



**Virginia Academy of Science
Fall Undergraduate Research Meeting**

Saturday, November 7, 2020

**Hampden-Sydney College
VIRTUAL/ONLINE SYMPOSIUM**

<https://symposium.foragerone.com/vas2020>

9:15 am - 3:00 pm

The VAS Fall Undergraduate Research Meeting is a research grant proposal competition which has been held annually since the Fall of 2001. Undergraduate students conducting research projects under the mentorship of VAS members at Virginia colleges and universities are invited to participate.

Interested undergraduate students, along with their mentors, must submit their grant applications/research proposals by the October 1 deadline. The grant applicants subsequently present posters outlining their research projects at the Fall Undergraduate Research Meeting. Both the grant applications-research proposals and the poster presentations at the meeting are evaluated to determine the recipients of the grants.

At least five research grant awards of \$500 each will be given to the top student grant applications/research proposals and poster presentations selected by the Fall Meeting Judges. The recipients of these research grant awards will be announced at the meeting's conclusion. The research grant award recipients will also be awarded Student Membership in the VAS for 2021 and will be expected to present the results of their funded research at the 2021 VAS Annual Meeting in May (which will be a virtual/online meeting).

The Academy extends special thanks to the administration and faculty of both Hampden-Sydney College and Longwood University (especially Michael Wolyniak and Amorette Barber) for making the arrangements for this year's virtual/online VAS Fall Undergraduate Research Meeting. Financial support for this year's meetings has been provided by both Hampden-Sydney College and Longwood University.

VAS President-Elect Amorette Barber, Associate Professor of Biology at Longwood University, serves as the Program Chair for the 2020 Fall Undergraduate Research Meeting.

Special thanks are extended to the following individuals who are serving as Judges at this the meeting:

Swati Agrawal, University of Mary Washington
Andrea Beyer, Virginia State University
Sarah Blythe, Washington & Lee University
Kim Chyer, Virginia State University
James Duchamp, Emory & Henry College
Sandy Fogel, Virginia Tech Carilion School of Osteopathic Medicine
Teresa Grana, University of Mary Washington
Maisoun Bani Hani, Hampton University
Kyle Harris, Liberty University
Sujan Henkanaththegedara, Longwood University
Allison Jablonski, University of Lynchburg
Ganesan Kamatchi, Norfolk State University
Elena Kuchina, Thomas Nelson Community College
Matthew Lazenka, Liberty University
Joe Merola, Virginia Tech
Jonathan Moore, Virginia Commonwealth University
Eunice Ndegw, Virginia State University
Deborah Neely-Fisher, Reynolds Community College
Son Nguyen, Hollins University
Brian Olechnowski, Old Dominion University
Piyusha Pagare, Virginia Commonwealth University
Robert Smith, Virginia Tech
Wei Son, Virginia Tech
Marie Vergamini, Virginia Commonwealth University
Parrish Waters, University of Mary Washington

Special thanks are also extended to the following individuals who are serving as panelists for the Science Careers Discussion:

Rachel Lombardi, Ph.D. candidate in the Department of Geography at University of Alabama
Adam Lynch, M.S degree in biological sciences from Indiana University of Pennsylvania; Research Scientist at Remedy Plan Therapeutics
Becca Osborne, M.S. degree in Environmental Science from University of North Carolina Wilmington; Field Technician in Front Royal, VA with the National Ecological Observatory Network (NEON)
Geoffrey Parriott, Ph.D. candidate in the Biosciences Program in Immunology at University of Chicago
Michael Wolyniak, Ph.D. in Genetics from Cornell University; Associate Professor of Biology, Hampden-Sydney College and Director of Undergraduate Research; VAS President



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Saturday, November 7, 2020
Hampden-Sydney College
Hampden-Sydney, VA
VIRTUAL SYMPOSIUM

SCHEDULE OF EVENTS

9:15 - 9:45 **Judges Meeting (Judges Only)**

All judges will meet with the VAS President-Elect and review the criteria for evaluating the grant proposals and posters as well as the procedure for selecting the grant recipients.

9:45 - 10:00 **Welcome and Opening Remarks**

Amorette Barber, Ph.D.

Dept. of Biological & Environmental Sciences, Director of the Office of Student Research, Longwood University
VAS President-Elect and Fall Undergraduate Research Meeting Coordinator

10:00 - 11:00 **Invited Keynote Speaker**

Sujan Henkanaththegedera, Ph.D.

Dept. of Biological & Environmental Sciences, Longwood University
VAS Treasurer

Putting off many fires! The journey of a conservation biologist

Global crises such as COVID 19 pandemic, climate change and sixth mass extinction provide us with a clear indication of global environmental change that is threatening the world's biological diversity and human wellbeing. Conservation biology is a recent response to these challenges where conservation biologists constantly trying to find practical solutions to mitigate these challenges. This talk summarizes the attempts of one such conservation biologist to find potential solutions from describing species new to science to creating new populations of endangered species, and from understanding mechanisms of invasive species impacts to work in conservation policy. Conservation biology is a crisis discipline and conservation biologists have to put off many fires.

11:15 - 12:30

Poster Presentation Sessions

Poster Presentations will be evaluated in groups.

Each poster and accompanying 5-10 minute oral presentation of the poster will be posted on the ForagerOne Symposium conference platform prior to the live session. Posters will be evaluated by a team of judges before this session.

During the live poster presentation session, the judges will listen to the poster presenters state their proposed research question and hypothesis and then respond to questions from the judges.

During this time, all meeting attendees are encouraged to listen to the other students present their projects.

12:15 - 1:00

Lunch Break

1:00 - 2:00

Career Panel Discussion

Advice from Science Professionals about Careers and Graduate School

1:00 - 2:00

Judges Meeting (Judges only)

During this meeting the judges will select the recipients of the 2020-2021 VAS Undergraduate Research Grant Awards.

2:30 – 3:00

Announcement of 2020-2021 Undergraduate Grant Recipients

Michael Wolyniak, Ph.D.

Dept. of Biology, Director of the Office of Undergraduate Research,
Hampden-Sydney College
VAS President

POSTER PRESENTATIONS

A-1 Using entropy stabilization to innovate new rare earth calcium-cobalt oxide p-type thermoelectric materials

Daniel Schmuckler

Mentor: Christina Rost, Dept. of Physics & Astronomy, James Madison University

I will use the entropy-stabilization approach to synthesize new p-type thermoelectric materials of the type $RE_{0.9}Ca_{0.1}CoO_3$. New compositions will be characterized in terms of structural phase, chemical arrangement and electrical and thermal properties.

A-2 Mathematical modeling of the efficacy of anti-cancer drugs

Clarice Savereux

Mentor: Iordanka Panayotova, Dept. of Mathematics, Christopher Newport University

We use a mathematical model of cancer-immune interactions consisting of a system of ordinary differential equations to study the effectiveness of three different anti-cancer drugs. Each drug triggers a different mechanism to prevent the tumor growth. We use the model to compare the efficacy and safety of the three different types of anti-cancer drugs.

A-3 Transfer deep learning for estimating bat flight kinematics

Sounak Chakrabarti and Hannah Thielman

Mentor: Rolf Mueller, Dept. of Mechanical Engineering, Virginia Tech

The proposed research is aimed at the design and implementation of a flight tunnel instrumented with an array of 50 high-speed video cameras for capturing bats in flight. This image data, obtained from multiple vantage points, will be used to train a deep neural network which will ultimately make a kinematic model based upon bat flight.

A-4 Development of computational models of prodrugs bound to nitroreductase enzymes

Madeline Clark

Mentor: Tobb Gruber, Dept. of Molecular Biology & Chemistry, Christopher Newport University

Gene-Directed Enzyme Prodrug Therapy (GDEPT) is a new approach to cancer therapy which relies on the delivery and expression of exogenous enzymes in tumor cells, followed by administration of a prodrug which will be activated into a cytotoxic form only in tumor cells. Research into possible enzyme/prodrug pairings (through docking simulations and enzyme kinetics assays) is necessary for improving efficacy.

B-1 *Cryptococcus neoformans* pH response genes

Hannah Finson

Mentor: Michael Price, Dept. of Molecular & Cellular Sciences, Liberty University

Cryptococcus neoformans is a fungal pathogen that causes meningitis. I am researching cryptococcal genes that play a role in its response to large changes in pH that it encounters upon infection of a host. If these genes have a significant effect on virulence, they will present interesting new targets for antifungal therapy.

B-2 Investigating the link between pH regulation and membrane trafficking in *Cryptococcus neoformans*

Allyson Hardin

Mentor: Michael Price, Dept. of Molecular & Cellular Sciences, Liberty University

A gene has been identified that is part of *C. neoformans* Rim pathway, a vital part of cell pH regulation. We will be working to knock out this gene to disrupt this pathway. To do this, we will use PCR, DNA cloning, gel electrophoresis, electroporation, and more. This will, hopefully, disrupt the cell's ability to adjust its pH.

B-3 The investigation of oral pathogens associated with neurodegenerative and cardiovascular disease and the link to periodontal disease

Jacob Siler and Luke Carter

Mentor: Michael Wolyniak, Dept. of Biology, Hampden-Sydney College

This project will evaluate the performance of red complex microbes in different agar environments, specifically blood and brain heart infusion agar. These microbes will be observed and manipulated to identify possible interactions such as synergistic relationships, competition, or the appearance of an invasive species. Thereby allowing us to further suggest how these microbes may contribute towards neurodegeneration and cardiovascular disease.

B-4 The influence of naturalistic social stress on the gut microbiome in mice: Relevance in human psychopathology

Sophie Dixon

Mentors: Parrish Waters and Swati Agrawal, Dept. of Biological Sciences, University of Mary Washington

The gut microbiome influences physiological and psychological health. As well, social subordination is a potent stressor that can result in psychopathology in humans, and disease in animals. We will keep colonies of laboratory mice and determine their social rank to assess the effects of naturalistic social subordination on the gut microbiome in these animals.

C-1 Amphibian skin disease chytridiomycosis (Bd) surveillance in Yasuni National Park, Ecuador

Connor Chapman, Abby Piddock, Christian Sorensen, Jaden Seman and Nathan Lamb

Mentors: Kyle Harris¹, Matthew Becker¹, Sherrie Welfel¹ and Alejandro Arteaga²,
¹Dept. of Biology & Chemistry, Liberty University and ²Tropical Herping

This project will seek to identify and quantify the amphibian skin disease chytridiomycosis (*Batrachochytrium dendrobatidis*, or Bd for short) in Yasuni National Park, Ecuador. This disease surveillance will aid the ongoing global conservation efforts by documenting amphibians afflicted by this waterborne fungus.

C-2 A tough shell to crack: Understanding parasitic struggles of infected Virginian freshwater snails

Carra Arrasmith, Jonathan Tenerovich, Nathan Lamb, Ashley Warren, Jessica Welty, Amelia Wickham and Ashton Young

Mentor: Kyle Harris, Dept. of Biology & Chemistry, Liberty University

This project seeks to expand the knowledge of parasitic presence and identification in freshwater snails of Central Virginia. Cercarial release from light exposure and dissection will be used to morphologically assess the extent of infection. In addition, genomic analysis of snail hosts will allow for molecular identification of both snail and potential trematode species to establish a host-specificity relationship.

C-3 Determining gene flow between bald cypress and pond cypress

Joshua Sprouse

Mentor: Edgar Lickey, Dept. of Biology, Bridgewater College

We will extract and amplify the cpDNA trnC-ycf6 intergenic spacer region from saplings grown from seeds of 2 parent pondcypress (*Taxodium ascendens*) and 2 parent bald cypress (*Taxodium distichum*) from two populations in North Carolina. To determine if gene flow is present between the taxa, the presence or absence of a unique restriction site found in pond cypress will be determined.

C-4 Groundwater well monitoring and analysis in urban wetlands

Benjamin Heskett

Mentor: Laura Henry-Stone, Dept. of Environmental Sciences, Studies, & Sustainability, University of Lynchburg

Through groundwater well installation and monitoring, this research will provide a hydrological analysis of a small urban watershed in Lynchburg, Virginia. The analysis will help inform a project being designed by the City of Lynchburg and University of Lynchburg to remove a high hazard dam, restore Blackwater Creek, and enhance the surrounding floodplain wetlands.

D-1 Molecular basis of deficient immunity triggered by the adaptor protein Tom1

Neha Reddy

Mentor: Daniel Capelluto, Dept. of Biological Sciences, Virginia Tech

This project will employ various binding assays and biophysical techniques to characterize the functional and structural properties of the naturally occurring mutation G307D in the adaptor protein TOM1 to better understand the molecular basis of autoimmunity and immune deficiency triggered in patients with this mutation.

D-2 Effects of JZL195 on A549 cell viability following NaOH insult

Carly Stewart

Mentor: Matthew Lazenka, Dept. of Biology & Chemistry, Liberty University

In this project, we will test the cell viability of A549 cells following an attack by varying concentrations of NaOH. This will be used to test the impact of JZL195 on the viability of cells.

D-3 Analysis of the effects of the protein survivin on histone H3 in metastatic breast cancer

Emma Strouse

Mentor: Allison Jablonski, Dept. of Biology, University of Lynchburg

Survivin is an inhibitor of apoptosis (IAP) protein known to be produced in high levels in cancerous cells. Using a breast cancer cell model, this project examines effects of the protein survivin on histone H3, potentially playing a role in epigenetics because of its interaction with the N-terminal tail of histone H3.

D-4 Developing a BSL1 titan cell model for cell cycle studies

Mary Richfield

Mentor: Michael Price, Dept. of Biology & Chemistry, Liberty University

This project will expound upon previous research on the virulence trait of titan cell formation within the *Cryptococcaceae* family. Specifically, I will investigate whether titan cell formation can be observed in nonpathogenic strains in *Cryptococcaceae*. Titan cells have a unique cell cycle that could be studied to better understand cancerous cell cycles.

E-1 Purification/characterization of isolated squash and pepper seed peroxidase/poroxygenase enzymes

Dylan Taylor, Myles Robison and Taylor Villani

Mentor: Gregory Raner, Dept. of Biology & Chemistry, Liberty University

Peroxidase enzymes from the skin of a related family of squash fruit and the seeds of a variety of pepper plants will be isolated and characterized with regard to their physical properties, classical peroxidase activities, and potential for novel enzymatic activities. Of particular note will be their ability to employ a so called “peroxygenation” mechanism in catalysis.

E-2 Characterization of novel peroxidase activity in broccoli

Christina Hardin

Mentor: Gregory Raner, Dept. of Biology & Chemistry, Liberty University

Approximately 50 plants have been screened for the presence of peroxidase activity, and broccoli (*Brassica oleracea*) has been found to possess high catalytic activity in a guaiacol oxidation assay. We intend to develop large scale procedures for the purification of peroxidase from broccoli, followed by an evaluation of its enzymatic properties, emphasizing novel peroxidase chemistries.

E-3 Investigation of individual pesticide toxicity in relation to γ -glutamyl-transferase (GGT) production

Megan Pizzo, Kaitlynn Gaebe, Kimberly Gaebe, Isaac Dotson and Brittany Carnathan

Mentors: Kyle Harris and Abigail Solitro, Dept. of Biology & Chemistry, Liberty University

Exposure to pesticides is known to have adverse effects on non-target organisms. This study intends to determine the specific toxicity of common pesticides that interact with non-target organisms. The toxicity of each pesticide will be observed utilizing flow cytometry to quantify the amount of GGT produced in crayfish following exposure to either atrazine, glyphosate, or 2,4-D.

E-4 Investigations into the redox Regulation of the protein BAM1

McKayla Riney

Mentor: Christopher Berndsen, Dept. of Chemistry & Biochemistry, James Madison University

Starch and starch regulation are very important, however little is known about either process. For this project, we'll analyze redox regulation of BAM1 from the model plant *Arabidopsis* and how it affects the ability of BAM1 to hydrolyze starch. Understanding how BAM1 is regulated will aid in improving many starch dependent industries such as papermaking and the food industry.

E-5 Optimizing a biosensor-based assay for ubiquitination activation

Roma Broadberry

Mentor: Christopher Berndsen, Dept. of Chemistry & Biochemistry, James Madison University

We are employing an ATP fluorescent biosensor to measure the enzyme activity of ubiquitination. Our goal is to optimize this fluorescence-based activity assay for continuous monitoring of ubiquitination activation by enzyme Ub-E1. The fluorescent sensor is ATP-dependent; thus, the approach is to measure ATP hydrolysis based upon continual E1. The fluorescent sensor is ATP-dependent; thus, the approach is to measure ATP hydrolysis based upon continual fluorescence loss in solution with ubiquitin and activating enzyme E1.

F-1 C-Glycosylation through reductive halide atom-transfer reaction with photo-irradiation

Jaclyn Ward and Kaitlyn Okin

Mentor: Son Nguyen, Chemistry Dept., Hollins University

The central theme of this proposal focuses on developing a new C-glycosylation method via reductive halide atom transfer with photo-irradiation with high stereoselectivity and yield and understanding mechanism of the method. This method will be applied in the total synthesis of some valuable natural products containing C-glycosidic bonds.

F-2 Enhancing efficacy of norcantharidin in target cells by direct coupling to aptamer

Shannon Fehr and Lauren Western

Mentor: Lindsey Stevenson, Dept. of Biology & Chemistry, Liberty University

This project will attempt to increase the effectiveness of NCTD as an anti-cancer drug by using a chemically bound aptamer to target cell death to cancer cells. This will potentially allow the drug to bind only to cancerous cells will allowing the uninterrupted proliferation of healthy cells.

F-3 Examining light pigments in *Arabidopsis thaliana*

Christopher Parrish

Mentor: Michael Wolyniak, Dept. of Biology, Hampden-Sydney College

Examining the effects of light stress events on the life cycle of *Arabidopsis thaliana* mutants that can not express pigments to prevent damage from UV radiation. I hope to see how this stressor may impact vegetative and reproductive growth.

F-4 Characterization of the apoptosis pathways in kinetoplastids using *Crithidia fasciculata* as a model organism

Kaelynn Parker and Clayton Parker

Mentor: Swati Agarwal, Dept. of Biological Sciences, University of Mary Washington

Apoptosis is a poorly characterized process in kinetoplastids. This project will study this intricate molecular pathway using RT-qPCR to determine which genes are differentially regulated in apoptosis in *C. fasciculata* from genes identified through gene ontology. A CRISPR-Cas9 protocol for *C. fasciculata* will be developed and used for tagging and knockout studies to further determine apoptosis gene candidates' function.

G-1 Investigating antimicrobial chemicals released from amphibian eggs

Christian Sorenson, Connor Chapman and Abby Piddock

Mentors: Kyle Harris¹, Gordon Wilson² and Matthew Becker¹, ¹Dept. of Biology & Chemistry, Liberty University, ²New Saint Andrews College

Early development away from direct maternal care involves a hostile environment (e.g. predation and disease). Amphibians typically deposit nutrient-rich eggs within aquatic environments and leave them to develop amidst heterotrophic microorganisms. The objective of this project is to investigate the extent of chemical protection that fertilized amphibian eggs produce to promote early development in a hostile aquatic environment.

G-2 Bioinformatic comparison of 1979 Sverdlovsk and 2016 Yamal Peninsula *Bacillus anthracis* strains via whole genome sequence and single-nucleotide polymorphism analysis

Rachel Craig

Mentor: Gary Isaacs, Dept. of Biology & Chemistry, Liberty University

This research project seeks to compare the pathologies and sequences of two *Bacillus anthracis* (anthrax) samples located in Russia in 1979 and 2016 to determine the genetic correlation between them. pXO1 and pXO2 plasmids (the two plasmids that make anthrax virulent) will be analyzed based on single nucleotide polymorphisms (SNPs) utilizing Bioconductor tools on R.

G-3 Biochemical characterization of a putative glutamate-2,3-aminomutase in methanogenic *Archaea*

Taylan Tunckanat

Mentor: Kylie Allen, Dept. of Biochemistry, Virginia Tech

Methanogens are ancient organisms capable of surviving in extreme conditions. In high salinity, they synthesize and accumulate osmolytes to prevent the dehydration of the cell. Although beta-glutamate is a common osmolyte, a glutamate-2,3-aminomutase required for its synthesis has not been studied before. Here, we propose a gene encoding a methanogenic glutamate-2,3-aminomutase and aim to biochemically characterize it in vitro.

G-4 Identification of interacting proteins with zinc finger protein 410

Mariko Locke, Feifan Xu and Moriah Payne

Mentor: Gary Isaacs, Dept. of Biology & Chemistry, Liberty University

This project is seeking to identify isolated protein bands from co-immunoprecipitation experiments that are believed to be interacting proteins of zinc finger protein 410 (ZFP410) using mass spectrometry. These findings may assist in determining the role of ZFP410 in the brain and might describe the molecular pathways involved in cognition and learning.

2020-2021 VAS Officers

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The Virginia Academy of Science

The **Virginia Academy of Science** (VAS) is the fifth largest state, region, or city academy of science in the US; it was founded in 1923 to promote the civic, academic, agricultural, industrial, and commercial welfare of the people of Virginia. Exemplary programs have included *Flora of Richmond and Vicinity* (published, 1930), the first comprehensive multidisciplinary studies of the James River Basin and the Great Dismal Swamp, volunteer research assistance to Virginia in the instance of the kepone pollution disaster, and leadership in establishing the Science Museum of Virginia.

The **2021 VAS Annual Meeting** will be held virtually/online in late May. The expectation is that during the meeting, there will be both Oral Presentation Sessions (for participating VAS sections) and a Poster Session (for all VAS sections).

Award recipients from the 2020 Fall Undergraduate Research Meeting are expected to present the results of their projects at the Annual Meeting, and all of today's participants are encouraged to present the results of their projects at the 2021 Annual Meeting.

Specific details about online submission of titles and other information for both oral and posters presentations, as well as more detailed information about the 2021 Annual Meeting, will be made available on the VAS website (www.vacadsci.org) as it becomes available.

To become a VAS Individual Member, Institutional Member, or Business Member, please contact The Virginia Academy of Science at vasoffice@vacasci.org or 804-864-1450.

VAS Membership Applications for Individuals, Institutions and Businesses, are available at <http://vacadsci.org/vas-membership/>.

VAS and VJAS Scientific Research Grants, Awards, Scholarships, etc. are made possible by hundreds of corporate and individual donors who believe in our work to benefit the people of Virginia. Many have found this a meaningful way to memorialize a loved one, support a student's education, or recognize the work of a colleague.

To Create an Endowment or Make a Donation, please contact Philip M. Sheridan, Executive Officer, Virginia Academy of Science at psheridan@vacadsci.org or 804-864-1451.

For Information and Applications for Research Grants, please contact one of the following individuals.

- Philip M. Sheridan, Executive Officer, Virginia Academy of Science at psheridan@vacadsci.org or 804-864-1451
- Carolyn M. Conway, Associate Executive Officers, Virginia Academy of Science at vasoffice@vacadsci.org or cconway@vacadsci.org or 804-864-1450

**Virginia Academy of Science
2500 W. Broad Street
Richmond, VA 23220
804-864-1450
804-864-1451**

Remember

Founded the Science Museum of Virginia ... With the Garden Clubs of Virginia, established the Virginia State Parks System ... Established, with the early support of the DuPont family, the first Scientific Research Fund in Virginia ... Founded the Virginia Institute for Scientific Research (erected at the University of Richmond), the forerunner of Virginia Centers for Innovative Technology, funded by the Virginia General Assembly ... Founded The Virginia Junior Academy of Science to foster original research in Virginia middle and high schools ... Published the Flora of Richmond and Its Vicinity ... Leaders' testimony at the Scopes Trial and later resolutions on evolution and its teaching in science curricula of Virginia schools ... Advocated inclusion of women and African-American scientists and science educators in professional meetings ... Founded the Virginia Journal of Science ... Hundreds of teacher education and training programs in the sciences, mathematics, medicine, and technology ... Established the Kiser Fund for Science Teacher Education ... Published The James River Basin: Past, Present, and Future, funded by the Virginia General Assembly, the first comprehensive, multidisciplinary account of the James and its resources, landforms, flora, fauna, industries and businesses ... Established the VJAS Research Fund to support scientific investigations by Virginia's secondary school students ... Annually sponsors "The VJAS Experience" bringing hundreds of secondary students to Virginia colleges and universities to stay on campus and visit research facilities ... Founded the Virginia Science Resource Network to mentor Virginia's teachers and students ... Established the Annual Undergraduate Research Conference to financially support original research in four-year and two-year curricula ... Established scientific advisory service to Virginia Governors and state agencies beginning with the state's kepone disaster ... Supported the founding of the Virginia Institute of Marine Science (College of William and Mary) ... Decades of leadership for the publication of the first *Flora of Virginia* since 1739 (to be published 2012)... ... Annually awards over \$80,000 in sponsored/endedowed scholarships and prizes to Virginia middle and high school students for original research ...

NEXT ...???

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