**PATHWAYS TO SCIENCE TEACHING:**

Using Authentic Research and Teaching to Improve the Preparation of K-12 Science Teachers

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**What is the Pathways program?**

- Diverse and well-prepared K-12 teachers are critical to expanding the future science workforce.
- Most teacher preparation programs do not include experiences in designing and conducting a scientific investigation, which is a core practice of teaching scientific practices as outlined by the Next Generation Science Standards Framework (NRC, 2012; NGSS Lead States, 2013).
- Pathways to Science Teaching is an Individualized 10-week summer program:
  - **Learn Science** – an introduction to local water quality issues through interaction with community stakeholders.
  - **Practice Science** – a participant-designed water quality investigation in urban and rural environments.
  - **Teach Science** – mentored teaching preparation and practice, followed by teaching in K-8 summer camps.

**Who are the target students?**

- **Pathways** is an extension of Pathways to Science Engagement, which engages undergraduate students in a 10-week summer program.
- **Target students** are 8 students selected from an applicant pool of 21 who participated in summer 2018.
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**How did we learn, practice, teach, and think science?**

**Pre-Program: Getting to Know The Team**

- **Goals:** Get to know participants and institutional team, learn to see scientific research as an authentic research experience.
- **Activities:** Afternoon walk through local nature preserve. Participants were asked to make observations of natural features and generate “I wonder” statements about their observations.

**WEEK 1: Identifying Local Water Quality Issues**

- **Goals:** Introduce NGSS, identify local water quality issues in the region.
- **Activities:** Introduction and group discussion of NGSS scientific practices, disciplinary core ideas, and cross cutting concepts;“I wonder” statements. Meeting with local stakeholders to identify critical water quality issues. Development of assignment summarizing each participant’s walk.

**WEEK 2: Planning & Collecting Data**

- **Goals:** Learn data collection and analysis protocols. Design a water quality study.
- **Activities:** Planning in GLOBE data collection and analyses protocols for water quality. Training in weather and cloud observation. Build and install a weather station. Discussion of calibration, data quality, data recording in field notebooks. Write and finalize water quality study plan.

**WEEK 3 - 4: Collecting Data**

- **Goals:** Collect and analyze water quality data.
- **Activities:** Field sampling (salinity, dissolved oxygen, pH, temperature) and collecting data quality, data quality, data recording in field notebooks. Write and finalize water quality study plan.

**WEEK 5: Interpreting & Synthesizing Data**

- **Goals:** Finish water quality study, prepare oral presentation of research.
- **Activities:** Data analysis, graphing, and writing. Prepare graphs, maps, and visualizations. Discussion of good practice for oral and poster presentations. Prepare and practice oral presentation of research.

**WEEK 6: Teaching Framework & Planning**

- **Goals:** Prepare and practice NGSS-aligned lessons for the middle school and youth summer camps.
- **Activities:** Discussion of classroom management, lessons, and preparing, documenting, and assessing teaching experiences from the instructional team, develop lessons for the summer camps. Microteach portions of the lessons to peers and the instructional team.

**WEEK 7: Teaching Preparation & Practice**

- **Goals:** Teach two grade 6-8 science camps and reflect on the experiences.
- **Activities:** Present water quality study. Discussion of measurement error, replication, quality of analysis, graphing, and communication.

**WEEKS 8 - 9: Teaching Summer Camps**

- **Goals:** Teach two one-1.5 week camps and reflect on the experiences.
- **Activities:** Teach two week-long camps. “What’s in your community?” Water study. “I wonder” statements about children’s camps (“Cloud Camp”). Discuss successes and next steps.

**WEEK 10 & Beyond: Communicating Results**

- **Goals:** Communicate results of the research and teaching experiences to stakeholders, peers, and the professional community.
- **Activities:** Final round of data collection before and after a storm event to confirm earlier findings. Discuss poster presentation of findings. Prepare abstracts and posters for submission to fall GSA meeting. Give poster and oral presentation at the regional science fair.

**How do we know it works?**

- **Science and Math Program Improvement (SAMP) at WMU provided project evaluation.

**References**


**Acknowledgements**

We thank the community organizations and WMU faculty and staff for the time they spent with our project participants. The BSCS 5E instructional model: Origins and effectiveness (Linn, 2002). Washington, DC: The National Academies Press.