Alliance for Aquatic Resource Monitoring's Annual Publication

Stream of Consciousness

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Alliance for Aquatic Resource Monitoring

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The Overlap of Citizen Science and Place-Based Learning

By: Nick Long

Everybody lives in a place. We often organize ourselves around each other in towns and cities. But towns and cities do not exist by themselves; they are inherently tied to the ground they are built on and the water that flows through them. The concept of place “is defined by its human scale: a household, neighborhood, community, forty acres, one thousand acres” (Orr, 2013, p. 184). No matter how disconnected they may seem, our places have a direct connection to the natural environment. It then follows that whatever happens in our backyards, neighborhoods, and cities affects their respective natural environment, both on local and global scales.

Consider the raindrops that fall onto your roof and property. Clearly, that water does not stay confined to your property lines. The natural world does not recognize the boundaries we have created for ourselves. Some of that water will eventually find its way to a close by waterway after travelling through a stormwater system. Stormwater is the water from precipitation events that does not soak into the ground due to impervious surfaces like compacted soil and asphalt. The storm drains on our streets are good reminders that we need a stormwater system in place to avoid flooding. Stormwater carries whatever pollutants it picks up from our lawns, streets, and other surfaces to the waterway it drains into. Therefore, everyone has an intrinsic connection to their respective watersheds through their use of the land and water. The term watershed, like our concept of place, is also flexible in its scale. The watershed of your local stream lies within the watershed of the big river it eventually flows into, which then empties into the ocean.

However, downstream impacts often lie out of sight of a place’s inhabitants until the consequences reach a drastic level. In general, individuals living in the developed world no

longer depend on their immediate places for "food, water, livelihood, energy, materials, friends, recreation, or sacred inspiration" (Orr, 2013, p. 184). This phenomenon has fostered a mental disconnect between ourselves and our places of inhabitance, as we lose sight of the importance of protecting our local environment. The local landscape no longer provides direct resources in the eyes of its inhabitant, who buys food from a supermarket and turns a faucet for seemingly endless potable water. This blurs what should be a clear picture, which is the importance of local environmental quality for its people and how it plays into the global environment. Until our natural resources are in jeopardy and our economies and livelihoods are at stake, we tend not to notice much of our effect on nature.

Here in Carlisle, the home of Dickinson College, our stormwater drains into the LeTort Spring Run. From there, the water flows into the Conodoguinet Creek, which empties into the mighty Susquehanna River and finally the Atlantic Ocean through the Chesapeake Bay. This may be conjecture, but you would be hard-pressed to find people in Carlisle discussing how their lawn fertilizer might be affecting the Susquehanna, let alone the Bay. The Chesapeake Bay's poor health has been acted upon for only as long as it has noticeably affected its communities and economies (Davison et al., 1997). The Bay's waters used to seem to offer endless supplies of fish, crabs, and oysters, at least until fishing vessels began to return to shore with less of a haul in their nets and traps. It takes time and effort, especially in the faraway communities, to notice and internalize our relationship to the Bay and what it provides for humans. Nevertheless, there are now many praiseworthy efforts at the community and governmental levels across the Bay watershed aimed at curtailing the pollution going into the Bay. These efforts have increased and will continue to do so as people in the Bay watershed states become more aware of how their actions impact the Bay and its natural resources (Davison et al., 1997). The adoption of a place-based philosophy in our thinking and education is one strategy that can reconnect us to our places, like the Chesapeake Bay, and invigorate our passion for protecting them.

Among many other things, "place-based consciousness means learning how to reinhabit our communities and regions in ways that allow for more sustainable relationships now and in the long run" (Smith, 2007, p. VIII). We can approach any number of problems with place-based education, which is a branch of place-based consciousness. David Sobel writes that placed-based education emphasizes "hands-on, real-world learning experiences, […] helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens" (2004, p. 4). Place-based education can be utilized in many different contexts, such as education in schools and other programs. For the purposes of this article, we will examine place-based learning, citizen science, and what they can do for each other.

Citizen science goes by a number of other names (community science, public participation in scientific research, etc.). Its goal is to involve community members/citizens/"non-professionals" in a scientific process. Of particular note is the use of citizen science as a means of environmental monitoring, which includes water and air quality, bird migrations, and a great deal of other exciting projects. Community members' involvement in environmental monitoring projects provides the prospect of expanding our capacity to learn about environmental quality at new spatial and temporal scales. As the movement continues to grow, participating communities become more conscious of environmental quality and develop social capital (Conrad and Hilchey, 2010, p. 280). Perhaps more importantly, citizen science initiatives help cultivate a strong, informed community of people who can advocate for their natural resources. The EPA's National Advisory Council for Environmental Policy and Technology recommends that the EPA work on "emphasizing

Community Science Specialist Helen Schlimm shares results from the Conodoguinet Creek Snapshot with members of the Big Spring Watershed Association.

the power of place" while integrating citizen science efforts into its environmental monitoring work (NACEPT, 2016). Our collective, large-scale knowledge has much to gain from the place-specific knowledge that only inhabitants hold. The experiential knowledge that citizen scientists have and develop feeds into their collective place-based consciousness at the same time that place-based consciousness informs and directs citizen science.

Citizen scientists have diverse backgrounds and bring invaluable experience and knowledge into projects. These individuals have ties to their locality and place that make them excellent and unique candidates for monitoring their environment. The term place attachment "broadly encompasses aspects of identity, physical or social dependence, and emotional connection to specific aspects of the physical environment or other creatures that share such space" (Haywood, 2014, p. 70-71). This concept provides words for the special knowledge that only inhabitants have, which can then be shared through those inhabitants' involvement in citizen science initiatives (Newman et al., 2017, p. 56). Who, aside from its inhabitants, could have intimate knowledge of the seasonal patterns and ecology of a specific place? Depending on the project, participants may even visit their study site on a regular basis. Repeated visits escalate their understanding of their sites and respective ecosystem, which is then compounded by the explicitly observant and scientific lens citizen scientists look through (Haywood, 2014, p. 71).

Community members who involve themselves in citizen science projects can be generalized as being conservation literate, especially when it comes to their local environment. Additionally, these projects are typically place-specific and local because they need to meet community members where they are geographically. This creates a promising formula for addressing place-specific, scientific questions and spreading the information generated by the project. Connections between the local environment, its inhabitants, and the overall community may be strengthened through citizen science, as it offers an avenue for motivated community members to actively observe their landscape and share their findings with the rest of the community. By organizing around a local scientific question,

Watershed Coordinator Nick Long '19 helps community members participating in the Conodoguinet Snapshot to measure the pH of their sample.

citizens can empower themselves and others and activate their specialized knowledge. Participation in citizen science projects has also been demonstrated to increase peoples' conservation action, which includes changing personal behavior and contacting government officials according to conservation goals (Haywood, Parrish, and Dolliver, 2016, p. 483). Citizens who are already motivated to participate in environmental monitoring are a force to be reckoned with in the political arena because they actively seek the protection of their environment through citizen science. Their involvement gives them new information and increased confidence that allows them to advocate for their natural resources and spread the word to their peers.

ALLARM works to provide assistance to community science projects centered on water quality monitoring. We have the privilege of working with the amazing citizens who involve themselves in protecting their local waterways, and our work would mean very little without their dedication and knowledge. Students are typically drawn to ALLARM because it marries both environmental science and community work. The multi-faceted work of ALLARM lends itself to giving students opportunities to interact closely with community members. ALLARM staff had the opportunity to share their stories about their experiences at community events and ALLARM's work in general through responding to a survey. This survey was geared towards learning about how the place-based knowledge of community members contributes to that of the ALLARM staff through their interactions. Many of the quotations throughout the rest of this article are taken from their survey responses.

A recurring event called the Conodoguinet Snapshot brings around thirty volunteers to the ALLARM workspace each season to test water samples they have collected from the Condoguinet Creek and some of its tributaries. Repeated

interactions with these participants led to some ALLARM students realizing "how many members of the community are aware of the factors affecting their stream health." The Snapshot gives its participants a chance to share their local knowledge of the area and how weather, land use, and time of year might affect water quality. ALLARM students have also noticed that "many of the volunteers grew up in the Carlisle area and therefore have a lifetime of knowledge about the local environment and how it has changed overtime." Beyond water quality, one staff member even "learned about an invasive moth that affects trees in PA." Place-based learning effortlessly reveals itself through citizen science and community events.

ALLARM students' sense of place may be focused on the Greater Carlisle community and the LeTort Spring Run and Conodoguinet Creek, but it also extends to whichever communities they work with. We may only spend a day or two with each community, but we learn a lot about each place through our conversations with community members. Our shale gas program brings us to communities in Pennsylvania, New York, and West Virginia, but state borders aren't the only lines we cross. We also cross major watershed boundaries, from the Chesapeake Bay watershed to the Mississippi River watershed and back again. Community members, as we have already established, have specialized knowledge of their respective places. Water quality monitoring workshops and other community events frame the conversation for us and open the floodgates of the participants' brains. There exists a special, mutually beneficial exchange of information, as ALLARM provides technical assistance and training for community members while they share their local experience with us. This give-and-take bolsters each party's capacity to fulfill their role in the community science project. The community scientists learn water quality monitoring techniques and how to work towards achieving their goals, while ALLARM staff may better understand the environmental issues, politics, and cultures unique to different parts of the program's geographic reach. One member of the ALLARM staff explained that she feels "geographically connected to most of our shale gas volunteers in PA" because she has interacted closely with most of them in-person or on the phone. She said, "that has given me the opportunity to hear about what is going on in their areas and has helped me feel as connected to that place as possible." Another ALLARM staff-member mentioned that the "emotional and intellectual investment of our volunteers in their local water quality" consistently stands out to her during community events. She went on to say that "the knowledge and investment of community members is one of [our] most indispensable and irreplaceable resources." Another staff-member demonstrated how, "most times I go into workshops or events thinking I will be an expert, but the true experts are the people who live in the location."

These workshops and community events also serve as a meeting ground for likeminded citizens. An ALLARM student shared that "it often happens that when a community member asks a question during a workshop presentation, another community member supplements our response with an additional piece of local knowledge that we would not have otherwise had." Orr's writing corroborates this observation, as he describes how studying the local environment together acts as "the basis for rational coordination and planning and as a vehicle for widespread public participation" (2013, p. 185). Haywood also writes that "the basic procedures involved in monitoring and analyzing natural phenomenon are used as platforms to unite scientists, communities, and stakeholders across scales, help frame socially legitimate indicators of environmental problems, and advance locally relevant and practical conservation goals and strategies" (2013, p. 65).

Watershed Coordinator Tom O'Donnell '19 (right) goes through an activity with community members at a shale gas workshop in Warren County. Some of these community members may continue on to be volunteer monitors.

Watershed Coordinator Nick Long ‘19 collects a water sample from the LeTort Spring Run.

Community members participating in the workshops must coordinate and cooperate with each other to a certain extent for their monitoring program to be successful. Together, they can address environmental questions and present their results to the rest of the community. Ideally, solutions will follow from those results.

Each water quality monitoring workshop requires special attention that is specific to the region of focus. Through our shale gas program, ALLARM students create and work with maps detailing the unconventional well (otherwise known as hydraulic fracturing or fracking) activity and waterways in a given area as well as conduct chemical analysis for quality control on the water samples flowing in from those areas. One student who works in the lab noted that “it is interesting to see the relationship between the areas where more shale gas is being extracted and where pollution levels are highest.” As these components of the shale gas program coalesce and members of the ALLARM staff collaborate and share information, we can form a more complete picture of how shale gas extraction impacts waterways in different areas. Beyond their knowledge, community members’ passion for environmental issues feeds the fire of the ALLARM staff’s passion because they realize “that people from all different walks of life are drawn to water quality monitoring.” Coupled with the data-driven parts of the shale gas program, the energy and devotion of volunteer monitors nourishes the ALLARM staff’s consciousness of the environmental justice issues presented by hydraulic fracturing in Pennsylvania communities. We gain unique insight into both the science and social aspect of this issue from the stories and data that citizens share with us.

Oftentimes, the most ecologically-versed locals are longtime anglers, hunters, and other outdoor recreationalists. By immersing themselves in an environment, especially in the context of hunting and fishing, these people must ‘tune into the landscape’ to some extent. Paul Errington, a distinguished wildlife ecologist, spent much of his early life in the outdoors. Kohler (2011) notes that “in his hunting and trapping he developed habits of close observation and analysis of what he saw that were also those of a naturalist” (p. 224). Errington also grew to be a close associate of Aldo Leopold, the father of the famous land ethic. Leopold, “like Errington, developed an early and passionate attachment to outdoor life. He too became an avid hunter and outdoorsman” (Kohler, 2011, p.226). In A Sand County Almanac, Leopold wrote that “we abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect” (Leopold, 1949, p. viii). In many ways, Leopold’s land ethic embodies our idea of place-based consciousness. Throughout its 32 year history, ALLARM has engaged with the outdoor enthusiast community and its conservation organizations. Anglers and hunters comprise a considerable portion of conservation efforts, partly because they have some stock in the wellbeing of the environment. Their many outdoor experiences lend themselves to developing a deep sense of place and ecological literacy. Orr quotes John Dewey’s statement that, “we cannot overlook the importance for educational purposes of the close and intimate acquaintance got with nature at first hand” (Orr, 2013, p. 186). The most ardent conservationists typically have closely held memories within nature and a remarkable sense of place.

The many community partners we work with inhabit all sorts of places, but they share important qualities. For one reason or another, they have the motivation to care for their local waterways. The place-specific work of community watershed associations alongside that of other groups sums up to a large scale collective of effective environmental stewardship. Part of ALLARM’s mission is to show community members that they have the knowledge and skills necessary for effective environmental monitoring. One student wrote that “if a person is equipped with the tools and knowhow to conduct monitoring, they can make environmentalism a personal and location-specific practice.” We embrace the ideal of thinking and acting globally and locally, which we satisfy through

citizen science. Armed with results and confidence, empowered communities can better protect their natural resources.

ALLARM works as part of the Chesapeake Monitoring Cooperative (CMC), whose mission it is to integrate volunteer water quality monitoring data into the Chesapeake Bay Program. As part of our work through CMC, ALLARM forms partnerships with community groups interested in doing citizen science in Pennsylvania and New York's share of the Bay watershed. The Otsego County Conservation Association (OCCA) of New York is one such community partner. ALLARM takes each community partner through a well-defined study design process to best address their needs and concerns. To establish a successful and meaningful monitoring program, we ask our partner to first define their group's mission. After that, we ask them why they are monitoring, which touches upon the watershed's history, land use, environmental concerns, how they will address these concerns, and how their overall monitoring goals align with the group's mission. We then identify what water quality indicators the group wants to monitor, along with the specifics of how they will monitor them.

This process is, by necessity, heavily based in the specific place the group operates in. For Otsego County, much of the land use in their watershed is devoted to agriculture. OCCA therefore identified high nutrient levels in their water as a key concern of theirs, which they address through monitoring levels of nitrate and orthophosphate in the water. ALLARM staff met with OCCA staff and leadership to go over the study design. Part of the meeting also included talking to scientists from labs in the area and a representative from the local Soil and Water Conservation District. ALLARM was able to advocate for the credibility of volunteer-collected data when it was called into question by people in the meeting. After completing the study design process, ALLARM and OCCA moved on to the quality assurance/quality control process, which ensures that the data collected will be credible and of known quality. This process includes training the volunteer monitors as well as analyzing their samples either in our lab or elsewhere to make sure that they are collecting data properly and according to procedure. In OCCA's case, they send their samples to the close by SUNY Oneonta Biological Field Station. Volunteer monitors working on OCCA's project contribute to our collective understanding of the Chesapeake Bay watershed, which, when summed with other monitoring initiatives, paints a more complete picture for resource managers, government officials, and communities.

Monitoring the water quality of local waterways is an excellent way for people to become more attached to their places. Streams and rivers carry with them the story of the surrounding and upstream land. Should there be a forest cut down upstream, the water quality will reflect that, albeit to varying degrees. Pennsylvania is an especially strong example of how waterways inform us about human impacts on an environment. With the greatest mileage of waterways of the lower 48 states, second only to Alaska, our waters make up a network of pathways reminiscent to our circulatory system. Just like we might test our blood for impurities, we can test our waters for the same purpose. In the context of water quality monitoring, the hard part is diagnosing how humans disturb their local natural environment. To use the Harrisburg-area as an example, we can point to our agricultural practices as the source of much of our high levels of nutrients and sediment.

Although this melding of place-based philosophy and citizen science sounds great on paper, there is more investigation to be done. Haywood (2013) notes that "expanding the PPSR [public participation in scientific research] research agenda to include inquiry on sense of place is particularly pertinent and timely given the extensive socioecological challenges of the twenty-first century" (p. 77). ALLARM, as an organization primarily focused on citizen science, has a role to play in this investigation. We can work towards this goal by collaborating with other citizen science groups and environmental protection entities. Identifying the benefits and dynamics of place-based learning in concert with citizen science lends itself to harnessing the two more effectively.

As our government officials call into question funding for environmental monitoring projects, citizen science increasingly becomes a source of hope. Let us keep the ball rolling and perpetuate the growth of citizen science. Each town is home to people with deep knowledge of their place, and their full potential to channel that knowledge towards citizen science, civic engagement, and conservation has yet to be realized. Now more than ever is the time to feed into our desire to learn more about our environment and how it is changing, both on local and global scales.

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Seasonal Suggestions to the Homeowner for Improving Stream Health

By: Rachel Krewson

Daily tasks and outdoor activities vary from season to season. During these seasonal changes, it is important to consider how these activities impact stream health and individually decide to reduce actions that negatively impact the local environment.

Spring

In the flowering of spring, you shed your winter coat and soak up the warm rays of sun after making it through the bitter cold of winter. The time to once again commence cutting and fertilizing your lawn has begun. But what does this mean for the stream running through your town? Along with the warming weather, spring is known for its plentiful showers and agricultural fertilization processes. The water from rainfall does not all get absorbed by the shallow root systems of grass or infiltrate the ground. Much of it runs off from yards, along impervious surfaces, and drains into local streams. This stormwater carries lawn fertilizers with it, causing an overabundance of nitrogen and phosphorus to enter streams. When this happens, the chemical composition of the water changes, allowing algal blooms to thrive. These algal blooms block sunlight from reaching farther into the body of water and when decomposed, can choke out the dissolved oxygen within a body of water. Sunlight and dissolved oxygen are both essential ingredients for most animal and plant life in the ecosystem. Nutrient levels in waterways are already particularly high in the spring due to agricultural fertilization. Alternatives to using standard fertilizers include laying down compost and leaving lawn clippings. Since these organic fertilizers release nutrients at a slower rate than chemically produced fertilizers, there is less chance that an excess of nutrients will be washed into a nearby body of water. It is best not to apply fertilizers or pesticides before a storm or when watering your lawn in order to decrease the amount that runs into other water ecosystems (ALLARM). To decrease the amount of harmful chemicals entering the ecosystem and damaging animal and plant populations through bioaccumulation, reduce pesticide use on lawns (ALLARM). Additionally, try not to cut your grass very short. With a higher grass height, there is likely to be less runoff and a more complex root system to support the larger grass growth (The Blackstone River Coalition). Another technique to reduce pollution is to use a rain barrel to collect stormwater before it hits the ground and runoff into streams. Rain barrels can then be used to water gardens. A particular type of garden, called a rain garden, prevents some pollutants from entering streams. Rain gardens are typically constructed out of native plants with denser root systems in order to absorb more of the stormwater before it reaches waterways (Chesapeake Stormwater Network). Road construction, to repair roads from winter groundwater freezing and thawing, is also heaviest in the spring (“How do potholes form?”). If potholes occur on personal property, such as on a driveway, consider the consequences to stormwater pollution before repaving the surface. Switching to a gravel or unpaved surface for personal property would greatly reduce the amount of runoff since more water would infiltrate the ground.

The LeTort Spring Run in the spring.

Home car washes can be fun, but sometimes release phosphates into local waterways (Speed Final 2018, https://bit.ly/2JwpOjE).

The LeTort Spring Run in the summer.

Summer

Eventually, daylight stretches and the warm temperature sticks around longer. Summer arrives, and travel tempts people to enjoy the warmer weather. While traveling, it is important to consider vehicle maintenance. Watch out for leaks that could contaminate ecosystems and run into streams. Used motor oil should be collected and recycled in order to properly maintain the vehicle. An added bonus, “recycling just one gallon of used oil can generate enough electricity to run the average household for almost 24 hours” (Office of Watersheds). Recycling motor oil would improve efficiency and decrease the overall amount of phosphate released to waterways through the process (Office of Watersheds). Phosphate-based soaps can also pollute waterways. When washing the vehicle, it is better to go to a commercial car washing facility in order to ensure the water used in the process is properly managed and does not run down the driveway and pollute other bodies of water with the car soap. If you do choose to wash your car at home, be sure to use phosphate-free soaps so that more phosphate does not pollute streams. Try to properly dispose of hazardous materials, such as cleaning supplies, to reduce the toxicity of materials entering aquatic ecosystems. Another source of phosphate and nitrate pollution is pet waste (EPA). When strolling with a pet in the summer sun, be sure to pick up any of the pet’s solid wastes. It is recommended to flush pet waste down the toilet instead of throwing it out (Office of Watersheds). Sewage gets treated before its release back into the ecosystem, whereas if sent to the trash, it could run into waterways untreated.

Top: The LeTort Spring Run in the fall.
Bottom: Rain barrels can be used year round to collect water instead of channeling it into local waterways. This water is great for watering lawns and gardens.

Autumn

The chill of Autumn creeps back, and jackets start to reappear as the leaves transition from a lively green to hues of red, orange, and brown and begin to fall down from the trees. If an over abundance of these leaves make their way into nearby streams, they could contribute to nutrient pollution. So that leaves don't get carried along with stormwater runoff, do not rake your leaves into the street. It is important to collect leaves to prevent them from flowing into storm drains that drain directly into waterways. These leaves could also be used as organic fertilizer for your lawn. The Fall is the best time to apply fertilizer, or compost if possible, since the ground is not frozen yet and the potential for runoff is lower. Back to school season, the Fall is also a perfect time to educate other members of the community about these practices and their importance to local aquatic ecosystem health. Encourage people to take a class offered by your local community, or even become a volunteer monitor, to bring them closer to understanding what happens outside their door every day. Even discussing these topics with neighbors, friends, and community will spread ideas and get people to think hard about their actions. With greater education, more knowledgeable actions can be taken to reduce environmental impacts.

Winter

Water pollution is a problem even during the coldest months of the year. Since the snow and ice complicate transportation and endanger travelers, the easiest solution implemented in many areas is to apply salt to the roadways to melt ice and remaining snow. Salt should only be applied when there is less than three inches of snow on the ground and when the temperature is greater than 25 degrees Fahrenheit, since beyond these conditions, the salt is ineffective (Office of Watersheds). Be sure to shovel frequently to decrease the chance of ice forming and to decrease the amount of salt application required to travel safely. Although, the salt makes roadways safer for traveling in ideal conditions, it also has many consequences for stream health. When disproportionately applied salts make their way into waterways, they increase the conductivity and impact stream chemistry when the salt ions dissolve in the water. Since public transportation departments still use these roadway salts heavily, shoveling and decreasing private use of them is only one method to combat salt pollution. Another way to decrease the amount of salt that makes it into streams is to plant salt tolerant, native vegetation (such as goldenrods, woody asters, and little bluestems) in buffer zones (Office of Watersheds).

In Pennsylvania, we are lucky to experience all four seasons. Our behavioral changes based on the season, however, directly affect the health of our local waterways. It is important to be aware of these impacts and to reduce the amount of pollution to our surrounding environments in order to live a more sustainable life and to enjoy the natural world around us. Every person can make a difference in reducing impact on local stream pollution, and education can spread the word to make a wider range of difference.

Top: Road salts are excellent for short-term safety, but have long-term consequences when they wash into local waterways (Xootr LLC 2018, https://bit.ly/2QbYkT0, Missouri Department of Natural Resources n.d., https://bit.ly/2JtNkhb).
Bottom: Watershed Coordinator Rachel Krewson ‘20 monitors the LeTort Spring Run in the winter.

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What Does a Scientist Look Like?

By: Tom O'Donnell

According to a report by Green 2.0, people of color comprise less than 16% of people working in environmental agencies and organizations across the United States of America (Green 2.0, 2014). This was a phenomenon I have felt in my bones and lived firsthand since the time I was young, before I had even read this study. I have always felt a bit out of place when it comes to the scientific community and my aspirations to become a geologist. As a man of color, I have been the "odd one out" in most settings throughout my life. When I came to college to study environmental geoscience, it was no exception either.

I was raised in a small, suburban town in New Jersey where over 94% of the population is white. In my adolescence, I never really thought about my race in relation to other people, especially since I come from a biracial family that includes people who are white. Most of the time, I was too focused on looking outwards to my peers to introspect and identify the reasons for my secret loneliness, my secret sense of unbelonging. Only after I came to college was I significantly exposed to the words, people, and studies that finally validated the way I was feeling. I wasn't crazy! Other people of color felt the same way that I did, and for good reason.

People of color support environmental protection at higher rates than people who are white (Green 2.0, 2014). Despite this, Green 2.0's diversity report outlined confidential interviews and survey data from environmental professionals that indicate a trend in "unconscious bias and alienation" that affects the retention of qualified people of color in the environmental community (Green 2.0, 2014). Therefore, the environmental community's low diversity relative to other fields is not wholly a result of disengagement or apathy on the part of people of color, but also by external factors that prevent them from building stable foundations on which to base their careers. Communities with higher minority populations and lower economic status are more likely to be heavily polluted or have toxic chemicals in the environment. As environmental conditions for everybody--regardless of identity--become a growing problem in coming generations, it is furthermore important to acknowledge the trends that are specifically preventing minority populations from accessing the tools needed to address the ecological issues that affect them most.

Shortly after I declared my major in Earth Sciences, I realized I would once again be the only man of color surrounded by people who most likely never had the same racial experiences as I have had in my life. Even if my peers hold many of the same opinions as me, I know nearly none of them have the same perspective. Overall, I am just one of three non-white people in the entire department. I know the number of declared majors from any particular group is not really in the department's control, but it can feel isolating and lonely nonetheless. Sure, I am confident in my scientific knowledge and in my abilities, but I know that sometimes they do not speak louder than my appearance depending on who I am speaking to.

ALLARM, in that respect, has been instrumental in my personal and professional growth over the past two years. I

Watershed Coordinator Tom O'Donnell '19 monitors the LeTort Spring Run.

Watershed Coordinator Tom O'Donnell '19 (right) trains students at York College who will go on to become volunteer monitors in ALLARM's Stream Team.

entered college anxious and unsure of who I "was". I was even more self-conscious about myself in relation to other people. Once I was hired as a Watershed Coordinator at ALLARM, I quickly found a space where I was encouraged to use my personal skills and experiences to collaboratively better the community. My identities and my unique upbringing were seen as valuable, not as liabilities. I've learned that an integral aspect of science is the notion of local or place-based knowledge: the collective body of varied life experiences and knowledge bases serves to enrich the bigger picture. Despite this, I was still initially worried about my future interactions with the local community. Because I felt like I looked so different from the majority of people, I was nervous that I would not be received as warmly as some of my peers.

However, ALLARM has given me a confidence that I will have to take with me into any setting I find myself in later in the future. Giving presentations and organizing workshops have been amazing opportunities to see in action how community members set aside their other preconceived notions about scientists, environmentalism, and academia in order to address concerns that are very real to them. They value and seek the assistance of ALLARM because ALLARM has helped countless groups and communities make a difference regarding the health of their watersheds. I am thankful that ALLARM's commitment to diversity and inclusion has given me the opportunity to be a part of that. Diversity increases the possible tools and skillsets available to solve a problem. This is why it is so important not to discount individuals because of an arbitrary trait such as race, sexual orientation, gender, or class. Even though we are inherently the same, these arbitrary differences are often the very things that create the individualized experiences we draw from our personal lives. ALLARM is a valuable platform that allows people with underrepresented identities like me to contribute our expertise to the field of science for a common good, and I am truly thankful.

At the heart of ALLARM's mission is its commitment to citizen science, which involves empowering local community members who are not necessarily trained scientists to collect and record valid, scientifically robust data. Citizen science, then, can be seen as a movement that challenges popular ideas of who can be a scientist or who can "partake" in science in general. In that same way, I feel like I and other people of color in the scientific community challenge many traditional ideas of who a scientist can be as well. I am confident that my work as a man of color in science and the efforts of our dedicated volunteer monitors are contributing to this shift in opinion, and none of it would be possible without ALLARM and the wonderful team behind it.

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Meet the Middle Susquehanna Riverkeeper

By: Sara Johnson

Last year, ALLARM began its partnership with the Middle Susquehanna Riverkeeper Association (MSRA), a non-profit organization in Sunbury, Pennsylvania. Sunbury is in Northumberland County on the east bank of the Susquehanna River in central Pennsylvania. The town is rural, mountainous, and home to high-quality cold water habitats (Parenzan, 2018). Historically, this area experienced logging, coal mining, and, most recently, natural gas extraction. The Middle Susquehanna Riverkeeper, Carol Parenzan, is 1 of 340 Waterkeepers globally on 6 continents and 42 countries. Each Waterkeeper (Riverkeeper, Coastkeeper, Baykeeper, etc.) is licensed by the Waterkeeper Alliance to be the voice of an identified waterway or watershed. The Waterkeeper Alliance is a non-profit organization, based in New York, working globally to protect clean water. Their goal is for everyone, everywhere to have swimmable, drinkable, and fishable water by holding polluters accountable.

On a personal level, monitoring the Susquehanna River is important to Carol because of her connection to the river and its surroundings when she was younger. Carol describes herself as a River Rat at birth. She swam competitively, but her passion for water did not spark until a canoe trip with her youth group at thirteen where they paddled the Mighty Susquehanna River. They paddled 30 miles of the river in three days, and camped on river islands, where she became one with nature. After this experience, she knew that she wanted to manage and protect the watershed as a Riverkeeper. She went to Penn State University to earn a degree in environmental engineering with a focus in water. As a detour in 1998, she lived in a log cabin in the Adirondack Mountains in upstate New York. This experience only deepened her appreciation for nature. With her passion for water and nature, she knew that she wanted to stay in Pennsylvania, so she submitted a proposal to the Waterkeeper Alliance to protect the Middle Susquehanna River region in 2015. This would protect the north and west branches of the Susquehanna River and its tributaries. In July 2015, the Waterkeeper Alliance named Carol as the Riverkeeper for the Middle Susquehanna

Watershed Coordinator Sara Johnson ’18 trains Carol Parenzan to measure dissolved oxygen in the ALLARM office.

River region. In January 2016, she established the Middle Susquehanna Riverkeeper Association, Inc. as a way to support her work as a Riverkeeper. The association also allowed her to start branding and bringing in funding for her work.

From MSRA’s perspective, stream monitoring is important because they want to document changes in the watershed due to the construction of well pads, access roads, and gathering lines, nuclear plants, coal burning plants, and natural plants along the waterways. The Riverkeeper details that in October 2016, a gasoline pipeline ruptured a pristine section of the watershed during an extreme rainfall event, which released 55,000 gallons of gasoline into the Loyalsock Creek, and then the Susquehanna River (Phillips 2016). This is equivalent to the amount of gas that approximately 110 Americans use in one year. Six million people use the Susquehanna River as a source for drinking water; when stream and rivers are unhealthy; this affects the health of its consumers. In addition to construction, MSRA wants to monitor signs of stream health and stream stress due to extreme weather events.

ALLARM chatted with Carol Parenzan about MSRA’s concern with excess nutrients in the Susquehanna River. She was

Watershed Coordinator Sara Johnson ’18 and the Middle Susquehanna Riverkeeper, Carol Parenzan, after a study design session. Sara is showing Carol some water quality testing equipment.

also concerned with acid mine drainage in her community. To address these concerns, we met in September to create a study design. ALLARM’s study design helps us and our community partners organize why they are monitoring, what type of monitoring would be useful, what they want to use the information for, and how it will impact their community. The study design assists the community partner in defining the roles involved to make the program successful.

From the study design, the MSR established a stream monitoring program involving 16 students and several faculty members of Our Lady of Lourdes Regional School in Coal Township during Earth Week, April 16-21, 2018. For the program, they will monitor acid mine drainage, pH, and visual stream assessment. Carol and MSRA also aims to teach the students how they can contribute water data collection as citizen scientists. Further goals of this program are to gather data to establish a baseline for future comparisons and to utilize the data to complement the work of other organizations and agencies working on the same watershed. MSRA hope that involving community members with citizen science would allow them to be a part of the solution and take ownership of the river and its local tributaries. Currently, the students and faculty members visit coal mines and streams impacted by acid mine drainage. From this, they are learning how to be flexible, adaptive, and cognizant to the changes in the streams. More importantly, they are actively engaged in the field collecting data. This is really important to MSRA.

Beyond the stream monitoring program with the high school, MSRA partnered with the Loyalsock Creek Watershed Association to nominate the Loyalsock Creek for Pennsylvania’s 2018 River of the Year, and won! Additionally, MSRA sponsors more than 20 events and activities annually, including Science on the ‘Socks program for families, yoga and meditation by the water, a music and arts celebration, a small business development showcase, an artist-in-residence program with a local school, a floating classroom, and more. They even contribute to their local public television station’s production of “Our Town”.

As a Watershed Coordinator at ALLARM, I helped Carol and the MSRA with ALLARM’s Director, Julie Vastine, to organize how and why they wanted to use the data. Afterwards, I personally trained Carol to use the equipment necessary to collect conductivity and temperature, water clarity, dissolved oxygen, nitrate nitrogen, pH, and sulfate for their high school program. This was my first one-on-one community training, and I had a great time learning the study design process and working with Carol. It was also beneficial to see how this training would be helpful to the association’s goals and help the community assess and conserve their water resources. Also, I enjoyed meeting the Little Susquehanna Keeper “Sussey”. Sussey is a Nova Scotia Tolling Retriever in training to detect leaking sewage and septic systems to assist Carol and the MSRA.

In the future, ALLARM will work with and support Carol and the MSRA in its stream monitoring programs. We wish them the best in their next steps. To learn more information, please go to www.MiddleSusquehannaRiverkeeper.org.

The Intersectional Future of Water Quality: Lessons Learned from the Waterkeeper Alliance

By: Meredith Jones

As a summer watershed coordinator at ALLARM, I had the privilege of exploring new experiences in the world of water quality monitoring. One such opportunity was attending and presenting at the annual Waterkeeper Alliance Conference in June of this year in Buffalo, New York. Through this event I was able to develop my skills as a communicator, leader, and observer, all while falling in love with water all over again.

The Waterkeeper Alliance was founded and is headed by Robert Kennedy Jr., a passionate, qualified, and recognizable face in the world of environmental nonprofit work. The alliance is an organizing force for waterkeepers all over the world who dedicate their time and effort to the protection of their local waterways and bodies. Waterkeepers often work alone or with small teams, fighting off large polluters and attempting to identify and manage all possible threats to water health in their region. The central objective of the alliance is to achieve and maintain swimmable, fishable waters around the world. This is a clear distinction from what many people perceive water preservation to be because waterkeepers are not responsible for supporting the drinking water industry. While surface water bodies and drinking water sources are typically linked to one another, they are not necessarily held to the same standards of quality. Rather, waterkeepers are focused on the broader picture of water health and the ability of water to support and heal people, spiritually and physically.

When the alliance hosts their annual conference to join all of the waterkeeper communities, a vast range of personalities and cultures come together. The result is a diverse, impassioned group, coordinated by language interpreters and workshops. These workshops deal with a variety of issues and topics related to the management of a body of water. One interesting factor in planning for any aspect of the conference is that the waterkeepers are associated with different types of waterways. Waterkeepers protect bays, rivers, lakes, and various other forms of water, each with a distinct set of characteristics and concerns. Several topics of the individual workshops included briefings on water policy, a social media 101 class, regional meetings for waterkeepers to discuss common themes in their areas of the globe, reflective presentations given by waterkeepers about their work, and an extended workshop on creating a water quality monitoring Study Design, led by ALLARM.

Our study design workshop was marketed to waterkeepers originating in Central and South American countries. Targeting this audience meant that the workshop had to cater to their language needs and therefore all of the worksheet and powerpoint materials were duplicated in Spanish translated formats by myself and my bilingual colleague, Hayat Rasul. This undertaking took an entire semester and required the oversight and assistance of several Spanish speaking experts, including Dickinson Professor of Spanish, Dr. Elise Bartosik-Velez.

All of this hard work and dedicated effort was immediately worthwhile upon arriving at our workshop of enthusiastic waterkeepers. Of the 22 participants, 16 were native Spanish speakers and 3 were from African countries, making it an extremely international audience. The core of the workshop was presented in English, relying upon Spanish language interpreters to translate the presentation in real time for the audience. Following the end of the organized powerpoint and use of the interactive worksheets, however, the rest of the time was free. During this section of the workshop, the attendees were able to experiment with visual aids for typical water monitoring processes, including preserved macroinvertebrates and water chemistry kits.

During this portion of the allotted time, I was able to communicate directly with the waterkeepers in Spanish. This oppor-

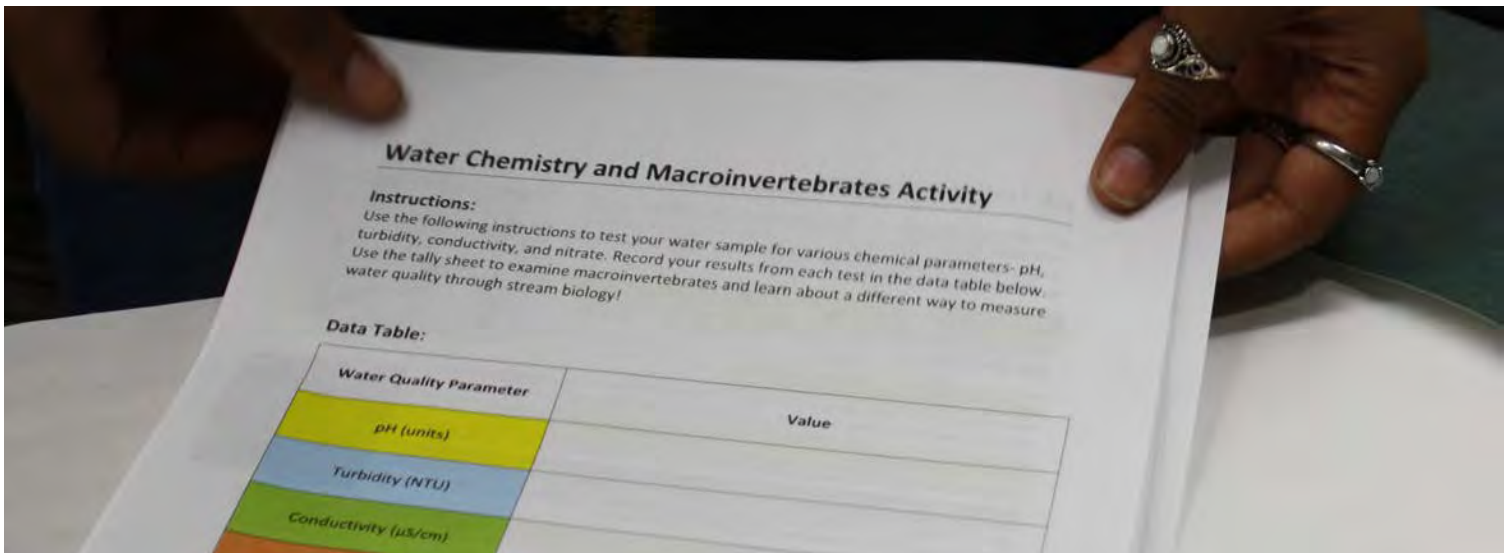
Watershed Coordinator Meredith Jones ‘20 consults with Spanish speaking waterkeepers as they look at macroinvertebrates through microscopes. Tracking the “bugs” living in a stream can tell you a lot about its water quality.

Watershed Coordinators Meredith Jones ‘20 (left) and Hayat Rasul ‘19 present at the Waterkeeper Alliance Conference.

ALLARM Director Julie Vastine talks to international waterkeepers about bacterial pollution in waterways.

tunity allowed me to learn about their individual personalities and watershed concerns, while they also told me about their cultures and we shared laughs. While the final hour or so of the workshop was slightly more chaotic, due to an overwhelming turnout and the less structured format, it was easily the most rewarding period of the entire conference for me. This was because it offered a fusion between my two areas of study and interest: Environmental Science and Spanish. It showed me that it is possible to build a connection between the two, or that a connection already exists.

The experience of the conference as a whole for me was new and exciting. Though I am not a waterkeeper and therefore was not invited to every event within the conference, I still was able to learn about the events from others and gained great insight into the life and work of a waterkeeper and their associated organizations. From this opportunity, I learned that there is a vast variety of issues regarding water quality which are faced around the world. For example, waterkeepers from Africa spoke about their struggles with bacteria as a result of improper wastewater disposal, specifically the threat of E. Coli. This issue was relatable to other waterkeepers from Mexico who were then able to communicate with their African counterparts, with the assistance of language interpreters. At meals, I was able to speak with waterkeepers and representatives of other water organizations. I learned that funding is a point of difficulty for many of them. I also found that a common theme in the development of water quality monitoring programs was the issue of volunteer attraction and retention. Throughout the conference, ALLARM director Julie Vastine was adept at providing guidance and insight into our organization’s experiences and successes in such areas.



Workshop attendees assessed their waterway health using ALLARM tools in both English and Spanish.

One interesting aspect of the experience was my difficulty in relating to other environmental professionals and the obstacles in my way as a college student trying to network withwater advocacy professionals. On several occasions I was referred to as an intern and I found myself running out of conversation topics with others because I am not a waterkeeper. Overall, however, I thought of myself as an observer in their space and learned a great deal about the field of water protection. An especially poignant event at the conference was the speech given by Robert Kennedy Jr. He spoke at dinner at one of the nights, as is traditional for the annual conference. His speech was centered around the idea that environmental harm is an active form of violence, and that environmental crime is real crime. He argued that both should be treated as such, but are often played down by society. This message fell on attentive ears and it was clear that Bobby Kennedy is a seasoned public speaker. The speech left me feeling empowered and inspired as a young professional and advocate in what frequently feels like a threatened field.

Leaving the conference after two days of complete immersion in a vibrant, diverse, water-loving community felt euphoric. I knew that ALLARM had accomplished something amazing and entered a new space in the environmental nonprofit field. I also felt like the most fulfilled Environmental Science and Spanish student in the world, as I had seamlessly merged my two central passions and areas of study. I know that this experience will live on in my personal and professional highlights for years to come, and I have not yet realized all of the lessons learned from the conference. One clear message from the workshop experience, that rings true no matter what, is that the future of water quality monitoring must be intersectional and diverse if we are to succeed at our mission of preserving this rich natural resource that fills the gaps in our Earth.

Watershed Coordinators Meredith Jones ‘20 (left) and Hayat Rasul ‘19 presented on the process of creating a water quality monitoring Study Design as well as specific case studies.

Senior Reflections

Left to right: Jinnie Monismith, Natalie McNeill, Sara Johnson ‘18, Cheyenne Moore ‘18, Jake Beley ‘18, Helen Schlimm, Julie Vastine.

Sara Johnson ‘18 (right) shows Watershed Coordinator Rachel Krewson ‘20 examples of the effects of stormwater runoff using a hands on activity.

Cheyenne Moore ‘18 trains volunteer monitors in the Conewango Creek Watershed Association.

Jake Beley ‘18 (left) prepares to lead community members on an informative hike around the LeTort Spring Run, along with Watershed Coordinators (left to right) Tom O’Donnell ‘19, Hayat Rasul ‘19, Nick Long ‘19, and Juliet Risko ‘19.

Jake Beley

One of my greatest accomplishments from this year at ALLARM was developing a program that can be used to convert data into the format needed for the new Chesapeake Bay water quality database. Through this process, I uploaded over 50,000 LeTort Spring Run data entries to the Alliance for the Chesapeake Bay database. Some of my fondest memories from my time at ALLARM have been the road trips and great community experiences. Thanks to these opportunities, the main skill that I developed while working at ALLARM is how to actively communicate with a diverse group of people. I was able to interact with community volunteers, teachers, children, young adults, and professionals. These diverse interactions helped me to gauge and understand how to succeed in different settings. Additionally, something I have really seen at my time at ALLARM is the power of community. A community with passion can do incredible things. I have been able to use this revelation with my work in computer science too when dealing with online communities of software developers which is something, without ALLARM, I wouldn't have seen so clearly. Overall, I loved all the different outreach events and opportunities that ALLARM has provided me with.

Sara Johnson

This was my first, and unfortunately last year, at ALLARM. My time here has been rewarding because it gave me a chance to learn more about the Carlisle and greater Pennsylvanian communities. Before ALLARM, I did not interact with the Carlisle much other than restaurants and local sites. As a watershed coordinator, I participated in the Stormwater Spectacular, Snapshots, Johnston's Run Council workshop, and Middle Riverkeeper Susquehanna training that allow me to interact and hear the concerns of community members about their water resources. Not only did I have the chance to interact with community members, I learned more about local environmental issues outside of the classroom. Initially, I applied to ALLARM to gain more experience research water policy. I gained this knowledge while also understanding environmental regulations and policies specific to Pennsylvania such as Shale Gas Policy and Act 13. I am thankful for this experience. Some of my favorite memories were showing Carol from the Middle Susquehanna Riverkeeper our water quality equipment in the back of the trunk, attending the Chesapeake Watershed Forum, and the educational activity at the Snapshots. Thank you for everyone at ALLARM and community partners that made my ALLARM experience great! To future and current ALLARMies, best of luck and enjoy the experience!

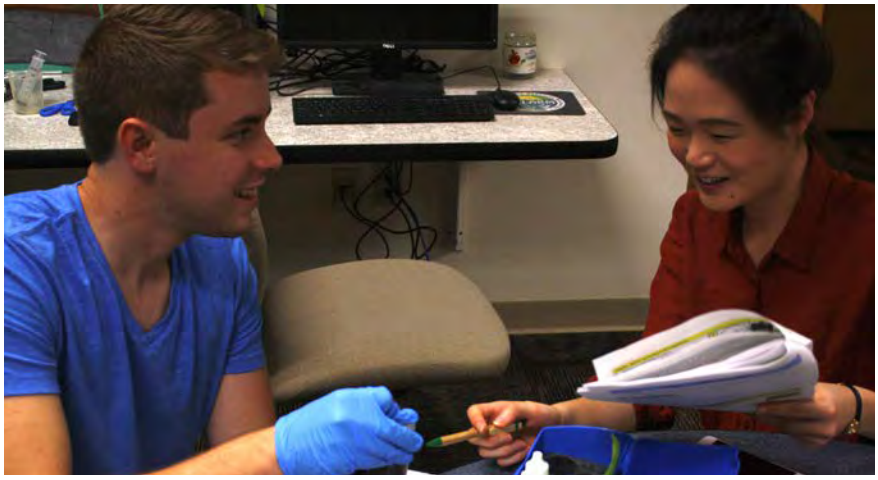
Cheyenne Moore

I learned about ALLARM my first year at Dickinson, both through founder, Candie Wilderman and Director, Julie Vastine. I remember Julie giving a talk one evening about the work ALLARM does. I emailed her later that same night, asking when I would be able to apply. Now my third year at ALLARM is coming to a close, and I am at a loss for words to express how thankful I am for the opportunity. ALLARM has taught me so much. Through my time and experiences here my confidence has been built in the lab, speaking in front of groups, guiding hands-on activities, and generally how I carry myself. ALLARM has been so much more than a job for me the past three years. Everyone here is a family and a support. I am constantly inspired and encouraged by the people around me here. This job has allowed me to become a more informed and engaged citizen not only of the Carlisle community, but also in my home town. I grew up wanting to help the environment. As I have aged my idea of what that looks like has changed. Until I came to ALLARM I thought the best way to do this was to collect data and publish a paper. ALLARM has taught me that that is only part of the solution. You need to involve the community. The work I have been able to do while at ALLARM, helping other Pennsylvanians with concerns that impact my own community, has been such a rewarding experience. In June I will start a M.S. at Bucknell University, where I intentionally chose an advisor who values science accessibility and outreach. I will take the skills I learned while working at ALLARM into this program, but more importantly I will take the passion I have gained for helping make science accessible for communities.

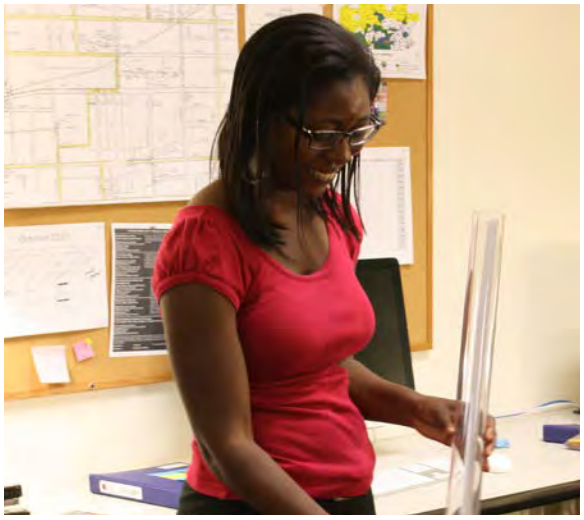
Sara Johnson '18 (right) prepares to enter a stream with Watershed Coordinator Allison Curley '19 (left) and Helen Schlimm.

Cheyenne Moore '18 (center) analyzes macroinvertebrates with Watershed Coordinator Tom O'Donnell '19 and Julie Vastine.

Jake Beley ‘18 practices water chemistry with Helen Schlimm and Watershed Coordinators Xinyi Wu ‘19 and Juliet Risko ‘19.



Jake Beley ‘18 prepares for a water quality monitoring workshop with Watershed Coordinator Xinyi Wu ‘19.



Sara Johnson ‘18 prepares to train the Middle Susquehanna Riverkeeper on methods such as water clarity testing.

Cheyenne Moore ‘18 discusses water quality with a community member at the seasonal Conodoguinet Creek Snapshot.

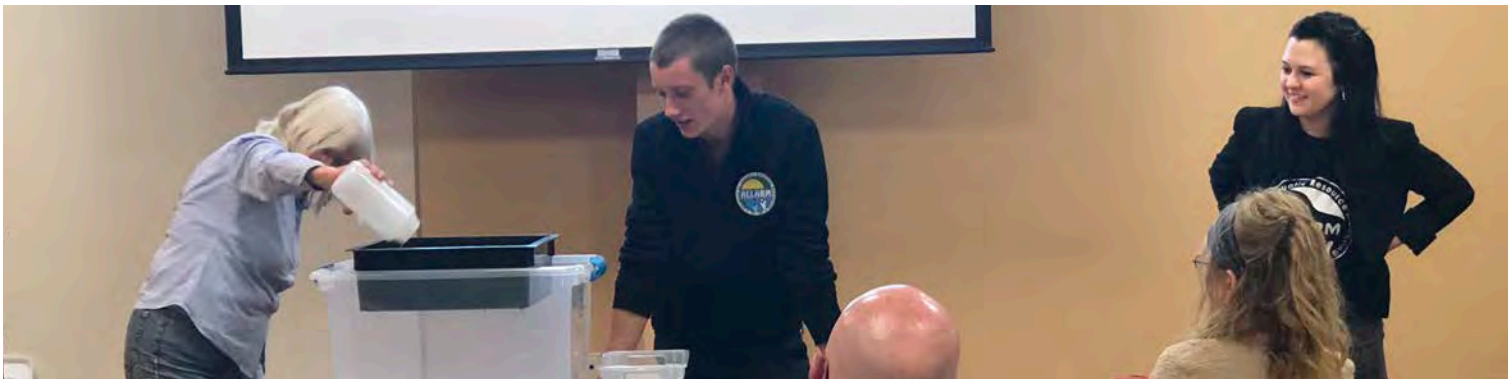
Jake Beley ‘18 collects macroinvertebrates with Watershed Coordinator Hayat Rasul ‘19.

ALLARM in Pictures

Katherine Altamirano ‘20 (left), Sara Johnson ‘18, and Abby Kaija ‘20 label bottles for Shale Gas volunteer monitors.

The 2017-2018 ALLARM staff after enjoying a team dinner.

Hayat Rasul ‘19 collects a water sample from the Conodoguinet Creek.



Pentti Hanlon ‘19 and Meredith Jones ‘20 educate Carlisle community members on stormdrain maintenance at Love the LeTort.

Xinyi Wu ‘19 (left) and Allison Curley ‘19 clean up local storm drains with a community member at the Stormwater Spectacular.

The ALLARM 2017-2018 staff.

Katherine Altamirano ‘20 and Tom O’Donnell ‘19 monitor the LeTort Spring Run.

Tom O’Donnell ‘19 and Allison Curley ‘19 train volunteer monitors in the Conewango Creek Watershed Association.

Rachel Krewson ‘20 (left), Sara Johnson ‘18, and Helen Schlimm prepare to train the Middle Susquehanna Riverkeeper.

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