ITech Preparatory students collect and record water samples on the Columbia River through the CRESCENDO Program.

PHOTOS: LAURA DUTELLE

TIME, PLACE AND *the river*

A PARTNERSHIP BETWEEN WSU VANCOUVER AND FIVE WASHINGTON HIGH SCHOOLS BLENDS SCIENTIFIC AND EDUCATIONAL RESEARCH TO LEARN MORE ABOUT COLUMBIA RIVER ECOLOGY.

A growing number of people live in the Columbia River watershed. They are rural, urban and suburban; they are building houses and roads, drawing water for energy and industrial use, farming, fishing and much more. Their activities affect the river upstream and down. Given the river's importance to the region's economy, understanding what is happening and why is essential to maintaining a healthy river, and growing sustainable communities and economies for future generations.

A research project led by scientists at WSU Vancouver is addressing this important need. Called CRESCENDO (Columbia River Scientific Education and Outreach), it is a partnership between five Washington high schools along the river and WSU Vancouver that integrates scientific and educational research. CRESCENDO has received $213,496 for this two-year project from Washington Sea Grant, a state entity set up to manage funds from the federal National Oceanic and Atmospheric Administration.

Each month, the high school science students collect water samples from docks near their hometowns, located along a geographic and ecological gradient of the river, from entirely freshwater (Washougal, just east of Vancouver) to coastal (Ilwaco on the Pacific Ocean). Bringing these river water samples back to their labs for analysis, the students are measuring how nutrients, harmful algae and invasive zooplankton species in their part of the river vary over time.

Their work complements longstanding research by WSU Vancouver's Aquatic Ecology Lab, which compiles and analyzes these and other samples in greater detail to identify how nutrients, plankton and invasive species vary from upstream to downstream and over time (years to decades). The results will help scientists understand what is contributing to these variations in different locations.

"This research extends what our lab has done for some time and enables us to advance what we're doing," said the project's principal investigator, Gretchen Rollwagen-Bollens, who, along with Steve Bollens, co-directs the Aquatic Ecology Lab. She is a clinical professor and he is a professor in the School of the Environment and School of Biological Sciences. Bollens is one of two co-principal investigators for CRESCENDO.

The research also helps integrate Next Generation Science Standards, a national effort to improve math and science education, into the curriculum. "We want kids to be doing science, not just reading about it or replicating it," said Tamara Holmlund Nelson, professor of science education at WSU Vancouver and the other co-principal investigator. "They will be getting authentic data and making sense of it."

IN THE BEGINNING

The schools involved in CRESCENDO are strategically located along the river. All offer students opportunities to study STEM-related concepts (Science, Technology, Engineering and Mathematics), and some have previously collaborated with WSU Vancouver. "All the teachers involved already do some sort of natural science class and pay attention to the local environment," Holmlund Nelson said.

The project leaders first contacted school administrators to make sure they would be onboard. One of them was Christina Iremonger, who until recently was principal at Vancouver iTech Preparatory School. "Students gain from hands-on learning and reporting their research out to an audience," she said. "This is what our STEM-based learning is all about. CRESCENDO fits beautifully. They couldn't have handed me something better."

Iremonger enlisted science teacher Tom Wolverton. Thirty-four students in his two chemistry classes participate. "I'm trying to get my students to look at the river as a whole system," Wolverton said. "I'm trying to get them to develop research questions and use data to answer them. It's getting my students to think like scientists."

The project got off the ground in the summer of 2016 with a workshop at WSU Vancouver for the five high school teachers. They learned how to use sampling and analytical equipment, and the software to create models predicting various effects on the river.

Field sampling will continue for 24 months, through summer 2018. High school students and teachers take most of the samples; WSU Vancouver graduate students cover the summer months.

SHARING THE WORK

The students use standard scientific and statistical techniques to describe variability in nutrient concentrations and plankton distributions found in different seasons and different places. WSU Vancouver scientists then use multivariate techniques to identify and quantify relationships between local and upstream conditions and variability in nutrients, phytoplankton and zooplankton communities.

These results are shared with high school teachers and students for further discussion and interpretation. Simulation and modeling software is used to visualize and predict potential relationships among variables. This information might be used, for example, by fisheries agencies to determine what level of salmon harvesting is sustainable.

"We have been collecting water samples in the Columbia River for 12 years. To have students measuring and collecting this information at five locations more or less simultaneously over the course of a couple of years is a substantial and important increase in our efforts," Bollens said.

Students will also help develop research questions about what the data means. "We have a set of explicit hypotheses in our proposal," Bollens said, "but as with any good science project, that will evolve into a fuller, additional set of questions, and we hope the students will be front and center in doing this."

The research is broadening students' perspective, said Jeff Rooklidge, science teacher at Wahkiakum High School in Cathlamet, Wash. "Students are looking at patterns and trends in the monthly data in order to better understand the complex Columbia River ecosystem," he said.

The benefits will extend beyond the current class of students. "I have already learned a lot about current research going on in the Columbia River ecosystem," Rooklidge said. "I have received a lot of valuable equipment that enables me to improve my students' science education by giving them access to some of the tools that scientists use in real-world research. I have been exposed to new ideas in how scientists are using biological modeling to study and make predictions about how best to protect our planet's ecosystems."

CRESCENDO PARTNERS

- Ilwaco High School, Ilwaco, Wash.
- iTech Preparatory High School, Vancouver, Wash.
- Kelso High School, Kelso, Wash.
- Wahkiakum High School, Cathlamet, Wash.
- Washougal High School, Washougal, Wash.
- School of the Environment, School of Biological Sciences and College of Education, WSU Vancouver

Tom Wolverton, left, with one of his students collecting samples on the Columbia River.
PHOTO: LAURA DUTELLE

One goal of CRESCENDO is to help students imagine themselves as scientists, whether as professionals or as good community stewards. "Research into STEM education shows that you start losing kids, especially girls and students of color, in science and math by middle school because they don't see themselves in science," Holmlund Nelson said. "It isn't connecting to their lives." CRESCENDO aims to help change this.

"Several studies have illustrated that when students are engaged in projects right from the beginning, especially when a project is connected with their local environment, their persistence in science is greater," Rollwagen-Bollens said. "In this way, you really do achieve what we hope to achieve—increase participation of students who may have been left out of the system."

CRESCENDO itself serves as an example of promoting diversity in STEM. Of the six key people involved—three investigators, two graduate students and a technician—four are women.

CRESCENDO RISING

By enabling students to contribute to high-quality research that is vital to the interests of their communities and state, the project aims not only to increase their understanding of scientific and ecological practices, but also to learn whether they become better stewards of the river as a result of their engagement.

Tests, questionnaires and classroom observations will seek to discover students' attitudes toward science and environmental awareness before and after the project. Case studies of two students will probe more fully how they feel about the environment, their stewardship, and the value of science to them and their communities.

"We hope they will share what they've learned with their communities," Rollwagen-Bollens said. "They might prepare posters or flyers, attend public meetings, and communicate what they know and what they think about it in their local communities."

At the end of the year, the teachers, WSU Vancouver faculty and graduate students, and representative high school students will come together in a symposium at the university to discuss data collected so far and develop preliminary interpretations to guide the next months of water sampling.

Beyond the two-year grant period, the investigators hope their work might help develop a model for partnerships between scientists and K–12 schools, one based on mentorships guiding students and teachers as citizen scientists collecting data with broad impact. Holmlund Nelson hopes that teachers, in particular, will find benefits for their students, lessons for community outreach and strategies on connecting with partners in higher education.

"Partnerships between higher education and K–12 schools can strengthen both sides," she said.