

## **The 2011 Science Training and Research Skills Program (STARS)**

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## **INTRODUCTION**

The Science Training and Research Skills program (STARS) was designed to increase educational programming at the St. Croix Watershed Research Station (SCWRS) while introducing new audiences to our National Parks. STARS is a partnership between the SCWRS of the Science Museum of Minnesota (SMM) and the National Park Service at the St. Croix National Scenic Riverway (SACN). The mission of the STARS program is to engage students in hands-on, scientific research in field and laboratory settings using the SACN as a living classroom. In 2011, programming focused entirely on high school students from communities underrepresented in the sciences. With the help of the Wilderness Inquiry organization STARS coordinators visited classrooms at Humboldt High School in Saint Paul to reach a larger number of students and introduce them to careers in the natural sciences. High school short programs at the SCWRS were attended by students from the Kitty Anderson Youth Science Center (KAYSC) at the SMM.

## **HIGH SCHOOL VISITS**

High school classroom visits were used as a means of reaching a large number of young adults interested in the sciences. The primary objective was to introduce students to careers in ecology and environmental science while increasing awareness of the St. Croix National Scenic Riverway and issues surrounding its management.

During 2011 we worked with Kathryn Clingan at Wilderness Inquiry and Kristen Butler at St. Paul Public Schools to target groups of students who are traditionally underrepresented in the sciences. STARS coordinators gave two high school classroom presentations at Humboldt High School in Saint Paul—one presentation to a class of 9th graders and the other to a class of 11th graders. In the process we reached a total of approximately 40 students. Students in both classes were part of the AVID program; AVID is a St. Paul Public School program and stands for Advancement Via Individual Determination. The mission of the AVID program is “to close the achievement gap by preparing all students for college readiness and success in a global society” (<http://avid.spps.org/Home>; October 28, 2011). AVID challenges students by placing academically average students in advanced classes, and strives to level the playing field for

students of color, rural families, families living on a low income, and other students who don't have a history of college in their families.

This was the first year that the STARS coordinators gave presentations at a high school within the Minneapolis/St. Paul urban core. The presentations were well received by the students and faculty, and we hope to continue developing this relationship with the St. Paul AVID program.

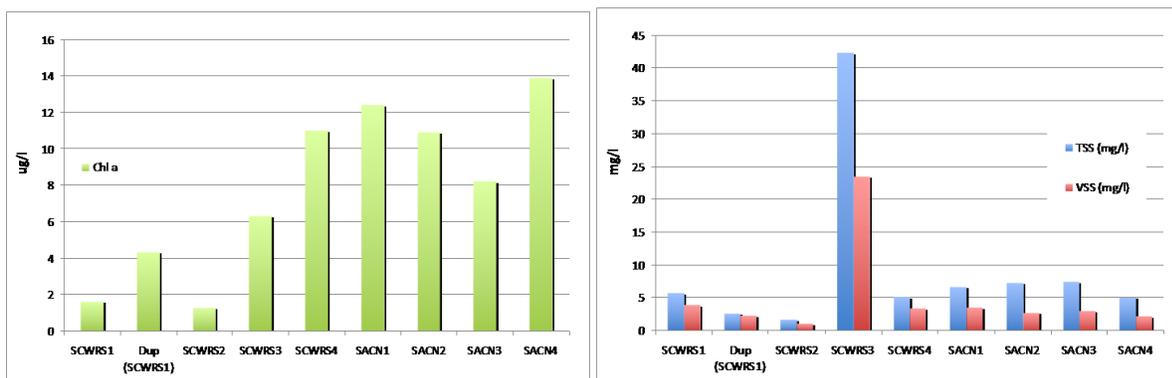
### **HIGH SCHOOL PROGRAMS AT SCWRS**

The goal of the STARS high school programs was to incorporate young people in scientific research in both field and laboratory settings, with an emphasis on working with students traditionally underrepresented in the sciences. STARS participants both learned from, and contributed to, cutting-edge science and resource management on the St. Croix River and its watershed. Immersive programs at the SCWRS were offered twice during the summer of 2011; a third half-day program was run which allowed a larger group of students to visit the SCWRS and learn about careers in science. The high school short programs reached over 20 students.

During the immersive programs the students participated in a variety of activities:

- Classroom discussions of important ecological issues facing the St. Croix River.
- Guided canoe trips on the St. Croix River to collect samples for water quality analysis.
- Water quality analyses such as pH, alkalinity, total suspended solids, and chlorophyll a conducted in an actual research laboratory.
- Macroinvertebrate collection and identification component with lessons and discussions on how these organisms can be used to indicate the health of an aquatic ecosystem.
- Fossil diatom activity demonstrating how scientists learn about past water quality from indicators preserved in lake sediment cores.
- Synthesis of field and lab results; determination of what the students' sampling and analyses indicate about the condition of the St. Croix River and its tributaries.

- Zooplankton sampling on the St. Croix River backwaters using tow nets; identification and classification of zooplankton to family using compound microscopes.
- Streamflow measurements in Spring Creek (a small tributary to the St. Croix River) using flow meter and dye drip methods.
- Informal student presentations on results of zooplankton sampling and streamflow measurements.



*Students collected chlorophyll a data (left) and total suspended solids/volatile suspended solids data (right) at 4 sites on the St. Croix River and 4 sites on Spring Creek, a small, spring-fed tributary to the St. Croix.*

We offered the 2011 STARS short programs exclusively for students from the Kitty Anderson Youth Science Center (KAYSC) at the SMM. The purpose of the KAYSC is to “empower youth to change our world through science.” KAYSC participants work in teams to increase their skills in leadership, career development, and science literacy. The students bring what they have learned back to their communities through service-learning projects and hands-on STEM workshops for younger (pre-K through grade 6) students. The KAYSC has an average of 100 youth participants each year, and current participants reflect the following demographics: 75% of participants are from low-income families, 60% are girls, and 90% are youth of color (<http://www.smm.org/kaysc/>; October 28, 2011).

Three short programs for KAYSC students were offered during the summer of 2011 at the SCWRS. The first three-day immersive program reached 8 students and was followed the same format as our 2010 STARS high school programs. The goal of this three-day program was to

guide students through through a research experience utilizing the St. Croix River as an outdoor learning laboratory. On the first morning of the program, students learned background information in environmental science, received an introduction to SACN, and discussed ecological issues facing the park. The group spent an afternoon canoeing out on the St. Croix River, walking a small, spring-fed tributary, making water quality measurements, and collecting water samples. On the second day students analyzed their samples in the research laboratory at the SCWRS, generating their own results using common laboratory equipment such as balances, a pH probe, and a fluorometer. They also spent time in the microscope lab at SCWRS learning about diatoms how these algae are used to reconstruct past environments. The third day students focused primarily on macroinvertebrates in classroom, field, and laboratory activities.



*Students learn about environmental science.*



*A student samples the pond at the head of Spring Creek.*

Students were made aware of a set of learning objectives at the beginning of the program and we returned to those objectives daily. At the end of this program students were expected to be able to:

- Design a basic water quality study.

- Operate scientific field and laboratory equipment commonly used in water quality monitoring studies.
- Explain the relationship between the natural sciences, ecological processes, and current social issues in the St. Croix watershed.
- Apply key concepts from taxonomy, biology, chemistry, ecology and physics to complex issues in the St. Croix system.

At the end of the program students were asked to give examples of how they had met each learning objective. By slowly building from foundational knowledge in environmental science and affirming general principles with very specific experiences in the field and lab students were able to draw conclusions about relationships between water quality and ecosystem health in the St. Croix and its environs using their own results and observations.



*Students model personal protective equipment in preparation for chlorophyll a analyses.*

The second and third programs allowed us to deviate from the 2010 three-day program model and pilot new teaching formats. During the second program, a group of 8 students from the

KAYSC came out for a half-day tour of the SCWRS. This format allowed for an additional group of KAYSC students, who did not have the time to participate in one of the longer programs, to gain exposure to SCWRS and SACN. During this program the STARS coordinators focused on introducing the students to ecological issues facing the St. Croix and careers in environmental science. The students listened to a short introductory talk on the St. Croix River, were given a tour of our water chemistry lab, spent time in the microscope lab with scientists looking at diatoms and macroinvertebrates, and took a walk to the river. Although this format was less hands-on, it allowed us to reach an additional group of KAYSC students who otherwise would not have had the time to participate.

The third program was another multiple-day, immersive experience for KAYSC students. It was designed for students who had already participated in the first program and were looking for a further research experience.

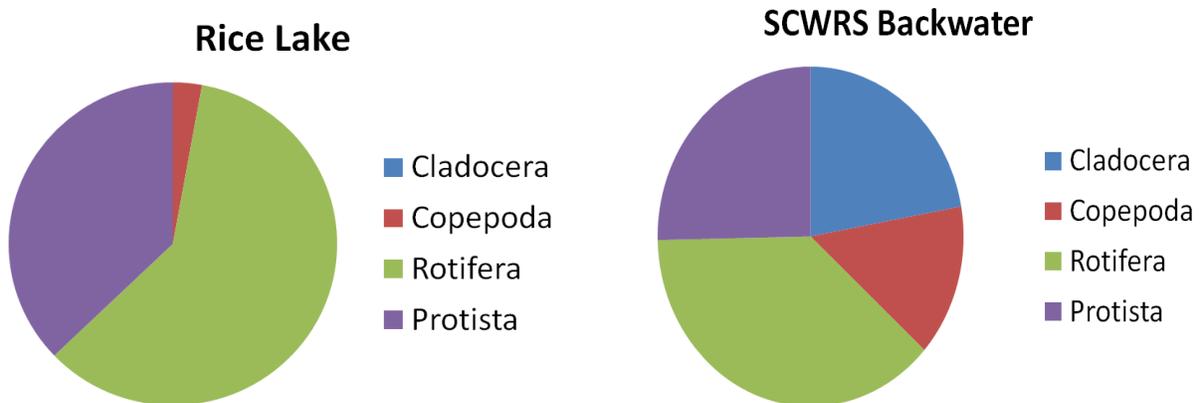


*Students prepare a tow net for zooplankton sampling.*

Five students attended this program; two participated in a hydrologic study of Spring Creek, a tributary to the St. Croix, and three participated in a survey of the zooplankton communities of

the St. Croix backwaters. Each group then assembled and interpreted its results and presented findings to the other group and SCWRS staff. This format allowed interested students to delve deeper into topics of interest, spend additional time being mentored by scientists, and gain further experience conducting a research project.

In addition to the benefits to the STARS participants, SACN will benefit from the data collected by the high school students. The water quality data collected by the 2010 and 2011 STARS participants is forming the beginning of a database that will be added to each year and available to the park; the sampling sites represent stretches of the river and backwaters that are not currently covered under other monitoring programs. Water quality data collected by these and future STARS groups will be available to all interested managers and scientists.



*Results of zooplankton sampling from two SACN backwater locations. Students generated, interpreted, and presented results themselves.*

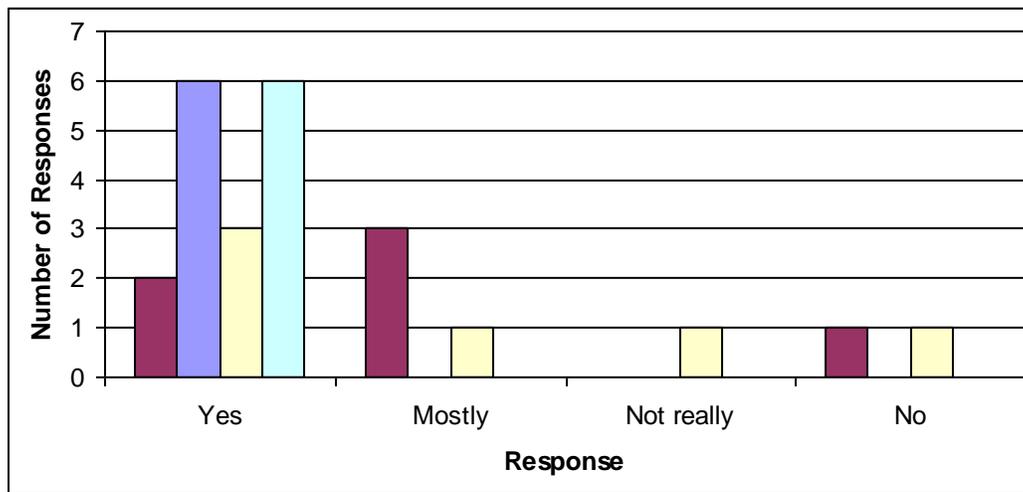
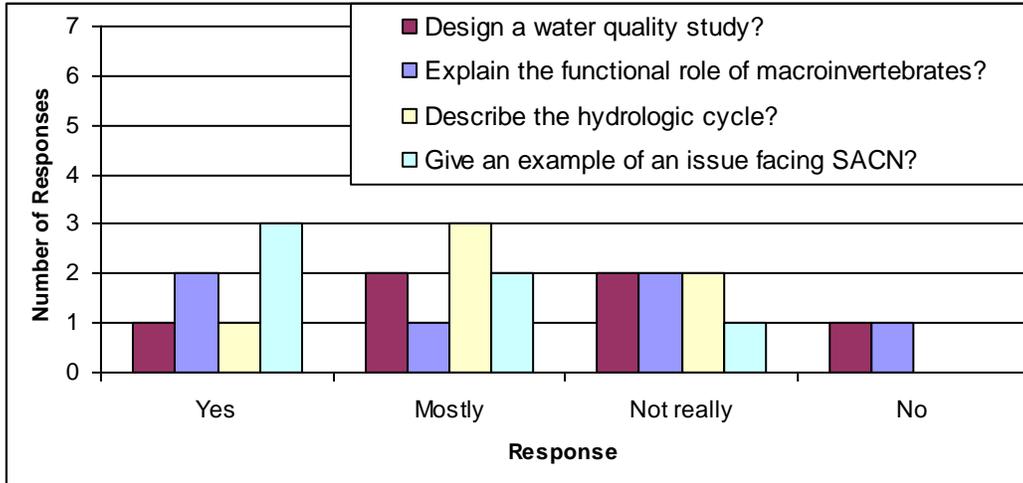
#### **SHORT PROGRAM EVALUATION**

Participants filled out formative and summative evaluation forms at the beginning and end of the multiple-day programs. Evaluations assessed knowledge before and after the program, student likes and dislikes, and suggestions for improvement.

Students were asked to respond to identical sets of statements about their perceived ability to explain several higher order scientific processes at the beginning and end of their program.

Student responses shifted significantly between the beginning and end of the program. Students

felt more confident in their ability to design a water quality study; explain the functional role of macroinvertebrates in an ecosystem; describe the hydrologic cycle; and give examples of issues facing the St. Croix River.



*Student responses before and after participating in the high school program to the following statements: 1) I think I could design a water quality study (purple); 2) I could explain the functional role of macroinvertebrates in an ecosystem (blue); 3) I could explain the hydrologic cycle (yellow); 4) I could give an example of how humans have affected the St. Croix and how science helps understand (teal). Height of bars indicate number of respondents giving a particular response.*

Students consistently listed canoeing and taking samples among their favorite experiences. Students also enjoyed collecting macroinvertebrates and working with laboratory instrumentation. Some students would have preferred all hands-on activities as opposed to

lectures. Students showed new skills in using scientific terminology when asked about their new knowledge, listing water quality related terms such as DO (dissolved oxygen), TSS (total suspended solids), EPT (*Ephemeroptera*, *Plecoptera*, and *Trichoptera*) and stating connections between water chemistry and stream health.

STARS coordinators will continue to work with Robby Callahan Schreiber, and other KAYSC staff, to track students' school and career paths to further evaluate the impact of STARS on subsequent educational and professional successes.

## **SUMMARY**

In 2011 the STARS program introduced environmental science careers and the St. Croix National Scenic Riverway to students traditionally underrepresented in the sciences. Classroom visits gave a larger number of students an introduction to the river and science careers, and the immersive programs at the SCWRS fostered hands-on science education and outdoor experiences for students of the KAYSC. STARS provided skills-oriented, experiential-learning opportunities that are crucial for youth interested in advancing into scientific careers.

Exposure to the beauty and wonder of the river, coupled with hands-on work in the field and the laboratory, brought environmental science alive for the KAYSC students. The opportunity to interact and work side-by-side with scientists in research-grade laboratories gave students a sense of the demands of a scientific career. In addition, these students generated valuable data for long-term monitoring database. This enhanced the experience as the students realized that they were directly contributing to cutting-edge science.

STARS was also successful in addressing the racial imbalance in SACN visitors. Collaboration with the KAYSC brought students from the Minneapolis-St. Paul urban area out to the river for participation in STARS; these students from traditionally underrepresented groups are often in need of experiences such as STARS to foster their academic success.

## **ACKNOWLEDGEMENTS**

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