



Columbia Undergraduate Science Journal

# **Guide to High School Science Research**



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## Introduction

Hi! We are college students in CUSJ, the Columbia Undergraduate Science Journal. From high school, we became interested in trying out research and working to make scientific discoveries. We put together this high school guide to research with all of the information that we wish we had known when we started out in high school. From learning about different fields to conducting your own projects, we hope that this guide helps you navigate your journey in science research! Hopefully, we'll see you at our CUSJ symposium in the spring, or you can publish your work in CJSJ, our scientific journal for high school students!

Best wishes in your research experiences!

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## What is science research?

What is science research? **A step beyond the high school classroom.**

Think about it like this: much of your high school science education is likely a one-way process. Most of the information you learn is either directly from your teachers or a science textbook, and you mostly learn things that are already known.

But have you ever wondered how all of this information was discovered? (hint: it's research!)

Even though it may seem like we've figured everything out, there are still many **unanswered questions** in science. For example:

- How can we cure cancer?
- What is at the bottom of the ocean?
- How fast and small can we make computers?
- Is there a prime number pattern?
- Why do we dream?
- And so many more!

So how are scientists trying to answer these questions? **Research!**

The goal of research is to further our knowledge and understanding of the world around us. Science research is an opportunity to **delve into the research process, make your own discoveries, and contribute to the greater scientific community.** It's a chance for you to apply some of the information you have already learned in high school, and a chance to learn so much more.



## Why should I do research in high school?

Conducting research is not only a great way to introduce yourself to new topics, but to also involve yourself in cutting-edge discoveries. Learning beyond the scope of introductory science classes **exposes you to a deeper understanding of topics**. Not only will you **develop technical skills** in the lab, such as cell culture, but you will also **acquire data analysis skills, experimental design and critical thinking skills**, which can be applied to different disciplines and your everyday life.

Research is a great way to learn new topics and can demonstrate your interest in academic fields, like genetics, astronomy, and chemical engineering. This can **help you stand out** among other college applicants and provide you with a mentor for letters of recommendation. Not only will you **gain a mentor** that you can rely on to learn about your field of research, but you will also **gain networking opportunities** into other research labs and into working in university settings.

Conducting research in high school also provides **career exposure**. You will gain experience in the laboratory, learn how researchers present their work, and witness how research goes from the lab into the real world. Gaining research experience early on will also prepare you to conduct research in college, if that is a goal of yours. Writing **scientific papers and presentations** are a large part of research, and in high school you can expose yourself to many opportunities now available, such as science fairs and **CUSJ's own CJSJ symposium for high schoolers!**



## Finding a field you're interested in!

The first step to research is **finding a field** that interests you! For social sciences, you may be interested in something that you haven't studied yet in class because it's such a broad topic--check out the topics below and see if anything stands out to you!

### You can do science research in many different fields:

- Biology
- Chemistry
- Political Science
- Psychology
- Sociology
- Environmental Science
- Physics
- Astronomy
- Mathematics
- Engineering
- Anthropology
- Linguistics
- Education
- Economics

### Try checking out these popular science resources to identify topics that you're interested in!

- Ted Talks
- New York Times science articles
- Science TV shows or documentaries
- YouTube science channels like ASAP Science
- Scientific American
- Science Daily
- World Science Festival
- Science twitter
- University science news websites
- FiveThirtyEight
- Reading any kind of Newspapers that follow current events! (WSJ particularly for anything economics related)
- Sciencenews



You can start by **checking out specific lab or research websites** for more information on specific topics, as well as checking out what has already been studied about them--oftentimes when you conduct research, you want to acknowledge and address existing research in the topic already.

- Nature
- Science
- PubMed / Sciencedirect / Researchgate / JSTOR
- University professor's websites
- University labs specifically in your interested field; Google (university name) (interested field) labs, and many should pop up.

**It's usually easier to work with a lab in your area**, so that you can physically make trips there once in a while, especially if it has to deal with studying the environment and field work might be necessary. For more computational projects, this might not be the case! You can **check out other people's previous research projects** and draw inspiration from them, as well as where they conducted their research--previous mentors are likely to be responsive and open to questions about their research and if they need any help. See the research opportunities they have available; oftentimes their websites have previous projects presented.

**For example**, you might have liked learning about genetic inheritance in your high school biology class. Using just a Punnett square, you can predict the eye color of someone's kids! Online, you read about how some diseases like Alzheimer's Disease are a combination of environmental conditions and genetics factors. Then, you look into a genomics lab that studies the basis of Alzheimer's inheritance.

**Don't worry if you don't understand everything that you're reading!** You can use Google searches or Wikipedia to understand more about jargony topics. You don't need to be an expert to start any science research!

The most important quality that you need for research is **passion** about the field you are going into!

For social sciences, the field can be broad and daunting, but even if you're not quite sure what to study in the realm of social sciences, flipping through sociology professors/grad students and their research is a good way to gauge the possible fields of interests-- and don't be shy to ask for more information



about the topic towards these people; they are happy to explain and provide you sources that will help you understand the topic better!

Sometimes, you may end up researching something you've never encountered before prior to interacting with a potential mentor!





## Getting into a research project

The hardest part of research is actually getting started. If you feel you'd benefit more from a structured program, look into [our next section](#) on summer research programs. These usually have an application process, and can involve interacting with other high school students and sometimes a stipend.

### Finding a Lab

It can take a long time to find a lab that excites you, and an even longer time to muster up the courage to reach out – don't worry, everyone gets nervous! But because research is a time-consuming process, timing is very important.

**Be ready to invest time** in experiencing the process of research and your project. Plan to start your project during the summer – these are a valuable 3 months without school that will go a long way. Make sure to start looking as early as the winter or spring and **secure your research experience well before summer** starts so you can hit the ground running.

### Who to Contact

If you can, first **reach out to people** in science you know **personally** (directly, or through others). Talk to your high school teachers, and to any friends or family that are involved in research or may know someone that is. Any friends or siblings of friends that are currently in college can also be a great resource. **Look into local universities** to find labs that interest you. Don't be afraid to find out more about a project by **emailing professors** or their grad students, who will most likely be your mentor.

Professors are very busy, so **don't be discouraged** if you don't receive a reply! Plan to contact at least 3 to 4 labs and be open-minded when picking!

When drafting an email to professors, introduce yourself as a high school student interested in learning more about their research. **Read about their projects** on their website and **mention why you are interested** in their work, or what brought you to their lab. Mention classes you have taken that might help you understand their work better and ask if they have space in their lab for you to help on any project.

Try not to get too nervous, remember that you are a high school student and no one expects you to be an expert or understand everything on their



website in one go. That said, do **put your best foot forward** and be open and clear about how much time you can commit, as taking on a high school student is a large commitment for professors. *Good luck and happy experimenting!*



## High School Research Programs

If you want to get involved with science research, **summer is a great time to start!** You have a lot more time compared to the school year, so you'll be able to dedicate yourself to working in a lab. There are many summer research programs designed for high school students to get involved with research. They are great, structured experiences that connect you directly with research labs and other science students. Many programs will also **pay you** to work in the lab! They also have useful seminars on scientific research, as well as poster presentations to showcase your work at the end of the summer!

Below, we compiled a list of some of the nationwide summer research programs available for high school students. Many are designed for sophomores and juniors. This isn't an all-encompassing list, though! If you don't see any programs on this list, **look locally for others!** Many universities have science outreach programs to help spread science research, and they may have a specific **program near you!**

### ★ [The Summer Science Program](#)

**Cost:** Every participant is subsidized to greater or lesser degree, by charging a fee considerably less than the cost to operate this 40-day residential program, and by awarding generous **need-based financial aid** up to the full program fee plus \$500 airfare

**Location:** Socorro, New Mexico (Astrophysics); Boulder, Colorado (Astrophysics); and Lafayette, Indiana (Biochemistry)

SSP is an immersion into experimental science, designed to challenge and inspire talented rising seniors from around the world. Working in teams of three, participants complete a research project from beginning to end: either in Astrophysics – near-earth asteroid imaging and orbit determination – or Biochemistry – fungal enzyme inhibition and drug discovery. Each team acquires its own original data and performs its own analysis. Field trips and guest speakers round out an intense 39-day schedule. The experience changes their lives, and the benefits continue for life.



★ [NIH Summer Internship Program](#)

**Cost:** Free! + Stipend provided (at least \$2,000 per month)

**Location:** Bethesda, MD, and the surrounding area as well as in Baltimore and Frederick, MD; Research Triangle Park, NC; Hamilton, MT; Framingham, MA; Phoenix, AZ; and Detroit, MI

The Summer Internship Program provides internships to outstanding high school, undergraduate, and graduate students interested in pursuing careers in the biomedical/biological sciences to work on a research project that entails exposure to the latest biochemical, molecular, and analytical techniques in a given field.

★ [Jackson Laboratory Summer Student Program](#)

**Cost:** Free! All students receive a stipend of \$5,250 for the 10-week program. The cost of round-trip travel between the student's home and the Laboratory is also provided.

**Location:** Bar Harbor, Maine or Farmington, Connecticut

The Summer Student Program is designed for students who want to immerse themselves in genetics and genomics research. It emphasizes laboratory discovery, communication of knowledge, and professional growth. Students participate in an ongoing research program with the support of an experienced scientific mentor. They develop an independent project, implement their plan, analyze the data, and report the results. At the end of the summer, they present their findings to researchers, other students, and parents.

★ [Research Experience for High School Students at Vanderbilt University](#)

**Cost:** \$1,500.00 for laboratory fees (need-based aid is available), transportation and housing not provided

**Location:** Nashville, TN



The Research Experience for High School Students is an intense, 6-week scientific research internship at Vanderbilt University, centering on full immersion in a Vanderbilt University or Vanderbilt University Medical Center research lab. Students engage in an independent research project under the mentorship of a research faculty member at Vanderbilt. All REHSS participants also attend weekly breakout sessions as a group, led by a team of Vanderbilt faculty, post-doctoral researchers, and graduate students. These breakout sessions complement the student's lab experience by developing skill sets for scientific communication and comprehension, as well as exposing students to the Vanderbilt research community, scientific careers, and university studies. REHSS culminates with an end-of-summer research symposium where students present their projects in a public research poster forum, consistent with national scientific meetings.

★ [MIT Research Science Institute \(RSI\)](#)

**Cost:** Free!

**Location:** Cambridge, MA

Participants experience the entire research cycle from start to finish. They read the most current literature in their field, draft and execute a detailed research plan, and deliver conference-style oral and written reports on their findings.

RSI scholars first participate in a week of intensive STEM classes with accomplished professors. The heart of RSI is the five week research internship where students conduct individual projects under the tutelage of mentors who are experienced scientists and researchers. During the final week of RSI, students prepare written and oral presentations on their research projects.

★ [MITES \(Minority Introduction to Engineering and Science\)](#)

**Cost:** Free! + All educational, food and boarding costs are covered. Students only pay for transportation to and from MIT.

**Location:** Cambridge, MA



Minority Introduction to Engineering and Science (MITES) is a rigorous six-week residential academic enrichment program for rising high school seniors – many of whom come from underrepresented or underserved communities – who have a strong academic record and are interested in studying and exploring careers in science and engineering. This national program stresses the value and reward of pursuing advanced technical degrees and careers while developing the skills necessary to achieve success in science and engineering.

★ [Stanford Institutes of Medicine Summer Research Program](#)

**Cost:** Free! + \$500 minimum stipend. Stipends of \$1500 and above are given on a needs-based system from special grants. Housing and transportation are not provided by the program and all participants are required to live with a family member/legal adult guardian during the program.

**Location:** Stanford, CA

SIMR is an 8-week summer internship program open to high school juniors and seniors. The program consists of hands-on research under the direct guidance of a one-on-one mentor at a top class lab within the Institutes of Medicine at Stanford University as well as select departments.

★ [Secondary Student Training Program at the University of Iowa](#)

**Cost:** \$6,235 (covers all room, board, materials, and admission to all regularly scheduled activities), **financial aid is available**)

**Location:** Iowa City, IA

The Secondary Student Training Program (SSTP) is a program of the Belin-Blank Center for Gifted Education and Talent Development, at The University of Iowa. This program offers students unique experiences, both academically and socially. Participants conduct scientific research under the guidance of a faculty mentor. Students spend approximately 40 hours a week working in labs on The University of Iowa campus.



★ [High School Honors Science/Mathematics/Engineering Program \(HSHSP\)](#)

**Cost:** \$3,800 (includes room and board), **financial aid is available**

**Location:** East Lansing, MI

The HSHSP provides its participants with a unique opportunity to “live and breathe” research in a university environment. Its goals are not only to educate individuals about the research process but to provide the right kind of social context for such knowledge and expertise to flourish. Our goal is not to produce award-winning projects (which often happens, I am pleased to note), but to provide opportunities to enrich one’s knowledge about intellectual work in science and mathematics and to make new and, hopefully, lasting friendships.

★ [The Clark Scholars Program](#)

**Cost:** Free! + \$750 tax-free stipend and room and board included.

**Location:** Lubbock, Texas

The Clark Scholar Program is an intensive seven week summer research program for highly qualified high school juniors and seniors. The Program at Texas Tech University helps the Scholars have a hands-on practical research experience with outstanding and experienced faculty. The Program includes fun activities, weekly seminars and field trips. This Program provides opportunities for research in all academic areas in the university. The Clark Scholars Program is unique in that it is open to gifted students in almost any area of academe from not only the natural sciences and mathematics but to the humanities and fine arts as well.

★ [RISE Internship / Practicum](#)

**Cost:** \$7,500 for residential program and \$4,800 for commuter program, **financial aid is available**

**Location:** Boston, MA.

Spend six weeks at BU conducting university laboratory research with some of the nation's brightest scientific minds - and advance your knowledge and skills in the sciences. Students who are passionate about the sciences and



entering their senior year of high school are invited to apply to the Research in Science & Engineering (RISE) program.

★ [UCLA Engineering High School Summer Research Program](#)

**Cost:** \$4,750, **financial aid is available**, as the goal of the program is to reach all underrepresented students interested in pursuing a career in engineering

**Location:** Los Angeles, CA

The High School Summer Research Program (HSSRP) is seeking 50 diverse juniors with high academic potential (3.6 or higher GPA) who have the initiative and interest to discover the wonderful world of innovative engineering research. HSSRP prides itself in offering underrepresented populations in Engineering this amazing opportunity.

★ [Einstein-Montefiore High School Summer Research Program](#)

**Cost:** Free!

**Location:** Bronx, NY

The Einstein-Montefiore Summer High School Research Program introduces high school students age 16 and older to the excitement of leading-edge scientific research. It is our hope that because of this experience, students will begin to think about a career in science while still in high school. Students are assigned to Einstein research labs and will join the lab team under the guidance of the laboratory director (or principal investigator) who will serve as a mentor. Students are expected to present their work at Einstein's Annual Summer Research Day together with college students in the Einstein/Montefiore Science Undergraduate Research Program (SURP).

In addition, students attend all SURP faculty lectures and enrichment activities, including research ethics sessions. Following the summer experience, students become Research Ambassadors to their high schools and, working with their high school science department, develop a program for their school.





★ [High School Research Program \(HSRP\) at Brookhaven National Laboratory](#)

**Cost:** Free! (housing and transportation is not provided)

**Location:** Upton, NY

The High School Research Program (HSRP) is a highly competitive six week educational program for students interested in pursuing science, technology, engineering and mathematics (STEM) studies. Selected students, together with Brookhaven National Laboratory (BNL) scientific staff collaborate on projects that support BNL and the Department of Energy mission.

★ [Rockefeller Summer Science Research Program](#)

**Cost:** Free! (housing and transportation is not provided)

**Location:** New York City, NY

The Rockefeller University Summer Science Research Program (SSRP) provides high school students with a unique and personalized opportunity to conduct hands-on research under the mentorship of leading scientists at one of the world's premier biomedical research facilities. During this rigorous 7-week program, SSRP students become immersed in scientific culture while gaining an appreciation for the process of biomedical discovery.

★ [Summer Cancer Research Experience Program for High School Students](#)

**Cost:** \$35 Application Fee + \$65 Program Fee

**Location:** Buffalo, NY

Your research experience will be set within the collaborative and mentored environment of a world-renowned cancer researcher's laboratory where you will work alongside a research staff of graduate students, post-doctoral scholars and technicians. Your core research experience will be supported by educational seminars and career development activities. These include a weekly course, invited speaker seminars and field trips to life sciences



companies. You will develop skill sets important to a scientific career, learn about cutting-edge cancer science topics and explore non-traditional science careers. You will conclude your research experience by giving a poster presentation at a research conference where you will hone your scientific communication skills. Throughout the program you will have opportunities to bond with peers who have the same interest in science by attending planned social activities.

★ [High School Internship Program in Integrated Mathematical Oncology \(HIP-IMO\)](#)

**Cost:** Free! (Housing and transportation not provided)

**Location:** Tampa, FL

HIP IMO is an integrated mathematical oncology centric internship program that delivers interdisciplinary team science research experiences for high school students aged 16 or older by the time of the internship. This mentored summer training program is designed for motivated aspiring scientists to help prepare them for interdisciplinary cancer research careers. Working under the direction and guidance of faculty/scientist mentors in the [Integrated Mathematical Oncology \(IMO\) department](#), interns are involved in activities designed to foster the development of life-long research skills. Students will be assigned individual research projects appropriate to their interests and abilities.

★ [J Craig Venter Institute Summer Internship](#)

**Location:** Rockville, Maryland or La Jolla, CA

**Cost:** Free! + High school students earn \$13/hour

The JCVI Summer Internship Program is a highly sought-after opportunity designed to mentor and inspire the next generation of great scientists. While occasionally we do have interns other times during the year, our official program runs from May through August, and provides motivated high-school, undergraduate and graduate students with an in-depth, structured research experience that includes: a dedicated mentor, collaboration and networking with world-class scientists, hands-on participation in research projects tailored to their academic experience,



access to state-of-the-art equipment and technology, and a judged poster presentation. During the course of the summer program, there are numerous workshops designed to help develop scientific and professional skills. These include journal clubs, career development sessions and multi-disciplinary scientific seminars.

★ [The Feinstein Institute Summer Student Intern Program](#)

**Cost:** Free! + \$2,000 stipend

**Location:** Manhasset, NY

The Feinstein Institute Summer Student Intern program is a competitive mentored program designed to provide high school, college and graduate students with hands-on experience in disease-oriented research and familiarize them with opportunities that exist for careers in medical research. At the end of the internship, students will be expected to present an academic poster summarizing their research to faculty and other students.

★ [MDI Summer Research Fellowship Program](#)

**Cost:** Free!

**Location:** Bar Harbor, ME

The MDI Summer Research Fellowship Program welcomes applicants who desire hands-on, research training experience within an advanced laboratory that complements current resident research programs. High school students become a summer cohort with each student assigned and supervised by a senior scientist mentor as well as residential life staff. Co-curricular and residential life programs extend our immersion program to help students develop professional skill sets and foster connections within the scientific research community. Summer high school fellows live on campus in a structured and supervised living-learning environment. High School Fellows are provided with on campus dormitory style accommodations, full meal plans in our dining hall, and a stipend. Travel is not funded. Dormitories are supervised by live-in residential advisors.



★ [Memorial Sloan Kettering HOPP](#)

**Cost:** Free! + Stipend

**Location:** New York City, New York

The Human Oncology and Pathogenesis Program (HOPP) Summer Student Program is designed for high school students who are interested in pursuing careers in the biomedical sciences. The program is focused on two distinct areas: Independent research and a stimulating learning environment and extracurricular events, tours, training, and luncheons. Students will have a chance to take part in independent research projects under the direct mentorship and guidance of a HOPP principal investigator (PI). The PI matches each student with a mentor — typically a senior member from the lab, such as a postdoctoral fellow, graduate student, or research technician. At the end of the summer, the students will be expected to present their research project at a poster session. The students will also have the opportunity to explore outside of the laboratory by participating in a variety of events. These extracurricular activities contribute an additional facet to the internship and allow them to become fully immersed in the world of translational medicine and research. The events are hosted by programs throughout Memorial Sloan Kettering, including the Office of Diversity, various Memorial Hospital clinical departments, and Human Resources.

★ [Simons Summer Research Program](#)

**Cost:** Free, with \$1,000 stipend award (\$2500.00 housing/ dining fee if living on campus)

**Location:** Stonybrook, NY

Established in 1984 as an outreach program for local high school students, the Simons Summer Research program now attracts applicants from all across the country to the Stony Brook campus: Simons Fellows are matched with Stony Brook faculty mentors, join a research group or team, and assume responsibility for a project. The Simons Fellows conclude their apprenticeship by producing a written research abstract and a research poster.



★ [Oak Ridge National Laboratory Next Generation STEM Internship Program](#)

**Cost:** Free! + \$400 per week stipend

**Location:** Oak Ridge, TN

The Next Generation STEM Internship Program (NEXTGENS) affords rising juniors and seniors from high schools or accredited home school programs in Anderson, Blount, Knox, Loudon and Roane counties the opportunity to participate in STEM or STEM-related projects with researchers at Oak Ridge National Laboratory (ORNL).

★ [Broad Summer Scholars Program](#)

**Cost:** Free! + \$12/hr compensation available for students who demonstrate financial need

**Location:** Cambridge, MA

The Broad Summer Scholars Program (BSSP) invites highly motivated high school students with a strong interest in science to spend six weeks at the Broad Institute. We match students with Broad scientists to conduct original, cutting-edge research projects in areas such as: cancer biology, psychiatric disease, chemical biology, computational biology, infectious disease, and more. In addition to original research, students will get to explore scientific careers; attend interesting scientific talks, including the Midsummer Nights' Science public lecture series; present their research to the Broad community in a scientific poster session; attend a college fair; participate in fun social events; and meet other students who share similar interests