IOWATER: A Freshman Research Initiative for geology and meteorology majors

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IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY
ISU Freshman Research Initiative

- Started in 2015 with HHMI funding
- Simplified version of FRI at University of Texas, Austin
  - Undergraduate peer mentors
  - Part-time graduate TAs
- Thirteen streams/courses from 9 disciplines and three colleges
  - SETUP: Safe & Efficient Transportation
  - Dancing for Parkinson’s
  - Stem Cells for Neuroregeneration
- Semester or half-semester experiences
  - Between 5 and 35 students in each stream
Earth Wind & Fire Learning Community

- First-year meteorology and geology students
- Field trip in August for new students, peer mentors, and faculty
- Fall and spring 1-credit orientation courses
- Fall covers introduction to university, academic services, and department
- Spring focuses on resilience and professionalism with research experience
Iowa DNR - IOWATER

- Volunteer water quality monitoring since 1998
- Network of easily accessible sites along streams in Iowa
- Developed protocols for stream habitat and physical/chemical assessment; provided starter kits
- Results stored in database
- Lack of funding reduced and eventually stopped data collection in 2015
IOWATER FRI experience

- Adopted IOWATER assessment protocols
- Assembled starter kits
  - pH, nitrate/nitrite, and chloride test strips
  - Transparency tubes
  - Meter sticks
  - Bailer and rope
- Learning community funds used for consumables - costs are kept low
- Offered spring 2016 and 2017 to class of approximately 20 students
August 2015 – Learning Community Field Trip
Map of sampling sites
Learning outcomes
- Students in small teams will study water quality and stream discharge near Ames
- Students will present their research results at the FRI Poster Symposium

Learning goals
- Locate, download, and perform simple statistical analysis on web-based data (USGS stream discharge from gauges, weather data from Iowa Environmental Mesonet)
- Plot daily precipitation and stream discharge data over a 3-month period
- Analyze water samples in the field using established protocols to answer specific research question
- Compare results with historical data from IOWATER database and data from City of Ames Water Treatment Plant
- Interpret water quality results within the framework of stream discharge and precipitation
FRI Assessment

- Undergraduate Research Student Self-Assessment (URSSA)\(^1\)
  - Thinking and working like a scientist
  - Personal gains
  - Gains in skills
  - Assessment of research experience
- STEM retention
  - All students from spring 2016 (N=9)
  - 89% of students from spring 2017 (N=18)

Thinking like a scientist - IOWATER (N=16)

- Formulating a research question that could be answered with data: GREAT GAIN
- Analyzing data for patterns: GOOD GAIN
- Understanding the relevance of research to my coursework: MODERATE GAIN
- Understanding the connections among scientific disciplines: MODERATE GAIN
- Figuring out the next step in a research project: MODERATE GAIN
- Understanding the theory and concepts guiding my research project: GREAT GAIN
- Identifying limitations of research methods and designs: GREAT GAIN
- Problem-solving in general: MODERATE GAIN
Personal gains – IOWATER (N = 12)

Fraction of total of IOWATER

- Ability to work independently
- Developing patience with the slow pace of research
- Taking greater care in conducting procedures in the lab or field
- Comfort in discussing scientific concepts with others
- Comfort in working collaboratively with others
- Confidence in my ability to contribute to science
- Confidence in my ability to do well in future science courses
- Understanding what everyday research work is like

Legend:
- great gain
- good gain
- moderate gain
- a little gain
- no gains
Skills – IOWATER (N = 12)

Fraction of Total of IOWATER

- Preparing a scientific poster
- Using statistics to analyze data
- Explaining my project to people outside my field
- Managing my time
- Understanding journal articles
- Keeping a detailed lab notebook
- Conducting database or internet searches
- Making oral presentations
- Conducting observations in the lab or field
- Defending an argument when asked questions
- Calibrating instruments needed for measurement
- Writing scientific reports or papers
- Working with computers

% Response

- great gain
- good gain
- moderate gain
- a little gain
- no gains
These questions ask about your research experience. Please comment on any of these aspects.

I felt like I worked well with my peers and the research mentors did a good job providing help and advice. (4/5)

Did you make other gains from doing research that we didn't mention? If so, please briefly describe these.

It helped me work well with others on a research project which I need to do in the future. (3/4)
Student Comments on Future Plans

Please state your intended degree and, compared to your intentions BEFORE doing research, HOW LIKELY YOU ARE NOW to enroll in a graduate program leading to an advanced degree.

Geology. I'm very likely to enter a graduate program, I wanted to before but I want to more now. (10/11)

How did your research experience influence your thinking about future career and graduate school plans? Please explain.

It allowed me to get a glimpse of what my senior thesis would be like and how to conduct research in a professional way.

It helped me understand future science research projects that I may undertake.

It helped me learn how to conduct a good experiment and I believe this will help me for my future career.

It made me think more about what I like and what I don't which cancelled some things out for me. (6/13 positive, 7/13 neutral)
Summary

- Introducing freshmen to authentic research has a positive effect on their skills, appreciation of their major, and future plans.
- Embedding a research experience in an orientation course/learning community is practical and ensures sustainability.
- A project created around water quality and surface water recharge is easy to implement and low cost.
- Implementing an assessment/revision loop allows to tune activity to student needs and interests.
Questions?

For more details about the implementation of a freshman research initiative, email Cinzia Cervato - cinzia@iastate.edu