



National Cancer Institute  
National Institutes of Health  
U.S. Department of Health and Human Services

## NCI Strategic Workshop

### Biomimetic Tissue Engineered Systems for Advancing Cancer Research

*February 26, 2014  
NCI Shady Grove Campus  
9609 Medical Center Drive  
Rockville, Maryland  
Terrace Room TE406  
8:00 a.m. – 5:30 p.m.*

#### AGENDA

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##### *Meeting Objectives*

Building on great progress at the convergence of physical sciences and oncology, we envision the development of new research areas centered on harnessing biomimetic systems used in tissue engineering and regenerative medicine to advance cancer research. Recapitulation of tumors and their context *in vitro* has been a challenge for cancer researchers. Notable advances have been made in cancer biology with 3D culture systems using biomimetic and natural biomaterials, microfluidic devices, and co-cultures. However, further technological developments must be achieved in order to create dynamic *in vitro* model systems that include multiple cellular, chemical, and physical parameters, all of which are important players in cancer biology. The field of tissue engineering and regenerative medicine has made advances in developing *in vitro* and *ex vivo* model systems to recreate tissues and their microenvironment. At this workshop we will assess the next steps for developing tissue engineered systems for cancer research and to determine what type of infrastructure or funding support may be required to advance current technologies.

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| 7:30 a.m. - 8:00 a.m. | <b>Security and Registration</b>  |
| 8:00 a.m. - 8:05 a.m. | <b>Welcome and Opening Remarks</b><br>Dinah Singer, Ph.D.<br>National Cancer Institute  |
| 8:05 a.m. - 8:15 a.m. | <b>Introduction and Goals of Workshop</b><br>Nastaran Kuhn, Ph.D.<br>National Cancer Institute  |
| 8:15 a.m. - 8:45 a.m. | <b>Keynote Presentation: From Cancer Biomechanics to Human Organ-on-Chip Disease Models</b><br>Donald Ingber, M.D., Ph.D.<br>Wyss Institute, Harvard University |

8:45 a.m. - 10:25 a.m.     **Session I: Vascularized Tissue Engineered Systems for Cancer Research**  
Scribe: Xin Yi Chan, Ph.D., Johns Hopkins University

8:45 a.m. - 8:50 a.m.     **Introduction by Session Moderator**  
Sharon Gerecht, Ph.D.  
Johns Hopkins University

8:50 a.m. - 9:10 a.m.     **Vascularizing Engineered Tumor Tissue *in Vitro***  
Steven George, MD., Ph.D.  
University of California, Irvine

9:10 a.m. - 9:30 a.m.     **Engineering Realistic Microvessel Tumor Systems for Studying Metastasis**  
Christopher Chen, M.D., Ph.D.  
Boston University

9:30 a.m. - 9:50 a.m.     **Bioengineering of Tissue Models for Cancer and Metastasis Research**  
Shay Soker, Ph.D.  
Wake Forest School of Medicine

9:50 a.m. - 10:25 a.m.     **Panel Questions and Discussion**  
Panel: Donald Ingber, Steven George, Christopher Chen, Shay Soker  
*Moderated by Sharon Gerecht*

10:25 a.m. - 10:40 a.m.     **Break**

10:40 a.m. - 12:00 p.m.     **Session II: Biomimetic Systems to Probe the Cancer Physical Microenvironment**  
Scribe: Ioannis Zervantonakis, Ph.D., Harvard University

10:40 a.m. - 10:45 a.m.     **Introduction by Session Moderator**  
Sanjay Kumar, M.D., Ph.D.  
University of California, Berkeley

10:45 a.m. - 11:00 a.m.     **Microenvironmental Factors Regulating Establishment of Tumors in Bone**  
Scott Guelcher, Ph.D.  
Vanderbilt University

11:00 a.m. - 11:15 a.m.     **Biomimetic System for Probing Metastatic Efficiency in Secondary Organs**  
Joyce Wong, Ph.D.  
Boston University

11:15 a.m. - 11:30 a.m.     **Gelatin-based Hydrogel Models of Glioblastoma**  
Brendan Harley, Sc.D.  
University of Illinois, Urbana-Champaign

11:30 a.m. - 12:00 p.m.     **Panel Questions and Discussion**  
Panel: Scott Guelcher, Joyce Wong, Brendan Harley  
*Moderated by Sanjay Kumar*

- 12:00 p.m. - 1:15 p.m.      **Lunch**
- 12:35 p.m. - 1:15 p.m.      **Poster Viewing in Terrace Room TE406**
1. David Beebe, Ph.D., Wisconsin Institute for Medical Research  
*Microscale in vitro Models Enable Cancer Research and Translation*
  2. Jennifer Elisseeff, Ph.D., Johns Hopkins University  
*The Independent Roles of Mechanical, Structural and Adhesion Characteristics of 3D Hydrogels on the Regulation of Cancer Invasion and Dissemination*
  3. Cynthia Reinhart-King, Ph.D., Cornell University  
*Tissue-Engineered Models of Follow-the-Leader Metastatic Migration*
  4. Laura Suggs, Ph.D., University of Texas, Austin  
*Dynamically Tunable Gels to Probe the Influence of Stiffness on Tumor Progression*
  5. Min Kim, M.D., Weill Cornell Medical College, Houston Methodist  
*Tumor Cells in the Circulating Media of the 4D Model Mimics the Circulating Tumor Cell Biology*
  6. Lance Munn, Ph.D., Harvard University  
*Biomimetic Microsystems for Neovascularization and Cell Sorting*
  7. Shannon Mumenthaler, Ph.D., University of Southern California  
*A Bioengineered Liver Tissue platform for studying cancer Metastasis*
  8. Meenakshi Upreti, Ph.D., University of Kentucky  
*The Tumor Microenvironment and 3-D Tumor Models: Implications in Biology and Therapy*
- 1:15 p.m. - 1:45 p.m.      **Keynote Presentation: Integrating Systems Biology and Tissue Engineering for Models of Cancer Dormancy and Drug Efficacy**  
Linda Griffith, Ph.D.  
Massachusetts Institute of Technology
- 1:45 p.m. - 3:45 p.m.      **Session III: Correlation of Molecular Phenotypes and Tissue Function with Biomimetic Systems**  
Scribe: Aranzazu Villasante, Ph.D., Columbia University
- 1:45 p.m. - 1:50 p.m.      **Introduction by Session Moderator**  
Michael Shuler, Ph.D.  
Cornell University
- 1:50 p.m. - 2:10 p.m.      **Tumor Engineering: Lessons from Regenerative Medicine**  
Gordana Vunjak-Novakovic, Ph.D.  
Columbia University
- 2:10 p.m. - 2:30 p.m.      **Drug Sensitivity of Ewing Sarcoma Cells in 3D Biomimetic Substrates**  
Joseph Ludwig, M.D.  
MD Anderson Cancer Center
- 2:30 p.m. - 2:50 p.m.      **Screening of Novel CRC Loci from Genome-scale Cancer Surveys in a Primary Colon Organoid System**  
Calvin Kuo, M.D., Ph.D.  
Stanford University
- 2:50 p.m. - 3:10 p.m.      **Identifying Molecular Markers of Breast Epithelial Dissemination using Engineered Microenvironment Systems**  
Andrew Ewald, Ph.D.  
Johns Hopkins University

- 3:10 p.m. - 3:45 p.m.      **Panel Questions and Discussion Session**  
 Panel: Linda Griffith, Gordana Vunjak-Novakovic, Joseph Ludwig, Calvin Kuo, Andrew Ewald  
*Moderated by Michael Shuler*
- 3:45 p.m. - 4:05 p.m.      **Break**
- 4:05 p.m. - 4:45 p.m.      **Breakout Discussions**  
 Moderator: Larry Nagahara, Ph.D., National Cancer Institute
- Scribes:  
 Joyce Chen, Cornell University  
 Kyungmin Ji, Wayne State University  
 Kyung Min Park, Ph.D., Johns Hopkins University  
 Alireza Roshan Ghias, Ph.D., Columbia University  
 Teresa Schuessler, M.S., National Cancer Institute  
 Pallavi Sethi, Ph.D., University of Kentucky  
 Archana Thakur, Ph.D., Wayne State University  
 Xi Tian, Ph.D., University of North Carolina
- Identify 3 outstanding cancer research questions that can be addressed with biomimetic tissue engineered systems
  - Identify 1 or more technological advancements needed to advance the field
  - Identify the " ideal team" for applying tissue engineering tools to cancer research
- 4:45 p.m. - 5:25 p.m.      **Breakout Summaries**  
 Moderator: Larry Nagahara, Ph.D., National Cancer Institute
- 5:25 p.m. - 5:30 p.m.      **Closing Remarks**  
 Nastaran Kuhn, Ph.D.  
 National Cancer Institute

**NCI Planning Committee**

***Division of Cancer Biology***

Dan Gallahan, Ph.D.  
 Nastaran Kuhn, Ph.D.  
 Jerry Li, Ph.D.  
 Suresh Mohla, Ph.D.  
 Nicole Moore, Sc.D.  
 Larry Nagahara, Ph.D.  
 Katrina Theisz, M.S.  
 Elizabeth Woodhouse, Ph.D.

***Division of Cancer Treatment and Diagnosis***

Lokesh Agrawal, Ph.D.  
 Ping Guan, Ph.D.  
 Brian Sorg, Ph.D.  
 James Tricoli, Ph.D.

***Center for Strategic Scientific Initiatives***

Tony Dickherber, Ph.D.