Water Research, Outreach, and Teaching in the Northern Plains and Mountains Region

Impacts and Outcomes, 2000-2012

Applying knowledge to improve water quality

Northern Plains & Mountains Regional Water Program

A Partnership of USDA NIFA & Land Grant Colleges and Universities

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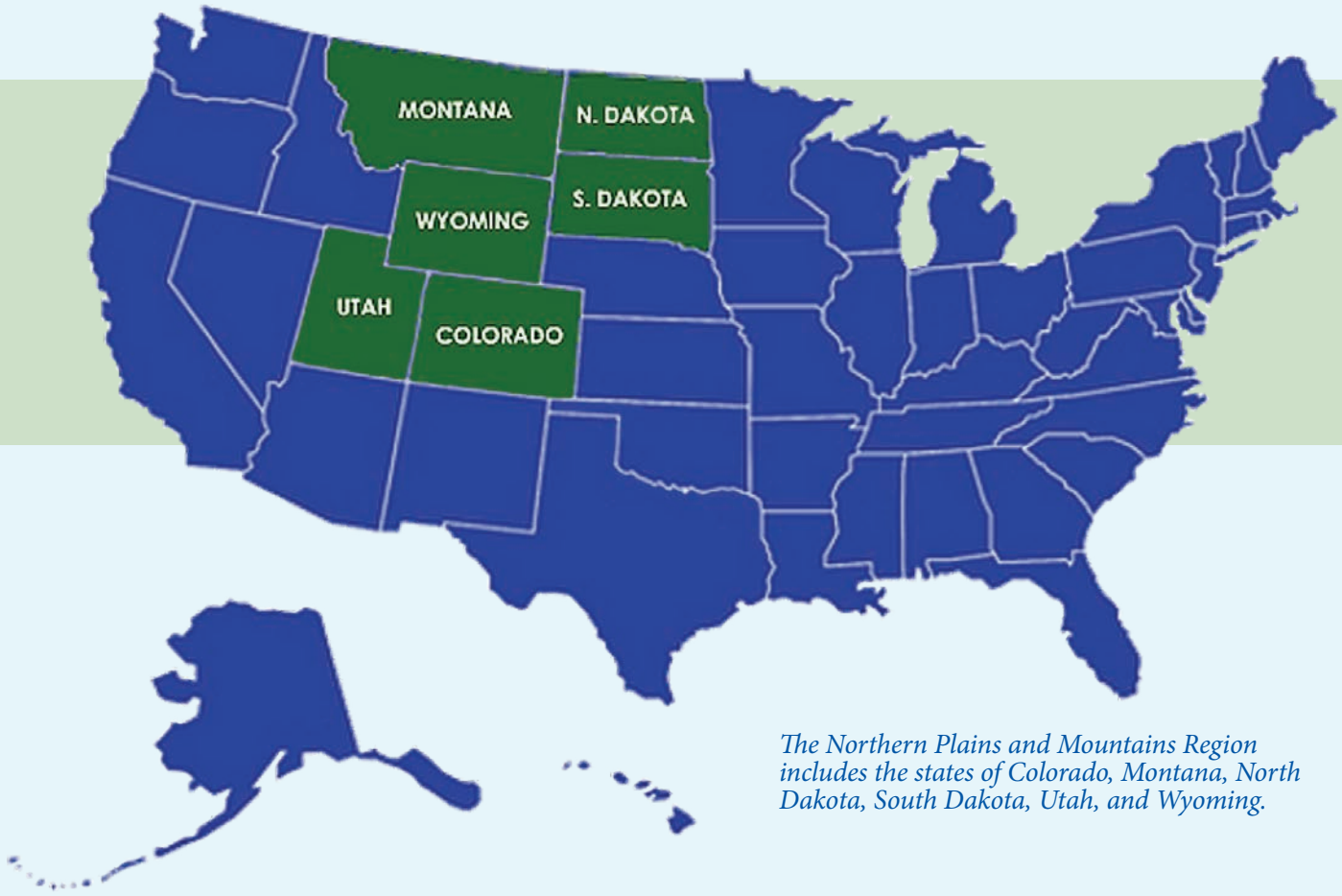


The Northern Plains and Mountains Region includes the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

NDSU NORTH DAKOTA STATE UNIVERSITY

UNIVERSITY OF WYOMING

Colorado State University

UtahStateUniversity

MONTANA STATE UNIVERSITY

SDSU

Cover photos from top, counterclockwise: Mountain stream, photo by Mark Byzewski; Nephi Cole, NRCS Wyoming, collecting macroinvertebrate water quality sample, photo by Ginger Paige, Univ. Wyo.; Nancy Mesner, USU, training high school teachers on Stream Side Science monitoring activities, photo courtesy of USU Water Quality Extension; Irrigated field, photo by Bill Cotton, CSU Photography

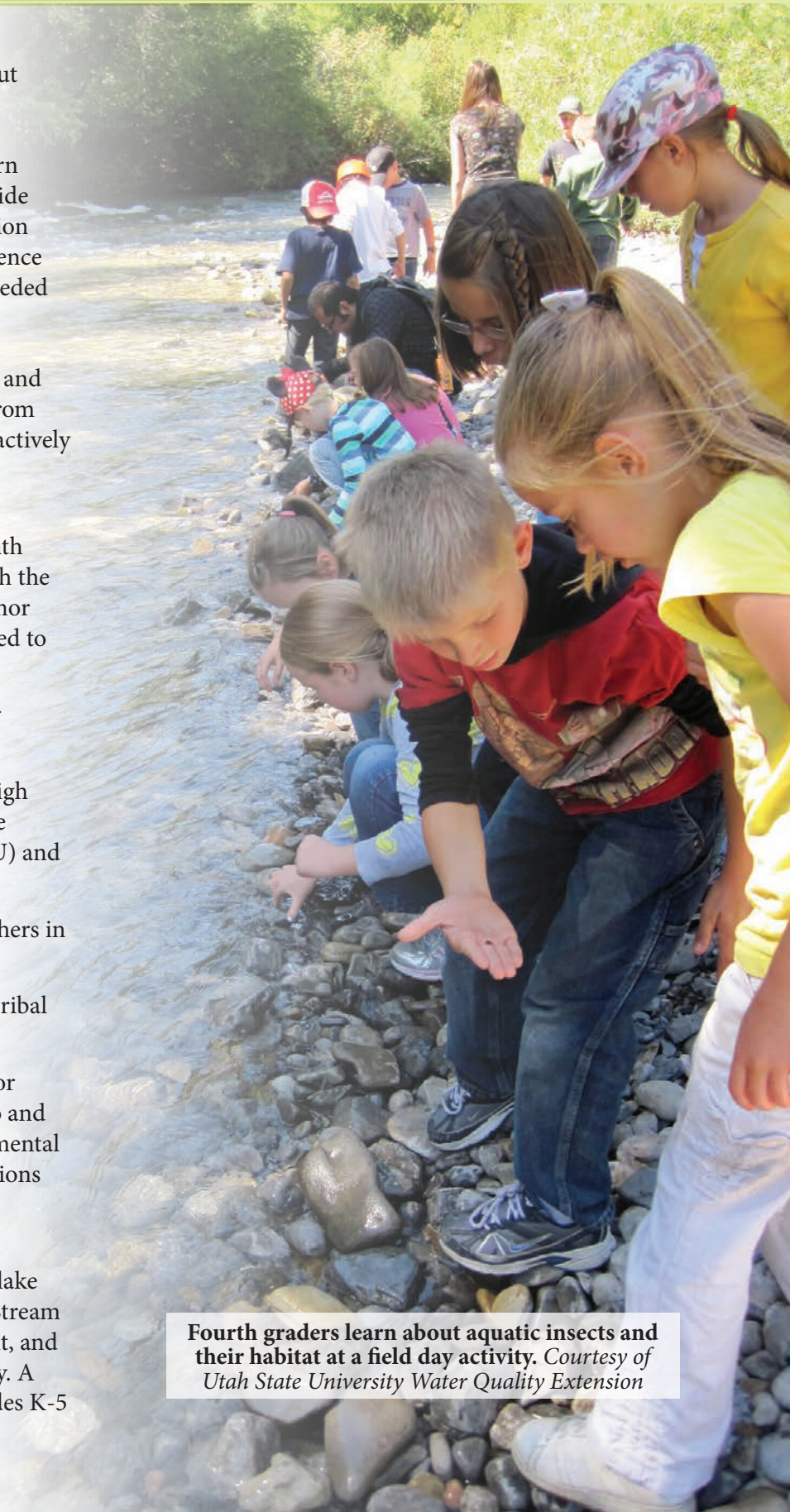
Stream Side Science: Hands-on Water Education that Makes a Difference

The goal of the Stream Side Science program is to promote and provide effective education about watershed functions and water quality issues for K-12 students, undergraduate and graduate students, and educators throughout the Northern Plains and Mountains (NPM) Region. Stream Side Science activities use hands-on stream exploration techniques to explain and teach about water science and watershed functions. This project has succeeded because of strong leadership; clearly defined objectives, goals, and approaches; a flexible and adaptable approach; and durable collaborations and partnerships. State water quality coordinators from Utah, Montana, Wyoming, and Colorado have actively participated in this NPM Regional Project.

Stream Side Science originated at Utah State University (USU) as a set of lesson plans for ninth graders, developed by USU in collaboration with the Utah State Office of Education and Utah Governor Walker's Watershed Initiative. It has since evolved to include:

- Lessons for all ages that are appropriate for multiple disciplines
- Online and face to face short courses for high school science teachers and master's degree students at Montana State University (MSU) and USU
- Workshops and summer institutes for teachers in Utah, Wyoming, Colorado, and Montana
- Hands-on programs for Native American tribal water quality interns
- Stream-side classroom learning modules for high school students in southern Colorado and students enrolled in introductory environmental science classes at Hispanic Serving Institutions (HSI) in Colorado

Stream Side Science began as a set of simple monitoring activities for stream, wetlands, and lake exploration. The twelve lesson plans in today's Stream Side Science manual cover science, management, and policy aspects of water science and water quality. A second set of lesson plans and activities for grades K-5



Fourth graders learn about aquatic insects and their habitat at a field day activity. *Courtesy of Utah State University Water Quality Extension*

(Bugs Don't Bug Me) focuses on exploration of aquatic macroinvertebrates, with additional lessons on the water cycle and water pollution.

In all cases, students are engaged directly through monitoring and other activities, and encouraged to become stewards of their local watersheds through service and community outreach projects. Teachers and leaders are encouraged to get kids outside, and when that is not possible, the lessons are easily adapted to bring samples from streams and lakes to the classroom.

Stream Side Science lesson plans are designed with the needs of educators in mind:

- Each lesson plan is formatted for easy use, providing clear instructions and explanations for teachers.
- All lessons are aligned to national and state science standards.
- All curricula and additional materials are available online or by request, and all materials needed for the lessons are inexpensive and easy to obtain or build.
- FAQs for each lesson plan provide "talking points" that teachers use to guide classroom discussions.
- STEM connections are explicitly provided, with tips on graphing, simple statistics and other math exercises provided throughout the Stream Side Science manual.
- Watershed specific materials have been developed in Utah for the Jordan River and the Bear River watersheds. Similar watershed specific materials are being developed as Stream Side Science is adapted for Fountain Creek watershed in Colorado.

All our lessons are reviewed by scientists, policy makers, and other content specialists to assure that they are scientifically accurate and unbiased. Educators and curriculum specialists then review the materials for appropriate pedagogy. All lessons are "field tested" with teachers who provide additional feedback. Finally, we have formally evaluated most of these activities by conducting before and after testing of approximately 500 ninth grade students using Stream Side Science activities and over 1,300 fourth grade students using our Bugs Don't Bug Us activities.

Fourth graders inspect macroinvertebrates and learn about adaptations and life cycles of these organisms. *Courtesy of Utah State University Water Quality Extension*

Actions and Outcomes

Stream Side Science provides high quality support and training for educators. Our focus groups and teacher surveys indicate that many K-12 science teachers and informal educators are hesitant to use experiential water oriented or field oriented activities because they have limited knowledge of water and watershed science. Stream Side Science teacher-training opportunities are designed to provide educators the knowledge and skills to effectively teach water science to their classrooms.

> *"My kids really loved our daily trips to the river. They learned much more than they would have from just lecture and testing."*
>
> *-Feedback from a participating teacher*

The Stream Side Science program provides this training for educators in a variety of formats:

- The Stream Side Science Manual is an integral part of "Stream Side Science– an Online Approach to Field-based Education," a three credit, semester-length graduate course taught through the MSU, Office of Extended Studies (http://btc.montana.edu/courses/aspx/descrip3.aspx?TheID=171).
- Stream Side Science educator workshops are organized to meet the needs of particular groups and interests, but always provide educators with the knowledge and skills to effectively teach water science to their students. Participants receive continuing education credits or college credit and credit toward teaching endorsements.
- Utah's Community Mapping Project workshops for social studies teachers routinely integrate Stream Side Science techniques during their weeklong workshops on GPS data collection and GIS mapping.
- In response to teacher requests, advanced workshops are now offered on aquatic macroinvertebrate collection and identification.
- The manual is also being used as a field and classroom guide for mentoring environmental science students at Colorado State University-Pueblo, Hopa Mountain College, Blackfeet Community College, Little Big Horn College, and Native Science Field Centers in the NPM Region.
- Leaders in Utah's Envirothon and Science Olympiad competitions use the Stream Side Science manual as a primary resource for preparing their students.

High school students analyze water quality samples as part of a statewide Envirothon competition. *Courtesy of Utah State University Water Quality Extension*

Stream Side Science is flexible, fun for students, and promotes stewardship through service and community projects:

- The lesson plans are currently being used nation-wide to teach many disciplines, including agriculture and natural resource education, biology, chemistry, math, geography, and other social studies.
- Informal educators across the country are using Stream Side Science for 4-H, scout, after-school and summer activities.
- Student projects using Stream Side Science concepts (4-H, science fair, classroom activities) include watershed-wide monitoring, riparian restoration, community education on urban stormwater, and more.

Impacts

- Formal evaluation of Stream Side Science lessons demonstrated that student knowledge about watershed science, aquatic biology and pollution impacts increases significantly with the use of these lessons and materials. Our study of fourth graders using Bugs Don't Bug Me lessons found significant and long-term (six month) increase and retention of knowledge about aquatic biology and water pollution.
- The results of a survey of students completing the Stream Side Science course of the MSU Master of Science in Science Education program revealed that 81 percent of respondents incorporated knowledge, skills or activities from Stream Side Science into their classrooms, including one or a combination of the following: chemical and physical parameters (69 percent), stream monitoring (38 percent), and macroinvertebrate counts (31 percent).
- More than 50 percent of the students completing the Stream Side Science course of the MSU Master of Science in Science Education program indicated their teaching methods had changed as a result of Stream Side Science; the primary change in pedagogy included incorporation of more hands-on lab activities inside and outside of the classroom.
- Since 2004, over 1300 Utah educators have attended our high quality educator workshops. Follow up surveys indicate that about 40 percent of these teachers use Stream Side Science in their teaching.
- Since 2006, an estimated 150 educators from around the U.S. and beyond have taken MSU's online course: Stream Side Science– an Online Approach to Field-based Education.
- Stream Side Science activities have been adapted and incorporated into many other programs, including Adopt a Waterbody Programs, Master Naturalist Programs, and a new Utah Water Watch citizen monitoring program.
- Stream Side Science materials are being used in developing training and course work at Tribal colleges and HSIs around the country.
- In Utah alone, an estimated 80,000 students have been taught at least one Stream Side lesson by a trained educator, resulting in an increased knowledge and awareness of water quality and water science.

> *"The curriculum reinforced concepts, builds on previous understanding of watersheds, and modeled how I can present to students."*
>
> *-Feedback from a participating teacher*

Leveraging and Partnerships

USU Extension, MSU Extension, and the USDA-NIFA National Water Quality Program provided funding for the initial and on-going efforts of the Stream Side Science project. Approximately 30 percent of the $202,820 that Utah's Extension program received in EPA 319 outreach grants from 2004-2010 was directed to Stream Side Science teacher education and youth activities. In 2011 and 2012, approximately 50 percent of the $205,000 in 319 grants were directed to teacher education, assessment, direct delivery of programs to youth, and to support a citizen monitoring program that draws on Stream Side Science activities. In addition, Utah has received $49,500 in internal USU grants for development and testing of these materials. In 2005, MSU received a $100,000 USDA Higher Education Challenge Grant to develop the online graduate water quality course.

Fourth graders use a simple kick net to collect aquatic insects. *Courtesy of Utah State University Water Quality Extension*

For more information on the Stream Side Science Curriculum and the Stream Side Science online course, please visit the following websites:

http://extension.usu.edu/waterquality/htm/educator-resources/lessonplans

http://btc.montana.edu/courses/aspx/descrip3.aspx?TheID=171

"Excellent background information and discussion is provided with the lesson plans. The lesson plans also make the information understandable which in turn makes it easier to teach and pass on to the students."

-Feedback from a participating teacher

"I am going to apply all of this to my class next year!"

-Feedback from a participating teacher