

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Board on Health Sciences Policy

**Examining the State of the Science of Mammalian Embryo
Model Systems – A Workshop**

January 17, 2020

Keck Center of the National Academies
Room 100
500 5th St. NW
Washington, DC 20001

STATEMENT OF TASK:

A planning committee of the National Academies of Sciences, Engineering, and Medicine will organize and conduct a one day public workshop to explore the state of the science of mammalian embryo model systems, including nonhuman primate and human models. The goal of the workshop will be to begin with an overview of the developments and uses that have set the foundation for the field, then to focus in on opportunities and challenges for future work with embryo model systems. Discussions may include topics such as the characteristics of advanced mammalian embryo model systems; differences between various mammalian embryo model systems and bona fide mammalian embryos; and differences between mammalian embryo model systems and mammalian “embryoid bodies” (culture systems in which pluripotent stem cells aggregate and differentiate, but the cells are not organized in the same manner as in a bona fide embryo). Discussion may include whether the embryo model systems, especially those using nonhuman primate cells, could be used to predict function of systems made with human cells. The functionality and organismal potential of the synthetic models may be considered, including whether embryo model systems have organismal potential if they lack trophoblast cells or other extraembryonic cell types. The current state of the science of the in vitro development of human trophoblast cells may be considered. As requested by NIH, the discussions at the workshop will focus on the state of the science and not policy or ethical implications given the existing legal limitations. Presentations during this workshop will be held with a broad array of invited stakeholders which may include research scientists from government, academia and the private sector, societies and associations, and representatives from pharmaceutical and biotech companies. The planning committee will develop the workshop agenda, select and invite speakers, and moderate the discussions. Proceedings from the workshop will be prepared by a designated rapporteur in accordance with institutional policies and procedures.

AGENDA

8:30 a.m. **Opening Remarks and Charge to Workshop Speakers and Participants**

MARTIN PERA
Professor
The Jackson Laboratory

8:45 a.m. **Opening Keynote Lecture**
Unique Aspects of Human Embryology and Opportunities and Challenges with Stem Cell-Based Embryo Models

JANET ROSSANT
Senior Scientist, Developmental & Stem Cell Biology
The Hospital for Sick Children

9:05 a.m. **Clarifying Questions from Workshop Participants**

SESSION I: MAMMALIAN EMBRYO RESEARCH AND PLURIPOTENT STEM CELLS

Session Objective:

- Explore the characteristics of mammalian embryo model systems and the potential benefits and limitations to using these models for studying human embryonic development.

Session Moderator: Renee Reijo Pera, California Polytechnic State University

9:20 a.m. KATHY NIAKAN
Group Leader
Francis Crick Institute

9:35 a.m. MAGDALENA ZERNICKA-GOETZ
Professor of Mammalian Development and Stem Cell Biology
University of Cambridge
Bren Professor of Biology and Biological Engineering
California Institute of Technology

9:50 a.m. HEIDI COOK-ANDERSEN
Assistant Professor, Reproductive Medicine
UC San Diego

10:05 a.m. **Panel Discussion with Speakers and Workshop Participants**

10:35 a.m. **Break**

SESSION II: EXAMINING THE DEVELOPMENT OF EXTRAEMBRYONIC LINEAGES

Session Objectives:

- Explore the current state of the science about human extraembryonic lineages and how they are defined and characterized.
- Examine the impact of extraembryonic lineages on human embryo model systems.

Session Moderator: Amander Clark, UCLA

- 10:50 a.m. MICHAEL ROBERTS
Chancellor's Professor, Animal Sciences and Biochemistry
University of Missouri
- 11:05 a.m. MANA PARAST
Professor in Residence, Pathology
UCSD
- 11:20 a.m. PAUL ROBSON
Associate Professor and Director, Single Cell Biology
The Jackson Laboratory
- 11:35 a.m. **Panel Discussion with Speakers and Workshop Participants**
- 12:05 p.m. **Break for Lunch**

SESSION III: STEM CELL-BASED MODELS OF HUMAN EMBRYOS

Session Objectives:

- Learn about the latest scientific and technical developments with models of human embryos and the direction for future research and applications of this work.
- Examine the fidelity of human embryo model systems to bona fide human embryos and explore methods for validation of the model systems.

Session Moderator: Arnold Kriegstein, UCSF

- 1:10 p.m. ALI BRIVANLOU
Robert and Harriet Heilbrunn Professor
The Rockefeller University
- 1:25 p.m. ARYEH WARMFLASH
Principal Investigator
Assistant Professor, Department of Biosciences
Rice University
- 1:40 p.m. NICOLAS RIVRON
Group Leader, Institute of Molecular Biotechnology
Austrian Academy of Science
- 1:55 p.m. JIANPING FU
Associate Professor, Biomedical and Mechanical Engineering
Associate Professor, Cell and Developmental Biology
University of Michigan

2:10 p.m. **Panel Discussion with Speakers and Workshop Participants**

2:40 p.m. **Break**

SESSION IV: COMPARATIVE EMBRYONIC DEVELOPMENT ACROSS SPECIES

Session Objectives:

- Understand the similarities and differences between nonhuman embryos, embryo models (e.g., chimeras), and human embryos.
- Identify scientific questions that may necessitate the study of human embryos.

Session Moderator: Jianping Fu, University of Michigan

2:55 p.m. SHAWN CHAVEZ
Assistant Professor
Division of Reproductive & Developmental Sciences
Oregon Health & Science University

3:10 p.m. TED GOLOS
Professor and Department Chair
University of Wisconsin

3:25 p.m. MARTIN GARCIA CASTRO
Associate Professor, Biomedical Sciences
UC Riverside

3:40 p.m. JUN WU
Assistant Professor, Molecular Biology
UT Southwestern

3:55 p.m. **Panel Discussion with Speakers and Workshop Participants**

SESSION V: FUTURE OPPORTUNITIES AND CHALLENGES WITH MAMMALIAN EMBRYO MODEL SYSTEMS

Session Objectives:

- Summarize the lessons learned and topics discussed throughout the workshop, and address the key questions shown below.

Key Questions:

- What did we hear today that was new and could be moved forward to help advance the field?
- What was not discussed today that you think is important and key to the development of human embryo model systems?
- What level of fidelity exists between human embryo model systems and bona fide human embryos?

Session Moderator: Nicolas Rivron, Austrian Academy of Science

- 4:25 p.m. **Final Panel Discussion**
ALI BRIVANLOU
JIANPING FU
KATHY NIAKAN
MANA PARAST
- 4:55 p.m. **Closing Keynote**

MARTIN PERA
Professor
The Jackson Laboratory
- 5:15 p.m. **Clarifying Questions from Workshop Participants**
- 5:25 p.m. **Final Remarks**

JANET ROSSANT
Senior Scientist, Developmental & Stem Cell Biology
The Hospital for Sick Children
- 5:30 p.m. **Adjourn**