

Diving Deeper: Venturing into Science with Rural Wisconsin

Introduction

As *Education* magazine bluntly noted, "Science education in rural schools can often be less than effective."^{*} Despite the best efforts of dedicated teachers, isolation and lack of resources can impair science instruction in rural school systems. Many sources have noted, however, that developing partnerships between rural school systems and universities is an effective way to enhance science curricula.

As undergraduates majoring in biology at the University of Wisconsin, we recognized the potential impact a science outreach program between UW-Madison and rural Wisconsin schools could have on how students and teachers view and do science. We therefore developed an outreach project entitled "Diving Deeper: Venturing into Science with Rural Wisconsin," for which we were awarded a Wisconsin Idea Undergraduate Fellowship in 2004. By conducting interactive presentations at high schools in Hayward and Mazomanie, Wisconsin, we wished to expand rural student awareness and understanding of scientific research, while at the same time opening the lines of communication between rural schools, the University of Wisconsin-Madison, and its Biology Core Curriculum (Biocore) Program. In 2003-2004 we conducted research on Red Bull energy drink under the guidance of the Biocore Program, and we wanted to use our research experience as an example to spark interest in high school students and teachers alike.

Our outreach project engaged students using an inquiry-based approach to teaching science, wherein students actively take part in the learning process by asking questions and developing their own ways to answer them. We hoped this approach would foster a true understanding of the material being presented and encourage students to question the world around them in a more sophisticated manner.

* Hadfield, O.D., Developing successful coalitions for the improvement of science education in rural schools. *Education*. Vol 112, Issue 3, p. 397, 1992.

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Project Goals

- Introduce/demonstrate the concept of scientific research to rural students and emphasize how scientists question the world around them.
- Share the research that we have done on Red Bull energy drink as an example of the scientific method.
- Inspire students to become more interested in science while opening their eyes to the opportunities that are available to them at UW-Madison.
- Establish a long-lasting connection between rural school districts, UW-Madison, and the Biocore Program.

"They were great role models."
-Diane Tremblay

What We Learned

- Science can be made interesting and fun. During our visit we saw:
 - Great experimental designs.
 - Application of ideas presented in the Experimental Checklist.
 - Creative and independent thought.
 - Greater interest in experiments because students had designed them themselves.
 - Students having fun!
- Inquiry-based learning is key.
 - Students' favorite parts of presentation were designing their own experiments and then carrying them out.
 - Inquiry-based approach helps students better understand the scientific method and makes learning more enjoyable and rewarding.
 - We met with the administration at Wisconsin Heights High School to discuss ways to incorporate more inquiry-based learning into their science curricula.
- Outreach can rectify misconceptions about science.
 - We gave rural students a better understanding of what scientists do.
 - We helped break down the stereotypical image of scientists, which our students defined as "old, white-haired men."
 - We served as role models that science can be done by anyone.
- Outreach is important for understanding rural students' attitudes about UW-Madison as well as informing them about the opportunities here.
 - Many students said they did not consider UW-Madison as an option for college, even though they had strong academic credentials. However, some students said they would be more interested in attending UW-Madison after participating in our presentation.
 - Some students said they and their families felt distanced from the University of Wisconsin and identified more closely with smaller local colleges.
 - If UW-Madison continues to reach out to rural Wisconsin, it will not only educate the Wisconsin community, but will also better learn the needs/concerns of rural students and recruit promising young scholars.

"The kids were really able to relate to the situations presented."
-Diane Tremblay, Hayward High School teacher

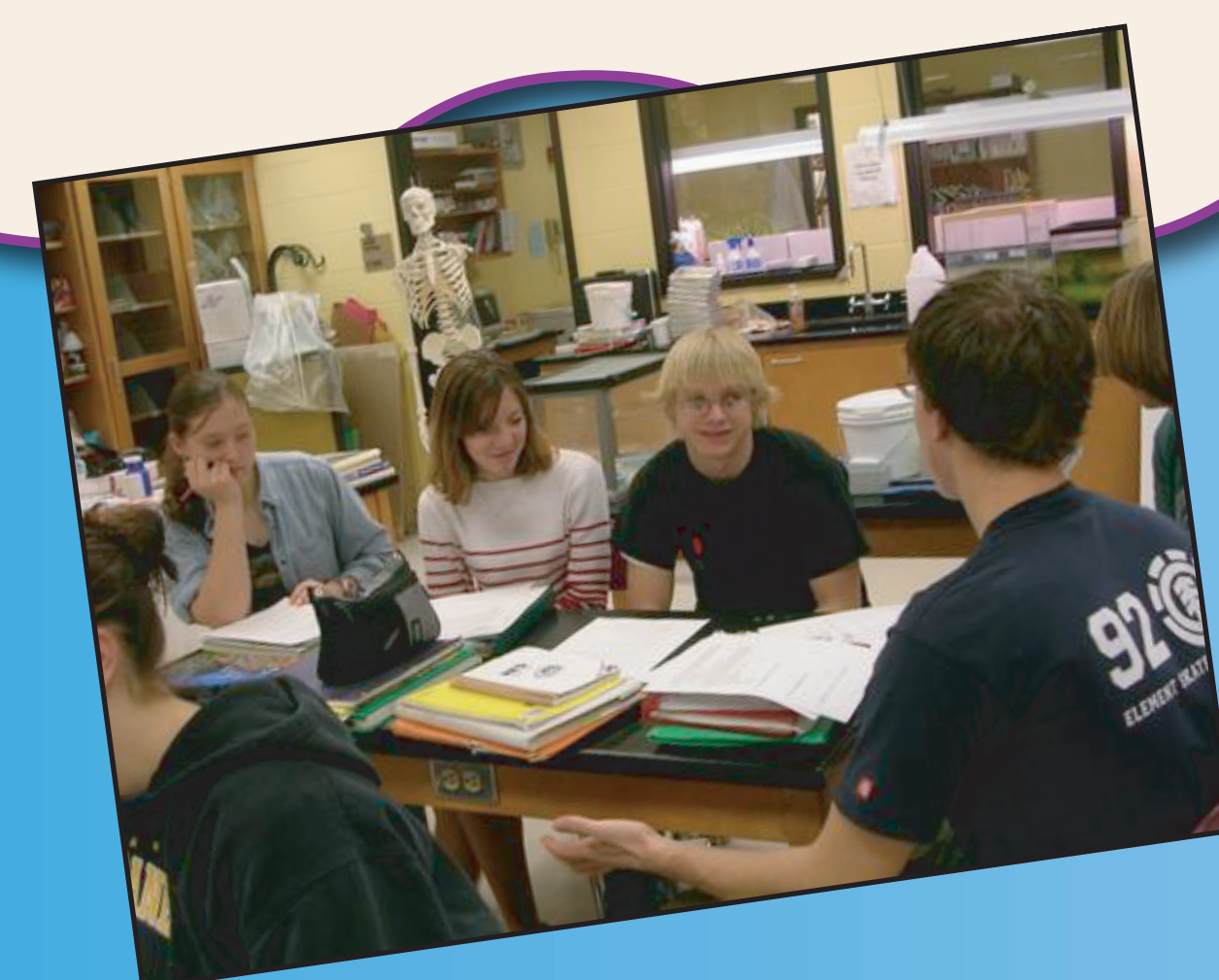
Presentations

Experimental Checklist

- Have you decided on a **question**?
- Do you have **background information** pertaining to the question?
- Do you have a clear, specific, testable **hypothesis** statement?
- Do you know how you will test your hypothesis? What **methods** will you use?
 - What will you measure?
 - What materials will you use?
 - What are your experimental groups and control groups?
 - Do you need replicates?
- Do you have **results** that you can believe?
 - Do they agree with your hypothesis?
- Can you make a **conclusion** from the experiment?
 - If not, what would you do differently next time to better test your hypothesis?
 - Do you have new questions and ideas for future experiments?

1. Introduction to the Scientific Method

- Discuss the steps to carrying out scientific research – use the "Experimental Checklist" as guide.
- Use our research on Red Bull to illustrate each step.



Summer 2004

- Met with teachers at Wisconsin Heights and Hayward High Schools to discuss presentations.
- Made supplemental teaching materials, including poster, worksheets and handouts.
- Designed and practiced our presentation.

Spring 2004

- Awarded Wisconsin Idea Undergraduate Fellowship from Morgridge Center for Public Service at UW-Madison.

2. Students Design and Perform Experiments to Test the Human Diving Response

- Students ask questions about any aspect of the diving response and use Polar Heart Rate Monitors and/or blood pressure cuffs to investigate it.
- Use the Experimental Checklist as a guide while designing protocol.
- Conduct the experiment and collect data.

What is the Human Diving Response?

The diving response is a set of physiological changes that occur when a person holds their breath and immerses their face in cold water. This causes heart rate to decrease and blood pressure to increase.



November 2, 2004

- Day one at Wisconsin Heights High School: Introduction to the scientific method.
- Presented to Human Anatomy and Physiology and AP Biology classes.

November 4, 2004

- Day two at Wisconsin Heights High School: Students designed and conducted their own experiments on the human diving response.

November 19, 2004

- Presented to Hayward High School students in the Physiology and Environmental Research classes.
- Students introduced to the scientific method and designed and carried out their own experiments on human diving response.

December 2004

- Met with Wisconsin Heights Superintendent and Principal to suggest possible improvements to the science curriculum, focusing on more inquiry based learning.

January 2005

- Met with two current Biocore students who will be "Outreach Ambassadors" in 2005.

Timeline

Future Directions

Due to our project's success, the Biocore Program is sponsoring more student-led outreach endeavors. Every year, new "Outreach Ambassadors" will be recruited from current Biocore students to engage in outreach projects. It is our hope that Biocore and the University of Wisconsin will continue to foster relationships with and extend their resources to the Wisconsin community for years to come.



"I had fun, we learned about the scientific method, and worked as a team. Thanks for everything!"
-Student

3. Class Discussion of Results

- Discuss experimental results.
- Discuss appropriateness of experimental designs/suggest improvements for future experiments.



About the Authors
Allison Bichler and Annika Swenson are very grateful for the opportunity to design and implement this project with the help of their mentor, Dr. Michelle Harris, the Biology Core Curriculum Program, and the Wisconsin Idea Undergraduate Fellowship. Both women graduated from UW-Madison with degrees in Biology and are pursuing careers as physicians.