

GEM<sup>4</sup> Summer School on  
**CELL AND MOLECULAR MECHANICS  
IN BIOMECHANICS**  
with a focus on **CARDIOVASCULAR SYSTEMS**



**July 21 - July 25, 2008**

**California Institute of Technology**

**Pasadena, California, USA**

Summer School Website: [www.its.caltech.edu/~gem4](http://www.its.caltech.edu/~gem4)

Email: [gem4@caltech.edu](mailto:gem4@caltech.edu)

## 1. Scope

This week long summer school will be the third in the series, following the previous successful summer schools held at the Massachusetts Institute of Technology (MIT) in August 2006 (with a focus on infectious diseases) and the National university of Singapore (NUS) in July 2007 (with a focus on cancer). Strong laboratory experience and exposure to local research facilities will be provided in addition to introductory and advanced tutorials.

The objective of this summer school is to educate researchers and graduate students in the fundamentals of cell and molecular biomechanics and its applications in medicine, to provide an intense learning experience, and to facilitate interactions among engineers, biologists and clinicians. The goals are to help train a new generation of researchers with in-depth knowledge of biomechanics and molecular medicine and to help scientists and clinicians apply biomechanical approaches in biomolecular, cellular, tissue-level, animal-model and clinical studies.

The philosophy of the summer school is to emphasize basic concepts and problem-based learning in cell and molecular biomechanics, and integrating lecturing, in-class discussion, case-studies, and hands-on experience. All teaching activities will have a focus on a particular broad disease type each year: for example, infectious disease (2006), cancer (2007), and cardiovascular disease (2008). The core teaching material may remain the same, but the examples, case-studies and lab work is chosen based on the focus topic. The summer school will also include laboratory demonstration sessions linking theory to practice.

The summer school is expected to be particularly appealing to:

- Engineering or biology faculty and post-docs/researchers who wish to expand their research horizons and move into biomechanics and related disease studies;
- Students who want to learn molecular and cell biomechanics, but could not do so at their own institutions, or who want to get a different perspective from what they have learned and a closer link to disease studies;
- Medical researchers who have the need to learn basic biomechanics and are interested in applying biomechanics to their clinical investigations.

## 2. Summer School Organization

*Organized by:* **GEM<sup>4</sup>** ([www.gem4.org](http://www.gem4.org))

*GEM<sup>4</sup> Steering Committee:* Gang Bao (Georgia Tech), B. V. R. Chowdari (NUS) (Executive coordinator), Mory Gharib (Caltech), Barry Halliwell (NUS), Roger D. Kamm (MIT) (Director), L. Mahadevan (Harvard), Geneviève Milon (Institut Pasteur), Taher Saif (UIUC), Leona Samson (MIT), Subra Suresh (MIT)

*Local organization:* **California Institute of Technology (Caltech), Pasadena, California, USA**

*Program Organizers:* G. Ravichandran (Caltech)  
M. Gharib (Caltech)

*Summer school venue:* **Lees-Kubota Auditorium, Guggenheim Laboratories, Caltech**

*Organizational contact:* Linda Miranda ([gem4@caltech.edu](mailto:gem4@caltech.edu))

**Fees:** US\$1,000/participant. The fees include participation in the summer school, coffee breaks, lunch, reception and banquet. Limited number of fellowships may be available.



**Registration:** Online registration starting April 2 at [www.its.caltech.edu/~gem4](http://www.its.caltech.edu/~gem4). Since the space is limited in the summer school, early registration is encouraged. Participants should register no later than May 16, 2008.

**Accommodations:** Rooms have been blocked for the participants in the Saga Motor Hotel in Pasadena (~15 minutes walk to the summer school venue) for the participants (Single, ~\$80/night, Double (shared), ~\$40/night). Details of accommodations and other travel information are provided at the website.

### 3. Topics & Instructors (Tentative)

The following is a tentative course outline of the topics for both cellular and molecular biomechanics, and cardiovascular systems. For the biology components, participants will be exposed to a broad range of topics encompassing the cell and molecular biology, physiology, and bio fluid and solid mechanics, modeling, disease (diagnosis, treatment) of cardiovascular systems.

#### **Topics:**

##### **Introduction to Continuum, Fluid and Solid Mechanics**

##### **Introduction to Cell and Molecular Biology**

##### **Introduction to Physiology**

##### **Cell & Molecular Biomechanics:**

*Basic mechanics*  
*Continuum & statistical mechanics*  
*Molecular biomechanics*  
*Cell Biomechanics*  
*Tissue and Muscle Biomechanics*  
*Computational Biomechanics*  
*Space, time and energy landscapes in mechanobiology*  
*Mechanosensing and transduction*  
*Cardiomyocytes*  
*Experimental methods*

##### **Cardiovascular Systems**

*Cardiogenesis*  
*Cardiac mechanics*  
*Cardio imaging*  
*Diseases (Diagnosis & Treatment)*  
*Biomedical devices*

##### **Lab Sessions:**

- *Cell & tissue culture lab*
- *Cell mechanics*
- *Cell and tissue imaging*
- *Microfluidics*
- *Cardiogenesis*
- *Cardiac fluid flow*

##### **Instructors:**

Markus Buehler (MIT), Dennis Discher (UPenn), Huajian Gao (Brown), Mory Gharib (Caltech), Sefi Givli (Caltech), Jimmy Hsia (UIUC), Roger D. Kamm (MIT), Arash Kheradvar (South Carolina), Matt Lang (MIT), Michael Liebling (UCSB), C.T. Lim (NUS), Kit Parker (Harvard), G. Ravichandran



(Caltech), Subra Suresh (MIT), Larry Taber (Washington U), Krystyn van Vliet (MIT), Taher Saif (UIUC), Geert Schmid-Schoenbein (UCSD), Michael Sheetz (Columbia), Han Wen (NHLBI)



### Tentative Schedule for the Summer School

<b>Date/Day</b>	<b>Time</b>	<b>Activity</b>
July 20 (Sun)		Arrival / Check-in Saga Motor Hotel
Day 1 July 21 (Mon)	8:00-8:30	Registration
	8:30-12:30	Introduction to Continuum Mechanics Fluid Mechanics Solid Mechanics
	12:30 - 1:30	Lunch Break
	1:30 - 5:30	Cell Biology Molecular Biology
	6:00 - 8:00	Reception
Day 2 July 22 (Tue)	8:30 - 12:30	Statistical Mechanics Molecular Mechanics
	12:30 - 1:30	Lunch Break
	1:30 - 5:30	Mechano-Biology
Day 3 July 23 (Wed)	8:30 - 12:30	Physiology Cardiovascular systems
	12:30 - 1:30	Lunch
	1:30 - 5:30	Cardiac Mechanics
Day 4 July 24 (Thu)	8:30 - 12:30	Cardiogenesis Cardio Imaging
	12:30 - 1:30	Lunch
	1:30 - 5:30	Cardiac Diseases (Diagnosis & Treatment) Biomedical Devices
Day 5 July 25 (Fri)	8:30 - 12:30	Experimental Methods (Cell and Cardiac Mechanics)
	12:30 - 1:30	Lunch
	1:30 - 5:30	Laboratory Demonstrations
July 26 (Sat)		Departure / Check-out

