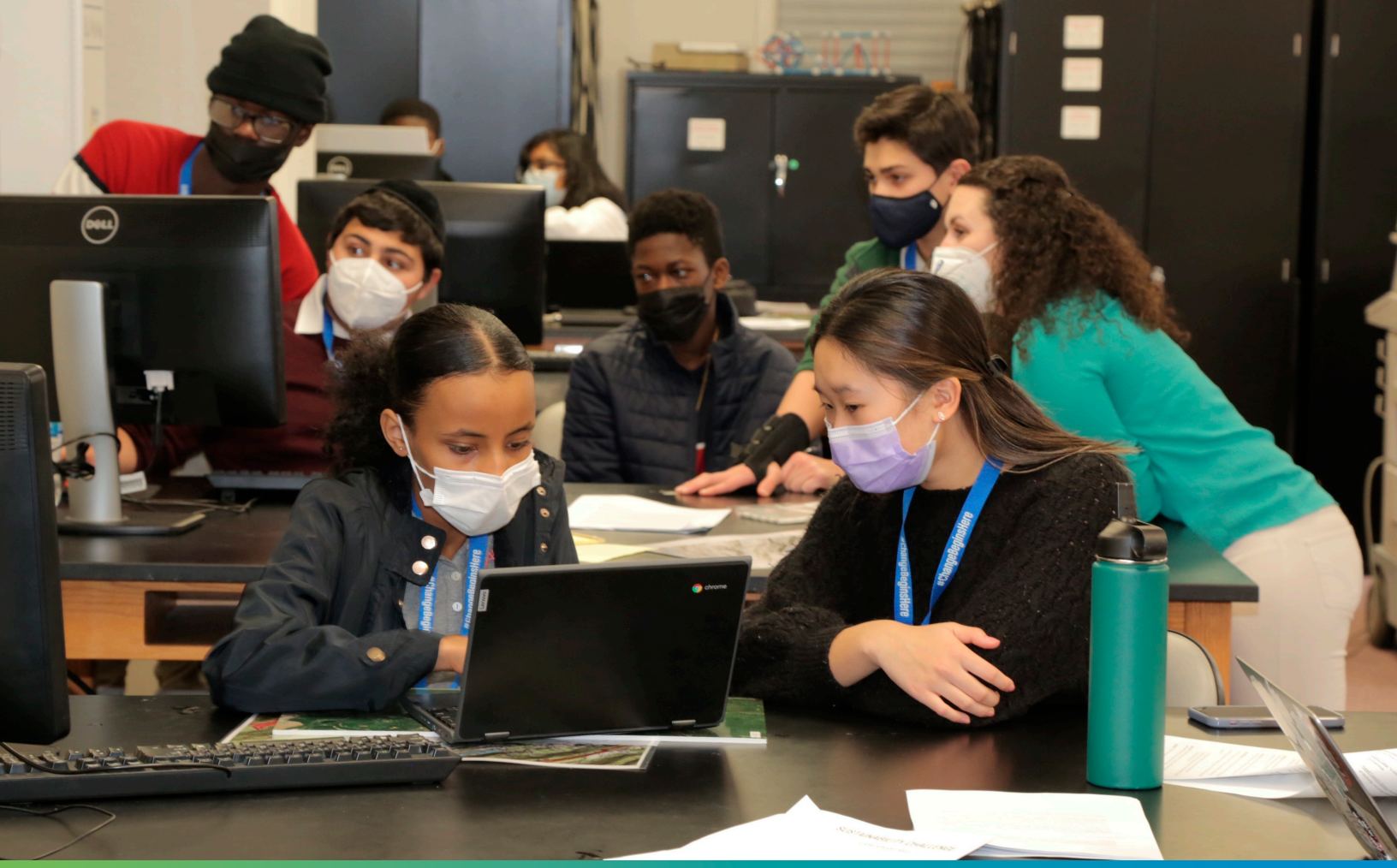


CLIMATE CHANGE CURRICULUM

FINAL REPORT

Student Global Ambassador Program

Michele Joseph, Chief Executive Director

Special thanks to:
Annalie Buscarino, Advisor
Jill Foster, Board Member

SGAP LEADERS

EXECUTIVE OVERVIEW

The Sustainability Challenge, one of SGAP Leaders' signature programs, is a one day workshop for up to 150 students that was first launched in 2014. In the ensuing years, SGAP Leaders has made multiple modifications in response to teacher and student feedback. SGAP provides participating schools with multiple learning materials and recommendations about how to prepare students for the Challenge event. Even so, a large portion of students arrived with insufficient knowledge and no prior introduction to the simulation tool, hindering their workshop experience and putting them at a distinct disadvantage compared to students given more in-depth preparation.

The pandemic offered SGAP unique opportunities to innovate our programming and consider how to address this gap in the face of a rapidly escalating climate crisis. We designed a new longitudinal Climate Change curriculum designed to instill students with a working knowledge of climate change, renewable energy, and the simulation tool without overburdening teachers.

With funding from Society for Science, we piloted our ten-week Climate Change Curriculum in fall 2021 at John F. Kennedy High School's (JFK) with their incoming 9th grade Leadership Training Institute (LTI) cohort. The program culminated with a modified Sustainability Challenge workshop as a final capstone. The purpose of the pilot was to demonstrate SGAP's abilities to implement a longitudinal in-school program and to assess the curriculum's effectiveness in engaging underserved students and advancing their knowledge in climate-related issues, environmental justice, and activism. We used a multipronged assessment strategy to examine key outcomes and to collect more granular qualitative feedback to inform future refinements

Students participating in the combined curriculum/workshop pilot demonstrated improved interest and knowledge of climate change and energy concepts as well as improvements in critical 21st century teamwork and communication skills. Feedback from multiple observers also indicate that students embarked on the Sustainability Challenge and delivered their presentation with much greater knowledge and ease than in past years. . SGAP Leaders has been invited to implement the Climate Change programming again at JFK High School in the 2023-2024 academic year, attesting to the value of this offering and our ability to engage a diverse student group.

In the interim, SGAP will utilize student and teacher feedback to enhance the curriculum. We will also seek one or more additional partner schools to test new delivery models and expand opportunities for student-to-student learning and collaboration.

During the present 2022-2023 period, SGAP has shifted its focus to a Climate Action program, a new initiative that was inspired by the Climate Change curriculum experience, but places greater emphasis on youth activism. Materials and lessons learned from the Climate Action experience will undoubtedly have relevance to the Climate Change curriculum and will be integrated into our 2023-2024 programming.

THE IMPERATIVE TO EMPOWER YOUTH FOR CLIMATE CHANGE LEADERSHIP

The world is facing a climate emergency that we are dismally unprepared for. The adverse impacts of climate change are being experienced across the globe and are threatening ecosystems, increasing food and water insecurity, exacerbating inequities, and destabilizing societies. Slowing the rate of global warming and mitigating its negative consequences is feasible, but requires innovation, collective action, and rapid multi-system transformations at a massive scale.

Climate change will have profound effects on today's youth, introducing weather extremes and new challenges that will disproportionately affect those in marginalized communities. Interestingly, climate change is generating novel opportunities and career options, especially for students with the skills needed to implement climate solutions and strengthen our climate resilience. Youth are therefore a critical target for climate change education. Public schools are increasingly discussing climate change, but coverage of this rapidly evolving topic is uneven and often falls short. **SGAP's Sustainability Challenge and new Climate Change curriculum were designed to address this gap by offering schools novel, highly-engaging learning experiences that spark curiosity and inspire students toward climate action.**

SGAP LEADERS' NEW CLIMATE CURRICULUM

SGAP designed the Sustainability Challenge Workshop to empower high school students in underserved communities to command their future in the era of climate change. The workshop brings students together for an engaging one-day out-of-school experience where they work through, as mixed-school groups, a real-world scenario centered on renewable energy. The Challenge encourages students to consider the diverse stakeholders involved or affected by decision-making as well as the prerequisites, costs, strengths, and limitations of different renewable energy options.

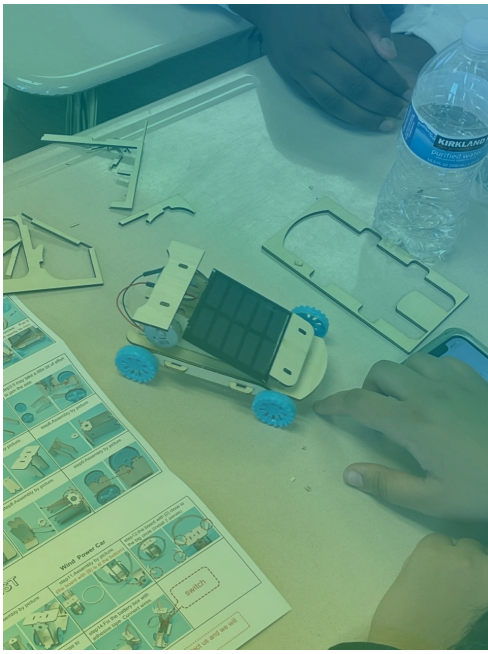
In 2021, SGAP Leaders developed a complementary 10-week climate change curriculum as a lead-up to the Sustainability Challenge event. The curriculum was designed, in part, to ensure that students embarked on their Sustainability Challenge with a sound understanding of climate change and renewable energy concepts. It also sought to empower BIPOC and marginalized students and to close the knowledge-to-action gap. The curriculum speaks to environmental justice and climate activism, and features youth climate champions, helping students to envision themselves as climate leaders. Consistent with our commitment to 21st century skills, the program also emphasized activities that promote critical thinking, innovation, communication, and collaboration. Novel learning strategies such as 1Huddle, a digital training game, engaged students with the program material and assessed their retention prior to the culminating workshop event.

BIPOC = Black Indigenous People of Color

The final weeks of the curriculum prepare students to excel in the Sustainability Challenge workshop. The last few sessions offered coaching on presentation skills and familiarized students with the workshop's simulation tool, targeting two key areas where students have struggled during past Challenge workshops. Time was also allocated to learn more about Picatinny Arsenal and other background details covered in the Workshop's case study. This investment provided students with critical context and enabled them to fully embrace their characters in the Challenge's role-play activity. The Sustainability Challenge combined with the complementary 10-week climate change curriculum results in a powerful learning experience that leaves students with a deeper understanding of climate change and inspires students to mobilize their climate literacy within their communities - hence establishing a familiarity and real-world experience for the students. This distinct model transcends the traditional classroom and delineates SGAP's programming from other climate change offerings.

PILOTING THE CLIMATE CHANGE CURRICULUM

SGAP implemented the newly developed curriculum for the first time in Fall 2021 at John F. Kennedy High School's Leadership Training Institute. The pilot enabled SGAP to assess the effectiveness of our program in nurturing students' climate change interest and literacy, and to revise accordingly for future curricular rollouts.



JFK LEADERSHIP TRAINING INSTITUTE

Kennedy High School is located in Montgomery County, Maryland and serves almost 1800 students. The majority of students are Hispanic (61%) or Black (25%), nearly half of the student body is eligible for Free and Reduced Meals (FARMS), and 27% of students participate in English for Speakers of Other Languages (ESOL) courses, reflecting the high portion of students from immigrant families. The average SAT scores for Kennedy students are significantly lower than the average county or national scores.

The Leadership Training Institute (LTI) is one of several magnet programs offered at Kennedy High School and emphasizes interdisciplinary experiential learning, community service, and leadership concepts. LTI envisions that students will become "civic-minded, self-reliant, service-driven young adults." SGAP Leaders first partnered with Kofi Frempong, Director of the LTI program, in 2018 and launched its first Maryland-based Energy from Waste Tour & Case Study and SGAP Leaders SPEAK programs for students in the LTI program and those in Kennedy's Minority Scholars program.

Kofi Frempongwas an instrumental catalyst leading to the new Climate Change Curriculum, and has closely collaborated with SGAP in planning and implementing the pilot. Mr. Frempong's enthusiastic partnership, the large portion of students who are BIPOC and come from homes with limited resources at Kennedy High School, and the opportunity to deliver the curriculum to students during the school day created an ideal setting to pilot the new curriculum.

STUDENT PARTICIPANT PROFILE

The Climate Change curriculum was offered to all twenty-two incoming ninth graders in the 2021-2022 LTI program. A baseline survey was completed by a diverse cohort of 10 male and 8 female students who identified as Black (n=6), Hispanic (n=4), Asian (n=5), white (n=1), Middle Eastern/Semetic (n=1) and Black and white (n=1). All but 3 students lived in close proximity to the school, as indicated by their 20902 (n=5) or 20906 (n=10) zip codes.

CURRICULUM IMPLEMENTATION

Beginning with a kick-off in October 2021, an SGAP facilitator joined the LTI's ninth-graders for a series of ten in-person sessions spanning four months that addressed various aspects of climate change. The lessons were planned as 90-minute sessions that included a mix of warm-up, didactic, and small group activities of up to 5 students, and sometimes featured guest speakers. The themes and objectives of each module in the original curricular plan are shown in the table below.

MODULE THEME	MODULE OBJECTIVE
0) SGAP Leaders Kick-off	Students will become familiar with SGAP Leaders and the goals and objectives of the 2021-2022 Climate Change Curriculum. Students sign a commitment letter and take home a photo release and parental form for signature. 1 Huddle Multiplayer Game to test student knowledge.
1) Let's Get Energized!	Students will better understand environmental justice and its impact through their exploration of the Flint, Michigan water crisis. In addition to developing the ability to define and identify water crises, students will be able to analyze the decisions of key environmental stakeholders in Flint, Michigan and empathize with the concerns that they brought to the crisis.
2) Energy Infrastructure	Students will use “Project Sunroof” to understand how to place solar panels on community infrastructure to calculate and optimize financial and environmental savings.
3) Getting Real About Climate Change, Part 1	Students will connect with two student activists and conduct a role-play exercise for COP26 to situate their command over climate change from a global perspective.
4) Getting Real About Climate Change, Part 2	Students will conduct carbon footprint and Life-Cycle Assessments (LCA) to recognize how they contribute to climate change through significant drivers such as food choices and industrialized food systems.
5) Getting Real About Climate Change, Part 3	Students will be able to understand the impact of their local carbon footprint on global warming and grasp the importance of solar energy as an ameliorating force.
6) Changing Our Energy Profile	Students will be able to understand the role of their local community in combating climate change.
7) Getting to Know Your Client-Picatinny Arsenal	Students will be able to understand the operations and energy needs of Picatinny Arsenal.
8) Community Responsibility	Students will be able to understand the purpose of different environmental stakeholders in their communities.
9) Becoming an Agent of Change	Students will be able to visualize themselves as agents of change by connecting with community leaders their age.
10) Sustainability Challenge Event	Students will familiarize themselves with Picatinny Arsenal, the subject of the 2022 Sustainability Challenge Workshop. They will learn about Picatinny’s solar and wind generation and discover the usage of the renewable energy calculator.

SUSTAINABILITY CHALLENGE WORKSHOP

Implementing the 2022 Sustainability Challenge Workshop required several adjustments to accommodate its culminating role following the Climate Change Curriculum. Historically, the Challenge has been implemented as a stand-alone one-day event for a heterogenous set of students drawn from multiple high schools. By contrast, the 2022 workshop was limited to the ninth-grade LTI students participating in the pilot Climate Change Curriculum due to COVID-19 safety concerns. Although teamwork remained a central element of the Workshop, the emphasis was shifted. Instead of encouraging students who had never met before to quickly establish effective teams, students were thoughtfully assigned to specific teams in the early weeks of the climate change curriculum, giving them time to establish trust, discover their relative strengths, and become a cohesive unit.

The role-play aspect of the Workshop was revamped, leveraging the power of established teams and the deeper knowledge that students brought to the event. The role-play scenario invited students to envision themselves as experts on a consulting team.

WORKSHOP LOGISTICS

THE CHALLENGE–AN EXPERIENTIAL LEARNING ACTIVITY

The heart of the Sustainability Challenge is the Challenge task. SGAP asked the LTI students to envision themselves as summer interns for a renewable energy consulting company called Ultimate Clean Energy Solutions (UCES). Their objective was to compete against other intern teams to secure a contract with UCES by developing the most effective renewable energy portfolio for their client, Picatinny Arsenal. SGAP encouraged students to read the case study to better understand Picatinny Arsenal and to spur their knowledge about solar and wind energy.

SGAP did not inform students about what constituted an "optimal" portfolio. Rather, students had to determine for themselves how to balance trade-offs among installation costs, energy generation, greenhouse gas offsets, annual cost savings, and community implications.

After completing their Challenge task, each team presented their recommendations to a panel of subject matter experts (SMEs). Panelists evaluated each team using a 6-domain scoring rubric to determine the top ranking teams..

SETTING

Catholic University's Pangborn School of Engineering provided two rooms in which to house the Sustainability Challenge workshop. SGAP Leaders had access to a computer lab and a presentation hall known as the Scullen Room. The combination of spaces allowed students to move about and experience different venues throughout the course of the day.

The Scullen Room served as the initial assembly site where students enjoyed a breakfast buffet and oriented to the day's activities. Students then moved into the computer lab and assembled into their teams. Students took a 25-minute break and moved back to the Scullen Room to enjoy a boxed lunch. Then they returned to the computer lab to complete their portfolios and presentations. Students finished the day in the Scullen Room where they shared their presentations with the judges, completed a final reflection, and found out which team won the competition.

To enhance students' exposure to a university setting, the CUA Admissions Office offered each student a merchandise bag and a campus tour, but unfavorable weather conditions prevented them from doing so.

Regardless, the college campus offered an enriching experience in that it prompted high school students to envision themselves as college students by making higher education seem more accessible and feasible.

SMES AND FACILITATORS

The workshop team is critical to the success of our Sustainability Challenge. The three small-group facilitators who led student teams throughout the Challenge were SGAP staff members who had experience with pedagogy, ESL students, environmental education, social justice, and international instruction. During the workshop, the facilitators assisted their student teams with the Renewable Energy Calculator and the culminating presentation.

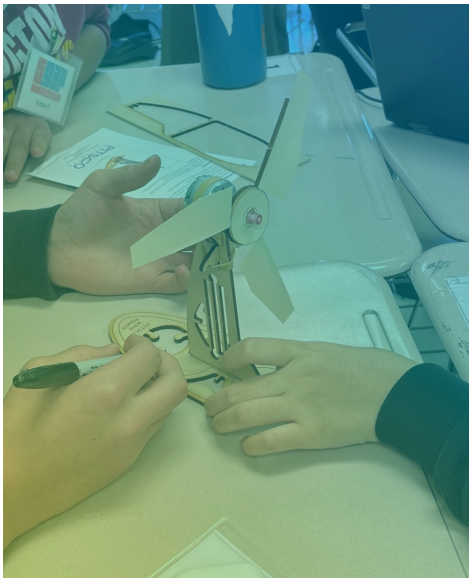
The four SMEs had expertise that included sustainability, youth leadership, financial analysis, biomedical engineering, and Picatinny Arsenal functions and infrastructure. The SMEs (who participated in the role-play and judged each presentation) were able to virtually share their expertise with the class and ask questions that widened student perspectives.

SMEs and facilitators generously shared their knowledge with the teams by asking prompting questions about the Challenge task and providing expert consultations. Theser close interactions helped the students think through options and key considerations that should inform their team's decision-making. Such interactions are an especially important element of the Sustainability Challenge. Many students have few opportunities to connect with others who are pursuing higher education or professionals who do not have public-facing roles. **The workshop bridges that gap and provides an environment that brings students face-to-face with relatable role models.** Classroom conversations frequently extend well beyond the Challenge task and allow students to explore their future education and career options. The exchanges between facilitators and students can be especially powerful catalysts to enable students to positively reimagine their futures.

SUPPORTING TOOLS AND MATERIALS

PICATINNY RENEWABLE ENERGY CALCULATOR

The proprietary Calculator spreadsheet, which SGAP LEADERS has used in previous Sustainability Challenges, provided real-world benchmark data about Picatinny Arsenal's current energy usage. The tool also described available sites where different types of energy installations might be placed at the Arsenal. The Calculator ultimately enabled students to model the simultaneous effects of different renewable energy combinations on several key outcomes.



SUSTAINABILITY CHALLENGE CASE STUDY

SGAP Leaders composed the Case Study as a companion document packet that included critical context for the Challenge task. The first half of the packet provides an overview of the military's enormous energy requirements and the rationale for its increasing focus on energy resilience. The case study further describes the distinct role of the Picatinny Arsenal installation as well as some of its award-winning energy projects, specifically the Solar Field, an initiative that illustrates how a remediated hazardous waste site can be repurposed to provide clean energy.

SGAP Leaders designed and developed the case studies to help students more fully understand the rationale of their Challenge task and to help them recognize how the task mirrors broader conversations about how to transform our energy infrastructure and mitigate climate change on a global scale.

EVALUATING THE CLIMATE CHANGE CURRICULUM/ SUSTAINABILITY CHALLENGE PILOT

ASSESSMENT METHODS

SGAP used a variety of methods to evaluate key outcomes and gauge students' perceptions of the Climate Change Curriculum pilot. SGAP partnered with Hilltop Consultants, a Georgetown University undergraduate cohort that aims to promote positive social change by leading projects for trail-blazing nonprofits, to plan and develop an impact report using survey outcomes. The surveys captured student demographics and assessed students at the beginning, midpoint, and end of the pilot. Each survey asked students to rate their self-perceived knowledge and skills on a 5-point likert scale. This approach generated subjective data, but was chosen to create a short consistent question set that students could access and complete using their cell phones and that supported comparisons across multiple time points. A companion survey set was designed to capture a complementary teacher perspective.

Following the 6th lesson, SGAP's lead facilitator conducted a focus group with five students participating in the pilot to obtain a quick pulse check on the curriculum. This qualitative assessment provided granular feedback about student engagement, what was working well, and areas needing improvement. This feedback highlighted the need to spend less time on didactic presentations and in favor of more engaging interactive activities and clarifying discussion. It also alerted the team to content that students found confusing. These insights allowed SGAP to make critical midcourse corrections and to circle back to address residual knowledge gaps.

VIDEO INTERVIEWS

During the Challenge workshop - the final day of the pilot program - SGAP's professional videographer, Stone Lyons, conducted a series of interviews with students, key SGAP staff, and our LTI teacher liaison. The interviews elicited perceptions of the Sustainability Challenge in rich detail and provided an important complement to the final survey. Three of the five student interviews were conducted in Spanish, enabling students to comfortably and confidently comment in their native language. SGAP intentionally sought the perspectives of these Latinx students as we strive for programming that is accessible and relevant to a broad audience.

Spanish interview: https://youtu.be/P2rb_tqczY0

KEY SURVEY FINDINGS

BASELINE SURVEY FINDINGS

Students and our LTI teacher liaison completed the baseline assessment survey as part of their initial orientation to the Climate Change Curriculum. More than 80% of the student participants expressed interest in the overall topic of climate change (Figure 1.) (Table A.) Overall, students indicated moderate knowledge in targeted areas, with greater perceived knowledge on climate change and the impact of their personal carbon footprint, and lesser knowledge of environmental justice and how common renewable energy technologies actually work.

FIGURE 1

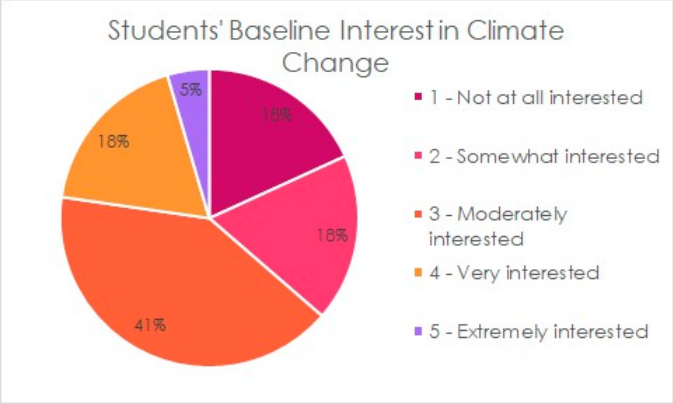


TABLE A

Baseline Self-Reported Knowledge (Based on 5-point scale, with 1 = Not at all knowledgeable and 5 = Extremely knowledgeable)	Student's Mean Rating (N=18)	Some Knowledge (Rating >=2)	Teacher's Rating of Student's Knowledge (N=1)
Climate Change	3.06	77%	4.00
The impact of your personal carbon footprint	3.00	73%	3.00
Current options of renewable energy	2.94	73%	3.00
Role of local government in dictating climate change policy	2.94	73%	4.00
Pros and cons related to renewable energy sources	2.89	73%	2.00
Professions and career paths involving renewable energy	2.61	68%	1.00
Environmental Justice	2.50	68%	3.00
How solar photovoltaic panels, wind turbines, and geothermal heat pumps work.	2.39	59%	1.00

Baseline Self-Reported Confidence (Based on 5-point scale, with 1 = Not at all confident and 5 = Extremely confident)	Student's Mean Rating	Some Confidence (Rating >=2)	Teacher's Rating of Student's Confidence
Working effectively in small groups to analyze a problem and determine a solution	3.61	77%	5.00
Presenting your project findings to an audience	3.39	77%	4.00
Analyzing your personal carbon footprint	2.89	68%	1.00

Consistent with their interest in leadership, most LTI students expressed at least modest confidence in their ability to work effectively in small groups and to deliver presentations. However a small number of students had very low confidence in these areas, indicating a subset that might especially benefit from opportunities to develop and refine these important soft skills.

Kofi Frempong, SGAP Leaders' school liaison, perceived a high correlation between the Climate Change curriculum and content being covered in the classroom, confirming important synergies. His teacher ratings of students' knowledge and skill were largely concordant with students' responses, but also suggested a few significant gaps that students may not have recognized.

Collectively, the baseline responses showed that students were receptive to the Climate Change Curriculum and had some familiarity in several topic areas, providing clues on how to appropriately level the content. The findings also suggest important synergy between the Climate Change Curriculum and what students would be learning in their routine classroom. Lastly, the survey affirmed a need for the programming and identified key opportunities for growth.

INTERIM SURVEY

Following completion of the first five modules, SGAP administered a mid-point survey that was completed by 16 students. Students' perceived knowledge, on average, increased in all items assessed. Since some of these increases occurred in areas that had not yet been covered, the significance of these changes is unclear. These changes may indicate that students perceived a global increase in their awareness and understanding of climate change and renewable energy concepts resulting from their exposure.

FINAL SURVEY

The Hilltop Consultants LLC team designed a final survey that students could complete digitally as the Challenge workshop concluded. The SGAP team developed a supplemental paper-based survey in response to digital survey fatigue and a recognized need for more qualitative insights into the pilot experience and its impacts. This paper-based survey instrument retained three of the eleven original rating questions and included four open-ended questions and a general comments section.

Among the 22 students who participated in the in-school curriculum, 16 attended the Challenge workshop at CUA, 11 completed the final digital survey and 15 completed the open-ended survey. Of those who identified as LatinX or Hispanic, 40% stated that they prefer to communicate in Spanish. The final digital survey (N=11) responses indicate, on average, moderate knowledge of climate change and renewable energy topics, but did not show any notable increases relative to the baseline or interim survey results. (Table B).

By contrast, **the paper-based survey, which garnered 14 responses, indicated an improved knowledge rating in wind and solar energy technologies as well as improved confidence ratings in working effectively in small and in presentation skills** (Table B and Table C). Although these findings must be interpreted cautiously given variation in sample size and survey format, they do suggest that students recognized substantive improvements in knowledge and skill that converged and were successfully applied at the final Sustainability Challenge event.

TABLE B

Comparison of Self-Assessed Knowledge in Baseline, Mid-term, and Final Surveys

	DIGITAL					PAPER
	Baseline			Mid-Term	Final	
Self-Assessed Knowledge (Based on 5-point scale, with 1 = Not at all knowledgeable and 5 = Extremely knowledgeable)	Student's Mean Rating (N=18)	Some Knowledge (Rating >=2) (N=18)	Teacher's Rating of Student's Knowledge (N=1)	Students Mid-Point Mean Rating (N=16)	Students Final Mean Rating (N=11)	Students' Mean Rating (n=14)
Climate Change	3.06	77%	4.00	3.31	2.73	
The impact of your personal carbon footprint	3.00	73%	3.00	3.50	2.64	
Current options of renewable energy	2.94	73%	3.00	3.56	2.73	
Role of local government in dictating climate change policy	2.94	73%	4.00	3.13		
Pros and cons related to renewable energy sources	2.89	73%	2.00		2.82	
Professions and career paths involving renewable energy	2.61	68%	1.00	3.06	2.64	
Environmental Justice	2.50	68%	3.00	3.19	2.64	
How solar photovoltaic panels, wind turbines, and geothermal heat pumps work	2.39	59%	1.00			
How wind turbines and solar photovoltaic panels generate energy and cost-savings						3.57

TABLE C

Comparison of Self-Assessed Confidence in Baseline and Final Surveys

	BASELINE DIGITAL SURVEY			FINAL PAPER SURVEY
Self-Reported Confidence (Based on 5-point scale, with 1 = Not at all confident and 5 = Extremely confident)	Student's Mean Rating (N=18)	Some Confidence (Rating >=2) (N=18)	Teacher's Rating of Student's Confidence (N=1)	Students' Mean Rating (N=14)
Working effectively in small groups to analyze a problem and determine a solution	3.61	77%	5.00	4.10
Presenting your project findings to an audience	3.39	77%	4.00	3.53
Analyzing your personal carbon footprint	2.89	68%	1.00	

Qualitative responses on the final paper-based survey suggest that students still struggled somewhat with the Renewable Energy calculator. Technical issues may have been a factor, but it is also possible that the simulation part of the Challenge Task needs to be simplified for ninth grade and tenth grade students.

Students were also asked how the pilot influenced their future career aspirations and how they might apply their learnings as a climate change leader in their community. In general, students' future aspirations were essentially unchanged and they did not envision themselves as climate change leaders. **However, students did indicate that the programming sparked their awareness and interest in an important topic and promoted attentiveness to how their everyday environments and activities may influence climate change. In addition, several students seemed empowered to engage in conversation and share their new knowledge with their family and peers. Thus, the Climate Change Curriculum & Sustainability Challenge seems likely to be an important primer, sparking interest and building foundational knowledge that will allow students to more effectively engage with future climate change information and may catalyze greater action when new opportunities for personal leadership arise.**

LESSONS LEARNED & BOTTOM LINE

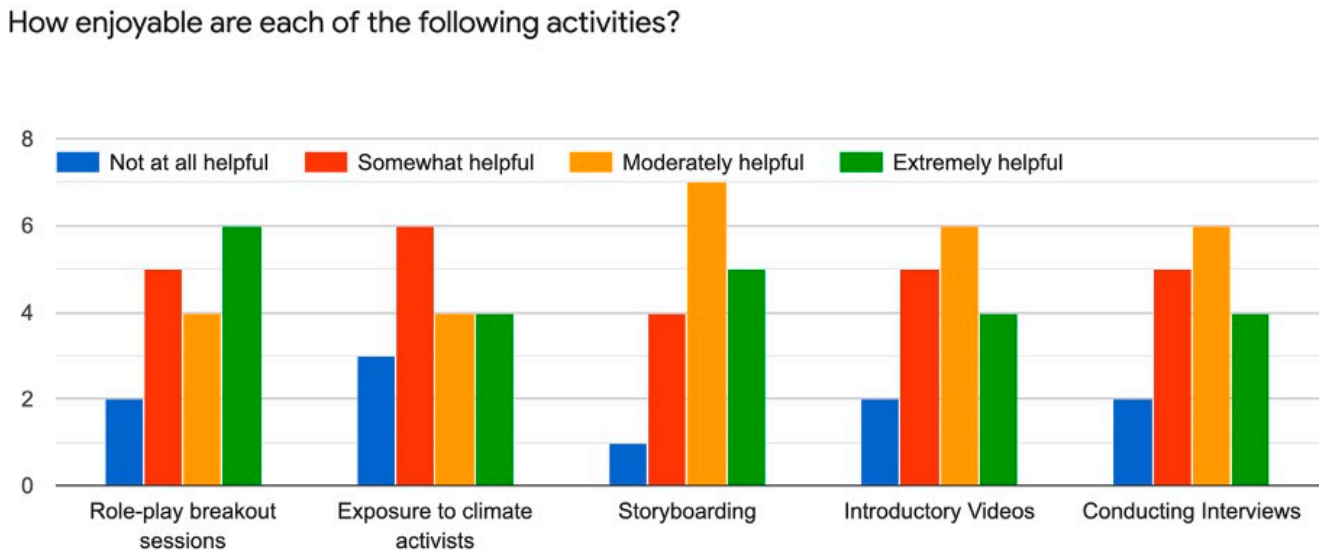
The overall success of the Climate Change Curriculum and Sustainability Challenge Workshop prompted JFK High School to invite SGAP Leaders back in the fall of 2023 for another curriculum rollout. The following section lists the most effective components of the curriculum and the workshop, and details the components that SGAP will improve upon before the start of Fall 2023.

CURRICULUM EVALUATION

EFFECTIVE CONVENTIONS

Overall, the modules enabled students to grow in their command of climate change literacy in engaging and innovative ways that are not often included in classroom syllabi. In reference to her educational growth, one student explained, “I learned about all the ways every item or action we do has a carbon footprint. One thing I can do now is just be more green with my life” (student, personal communication, January 28, 2022).

Mr. Frempong reported that the mix of activities in the classroom constantly kept students on their toes, always activating different parts of their skill sets (K. Frempong, personal communication, February 3, 2022). Role-playing and empathy-building activities were particularly engaging, prompting students to expand their perspectives and make decisions as if they were community stakeholders. Often revolving around topics of environmental justice, the role-play activities encouraged students to understand systemic processes through systemic lenses.



CLASSROOM KITS

Students were also particularly engaged with classroom kits. At the beginning of the curriculum, SGAP ordered bags of module-specific items for each student. The bags contained build-your-own materials such as solar cars, solar propellers, and wooden wind-turbines. Students were often excited by activities that required the use of the kits, as those lessons enabled them to apply and reinforce their knowledge through hands-on mediums. According to Mr. Frempong, the hands-on approach “[pulled] more kids into the lesson and [prompted] them to remain engaged” (K. Frempong, personal communication, February 3, 2022). In response to the kits, many students suggested that we reuse topics such as solar panels, wind turbines, and STEM topics in the future. The kits, alongside role-playing activities, effectively prompted students to ask important, granular, and organic questions that peaked their engagement and helped them retain lesson materials.

Beyond benefitting from engaging class activities, the students enjoyed the multiplayer 1Huddle games (sporadically implemented to assess their retention), in-person community service events, and all bilingual resources. The program also immensely benefited from access to Zoom, which facilitated access to several guest speakers. All positive conventions will be included in future SGAP curriculums.

INEFFECTIVE CONVENTIONS

Despite our overall success with the modules, SGAP did experience some limitations with our lectures and guest facilitators. Occasionally, the inclusion of additional facilitators sometimes hindered student retention and engagement. Almost all the guest speakers were long winded and prioritized their presentations over student engagement, often leaving students confused about lecture material after failing to adjust to their needs (K. Frempong, personal communication, February 3, 2022). SGAP will have to be more diligent in selecting and training guest speakers in the future.

In addition to struggling with long-winded facilitators, students often disengaged from long lectures and unclear vocabulary. Lessons that involved heavy computational material, such as Module 2 (“Energy Infrastructure”), or those that had a significant amount of vocabulary, such as Module 3 (“Getting Real About Climate Change, Part 1”), often struggled to maintain student attention because they overwhelmed students with new and difficult information. Students specifically acknowledged the “long classes” as being some of the most challenging and least interesting parts of the curriculum.

Additionally, some modules, such as Module 5 (“Getting Real About Climate Change, Part 3”), did not end up being relevant to the Sustainability Challenge Workshop, and students were quick to disconnect when they could not identify a lesson’s relevance. In fact, in offering feedback for future rollouts, one student commented, “I would make learning the topics at hand more engaging and further illustrate the importance of being knowledgeable about climate sustainability.” Since one of the goals of the Climate Change Curriculum is to help students connect instructional material to their communities, clarity about the relevance of our modules is a standard we must uphold in all future rollouts.

WORKSHOP EVALUATION

EFFECTIVE CONVENTIONS

CHALLENGE TASK

The Sustainability Challenge Workshop reported tremendous and overwhelming success. From the moment students walked on to Catholic University campus, they were engaged and purpose-driven. Every student embraced the specificity of their workshop role, conducting thorough research to ensure they optimized their contribution to their team. Though initially excited by the cash prize, students quickly abandoned the external motivator and replaced it with a desire to solve the puzzle of the Renewable Energy Portfolio. In fact, several students became so immersed in their work that teachers and facilitators had to remind them multiple times to break for lunch, as they were reluctant to step away from the thrill of their task.

When asked what they learned most from the workshop, one student noted that he better understands "how to foresee and summarize numbers and big ideas" (student, personal communication, January 28th, 2022). Another student noted that she could better support climate action in her community by "problem-solving under a lot of pressure," an essential capacity for climate change leadership (student, personal communication, January 28th, 2022). The workshop therefore generated important research and critical thinking skills that students can implement in their academic careers and community extracurriculars.

Most importantly, **students who did not often participate in the classroom flourished in the workshop, and several of them suggested that we implement more Sustainability Challenge Workshops in the future.** Mr. Frempong noted that the Workshop is particularly beneficial for students who have infinite potential, but are overlooked because of their marginalized backgrounds and communities (K. Frempong, personal communication, February 3, 2022). The Workshop challenged those students by calling on their skills in demanding, fast-paced environments that peaked their interest and prompted their engagement. Students who never volunteer to speak or present were constantly asking for the microphone and making contributions to their groups' presentations. One student who SGAP interviewed was shocked that we selected him, because, Mr. Frempong explained, he does not recognize his value as a student or a leader (K. Frempong, personal communication, February 3, 2022). The Sustainability Challenge incites a revelation among students with similar mentalities, offering them insight of their potential along a path of leadership by exposing them to challenging educational experiences. According to Mr. Frempong, the students have power in them, and programs like the Sustainability Challenge help to expose that (K. Frempong, personal communication, February 3, 2022).

PRESENTATIONS

One of the most impressive components of the 2022 workshop was students' final presentations. It was clear from the granularity of their content that students had a much stronger understanding of Picatinny Arsenal, renewable energy, and environmental justice than they had in previous years, and they could offer much more compelling arguments as a result. While delivering their presentations, students employed storytelling skills, describing their projects in a sequential and cohesive format. They also included structured visuals and transitioned cleanly between speakers, making it easy for the judges to retain information. Most notable was students' eagerness to interact with their audience through content-based questions, prompting the judges by asking them questions about important definitions or information. Engaging directly with the presentation training from the curriculum, their performance encourages SGAP about our ability to support students through presentation skills in the future.

Samriddi's video: https://youtu.be/HAxeyCyCHvg

INEFFECTIVE COMPONENTS

The few ineffective components of the Workshop included clarity around the Challenge task and the monetary cash prize offered at the end. Like previous workshops, students and facilitators were confused about the goals and objectives of the Renewable Energy Calculator. Confusion among facilitators is particularly problematic because it prevents students from receiving necessary guidance when they have questions about the challenge. SGAP will have to ensure that facilitators have a stronger understanding of the Calculator's functionality and purpose in future workshops.

The greatest limitation of the Workshop, however, was in SGAP's offer of a monetary cash prize. Especially since there were only three student teams, offering rewards to the first- and second-place team and nothing to the third likely exaggerated the disappointment and self-doubt of the last-place team. Offering a significant amount of money to all but one team may cause harm to some students that we must avoid in the future.

REVISIONS

CURRICULUM

Before pursuing our ultimate scaling endeavors, SGAP will revise the 2021-2022 pilot curriculum for another rollout at John F. Kennedy High School. Over the summer of 2023, SGAP will centralize the curriculum around a few key topics to increase student competencies in specific areas that are directly relevant to the Sustainability Challenge Workshop. Though SGAP may not be able to cover as many topics as we did in the 2021-2022 curriculum, situating the next curriculum in a helix around focused subject areas will increase student competencies in relevant, targeted areas more effectively than can be accomplished with the implementation of different topics every lesson. Additionally, SGAP will explore the feasibility of targeted homework assignment , to introduce and reinforce terminology and key takeaways. Increasing learning retention in targeting areas is expected to accelerate student growth and enable students to better connect the material to the Sustainability Challenge Workshop and to activism in their communities.

SGAP will also add a new curricular objective focusing on media literacy. Doing so will guide students in developing essential research skills as they complete projects throughout the curriculum.

SCALING

We intend to refine our curriculum and launch another pilot with our partner school, and possibly one other school, during the Fall 2023. This is a prerequisite for our longer-term goal. SGAP ultimately aims to offer the Climate Change Curriculum as a menu-based repository that allows schools to purchase modules individually or as sets to implement in their classroom. Every purchase will include optional projects to encourage students to pursue activism in their communities. All schools will also have the option to purchase the entire curriculum and the Workshop, ultimately incorporating SGAP facilitators into the classroom and participate in the Sustainability Challenge Workshop at the end of the program. As we expand our reach, SGAP hopes to generate sufficient revenue to subsidize the cost of our programs to facilitate access for under-resourced schools.

ACKNOWLEDGEMENTS

SGAP LEADERS

Michele Joseph, MBA - lead facilitator

Annalie Buscarino,BA - facilitator

Jill Foster, MPH, MD -evaluator/judge/curriculum designer

Ting Huang, BA - facilitator

Susan Marquardt, MBA - curriculum designer

Christopher Painter, MBA - facilitator

Lauren Peters, PhD, JD - facilitator

MaryKate Selgrath - CE - curriculum designer

Jose Soto, BA - facilitator

Stephanie Stinson, MMP - curriculum designer

GUEST FACILITATOR:

Zainab Abbas, PhD guest facilitator - Scitech2U

Kennedy High School (LTI):

Kofi Frempong, MA - LTI coordinator

Subject Matter Experts/Judges:

Liana Abbott, MBA - SGAP Leaders Advisor

Helene Ferm, Energy Engineer - Picatinny Arsenal

Jill Foster - MPH, MD - Board Member

Otto Wilson PhD - Catholic University School of Engineering

FUNDERS

The 2021-2022 Climate Change Curriculum/Sustainability Challenge Workshop pilot was made possible by a STEM Action grant from the Society for Science and contributions from several anonymous donors.

We are grateful for the STEM ACTION Grant from the Society for Science. Not only did it help with the design/development of the curriculum, it also provided the funding to assemble the STEM kits for the students during the pilot. Moreover, it fueled our board, volunteer staff, students and partner school around our climate change curriculum. We are excited to enhance the curriculum based on the outcomes of our pilot, and hope to partner with Society for Science as we roll-out our refined curriculum to additional schools in the future.

APPENDIX

INTERNAL REPORTING RESOURCES

QUOTES RELATED TO IPCC 2022 REPORT TO SUPPORT RATIONALE FOR CURRICULUM

"It's now or never, if we want to limit global warming to 1.5°C (2.7°F); without immediate and deep emissions reductions across all sectors, it will be impossible," said Jim Skea, Co-Chair of IPCC Working Group III, which released the latest report.

> Source: UN climate report: It's 'now or never' to limit global warming to 1.5 degrees. UN News. Apr 4, 2022. Accessed at https://news.un.org/en/story/2022/04/1115452

From IPCC AR6

FROM: IPCC Working Group III report, Climate Change 2022: Mitigation of climate change

"[Global] warming cannot be limited to well below 2°C without rapid and deep reductions in energy system CO2 and GHG emissions." "Limiting warming to well below 2°C will require substantial energy system changes over the next 30 years. This includes reduced fossil fuel consumption, increased production from low- and zero-carbon energy sources, and increased use of electricity and alternative energy carriers."

> **Source: IPCC WGIII AR6 Chapter 6 Executive Summary (p. 6-3)**
>
> IPCC Working Group III report, Climate Change 2022: Mitigation of climate change
>
> The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.
>
> **Full Report**
>
> IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926
>
> **Chapter 6**
>
> Clarke, L., Y.-M. Wei, A. De La Vega Navarro, A. Garg, A.N. Hahmann, S. Khennas, I.M.L. Azevedo, A. Löschel, A.K. Singh, L. Steg, G. Strbac, K. Wada, 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.008

CONTACT US

If you are interested in bringing an SGAP Leaders' curricular program to your school, please reach out to Michele Joseph at mj@sgapleaders.org for more information.

CONTACT US

SGAP LEADERS

Non-profit Incubator
15800 Crabbs Branch Way, Unit 300
Rockville, MD 20855, USA

Phone: 862-242-0226

mj@sgapleaders.org
www.sgapleaders.org

@sgap_leaders

@sgapleaders

The Student Global Ambassador Program (SGAP Leaders) - Where underserved teens develop leadership and soft skills through the lens of STEM, sustainability and social justice challenges.