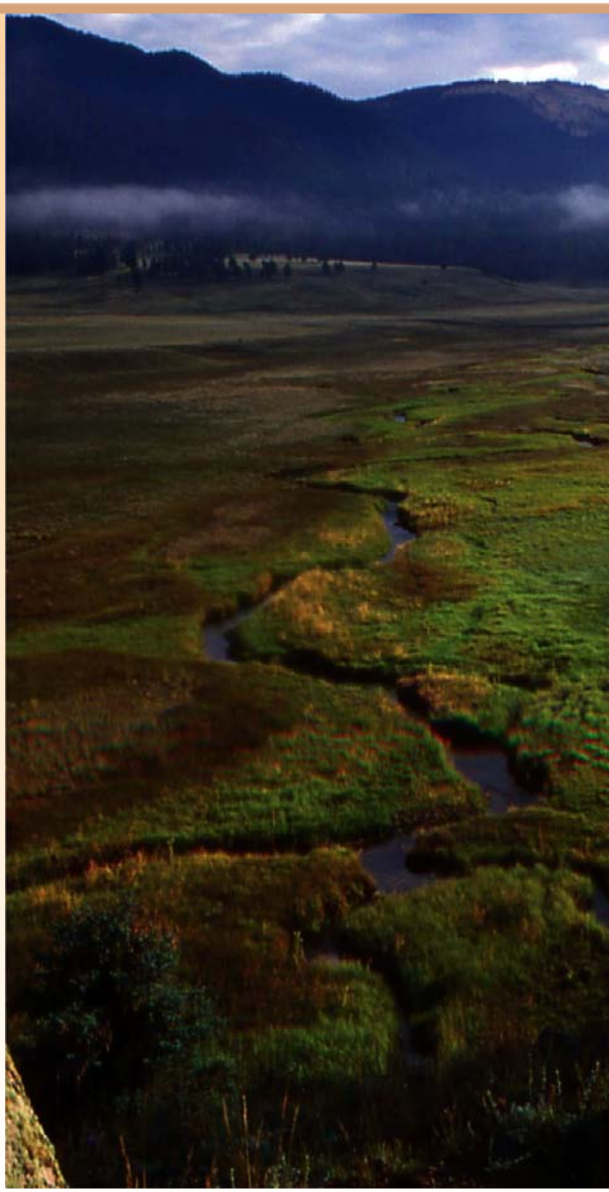
Water Quality in Snowmelt Dominated Systems: Coupled Hydology and Biogeochemistry

- 1:50-2:10 - Bob Parmenter, Valles Caldera National Preserve: *Interannual and seasonal differences in stream water quality in the Valles Caldera National Preserve*
- 2:10–2:30 - Michael Pullin, New Mexico Tech: *Overview of water quality research at NMT*
- 2:30–2:50 - Paul Gabrielsen, New Mexico Tech: *Agent-based modeling of hyporheic zone carbon biogeochemistry*
- 2:50-3:15 - Discussion

Enabling Climate Change Research: Monitoring Environmental Parameters

- **3:50 – 4:05 - Jevon Harding, New Mexico Tech:** *Applying distributed temperature sensing (DTS) to New Mexico climate change research*
- **4:05 – 4:20 - Laura Crossey, University of New Mexico:** *Tackling the water quality challenge in the new millennium: Using new technology to track geologic salinity sources to surface and ground water*
- **4:20 – 4:35 - Asitha Cooray, New Mexico Tech:** *Colorimetric analysis of iron in natural waters at nanomolar concentrations*
- **4:35 – 4:50 -Scotty Strachan, University of Nevada, Reno:** *Building Climate Monitoring Infrastructure in Nevada: Cyberinfrastructure meets field science along high elevational transects*
- **4:50– 5:15 - Discussion**

New Mexico EPSCoR



Overview of Water Quality Research at New Mexico Tech

Stream DOM Dynamics

Michael Pullin
Department of Chemistry
New Mexico Tech

Water Quality Monitoring

- How is water quality coupled to hydrology?
- How do material fluxes vary seasonally and with wet and dry years?
- How do DOC chemical characteristics vary seasonally and with wet and dry years?
- How do algal and terrestrial contributions to DOC amount and chemistry vary seasonally and with wet and dry years?
- What role does the hyporheic zone play in these variations?

Water Quality Monitoring

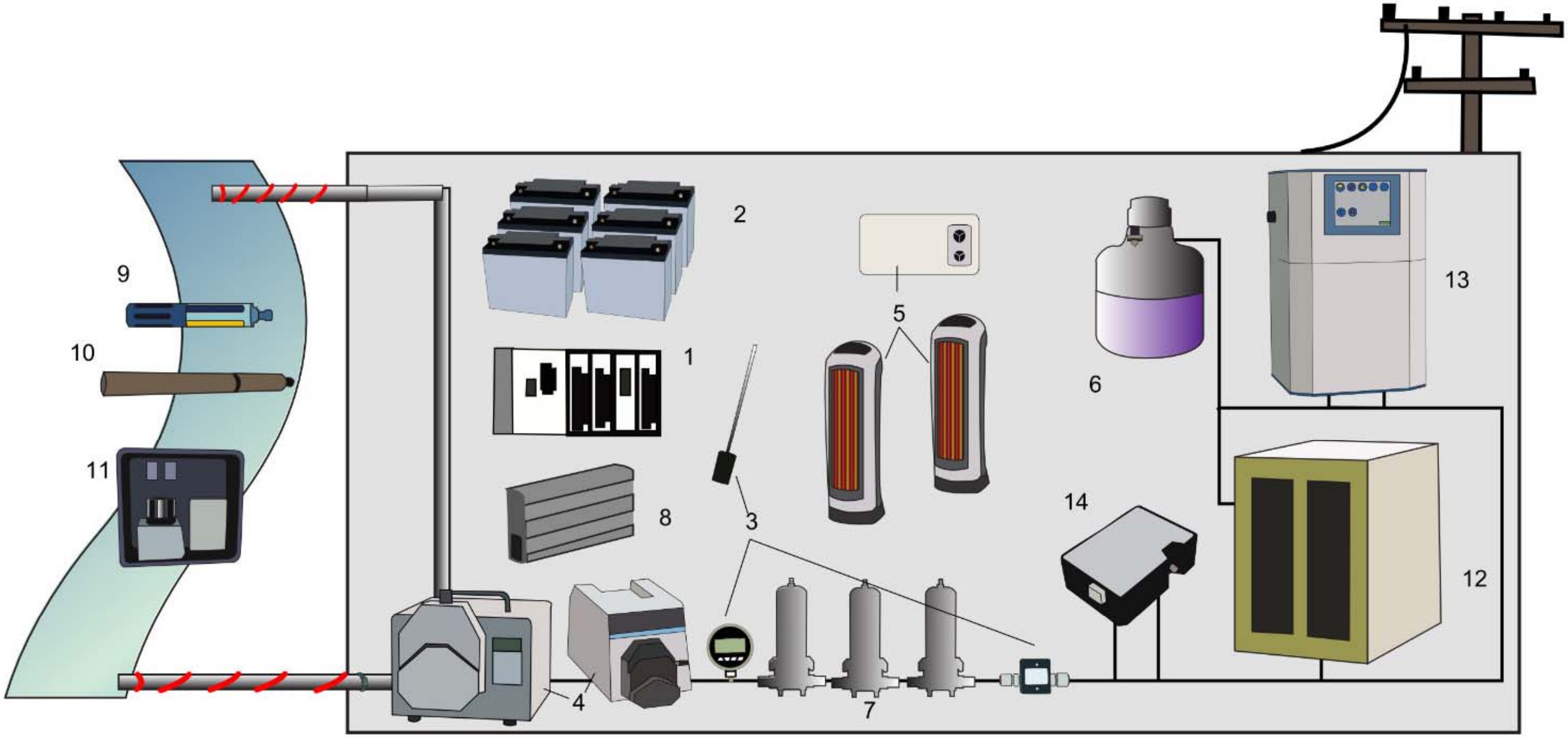
- Sporadic sampling misses high flow events
  - Snow melt – a difficult time to sample
  - Thunderstorms
    - A hazardous time to sample
    - Difficult to anticipate
  - Probably underestimates the mass of material moving through watersheds
- Sporadic sampling over long time periods difficult to maintain
  - Students are geared towards degree completion
  - Hard to compare wet and dry years

Water Quality Monitoring

- Develop, build, and deploy a system of chemical analysis instruments to monitor stream water chemistry
  - Operate without human intervention for 30 days
  - Relay data back continuously
  - Respond to remote user instructions
  - Operate in freezing temperatures
  - Operate off grid
- Adapt oceanography-based instruments where possible
- Conduct all analyses in a continuous or inline mode

Water Quality Monitoring

- Trailer-based monitoring laboratory
- Will monitor:
  - pH, cond., temp., D.O., turb., Chl A
  - Nitrate, phosphate, silica
  - DOC and DIC
  - DOM absorbance and fluorescence spectra
- Automated operation via NI technology
  - CompactRIO – computer and I/O devices
  - Labview – instrument control and data collection software
  - Compact RIO will collect data from all devices and transmit to a live web page using a cell phone modem
  - Will have the ability to respond to monitored parameters



Instrumentation

9. YSI 6920 Sonde -- Stream temperature, DO, pH, turbidity, conductivity
10. Satlantic SUNA -- Total Nitrate via UV absorption
11. Iron Analyzer -- Dissolved ferrous iron, total dissolved iron
12. AutoLab 4 -- Phosphorus (as phosphate), nitrogen (as nitrate), silica
13. OI 9120E -- Total organic, total inorganic carbon
14. Ocean Optics USB-2000 -- Fluorescence and absorbance

DOM Dynamics

- Dissolved Organic
  - A mixture of nat ... e from terrestrial plant ... nous) sources
  - Found in all natu
  - A complex mixtu concentration
  - Not possible to c ... ical structures

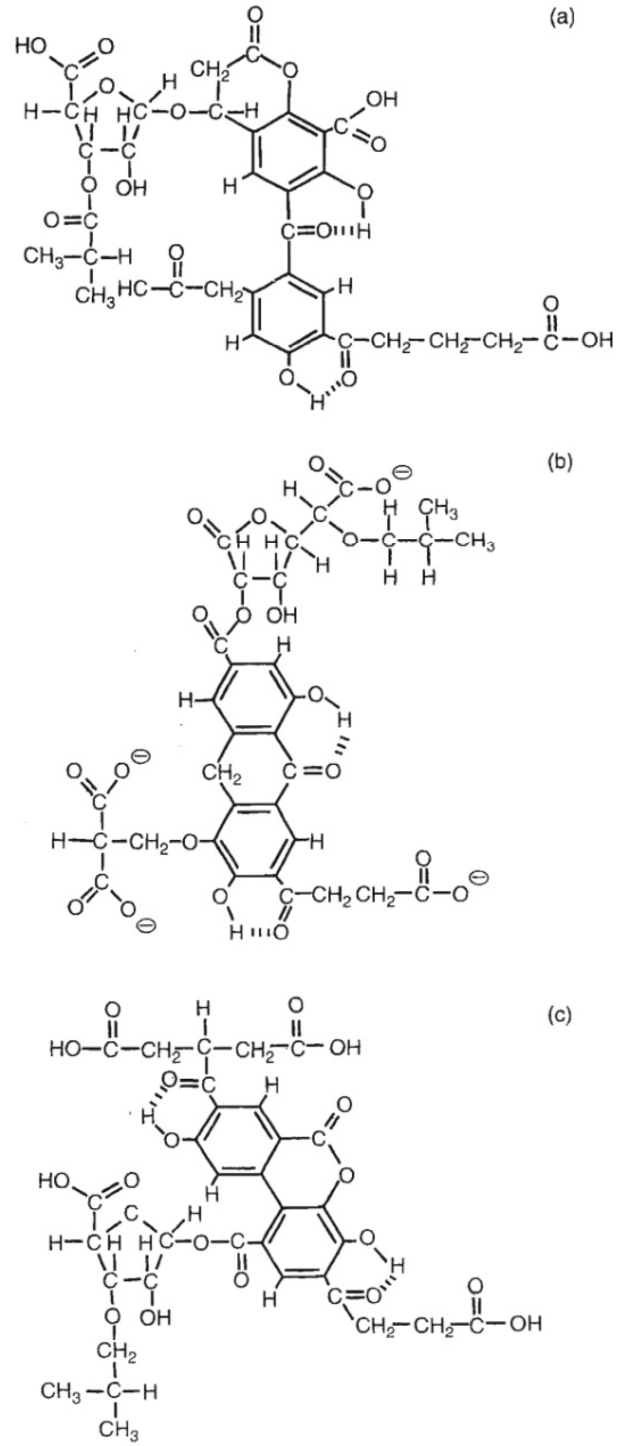


FIGURE 6-4 Three proposed average structural models of Suwannee River fulvic acid (from Leenheer et al., 1994).

DOM Dynamics

- Typically studied by measuring bulk properties and/or property distributions

- Example: Molecular Weight Distribution
- Typically measured by an HPLC method
- Difficult to automate in the field

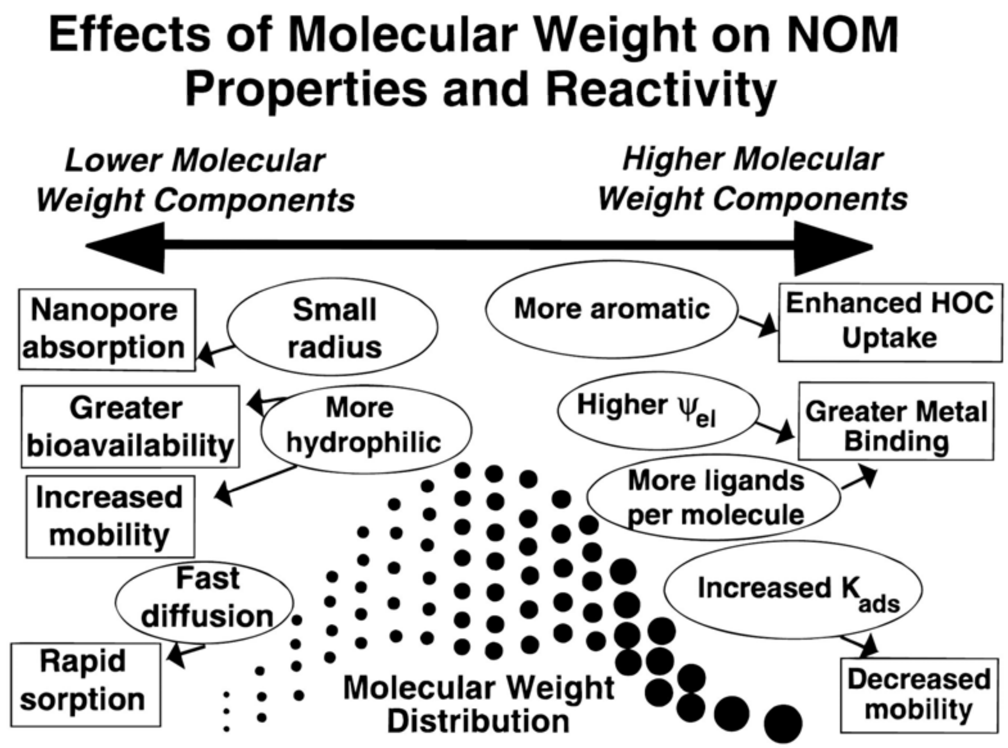


FIGURE 1. Effects of molecular weight on NOM properties and behavior, assuming consistent chemical composition across the MW range.

Cabaniss et al., ES&T, 2000

DOM Dynamics

- Spectroscopic measurements of DOM monitored in our trailer
- UV-Vis light absorbance
  - Light energy removed by the DOM as a function of wavelength (200 – 600 nm)
  - Depends on both amount and character of the DOM
  - Can factor out the variation in amount by ratioing to DOC concentration
  - Absorbance at specific wavelengths correlated to
    - Aromatic character of the DOM
    - Molecular weight
    - Chlorine disinfection byproducts

DOM Dynamics

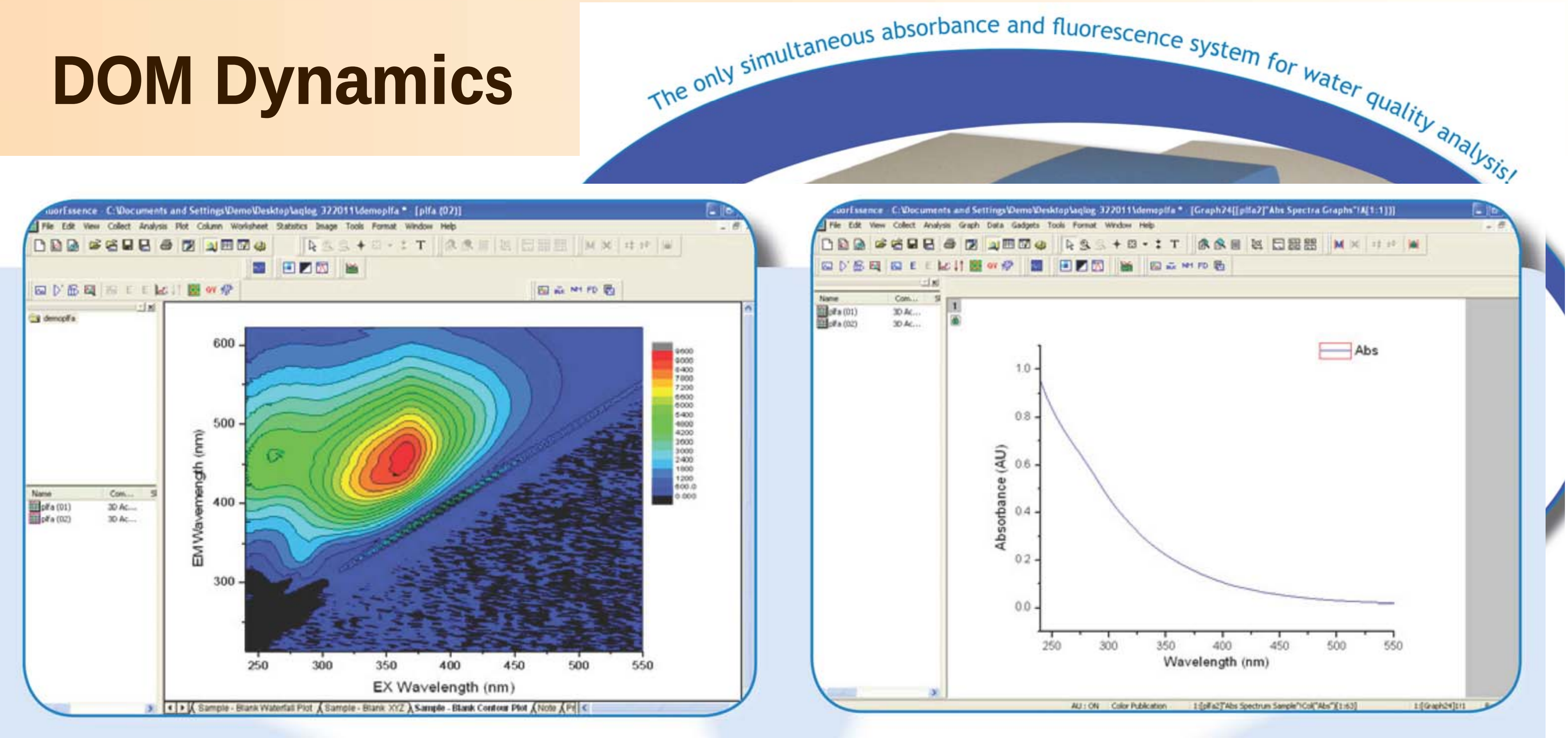
- UV-Vis light absorbance
  - Can also examine the spectral shape, the distribution of absorbance vs wavelength
  - Changes in spectral shape correlated with biological and photochemical changes in DOM composition

- Fluorescence
  - Light emitted when DOM that is electronically excited by UV/Vis light returns to the ground state
  - Highly sensitive to chemical structure
  - Has been used to understand changes in DOM origin and composition

DOM Dynamics

- Fluorescence
  - McKnight and coworkers
    - Fluorescence Index – Relative amounts of allochthonous and autochthonous DOM
    - Redox index – Is the DOM originating from oxic or reducing environments?
  - Stedmon and coworkers
    - PARAFAC – use Factor Analysis to determine spectral components that account for the variation in DOM fluorescence in time or space
    - Identified spectral components include those that correlate to autochthonous and autochthonous DOM sources
    - Requires large and 3D datasets

DOM Dynamics



Instrument measures both absorbance and fluorescence simultaneously every 2-4 min.

Aqualog

JOBIN YVON Technology

Water Quality Monitoring

- How is water quality coupled to hydrology?
- How do material fluxes vary seasonally and with wet and dry years?
- H … y and w…
- H … mount a… y…
- W… va…

Supplement field monitoring with:

- Upstream periodic hand sampling
- More complex chemical analyses
- Stream and hyporheic zone tracer injections
- Bottle/Lab simulation of specific processes

Other projects

- Development of water quality monitoring instruments
  - Iron(II)/Iron(III)
  - Ammonia/amino acids
  - Low cost water quality sondes (pH, cond., O_2, temp, etc)

- Collaboration with Diné College
  - Marnie Carroll
  - Rachel Clements and Katrina Koski
  - NM EPSCoR Seed Grant to Diné College
  - Development of an educational watershed – system of water quality and amount sensors that can be operated and configured by faculty and students