DAN BURGARD--RESEARCH INTERESTS

When I arrived at Puget Sound my research had focused primarily on the remote sensing of mobile source (vehicle) emissions. The remote sensor is the Fuel Efficiency Automobile Test (FEAT) that was initially developed at the University of Denver and has since been commercially developed and marketed worldwide. I have continued the remote sensing research at Puget Sound with seven different students as part of their senior thesis work. This line of study involves the application of my long-term interests in analytical chemistry to environmental problems. Recently these combined interests have taken me to aqueous environments and quantifying trace levels of licit and illicit drugs in wastewater. All research opportunities for undergraduates working with me will involve monitoring of real-world, environmental concerns.

Remote Sensing of Mobile Source Emissions

Background
My students use a Remote Sensing Device (RSD) to measure previously unmeasured or under-measured in-use vehicles, vehicles that have been studied in the lab but not in-use, or to monitor new trends in emissions from vehicles that have had recent changes in regulations. An RSD has the benefit of being an unobtrusive and noninvasive technique to measure a large number of in-use vehicles with relatively low cost.

Research
My students have measured emissions from school buses with new catalytic technology to reduce emissions. They have also measured marine vessels, a category of mobile source emissions that had previously never been measured by an RSD. This included small recreational boats, commercial tugboats, and ocean-going container and cruise ships. More recently my students have measured on-road trucks and transit buses to determine if two new sets of emissions regulations were having the intended effects on-road as were verified in the laboratory as well as using the remote sensor to measure in-use emissions from train locomotives. Future research will involve more work on measuring the emission control devices on trucks/buses/ships/etc…

Wastewater Monitoring

Background
Recently research groups both locally and internationally have been examining the possibilities of detecting drugs in wastewater. Once detected, these groups have been able to approximate the drug use occurring within a given community. The first tests were done in an Italian river to determine the level of cocaine consumption from the surrounding population. The water results showed very different consumption estimates than the official national estimates. The national estimates were presumably determined using medical records, police reports, or reports from official surveys. However, traditional methods suffer from bias either through under reporting in self-administered surveys or underrepresenting the population with medical or police reports. Sewer-based drug epidemiology has the promise to be an objective, complementary method in determining community drug use.

Research
We have applied sewage-based drug epidemiology to measure a variety of drugs from a variety of wastewater sources. Initially we tested University of Puget Sound wastewater for Adderall and Ritalin over the course of one academic year. Adderall (amphetamine salts) is a prescription drug for the treatment of attention deficit hyperactivity disorder (ADHD). It is common rumor amongst students that taking non-prescription Adderall increases one’s ability to focus for long
periods of time and that this can be beneficial during midterms or final exams. According to one survey, approximately 24% of students on a college campus reported having used Adderall or other drug (without a prescription) for the purpose of improved academic performance. We determined the amount of Adderall being used by our college community during final exams and midterm exams was higher than during periods of low academic stress, in the case of one exam period nearly 8× higher (~25%). We have also detected stimulants such as amphetamine and methamphetamine in portable toilets at a truck weigh station. Current projects involve the determination of trends in marijuana use in Tacoma since the introduction of legal recreational cannabis in Washington State, as well as chiral analysis of other drug metabolites to determine origin.

Participation in these projects includes learning about sample collection, method development, and analysis. Solid Phase Extraction (SPE) is used to extract and concentrate trace amounts of drug metabolites from wastewater samples. Analysis is performed on Liquid Chromatography tandem Mass Spectrometry (LC-MS/MS).

References (Puget Sound student authors denoted with *)