LABORATORY RESEARCH PROGRAMS

Curriculum Guide

*Hands-on laboratory science programs for middle school, high school, and undergraduate learners for the **2026 - 2027** school year*

Our Mission

InnovaTEEN's mission is to expand access to meaningful research experiences for students, with a focus on underserved communities. Programs connect learners with laboratory environments, scientific tools, and opportunities to learn through hands-on investigation.

Flexible Teaching Approach

Teaching styles are unique, and the curriculum may be adjusted to best suit student interests, learning needs, and the direction of each program. The timings of each section in the K-12 programs are a general guideline and will not exceed two hours. Exceptions are discussed with guardians beforehand.

Program Website: innovateen.org

Curriculum Scope: Molecular Foundations, DNA Exploration, Genetic Analysis, and undergraduate opportunities

Program Framework

InnovaTEEN provides hands-on research experiences that build practical laboratory confidence and scientific thinking. With a focus on underserved communities, the organization works to make laboratory learning and research participation more accessible. This guide is organized by program module as listed on the website rather than by meeting number, which was the legacy version.

What Students Will Learn in All Programs

- Essential laboratory techniques
- Data analysis and interpretation
- Scientific presentation and communication

Eligibility

Middle School Modules

- Currently enrolled as a 6^{th} - 8^{th} grader in school
- Either currently or have already taken a science class

High School Modules

- Currently enrolled as a 9^{th} - 12^{th} grader in school
- Either currently or have already taken Biology
- Either currently, have already, or plan on taking Chemistry, Advanced Biology, or Physics 1, Physics 2, Physics C: Mechanics, or Physics C: Electricity and Magnetism. Exceptions are allowed, contact us for more information.

Undergraduate Modules

- Have received a high school diploma or completed high school and over 18 years old
- Either currently or plan on attending a post secondary institution within one year of program

Program Guide

Program	Level	Program Focus
Molecular Foundations	Middle School	Laboratory foundations
DNA Exploration	High School	DNA methods
Genetic Analysis	High School	PCR and analysis
Applied Laboratory Science	Undergraduate	Independent student project
Research Internship Practicum	Undergraduate	Active laboratory projects

MIDDLE SCHOOL MODULE

Molecular Foundations

Students gain hands-on experience with essential laboratory techniques through guided activities involving instrument handling, solution chemistry, sterile technique, and safe laboratory practice.

Eligibility: Middle school students

Format: Each section meets for up to 2 hours and is scheduled across a one-month long duration

What You Will Learn

- Safe laboratory conduct and appropriate use of personal protective equipment
- Purpose and operation of common laboratory equipment
- Buffer and pH concepts, including practical measurement
- Aseptic technique and safe work in a cell culture hood

Curriculum Sections

Laboratory Equipment Use | 1 ½ hours

Students become familiar with the design of a laboratory, expected work practices, and the proper supervised use of common tools.

- Equipment includes pipettes, measuring cylinders, glassware, burettes, burners, pH meters, centrifuges, culture flasks, and related controls.
- Instruction covers glassware care, labeling, Safety Data Sheets, hazard symbols, chemical compatibility, protective equipment, emergency equipment, and waste segregation.

Buffers: Theory and Hands-on Preparation | 2 hours

Students learn that a buffer combines a weak acid with its conjugate base, or a weak base with its conjugate acid, to resist changes in pH.

- The discussion introduces how buffer components respond when hydrogen or hydroxide ions are added.
- Students connect buffer effectiveness to the acid dissociation constant and the useful range around pKa.

pH: Theory | 1 hour

Students study pH as a logarithmic measure of active hydrogen ions in solution and distinguish acidic, neutral, and basic conditions.

- The session explains that each whole pH unit represents a tenfold change.
- Students compare strong substances that dissociate completely with weak substances that establish an equilibrium in water.

pH: Hands-on Preparation and Measurement | 1 ½ hours

Students prepare a buffer under supervision and use a pH meter to measure and adjust its pH.

Cell Culture Hood | 1 hour

Students are introduced to a biosafety cabinet, contamination control, and the expectations for working in a sterile environment.

- Instruction distinguishes a biosafety cabinet from a chemical fume hood.
- Safety points include correct use of protective equipment, avoiding contact with common surfaces while gloved, and never working while the hood's ultraviolet light is active.

HIGH SCHOOL MODULE

DNA Exploration

Students explore how genetic material is isolated, measured, and visualized using laboratory methods. Microscopy and extraction activities are paired with interpretation so students can explain their results.

Eligibility: High school students

Format: Each section meets for up to 2 hours and is scheduled across a one-month long duration

What You Will Learn

- Principles used to detect and visualize DNA
- Purpose and use of light, phase-contrast, and fluorescence microscopes
- How stains increase contrast in cells and tissues
- Core concepts in DNA isolation, measurement, and gel interpretation

Curriculum Sections

DNA Visualization | 1 ½ hours

Students learn why DNA is not visible to the naked eye and how molecular properties, electrical charge, and light-based detection make analysis possible.

- Agarose gel electrophoresis and fluorescent DNA stains are introduced at a conceptual level.
- Students connect visible DNA bands to the separation and detection of nucleic acids.

Use of Different Microscopes | 1 hour

Students receive a practical overview and demonstration of light, phase-contrast, and fluorescence microscopy.

Staining Tissues and Cells | 1 ½ hours

Students learn how stains improve contrast by binding to specific cellular components such as nucleic acids, proteins, or lipids.

- Hematoxylin is introduced as a stain that highlights nuclei, while eosin provides contrast for cytoplasm and extracellular proteins.
- Prepared tissue slides are stained and viewed to identify cellular components.

DNA Isolation | 2 hours

Students examine the purpose of DNA isolation: opening cells, separating DNA from proteins, lipids, and RNA, and concentrating purified nucleic acids in a stable buffer.

- Sample tissue or cells provide practical experience with the overall DNA-isolation workflow.

DNA Measurement | 2 hours

Students analyze sample DNA using gel electrophoresis and learn how a molecular-weight marker supports size and mass estimates.

- Migration distance is related to the logarithm of DNA molecular weight.
- Band brightness is used as an indicator of the amount of DNA present.

HIGH SCHOOL MODULE

Genetic Analysis

Students investigate how PCR is used to detect, amplify, and analyze DNA. Practical concepts are paired with data interpretation and scientific presentation.

Eligibility: High school students

Format: Each section meets for up to 2 hours and is scheduled across a one-month long duration

What You Will Learn

- Core PCR components and the temperature-cycle stages
- Applications of PCR across science and medicine
- Differences among standard PCR, qPCR, RT-PCR, multiplex PCR, and digital PCR
- Methods for interpreting PCR results and communicating findings

Curriculum Sections

PCR Data Analysis and Data Presentation | 2 hours

Students compare end-point PCR analysis using gels with real-time or quantitative PCR analysis using fluorescence curves.

- Data from an experimental PCR run are used for interpretation practice.
- Students organize and present findings using the type of evidence produced by the selected PCR method.

What Is PCR? Study of DNA and RNA | 2 hours

Students learn that polymerase chain reaction makes many copies of a selected DNA segment so that small amounts of genetic material can be detected and analyzed.

- The session introduces target DNA, Taq polymerase, primers, nucleotides, and buffer as core reaction components.
- Students study denaturation, annealing, and extension in a thermal cycler and learn how a PCR reaction is prepared and programmed under supervision.

What PCR Is Used For | 2 hours

Students examine applications including pathogen detection, cancer monitoring, genetic testing, forensic DNA fingerprinting, molecular biology research, agriculture, and food safety.

Types of PCR | 1 ½ hours

Students receive a high-level comparison of standard PCR, quantitative PCR, reverse-transcription PCR, multiplex PCR, and digital PCR.

- The emphasis is on what each method measures and why a researcher would select one method over another.

PCR Analysis of a Gene | 2 hours

Students practice one selected analysis method, such as interpreting gel bands, fluorescence curves, or cycle-threshold values.

UNDERGRADUATE MODULE

Applied Laboratory Science

Students pursue an independent project of their own design using resources available through InnovaTEEN.

Eligibility: Undergraduate college students

Format: Scheduled timings for requested amounts by students to be approved by the mentor

What You Will Learn

- How to carry out an independent research project using InnovaTEEN resources
- The entire process of creating, formatting, and publishing a scientific paper.

Curriculum Sections

Independent Project Experience | Untimed amount

Students work on their own capstone project using resources provided by InnovaTEEN. Sessions are scheduled across the month to support continued project work and can be done in any field of the student's choice.

Scientific Paper Creation | Untimed amount

Students will be shown how to create a high standard paper detailing the work they have completed to be showcased to the scientific community.

UNDERGRADUATE MODULE

Research Internship Practicum

Students contribute to projects that scientists are currently conducting in the laboratory.

Eligibility: Undergraduate college students

Format: Scheduled timings for requested amounts by mentor, and not by the student

What You Will Learn

- How scientists carry out active research projects in a laboratory setting
- Explore the rigor of scientific experiments and the ethics involved with results

Curriculum Sections

Active Laboratory Project Experience | Untimed Amount

Students work alongside current laboratory projects being conducted by scientists. Sessions are scheduled across the month to provide sustained exposure to ongoing research.