The Year of Science is a nationwide effort to engage the American public in activities that will stimulate their interest in the process of science. The overall goal of this celebration is to focus on “how we know what we know,” and to help connect YOU to the amazing science that is contributing so much to our lives.

Science is intertwined throughout the program of The South Dakota Water Resources Institute. The process of science is the foundation of the Institute’s research and training programs. The Institute’s grants program funds proposals that use the best science to discover facts about the State’s water resources. The water quality laboratories use standardized techniques to produce accurate measurements (Figure 1).

Public Understanding of Science

Research indicates that the public has a poor understanding of the nature of science. The public is often unsure about the process of scientific research and sometimes even skeptical of its value. This is bad news at a time when science means so much to our lives. South Dakota needs a scientifically literate public to support the State’s commitment to opening frontiers of knowledge about physics, health, energy, and the environment – and, yes, about the water resources of South Dakota.

The word “science” probably brings to mind visions of charts, facts, measurements, text books, and lengthy reports, but these are only part of the story. Just as importantly, science is also a process of discovery. The scientific data are only as good as the process used to discover them.

A general public with an understanding and appreciation of the nature of science is a prerequisite for a skilled workforce. A public that understands the process of science is a public that is able to make informed decisions about options for water use and protection, or about the relative risks of medical treatments, or about other quality of life factors. South Dakota needs a public that is also able to distinguish science from non-science, and recognize attempts of special interest groups to drive public perceptions with biased science and biased information.
South Dakota’s Year of Science Program

South Dakota State University and a dozen other institutions in South Dakota (and the number is growing each week) have joined the Coalition for the Public Understanding of Science (www.copusproject.org). Members of the Coalition will be shining a spotlight on science in 2009 to improve public understanding about how science works, why it matters in South Dakota, and who South Dakota scientists are.

This article in your Water News and articles in other outlets are one way the public will be hearing more about The Year of Science. Most universities will have programs, and other organizations are also involved including The Sioux Falls Outdoor Campus of the Game, Fish and Parks Department, the South Dakota Wildlife Federation, the South Dakota Academy of Science, and the Museum of Geology.

While the Water Resources Institute will focus on the physical sciences (e.g., hydrology, geology, biology), the Year of Science in South Dakota is also about the other natural sciences and social sciences, and about the intersection of science in art, journalism, theater, religion, philosophy, politics and policy.

Educators and Organizations – Get involved!

Heads-up! Educators. Research indicates that students and teachers at all levels have a poor understanding of the nature of science. To address this problem, the Coalition has created a freely accessible web-based resource that provides a new approach for teaching the nature of science. Its goals are to (1) improve teacher understanding of the scientific enterprise and (2) provide materials and tools that enable K-16 teachers to incorporate the true nature and process of science throughout their teaching.

Go to www.understandingscience.org to find a dynamic representation of the real process of science, science stories, scientist profiles, cartoons, science in the news, activities for students, vetted lesson plans, teaching tips and strategies, clarifications of misconceptions, and friendly but comprehensive background material.

Get your organization involved if you care about science and want to help improve scientific literacy! It is easy to participate. There is no cost and your only obligation is to do something to promote the objectives of the Year of Science. Your activities will receive statewide and even national publicity because you are a member of the Coalition. Registering your organization at the Coalition web site takes about 2 minutes and gives you access to all Year of Science logos, newsletters, and other information to help you create an educational program to address Year of Science goals.

Show me the data!

Show me the data. This is the take-home message I tried to convey to a group of kids who had signed up for a summer science class. As we stood beside a pond where I had set nets to capture fish, I told them a fictitious story about one of their Dads who went fishing in this pond and didn’t catch any fish. This happened several times so he believed that the pond didn’t have enough fish and therefore needed stocking. He called the Game Fish and Parks Department and asked the state fish biologist to stock more fish.

The biologist replied “Before we stock fish, we collect data on the fishes in the lake. We use standard methods and standard nets, and then we count, identify, weigh and measure fish and then analyze the data to determine the facts about the fish populations. Then, we decide whether stocking is needed.”

The kids helped pull in the nets and found about
100 fish of six species – black bullheads, northern pike, green sunfish, orange-spotted sunfish, fathead minnow, stickleback. The kids saw predator and prey, male and female of different sizes, and lots of little fish showing that there was spawning and survival.

From this small sample of fish the kids got the idea that the pond fish community was healthy and didn’t need stocking. One of the kids said “It shows that my Dad is a bad fisherman.”

Show me the data. What powerful words! These four words lead to shorter arguments, more accurate decisions, and new knowledge when studies are started because the data isn’t there. Science should trump belief when spending public money to manage the State’s land and water habitats and the fish and wildlife that use them.

The Challenge to Scientists

Scientists need to convince people that they have developed honest procedures for understanding how the world works, that they can put confidence limits around most of their conclusions, and that their track record shows that they have achieved reliable, if still incomplete, knowledge.

This is the goal of the South Dakota members in the Coalition for the Public Understanding of Science 2009. Find more information at the Year of Science web site (www.yearofscience2009.org) or address questions to Charles Berry at charles.berry@sdstate.edu.
BROOKINGS, S.D. – The goal of the 2008 Eastern South Dakota Water Conference held Oct. 22 and 23 in Brookings, SD was to bring together federal, state, and local governments, along with university and citizen insights. The event, in its third year, and included speakers and presenters from South Dakota State University (SDSU), the U.S. Army Corps of Engineers, South Dakota School of Mines and Technology, the Day Conservation District, and many others.

In addition to the conference, a poster competition for college students was held. First prize of $200 went to Kristopher Dozark in the SDSU Department of Biology & Microbiology, and a $100 second prize awarded to Casey Schoenebeck in the SDSU Department of Wildlife and Fisheries Sciences.

John Davidson, a professor of law from the University of South Dakota, delivered the lunch keynote address on water law Oct. 23.

“This event was an opportunity for hydrologists, geologists, engineers, legislators, scientists, and students to meet and exchange ideas,” said David German, an SDSU water resources research associate. “Water is a crucial part of South Dakota’s future, and this conference helped educate participants on the future of this resource.”

Information on the conference is available at this link: http://wri.sdstate.edu/esdwc. Presentations from the 2008 Conference are available online at: http://wri.sdstate.edu/sssss.

Call Jennifer Pickard, Program Assistant for the SDSU Water Resources Institute at (605) 688-5611 for more information.
Program Objectives

USGS 104(g) grants authorized under the Water Resources Research Act focus on regional and interstate water resources problems beyond those of concern only to a single state. Research priorities for 104(g) grants are set jointly by the NIWR and the U.S. Geological Survey.

All 104(g) grants must be matched by at least one non-federal dollar for each federal dollar. Awards are made only after joint state and federal priority setting and reviews for regional and national relevancy and technical merit. Objectives of this program include the following:

- Promote collaboration between the USGS and university scientists in research on significant national and regional water resources issues;
- Promote the dissemination and application of the results of the research funded under this program; and
- Assist in the training of scientists in relevant water resource fields. Proposals that include a strong educational component (student support) are encouraged, as are proposals from faculty beginning their careers.
- Proposed projects may be of 1 to 3 years in duration, with discrete 12-month budget periods.
- Applicants shall not request total federal funds exceeding $250,000 per project. Each applicant must match each Federal dollar provided to support each proposed project with not less than one dollar from non-federal sources (1:1).

Important regional research has not been adequately supported by any other federal programs and is weakly supported by state consortia. The 104(g) effort effectively taps the potential of academic expertise while facilitating linkages of Institutes across states and with federal and state agencies. 104(g) provides the major mechanism to meet the growing needs not filled by state or federal research programs.

Research grants awarded from 1996 to 2008 under Section 104(g) can be viewed at: http://water.usgs.gov/wrrl/projects.html.

Please visit the USGS 104g Water Resources Research National Competitive Grants Program RFP (https://niwr.net/competitive_grants/RFP) to view the complete request for proposals issued by the USGS.

Email all related material to Jennifer Pickard (Jennifer.Pickard@sdstate.edu) no later than February 1, 2009. This date is earlier than stated in the USGS RFP as WRI staff will submit all the proposals in the application process. If you wish to enter your own proposal at the NIWR website https://niwr.net/, please notify Jennifer of your intention.

The SD WRI website (http://wri.sdstate.edu/USGS104g.cfm) has program specifications as well as a budget planning worksheet. If you have questions about this RFP, please email or call Jennifer Pickard (605-688-4910).
ATTENTION LAKE and STREAM LOVERS!

David German (South Dakota Water Resources Institute) and Dennis Skadsen (Day Conservation District) will be conducting two basic Lake Water Quality workshops for improved lake water quality education in the Black Hills during June and at NeSoDak Camp on Enemy Swim Lake during August. Specific dates will be available on the WRI website at http://wri.sdstate.edu/lake_qw.cfm.

Two options are available for this year’s workshops for those who wish to receive continuing education credits (CEUs). The workshop has been expanded to three days with the addition of a unit on bioassessment of both streams and lakes. The three day workshop has been approved for 2.0 CEUs and the two-day workshop will emphasize basic limnology concepts and has been approved for 1.2 CEUs.

The workshop is designed for teachers, extension educators and lake residents. Attendees will be able to share what they have learned with their students, neighbors and friends. Participants will learn limnology (the study of lakes) and ecosystem concepts, the use of lake sampling equipment, and fun games and other techniques to help demonstrate learned concepts. The priority topic that will be covered through this workshop will be lake water quality and how watershed processes and humans affect lake water quality. The workshop is held in an informal atmosphere and is designed to be fun as well as informative. There is no charge for the workshop OR for food and lodging but travel is the participant’s responsibility.

Pre-registration is necessary to plan for workbook materials. For more information or to register, please call Jennifer at: (605) 688-4910 or email Jennifer.Pickard@sdstate.edu.

2008 Workshop Photos
**Leaching Tests for Encapsulation of Waste after Arsenic Removal from Drinking Water**

Many areas of the United States and the world are facing arsenic contamination of drinking water. After the U.S. Environmental Protection Agency (EPA) announced the lowering of the maximum contaminant level for arsenic from 50 parts per billion to 10 ppb, several arsenic-removal methods have been investigated. Most of them have the disadvantage of high waste-disposal costs because of the potential for leaching of arsenic from the arsenic-enriched waste. This work focused on improving the limestone-based removal technique by encapsulating the waste in concrete, thus increasing its economic advantages through recycling.

Arsenic reacts with limestone-based material during arsenic removal, most likely forming either hydrated calcium arsenate or calcium arsenate. Scanning electron microscopy shows that arsenic-rich crystals adsorb onto the surface of limestone particles (Figure 1). Solubility products for the dissolution of various forms of calcium arsenate range from $10^{-21}$ to $10^{-38}$.

The objectives of this research were to:

- Remove arsenic from water by adsorption onto limestone, and determine the mass of arsenic that was adsorbed.
- Prepare concrete cubes with the limestone waste after arsenic removal, and determine the strength of the concrete cubes by testing in accordance with standards of the American Society for Testing and Materials (ASTM).
- Determine leaching, if any, of arsenic from the concrete cubes by analyzing the results from Toxicity Characteristic Leaching Procedure (TCLP) tests, in order to assess the suitability of encapsulating the waste material as concrete mortar.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Mass of As (mg in 640 mL)</th>
<th>Mass of As (mg) in solution and rinse</th>
<th>Mass of As adsorbed (mg)</th>
<th>% of As removed by limestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.91</td>
<td>0.028</td>
<td>0.88</td>
<td>95.4</td>
</tr>
<tr>
<td>C2</td>
<td>0.90</td>
<td>0.028</td>
<td>0.87</td>
<td>94.9</td>
</tr>
<tr>
<td>C3</td>
<td>4.25</td>
<td>0.340</td>
<td>3.91</td>
<td>86.9</td>
</tr>
<tr>
<td>C4</td>
<td>4.23</td>
<td>0.338</td>
<td>3.90</td>
<td>85.9</td>
</tr>
</tbody>
</table>

(Continued on page 8)
Experimental Methods

A stock As(V) solution was used to prepare influent solutions of water. One-liter bottles were filled with with 1000 grams of 0.5 to 1 mm sized Minnekahta Limestone. The prepared solutions were introduced into the bottles, which were shaken several times a day for one month. The treated solutions then were separated, and the limestone was air-dried for two weeks.

Limestone was used as a substitute for sand in the preparation of concrete mortar cubes because the grain size of the limestone, 0.5 to 1 mm, was similar to the grain size of sand. This substitution was made in consideration of economic advantages of cost reduction (i.e., cost of sand replaced by cost of available limestone waste). The concrete cubes were prepared for strength testing and to conduct TCLP tests for leaching. Untreated limestone also was used in preparing concrete mortar cubes, to compare the results to the strengths of cubes of treated limestone.

A Tinius Olsen machine was used for conducting compressive strength tests on the concrete mortar cubes. Specimens were tested at 1, 3, 7, and 28 days, and were saved for conducting TCLP tests.

Results

Arsenic Removal

Part of the experimental work focused on determining the mass of arsenic that was adsorbed by the limestone. The difference between the amounts of arsenic before and after treatment by limestone was the mass adsorbed onto the surface of the limestone (Table 1). The amount of arsenic removed from each solution by the limestone is shown on Table 2. Each gram of limestone in samples C1 and C2 adsorbed 0.88 μg of arsenic. Similarly, each gram of limestone in samples C3 and C4 removed 3.9 μg of arsenic.

Table 2. Amount of arsenic adsorbed onto the surface of limestone and total amount of arsenic, in mg, resulting in combination of C1 and C2, and C3 and C4.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Mass of As adsorbed (mg)</th>
<th>Mass of As in μg/g of Minnekahta Limestone</th>
<th>Mass of As in 1000g of limestone</th>
<th>Mass of As (μg) in combined samples</th>
<th>Mass of As (mg) in combined samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.88</td>
<td>0.88</td>
<td>881</td>
<td>1756</td>
<td>1.8</td>
</tr>
<tr>
<td>C2</td>
<td>0.87</td>
<td>0.87</td>
<td>875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>3.91</td>
<td>3.91</td>
<td>3910</td>
<td>7803</td>
<td>7.8</td>
</tr>
<tr>
<td>C4</td>
<td>3.90</td>
<td>3.90</td>
<td>3893</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued from page 7)

(Continued on page 9)
Compressive Strength
Strength tests were conducted in accordance with ASTM C 109-93 specifications. The strengths of untreated samples at 1, 3, 7, and 28 days (Figure 2) indicate that use of limestone as a replacement for sand could be suitable for disposal of arsenic as well as for use in concrete mortar. Cubes made with encapsulated arsenic in limestone waste also were tested. Compressive strength values are shown on Figure 2. The percentage difference of compressive strengths between the combined samples C1 and C2 and the control test at 28 days was approximately 1.1%, and the percentage difference between the combined samples C3 and C4 and the control test was approximately 5.9%. The results indicate that the encapsulated contaminant had no appreciable effect on strength.

Toxicity Characteristic Leaching Procedure Tests
The TCLP test results indicate that leaching of arsenic was less than 0.05 mg/L from the concrete cubes (Table 3). The U.S. EPA’s leaching limit for the disposal of arsenic in a landfill is 5 mg/L. The results were less than 1/100 of the U.S. EPA standard.

Summary
The strength of concrete mortar cubes did not appear to be affected by encapsulation of limestone waste; strengths were essentially the same as in the control test. Because leaching of arsenic was far less than the U.S. EPA standard, encapsulation of limestone waste in concrete has potential as an option for recycling of the waste material, which could help reduce disposal costs of the limestone-based method.

Acknowledgments
This work was funded by the U.S. Geological Survey’s 104b program through the South Dakota Water Resources Institute.

Authors
Arden D. Davis, David J. Dixon, and M.R. Hansen, South Dakota School of Mines and Technology.

Table 3. Results of the TCLP tests.

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>Arsenic - TCLP (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1,2 D-1,2</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-1,2 D-3,4</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-1,2 D-7,6</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-1,2 D-28,7</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-3,4 D-1,2</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-3,4 D-3,3</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-3,4 D-7,6</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>C-3,4 D-28,9</td>
<td>&lt;0.050</td>
</tr>
</tbody>
</table>

The quality of water and the quality of life in all its infinite forms are critical parts of the overall, ongoing health of this planet of ours, not just here in the Amazon, but everywhere... The hardest part of any big project is to begin. We have begun. We are underway. We have a passion. We want to make a difference.

-Sir Peter Blake (1948-2001)
South Dakota Drought Status

By Dr. Dennis Todey
South Dakota State University

The calendar year of 2008 was record setting in many ways for the state of South Dakota. Looking from daily to annual time scales there were records broken or nearly broken. Final data from all locations will not be available for a couple months. But there are some records that can be listed at longer time scales. All the annual ones were from the western part of the state which experienced one of its wettest years on record.

Several other stations were in the top 5 all time totals. One other annual total is worth mentioning. Deadwood 2NE recorded 45.17” for the year. This is the third highest for that station. But it is also the 3rd highest annual total ever reported in the state.

Some other state-wide rankings for the year were reported according to the National Climatic Data Center. These are averages for the whole state ranked over a 114 year record.

Other seasons were nearer average and not reported here.

- Annual precipitation 11th wettest
- Spring 25th wettest
- Spring 30th coldest
- Summer temperature 38th coldest
- Summer precipitation 14th wettest
- Fall 8th wettest

The whole state saw many late winter storms with heavy snowfalls and blizzard conditions. Late fall and early winter saw the return of several storm events. This produced some near record snowfalls in December. Milbank and Brookings reported the 2nd snowiest Decembers on record.

Dr. Dennis Todey is South Dakota’s State Climatologist.

http://climate.sdstate.edu/climate_site/climate.htm

ANNUAL RAINFALL RECORDS SET IN 2008

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>YEAR</th>
<th>NEW RECORD</th>
<th>OLD RECORD</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devils Tower</td>
<td>2008</td>
<td>26.05 inches of rainfall</td>
<td>25.05 inches of rainfall</td>
<td>1982</td>
</tr>
<tr>
<td>Lead</td>
<td>2008</td>
<td>42.92 inches of rainfall</td>
<td>42.76 inches of rainfall</td>
<td>1962</td>
</tr>
<tr>
<td>Maurine 12SW</td>
<td>2008</td>
<td>29.55 inches of rainfall</td>
<td>28.36 inches of rainfall</td>
<td>1986</td>
</tr>
<tr>
<td>Milesville 5NE</td>
<td>2008</td>
<td>31.28 inches of rainfall</td>
<td>30.64 inches of rainfall</td>
<td>1982</td>
</tr>
<tr>
<td>Spearfish</td>
<td>2008</td>
<td>36.08 inches of rainfall</td>
<td>35.94 inches of rainfall</td>
<td>1982</td>
</tr>
</tbody>
</table>

US Drought Monitor

1/8/2008

US Drought Monitor

1/6/2009

Intensive:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
2009 ESDWC

Details coming soon!

http://wri.sdstate.edu/esdwc

Water News

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Links of Interest

★ South Dakota Water Resources Institute
http://wri.sdstate.edu

★ Eastern South Dakota Water Conference
http://wri.sdstate.edu/esdwc

★ Water & Environmental Engineering Research Center http://weerc.sdstate.edu/

★ South Dakota Climate and Weather
http://climate.sdstate.edu/

★ East Dakota Water Development District
http://www.eastdakota.org

★ South Dakota Section of the American Water Works Association
http://sio.midco.net/sdawwa.website/index.htm

★ Missouri River Institute http://www.usd.edu/mri/

★ South Dakota Drought Task Force
http://www.state.sd.us/applications/MV31DroughtTaskForce/index.htm

★ South Dakota Water and Wastewater Association
http://sio.midco.net/sdwwa.website/index.htm

★ Missouri River Basin Association
http://www.mrba-missouri-river.com/

★ South Dakota Department of Environment and Natural Resources
http://www.state.sd.us/denr/denr.html

★ Resource Conservation Using Native Turfgrasses in the Northern Plains
http://hflp.sdstate.edu/turf/IALCFinal.htm