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How Climate Change is Increasing Demand for Water-Related Curricular Resources; A Q&A with the California Academy of Sciences

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and

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Abstract: *Journal of Sustainability Education* senior editor Amanda Bielawski sits down with Megan Schufreider, director of education for the California Academy of Sciences to discuss how climate change is creating more demand for water-related curricular resources, with a specific emphasis on the importance of teaching about virtual water footprints. The Q&A interview concludes with a list of water-related curricular resources, including various water footprint calculators, available to both educators and the public.

Keywords: California Academy of Sciences; curriculum; virtual water

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According to Megan Schufreider, director of education for the California Academy of Sciences (Academy), "the urgency of climate change was at the root of [the Academy's] decision" to develop new curriculum resources addressing water conservation. During recent years, the Academy introduced its "Fresh Solutions: Water Use and Conservation" curriculum, which includes dedicated learning modules related to so-called *virtual* water, including resources for calculating a *virtual* water footprint. Designed for students in grades 6-8, the curriculum is freely available for educators at https://www.calacademy.org/educators/fresh-solutions-water-use-and-conservation.

Figure 1. The "Fresh Solutions: Water Use and Conservation" curriculum was developed as the result of increasing demand for water literacy resources associated with climate change.

In this Q&A interview, *Journal of Sustainability Education* senior editor Amanda Bielawski asks Schufreider a series of questions relating to the recognized growing demand for water-related curriculum resources in the era of climate change, as well as the importance of directly addressing *virtual* water issues in such curricula.

Bielawski (JSE): Before we dive into the specifics about water curricula development, tell us about your specific role at the California Academy of Sciences (Academy):

Schufreider (The Academy): "In my current role as the Director of Education, K-12 Partnerships and Online Learning, I oversee the team responsible for all of the Academy's efforts supporting K-12 science education, be it through field trips for school groups, distance learning programs for students from afar, professional development for teachers, or the creation of teaching resources for the science classroom. After a stint as a middle and high school science teacher in Los Angeles, I joined the Academy in 2007. At that time, I managed a multiple-touchpoint outreach program focused on connecting San Francisco public school students with their local natural landscapes. Since then, I simply took on more responsibility over time, building out new programs, focusing on marketing our resources, developing our reputation, and keeping my extremely talented and passionate team of educators as happy as possible!"

Bielawski (JSE): What prompted the Academy to develop new water conservation teaching materials? What specifically does the new curriculum teach?

Schufreider (The Academy): "The urgency of climate change was absolutely at the root of our own decision to make the materials. However, we didn't survey teachers directly to ask them if they would select this topic over others.

Humans depend on water, and our need for this precious resource is growing alongside our population. In this unit designed for middle school audiences—but applicable for high school and community college classrooms, as well—students engage in the design thinking process as they explore key water issues, the water cycle, and some of the technology used to conserve water, with the ultimate challenge being to tackle a water use issue at their own home or their own school. Teachers can access a one-page unit summary here.

Figures 2 and 3. The "Flipside Science" curriculum from the California Academy of Sciences focuses on increasing scientific and environmental literacy.

The 'Fresh Solutions' curriculum is part of a larger series we call 'Flipside Science,' which we developed starting in 2015 as part of a broader initiative to increase scientific and environmental literacy nationwide by providing free, online resources for K-12 teachers.

In response to the need to foster '21st Century Skills,' "Flipside Science" empowers students to make choices that positively impact their communities while teaching them about important environmental science concepts; teaches critical thinking by providing opportunities for groups to evaluate evidence and competing viewpoints; fosters collaboration with the embedded group-work; and highlights youth voice and a sense of creative agency that will be necessary for solving current problems related to water availability."

Bielawski (JSE): The "*Fresh Solutions*" curriculum focuses a significant amount of time on so-called *virtual* water. Why? And, for our readers, what exactly is *virtual* water?

Schufreider (The Academy): "You can think of your *water footprint* as the water you notice you directly use in your everyday life: drinking, washing your clothes, doing the dishes. Your *virtual water footprint* is much, much larger, as this takes into account the water that is needed to produce the goods (and services!) you consume, buy, or utilize daily.

It's imperative that we understand the concept of virtual water because the sheer volume of virtual water that is invisible to us will be a more effective 'lever' to pull when making policy decisions related to water conservation.

For instance, the curriculum supports students in understanding that it takes 350 times as much water to *produce* soda than the volume of soda consumed directly itself! According to Your Water Footprint, a resource used within the Academy's virtual water curriculum, it takes 175 liters (46 gallons) of water to *produce* a half-liter bottle of soda. Why is so much water used in the production? According to Your Water Footprint, to produce a half-liter of soda, it takes 163 liters of water to produce the flavor and another 11.5 liters of water to support the manufacturing and supply chain. Just 500 milliliters of water is used directly in the product itself.

In the first lesson of the 'Fresh Solutions' unit, titled 'Your Hidden Water Footprint,' students explore the often surprising amount of water indirectly used in producing everyday products like cola, leather boots, smartphones, and chocolate bars, to set the stage for the later design challenge."

Bielawski (JSE): How has climate change changed the urgency of the need for students and the public to understand the concept of *virtual* water consumption?

Schufreider (The Academy): "Climate change only exacerbates the urgency of this need since changes in the availability of water due to climate change—particularly for agriculture, which our future community will depend on—have been observed and reported globally. Moreover, freshwater is not distributed equally around the globe, and the over two billion citizens who live in water-stressed areas will rely on solutions to water scarcity."

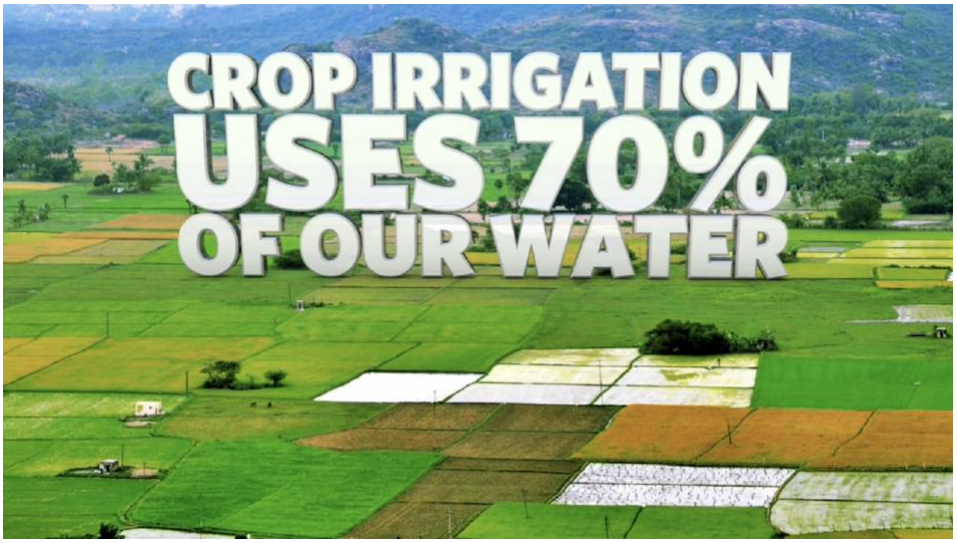

Figure 4. The "Fresh Solutions" "Your Hidden Water Footprint" curriculum helps students contemplate the water used in products they consume, including food.

Bielawski (JSE): Do you recommend any specific virtual water calculators?

Schufreider (The Academy): "We integrated the water calculator from the Alliance for Water Efficiency into the second lesson of the unit, but I wouldn't say we endorse any one specific water calculator, as the tool may change depending on your learning goal." ***(Editor's note:*** *The JSE has compiled a list of available virtual water calculators and curricular resources at the end of this Q&A article.)*

Bielawski (JSE): Have you personally gone through the process of calculating your own virtual water footprint? What did you learn? Were you surprised?

Schufreider (The Academy): "I remember when, during one of our science nights at the museum for local families, I approached the activity table where a volunteer was facilitating a demonstration that we eventually morphed into the 'How Much Water Do You Eat?' lesson plan. Since I don't cook meat at home, I figured the choices that I put into my hypothetical meal would involve a lower water usage. While this was true for all the fruits and vegetables, I was surprised at how much water went into eggs and cheese. Upon reflection, I realized that 'Of course! Those are animal products, too!' but the water footprint didn't click until that point."

Bielawski (JSE): Did the Academy develop the curriculum in response to any particular demand for it? How did the Academy get the idea that this was a curricular niche that needed filling?

Schufreider (The Academy): "We chose to focus on key sustainability issues related to food, water, and energy systems, as these broader topics could highlight behaviors at the individual, community, or systemic level that would contribute to a resilient future. We heard a few things from our local teachers: the need for resources that are relevant to a diverse student population of varied skills, backgrounds, and identities; an anxiety around the adopted-but-not-yet-implemented Next Generation Science Standards; and an increased use of media in the classroom to engage their kids. As such, we intentionally selected high school students from our own youth interns at the museum to act as hosts. Speaking of the standards, the curriculum used the 'Human Impacts on Earth Systems' Disciplinary Core Idea as its anchor, while the design thinking cycle engages students in various Science and Engineering Practices. We wove the videos into the lesson plans as engagement pieces, and made sure to keep a 'can-do,' solutions-oriented tone."

Bielawski (JSE): Do you have a sense of how many classroom teachers have used this curriculum, and how both students and teachers have reacted to the learning?

Schufreider (The Academy): "The need for the materials produced by the Academy (and other amazing organizations!) is clear. Nearly all teachers who responded to a 2018 survey conducted by an external evaluator, Public Profit, which reported their schools have time set aside for science instruction (85%), but 41% reported not having adequate science teaching materials, and 62% said they do not have adequate professional development opportunities in science learning at their schools. These findings support the case for the Academy's sense of urgency around our efforts to distribute free, high-quality supplemental learning resources.

Tracking webpage views is not an exact science, but across the "Flipside Science" series (which also includes units not focused on water), the resources have garnered over 600,000 views to date. We've also mailed USB drives to over 900 educators who requested a free hard copy of the materials; they reported using the resources with a cumulative 180,000+ people. Here are some of the comments we've received directly from educators related to the specific water conservation unit:

> 'It can be hard to have urban youth feel connected with nature, understand that their actions have repercussions (and that their water and food do not originate from a faucet or local supermarket), and feel empowered to make a difference.' (7th and 8th grade teacher, Bridgeport, Connecticut)
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> 'The biggest problems confronting our planet are all related to the environment. My students, like most low income students, do not have the opportunity to participate in programs that introduce them to the issues we confront. Given that we are so busy still teaching to standards there is often not time to develop resources to teach students about these problems. In addition, I live and teach in an area which has been especially hard-hit by the California drought. Many of my students live in homes without running water. These resources will help educate these students how they can work to solve some of our most pressing problems.' (9th-12th grade teacher, Porterville, California)

> 'We are a high school that has a large percentage of free or reduced lunch students. I am very appreciative of any resources that we can receive to help our students relate to the material they are learning. I will be able to tell the students this information, especially on the water unit, comes from one of the areas that has a water shortage that we learn about.' (9th grade teacher, Amite, Louisiana)
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> 'As access to water and food become bigger issues, especially in California during the drought, I hope to use these resources to better inform and educate my students so they can be educated consumers and advocates.' (7th grade teacher, Auburn, California)
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> 'Stewardship of the environment is a principle that we hold dearly and emphasize throughout our curriculum. It is important for students to learn about being responsible ecocitizens at an early age. It is not enough to just have students learn about the water cycle or carbon cycle, they should be exposed to information that stresses their (and our) responsibility for caring for the planet and conserving our valuable natural resources.' (6th-8th grade teacher, San Anselmo, California)
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> 'In the last few years I have had my students work on in class science fair projects that revolve around these topics! How to feed the increasing population. How to use grey water and what biodegradable detergents are best used for this. Always looking for ways to increase knowledge and connections to what they are doing with the "real world" and this is perfect!' (7th grade teacher, San Jose, California)

Sentiments such as these illustrate how educators feel compelled to focus classroom learning on topics with contextual relevance for their students that subsequently tie into matters of global concern. When I read survey responses from educators expressing how it is 'so important that kids know there are ways to combat climate change' or showcase teachers who strive to 'help students go forward in our communities as climate change warriors and agents of change,' I can see how teachers are pairing a growing understanding of human impacts on the planet with a positive outlook, framing water conservation issues as an opportunity for young people to shape our future. "

Bielawski (JSE): Tell us a little bit about how the Academy engages more broadly in curriculum development around sustainability and environmental issues. For instance, while many people are aware of the California Academy of Sciences Museum in San Francisco, many may not be aware of the role the Academy plays in providing curricular resources. Tell us more! How can educators get involved?

Schufreider (The Academy): "Gladly! Even before I started at the Academy in 2007, our education department has posted free lessons and videos online, primarily those produced as model lessons for our in-person professional development workshops, teacher institutes, or student field trip programs. The Academy is fortunate to have an in-house Science Visualization Studio, with graphic artists and animators working lockstep

with scientists and educators to produce award-winning Planetarium shows, interactives for exhibits, and videos for free online publication. Our K-12 education department partners with this 'Viz Studio' to repurpose existing works for free educational use (e.g., we rendered our immersive full-dome shows into flat high-definition films that can stream into classrooms via YouTube), as well as to create new content. In 2015, thanks to a generous multi-year grant from the Pisces Foundation, we were able to focus our efforts on some new product lines, one of which included "Flipside Science." Educators who want to learn more about these resources can join our educator e-newsletter. We regularly share out new and existing resources, remind teachers of our free distance learning broadcasts for students, and announce our teacher professional development calendar each season. Educators also can learn more at www.calacademy.org/educators."

Bielawski (JSE): I understand the Academy has an interesting history of how it developed and grew over time. For educators who might be curious, would you share part of that story for context?

Schufreider (The Academy): "On an evening in 1853—just three years after California joined the United States—seven men assembled in a candle-lit room in San Francisco and founded the first scientific academy west of the Atlantic seaboard. Local naturalists' fieldwork generated a growing collection of research specimens, so a museum was opened on Market Street to display these scientific treasures. The California Academy of Sciences soon became one of the West's most popular destinations, drawing some 80,000 visitors annually to gaze at its giant wooly mammoth, taxidermied grizzly bears, native plant specimens, and rare artifacts.

But when the Great Quake of 1906 struck the city, the Academy's home—and all but a handful of its specimens—were lost. As luck would have it, however, a two-year Academy expedition was in the Galapagos Islands at the time, gathering material that would one day form the nucleus of the institution's new collections.

In 1916, the Academy found a new home in Golden Gate Park, where it grew over the decades to include North American Hall, Steinhart Aquarium, Simson African Hall, Science Hall, Morrison Planetarium, and more. But 1989, the Loma Prieta earthquake shook the area once more, causing major structural damage that left the Academy in need of another beginning.

The Academy used this as an opportunity to rethink the entire museum-going experience. The new vision: to create an institution for the 21st century—a premier destination of grand design that would bring the latest in scientific research to the public in the most engaging, educational, and inspiring ways imaginable. Now home to Steinhart Aquarium, Morrison Planetarium, and the Kimball Natural History Museum—as well as world class research and education departments—the Academy's mission is to explore, explain, and sustain life."

Bielawski (JSE): Megan, thank you for sharing insights about teaching water conservation and virtual water in the context of climate change.

Schufreider (The Academy): "You are most welcome. Thank you for keeping the dialogue going between formal and informal educators so that we can continue to cultivate our own environmental literacy and improve our teaching practice—our children, youth, and communities deserve it!"

The *Journal of Sustainability Education* offers the following list of resources related specifically to virtual water:

- **California Academy of Sciences:**
  - "Fresh Solutions: Water Use and Conservation" "Flipside Science" Unit
  - "Your Hidden Water Footprint: Defining a Problem to Find a Solution" Lesson

- **Water Footprint® Calculator:**
  - Calculator
  - Curricular materials

- **Water Footprint Network:**
  - Calculator
  - Curricular materials

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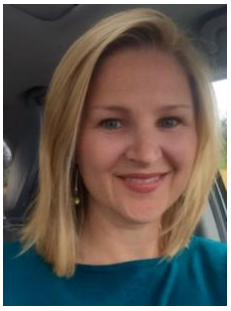

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