SOIL RESEARCH CLUSTER LABORATORY (SRCL)

Department of Ecosystem Science & Management

PennState College of Agricultural Sciences

Lab Rooms: 430, 439, 461, 462 & 470
Agricultural Sciences & Industries Building

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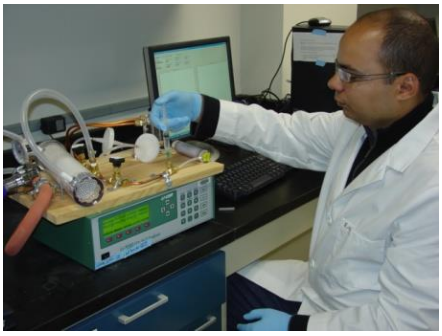
WELCOME TO THE ANALYTICAL INSTRUMENTS IN THE SOIL RESEARCH CLUSTER LABORATORY

Ephraim Muchada Govere, PhD, MBA, CPSS
Laboratory Director

- **Get guidance on instrumental methods and quality control.**
- **Get access to and trained in using analytical instruments.**
- **Get supervision during your sample analyses.**

SOIL RESEARCH CLUSTER LABORATORY
UNCOVERING THE ECOSYSTEM SECRETS

Supports research for faculty members, graduate and undergraduate students, post-docs, research fellows, research technicians and visiting scholars



The SRCL supports course laboratory exercises to give students hands-on experience in analytical skills.

• **Instrument:** **CE Instruments EA 1110 CHNS-O Elemental Analyzer**

• **Principle:** **The CHNS(O) Analyzer determines the percentages of C, H, N, S & O of organic compounds, based on the principle of "Dumas method" which involves the complete and instantaneous oxidation of the sample by "flash combustion". The combustion products are separated by a chromatographic column and detected by the thermal conductivity detector (T.C.D.), which gives an output signal proportional to the concentration of the individual components of the mixture.**

• **Capabilities:** **Analysis of C, H, N, S, (O) in organic compounds at 1800^{o} C: Organic compounds, Pharmaceuticals, Food & Agricultural Industries, Chemistry & Chemical Engineering, Geological & Environmental samples, Organometallics, Gasoline and fuels, Coal and coke, Graphite and carbides, Metals and alloys**.

• **Operator:** **Julie Weitzman, as a PhD Candidate**

- **Instrument:** **Shimadzu SSM-5000A and TOC-5000A Analyzer**

- **Principle:** **The sample is combusted or decomposed to CO_2. and detected in a non-dispersive infrared gas analyzer (NDIR). The peak area counts are proportional to concentration of carbon in sample.**

- **Capabilities:** **Analysis of total carbon (TC), total organic carbon (TOC), inorganic carbon (IC), dissolved organic carbon (DOC), purgeable organic carbon (POC), and non-purgeable organic carbon (NPOC).**

- **Operator:** **Beth Hoagland, as a PhD Candidate**

• **Instrument:** **UV-VIS-NIR Scanning Spectrophotometer Shimadzu UV-3101PC**

• **Principle:** **The UV-3101PC Ultra Violet Near Infra Red Spectro photometer (UV-Vis NIR) measures the percentage of radiation that is absorbed at each wavelength. Typically this is done by scanning the wavelength range and recording the absorbance. The UV-3101PC is equipped with three detectors: the PMT detector (photomultiplier tube) for the ultraviolet and visible regions, and InGaAs and PbS detectors for near infrared region. The InGaAs detector bridges the gap between the PMT – PbS switching wavelength where sensitivity is typically low to ensure high sensitivity over the entire measurement wavelength range. An all-in-one software package (UVProbe) is used to control the 3101PC and it incorporates four functions: Spectrum, Photometric (Quantitation), Kinetics,and Report Generator.**

• **Capabilities:** **The UV-VIS-NIR instrument provides for optimum sensitivity from 190-3,200nm.**

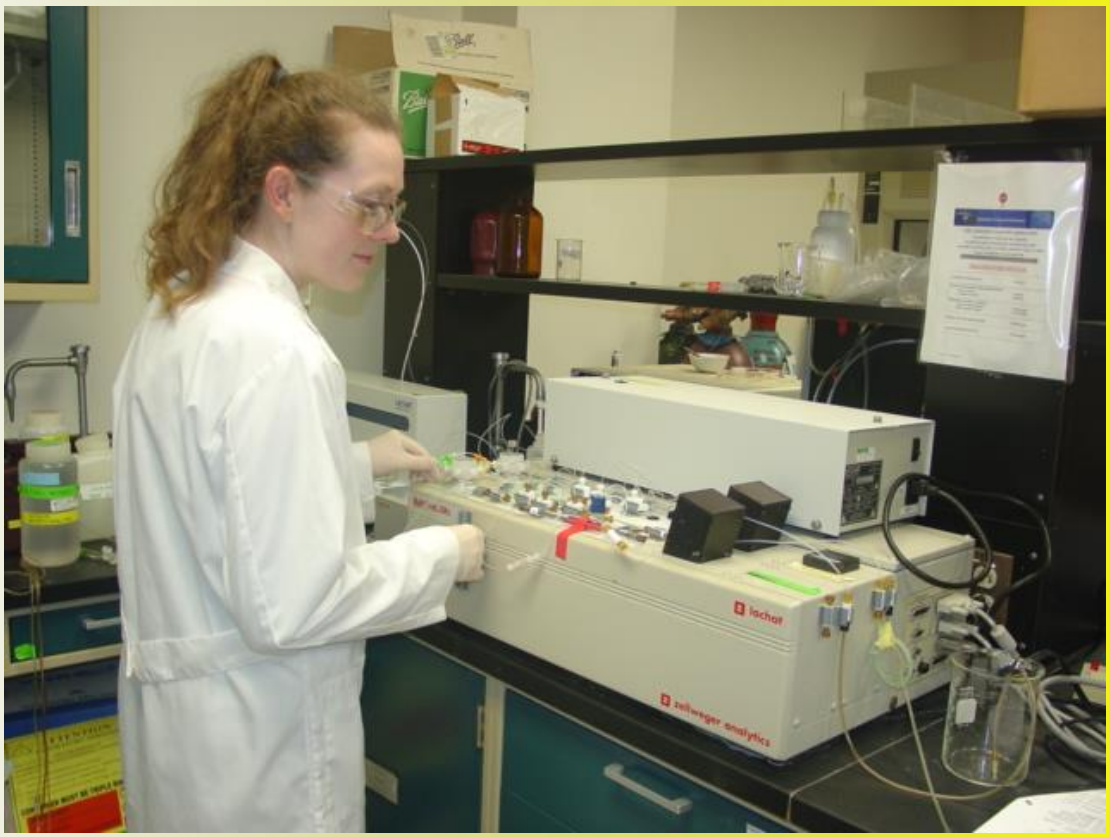
• **Operator:** **Fiona Kizewski, as a Postdoc**

Instrument: Lachat QuikChem® FIA + 8000 Analyzer

- **Principle:** Analysis is based on reacting sample with reagent to form color complex which absorbs light at a specific wavelength. The absorbance of the reaction product is directly proportional to the concentration of the analyte in the sample.

- **Capabilities:** Two sample processing modules (channels) configured to analyze acidity, alkalinity, silica, iron, exchangeable and total aluminum, nitrate, nitrite, ammonia, total Kjehldahl nitrogen (TKN), total dissolved nitrogen, ortho-phosphate, total dissolved phosphorus, molybdenum, bromide, iodine, etc in drinking water, waste water, seawater, brackish water, soil, plant material, fertilizers, foods, etc.

- **Operator:** Alison Franklin, as a PhD Candidate



- **Instrument:** **Perkin Elmer Optima 7300DV ICP-OES**

- **Principle:** **Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is the measurement of the light emitted by the elements in a liquid sample introduced into an ICP source. This technique exploits the fact that excited electrons emit energy at a given wavelength as they return to ground state after excitation by high temperature Argon Plasma that can reach temperatures as high as 10,000°K. Each element emits energy at specific wavelengths peculiar to its atomic character. And the measured emission intensities are then compared to the intensities of standards of known concentration to obtain the elemental concentrations in the unknown sample.**

- **Capabilities:** **Simultaneous analysis of a large number of metals, transitional metals, metalloids and other elements in liquid matrices.**

- **Operator:** **Carla Rosenfeld, as a PhD Candidate**

• **Instrument:** **Pressure Plate Extractor Apparatus SoilMoisture® 0700CG23 manifold**

• **Principle:** **Used for the determination of soil (or other materials') water retention at an imposed matric potential. The technique involves placing a saturated soil sample on a porous ceramic plate inside a pressure chamber. The underside of the ceramic plate is maintained at atmospheric pressure while the soil samples are pressurized, thus creating a hydraulic gradient and subsequent flow of water from the samples through the saturated ceramic plate. In theory, flow ceases once the soil samples reach equilibrium with the imposed pressure. The characteristic curves that relate the soil suction (matric potential), at which moisture is held by the soil to its moisture (water = soil solution) content can be developed. These curves are known by various names such as *water retention curve*, *water characteristic curve*, *water content–matric potential curve*, and *capillary pressure–saturation relation*.**

• **Capabilities:** **Can be set to constant preset pressures ranging from 10- to 1500-kPa (0.1 to 15 bars or 100 to 15000 cm H_2O) using Pressure Plate Extractor System Apparatus comprising SoilMoisture® 0700CG23 manifold with 1500G1 (15-bar) and 1600G1 (5-bar) Pressure Plate Extractors and a 2 MPa (300 psi) air compressor (source of pressure).**

• **Operator:** **Amin Afzal, as a PhD Candidate**

- **Instrument:** **ku-pF Unsaturated Hydraulic Conductivity Apparatus DT 04-01 UGT**

- **Principle:** **The ku-pF Apparatus measures the hydraulic conductivity (ku) and the pF curve of samples in the unsaturated range based the evaporation method. Samples get fully saturated in the sample ring and then sealed at the base. The free surface is exposed to evaporation, and the gradient of the resulting water movement is recorded with a data logger. Water movement, i.e. the amount of water which per time interval passes through the sample surface, gets weighed, and the gradient of water tension is measured in each sample ring by two tensiometers spaced at a distance of 3 cm. The tensiometer values are recorded with the time pulse of weighing. The hydraulic conductivity of the samples is calculated according to DARCY's equation, assuming quasi-stationary flow.**

- **Capabilities:** **Using the ku-pF Apparatus, up to ten soil samples can be analyzed simultaneously. For this, the sample rings are put onto a star-shaped sample changer and put periodically, with a suitable time interval, onto a scale.**

- **Operator:** **William E. Berger, as an MS Candidate**

- **Instrument:** **Dionex DX 500 Ion chromatograph (IC)**

- **Principle:** **Dionex DX 500 is a liquid chromatograph where charged species are separated by selective distributions in an electrolytic mobile phase and a stationary phase with weak ionic sites. Detection is performed by a conductivity detector – the greater the concentration of ions the higher the conductivity of the solution.**

- **Capabilities:** **Rapid, sequential measurements of halides (Br^-, Cl^- and F^-), oxides (NO_2^-, NO_3^-, PO_4^{3-}, SO_3^{2-} and SO_4^{2-}) and alkali metal and alkaline earth cations.**

- **Operator:** **Dr. Ephraim Govere, Director, SRCL**

- **Instrument:** Voltammeter - Metrohm 797 VA Computrace

- **Principle:** Voltammetry relies on the phenomenon that many elements and compounds undergo reduction or oxidation at a potential that is unique to the specific element or compound. This unique potential allows for the selective qualitative information provided from the value of the applied potential referenced to a standard reference electrode and quantitative information obtained from the amount of current or charge generated from the reduction/oxidation process

- **Capabilities:** Can be applied to the analysis of about one-half of the elements in the periodic table as dissolved ionic species, polyatomic ions, complexes of ions, or organic compounds.

- **Operator:** Nadia Martínez-Villegas, as a PhD Candidate

- **Instrument:** SPEX SamplePrep 8000D Mixer/Mill

- **Principle:** High-energy ball mill which grinds samples by placing them in a container along with one or more grinding elements, and imparting motion to the container. As the container is swung, the inertia of the grinding elements causes them to move independently, into each other and against the container wall, grinding the sample.

- **Capabilities:** Rapidly shakes containers back and forth several thousand times a minute. Accommodates sample sizes 0.2 - 10 grams; capable of pulverizing rocks, soil, plant and animal tissue, fruit and seeds, minerals, sand, cement, slag, ceramics, glass, pharmaceutical, and hundreds of other brittle, often hard samples. It rapidly reduces hard, brittle samples to analytical fineness, blending powders, or making emulsions.

- **Operator:** Luis Eduardo Castillo Meza, as a PhD Candidate

Erynn Maynard, as a PhD Candidate

• **Instrument:** **Coy Vinyl Anaerobic Glovebox Chamber and Vacuum Airlock**

• **Principle:** **Enclosed, controlled environment chambers that serve as isolation or containment spaces that meet precise requirements for humidity, temperature, safety, particulates, atmospheric composition and/or other environmental conditions for laboratory work. Operates in isolation mode, under positive pressure, to protect samples or experiments from the environment and shields the operator from the process.**

• **Capabilities:** **Provides a strict anaerobic atmosphere of 0-5 parts per million (ppm) using a palladium catalyst and hydrogen gas mix of 5%. Provides a clean, safe and anaerobic working environment suitable for carrying various microbiological investigations.**

• **Operator:** **Xin Peng, as a PhD Candidate**

• **Instrument:** **Consolidated Model 3AV-ADVPRO: 20" x 20" x 38" Sterilizer**

• **Principle:** **Heat is delivered under pressure to a chamber to decontaminating or sterilize the contents of the chamber. Decontamination is the reduction of contamination to a level where it is no longer a hazard to people or the environment. While sterilization is the total destruction of microorganisms present.**

• **Capabilities:** **Steam-sterilization at 100 °C to 135 °C using three basic sterilization cycles. Sterilization of glassware, unwrapped goods, waste, utensils, redbags using the gravity cycle; sterilization of wrapped materials, packs, bedding, cages, porous materials, redbags using pre-vacuum and/or post-vacuum cycle and sterilization of liquids using the liquid cycle.**

• **Operator:** **Iffa Gaffoor, as a Postdoctoral Research Associate**

• **Instrument:** Thermolyne Muffle Furnaces 30400

•**Principles:** The unit consists of a vented heating chamber; a manual control or an automatic proportioning digital set, digital readout control with over-temperature protection; and a door interlock relay for operator safety. The furnace chamber is heated by two open coil electric resistance heaters and is insulated with a ceramic fiber insulation. The temperature is controlled by an automatic proportioning controller using a type K thermocouple for feedback information.

•**Capabilities:** Temperatures from 400°F (204°C) to 2000°F (1093°C) for continuous use (operating the furnace for more than 3 hours), or temperatures from 2000°F (1093°C) to 2192°F (1200°C) for intermittent use (operating the furnace for less than 3 hours).

• **Operator:** Brosi Anna Bradley, as a Research Technologist

- **Instrument:** **Forma-Quick Glassware Dryer**

- **Principle:** **Incoming air is filtered, then forced through the unit at temperatures of up to 200C. Adjustable temperature unit can run constantly, or on a 12-hour cycle timer.**

- **Capabilities:** **Large glassware stainless steel dryer brings intense drying power to large loads of product. Temperature Range: +50C above ambient to +200C.**

- **Operator:** **Lillian Z Hill, as an MS Candidate**

- **Instrument:** Microbalances

Sartorius CP2P

Mettler Toledo MX5

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- **Capabilities:** High resolution mode readability = 0.001mg

- **Operators:** Dr. Govere instructing college students

Pennsylvania School of Excellence in the Agricultural Sciences (PSEAS)

Dr. Govere instructing high school students