

Polarized Light Microscopy

**A Course For
High School Students**

Fermi National Accelerator Laboratory

Spring 2007



Sponsored by

*The State Microscopical Society of Illinois
and
Fermi National Accelerator Laboratory*

Purpose of Polarized Light Microscopy

“PLM” is a useful, relatively inexpensive analytical tool that may be applied to problem solving in biology and medicine, chemistry, physical optics, forensics, art restoration and authentication, and pharmaceuticals, to name a few.

Who May Participate

Any high school student who has a strong interest in understanding how a part of our world works.

When to Apply

Now! This introductory course is limited to the first 15 applicants. Others will be placed on a waiting list and notified as to course availability. Classes for this six-week course begin on April 7 and continue through May 12, 2007. Deadline for application is April 5, 2007.

Scope of Instruction

This six-week course is problem based, integrating all of the physical sciences wherever possible. Except for the last week when students will demonstrate what they have learned and receive awards, all meeting dates will include lectures, demonstrations, and hands-on laboratory experiences.

Eligibility

High school students who feel that they will be more effective in the classroom when their microscopy skills have been enhanced are eligible to participate. Individual high school principals and / or science department chairpersons are encouraged to share the information in this booklet with their science faculty and any other teachers they deem appropriate.

Notification

Students who send in the completed application form by conventional or e-mail will be notified by April 5, 2007 by e-mail and by telephone as to course availability. Limit: first 15 applicants.

Costs / Fees

Samples, optical materials, a laboratory notebook and lecture notes are provided by SMSI. The fee is a desire and dedication to learn about polarized light and polarized light microscopy.

Class Location

Classes will meet at Fermi National Accelerator Laboratory in the Leon Lederman Building at 9:00 AM beginning Saturday, April 7, 2007.

Web Site

SMSI has a web site at <http://smsi.org>. You will be able to find information about our most recent activities and you may register for this course on-line if you click the "Education" button.

Lecture Topics

The Microscope: Its history and use:

Types of microscopes and their applications. The nature of polarized light and microscopy and more (refractive index, the Becke line, etc). Photomicrography vs. microphotography (which end of a light microscope do you look into and why).

Maintaining a laboratory notebook:

What did you see? What does it mean?

Component parts of a compound microscope and their purpose: Setting up the microscope for optimal viewing (Koehler illumination).

Optics of the microscope;

Lenses and mirrors, orthoscopy (normal viewing of samples) vs conoscopy (optical measurements of samples). Specimen preparation, observing isotropic (direction independent) and anisotropic (direction dependent) materials. Micrometry: how big is it?

The Microscopist's Tools of the Trade:

The Michel-Levy color chart (Newton's colors), elementary fusion techniques (thermal melting) and crystallization from solution, states of matter, classes of crystals, symmetry and the optical indicatrix (3-D graphical descriptions of specific optical Information)

Chemical Microscopy and Fibers:

Animal (silk, human), synthetic polymers (rayon, polyester, acrylics), glass, plant (cotton, hemp), and mineral fibers (asbestos). DDT, cholesterol acetate, TNT, and various starches. Observe pollens, diatoms (skeletal remains of algae), paint pigments.

Microchemical Tests:

Trace evidence explosive residues (TNT, plastics, etc.), dispersion staining techniques (staining with light), art forgery and restoration, licit and illicit drugs, palynology (pollen grain identification) for forensics and oil exploration.

Minerals, meteorites, tektites, air pollutants, blood, epithelial cells, dust, combustion products, water pollution, strain birefringence and photoelasticity: bridges and French cathedrals, acid fuchsin and bow ties. Determination of unknowns.

Class Project: A Real Crime Lab Investigation of Crime Scene Evidence

Use your new-found skills and techniques to solve a crime. The final project for the course requires you, as a rookie member of the prestigious and famous SMSI-Crime Laboratory, to solve a murder case. All rules apply. You must determine the identity of the offender through careful examination of all the evidence as it becomes available to you through the chain of custody. As in the real world, losing evidence, contaminating samples or breaking the chain of custody can result in a murderer escaping justice. As the professionals must do, be alert to the possibility that one of your own may have ulterior motives and might be working against you as you rush to solve the crime.

Instructors & Guest Lecturers

Instructors and guest lecturers will be professionals from industry and academia specializing in microscopy, chemistry, biochemistry/molecular biology, forensics and art.

Class Schedules and Facilities

Classes will be held on six consecutive Saturday mornings from 9:00 AM - 12:00 Noon. Laboratory, lecture, and demonstrations will be integrated. These sessions will be held in the Leon Letterman Building at Fermi National Accelerator Laboratory. Time permitting, there is the possibility for field trips to various locations on the laboratory grounds.

Recognition

High school students completing this course and demonstrating a practical working knowledge of polarized light microscopy will be awarded a certificate by the State Microscopical Society of Illinois. Students that successfully complete this introductory course will be permitted to enroll in a more advanced course in PLM at a future date.

Fermilab's Location

Fermilab is located ~ 40 miles west of Chicago and east of the business district of Batavia. It is North of Butterfield Rd. and South of Rte. 38. Entrance is from Pine Street off Kirk Rd. which parallels western-most boundary of Fermilab. Maps and more detail directions are available at <http://www.fnal.gov> and click on Visiting Fermilab.

A Brief History of SMSI

The State Microscopical Society of Illinois was first organized as the Chicago Microscopical Club in December 1868. Persons involved in the organization of this microscopically orientated group were active members and founders of the Chicago Academy of Sciences. On March 31, 1869, the State of Illinois granted a charter to The Chicago Microscopical Club which, less than a month later, reorganized as the State Microscopical Society of Illinois.

The founders of this organization are credited with forming one of the first scientific organizations in the United States.

Success in SMSI's first year of existence gratified its founders, and interest in SMSI (as well as the microscope itself) continued to grow over the following years. A joint meeting between members of SMSI and the American Microscopical

Society in 1883 held claim to being one of the largest meetings of any kind held in the United States to date.

The members realized the importance of communicating with people all over the world with similar interests. This led to SMSI's first official journal, *The Lens*, in 1871 with S.A. Briggs, former President of the Chicago Board of Education, as editor.

SMSI still continues its mission to interest and educate people of all ages in the science and art of microscopy by offering courses such as this.

Our members include metallurgists, chemists, physicists, biologists, botanists, physicians, microscopists, law enforcement agency forensic personnel (sheriffs police, FBI, U.S. Customs), a handwriting analyst, a local mystery writer, attorneys, experts from the Oriental Institute, the Art Institute of Chicago, and the Smithsonian Institution, and a person who keeps bees.