

# 生物力學簡介 (Fall 2008)

## Introduction to Biomechanics

**Instructor:** 紀凱容 (Kai-Jung Chi)    **Email:** kjchi@phys.nchu.edu.tw    **Office:** 理學大樓 617 室  
**Class time/location:** Wednesdays, 3:10-6:00pm/ S210    **TA:** 張家慈 (S510)

### Grading Scheme:

Participation (10%)—most activities are conducted in group of 2-3 students.

In-class activities & reports (30%)

Homework (20%)

Group project (40%)—discussion, oral presentation (project proposal + defense)

Group size: 2-3 students/ group

Pick a topic from: (1) 科普書籍 (貓掌與彈弓、學蜘蛛人趴趴走、飛行的奧秘), or (2) 科技報導。

Form biomechanical questions and conduct literature research (2 original articles).

### Syllabus:

<i>Wk</i>	<i>Dates</i>	<i>Topics</i>	<i>Readings/Notes</i>
1	9/17	(1) Introduction to biomechanics/ Class info (2) Survey—Students' interests	Reading #1-Ch. 1, 2
2	9/24	(1) Literature search—use databases (2) In-class project: science in entertainment	Handout: databases
3	10/1	(1) Basic physical tools (2) Scaling in biology	Reading (1) Ch. 3, 4
4	10/8	(1) Scaling and biomechanics of footpads (2) Presentation: video clips & literature overview	
5	10/15	Bio-solid mechanics	
6	10/22	Bio-fluid mechanics (I)	
7	10/29	Bio-fluid mechanics (II)	Form project group; About project
8	11/5	(1) Biological attachment (2) Achieving motility: biological engines	Homework I due; Reading (2): Dickinson et al 2000 (as group)
9	11/12	Project: Group discussion	[Midterm week]; *11/14-11/16
10	11/19	*Biophysics workshop (no regular class)	Project topic due; Handout: jump. ants
11	11/26	Animal locomotion (figs by students); Discussion	Reference: Reading (3) for lab
12	12/3	In-class exercise: motion analysis of jumping ants	Project reading list due (2 refs)
13	12/10	Presentation: Jumping ants	
14	12/17	Final project: literature discussion w/ instructor	Homework II due
15	12/24	Final project: preparation	
16	12/31	Oral presentation I—project proposal	
17	1/7	Final project: preparation	
18	1/14	Oral presentation II—project defense	[Final exam week]

~ A course website will be created to post course related materials ~

## Readings for classes:

- (1) Vogel S (2003) *Comparative Biomechanics: Life's Physical World* (Princeton Univ. Press) —物理系圖
- (2) Dickinson, M.H., Farley, C.T., Full, R.J., Koehl, M.A.R., Kram, R., Lehman, S. (2000). How animals move: an integrative view. *Science* 288, 100-106.
- (3) Patek, S. N., Baio, J. E., Fisher, B. L. and Suarez, A. V. (2006). Multifunctionality and mechanical origins: Ballistic jaw propulsion in trap-jaw ants. *Proceedings of the National Academy of Sciences* 103, 12787-12792.
- (4) **Project ideas could come from:**
  - (i) 【貓掌與彈弓：當自然設計遇上人類科技】(先覺出版社) (原文：Cats' Paws and Catapults: Mechanical Worlds of Nature and People, by Steven Vogel)
  - (ii) 【學蜘蛛人趴趴走】(遠流出版社) (原文：The Gecko's Foot—Bio-inspiration: Engineered from Nature, by Peter Forbes)
  - (iii) 【飛行的奧秘】(貓頭鷹出版社) (原文：The Miracle of Flight, by Stephen Dalton)

## Other References:

1. S. Vogel, *Life in Moving Fluids: The Physical Biology of Flow*, 2<sup>nd</sup> ed. Princeton University Press (1994). —物理系圖
2. S. Vogel, *Vital Circuits: On Pumps, Pipes,, and the Workings of Circulatory Systems*, Oxford University Press (1992). —物理系圖
3. S. Vogel, *Life's Devices: The Physical World of Animals and Plants*, Princeton University Press (1988). —物理系圖
4. S. Vogel, *Cats' Paws and Catapults: Mechanical Worlds of Nature and People*, W. W. Norton & Co. (1998). —物理系圖 (中譯：貓掌與彈弓—當自然設計遇上人類科技)
5. S. Vogel, *Prime Mover: A Natural History of Muscle*, W. W. Norton & Company (2001). —物理系圖
6. M. W. Denny, *Air and Water: The Biology and Physics of Life's Media*, Princeton University Press (1993). —物理系圖
7. M. W. Denny, *Biology and the Mechanics of the Wave-Swept Environment*, Princeton University Press (1988). —成功大學
8. R. M. Alexander, *Principles of Animal Locomotion*, Princeton University Press (2003). —物理系圖
9. R. M. Alexander, *Animal Mechanics*, 2<sup>nd</sup> ed. Blackwell (1983). —台灣大學
10. R. M. Alexander, *Optima for Animals*, Revised ed. Princeton University Press (1996). —物理系圖
11. R. M. Alexander, *Exploring Biomechanics: Animals in Motion*, Scientific American Library (1992). —總圖
12. R. M. Alexander, *The Human Machine*, Columbia University Press (1992). —總圖
13. K. Schmidt-Nielsen, *How Animals Work*, Cambridge University Press (1972). —昆蟲系圖
14. K. Schmidt-Nielsen, *Animal Physiology: Adaptation and Environment*, 5<sup>th</sup> ed. Cambridge University Press (1997). —總圖
15. T. A. McMahon and J. T. Bonner, *On Size and Life*, Scientific Am. Library (1983). —總圖
16. T. A. McMahon, *Muscles, Reflexes, and Locomotion*, Princeton University Press (1984). —物理系圖
17. A. A. Biewener, *Animal Locomotion*, Oxford University Press (2003). —畜產系圖
18. D. E. Alexander, *Nature's Flyers: Birds, Insects, and the Biomechanics of Flight*, Johns Hopkins University Press (2002). —物理系圖
19. R. Dudley, *The Biomechanics of Insect Flight: Form, Function, Evolution*, Princeton University Press (2000). —昆蟲系圖
20. D. Boal, *Mechanics of the Cell*, Cambridge University Press (2002). —物理系圖
21. J. Howard, *Mechanics of Motor Proteins and the Cytoskeleton*, Sinauer Associate Inc. (2001). —物理系圖
22. S. Childress, *Mechanics of Swimming and Flying*, Cambridge University Press (1981). —物理系圖
23. Y. C. Fung, *Biomechanics: Mechanical Properties of Living Tissues*, 2<sup>nd</sup> ed. Springer-Verlag (1993). —應數系圖
24. Y. C. Fung, *Biomechanics: Circulation*, 2<sup>nd</sup> ed. Springer-Verlag (1997). —應數系圖
25. Y. C. Fung, *Biomechanics: Motion, Flow, Stress, and Growth*, Springer-Verlag (1990). —總圖