

Program Prioritization (Institute of Biological Chemistry): Self-Assessment and Rationale for Growth/Investment

The IBC: Since its creation in 1980, the Institute of Biological Chemistry (IBC) has developed a well-deserved scientific status and worldwide reputation as one of the internationally renowned research centers in the area of Plant Biochemistry/Plant Biotechnology. We are now poised to move the IBC to the next level of excellence via strategic growth and investment. In this 7-page summary, the focus is first on IBC's historical record of strengths and successes, and then shifts to describe a path recommended to attain an even higher level of recognition and achievement. Note also that IBC has managed/overseen all aspects of the multi- and inter-disciplinary Molecular Plant Sciences (previously Plant Physiology) Program since the 1980s. The Program has progressively evolved under IBC leadership, with several IBC faculty successively chairing the Program. MPS is currently ranked as a premier WSU graduate program. MPS now extends well beyond IBC faculty involvement, and it is summarized in a separate document by the current chair (IBC faculty member, D.M. Kramer).

IBC's Relationship to WSU Strategic Plan: There is a seamless link between WSU's proposed Strategic Plan and IBC faculty's research productivity record and aspirations for the future. That is, WSU has, in its most recently proposed vision/mission statement (January 15, 2008), goals that are consistent with IBC's endeavors. The historical successes of IBC in sustainably reaching/attaining WSU goal and mission priorities are summarized below, as they pertain to the Academic Affairs Program Prioritization Criteria in Scholarship/Research, Teaching/Learning, and Outreach/Engagement. A four-page appendix of relevant key performance criteria and statistics is also provided for benchmarking purposes. The self-assessment finishes with the current projected needs for Growth and Investment in IBC.

Scope and Expectations for IBC Faculty Members: The IBC faculty are involved in key aspects of fundamental plant biochemistry/plant biotechnology related to nutrition, human health, sources of potential bioproducts/biofuels, and various interactions that plants have with the environment – including, for example, nitrogen fixation. In terms of faculty numbers, there were 8.5 FTEs (5 Full, 3 Assoc., and 1 Asst. Professors) in 1990, whereas in 2008 the IBC numbers were 7.5 FTEs [5 Full (4.5 FTEs) and 2 Asst. (2 FTEs) Professors], with one (1 FTE vacancy) at the Asst./Assoc. Professor level remaining to be filled. Reductions in overall IBC FTE complement were due to retirement of one FTE (J. Rogers) in 2005, the phased retirement of Professor Croteau (down to 0.5 FTE) in August 2006, the passing of one faculty member (Ryan, 0.4 FTE) in Fall 2007, and the very recent transition of Professor Kahn (0.5 FTE) to CAHNRS administration (January 2008). Together, this has resulted in essentially 2.5 FTE positions that now must be fully replaced to restore IBC to our previous numerical strength of ~9 FTEs, i.e. even *without* considering the Growth and Investment recommendations proposed later.

In terms of IBC faculty productivity indices, there has been the unwavering expectation that each faculty member will develop an internationally recognized, federally funded, competitive research program. Performance expectations/milestones are thus continually monitored and include parameters such as: graduate student training and placement; post-doctoral/research associate training and placement; competitive federal/other funding program support; professional responsibilities (such as panel responsibilities, panel management, editorial duties, advisory boards, etc.); invitations (for talks, lectures at national/international meetings, research institutes and universities); editorial responsibilities; invited papers and contributions; recipient of professional awards/other forms of recognition, as well as the impact on overall research activities, not only globally and federally, but also within the State.

Scholarship and Research: The IBC is a recognized “area of excellence” or “signature program” within WSU, and in the plant sciences internationally, for the following reasons.

Centrality: The self-assessment of IBC as a “signature program” for WSU can be justified in many ways. For example, two of the faculty (Croteau, Ryan) were elected to the U.S. National Academy of Sciences, and three are WSU Regents' Professors (Browse, Croteau and Lewis). Three (Browse, Croteau and Ryan) have received other forms of internal recognition at WSU including: the 2004 Sahlin Faculty Excellence Award in Research (Browse); the Senior Faculty Award for Excellence in Research, the Award for Teaching Excellence, the President's Faculty Excellence Award for Research and Creative Activity, the Eminent Faculty Award (Croteau); the WSU Phi Kappa Phi Research Award, the President's Faculty Excellence Award in Research, the Lifetime Achievement Award of the WSU Faculty Association for Scholarship and Research, and the Award of Professional Recognition from the WSU Biochemistry Graduate Students Association (Ryan). The late Professor Ryan was also given a WSU honorary doctorate in 2005, an essentially unprecedented distinction for a WSU faculty member. Professor Kahn was named College of Sciences Advisor of the Year in 2002. All of the other faculty (Drs. Kramer, Lange, Okita and Roje) have evolving research and teaching programs in their respective scientific areas,

and are anticipated to achieve at least comparable levels of recognition in the future as their programs more fully mature.

The IBC faculty members also continue to enjoy excellent scientific reputations internationally. Several faculty are among the Institute for Scientific Information (ISI)'s most highly cited scientists (Ryan, Browse), and most of the remaining faculty have received numerous other forms of external recognition. In particular, all of the IBC faculty have disproportionately contributed very significantly to WSU grant funding successes in overall external federal competitive funding sources from NSF, DOE, USDA, NIH, NASA, etc. Indeed, external funding expenditures from all sources relative to WSU expenditures are roughly 66:34 at present, with this ratio having been essentially stable since 1993. [For most IBC faculty, successful/uninterrupted funding has continued since the early nineteen-eighties for the most mature programs (i.e. Browse, Croteau, Kahn, Lewis, Okita and Ryan). A similar trend is beginning to emerge with the (then) newer researchers (Kramer, Lange, Rogers (retired) and Roje).] Most IBC faculty also either have or have had significant levels of scientific Editorial Board and grant panel experience, including panel manager responsibilities (discussed below).

Evidence of the centrality of the educational mission of the IBC includes the striking successes in undergraduate/graduate student training and placement, in postdoctoral/visiting scientist training and placement, and in recognition through invited talks/lectures, etc. Faculty members are also highly prolific, with over 272 scientific papers published in high impact journals in the last five years alone. Many of these high quality and high impact contributions also involve collaborations with other WSU faculty, representing the School of Molecular Biosciences, the School of Biological Sciences, the Wood Engineering and Materials Laboratory, and other departments within CAHNRS, as well as with numerous external organizations.

Productivity: Figure 1 summarizes a fourteen year comparison of competitive external grant and development funding, from 1990 to the present date, for the existing faculty complement of 6.5 FTE. Competitive federal grant funding is largely from the National Science Foundation, the US Dept. of Energy, the National Institutes of Health, the United States Department of Agriculture, with industrial support from Monsanto, Kemin Industries, Philip Morris USA, NSF International, Bayer, Crop Science, Dow Agrosciences, Pioneer Hybrid, DuPont, DNA Plant Technologies, Elsevier, etc. Other sources of funding include, for example, The M.J. Murdock Charitable Trust and from various endowments.

As can be noted from the graph, the slight dip in expenditures from 2002 to 2005 reflects reduced activities via one full FTE retirement (1 FTE, J. Rogers) and two phased retirements (0.5 FTE Croteau and 0.4 FTE Ryan), as well as from the addition of two new faculty members at the Assistant Professor level (Roje and Lange in 2003 and 2004). Additionally, the slight "increase" in WSU expenditures from 2004 to 2007 reflect start-up costs for these new faculty, as well as cost-sharing in successful equipment applications. Over the last decade, the ratio of external:internal (WSU) funding ratio has varied between 73:27 (1997-1998) to the current ratio of 66:34 (2007-2008*, Figure 1). We believe this to be among the highest productivity (external:internal) ratios in WSU.

Faculty scholarly productivity is superb, with the current faculty complement having published more than 1500 papers to date, of which >270 were published in the last 5 years alone. Journal articles in the last 5 years include: Nature and Nature Biotech (5), Science (2), USA Proceedings of National Academy of Sciences (14), Journal of Biological Chemistry (11), Cell (1), Phytochemistry (21), Plant Cell (3), Plant Journal (9), Plant Physiology (7), Plant Molecular Biology (3), Planta (3), Archives of Biochemistry and Biophysics (8), Journal of Bacteriology (2), and Biochemistry (5), as well as numerous other high impact, scholarly, publications (see Appendix 1 for a summary).

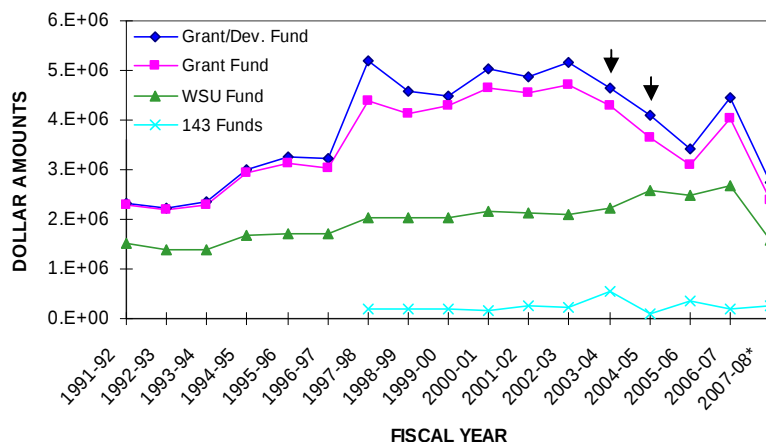


Figure 1. 14 Year Comparison of External Grant and Development Fund Expenditures and Internal WSU Fund Expenditures for IBC.

* As of February 25, 2008.

→: New faculty hires/phased retirements.

Overall faculty literature citations (IBC versus overall MPS): In addition to the IBC faculty productivity indices described above, the MPS program has added 19 additional faculty members in various departments/colleges university wide. These include A. Dhingra (Hort.), J. Fellman (Hort.), K. Gill (CSS), H. Grimes (SMB), L. Hadwiger (Pl. Path.), H. Hellmann (SBS), A. Kalyanaraman (Elect Eng & Comp Sci), M. Knoblauch (SBS), D. Main (Hort.), A. McCubbin (SBS), M. Neff (CSS), P. Okubara (Pl. Path.), C. Steber (CSS), J. Pooviah (Hort.), L. Taylor (SMB), M. Tegeder (SBS), L. Thomashow (Pl. Path.), D. von Wettstein (CSS), and J. Wyrick (SMB). Interestingly, the ISI citations (January 2008) for the IBC (and IBC associated) faculty totaled 44,800 versus that of 21,348 for the remaining 19 faculty. Thus, despite its small size of faculty, the IBC program accounts currently for 44,800/66,148 = 67% of all citations, this again presumably reflecting the core mission of the IBC and its preeminence.

Demand – External: As indicated above, extramural funding has continued to be excellent, this being largely based upon the outstanding scientific achievements of the IBC faculty. However, with the current renewed interest in plants as sources of (new) biofuels and bioproducts there are now many new opportunities for funding, either via competitive federal programs, industrial support and/or from foundations/philanthropic sources. On a per faculty basis, funded expenditures/FTE corresponded to \$543K for 2007, this having increased from, for example, ~\$485K in 1999 (see Appendix 2).

Review panels, journal editors and advisory boards: The IBC faculty have a long and an excellent record of service on national review panels, in roles as journal editors and on national advisory boards. They are briefly summarized as per current faculty member to give a sense of the overall scope and breadth.

J.A. Browse: Am. Soc. of Plant Biol. Committee Member for Martin Gibbs Medal Award (2006-11); Assoc. Monitoring Ed., Plant Physiol. (1991-2005); Panel Member, USDA-NRI Plant Responses to the Environ. Competitive Grants (2003); Review Team Member, Dept. of Biochem. and Center for Biol. Chem., Univ. of Nebraska (2004).

R. Croteau: Review Panel Member for NSF, DOE, USDA, NIH (1988-99); Scientific Advisory Committees (from 1988 onwards) for NSF, DOE, NIH, Washington Technology Centers, Mint Industry Research Council; Exec. Editor, Arch. Biochem. Biophys.-Plant Molecular Biol. Biochem. Section (1990-2001); Editorial Board, Arch. Biochem. Biophys. (1981-2001); Analytical Biochem. (1985-2000); J. Essent. Oil Res. (since 1988); Phytochemistry (since 1993); Plant Physiol. (1980-92); J. Chromatogr. (1982-90); J. Biol. Chem. (2004-06); edited five Symp. Proceedings (mostly ACS Symp. Series); Scientific Advisory Board Member of Exlexis Plant Science, Librophyt SAS, and Kemin Industries.

M.L. Kahn: Detailee (equivalent to Program Director), DOE (2005-06); Panel Member for NSF Microbial Genetics (2002, 2004), NSF Microbial Genomics (2005), NIH Microbial Biochem. and Metabolism (1997), USDA Competitive Grants-Nitrogen Fixation and Metabolism (1985, 1993), DOE Energy Biosciences (1993); Program Manager, USDA-CRGO Nitrogen Fixation and Metabolism (1988-89).

D.M. Kramer: Panel Member for USDA, Photosynthesis and Respiration (1997) and Plant Biochem. (2001, 2004); U.S. DOE Biosciences (2001); Editorial Boards: Photosynthesis Research, Plant Cell and Environment, and Plant Science.

B.M. Lange: Advisory Board, Canadian Tree Genomics Program.

N.G. Lewis: Panel Member for DOE-Basic Energy Sciences (BES) (2008), NIH-NCDDG Chem./Natural Prod. (2004), NSF Metabolic Biochem. (2002, Apr./Oct. 2003); NIH-Natural Products Study Section (2002); Chair: NASA Life Sciences Gravitational Biol. (Plants) Competitive Grants Panel—Ground-Based Studies (1999-2000) and Flight Experiments (1999-2000); NASA Life Sciences Gravitational Biol. (Plants) Competitive Grants Panel (1995); NASA Competitive Grants Panel on Innovative Research (1995); Competitive Grants Panel Member: USDA, (3X); U.S. DOE, Basic Energy Biosciences (2x); NSF (Centers for Science and Tech.); NREL (2X); NASA (5X) (through 1999); Phytochemistry Regional Ed. (1998-present); Phytochemistry Assoc. Ed./Member, Editorial Board (1993-97); Medicinal & Aromatic Plants Abstracts (MAPA) (2005-07); Polyphénols Actualités (1992-2006); Cellulose Chem. and Tech. (1987-present); Plant Physiol., Monitoring Ed. (2005-10); Wood Sci. Tech., J. Int'l Academy of Wood Science (2001-present); Recent Patents on Biotech. (2007-present); Ed.-in-Chief of Series "Advances in Plant Biochem. and Molecular Biology," Elsevier Science (2007-present); ACS Symp. Series, Lignin and Lignan Biosynthesis (Lewis, N.G. and Sarkanen, S., eds.), 1998, **697** (466 pp); ACS Symp. Series, Plant Cell Wall Polymers: Biogenesis and Biodegradation (Lewis, N.G. and Paice, M.G., eds.), **399** (676 pp); Holzforschung (1986); J. Wood Chem. Tech. (1987); Cellulose Chem. and Techn. (1987); TAPPI (1986, 1989); Member, Scientific Advisory Boards of Agricultural Biotech. Research Center (ABRC), Academia Sinica, Taiwan (2007-10); Center for Marine Science, Univ. North Carolina, for the Marine Biotech initiative (2005-present); National Center for Natural Products Research, Research Inst. of Pharmaceutical Sci., Schl. Pharmacy, Univ. of Mississippi (2003-present); Donald Danforth Plant Science Center, St. Louis, MO (2002-present); Consultant on a project on bioprospecting in Brazil (funded

by FAPESP), with goals of bioassay-guided fractionation and studying biosynthetic pathways and ecological interactions (2003-present).

T.W. Okita: Panel Manager, USDA-NRICGP Plant Biochem. Program (2000-01, 2006-07, 2007-08); USDA-NRICGP Plant Genetic Mechanisms and Molecular Biol. Program (1995-96); Chair, Committee of Visitors, NSF, Div. of Biological Infrastructure (1999); NSF Plant Genome Program (2008); USDA Office of Scientific Quality Review (2005); NSF Molecular Biochem. Program (1994-96, 1999-2000, 2003-04); Inter-Agency (DOE, USDA, NSF) Grant Panel in Metabolic Engineering (1998); USDA NRICGP Molecular Genetics and Biochem. (1994-95); U.S. DOE (1991, 2000, 2002); NSF Developmental Biol. Program (1987-91); NSF Presidential Young Investigators Award (1986); Chief Ed., Plant Science (1998-present); Editorial Board, J. Applied Glycoscience (2006-present); Plant Science (1990-98); Advances in Life Sciences-Plant Physiol. (1995); Plant Physiol. (1988-92); Tree Physiol. (1988); Plant Molecular Biol., guest ed. (1992-95); Monitoring Ed., Plant Physiol. (1995-2000).

Sanja Roje: Panel Member, USDA-NRI, Agricultural Plant Biochemistry (2005); Interagency (USDA-NRI, NSF, NIH, DOE, EPA, NIST, NASA, DOD), Metabolic Engineering (2005); NSF, Metabolic Biochem. (2005-07).

Research/Scholarship University Seminars and Active Collaborations (Last three years): These are summarized per faculty member from 2005-present.

J.A. Browse: Seminars/invited talks: Gordon Conf. Molecular and Cellular Biol. of Lipids (2007); EuroFedLip Conf., Gothenburg, Sweden (2007); Univ. of Missouri, Columbia, MO (2007); Carnegie Inst. for Plant Biology, Stanford (2007); 17th Int'l Symp. on Plant Lipids, East Lansing, MI., Terry Galliard Lecture (2006); EPOBIO Workshop, Wageningen, The Netherlands (2006); Univ. of California Davis, CA (2006); Donald Danforth Plant Science Center, St. Louis, MO (2006); 3rd Cycle Romande en Sciences Biologiques Meeting on Regulatory Oxylipins, Lausanne, Switzerland (2005); Mendel Biotechnology, Hayward, CA (2005); Carnegie Institute for Plant Biology, Stanford, CA (2005); Max Planck Inst. for Plant Breeding, Cologne, Germany (2005). Active external collaborations: E. Cahoon, J. Jaworski (Donald Danforth Plant Science Center); J. Ohlrogge, R.L. Last, and S. Mekhedov (Michigan State Univ.); J. Shanklin (SUNY, Stony Brook and Brookhaven National Lab.); C. Lu (Montana State Univ.); A. Green (CSIRO Plant Industry, Canberra, Australia); S. Stryme (Swedish Univ. of Agr. Sciences, Alnarp, Sweden); E. Kombrink (Max Planck Institute, Cologne, Germany); B. Bartel (Rice Univ.); I. Graham (CNAP, Univ. of York, UK); R. Welti (Kansas State Univ.); R. Innes (Indiana Univ.); C. Nawrath (Univ. of Lausanne, Switzerland); J. Napier (Rothamsted Research, Rothamsted, UK); B. Nikolau (Iowa State Univ.); G. Basset (Univ. of Nebraska-Lincoln); Y.D. Choi (Kumho Life and Environ. Sci. Lab., Gwangju, Korea); A. Rasmuson (Lund Univ., Sweden); I.M. Møller (Veterinary and Agr. Univ., Frederiksberg, Denmark); M. A. Miller (Univ. of Alabama).

R. Croteau (0.5 FTE phased retirement): Seminars/invited talks: Univ. of British Columbia (2006); Mint Industry Research Council Nat'l Meeting (2006); Mint Commission, WA, ID, OR (3 talks, 2006, 2007). Active external collaborations with R.M. Coates, Univ. of Illinois and R.M. Williams, Colorado State Univ., as well as Exlexis.

M.L. Kahn: Seminars/invited talks: EMBO Workshop "Functional Analysis of Microbial Genomes," Montevideo, Uruguay (2006). Active external collaborations with F. Noya, Univ. of Uruguay, and S.R. Long, Stanford Univ.

D.M. Kramer: Seminars/invited talks: Am. Soc. Plant Biology, Seattle, WA (2005); Photosynthesis Gordon Conf. (2005); Molecular and Cellular Bioenergetics Gordon Conf. (2006); CNRS, Marseilles, France (2006); CEA, Saclay, France (2006); CNRS, GIF-sur-Yvette, France (2006); Max Planck Institute for Plant Biology, Golm, Germany (2006); Workshop on Non-photochemical Quenching, Parsberg, Germany (2006); Int'l Society for Photosynthesis Research (2007). Active external collaborations with M.K. Bowman (Univ. Alabama) and C. Sacksteder (PNNL).

B.M. Lange: Seminars/invited talks: Phytochemical Society of N. Am., St. Louis, MI (2007); 18th Int'l Conf. on Arabidopsis Research, Beijing, China (2007); Canadian Soc. of Plant Physiologists (Western Region), Kelowna, BC, Canada (2007); 30th Annual Meeting of the Mint Industry Research Council, Las Vegas, NV (2007); Workshop: Systems Biology – From Single Cells to Environments, Melbourne, Australia (2006); Plant Integrated Functional Genomics Workshop, Ardmore, OK (2005); 3rd Canadian Workshop on Plant Genomics, Saskatoon, SK, Canada (2005); 7th Int'l Terpnnet Meeting, Wageningen, The Netherlands (2005). Active external collaborations with P. Quail (U.C. Berkeley); B. Nikolau (Iowa State Univ.); L. Sumner (Noble Foundation); Dr. Schmidt (Montana State Univ.); M. Wuest (Haute Ecole Valaisanne, Switzerland); S.Y. Rhee (Carnegie Inst. of Washington, Stanford Univ.); O. Fiehn (UC Davis); and M. Ghassemian (Diversa).

N.G. Lewis: Invited talks/seminars: University of Missouri-Columbia (2008); Fall Symposium, Donald Danforth Plant Science Center, St Louis, MO (2008); 5th World Congress on Allelopathy, Saratoga Springs, NY (2008); Canadian Society of Plant Physiologists 50th Annual Meeting, Ottawa, Canada (2008); Int'l Conf. on Plant Secondary Metabolism ("Human Health and Plant Secondary Metabolites"), Chinese Academy of Sciences, Kunming, China (2008); Ann. Int'l Symp.: Biotech for Better Crops, Energy and Health Symp.: ABRC 10th Anniversary, Academia Sinica, Taipei, Taiwan (2008); Assoc. of Biomolecular Resource Facilities (ABRF) 2008 Meeting, Salt Lake City, UT (2008); University of Mississippi, Oxford, MS (2008); The 1st Brazilian Conf. on Natural Products, São Paulo, Brazil (2007); VI Int'l Symp. on Natural Product Chemistry and Its Applications, Chillán City, Chile (2007); Joint Int'l Symp. of Plant Metabolism Research Center (PMRC) & the Korean Society for Applied Biological Chemistry, Pusan, Korea (2007, could not attend); Phytochemical Society of Europe 50th Anniversary Meeting, Cambridge, UK (2007); Symp. on Plant Secondary Metabolism, German Society for Lipid Research, Potsdam, Germany (2007); Virginia Polytech, Blacksburg, VA (2007); WSU Research Commercialization Opportunities Conference, Spokane, WA (2007); NMR Workshop, WSU (2007); Phytochemical Society of N. Am. (2006); 23rd Int'l Conf. on Polyphenols, Winnipeg, Manitoba, Canada (2006); IUPAC Int'l Conf. on Biodiversity and Natural Products, Kyoto, Japan (2006); Tokushima Bunri Univ., Tokushima, Japan (2006); 2006 Phytochemical Society of N. Am., Oxford, MS (2006); 8th Int'l Symp. on Pharmaceutical Sciences, Ankara, Turkey (2006); 3rd Mexican Natural Products Chemistry Meeting, Querétaro, Mexico (2006); Georgia State Univ., Atlanta, GA (2006); Univ. of Arizona, Tucson, AZ (2006); The Institute of Physical and Chemical Research (RIKEN), Yokohama, Japan (2006); Univ. of Strathclyde/Glasgow Univ., Scotland, (2006); Philip Morris, Richmond, VA (2006); Commercialization of Plant Research Conference, Panel Discussion, Office of Intellectual Properties, WSU (2006); Pacificchem 2005 Conference, Honolulu, HI (2005); 2nd International Symposium on *Eucommia ulmoides*, Yangling, Shaanxi Province, China (2005); Am. Society for Enology and Viticulture Annual Meeting, Seattle, WA (2005); Canadian Society for Chemistry, Saskatoon, Canada (2005); 17th International Congress of Botany, Vienna, Austria (2005); NRC Plant Biotechnology Institute, Saskatoon, SK, Canada (2005); Genomics Symposium, Philip Morris, Richmond, VA (2005); Interdisciplinary Plant Group, Univ. of Missouri-Columbia (2005); Univ. of Louisville, Louisville, KY (2005); Univ. of Kentucky, Lexington, KY (2005). Active external collaborations with A. Darvill, D. Mohnen (Complex Carbohydrate Research Center, Univ. of Georgia); J.W. Brady (Cornell Univ.); R.L. Lynd (Dartmouth College); K.A. Gray (Diversa); A.J. Ragauskas (Georgia Inst. of Tech.); D. Strack, T. Vogt (Institut für Pflanzenbiochemie, Halle, Germany); M.E. Himmel (Nat'l Renewable Energy Lab., CO); R.M. Kelly (N. Carolina State Univ.); M. Keller, T.J. Tschaplinski, G.A. Tuskan (Oak Ridge National Lab., TN); R.A. Dixon (Noble Foundation); M.J. Kato (Universidade de São Paulo, São Paulo, SP, Brasil); M. Furlan, L.M.X. Lopes (Universidade Estadual Paulista, Araraquara, SP, Brasil); D.R. Gang (Univ. of Arizona); C.E. Wyman (Univ. of California at Riverside); G.P. Bolwell (Univ. of London, Royal Holloway, UK); E. Pichersky (Univ. of Michigan); S. Sarkanen (Univ. of Minnesota); M.A. Bernards, S. Kohalmi (Univ. of Western Ontario, London, ON, Canada); Y.-H. P. Zhang (Virginia Tech); Z.-H. Ye (Univ. of Georgia); C.J. Liu (Brookhaven Nat'l Lab.); R.A. Jensen (Univ. of Chicago).

T.W. Okita: Invited talks/seminars: Int'l Workshop on Genetic Resources in Rice, International Center, Kyushu University, Fukuoka, Japan (2005); Int'l Symp. on Molecular and Cellular Biology of Plant Storage Function: From Gene to Food, Nagoya University, Japan (2005); 16th Penn State Plant Physiology Symp. on "RNA Biology: Novel Insights from Plant Systems," Univ. Park, PA (2006); Int'l Symp. in Memory of Vincent R. Franceschi: Plant Cell – Structure and Functions, WSU (2006); Dept. of Chem. and Biochem., California State Univ. at Fullerton, (2 seminars, 2005); Dept. of Chem. and Biol. Engineering, KOC Univ., Istanbul, Turkey (2005); Dept. of Biol. Sciences and Bioengineering, Sabanci Univ., Istanbul, Turkey (2005); Biol. Dept., Univ. of Delaware (2006); NC-1142 National Project on Photosynthesis, Lexington KY (2006); Horticulture and Landscape Architecture Dept., Purdue Univ. (2008). Active external collaborations with J.-S. Jeon (Kyung Yee Univ., Korea); H.-G. Kang (Kyungpook Nat'l Univ., Korea); Y. Han (Myongii Univ., Korea); G. An (Pohang Univ. of Science and Tech., Koresa); H. Ito (Hokkaido Univ, Japan); L.C. Hannah (Univ. of Florida); T.W. Greene (Dow AgroScience LLC); M. Ogawa (Yamaguchi Prefectural Univ., Japan); H. Satoh (Kyushu Univ., Japan); P.R. Salamone (E&J Gallo Winery, CA); J. Messing (Rutgers Univ.); A. Esen (Virginia Tech.).

S. Roje: Invited talks/seminars: Univ. of Arizona (2007); Phytochemical Society of N. Am. (2006); Waksman Inst., Rutgers Univ. (2005). Active external collaborations: A.S. Edison (Univ. of Florida); J.M. Vivanco (Colorado State Univ.); L. Levine (Dynamac Corp., Kennedy Space Center, Titusville, FL); R. Bruschweiler (Florida State Univ.); H. Alborn (USDA, Gainesville, FL); W. Zhao (St. Jude Hospital, Memphis, TE); P.W. Sternberg (Caltech, Pasadena, CA); S.S. Merchant (UCLA and scientists in 61 other institutions worldwide).

C.A. Ryan (deceased Oct. 2007): Active external collaborations (still ongoing): J. Narváez-Vásques, M.L. Orozco-Cardenas (Univ. of California at Riverside); R. Wititsuwannakul (Prince of Songkla Univ., Songkla, Thailand); D. Wititsuwannakul (Mahidol Univ., Bangkok, Thailand); D. Moura (Univ. of San Paolo, Piracicaba, Brazil); C. Nelson (Kemen Industries, Des Moines, IA); J. Pitkin (Monsanto, St. Louis, MO); P. Bedinger (Colorado State Univ.); J. Scheer (New Bio Inc., CA).

Demand - Internal: All IBC faculty and/or their designates have given seminars within WSU in various departments. Additionally, the IBC faculty conduct research/scholarship in all of their above areas of excellence, and the numbers of collaborations within WSU are increasing. These include collaborations with G.L. Helms (WSU NMR Center), C.H. Kang (WSU X-ray Crystallography Center); J. Wyrick (School of Molecular Biosciences); J.M. Lee (College of Engineering), V. Franceschi, now deceased (School of Biological Sciences), M.P. Laborie (Wood Materials and Engineering Lab), W. Siems (Chemistry), all of which have resulted in joint publications/grant applications. These reflect our strength in plant biochemistry/plant metabolism and structural biology.

Quality: The IBC is an internationally top-tier program in Plant Biochemistry, being amongst a handful of organizations of this type worldwide. Two faculty (one deceased) of the IBC are National Academy of Sciences Members, and others have recently received various awards and honors, i.e. J. Browse (Terry Galliard Medal); R. Croteau (Friend of the Mint Industry Award and NIH Merit Awards); N.G. Lewis (President, PSNA, NSF Accomplishment-based Award); B.M. Lange (Arthur Neish Young Investigator Award, PSNA); C.A. Ryan (WSU Honorary Doctorate 2005).

Cost effectiveness: IBC generates roughly 2x extramurally funded revenue through State investment, with all graduate students in IBC being largely supported through their studies using externally sponsored funding. The IBC also regularly use external funds to enable acquisition of equipment needed for research/scholarly activities, including that of the successful 2007 M.J. Murdock Charitable Trust request. (This request was the second award to IBC from this organization, and these are the only two such awards within CAHNRS). IBC uses all of the returned indirect cost (overhead/F&A) funds to support research/scholarship activities.

Teaching and Learning: Each IBC faculty member has ~11% teaching appointments with formal coursework targeted mainly to MPS 587 (Advanced Topics in Plant Biochemistry), and annually the IBC faculty participate in MBioS 414, MBioS 426, MBioS 492, MBioS 494, MBioS 496, MBioS 498, MBioS 514, MBioS 593, MPS 570, Biol 513 and Hort 515. In terms of the main focus (graduate student training), the IBC faculty have grown the MPS complement in IBC from 10 (1990) to 22 in 2007/2008, whereas the SMB (IBC student complement) has dropped from 13 in 1990 (with a high of 20 in 1998-99) to 5 in 2007/2008; the latter decline parallels the loss in biochemical expertise within SMB and the retirement of various IBC faculty.

Regardless of degree (MPS or SMB) affiliations, the IBC-trained graduate students are in very high demand, this being essentially an one-of-a-kind program in WA and beyond. Appendix 3 thus summarizes the outcomes of our graduate student training programs at IBC since 1990, in terms of position placements. The IBC-trained students (whether from SMB and/or MPS) have essentially all developed strong career paths in either academia, industry, government and/or research institute/foundations, as well as in other areas (e.g. patent attorneys). This IBC training is successful for three main reasons: high academic standards, specific and timely research emphases, and the fact that all trainees are supported to a large extent by extramural competitive funds.

In an even more striking manner (see Appendix 4), the postdoctoral fellow (PDF)/visiting scientist program has also been – and continues to be – remarkably successful. This continues to be the strongest educational/research component of the IBC, and the summary in Appendix 4 demonstrates the extremely high demand for our PDFs/visiting scientists in academia, industry, government and other career paths.

The IBC also maintains a very strong undergraduate and high school science teacher research training program (Appendix 5), with the former often resulting in research credit (including that of Honors theses). In general, there are about 20 or so undergraduates trained per semester, many of whom go on to successful graduate school and/or careers in science and medicine as indicated in Appendix 5. The WA State high school teacher's program has 1-2 teachers/year supported by NSF.

IBC, an Area of Preeminence and Self-Study, Recommendations: The IBC program has as its mission to sustain and enhance its strong, internationally recognized, scientific presence and preeminence. The successes of its faculty (currently and historically) have been previously documented in both the text and the appendices. In this regard, the programs that have arguably achieved international recognition include those of Drs. Browse, Croteau, Lewis, Okita, and the late Professor Ryan, as well as the highly recognized program of Dr. Kahn (who has largely transitioned into an university administration role). The others

(Drs. Kramer, Lange and Roje) are progressing towards the goals of international recognition, but need additional time and dedicated focus to achieve them.

In order to both maintain and enhance international recognition/preeminence of IBC faculty programs in the future, growth and investment is now urgently needed. This is not only for the 2.5 FTEs needed to restore our previous numerical strengths, but to also add another 5 FTEs to address the most compelling scientific questions that face us in the plant biochemistry fields. Indeed, it is these areas where WSU is best known. Another compelling reason for substantial growth and investment is that of the recent public concern over identifying and providing novel sources of sustainable, ecologically neutral, plant-derived substances for biofuels/bioenergy and other intermediate chemicals/polymers. This, together with rising food prices, underscores once again the need for basic scientific research to address humanity's future and the current challenges/needs that humanity now faces.

The time tested and successful IBC approach to scientific enquiry is the guiding determining factor for ensuring scientific excellence, accountability, and sustainability of achievements in science in the future. To build on this success, a significant level of growth and investment is now required to take us to the next level of excellence. The model that IBC has links both CAHNRS and the COS in a synergistic manner, i.e. through a balance of training in fundamental (bio)chemistry, with undergraduate/graduate students from both Colleges, as well as that of postdoctoral fellow/visiting scientist training. In this way, we are placed to significantly enhance the WSU preeminence in Plant Biochemistry and its impact internationally. Finally, WSU is of such an organizational size and geographical location, that carefully selected areas of preeminence need to be nurtured, their scientists left to address the compelling scientific questions, and the WSU administration to help facilitate such goals.

**Appendix 1: IBC Faculty Productivity Indices (Peer-reviewed Publications only)
based on January 18, 2008, SciFinder/PubMed Analysis—excluding Patents.**

IBC Faculty Member	FY2007¹	FY2006	FY2005	FY2004	FY2003	FY2002	Total
Browse, J.A.	5	10*	3.5*	5.5*	4	8.5*	36.5*
Croteau, R.B. (0.5 FTE as of 2006)	5	6	9	11	11	17	59.0
Edwards, G.E. ² (no IBC FTE)	9.5*	5.5*	7*	4.5*	3.5*	6*	36.0*
Kahn, M.L.*** (0.5 FTE)	2	2	4	4	1	3	16.0
Kramer, D.M.	7	3	14*	9.5*	4	3	40.5*
Lange, B.M. ⁺	2.5*	2.5*	2	2.5*	(3)	(3)	15.5*
Lewis, N.G.	9	11	6.5*	4	11	8	49.5*
Okita, T.W.	4.5*	3.5*	3	4.5*	10.5*	3.5*	29.5*
Rogers, J.C.**	(2)	(1)	(3)	2	2	1	11.0
Roje, S. ⁺	4	1	1	1	1	(3)	11.0
Emeritus Faculty							
Loewus, F.A. (Emeritus, no FTE)	-	-	-	1	-	1	2.0
Ryan, C.A.*** (40% annual rehire, 0.4 FTE)	4	7	2	3	8	6	30.0
Total/per year	54.5	52.5	55	52.5	59	63	336.5
No. of FTE/year	7.4	7.9	7.9	8.9	7.9	6.9	7.82
Average scholarly publications/year/FTE	7.37	6.65	6.96	5.90	7.47	9.13	7.25

¹ As of 1/18/2008.

² Associate IBC Member.

* To avoid double counting of papers within IBC, an asterisk (*) indicates papers co-authored by 2 IBC faculty. In such cases, each author is credited with 0.5 rather than 1 paper. For example, in 2005, J.A. Browse and N.G. Lewis co-published 1 paper jointly—therefore, 0.5 each.

⁺ = did not join IBC until 2003 (Roje) and 2004 (Lange).

** retired in 2005.

*** One Emeritus faculty (Ryan) passed away 2007; another (Kahn) has transitioned to CAHNRS administration while retaining a small research program, and a third (Croteau) will retire fully by the end of Summer Session 2011.

**Appendix 2: Summary of Institute of Biological Chemistry Research Expenditures,
1998–Present (Source: WSU Office of Research Annual Summaries)**

	FY 2007	FY 2006	FY 2005	FY 2004	FY 2003	FY 2002	FY 2001	FY 2000	FY 1999
Externally Funded Expenditures	4,020,377	3,110,675	3,658,844	4,297,041	4,706,304	4,555,875	4,642,372	4,279,609	4,124,554
WSU-State Expenditures	2,664,414	2,474,063	2,573,489	2,212,314	2,101,944	2,119,439	2,148,065	2,022,172	2,046,890
Ratio (E:I)	60:39	56:44	59:41	66:34	69:31	68:32	68:32	68:32	67:33
No. of IBC FTE's	7.4	7.9	7.9	8.9	7.9	6.9	7.9	7.5	8.5
External Funding/FTE	543,294	393,756	463,145	482,814	595,735	660,272	587,642	570,615	485,242

Appendix 3 - IBC Graduate Students and Current Positions (1990-Present)

University Full Professor: Kim, W.T., 1990 PhD, Yonsei U., Seoul, Korea.

University Associate Professor: Alfano, J., 1993 PhD, U. of Nebraska; Gang, D., 1999 PhD, U. of Arizona; Kim, S.-R., 1993 PhD, Sogang U., Seoul, Korea; LaFever, R., 1991 PhD, Cal State U., Bakersfield; Ona, T., 1991, Kyushu U., Japan.

University Assistant Professor: Anterola, A., 2001 PhD, S. Illinois U., Carbondale; Chisholm, S., 2000 PhD, Colorado State U.; Chung, Y.Y., 1995 PhD, Korea U., Seoul, Korea; Dinkova-Kostova, A., 1996 PhD, U. of Dundee Biomedical Research Centre, Ninewells Hospital and Medical School, UK; Fujita, K., 1993, Kyushu U., Fukuoka, Japan; Kavakli, I.H., 2001 PhD, Koc U., Turkey; Lopes, N., 1992-93, PhD, U. São Paulo, San Carlos, Brazil; Nascimento, I., 2000, Univ. Estadual Paulista, Araraquara, Brazil; Roberts, A., U. of Iowa; Sakulsingharoj, C., 2002 PhD, Maejo U., Chiang Mai, Thailand; Savage, T., 1997, Dept. of Chem., Cal State U., Sacramento; Wagner, R., 2001 PhD, Millersville U.

University Instructor/Lecturer/Researcher: Burgal, J., 2005 MS, Program Coordinator, Obesity Treat. Ctr., Davis, CA; Burke, C., 2001 PhD, Instructor, U. of Idaho; King, B., 2002 MS, Tech., UCSF; Kwon, M., 2000 PhD, Lecturer, Kookmin U., Seoul, Korea; Leisse, T., 1999 MS, Res. Spec., U. of Pennsylvania; Lovy-Wheeler, A., 1999 MS, Core Manager, Imaging and Cell Anal., GRASP, Tufts U.; McConn, M., 1997 PhD, Senior Researcher, Baylor Coll. of Med.; Moura, D.S., 2000 PhD, Res. Scientist, Dept. of Genetics, ESAL Q/U. of San Paolo, Piracicaba, Brazil; Narvaez-Vasquez, J., 1991 PhD, Asst. Researcher, UC Riverside; Orozco-Cardenas, M., 2000 PhD, Dir., Plant Transformation Research Center, UC Riverside; Powers, E., 1998 MS, Lab Tech., Colorado State U.; Ringer, K., 2004 PhD, Asst. Scientist, WSU Prosser-IAREC; Rushing, G., 1999 MS, County Extension Director, Colorado State U.; Tide, C., 2000 MS, Instructor, U. of Alaska; Walt, A., 2002 PhD, Life Sciences Instructor, Spokane Com. College.

Postdoctoral: Avenson, T., 2005 PhD, UC Berkeley; Bergamo, D., 2001, Univ. Estadual Paulista, Araraquara, Brazil; Brock, T., 2006 PhD, U. of Utah; Cape, J., 2006 PhD, Chemistry Dept., WSU; Carter, O., 2002 PhD, Oregon State U.; Diez-Diaz, M., 2004 PhD, U. of Valentia, Spain; Huffaker, A., 2005 PhD, IBC, Kim, S.-J., 2006 PhD, IBC; Lellis, A., 2001, Dept. of Chem/Biochem, UT Austin; Little, D., 2001 PhD, U. of Strasbourg, France; McConkey, M.E., 2001, Biol., U. Mass, Worcester; Min, T., 2002 PhD, Eye Inst., Cornell U.; Parra-Colmenares, A., 2003 PhD, Stanford; Patten, A., 2007 PhD, IBC; Peyou-Ndi, M., 1999 PhD, Oregon Health Sci U.; Poxleitner, M., 2004 PhD, UC Berkeley; Thines, B., 2006 PhD, UC Berkeley; Tilton, G., 2003 PhD, Michigan State U.

Industry: Atwell, K., 2000 MS, Scientist, MDS Pharma Svc., Bothell, WA; Bai, X., 1996 MS, Systems Programmer, BSI, Austin, TX; Birkenmeier, G., 1998 PhD, Attorney, Baker Botts LLP, Austin, TX; Funk, C., 1993, Scientist, F. Hoffmann LaRoche, Basel, Switzerland; Chau, M., 2004 PhD, Research Scientist, Xanthus Pharmaceuticals; Crock, J., 2001 PhD, small business owner (Hyperspud Sports), Moscow, ID; Crowell, A., 2000, Tech., Immunex, Seattle, WA; Greene, T., 1996 PhD, Project Coordinator, Dow AgroSciences, Indianapolis, IN; Halls, S., 2002 PhD, Res. Scientist, Monsanto, St. Louis, MO; Halls, C., 2004 PhD, Res. Scientist, Monsanto, St. Louis, MO; Hefner, J., 1999 PhD, Patent Attorney, San Diego, CA; Inciong, M., 1991, Pharmaceutical Industry; Li, Y., 2002 MS, Res. Assoc., Roche Biosciences, Palo Alto, CA; Lightner, J., 1993 PhD, Lead Scientist, Pioneer, Johnston, IA; Liu, Y., 1993 PhD, Scientist, Bioinformatics Div., Merck Pharm.; Mahajan, S., 2000, Staff Scientist, Abbot Laboratories, Chicago, IL; Rajaonarivony, J., 1991 PhD, Tech. Import/Export Official, Paris; Salamone, P., 2000 PhD, Scientist, Enology Res Group, E & J Gallo Winery, Modesto, CA; Scheer, J., 2003 PhD, owner, New Bio Inc., CA; Steele, C., 1996 PhD, Scientist, Bristol-Meyers-Squibb, Syracuse, NY; Thomas, D., 1998 MS, Research Scientist, Amgen Corp; Wu, J., 1993 PhD, Research Scientist, Monsanto, St. Louis, MO; Zhao, Y., 1993 PhD, Staff Scientist, Westvaco Corp., Summerville, IL.

Government: Akowski, J., 1996, Researcher, Argonne Nat'l Lab, Argonne, IL; Eberhardt, T., 1991, Res. Scientist, USDA Forest Svc., Pineville, LA; Delano-Frier, J., 1997 PhD, Res. Scientist, Nat'l Polytech. Inst., Mexico; Ford, J., 2001 PhD, Scientist, FBI, New Haven, CT; Gijzen, M., 1992, Res. Scientist, Ag and Agri-Food Can., London, Ontario; House, B., 2003 PhD, 2nd Lieutenant, U.S Naval Research, Bethesda, MD; Keates, S., 1997 PhD, Postdoc, USDA, Beltsville, MD; Laughlin, M., 1997 PhD, Scientist, Oregon State Public Health Lab., Portland; Li, X., 1993 PhD, CEO, Cellex Inc. Federal Drug Admin, Washington DC; Lupien (Hayes) S., MS 1995, Staff Assoc. USDA (ARS), Pullman, WA; Miller, K., 1999 PhD, Scientist, PNNL; Nakata, P., 1994 PhD, USDA-ARS Scientist, Children's Res Center, Baylor Coll. of Medicine; Park, K.-S., 1997 PhD, Staff Scientist, Nat'l Plant Quarantine, Kyonggi-do, Korea; Sacksteder, C., 2000 PhD, Scientist, PNNL, Richland, WA; Schnurr, J., 2002 PhD, USDA-ARS Scientist, St. Paul, MN; Shockey, J., 2003, Scientist, USDA-ARS, SBRC, New Orleans, LA; Woodbury, R., 2000, Staff Scientist, PNNL, Richland, WA; Wu, Y., 1998 MS, USDA Scientist; Young, K., 1992 MS, Scientist, USDA-ARS, Missoula, MT.

Research Institute: Fischer, S., 1999 MS, Res. Tech., Mayo Clinic, Rochester, MN; Phillips, M., 2000 PhD, Postdoc, Max Planck Inst. for Chem Ecol, Jena, Germany.

Current Graduate Students (at IBC unless otherwise noted) and Start Year: Cardenas, C., 2004; Cheng, P., Corea, O., 2007; Crofts, N., 2004; Cuthbertson, D., 2005; Dahmen, J., 2005; Feldman, M., 2006; Forquer, I., 2002; Foster, W., 2002, Engineering, WSU; Jewell, J., 2007; Ki, C., 2007; Lee, C., 2005; Livingston, A., 2004; Nagai, Y., 2006; Nguyen, J.H., 2006; Niu, Y., 2004; Podelnik, K., 2006; Rice, R., 2002; Rios, R., 2004; Sun, K., 2006; Tuncel, A., 2007; Turlapati, P., 2004; Vassao, D., 2003; Wayne, L., 2006; Wei, Z., 2007; Weng, H., 2004; Zhang, Y., 2004.

Other Graduate Programs: Gillespie, J. (MSc, WSU, 2004) now in Pharmacy (PhD) at Purdue Univ.; Marques, J. (Sandwich Research Training at WSU, 2006-07) while in PhD program at U. São Paulo, Brazil; Zeigler, M. (MSc, WSU, 2004), now in PhD program at Univ. Waterloo, Canada.

Others: Homemakers: Anterola, F.A.M., 2004, Carbondale, IL; Baker, R., New Orleans, CA; McKenzie, M., 1992, Postdam, Germany.

Current Position Unknown: Bovitz, J.J., 2006 MS SMB, Spokane, WA; Chen, W.-B., 1993 MS; Choi, J.-L., 1992 PhD; Kim, D.-W., 2007; Kim, Y.-J., 1999; Olsen, R., 2006 PhD SMB, Rao, S. B.K., 1998 PhD, Santiago, K., 2007 (did not finish, DNF), Bellingham, WA; Slattey, C., 2003 (DNF); Subbu, S., 1997; Takizawa, K., 2006 PhD; Williams, D.C., 2004; Yamamoto, E., 2003.

Appendix 4 – IBC Postdoctoral Fellows and Current Positions (1990-present)

University Full Professor: Abreu, H., 1996-99, Rural Fed. U., Rio de Janeiro, Brazil; Dicke, M., 1993, Wageningen Ag. U., Netherlands; Farmer, E., 1987-92, U. of Lausanne, Switzerland; Fujita, M., 1996-97, Kagawa U., Kagawa, Japan; Furlan, M., 1992-93, Paulista State U., Araraquara, Brazil; Jennewein, S., 2000-02, Technical Univ Darmstadt, Germany; Katayama, T., 1991-92, Kagawa U., Kagawa, Japan; Kato, M., 1992-93, U. of Sao Paulo, Brazil; Lee, J.S., 1997; Lewinsohn, E., 1988-95, Veg. Crops, Ya'ar Res. Assoc., Newe Ya'ar, Israel; Lopes, L.M.X., 2000, Paulista State U., Araraquara, Brazil; Medeiros, J.M., 2001, U. of the Azores; Park, M.-C., 1993-94, Catholic U., Seoul, Korea; Schaller, A., 1994-95, Universität Hohenheim, Stuttgart, Germany; Sung, C.-K., 1998-99, Korean Natl. U.; Tian, J., 2006-07, Vice Dir., Zhejiang U., Hangzhou, China; Wuest, M., 1999-2002, HEV, Sion, Switzerland; Zhang, Y., 1991-97, Yunnan U.

University Assoc. Professor: Amakura, Y., 2003-04, Matsuyama U., Japan; Bergey, D., 1993-98, Montana State U.; Bernards, M., 1991-97, U. of Western Ontario, Canada; Böhlmann, J., 1995-97, U. of British Columbia; Brown, P., 1997-98, Trinity Western U., Langley, BC; Burlat, V., 1997-99, Université de Tours, Tours, France; Constabel, P., 1993-96, U. of Victoria, Canada; Della Penna, D., 1989-90, Michigan State U.; Fuller, G., 1995-96, Pennsylvania Nazarene Coll.; Goleniowski, M., 1995-97, Universidad de Rio Cuarto, Argentina; Howe, G., 1993-97, Michigan State U.; Ito, H., 1996-98, Hokkaido U., Sapporo, Japan; Jetter, R., 1994-96, U. of British Columbia; Marton, L., 1989-90, U. of S. Carolina; McDermott, T., 1989-93, Montana State U.; Modi, M., 2000-01, Assam Agric. U., India; Nose, M., 1993-94, Nagoya City U., Nagoya, Japan; Ozawa, S., 1991-92, Rakuno Gakuen U., Hokkaido, Japan; Pare, P., 1992-94, Texas Tech. U.; Perez-Galdona, R., 1990-92, U. of LaLaguna, Tenerife, Spain; Peters, R., 1998-2002, Iowa State U.; Poulson, M., 1995-97, U. of Idaho; Schwab, W., 1989-98, U. of Wurtzburg, Germany; Sikka, V., 1999-2000, Haryana Agr. U., Hissar, India; Stratmann, J., 1997-2000, U. of S. Carolina; Vellanoweth, R.L., 1988-92, Cal. State U., Los Angeles, CA; Whitham, S., 1997-99, Iowa State U.

University Asst. Professor: Cao, X.-F., 1997-99, UCLA; Chen, Y.-C., 2004-07, Taiwan; Choi, S.-B., 1996-2001, Myongji U., Korea; Maejo U., Chiang Mai, Thailand; Conconi, A., 1998, U. of Sherbrooke, Canada; Fulda, M., 2000-02, U. of Goettingen, Germany; Jauh, G.-Y., 1997-99, Academia Sinica, Taipei, Taiwan; Jiang, L., 1997-2000, Chinese U. of Hong Kong; Johansen, L., 2000-01, U. of Colorado; Lange, M., 1997-2000, IBC; Mahmoud, S., 1999-2003, U. of British Columbia, Okanagan; Muench, D., 1994-97, U. of Calgary, Canada; Rose, U., 1997-98, U. Braunschweig; Savage, T., 1988-97, Cal State U., Sacram.; Schroeder, B., 2002-06, Plant Path., WSU; Takahashi, H., 2003-05, Tokushima Bunri U., Japan; Tholl, D., 1996-98, Virginia Polytech; Tokuhisa, J., 1991-99, Virginia Polytech; Watts, J., 1997-2007, SMB, WSU; Xie, Z., 2000-01, Sci., Texas Tech U.

University Instructor/Lecturer/Researcher: Aryan, A., 1988-91, Senior Lecturer, U. of Adelaide, Australia; Cho, M. H., 2000-06, Res. Prof., Kyung Hee U., Korea; Cruz, E., 1996-98, Res. Assoc., WSU; Czako, M., 1988-91, Scientist, U. of S. Carolina; Daros, J.-A., 1997-98, Scientist, CSIC/U. Politécnica de Valencia, Spain; Davis, E., 1997, Asst. Scientist, IBC; Gupta, S., 1995-97, Scientist, U. of Minn., Grand Forks, ND; Hamada, S., 2002-04, Hokkaido U., Japan; Hwang, S.-K., 2001, Asst. Res. Prof., IBC; Ichikawa, N., 1998-2001, School Teacher, Yokohama Hiranuma High School, Yokohama, Japan; Jang, J.-C., 1990-91, Scientist, Ohio State U.; Kasschau, K., 1997-2001, Senior Scientific Coordinator, Oregon State U.; Ketchum, R., 1997, Asst. Res. Scientist, IBC; Kim, M.-R., 2001-03, Res. Prof., Chosun U., Korea; Kim, Y., 1989-94, Scientist, San Myung Women's U., Chung Nam, Korea; Kumar, D., 1998-99, Res. Scientist, Indian Ag. Res. U., New Delhi, India; Kumar, R., 2000-05, Res. Scientist, U. of Missouri; Ma, X., 1999-2001, Res. Assoc., U. of Florida; Marles, M.S., 2003-04, Res. Assoc., U. of Saskatchewan; Moura, D.S.1., 1996-2000, Res. Scientist, ESAL Q/U. of San Paolo, Piracicaba, Brazil; Nakazawa, Y., 2001-02, Res. Scientist, Osaka U., Japan; Narvaez-Vasquez, J., 1987-91, Asst. Res., UC Riverside; Orozco-Cardenas, M., 1997-2000, Dir., Plant Transformation Res. Ctr., UC Riverside; Palm, C., 1986-91, Scientist, Biotech. Lab., Stanford U.; Ponnampertuma, K., 1992-95, Instructor, Chem., Texas A&M U.; Ringer, K., 1999-2004, Asst. Sci., WSU Prosser-IAREC; Stintzi, A., 1995-2001, Universität Hohenheim, Stuttgart, Germany; Sun, J., 1996-2000, Scientist, U. of Illinois; Teoh, T., 2001-03, Res. Assoc., U. of Arkansas; Vijayan, P., 1994-98, Scientist, U. of Saskatchewan; Warwick, N., 1991-93, Scientist, Monash U., Clayton, Australia; Yipp, L., 1993-96, Scientist, U. of Victoria, Canada.

University Postdoctorals: Carlsson, A., 1997-99, Swedish U., Uppsala, Sweden; Cochrane, F., 2001-05, Massey U., New Zealand; Crofts, A., 2001-present, IBC; Cross, J., 2005-06, Michigan State U.; Dittrich, F., 1998-99, U. of Hamburg, Germany; Domergue, F., 1998-99, U. of Hamburg, Germany; Gopalan, S., 1999-2001, Michigan State U.; Huang, K.-S., 2000-01, U. of Wisconsin; Hyatt, D., 1987, Mathematics, WSU; Iyer, S., 2002-05, Hort., WSU; Kaspera, R., 2004, U. of Washington; Kim, S.-J., 2000-06, IBC; Lawrence, P. K., 2002-04, Vet. Microbiol. Path., WSU; Patten, A., 2002-07, IBC; Salehuzzaman, S., 1995-96, U. of Waterloo, Ontario, Canada; Takizawa, K., 2001-06; Turner, G., 1996-Present, IBC; Winder, T., 1995-96, U. of Iowa.

Industry: Adam, K.-P., 1994-95, Method Develop. Spec., Cedra Corp., Austin, TX; Alonso, W., 1987-1992, Res., Bayer, Inc., Clayton, NC; Bouwmeester, H.J., 1994, Scientist, AB-DLO, Wageningen, The Netherlands; Chu, A., 1991-94, Senior Sci., Pfizer Global Res. & Develop., San Diego, CA; Colby, S.M., 1991-92, Scientist, Perkin-Elmer Corp.; Doares, S.H., 1990-94, Scientist, Lederle-Praxis Biologicals, Sanford, NC; Eichinger, D., 1999-2000, Res. Scientist, GenPatt77, Pharmacogenetics AG, Berlin, Germany; Everard, J., 1984-90, Res. Scientist, DuPont, Wilmington, DE; Graser, G., 1997-98, Scientist, Diversa; Haudenschield, C., 1995-97, Staff Scientist, Lynx Therapeutics, Hayward, CA; Hezari, M., 1993-97, Regulatory Affairs Mgr., PPD, Inc., Austin, TX; Jiao, Y., 1995-98, Res. Scientist, Diversa, San Diego, CA; Kim, M., 1997-2001, Staff Scientist, Syngenta Biotech Inc Res. Triangle Park, NC; LaBrie, S., 1994-96, Res. Scientist, INCYTE Pharm., Palo Alto, CA; McCaskill, D., 1988-99, Scientist,

Dow AgroSci., Indianapolis, IN; McGarvey, D., 1992-97, Technical Writer, QIAGEN GmbH, Hilden, Germany; McGurl, B., 1987-94, Patent Attorney, Christensen, O'Connor, Johnson and Kindness, Seattle, WA; Mihaliak, C., 1987-91, Scientist, Dow Chemical, Indianapolis, IN; Miyazaki, J., 1987-90, Scientist, Abbot Labs, Abbot Park, IL; Morris, J., 1990-93, Bioinformatics Analyst, Millenium Pharm., Cambridge, MA; Oufattole, M., 2000-04, Res. Assoc., Monsanto, St. Louis, MO; Roberts, M., 1999-95, Patent Lawyer, Klarquist, Sparkman, Campbell, Leigh and Whinston, Seattle, WA; Schaad, M., 1997-99, Project Coordinator, Asuragen, Inc., Austin, TX; Schalk, M., 1998-2000, Staff Scientist, Firmenich, Geneva; Scheer, J., 1996-2003 PhD, Owner, New Bio Inc., CA; Spychalla, J., 1993-95, Director, Spychalla Farms, Antigo, WI; Trapp, S., 1997-2000, Staff Scientist, Infomax, Golden, CO; Van Heerden, P., 1995-96, Res. Sci., Sastech R&D, Sasolburg, South Africa; Van Rensburg, H., 1998-99, Res. Sci., Sastech R&D, St. Andrews, Scotland; Venkatramesh, M., 1988-89, Project Dir., Exelixis Plant Sci, Portland, OR; Wang, C.-Z., 1999-2001, Postdoc, Isotec (Sigma-Aldrich); Wang, H.-B., 1993-99, Senior Chemist, Crompton Corp., Middlebury, CT; Wingate, V., 1987-90, Res. Group Leader, Rhone-Poulenc, Res. Triangle Park, NC; Xia, Z., 1994-2000, Scientist, Synta Pharm., Lexington, MA; Xin, Z., 1997-99, Res. Scientist, Cereon Genomics, Cambridge, MA; Zhang, F., 1996-97, Staff Scientist, Monsanto, St. Louis, MO.

Government: Anderson, J., 1987-90, Scientist, USDA-ARS, Purdue U.; Dombrowski, J., 1995-2000, Res. Sci., USDA Natl. Forage Seed Prod. Res. Fac., Corvallis, OR; Flory, J., 1996-98, Scientist, Georgia State Water Quality Board; Guerra, D., 1988-90, Researcher, USDA, Pullman; He, L., 1990-95, Senior Res. Sci., Dynamac Corp., Kennedy Space Assoc., Cape Canaveral, FL; Heyenga, G., 1991-93, Res. Scientist, NASA, Ames Res. Assoc., CA; House, B., 1998-2003 PhD, 2nd Lieutenant, U.S Naval Res., Bethesda, MD; Ishiyama, K., 2000-01, Politician, Japan; Kim, D., 1997-98, Res. Sci., Rural Dev. Agency, Suwon, Korea; Kim, Y.-T., 1996-97, Res. Sci., Rural Dev. Agency, Suwon, Korea; Kiyosue, T., 1996-97, Res. Sci., Natl. Inst. for Basic Biol., Okazaki, Japan; Lee, S.-K., 1996-97, Res. Sci., Rural Dev. Agency, Suwon, Korea; Park, J.-S., 2000-01, Staff Sci., Rural Dev. Agency, Suwon, Korea; Wise, M., 1995-2002, Staff Sci., USDA, Madison, WI.

Research Institute: Choi, J.-W., 1999-2002, Res. Sci., Dept. Forest Prod., Korea Forest Res. Inst., Hongnung Arboretum; Chung, B.-Y., 2002-03, Res. Sci., Korea Atomic Energy Res. Inst.; Croissant-Sych, Y., 1994-95, Instructor, Fachhochschule fur Technik Sigmaringen, Germany; Gupta, H.S., 1992-94, Scientist, ICAR Res. Complex, Barapani, India; Heitz, T., 1994-95, Scientist, Inst. de Biologie Moléculaire des Plantes, Strasbourg, France; Hishiyama, S., 1999-2001, Res. Sci., Forestry & Forest Prod. Res. Inst., Tsukuba Norin Kenkyu, Ibaraki, Japan; Hoelscher, D., 1998-2001, Postdoc, Max Planck Inst. of Chemical Ecology, Jena, Germany; Jeon, J.-H., 1997-99, Senior Res. Sci., Korea Inst. of Life Science; Kasahara, H., 1997-2000, Res. Scientist, RIKEN, Inst. of Physical and Chemical Res., Yokohama, Japan; Llave-Correas, C., 2000-01, Scientist, Centro de Investigaciones Biológicas, CSIC, Madrid, Spain; Marchand, P., 1994-97, Scientist, Centre de Biophysique Moléculaire (CBM), CNRS, Orleans, France; Miquel, M., 1988-98, Res. Scientist, Inst. Natl. de la Recherche Agronomique, Versailles, France; Ozawa, K., 1998-99, Res. Sci., Natl. Inst. of Agrobiol. Res., Tsukuba, Japan; Routaboul, J.-M., 1994-97, Postdoc, Biologie Cellulaire, Inst. Natl. de la Recherche Agronomique, Versailles, France; Udvardi, M., 1990-92, Noble Foundation; Vogel, B.S., 1992-95, Researcher, Kantonales Lab., Basel, Switzerland; Vogel, G., 1991-95, Researcher, Kantonales Lab., Basel, Switzerland; Zhang, D., 2001-04, Postdoc, Children's Hospital. Sandpoint Way, Seattle, WA;

Current IBC Postdoc/Visiting Scientist and Start Year: Bayon de Noyer, S., 2007; Cruz, J., 1997; Dorochenck (Polloquin), K., 2006; Hampel, D., 2006; Humann, J., Fall 1998, 2005; Hwang-Kim, K.W., 2001; Jourdes, M., 2004; Kim, H.U., 2005; Laskar, D., 2003; Liang, B., 2006; Lui, P., 2007; Moinuddin, S., 2002; Rani, K., 2006; Sato, M., 2006; Tzoneva, M., 2006; Washida, H., 2002; Yamaguchi, Y., 2005; Yang, H., 2006.

Others: Homemakers: Nose, Y., 1993-94; Vuyyuru, V.B., 1994-95.

Position/Affiliation Unknown: Barkan, L., 1996-2007; Been, C.-G., 1994-95; Celimene, C., 1996-97; Chen, C., 2006; Figueroa, P., 2007; Finkel, D., 1991-93; Gibson, K., 2001-02; Grzemeski, W., 1997-2002; Jager-Vottero, P., 1995-99; Jones, C., 1989-90; Lopez, M., 1992-93; Lourith, N., 2005; Lu, H., 1999-2001; Mandaokar, A., 2004-07; Okuley, J., 1991-93; Schoendorf, A., 1998-2000; Segura, C., 1997-99; Sritanyarat, W., 2004-05; Warmers, U., 2000-01; Williams, D.C., 1994-04; Zhou, J.-M., 2003-04; Ziemkiewicz, H., 2003-05.

Appendix 5 - Institute of Biological Chemistry Undergraduate and High School Teacher Research Interns (1990-Present)

Undergraduates (Each undergraduate student is listed with years at IBC, U. of Origin, Position(s) after IBC (if known), GRA = graduate research assistant.): Abbo, H., 2006-07, WSU, Graduated, Seattle; Aidisani, D., 2005, WSU, Unknown; Alvarez-Calvillo, S., 2007, GRA, Albert Einstein; Arendt, T., 1995-96, WSU, Scientist, Forensic Sci. Lab.; Barrios, D.T., 2007, Cal State U. (LA), Undergrad, Cal State U. (LA); Barthol, A., 1999, WSU, GRA, U. of Washington; Bashor, C., 1997, Reed Coll., OR, GRA, UC San Francisco; Batchelor, M., 1996, WSU, Ph.D. (Michigan), Private Industry; Beaster, L., 1995, Whitman Coll., WA, Asst. Prof., Augustana Coll., SD; Beatty, L.M., 2004, Unknown; Berrocal, J., 2003, WSU, GRA, Cornell U. 2007; Bindler, R., 2007, WSU, Currently at IBC; Bradford, S., 1996-97, WSU, GRA, Arizona State U.; Bridges, S., 1997, Fisk U., TN, GRA, U. of Missouri, Columbia; Burnham, R., 2003, WSU, Research Tech, Seattle Biomedical Res. Inst.; Cape, J., 2000, Jersey City State Coll. (BS), Ph.D. (IBC, 2006), PDF, Chem. Dept., WSU; Carlson, J., 1998, U. of Illinois-Urbana, Unknown; Chau, M.D., 1999, SUNY Geneseo (BS), Ph.D. (IBC, 2004), Res. Scientist, Xanthus Pharmaceuticals; Collins, E., 2000, WSU, GRA, U. of Washington; Conrad, D., 1998, Dartmouth Coll., Ph.D. Student, U. of Chicago; Creasap, J., 1999, Hiram Coll., OH, Ph.D. (Cornell), PDF, Michigan State U.; Cruse, M., 1997, 1998, WSU, Medical Technologist, Pullman Memorial Hospital, Pullman, WA; Davis, J., 1998, U. of New Hampshire, GRA, Dartmouth Coll., MA; DeMarco, L., 1998, Jersey City State Coll., GRA, Rutgers U., NJ; DiMaggio, V., 1998, Central Wash. U., Unknown; Eller, R., 1996, 1997, WSU, Unknown; Emmert, S., 1999, Southern IL U., USDA Research Entomologist, Fairbanks, AK; Ford, D., 1995-96, WSU, Res. Tech., Salk Inst.; Ford, J., 1996, St. Lawrence U. (BS), Ph.D. (SMB, 2001), Scientist, FBI, New Haven, CT; French, J., 1996, S. Orange State Coll., Lab. Tech., S. Orange State Coll.; Frohlick, J., 2000, U. of Colorado, Research Technician, U. of Colorado; Gaffney, D., 2000, WSU, Medical Student, Creighton U.; Ganko, E., 1997, Eckerd Coll., FL, SPIRE PDF, U. North Carolina (PhD U. Georgia); Garribaldi, E., 2001, Université de Compiègne, France, Engineering degree, Université de Compiègne, France; Gonzalez, L., 1997, Univ. (in Chile), Unknown; Gordon, C., 2005, Pacific Lutheran U., Unknown; Gray, L., 2005, WSU, GRA, U. of Washington, Seattle, WA; Greenberg, A., 2006-07, WSU, Currently at IBC; Greene, J., 1997, Cornell U., GRA, Purdue U.; Griswold, J., WSU, Technician in Boston Biotech Co.; Guerra, D., 2005-07, WSU, GRA, UC Davis; Guess, G., 2005-06, WSU, Dental School; Gulya, D., 1997, Macalester Coll., MN, Unknown; Haefel, R., 1995, Reed Coll., OR, M.S. Env Engineering, WSU; Hamilton, M., 1995, Reed Coll., OR, Unknown; Hamm, C., 2000, SUNY Plattsburgh, GRA, U. of Iowa Medical School; Hanley, N., 1998, Trinity Coll., CT, Instructor, Community Coll. (MS Cornell); Hendrix, K.P., 2005, WSU, Research Technician, WSU; Henry, S., 1995, Biola U., CA, Res. Tech., Oakland, CA; Hoffman, M., 2000, U. of Texas, Austin, , Undergrad., U. of Texas; Hubley, K., 1996, Carroll Coll., MT, Medical School, Unknown; Humann, J., 1998, WSU. (BS), Ph.D. (OSU, 2005), PDF, IBC, WSU; Jordan, K., 2002, WSU, Unknown; Kaser, F., 1998, Reed Coll., OR, Ph.D. (UC Berkeley), Environmental Consulting, Portland, OR; Kerkman, M., 1999, Northern AZ U., Botanical Educator, Huntington Library, San Marino, CA; Kleene, J., 1999, WSU, Intern, Center for Disease Control, Atlanta, GA; Kuntz, L., 2005, Ingénieur en bureau d'études, Environmental Resources Management (ERM), Lyon, France; Larroque, A.-L., 2001, Ph.D. (CNRS Gif-Sur-Yvette, France), PDF, U. of Montreal; Londo, J., 1999, FL Inst. of Technology, Ph.D. (WSU), PDF EPA, Corvallis, OR; Ludwig, A., 2000, Western WA U., Undergrad., Western WA U.; Lupkes (Detmering), A., 1993, WSU, Res. Scientist, Weyerhaeuser; Martin, D., 1995, Humboldt State U., CA, Staff Scientist, Wine Inst., U. of British Columbia; Martin, W., 1996, U. of Wisconsin, Ph.D. (USCF), Scientist, Dept of Pharmacology, Merck Research Lab, Rahway, NJ; Merritt, B., 1995, Utah State U., Unknown; Miller, A., 1999, Rochester Inst. of Tech., NY, Undergrad, Rochester Inst. of Tech.; Miller, K., 1995, WSU, Ph.D. (Univ. College, London), Gordon Inst., Cambridge, UK; Minga, H., 2004, WSU, Ski instructor, New Zealand; Moe, L., 1999, WSU, PDF, U. of Wisconsin; Near, D., 1999, WSU, Unknown; Nguyen, L., 1995, WSU, Ph.D. (IBC, 2006), PDF, Northwestern U.; Nicholson, K., 1996, WSU, GRA, Australia; O'Hair, E., 1996-97, WSU, Unknown; Palmer, J., 1996, Whitman Coll., Ph.D. (UC Berkeley), Asst. Professor, Lewis and Clark State Coll., ID; Phillips, M., 1995, Humboldt State U. (BS), Ph.D. (IBC, 2000), PDF, Max Planck Inst. for Chem Ecol, Jena, Gmny; Proctor, J., 1998, Texas A & M U., Ph.D., Application Scientist, MDS Analytical Technologies, Sunnyvale, CA; Roberts, K., 1997, Lycoming Coll., PA, Ph.D. Cornell, PDF, Boyce Thompson Inst; Rogers, K., 1997, Dartmouth Coll., K-12 Science Teaching; Rohwer, C., 1999, Iowa State U., GRA, Hort Dept, U. of Minnesota; Ross, E., 1996, Reed Coll., Ph.D. (U. Nebraska), Asst Prof., Highpoint U.; Sanchez, C., 1998-99, WSU, GRA, WSU; Santiago, K., 2006-07, WSU, Moved to Bellingham, WA; Scheer, J., 1996, Carroll Coll., MT (BA), Ph.D. (IBC, 2003), Owner, New Bio Inc., CA; Smith, A., 1997-98, WSU, High School Teacher, Tacoma, WA; Smith, B., 1995-96, WSU, Private Industry; Smith, C., 1996-97, WSU, Technician, CAHNRS, WSU; Somayaji, C., 2005, WSU, Unknown; Spens, E., 1998, West Virginia U., Currently at IBC; Strohmeier, T., 2003, WSU, Unknown; Taeya, V., 1997, Unknown; Taylor, M., 2006, Pacific Lutheran U., Unknown; Thines, B., 2000, SUNY Plattsburgh (BS), Ph.D. (IBC, 2006), PDF, UC Berkeley; Tschauner, A., 2007, Pacific Lutheran U., Currently at IBC; Valdespino, V.M. , 2004, Unknown; Veber, Y., 1996, U. California-Davis, Unknown; Weidenbach, T., 1995-96, WSU, Quality Control, Moses Lake, WA; Wetzig, K., 2000, Pharmacist, Germany; Willies, D., 2000, Dartmouth Coll., Ph.D. (Dartmouth), Research Assoc., Mascoma Corp.; Yamamoto, M., 1997-98, WSU, GRA, UC Berkeley.

High School Teacher (Summer Interns): Bassett, E., 2000, Olympia, WA; Wright, B., 2002-03, Olympia, WA; Campbell, D., 2004, Shelton, WA; Stratton, M., 2004-05, Centralia, WA; Bruncke, D., 2005, Aberdeen, WA; Michovek, M., 2007, Aberdeen, WA.

