Engineering the Environment: A Lori Siegel Biography

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Eleven million gallons of oil spill into Alaska's clear blue waters, polluting the Bligh Reef and contaminating the surrounding ecosystems. Animals lose their habitats and what was once an environment teeming with life is now a puddle of crude oil, destined to remain polluted for years to come. In 1989, Lori Siegel, a senior in high school, witnessed the devastation of the Exxon Valdez oil spill through the current issues class being offered at her school. Seeing the utter devastation of the wildlife, she made a crucial decision: "this can't be."

Growing up in Providence, Rhode Island, Lori had always been drawn to math and science. Maybe it was the fact that math was not ambiguous, or maybe it was simply how her brain worked, but math and science just made sense. Along with her passion for mathematics, she always had a fervor for the environment. "After all," she exclaimed, "the environment is the only thing that affects us all, and if we don't take care of it, we're done for." The Exxon oil spill was clearly not ambiguous to eighteen-year-old Lori—it was horrific, and absolutely wrong. Seeing the rising environmental crisis along with the tragic oil spill only reaffirmed her ambitions to find a career that utilizes her passion for mathematics and science, along with her fervor for helping the environment.

Motivated by the ongoing climate crisis, Siegel went on to get her bachelor's and master's degree in civil engineering at Tufts University, majoring in environmental engineering. Later, while pursuing her PhD at Northeastern University, she discovered that system dynamics analysis would help her accomplish the objectives of her doctoral dissertation, which required assessing the impacts of chemical, biological, and physical processes. She learned that this modeling methodology is a powerful tool to understand complex systems because it can capture the interrelationships of many factors within a system. As Siegel states, "It helps us understand the bigger picture of what's actually happening throughout the world by using math to describe physical behaviors." This specific type of mathematical modeling is now what Siegel currently uses within her field of environmental engineering.

Climate change has been a long standing global issue, and is now one of the most notorious concerns of the modern era. People struggle to understand the effects that this crisis has on the world because of the complex factors it involves—climate change is experienced differently by everybody depending on aspects such as region and socioeconomic status. This obstacle is combatted from a unique perspective by Climate Interactive, the non-profit organization that Siegel is currently dedicated to. Driven by a system of mathematical equations, Siegel creates computer modeling tools for Climate Interactive directed towards helping people understand the implications that their decisions have on the climate. For instance, in Climate Interactive's En-ROADS simulator, users can adjust variables like carbon pricing, renewable energy

subsidies, or deforestation rates. The model uses differential equations to calculate how atmospheric CO_2 concentration changes over time—if you increase renewable energy subsidies by X%, the model shows how much global temperature rise might be reduced by 2100. What makes this powerful is that the equations capture feedback loops: as temperature rises, it affects ice melt, which affects albedo (earth's reflectivity), which further affects temperature—all interconnected through mathematical relationships.

The model allows everybody from students to policymakers to test the effects that their own parameters have on the environment. Siegel states that "by allowing people to conceptualize the consequences that their specific settings have on the climate, it causes them to take action and go teach others about what they have learned, and that in itself is an action." Part of the battle against climate change is acknowledging that "the only definitive solution is that there is no one silver bullet when stopping it," as Siegel puts it. By creating accessible tools that display every unique parameter, it simultaneously creates the accessibility required to make informed decisions upon the matter. The models that Siegel develops give us insights on unforeseen consequences that need to be considered before making decisions in order to properly mitigate the issue of climate change.

As someone currently studying algebra and geometry, I initially thought of math as abstract—solving for x, proving theorems. But Siegel's work showed me that equations can be verbs, not just puzzles. They do things: they predict, they warn, they help us make better decisions. The climate crisis isn't solved by one calculation, but by building systems of equations that mirror the complexity of reality itself.

Siegel's work at Climate Interactive has had widespread effects on how people from all over the globe understand the effects of climate change. The accessibility that her models provide have influenced not only the general public, but the drafting of the Paris Climate Accords—which she recalls as one of her most significant breakthroughs her work has brought. Siegel reveals that she believes that her work gives her a purpose—by playing these significant roles in influencing the public's decisions, she can say that her developments help her achieve her childhood goal: make the environment a better place.

Lori talks to me in the comfort of her home with the passion of someone who just started their career. Her whole career has been dedicated to helping the world and she has openly expressed that her models, as well as passions, are only evolving alongside ongoing climate issues. By developing mathematical models, she has created unique insights that play crucial roles in the decision making of many across the globe. Siegel acknowledges that the climate crisis will never be fully resolved, however she is driven by the fact that we as a society can take steps to mitigate it.

Lori confesses that she believes herself to be incredibly lucky—"It was really fortuitous. It started as a project within another organization, then in 2010 we spun off to become our own organization." Her path naturally aligned with her dedication to doing good for the world and

what she simply enjoys: equations. After expressing my concerns towards future paths, Lori left me some insightful advice: "discovering your passions won't be a linear path." She expresses how her current job (environmental engineering) was not even created until she was starting college. Her best advice as many of us travel this bumpy, unclear path: advocate for yourself, and find others who will advocate for you—and don't forget to leave the world better off than you found it.

About the author:
Cassidy Saxon is a 9th grader at Lebanon High School. After skipping a grade, she is currently dual enrolled in Algebra/Geometry 1 and Algebra/Geometry 2. With a profound interest in competition, she is a member of the Lebanon debate team and selective Model United Nations team. Along with the diversity club, she takes part in communities that all strive in making the high school more inclusive and intellectual. Cassidy's free time is spent on her passion for piano, which she has played since childhood, tennis, discovering fascinating new historical events to research, and indulging in long book series.