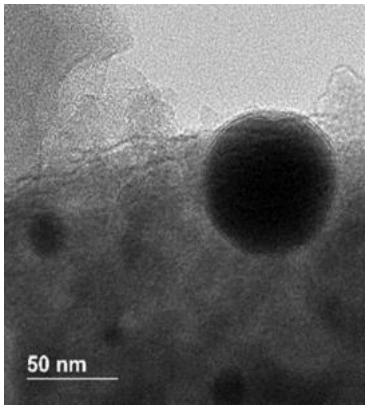
Nanotechnology and Environmental Remediation: Dr. Dungey's Lab

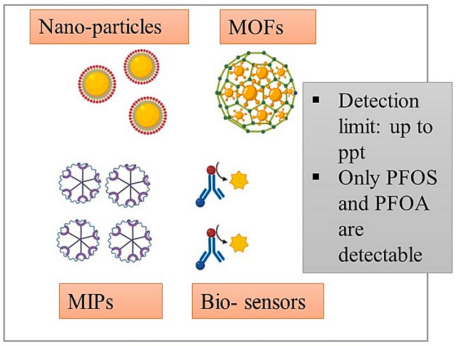
Nanotechnology, the manipulation of matter at the nanometer scale, produces new effects not seen in bulk materials (Atkinson 2003).

Project 1: Nanoparticles for Environmental Remediation

Nanoparticles are effective catalysts due to their large surface area to volume ratios. Due to these enhanced properties, nanoparticles are being explored for environmental remediation applications. Our approach to nanotechnology is to use environmentally benign materials, prepared using green chemistry principles (ACS). In particular, we are using Zero-Valent Iron Nanoparticles (nZVI) to enhance bacterial denitrification in agricultural soils (Kerr and Dungey 2019). Excess nitrates in agricultural fields are pollutants and should be reduced to prevent degradation of environmental waters (lakes, rivers, oceans). We will measure denitrification rates of the bacteria cultures as a function of nanoparticle preparation and support material. Ion chromatography will be used to separate the nitrate peaks from background so that we can quantify the denitrification process.



Project 2: Detection of PFAS in Aqueous Samples



Per-and Polyfluoroalkyl substances (PFAS) are a class of synthetic chemicals that are found in many industrial settings (lithium-ion battery packs, flame-retardant foams, coatings for food containers, dirt-resistant paints, etc.). Despite their strengths, PFAS have been classified as "forever chemicals" and are being banned by the EPA because of their tendency to accumulate in soil, water, and living tissues. The purpose of this project is to develop a low-cost, rapid methodology for the detection of PFAS in aqueous samples. Nanoparticles coupled with fluorescent dyes have shown promise in this area (Dhiman and Ansari 2025). Students will learn how to prepare nanoparticles, collect environmental surface water samples, and use the spectrofluorometer to quantify PFAS.

ACS. "12 Principles of Green Chemistry." American Chemical Society, from https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html.
Atkinson, W. I. (2003). Nanocosm. New York, Amacom.
Kerr, N. and K. Dungey (2019). Using Green Chemistry to Produce Supported Iron Nanoparticles from Oak Leaf Extract and Biochar. National Conference of Undergraduate Research, Kennesaw, GA, University of North Carolina at Asheville.

Dhiman, S. and N. G. Ansari (2024). "A review on extraction, analytical and rapid detection techniques of Per /Poly fluoro alkyl substances in different matrices." Microchem. J. **196**: 109667.