



WATER IN THE WORLD

*Advancing Research to Solve the Water
Security Challenges of the 21st Century*

WATER CENTER

THE UNIVERSITY OF UTAH



The University of Utah's Water Center is dedicated to improving lives through interdisciplinary research promoting the security of the Earth's water systems.

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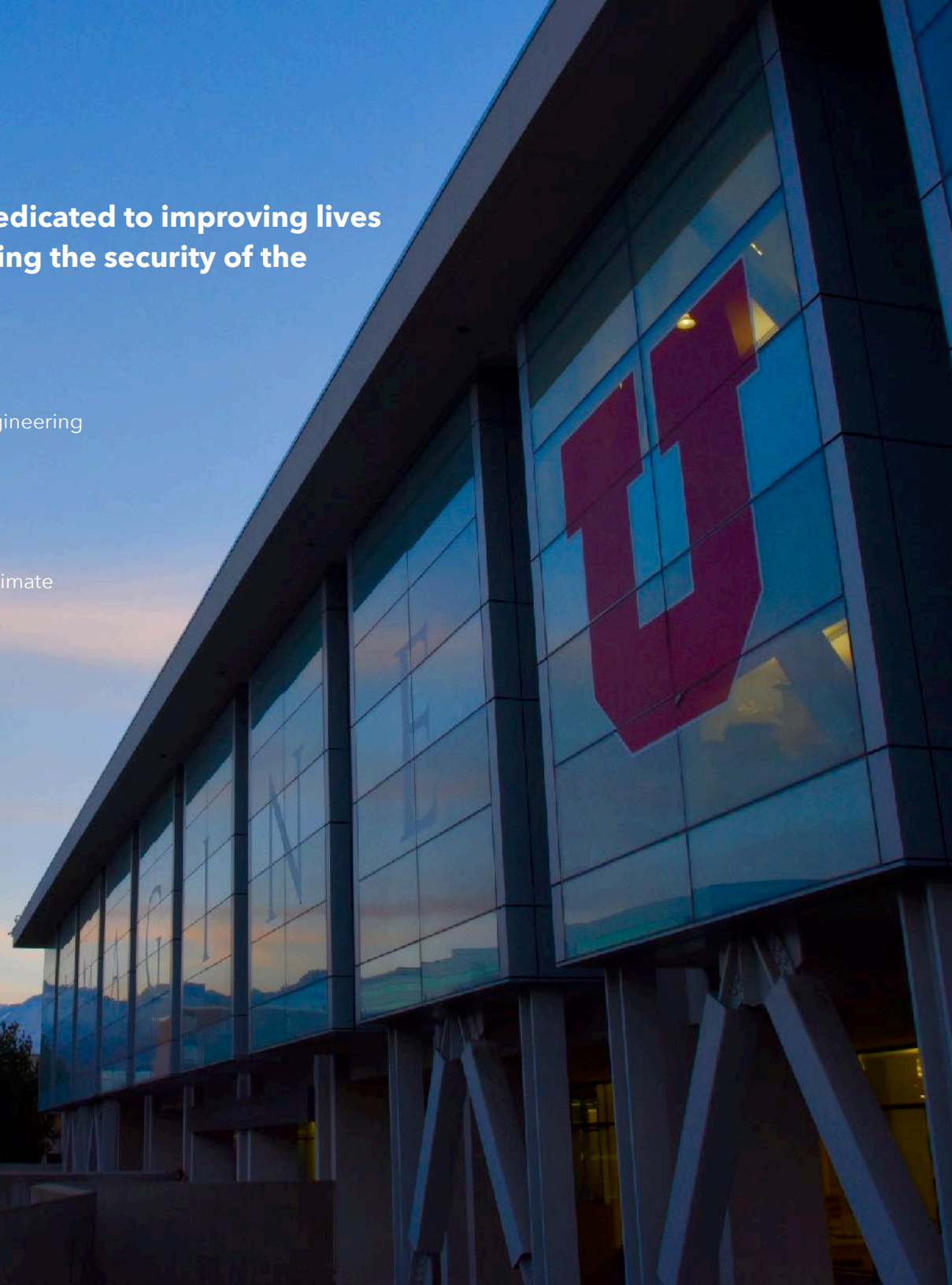
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VISION



WELCOME...

to  Water in the World

This publication is an effort to tell the stories of the research taking place at the University of Utah that is focused on solving some of the world's most pressing water security challenges. In this issue we feature the work of two U of U researchers working on the forefront of their respective fields. Ramesh Goel has had a remarkable career, working on water engineering projects all over the world. Our profile focuses on his current research initiative working to track, contain, and decontaminate water infected with antibiotic resistant bacteria. Krista Carlson's work offers a model example of applied academic research leading to technological innovations and venture development. We look at her new patented technology that uses nanotubes to create a portable and inexpensive water purification device. We conclude with an update from the Water Center's USAID-funded U.S.-Pakistan Centers for Advanced Studies in Water student exchange program, which brings aspiring engineers and water technicians from Pakistan to study for a semester at the U. This program is entering its third year, and this is an opportunity to look back on what we have accomplished.

We are looking forward to the work ahead!

-Steve Burian
Director, The Water Center

CONTENTS

WATER IN THE WORLD



RESEARCH

5 | The quest to detect, contain, and decontaminate water infected with antibiotic resistant bacteria.



INNOVATION

7 | Using nanotechnology to innovate new methods of purifying contaminated water—new patented technology.



EDUCATION

9 | Two years of lessons and accomplishments from the USPCASW student exchange program.

RAMESH GOEL & THE QUEST TO DETECT AND CONTAIN ANTIBIOTIC RESISTANT BACTERIA IN WATER

The development of antibiotic drugs was one of the defining public health achievements of the twentieth century. These medications have saved millions of lives by enabling the body to better fight off infections. Over the past decade, especially in part of India and Africa, strains

of bacteria have emerged that are resistant to antibiotics. News reports have gone as far as to label this resistant bacteria “super bugs,” and the Centers for Disease Control rates their emergence as one of the world’s most pressing health challenges.

Professor Ramesh Goel is dedicating himself to finding a solution to this emerging public health crisis. He directs the University of Utah's Surface Water Quality and Water Sustainability Lab in the Civil and Environmental Engineering Department. The source of the problem, according to Goel, is the overuse of antibiotics in much of the developing world. According to the CDC, as much as 50% of outpatient antibiotic use around the world is unnecessary.

These drugs are often improperly disposed of and accumulate in local water supplies. Over time, bacteria in the water grow genetically resistant to the drug's effect. This resistant bacteria can make people susceptible to what today are routine strains of pneumonia and diarrhea—the two leading causes of human death prior to the discovery of antibiotics.

Professor Goel and his team are researching the “kinetics of infection”—how this resistant bacteria travels through water systems. The lab is also working on developing new techniques to track, contain, and ultimately disinfect contaminated water. This research involves studying the efficacy of UV radiation in treating contaminated water, in addition to testing the potency of different dosage levels of chlorine and monochloramine.

This research project is being funded through grants from USAID and the National Science Foundation. “We have to be proactive to meet these challenges,” Goel explains. “The research we are conducting in our lab is directly related to people's health. We are working to safeguard the welfare of communities on a global scale.”



Visit WATER.UTAH.EDU to read about additional research into antibiotic resistant bacteria being done at the U by Professor **Jim VanDerslice** and his grad students in the Division of Public Health.



Professor **Krista Carlson** and a prototype of the ElectroPur water purification system.

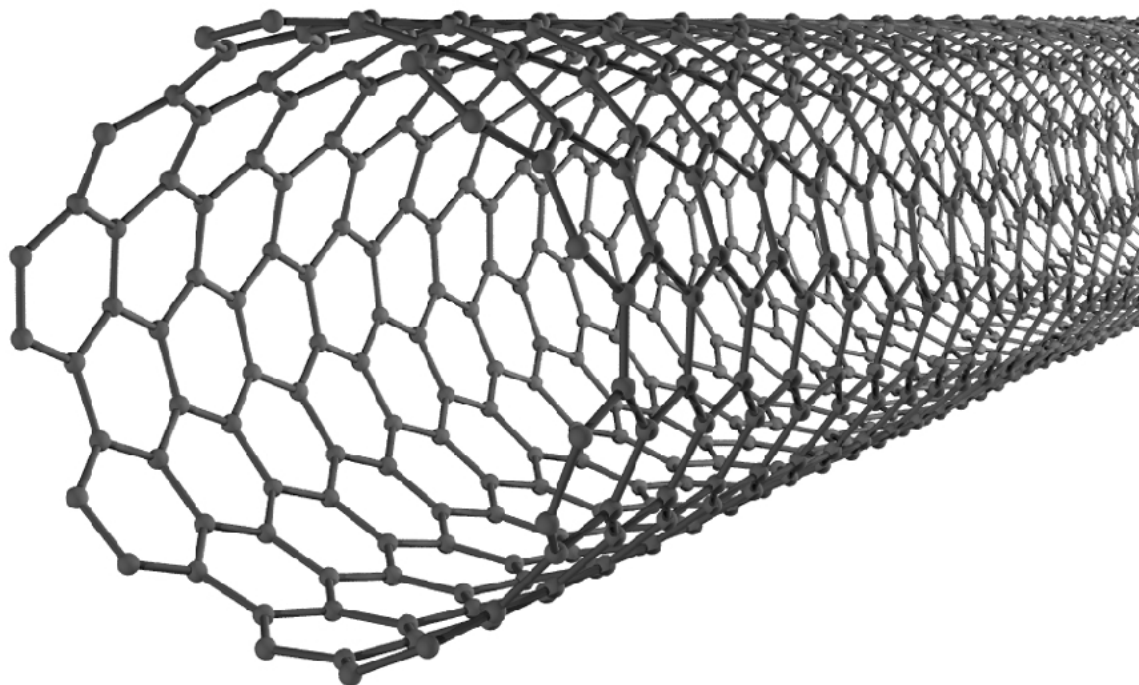
USING NANOTECHNOLOGY TO PURIFY WATER

Professor Krista Carlson's research is at the forefront of using the field of nanotechnology to develop new and innovative methods of treating contaminated water. Her patented technology has resulted in a new commercial venture, the ElectroPur System, and is a prime example of academic research resulting in a commercially viable end product that addresses real world problems.

The ElectroPur System is still in its product development stage, but shows great promise as a low cost, portable, and environmentally sensitive water purification system.

Professor Carlson and her team work in the Department of Metallurgical Engineering Renewable Energy Lab. Researchers in her lab are developing new ways to create tiny nanotubes out of titanium dioxide (TiO_2). These tubes, combined with a low voltage of electricity, can be used to treat contaminated water. Running a low voltage electric current through TiO_2 nanotubes results in the generation of hydroxyl radicals that attack water borne contaminants such as bacteria and e coli.

The ElectroPur System is still in its product development stage, but shows great promise as a low cost, portable, and environmentally sensitive water purification system. The technology's low energy demands make it compatible with portable solar power sources, making the system a viable alternative for remote communities or as a good treatment



option in the wake of natural disasters. Carlson's research is being funded through a grant from the National Science Foundation and the STTR.

Professor Carlson sees her work as one piece of a larger puzzle of meeting the growing need for new innovations in dealing with the world's water pollution and sanitation challenges. She is emphatic: "There needs to be a paradigm shift in the way our communities think about and use water."

EDUCATION

The U.S.-Pakistan Centers for Advanced Studies in Water student exchange program enters its third year

In 2015, with the help of a \$10 million grant from USAID, the University of Utah entered into an innovative partnership with Mehran University of Engineering & Technology in Pakistan to create the U.S.-Pakistan Centers for Advanced Studies in Water. The goal of the USPCASW is to build up the capacity of Pakistan's engineers, water technicians, and institutions in order to help confront the serious water security challenges facing the region. A centerpiece of this effort has been the development of an international student exchange program bringing aspiring engineers and technicians from Pakistan to study for a semester at the U. This exchange program is entering its third year, and we are taking this opportunity to reflect back on some of the program's key accomplishments.

"The USPCASW student exchange program has enabled me to build up my capacity as a researcher and improve my technical writing skills. This program gave me access to information, technology, and training I would not have had otherwise."

-Zohaib Nizamana
Spring 2017 Cohort



KEY ACCOMPLISHMENTS

USPCASW STUDENT EXCHANGE PROGRAM



Applied Research-

Each exchange student is given a faculty mentor, and works on an independent research project. This effort includes a minimum of 100 hours of focused effort, and results in a poster presentation at the Water Center's semiannual Water Security Symposium.

Technical Writing-

The program offers students an intensive workshop in technical writing. The writing workshop incorporates thirty hours of formal instruction on grammar, syntax, and style, with eighty hours of writing practicum.

Course Work-

Students participate in some of the most challenging courses available at the university, including: epidemiology, hydroinformatics, and climate change impacts, among others.

Cultural Immersion-

The "Cultural Diplomats" program encourages students to take the initiative to get involved in the community. Through this effort students have helped build homes for the needy, visited art museums, taken nature hikes, and attended community festivals.

The fall 2017 USPCASW cohort touring Salt Lake City's Municipal Waste Water Treatment Facility.

Professor **Rick Bereit's** writing workshop serves as one of the anchors to the exchange program. The workshop incorporates thirty hours of formal instruction in technical writing with over eighty hours of writing practicum.





USAID
FROM THE AMERICAN PEOPLE

U.S.-Pakistan

Centers for Advanced Studies in Water



Professor **Jennifer Weidhaas's** students had the opportunity to demonstrate surface water and sediment porosity experiments for local school children as a part of the exchange program's community engagement initiative.

"The experience of the exchange program went far beyond the classroom. We had the opportunity to tour many of Utah's largest water infrastructure projects and meet with local water resource managers. Amazing opportunity."

-Faris Ahmed, fall 2017



EVENTS



The Water Center hosts a variety of events in an effort to promote cross-disciplinary cooperation on water related research at the University of Utah and with the local community.



WORLD WATER DAY–

In April the Water Center organized the University of Utah's first annual World Water Day. The event brought together an interdisciplinary panel of faculty and researchers to present their unique ideas and perspectives on water scarcity, sanitation, and security. The event emphasized ways to further academic collaboration.

Professor **Tariq Banuri** speaking at the U's 2017 World Water Day



UTAH WATER FORUM–

The Utah Water Forum brought together academic researchers from the U with Utah's water resources managers and representatives from local utilities. The focus of the event was fostering communication and finding new ways to make academic research directly relevant to solving real world community challenges.

The U's Senior Vice President **Ruth Watkins** introduces the Utah Water Forum



WATER SECURITY SYMPOSIUM–

The Water Center organizes a semiannual symposium that features student research projects focused on international water security issues. The symposium allows students to discuss their research and receive feedback from university faculty, staff, and students.

Utah State Representative **Eric Hutching** gives the Keynote at the Water Security Symposium



Professor **Pat Shea** from the University of Utah's Biology Department is dedicating his USPCASW Water Seminar to solving real world problems in Pakistan.



University of Utah hosted a delegation of officials from the Pakistan's Sindh province and Mehran University of Engineering and Technology, including MUET Vice Chancellor Dr. **Mohammad Aslam Uqaili**.



Dr. **Scott Benson** from the U's Division of Public Health uses environmental engineering to help prevent the spread of disease in Ghana.



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For more stories and images



Autumn runoff in Big Cottonwood Canyon, one of the many spectacular resources in the watersheds of the Wasatch Mountains.