

Woodchip Bioreactors

The Search for Fewer Nitrates

TEACHER NOTES

Iowa State University scientist background:

In 2008, Dr. Michelle Soupir joined the Agriculture and Biosystems Engineering department at Iowa State University. The goal of Dr. Soupir's research program is to conduct basic research to move us toward more sustainable water systems. Dr. Soupir uses lab- and field-based research projects to monitor the occurrence, fate and movement of nutrients and microorganisms in surface and drainage water.

In 2013, Dr. Soupir's lab began a project on which these curriculum modules are based. Experimental woodchip bioreactors were designed and installed at the Agricultural Engineering Research Farm near Ames, Iowa. These pilot-scale woodchip bioreactors are used to evaluate the nutrient removal from agricultural drainage water. Dr. Soupir's students manipulate a variety of variables including hydraulic retention times, bioreactor fill materials, and influent nutrient conditions to determine the effectiveness and efficiency of the bioreactors and investigate ways to make bioreactors work better.



Research background:

Many parts of the Upper Midwestern United States have wet soils that require drainage in order for them to be used for agriculture. Draining of subsurface water (tiling) in farm fields is a practice that farmers have used for more than 100 years because doing so results in a significant increase in crop yield. Concerns have grown, however, about the effect this practice has on the movement of pollutants (i.e., nitrates and phosphates) through fields and into waters. systems. Nitrate (NO_3^-), which can be present in high amounts in drainage water, makes its way into streams, rivers and lakes where it unbalances ecosystems and can result in hypoxic conditions, as we have seen develop in the Gulf of Mexico, also known as the Gulf Dead Zone.

Woodchip bioreactors have proven to be a simple, yet highly effective way to remove nitrate pollution without impacting current land management practices. Field runoff water is collected via tiling and diverted into the bioreactor, which is essentially a buried trench filled with woodchips. Denitrification occurs when microbes living on the surface of woodchips (or other suitable material) use the wood as a carbon source to convert nitrate to nitrogen gas (N_2). The result is cleaner water which can be discharged into existing streams and rivers.

Students' use of the **Science and Engineering Practices:**

- Students will collect data to serve as the basis for evidence to answer scientific questions or test design solutions. SEP-INV-M4/H2
- Students will analyze and interpret data to determine similarities and differences in findings and/or optimize a process. SEP-DATA-M7/H6
- Students will construct a written argument supported by evidence and scientific reasoning to support or refute an explanation. SEP-ARG-M3/H4

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Our Mission

We exist to empower learners, build inclusive communities, and activate fail-forward mindsets in partnership with those we support.

We believe in...

Teacher Expertise

High-quality research and collaborative learning experiences will bring new perspectives and knowledge to educators' work.

Experience Design

Carefully designed, inclusive experiences produce a strong culture. Our human-centered approach builds the foundation upon which everyone can be transformed.

Healthy and Inspirational Partnerships

Relationships between university researchers and K-12 educators result in a learning community brave enough to ask 'what if' questions while embarking on the exciting journey to find answers.

Biotech Outreach offers:

- Year-round teacher professional development workshops
- Free supplies and equipment lending for our teacher-partners
- Coordination of on-campus visits to the Biotech Outreach Education Center (for student or teacher groups)
- Summer research experiences for in-service teachers and undergraduate pre-service teachers

Want to know more?

Eric Hall

BOEC Program Coordinator

Email: ethall@iastate.edu

Phone: 515-294-5949