UPCI SUMMER ACADEMY 2012 FINAL REPORT

EXECUTIVE SUMMARY

The **4th annual University of Pittsburgh Cancer Institute (UPCI) Summer Academy** was successfully completed after eight weeks (from June 18 to August 10, 2012) of experiential and didactic learning activities designed specifically for rising high school seniors. After the pilot program in 2009, the academy was federally funded by the National Cancer Institute to continue in the summer of 2010 as a supplement to our P30 Cancer Center Support Grant. The UPCI Summer Academy received support again in 2011 and 2012 from the University of Pittsburgh Cancer Institute, Bayer Material Sciences, the Queen's Hospital of Honolulu, the UPCI Volunteer Office, and the National Cancer Institute to provide research opportunities for 28 local and national high school rising seniors. Through continued collaborations with Pittsburgh Public Schools, SciTech Academy, the Fund for Advancement of Minorities through Education (FAME), the Doris Duke Charitable Foundation, the Pittsburgh Tissue Engineering Initiative, Bayer Material Sciences, the Jack Kent Cooke Foundation and the University of Pittsburgh's Office of Diversity and Office of Science Education Outreach, scholars were immersed in science research learning experiences that included: 1) daily studies in an individual mentor's research laboratory; 2) clinical and basic science cameo appearances from cancer professionals, 3) field trips to local scientific activities and to the National Cancer Institute; and 4) weekly didactic sessions led by qualified graduate, medical students, postdoctoral fellow, and faculty.

We seek out the best and brightest and the most committed and suitable for our Program. In addition, we continue to recruit and retain academically successful under-represented minority and disadvantaged students. The Academy, now for its second year, has maintained three distinct sites among the University of Pittsburgh campus: the Hillman Cancer Center in Shadyside, the Magee Women's Cancer Research Center in Oakland, and the Departments of Computational/Systems Biology and Biomedical Informatics (CoSBBI) program at the Biomedical Science Tower-3. Through the dedication of the Hillman, CoSBBI and MWRI-

WCRC faculty and staff in addition to the operation of three unique and well-equipped sites, we are able to offer scholars specialized areas of research interests as well as reach out to a larger number of outstanding, committed students including underrepresented and minority students in the region and nation.

Hillman Site Overview

Scholars' interest and knowledge in cancer careers developed and increased significantly throughout the summer, as they were exposed to innovative and specific knowledge of cancer biology and clinical care. The Academy proposed the following goals to help prepare high school rising seniors to further their studies in science, technology, engineering, and mathematics (STEM) subjects and to consider careers in cancer care and research. Through immersion in our dedicated laboratories with qualified faculty mentors (**see Appendix A**), scholars showed an increased knowledge of (1) STEM careers in cancer care and research, (2) education in cancer biology and therapeutic strategies, and (3) development of research and communication skills.

Along with the time spent in the laboratory, scholars attended a comprehensive series of didactic cancer biology lectures presented by program academic staff, largely PhD and medical students, postdoctoral fellows and mentors. They attended presentations from clinicians and researchers from across UPCI disciplines focusing on clinical care, career options, and career preparation. Scholars were led on tours of a variety of clinical and research facilities at UPCI, UPMC Shadyside, and the Biomedical Science Tower III. Activities were designed specifically to promote scholars' interest, knowledge and awareness about cancer care and careers.

CoSBBI Site Overview

Scholars' awareness and knowledge of careers in basic sciences, such as Computational and Systems Biology, as well as in applied sciences, such as Biomedical Informatics, expanded throughout the course of this Academy. Through class-based didactic lectures, work in our dedicated laboratories, and interactions with faculty and students, our scholars achieved, through this Academy, (1) increased understanding of the variety of careers in Computational & Systems Biology (CSB) and in Biomedical Informatics (BI); (2) education in mathematical modeling of biological processes as well as in selected aspects of Biomedical Informatics, such as genomics and proteomics; (3) greater development of research and presentation skills; and (4) better awareness of strategies and approaches for selecting undergraduate institutions to apply to, how to maximize their success in the application process, and how to be successful throughout their undergraduate studies.

This academy was composed of several components, among which we can cite (1) a class-based, didactic component in which the scholars were taught by the University of Pittsburgh's world class faculty, (2) a learning-on-site component, in which scholars visited and received instruction at facilities such as a Drosophila lab at CMU, the NMR lab at Pitt, the supercomputer machine room at the Pittsburgh Supercomputing Center, etc, and a (3) mentoring component, in which the scholars interacted with undergraduate students of CSB's REU program. The instruction was supplemented by a textbook. All of these activities were designed to instruct scholars on the rich diversity of CSB and BI, and to expose them to the variety of careers within these fields. Unique aspects included a weekly research roundtable and a commitment to integrated computational solutions to the problems of cancer.

MWRI Site Overview

The UPCI Scholars placed at the Magee Women's Cancer Research Center (WCRC) were exposed to various aspects of research in women's cancer, which has become a major strength at the MWRI with the recent creation of the WCRC. Research projects and presentation centered on critical research projects in breast and ovarian cancer, and state-of-the-art technologies and approaches for the studies, such as novel methods in mass spectrometry. The scholars were exposed to class-based didactic courses, to extensive research program in individual mentors' laboratories, and to a number of visits at clinical and core support components of the Magee Hospital, and MWRI. The cancer-focused coursework was designed to give the scholars a rigorous introduction to the complexity of cancer, but at the same time helped them to better understand the lab projects they were working on under the direction of the Faculty mentors.

Scholars' knowledge of the fields relating to cancer related to women's health increased significantly in depth throughout the summer as they participated in (1) a daily didactic component taught by medical students from the University of Pittsburgh Medical School centered on Robert Weinberg's *The Biology of Cancer* textbook, (2) a laboratory experience with a dedicated MWRI faculty mentor, and (3) cameo experiences which included tours, guest lectures, and clinical shadowing of doctors at Magee Women's Hospital. These components of the Magee Academy helped scholars to achieve the following goals: (1) an increased understanding of the science behind cancer, (2) an improved ability to understand, discuss, and present scientific research, (3) an understanding of specific laboratory techniques, and (4) a greater appreciation for the breadth of the field of oncology and how it translates to innovations and progress in women's health.

Cameo experiences included guided tours of MWRI facilities such as the Histology Core Facility and Mass Spectrometry platform, as well as visit to other University of Pittsburgh core facilities such the Genomics and Proteomics Core Facility. To provide further insight into the biomedical research community, the UPCI Summer Academy Scholars were afforded a special presentation from the **School of Medicine Office of Diversity Programs**, as well as numerous informal career guidance lectures from clinicians and researchers in the **Magee Womens Hospital and Research Institute**.

The scholars' understanding of women's health with a focus on cancer and oncology was evaluated based on pretests, post-tests, and interim exams. The scholars were also expected to discuss their lab's current research by participating in a weekly journal club in which they presented relevant scientific articles. The scholars not only improved significantly throughout the summer in their knowledge of the basic science behind cancer, but also improved in their ability to analyze, share and present their knowledge to others.

RECRUITMENT

Local. Eleventh-grade [rising seniors] students are recruited from the Pittsburgh Public Schools (PPS), the largest of 43 school districts in Allegheny County and the second largest in Pennsylvania. According to 2010-2011 data, PPS has 7,504 students (grades 9-12) enrolled in 9 high schools, approximately 55% of whom are African-American (37% white, 2% Asian, 1%

Hispanic). Approximately 70% of the graduates go on to enroll in higher education. Seventy-one percent of Pittsburgh Public School students (K-12) are eligible for free or reduced price lunch. For the past two years of the Academy, we have also recruited widely from the **Pittsburgh Science & Technology Academy**, located on the Oakland campus, and designed specifically for students with an interest in science, technology, engineering, or math. Efforts have also been continued to reach out to the many private schools in the immediate Pittsburgh region, such as Winchester Thurston, Ellis School, Shadyside Academy, Oakland Catholic, Central Catholic and Sewickley Academy. We have many applicants and participating scholars who are enrolled in these private academies, and a number of them who maintain a scholarship for enrollment based on academic excellence.

Regional. Targeting these urban schools immediately surrounding the University of Pittsburgh and Hillman Cancer Center provides the appropriate geographic, minority, and economic focus to our program. Access to public transportation hubs and the central location of the Shadyside and Oakland campuses and Hillman Cancer Center throughout the city obviates our need to provide residential or on-campus housing for local student participants. The MWRI building in Oakland and the BST-3 in Oakland are less than 2 miles from the Hillman Cancer Center in Shadyside, and utilizes University of Pittsburgh Cancer Institute and UPMC dedicated shuttles to transport scholars between sites. On campus housing in the dormitory provides out of state students with an opportunity for working with our faculty and mentors.

National. In addition to recruiting from regional urban schools, we expanded our efforts this year to include suburban districts in Allegheny County, including Hampton Township, Fox Chapel, North Allegheny School District and others. National interest grew in 2012 with applicants from Oregon, New York, Massachusetts, Hawaii and New Jersey. A special effort was made through connections of the Director to recruit native Hawaiians and two students matriculated from the **Kamehameha School** this year. We have also continued our unique partnership with the **Jack Kent Cooke Foundation**, a private, independent foundation established to help exceptionally promising scholars with modest family means reach their full potential through education. The Foundation's scholarship and direct service programs support the education of approximately 650 remarkable scholars each year. This past summer, our program hosted four out-of-state scholars under the JKCF's Young Scholars Program to spend the summer in Pittsburgh. We plan to expand the number of Jack Kent Cooke Foundation student participants next summer to five or more scholars, in our core program at the Hillman site as well as in the CoSBBI and MWRI programs. We will work with the JKCF Education Director, Rebecca Cullen, as well as JKCF educational advisors to help identify qualified students and facilitate their attendance in the program.

Getting the Word Out. We continued partnerships with local organizations and programs such as the Pittsburgh Tissue Engineering Initiative, Bayer Material Sciences and the University Of Pittsburgh Office Of Diversity (Director, Paula K. Davis) and the Office for Science Education Outreach, directed by Dr. Joan Lakoski. Our contacts in the Office of Diversity provided our scholars with unique opportunities to participate in shared activities, namely diversity training, with the University of Pittsburgh School of Medicine Summer Premedical Academic Enrichment Program (SPAEP). Two open houses were offered during the winter of 2012 to prepare applicants, parents and teachers for the Academy – the open houses gave applicants a chance to

better understand the application process and learn more about each particular program site. We reached out to local urban and suburban schools, guidance counselors and teachers to advertise the open houses and encourage potential candidates to apply.

PROGRAM LEADERSHIP AND MENTORSHIP

We recruited many graduate, undergraduate and medical students to serve as teaching mentors who provided weekly mentoring and tutoring sessions to the scholars, so that all scholars had the opportunity to manage assigned coursework in an appropriate and timely manner. Offering a one-on-one experience with scholars led to overall better understanding of the material and more interactive didactic sessions and experiences in the laboratory. Staff mentors and block leaders for each site are listed below.

PERSONNEL AND OVERSIGHT

The **Hillman Program** leadership team was comprised of:

- Michael Lotze, MD – a UPCI clinician/researcher. Program Director and Instructor. Provided overall logistics and support for the program; developed funding requests and interactions with outside agencies and promoted the expansion of the current program.
- Megan Seippel, MPA – Program Administrator. Recruited scholars and provided student support. Coordinated guest speakers, tours, application and recruitment development, advisory meetings, and overall program management. She also conducted the NCI trip.
- Philip Vernon, BS – Pre-doctoral Candidate. Academic Administrator. Developed curriculum for the Hillman and Magee sites, oversaw didactic sessions, served as assessment consultant and instructor. Worked daily with scholars on developing research projects and laboratory experiments.

The **Magee Womens Cancer Research Center** leadership team was comprised of:

- Steffi Oesterreich, PhD – Dr. Oesterreich is the Director of Education at the Womens Cancer Research Center. She took an active role in the education of the scholars in the biology of women's cancer. She was also involved in the organization of the social activities of the program, as well as a team-building exercise for the scholars, and attended the day long trip to the NCI.
- Rebecca Watters, PhD – Postdoctoral Fellow. Developed curriculum for the Magee site, oversaw didactic sessions, served as assessment consultant and instructor. Worked with scholars on developing research projects and laboratory experiments.

The **CoSBBI Program** leadership team was comprised of:

- Claudia Mello-Thoms, MS, PhD – a Pitt professor of Biomedical Informatics and Radiology. Co-Program Director and Instructor. Recruited scholars, provided student support, prepared schedule, tours, advisory meetings, and program management.
- Joseph Ayoob, PhD – a Pitt professor of Computational and Systems Biology. Program Co-Director and Instructor. Recruited scholars, provided student support, prepared schedule, tours, advisory meetings, and program management.

- Vanathi Gopalakrishnan, PhD - Associate Professor of Biomedical Informatics. Co-Director and Instructor who worked alongside Drs. Mello-Thoms and Ayoob to design and implement the CoSBBI curricula and research projects.

Teachers
Led by Philip Vernon and Rebecca Watters, the following personnel served as program mentors, teachers and block leaders, and coordinated regular didactic and tutoring sessions with the scholars:

Hillman:
William Buchser
Adriana Forero
Michelle Heid
James Kaus
Alex Wu
Peter Keyel
Michelle Messmer
Jillian Bonaroti
Anna Gustafierro
Nydiaris Hernandez-Santos
Fernando Concha-Benavente
Jeff Wong

WCRC:
Brian Nolen
Adam Cohen
David Boone
Susan Farabaugh
Steffi Oesterreich
Melanie Flint
Priscilla McAuliffe
Anda Vlad
Xin Huang
Robin Laskey

CoSBBI:
Dr Chakra Chennubhotla, PhD – Assistant Professor of Computational & Systems Biology
Dr Tim Lezon, PhD - Assistant Professor of Computational & Systems Biology
Dr Bino John, PhD - Assistant Professor of Computational & Systems Biology
Dr David Koes, PhD – Research Assistant Professor of Computational & Systems Biology
Dr Carlos Camacho, PhD – Associate Professor of Computational & Systems Biology
Dr Vanathi Gopalakrishnan, PhD - Assistant Professor of Biomedical Informatics
Dr Shyam Visweswaran, MD, PhD - Assistant Professor of Biomedical Informatics

Program Staff
Alexandra Ashley, who participated in our Pilot Program as a rising junior in 2009, is majoring in Biology at the University of Pittsburgh. Since her experience in her first summer, she has worked throughout the school year and each summer with the Thorne laboratory. Ms. Ashley played a role as resident advisor to our out-of-state scholars, facilitated meal vouchers, poster presentations, survey collection and feedback analysis, and daily activities. Ms. Ashley also attended faculty mentor meetings and served as a contact for scholars at the Hillman site.

Jesse Payton is a student from Hawaii currently working in the Lotze lab and studying at Carnegie Mellon University. Mr. Payton also served as a resident advisor and spent his summer working closely with the out-of-state scholars in all capacities relating to their time in the dorm, transportation, and activities.

Andrew Muse is a pre-med student at the University of Pittsburgh and alumna from the 2010 Academy. Mr. Muse served as the activities advisor and organized all of the social events for the scholars throughout the eight-week program. Mr. Muse assisted with planning and preparation of weekend and weekday events and coordinated participation among the other sites as well as working in Dr. Tao Cheng's laboratory.

Curriculum

HILLMAN GOALS

Specific Aim 1: Awareness of Science, Technology, Engineering, and Mathematics (STEM) Careers in Cancer Care and Research. The primary aim was to motivate high school scholars to continue their study of STEM subjects by introducing them to the many STEM disciplines that are employed by professionals working in a Comprehensive Cancer Center. This was pursued through presentations by professionals recruited to represent the diversity of opportunities in the cancer field, focusing on the roles, skills, and educational backgrounds of cancer team members.

Specific Aim 2: Education in Cancer Biology and Therapeutic Strategies. Our secondary aim was to educate scholars in the biology of cancer and the strategies in use and under development for its prevention, diagnosis, and treatment. This was pursued through a variety of lectures, textbook readings, and guest presentations.

Specific Aim 3: Development of Research and Communication Skills. Our tertiary aim was to educate scholars in the process of scientific research. This was pursued through participation in a project under the supervision of a cancer researcher and by preparing an oral/visual presentation to their peers and mentors describing their research goals, methods, and results.

Specific Aim 4: Participation of Underrepresented Minorities and Disadvantaged Students. The Office of Diversity, Health Sciences (ODHS) and the School of Medicine's Office of Student Affairs/Diversity Programs have played a major role over the past year in helping us to identify and reach out to local talented, disadvantaged youth. These programs and leaders are experienced in supporting scholars who come from economic, social or educational disadvantaged background, and those who are underrepresented in Medicine and Science. The director of these programs (Paula Davis) have been instrumental in working with us during the application and recruitment process to create avenues by which scholars can be appropriately paired with a science and/or medicine internship. Additional collaborations with Brian Corr, Director of Pittsburgh Public Schools Science and Dr. Edwina Kinchington, teacher at the Pittsburgh & Science Technology School have been an important resource as we expand our outreach and look to recruit more disadvantaged and minority scholars.

We will continue to work closely with Brian Corr from the Pittsburgh Public Schools Science Curricula Department to advertise our program to rising seniors in local high schools. Over the next academic year, we plan to visit various science classes within PPS high schools to talk about our program and identify eligible and high-achieving scholars for 2013. Laurie Heinreicher from Hampton School District has served as our liaison for recruitment and advertising among suburban school districts, and we have made additional contacts through Allegheny County to raise awareness about STEM education and how our programs are uniquely designed for rising seniors who desire an immersive and intensive hands-on experience in basic science and translational research.

Visit to the NIH. This has been the third year that our program has visited the National Institutes of Health and National Cancer Institute in Bethesda, MD, and we restructured the field trip so that our scholars could get the most out of their time on campus. Each scholar was individually paired with a laboratory on the NIH campus that was working on similar research and was a personal collaborator with the scholar's faculty mentor at the University of Pittsburgh. We designed this interactive and one-on-one approach to give the scholars a chance to see how the same type of research is conducted nationally and on a larger scale. Scholars were placed in laboratories including:

- Lab of Human Carcinogenesis
- Molecular Imaging Program
- HIV and AIDS Malignancy Branch
- Receptor Biology and Gene Expression
- Cancer Biology and Genetics
- Pediatric Oncology Branch
- Lab of Molecular Pharmacology
- Surgery Branch
- Lab of Molecular Pharmacology
- Lab of Cellular Oncology
- Vaccine Branch
- Receptor Biology and Gene Expression

SYLLABUS – HILLMAN AND MAGEE SITE (FIRST HALF IDENTICAL)

The syllabus was based on Weinberg and Hanahan's revised hallmarks of Cancer.

- Chapter 1. Biology Review. The Body / Organ systems, Anatomy, Physiology, The Cell
- Chapter 1. Goals of Cancer Research, Lab Organization, Scientific Method, (provide handouts for lab math)
- Chapter 1. Biology Review. Cell biology: DNA, Genes, Genetics, Proteins, Transcription, Translation, ATP (1.2, 1.4, 1.6, 1.7, 1.8, 1.10)
- Chapter 1. Lab Math, Lab Materials (Flasks, Tubes), Techniques, Sterility
- Chapter 2. Overview of Cancer. 2.1 Where do tumors arise, 2.2 Specialized cells, 2.4 Cancer Progress, 2.5 Monoclonal
- Chapter 2.6. Cancer etiology and epidemiology (2.6, - 2.11), Clinical/ Epidemiologic. 2.6 Frequency in human populations. 2.7 Lifestyle risks, 2.8 chemical agents, Carcinogens vs. Mutagens, Ames test

- Chapter 3. Tumor Viruses. 3.2 Transformation, 3.3 RSV, 3.6 Integration, 3.8 src, 3.9, 3.12. Transfection.
- Chapter 4. Oncogenes. 4.3 Oncogenes discovered, 4.4 Proto-oncogenes, 4.5 myc oncogene, 4.6 changes that make oncogenes
- Chapter 5. Growth Factors. 5.1 cell-cell signaling, 5.2 Kinases, 5.3 Growth factors, 5.4 Growth Factor Receptor, 5.6 Transphosphorylation and RTKs, 5.9 Basic Pathway to RAS (talk about signaling cascade in general, not very specific)
- Chapter 6. Cytoplasmic Signaling. 6.1 Cell surface to nucleus, 6.2 Ras protein, 6.3 Tyrosine phosphorylation, 6.4 SH2 domain, phosphatases, specific proteins, either 6.6 Akt, 6.8 Jak-STAT, or 6.9 Wnt pathway. Or have groups look into one of cascades and talk about it. Mention phosphatases.
- Chapter 7. Tumor suppressor genes. 7.2 Pedigrees and recessive phenotype, 7.3 Retinoblastoma, 7.7 Familial cancers, 7.6 Loss of Heterozygosity, 7.8 Promoter Methylation, 7.11 APC and colon cancer, 7.12 VHL.
- Chapter 8. Cell Cycle and pRb. Cell Cycle, phases, ppMAT 8.1 External signals trigger, 8.3 Cyclins and CDKs, 8.5 Viral oncoproteins and Rb block, 8.9 Myc and pRb
- Chapter 9. Apoptosis, p53. 9.2 p53 is a tumor suppressor gene, 9.3 mutant p53, 9.5 p53 Induction, 9.7 MDM2 and Arf, 9.9, 9.13 Apoptosis, 9.14, 9.15
- Chapter 10. Imortality, senescence. 10.1 Cell generations, 10.2 Immortality, 10.3 senescence, 10.4 telomeres, 10.6 telomerase, 10.11 connection with human tumors. Introduction to AUTOPAHGY
- NA. Breast Cancer, Ovarian Cancer, and Women's Health Perspective
- Chapter 11. Tumor Progression, Tumorigenesis. 11.1 Develop over decades, 11.2 Histology and Multistep, 11.3 Colon cancer, 11.4 Familial Polyposis, 11.6 Cancer stem cells, 11.9 Normal cells resistant to transformation, 11.12 Human cells are resistant to immortalization and transformation, 11.15,11.16 Chronic Inflammation
- Chapter 12. Genomic Integrity and effects of mutagens (12.1, 12.2, 12.3, 12.4, 12.5)
- Chapter 12.8. Inherited defects in genomic integrity (12.8, 12.19, 12.12)
- Chapter 13. Heterotypic Interactions. 13.1 TME, 13.2 Cell lines are not like real cancers, 13.3 Tumors resemble wound healing sites, 13.4 Stromal cells, 13.5 Macrophages. Talk about Breast Cancer and Bystander effect.
- Chapter 13.6. Angiogenesis. 13.6 Requirement of blood vessels, endothelial cells, 13.7/8 Angiogenic Switch, 13.9 Angiogenic Inhibitors, 13.10 Therapies
- Chapter 14. Metastasis. 14.1 Steps of metastasis, 14.2 Cascade, 14.3/4 Epithelial-mesenchymal transisition, 14.6 Proteases, 14.7 Small GTP-ases, 14.8 Lymphatics, 14.9 Seed and Soil, 14.12 Micromets.
- Chapter 15. Immunology Overview. 15.1-6, Innate and Adaptive Immune System. 15.7 Immunosurviellence
- Chapter 15.9. Tumor Immunology. 15.9 Protection against cancer, 15.10,12,13 Tumor antigens, 15.11 Recognition may be late, 15.4 Cancers evade detection, 15.15 Cancers evade NK mediated, 15.16,17,18 Cancer counter-attacks, Tregs.
- NA. Mitochondria (pg 337) and Metabolism. Glycolysis, OxPhos, Warburg, Redox, Autophagy. Mitochondrial biogenesis Fission/Fusion.

- Chapter 15.19. Cancer Vaccines/Immunotherapies (15.19 -15.23) / Leukemia Rituximab CD20 / Breast Cancer Herceptin / Dendreon, Rosenberg's TILs, anti-CTLA4, other cool immunotherapies.
- Chapter 16. Drug Development (16.0 - 16.5) and Clinical Trials (16.6 - 16.9), Classic Cancer Chemotherapies
- Chapter 16.1. Current Cancer Chemotherapeutics (16.10 - 16.11, 16.13 - 16.16), targeted, also future therapies

Specialized WCRC Curricula. The Magee Site spent the last half of their curricula on breast and ovarian cancer using scholarly articles and reviews from the recent literature to guide the teaching.

CURRICULAR ACTIVITIES

The Hillman scholars participated in a wide variety of learning activities, including lectures, textbook readings, guest speaker presentations, tours of clinical and research facilities, laboratory research, lab meetings, research seminars, discussions, and their own presentations. The scholars found the majority of these categories of learning activities beneficial.

- Opening reception, orientation to labs, administrative orientation
- Pathology and Genomics Facility Tour - Dr. Sheldon Bastacky
- Molecular and Cellular Biology Lecture - Dr. Richard Steinman; a career in hematology
- Flow and Imaging Cytometry Tour (Michael Meyer)
- Joe Newsome - guest lecturer and tour of the animal facility at the BST3
- Field trip to RiverQuest
- Lyn Robertson - Community health education and screening
- Beth Dudley - Genetic counseling and familial centers
- Trip to the National Institutes of Health, National Cancer Institute
- Shadyside Hospital Operating Room Observations with Paul Feight, RN
- Weekly journal presentations by scholars
- College admissions counseling sessions from CMU and Pitt
- Michael Becich - BioInformatics lecture
- Nathan Bahary – lecture on zebrafish and a career in medical oncology

COSBBI CURRICULUM, INCLUDING SYLLABUS, GOALS, ACTIVITIES AND FEEDBACK

CoSBBI GOALS

Aim1: Awareness of Careers in Computational and Systems Biology and in Biomedical Informatics. The CoSBBI program introduces the scholars to the many career options available in these fields, and makes them aware of the incredible rewards available in a career dedicated to health care research in a computational environment. Scholars have opportunities to learn about these careers through a series of ‘cameos’/visits by those actively working in these areas.

Aim 2: Education in Modeling of Biological Processes and in Selected Topics in Biomedical Informatics: Another goal of this site was to introduce the scholars to concepts such as genomic and proteomic research, computational modeling of disease, bioinformatics, cognitive and

translational informatics. Albeit these represent only a few of the research tracks available in both fields, they are very important in a cancer research context, because understanding of disease biology and complex interactions, as well as clinical applications, is crucial for early diagnosis and successful treatment.

Aim 3: Development of Research and Communication Skills: CoSBBI also focused on the development of research skills through one-on-one interactions with faculty mentors in the development of individual projects, as well as in the development of communication skills needed to carry out such projects and to present them to the entire group at the end of the eight weeks.

CoSBBI Syllabus

- Computer Use, Ethics, and How to Keep a Notebook (Ayoob)
- Introduction to Research Methodology (Mello-Thoms)
  - HSLS Day (Chattopadhyay)
  - Introduction to Programming (McDade)
  - Introduction to Molecular Biology (Liu)
  - Modeling and Visualization (Paris)
  - Computational Structural Biology (Lezon)
  - Molecular Dynamics (Lettieri)
  - Computational Drug Discovery (Koes)
  - Modeling Signaling Pathways (Zivanov, Harris)
  - Introduction to Biomedical Informatics (Becich)
  - Statistics and R (McDade)
  - Introduction to Bioinformatics (McDade)
  - Industry in Bioinformatics (Menon)

Textbook: "Understanding Bioinformatics", by Marketa Zvelebil and Jeremy Baum, Garland Science, 2007.

CoSBBI Activities

The CoSBBI scholars participated in a number of different learning activities, including didactic lectures, guest speaker presentations, tours of clinical and research facilities, laboratory research, lab meetings, research seminars, research round tables, and their own presentations at the end of the Academy. The scholars found the majority of these categories of learning activities beneficial.

- Opening reception, orientation to labs, administrative orientation
- Supercomputer Machine Room Tour - Drs. Joe Ayoob and John Urbanic
- Health Sciences Diversity Awareness Workshop - Dr. Claudia Mello-Thoms
- DDI and NMR Tours – Drs. Joe Ayoob, Judith Klein, James Conway, and Andreas Vogt
  - Trip to the National Institute of Health, NCI attended by Dr. Dr Vanathi Gopalakrishnan
- Panel discussion on College Admissions with REU scholars – Dr Joe Ayoob
- Opportunities in Biomedical Informatics – Dr Michael Becich
- Zebrafish facility tour – Dr Nathan Bahary

- Workshops on preparing and presenting scientific research talks – Dr. Joe Ayoob, Dr Claudia Mello-Thoms
- Closing meeting and informal feedback session with scholars (student feedback and comments listed immediately below) – Dr. Joe Ayoob, Dr Claudia Mello-Thoms

By providing a balanced curriculum of didactic training, mentored research experiences, demonstrations, hands-on training, special guest lectures, presentation opportunities, and field trips, we were able to provide a graduate-level experience to our cohort of 7 students to better prepare them for careers in cutting-edge research and related fields. By all accounts, this year's CoSBBI Academy was a singular success. We were able to achieve many of the goals that we initially set out to attain with the end result of a more highly trained and more prepared cohort of students. In order to grow and improve our efforts of training the next generation of scientists and physicians, students provided candid feedback on the various elements of the program as well as their overall satisfaction of the experience. Overall, the students' feedback was very positive, but also indicated several areas that could be improved upon. A synopsis of the students' comments on the various topics is listed below.

Classes – Scholars requested that the number of lecture-based classes be increased, as this year we compiled all lectures in the first 3 weeks of the program. Scholars would like the lectures to be shorter, more hands-on, and to have greater consistency between different topics.

Weekly Quizzes – Scholars were not given a weekly quiz, but suggested that such testing could have been useful in their learning of the materials presented in the lectures.

Reading Materials – Scholars asked for reading materials to be suggested prior to each lecture, so they could come prepared to hear about subjects that were very new to them.

Interaction with Students – Scholars indicated that they greatly benefited from interactions with the undergraduate and graduate students from the REU program, as well as from CSB and DBMI, and with the trainees from the other two UPCI Academies. They were in favor of increasing those interactions, and also requested greater interactions with scholars from the other associated sites in the Academy.

Research Roundtable – Each week, the scholars would write a summary of the work they performed and briefly present their work in a weekly roundtable meeting. This activity was generally received well, with students indicating that it was very useful for organizing their thoughts and experiments, while also helping them prepare for their presentations, abstracts, and posters that they assembled at the end of the program.

Professional Development Opportunities – Scholars were given advice on undergraduate admissions and what to expect academically in college. This was a great benefit to the scholars, but they also requested that we provide more insight into graduate and medical school admissions, academics, etc, plus discussions of different career paths and career options in biomedical research and related fields.

Tours, Field Trips, and Social Activities – Scholars were very pleased with the variety and number of the different enrichment activities that were made available to them. One suggestion was to have the different tours and special guest lectures earlier in the program since the students indicated that these events helped put things into perspective for them, plus having them earlier would give them more time to follow-up with and meet with the presenters if they happen to be interested in that particular field.

MWRI CURRICULUM, INCLUDING SYLLABUS, GOALS, ACTIVITIES AND FEEDBACK

WCRC GOALS

In its first year, the UPCI Summer Academy-MWRI Pilot Program sought primarily to mirror the programming of the established Hillman Cancer Center site. This was achieved using MWRI site-specific instructional staff; site-specific research mentors; and a combination of site-specific and joint content-deepening experiences with the other two sites.

- An ancillary aim was to establish the administrative mechanisms to permit these activities within MWRI, while not interfering with the long-running Magee Womens Hospital summer internship program, which also places high school students within select MWRI research laboratories.

Specific Aim 1: Education in Cancer Biology and Therapeutic Strategies.

Our foremost aim was to educate scholars in the biology of women's cancer; and in the strategies currently employed or under development for its prevention, diagnosis, and treatment. This was achieved through a variety of lectures, textbook readings, guest presentations, physician shadowing, visits to research core facilities and operating rooms, and most importantly direct mentoring in laboratory research (see Aim 2)

- An ancillary aim was to provide nuanced understanding of gynecological and breast oncology in the greater context of women's reproductive health.

Specific Aim 2: Development of Research and Scientific Communication Skills.

Our second aim, which supported the first, was to provide scholars with hands-on experience in laboratory scientific women's cancer research. This was achieved through participation in a project under the supervision of a cancer researcher (faculty, post-doctoral or other dedicated laboratory staff) including: literature research and reading on a specific topic; extensive practicum in laboratory bench methods; experiment design and performance; analysis of results; and communication of findings through oral and poster presentations.

Specific Aim 3: Establishing Awareness of STEM disciplines; Fostering Significant Connection to Post-secondary Education or Employment in STEM.

Our third aim - which emerged from pursuit of the first two aims - was fostering awareness of (and lasting connection to) the many science, technology, engineering, and mathematics (STEM) disciplines which are involved in performing cancer research at a collaborative research institutes such as UPCI and MWRI.

- This was achieved by incorporating many diverse researchers, clinicians and professional staff in oral presentations, laboratory tours, physician shadowing and OR observation experiences for Summer Academy students, as described above.
- Connection to STEM careers was supported by arranging permission to attend twice-weekly lunchtime presentations at MWRI by clinicians and researchers, who are encouraged to speak informally about their own paths through higher education and professional career development.
- This was also supported by the use of near-peer mentors (undergraduates, graduate students, postdoctoral fellows and early medical students) as course instructors, who

could contribute guidance on transitioning to undergraduate STEM education and thereafter to medical school.
- This was also supported by shadowing in the Womens clinic

Specific Aim 4: <u>Service to Underrepresented Minorities and Disadvantaged Students</u>.
An aim of the entire UPCI Summer Academy is to extend their unique scientific experience to minority and disadvantaged students in the Pittsburgh city and region.

- This has previously been supported through UPCI Summer Academy consulting The Office of Diversity, Health Sciences (ODHS) and the School of Medicine's Office of Student Affairs/Diversity Programs on how best to identify and reach out to local talented, disadvantaged youth.
- The UPCI-MWRI Pilot has supported this aim
  - by hosting two underrepresented and disadvantaged scholars, and
  - arranging an extracurricular experience in engineering for this student (see above)
  - by consulting University of Pittsburgh Health Sciences Associate Vice Chancellor for Science Education Outreach (Joan Lakoski)
  - byarranging a special presentation of a newly modified version of the University of Pittsburgh School of Medicine Diversity Workshop, for secondary students considering Health Sciences professions.

EXTRACURRICULAR ACTIVITIES

To create a close-knit community among the scholars, teachers and faculty we created a weekend activities schedule where scholars would sign up on a weekly basis to attend weekend social outings. The academy went on a number of outings: attending a Pirates game, touring Falling Water, a trip to Sandcastle Waterpark, group dinners and lunches, watching movies at Flagstaff park and the Batman premier, and other fun activities. Andrew Muse, Drs. Lotze, Oesterreich, Mello-Thoms and Ayoob, as well as the resident advisors, Jesse Payton and Alexandra Ashley, were instrumental in organizing these events and coordinating transportation for the scholars.

CLOSING RECEPTION AND POSTER PRSENTATIONS

The closing receptions and poster presentations took place on Friday, August 10, 2012. Each site, Hillman, CoSBBI and MWRI, as well as conducted their own, distinct oral presentations and ceremonies in the morning, where scholars presented their projects and faculty had an opportunity to speak about theirs scholars' work and their time in the laboratories and facilities. Following the oral presentations and closing ceremonies, all sites came together at the Hillman Cancer Center atrium to participate in an open house poster session. The entire UPCI community of faculty and staff were invited to see the scholars' posters and talk with them about their individual projects, research findings and work completed throughout the summer (**see Appendix B for program and abstract booklet**).

We formed a poster review committee, co-chaired by Drs. Bakkenist and Beumer, consisting of faculty from the UPCI and across the University of Pittsburgh campus and various departments.

The judges viewed their assigned posters and ranked them according to experimental methods, scientific thought, analytic approach, and oral presentation.

The following faculty members served on the **Poster Review Committee**:
Co-Chairs

Jan Beumer, PharmD, PhD
Christopher Bakkenist, PhD

Judges:

Robbie Malliard
Russell Salter
Saumendra Sarkar
Madhavi Ganapathiraju
Robert Ferris
Walter Storkus
Frank Jenkins
John Schmitz
Edwina Kinchington (SciTech)
Ted Frick (Bayer)
Amy Wesa (Celsense)
Sudesh Pawaria
Jian Yu
Elia Zomot
Kevin Ashley (LRDC)
Stephen Ashley (National Geographic)

ASSESSMENT

In order to measure behavioral outcomes, scholars were evaluated at regular intervals by their research mentors and teachers throughout the program using a short survey form. Mentors then reported back to the program director and administrator feedback on scholars' enthusiasm, interest, punctuality, understanding of topics, attention to detail in conducting research, ability to follow instructions, compliance with safety standards, grasp of scientific content, and discipline in completing assigned readings. Scholars were also surveyed to assess their overall satisfaction with the program and to identify its strengths and weaknesses so that we may continue to improve upon program design for future years.

Assessment of program performance was conducted using two methodologies: feedback surveys using Survey Monkey (weekly and cumulative surveys) and a pre-/post test given by all sites.

Follow-Up Evaluation

Both scholars and faculty mentors who participated in the 2012 UPCI Summer Academy have also been asked to provide feedback via an electronic survey to determine their overall satisfaction and learning experience from the program. These surveys have been designed to gauge the increased knowledge of the scholars, their increased interest in cancer careers, the faculty's perception of the scholars' success, and ways in which we can further improve and build upon our program.

Specific Feedback on learning activities

Laboratory Experiences:

Lab experience has been the best part of the program. It gave me a hands-on experience and everyone in my lab was extremely helpful.

After spending 8 weeks in the lab, I am very comfortable using the equipment and following standard procedures. I loved working in the lab and want to come back during the year.

It's my favorite part of the whole program. I now have a better idea of the "culture of science" and molecular research.

Lab was very focused, but I had quite a bit of down time. Overall, I completed the challenges presented to me. It is very important to have a feel for lab research to decide if it is a path I want to take.

Not enough [laminar flow] hoods. Wanted to be able to do more techniques (PCR, gels, flow)

My laboratory experience has given me great hands on experience and an introduction to the field of research.

I thought that my laboratory experience was very informative and I learned many things that school hasn't shown me. Some of the work was tiresome but overall I thought that it was an amazing and enthralling experience.

Lectures and Didactic Component:
Allow more time to work on posters, presentations, and abstracts as a group

Some of the lectures moved very quickly and covered material that is far above my level. I think more review sessions (like the whiteboard schematic) would be helpful.

More hands on, because the lecture usually doesn't have to do with lab work.

More diagrams/visuals

More review/discussion

Lectures should have more pictures and videos instead of words.

Field Trips and Weekend Activities:

Transportation should be provided for all students to all weekly and weekend activities and field trips

NIH was very disappointing to me. I think we should drive down the night before so we can spend more time together

The weekend activities seemed to be geared toward the out of state students. The program should provide the in-state students with the same opportunities as the out of state students

For the NIH trip, more tours (and less lectures) should be planned to take full advantage of our time there (we could have those lectures here in Pgh).

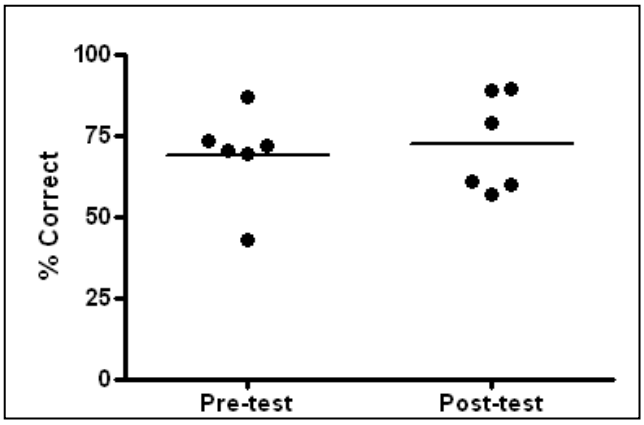
Remove RiverQuest, and add more clinical exposure (shadowing opportunities)

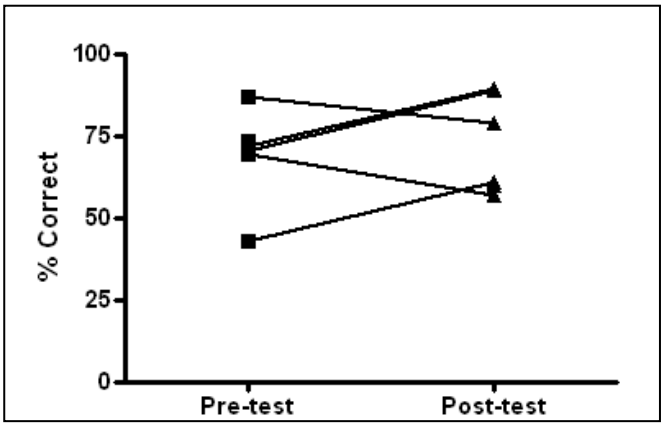
Museum field trips should be knocked out. More nature/outdoor trips encouraged: hiking, cycling, swimming, sailing, kayaking.

The NIH would have been better if we would have spent more time in the lab or seeing different facilities instead of talks. Also, on the animal tour we should have seen the monkeys.

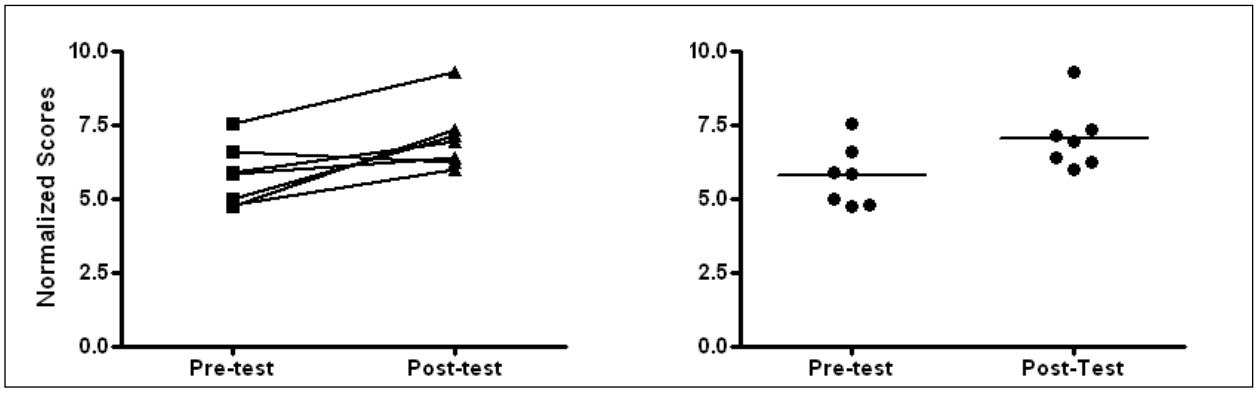
Examination Results and Improvement
A comprehensive examination was given early in the course, and at the end of the didactic lectures. The pre-test had 30 questions and the post-test had 37 questions (true/false, matching, multiple choice, short answer, and essay). None of the test material was given to the scholars; some required an extension of the information provided in class. The final scores ranged from 49-100% correct, With the majority of scholars vastly improving their performance on the final exam, which was considerably more difficult. Below, grades of the tests are displayed as scatter plots.

Magee Test Scores

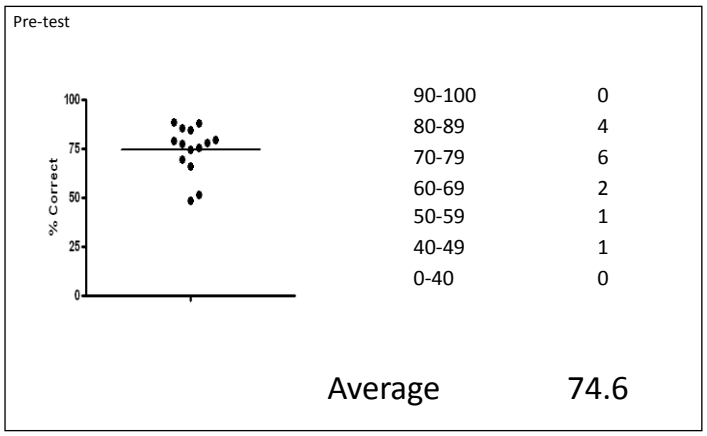


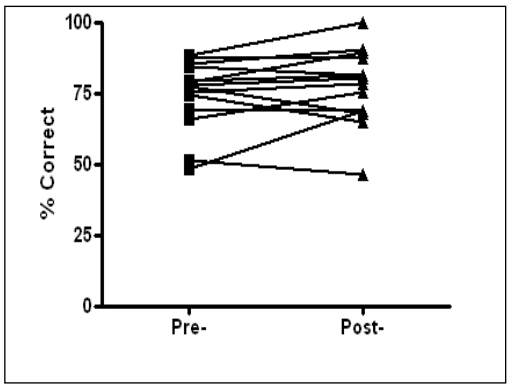


CoSBBI Test Scores

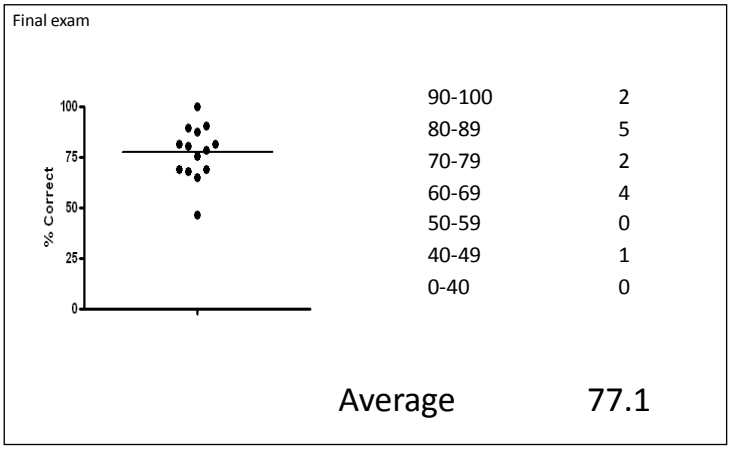


Hillman Test Scores The average improvement at the Hillman site was 6.7 pts.





Hillman Test Scores, cont.



IMPACT

Scholars, their families, their research mentors, teachers and other professionals witnessing these scholars' presentation all had significant praise for the quality of the scholars' research and their articulation of it to audiences. Below are just some of the testimonials provided by the 2012 scholars:

In few years it will be one of the most well-known and prestigious summer programs! Thank you so much for all the opportunities.

I have an excellent understanding of the career path I now want to take, and I also have more preparation for the biology classes that are still to come. This course has changed my life and understanding of myself as well as the purpose of scientific research.

This program truly sparked my interest for medicine. I learned so much about cancer and immunology and I would like to pursue a health sciences major in college.

Coming here was one of the best choices I've made in my life. I really enjoyed working with my lab people and thank you so much for all the opportunities. It allowed me to explore future careers and it was so helpful. To make this even better you could also incorporate some volunteering with patients and more clinical exposure. Thank you soooo much for everything – all the friendships, unforgettable memories and for all the fun I had.

This course has helped me understand the complexities of cancer progression.

The course was overall very informative and provided a lot of insight into cancer biology.

I really enjoyed the course. Coming into the program, I did not know much about cancer. Some of the lectures were very challenging to understand, but I learned a lot.

Appendix A. Faculty mentors and scholars

Site	Name (Last, First)	Faculty Mentor
Hillman	Assefa Biruktawit "Birdy"	Yuan Chang/Patrick Moore
Hillman	Bansal Rohan	Richard Steinman
Hillman	Clarchick Pauline	Christopher Bakkenist
Hillman	Diarra Fatoumata	Charles Horn
Hillman	Fan Ryan	Per Basse
Hillman	Kook Yoojin "Sarah"	Stephen Thorne
Hillman	Ledesma Regina	Xinhui Wang
Hillman	Lee Nathan	Jill Siegfried
Hillman	Musacchio James	Julie Eiseman
Hillman	Ponce Aaron	Lisa Butterfield
Hillman	Saha Mallika	Jing Hu
Hillman	Scoratow Rachel	Hideho Okada
Hillman	Winter Lia	Michael Lotze
Hillman	Fuhrman Leah	Kara Bernstein
WCRC	Gelernter Eli	Jane Wang
WCRC	Crawford Brianna	Nathan Yates
WCRC	Nimgaonkar Alok	Anda Vlad
WCRC	Robins Adam	Steffi Oesterreich
WCRC	Scott Chai	Adrian Lee
WCRC	Zhang Amy	Melanie Flint
CoSBBI	Becich Michael	Bill LaFramboise
CoSBBI	Cao Perry	David Koes
CoSBBI	Kedia Raghav	Vanathi Gopalakrishnan
CoSBBI	Taxifulati Mukadasi	Tim Lezon
CoSBBI	Troscinski Rachel M.	Claudia Mello-Thoms/Chennubhotla
CoSBBI	Tsui David	Harry Hochheiser
CoSBBI	Watts Jerome	Teresa Liu

Appendix B. Program and Abstract Booklet