SUMMARY STATEMENT

PROGRAM CONTACT:
Zeynep Erim
(301) 451-4792
erimz@mail.nih.gov

(Privileged Communication)

Release Date: **07/15/2016**
Revised Date:

Application Number: **1 F31 EB023784-01**

TRUONG,DANH
AZ Board of Regents on behalf of Arizona State Uni
P.O Box 876011
Tempe, AZ 852876011

Review Group:	**ZRG1 F09B-B (20)** **Center for Scientific Review Special Emphasis Panel** **Fellowships: Oncological Sciences**
Meeting Date:	**06/27/2016**
Council:	**OCT 2016** ***PCC:*** **TTEZW**
Requested Start:	**12/01/2016**

Project Title:	**Microengineered Tumor-Stroma Platform Investigating the Biochemical and Biophysical Influence of Fibroblasts in Cancer Invasion and Drug Resistance**
	***Requested*: 3 Years**
Sponsor:	**Nikkhah, Mehdi**
Department:	**Biological and Health Systems**
Organization:	**ARIZONA STATE UNIVERSITY-TEMPE CAMPUS**
City, State:	**TEMPE ARIZONA**
SRG Action:	**Impact Score:29 Percentile:20**
Next Steps:	**Visit http://grants.nih.gov/grants/next_steps.htm**
Human Subjects:	**10-No human subjects involved**
Animal Subjects:	**10-No live vertebrate animals involved for competing appl.**

ADMINISTRATIVE NOTE

1F31EB023784-01 Truong, Danh

ADMINISTRATIVE NOTE

RESUME AND SUMMARY OF DISCUSSION: This initial pre-doctoral fellowship application submitted by Danh Truong proposes to further develop a micro-engineering platform for three-dimensional modeling of cell-cell, tumor-stroma and drug-stroma interactions that incorporates a perfusable vasculature that will provide the basis for future biophysical models of tumor growth and treatment. The excellent applicant has a mixed academic record but is strongly supported by letters of reference and has demonstrated scientific productivity by co-authoring four manuscripts. The research environment at Arizona State University was deemed to be excellent. The educational plans are detailed and will provide the applicant an opportunity to master new scientific methods and leadership skills. Thus the applicant, environment and training potential were judged to be excellent. The team of sponsors and research training plan had a modest negative-score driving effect on the overall score. The technological advancement proposed in the research plan was viewed as innovative and essential. However, there was a concern that adding more than two cells types, specifically adding immune cells, was not addressed. While the primary sponsor, Dr. Nikkhah, possesses the needed expertise and funding to support this application, there was concern that Dr. Nikkhah's laboratory currently has a large number of trainees. Even with an involved co-sponsor, Dr. LaBaer, who can provide essential cell biology expertise, the panel remained concerned that the large number of trainees in Dr. Nikkhah's lab would diminish the individualized training available to Mr. Truong. The panel considered the positive aspects of the application to outweigh the negative concerns, which lead the panel to conclude that, if funded this application would have a high positive impact on the future scientific career of Mr. Truong.

DESCRIPTION (provided by applicant): Breast cancer is the second cause of mortalities among women in the United States. Although there has been a major thrust in cancer therapeutic research, the majority of clinical studies fail due to not taking into account the complex interactions in the tumor-stroma microenvironment, such as cell-cell and cell-ECM, that generally up-regulate drug resistance. Preclinical studies are often being conducted within 2D mono-layer assays of mono-culture of cells, which do not represent the tumor microenvironment inside the body. There is ample evidence suggesting that stromal cells impart drug resistance to cancer cells but there are few models that can recapitulate the tumor-stroma microenvironment with multi-parametric control to study this phenomenon. Although in vivo models enable organism-level studies, key parameters, such as cell- and ECM-types, cell-cell signaling, and drug transport, prove challenging to control. This has created a need to develop a model that can precisely control these parameters to study such behavior in vitro. Current models do recapitulate certain aspects of the tumor-stroma, such as the primary tumor region, but without a stromal region, vasculature, and 3D matrices. This has created a disruption in cell-cell and cell-ECM interactions that may affect drug responsiveness. To that end, this proposal describes the application of a developed tumor-stroma microfluidic platform investigating pharmacological effects within a co-culture system of breast cancer and stromal cells. The developed model is a microengineered device featuring well-defined spatial organization of cells and precise control of biochemical cues containing localized tumor constructs, 3D hydrogel matrices, and media perfusion channels. The goal of this project is to validate and apply a three-dimensional tumor-stroma platform for fundamental tumor-stroma interactions and pharmacological studies. Aim 1 focuses on the investigation of how fibroblasts within the tumor-stroma system affect the growth and invasiveness of the cancer. Aim 2 focuses on the communication between fibroblasts and cancer cells. We will investigate the CXCL12/CXCR4 pathway and its role in doxorubicin resistance. AMD3100, a CXCR4 inhibitor, will be introduced to the tumor- stroma microenvironment to enhance the effectiveness of doxorubicin. Finally, Aim 3 will utilize the model to study drug transport. Fibroblasts deposit ECM into the stroma limiting the effectiveness of drug delivery. We intend to create a cell-free remodeled stroma to isolate the physical alterations from cell-cell signaling for the study of drug penetration. The results from this project will

validate our platform and provide expansive use of it for fundamental cancer biology and pharmacological studies.

PUBLIC HEALTH RELEVANCE: Breast cancer is the second leading cause of death among American women highlighting a need to fabricate targeted platforms recapitulating the tumor microenvironment for aggressive development of cancer therapeutics. The goal of this proposal is to develop and validate our complex tumor-stroma model describing the role of fibroblasts in cancer invasion and pharmacological studies. This should translate into a novel drug- screening tool utilizing a physiologically relevant 3D tumor microenvironment. The results from this project will likely affect the drug development pipeline by providing an alternative and complementary testing environment for current used models.

Critique 1

Fellowship Applicant: 3
Sponsors, Collaborators, and Consultants: 3
Research Training Plan: 2
Training Potential: 3
Institutional Environment & Commitment to Training: 3

Overall Impact/Merit: This proposed research plan would develop a 3D tumor-stroma micro-platform for breast cancer. The technology will permit study of tumor growth, tumor invasion, and drug-tumor interaction in a single cell basis and will be greatly beneficial to the understanding of cancer biology. The applicant is a predoctoral candidate 2 year into the program for a PhD in Biomedical Engineering since 2014 (for a 5-year program to complete in 2018). The candidate has good scholastic performance and is greatly motivated to perform the proposed research with prior involvement in the relevant research. The mentor has relevant expertise and is an expert in the proposed technology. That said, some weaknesses have been noted. There are some needs for Mr. Truong to learn to write peer-reviewed publications. Funding this application for the requested 3 years would help him to complete the PhD degree and grow into competent scientist.

1. Fellowship Applicant:
Strengths

- The scholastic performance of the candidate was good with a mixture of A's and B's.
- Biomedical engineering background of the candidate is a good fit for the proposed project.
- The letters of recommendations speak highly of his relevant research experiences and hard work ethic.

Weaknesses

- The candidate has no first authored peer-reviewed publications.

2. Sponsors, Collaborators, and Consultants:
Strengths

- The sponsor, Dr. Mehdi Nikkhah, is an assistant Professor of Bioengineering at ASU and has extensive experience and NIH funding for microengineering of tissue.
- The co-sponsor, Dr. Joshua LaBaer, MD, PhD, is a Piper Chair of Personalized Medicine at ASU.

Weaknesses

- None noted.

3. Research Training Plan:
Strengths

- The specific aims are logically laid out for the duration of PhD training period from (1) develop a 3D co-culture cell platform to assess the tumor growth and invasion; to (2) study the role of anti-cancer drug resistance on the 3D micro-platform; to (3) assess the role of fibroblast-induced desmoplasia in doxorubicin penetration and function.
- Strong preliminary data to show the feasibility to construct a 3d tumor-stroma platform integrated with perfusable vasculature.

Weaknesses

- None noted.

4. Training Potential:

Strengths

- The candidate will learn a lot of innovative technology in microengineering.

Weaknesses

- The candidate will benefit from learning scientific writing to develop writing skills for grantsmanship and peer-reviewed publications.

5. Institutional Environment & Commitment to Training:

Strengths

- Arizona State University provides adequate environment for the proposed research.

Weaknesses

- None noted.

Protections for Human Subjects:
Not Applicable (No Human Subjects)

Vertebrate Animals:
Not Applicable (No Vertebrate Animals)

Biohazards:
Not Applicable (No Biohazards)

Training in the Responsible Conduct of Research:
Acceptable
Comments on Format (Required):

- CRC training course is provided online in partnership with University Miami's Collaborative Institutional training initiative (CITI).

Comments on Subject Matter (Required):

- No information provided on the subject matter except for animal training and human subject training.

Comments on Faculty Participation (Required):

- Faculty participation is as needed basis.

Comments on Duration (Required):

- No information is provided on the duration of the RCR training.

Comments on Frequency (Required):

- No information is provided on the frequency of the RCR training.

Select Agents:
Not Applicable (No Select Agents)

Resource Sharing Plans:
Not Applicable (No Relevant Resources)

Budget and Period of Support:
Recommend as Requested

- Funding for 3 years is adequate.

Critique 2

Fellowship Applicant: 3
Sponsors, Collaborators, and Consultants: 4
Research Training Plan: 3
Training Potential: 3
Institutional Environment & Commitment to Training: 3

Overall Impact/Merit: The purpose of this application is to train Danh Truong to develop and validate a platform for 3D tumor-stroma model to analyze the role of fibroblasts in cancer invasion and pharmacological effect. Breast cancer is the second leading cause of death among American woman and the 3D model could provide a better readout system to test pharmaceutic reagent than 2D cell culture system. Therefore, the proposed study is important. The key strengths of this application are the strong motivation of applicant, and the productive progress (two papers and one submitted manuscript) of applicant in the laboratory. The proposed studies are with expertise of the primary sponsor, Dr. Mehdi Nikkhah. Dr. Joshua LaBaer is a very strong co-sponsor in the application. The key weakness is the primary sponsor has limited experience for mentorship and lacks tracking record for training. Nevertheless, funding this application for the requested 3 years would have a major impact on Mr. Truong's graduate study.

1. Fellowship Applicant:
Strengths

- Applicant's academic record is excellent and his research experience in the current lab is outstanding.
- For <2 year in Biomedical engineer Ph.D. program at Arizona State University, he has worked on several projects and has one first author manuscript submitted, and two co-authorship paper published, including one with equal contribution of first authorship.
- Applicant has great passion for teaching other minority undergraduate students in STEM in the laboratory.

Weaknesses

- None noted.

2. Sponsors, Collaborators, and Consultants:
Strengths

- The primary sponsor, Dr. Mehdi Nikkhah was a recipient of NIH NRSA F32 Fellowship trainee for 6 months.
- Dr. Nikkhah's research interest match to applicant's research training plan.
- Co-sponsor, Dr. Joshua LaBaer has extensive experience for proteomics and autoantibody biomarkers cancer biomarker.
- Co-sponsor, Dr. LaBaer has a track record of mentoring.

Weaknesses

- Dr. Nikkhah is a faculty member in Arizona State University since 2014 and there is no established track record of mentoring.
- The sponsor has one NSF funding that will end in 2017.

3. Research Training Plan:
Strengths

- The proposed research plan will use a new microengineered platform to validate 3D co-culture of tumor cell with cancer associate fibroblasts or normal fibroblasts with perfusable vasculature to study how fibroblast affect tumor growth and invasion, the role of CXCL12/CXCR4 blocker AMD3100 to chemotherapeutic effect of doxorubicin, and the fibroblast induced desmoplasia in doxorubicin penetration. The proposed research is highly relevant to cancer microenvironment study.
- The applicant engineered the platform and produced preliminary study, therefore, the training plan is consistent with the applicant's stage of research development.
- The research training plan provide the applicant with individualized and supervised experience.

Weaknesses

- The research plan need more emphasize the biology of cancer, microenvironment and host immune system.
- The current platform is still at infant stage of mimic tumor microenvironment in vivo.
- The outcome from the proposed study, at most, provide the hint for how cancer associate fibroblast affect tumor cell invasion, which has been proved in other system.

4. Training Potential:
Strengths

- Proposed research training plan have the potential to provide the applicant with supervised experiences that will develop his research skills.
- Training plan has listed 4 goals to train Mr. Truong in the area of research: for microfabrication and biomarker, cancer biology and invasion, cell imaging and biostatistics and in leadership area of educational outreach.

Weaknesses

- None noted.

5. Institutional Environment & Commitment to Training:
Strengths

- The environment in Arizona State University is adequate for the proposed studies.

Weaknesses

- None noted.

Protections for Human Subjects:
Not Applicable (No Human Subjects)

Vertebrate Animals:
Not Applicable (No Vertebrate Animals)

Biohazards:
Not Applicable

Training in the Responsible Conduct of Research:
Comments on Format (Required):

- The RCR training has three phase: Online course, seminar, and by PI to ensure the high ethical standard in each research lab which are acceptable.

Comments on Subject Matter (Required):

- The Arizona State University host seminars discuss bioethics, research misconduct, and research integrity.

Comments on Faculty Participation (Required):

- PI serves as a role model.

Comments on Duration (Required):

- No particular duration stated in application.

Comments on Frequency (Required):

- No frequency stated in application.

Select Agents:
Not Applicable (No Select Agents)

Resource Sharing Plans:
Not Applicable (No Relevant Resources)

Budget and Period of Support:
Recommend as Requested

Additional Comments to Applicant:

- Only one of three reference letters directly relates to this funding mechanism.

Critique 3

Fellowship Applicant: 2
Sponsors, Collaborators, and Consultants: 2
Research Training Plan: 2
Training Potential: 2
Institutional Environment & Commitment to Training: 2

Overall Impact/Merit: The application seeks to train a great candidate in the area of tumor immunology. The well-written application seeks to develop a tumor stroma microfluidic platform to better study these interactions in vitro. The successful completion of this research will be impactful as the widely used 2-D in vitro platform has too many limitations but is used as it is convenient and can be easy to establish. This platform will be used to test the role of fibroblasts in breast cancer, to study if the combination of doxorubicin and a CXCR4 inhibitor show enhanced effectiveness, and as means of drug delivery. Enhanced models to study the interaction of tumor cells with the stroma, if easily adoptable, can have a high impact on cancer research providing a more relevant in vitro test to test potential therapeutics. The experiments are well outlined and potential pitfalls and alternative approaches are addressed. Preliminary data supports the feasibility of the project. The sponsor has extensive experience training graduate students and the training environment appears to be quite good. If funded, this application will have a strong impact on training the applicant.

1. Fellowship Applicant:
Strengths

- The applicant has previous research experience that has led to four peer reviewed publication.
- Strong letters of support.
- Good grades and test scores.

Weaknesses

- None noted.

2. Sponsors, Collaborators, and Consultants:
Strengths

- The sponsors have the proper expertise and experience to mentor the applicant.

- The sponsors form a strong team to guide the applicant through the different stages of the project.
- Both have strong prior experience mentoring students.

Weaknesses

- None noted.

3. Research Training Plan:

Strengths

- Well written research plan.
- Research plan addresses potential pitfalls and includes alternative approaches.
- Preliminary data included supports the feasibility of the project.
- Well populated lab with other graduate students and post docs should enhance the applicant's training.

Weaknesses

- None noted.

4. Training Potential:

Strengths

- This is an interesting project with strong training potential.

Weaknesses

- None noted.

5. Institutional Environment & Commitment to Training:

Strengths

- This is a very good training environment.

Weaknesses

- None noted.

Protections for Human Subjects:

Not Applicable (No Human Subjects)

Vertebrate Animals:

Not Applicable (No Vertebrate Animals)

Biohazards:

Not Applicable (No Biohazards)

Training in the Responsible Conduct of Research:

Acceptable

Comments on Format (Required):

- online CITI course, seminars, and PI's enforcing ethical behavior in their labs

Comments on Subject Matter (Required):

- bioethics and research misconduct

Comments on Faculty Participation (Required):

- enforcing in their own lab

Comments on Duration (Required):

- not mentioned

Comments on Frequency (Required):

- not mentioned

Select Agents:
Not Applicable (No Select Agents)

Resource Sharing Plans:
Unacceptable

- Not delineated.

Budget and Period of Support:
Recommend as Requested

THE FOLLOWING SECTIONS WERE PREPARED BY THE SCIENTIFIC REVIEW OFFICER TO SUMMARIZE THE OUTCOME OF DISCUSSIONS OF THE REVIEW COMMITTEE, OR REVIEWERS' WRITTEN CRITIQUES, ON THE FOLLOWING ISSUES:

COMMITTEE BUDGET RECOMMENDATIONS: The budget was recommended as requested.

ADMINISTRATIVE NOTE:
During the review of this application, reviewers and/or NIH staff noted that one or more biosketches did not comply with the required format (NOT-OD-15-032). An electronic notification has been sent to the contact Program Director/Principal Investigator and Signing Official for this application, to ensure that future applications use the correct biosketch format. NIH has the authority to withdraw such applications from review or consideration for funding.

Footnotes for 1 F31 EB023784-01; PI Name: Truong, Danh

NIH has modified its policy regarding the receipt of resubmissions (amended applications). See Guide Notice NOT-OD-14-074 at http://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-074.html. The impact/priority score is calculated after discussion of an application by averaging the overall scores (1-9) given by all voting reviewers on the committee and multiplying by 10. The criterion scores are submitted prior to the meeting by the individual reviewers assigned to an application, and are not discussed specifically at the review meeting or calculated into the overall impact score. Some applications also receive a percentile ranking. For details on the review process, see http://grants.nih.gov/grants/peer_review_process.htm#scoring.

MEETING ROSTER
Center for Scientific Review Special Emphasis Panel

CENTER FOR SCIENTIFIC REVIEW
Fellowships: Oncological Sciences
ZRG1 F09B-B (20)
06/27/2016 - 06/28/2016

CHAIRPERSON(S)

BOGLER, OLIVER, PHD
PROFESSOR
SENIOR VICE PRESIDENT FOR ACADEMIC AFFAIRS
DEPARTMENT OF NEUROSURGERY
DIVISION OF SURGERY
UNIVERSITY OF TEXAS MD ANDERSON CANCER CENTER
HOUSTON, TX 77030

MEMBERS

AGHI, MANISH, MD, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF NEUROLOGICAL SURGERY
UNIVERSITY OF CALIFORNIA AT SAN FRANCISCO
SAN FRANCISCO, CA 94143

ALBANESE, CHRISTOPHER, PHD
PROFESSOR
DEPARTMENTS OF ONCOLOGY AND PATHOLOGY
GEORGETOWN UNIVERSITY MEDICAL CENTER
WASHINGTON, DC 20057

ANDRECHEK, ERAN ROBERT, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF PHYSIOLOGY
MICHIGAN STATE UNIVERSITY
EAST LANSING, MI 48824

AVRAHAM, HAVA KARSENTY, PHD
ASSOCIATE PROFESSOR
NORTHEASTERN UNIVERSITY
THE CENTER OF DRUG DISCOVERY
360 HUNTINGTON AVE
BOSTON, MA 02115

BARTON, MICHELLE ANN, PHD
DEAN
DEPARTMENT OF EPIGENETICS AND MOL. CARCINOGENESIS
GRADUATE SCHOOL OF BIOMEDICAL SCIENCES
MD ANDERSON CANCER CENTER
UNIVERSITY OF TEXAS
HOUSTON, TX 77030

CHEN, WENYONG, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF CANCER BIOLOGY
BECKMAN RESEARCH INSTITUTE/CITY OF HOPE
DUARTE, CA 91010

CORRY, PETER M., PHD
DISTINGUISHED PROFESSOR
DEPARTMENT OF RADIATION ONCOLOGY
UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES
LITTLE ROCK, AR 72205

CUMMINGS, BRIAN S, PHD
ASSOCIATE PROFESSOR
PHARMACEUTICAL AND BIOMEDICAL SCIENCES
COLLEGE OF PHARMACY
UNIVERSITY OF GEORGIA
ATHENS, GA 30602

DATTA, KAUSTUBH, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY
EPPLEY CANCER CENTER
UNIVERSITY OF NEBRASKA MEDICAL CENTER
OMAHA, NE 68198

DHANASEKARAN, DANNY N., PHD
PROFESSOR OF CELL BIOLOGY
DEPUTY DIRECTOR FOR BASIC RESEARCH
STEPHENSON OKLAHOMA CANCER CENTER
UNIVERSITY OF OKLAHOMA HEALTH SCIENCES CENTER
OKLAHOMA CITY, OK 73104

DU, HONG, PHD
PROFESSOR
DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE
INDIANA UNIVERSITY SCHOOL OF MEDICINE
INDIANAPOLIS, IN 46202

FAN, MEIYUN, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF PATHOLOGY
UNIVERSITY OF TENNESSEE HEALTH SCIENCE CENTER
MEMPHIS, TN 38163

GNJATIC, SACHA, PHD
ASSOCIATE PROFESSOR
DEPT OF HEMATOLOGY/ONCOLOGY, IMMUNOLOGY
TISCH CANCER INSTITUTE, IMMUNOLOGY INSTITUTE
ICAHN SCHOOL OF MEDICINE AT MOUNT SINAI
NEW YORK, NY 10029

GUZMAN, ESTHER AMALIA, PHD
ASSOCIATE RESEARCH PROFESSOR
HARBOR BRANCH OCEANOGRAPHIC INSTITUTE
FLORIDA ATLANTIC UNIVERSITY
FORT PIERCE, FL 34946

HALABAN, RUTH, PHD
SENIOR RESEARCH SCIENTIST
DIRECTOR, YALE SPORE IN SKIN CANCER
DEPARTMENT OF DERMATOLOGY
YALE UNIVERSITY SCHOOL OF MEDICINE
NEW HAVEN, CT 06520

HECK, DIANE E, PHD
CHAIR AND PROFESSOR
DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCE
NEW YORK MEDICAL COLLEGE
VALHALLA, NY 10595

HILLGARTNER, FRANK B, PHD
PROFESSOR
DEPARTMENT OF BIOCHEMISTRY
WEST VIRGINIA UNIVERSITY
MORGANTOWN, WV 26506-9142

HU, HONG-MING, PHD
CHIEF
LABORATORY OF CANCER IMMUNOBIOLOGY
PROVIDENCE PORTLAND MEDICAL CENTER
PORTLAND, OR 97213

IGNATENKO, NATALIA A, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF CELLULAR AND MOLECULAR MEDICINE
UNIVERSITY OF ARIZONA
TUCSON, AZ 85724

KOLESAR, JILL MARIE, PHAR
PROFESSOR
SCHOOL OF PHARMACY
UNIVERSITY OF WISCONSIN
MADISON, WI 53792

LUPU, RUTH, PHD
PROFESSOR
DEPARTMENT OF EXPERIMENTAL PATHOLOGY
DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY
MAYO CLINIC ROCHESTER
ROCHESTER, MN 55902

MOHAMMED, SULMA IBRAHIM, PHD, DVM
ASSOCIATE PROFESSOR OF CANCER BIOLOGY
DEPARTMENT OF COMPARATIVE PATHOBIOLOGY
PURDUE UNIVERSITY CENTER FOR CANCER RESEARCH
WEST LAFAYETTE, IN 47907--202

NEWFELD, STUART J, PHD
PROFESSOR AND FACULTY LEADER
CELLULAR AND MOLECULAR BIOSCIENCES
SCHOOL OF LIFE SCIENCES
ARIZONA STATE UNIVERSITY
TEMPE, AZ 85287

POLLOK, KAREN ELIZABETH, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF PEDIATRICS
INDIANA UNIVERSITY SCHOOL OF MEDICINE
INDIANAPOLIS, IN 46202

PUDUVALLI, VINAY K, MD
PROFESSOR
DIVISION OF NEURO-ONCOLOGY
320 W 10TH AVENUE, STARLING LOVING HALL SUITE M410
THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER
COLUMBUS, OH 43210

REYLAND, MARY ELAINE, PHD
PROFESSOR
DEPARTMENT OF CRANIOFACIAL BIOLOGY
SCHOOL OF DENTAL MEDICINE
UNIVERSITY OF COLORADO, DENVER
AURORA, CO 80045

ROGERS, ARLIN B, DVM, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOMEDICAL SCIENCES
CUMMINGS SCHOOL OF VETERINARY MEDICINE
TUFTS UNIVERSITY
200 WESTBORO RD
NORTH GRAFTON, MA 01536

SCHWARTZ, JEFFREY L., PHD
PROFESSOR
DEPARTMENT OF RADIATION ONCOLOGY
UNIVERSITY OF WASHINGTON
SEATTLE, WA 98195

VISHWANATHA, JAMBOOR K, PHD
PROFESSOR AND VICE PRESIDENT
UNIVERSITY OF NORTH TEXAS HEALTH SCIENCE CENTER
FORT WORTH, TX 76107

WARGOVICH, MICHAEL, PHD
PROFESSOR
DEPARTMENT OF MOLECULAR MEDICINE
CANCER CENTER COUNCIL DISTINGUISHED CHAIR
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER
SAN ANTONIO, TX 78229

YEH, SHUYUAN, PHD
PROFESSOR
DEPARTMENT OF UROLOGY AND PATHOLOGY
UNIVERSITY OF ROCHESTER MEDICIAL CENTER
ROCHESTER, NY 14642

ZAMBETTI, GERARD PAUL, PHD
VP AND DIRECTOR OF ACADEMIC PROGRAMS
DEPARTMENT OF PATHOLOGY
ST. JUDE CHILDREN'S RESEARCH HOSPITAL
MEMPHIS, TN 38105

ZHANG, BIN, PHD, MD
ASSOCIATE PROFESSOR
DEPARTMENTS OF MEDICINE-HEMATOLOGY/ONCOLOGY
AND MICROBIOLOGY-IMMUNOLOGY
NORTHWESTERN UNIVERSITY FEINBERG SCHOOL
OF MEDICINE
CHICAGO, IL 60611

ZHU, TIMOTHY C, PHD
PROFESSOR
DEPARTMENT OF RADIATION ONCOLOGY
PERELMAN SCHOOL OF MEDICINE
UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA, PA 19104

MAIL REVIEWER(S)

PHILLIPS, GREGORY J, PHD
PROFESSOR
DEPARTMENT OF VETERINARY MICROBIOLOGY
IOWA STATE UNIVERSITY
AMES, IA 50011

SCIENTIFIC REVIEW OFFICER

HOWARD, OLA MAE ZACK, PHD
SCIENTIFIC REVIEW OFFICER
CENTER FOR SCIENTIFIC REVIEW
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20892

EXTRAMURAL SUPPORT ASSISTANT

ROGERS, YVETTE
EXTRAMURAL SUPPORT ASSISTANT
CENTER FOR SCIENTIFIC REVIEW
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20892

Consultants are required to absent themselves from the room during the review of any application if their presence would constitute or appear to constitute a conflict of interest.