

## **Legislative Oversight Commission on Education Accountability** **October 11, 2021**

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WEST VIRGINIA

# Higher Education Policy Commission

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**Report to the Legislative Oversight Commission  
on Education Accountability**

**Funding Formula Progress Report  
(§18B-1B-4(d))**



October 1, 2021

**West Virginia  
Higher Education  
Policy Commission**

Andrew A. "Drew" Payne III  
*Chair*

Sarah Armstrong Tucker, Ph.D.  
*Chancellor*

[www.wvhepc.edu](http://www.wvhepc.edu)

The Honorable Craig Blair, Co-Chair  
The Honorable Roger Hanshaw, Co-Chair  
Joint Committee on Government and Finance

The Honorable Patricia Rucker, Co-Chair  
The Honorable Joe Ellington, Co-Chair  
Legislative Oversight Commission on  
Education Accountability

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Re: Higher Education Funding Model

**West Virginia  
Council for Community  
and Technical  
College Education**

Christina Cameron  
*Chair*

Sarah Armstrong Tucker, Ph.D.  
*Chancellor*

[www.wvctcs.org](http://www.wvctcs.org)

Dear Committee Co-Chairs:

Senate Bill 760, passed during the 2020 Legislative Session, amended W.Va. Code §18B-1B-4(d) to require the West Virginia Higher Education Policy Commission (Commission) and the West Virginia Council for Community and Technical College Education (Council) to examine and analyze the general revenue appropriations to public institutions of higher education. The statute also requires that, by October 1 of each year, the Commission and Council shall recommend to the Legislature a formula or methodology for the allocation of general revenue to be appropriated to our higher education institutions. Id. Further, the Code specifies that the Commission and Council shall consider the needs of each institution relating to a base-level of appropriation support and mission differentiation, and required that our agencies seek to develop a consensus on the formulas and methodologies in our recommendation. Id.

I am pleased to report that following unavoidable delays in 2020 and early 2021 due to the COVID-19 emergency, our agencies and the presidents of our public institutions have resumed work toward a recommended funding formula for higher education in West Virginia. Throughout the spring and summer, we had discussions with presidents and legislators about general recommendations for resuming our previous progress on a funding model, as well as the timeline to make a recommendation by the 2022 Regular Session.

On September 15-16, 2021, the Commission and Council convened an in-person working session with community college and baccalaureate institution presidents and their chief academic and finance officers to recap progress that had been made and to evaluate previously proposed recommendations. We were joined by national funding model experts from HCM Strategists, who provided an overview of funding formulas in place across the country. HCM also provided an in-depth review of the Tennessee Outcomes Based Funding Formula, an historically successful model which is serving as a basis for West Virginia's proposed formula.

From that working session summit, both two-year and four-year institution leaders agreed to a broad framework incorporating a variety of outcomes-based metrics, including progression toward degree completion, degree production and institutional efficiency. Under this proposed framework, each institution's annual base appropriation would be determined, in part, by the number of students who reach key credit-hour

The Honorable Craig Blair  
The Honorable Roger Hanshaw  
The Honorable Patricia Rucker  
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October 1, 2021  
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accumulation milestones, earn a high-quality certificate or degree, and contribute to the overall economic health of the state through research and development.

Institutions will work with the Commission and Council to negotiate mission-specific weights (from a predetermined range) that will determine the extent to which each metric will contribute to the institution's overall score. For example, Marshall University, West Virginia University, and West Virginia State University might choose to place a greater emphasis on research than other institutions because of their research mission. As is done in Tennessee, these selections would be re-evaluated every five years at which point the institutions could alter their weighting percentages.

In the proposed framework, all institutions would be measured for efficiency – the number of certificates and degrees produced for every 100 full-time equivalent (FTE) students. Other metrics we are currently evaluating include successful transfer of a student from a community and technical college to a baccalaureate institution and additional premiums for students belonging to certain focus populations, including low-income and academically underprepared students.

An additional “premium” we are currently developing would credit institutions for producing degrees in high-demand fields. This would incentivize schools for advancing students in fields deemed by the Department of Commerce, or another independent entity authorized by the Legislature, to be in high demand in West Virginia. This would encourage institutions to successfully train more nurses and teachers, for example.

The initial draft of our recommendation has been shared with all presidents and we have received constructive feedback that reflects what I have written above. As we reach agreement on the additional metrics, we will begin to run funding scenarios based on currently available data.

As for this update, I am pleased to share we are making significant progress and all understand the urgency for providing this framework to the Legislature by January, with the collective goal of finding a way to fund public higher education that results in a stronger workforce for West Virginia. We have scheduled meetings in the next two weeks to address questions raised following our recent working session summit and to reach agreement on the additional metrics.

We have important work ahead, and I will keep you updated as we move forward. Please share with me any questions you may have.

Sincerely,



Sarah Armstrong Tucker, Ph.D.  
Chancellor

## Outcomes-Based Funding Formula

### Proposed Framework

October 7, 2021

## Outcomes

### Community Colleges

#### Progression Metrics

- Students Accumulating 15 hrs. ✱
- Students Accumulating 30 hrs. ✱
- Students Accumulating 45 hrs. ✱

#### Completion Metrics

- Associate and Bachelor's Degrees Awarded ✱ ✪
- Academic Certificates Awarded ✱ ✪
- Transfers to a Four-Year Institution ✱
- Workforce Certificates Awarded<sup>1</sup>
- Workforce Training / Contact Hours Completed

#### Efficiency Metrics

- Awards per 100 FTE

### Baccalaureate Institutions

#### Progression Metrics (Undergraduate)

- Students Accumulating 30 hrs. ✱
- Students Accumulating 60 hrs. ✱
- Students Accumulating 90 hrs. ✱

#### Completion Metrics

- Associate and Bachelor's Degrees Awarded ✱ ✪ ✧
- Master's Degrees and Post-Master's Certificates Awarded ✪
- Doctoral / Law Degrees Awarded ✪

#### Research and Development Metrics

- Expenditures on Research and Development

#### Efficiency Metrics

- Awards per 100 FTE

✱ = Focus population premium applies   ✪ = High-demand field premium applies   ✧ = On-time bachelor's completion premium applies

<sup>1</sup>Workforce completions will not be included in the implementation year due to unavailability of data.

## Focus Population Premiums

- 1 Focus Population = 80% = 1.8 Outcomes
- 2 Focus Populations = 100% = 2.0 Outcomes
- 3 Focus Populations = 120% = 2.2 Outcomes
- 4 Focus Populations = 140% = 2.4 Outcomes

## High-Demand Field Premiums

Programs and weights TBD

## On-Time Completion Premium\*

Bachelor's Completed in 8 Sems. = 20% = 1.2 Outcomes

\*Baccalaureate institutions only





**Report to the Legislative Oversight Commission  
on Education Accountability**

**Annual Report on Research Trust Fund  
 (§18B-18A-12)**



**MEMORANDUM**

**TO:** Legislative Oversight Commission on Education Accountability (LOCEA)

**FROM:** Dr. Juliana Serafin, Senior Director Division of Science and Research, HEPC

**DATE:** October 11, 2021

**RE:** Research Trust Fund Annual Report

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The State of West Virginia's initial \$50 million investment in STEM research through the Research Trust Fund (RTF), also known as Bucks for Brains, continues to support research important to the state's economy as well as the quality of life of West Virginians.

The two primary institutions to receive the majority of this investment in 2008 were the state's largest research institutions, WVU and Marshall. WVU was allotted \$35 million and Marshall, \$15 million. Each year, the Higher Education Policy Commission is required to submit to the governor and the Legislature this report on the status of the trust fund's distributions.

Please note that the state's initial \$50 million investment was a 50-50 matching program, whereby the research institutions had to obtain equal *private* investment dollars to draw down the state funds. Those state funds were then transferred to the institutions' foundations or investment arms to join with the private donations as an endowment. The institutions subsequently distribute the investment proceeds for sponsored faculty research.

By 2013, all of the \$50 million state investment was distributed to the institutions, so there no longer is a balance in the state's trust fund. That investment, combined with the matching private donations, is supporting research endowments at the institutions, as prescribed by the legislation and envisioned by its authors.

**Summary of FY21:**

As of June 30, 2021, the Marshall University RTF endowments total \$39 million, with \$6.1 million of endowment proceeds expended over the life of the program. Earnings to date are \$14 million. The amount spent in FY21 was \$595,149.

For West Virginia University, at the end of FY21 a cumulative amount of \$16,884,759 has been expended from RTF. The amount available to spend in FY21 was \$3.3 million. The market value for all the private RTF endowments is \$59 million and that for the state RTF endowments

\$49 million. The amount available to spend in FY 22 from the private RTF endowments is \$1.8 million, and for the state RTF endowments \$1.6 million, totaling \$3.5 million.

## **Background**

Outlined in Legislative Rule Series 48, Research Trust Fund Program (RTF), the Higher Education Policy Commission (Commission) receives annual reports from institutions and is required to submit a combined annual report on the Research Trust Fund to the Governor and the Legislative Oversight Commission on Education Accountability (LOCEA) by January 1 of each year.

In compliance with this statutory requirement, the Commission is provided a draft annual report for FY2021 activities within the Research Trust Fund for review, comment, and approval.

## **RTF Activities through June 30, 2021**

The Commission completed its initial implementation plan during the fall of 2008 which resulted in Title 133 Legislative Rules Series 48, subsequently approved by the Legislature during the 2009 regular session. The rule establishes guidelines, procedures and documentation standards for the distribution of funds in the West Virginia Research Trust Fund. The final rules are available at wvresearch.org: <https://westvirginiaresearch.org/wp-content/uploads/2019/07/ResearchTrustFundRules.pdf>

Commission staff created an electronic “Match Request System” (MRS) in 2008 that allowed secure transactions for RTF requests made by the universities. All requests, documentation and invoicing are permanently recorded in files that allow sorting, analysis and up-to-date balance information. The MRS was cross referenced with university records annually to ensure accuracy in drawdown reporting for previous reports.

Required “Research Plans” specified by the legislation and approved by Marshall’s and WVU’s boards of governors were received. Both institutional plans are on file with the Commission and are found to be generally compliant with legislative requirements.

The RTF financial account was established in late June 2008 by the State Auditor and made accessible to Commission staff for distribution to public institutions in addition to Marshall and WVU. *All transactions from this fund were completed in 2013.*

Interest funds generated by the RTF account have been separately tracked for distribution to State Colleges as defined by the Legislature. On May 15, 2009, the Commission released the first competitive request for proposals for RTF interest funds collected on the account specifically for state colleges and the West Virginia School of Osteopathic Medicine, in accordance with

provisions of §18B-18A-10 of the Code. A second request for proposals was issued on March 9, 2010; a third on June 2, 2011; a fourth on May 30, 2012; and a fifth on September 21, 2012. Proposals for up to \$100,000 each were received from eligible institutions and subsequently reviewed by external peers for program merit. Two awards were issued in 2009, two in 2010 and one in 2011 as a result. No applications were received in response to the May 2012 request for proposals. A request for proposals was issued September 7, 2012 – one institution was awarded. A final award was made on May 6, 2013.

The institutions that received awards from the RTF for State Colleges and Universities from 2008-2013 were Shepherd University, Fairmont State University, West Liberty University, West Virginia State University and West Virginia University Institute of Technology.

The Research Trust Fund has been fully matched and no additional funds are available for distribution.

Marshall University and West Virginia University Annual Reports for FY2021 are attached.



**Marshall University  
Research Endowment Plan Annual Report  
2020-2021**

Submitted to the Division of Science and Research at the  
West Virginia Higher Education Policy Commission

## **I. Summary**

The West Virginia Research Trust Fund program has created sixteen endowments at Marshall University to fund allowed research-related activity. Over fifteen million dollars of private donations and the fifteen million dollars of state match have been invested in the Marshall University Foundation and Marshall University Research Corporation, respectively. These endowments span research areas from Engineering to Clinical and Translational Research and specify uses from direct research support to student research stipends. In FY 2013, the full \$15MM in gifts and pledges was raised, along with an excess of over \$800,000.

As of June 30, 2021, the Marshall University Bucks for Brains Endowments totaled \$ 39,023,000 MM, with \$ 6,146,713.15 MM of endowment proceeds expended over the life of the program. FY 21 expenditures totaled \$ 595,149.34 MM. Earnings to date have amounted to \$ 14,500,278 MM.

Past years' expenditures were as follows:

FY 16	\$450,000
FY 17	\$560,000
FY 18	\$672,000
FY 19	\$560,000
FY 20	\$3,100,000

## **II. Review of the Marshall University Research Endowment Plan**

Marshall's original Research Endowment Plan approved by the University's Board of Governors in 2008, directed donations to:

- Endowment of the Marshall Institute for Interdisciplinary Research (MIIR), continuing with the plan laid out in Marshall's application to the Eminent Scholars Recruitment and Enhancement (ESRE) initiative; and
- Advancement of Intelligent Transportation Systems research at the Rahall Transportation Institute (RTI).

In November 2010, the Marshall University Board of Governors approved a Research Trust Fund Addendum (Appendix One) that broadened the recognition of Biomedicine/ Biotechnology as a focus for donor activity across the University, and further included aspects of Engineering, Environmental Science and the Physical Sciences.

### **III. Endowed Research Area Highlights**

A brief update on highlighted activities of some of the endowments is included below. A comprehensive summary of the endowments is included in previous versions of this report.

#### **MIIR Investigator Dr. Sandrine Pierre awarded NIH R01 Grant**

Sandrine V. Pierre, Ph.D., associate professor of biomedical sciences at the Marshall University Joan C. Edwards School of Medicine and Interim Director of the Marshall Institute for Interdisciplinary Research (MIIR), has been awarded a Research Project Grant (R01), one of the most competitive grants issued by the National Institutes of Health (NIH).

Dr. Pierre was awarded the \$1.36 million, four-year grant from the National Institute of Diabetes and Digestive and Kidney Diseases to study the regulatory mechanism of salt handling by the kidney and malfunction of this mechanism that compromises the body's ability to remove salt. The new study will draw upon the expertise of Marshall investigators in the signaling and scaffolding function of the Na/K-ATPase protein and its impact on cardiovascular function.

Dr. Pierre will work with a team of researchers across the Joan C. Edwards School of Medicine with expertise in renal physiology and preclinical studies of Na/K-ATPase receptor function.

#### **Industrial Safety Investigation of Regulations and Falls: Dr. James McIntosh**

Occupational falls are a leading problem in many industries and result in serious injuries and fatalities. Year after year occupational falls lead the list of injuries and costs in the construction industry. Falls also are on high on OSHA'S top ten list of violations. The result is added cost burden to industry in terms of both direct and indirect costs.

The project is examining accident/ incident data relative to occupational falls to determine industries where falls occur in the context of the regulatory and consensus standards involved and their ultimate impact.

## Other Highlights

The investments enabled by the Bucks for Brains funds is creating a cadre of researchers applying for and being successful in obtaining federal funding. In FY 21, these researchers have received three new NIH R01 awards and a significant VA Merit award. This is some of the most significant competitive funding ever achieved at Marshall, and two of the four investigators are women.

### Appendix One- Marshall University's Research Trust Fund Addendum

The University's directed research endowment plan has concentrated initially in two domains of interdisciplinary research, which are strengths at Marshall: research clusters in biomedicine/biotechnology/ bionanotechnology and transportation technology/logistics. Marshall's Research Trust Fund activities are to be expanded to include the following areas:

#### I. Engineering

Engineering is a foundational discipline essential to the development and implementation of research in the approved areas in the Research Trust Fund legislation<sup>1</sup>. Marshall has recently achieved ABET accreditation of its engineering program, and has experienced dramatic facilities growth with the construction and occupation of The Arthur Weisberg Family Engineering Laboratories facility and is planning for the future addition of an Advanced Engineering and Technology Center Complex. Development of robust undergraduate and graduate programs and the associated integral research opportunities are essential to developing and enhancing the capabilities and profile of the school.

Match from the Research Trust Fund will be requested to enhance private donations for endowed professorships and other research-related positions and

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- 4.3.1. Energy and environmental sciences;
- 4.3.2. Nanotechnology and materials sciences;
- 4.3.3. Biological, biotechnical and biomedical sciences;
- 4.3.4. Transportation technology and logistics;
- 4.3.5. Biometrics, security, sensing, and related identification technologies; and
- 4.3.6. Gerontology.

initiatives in all aspects of Engineering as they relate to the allowed subject areas of the Research Trust Fund Program and the associated uses allowed in the legislation.

Two examples of gifts that have been received in support of engineering endowments are included, and a third solicitation is discussed:

#### **A. Applied Research- Safety Engineering Program**

Risk management is a highly specialized field that involves applying the principles of safety engineering and industrial hygiene and integrating them with economic and financial analysis. Marshall University will expand its Research Trust Fund Plan in this area important to transportation and logistics and energy to support an endowment in risk management research. The proposed endowment will support the development of research expertise in the school of engineering in the area of risk management, a highly interdisciplinary pursuit at the interface of management, engineering and applied mathematics.

The proposed applied research employs advanced risk management concepts and research to identify, trend, estimate and reduce workplace hazards in industry based in WV. The area will be supported by a \$100,000 endowment received from BrickStreet and the corresponding state match.

Risk management is of particular interest to the energy industry in our state because of the safety and economic risks associated with the extraction process. In energy, risk management research is essential to find new ways to:

- deal with its high element of monetary risk due to the uncertainty of the economic and regulatory outlook
- reduce the physical risk associated with extraction and development activities, and improve the safety of individual employee

In transportation and logistics research, risk management has become central to understanding many critical elements such as:

- the robustness and resilience of our transportation systems to interruptions due to system load, natural phenomena, and man-made disruptions
- the risks associated with transport of hazardous materials and the potential benefits of mitigation of those risks
- the robustness of logistics networks
- the risks associated with logistics and supply chain outsourcing

These benefits are of particular relevance to the state given current events, and are particular interests of the donor.

#### **B. Mechanical Engineering**

Mechanical engineering applies the principles of physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. Mechanical engineers use the core principles of mechanics, kinematics, thermodynamics, materials science, and structural analysis along with tools like computer-aided engineering and product lifecycle management to design and analyze items as diverse as manufacturing plants, industrial equipment and machinery, heating and cooling systems, motorized vehicles, aircraft, watercraft, robotics, medical devices and more.

The field has continually evolved to incorporate advancements in technology, and mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology. Mechanical engineering overlaps with aerospace engineering, civil engineering, electrical engineering, and petroleum engineering to varying amounts.

A gift from the Fletcher family will endow a founding Chair of Mechanical Engineering. Mechanical Engineering is an important discipline in Bioengineering and energy sectors. This endowment is essential to developing a Department of Mechanical Engineering, by attracting a senior-level professor to Marshall, with his/her associated research programs.

Another area that is endorsed by the Board of Governors for planning and an active source of solicitation is:

### **C. Bioengineering**

In the translation of biomedical and biotechnology advances, bioengineering is a lynchpin in bridging the transition from academe to commercialization. Marshall University is planning to develop a Bioengineering Department contemporaneously with the construction of the Applied Technology and Engineering Complex. The development of the Department would follow a trajectory very similar to that of Mechanical Engineering, with the attraction of a founding research scientist/bioengineer.

“Biological engineering, biotechnological engineering or bioengineering (including biological systems engineering) is the application of engineering principles to address challenges in the life sciences, which include the fields of biology, ecology, and medicine. Biological engineering is a science based discipline founded upon the biological sciences in the same way that chemical engineering, electrical engineering, and mechanical engineering are based upon chemistry, electricity and magnetism, and statics, respectively”<sup>2</sup>.

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<sup>2</sup> Cuello J.C., “Engineering to biology and biology to engineering, The bi-directional connection between engineering and biology in biological engineering design”, Int. J. Eng. Ed., **21**,1-7 (2005).

“Biological Engineering can be differentiated from its roots of pure biology or classical engineering in the following way. Biological studies often follow a reductionist approach in viewing a system on its smallest possible scale, which naturally leads toward the development of tools such as functional genomics. Engineering approaches using classical design perspectives are constructionist, involving the building and research of new devices, approaches, and technologies from component concepts. Biological engineering utilizes both of these methods in concert relying on reductionist approaches to define the fundamental units, which are then commingled to generate something new”.<sup>3</sup> “Although engineered biological systems have been used to manipulate information, construct materials, process chemicals, produce energy, provide food, and help maintain or enhance human health and our environment, our ability to quickly and reliably engineer biological systems that behave as expected remains less well developed than our mastery over mechanical and electrical systems”.<sup>4</sup>

Given Marshall’s research strengths in the biological and biomedical sciences and the emphasis of new initiatives, like the Marshall Institute for Interdisciplinary Research (MIIR), on translating key research findings into commercialization, the discipline of bioengineering sits at a nexus of opportunity for the University. It will be a critical element in fully developing the potential of Marshall’s applied research enterprise and its translation to economic development.

## **II. Mathematics and the Physical Sciences**

Mathematics and the Physical Sciences are basic sciences that have relevance to all aspects of the allowed areas of the Research Trust Fund legislation. Research Trust Fund match will be sought to enhance private donations supporting endowed professorships and other research-related positions and initiatives focusing on research in the allowed areas in these disciplines.

The first application will be for an endowed rotating professorship to promote an undergraduate summer research experience in Chemistry.

This match for the undergraduate research endowment is being requested under the Research Trust Fund because undergraduate summer research in Chemistry is relevant to so many of the legislatively enabled areas:

- Chemistry is one of the fundamental underpinnings of nanoscience because of the molecular nature of the discipline

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<sup>3</sup> Riley MR, “Introducing Journal of Biological Engineering”, *Journal of Biological Engineering* **1**, 1 (2007).

<sup>4</sup> Endy D, “Foundations for Engineering Biology”, *Nature*, **438**, 449-4 (2005).

- The Department of Chemistry at Marshall University has core groups in biochemistry/biotechnology and materials science
- Faculty members also work on energy research and molecular energetics.

# WV Research Trust Fund

Annual Report

from

West Virginia University<sup>1</sup>

August 5, 2021

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<sup>1</sup> Address questions and requests for additional information regarding WVU's Strategic Research Plan and the Research Trust Fund initiative to Provost Maryanne Reed, West Virginia University ([maryanne.reed@mail.wvu.edu](mailto:maryanne.reed@mail.wvu.edu)) or Vice President for Research, Dr. Fred King, West Virginia University ([fred.king@mail.wvu.edu](mailto:fred.king@mail.wvu.edu)).

## Introduction

This annual report describes the history of the Research Trust Fund, responds directly to the reporting requirements outlined in Series 48 (§ 133-48-14), and lays out the proposed spending plan for the earned interest and carry over funds from each endowment for FY 2022.

### History of the Research Trust Fund (2008-2009)

In March 2008, the West Virginia Legislature enacted Senate Bill 287, commonly referred to as the Research Trust Fund, as an effort to build a critical mass in selected areas of research and thus lay the groundwork for future economic development. The initial Bill provided a five-year window for the deposit of qualified donations into research endowments. Senate Bill 239 (Passed March 12, 2011) amended §18B-18A-9 of the Code of West Virginia to provide a seven-year window. Senate Bill 287 committed \$35 million to West Virginia University as a basis for a 1:1 match with private dollars to create endowments that would provide a sustainable source of funds for research and development. West Virginia University's approved Strategic Research Plan identified four areas for investment:

- Energy and environmental sciences;
- Nanotechnology and material science;
- Biological, biotechnological, and biomedical sciences; and
- Biometrics, security, sensing and related identification technologies.

These areas were selected because in 2008 they complemented the expertise of WVU's faculty, were critical issues of importance to the public, and were at the core of WVU's land-grant mission.

An Addendum to WVU's Strategic Research Plan for the Research Trust Fund was approved by the WVU Board of Governors in December 2010 and incorporated therein. Three modifications were made:

1. Adding forensic sciences as an area of emphasis under the biometrics, security, sensing, and related identification technologies, providing the opportunity for private investment into this area of research.
2. Adding a Library endowment to support the acquisition of materials in the four research areas, clarifying the importance that library resources provide to a vibrant research agenda.
3. Removing the language "no research area may receive more than \$17.5 million in private donations within the first two years," allowing WVU to maximize private investment regardless of focus area.

## Achieving the Goal: \$70 million in Private and State Endowments

During the first four years after the inception of the Research Trust Fund, West Virginia University received gifts and pledges totaling \$35 million, the total amount allocated to the University through the Research Trust Fund initiative. Each endowment was qualified by the West Virginia University Board of Governors and thus eligible for state matching funds. **Thus the University's goal was achieved.**

The seven-year pledge period has officially concluded. The 85 endowments in Appendix A represent the final portfolio established under the Research Trust Fund initiative. These endowments include five generic types of gifts: 12 chairs and professorships, 12 undergraduate scholarships, 14 graduate fellowships, 2 graduate or undergraduate fellowships, 43 broad-based research support funds, and 2 library endowments.

## Compliance with Legislative Rule for Research Trust Fund

Three specific reporting requirements are identified in Series 48 (§ 133-48-14), the Research Trust Fund Program.

1. *14.1. By August 15, 2009, and annually thereafter, each participating institution shall provide an annual report to the Commission that includes a full accounting of the trust funds, endowment proceeds, and adherence to the objectives established by the research plan.*
2. *14.2. Each participating institution shall detail in its annual report to the Commission the total amount of qualified donations received, the investment earnings realized and any anticipated expenditures of the research endowment proceeds in its annual operating budget.*

The data in APPENIDX A summarize much of the information requested by the Legislative Rule.

Through June 30, 2020 the following results have been achieved:

- **FY21 Market Value for all the Private RTF Endowments**  
The market value of Directed Research Endowments established with private gifts invested in the Research Trust Fund Program of the WVU Foundation Endowment for fiscal year ending June 30, 2021 is \$58,661,299.
- **FY22 Spend Available for the Private RTF Endowments**  
The available proceeds from Directed Research Endowments established with private gifts invested in the Research Trust Fund Program of the WVU Foundation Endowment for FY22 are \$1,827,471.

- **FY21 Market Value for all the State RTF Endowments**

The market value of Directed Research Endowments established with trust distributions (state funds) to the Research Trust Fund Program of the WVU Foundation Endowment for fiscal year ending June 30, 2021 is \$49,086,235.

- **FY22 Spend Available for the State RTF Endowments**

The available proceeds from Directed Research Endowments established with trust distributions to the Research Trust Fund Program of the WVU Foundation Endowment for FY22 are \$1,630,477.

- **NOTE:** During the period from March 08, 2008 to June 30, 2012, the WVU Foundation received 19 distributions from the Research Trust Fund totaling \$35,000,000; these dollars provided the matching funds for 1210 qualified gifts (donations and pledges) to Directed Research Endowments established under the Research Trust Fund.

3. 14.4. *Each participating institution's research corporation and/or foundation shall provide the Commission with an audited financial statement annually. These statements shall be treated as confidential.*

A copy of the audited financial statements for years ending June 30, 2020 and 2019 for the WVU Foundation has been forwarded, under separate cover, to the Policy Commission. Because of timing of submission of this report relative to the receipt of the audited financial statement, the audited financial statement of the WVU Foundation, Inc. will always be a year in arrears.

## Impact of the Research Trust Fund

Vice President for Research Fred King remarked previously that: “The Research Trust Fund is not only an investment in our University, it is an investment in the future of our state. We know that research and innovation are the key economic drivers as we move forward in the 21<sup>st</sup> Century and compete in a global economy. The ideas generated and the students educated through the endowments establish under the Research Trust Fund initiative provide a basis for West Virginia’s future prosperity. We are thankful to the donors and the West Virginia legislature for their confidence in our ability to deliver the innovation and education essential to the state’s economic future.”

To place Vice President King’s remarks in a more specific context, WVU continues to be classified as West Virginia’s only R1 Doctoral Research University by the Carnegie Classification of Institutions of Higher Learning. Only 129 other universities in the United States received this highest ranking in the Carnegie Classification. It is worth noting that data from 2017 show that in terms of GDP, WV with WVU as its R1

university ranks ahead of seven similar rural states (AK, ID, ME, ND, SD, VT, and WY) that do not have a University that is R1. This ranking also evidences WVU's reputation as one of the leading U.S. Research Universities. This is supported by the fact that in FY 2021, WVU faculty secured over \$191 million in externally sponsored grants and contracts, excluding charitable gifts and donations.

WVU is committed to using its RTF resources to improve the quality of life for all West Virginians. These efforts are interwoven with the statewide West Virginia Forward effort that Marshall University, West Virginia University, and the Department of Commerce are engaged in to diversify and grow the economy of the State of West Virginia.

President Gordon Gee continues to make the point that WVU's prominence in research is critical to reshaping West Virginia's economy for a brighter future. Three pillars undergird this transformation of the state: education, healthcare, and broad-based prosperity. The institution's research investments, the research funds generated by our faculty, and the support provided by the Research Trust fund set the foundation on which these pillars rest. The establishment of Vantage Ventures with a donation from John Chambers facilitates the conversion of research and innovation supported by the RTF into economic impact.

## Business Plan

In addition to the legislatively mandated reporting requirements, the Higher Education Policy Commission requires a business plan for each research area. APPENDIX A reflects the anticipated use of the money available to spend in FY22.

In FY21, \$16,884,759 of Research Trust Fund dollars, both that from private accounts and matching state accounts, was spent on research – for scholarships, fellowships, prominent scholars, and in support of ongoing research initiatives.

For FY22, \$15,240,751 will be available. This number includes the proceeds from each private endowment and its equivalent state matching endowment plus any unspent money from the preceding year. Of this amount, \$3,457,949 will come from interest earned on both the private endowments and that from the matching state endowments established from the Research Trust Fund; \$11,782,802 will come from unspent funds from the previous year. The significant amount of interest dollars reflects the positive impact of the stock market and the fact that all endowments are fully funded. All funds for each endowment are distributed according to the intent of the respective endowment.

WVU looks forward to the significant and sustained impact that programs supported by the Research Trust Fund will have on addressing some of the state's and the nation's most important issues in education, energy, health care and security.

WVU Research Trust Fund

Annual Report through Fiscal Year 2021

Fund ID	Fund Description	Budget Division	Unit	FY14 & Prior Budgets	FY15 Spend	FY16 Spend	FY 17 Spend	FY 18 Spend	FY19 Spend	FY20 Spend	FY21 Spend	Budget through FY21 Spend	Expenses through CLS-2021	Balance through FY21	FY22 Spend	Balance Forward
R085	Frederick P. Jr. & Joan C. Stamp Cancer Research	Cancer Center(CAN)	Cancer Center (CAN)	\$ 46,473.97	\$ 14,615.22	\$ 14,670.34	\$ 13,236.92	\$ 13,490.61	\$ 17,528.34	\$ 15,322.17	\$ 14,857.40	\$ 150,194.97	\$ 93,130.19	\$ 57,064.78	\$ 16,005.60	\$ 73,070.38
R095	Norma Mae Huggins Cancer Research Endowment	Cancer Center(CAN)	Cancer Center (CAN)	\$ 67,059.85	\$ 42,369.96	\$ 45,353.50	\$ 48,251.48	\$ 58,587.18	\$ 79,492.32	\$ 91,990.34	\$ 87,046.97	\$ 520,151.60	\$ 389,401.32	\$ 130,750.28	\$ 137,996.10	\$ 268,746.38
R100	Walter H. Moran Jr. General Surgery Resident Research	Medicine(MED)	Medicine (MED)	\$ 65,191.73	\$ 19,117.84	\$ 19,462.15	\$ 13,538.57	\$ 18,445.30	\$ (30,487.10)	\$ 18,940.83	\$ 17,508.70	\$ 141,718.02	\$ 498.50	\$ 141,219.52	\$ 18,757.04	\$ 159,976.56
R103	Schoepp Neuroscience Research Student Support	Medicine(MED)	Medicine (MED)	\$ 10,878.56	\$ 5,189.25	\$ 5,202.38	\$ 4,714.40	\$ 4,815.56	\$ 6,247.01	\$ 4,722.48	\$ 4,712.59	\$ 46,482.23	\$ 24,765.44	\$ 21,716.79	\$ 4,974.74	\$ 26,691.53
R106	Verizon WV for Biometrics Research	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 71,717.52	\$ 24,152.12	\$ 24,706.86	\$ 21,958.34	\$ 22,509.39	\$ 29,534.79	\$ 21,980.42	\$ 22,842.99	\$ 238,902.43	\$ 166,490.79	\$ 72,411.64	\$ 23,322.19	\$ 95,733.83
R107	Raymond Brooks Vanscoy Cancer Research Endowment	Cancer Center(CAN)	Cancer Center (CAN)	\$ 16,798.83	\$ 11,224.59	\$ 13,395.08	\$ 13,360.13	\$ 14,852.22	\$ 18,677.19	\$ 17,319.65	\$ 17,076.91	\$ 122,704.60	\$ 54,251.24	\$ 68,453.36	\$ 18,494.16	\$ 86,947.52
R108	Allen S. Pack Endowment for Mining Engineering	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 8,700.43	\$ 5,261.21	\$ 4,801.56	\$ 4,357.40	\$ 4,427.32	\$ 5,945.27	\$ 4,379.67	\$ 4,492.57	\$ 42,365.43	\$ 31,298.73	\$ 11,066.70	\$ 4,588.15	\$ 15,654.85
R109	L. Zane Shuck Laboratory Nanobiotechnology	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 25,615.53	\$ 9,617.61	\$ 9,639.17	\$ 8,745.05	\$ 8,964.90	\$ 11,774.61	\$ 8,753.03	\$ 9,088.77	\$ 92,208.67	\$ 52,825.99	\$ 39,382.68	\$ 9,290.19	\$ 48,672.87
R110	Alpha Natural Resources Endowment for Energy Research	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 31,993.78	\$ 24,966.44	\$ 25,004.06	\$ 25,906.10	\$ 26,529.69	\$ 35,011.11	\$ 25,926.14	\$ 26,941.09	\$ 222,278.41	\$ 52,479.27	\$ 169,799.14	\$ 27,513.07	\$ 197,312.21
R113	Alan Susman Cortico-Basal Ganglionic Degeneration Research	Medicine(MED)	Medicine (MED)	\$ 28,368.37	\$ 10,030.64	\$ 10,053.43	\$ 9,118.43	\$ 9,347.17	\$ 12,257.91	\$ 9,128.31	\$ 9,484.84	\$ 97,789.10	\$ -	\$ 97,789.10	\$ 9,683.50	\$ 107,472.60
R114	Blaine S. West Endowment for Civil and Environmental Engineering	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 36,458.45	\$ 10,094.28	\$ 10,117.10	\$ 9,176.55	\$ 9,407.24	\$ 12,343.36	\$ 9,186.50	\$ 9,546.82	\$ 106,330.30	\$ 124,240.16	\$ (17,909.86)	\$ 9,747.10	\$ (8,162.76)
R115	William J. Maier, Jr. Chair of Research	Health Sciences - Charleston Division(MCC)	Health Sciences - Charleston Division (MCC)	\$ 123,571.88	\$ 94,611.05	\$ 94,815.79	\$ 86,044.07	\$ 88,105.87	\$ 116,396.16	\$ 86,103.44	\$ 89,480.45	\$ 779,128.71	\$ 185,048.16	\$ 594,080.55	\$ 91,384.91	\$ 685,465.46
R116	Branson-Maddrell Endowed Professorship in Orthodontics	Dentistry(DEN)	Dentistry (DEN)	\$ 61,907.83	\$ 42,811.27	\$ 42,904.37	\$ 38,931.69	\$ 39,851.33	\$ 52,614.42	\$ 38,959.57	\$ 40,467.95	\$ 358,448.43	\$ 310,675.79	\$ 47,772.64	\$ 41,326.86	\$ 89,099.50
R117	George B. Bennett Dean's Research Opportunity Endowment	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 239,051.11	\$ 97,264.66	\$ 97,489.29	\$ 88,423.19	\$ 90,630.87	\$ 118,743.74	\$ 88,518.48	\$ 91,953.53	\$ 912,074.87	\$ 678,163.21	\$ 233,911.66	\$ 93,874.18	\$ 327,785.84
R118	E. Elizabeth Morgan Cancer Research	Cancer Center(CAN)	Cancer Center (CAN)	\$ 6,282.37	\$ 2,560.30	\$ 2,565.61	\$ 2,326.38	\$ 2,384.83	\$ 3,129.08	\$ 2,329.34	\$ 2,420.79	\$ 23,998.70	\$ 11,408.28	\$ 12,590.42	\$ 2,471.56	\$ 15,061.98
R119	Badzek Family Endowment for Nursing Research	Nursing(NSG)	Nursing (NSG)	\$ 3,827.00	\$ 2,457.40	\$ 2,440.34	\$ 2,215.10	\$ 2,262.86	\$ 2,998.27	\$ 2,216.46	\$ 2,298.67	\$ 20,716.10	\$ 10,000.00	\$ 10,716.10	\$ 2,347.60	\$ 13,063.70
R120	Ruth and Robert Kuhn Nursing Faculty Research	Nursing(NSG)	Nursing (NSG)	\$ 5,603.97	\$ 2,392.23	\$ 2,397.44	\$ 2,175.76	\$ 2,230.94	\$ 2,939.66	\$ 2,177.36	\$ 2,265.10	\$ 22,182.46	\$ 4,028.35	\$ 18,154.11	\$ 2,313.20	\$ 20,467.31
R121	Heil - de Graaf Endowment for Women in Science & Engineering	Arts & Sciences(A&S)	Arts & Sciences (A&S)	\$ 5,431.22	\$ 2,371.38	\$ 2,376.58	\$ 2,156.12	\$ 2,210.68	\$ 2,912.23	\$ 2,157.57	\$ 2,244.93	\$ 21,860.71	\$ 14,731.31	\$ 7,129.40	\$ 2,292.59	\$ 9,421.99
R122	Fithian Family Foundation #2/Behavioral Medicine- Psychiatry	Medicine(MED)	Medicine (MED)	\$ 14,225.36	\$ 9,439.44	\$ 9,459.59	\$ 8,585.80	\$ 8,769.56	\$ 11,636.76	\$ 8,590.78	\$ 8,908.46	\$ 79,615.75	\$ 49,764.31	\$ 29,851.44	\$ 9,098.68	\$ 38,950.12
R123	WVU Evidence Based Practice Research Professorship/Nursing	Nursing(NSG)	Nursing (NSG)	\$ 60,772.63	\$ 33,299.12	\$ 33,370.70	\$ 30,284.25	\$ 30,902.91	\$ 40,985.52	\$ 30,302.21	\$ 31,388.96	\$ 291,306.30	\$ 118,584.27	\$ 172,722.03	\$ 32,056.14	\$ 204,778.17
R124	Grace C. Clements Speech Pathology and Audiology Research	Human Resources & Education(HRE)	Human Resources & Education (HRE)	\$ 8,110.06	\$ 4,521.25	\$ 4,533.84	\$ 4,112.76	\$ 4,220.15	\$ 5,538.51	\$ 4,120.99	\$ 4,146.77	\$ 39,304.33	\$ 24,268.14	\$ 15,036.19	\$ 4,372.53	\$ 19,408.72
R125	Virginia Oil and Gas Research Endowment for PNGE	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 9,748.91	\$ 5,590.62	\$ 5,602.27	\$ 5,085.52	\$ 5,208.49	\$ 6,904.59	\$ 5,087.93	\$ 5,130.31	\$ 48,358.64	\$ 20,416.81	\$ 27,941.83	\$ 5,406.21	\$ 33,348.04
R126	Michael Baker Corporation Endowment/CEE	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 8,202.22	\$ 7,158.89	\$ 7,174.30	\$ 6,509.98	\$ 6,652.62	\$ 8,797.11	\$ 6,515.10	\$ 6,755.90	\$ 57,766.12	\$ 57,204.41	\$ 561.71	\$ 6,899.05	\$ 7,460.76

WVU Research Trust Fund

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Fund ID	Fund Description	Budget Division	Unit	FY14 & Prior Budgets	FY15 Spend	FY16 Spend	FY 17 Spend	FY 18 Spend	FY19 Spend	FY20 Spend	FY21 Spend	Budget through FY21 Spend	Expenses through CLS-2021	Balance through FY21	FY22 Spend	Balance Forward
R127	Darrell & Diane Williams Research for PNGE	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 8,371.61 \$	4,640.94 \$	4,650.47 \$	4,220.87 \$	4,329.74 \$	5,732.41 \$	4,223.25 \$	4,265.01 \$	40,434.30 \$	14,513.11 \$	25,921.19 \$	4,494.18 \$	30,415.37 \$
R128	Preservat Cancer Research	Cancer Center(CAN)	Cancer Center (CAN)	\$ 19,935.35 \$	13,854.66 \$	13,884.13 \$	12,601.71 \$	13,001.75 \$	17,080.54 \$	12,610.13 \$	12,783.44 \$	115,751.71 \$	47,632.37 \$	68,119.34 \$	13,470.93 \$	81,590.27 \$
	Martha Gaines & Russell	Qualifying - Biological, Biotech & Biomedical	Health Sciences - Charleston Division (MCC)													
R129	Wehrle Pediatric Research Endowment	Qualifying - Biological, Biotech & Biomedical	Qualifying - Biological, Biotech & Biomedical (MCC)	\$ 5,947.51 \$	4,717.99 \$	4,727.80 \$	4,291.33 \$	4,381.50 \$	5,817.66 \$	4,293.09 \$	4,451.43 \$	38,628.91 \$	8,300.82 \$	30,328.09 \$	4,546.53 \$	34,874.62 \$
	E. Jane Martin Research	Nursing(NSG)	Nursing (NSG)	\$ 3,765.27 \$	2,300.73 \$	2,396.28 \$	2,174.38 \$	2,210.19 \$	2,946.42 \$	2,177.21 \$	2,247.37 \$	20,307.85 \$	1,000.00 \$	19,307.85 \$	2,295.07 \$	21,602.92 \$
R130	Doctoral Fund															
R131	John T. & June R. Chambers Chair of Oncology Research	Cancer Center(CAN)	Cancer Center (CAN)	\$ 80,991.71 \$	69,410.20 \$	69,553.32 \$	63,140.72 \$	64,770.18 \$	85,803.93 \$	63,170.99 \$	63,812.58 \$	560,653.63 \$	518,422.10 \$	42,231.53 \$	67,238.19 \$	109,469.72 \$
	Christopher Cline Chair in Orthopedic Surgery	Medicine(MED)	Medicine (MED)	\$ 289,105.65 \$	189,944.30 \$	190,352.53 \$	172,750.08 \$	176,364.18 \$	233,836.22 \$	172,852.40 \$	179,137.32 \$	1,604,342.68 \$	1,154,998.90 \$	449,343.78 \$	182,948.19 \$	632,291.97 \$
R133	Mabel C. Phares Leukemia Research Endowment	Cancer Center(CAN)	Cancer Center (CAN)	\$ 116,260.95 \$	32,843.74 \$	32,910.92 \$	29,878.51 \$	30,380.77 \$	40,051.33 \$	29,885.26 \$	29,935.99 \$	342,747.47 \$	195,608.82 \$	147,138.65 \$	31,545.56 \$	178,684.21 \$
	Gary and Lisa Christopher Graduate Fellowship	Qualifying - Interdisciplinary	Engineering & Mineral Resources (EMR)	\$ 8,005.75 \$	10,354.22 \$	11,475.29 \$	9,094.01 \$	10,708.45 \$	14,268.69 \$	10,471.67 \$	10,556.53 \$	84,934.61 \$	41,526.41 \$	43,408.20 \$	10,790.46 \$	54,198.66 \$
	WV United Health System Evidence-Based Nursing	Nursing(NSG)	Nursing (NSG)													
R135	Mike Ross Family Pediatric Practice Res.	Qualifying - Biological, Biotech & Biomedical	Qualifying - Biological, Biotech & Biomedical (NSG)	\$ 4,634.98 \$	3,970.86 \$	3,979.63 \$	3,612.89 \$	3,690.48 \$	4,908.00 \$	3,614.45 \$	3,635.95 \$	32,047.24 \$	16,908.46 \$	15,138.78 \$	3,831.51 \$	18,970.29 \$
R136	Diabetes Research Endowment	Qualifying - Biological, Biotech & Biomedical	Medicine (MED)	\$ 51,100.53 \$	38,283.26 \$	38,364.96 \$	34,818.16 \$	35,396.78 \$	47,145.86 \$	34,835.07 \$	35,956.16 \$	315,900.78 \$	32,663.16 \$	283,237.62 \$	36,719.41 \$	319,957.03 \$
	Van Wyk Cancer Research Endowment	Cancer Center(CAN)	Cancer Center (CAN)	\$ 2,286.82 \$	2,369.11 \$	2,374.00 \$	2,154.47 \$	2,204.78 \$	2,914.76 \$	2,155.74 \$	2,239.19 \$	18,698.87 \$	8,234.21 \$	10,464.66 \$	2,286.81 \$	12,751.47 \$
	Robert T. Bruhn Physics Research Endowment	Arts & Sciences(A&S)	Arts & Sciences (A&S)	\$ 10,479.88 \$	4,920.12 \$	4,928.72 \$	4,474.98 \$	4,550.70 \$	6,093.51 \$	4,475.46 \$	4,484.63 \$	44,409.00 \$	- \$	44,409.00 \$	4,725.47 \$	49,134.47 \$
	Women in Science and Engineering Giving Circle Endowment	Qualifying - Interdisciplinary	Arts & Sciences (A&S)	\$ 3,568.78 \$	2,379.04 \$	2,384.07 \$	2,164.17 \$	2,200.37 \$	2,934.86 \$	2,165.65 \$	2,166.14 \$	19,963.08 \$	3,364.67 \$	16,598.41 \$	2,283.17 \$	18,881.58 \$
	Jarrett Family Research Endowment for Dentistry	Dentistry (DEN)	Dentistry (DEN)	\$ 14,827.90 \$	9,399.93 \$	9,415.64 \$	8,551.08 \$	8,694.46 \$	11,628.97 \$	8,553.48 \$	8,566.26 \$	79,641.72 \$	23,587.08 \$	56,054.64 \$	9,027.13 \$	65,081.77 \$
R140	Donald R. & Linda E. Holcomb Research Endowment	Qualifying - Biological, Biotech & Biomedical	Dentistry (DEN)	\$ 6,393.24 \$	9,184.74 \$	9,203.22 \$	7,301.36 \$	8,576.05 \$	11,458.77 \$	8,406.34 \$	8,455.23 \$	68,978.95 \$	11,121.83 \$	57,857.12 \$	8,642.46 \$	66,499.58 \$
R141	Arch Coal Inc. Endowment for Mine Health & Safety Research	Engineering & Mineral Resources (EMR)	Engineering & Mineral Resources (EMR)	\$ 24,922.03 \$	23,403.84 \$	23,458.56 \$	23,328.89 \$	23,798.75 \$	31,003.45 \$	23,364.20 \$	23,310.45 \$	196,590.17 \$	81,026.87 \$	115,563.30 \$	24,602.55 \$	140,165.85 \$
R142		Qualifying - Biological, Biotech & Biomedical	Medicine (MED)	\$ 7,919.37 \$	4,793.89 \$	4,804.60 \$	4,360.15 \$	4,482.30 \$	5,901.62 \$	4,362.50 \$	4,502.25 \$	41,076.68 \$	8,437.01 \$	32,639.67 \$	4,597.72 \$	37,237.39 \$
	Dr. Mohindar S. Seehra Research Award	Arts & Sciences (A&S)	Arts & Sciences (A&S)	\$ 6,289.66 \$	2,373.05 \$	2,377.86 \$	2,158.19 \$	2,194.21 \$	2,927.72 \$	2,157.88 \$	2,228.30 \$	22,706.87 \$	1,264.00 \$	21,442.87 \$	2,275.88 \$	23,718.75 \$
	Oleg D. & Valentina P. Jefimenko Library Resources #2	Library (LIB)	Library (LIB)	\$ 30,671.04 \$	17,249.19 \$	17,384.71 \$	15,500.33 \$	15,587.05 \$	15,906.99 \$	15,696.12 \$	15,311.93 \$	143,307.36 \$	143,307.32 \$	0.04 \$	15,413.42 \$	15,413.46 \$
R146	Frank and Susan Klatskin Cerminara Endowment	Qualifying - Interdisciplinary	Engineering & Mineral Resources (EMR)	\$ 3,065.12 \$	3,274.79 \$	4,479.59 \$	4,261.72 \$	4,558.07 \$	5,849.18 \$	4,737.77 \$	4,646.14 \$	34,872.38 \$	19,639.41 \$	15,232.97 \$	5,041.26 \$	20,274.23 \$
	Nesselroad Family Glaucoma Research	Qualifying - Biological, Biotech & Biomedical	Medicine (MED)	\$ 5,412.79 \$	6,672.77 \$	6,689.51 \$	6,070.02 \$	6,213.72 \$	8,195.76 \$	6,206.55 \$	6,437.99 \$	51,899.11 \$	10,779.47 \$	41,119.64 \$	6,572.46 \$	47,692.10 \$
	Salvatore and Josephine Cienfro Research Enhancement	Qualifying - Interdisciplinary	Engineering & Mineral Resources (EMR)	\$ 2,902.67 \$	2,353.89 \$	3,027.26 \$	2,962.41 \$	3,247.53 \$	4,461.26 \$	- \$	3,565.71 \$	22,520.73 \$	11,212.00 \$	11,308.73 \$	3,823.10 \$	15,131.83 \$
	Statler Research Endowment	Engineering & Mineral Resources (EMR)	Engineering & Mineral Resources (EMR)	\$ 774,902.92 \$	746,644.80 \$	889,621.40 \$	849,119.16 \$	867,755.33 \$	1,153,700.17 \$	849,469.69 \$	854,830.75 \$	6,986,044.22 \$	3,777,612.24 \$	3,208,431.98 \$	900,793.99 \$	4,109,225.97 \$

split between MAP and Financial Aid

split between MAP and Financial Aid

split between MAP and Financial Aid

WVU Research Trust Fund

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R150	WVU School of Medicine Research Endowment	Qualifying - Biological, Biotech & Biomedical	Medicine (MED)	\$ 47,014.17	\$ 35,152.13	\$ 35,229.84	\$ 31,967.01	\$ 32,822.84	\$ 43,167.98	\$ 31,998.10	\$ 33,325.46	\$ 290,677.53	\$ -	\$ 290,677.53	\$ 34,032.55	\$ 324,710.08
V613	Quad/Graphics Chair in Internal Medicine, Eastern Division	Health Science East (HSE)	Health Science East (HSE)	\$ 214,733.08	\$ 93,816.58	\$ 94,017.22	\$ 85,327.11	\$ 87,517.22	\$ 115,566.29	\$ 85,383.79	\$ 86,150.10	\$ 862,511.39	\$ 329,607.94	\$ 532,903.45	\$ 90,796.25	\$ 623,699.70
V815	James H. Walker Chair of Pediatric Cardiology	Medicine(MED)	Medicine (MED)	\$ 138,428.65	\$ 25,275.66	\$ 25,324.91	\$ 20,131.10	\$ 28,332.67	\$ 39,414.36	\$ 34,329.23	\$ 12,550.63	\$ 323,787.21	\$ 359,249.56	\$ (35,462.35)	\$ 35,704.37	\$ 242.02
V824	James A. Kent Endowment for Biomedical Engineering	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 40,051.96	\$ 16,972.40	\$ 17,013.02	\$ 15,425.90	\$ 15,783.79	\$ 20,634.35	\$ 15,445.32	\$ 16,005.90	\$ 157,332.64	\$ 134,057.97	\$ 23,274.67	\$ 16,336.24	\$ 39,610.91
V828	Osborn Professorship in Hematological Malignancies Research	Cancer Center(CAN)	Cancer Center (CAN)	\$ 178,442.27	\$ 61,145.60	\$ 61,285.68	\$ 55,609.42	\$ 56,999.65	\$ 74,708.84	\$ 55,668.88	\$ 57,835.36	\$ 601,695.70	\$ 524,121.58	\$ 77,574.12	\$ 59,044.73	\$ 136,618.85
V829	BrickStreet Neurology Fellowship	Medicine(MED)	Medicine (MED)	\$ 20,396.56	\$ 9,527.34	\$ 9,548.39	\$ 8,663.68	\$ 8,865.83	\$ 11,703.83	\$ 8,671.21	\$ 9,003.87	\$ 86,380.71	\$ -	\$ 86,380.71	\$ 9,194.70	\$ 95,575.41
V830	Robert E. Murray Chairmanshp Mining Engineering Department	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 240,201.67	\$ 96,005.33	\$ 96,221.00	\$ 87,293.35	\$ 89,472.27	\$ 117,600.19	\$ 87,374.18	\$ 90,817.86	\$ 904,985.85	\$ 517,625.39	\$ 387,360.46	\$ 92,731.02	\$ 480,091.48
V833	Rita Radcliff-Depepe & Brian Depepe Fellowship Award	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 6,748.16	\$ 4,148.99	\$ 4,160.55	\$ 3,766.35	\$ 3,839.28	\$ 4,920.67	\$ 3,775.14	\$ 3,743.89	\$ 35,103.03	\$ 3,179.97	\$ 31,923.06	\$ 3,956.15	\$ 35,879.21
V835	Energy Materials Science & Engineering Facilities Support	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 760.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 760.00	\$ -	\$ 760.00	\$ -	\$ 760.00
V841	Oleg D. and Valentina P. Jefimenko Library Resources	Library(LIB)	Library (LIB)	\$ 42,458.06	\$ 19,144.41	\$ 19,187.14	\$ 17,407.54	\$ 17,847.29	\$ 23,464.03	\$ 17,422.85	\$ 18,116.72	\$ 175,048.04	\$ 175,048.04	\$ (0.00)	\$ 18,499.03	\$ 18,499.03
V842	Jefimenko Physics Fellowship	Arts & Sciences(A&S)	Arts & Sciences (A&S)	\$ 9,113.71	\$ 4,757.38	\$ 4,805.21	\$ 4,284.70	\$ 4,308.37	\$ 4,396.64	\$ 4,338.24	\$ 3,967.86	\$ 39,972.11	\$ 7,430.85	\$ 32,541.26	\$ 4,260.44	\$ 36,801.70
V844	Bowby Wood Science Graduate Research Fellowship	Agriculture & Forestry(AGR)	Agriculture & Forestry (AGR)	\$ 57,583.95	\$ 50,990.88	\$ 51,119.64	\$ 46,434.62	\$ 47,445.70	\$ 62,243.42	\$ 46,698.86	\$ 48,305.89	\$ 410,822.96	\$ 246,614.73	\$ 164,208.23	\$ 49,295.60	\$ 213,503.83
V850	James P. Boland, M.D. Department of Surgery Endowed Research	Qualifying - Biological, Biotech & Biomedical	Health Sciences - Charleston Division (MCC)	\$ 34,613.93	\$ 29,786.99	\$ 30,385.23	\$ 27,758.17	\$ 28,151.39	\$ 32,716.65	\$ 28,165.21	\$ 26,882.23	\$ 238,459.80	\$ -	\$ 238,459.80	\$ 38,474.16	\$ 276,933.96
V854	WVU Ruby Scholars Graduate Research Fellowships	Academic Affairs(AAR)	Academic Affairs (AAR)	\$ 1,077,020.30	\$ 489,473.38	\$ 492,539.15	\$ 449,760.40	\$ 464,039.56	\$ 607,423.23	\$ 458,277.63	\$ 474,804.89	\$ 4,513,338.54	\$ 3,028,447.54	\$ 1,484,891.00	\$ 487,266.74	\$ 1,972,157.74
V858	Robert E. Pyle Chemical Engineering Graduate Fellowship	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 11,425.62	\$ 4,842.02	\$ 4,853.66	\$ 4,402.54	\$ 4,512.80	\$ 5,917.73	\$ 4,406.37	\$ 4,578.80	\$ 44,939.54	\$ 23,711.65	\$ 21,227.89	\$ 4,674.70	\$ 25,902.59
V859	James & Ruby Romano Civil & Environmental Engineering End.	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 80,376.15	\$ 33,733.16	\$ 33,810.18	\$ 30,669.17	\$ 31,439.49	\$ 41,251.48	\$ 30,701.53	\$ 31,906.20	\$ 313,887.36	\$ 263,502.30	\$ 50,385.06	\$ 32,575.51	\$ 82,960.57
V880	Robert & Stephany Ruffolo Pharmacy Graduate Fellowship	Pharmacy(PHR)	Pharmacy (PHR)	\$ 3,291.97	\$ 2,224.80	\$ 4,674.51	\$ 4,243.42	\$ 4,342.53	\$ 5,761.12	\$ 4,245.67	\$ 4,277.59	\$ 33,061.61	\$ 8,000.00	\$ 25,061.61	\$ 4,507.68	\$ 29,569.29
V882	James and Betty Hall Fellowship	Qualifying - Interdisciplinary	Qualifying & Mineral Resources (EMR)	\$ 5,063.97	\$ 9,449.02	\$ 9,468.96	\$ 8,595.04	\$ 8,738.65	\$ 11,674.29	\$ 8,597.77	\$ 8,606.92	\$ 70,194.62	\$ 45,605.00	\$ 24,589.62	\$ 9,070.79	\$ 33,660.41
V886	Stuart M. & Joyce N. Robbins Distinguished Prof/Epidemiology	Qualifying - Biological, Biotech & Biomedical	Health Sciences Center (HSC)	\$ 76,041.30	\$ 93,751.72	\$ 93,949.93	\$ 85,273.22	\$ 87,312.47	\$ 115,619.13	\$ 85,322.25	\$ 85,968.57	\$ 723,238.59	\$ 456,999.39	\$ 266,239.20	\$ 90,601.03	\$ 356,840.23
V887	Academy of Chemical Engineers Graduate Fellowship	Engineering & Mineral Resources(EMR)	Engineering & Mineral Resources (EMR)	\$ 10,184.78	\$ 13,614.86	\$ 14,815.60	\$ 14,154.56	\$ 14,515.48	\$ 18,477.40	\$ 14,281.29	\$ 14,130.77	\$ 114,174.74	\$ 26,194.45	\$ 87,980.29	\$ 14,939.13	\$ 102,919.42
V892	J.F. Brick Chair in Neurology	Qualifying - Biological, Biotech & Biomedical	Medicine (MED)	\$ 222,418.50	\$ 140,998.90	\$ 141,289.29	\$ 128,267.85	\$ 130,421.90	\$ 174,436.10	\$ 128,300.38	\$ 128,496.65	\$ 1,194,629.57	\$ 868,142.04	\$ 326,487.53	\$ 135,409.92	\$ 461,897.45
V894	Jack and Marietta Mullenger Fellowship	Qualifying - Biological, Biotech & Biomedical	Engineering & Mineral Resources (EMR)	\$ 752.86	\$ 2,266.03	\$ 2,957.19	\$ 2,655.54	\$ 2,689.62	\$ 3,076.47	\$ 2,676.60	\$ 2,546.84	\$ 19,621.15	\$ 3,179.97	\$ 16,441.18	\$ 2,713.30	\$ 19,154.48
V900	Research Trust Fund Jefimenko Professorship in Physics	Qualifying - Interdisciplinary	Arts & Sciences (A&S)	\$ 33,458.84	\$ 22,560.43	\$ 22,485.17	\$ 20,812.86	\$ 21,408.59	\$ 35,632.10	\$ 20,545.40	\$ 22,510.45	\$ 199,413.84	\$ 158,026.74	\$ 41,387.10	\$ 23,316.08	\$ 64,703.18

includes F3V830W

All financial aid - nothing in MAP

split between MAP and Financial Aid

split between MAP and Financial Aid

split between MAP and Financial Aid

split between MAP and Financial Aid

WVU Research Trust Fund

Annual Report through Fiscal Year 2021

Fund ID	Fund Description	Budget Division	Unit	FY14 & Prior Budgets	FY15 Spend	FY16 Spend	FY 17 Spend	FY 18 Spend	FY19 Spend	FY20 Spend	FY21 Spend	Budget through FY21 Spend	Expenses through CLS-2021	Balance through FY21	FY22 Spend	Balance Forward
	Cyber Physical System Center	WVU Institute of Technology	WVU Institute of Technology	\$ 19,999.78 \$ -	\$ -		\$ -	\$ -	\$ -	\$ -		\$ 19,999.78 \$ 22,174.32	\$ 22,174.32	\$ (2,174.54)	\$ -	\$ (2,174.54)
			Sub-Totals	\$ 5,008,333.35 \$ 2,946,184.84	\$ 3,108,626.69	\$ 2,871,107.13	\$ 2,964,862.42	\$ 3,862,895.24	\$ 2,951,240.15	\$ 2,983,131.67	\$ 26,696,381.49	\$ 15,805,754.36	\$ 10,890,627.13	\$ 3,179,580.92	\$ 14,070,208.05	
Financial Aid Accounts																
Z232	Wells Fargo Energy Group Scholarship	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 17,695.37 \$ 8,495.53	\$ 8,513.57		\$ 7,727.16	\$ 7,868.22	\$ 10,487.38	\$ -	\$ 7,749.60	\$ 68,536.83	\$ 14,500.00	\$ 54,036.83	\$ 8,167.52	\$ 62,204.35
Z238	Benjamin James Galford Research Scholarship	Financial Aid(FAD)	Arts & Sciences (A&S)	\$ 12,431.87 \$ 7,440.33	\$ 8,204.83		\$ 8,090.52	\$ 8,945.51	\$ 11,564.01	\$ -	\$ 10,454.24	\$ 67,141.31	\$ 73,638.00	\$ (6,496.69)	\$ 11,164.05	\$ 4,667.36
Z245	Carl Del Signore Foundation Graduate Fellowship	Financial Aid(FAD)	Academic Affairs (AAR)	\$ 9,551.14 \$ 4,706.32	\$ 4,716.92		\$ 4,280.70	\$ 4,388.21	\$ 5,794.52	\$ -	\$ 4,457.11	\$ 37,894.92	\$ 24,500.00	\$ 13,394.92	\$ 4,552.21	\$ 17,947.13
Z247	George M. & Mary Freda Vance Medical Scholarship-Fellowship	Financial Aid(FAD)	Cancer Center (CAN)	\$ 124,110.05 \$ 36,072.40	\$ 36,154.43		\$ 32,795.97	\$ 33,618.96	\$ 44,111.30	\$ 32,829.73	\$ 34,118.01	\$ 373,810.85	\$ 371,141.94	\$ 2,668.91	\$ 34,833.73	\$ 37,502.64
Z277	William S. Clapper Mechanical & Aerospace Engineering Scholarship	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 12,300.26 \$ 4,869.60	\$ 4,880.85		\$ 4,426.98	\$ 4,537.29	\$ 5,942.84	\$ -	\$ 4,602.96	\$ 41,560.78	\$ 28,738.00	\$ 12,822.78	\$ 4,699.03	\$ 17,521.81
Z279	Everette C. Dubbe Research Scholarship	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 18,139.76 \$ 9,492.32	\$ 9,512.98		\$ 8,632.95	\$ 8,828.11	\$ 11,676.38	\$ -	\$ 8,966.00	\$ 75,248.50	\$ 75,198.00	\$ 50.50	\$ 9,156.59	\$ 9,207.09
Z282	Oleg D. and Valentina P. Jefimenko Physics Scholarship	Qualifying - Interdisciplinary	Financial Aid (FAD)	\$ 5,984.63 \$ 3,548.99		\$ 3,588.22	\$ 3,198.72	\$ 3,216.65	\$ 3,282.10	\$ -	\$ 2,961.45	\$ 25,780.76	\$ 28,950.00	\$ (3,169.24)	\$ 3,179.82	\$ 10.58
Z326	James Bergen and Randy Monteith Anderson Scholarship in MAE	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 3,415.52 \$ 2,355.38	\$ 2,361.01		\$ 2,142.04	\$ 2,208.59	\$ 2,889.42	\$ -	\$ 2,239.93	\$ 17,611.89	\$ 10,075.00	\$ 7,536.89	\$ 2,287.45	\$ 9,824.34
Z329	Morton Scholarship	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 13,533.28 \$ 9,318.01	\$ 9,339.13		\$ 10,217.87	\$ 10,491.25	\$ 13,210.29	\$ -	\$ 16,186.35	\$ 82,296.18	\$ 39,500.00	\$ 42,796.18	\$ 16,422.36	\$ 59,218.54
Z333	David Vandorn Sutton Scholarship	Financial Aid(FAD)	Financial Aid (FAD)	\$ 53,456.18 \$ 37,343.05	\$ 37,419.69		\$ 33,971.00	\$ 34,704.64	\$ 46,198.10	\$ -	\$ 34,195.06	\$ 277,287.72	\$ -	\$ 277,287.72	\$ 36,031.63	\$ 313,319.35
Z337	William "Bill" Closser Memorial Electrical Engineering Sch.	Qualifying - Interdisciplinary	Financial Aid (FAD)	\$ -	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Z339	Morrissey-Ropp Scholarship	Financial Aid(FAD)	Arts & Sciences (A&S)	\$ 8,061.77 \$ 6,921.31			\$ 6,296.26	\$ 6,432.85	\$ 8,569.51	\$ -	\$ 6,339.01	\$ 49,556.26	\$ 54,151.00	\$ (4,594.74)	\$ 6,679.03	\$ 2,084.29
Z341	Martha Hopkins Hashinger Scholarship	Financial Aid(FAD)	Engineering & Mineral Resources (EMR)	\$ 3,563.52 \$ 2,568.93	\$ 2,578.74		\$ 2,344.51	\$ 2,387.64	\$ 3,181.70	\$ -	\$ 2,352.69	\$ 18,977.73	\$ 10,980.00	\$ 7,997.73	\$ 2,480.31	\$ 10,478.04
Z364	Research Trust Fund Taylor Endowment	Qualifying - Interdisciplinary	Engineering & Mineral Resources (EMR)	\$ 163.34 \$ 2,436.67		\$ 2,859.35	\$ 2,587.07	\$ 2,646.88	\$ 3,604.62	\$ 1,006.36	\$ 3,014.52	\$ 18,318.81	\$ 1,050.00	\$ 17,268.81	\$ 3,677.65	\$ 20,946.46
Z365	Mitchell-Morey Family Endowed Scholarship	Qualifying - Interdisciplinary	Financial Aid (FAD)	\$ 2,011.72		\$ 2,548.16	\$ 2,035.62	\$ 2,566.95	\$ 3,373.49	\$ -	\$ 2,802.19	\$ 15,338.13	\$ -	\$ 15,338.13	\$ 2,974.18	\$ 18,312.31
Z368	Statler Research Scholars Program	Qualifying - Interdisciplinary	Financial Aid (FAD)	\$ 35,792.33 \$ 44,437.66	\$ 44,289.43		\$ 72,656.53	\$ 85,721.57	\$ 113,972.98	\$ -	\$ 84,502.68	\$ 481,373.18	\$ 333,117.00	\$ 148,256.18	\$ 86,374.15	\$ 234,630.33
Z372	William E. & Bonniegall Kucan Coleman Research Scholarship	To Be Determined	Financial Aid (FAD)	\$ 1,459.93 \$ 1,243.55	\$ 1,252.19		\$ 1,115.61	\$ 1,121.99	\$ 1,144.53	\$ -	\$ 1,101.05	\$ 8,438.85	\$ 13,466.00	\$ (5,027.15)	\$ 1,108.35	\$ (3,918.80)
Z375	Bettie D. Gallaher Research Fellowship	Qualifying - Interdisciplinary	Financial Aid (FAD)	\$ 37,570.07 \$ 44,862.48	\$ 48,341.57		\$ 44,276.53	\$ 44,661.37	\$ 48,135.66	\$ -	\$ 44,159.91	\$ 312,007.59	\$ -	\$ 312,007.59	\$ 44,579.92	\$ 356,587.51
Sub-Totals				\$ 359,240.74 \$ 226,112.53	\$ 233,496.62		\$ 246,796.04	\$ 264,346.68	\$ 337,138.83	\$ 33,836.09	\$ 270,212.76	\$ 1,971,180.29	\$ 1,079,004.94	\$ 892,175.35	\$ 278,367.98	\$ 1,170,548.33
Combined Totals				\$ 5,367,574.09 \$ 3,172,297.37	\$ 3,342,123.31		\$ 3,117,903.17	\$ 3,229,209.10	\$ 4,200,034.07	\$ 2,985,076.24	\$ 3,253,344.43	\$ 28,667,561.78	\$ 16,884,759.30	\$ 11,782,802.48	\$ 3,457,948.90	\$ 15,240,751.38

split between MAP and Financial Aid

split between MAP and Financial Aid



WEST VIRGINIA

# Higher Education Policy Commission

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**Report to the Legislative Oversight Commission  
on Education Accountability**

**Annual Report on Research Challenge Fund  
(\$18B-18B-12)**



**MEMORANDUM**

**TO:** Legislative Oversight Commission on Education Accountability (LOCEA)

**FROM:** Dr. Juliana Serafin, Senior Director, Division of Science, Technology and Research, HEPC

**DATE:** October 11, 2021

**RE:** Research Challenge Fund Annual Report

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West Virginia Code §18B-1B-12 requires the West Virginia Higher Education Policy Commission to report to LOCEA annually on the results of the projects and activities funded by the Research Challenge Fund (RCF) appropriation.

Since it was created in 2004, the Research Challenge Fund has been instrumental in helping West Virginia build its scientific research capacity and reputation by attracting and developing top university scientists. Through funding for undergraduate and graduate STEM students, the Research Challenge Fund creates a highly skilled, culturally diverse workforce, leading to new economic possibilities for West Virginia. The Research Challenge Fund is evidence of the state's ongoing commitment to support science and technology research, education, and outreach.

***Vision 2025: West Virginia Science & Technology Plan*** identifies growth of the research enterprise at our universities as one of the key areas of focus for the state. The plan includes a specific recommendation to re-establish the original level of funding of the Research Challenge Fund at \$4.5 million a year. It is now funded at \$1,731,820 per year from the lottery. In Fiscal Year 2021, RCF supported the following grant programs and services:

- **Research Challenge Grants** support the creation of research centers and foster economic development and workforce advancement (\$1.3 million for each of 3 awards distributed over 5 years).

For the period 2018 – 2022, Research Challenge Grants are:

- 1) Advancement of Science and Engineering for Localized Gas Utilization (WVU and Marshall University),
- 2) Foundation of the Vaccine Development Center at WVU (WVU)
- 3) Center for Cognitive Computing (C3): A Multidisciplinary Research Center for Excellence (WVU).

All three projects have made excellent use of the state's investment by leveraging the initial investment into further grant funding from federal sources, supporting scores of graduate students and postdoctoral fellows, and producing hundreds of publications on important research. Project 2 (Vaccine Development Center) has a 25:1 return on investment ratio for the money from the RCG, and has developed several industry-academia partnerships. Please see the detailed reports for each of the three projects which are combined into ***Attachment 1: Annual Reports Research Challenge Grants 2020-2021***. These awards will expire at the end of 2022, and new awards will start in 2023.

- **Summer/Semester Undergraduate Research Experience (SURE)** awards for undergraduate research stipends to fully or partially support ~100 students annually at WVU, Marshall, West Virginia State University, West Virginia Wesleyan College, Shepherd University, and West Liberty University. (The sum of six awards is \$300,000 per year, for three years from 2020-2022. Note that due to 2020 summer COVID-19 cancellations, some of these grants have requested a no cost extension to 2023.)
- **Science, Technology, Engineering and Mathematics (STEM) Fellows** grants for STEM doctoral (PhD) students at WVU and Marshall. This grant provides significant support to WVU and Marshall for their STEM research programs and helps maintain their respective R1 and R2 research classifications. Due to COVID-19, the awards have been extended a fifth year, i.e., to 2017-2022. The total for five years will be \$800,000 to Marshall and \$1,675,000 to WVU. Proposals for the next cycle of awards from 2022-2026 will be reviewed later this year.
- **Technical Assistance** provides an external expert peer review service for STEM faculty to help develop competitive proposals for funding from federal agencies. In FY'21, 32 faculty proposals were reviewed, 1 large scale proposal to the NSF was reviewed multiple times, and 50 proposals were reviewed for 9 competitions. (\$150,000)
- **Opportunity Fund** provides small, one-time awards (~\$5000 each) to assist faculty and STEM programs with expenses related to development of proposals for federal funding, and for summer student programs (total funding per year is \$40,000). In FY'21, no grants were given although some were awarded, because awardees were unable to spend the money due to COVID-19.
- **Innovation Grants** provides one-time awards (~\$40,000 each) for equipment, supplies and minor renovations of laboratory spaces for undergraduate education and research. Two awards are made per year. FY'21 awards went to Shepherd University and West Virginia Wesleyan College.
- **Administration and Cost Share to NSF EPSCoR RII grant** (\$255,000)



# ANNUAL REPORTS

*Research Challenge Grants 2020-2021*

# **Project Title: Advancement of Science and Engineering for Localized Gas Utilization**

## **A Summary Report**

Reporting Period: 4<sup>th</sup> Year, September 1, 2020 to August 31, 2021

### **Research Team**

John Hu, WVU Department of Chemical and Biomedical Engineering

Jesse Richardson, WVU College of Law

Cosmin Dumitrescu, WVU Department of Mechanical and Aerospace Engineering

Vyacheslav Akkerman, WVU Department of Mechanical and Aerospace Engineering

Levan Elbakidze, WVU Department of Resource Economics and Management

Bingxin Li, WVU Department of Finance

Melanie Wilson, Project Coordinator. WVU Statler College of Engineering

Rosalynn Quinones-Fernandez, Department of Chemistry, Marshall University

Shikha Sharma, WVU Department of Geology & Geography

Yuxin Wang, WVU Department of Chemical and Biomedical Engineering

Wenyuan Li, WVU Department of Chemical and Biomedical Engineering

## 1. Narrative ( 4<sup>th</sup> year, September 1 2020-August 31, 2021)

Faculty from the WVU Center for Innovation in Gas Research & Utilization (CIGRU) and Marshall University collaborate on this HEPC RCG project. In the 4<sup>th</sup> year of the project, significant progress has been made. The Science & Engineering faculty continue to develop shale gas conversion technologies. Dr. John Hu's team has been exploring shale gas conversion to chemicals including C<sub>4</sub> olefins, aromatics, and ammonia. These chemicals can be transported by rail and truck from stranded gas field where pipelines are not available. Dr. Dumitrescu's and Dr. Akkerman's groups are developing advanced shale gas combustion technologies using the optical combustion engine. Recently, a mixture of simulant mimicking off-gas from a chemical synthesis reactor was purchased to be used in the optical combustion engine to simulate wellhead co-production of chemical-electricity. This is the-first-of-its-kind technology that is developed for distributed production. If successful, it will significantly reduce the emission at stranded gas fields (gas flaring), and turn pollutants into value-added products.

In the 4<sup>th</sup> year, CIGRU faculty received 7 grants with total funding amounts of \$ 1,171,000, submitted 20 proposals with total budget request of \$ 22 million, published 40 peer-reviewed journal articles, made 38 presentations in conference, and filed/granted 11 U.S. patents. In the 4<sup>th</sup> year, CIGRU faculty received several recognitions:

- John Hu received the prestigious 2020 Benedum Distinguished Scholar Award
- John Hu received the 2020 WVU Statler College Researcher of the Year Award
- Cosmin Dumitrescu received the 2020 WVU Statler College Outstanding Advisor Award
- Vyacheslav Akkerman received the 2020 WVU Statler College Outstanding Researcher Award
- John Hu: received the prestigious IChemE Global Award.
- Vyacheslav Akkerman was promoted to the rank of full professor; Cosmin Dumitrescu was promoted to the rank of associate professor. Rosalynn Quinones-Fernandez was promoted to associate professor with tenure.

Dr. Richardson, CIGRU Law faculty, received \$307,000 in competitive research funds from USEA/DOE. Traditionally, law school faculty do not compete for research grants in open solicitations. The HEPC project provides the opportunity for Dr. Richardson to devote his effort to energy research.

Five WVU faculty in the Science & Engineering discipline joined CIGRU: Dr. Shikha Sharma, Dr. Yuxin Wang, Dr. Wenyuan Li, Dr. Madlyn Ball and Dr. Omid Askari. Drs Sharma and Wang are contributing to this HEPC RCG project. These faculty have been collaborating to develop new research proposals in the areas of decarbonization and waste plastics upcycling.

The HEPC project tightly integrates the collaboration wherein the faculty of Engineering can engage with faculty of Law, Finance and Geology to come up with innovative solutions to the energy and environmental issues. Presently, CIGRU faculty received grants from several federal agencies including DOE, NSF, USEA, USDA, WV HEPC. Industrial companies such as Shell and SoCalGas provide cost share to the project.

As of September 1, 2021, the project has trained 25 PhD/MS students, 10 BS students and 4 postdocs. Since the beginning of the project on January 1, 2018, the project team submitted 13 quarterly reports and 3 annual reports to WV HEPC. Each year, the team also held project an annual review meeting with HEPC Directors and the Advisory Committee. **Appendix A** summarizes the accomplishment in the last 4 years.

## Appendix A: Updated Summary (Last 4 years, 2018-2021)

### OUTCOMES

The HEPC RCG grant supports 10 WVU faculty and one Marshall University Faculty. Since 2014, through a series of cluster hires, WVU created a Center for Innovation in Gas Research and Utilization (CIGRU) to promote gas utilization science, engineering, law, policy, economic development, and community development. CIGRU involves 8 faculty from across five Colleges at WVU. Then, in January of 2018, we were awarded five years of funding under a Research Challenge Grant (RCG) from the West Virginia Higher Education Policy Commission (HEPC). The RCG grant allows multidisciplinary faculty working together to commercialize shale gas technology by providing science & engineering solution, legal & regulatory guidance, environmental and finance consultation. When industrial companies consider to invest in WV State on shale gas, they will have an entire package of solution (one-stop shopping).

For shale gas utilization, funding from federal agencies such as DOE or NSF, are granted to project having very specific topics. It is unusual to find funding opportunity to support a project where multidisciplinary approach is involved. RCG grant enables such a collaboration among multidisciplinary faculty to solve shale gas utilization issues in a more broadways to create strong impact. RCG grant enables S&E faculty to win federal grants, and some CIGRU faculty who are traditionally not used to compete at national level but now won the federal grants. Professor Jesse Richardson from WVU College of Law, won an EPA grant this year. Professor Rosalynn Quinones-Fernandez from Chemistry Department of Marshall University Won NSF MRI and NASA grants.

### PUBLICATIONS

Leveraging the resources from RCG, Faculty from WVU and Marshall University published 179 peer-reviewed journal articles and made 183 presentations at national and international conferences. Among these publications, **HEPC is acknowledged on 54 papers as a funding agency.** The details of these publications are listed in 2018, 2019 and 2020 annual reports submitted to HEPC.

Year	Peer Reviewed Journal Articles	Conference Presentations
2018	36	44
2019	52	65
2020	51	37
2021	40	37
Total	179	183

Note: CIGRU faculty filed/granted 11 U.S. patents.

### STUDENTS

Name	BS/MS/PhD	Major	University	Status
Ashley Caiola	PhD	ChE	WVU	Current Student
Brandon Robinson	PhD	ChE	WVU	Current Student
Christopher Ulishney	PhD	ME	WVU	Current Student
Jinlong Liu	PhD	ME	WVU	Graduated
Abdulafeez Adebiyi	PhD	ME	WVU	Graduated
Olatunde Abidakun	PhD	ME	WVU	Graduated
Furkan Kodakoglu	PhD	ME	WVU	Graduated
Lateef Kareem	PhD	ME	WVU	Current Student
Samuel Ogunfuye	PhD	ME	WVU	Current Student
Ali Sivri	PhD	ME	WVU	Graduated
Iolanda Stocchi	MS	ME	WVU	Graduated

Lorenzo Gasbarro	MS	ME	WVU	Graduated
Luca Ambrogi	MS	ME	WVU	Graduated
Mohammed Alkhabbaz	MS	ME	WVU	Graduated
Sunita Pokharel	MS	ME	WVU	Graduated
Amanda Cathreno	BS	ME	WVU	Graduated
Elizabeth Ridgeway	BS	ME	WVU	Graduated
Brian Leonard	BS	ChE	WVU	Graduated
Brendan Hmiel	BS	ME	WVU	Graduated
Brian Frongello	BS	ME	WVU	Graduated
Deben Shoup	MS	Chemistry	Marshall University	Graduated
Sarah Nickel	BS	Chemistry	Marshall University	Graduated
Sara Moreno	MS	Chemistry	Marshall University	Current Student
Lena Salameh	BS	Chemistry	Marshall University	Graduated
Grayce Behnke	MS	Chemistry	Marshall University	Graduated
Keerigan Parks	BS	Chemistry	Marshall University	Graduated
Carrie Sullins	BS	Chemistry	Marshall University	Current Student
Haley Pijor	BS	Chemistry	Marshall University	Current Student
Aakriti Damai	BS	Chemistry	Marshall University	Current Student
Erin O'Brien	J.D.	Law	WVU	Graduated
Bailey Emory	J.D.	Law	WVU	Graduated
Amanda Demmerle	J.D.	Law	WVU	Graduated
Kathryn Stewart	J.D.	Law	WVU	Current
Madison Hinkle	J.D.	Law	WVU	Current
Samsher Dhaliwal	J.D.	Law	WVU	Current

#### POSTDOCS

Name	Postdoc	Major	University	Status
Yuxin Wang	Postdoc	ChE	WVU	Current
Qingyuan Li	Postdoc	ChE	WVU	Left WVU
Jinlong Liu	Postdoc	ME	WVU	Left WVU
Sonit Balyan	Postdoc	ChE	WVU	Current

#### SUBMITTED PROPOSALS

##### Total Number of Proposals Awarded

Year	Number of Proposals Submitted	Number of Proposal Funded/funding amount \$
2018	25	9/\$1.27 Million
2019	31	13/\$5.5 million
2020	17	13/\$5.1 million
2021	20	7/\$1.17 million
Total	93	42/\$13.04 million

##### Currently Funded Proposals Related to Shale Gas Utilization or RCG

Name of PI/Co-PI	Proposal Title	Funding Agency	Funding Amount	Status
John Hu	Natural gas catalytic pyrolysis to carbon nano materials	DOE NETL	\$ 3.75 million	Funded
John Hu	Microwave catalysis for natural gas conversion	DOE EERE	\$ 4.65 million	Funded

Jesse Richardson	Study on State's Policies and Regulations per CO <sub>2</sub> -EOR-Storage, Conventional, ROZ and EOR in Shale: Infrastructure, Incentives, Royalty Owners, Eminent Domain, Mineral-Pore Space, and Storage Lease Issues	USEA/DOE	\$ 307,000	Funded
Rosalynn Quinones-Fernandez	NASA WVSGC Undergraduate Research Fellowship-Sara Moreno	NASA	\$15,000	Funded
John Hu	Renewable Energy to Fuels through Microwave Catalytic Synthesis of Ammonia	DOE ARPA-E	\$3.1 million	Funded
John Hu	Center of Advancement of Science and Engineering for Localized Gas Utilization	WV HEPC	\$ 1.29 million	Funded
John Hu	Core-Shell Oxidative Aromatization Catalysts for Single Step Liquefaction of Distributed Shale Gas	DOE	\$270,000	Funded
John Hu	A Novel Molten Salt System for CO <sub>2</sub> Based Oxidative Dehydrogenation with Integrated Carbon Capture	DOE	\$300,000	Funded
Akkerman	CAREER: Promotion and Prevention of Flame Acceleration and Deflagration-to-Detonation Transition: From Fundamental Study to Practical Consideration.	NSF	\$50,000	Funded
Akkerman (Co-PI)	Development of Critical Components for the Modular Staged Pressurized Oxy-Combustion (SPOC) Power Plant	DOE	\$322,000	Funded
Dumitrescu (Co-PI)	Fast Simulation of Real Driving Emissions from Heavy-duty Diesel Vehicle Integrated with Advanced Aftertreatment System	DOE	\$250,000	Funded
Total			\$14.3 million	

## HIGHLIGHTS

- John Hu received the prestigious 2020 Benedum Distinguished Scholar Award
- John Hu received the 2020 WVU Statler College Researcher of the Year Award
- Cosmin Dumitrescu received the 2020 WVU Statler College Outstanding Advisor Award
- Vyacheslav Akkerman received the 2020 WVU Statler College Outstanding Researcher Award
- John Hu: received the prestigious IChemE Global Award.

- Vyacheslav Akkerman was promoted to full professor; Cosmin Dumitrescu was promoted to associate professor with tenure. Rosalynn Quinones-Fernandez was promoted to associate professor with tenure.
- Brian Leonard, WVU undergraduate student, won First Prize in the undergraduate student competition at 2019 AIChE Annual Meeting, Orlando, Florida. Brian also co-authored two journal papers currently under revision (ACS Catalysis, Applied Catalysis B).

**Annual Progress Report**  
**Reporting Period: January 1, 2021 to December 31, 2021**

**Award Number:** HEPC.dsr.18.5

**Project Title:** Center for Cognitive Computing (C3): A Multidisciplinary Research Center for Excellence <https://cognitivecomputinglab.faculty.wvu.edu/>

**Project Period:** January 1, 2018 to December 31, 2022

**Recipient Organization:** West Virginia University

**Principal Investigator:** Nasser M. Nasrabadi, [Nasser.Nasrabadi@mail.wvu.edu](mailto:Nasser.Nasrabadi@mail.wvu.edu)

**Research Team:**

**Dr. Nasser M. Nasrabadi (PI)**, WVU Department of Computer Science & Electrical Engineering

Dr. Xin Li (Co-PI), WVU Department of Computer Science & Electrical Engineering

Dr. Brian Woerner, WVU Department of Computer Science & Electrical Engineering

Dr. Jeremy Dawson, WVU Department of Computer Science & Electrical Engineering

Dr. Yu Gu, WVU Department of Mechanical & Aerospace Engineering

Dr. Saiph Savage, WVU Department of Computer Science & Electrical Engineering

Dr. Guodong Guo, WVU Department of Computer Science & Electrical Engineering

Dr. Yanfang Ye, WVU Department of Computer Science & Electrical Engineering

Kathleen Cullen, WVU Statler College of Engineering & Mineral Resources Dean's Office

Dr. Erin Winstanley, West Virginia University School of Pharmacy

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## **1. Executive Summary:**

The Center for Cognitive Computing (C3): A Multidisciplinary Research Center for Excellence has met its milestones during its fourth year of program. One of the key achievements of the center for cognitive computing is the financial milestone of reaching **\$8.246** million in the fourth year of research activities compared with \$5.557 million in the third year, \$7.584 million in the second year and \$4.631 in the first year. The center's funding has come from 17 awarded projects in the fourth year mainly from several federal agencies such as IARPA, NASA EPSCoR, Facebook, FBI, NASA, NSF-NRT, NSF I/UCRC (CITeR), USDA, DoE EPSCoR, Twitch Fellowship and NIJ. Researchers in the center for cognitive computing have also authored or co-authored 39 new proposals with a total budget of **\$56.876** million which are still pending for decision.

Since receiving the WV HEPC Research Challenge Grant, members of the Center for Cognitive Computing have worked on 7 different projects in the fourth year, 12 different projects in the third year, 12 projects in the second year and 11 different projects in the first year of the program and proposing to initiate 6 new projects in the fifth year of the program. The team has published 23 journal publications in the fourth year, 28 journal publications in the third year, 28 in the second year and 15 in the first year. The team has 21 conference papers in the fourth year, 57 conference papers in the third year, 57 in the second year and 38 papers in the first year and 12 different prestigious awards such as the NSF Career Award, Journal editorial-ship, best student conference paper, Facebook student internship, student DOJ fellowship and student travel award, NSF panel member, and NASA concept fellow. Supporting directly from the WVU HEPC grant a total of 49 graduate students to date: 37 PhD, 11 Masters, and one undergraduate. Graduated 9 PhD and 7 Master students as of 09/01/2021.

The center has close collaborations with several DoD labs such as the U.S. Army Research Laboratory (ARL), NASA, USDA/NIFA, Facebook as well as WVU NSF Center for Identification Technology Research (CITeR) with which the groups have forged a strong, unified, interdependent synergy that has moved Biometrics Technologies at West Virginia University even more to the forefront of the science and has magnified its national reputation and presence at international conferences and DoD meetings.

The major goal of the center for cognitive computing is establishing an institute that would be the source for innovation with government & industrial researchers, faculty, and students in machine learning and big data technologies and serve as a magnet for further funded activity investment in WV. To achieve this goal, the team will submit more proposals in harvesting big data for engineering applications and establish stronger relationships with federal agencies and industrial partners.

## **2. Noteworthy accomplishments by the members of the center in FY2021:**

- Receiving awards to date worth **\$8.246** million from 17 awarded proposals.
- Submitted 39 new proposals worth **\$56.876** million, pending for award.
- Total funded research activities by the center between FY18-FY21 as of today: **\$26.018** million.
- Broadening research to include not only the originally proposed projects but also including aerial super-resolution for pedestrian and vehicle detection for surveillance and border control, Quantum machine learning, multi-camera video analytics and multimodal sensor fusion, use of AI/ML for power & energy and Neuroscience.
- Conducting preliminary discussions with prospective DoD investors (i.e., IARPA, ARL, NGIA, DHS, USDA/NIFA) on aerial surveillance, super-resolution, and biometrics for entry and exit applications.
- IEEE Transactions on Image Processing, Xin Li is the Senior Area Editor
- Dr. Saiph Savage was the keynote speaker at Neurips 2020 Conference (the largest and most prestigious A.I. conference in the world.)
- Two graduate students were selected for internship, one working at Facebook and another one working at Amazon.

- Organized Summer School on AI & Smart Health, July 20-21, 2021, two members (N. Nasrabadi and X. Li with collaboration with Don Adjeroh) of the center presented papers on Deep Learning and AI in Smart Health.
- Published 23 papers in peer-reviewed journals. Published 21 national/international conference papers in FY2021.
- Hosting several educational & outreach activities such as Engineering Challenge Camps for female high school students, created a new Coding & Cybersecurity Summer Camps, and presented at several educational outreach meetings.
- Supporting a total of 49 students directly to date 37 PhD, 11 Masters, one undergraduate. Graduated 9 PhD and 7 Master students as of 09/01/2021.
- Received 12 different prestigious awards such as NSF-NRT, IARPA, NASA EPSCoR, USDA best student awards, student fellowship & travel award.

### **3. Total Projects Awarded in FY21 (\$8.246 Million)**

1. Proposal to NSF 16-504 I/UCRC, via Department of Homeland Security (DHS), Award CNS-ID 1650474, Proposal number:2149437 – Supplement (Valenti-PI, Nasrabadi-Co-PI), **\$500,000**, 03/15/2017 to 02/28/2022.
2. Proposal to IARPA BRIAR project (Nasrabadi-PI, Dawson Co-PI), **\$1,085,086**, “Biometric Recognition and Identification at Altitude and Range,” Oct. 01, 2021 to Sept. 31, 2026.
3. Proposal to IARPA BRIAR project (Dawson-PI, Nasrabadi Co-PI), **\$751,654**, “STR BRIAR Data Collection,” Oct. 01, 2021 to Sept. 31, 2025.
4. Proposal to NASA EPSCoR, (Mehta-PI, Nasrabadi Co-PI), **\$750,000**, “Adaptive and Scalable Data Compression for Deep Space Data Transfer Applications using Deep Learning” 21-EPSCoR2021-0001, Oct. 01, 2021 – Sept. 31, 2024.
5. Proposal to NSF I/UCRC, CITeR (Nasrabadi-PI, Dawson Co-PI), **\$50,000**, “Towards the Creation of a Large Dataset of High-Quality Morphs,” 21S-03W-SP, Aug. 01, 2021 – July 31, 2022.
6. Proposal to NSF I/UCRC, CITeR (Dawson-PI, Nasrabadi Co-PI), **\$55,000**, “Evaluation of the Performance of Multi-Finger Contactless Fingerprint Matching” 21S-04W-SP, Aug. 01, 2021 – July 31, 2022.
7. Proposal to NSF I/UCRC, CITeR (Dawson-PI, Nasrabadi Co-PI), **\$60,000**, “Expansion of Contactless Mobile Phone Fingerprint Datasets,” 21S-04W-SP, Aug. 01, 2021 – July 31, 2022.
8. Proposal to NSF I/UCRC, CITeR Dawson-PI, Nasrabadi Co-PI), **\$55,000**, “Biometric Data Classification for Large-Scale Database Error Detection and Correction,” 20F-02W-SP, Jan. 01, 2021 to Dec. 31, 2021.
9. Proposal to NSF I/UCRC, CITeR (Nasrabadi-PI, Dawson Co-PI), **\$50,000**, “Joint Face Pose Estimation and Frontalization,” 20F-07W, Jan. 01, 2021 to Dec. 31, 2021.
10. Proposal to NSF I/UCRC, CITeR (Dawson-PI, Nasrabadi Co-PI), **\$50,000**, “Deep Deblurring of Fingerphotos Captured by Smartphones,” 20F-03W, Jan. 01, 2021 to Dec. 31, 2021.
11. NSF-CITeR, deepfake detection, Total **\$50,000** (Li-Co PI), 2021-2022.
12. Proposal to NSF I/UCRC, CITeR (Li-PI), **\$70,000**, “Towards the Creation of a Large Dataset of High-Quality Morphs,” 21S-03W-SP, Aug. 01, 2021 – July 31, 2022.
13. USDA, “Integrated Invasive Pest Survey Using Satellites, Unmanned Aerial Systems, Sensors, and Artificial Intelligence”, Total **\$400,000**, (Li Co-PI), 2021-2023.
14. NSF, “HCC: SMALL: Toward Computational Modeling of Autism Spectrum Disorder: Multimodal Data Collection, Fusion, and Phenotyping”, Total **\$500,000**, (Li-PI), 2021-2023.
15. ObEN donation to WVU Foundation, Total **\$20,000**, (Li-PI), 2021
16. NSF, “NRT-HDR: Bridges in Digital Health A Cross-Disciplinary Traineeship”, **Total \$3,000,000**, (PI-Adjeroh, Co-PI Nasrabadi, Li) August 8, 2021 – July 31, 2025.
17. NASA WV Space Grant Consortium, EPSCoR-R3, “Cooperative Energy-aware Navigation of Hybrid Airships in the Atmosphere of Venus,” **Total \$99,999**, (Co-PI Gu), 2021-2024.
18. USDA/NIFA PI, Collaborative Research: National Robotics Initiative (NRI): StickBug – An Effective Co-Robot for Precision Pollination,” **Total \$750,000**, (PI - Gu), 2021-2022.

**4. Proposals Submitted & Still Pending or Declined for Award: From Jan. 01 2021 to present (Total \$56.876 million):**

1. US DOE Department of Energy, UI-PREFER: University-Industry PartneRship for Scalable and Flexible Solutions to Enable Resilient Cyber-Power System, Total \$2.9M
2. Athena Sciences Corporation, Machine Learning-Based Biometric Database Cleansing and Quality Assessment, Total \$85.9k
3. Army Research Office (ARO), Deep Transductive Transfer Learning for Automatic Target Classification: Visible to MWIR/LWIR, Total \$60K
4. NSF, RII Track-2 FEC: HBD (Hybrid Big-Data) based intelligent INFLAME (IdeNtiFy, Locate, Assess and MitigatE) framework for Power Grid Oscillations, Total 4M
5. NSF, HDR Institute: The Social Genome Institute for Harnessing Data, Modeling and Action on Emergent Social Phenomena, Total 2.2M
6. NSF, "RII Track-1: Structural and Functional Connectomics: Innovations in Neuroscience through Advanced Data Science" Total \$20M
7. NSF, NRT-FW-HTF: Rural Robotics Transforming Rural Workforce through Graduate Training on Human-Centered Assistive Robotics, Total 3M
8. National Robotics Initiative (NRI), NIOSH "Collaborative Research: NRI: Reducing Falling Risk in Robot-Assisted Retail Environments, Total \$36.7K
9. NSF, "Towards Unified Neural and Computational Models of Face Representation", Total \$611K
10. NSF, "CCSS: Collaborative Research: Adaptive Sensor Processing for Connected Autonomous Vehicles: A Collaborative Deep Learning Approach", Total \$331K
11. DOE, "Physics-based Data-Driven Proxy Drag Models for Gas-Particle Flows", Total \$500K
12. NIH, "Single-neuron representation of faces in the human medial temporal lobe", Total \$1.9M
13. NSF, "SenSE: SenSE: Integrating Multimodal Sensing with Data Fusion for Precision Diagnosis of Autism Spectrum Disorder" Total \$750K
14. USDA, "Integrated Invasive Pest Survey Using Satellites, Unmanned Aerial Systems, Sensors, and Artificial Intelligence" Total \$500K
15. DOD, "Toward Computational Modeling of Face-avoidance Neurons", Total \$50K
16. NSF pre-proposal, "Convergence Accelerator Track D: Developing an Academic-Industry Partnership in Biologically-Inspired Neural Computation", Total \$1M
17. DOE, "Optically controlled quantum phase transitions at Van der Waals interfaces", Total \$750K
18. NIH, "Toward closed-loop deep brain stimulation: an explainable Artificial Intelligence approach", Total \$1.75M
19. NSF, "GCR: Toward Next-generation Neural Technologies: An Interdisciplinary Team Science Approach", Total \$1M
20. NSF, RII Track-2 FEC: Toward Convergence Research in Carbon Sequestration and Reuse through AI-based Meta Techno-economic Modeling", Total \$4M
21. NIH, "Toward Online Early Autism Diagnosis: A Home Video-based Approach", Total \$1.5M
22. NIH, "Model-based Investigation of Aberrant Neural Face Representation in Autism", Total \$1.5M
23. NSF, "HCC: SMALL: Toward Computational Modeling of Autism Spectrum Disorder: Multimodal Data Collection, Fusion, and Phenotyping", Total \$500K
24. NSF, "HEGS: Promoting GeoAI for Public Health: Causality Modeling, Inference Algorithms, and Novel Applications", Total \$500K
25. NSF, "Collaborative Research: SaTC: CORE: LARGE: Next-generation Cyber Defense Systems for Cyber Pandemic", Total \$600K
26. NASA, "An AI-based framework for real-time RFI detection in radio astronomy data", Total \$100K
27. IARPA, "DISCOVER: Dynamic human Identification System mitigating COVariate Effects in Real-time", total \$423,791
28. NIH, "Investigating single-neuron mechanism of face coding in humans using explainable artificial intelligence (XAI)", Total \$1.5M

29. NSF “CIF:SMALL: Image Restoration via Explainable and Efficient Deep Neural Networks: Unfolding Theory, Search Algorithms, and Real-world Applications”, Total \$300K
30. NIH, “Investigating the single-neuron mechanisms of social perception in humans,” Total \$1.5M
31. DOD, “Delineating Single-neuron Mechanisms Underlying Aberrant Social Behavior in Autism”, Total \$200K
32. NSF, “RINGS: Resilient Network Systems for Connected Autonomous Vehicles: Where Multimodal Sensing Meets Distributed Communication”, Total \$300K
33. NSF, “CCSS: Toward Efficient Super-Resolution Imaging in the Wild: Degradation Modeling, Unfolded Networks, and Real-World Applications”, Total \$300K
34. NSF, “Collaborative Research: D-IsN: An AI-augmented Framework to Detect, Disrupt, and Dismantle Opioid Trafficking Networks”, Total \$250K
35. NSF, “Convergence Accelerator Track F: “National Disinformation Research,” Total \$668k
36. NSF, “Collaborative Research: FW-HTF-R: Digital Guilds and Worker Technologies,” \$621K
37. NSF, “Collaborative Research: HCC: Medium: Crowd Work Cooperatives: Designing,” \$259K
38. Facebook Research Grant, \$50K
39. Microsoft Future of Work Grant, \$50K

**5. Students Advised & Supported FY18 & FY19 & FY20 & FY21: (Total number students 49 – 1 undergraduate, 11 Masters, 37 PhD) 9 PhD + 7 Masters graduated as of 09/01/21)**

1. Na Zhang, “Face recognition with deep learning,” May 2022 (PhD – Guo advisor)
2. Qiangchang Wang, “Deep Face Recognition,” May 2022, (PhD – Guo advisor).
3. Min Jiang, “Visual BMI from Face and Body,” **Graduated** May 2019 (PhD – Guo advisor)
4. Mohamad Nouyed, “Facial Image Processing,” Dec. 2023 (PhD – Guo advisor)
5. Mohamad Jazaery, “Facial Image Processing,” **Graduated Dec. 2019** (Master – Guo advisor)
6. Connor Castle, “Morphological computing for robust robot operations”, **Graduated** Fall 2019 (Master – Guo advisor)
7. Qiangchang Wang, “Deep Face Recognition,” May 2022, (PhD – Guo advisor).
8. Yiming Zhang, “Machine learning, data mining, and applications in cybersecurity and health intelligence,” **Graduated** May 2021 (PhD – Ye advisor)
9. Shifu Hou, “Automatic detection of insecure codes in stack overflow”, May 2023 (PhD – Ye advisor)
10. Yujie Fan, “Cybersecurity Using AI,” May 2023 (PhD – Ye Advisor)
11. Aaron G. Saas, “Malware Detection,” **Graduated** Sept. 2021, (PhD – Woerner Advisor)
12. Sobhan Soleymani, “Deep learning for multimodal fusion,” **Graduated** May 2021 (PhD – Nasrabadi advisor)
13. Seid Mehdi Iranmanesh, “Deep cross-spectral matching,” **Graduated** Aug. 2021 (PhD – Nasrabadi advisor)
14. Fariborz Taherkhani, “Deep multispectral face recognition,” **Graduated** May 2021 (PhD – Nasrabadi advisor)
15. Hadi Kazemi, “Deep learning sketch-to-image synthesis,” **Graduated** Aug. 2019 (PhD – Nasrabadi advisor)
16. Ali Dabouei, “Deep Fingerprint recognition,” May 2022 (PhD – Nasrabadi advisor)
17. Domenick Poster, “Deep iris recognition,” May 2023 (PhD – Nasrabadi advisor)
18. Moktari Mostofa, “Deep target detection,” May 2023 (PhD – Nasrabadi advisor)
19. Osahor Uche, “Deep adversarial sketch-to-face synthesis,” May 2023 (PhD – Nasrabadi advisor)
20. Poorya Aghdaie, “Fake image detection,” May 2024 (PhD – Nasrabadi advisor)
21. Paria Jeihouni, “OCT Retinal Image Segmentation,” May 2024 (PhD – Nasrabadi advisor)
22. Amol Josh, “Contactless fingerprint recognition,” May 2024 (PhD – Nasrabadi advisor)
23. Mahdi Hasan, “Fingerprint recognition,” May 2024 (PhD – Nasrabadi advisor)
24. Sahar Rahimi Malakshan, “Fingerprint recognition,” May 2024 (PhD – Nasrabadi advisor)
25. Mohammad Saeed Ebrahimi, “Multi-camera face recognition,” May 2024 (PhD – Nasrabadi advisor)
26. Ali Zafari, “Deep Compression,” May 2024 (PhD – Nasrabadi advisor)
27. Salam Mohamadi, “Cross-spectral iris matching,” May 2024 (PhD – Nasrabadi + AdjeroH advisor)
28. Alexandria Wilson, “Off-angle iris matching,” Dec. 2021 (Master – Nasrabadi advisor)
29. Baarria Chaudhary, “Morphed face detection,” Dec. 2021 (Master – Nasrabadi advisor)

30. Kelsey O'Haire, "Morph Generation," May 2022 (Master – Nasrabadi advisor)
31. Samuel Adam, "StyleGAN Morphing," May 2022 (Master – Nasrabadi advisor)
32. Syeda Nyma Ferdous, "Deep pedestrian detection," May 2023 (PhD – Li advisor)
33. Jacob Dameron, "Image and video forensics: deepfake detection", **Graduated** May 2021 (MS – Li advisor)
34. Ahmed Cheikh Sidiya, "Point cloud processing for intelligent vehicles," May 2021 (PhD – Li advisor)
35. Mindi Ruan, "Computational methods for autism research," May 2021 (MS/PhD – Li advisor)
36. Jinge Wang, "Image processing for smart agriculture," May 2021 (PhD – Li advisor)
37. Xuan Xu, "Deep learning for image superresolution," **Graduated** May 2020 (PhD – Li advisor)
38. Yixin Du, "Deep learning for image restoration," **Graduated** May 2019 (PhD – Li advisor)
39. Nathan Utzman, "Deep Learning, **Graduated** August 01, 2021, (MS – Li advisor)
40. Minglei Yin (Deep Learning) (PhD – Li advisor)
41. Surekha Pachipulusu, Deep learning for image restoration, **Graduated** April 2020 (MS – Li advisor)
42. Sruthi Valicharla, "Weed recognition in agriculture: A Mask R-CNN approach," **Graduated**, May 01, 2021 (Master – Li advisor)
43. Benjamin Buzzo, "Designs and Practical Control Methods for Soft Parallel Robots," **Graduated**, Jan. 2021 (Master – Gu advisor)
44. Benjamin Buzzo, "Design Parallel Robots," Jan. 2024 (PhD – Gu advisor)
45. Dylan Covell, "Design Parallel Robots," Jan. 2022 (Master – Gu advisor)
46. Conner Castle, autonomy," **Graduated** Dec 2019 (PhD – Gu advisor)
46. Dylan Covell, Robot Design," May 2019 (undergraduate – Gu advisor)
47. Carlos Toxtli, "Crowdsourcing social good," May 2023 (PhD – Savage advisor)
48. Claudia Flores Saviaga, "Mobilizing online collective action," May 2023 (PhD – Savage advisor)
49. Nikola Janevski, "Cybersecurity," May 2023 (PhD – Woerner advisor)

## 6. **Awards & Service FY18 + FY19 + FY20 + FY21:**

1. Yu Gu - Virtual presentations was made at West Virginia State Univ., Keynote, CNSM Research Symposium, Institute, WV, April 2021.
2. Yu Gu - Virtual presentations was made at Saint Louis University, St. Louis, MO, Feb 2021.
3. Xin Li - Three NSF panels in 2021 (reviewed around 24 proposals).
4. Xin Li - IEEE Transactions on Image Processing, Senior Area Editor (screened >30 papers)
5. Dr. Savage research was covered in the New York Times 2021.
6. **Best Student paper Award 2020**, IEEE IJCB'2020: F. Taherkhani, V. Talreja, J. Dawson, M. Valenti, N. Nasrabadi, "PF-CpGAN: profile to frontal coupled GAN for face recognition in the wild," IEEE International Joint Conference on Biometrics, (Nasser Nasrabadi)
7. **Best Poster Paper Award**, IEEE BTAS, 2019, Tampa, FL, Oct. 23-25, 2019. (Nasser Nasrabadi)
8. **Best Paper Award**, SPIE 2020, Target classification in infrared imagery by cross-spectral synthesis using GAN, Anaheim CA, 27 April - 1 May 2020. (Nasser Nasrabadi)
9. Yu Gu - NASA Innovative Advanced Concepts (NIAC) Fellow, April 2019,
10. Yanfang Ye - **Panels**, NSF Panels (2018-2019), UTSA-DoD Panel (2019), Cyber Florida Panel (2018), Heidelberg Laureate Forum (2018-2019).
11. Yanfang Ye - **Program Committee**: S&P (2020), ACSAC (2019), AAAI (2019), ACM SIGKDD (2017-2019), IJCAI (2017, 2019), CIKM (2019), IEEE ICDM (2018-2019), SciSec (2019), ICMLA (2019), ICICS (2018), EISIC (2018), SNAIST (2016-2019), WEBIST (2017-2018), WISE (2015-2018), SIA (2017), ACCSE (2016), MobiApps (2016), ICTAI (2016), DPNOC (2016).
12. Saiph Savage's blockchain based systems for helping immigrants was **featured in Fortune Mexico! 2019**
13. Saiph Savage's **3 PhD Students were awarded scholarships** to attend and present at the AAAI Conference on Human Computation and Crowdsourcing (HCOMP'18) Doctoral Consortium!
14. Nasser Nasrabadi - **Best Poster Presentation Award 2019**, IEEE BTAS'19, Tampa, FL, 23-26 Sept., 2019.
15. **Best Outstanding Researcher**, Statler College of Engineering and Mine. Res., WVU, 2019
16. **Best Researcher** of the Year, Statler College of Engineering and Mine. Res., WVU, 2019
17. Yanfang Ye - **NSF Career Award**, 2019.
18. Yanfang Ye - **IJCAI Early Career Spotlights**, 2019.
19. Yanfang Ye - **APLU Member Spotlights**, 2019.
20. Yanfang Ye - AAAI Workshop on AI for Cyber Security (AICS) Challenge Problem Winner, 2019.
21. Yanfang Ye - **Associate Editor**, IEEE Transactions on Big Data (IEEE TBD), 2018-2020.

22. Yanfang Ye - **Editorial Board**, Journal of Information Engineering and Applied Computing, 2018-2020.
23. Yanfang Ye - **Invited Talks**, IJCAI 2019 Early Career Spotlights, 2019.
24. Yanfang Ye - **Workshop/Tutorial/Session/Publicity Chair**: IJCAI (2019), IEEE ICDM (2019, 2018), IEEE Big Data (2019, 2018), CIKM (2017), IEEE ICSC (2015-2016), ICMLA (2015), WISE (2015).
25. **Best Student Paper Award 2018**, IEEE BTAS'18, Los Angeles, CA, October 22-26, 2018. (Nasser Nasrabadi)
26. **Best Poster Presentation Award 2018**, IEEE BTAS'18, Los Angeles, CA, October 22-26, 2018. (Nasser Nasrabadi)
27. **Highest Impact Paper Award 2018**, IEEE Trans. on Geoscience and Remote Sensing Society, July 2018. (Nasser Nasrabadi)
28. **Best Paper Award Grand Challenge**, IEEE ICME'18, San Diego, CA, 23-27 July, 2018. (Nasser Nasrabadi)
29. **Best Student Paper Award**, IEEE CVPRW'18, Salt Lake City, UT, 18 June, 2018. (Nasser Nasrabadi)
30. **Best Paper Award**, IEEE WACV-CDBR, Lack Tahoe, Nevada, 12-14 March, 2018. (Nasser Nasrabadi)
31. **Best Student Paper Award**, 11th IAPR International Conference on Biometrics, ICB'18, 20-23 February, 2018. (Nasser Nasrabadi)
32. **J&J Women in STEM Award Nominee**, 2018. (Yanfang Ye)
33. **Big 12 Faculty Fellow 2018-2019**, WVU, June 2018. (Yu Gu)
34. **Excellence in Research**, Statler College of Engineering and Mineral Resources, Mar. 2018. (Yu Gu)
35. **Recognition for Mountaineer Values during WVU's 150<sup>th</sup> Anniversary Celebration**, Feb. 2018. (Yu Gu)
36. Saiph Savage's research on Crowd Workers' earnings won an **honorable mention at CHI'18!**

## 7. Status of the Patents Filed:

1. N. M. Nasrabadi, J. Dawson and A. Dabouei, "Cross Matching Contactless Fingerprint Against Contact-based Fingerprints," patent application filed on 05/23/2019.
2. N. M. Nasrabadi, J. Dawson and A. Dabouei, Patent Awarded, "Fingerprint Distortion Rectification & Restoration Using Deep Convolutional Neural Networks" on 03/12/2020.

## 8. Total Journal Publications for FY18 + FY19 + FY20 + FY21: (Total Journal Publications 65)

### Journal Publications in FY 2021 (23 publications):

1. Paria Jeihooni, Omid Dehzangi, Annahita Amireskandari, Ali Rezai, **Nasser M. Nasrabadi**, "MultiSDGAN: Translation of OCT Images to Superresolved Segmentation Labels Using Multi-Discriminators in Multi-Stages," *IEEE Journal of Biomedical and Health Informatics*, Aug. 26, 2021.
2. Moktari Mostofa, Salman Mohamadi, Jeremy Dawson, **Nasser M. Nasrabadi**, "Deep GAN-Based Cross-Spectral Cross-Resolution Iris Recognition," *IEEE Transactions on Biometrics, Behavior, and Identity Science*, August 01, 2021
3. Domenick D. Poster, Shuowen Hu, Nathan J. Short, Benjamin S. Riggan, and **Nasser M. Nasrabadi**, "Visible-to-Thermal Transfer Learning for Facial Landmark Detection," *IEEE Access*, vol. 8, issue 1, pp. 82306-82319, Dec. 2021.
4. Sertac Arisoy, **Nasser M. Nasrabadi**, and Koray Kayabol "Unsupervised Pixel-wise Hyperspectral Anomaly Detection via Autoencoding Adversarial Networks," *IEEE Geoscience and Remote Sensing Letters*, vol. 0, no. 0, pp. 1-5, January 20, 2021.
5. Seyed Mehdi Iranmanesh, **Nasser M. Nasrabadi**, "HGAN: Hybrid Generative Adversarial Network," *Journal of Intelligent & Fuzzy Systems*, Vol. 41-1, Feb. 2021.
6. Veeru Talreja, Matthew Valenti, and **Nasser M. Nasrabadi**, "Deep Hashing for Secure Multimodal Biometrics," *IEEE Transactions on Information Forensics and Security*, vol. 16, pp. 1306-1321, Oct. 22, 2021. [10.1109/TIFS.2020.3033189](https://doi.org/10.1109/TIFS.2020.3033189)
7. Chuanbo Hu, Minglei Yin, Bin Liu, Yanfang Ye, and **Xin Li**, "Identifying Illicit Drug Dealers on Instagram with Large-scale and Multimodal Data Fusion," *ACM transactions on intelligent systems and technology (TIST)*, In press, 2021
8. Wu, F., Yuan, P., Shi, G., **Li, Xin**, Dong, W., & Wu, J., "Robust Subspace Clustering Network with Dual-Domain Regularization," *Pattern Recognition Letters*, 2021.
9. Dong, Weisheng, Chen Zhou, Fangfang Wu, Jinjian Wu, Guangming Shi, and **Xin Li**, "Model-Guided Deep Hyperspectral Image Super-resolution," *IEEE Transactions on Image Processing*, 2021.

10. Jia, S., Hu, C., **Li, X.** and Xu, Z., "Face spoofing detection under super-realistic 3D wax face attacks," *Pattern Recognition Letters*, 145, pp.103-109, 2021.
11. Yang, W., **Li, Xin** and Zhang, L., "Toward semantic image inpainting: where global context meets local geometry," *Journal of Electronic Imaging*, 30(2), p.023028, 2021.
12. Wu, F., Huang, T., Dong, W., Shi, G., Zheng, Z. and **Li, Xin**, "Toward Blind Joint Demosaicing and denoising of raw color filter array data," *Neurocomputing*, 2021.
13. Paula Webster, Shuo Wang and **Xin Li**, "Posed vs. Genuine Facial Emotion Recognition and Expression in Autism and Implications for Intervention", *Frontiers in Psychology*, 2021
14. Y Cao, G Shi, T Zhang, W Dong, J Wu, X Xie, **Xin Li**, "Bayesian Correlation Filter Learning with Gaussian Scale Mixture Model for Visual Tracking", *IEEE Transactions on Circuits and Systems for Video Technology*, 2021.
15. Smith, T., Chen, Y., Hewitt, N., Hu, B., **Y Gu**, "Socially Aware Robot Obstacle Avoidance Considering Human Intention and Preferences," *Springer International Journal of Social Robotics*, July 2021.
16. M De Petrillo, J Beard, **Y Gu**, JN Gross, "Search Planning of a UAV/UGV Team With Localization Uncertainty in a Subterranean Environment," *IEEE Aerospace and Electronic Systems Magazine*, vol. 36 (6), pp. 6-16, 2021.
17. C Kilic, N Ohi, **Y Gu**, JN Gross, "Slip-Based Autonomous ZUPT through Gaussian Process to Improve Planetary Rover Localization," *IEEE Robotics and Automation Letters*, vol. 6 (3), pp. 4782-4789, 2021.
18. G Hedrick, **Y Gu**, "Terrain-aware traverse planning for a Mars sample return rover," *Advanced Robotics*, pp. 1-16 2021.
19. C Flores-Saviaga, **S Savage**, "Fighting disaster misinformation in Latin America: the# 19S Mexican earthquake case study," *Personal and Ubiquitous Computing*, vol. 25 (2), pp. 353-373, 2021
20. **S Savage**, C Toxtli, E Betanzos, "Research Methods to Study & Empower Crowd Workers," *Oxford*, 2021.
21. C Toxtli, S Suri, **S Savage**, "Quantifying the Invisible Labor in Crowd Work," Computer supported cooperative work CSCW, 2021.
22. Mohammad Hossein Jarrahi, Gemma Newlands, Brian Butler, **S. Savage**, Christoph Lutz, Michael Dunn, Steve Sawyer, "Flexible Work and Personal Digital Infrastructures," *Communications of the ACM*, July 2021, Vol. 64 No. 7, Pages 72-79
23. CA Norville, KZ Smith, **JM Dawson**, "Parametric optimization of visible wavelength gold lattice geometries for improved plasmon-enhanced fluorescence spectroscopy," *Applied Optics*, 59 (8), pp. 2308-2318, 2020

## 9. Conference Publications for FY18 + FY19 + FY20 + FY21: (Total conference publications 132)

### Conference Publications in FY2021 (21 publications)

1. Brady Williams, John McCauley, John Dando, Jeremy Dawson, **Nasser M. Nasrabadi**, "Interoperability of Contact and Contactless Fingerprints Across Multiple Fingerprint Sensors," *IEEE 20th International Conference of the Biometrics Special Interest Group (BIOSIG'21)*, September 15th-17th, 2021, Darmstadt, Germany.
2. John McCauley, Sobhan Soleymani, Brady Williams, Jeremy Dawson, **Nasser M. Nasrabadi**, "Identical Twins as a Facial Similarity Benchmark for Human Facial Recognition," *IEEE 20th International Conference of the Biometrics Special Interest Group (BIOSIG'21)*, September 15th-17th, 2021, Darmstadt, Germany.
3. Paria Jeihouni, Omid Dehzangi, Annahita Amireskandari, Ali Rezai, **Nasser M. Nasrabadi**, "GAN-based super-resolution and segmentation of retinal layers in optical coherence tomography scans," *IEEE Int. Conference on Image Processing (ICIP21)*, Anchorage, Alaska, 19-22 Sept. 2021. (Acceptance Rate 46%)
4. Amol S. Joshi, Ali Dabouei, Jeremy Dawson, **Nasser M. Nasrabadi**, "FDeblur-GAN Fingerprint Deblurring Using Generative Adversarial Network," *IEEE Int. Joint Conference on Biometrics (IJCB'21)*, Aug. 4-7, 2021. (Acceptance rate 40.2%)
5. Poorya Aghdaie, Baaria Chaudhary, Sobhan Soleymani, Jeremy Dawson, **Nasser M. Nasrabadi**, "Attention Aware Wavelet-based Detection of Morphed Face Images," *IEEE Int. Joint Conference on Biometrics (IJCB'21)*, Aug. 4-7, 2021. (Acceptance rate 40.2%)

6. Baaria Chaudhary, Poorya Aghdaie, Sobhan Soleymani, Jeremy Dawson, **Nasser M. Nasrabadi**, "Differential Morph Face Detection using Discriminative Wavelet Sub-bands," *IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop on Biometrics (CVPRW)*, Virtual, June 19-25, 2021.
7. Fariborz Taherkhani, Ali Dabouei, Sobhan Soleymani, J. Dawson, **N. M. Nasrabadi**, "Self-Supervised Wasserstein Pseudo-Labeling for Semi-Supervised Image Classification," *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, Virtual, June 19-25, 2021. (Acceptance rate 27%)
8. Ali Dabouei, Sobhan Soleymani, Fariborz Taherkhani, **Nasser M. Nasrabadi**, "SuperMix: Supervising the Mixing Data Augmentation," *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, Virtual, June 19-25, 2021. (Acceptance rate 27%)
9. Poorya Aghdaie, Baaria Chaudhary, Sobhan Soleymani, Jeremy Dawson, **Nasser M. Nasrabadi**, "Detection of Morphed Face Images Using Discriminative Wavelet Sub-bands," the *9th IEEE International Workshop on Biometrics and Forensics (IWBF21)*, May 6-7, 2021, Rome, Italy.
10. Sobhan Soleymani, Baaria Chaudhary, Ali Dabouei, Jeremy Dawson, **Nasser M. Nasrabadi**, "Differential Morphed Face Detection Using Deep Siamese Networks," *ICPR Workshop, MultiMedia FOREnsics in the WILD (MMForWILD'2020)*, Jan. 10-15, 2021, Milan, Italy.
11. Sobhan Soleymani, Ali Dabouei, Fariborz Taherkhani, Jeremy Dawson and **Nasser M. Nasrabadi**, "Mutual Information Maximization on Disentangled Representations for Differential Morph Detection," *IEEE Winter Conference on Applications of Computer Vision (WACV 2021)*, March 5-9, 2021, Waikoloa, Hawaii.
12. Domenick Poster, Matthew Thielke, Robert Nguyen, Srinivasan Rajaraman, Xing Di, Cedric Nimpa Fondje, Vishal Patel, Nathan J. Short, Benjamin S. Riggan, **Nasser M. Nasrabadi**, Shuowen Hu "A Large-Scale, Time-Synchronized Visible and Thermal Face Dataset," *IEEE Winter Conference on Applications of Computer Vision (WACV 2021)*, March 5-9, 2021, Waikoloa, Hawaii.
13. Omid Dehzangi, Saba Heidari Gheshlaghi, Annahita Amireskandari, **Nasser M. Nasrabadi**, Ali Rezai, "OCT Image Segmentation Using Neural Architecture Search and SRGAN," *25<sup>th</sup> Int. Conf. on Pattern Recognition (ICPR'21)*, Jan. 10-15, 2021, Milan, Italy.
14. Omid Dehzangi, Arash Shokouhmand, Paria Jeihouni, Jad Ramadan, Victor Finomore, **Nasser M. Nasrabadi**, and Ali Rezai "XGBoost to Interpret the Opioid Patients' State Based on Cognitive and Physiological Measures," *25<sup>th</sup> Int. Conf. on Pattern Recognition (ICPR'21)*, Jan. 10-15, 2021, Milan, Italy.
15. Syeda Nyma Ferdous, Ali Dabouei, Jeremy Dawson and **Nasser M. Nasrabadi**, "Super-resolution Guided Pore Detection for Fingerprint Recognition," *25<sup>th</sup> Int. Conf. on Pattern Recognition (ICPR'21)*, Jan. 10-15, 2021, Milan, Italy.
16. Sertac Arisoy, **Nasser M. Nasrabadi**, Koray Kayabol, "GAN-based Hyperspectral Anomaly Detection," *28<sup>th</sup> European Signal Processing Conference (EUSIPCO2020)*, January 18-22, 2021, Amsterdam, Nederland.
17. Chuanbo Hu, Minglei Yin, Bin Liu, **Xin Li** and Yanfang Ye, "Detection of Illicit Drug Trafficking Events on Instagram: A Deep Multimodal Multilabel Learning Approach," *CIKM, 2021*. (Acceptance rate: 24%)
18. Bi'an Du, Xiang Gao, Wei Hu, and **Xin Li**, "Self-Contrastive Learning with Hard Negative Sampling for Self-supervised Point Cloud Learning," *ACM Symposium on Multimedia, 2021*. (Acceptance rate: 27%)
19. Zhang, Y., Qian, Y., Fan, Y., Ye, Y., **Xin Li**, Xiong, Q. and Shao, F. (2020, December), dStyle-GAN: Generative Adversarial Network based on Writing and Photography Styles for Drug Identification in Darknet Markets," *In Annual Computer Security Applications Conference*, pp. 669-680, Dec. 2020. (Acceptance rate: 21%)
20. Wang, R., Chen, C.F., Peng, H., Liu, X. and **Xin Li**, 2020, November. Learning 3D Faces from Photo-Realistic Facial Synthesis. In *2020 International Conference on 3D Vision (3DV)* (pp. 858-867). IEEE.
21. Xudong Liu, **Xin Li**, et al., "Sparse Feature Representation Learning for Deep Face Gender Transfer," *ICCV Workshop on Human-Centric Trustworthy Computer Vision (HTCV)*, 2021.



## WVU VACCINE DEVELOPMENT CENTER REPORT 2018-AUG 2021

Prepared by: Director, Vaccine Development Center F. Heath Damron  
and Assistant Director, Justin Bevere

## 1. Most important Outcomes of the Vaccine Development Center:

The Vaccine Development Center (VDC) is supported by a Research Challenge Grant from WV HEPC. The VDC at the West Virginia University Health Sciences Center has 3 main goals: 1) stimulate vaccine research, 2) enhance partnerships with industry, and 3) provide STEM education / biomedical research training. The Center has acquired **\$26,505,646** in extramural support to date from private and federal sources of funding. The VDC has funded seven faculty lead projects over the past three years which has allowed those labs to become competitive for extramural support. Furthermore, the support has facilitated numerous publications in high tier journals and illuminated the research that is occurring at WVU. To facilitate translating pre-clinical research to humans, the VDC partners with vaccine industry companies and there are currently **six** VDC-industry partnership projects in progress at this time that have resulted in sponsored research. There are countless other industry partners that we have on going research collaborations with, as well as material transfer. These partnerships offer the opportunities to access the required substantial resources that are needed to develop vaccines to protect humans from deadly diseases. Dr. Damron and VDC supported staff and students enhance STEM education through the administration of a senior undergraduate and PhD student level course in Vaccinology that has currently taught 66+ students since 2018. The VDC has supported 8 graduate student projects directly and 5 projects indirectly through support of their mentors.

The COVID-19 pandemic has impacted the entire world and the VDC has been involved in the WVU COVID-19 response since March 2020. Dr. Damron joined the WVU-HSC Task Force, that is led by Dr. Laura Gibson, with the goal to develop serological assays to determine antibody responses in COVID-19 patients treated at WVU Medicine. A collaboration was formed with the Department of Pathology where 500 human specimens were studied from 80 patients. The temporal production of antibodies was characterized and a novel biomarker of severe infection was identified along with critical observations regarding the ratios of antibody to surface antigens or internal proteins of SARS-CoV-2. The Medrxiv manuscript is listed below and is currently under peer review at a high impact journal. The antibody assays developed are soon to be used to study serological responses of people who work at Montgomery General Hospital in Fayette County, WV. This field study will be performed in collaboration with WVCTSI to illuminate the duration of antibody responses and paint a picture of exposure to SARS-CoV-2 in a rural WV population. The assays developed will soon be submitted for FDA approval. Furthermore, major investment in automation equipment through the establishment of the WV Rapid Response Development Laboratory have allowed for enhance testing capacity. The antibody assays developed by the VDC also initiated COVID-19 vaccine development studies at WVU. Dr. Damron currently has a patent application on vaccine formulations that would be ideal for low and middle income countries and are currently under review with an industry collaborator. These vaccines are being studied in animals and industry partnerships are being sought to push the formulations forward into clinical development. In addition to the outcomes directly defined in the mission statement, the VDC has been directly involved in the response to COVID-19 and will continue to develop vaccines, assays, push WV economic development, train talent, and make an impact.

In 2021, The VDC started 2 sponsored research projects with one of the world's largest and leading vaccine/therapeutic manufacturer. Dr. Damron and the COVID-19 research team evaluated a polyclonal antibody therapeutic and its protective properties against the Alpha, Beta, and Delta strains of SARS-CoV-2. The second project with this new partner evaluated 10 different vaccine formulations against the Alpha and Beta strains of SARS-CoV-2. These projects were performed to assist with decision making in regards to clinical trial designs and implementation in India.

Last year Dr. Heath Damron was awarded an R01 in collaboration with Moderna for the development of a novel multi-valent mRNA whooping cough vaccine. We expect by the end of 2021, there will be a journal publication accepted that will highlight this major industry-academic collaboration for the first time in the public eye. Additionally, we expect another journal publication by the end of 2021 to highlight another confidential industry-academic project for the first time.

## 2. List of Publications Since the Award Started (bold = Member of VDC):

### **COVID-19**

- **A. Horspool**, T. Kieffer, **B. P. Russ**, **M. A. DeJong**, **M. A. Wolf**, J. M. Karakiozis, B. J. Hickey, P. Fagone, D. H. Tacker, **J. R. Bevere**, I. Martinez, **M. Barbier**, P. L. Perrotta, **F. Heath Damron**. Interplay of antibody and cytokine production reveals CXCL-13 as a potential novel biomarker of lethal SARS-CoV-2 infection. <https://www.medrxiv.org/content/10.1101/2020.08.24.20180877v1>

- **A.Horspool**, T. Kieffer, **B. P. Russ**, **M. A. DeJong**, **M. A. Wolf**, J. M. Karakiozis, B. J. Hickey, P. Fagone, D. H. Tacker, **J. Bevere**, I. Martinez, M. Barbier, P. L. Perrotta, **F. Heath Damron**. Interplay of antibody and cytokine production reveals CXCL-13 as a potential novel biomarker of lethal SARS-CoV-2 infection. *mSphere* Jan 2021, 6 (1) e01324-20; DOI: 10.1128/mSphere.01324-20
- **Horspool AM**, **Russ BP**, **Wolf MA**, **Kang J**, **Blackwood CB**, **Hall JM**, **Wong TY**, **DeJong MA**, **Bitzer G**, **Bevere JR**, Eggleston R, Stewart A, Costello L, Welch S, Kieffer T, Hodder S, **Damron FH**. Serological survey of SARS-CoV-2 incidence conducted at a rural West Virginia hospital. *medRxiv* [Preprint]. 2021 Aug 18:2021.08.16.21262128. doi: 10.1101/2021.08.16.21262128. PMID: 34426815; PMCID: PMC8382132.
- **Horspool AM**, **Ye C**, **Wong TY**, **Russ BP**, **Lee KS**, Winters MT, **Bevere JR**, Kieffer T, Martinez I, Sourimant J, Greninger A, Plemper RK, Denvir J, Cyphert HA, Torrelles J, Martinez-Sobrido L, **Damron FH**. SARS-CoV-2 B.1.1.7 and B.1.351 variants of concern induce lethal disease in K18-hACE2 transgenic mice despite convalescent plasma therapy. *bioRxiv* [Preprint]. 2021 May 5:2021.05.05.442784. doi: 10.1101/2021.05.05.442784. PMID: 33972945; PMCID: PMC8109207.

### **Damron Lab**

- **M. Barbier**, **D.T. Boehm**, **E. Sen-Kilic**, C. Bonnin, T. Pinheiro, C. Hoffman, M. Gray, E. Hewlett, **F.H. Damron** Modulation of pertussis and adenylate cyclase toxins by sigma factor RpoE in *Bordetella pertussis*. *Infection and Immunity*, 2017 vol: 85 (1) pp: IAI.00565-16. PMCID: PMC5203664
- **D.T. Boehm**, **J.M. Hall**, **T.Y. Wong**, A.DiVenere, **E. Sen-Kilic**, **J. R. Bevere**, **S. D. Bradford**, **C.B.Blackwood**, C. Elkins, K. A. DeRoos, M.C. Gray, **C. G. Cooper**, **M.E. Varney**, J. A. Maynard, E. L. Hewlett, **M. Barbier**, and **F.H. Damron**. Evaluation of adenylate cyclase toxoid antigen in acellular pertussis vaccines using a *Bordetella pertussis* challenge model in mice. *Infection and Immunity*. 2018 Sep 21;86(10). pii: e00857-17. doi: 10.1128/IAI.00857-17. Print 2018 Oct. PCMID: PMC5218874
- **D. T. Boehm**, **M. E. Varney**, **T. Y. Wong**, **E. S. Nowak**, **E. Sen-Kilic**, **J. M. Hall**, **S. D. Bradford**, **K. A. Begley**, **J. U. Bevere**, **M. S. Epperly**, J. A. Maynard, E. L. Hewlett, **M. Barbier**, **F. H. Damron**. Characterizing the innate and adaptive responses of immunized mice to *Bordetella pertussis* infection using in vivo imaging and transcriptomic analysis. <https://www.biorxiv.org/content/10.1101/674408v2>
- **M.E. Varney**, **D.T. Boehm**, K. DeRoos, E.S. Nowak, **T.Y. Wong**, **E. Sen-Kilic**, **S.D. Bradford**, C. Elkins, M.S. Epperly, **W.T. Witt**, **M. A. Barbier** and **F. H. Damron**. *Bordetella pertussis* Whole Cell Immunization, Unlike Acellular Immunization, Mimics Naïve Infection by Driving Hematopoietic Stem and Progenitor Cell Expansion in Mice *Frontiers in Immunology* 2018 vol: 9 pp:2376 PMCID: PMC6200895
- **T.Y. Wong**, **J.M. Hall**, **E. S. Nowak**, **D. T. Boehm**, L. A. Gonyar, E. L. Hewlett, J. C. Eby, **M. Barbier**, and **F. H. Damron**. Analysis of the *in vivo* transcriptome of *Bordetella pertussis* during infection of mice. *mSphere*. 2019 Apr 17;4(2). pii: e00154-19. doi: 10.1128/mSphereDirect.00154-19. PMID: 30996109
- **D. T. Boehm**, **M. A. Wolf**, **J. M. Hall**, **T. Y. Wong**, **E. Sen-Kilic**, H. D. Basinger, S.A. Dziadowicz, M. P. Gutierrez, **C. B. Blackwood**, **S. D. Bradford**, K. A. Begley, W. T. Witt, **M. E. Varney**, **M. Barbier** and **F. H. Damron**. Intranasal acellular pertussis vaccine provides mucosal immunity and protects mice from *Bordetella pertussis* *Nature Vaccines. npj Vaccines* volume 4, Article number: 40 (2019)
- **F. H. Damron**, **M. Barbier**, P. Dubey, K. M. Edwards, X. Gu, N. P. Klein, K. Lu, K. H. G. Mills, M. F. Pasetti, R. C. Read, P. Rohani, P. Sebo and E. T. Harvill, Overcoming Waning Immunity in Pertussis Vaccines: Workshop of the National Institute of Allergy and Infectious Diseases *Journal of Immunology* PMID: 32769142
- C. Loch, N.H Carbonetti, J. D Cherry, **F H. Damron**, K. M Edwards, R.Fernandez, E.T Harvill, D. Hozbor, K. H G Mills, M. E. Rodriguez, F. Mascart, Highlights of the 12th International Bordetella Symposium, *Clinical Infectious Diseases*, PMID: 32463883
- **M Wolf**, **D. Boehm**, **M. A DeJong**, **T Wong**, **E. Sen-Kilic**, **J. M Hall**, **C. Blackwood**, **K. L Weaver**, **C. Kelly**, **C. Kisamore**, **G. Bitzer**, **J. Bevere**, **M. Barbier**, **F H. Damron** Intranasal immunization with acellular pertussis vaccines results in long-term immunity to *Bordetella pertussis* in mice *Infection and Immunity* 2021 Feb ;IAI.00607-20 PMCID: PMC8097269
- **Hall JM**, **Kang J**, **Kenney SM**, **Wong TY**, **Bitzer GJ**, **Kelly CO**, **Kisamore CA**, **Boehm DT**, **DeJong MA**, **Wolf MA**, **Sen-Kilic E**, **Horspool AM**, **Bevere JR**, **Barbier M**, **Damron FH**. Re-investigating the coughing rat model of pertussis to understand *Bordetella pertussis* pathogenesis. *Infect Immun*. 2021 Jun 14:IAI0030421. doi: 10.1128/IAI.00304-21. Epub ahead of print. PMID: 34125597.
- **Hall JM**, **Bitzer GJ**, **DeJong MA**, **Kang J**, **Wong TY**, **Wolf MA**, **Bevere JR**, **Barbier M**, **Damron FH**. Mucosal immunization with DTaP confers protection against *Bordetella pertussis* infection and cough in Sprague-Dawley rats. *Infect Immun*. 2021 Aug: IAI00346-21R1.

## **Barbier Lab**

- M.C. Gestal, L.K. Howard, K. Dewan, H.M. Johnson, **M. Barbier**, C. Bryant, I.H. Soumana, I. Riviera, B. Linz, U. Mas-Blanchado, E.T. Harvill. Enhancement of immune response against *Bordetella* spp. by disrupting immunomodulation. *Nature Scientific Reports* 2019 Dec 30;9(1):20261. DOI: 10.1038/s41598-019-56652-z.
- **E. Sen-Kilic, C. Blackwood, D.T. Boehm, W.T. Witt, A.C. Malkowski, J. Bevere, T.Y. Wong, S.D. Bradford, J.M. Hall, M.E. Varney, F.H. Damron, and M. Barbier.** Intranasal peptide-based FpvA-KLH conjugate vaccine protects mice from *Pseudomonas aeruginosa* acute murine pneumonia. *Frontiers in Immunology* 2019. 10:2497; DOI: 10.3389/fimmu.2019.02497.
- **Sen-Kilic E, Blackwood CB, Horspool AM, Huckaby AB, Weaver K, Malkowski A, Witt WT, Bevere JR, Winters MT, Damron FH, Barbier M.** Identifying mechanistic correlates of protection against *Pseudomonas aeruginosa* in an acute lung pneumonia model. *The Journal of Immunology*. 2020 May, 204, 1 Supplement, 168.8
- **C.B. Blackwood, E. Sen-Kilic, K.Y. Weaver, D.T. Boehm, J.M. Hall, T. Wong, A. Malkowski, W. T. Witt, F.H. Damron, M. Barbier.** Two for one: Identification of *P. aeruginosa* and *B. pertussis* Cross-species Antigens. *The Journal of Immunology*. 2020 May, 204, 1 Supplement, 168.7
- **J.M Hall, J. Kang, S. Kenney, T. Wong, G. Bitzer, C. Kelly, C. Kisamore, D.T. Boehm, M. DeJong, M.A. Wolf, E. Sen-Kilic, A. Horspool, J. Bevere, M. Barbier, and F.H. Damron.** Re-investigating the coughing rat model of pertussis to understand *Bordetella pertussis* pathogenesis. In print at the *Journal of Infectious Diseases* in April 2021.
- **J.M. Hall, G. Bitzer, M. DeJong, J. Kang, T. Wong, M.A. Wolf, J.R. Bevere, M. Barbier, and F.H. Damron.** Mucosal immunization with DTaP confers protection against *Bordetella pertussis* infection and cough in Sprague-Dawley rats. 2021 In print at *Infection and Immunity*
- **M.A. Wolf, D.T. Boehm, M.A. DeJong, T. Wong, E. Sen-Kilic, J. Hall, C. Blackwood, K. Weaver, C. Kelly, C. Kisamore, G. Bitzer, J.R. Bevere, M. Barbier, and F.H. Damron.** Intranasal immunization with acellular pertussis vaccines results in long-term immunity to *Bordetella pertussis* in mice. *Infect Immun*. 2020 Dec 14;IAI.00607-20. doi: 10.1128/IAI.00607-20. PMID: 33318136.
- **A.M. Horspool, T. Kieffer, B.P. Russ, M.A. DeJong, M.A. Wolf, J.M. Karakiozis, B.J. Hickey, P. Fagone, D.H. Tacker, J.R. Bevere, I. Martinez, M. Barbier, P. Perrotta, and F.H. Damron.** Interplay of antibody and cytokine production reveals CXCL-13 as a potential novel biomarker of lethal SARS-CoV-2 infection. *mSphere* Jan 2021, 6 (1) e01324-20; DOI: 10.1128/mSphere.01324-20. PMID: 33472985
- **E. Sen-Kilic, C.B. Blackwood, A.B. Huckaby, A.M. Horspool, K.L. Weaver, A.C. Malkowski, W.T. Witt, J.R. Bevere, F.H. Damron, and M. Barbier.** Defining the mechanistic correlates of protection conferred by whole-cell vaccination against *Pseudomonas aeruginosa* acute murine pneumonia. *Infect Immun*. 2021 Jan 19;89(2):e00451-20. doi: 10.1128/IAI.00451-20. PMID: 33199354
- **C.B. Blackwood, E. Sen-Kilic, D.T. Boehm, J.M. Hall, M.E. Varney, T.Y. Wong, S.D. Bradford, J.R. Bevere, W.T. Witt, F.H. Damron, and M. Barbier.** Innate and adaptive immune responses against *Bordetella pertussis* and *Pseudomonas aeruginosa* in a murine model of respiratory infection and mucosal whole cell vaccination. *Vaccines* 2020, 8(4), 647. DOI: 10.3390/vaccines8040647. PMID: 33153066.
- M. Schaller, and **M. Barbier.** FastTrack, A Strategy to Shorten Time to Degree. *FASEB BioAdvances*. 2021 Jan; <https://doi.org/10.1096/fba.2020-00144>

## **Robinson Lab**

- Gleave Parson M, Grimmer J, Vance JK, Witt MR, Seman BG, Rawson TW, Lyda L, Labuda C, Jung JY, **Bradford SD, Robinson CM.** Murine myeloid-derived suppressor cells are a source of elevated levels of interleukin-27 in early life and compromise control of bacterial infection. *Immunol Cell Biol*. 2019; 97:445-456. PMID: PMC6536317
- Seman BG, Vance JK, Rawson TW, Witt MR, **Huckaby AB, Povroznik JM, Bradford SD, Barbier M, Robinson CM.** Elevated levels of interleukin-27 in early life compromise protective immunity in a mouse model of gram-negative neonatal sepsis. *Infect. Immun*. 2020 20;88(3) pii: e00828-19. doi: 10.1128/IAI.00828-19. PMID: 31818960
- M Povroznik J, **Robinson CM.** IL-27 regulation of innate immunity and control of microbial growth. *Future Sci OA*. 2020 Jun 17; 6(7):FSO588. doi: 10.2144/fsoa-2020-0032. PMID: 32802395.
- Seman BG, Povroznik JM, Vance JK, Rawson TW, **Robinson CM.** A Neonatal Imaging Model of Gram-Negative Bacterial Sepsis. *J Vis. Exp*. 2020; 162:e61609. doi: 10.3791/61609.

- Seman BG, Vance JK, **Robinson CM**. Neonatal low-density granulocytes suppress bacterial clearance by monocytes in an extracellular DNA-dependent manner. J Cell Science. *In review*.
- **Vance JK, Rawson TW, Povroznik JM**, Brundage KM, **Robinson CM**. Myeloid-Derived Suppressor Cells Gain Suppressive Function during Neonatal Bacterial Sepsis. Int J Mol Sci. 2021 22:7047.
- Seman BG, **Robinson CM**. The enigma of low-density granulocytes in humans: complexities in the characterization and function of LDGs during disease. Pathogens. 2021; In Review.
- Miller NM, Seman BG, Akers SM, **Povroznik JM**, Brundage KM, Fang W, **Robinson CM**. The impact of opioid exposure during pregnancy on the human neonatal immune profile. Pediatric Research. 2021; In Review.

### **Lukomski Lab**

- **Megan E Grund, Soo J Choi**, Dudley H McNitt, **Mariette Barbier**, Gangqing Hu, Paul R LaSala, Christopher K. Cote, Rita Berisio, and **Slawomir Lukomski**. 2020. Burkholderia collagen-like protein 8, Bcl8, is a unique outer membrane component of a tetrapartite efflux pump in *Burkholderia pseudomallei* and *Burkholderia mallei*. PLoS One. 15: e0242593.
- **Megan E Grund**, Rita Berisio, and **Slawomir Lukomski**. 2020. Outer-membrane proteins as vaccine candidates against *Burkholderia pseudomallei* select agent. Cells. In Preparation. /invited for a special issue: Molecular Immunology in Bacterial Vaccine Discovery.
- **Grund, M., Choi, S. J., Cote, C. K., Berisio, R., and Lukomski S.** (2021) Thinking outside the bug: targeting outer membrane proteins for Burkholderia vaccines. Cells. 10: 495. /review/

### **3. List of BS, PHD Students, and Post-Doctoral Fellows Supported by the RCP Award:**

#### **1. Undergraduate students:**

- Emily Airing – Mariette Barbier laboratory
- Annalisa Huckaby – Mariette Barbier laboratory – now research technician
- Aaron Malkowski – Mariette Barbier laboratory – now at Cornell University pursuing MPH degree
- Elise Jacobson – Heath Damron laboratory
- Caleb Kissamore – Heath Damron laboratory – now MD student at WVU
- Claire Kelly (Kissamore) – Heath Damron laboratory – now PhD student at WVU
- Katherine Lee – Heath Damron laboratory – now PhD student at WVU
- Zeriel Wong – Heath Damron laboratory (UCLA student)
- Olivia Miller – Heath Damron laboratory – now research technician
- Sarah Miller – Mariette Barbier laboratory – now research technician
- Nathanial Radar – Heath Damron laboratory
- Matthew Warden – Heath Damron laboratory
- Evita Yang – Mariette Barbier laboratory
- Matthew Hudson – Mariette Barbier laboratory (RAP)
- Spender Dublin – Mariette Barbier laboratory
- Elisabeth Six – Tim Driscoll laboratory
- Ryan Vaught – Holly (Damron) Cyphert – Marshall University
- Lillie Powell – Slawomir Lukomski laboratory (SURE)
- Chloe Chipman – Slawomir Lukomski laboratory (SURE)
- Travis Rawson – Cory Robinson laboratory

#### **2. Graduate students:**

- Shelby Bradford – 5<sup>th</sup> year graduate student – Cory Robinson laboratory
- Emel Sen-Kilic – Mariette Barbier laboratory (graduated) – Scientist, Antibody Discovery WVU VDC
- Catherine Blackwood – Mariette Barbier laboratory (graduated) – Post-Doctoral Fellow NIOSH CDC
- Jesse Hall – Heath Damron laboratory (graduated) – Ohio State University Post-Doctoral Fellow
- Ting Wong – 5<sup>th</sup> year graduate student – Heath Damron laboratory
- Brynnan Russ – Scott Bowdridge laboratory (graduated)
- Megan Grund – 4<sup>th</sup> year graduate student – Slawomir Lukomski laboratory
- Jessica Towey – 4<sup>th</sup> year graduate student – Timothy Driscoll laboratory
- Dylan Boehm – Heath Damron laboratory (graduated) – currently a Post-Doctoral Fellow at Oregon Health and Sciences University, Vaccine and Gene Therapy Institute
- Dr. Jason Kang – 4<sup>th</sup> year CTSI graduate student – Heath Damron laboratory
- Jessica Towey – Tim Driscoll laboratory
- Barrett Briggs – 1<sup>st</sup> year graduate student – Tim Driscoll laboratory

- m. Katherine Lee – 1<sup>st</sup> year graduate student – Heath Damron laboratory
- n. Graham Bitzer – 3<sup>rd</sup> year graduate student – Heath Damron laboratory
- o. Megan DeJong – MD/PhD student – Heath Damron laboratory
- p. Ashley Divens – 2<sup>nd</sup> year graduate student – Cory Robinson laboratory

### 3. **Post-Doctoral fellows:**

- a. Dr. Allison Wolf – PI Damron, supported *Bordetella pertussis* vaccine project
- b. Dr. Alexander Horspool – PI Barbier, supported *Pseudomonas aeruginosa* vaccine project
- c. Dr. Melinda Varney – PI Damron, supported *Bordetella pertussis* vaccine project – Currently Assistant Professor in the Department of Pharmaceutical Science and Research at Marshall University, WV.
- d. Dr. Brynna Russ – PI Damron, supported COVID-19 research / vaccine projects
- e. Dr. Maria de la Paz Gutierrez – PI Barbier, supported Lyme disease vaccine projects
- f. Dr. Margalida Borrás – PI Barbier, supported *Pseudomonas aeruginosa* vaccine and therapeutic projects
- g. Dr. Emel Sen-Kilic – PI Barber/Damron, supported *Pseudomonas*, Lyme, and COVID-19 vaccine projects

### 4. **Grants, Contracts, and Sponsored Research, that Leveraged Resources from the RCG:**

The members of the Vaccine Development Center are highly active in seeking extramural support from numerous agencies. Since the VDC was formed researchers have applied for funding from the National Institutes of Health, Center for Disease Control, Department of Defense, Cystic Fibrosis Foundation, etc. The Assistant Director of the VDC is actively seeking extramural support from industry partners through sponsored research. Both fronts have been extremely successful and below is a brief summary of these efforts.

**2018** – A total of 16 proposals were submitted requesting \$18.74 million, of which \$3.85 million were funded. For every \$1.00 dollar of support from the RCP this resulted \$14.8 of extramural support to members of the VDC. This is a **1,381%** Return on Investment for year 2018.

**2019** – A total of 16 proposals were submitted requesting \$18.47 million, of which \$3.46 million were funded. For every \$1.00 dollar of support from the RCP this resulted in \$13.3 of extramural support to members of the VDC. This is a **1,234%** Return on Investment for year 2019.

**2020** – A total of 39 proposals were submitted requesting \$36.51 million, of which \$12.54 million were funded. For every \$1.00 dollar of support from the RCP this resulted in \$48.23 of extramural support to members of the VDC. This is a **4,723%** Return on Investment for year 2020.

**2021** – A total of 27 proposals have been, or are anticipated to be submitted totaling \$26.03 million, of which \$6.65 million have thus far been awarded. For every \$1.00 dollar of support from the RCP this resulted in \$25.56 of extramural support to members of the VDC. This is a **2,455%** Return on Investment. Of proposals submitted, 9 have been supported thus far, 11 have not been supported, and 7 are pending (\$3.91 million, we anticipate some will be successful and we project greater than **3,000%** return on investment for the 4<sup>th</sup> year of the Vaccine Development Center.

### 5. **Industry partners, Patents, and legal agreements:**

Justin Bever leads the front on coordinating legal agreements between collaborators (industry or academic) and WVU researchers. From 2018 to 08/31/21, the WVU technology transfer office has moved forward with 5 patent applications from members of the VDC. One for a *Bordetella pertussis* vaccine, one for a *Pseudomonas aeruginosa* vaccine, one for a *Burkholderia* vaccine, one for a COVID-19 vaccine, and one for the development of novel bacterial strains that produce vaccine antigens. The Vaccine Development Center now has 6 sponsored research projects with industry partners, and a multitude of industry partners that provide free materials under MTAs. There is 30+ NDAs, MTAs, MSAs, etc in place between our researchers and industry/academic partners that are directly focused to vaccine development research at WVU.

One licensing agreement is currently in the negotiation phase between an industry partner and WVU Technology Transfer Office.

### 6. **Highlights of the Vaccine Development Center per year:**

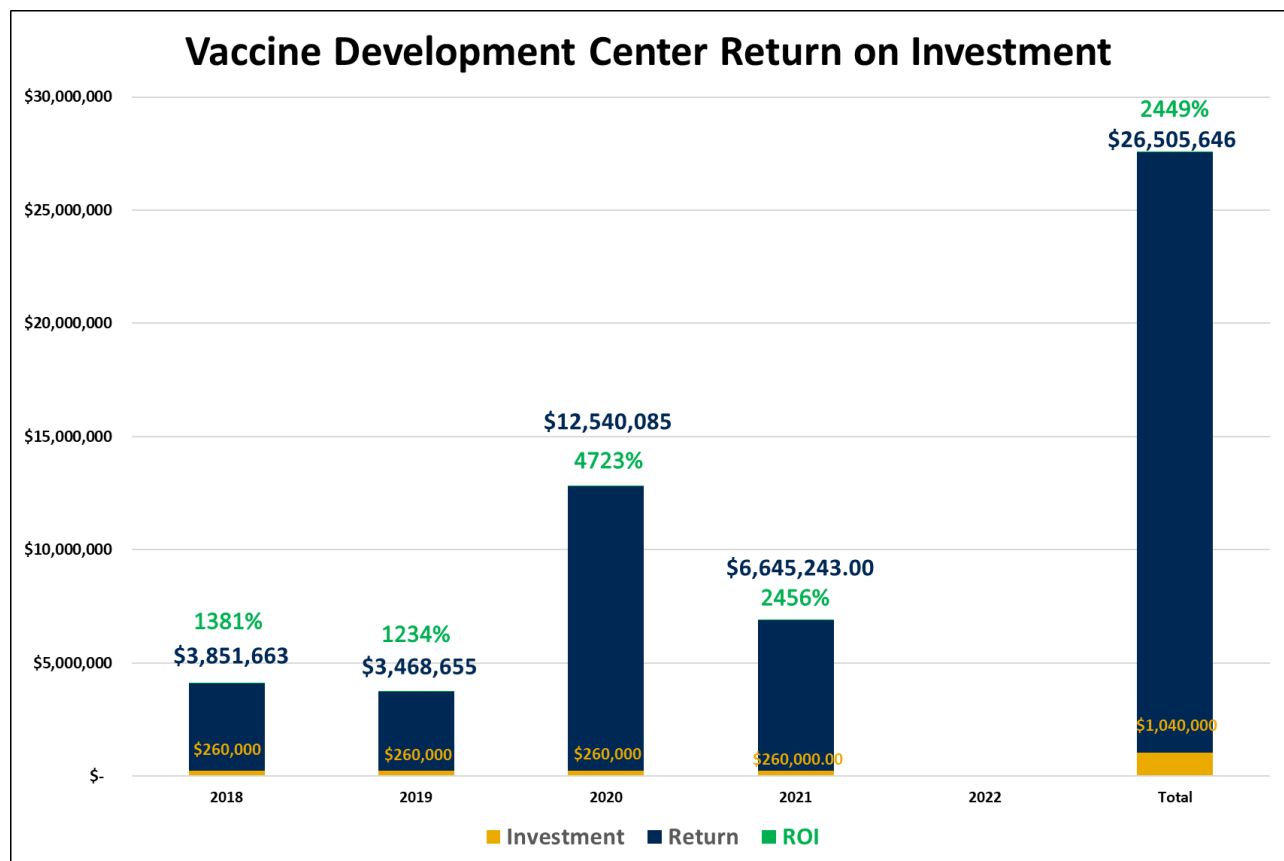
**2018 Highlight** – Dr. Heath Damron received a 5<sup>th</sup> percentile score on an NIH R01, and is awarded \$2,898,165 for the development of a mucosal vaccine to protect against whooping cough.

**2019 Highlight** – Dr. Mariette Barbier received a 12<sup>th</sup> percentile score on an NIH R01, and is awarded \$2,610,412 for the development of a vaccines against bacterial pathogens by targeting iron acquisition proteins.

**2020 Highlight** – Dr. Alexander Horspool publishes a study in MedRxiv on the antibody and cytokine profile of West Virginian residents with COVID-19 infections (in peer review at PLOS Medicine 09/2020). Dr. Mariette Barbier (Tim Driscoll Co-I) received NIH R01 and is awarded \$1,900,000 for the development of Lyme disease vaccines.

**2021 Highlight** – Dr. Cory Robinson received a 15<sup>th</sup> percentile score on an NIH R01, and is awarded \$2,549,890 to study cytokines in the context of protective immunity. Dr. Tim Driscoll receives major funding on a COVID-19 initiative with the state of WV. Dr. Lukomski works as Co-PI on DOD funded project with Dr. Barbier (PI)

**Overall highlight:** Every PI (5 – Damron, Barbier, Robinson, Driscoll, Lukomski) that has received pilot funding through the VDC have obtained significant funding through extramural sources either (independently or as Co-PI)





**Report to the Legislative Oversight Commission  
on Education Accountability**

**Advanced Career Education Pathways Annual Legislative Report  
(§18-2E-11(g))**





# Advanced Career Education Pathways

## ***Annual Legislative Report***

***Presented by***

***W. Clayton Burch***

***State Superintendent of Schools***

***West Virginia Department of Education***

***Dr. Sarah Tucker***

***Chancellor***

***West Virginia Council for Community and Technical***

***College Education***

***October 2021***



**WEST VIRGINIA**  
**Community & Technical**  
**COLLEGE SYSTEM**



**W. Clayton Burch**  
State Superintendent of Schools  
West Virginia Department of Education

**Sarah Armstrong Tucker, Ph.D.**  
Chancellor  
West Virginia Higher Education Policy Commission  
West Virginia Council for Community and Technical College Education

# Advanced Career Education (ACE)

## *Annual Report to the Legislative Oversight Commission on Education Accountability* **October 2021**

The ACE report is presented to the Legislative Oversight Commission on Education Accountability pursuant to the requirements of Senate Bill 1, enacted in the 2019 West Virginia Legislative Session.

### **§18-2E-11 Advanced Career Education (ACE)**

Advanced Career Education (ACE) herein established is known and may be cited as “ACE”. ACE program pathways are established through the formation of partnerships between state education agencies and institutions. These partnerships enable students to attain advanced career education and valuable workforce skills in a more efficient and advantageous manner by ensuring that a full range of educational training programs and services are provided in all areas of the state. Additionally, these programs create clear and efficient pathways that begin during secondary education and lead to obtaining advanced certifications and associate degrees, providing students with increased access to post-secondary career education. Lastly, the purpose of ACE is to connect secondary schools and community and technical colleges or public baccalaureate institutions that provide associate degrees to accomplish the following objectives.

1. Prepare secondary students for success in post-secondary education and the workforce.
2. Provide more opportunities for secondary students to earn post-secondary college credits, certifications, and associate degrees.

# Partnerships, Pathways, Objectives, Guidelines and Accountability for ACE

## **§18-2E-11(c) Partnerships**

Community and technical colleges, public baccalaureate institutions, career technical education centers, and county boards of education, or any combination of such secondary and postsecondary entities, shall establish partnerships that provide for ACE programs. ACE programs must feature defined pathways that begin when a student is in secondary education and that ultimately lead to advanced certifications or associate degrees awarded by community and technical colleges or baccalaureate institutions. ACE programs are available to public, nonpublic, and homeschool students.

## **§18-2E-11(d) Pathways**

ACE programs include pathways that consist of a curriculum of courses leading to advanced certifications or an associate degree that have been deemed to satisfy a workforce need as determined by the Department of Commerce. The Department of Commerce will work the State Board of Education, the West Virginia Council for Community and Technical College Education and the West Virginia Higher Education Policy Commission to assess program pathway needs by sharing the following workforce information annually.

1. Written notification of a determination of areas of workforce need within the state.
2. Develop a hierarchy of high demand skilled professions and workforce needs with shortages, which shall be given priority in administration of the program.

## **§18-2E-11(e) Objectives**

The State Superintendent of Schools, the Chancellor of the Council for Community and Technical College Education, and the Chancellor of the Higher Education Policy Commission oversee the administration and implementation of ACE. Pursuant to Senate Bill 1, these programs must fulfill the objectives listed below.

1. Provide additional opportunities to students in this state to attain advanced certifications and college credentials leading to associate degrees through ACE pathways.
2. Increase the number of students in this state that attain advanced certifications and college credentials leading to associate degrees through ACE pathways.
3. Allow students in this state to attain advanced certifications and college credentials leading to associate degrees through ACE pathways at little or no cost.
4. Ensure that ACE pathways provide a clear roadmap to the courses and requirements necessary to attain advanced certifications and college credentials leading to associate degrees.
5. Ensure that course requirements within ACE pathways are not duplicated.

### **§ 18-2E-11(f) Guidelines**

Senate Bill 1 requires that the board and council promulgate a joint rule to further define guidelines for the administration of ACE programs and pathways. Specifically, the joint guidelines must address the areas outlined below.

1. That ACE program partnerships established between community and technical colleges, public baccalaureate institutions, career technical education centers, and county boards of education, or any combination of such secondary and postsecondary entities, shall be reduced to written partnership agreements.
2. The information required to be contained within partnership agreements.
3. That ACE programs and pathways must meet the requirements of the accrediting entity for the community and technical college or public baccalaureate institution awarding the associate degrees or advanced certificates.
4. That partnership agreements shall be approved by the State Superintendent of Schools, the Chancellor for the Council for Community and Technical College Education and the Chancellor of the Higher Education Policy Commission.
5. Any other provisions necessary to operate ACE programs.

### **§ 18-2E-11(g) Accountability**

Pursuant to Senate Bill 1, the board and the council shall provide an annual report to the Governor and the Legislative Oversight Commission on Education Accountability on the ACE programming outcomes listed below.

1. The identity and number of partnership agreements.
2. The ACE programs and pathways that are being utilized by career technical education centers, county boards of education, community and technical colleges, and public baccalaureate institutions.
3. The nature and number of degrees and certifications awarded to students participating in ACE programs by each community and technical college, public baccalaureate institution and career technical education center.

# Pathway Agreements



County	School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)										
Boone	Boone Career and Technical Center	Medical Assisting	Memorandum of Understanding (MOU)	<table><tr><td>Southern West Virginia Community and Technical College</td></tr><tr><td><b>Course Name</b></td></tr><tr><td>MA 100 Introduction to Medical Assisting</td></tr><tr><td>MA 101 Medical Assisting I</td></tr><tr><td>MA 105 Medical Office Billing and Coding I</td></tr><tr><td>MA 106 Medical Office Billing and Coding II</td></tr><tr><td>MA 201 Medical Assisting II</td></tr><tr><td>MA 210 Medical Assisting III</td></tr><tr><td>MA 225 Medical Assisting Capstone</td></tr><tr><td><b>Total Credits</b></td></tr></table>	Southern West Virginia Community and Technical College	<b>Course Name</b>	MA 100 Introduction to Medical Assisting	MA 101 Medical Assisting I	MA 105 Medical Office Billing and Coding I	MA 106 Medical Office Billing and Coding II	MA 201 Medical Assisting II	MA 210 Medical Assisting III	MA 225 Medical Assisting Capstone	<b>Total Credits</b>
Southern West Virginia Community and Technical College														
<b>Course Name</b>														
MA 100 Introduction to Medical Assisting														
MA 101 Medical Assisting I														
MA 105 Medical Office Billing and Coding I														
MA 106 Medical Office Billing and Coding II														
MA 201 Medical Assisting II														
MA 210 Medical Assisting III														
MA 225 Medical Assisting Capstone														
<b>Total Credits</b>														
				<table><tr><td><b>Credits</b></td></tr><tr><td>3</td></tr><tr><td>3</td></tr><tr><td>3</td></tr><tr><td>3</td></tr><tr><td>5</td></tr><tr><td>7</td></tr><tr><td>3</td></tr><tr><td><b>27</b></td></tr></table>	<b>Credits</b>	3	3	3	3	5	7	3	<b>27</b>	
<b>Credits</b>														
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Brooke	Brooke County High School	Welding	Dual Enrollment	<table><tr><td>West Virginia Northern Community College</td></tr><tr><td><b>Course Name</b></td></tr><tr><td>WELD 101 Oxyacetylene Welding</td></tr><tr><td>WELD 102 Basic Shielded Metal Arc Welding</td></tr><tr><td>WELD 202 Beginning MIG</td></tr><tr><td>WELD 206 Beginning TIG</td></tr><tr><td><b>Total Credits</b></td></tr></table>	West Virginia Northern Community College	<b>Course Name</b>	WELD 101 Oxyacetylene Welding	WELD 102 Basic Shielded Metal Arc Welding	WELD 202 Beginning MIG	WELD 206 Beginning TIG	<b>Total Credits</b>			
West Virginia Northern Community College														
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WELD 102 Basic Shielded Metal Arc Welding														
WELD 202 Beginning MIG														
WELD 206 Beginning TIG														
<b>Total Credits</b>														
				<table><tr><td><b>Credits</b></td></tr><tr><td>1</td></tr><tr><td>6</td></tr><tr><td>3</td></tr><tr><td>3</td></tr><tr><td><b>13</b></td></tr></table>	<b>Credits</b>	1	6	3	3	<b>13</b>				
<b>Credits</b>														
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<b>13</b>														
Cabell	Cabell Midland High School	AFJROCT	Memorandum of Understanding (MOU)	<table><tr><td>Mountwest Community and Technical College</td></tr><tr><td><b>Course Name</b></td></tr><tr><td>Military Science 101</td></tr><tr><td>Military Science 102</td></tr><tr><td><b>Total Credits</b></td></tr></table>	Mountwest Community and Technical College	<b>Course Name</b>	Military Science 101	Military Science 102	<b>Total Credits</b>					
Mountwest Community and Technical College														
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Military Science 101														
Military Science 102														
<b>Total Credits</b>														
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<b>Credits</b>														
3														
3														
<b>6</b>														

CTE Program of Study			Pathway Agreement		Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
County	School					
Grafton and Preston	Grafton High School and Preston High School	Therapeutic Services	Dual Enrollment	Pierpont Community & Technical College	<b>Course Name</b>	<b>Credits</b>
					HLCA 1100 Medical Terminology	3
					<b>Total Credits</b>	<b>3</b>
Hampshire	Hampshire Career Training Center	Automotive Technology	Articulation Agreement	Universal Technical Institute	<b>Course Name</b>	<b>Credits</b>
					ADTC 107 Brakes	2
					ADTC 128 Steering and Suspension	2
					<b>Total Credits</b>	<b>4</b>
Hampshire	Hampshire Career Training Center	Automotive Technology	Articulation Agreement	University of Northwestern Ohio	<b>Course Name</b>	<b>Credits</b>
					AU 127 Brakes	2
					AU 126 Steering and Suspension	2
					<b>Total Credits</b>	<b>4</b>
Hardy	Hardy County School System	Business Management	Articulation Agreement	Eastern West Virginia Community and Technical College	<b>Course Name</b>	<b>Credits</b>
					BUS 101 Introduction to Business	3
					FIN 232 Personal Finance	3
					CIS 114 Intro to Computer Applications	3
					<b>Total Credits</b>	<b>9</b>
Mercer	Mercer County Technical Education Center	Management & Admin Support, Accounting/ Finance, & Marketing Management	Articulation Agreement	Bluefield State College	<b>Course Name</b>	<b>Credits</b>
					BUSN 130	3
					BUSN 240	3
					ACCT 201	3
					<b>Total Credits</b>	<b>9</b>

County		School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Mercer	Mercer County Technical Education Center	Mercer County Technical Education Center	Management & Admin Support, Accounting/ Finance, & Marketing Management	Articulation Agreement	Bluefield State College	
					<b>Course Name</b>	<b>Credits</b>
					ACCT205	3
					BGEN105	3
					BGEN110	3
					BGEN222	3
					<b>Total Credits</b>	<b>12</b>
Mercer	Mercer County Technical Education Center	Mercer County Technical Education Center	Careers in Education	Articulation Agreement	Bluefield State College	
					<b>Course Name</b>	<b>Credits</b>
					EDUC 110 Foundations of Education	2
					EDUC 160 Diversity in Education	2
					EDUC 200 Child and Adolescent Development	3
					<b>Total Credits</b>	<b>7</b>
Mercer	Mercer County Technical Education Center	Mercer County Technical Education Center	Law and Public Safety	Articulation Agreement	Bluefield State College	
					<b>Course Name</b>	<b>Credits</b>
					CRMJ 151 Introduction to Criminal Justice	3
					CRMJ 221 American Correctional System	3
					CRMJ 232 Criminal Justice Writing	3
					<b>Total Credits</b>	<b>9</b>
Mercer	Mercer County Technical Education Center	Mercer County Technical Education Center	Automotive Technology	Articulation Agreement	University of Northwestern Ohio	
					<b>Course Name</b>	<b>Credits</b>
					AU126 Suspension and Steering	3
					AU127 Hydraulic	3
					<b>Total Credits</b>	<b>6</b>

County		CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Multi-County	Mountwest Consortium Schools	Therapeutic Services	Dual Credit		
				<b>Course Name</b>	<b>Credits</b>
				EME 105 First on Scene	3
				AH 200 Basic Nutrition	3
				AH 151 Medical Terminology	3
				<b>Total Credits</b>	<b>9</b>
Multi-County	Mountwest Consortium Schools	Health Informatics	Dual Credit		
				<b>Course Name</b>	<b>Credits</b>
				HINF 101 Intro to Health Informatics	3
				HIT 206 Healthcare Statistics	3
				AH 151 Medical Terminology	3
				<b>Total Credits</b>	<b>9</b>
<i>*Clinicals must be in a health informatics setting.</i>					
Multi-County (Berkeley, Jefferson, Morgan)	James Rumsey Technical Center	Careers in Education	Articulation Agreement		
				<b>Course Name</b>	<b>Credits</b>
				ECED 101 Foundations in Early Childhood Education	3
				ECED 103 Early Language and Literacy	3
				ECED 106 Health, Nutrition, and Safety	3
				ECED 165 Assessment of Young Children	3
				ECED 206 Family/Community Engagement	3
				ECED 220 Early Childhood Inclusion	3
				<b>Total Credits</b>	<b>18</b>
Multi-County (Berkeley, Jefferson, Morgan)	James Rumsey Technical Center	Automotive Technology	Articulation Agreement		
				<b>Course Name</b>	<b>Credits</b>
				AU 126 Steering and Suspension	6
				AU 127 Hydraulic Brake Systems	6
				<b>Total Credits</b>	<b>12</b>

County		School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Multi-County (Berkeley, Jefferson, Morgan)		James Rumsey Technical Center	Automotive Technology	Articulation Agreement	Universal Technical Institute	<b>Credits</b>
					C107 Brakes	3
					C117 Electronic Fund	3
					A104 Fuel & Injection	3
					C128 Auto Undercar	3
					A109 Auto Trans.	3
					C108 Climate Control	3
					A106 Auto Power Trains	3
					<b>Total Credits</b>	<b>21</b>
Multi-County (Berkeley, Jefferson, Morgan)		James Rumsey Technical Center	Diesel Technology	Articulation Agreement	University of Northwestern Ohio	<b>Credits</b>
					AU 126 Steering and Suspension	6
					AU 127 Hydraulic Brake Systems	6
					<b>Total Credits</b>	<b>12</b>
Multi-County (Berkeley, Jefferson, Morgan)		James Rumsey Technical Center	CCNA	Memorandum of Understanding (MOU)	Blue Ridge Community & Technical College	<b>Credits</b>
					CNET 131	4
					CNET 211	5
					<b>Total Credits</b>	<b>9</b>

County	School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Multi-County (Berkeley, Jefferson, Morgan)	James Rumsey Technical Center	Diesel Technology	Articulation Agreement	Universal Technical Institute	Credits
				C107 Brakes	3
				C117 Electronic Fund	3
				A104 Fuel & Injection	3
				C128 Auto Undercar	3
				A109 Auto Trans.	3
				C108 Climate Control	3
				A106 Auto Power Trains	3
				Total Credits	21
Multi-County (Grant, Hardy, Pendleton)	South Branch Career & Technical Center	Automotive Technology	Articulation Agreement	University of Northwestern Ohio	Credits
				AU 126 Steering and Suspension	6
				AU 127 Brakes	6
				Total Credits	12
Multi-County (Grant, Hardy, Pendleton)	South Branch Career & Technical Center	Automotive Technology	Articulation Agreement	Allegany College of Maryland	Credits
				105 Related Technical Automotive	2
				Total Credits	2
Multi-County (Grant, Hardy, Pendleton)	South Branch Career & Technical Center	Automotive Technology	Articulation Agreement	Eastern WV Community & Technical College	Credits
				ATT 100 Introduction to Automotive Technology	1
				ATT 105 Braking Systems	4
				ATT 124 Automotive Electricity/Electronics I	4
				Total Credits	9

CTE Program of Study			Pathway Agreement		Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
County	School					
Multi-County (Grant, Hardy, Pendleton)	South Branch Career & Technical Center	Information Technology	Articulation Agreement	Eastern West Virginia Community & Technical College	<b>Course Name</b>	<b>Credits</b>
					AIT 110 Introduction to Information Technology	3
					IT 180 PC Repair and Troubleshooting	3
					IT 275 Security Fundamentals	3
					IT 220 Windows Server Administration Fundamentals	3
					IT 134 Networking Fundamentals	3
					IT 181 Operating Systems	3
<b>Total Credits</b>					<b>18</b>	
Multi-County (Grant, Hardy, Pendleton)	South Branch Career & Technical Center	Therapeutic Services	Memorandum of Understanding (MOU)	Eastern West Virginia Community & Technical College	<b>Course Name</b>	<b>Credits</b>
					108-SBE Medical Terminology	3
					<b>Total Credits</b>	<b>3</b>
Multi-County (Pleasants, Tyler, Ritchie, Wetzel)	Mid-Ohio Valley Technical Institute	Careers in Education	Memorandum of Understanding (MOU)	West Virginia University at Parkersburg	<b>Course Name</b>	<b>Credits</b>
					EDUC 100 Introduction to Teacher Evaluation	3
					EDUC 108 Educational Technology	3
					<b>Total Credits</b>	<b>6</b>
*Students must pass Praxis Core Academic Skills for Educators (Core/CASE) and have scores sent to WVUP to receive credit.						
Multi-County (Pleasants, Tyler, Ritchie, Wetzel)	Mid-Ohio Valley Technical Institute	Advanced Medical	Memorandum of Understanding (MOU)	West Virginia University at Parkersburg	<b>Course Name</b>	<b>Credits</b>
					PCT 101 Patient Care Technician I	3
					PCT 102 Patient Care Technician II	3
					NURS 153 Medical Terminology	3
					HPER 172 Standard First Aid	2
<b>Total Credits</b>					<b>11</b>	
*Students must pass the National Healthcare Association Certified Patient Care Technician examination and have scores sent to WVUP to receive credit.						

County		CTE Program of Study	School	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Multi-County (Harrison, Taylor, Doddridge)	United Technical Center	Machine Tool	Dual Credit		Mountwest Community and Technical College	
					<b>Course Name</b>	<b>Credits</b>
					MAT 135 Mathematics for Machinist Technology	3
					MT 105 Industrial Safety	2
					MT 121 Introduction to Machinery	4
					MT 200 Blueprint Reading	3
					MT 205 Precision Measurement	3
					MT 215 Metal Theory & Application	10
					MT 233 NIMS Credentialing	4
					MFE 220 Computer Aided Design	4
					MT 244 Setup & Operation CNC	4
					MT 248 NIMS/CNC	4
					<b>Total Credits</b>	<b>41</b>
Ohio	Wheeling Park High School	Welding	Articulation Agreement		West Virginia Northern Community College	
					<b>Course Name</b>	<b>Credits</b>
					WELD 101 Oxyacetylene Welding	1
					WELD 102 Basic Shielded Metal Arc Welding	6
					WELD 202 Beginning MIG	3
					WELD 206 Beginning TIG	3
					<b>Total Credits</b>	<b>13</b>
Morgan	Berkeley Springs High School	Advanced Manufacturing	Articulation Agreement		Blue Ridge Community and Technical College	
					<b>Course Name</b>	<b>Credits</b>
					ENGL 101 Written English	3
					PHYS 103 General Physical Science I	4
					ECON 205 Principles of Macroeconomics	3
					MATH 100A Algebra Essentials (3) or MATH 114 Probability and Statistics	3
					<b>Total Credits</b>	<b>13</b>

CTE Program of Study			Pathway Agreement		Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
County	School					
Statewide	Statewide	Careers in Education	Memorandum of Understanding (MOU)	Concord University	<b>Course Name</b> EDUC 210 Diversity, Culture, and Education in a Pluralistic Society EDSP 265 Child and Adolescent Development*	<b>Credits</b> 3 3 <b>6</b>
*Students must be pursuing Special Education or Elementary Education to receive credit for this course.						
Statewide	Statewide	Careers in Education	Memorandum of Understanding (MOU)	Marshall University	<b>Course Name</b> EDF 201 Educational Psychology and Development Learner and EDF 270 (Required Clinical) CI 342 Literature and Language Arts Methods* CI 345 Critical Reading, Writing and Thinking**	<b>Credits</b> 3 3 3 <b>9</b>
*Students must have taken Careers in Education Course 1305 Elementary Literacy Awareness and be pursuing Elementary Education to receive credit for this course.						
**Students must have taken Careers in Education Course 1304 Secondary Literacy Awareness and be pursuing Secondary Education to receive credit for this course.						
Note: Students must have Praxis Core scores sent to Marshall University to receive credit for any course.						
Statewide	Statewide	Therapeutic Services	Memorandum of Understanding (MOU)	Bluefield State College	<b>Course Name</b> HLTH 100 Allied Health Pre-Readiness HLTH 101 Personal Health and Wellness HLTH 201 Safety and First Aid HLTH Medical Terminology	<b>Credits</b> 1 2 2 3 <b>8</b>
*This agreement is solely intended for students who have completed courses associated with the Therapeutic Services/Health Occupations program of study.						

County		School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)
Statewide	Statewide	Statewide	ACE Surgical Technology	Memorandum of Understanding (MOU)	Alderson Broadbodus University
					Alderson Broadbodus University will provide 45 higher education credits to students who complete the Surgical Technology program through WVDE's Office of Technical & Adult Education.
					<i>*AB will provide instruction in 15 credit hours in liberal studies (general education) in a distance learning format to students who complete their program of study in surgical technology through WVDE's Office of Technical &amp; Adult Education to complete the requirements of an Associates of Applied Science degree.</i>

**Total Credits: 45**

Statewide	Statewide	Pre-Engineering-Project Lead the Way	Dual Credit	Marshall University
				<i>*Students must have taken 2461 Introduction to Engineering and Design (PLTW) and 2463 Principles of Engineering (PLTW) to receive credit for these course(s).</i>
				Note:
				» Understand the various engineering disciplines and career choices.
				» Identify the skills and attributes required to be a successful engineering student and a successful engineering professional.
				» Demonstrate an ability to generate a methodical solution to an engineering analysis problem, based on reasonable assumptions, independent research, and critical thinking.
				» Successfully work in a team environment.
				» Describe and apply the engineering design process, including optimization of design parameters, to achieve a maximally efficient result.
				» Demonstrate an ability to communicate effectively.
				» Utilize engineering and architectural scales to determine dimensions on drawings.
				» Interpret engineering drawings.
				» Draw organized, neat, and legible free-hand sketches.
				» Create organized, neat, and legible drawings with straightedges.
				» Interpret and draw orthographic projections.
				» Utilize CAD software to create organized, neat, and legible 2D drawings.
				» Utilize CAD software to create organized, neat, and legible 3D drawings.

County		School	CTE Program of Study	Pathway Agreement	Higher Education Agency Pathway Agreement (Courses and semester credit hours)	
Tucker	Tucker County High School	Automotive Technology	Articulation Agreement		Eastern WV Community & Technical College	
					<b>Course Name</b>	<b>Credits</b>
					ATT 100 Introduction to Automotive Technology	3
					ATT 105 Braking Systems	3
					ATT 124 Automotive Electricity/Electronics I	3
					<b>Total Credits</b>	<b>9</b>
Wood	Wood County Technical/Caperton Center	Pre-Engineering	Dual Credit		West Virginia University at Parkersburg	
					<b>Course Name</b>	<b>Credits</b>
					IED - DRAF 226 3D Parametric Model w/Inventor	3
					POE - ENGR 097	3
					CIM- IM 254 CNC Machining 1	3
					CSP- CS 121 Introduction to Programming	4
					ENGR 101 Engineering Problem Solving I	2
					<i>*Must be in College level calculus</i>	
					<b>Total Credits</b>	<b>15</b>
Wyoming	Wyoming County Career & Technical Center	Diesel Technology	Articulation Agreement		University of Northwestern Ohio	
					<b>Course Name</b>	<b>Credits</b>
					AU 126 Steering and Suspension	6
					AU 127 Hydraulic Brake Systems	6
					<b>Total Credits</b>	<b>12</b>

## Conclusions & Recommendations

The creation of Advanced Career Education has aligned the intentions of several state agencies to move forward with developing career pathways, which can and will strengthen the workforce readiness endeavors of West Virginia. Further advancement of this work continues to be revealed through the collaboration efforts of community and technical colleges, public baccalaureate institutions, career technical education centers, and county boards of education. Advanced Career Education legislation has identified three areas to successfully implement this initiative.

1. Prioritize career pathway alignments to guarantee a seamless transition for students pursuing post-secondary education, thus creating a highly skilled workforce;
2. Plan around existing resources to ensure sustainability;
3. Jointly market new pathways to potential students.

The success of the Advanced Career Education initiative must be the responsibility of both the secondary and postsecondary agencies working jointly with the Department of Commerce and WorkForce West Virginia. The Advance Career Education legislation sets a clear vision of the initiative and demonstrates a focused and committed effort by West Virginia to developing a competitive first-rate workforce.

# Appendix



## *State of West Virginia*

### DEPARTMENT OF COMMERCE

September 2, 2021

Dr. Sarah Armstrong Tucker  
Chancellor West Virginia Higher Education Policy Commission and West Virginia Council for  
Community and Technical Education  
WV Council for Community and Technical College Education  
1018 Kanawha Boulevard, East – Suite 700  
Charleston, West Virginia 25301

#### **RE: Advanced Career Education**

Dear Dr. Tucker:

Preparing West Virginians for success in postsecondary career education and to excel in the workforce is a critical responsibility of state government. The West Virginia Department of Education and providers of higher education lead in fulfilling this responsibility by results driven strategies that enable students to attain advanced education and valuable workforce skills.

This letter is to inform you that, pursuant to **§18-2E-11. Advanced Career Education**, the West Virginia Department of Commerce is providing notice to the West Virginia Council for Community and Technical College Education and the West Virginia Higher Education Policy Commission regarding areas of workforce needs across the state.

The Department of Commerce has identified in the attached spreadsheet (1) the fastest-growing and (2) the highest-paying occupations as the best opportunities for West Virginians to pursue promising careers and for West Virginia to reach greater economic prosperity. Through pursuit of these identified occupations and in collaboration with industries across West Virginia, we can put more of our state's residents on a direct path to workforce success.

If I may provide any additional information related to West Virginia's occupational outlook, please do not hesitate to contact my office.

Sincerely

A handwritten signature in blue ink, reading "C. Edward Gaunch".

C. Edward Gaunch  
Cabinet Secretary

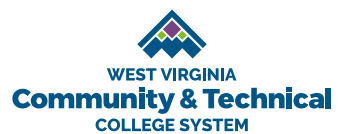
State Capitol | 1900 Kanawha Boulevard East, Building 3, Suite 600, Charleston, WV 25305  
(304) 558-2234 | Fax: (304) 957-0175 | [www.wvcommerce.org](http://www.wvcommerce.org)

Occupation	2020 Jobs	2030 Jobs	2020 - 2030 Change in Jobs	2020 - 2030 % Change	Median Hourly Earnings
Healthcare Support Occupations	33,659	41,190	7,531	22%	\$11.38
Healthcare Practitioners and Technical Occupations	57,212	62,205	4,993	9%	\$27.81
Business and Financial Operations Occupations	26,175	29,351	3,176	12%	\$28.31
Management Occupations	32,745	35,774	3,029	9%	\$38.34
Food Preparation and Serving Related Occupations	53,828	56,091	2,263	4%	\$10.36
Computer and Mathematical Occupations	12,043	14,210	2,168	18%	\$32.11
Community and Social Service Occupations	12,514	14,624	2,110	17%	\$17.78
Personal Care and Service Occupations	12,040	14,143	2,103	17%	\$11.38
Transportation and Material Moving Occupations	55,142	57,169	2,027	4%	\$14.72
Building and Grounds Cleaning and Maintenance Occupations	19,780	20,845	1,064	5%	\$12.18
Protective Service Occupations	13,878	14,638	759	5%	\$17.57
Arts, Design, Entertainment, Sports, and Media Occupations	4,926	5,469	542	11%	\$18.45
Architecture and Engineering Occupations	9,424	9,900	475	5%	\$36.07
Life, Physical, and Social Science Occupations	7,193	7,658	465	6%	\$28.10
Installation, Maintenance, and Repair Occupations	30,955	31,143	188	1%	\$19.63
Farming, Fishing, and Forestry Occupations	1,896	1,992	96	5%	\$14.95
Legal Occupations	5,063	5,076	13	0%	\$33.20

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Life, Physical, and Social Science Occupations	7,193	7,658	465	6%	\$28.10
Healthcare Practitioners and Technical Occupations	57,212	62,205	4,993	9%	\$27.81
Construction and Extraction Occupations	38,744	37,055	(1,689)	(4%)	\$20.96
Educational Instruction and Library Occupations	31,459	29,940	(1,519)	(5%)	\$20.76
Installation, Maintenance, and Repair Occupations	30,955	31,143	188	1%	\$19.63



W. Clayton Burch  
West Virginia Superintendent of Schools



Sarah Armstrong Tucker, Ph.D.  
Chancellor