# Roanoke Valley Governor's School for Science and Techology

## RVGS Profile

## 2022-2023


www.rvgs.k12.va.us

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## Grading System

The Governor's School follows a semester grading system.

The grading scale is:

**A=90-100**

**B=80-89**

**C=70-79**

**D=60-69**

**F=below 60**

## Program Overview

The Roanoke Valley Governor's School for Science and Technology serves approximately 270 students in grades 9—12 for a half-day program. Students take their math, science and a research elective at RVGS and the remainder of their schedule at their base school. RVGS opened in 1985 as a regional center for the advanced study of science, technology, engineering and mathematics (STEM). The school is a joint initiative between the Virginia Department of Education and seven school districts; Bedford County, Botetourt County, Craig County, Franklin County, Roanoke City, Roanoke County, and Salem City. Students must apply for admission and are chosen competitively by selection committees from each of the participating school districts.

## Curriculum

Students selected for this program are choosing the most challenging science and mathematics courses available in this region. The students are participating in a rigorous college preparatory STEM curriculum employing gifted education best practices. Students have the opportunity to earn advanced credit in a variety of advanced placement and dual enrollment courses.

Special emphasis is given to hands-on laboratory experiences including experimental design, statistical analysis of data, problem solving, cooperative learning, use of technology, connections among disciplines, and the applications of science and technology.

Each student works on an independent research project each year as part of the requirements of their research elective class. Most data collection and analysis takes place during the January Intersession, when students pause their core classes and focus solely on their projects. All students participate in the RVGS Student Project Forum (science fair) and many go on to participate in a variety of local, regional, state and international competitions.

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## Highlights

- Class of 2022 offered over $5 million in scholarships
- Class of 2022 SAT average exceeds National average by 340 points
- Three year average AP qualifying score rate of 89.9%
- AP qualifying score rates 45.6% higher than national rates and rate of 5's 89.1% higher than national rates
- Seven awards at International Science and Engineering Fair (ISEF) over the past four years
- RVGS students earned 17 science fair awards at the state level or higher in 2022

## Student Achievement

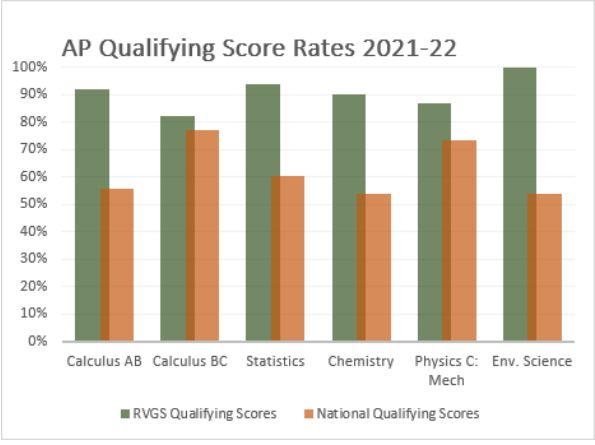
Of the 74 students in the class of 2022, thirteen were National Merit Commended Scholars, and one was a finalist. The average SAT Test score for the Class of 2022 was 1400 (Mathematics=710, Reading/Writing=690) and the average ACT composite score was 32. The 2022 graduates accumulated in excess of $5million in scholarship and award offers. Many students have competed in and won awards in local, regional, state and international science fairs as well as in the Virginia Junior Academy of Science and the Virginia Junior Science and Humanities Symposium.

## Rigor

RVGS serves the most accelerated students in our region, and with a student body representing the top 1.85% of our area's top science and mathematics students, providing a rigorous and challenging program for our study body is essential to our mission.

Our program features our unique versions of standard courses along with college credit courses through AP and dual enrollment. We not only meet, but exceed instructional expectations, requirements, and course standards. Due to the average student ability level and high expectations at RVGS, our courses are far more rigorous and demanding than the same courses at a regular high school, with over 85% of students typically reporting that 'more' or 'much more' effort is required in their RVGS courses compared to the rest of their schedule.

Due to our students spending all of January completing their independent research projects during Intersession, our students are not only mastering rigorous coursework, but are doing so with one less month of instruction!



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## Official Transcripts, Class Rank & Grade Point Average

Grades earned at the Governor's School are reported to the student's home school to be placed on the student's official transcript. Since the Governor's School is a half-day program, rank in class is not computed. The home high school computes class rank and grade point average using their individual system of weighting.

## Supplemental Transcript

To aid in the clarification of the home school transcript, a Governor's School transcript may accompany this profile. Additional supplementary information including course outlines, competencies, syllabi, or portfolios is available at your request. If you have any questions or concerns, please contact the Governor's School at (540) 853-2116.

## Course Descriptions

### Science Courses

**RVGS Physics**

RVGS Physics is the introductory science course for all first-years students. Topics include motion, forces, momentum, work, and energy. A focused approach allows students to develop a deep factual, conceptual, mathematical, and procedural knowledge of fundamental physics concepts. Skills in technology, statistics, data collection, and experimentation are reinforced by labs and activities throughout the course. The primary goals of the course are to improve problem solving skills, correct basic preconceptions about physics, and build a “big picture” foundation for future higher level science courses.

**RVGS Chemistry**

RVGS Chemistry explores the fundamental laws, theories, and mathematical concepts of chemistry. The major themes include the study of matter, its composition, structure, and properties, the changes they undergo, and the flow of energy that accompanies those changes. There is an emphasis on the use of technology for data collection and analysis. Virginia chemistry Standards of Learning are covered during the course.

**AP Chemistry**

AP Chemistry is an in-depth laboratory-focused course equivalent to an introductory college course for science majors. The major themes include the phases of matter and the forces that produce them, the study of energy transfer in chemical reactions, how far chemical reactions proceed and how fast they go, and the role of electron transfer in chemical reactions. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Chemistry exam at the end of this course.

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## Science Courses continued

### RVGS Biology

RVGS Biology is an in-depth, accelerated course that emphasizes an inquiry-based approach to the study of living organisms. This course is equivalent to an introductory college course for science majors. The major themes include evolution and the unity and diversity of life; principles of cell and molecular biology with an emphasis on DNA technology; Mendelian genetics; ecology; and energy flow in the cell, organism, and ecosystem. Virginia biology Standards of Learning are covered during the course. (Dual enrollment course with Virginia Western Community College)

### AP Physics

AP Physics C is the equivalent to a first year college Mechanics Course for science and engineering majors. Topics include Kinematics, Forces, Newton's Laws, Energy, Momentum, Rotational Dynamics, Gravity, and Oscillations. Emphasis is placed on the use of technology for data collection, analysis, and lab report presentation in order to enhance self-directed learning. Use of outside resources is encouraged. Computer use includes modeling, graphing, lab interfacing, and video analysis. Individual and/or group explorations at an advanced level will be required during the year. Students are expected to obtain a qualifying score of 3, 4 or 5 on the AP Physics C Mechanics exam at the end of this course.

### AP Environmental Science

AP Environmental Science is an interdisciplinary course equivalent to an introductory college course for science majors. There is an emphasis on data collection and analysis both outdoors and in the lab. The major themes include the connection between living organisms and their environment, the flow of energy and chemicals through ecosystems, and human impact on the environment. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP environmental science exam at the end of this course.

## Math Courses

### RVGS Algebra II

RVGS Algebra II provides a thorough treatment of advanced algebraic topics through the study of function families and their properties by simplifying expressions, solving equations, graphing and analyzing functions and their inverses. Function families include absolute value, quadratics, power and polynomials, rational, radical, exponential and logarithmic, and sequences and series. Applications, modeling, and technology are incorporated into each instructional unit. The course also includes the study of statistics, probability, and data analysis to support the research elective courses at RVGS. Emphasis is placed on concept development and the proper use of mathematical vocabulary. Virginia Algebra II Standards of Learning are covered during this course.

### RVGS Precalculus

RVGS Precalculus is designed to prepare students for AP Calculus. The major themes include: functional analysis (rational functions, exponential functions, logarithmic functions, trigonometric functions, polar functions, and parametric functions); conic sections; systems of equations and inequalities; matrices; sequences and series; continuity and limits; vectors; and mathematical modeling.

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## Math Courses Continued

### AP Calculus AB

AP Calculus AB emphasizes a multi-representational approach to college level calculus with concepts, results, and problems expressed graphically, analytically, numerically, and verbally. Topics include limits, derivatives and their applications, integration techniques, differential equations and modeling, approximation techniques, area and volume. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Calculus AB exam at the end of this course.

### AP Calculus BC

AP Calculus BC builds on the concepts learned in AP Calculus AB. The major themes include: advanced integration techniques, differential equations, series and approximation, parametric and polar functions presented numerically, geometrically, symbolically, and verbally as students learn to communicate the connections among these representations. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Calculus BC exam at the end of this course.

### AP Accelerated Calculus BC

AP Accelerated Calculus BC provides motivated and talented students a unique opportunity to cover the AB and BC calculus content in one year. The major themes are limits, continuity, derivatives, optimization, related rates, integration techniques, series and approximation, parametric and polar functions, multivariable functions, differential equations, and real world modeling of scientific phenomena. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Calculus BC exam at the end of this course . (Dual enrollment course with Virginia Western Community College)

### AP Statistics

AP Statistics emphasizes interdisciplinary applications built around four broad conceptual themes of exploring data, planning a study, anticipating patterns, and statistical inference. The topics include descriptive statistics, elementary probability, probability distributions, estimation, hypothesis testing, correlation and regression, analysis of variance, chi-square test, non-parametric methods, the calculus foundation of properties and formulas. Students are expected to obtain a qualifying score of 3, 4, or 5 on the AP Statistics exam at the end of this course. (Dual enrollment course with Virginia Western Community College)

### RVGS Multivariable Calculus

Multivariable Calculus builds on the concepts learned in Accelerated Calculus (AP Calculus AB and AP Calculus BC) and is the equivalent of a third semester college calculus course. Students investigate the geometry of three-dimensional curves and surfaces and extend their knowledge of single-variable derivatives and integrals to three and more dimensions. The major topics include: vector valued functions, partial derivatives, multiple integrals, vector fields, line integrals, and Green's Theorem. (Dual enrollment course with Virginia Western Community College)

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## Elective Courses

### Applied Chemical Research

This elective allows students to examine the many ways chemistry affects our world. Major topics include materials science, food chemistry, environmental chemistry, nanotechnology, forensic science, consumer products, agricultural chemistry and space exploration. Each student conducts an experimental research project. All students will write a scientific paper using VJAS format describing their research projects.

### Biotechnology and Bioinformatics

This college-level course is designed to introduce students to the wide array of tools and applications in the area of biotechnology while allowing them to complete an experimental research project in a specific area of interest. The major themes in the course include recombinant DNA technology, the use of proteins and living organisms as tools in biotechnology, the ways in which biotechnology can be used to improve the quality of human life, and the ethical issues surrounding all of these areas. All students will write a scientific paper using VJAS format describing their research projects.

### Directed Study

Opportunities are provided for students to work one on one with a faculty member to do advanced research. Learning contracts provide the framework for a specific product including timelines, special resources, materials, and specific expectations. Students desiring a directed study should discuss their plans with the appropriate teacher as soon as possible and must complete a directed study application by the published date. A faculty committee will review all directed study applications. Applications will be approved based on quality of proposed project. Students choosing to do a directed study are expected to work individually and responsibly. Students will conduct a research project suitable for presentation at Project Forum and other science fairs. All students will write a scientific paper using VJAS format describing their research projects.

### Environmental Research

Environmental Research explores environmental quality issues caused by human activity locally, regionally, and globally. The major themes include air, water, and soil quality, the soil/water interface, biota, biogeochemical cycling, and resource use. Each student conducts an experimental research project. All students will write a scientific paper using VJAS format describing their research projects.

### Fundamentals of Research

Fundamentals of Research (FOR) is required for all first year freshmen, sophomores, and juniors. This elective lays the foundation for the research process implemented in all upper level electives. Students in this course learn how to design and implement a research project which meets international science fair guidelines. Skills covered in this course are extensions of those learned during the first semester of RVGS Physics and Algebra II. During the first semester students develop a project idea, learn how to conduct research using the internet to find credible sources, write a formal introduction to a research paper on their topic, and design their experiment. During intersession, students implement their experimental design and maintain a detailed lab notebook of their experiences. Students also develop skills in data analysis using inferential statistics and computer software applications. Students will conduct a research project suitable for presentation at Project Forum and other science fairs. All students will write a scientific paper using VJAS format describing their research projects.

### Engineering Design & Fabrication

This class is designed for students who are interested in engineering or are considering engineering as a possible college major. This class will be very hands-on and will include: CAD (Solid Works) training, 3-D printer fabrication, laser cutting fabrication, 3 axis machining, building-testing electronic circuits, and Arduino programming. All students will work in small groups to design, build, and develop the code for a Robotic System (chosen by the instructor) that is controlled by a microcontroller. Students will be responsible for designing and fabricating all components for their robotic system and will only be allowed to procure items that cannot easily be built. Students will learn numerous engineering skills in this class that will assist them throughout their college careers.

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## Elective Courses Continued

### Mentorship

Mentorship provides students with the opportunity to carry out independent research projects in laboratories or worksites under the guidance of professionals from the local scientific and technological community. Each student is matched with a mentor based on mutual interests. Contributions from the scientific and technological community provide resources for student project work and to the school-based research lab program. All students will write a scientific paper using VJAS format describing their research projects.

### Product Design Engineering

This is an advanced course in which students will increase their understanding of designing, interfacing, configuring, and programming embedded systems using microcontrollers. Students must have completed the Engineering Design and Fabrication class prior to enrolling in this class. Students will have an opportunity to select their own project based upon their instructor's approval. The project the student chooses must be able to read data from sensors and make decisions based upon this data. Students will also be required to design and build a physical system that will respond to this data. Students will be expected to give several presentations as to the status of their project and meet committed deadlines. By the end of the course students will have developed a sound understanding of embedded system design, programming, and project management.

### Python Coding

Python Coding is an introduction to object-oriented software development using the Python programming language. The major themes include: decision making structures, functions, various looping structures, objects, and graphical user interface design. Each student will design, develop, and test a computer application as part of a research project. This research project will include a research paper and a class presentation.

### Computational Biology and Bioinformatics

This course explores the interdisciplinary analysis of biological data, with a focus on bioinformatics and genomics. Students will learn to use existing software, along with developing their own code, to employ gene expression databases in pursuit of research objectives. Major topics include molecular biology, comparative sequence analysis, 'big data' resources, human health, and evolutionary biology. Students will gain direct experience with database searches, sequence alignments, visualization of gene expression profiles, and coding in Biopython. Each student will conduct an analytical research project in the area of human health, phylogeny, or a related biological topic. Each student will write a scientific paper, using VJAS format, to describe their research project.

### Research Psychology

This course is an introduction to the basic principles of research in psychology, with an emphasis on statistical techniques used in psychological science. Major themes include the standards of ethical psychological research, the pros and cons of experimental, quasiexperimental, and correlational research designs, how to operationalize variables, how to ensure construct validity, and the process of using various statistical analyses to test psychological hypotheses. Students will conduct a thorough literature review, develop a project proposal, become proficient with statistical software, conduct a research project, and write a VJAS style research paper.