

ANNUAL REPORT 2022-23

Interdisciplinary Science and Research Program

Overview

The Interdisciplinary Science & Research (ISR) Program is a partnership between the Vanderbilt Collaborative for STEM Education and Outreach, formerly the Vanderbilt Center for Science Outreach, and Metropolitan Nashville Public Schools. The program aims to enhance students' understandings of STEM concepts and research principles and to empower teachers through scientific research.



ISR course offerings are available to students at three Metro Nashville high schools: Stratford STEM Magnet High School, Hillsboro High School and John Overton High School. All ISR courses are co-taught by a scientist-teacher team focused on individualized instruction to meet student needs.

The program leads students from understanding the basics of scientific disciplines in the first year to deepening their research skills and ultimately, performing independent research in their junior and senior years.

The Interdisciplinary Science & Research Program is elevating both the teaching and learning of STEM—preparing students to solve 21st century problems, and be critical thinkers and leaders.



Course Progression

ISR fits uniquely into each school's curriculum, following the Academies and Pathways model in MNPS high schools. The ISR Program consists of seven courses (four sequential content-focused courses and three research-focused sequential courses) each earning honors-level credit. Eligible students can also select to complete the final two content-focused and research-focused courses for college credit through a dual-enrollment opportunity provided by Tennessee Tech University.



Content-Focused Courses

Interdisciplinary Science I	Students develop an understanding of the fundamental concepts essential to scientific inquiry.
Interdisciplinary Science II	In this accelerated, multidisciplinary course, students investigate real-world relevant research questions under major themes during each nine-week period.
Interdisciplinary Science III (*ESS 1100: Introduction to Environmental Studies)	This course is an introductory course to the field of environmental studies. Environmental problems are complex, involving interconnections between people, ecosystems, and the biosphere. The solution to these problems requires an understanding of diverse areas of study, including chemistry, biology, ecology, toxicology, hydrology, psychology, sociology, anthropology, economics, ethics, history, law, politics, literature and communication.
Interdisciplinary Science IV (*ESS 2200: Environmental Research II)	An intermediate-level course on conducting research in the environmental sciences and allied fields. Students will be paired with a research mentor and will conduct an undergraduate-level research project, which may be a new project or a continuation of a research project initiated in prior school years; however, students will be more involved in the research design and implementation than previously.

*These courses are eligible for dual-credit at Tennessee Tech University.



Research-Focused Courses

Research I	Students develop an understanding of the fundamental concepts essential to scientific inquiry.
Research II (ESS 1200 – Environmental Research I)	In this accelerated, multidisciplinary course, students investigate real-world relevant research questions under major themes during each nine-week period.
Research III (ESS 2300 – Environmental Science Communication)	This course is an introductory course to the field of environmental studies. Environmental problems are complex, involving interconnections between people, ecosystems, and the biosphere. The solution to these problems requires an understanding of diverse areas of study, including chemistry, biology, ecology, toxicology, hydrology, psychology, sociology, anthropology, economics, ethics, history, law, politics, literature and communication.

Community Partners

In addition to Vanderbilt University and Peabody College, many community partners and organization contribute each year to the success of the ISR program by providing field trip sites, transportation, supplies, and additional support. ISR partners this year included:

- Coon Creek Science Center
- Cheekwood Botanical Garden
- VU Evolutionary Biology
- Vanderbilt Institute of Nanoscale Science and Engineering
- Dyer Observatory
- Tennessee Bureau of Investigation
- Gear Up
- Inglewood Neighborhood Association
- Land Trust of TN
- Metro Water Services
- Pizza Perfect
- The Tennessee Environmental Council
- Shelby Bottoms Nature Center
- Tennessee State Park Conservancy
- Andrew Jackson's Hermitage



Academic Accomplishments

7
GRADUATES
from Stratford ISR

2
Bell Tower
Scholars

14
GRADUATES
from Hillsboro ISR

2
earned an
IB Diploma

9
earned an
IB Career-
Related
Diploma
Certificate

5
GRADUATES
from Overton ISR

2
earned a
Cambridge Diploma

All ISR students graduate with up to:

7
HONORS CREDITS
in addition to regular coursework

The following ISR graduates were valedictorians and salutatorians this year:



Hillsboro High School

Carl Schmidt (Valedictorian)
Mohamed Sankari (Salutatorian)



Stratford High School

Benjamin Strausbaugh (Valedictorian)
Jacob Cesario (Salutatorian)



Competitions

Tennessee Junior Academy of Science

Hillsboro High School:

10

project submissions

5

selected to present

2

winning projects

John Overton High School:

3

project submissions

2

selected to present

1

winning project

Stratford High School:

4

project submissions

3

selected to present

1

winning project



Experiential Learning

ISR students from Stratford STEM Magnet and John Overton High Schools traveled to Coon Creek Science Center for a 3-day research expedition. The students explored a temperate deciduous forests and a variety of terrestrial ecosystems; dug for, preserved, and researched 73-million-year-old fossils; and discussed educational journeys and college life with college students from University of Tennessee Martin and Vanderbilt University. Additionally, the students braved wasps, uncharted hikes at sunset, bunk beds, and a 50-degree temperature drop to make s'mores, eat squirrel, play hide-and-seek in the dark, and attend raves in the woods. This educationally and culturally valuable trip was made possible by UT Martin Coon Creek Science Center, Vanderbilt Evolutionary Studies Initiative, UT Martin's Wildlife Society, the Paleontological Society, the Association of Women's Philanthropists, and Gear Up.



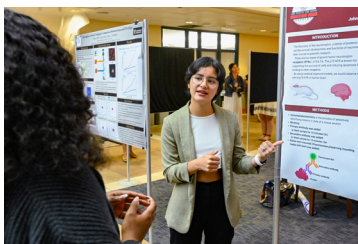
Events

The second annual ISR Symposium was held in May. **Over 160** ISR students from all three high schools participated. Seniors gave research talks and students from all grades presented scientific posters about their research projects.



Research Experience for High School Students

10 ISR students representing all three high schools participated in the six-week summer research lab internship at Vanderbilt University. Every student was paired with a lab and worked alongside graduate students, post-doctoral fellows, and principal investigators on an independent research project. The results of their work were presented at a research symposium at Vanderbilt in July.



Selected list of colleges and Universities that ISR graduates are attending:

- Belmont University
- Sewanee: The University of the South
- Tennessee Tech
- Vanderbilt University
- Tennessee State University
- Austin-Peay University
- University of Tennessee, Knoxville
- University of Tennessee at Chattanooga
- Middle Tennessee State University



Highlights from ISR Stratford STEM Magnet High School

Tennessee Junior Academy of Science Competition Select project titles

- The Effect of Randomized Food Locations on Domestic Goats' Behavior (Ben Strausbaugh)
- Quantification of Mitochondrial Metabolic Products in ARDS Patient HME Fluid (Yatzil Cervantes-Cruz)
- Identifying Tuft Cell Markers in Human IPMN Samples (Jacob Cesario)

Additional Students Accomplishments

- Meharry, Vanderbilt, and Tennessee State University Cancer Partnership's Cancer Research Education Program 2023-2025 (Isioma Ikhile and Henry Cervantes-Cruz)
- Vanderbilt-Ingram Cancer Center's Summer Healthcare Experience in Oncology 2023 (Shanya Mirza)
- Discover Biomedical Research Summer Program (George Utley and Henry Cervantes-Cruz)

Community Service

ISR Students at Stratford STEM Magnet fulfill volunteer opportunities all year long, whether on campus or in the community. Stratford's ISR students completed **over 450 hours of community service** this school year.

Shelby Park Nature Center

Students practiced population estimation using transects, journaling, and plant and animal identification at Shelby Bottoms Park in Nashville, TN.

Cosmetic Chemistry and "Shark Tank" Event

Focusing on chemicals used in skin-care, hair-care, and cosmetics, students learned not only about the chemistry of cleaning, moisturizing, lightening, and straightening, but also the differences in products for different consumers and lies in advertising. Students developed their own skin care companies, complete with a line of products. They pitched their products to a panel of judges. The winning product received funding for production.



Nissan Materials Lab Job Shadow

Students visited the Nissan plant in Smyrna, TN where they learned about quality control procedures on incoming materials used to make cars. They performed tests on paint and plastics and got to use the 3-D and scanning microscopes.

Vanderbilt Mood, Emotion, and Development Lab Job Shadow

Students met with the director of the Mood, Emotion, and Development (MED) lab and then toured the lab and participated in a demonstration collecting physiological data.

Waterfall Tour of Tennessee

Students explored forest and aquatic ecosystems in three TN State Parks. Students met with park rangers for a tour of Burgess Falls State Park, a night hike of Fall Creek Falls State Park, saw snakes and owls, and learned to throw atlatls (wooden spear-throwers). The one park with no ranger-led programming, Rock Island SP, was more of a wade than a hike. They saw 10 waterfalls over 3 days, 6 rivers, a bunch of deer, squirrels, and bats, a fox, a million spiders, a billion stars, and only one snake.



Highlights from ISR Hillsboro High School

Samsung Solve for Tomorrow Competition

ISR Juniors students designed bat houses out of sustainably locally sourced bamboo from Cheekwood Botanical Gardens. Students proposed the development of Bamboo Bat Houses to address the declining population of bats in the Middle Tennessee Region. This also allowed for the decrease of local pest populations (and potential disease-carrying mosquitoes), the removal of invasive bamboo, and the potential production and use of a natural fertilizer.

10

students named state finalists

\$12,000

awarded to the Hillsboro ISR program
for the above proposal

Science Demo Day with elementary school students



Additional Student Accomplishments

Tennessee Junior Science and Humanities Symposium

5

submissions

5

selected to present



Select project titles

- Learning From Mistakes: The Benefit of Incorrect Worked Examples (Amanda Shelton)
- Quantifying Microplastics within Water Bottles Exposed to Different Heat Levels (Rodney Glover)

ISR Teacher and Fellow Accomplishments

- 2023 MNPS Academy Champion of the Year – Dr. Joshua Swartz, ISR Hillsboro High School



Highlights from ISR John Overton High School

Select project titles

- Benjamin Watts 1st place in Microbiology – Middle Tennessee Science and Engineering Fair, 2023 and TJAS winner for his project, “Comparing the Prevalence of Wolbachia in Two Distinct Ecosystems.”
- Bryson Smith-Dills 1st Place in Environmental Sciences for his project, “Degradation of Biodegradable Products and their Effects on Soil Composition.” His project also earned 2nd Place for the David J. Wilson Environmental Award
- Nicholas Bourque 1st Place in Animal Science/Zoology with his project, “Effects of Caffeine from Different Sources on C. elegans Developmental Processes.” Additionally, he earned the Best Biological Sciences Award from the **Tennessee Academy of Science**.



Notable Lab & Field Experiences

- ISR Freshmen traveled to the Dyer Observatory at Vanderbilt to learn about how astronomers view the sky and track the movement of stars, constellations, and other celestial bodies.
- ISR Sophomores began the year by studying nanoscience – the science of small things. Students made ferrofluids, nanosand, and gold nanoparticles. We included the unit with a field trip to the Vanderbilt Institute of Nanoscale Science and Engineering's cleanroom where we made solar cells.
- ISR Sophomores learned about the chemistry and biology used in Criminal Investigations. The unit culminated with a field trip to the state headquarters of the Tennessee Bureau of Investigation.
- ISR Juniors investigated the effects of invasive Amur bush honeysuckle at Glen Leven Farm. They tested the soil, placed insect traps, and sampled the plant population.



TSIN/TVA STEM Classroom Grant

John Overton High School was awarded a grant from the Tennessee Valley Authority, in partnership with Bicentennial Volunteers, Inc., a TVA retiree organization, to develop science, technology, engineering, and math education projects to help spark student interest in future careers in STEM-related fields. The grant was used to purchase supplies for students to learn about rocket design. Students used snap circuits to model rocket circuit design.

Then, they designed, built, and tested water rockets to help understand the engineering design process, the concept of flight, and trigonometry.

Metro Water Job Shadow

Students visited three water treatment plants in Nashville – the Drinking Water Treatment Plant, the Water Reclamation Facility, and the state-of-the-art Biosolids facility, which makes a Grade A fertilizer used to replenish soil health and grow staple crops in TN. They also learned about the myriad jobs they could get related to water quality working for the state of TN.



ISR – DoD Water Quality Collaboration

ISR juniors met up with Day of Discovery Middle School students at the Nashville Zoo to analyze water from the Sevenmile Creek Watershed focusing in on chemical and biological contaminants. It was a great chance for the upperclassmen to teach the middle schoolers about inquiry-based science, safe handling of chemicals, and fieldwork. Plus, the middle schoolers got to ask the high school students all their questions about applying to (and surviving!) high school.

Additional Students Accomplishments

- Vanderbilt-Ingram Cancer Center's Summer Healthcare Experience in Oncology 2023 (Ximena Pacheco-Gallegos)
- Visualizing our Invisible Surroundings Immersion at Belmont Labs (Katie Hutchinson, Mailee Srilouangkhol, Abram Shea)
- Distinguished Young Women of Tennessee Scholarship (Gracie Bixler)

Middle Tennessee Science and Engineering Fair

4	4	3	2
submissions	selected to present	category winners	special award winners

Tennessee Junior Academy of Science

3	2	1	2
submissions	selected to present	category winner	proposal grant winners

ISR Teacher and Fellow Accomplishments:

- 2023 National Association of Geoscience Teachers (NEST) Outstanding Earth Science Teacher (OEST) Award for Tennessee – Dr. Gregory Smith, John Overton High School



Student Testimonials

"I would recommend ISR to other students because it helps teach valuable skills and provides amazing opportunities. The ISR program taught me writing skills, presentation skills, and how always to improve myself. The program did not only teach me academic lessons but also personal lessons. It provided me with a lot of meaningful relationships."

Natalie, Class of 2023

"Being in the ISR program has taught me how to present and thoroughly research subjects on a college level basis. ISR has impacted my high school experience by pushing to work harder and make me a better student. The payoff has been worth the hard work and has overall made me a better student."

Ben, Class of 2023

"ISR has given me one-of-a-kind opportunities in the lab and in the field and has helped me build relationships that will last through college and beyond. ISR changed my high school experience by making science fun and accessible and giving me confidence in my future in STEM."

Willa, Class of 2024

