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Introduction

Many of today's established ophthalmic photographers began their careers trained as general or biomedical photographers as well as ophthalmic technicians. After exposure to ophthalmology, some of these photographers might have practiced as apprentices and increased their skills. With time, they progressed on to establish independent careers. With the exception of continuing education courses either through the OPS or private concerns, little formalized education in ophthalmic photography has been available. However the BioMedical Photographic Communications (BPC) program at the Rochester Institute of Technology (RIT) has been very progressive in developing its offerings in Ophthalmic photography over the last 10 years.

RIT and SPAS

The BPC is part of RIT's unique College of Imaging Arts & Sciences. The College houses internationally known programs in Printing, Imaging Science, Art & Design as well as American Crafts. (Many of RIT's program portfolio would be categorized as non-traditional including the nation's only Ph.D. program in Imaging Science.) The BPC is part of the School of Photographic Arts & Sciences (SPAS). Besides Biomedical Photography, students can enroll in 5 other very specialized programs including: Imaging and Photographic Technology, Fine Art Photography, Applied Photography (Photojournalism or

Advertising), Film and Video, Computer Animation, and Imaging Systems Management.

The enrollment in the School of Photographic Arts and Sciences includes over 900 full time students who are instructed by more than 40 full time faculty members. Additionally the school may use approximately 25 adjunct faculty over the course of any year. In any given quarter (a 10 week period), over 180 different courses might be offered investigating such topics as digital image processing, the materials and processes of photography, scanning electron micrography, fine art photography and countless other opportunities. The various curriculums may lead to: an Associate of Science, a Bachelor of Science, a Bachelor of Fine Arts, Master of Fine Arts as well as a Ph.D.

The school is housed in a dedicated four story building covering 65,000 sq. ft. Some of the facilities available to the students include: 151 fully equipped darkrooms, 35 photographic studios equipped with Sinar 4 x 5" cameras and various tungsten and electronic flash equipment. There is a full service photofinishing lab and a fully automated color complex for students capable of processing RA-4, Ilfochrome and R-3 papers. Additionally, state-of-the-art facilities allow students hands-on experiences in electronic prepress as well as, multi-media, Internet publishing and digital imaging. There is also a Scanning EM Lab that allows imaging at up to 20,000x magnification. A Holography Lab, and a High Speed Photography Lab are available to explore image making beyond what is detectable to the naked eye.

The BioMedical Photographic Communications program was created in 1969 with the acquisition of a federal grant. The program originally offered an AS degree opportunity to 19 students in the Fall of 1970. The original curriculum was written in conjunction with many members of the Biological Photographic Association including H. Lou Gibson, RBP, FBPA (1905-1992). In 1974, the curriculum was expanded to include a Bachelor of Science option. The program's mission has remained consistent: To graduate self directed, self confident, and self starting students with a diversity of relevant skills focused into the life sciences industry." Additionally, the program instills into its students a 'career' rather than 'job' philosophy, so they graduate with an attitude leading to professional and personal growth. While the mission has remained constant, the curriculum is continually revised to reflect the changes that are found in our industry. Consequently, the evolving curriculum is the driving force leading to an over 85% placement rate for its graduates.

Curriculum

The four year program results in the awarding of a Bachelor of Science in BioMedical Photographic Communications from the College of Imaging Arts & Sciences. To successfully complete the degree students need to finish the following curriculum:

- 54 credits of Liberal Arts including English Composition, Psychology, and other courses including a 3 course concentration
- 24 credits of Sciences including, Human Biology, Medical Terminology
- Algebra & Calculus
- 8 credits of Business Electives
- 8 credits of Computer Science
- 91 credits of Imaging Curriculum, including:
 - Materials & Processes of Photography
 - Basic Photography
 - 4" x 5" and Studio Lighting
 - Basic Medical Photography
 - Traditional and Electronic Graphic Techniques
 - Electronic Typography for Photographers
 - Close-Up and Specimen Photography
 - Photography through the Light Microscope
 - Electronic Flash Photography in Medicine and Science
 - Color Photography and Printing
 - Electronic Still Photography
 - Advanced Applications in Biomed Photography
 - Multi-Media Production
 - Thesis or Photographic Concentration
 - 15 - 18 Professional Electives
 - one 10 week Co-Op block

Facility

The department's teaching labs are estimated to house over \$750,000 in equipment. The department's curriculum is heavily dependent on this equipment which includes: 13 Trinocular photomicroscopes and accessories, twenty - 35mm cameras with various accessories & lenses, medium format equipment, Polaroid and Bencher Vertical Copy Stands, as well as Optical Cameras for slide creation and duplication. There is a variety of tungsten and electronic flash lighting equipment, and specialized equipment for photomacrography and intraoral photography.

The program's students experience opportunities in the electronic areas which are reinforced in their labs. At present the department is sharing computers with the Imaging and Photographic Technology (IPT) department bringing the total number of workstations available to the students to 12 with many peripherals. Macintosh computers are networked and connected through ethernet to the World Wide Web. Two film scanners, three flat bed scanners, one film recorder, a thermal printer, two laser writers, and various imaging software applications support the 73 BPC students and approximately 90 IPT students in the two programs. Some of the applications include: Photoshop, Quark, Persuasion, Illustrator, Freehand, PowerPoint, MacroMind Director, Astound, Premier, Netscape, NIH Image, IDL Image processing software. The department's quarterly BPC Bulletin, mailed to all members of the BPA and OPS, is produced here.

The department's ophthalmic imaging resources are quite substantial. Through equipment purchases, vendor support from Topcon and Zeiss, and private donations, the department has acquired a considerable amount of equipment for student use. The department's Fundus Cameras include: two Zeiss FF-4, Zeiss FK-30, Zeiss FF-2, Topcon 50X, Topcon TRC-W, Topcon



Figure 1: Professor William Fischer, CRA, demonstrates proper techniques used in the dissection of an eye for his Intermediate Ophthalmic Photography class. (Photograph: M. Peres)

JE, two Kowa RCXV2, and an Olympus handheld camera. Slit-Lamp cameras include: Zeiss 40SLP, Zeiss SL-2, and a Topcon SL-7E. Additional resources include a Topcon SP-1000 non-contact specular biomicroscope, and video capabilities allowing the teaching and illustration of imaging techniques. Recently, Ophthalmic Imaging Systems announced the placement of a WIN1024 digital imaging system in the department for student use. Collaboration between industry and RIT has provided opportunities and access to equipment that otherwise would have been impossible.

The ophthalmic course work is designed to provide the students with a solid foundation in ophthalmic imaging skills. There are currently three courses offered, Basic, Intermediate, and Advanced Applications in Ophthalmic Photography. Basic Ophthalmic photography encompasses anatomy & physiology of the eye, pharmacology, fundus photography, stereo photography, and an introduction to fluorescein angiography and disease processes. Intermediate Ophthalmic photography explores further posterior segment imaging including fluorescein angiography, descriptive interpretation, and disease processes. Imaging of the anterior segment is also explored, including slit-lamp biomicrography and its various lighting techniques, specular biomicrography and external imaging.

The lecture portion of each course investigates specific topics and relates them to the experiences worked on in lab. The lab portion of the classes are designed to allow the students to put into practice the discussions from class. The lab time allows students more practice to improve their photographic techniques, in preparation for work with real patients in the Advanced class. Students photograph each other for all the class assignments. In this fashion, students become familiar with the role of both photographer and patient.

In order to minimize the risks and insure student safety for dilation, all students taking the three course sequence are required to undergo a complete eye examination by an ophthalmologist at the University of Rochester. If the physician finds no contraindication for dilation, students are given written permission to be dilated. Dilation subsequently occurs at RIT's Student Health facility under the supervision of Institute physicians.

The classroom environment provides the appropriate place for the didactic component while the lab environment is a safe place for students to work through the problems many beginning ophthalmic photographers confront. Photographing fellow students and friends, performing color fundus photography and mock fluorescein angiography on well dilated cooperative "subjects" is one thing, but hardly representative of the "real thing." The challenges found in photographing real patients that are poorly dilated, nervous, and uncooperative is the real test of skills and abilities for the programs aspiring ophthalmic photographers. For students at RIT, which is not a

teaching hospital, getting clinical experience has proven to be another challenge.

Solving difficult problems sometimes requires creative and unique approaches as was the case with our need for real patients. To insure the same level of standards, the BPC looked to the field of ophthalmology for the solution to this dilemma. An affiliation agreement between the program and the University of Rochester, (U of R) School of Medicine and Dentistry, Department of Ophthalmology was formed, facilitating many positive outcomes for all parties. This agreement allows RIT students enrolled in an ophthalmic photography class to access the U of R's eye clinic for practical experience under faculty supervision. In addition to student access, the agreement also allows the RIT faculty member to gain adjunct faculty status at the University of Rochester enhancing the quality of the educational experience for the students.

The Advanced Applications in Ophthalmic Photography class places students in a clinical setting. Working one-on-one with U of R faculty, students perform fundus photography, fluorescein angiography, digital angiography, and slit-lamp biomicrography. The faculty member assess on a case-by-case basis when each student is ready to 'solo' on various photographic assignments with real patients. The students gain valuable clinical experience related to photography and patient management that could not be taught in the classroom. In this fashion, education and experience are balanced so as to not compromise patient care.

In addition to the clinical experience provided by the Advanced class, students are encouraged to perform at least one extramural or cooperative (Co-Op) work experience in ophthalmic photography. The Co-Op allows the students the chance to work in a clinical setting on a daily basis for approximately 10 weeks. This clinical experience in conjunction with their classroom experience has historically provided the graduates with a solid background in imaging relative to ophthalmology. More often than not, the department finds itself with more requests from perspective employees than graduates to fill these requests.

Co-Op and Access to Professionals in the Field

As was mentioned, students pursuing this degree are exposed to the field through a variety of channels including the required Co-Op. One Co-Op is required to matriculate while two are suggested. The Institute typically will send out over 400 letters seeking sponsors for typically 25 students per summer. Past sponsors of students have included, Eastman Kodak Company, Leaf, Sinar Bron, Johns Hopkins Hospital, Scheie Eye Institute, Henry Ford Hospital, Dade County Medical Examiners Office, Wake Forest University Eye Center, Bowman Gray School of Medicine, Medical College of Georgia, Duke University and the Moran Eye Center in Salt Lake City to name a few.

Additionally students also interact regularly with working professionals. Established professionals are invited to campus to deliver lectures and/or workshops in the areas of: ophthalmic photography, the photography of laboratory animals, or patient photography, to name a few. Some of our recent distinguished visitors include: J. Michael Coppinger, CRA, Mark Maio, FOPS, Kirby Miller, CRA, Paula Morris, CRA, FOPS, James Gilman, CRA, Peter Buch, CRA and Gary Michalec, CRA. With over 450 alumni working in a variety of areas including medicine, science, industry, printing, education, and other self directed opportunities such as stock photography, the BPC enjoys many of its alumni coming back to share with the current students. Combined, the department's faculty have produced hundreds of presentations and workshops for the field of Biomedical Photography. Additionally well over 40 publications can be attributed to the department's past and current faculty.

Lastly but no less important for the students is the exposure to professionals through professional organizations. Many of these groups are very active with the school and its curriculum development. These groups specifically include the Biological Photographic Association (BPA) and Ophthalmic Photographers' Society (OPS). In fact over the years, the program has created a student organization modeled after the BPA, entitled the Biological Photographic Student Association. All students are automatically members and are encouraged to join in the many activities—from fund raisers and field trips. In the past, each of the major professional societies has held annual meetings that are open to students while the BPA has annually hosted an annual workshop in Rochester. For this workshop, students often help out with the session while gaining valuable contacts in the field. RIT's facilities will also be used for the OPS June 1996 Electronic Imaging course.

Alumni Accomplishments

Over the years, many RIT graduates have been recognized for their accomplishments. Their achievements have included becoming certified as retinal angiographers or registered as biological photographers. Over 20 alumni have their CRA, with seven becoming certified in the last five years. Additionally many have been awarded with fellowships and other recognitions including the Louis Schmidt Award bestowed by the Biological Photographic Association. Tom Hurtgen and Nile Root RBP, FBPA, received this award given by the BPA for outstanding and meritorious performance as life science communicators.

Clearly there exists no perfect way to become anything in life. Sacrifice, dedication and a few lucky opportunities seem to help. RIT is by no means the only path into the field of ophthalmic imaging, however it does provide the significant advantage of a global perspective as a result of its curriculum, facilities, history, alumni network and the required work study experience. Some will always question the advantages of university based experiences as contrasted to on-the-job training programs. University based education teaches individuals to learn skills and develop approaches to problem solving non-specific to any industry, while on-the-job training is specific to the desired learned task. Consequently, in the long term, learning how to learn and problem solve provides a powerful skill necessary for evolution into the future of imaging.

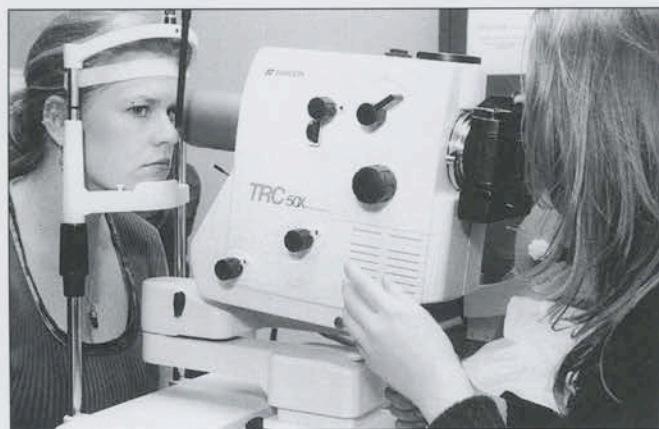


Figure 2: RIT student Robyn Kennick works on refining her retinal imaging skills on classmate Emma Graydon-Foy. (Photograph: J. Sidorik)

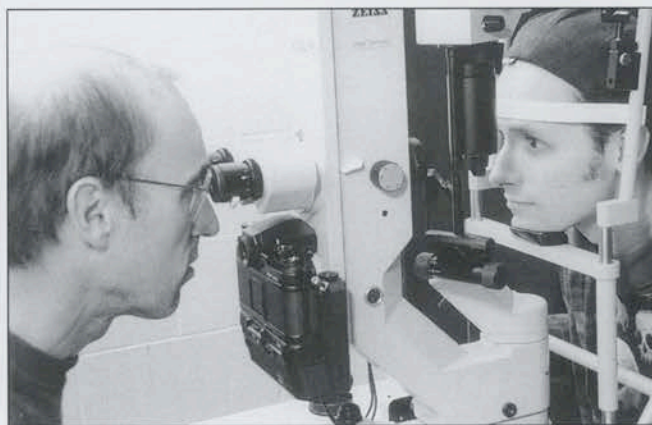


Figure 3: Ron Leible works on his anterior segment skills using a Zeiss slit-lamp camera on fellow student Adam Hartley. (Photograph: J. Sidorik)

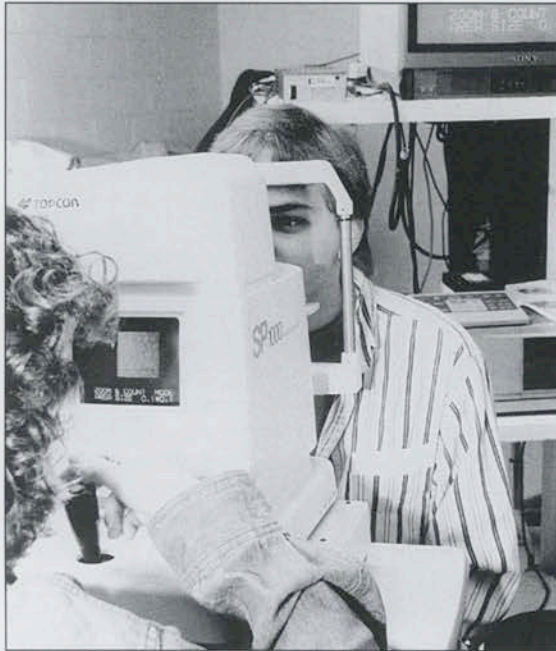


Figure 4: Students taking the Intermediate Ophthalmic Photography class work on techniques necessary for imaging using the Topcon SP-1000 biomicroscope. (Photograph: J. Sidoriak)

About the authors: Michael Peres, (mrppph@rit.edu) is a fellow and Registered Biological Photographer in the Biological Photographic Association. He has been the Chairman of the BioMedical Photographic Communications for the last seven years, and is Associate Professor at the Rochester Institute of Technology. He has authored over 15 publications as well as presented over 50 oral papers for a variety of audiences investigating many imaging topics. Peres has been a member of BPA for 17 years and is currently serving as director of COPE, the Committee for Professional Education.

William Fischer (wsfp@ritvax.isc.rit.edu) is a Certified Retinal Angiographer, who has been working in the field of ophthalmology for the last 10 years. He holds academic appointments as an Assistant Professor in the BioMedical Photographic Communications department at RIT and a Clinical Professor at the University of Rochester, Strong Memorial Hospital, Department of Ophthalmology. He has been at RIT since 1990 and is responsible for the ophthalmic component of the program. He has presented numerous lectures for both the OPS and the BPA on varying topics of ophthalmic photography. Currently, he is completing his MS degree in Electronic Publishing and serving as general meeting chair for the OPS Rochester 1996 Mid-Year meeting.

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