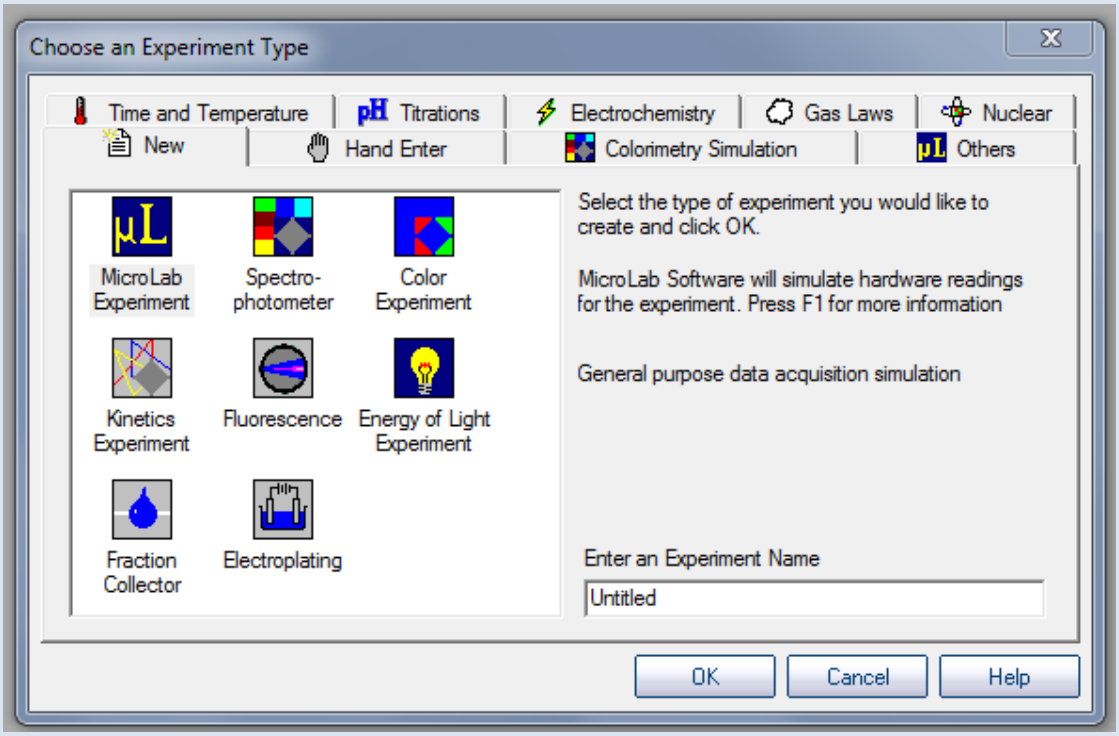
MicroLab "Instrument" Experiments

There are three types of MicroLab experiments:

- **Pre-written "template" programs** that produce quick, reliable data for proof-of-concept experiments.
- **"MicroLab Experiments",** in which students plan their experiment, select and calibrate their sensors, and set up their data display for easy data analysis.
- **Instrument Experiments,** which use special multi-variable graphic displays and calculations for complex spectrophotometry and electrochemistry experiments.

The figure below shows the opening screen for MicroLab's software. Each of these program types can be accessed from this opening screen.

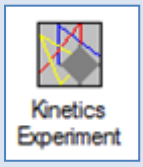
- Pre-written **"template" programs** are accessed from the tabs, each serving a different area of chemistry. The hand-enter routines are also accessed from a tab.
- The **"MicroLab Experiment"** icon loads the general purpose MicroLab experiment builder and analysis package.
- The other seven icons load different **"instrument" programs**. Each of these MicroLab "instruments" makes a specific kind of measurement and displays data for the most convenient analysis.



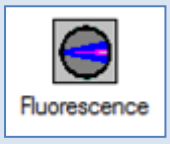
The MicroLab ***FASTspec*** Scanning Spectrophotometer simultaneously measures transmission, absorbance, scatter, and fluorescence in the range 360-940 nm. Fluorescence may be excited at sixteen different discrete wavelengths in this range. Analysis software supports Beer's Law and systems that deviate from Beer's Law, as well as fluorescence/concentration plots. Spectral profiles may be presented as histograms or smooth diode-array graphs. Turbidity (scatter)

measurements are true nephelometric measurements made at 90 degrees to the excitation beam. One of the excitation wavelengths is the international standard 880 nm used for nephelometry.

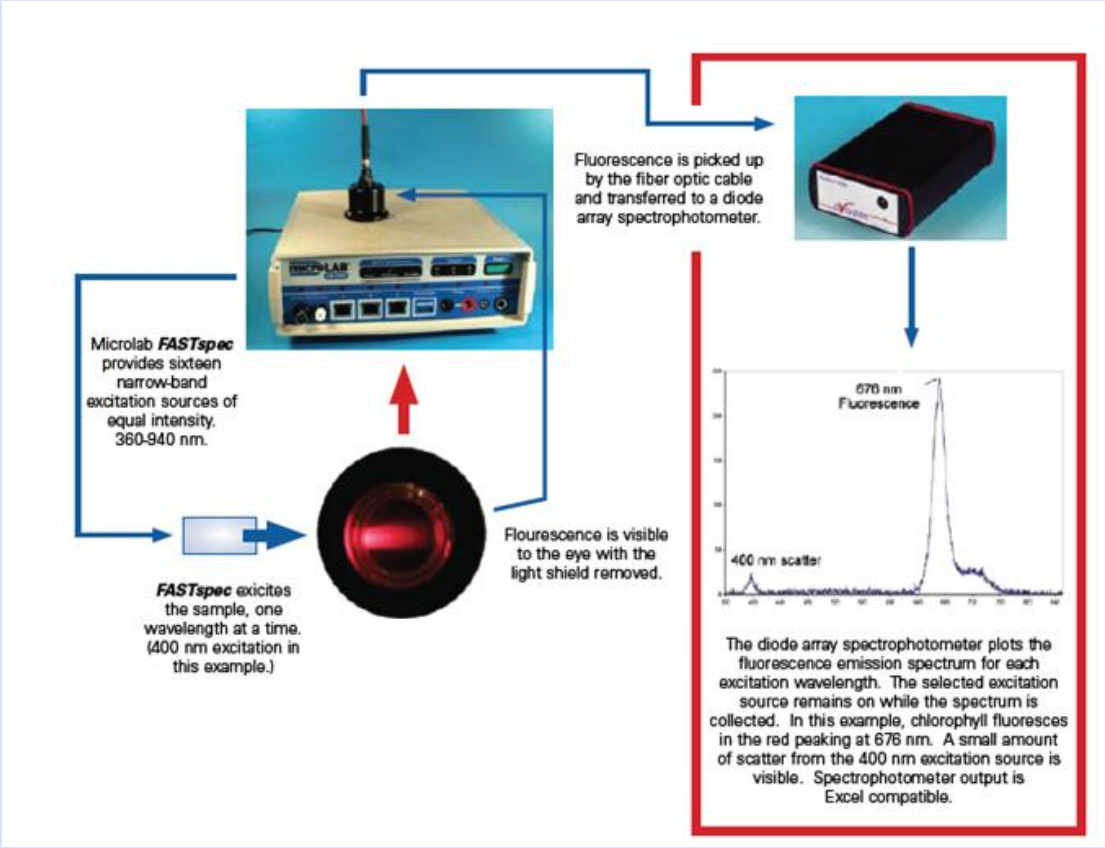
The MicroLab **Color** experiment also runs in the 360-940 nm spectral range. It measures and compares spectral profiles of different colored samples. For example, one can compare the spectral transmission or absorbance profile of a known food dye with food dyes chromatographically separated from soft drinks, and identify the dyes used in the soft drink. The **Color** experiment can also predict the transmission and absorbance resulting from a mixture of two different colored compounds. For example, this can be used in an introduction to color to predict that a mixture of yellow and blue food dye will produce a green solution. It also can be used to determine the ratio of acid form to base form for a chemical indicator, comparing a sample containing the indicator with a percentage "mix" generated from electronically adding absorbances of an acid-form and a basic-form of the indicator sample.



The MicroLab **Kinetics** experiment provides a timed measurement of transmission, absorbance, or scatter (turbidity). This program can be used to determine rate constants and reaction orders. It also operates in the 360-940 nm range. Time between measurements can be set from 3 to 300 seconds, with up to more than 1000 measurements during the experiment. Internal software will plot regression lines to check for reaction order: A vs time (0 order), ln A vs time (first order), and 1/A vs time (second order). As with all of the MicroLab spectrophotometry programs, data may be transparently exported into Excel for more complex analysis, or to select domains within the data set for special analysis.

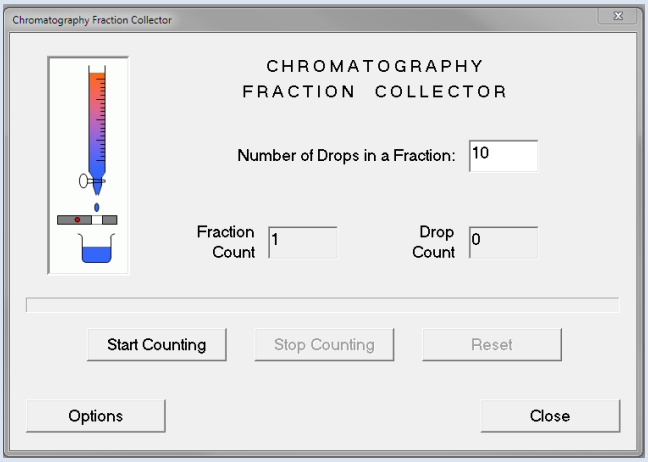


The MicroLab **Fluorescence** program can be used to create fluorescence in samples, for visual and diode-array observation. Sixteen different narrow-band excitation wavelengths are available in the 360-940 nm range. Fluorescence may be observed by looking down into the sample vial with the eye, or with a fiber optic cable connected to a diode array spectrophotometer.



The MicroLab **Energy of Light** experiment works with the Model 210 Energy of Light Module to demonstrate the relationship between energy and color (frequency) of light, and to determine Planck's constant. It does this by measuring the band-gap energy for six LED's which operate from 940 nm in the infra-red to 502 nm in the green region.

The MicroLab **Fraction Collector** program operates with the Model 226 drop counter to count drops from a chromatography column. The operator may select a number of drops for each fraction. An alarm will ring two drops before the selected number is counted, and a second alarm will ring as the selected number is counted. The operator may then change the collection vial. The counting program starts over automatically.



The MicroLab **Electroplating** program operates with the Model 270 Electrochemistry Power Supply. This instrument sets the voltage applied to an electroplating cell. It will measure current during the plating operation, integrate this current with respect to time, and then calculate coulombs and moles of electrons transferred during the experiment. From this data and the mass of metal deposited, and given two of the three quantities listed here, one can calculate the third: atomic mass, Avogadro's number, and ionic charge of the metal ion.