules, Cells, and the Foundation of Life Content Themes Course Goals: Students are introduced to the fundamental characteristics of life, from the molecular to the cellular level, with an emphasis on structure/function relationships and placed in an evolutionary context. This course explores topics including chemicals of life, cell biology, bioenergetics, cell cycle, genetics, DNA replication, protein synthesis, and gene regulation.	
Topic	Key Focus/Skills
Foundations of Life & Scientific Observation Students use scientific inquiry to make observations, develop questions, and analyze data to explain patterns in living systems.	Explain the chemistry of life and how it supports biological systems. Describe cell structure and function. Use microscopy tools to observe and analyze cells. Develop research questions based on scientific concepts. Apply foundational research skills to investigate topics. Make accurate scientific observations. Document findings clearly and effectively.
Evolution & Chemistry of Life Students explain how chemical principles and evidence support the theory of evolution and the diversity of life.	Explain the principles of evolution. Describe the structure of atoms and how chemical bonds form. Analyze the properties of water and the pH scale.
Biological Macromolecules Students model how the structure of biological macromolecules determines their function in living organisms.	Compare the structure and function of carbohydrates and lipids. Explain the role of nucleic acids in storing genetic information. Describe how protein structure relates to function.

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<p>Cell Structure & Function Students investigate how different cell types and internal structures work together to maintain life and support cellular processes.</p>	<p>Distinguish between prokaryotic and eukaryotic cells.</p> <p>Explain the function of organelles, including the endomembrane system.</p> <p>Describe the roles of the cytoskeleton and cell connections.</p> <p>Analyze membrane structure and function.</p>
<p>Energy & Metabolism Students examine how organisms capture, transform, and use energy to fuel biological processes and maintain homeostasis.</p>	<p>Explain how energy is transferred through chemical reactions and ATP.</p> <p>Describe how enzymes regulate metabolic processes.</p>
<p>Cell Division Students analyze how cells grow, replicate, and divide, and how these processes ensure continuity and variation in living organisms.</p>	<p>Describe the stages of the cell cycle, including interphase and mitosis.</p> <p>Explain the mechanisms that regulate the cell cycle.</p> <p>Compare and contrast the processes of mitosis and meiosis.</p>
<p>Cellular Respiration & Photosynthesis Students explore how energy is stored and released in living systems through interconnected processes that sustain life.</p>	<p>Explain the stages of cellular respiration.</p> <p>Compare aerobic and anaerobic processes.</p> <p>Describe the processes of photosynthesis, including light reactions and carbon fixation.</p>
<p>Genetics & Inheritance Students investigate how traits are passed from one generation to the next and how variation occurs within populations.</p>	<p>Apply Mendelian principles to predict inheritance patterns.</p> <p>Analyze non-Mendelian inheritance patterns.</p> <p>Explain how sex-linked traits and genetic mapping work.</p>

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	Describe epigenetics and genetic diseases.
DNA & Gene Expression Students examine how genetic information is stored, copied, and used to direct the structure and function of organisms.	Describe the structure and function of DNA. Explain DNA replication and biotechnology applications like PCR. Analyze gene expression, including transcription and translation. Explain how mutations occur and how DNA is repaired.
Gene Regulation & Communication Students analyze how cells control gene activity and communicate with one another to coordinate complex functions.	Compare gene regulation in prokaryotes and eukaryotes. Explain how cells communicate through signaling pathways.
Microbiology Students study microscopic organisms to understand their structures, functions, and impacts on living systems and the environment.	Describe the structure and function of prokaryotes. Explain how viruses replicate and impact living organisms.

College Biology Research & Application

Course Goals:

This course extends biological concepts into college-level study of human anatomy, physiology, and biomedical research. Students investigate the structures, processes, and interactions of human body systems to understand how they work together to maintain homeostasis and respond to imbalance. Through a problem-based and inquiry-driven approach, students design and conduct experiments, collect and analyze data, and apply research methods to real-world biomedical challenges. Key concepts may include coordination and communication (skeletal, muscular, endocrine, and nervous/sensory systems), metabolism (cardiovascular, respiratory, and digestive systems), protection (immune and lymphatic systems), and

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reproduction. The course culminates in the completion, submission, and presentation of an experimental research project that connects anatomy, physiology, and biomedical investigation.	
Topic	Key Focus/Skills
Select Sufficient and Relevant Sources of Information	Students must select sufficient and relevant biological and medical sources for their culminating project, considering the reliability of the source.
Formulate Research Questions and Hypotheses	The research questions developed for the culminating project (Research Question Development) must be specific to identify relevant variables and biological systems, including stating null and alternative hypotheses.
State and Explain Predictions	State and explain predictions for the culminating research project using background knowledge of core biology principles and their relation to hypotheses.
Demonstrate Creativity	Demonstrate creativity in the design, implementation, and presentation (Capstone Symposium & Exhibit) of the culminating project investigation, ensuring the research questions demonstrate personal interest in biology or real-world relevance.
Develop Investigations	<p>Develop the culminating project investigation using appropriate methods (hands-on laboratory experiments, databases, simulations, or modeling) relevant to biology.</p> <p>Identify and justify the choice of dependent, independent, and control variables.</p> <p>Justify the range and quantity of measurements. Reasoning for the selection of the range of the independent variable will be provided.</p>
Design and Explain	<p>Design and explain a valid methodology for the culminating project that clearly demonstrates validity, reliability, specificity, and accuracy in a biology context.</p> <p>Methods should be clearly written to allow for procedures to be repeated and verified by others.</p> <p>All relevant variables that could impact the results are controlled.</p>

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Appreciate to Reduce Bias	Appreciate when and how to reduce bias in the culminating project study design, utilizing methods common in biology research such as blind/double-blind studies, addressing the placebo effect, and randomizing groups/test subjects.
Appreciate to Reduce Effects	Appreciate when and how to reduce the confounding effects of human factors (e.g., age, sex, nutrition, motivation) on physiological performance within a biology study, especially as related to the Culminating Project's Human Being Project or other human-focused studies.
Appreciate to Calibrate	Appreciate when and how to calibrate measuring apparatus for the culminating project to increase the accuracy of the biology data collected.
Identify and Record	Identify and record relevant qualitative observations for the culminating project, noting that this data, though not statistically analyzed, provides important supplementary biology information.
Collect and Record	Collect and record sufficient relevant quantitative biology data for the culminating project, understanding that large sample sizes help strengthen confidence that what is being measured is a true representation of the population.
Identify and Address Issues	Identify and address issues that arise during culminating project data collection (Data Collection & Analysis), recognizing that both internal and external factors influence biology measurements, with some being confounding and others controllable in lab settings.
Compare the Outcomes	Compare the outcomes of the culminating project investigation to the accepted scientific context in biology, relating findings to previously cited research and explaining any agreement or disagreement.
Relate the Outcomes	Relate the outcomes of the culminating project investigation (Capstone Symposium & Exhibit) to the stated research question or hypothesis, ensuring collected biology data addresses the question and is explained using scientific principles.

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Biomedical Art

Course Goals:

Students will work with a variety of materials, subjects, and techniques to create artwork inspired by concepts and experiences from the Biomedical Research Academy. In this project-based course, students explore the intersection of art and science, using the creative process to express ideas and visualize scientific concepts through art-making.

High School Enduring Understandings:

Creating: Artists use creative thinking and reasoning skills to perceive concepts and ideas to develop works.

Performing: Artists employ personal processes and skills to solve problems creatively and present work in various contexts.

Responding: Artists engage in analysis and interpretation to understand and evaluate artistic works.

Connecting: Artists understand and communicate the value of creative expressions in internal and external contexts.

Topic	Achievement Level	Standard
Creating	Proficient	HSP.1CR Evaluate various sources for visual reference. HSP.2CR Explore multiple solutions to artistic problems. HSP.3CR Identify visual literacy strategies as a means to communicate concepts. HSP.4CR Determine and apply what it means to create and share works of art ethically.
	Intermediate	HSI.1CR Develop a practice of engaging with sources for idea generation. HSI.2CR Select the appropriate creative processes for potential solutions to artistic problems. HSI.3CR Explore visual literacy strategies as a means to develop individual communication. HSI.4CR Develop a practice of ethical use of visual resources.
	Accomplished	HSAC.1CR Utilize sources to conceptualize a personally relevant idea. HSAC.2CR Develop aesthetic and stylistic solutions to artistic problems through preparatory work. HSAC.3CR Expand visual literacy strategies to express personal meaning. HSAC.4CR Utilize practices that protect personal works of art from unethical use.
	Advanced	HSAD.1CR Utilize multiple sources to establish a central theme for a body of work. HSAD.2CR Determine potential solutions for artistic problems with independence and purpose.

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		HSAD.3CR Synthesize visual literacy strategies to fluently communicate meaning. HSAD.4CR Defend the ethical incorporation of visual resources in personal works of art.
Performing	Proficient	HSP.1PE Determine appropriate levels of artisanship through persistence. HSP.2PE Demonstrate increasing skill with materials and techniques. HSP.3PE Integrate selected elements of art and principles of design to construct works of art. HSP.4PE Select works of art for a foundational portfolio.
	Intermediate	HSI.1PE Refine levels of artisanship while modeling persistence. HSI.2PE Apply and defend the selection of materials and techniques. HSI.3PE Organize the elements of art and principles of design to intentionally construct works of art. HSI.4PE Select, prepare, and present works of art for a portfolio.
	Accomplished	HSAC.1PE Demonstrate skilled artisanship through persistence. HSAC.2PE Broaden the selection of materials and techniques while demonstrating technical skills. HSAC.3PE Use selected elements of art and principles of design to inform personal style. HSAC.4PE Determine criteria used in the personal selection of works of art for an accomplished portfolio.
	Advanced	HSAD.1PE Initiate sophisticated levels of artisanship through self-motivated persistence. HSAD.2PE Justify the intentional selection of materials and techniques while exhibiting advanced technical skills. HSAD.3PE Shape a body of work with independently selected elements of art and principles of design. HSAD.4PE Justify the selection of individual pieces for a portfolio of cohesive work.
Responding	Proficient	HSP.1RE Increase relevant vocabulary to describe and analyze components related to visual art. HSP.2RE Engage with self-assessment to set and monitor goals to document personal growth. HSP.3RE Utilize art criticism methods when responding to works of art. HSP.4RE Identify the relationships between community or cultural values and trends in visual art.

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	Intermediate	HSI.1RE Expand relevant vocabulary to analyze and interpret works of art. HSI.2RE Apply self-assessment and goal-setting practices to revise artworks and document personal growth. HSI.3RE Develop art criticism methods when responding to artworks. HSI.4RE Explain the relationship between cultures, communities, and artists.
	Accomplished	HSAC.1RE Apply relevant vocabulary to interpret and evaluate works of art. HSAC.2RE Refine self-assessment and goal-setting strategies to understand progress and prioritize steps for improvement. HSAC.3RE Use art criticism methods independently when responding to works of art. HSAC.4RE Analyze the work of individual artists and explain how they are influenced by cultural factors.
	Advanced	HSAD.1RE Utilize relevant vocabulary to interpret, evaluate, and defend works of art. HSAD.2RE Provide evidence of self-assessment and goal setting throughout the production of artworks. HSAD.3RE Develop a personal art criticism method to defend the merits of works of art. HSAD.4RE Justify how individual artists impact cultural developments.
Connecting	Proficient	HSP.1CO Understand how works of art reflect diverse communities, viewpoints, and perspectives. HSP.2CO Recognize contributions of the visual arts in everyday life. HSP.3CO Examine personal and social contexts related to works of art. HSP.4CO Examine various aesthetic theories and visual culture.
	Intermediate	HSI.1CO Explore how works of art can impact issues relevant to various communities. HSI.2CO Connect universal themes in the visual arts to personal life experiences. HSI.3CO Investigate emotional experiences through personal and collaborative artistic processes. HSI.4CO Compare aesthetic theory and visual culture to inform personal aesthetic development.
	Accomplished	HSAC.1CO Articulate evidence of how works of art impact communities. HSAC.2CO Assess the impact of advocacy in the visual arts personally and professionally. HSAC.3CO Analyze the personal impact of art experiences.

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		HSAC.4CO Develop a personal philosophy of art based on aesthetic theory and an understanding of visual culture.
	Advanced	HSAD.1CO Develop strategies for artmaking that impact communities. HSAD.2CO Demonstrate personal strategies for lifelong involvement and advocacy in the visual arts. HSAD.3CO Predict potential impact and responses to works of art based on contextual considerations. HSAD.4CO Defend a personal philosophy of art based on aesthetic theory and visual culture.

Culminating Experience

In this problem based inquiry capstone, students will pick a medical problem to explore in depth while integrating all learning from the Biomedical Academy. Through quality research and analysis, students will prototype their proposed solution.

Topic	Student Competencies
Scientific Observation Launch	Learn lab tools, microscopy, and anatomical terminology. <ul style="list-style-type: none"> Deliverable: Observation sketches and scientific notebook setup
MicroArt Project	Create artistic representations of microscopic structures to strengthen observation and precision. <ul style="list-style-type: none"> Deliverable: MicroArt piece + mini research abstract
Research Question Development	Develop ARIS research questions and background research. <ul style="list-style-type: none"> Deliverable: Research question proposal
Medical Illustration Project	Translate biological processes into visual explanations (cardio/respiratory focus). <ul style="list-style-type: none"> Deliverable: Medical illustration + lab report
Research Proposal Submission Biomedical Engineering Design Launch	Finalize experimental plans and pilot testing. <ul style="list-style-type: none"> Deliverable: Formal research proposal Explore genetics, physiology, and biomedical problems. <ul style="list-style-type: none"> Deliverable: Prototype concept and research progress update

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Innovation Prototype Development	Design and test solutions related to biomedical challenges. <ul style="list-style-type: none"> • Deliverable: Prototype + presentation
Data Collection & Analysis	Refine methods and analyze research results. <ul style="list-style-type: none"> • Deliverable: Data analysis report and presentation practices
Human Being Project	Reflect on biology, identity, and health through artistic expression. <ul style="list-style-type: none"> • Deliverable: Biomedical reflection artwork
Capstone Symposium & Exhibit	Present research findings and artwork to authentic audiences. <ul style="list-style-type: none"> • Deliverable: Final research paper, poster presentation, and art exhibit