MEMORANDUM

TO: Arlington School Board

FROM: Science Advisory Committee

DATE: February 19, 2020

SUBJECT: 2019-20 Recommending Year Report

INTRODUCTION

The Science Advisory Committee (SAC) 2019-20 recommendations focus on independent projects and elementary outdoor and experiential learning.

The SAC recommendations:

- Support and sustain the Science Program mission and vision, which emphasize enthusiasm, inquisitive spirit, and inquiry in everyday contexts.[1]
- Align with the new 2018 Virginia Science Standards of Learning[2] (SOL), which emphasize integrating scientific and engineering practices with curriculum content throughout the school year.
- Calibrate science curriculum delivery with APS equity priorities and policies.
- Act on research-based evidence of the benefits of consistent outdoor and experiential learning for child growth and well-being.
- Respond to the 2017 Community Questionnaire results, which prioritized STEM and project-based learning as the highest areas of interest for instruction.

Recommendation #1: Independent Projects (IP)

Timeline: 2021-22 school year

1.A. Align the IP required for an APS science course with the curriculum of that course and support projects within each classroom and school.

1.B. Expand eligible IP types to include all types of scientific investigations[3].

1.C. Ensure project due dates allow sufficient time for meaningful investigation and provide opportunities for students to present project findings.

[1] Arlington Public Schools. Science Program. https://www.apsva.us/science/

[2] Virginia Department of Education. 2018. Virginia Science Standards of Learning. http://www.doe.virginia.gov/testing/sol/standards_docs/science/2018/index.shtml

[3] Not limited to independent/dependent variable hypothesis testing of traditional science fair model. The 'Recommendations for a new IP framework' section contains further detail.

Rationale and Supporting Information

The APS Science Program's mission and vision, developed more than a decade ago, remain on-point:

Mission: The APS Science Program serves to inspire an enthusiasm for scientific literacy, foster an inquisitive spirit in learners through inquiry-based experiences in real-life contexts, and create a community of scientifically literate individuals who are able to make informed decisions.

Vision: All APS students will have the scientific knowledge and skills to become part of a productive global work force of problem solvers and innovators.

To support the mission and vision, the science IP delivery model within APS is intended as an opportunity for students to apply scientific and engineering practices. These practices include investigations that ask questions (science) or define problems (engineering)[4]. Virginia's 2018 Science SOLs curriculum framework explains that students who use both types of practices in the science classroom develop deeper understandings and competencies with each discipline's fundamental techniques[5].

SAC's recommendation supports APS' intention and goals for science IPs, but evolves how APS executes IPs in order for the Science Program mission and vision to be fully realized. This recommendation also responds to APS' increased emphasis on equity.

Basis for recommending changes to IP model

There are three essential and inter-related reasons for the evolution of IPs that will benefit both students and teachers and also facilitate alignment with the 2018 Virginia SOL requirements and APS' equity policies:

- IP work is not necessarily aligned with the curriculum, with the IP subject matter often different from course content. In practice, IPs are conducted in a primarily 'outside the classroom' environment, drawing teachers' and students' time and energy away from core curriculum instruction and learning.
- There are clear equity challenges for students without external resources (e.g., professional connections, parent/guardian time or expertise, financial means, etc.) to provide project infrastructure and support.
- The traditional 'science fair' independent/dependent variable (IV/DV) hypothesis testing model is only one of several types of scientific investigation that are valuable for science instruction and learning.

[4]Achieve. 2013. Next Generation Science Standards, Appendix F (Science and Engineering Practices). https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

[5] Virginia Department of Education. 2018. Virginia Science Standards of Learning Curriculum Framework. http://www.doe.virginia.gov/testing/sol/standards_docs/science/2018/2018-revised-science-curriculum-framework.docx

These challenges are compounded by compressed project delivery schedules early in the academic year, driven by 'science fair' timelines and processes[6].

- Project topics and materials and methods necessarily take time for students to choose and teachers to approve. This is especially true for IV/DV hypothesis testing investigations because of the difficulty of finding a topic of interest that also can be tested in a limited timeframe with available resources. These decisions and approvals generally take place in mid- to late October, which results in short data collection and project reporting windows in November and December.
- In turn, these tight schedules diminish the depth and value of scientific inquiry for many students and add considerable student workload—and stress—during a parallel high 'inside the classroom' workload period.

The unintended but adverse effects of the IP resource and timeline challenges on the student experience with this model of scientific investigation are illustrated by the 2014 APS Science Program Evaluation[7] results from middle and high school focus groups:

- Middle school. *[F]or those students who attended schools where science [fair] participation was optional, the overwhelming response was that they did not plan to participate in the science fair because the additional work would impinge on other activities and participation was stressful. Several students who had started science fair projects for extra credit reported that they had dropped out early in the process because they lost motivation.*
- High school*. For most of the students, science fair did not factor into their course decision-making, but science fair also did not receive popular support. In fact, it was generally disliked by this group as being more of a hassle—due to "annoying" paperwork—than a benefit. Students said they did not like it when teachers were "hands off" about science fair. They appreciated a more direct approach towards their work.*

These findings reinforce the importance of evolving and adapting how APS approaches science IPs to an 'inside the classroom' approach with multiple pathways for investigation.

A closer look at equity

The equity challenges of the 'science fair' model have been covered in both media reports and research studies. Appendix A provides examples as supporting information for this report, including a 2018 study funded by the National Science Foundation. SAC has requested that APS provide aggregated demographic and income information for science fair participation at the school and regional levels. At this writing, staff is working to provide the former, but report that they cannot provide the latter.

[6] While, as official policy, APS students are not required to participate in school, regional, or state science fair competitions, in practice, the IP framework at the middle and high school levels follows the International Science and Engineering Fair (ISEF) rules, processes, and timelines. After accounting for school-based and regional science fair competition schedules, along with Virginia Junior Academy of Science (VJAS) deadlines, IP due dates are typically in December or early January.

[7] Arlington Public Schools Office of Planning and Evaluation. 2014. Science Evaluation Report.

The 2019 Northern Virginia Regional Science and Engineering Fair participation data[8] for Arlington students provide a broader snapshot through the equity lens. Wakefield High School, which is the most racially diverse and economically disadvantaged of Arlington's high schools and comprised 30%[9] of the high school population (of the Arlington high schools that participated in the fair) in 2019, had only nine (9) participants—11 percent of the total Arlington high school participants. Yorktown, which is the least racially diverse and economically disadvantaged of Arlington's high schools and also comprised 30% of the high school population (of the Arlington high schools that participated in the fair) in 2019, had 35 participants—42% percent of the total Arlington high school participants. SAC understands that there are other factors to consider in this comparison, such as the lower enrollment rates for minority students in intensified science classes. But, this contrast illustrates the cascading impacts of the achievement gap, with the science fair model both a symptom and an unintended but contributing influence.

A recent report from the National Academies of Science, Engineering, and Medicine (NASEM), *Science and Engineering for Grades 6-12*[10], emphasizes that "equitable outcomes require the development and use of instructional strategies that make education more inclusive of students from diverse backgrounds and cultures, as well as attention to resource distribution and the ways educators think about student access, inclusion, engagement, motivation, interest, and identity."

The NASEM report also highlights that "engaging students in investigation and design requires attention to facilities, budgets, human resources, technology, equipment, and supplies. These resources can impact the quantity and quality of investigation and design experiences in the classroom and the students who have access to them."

Moving toward a new IP model

With today's complex environmental challenges, especially climate change, inspiring enthusiasm for science and scientific literacy, to create the next generation of problem-solving scientists, is as important as it has ever been.

The updated science SOL framework[11], in alignment with this SAC recommendation, emphasizes embedding science and engineering practices in the classroom and throughout the school year.

> *Engaging in the practices of science and engineering helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the many ways to investigate, model, and explain the world…. The engineering design practices are the application of science content to solve a problem or design an object, tool, process, or system. These scientific and*

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[8]Northern Virginia Regional Science and Engineering Fair. 2019. https://www.apsva.us/wp-content/uploads/2019/03/Abstracts_Directory.pdf

[9]Arlington Public Schools. 2019. Membership Summary. https://www.apsva.us/wp-content/uploads/2019/06/June-27-Membership-2018-19.pdf

[10] National Academies of Sciences, Engineering, and Medicine. 2019. Science and Engineering for Grades 6-12: Investigation and Design at the Center. Washington, DC: The National Academies Press. https://doi.org/10.17226/25216

[11]Virginia Department of Education. 2018. Virginia Science Standards of Learning Curriculum Framework. http://www.doe.virginia.gov/testing/sol/standards_docs/science/2018/2018-revised-science-curriculum-framework.docx

engineering practices are critical to science instruction and are to be ***embedded throughout the year****.*

APS should begin the process to adapt and evolve the current IP delivery model by de-coupling IPs from the constraints of external organizations like ISEF and VJAS (along with the extensive paperwork that teachers and students labor to complete), while still allowing the option for students to participate in these competitions (SAC has provided options for consideration in Appendix B). Less than two (2) percent of Arlington middle and high school students participated in the Regional Science Fair in 2019, and even fewer in VJAS. This statistic does not diminish the value of the effort and experience for those students, but does highlight that, when it comes to achieving the science program's mission and vision, including inspiring enthusiasm for inquiry, the ISEF-defined science fair pathway is of limited overall impact to science teaching and learning for APS' student population as a whole.

This step will position APS well to offer students multiple science investigation options and to implement the new 2018 Virginia SOLs for Science, required to be embedded in the science curriculum by the 2021-22 school year. APS should also consider offering these options to more students (i.e., not only for intensified science classes).

The new Virginia SOL framework's emphasis on integrating scientific and engineering practices with curriculum delivery follows the (formerly) National Research Council (NRC; now NASEM) recommendations in the report: *A Framework for K-12 Science Education*[12]. This framework calls for a 'three-dimensional' approach to teaching and learning science, which has been endorsed by The National Science Teaching Association (NTSA)[13].

> *The integration of science and engineering practices, disciplinary core ideas, and crosscutting concepts in science teaching and learning is currently considered an effective method of gaining a deeper understanding of science and engineering concepts and applying them to daily life.*

The 'exclamation point' to the SAC recommendation to offer multiple investigation pathways is provided in the following passage from Part 1, Chapter 3 of the NRC report:

> *[T]here is a strong consensus about characteristics of the scientific enterprise that should be understood by an educated citizen. For example, the notion that there is a single scientific method of observation, hypothesis, deduction, and conclusion—a myth perpetuated to this day by many textbooks—is fundamentally wrong. Scientists do use deductive reasoning, but they also search for patterns, classify different objects, make generalizations from repeated observations, and engage in a process of making inferences as to what might be the best explanation. Thus, the picture of scientific reasoning is richer, more complex, and more diverse than the image of a linear and unitary scientific method would suggest.*

To emphasize this point further, the report also explains the intentional use of the term 'practices' in the plural to avoid "the mistaken impression that there is one distinctive

[12] National Research Council. 2012. A framework for K–12 science education: Practices, crosscutting concepts, and core ideas. Washington, DC: The National Academies Press. https://www.nap.edu/read/13165/chapter/1

[13] National Science Teaching Association. 2018. Transitioning from Scientific Inquiry to Three-Dimensional Teaching and Learning. https://www.nsta.org/about/positions/3d.aspx

approach common to all science—a single "scientific method"—or that uncertainty is a universal attribute of science."

Recommendations for a new IP framework

There are multiple types of investigations that are essential to learning science. These include IV/DV hypothesis testing but also many others, including but not limited to: observing and explaining natural phenomena; research that gathers and analyzes other opinions or scientific findings to answer a question or to help explain observed events; developing/building models to help understand how a process works, or to explain ideas or a concept; and identification and classification to sort objects or events into groups or categories[14,15].

SAC recommends a new IP framework that:

- Encourages and facilitates all types of scientific investigation.
- Focuses IP topics on the course content for the academic year.
- Allows sufficient time for meaningful investigation.
- Provides opportunities for students to present project findings to peers and adults.

SAC believes this framework offers more choice and engagement for students, facilitates students and teachers working together on deeper course content understanding and application, ensures that students have the necessary underlying content knowledge to carry out scientific investigation with competence and confidence, and increases accessibility to scientific investigation experiences for more students.

There are also opportunities under this framework to offer 'project-based learning' (PBL) opportunities, like the curriculum at Arlington Tech. Under the PBL model, the project is the curriculum delivery, more engaging for students and teachers while making the most of finite teaching and learning resources[16].

This SAC recommendation also aligns with and supports the English Language Arts Advisory Committee (ELAAC) recommendation ***to adopt a rigorous secondary writing curriculum incorporating instructional best practices for grades 9-12 that is continuous from year to year***. Research and technical writing skills are essential for our students as they prepare for college and beyond. The SAC recommendations to expand IP project types (all of which will require research and writing) ***and*** to provide more time for project work will facilitate collaborative and resource-efficient delivery of more rigorous and supported writing instruction across the curriculum.

[14] National Academies of Sciences, Engineering, and Medicine. 2019. Science and Engineering for Grades 6-12: Investigation and Design at the Center. Washington, DC: The National Academies Press. https://doi.org/10.17226/25216

[15] Science Online. Types of Investigation. https://scienceonline.tki.org.nz/Teaching-science/Teaching-strategies/Types-of-investigation

[16] Arlington Public Schools (Arlington Tech). 2019. Project-based Learning Handbook for Students and Families. http://careercenter.apsva.us/wp-content/uploads/sites/11/2019/02/Student-and-Family-PBL-Handbook.pdf

Budgetary Implications

This recommendation does not drive a direct monetary cost on its own. The new 2018 Virginia Science SOLs will require training and professional development to integrate science and engineering practices into the curriculum and classroom. This investment will support and facilitate implementation of SAC's recommendations.

In fact, SAC notes that the integration of IPs with curriculum delivery should increase teaching and learning 'efficiencies' relative to the current IP model which can draw time and attention away from the learning priorities of the classroom.

Further, SAC expects that many APS science teachers may already have the knowledge, skills, and abilities to implement this recommendation today. It is inherently more flexible than the current IP framework, aligns with the courses that they teach, and allows for more teacher creativity and involvement.

Strategic Plan Alignment

This recommendation aligns with multiple components of the 2018-24 APS Strategic Plan, highlighted under each main category below:

Goals

- *Student success: multiple pathways to student success*
- *Student well-being: Healthy, Safe, and Supported Students*

Mission
To ensure all students learn and thrive in safe, healthy, and supportive learning environments
Vision
To be an inclusive community that empowers all students to foster their dreams, explore their possibilities, and create their futures

Core values

- *Excellence: Ensure all students receive an exemplary education that is academically challenging and meets their social and emotional needs.*
- *Equity: Eliminate opportunity gaps and achieve excellence by providing access to schools, resources, and learning opportunities according to each student's unique needs.*
- *Innovation: Engage in forward-thinking to identify bold ideas that enable us to be responsive to the expectations of our organization and community while cultivating creativity, critical thinking, and resourcefulness in our students*

Committee vote

6 YES – 0 NO

Recommendation #2: Outdoor and Experiential Learning

Timeline: 2021-22 school year

2. Contract with a consultant to support and train elementary teachers to incorporate outdoor and experiential learning into delivery of the updated Virginia science curriculum.

Rationale and Supporting Information

Like Recommendation #1, this recommendation is rooted in the overall science program mission and vision—especially fostering an inquisitive spirit and love of science in our youngest learners through inquiry-based experiences in real-life contexts. The new Virginia SOLs also support this recommendation, with the emphasis on scientific and engineering practices in curriculum delivery.

On-campus and consistent outdoor learning, with dedicated instructional resources, is provided at a small number of APS' 24 elementary schools. While SAC understands that some schools may have chosen to prioritize resources for these programs, SAC believes that the well-established benefits of outdoor learning should be available to all students, starting with all APS elementary schools.

While SAC greatly appreciates the funding to keep the Outdoor Lab and its unique 'science retreat' environment going strong, additional outdoor learning opportunities should also be ongoing for the benefits to accrue and deepen.

This recommendation is reinforced by APS' equity objectives.

There are a growing number of studies, reports, books, and articles written on this important topic, studies that are becoming more relevant in our digitally-dominated world. A web-based article, *10 Ways that Outdoor Learning Benefits your Child*[17], provides the following succinct but comprehensive summary:

High-quality outdoor learning experiences are proven to:

- Develop reflective and inquisitive thinking along with problem-solving approaches in 'real' situations.
- Encourage holistic development of children.
- Develop resilience and adaptability in occasionally adverse circumstances.
- Allow children to become more able to identify hazards and risks.
- Develop a love, appreciation and respect for nature and all that is living.
- Develop an understanding of how we can look after our environment.
- Develop self-awareness, confidence and self-esteem.
- Develop collaborative-working and communication skills.
- Provide positive health benefits – both physically and mentally – and assist gross and fine-motor development.
- Develop a lifelong love of the outdoors.

[17] Independent School Parent Magazine. 10 Ways that Outdoor Learning Benefits your Child. https://www.independentschoolparent.com/school/outdoor-learning-benefits/

The 2018 Virginia SOLs also strongly underpin this recommendation. The new standards not only emphasize more investigation in the curriculum but also establish overall themes for each elementary grade level that correlate directly with outdoor learning methods and objectives.

The theme for the kindergarten curriculum framework, for example, is directly related to outdoor and experiential learning[18]:

Using my senses to understand my world
In science, kindergarten students use their senses to make observations of the characteristics and interactions of objects in their world. Students study the characteristics of water and the basic needs of living things. They also study the relationship between the sun and Earth through shadows and weather. They determine how their actions can change the motion of objects and learn how they can make a difference in their world.

These experience and nature-based themes continue with: *First grade – How I interact with my world; Second grade – Change occurs all around us; Third grade – Interactions in our world; Fourth grade – Our place in the solar system; and Fifth grade – Transforming matter and energy.*

Finally, this recommendation is consistent with the Arlington County Board's recent *Biophilic City Resolution*, which committed the County to join the Biophilic Cities Network—" a community of biophilic cities that places nature at the core of design and planning and works to create abundant opportunities to learn about and connect with nature[19]."

Recommendation

Beginning in the 2021-22 school year (FY 2022), provide funding to hire a consultant to train elementary teachers how to incorporate outdoor and experiential learning into delivery of the updated Virginia science curriculum. This consultant will work across APS' 24 (to be 25) elementary schools to develop and deliver curriculum materials and activities, working in conjunction with and supporting teachers.

This training and curriculum investment will build on and 'multi-task' the internal training that the science program will begin in the 2020-21 school year to prepare for new SOL implementation required in 2021-22. The goal is for each elementary school to establish an outdoor learning model that is supported and sustained going forward. This may require more than a one-time investment, and, if this recommendation is approved, SAC will work with the Science Program Coordinator on monitoring progress and determining if additional resources are needed.

SAC will work with the Science Program Coordinator to determine the procurement approach and overall scope of work for the consultant. There are existing educational

[18] Virginia Department of Education. 2018. Virginia Science Standards of Learning Curriculum Framework. http://www.doe.virginia.gov/testing/sol/standards_docs/science/2018/2018-revised-science-curriculum-framework.docx
[19] Arlington County Board. 2019. Biophilic City Resolution. https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/22/2019/12/Biophilic.pdf

resources and models to build from, including the 'Project Learning Tree Virginia' framework[20].

Budgetary Implications

SAC recommends an FY 2022 allocation of $75,000 be provided for 10 months of time for an outdoor learning consultant, with an additional similar allocation expected for FY 2023. Looking ahead, SAC will work with the Science Program Coordinator to determine the training and support model and funding needs for future years.

Strategic Plan Alignment

This recommendation also aligns with the multiple components of the 2018-24 APS Strategic Plan highlighted under Recommendation #1.

Committee vote

6 YES – 0 NO

Past recommendations

Over recent recommending cycles (2013-14, 2015-16, and 2017-18), SAC has focused on several main themes: middle school independent projects consistency and support; outdoor lab funding; outdoor learning coordinator; and integrative learning across the curriculum.

Implementation progress has been made on the first two recommendation areas:

- Middle school progression approach for independent projects leading to completion of an independent project in 8th grade[21].
- Funding and resources to keep the Outdoor Lab going (although pressures continue with growth).

SAC greatly appreciates the support and work of the School Board and Science Program staff and teachers in these efforts to date.

Committee members: Lida Anestidou, Judy Collins, Ann Marie Douglass, Melanie Mason, Melody Mobely, Jason Papacosma (chair)

ACI Liaison: Nina Nichols

APS Staff Liaison: Dat Le, Science Program Coordinator

[20] Project Learning Tree Virginia. https://www.plt.frec.vt.edu/

[21] SAC's 2020 IP recommendations build on this prior SAC-supported improvement to ensure that IP delivery at all levels meets the fundamental objectives of equity, student support and well-being, and enhanced curriculum delivery.

Appendix A. Science fairs and equity challenges.

A recent National Science Foundation-funded study of middle school science fairs by the Educational Development Center[22] highlighted several challenges and areas for improvement:

- *High-income parents were significantly more likely to provide substantive support to their children compared to mid-income parents.*
- *If schools want all students to have equal access to an authentic science fair experience and the support needed for that experience to be a positive one, the time teachers need to adequately support their students' learning must be anticipated and built into the implementation plans.*
- *In schools where teachers provided a high level of support for students to communicate about and evaluate their work, such as providing opportunities for students to practice presenting prior to meeting judges, students were more likely to show gains in their understandings of [science and engineering practices].*

A 2015 Atlantic Magazine article[23] also looked at where the 'science fair' model falls short—and could be improved:

- *Many children don't have the luxury of parents who have the time to engage with their schoolwork. Lots of research supports this observation, with one University of Toronto study of four national science fairs in Canada concluding that students from "advantaged, resource-rich backgrounds" were more likely to both participate in and win these competitions.*
- *[S]tandardized testing is taking over classroom learning these days, leaving little room for the throw-out-the-textbook atmosphere that science fairs require.*
- *There is a disconnect between the materials that teachers have to teach with…versus the hands-on materials that they would need to do inquiry work*
- *Imagine a science fair that ensures all students can engage in hands-on scientific investigation. Imagine classrooms across the country that equip kids with the tools they need to come up with their own inventions and experiments. It would be lovely—that imagined world in which no one hates the science fair.*

Notably, the science fair handout for Washington-Liberty and Wakefield states: *With the exception of certain model organisms, chemicals, and lab equipment, schools are not responsible for project expenses.* Although likely based on budget realities, this policy falls short of equity standards, especially for a project that is required as part of the curriculum.

[22] Educational Development Center. 2019, Science Fairs Under the Scope. http://sciencefairstudy.edc.org/?page_id=267

[23] Atlantic Magazine. March 12, 2015. Science Fairs Aren't So Fair. https://www.theatlantic.com/education/archive/2015/03/why-science-fairs-arent-so-fair/387547/

Appendix B. Science fair participation options.

While SAC understands and acknowledges the value of the science fair competition experience, especially for those students who are able to excel, the benefits do not outweigh the priority changes and improvements for the APS science IP framework outlined in this report.

SAC recommends two alternative options for students who wish to participate in these experiences:

1. Adapt science fair to an extracurricular ‘club’ format. This would allow for subjects beyond curriculum content.
2. Change the schedule to winter/spring data collection for participation in following year’s science fair (with current year curriculum-based topic) because ISEF rules do not allow data collection prior to January 1 of the year preceding science fair participation.

Option 1 may be the most feasible and defensible pathway overall for several reasons:

- To accommodate students who wish to choose a topic outside the current year science curriculum content
- To give science teachers the option to support the club, rather than being required to support ‘science fair’ projects under the current model (which draws time and resources from curriculum delivery).
- To provide equitable and inclusive support to all students who choose to participate in the science fair.

This option could also develop into a cross-curricular inquiry platform, involving social studies, mathematics, and other disciplines as well as allow for support and participation from outside scientists.

Option 2 has potential merit if the student can finish all the work by the end of the academic year, so that the current year teacher can mentor the student through project completion. Under this option, there is significantly more time during the fall for the student to work with the course teacher to choose a topic and to obtain the core content knowledge and resources needed. Data collection could start in early in January and proceed for several months, allowing for more robust, in-depth inquiry.

SAC does not recommend the continuation of the current compressed timeline for IPs and science fair participation. This approach is not consistent in multiple ways with the best instructional and learning practices referenced and discussed in this report.

	Recommendation 1: ***Independent projects***	**Recommendation 2:** ***Outdoor and experiential learning***
Critical Need: The recommendation addresses an identified area of critical need or a key area for improvement.	YES • Improving student engagement and capabilities in science and engineering has global criticality. • APS has identified equity as a critical priority for improvement.	YES • Current research urgently calls for prioritizing nature-based and outdoor experiences over digital experiences. • Improving student engagement and capabilities in science and engineering has global criticality. • APS has identified equity as a critical priority for improvement.
Proven Solutions: The recommendation proposes an evidence- or research-based solution; once implemented, it has a high probability of success.	YES • This recommendation aligns with state and national research and best practices for science instruction and scientific and engineering investigation.	YES • Current and growing research documents the multiple benefits to child learning and overall well-being.
Consistency: The recommendation supports or improves consistency across the school division.	YES • The execution of the current IP model in terms of student experience and outcomes varies considerably by teacher and school—primarily because of the current 'outside the classroom' approach. • Connecting IPs to the curriculum ensures students have the underlying	YES • On-campus and consistent outdoor learning, with dedicated instructional resources, is provided at only a small number of APS' 24 elementary schools. • The well-established benefits of outdoor learning should be available to all students,

	Recommendation 1: ***Independent projects***	**Recommendation 2:** ***Outdoor and experiential learning***
	knowledge to carry out the projects with competence and confidence	starting with all APS elementary schools.
Equity: The recommendation supports or improves equity across the school division. It addresses providing access to schools, resources, and learning opportunities according to each student's unique needs.	YES • The equity challenges of the current IP model—and the science fair model overall—are well-documented. • By re-positioning the IP approach to a supported, 'inside the classroom' model, equity will be improved in science curriculum delivery.	YES • A well-constructed outdoor and experiential learning program will provide all students with multiple benefits that are correlated with their individual learning styles, capabilities, and needs.
Academic Growth: The recommendation supports the achievement of at least one year of academic growth for individual students each year.	YES • The recommendation offers more choice and engagement for students, facilitates students and teachers working together on deeper course content understanding and application, and increases accessibility to scientific investigation experiences for more students.	YES • High-quality outdoor learning experiences have multiple proven benefits, including developing inquisitive thinking along with problem-solving approaches in 'real' situations; encouraging holistic development of children; and developing collaborative-working and communication skills.
Achievement, Opportunity and Excellence Gaps: The recommendation directly addresses closing an identified gap, particularly in a traditionally underserved population.	YES • The recommendations' benefits toward achieving equity objectives will concurrently address achievement, opportunity, and excellence gaps in science curriculum delivery.	

	Recommendation 1: ***Independent projects***	**Recommendation 2:** ***Outdoor and experiential learning***
Social and Emotional: The recommendation supports students' social and emotional learning and needs.	YES • Re-positioning the IP approach to an 'inside the classroom' model will increase student support and reduce stress and anxiety (see 2014 Science Program evaluation focus group results).	YES • The benefits of high-quality outdoor learning experiences include encouraging holistic development of children; developing resilience and adaptability; developing self-awareness, confidence and self-esteem; and developing collaborative-working and communication skills.
Other Strategic Plan/Priority Alignment: The recommendation advances or supports achievement of other objectives in the current Strategic Plan and/or addresses a current School Board priority.	YES The recommendations particularly support the 'Student success' and 'Student well-being' strategic plan goals; the 'Excellence,' 'Equity,' and 'Inclusivity' core values, and the overall strategic plan mission and vision.	
Budget: The recommendation is sufficiently important or meritorious that it is worth the associated cost, even in a challenging budget environment.	N/A • This recommendation does not drive a direct monetary cost on its own. The new 2018 Virginia Science SOLs will require training and professional development to integrate science and engineering practices into the curriculum and classroom. This investment will support and facilitate implementation of SAC's recommendations.	YES • This modest training and curriculum investment will 'multi-task' the required internal training that the science program will begin in the 2020-21 school year to prepare for new SOL implementation required in 2021-22.

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