

**Canada-California Strategic Innovation Partnership
Cancer Stem Cell Workshop**

**January 20, 2007
Stanford University School of Medicine
Institute for Stem Cell Biology and Regenerative Medicine**

AGENDA:

CANADA-CALIFORNIA STRATEGIC INNOVATION PARTNERSHIP

**CANCER STEM CELL WORKSHOP
January 20, 2007**

**Upstairs Conference Room
Building A
Stanford University School of Medicine
Institute for Stem Cell Biology and Regenerative Medicine**

TIME	TOPIC	DISCUSSION LEADER
8:30 am	Breakfast	
9:00 am	Welcome, Introductions, and Objectives of Workshop	John Hassell
9:15 am	Overview of CCSIP	Marc LePage
9:30 am	Canadian Stem & Cancer Stem Cell Research Programs (SCN and OCRI)	Michael Rudnicki Tom Hudson
	California Stem & Cancer Stem Cell Research Activities	Irv Weissman Owen Witte
	CCSIP & Stem Cells: Developments to Date	John Hassell
10:45 am	Break	
11:00 am	Roundtable Discussion <i>Challenges</i> <ul style="list-style-type: none"> • Cancer stem cells (CSC); case proven? • Clinical relevance of CSC • Xenograft models; CSC identification & quantification • Scarcity of stem/cancer stem cells <i>Opportunities</i> <ul style="list-style-type: none"> • Live CSC biobanks – rapid autopsy program • Propagation/Expansion of CSC in vivo & in vitro 	Irv Weissman

- Genomic/epigenomic & proteomic analyses
- Standardized Operating Procedures
- Joint Training Programs

1:00 pm Lunch

1:30 pm Roundtable Discussion
Resource Development

Tom Hudson

- Live cell biobanks
- Expanded CSC populations
- Antibodies (biomarkers, cell purification)
- Xenograft models

Core Technology Platforms

- Cell purification
- Genomics/epigenomics
- Proteomics
- Informatics
- Functional genomics
- Chemical biology

3:30 pm Break

3:45 pm Models and Mechanisms for Collaboration

Michael Rudnicki
Cindy Bell
Phil Branton
Irv Weissman
Owen Witte

5:00 pm Recap and Next Steps

John Hassell

- Formation of a CSC Working Group
- Future Meetings
- Networking/Cancer Center Directors

5:30 Reception Stanford Park Hotel, Menlo Room

PARTICIPANTS

John Hassell (Workshop Chair, McMaster University)	Phil Beachy (Stanford University)	Catriona Jamieson (University of California, San Diego)
Thomas Hudson (Ontario Institute for Cancer Research)	Phil Branton (CIHR Institute for Cancer Research)	Connie Eaves (British Columbia Cancer Research Centre)
Michael Rudnicki (Ottawa Health Research Institute)	Sam Weiss (University of Calgary)	Marc LePage (Consulate General of Canada, San Francisco)
Miguel Andrade (Ottawa Health Research Institute)	Mark Henkelman (University of Toronto)	Keith Humphries (British Columbia Cancer Research Centre)
Allen Eaves (Stem Cell Technologies, Inc.)	Peter Lansdorp (British Columbia Cancer Research Centre)	Ichiro Nakano (University of California, Los Angeles)
Chuck Hasel (Genome Canada)	Mark Bisby (Consultant)	Lali Reddy (Consulate General of Canada, San Francisco)
Clay Smith (British Columbia Cancer Agency)	Sam Aparicio (British Columbia Cancer Research Centre)	“Sandy” Alexander Borowsky (University of California, Davis)
Hsing-Jien Kung (University of California, Davis)	Rhavi Bhatia (City of Hope)	Cindy Bell (Genome Canada, Ottawa)
Norman Iscove (University of Toronto)	Owen Witte (University of California, Los Angeles)	Luika Timmerman (University of California, San Francisco)
Arlene Chiu (California Institute for Regenerative Medicine)	Stephen Quake (Stanford University)	Irv Weissman (Stanford University)
Robert Klein (California Institute for Regenerative Medicine)	Emmanuel Passague (University of California, San Francisco)	Bob Oshima (Burnham Institute for Medical Research)
Alexey Terskikh (Burnham Institute for Medical Research)	Tia Moffat (Stem Cell Network)	John Dick (University of Toronto; teleconference)
Peter Dirks (Hospital for Sick Children; teleconference)		

1. Workshop Objectives

John Hassell welcomed the participants and briefly described the events in 2006 that led up to the Workshop, namely the 1st Canada-California Strategic Innovation Partnership (CCSIP) Summit held in January 2006 in Los Angeles, a follow-up meeting attended by Canadian cancer stem cell researchers to discuss the CCSIP held in May in Toronto, the 2nd CCSIP Summit held in June in Vancouver, and more recently his presentation to the CCSIP Steering Committee held in December in Ottawa. John recounted that the objectives of the workshop were to: learn of interest among the participants in collaborative research programs; discuss opportunities and challenges in cancer stem cell (CSC) research; identify resources and technology platforms/facilities required to catapult CSC research to the next level; and discuss funding models to promote joint cancer stem cell projects. Because the Workshop represented the first time that the majority of the participants had met, they introduced themselves and briefly described their affiliations and fields of interest. The participants included primarily researchers and representatives of government funding agencies.

2. Overview of CCSIP

Many of the workshop participants, particularly the Californian researchers, were not aware of the CCSIP and hence **Marc LePage** briefly described this initiative and highlighted the status of the CCSIP in the context of cancer stem cells (CSC). CSC research represents an area of research strength, great mutual interest and scientific fit between Canada and California. The field of CSC

research has its origins in Toronto, Canada and the vast majority of the world-renowned scientists in this field are residents of either Canada or California. Marc described the evolution of the CCSIP from the 1st Summit in January 2006 in Los Angeles to the 2nd Summit, held in June 2006 in Vancouver. At the 2nd Summit, Peter Dirks and Michael Clarke presented an overview of the current status of CSC research in Canada and California, respectively sparking the interest and excitement of representatives of funding agencies and other Summit participants. (A Whitepaper authored by Peter Dirks and John Hassell was tabled at the 2nd Summit.) Based on the enthusiasm for the CSC Initiative expressed in Vancouver and Ottawa, Marc LePage explained that the purpose of the current workshop was to define the research directions and mechanisms to accelerate the CCSIP CSC Initiative.

Various discussions arose following Marc's presentation that addressed the uncertainty surrounding funding for the CCSIP CCS Initiative. One potential source of monies from California is the California Institute for Regenerative Medicine (CIRM). However, disbursement of funds to researchers other than trainees has been held up in the courts; CIRM is working to solve this issue. Robert Klein pointed out that CIRM had roughly \$200 million to fund research this year and had already provided fellowships for trainees in the amount of \$12 million. Robert also described the advantages of selling bonds to raise funds to build intellectual infrastructure for the long term. This funding mechanism has been adopted not only by California but also other States in the USA to fund stem cell research. Robert suggested that this means of raising funds for research could also be a model for Canada. Phil Branton recounted that the Canadian funding agencies support targeted research programs and have expressed enthusiasm for the CSC Initiative.

Discussion arose about the need for targeted research programs for CSC research especially in light of very low success rates among applicants to the major medical research funding agencies including the National Institutes of Health (NIH) and the Canadian Institutes of Health Research (CIHR). This situation has resulted in disquiet among researchers in both venues. All agreed that we must work together with the funding agencies to keep support for medical research at the forefront of public consciousness and thereby ensure adequate funding.

The participants agreed that the emerging field of CSC research has excited the Canadian and Californian research communities and that it is timely to mount a major research effort in this area. A Canada-California collaborative CSC Initiative, if properly justified, will appeal to the public and will motivate both the Canadian and Californian governments to direct funding to such a partnership. The potential for synergy between CSC researchers in Canada and California was obvious to all and needs to be clearly articulated in a written proposal.

3. Stem Cell and Cancer Stem Cell Research in Canada and California

Michael Rudnicki, in his role as Director of the Stem Cell Network (SCN) based in Ottawa, described the organization, mission, funding mechanisms, multidisciplinary research and training programs, achievements to date, and commercialization strategy of the SCN, a federally-funded Canadian National Centre of Excellence. The SCN was founded in 2001 and received over \$37 million in financing for a 7-year period; funding is renewable for one more 7-year period. The Network includes over 70 research groups dispersed across the country at 24 universities/hospitals, 18 companies and 8 government departments and agencies. The mission of

the SCN is “to act as a catalyst to realize the full potential of stem cell research for Canadians”. The SCN and its partners have succeeded in implementing innovative and collaborative research programs; attracting, training and retaining top stem cell researchers and entrepreneurs; and translating research outcomes into clinical practice under an ethical and legal framework that has widespread public support. These accomplishments were achieved with relatively little direct funding to the SCN.

The research strategies and funding mechanisms adopted by the SCN have facilitated collaborations among the members of research teams, reduced duplication and dramatically enhanced synergies. Michael outlined funding mechanisms, the management of SCN-sponsored research programs and commercialization activities particularly the spin out of Aggregate Therapeutics, Inc. He also described the SCN-funded CSC project led by John Hassell, which makes use of high-throughput screening to identify new therapeutic agents that target cancer stem cells. Many of the Canadian researchers at the Workshop are members of the SCN CSC project team.

The Californian participants were particularly interested in the management of the SCN research programs, the establishment of Aggregate Therapeutics, Inc., and the development of the intellectual property (IP) Toolkit. Michael noted that the IP Toolkit can be obtained from the University of British Columbia’s Technology Transfer Office and that the IP principles could be translated to U.S. regulations.

Tom Hudson, in his capacity as President and Scientific Director of the Ontario Institute for Cancer Research (OICR), presented an overview of the OICR, a newly inaugurated research institute with headquarters in Toronto. OICR is loosely modeled after the Broad Institute in Boston. OICR will include research groups at multiple institutions in the Province, with a concentration of investigators in Toronto. OICR has secured substantial long-term funding (ramping up to \$82 million annually) from the Province of Ontario. Tom described the various medical innovation programs (prevention, early diagnosis, disease monitoring and selective therapies), priority areas of basic and clinical research (5 to 6 high impact research programs including imaging and cancer stem cells) and innovation platforms of the OICR. Whereas strategic planning for the OICR is ongoing, the OICR research programs include a Cancer Stem Cell Project, led by Dr. John Dick, a world-renowned cancer stem cell scientist in Toronto. Enabling core facilities of relevance to the Cancer Stem Cell Project will include infrastructure and facilities for imaging, bio-repositories and pathology, genomics, high-throughput screening and bioinformatics. The discussion centered on the obvious potential for collaboration and synergy between the OICR Cancer Stem Cell Project and a cancer stem cell research program emanating from the CCSIP CSC Initiative.

Arlene Chiu, representing the California Institute for Regenerative Medicine (CIRM), described funding for stem cell research by the CIRM, a new State agency established by Proposition 71 which authorizes the allocation of \$3 billion in public bond funds for medical research. Arlene reviewed the potential of stem cells for regenerative medicine and pointed out that stem cells are a model for understanding and targeting cancer. Arlene stated that CIRM is authorized to spend up to \$295 million annually to fund stem cell research at institutions in California. She outlined the history, governance and funding of CIRM, and the nature of its various research grant

programs. Arlene also explained the extent and nature of NIH funding for stem cell research and the restrictions on this research using U.S. federal monies.

Discussion of Arlene's presentation centered on new infrastructure that had developed as a result of NIH regulations governing embryonic stem cell research and the large number of grant applications received by CIRM for funding. She went on to describe the training program, construction of shared research and teaching facilities and the disbursement of funding that had taken place for this activity thus far.

4. CSC Roundtable Discussion: Challenges and Opportunities

Irv Weissman, Professor at Stanford University, led the morning roundtable discussion and at the outset identified several key challenges in CSC research:

- 1) There is a discontinuity between cancer stem cell researchers and clinical researchers. How can stem cell researchers engage clinicians that are involved in cancer treatment?
- 2) There is a paucity of suitable tumor tissue samples and correspondingly of CSC for research.
- 3) The research community needs access to low cost and high quality animal models for xenograft studies.

CSC case proven?

The discussion turned to whether CSCs are a general feature of all human cancers. CSCs have been found in many human tumors including leukemia, and solid tumors such as those of the brain, breast, prostate, colon, lung and pancreas. The general sense was that CSCs are characteristic of most human tumors but that the rigor by which these cells have been defined varies. The functional definition of CSC as tumor-initiating cells (TIC) had not been met in all cases. (TICs are the cells from human tumors that are capable of re-growing the tumor after transplant into immune-compromised mice.)

John Dick discussed the fact that we know little about the cellular hierarchy (cellular precursor-product relationships) in most tissues, the blood excepted, largely because few biomarkers of the cells within such hierarchies are known. (Stem cells give rise to the terminally differentiated cells of our organs and tissues through intermediary cells termed progenitors.) Biomarkers of stem cells, differentiating progenitor cells and fully differentiated cells are lacking for nearly all of the organs and tissues in which the major human cancers arise. These cellular biomarkers are critical for characterizing CSC, which likely originate from normal stem or progenitor cells. A clear need for biomarkers of stem, progenitor and differentiated cells in various human tissues and organs was noted and should be a priority for future research. The availability of CSC biomarkers will be a decided asset not only for basic research, but also for clinical studies of CSCs in human malignancies.

The need to study the evolution of tumors was expressed by several participants. Whereas cancer is considered to be a clonal disease, it may be multi-clonal at initiation. Tissue collection at various stages of tumor progression will allow us to examine whether tumor heterogeneity

reflects the heterogeneity of the CSC population, or whether heterogeneity occurs downstream of a homogeneous CSC population. The evolution of tumors could be studied by developing reliable models of tumor progression that start with normal stem cells engineered with gain of function and/or loss of function mutations in oncogenes and tumor-suppressor genes respectively.

The genetic instability of tumor cells and whether mutations arise in the CSC or their descendants was also discussed. Connie Eaves called attention to the heterogeneity of stem and CSCs themselves, a theme that was further developed by John Dick. The need for studying tumor progression at the level of CSC was cited; animal models were suggested to be an appropriate means to this end.

Clinical relevance of CSC

The clinical relevance of CSCs was briefly discussed. For example, at present there are no studies that link CSCs or their prevalence in tumors to disease prognosis or treatment. There is a clear need for such clinical studies; however these are hindered by the requirement to perform long-term and expensive animal studies to assess the presence and frequency of CSCs by limiting dilution tumor cell transplant assays in immune-compromised animals, principally mice. Clinical studies of the role of CSC in tumor progression and response to therapy would be dramatically accelerated by the availability of CSC biomarkers (as discussed above).

Xenograft models; CSC identification and quantification/ Propagation and expansion of CSC in vivo and in vitro

Studies of various human tumors reveal that CSCs are exceedingly rare in tumors representing as few as 0.01% (leukemia) to 0.1% (brain tumors) of all the tumor cells that comprise a tumor. The limitations of the xenograft assay to identify and enumerate CSC were briefly discussed. All CSCs may not be identified by these assays and in consequence we may have underestimated their frequency in human tumors. The need to humanize mice to express human gene products likely required for human tumor cell growth was cited as a priority for research in the context of a CCSIP CSC research program.

Several participants including Norman Iscove, Peter Dirks, Phil Beachy and Allan Eaves suggested that studies of normal stem cells are needed to compare their behavior to that of CSCs. The limitations of functional assays to identify many stem cells, and in particular neuronal stem cells, were also discussed. The challenge of establishing and growing stem and CSCs in vitro to facilitate their study was similarly discussed. The importance of learning what signaling pathways are required for stem and CSC self-renewal and differentiation was also expressed. Phil Beachy pointed out that developmental signaling pathways used during embryogenesis were also employed to maintain tissue homeostasis in adults and that it was the dysregulation of these pathways that led to tumors. The importance of learning whether tumors change during their serial propagation in immune-compromised mice and during culture in vitro were cited as important goals for future research.

Scarcity of stem and cancer stem cells/Live CSC biobanks

Tumor samples available for basic research are typically small and not suitably preserved for cancer stem cell studies. Live cell bio-repositories from tumors are needed for CSC research. An infrastructure and standard operating procedures should be established to obtain tumors and metastases from cancer patients. Discussion centered on rapid autopsy programs (autopsies within 2 hours post mortem) to obtain sufficient quantities of viable tumor cells and surrounding normal cells for research. Catriona Jamieson stated that the majority of U.S. cancer patients self-identify as tumor donors without coaxing from their physicians, and that patient approval for tumor tissue donation would not present a problem.

Owen Witte noted that there are institutions in California that are interested in CSC research and that have clinical expertise; for example, California Comprehensive Cancer Centers. John Hassell pointed out that some of these Centers were represented at the Workshop and that he would meet with Center Directors during the next several months. Tom Hudson informed the participants that OICR funds tumor banks at 5 hospitals in the province of Ontario which function as nodes of one central bank. All such centers follow standard operating procedures, data collection standards and tissue quality control is monitored at a central location. The OTB collects tumors, normal adjacent tissues and peripheral serum with buffy coat. Tom also stated that early quality control testing established the need for external review of all samples (a process not currently performed by most tumor banks). OICR has posted a request for proposal for outsourcing this activity to a central pathologist in Ontario (and identified four candidates; although we note that we seriously considered to get two offshore pathologists) to review digital images via online images. The OICR experience may provide a useful model for the CCSIP CSC initiative.

Because there are numerous tissue banks operating in both Canada and California, the potential for problems relating to quality control and protocol variations for preparing single cell suspensions and preservation were identified. It was suggested that the participants organize a workshop to decide on standard operating procedures (SOPs) for tissue banking in advance of writing a proposal. It was noted that such a workshop could lead to the development an SOP toolkit to ensure all bio-banks have equivalent quality samples.

The participants identified the lack of available tumor samples suitable for CSC research as the main bottleneck in moving the field forward. A great deal of organization and funding would be required to collect and preserve tumor tissue on an ongoing basis and to make all tissue banks available to CSC researchers. However, if live tumor cell samples were readily available, it would revolutionize the field. A sense developed that the Canadian healthcare system, which appears highly organized and has a robust clinical trials network, would be best positioned to collect tumor samples. Irv Weissman stressed the need to identify particular tumors as being of interest to CCSIP CSC researchers to avoid banking tumor cells that might not be used.

Propagation/Expansion of CSC in vivo and in vitro

The participants briefly discussed the potential that serial transplant of human tumor tissue in immune-compromised mice might provide an abundant source of tumor cells for analyses. The

establishment of tumor cell cultures that could be serially propagated and expanded in vitro would similarly serve the same end. The central point raised by the discussion was to ensure that any xenograft or cell culture system be compared to the primary tumors from which they arose to ensure that programs of gene expression and functional properties of the cell populations were preserved. The need to investigate this topic was viewed as a high priority.

Animal models: Comparative analyses of human and mouse cancer stem cells

Many mouse models of human cancers have been developed and studied during the last 10-20 years, and have led to important insights into the initiation and progression of the disease. Several recent publications suggest that cancer stem cells occur in mouse tumors and that these cells may be more frequent than their human counterparts. Several participants suggested that whereas human tumors have traditionally been used to isolate and characterize cancer stem cells, tumors from animal models may provide useful comparative information, and do not suffer from some of the difficulties inherent in studies of human cancer stem cells. Notably the ability to perform syngeneic transplants in mice eliminates some of the caveats associated with xenotransplantation of human tumor cells into immune-compromised mice. Residual immune function and the interaction between the tumor cells and their microenvironment can be more faithfully recapitulated by orthotopic transplant of mouse tumor cells into syngeneic mice. Strong enthusiasm was expressed for using mouse models of various malignancies to study cancer stem cells. Indeed there ought to be an appropriate balance between studies of cancer stem cells and their human counterparts in several malignancies.

Joint training programs

Marc LePage explained that training of high quality personnel is an independent thematic area currently being explored in the CCSIP. A working group headed by Gretchen Kalonji (University of California) is investigating means of supporting such joint training programs. Phil Branton pointed out that training was a major area of funding by CIHR and that a dedicated graduate program in the area of CSC was a possibility. Similarly, Arlene Chiu pointed out that a training program is within the CIRM mandate. John Hassell commented that fellowships for undergraduate-co-op and graduate students were an important and highly praised component of funding to SCN research programs. He enthusiastically endorsed a co-op undergraduate program within the CCSIP CSC initiative. Whereas Arlene Chiu noted that the idea of funding international students has not been approved by the CIRM Board, the participants felt that exchange of undergraduate and graduate students or post-doctoral fellows to learn techniques or perform collaborative experiments would be both beneficial and easy to set up. Because CIRM funds are not able to flow to an institution outside of California, Phil Branton suggested that Canada may be able to fund student exchanges in both directions provided that California help out in some other aspects of the CSC Initiative. The participants recognized that it is important to include M.D./Ph.D. students in training programs because there is a great need for clinical scientists.

The Workshop participants enthusiastically endorsed a joint training program and expressed the view that it should move forward in concert with the CSC initiative. The participants

recommended that a Working Group be formed to discuss options for implementing a joint Canada-California training program.

5. Round Table Discussion: Core Technology Platforms

Genomics

The afternoon Roundtable Discussion was lead by **Tom Hudson** and centered on technology platforms that are required to support CSC research. The central focus was to learn what the limitations were for analyzing DNA and RNA in small numbers of CSC in light of their rarity in human tumors. **Stephen Quake**, Department of Bioengineering at Stanford University, described his recent work on DNA sequencing at the single cell level and on a microfluidic, chip-based digital RT-PCR assay that permits analysis of gene expression at the single cell level. Steve pointed out that this assay had been applied to identify and quantify the expression of mRNAs encoding transcription factors in flow cytometry-sorted populations of hematopoietic stem and progenitor cells. Tom Hudson also reported on his experiences as a genome scientist in cancer stem cell genome sequencing and global expression profiling. Both experts agreed that DNA sequencing and RNA profiling could be readily performed with 1,000 mammalian cells at this time and that the goal was to be able to analyze single cells.

The participants discussed the fact that the purity of cell samples will need to be verified before the cells are analyzed, and that the data must be validated by comparing results from many purified cell populations. The participants also stated the importance of analyzing the CSC genome and its global expression at various time points during tumor cell isolation to ensure they accurately represent the original tumor sample. Discussion ensued about the potential that CSCs might occur in the blood of cancer patients and that following their purification these cells might be amenable for analyses of the sort described above. The participants highly endorsed the idea that studying the CSC genome and its expression should be the primary goal of the CCSIP CSC Initiative. Such studies will lead to the identification of CSC biomarkers and molecular therapeutic targets. Genomics technology platforms are central to the goals of this initiative.

The need for bioinformatics was also recounted. Miguel Andrade described StemBase, an online database of microarray data from different stem cell populations, whose implementation was funded by the SCN. The participants noted that the value of this database is contingent on the cellular purity of the samples. A continuing effort should be mounted to augment StemBase or similar databases with gene expression profiles of pure homogeneous stem cell populations. A database of CSC gene expression profiles from different tumors should be a goal of the CCSIP CSC Initiative.

Imaging

Tom Hudson presented his recent work using reverse-transfection microarrays, and described how this technique could be used to track marker expression during stem and CSC self-renewal

differentiation and to conduct RNAi experiments. **Mark Henkelman** described his recent research in whole animal imaging. A major goal of the OICR Imaging Project, with which Mark is involved, is to detect 1mm³ tumors. **Peter Lansdorp** presented a video of a mouse embryonic stem cell that demonstrated how telomeres tether the chromatids as the cell divides. It seems clear from the various presentations that high-content cellular imaging and tumor imaging will be important tools in CSC research and should be supported.

6. Models and mechanisms for collaboration

The participants discussed potential mechanisms to fund a proposal emanating from the CSC Initiative. **Cindy Bell** described Genome Canada's experience with multi-country international programs. Approved research projects, co-led by scientists from California and Canada, could be independently funded by each government. Funding from each venue would remain in the country or state of origin. Funding for collaborative projects could occur through formal bilateral agreements and competitions, involving a single review team or by a less formal mechanism in which the project leaders would submit requests for funding of their components to their respective country. In addition, strategic areas could be defined that each country could pursue under a collaborative arrangement that would ensure co-operation, minimize duplication and enhance synergy.

By contrast to Canada, which has experience with multi-country research funding, CIRM does not have mechanisms for international funding, although its relationship with Canadian scientists is expanding through the incorporation of Canadian reviewers in their grant study sections. Bob Klein suggested that new monies dedicated to the CSC research may be needed to fund a joint project between Canada and California. Arlene Chiu expressed the view that if new funds become available to fund a partnership with Canada, CIRM would be happy to review proposals and administer funding.

Several participants noted that it might be challenging to secure additional monies from California for this Initiative because substantial funding has already been announced for stem cell research. Phil Branton pointed out that in Canada the federal government had recently invested in cancer control and research, although he allowed that if a compelling story were developed one might secure additional funding for CSC research. Several participants noted that the Canadian government is supportive of international collaborations, such as the CCSIP. Sam Weiss reported that the province of Alberta was about to announce substantial funding for an Alberta Cancer Center and that this development coupled with other provincial cancer research initiatives such as the OICR could be leveraged for CSC research.

7. Next Steps

The participants agreed that it is imperative to build on the momentum created by events leading up to and including the Workshop. The participants were encouraged to investigate the potential for collaborative projects between researchers in Canada and California as soon as possible. The participants suggested that the scope of the Canada-California partnership on CSC should include translational and commercialization aspects. Several participants commented that the Whitepaper, originally written for presentation at the 2nd CCSIP Summit, could be expanded to

form the basis of a proposal, which includes a description of the research strengths in Canada and California. It is essential that the proposal define areas of strategic advantage in bringing Canadian and Californian researchers together.

Irv Weissman led a discussion surrounding the funding needs of a Canada-California CSC project to elucidate the structure and expression of CSC genomes over the next 5 years. The research program should be buttressed by unique resources, core facilities, and bilateral research and training programs.

The participants expressed a need to establish Working Groups to identify the players and the projects that will form the proposal for funding, and which will provide a roadmap in a relatively short timeframe. Whereas an outline should be assembled prior to March 2007 when the federal budget is announced in Canada, a draft proposal with a compelling long-term vision should be ready for May 2007 when the Governor of California is expected to visit Canada, an event that may be catalytic for this partnership.

8. Workshop Adjournment

John Hassell thanked all participants, including members of the Workshop Steering Committee, for their time and contributions to the Workshop. John also thanked Irv Weissman and his staff for hosting the meeting, and Cindy Bell and Lali Reddy for their organizational support, as well as Tia Moffat for recording notes of the Workshop. Cindy Bell also thanked those who supported the Workshop, including Irv Weissman and the Stanford Institute for Stem Cell Biology and Regenerative Medicine, the Canadian Department of Foreign Affairs and International Trade, the Ontario Institute for Cancer Research, the Canadian Institutes of Health Research, the Stem Cell Network, Genome Canada and the Canadian Consulate in San Francisco.

John will work with key participants to organize a CCSIP CSC Initiative Steering Committee; this body will form appropriate Working Groups (i.e., Research and Training; Funding; and Commercialization). John will forward the final Workshop Report (approved by the Workshop Steering Committee) to all invitees to the Workshop, who include California Cancer Center Directors, and will meet with these Directors in the upcoming months.