

SCIENCE & ENGINEERING EDUCATION



MINERVA[®]
SCHOOLS AT KGI

The Minerva Schools at KGI are dedicated to educating the brightest, most motivated students in the world. Within the Colleges of Natural Sciences and Computational Sciences, we provide those interested in science and engineering with the knowledge, skills and experiences necessary to begin successful careers. The purpose of this document is to explain briefly how Minerva educates and prepares students for the best post-graduate opportunities in science and engineering, including, but not limited to medical school, graduate studies, or employment in science — as well as technology-oriented industries and government laboratories. Our students majoring in the natural or computational sciences may also choose careers in policy and law, in which their strong science and engineering backgrounds will make them highly competitive as the world's societies become increasingly more influenced and impacted by science and technology.

Minerva has designed a flexible, student-centered curriculum that will enable students to gain the broad lifelong learning skills that come with a liberal arts education, while also obtaining the practical knowledge and hands-on experiences needed for science and engineering. Minerva faculty work closely with each student to design an individual study plan based on the student's interests. The flexible curriculum provides students with the fundamentals of science and engineering, enabling them to emphasize physics, chemistry or biology, or to combine disciplines, which is very important for success in the twenty-first century. The six required courses for each major and concentration provide the fundamentals and breadth, while the multiple, individually-designed tutorials and the senior Capstone project provide in-depth exploration of topics the student selects. A key aspect of science and engineering training is providing relevant, practical experiences in authentic research laboratories. Through summer and term-time internships in research laboratories around the world, students will have opportunities to carry out faculty-mentored research projects, in which the students actually do science and engineering, rather than merely learning about it through coursework. Minerva administrators and faculty actively help students obtain such internships.

A Student-Centered Approach

In science and engineering we offer six broad concentrations, in both the College of Natural Sciences and the College of Computational Sciences (see sidebar). Students can combine concentrations within a college and across colleges. Following the three foundational courses for the major, individual concentration have three courses that provide a springboard for further, personalized study. Central to this approach are senior-year Tutorial courses and the final Capstone project. Each Tutorial consists of three students and a professor, studying a topic chosen by the students; the Capstone project spans two years, and allows students to produce something novel in a field of their choosing. Depending on their interests and career goals, students may also take third- and fourth-year courses from the other colleges.

Potential Academic Paths

The following table illustrates how the curriculum works. These examples for the Natural Sciences major should be viewed as only a few of a vast number of study plans students can follow.

Area of Interest	Concentration(s)
Physical or Chemical Engineering	Double-concentration: Molecules and Atoms + Designing Solutions
Bioengineering	Double-concentration: Cells and Organisms + Designing Solutions
Graduate Study in Natural Science <ul style="list-style-type: none"> • <i>Physics</i> • <i>Chemistry</i> • <i>Life Sciences</i> • <i>Earth Sciences</i> 	Theoretical Foundations of Natural Science + Second concentration in one of the following: Molecules and Atoms Molecules and Atoms Cells and Organisms Earth's Systems
Health Sciences <ul style="list-style-type: none"> • <i>Medical School</i> • <i>Biotechnology Careers</i> 	Cells and Organisms + Second concentration in one of the following: Theoretical Foundations of Natural Science Research Analyses in Natural Science

Majors and Concentrations

All majors at Minerva are organized into matrices to enable inter- and multidisciplinary studies. Each row and each column of a matrix represents a different concentration, with required courses listed in each cell. This structure allows double-concentration with only two additional courses.

Computational Sciences Concentrations			
	Computational Theory and Analysis	Contemporary Knowledge Discovery	Applied Problem Solving
Computer Science and Artificial Intelligence	CS142 / Computability and Complexity	CS152 / Harnessing Artificial Intelligence Algorithms	CS162 / Software Development: Building Powerful Applications
Mathematics and Operations Research	CS144 / Principles of Advanced Mathematics	CS154 / Contemporary Applied Mathematics	CS164 / Modeling, Simulation, and Decision Making
Data Science and Statistics	CS146 / Modern Computational Statistics	CS156 / Machine Learning for Science and Profit	CS166 / Building Useful and Usable Database Systems

Natural Sciences Concentrations			
	Theoretical Foundations of Natural Science	Research Analyses in Natural Science	Designing Solutions
Molecules and Atoms	NS142 / Analyzing and Synthesizing Matter	NS152 / Advancing Chemistry and Physics	NS162 / Designer Chemicals and Devices
Cells and Organisms	NS144 / Analyzing Life	NS154 / Probing Life	NS164 / Solutions from and for Life
Earth's Systems	NS146 / Exploring Earth's Emergent Systems	NS156 / Monitoring and Modeling Earth's Systems	NS166 / Keeping Earth Habitable

Seminar Classes

All classes at Minerva are taught as seminars on the Active Learning Forum, our proprietary software platform. Students are not limited to reading about how to do science because the platform provides opportunities for students to explore scientific and engineering methods, through simulations and access to remote facilities. Because Minerva is not a “bricks and mortar” institution, it does not have teaching laboratories, where in traditional universities science and engineering students practice pre-designed “experiments” (i.e., classroom exercises) and techniques in their physics, chemistry, biology and engineering classes. These laboratory courses are typically taught in environments very different from those where actual research is carried out and do not provide students with the skill sets needed for either graduate study or employment in industry. It is now widely recognized that employers and graduate schools are looking for students who have had experience doing actual research with individual faculty, working on real projects (see below).

Students will also take multiple tutorials, in which a total of three students will work with a faculty member to design deeper dives into areas of interest. These tutorials can be designed to expand on and complement research laboratory experiences in specific areas of science and engineering that meet the student’s learning and career goals. Students will also design and carry out their Capstone Project with faculty guidance.

Practical Experience

Graduate and professional school admissions committees and employers downplay laboratory coursework because it does not actually teach practical knowledge or useful skills. Rather, it is widely recognized that students learn through hands-on experiences in research laboratories. In these experiences students work closely with faculty members and graduate students to generate hypotheses, design and perform experiments. Minerva's approach is to help students learn how to conduct science and/or engineering by experiencing it. At Minerva, students will reside in seven major world cities during their four years, which provides many opportunities to visit and work in research facilities of universities, research institutes, and national and industrial laboratories around the world. Minerva students also have a four-month long summer break, during which students can complete extensive research-based internships. Numerous opportunities exist, including in the laboratories of Keck Graduate Institute and multiple Research Experiences for Undergraduates (REU) summer programs at multiple universities.

Working Partnerships

Minerva faculty work closely with individual students to identify summer or academic year opportunities that allow them to explore their research interests. These opportunities might include working directly with Minerva faculty who are actively conducting research, pursuing internships in other laboratories or participating in formal competitive Research Experiences for Undergraduates, such as those supported by the US National Science Foundation or similar programs in other countries.

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