Suggested Further Reading

I list books from which you can learn modeling, in the spirit and style akin to those of my course.

[1] S. Mahajan, *Order-of-Magnitude Physics*, 1999;
downloadable from `http://www.inference.phy.cam.ac.uk/sanjoy/oom/`

[2] L. C. Epstein, *Thinking Physics*, Insight Press 1979.

[3] Ja. B. Zel'dovič i A. D. Myškis, È lementy Prikladnoĭ Matematiki, Nauka 1974.

[4] G. I. Barenblatt, *Scaling*, Cambridge UP 2003.

[5] R. Eastaway & J. Wyndham, *Why do buses come in threes?*, Robson Books 1998.

[6] D. MacKay, *Sustainable Enery—without the hot air*, UIT Cambridge 2009;
downloadable from `http://www.withouthotair.com/`

[7] J. Maynard Smith, *Mathematical Ideas in Biology*, Cambridge UP 1968.

[1], or rather its author, was the most direct influence on this course. [2] is a collection of very easy and very entertaining puzzles. The best way for you to round off this course is to study [1] and to work through [2]. For those who read Russian, an equally excellent way is to study [3] and to browse from scores of books by Ja. I. Perel'man, perhaps the greatest popularizer of science of all time.

[4] details the mathematics behind dimensional analysis and goes on to advanced applications. [5] is a popular book on applied mathematics of social phenomena (whereas my course focused on natural ones). [6] teaches how to model and figure out on your own anything in energy issues, instead of having to trust media or gurus. [7] is a very elementary and very tasteful introduction to modeling biological phenomena.

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[8] R. P. Feynman, R. B. Leighton, M. Sands, *The Feynman Lectures on Physics*, Addison-Wesley 1963.

[9] A. Sommerfeld, *Vorlesungen über theoretische Physik*, 1943–52; neu hrsg. Harri Deutsch 1988–2005.

[10] E. Guyon, J.-P. Hulin, L. Petit, *Ce que disent les fluides*, Belin 2005.

[11] T. Faber, *Fluid Dynamics for Physicists*, Cambridge UP 1995.

[12] J. Gordon, *Science of Structures and Materials*, Scientific American Library 1988.

[13] R. Phillips, J. Kondev, J. Theriot, *Physical Biology of the Cell*, Garland Science 2009.

[14] D. Maoz, *Astrophysics in a Nutshell*, Princeton UP 2007.

In order to model phenomena, first and foremost you need to *know* those actual, raw phenomena—*what* happens, before you can start arguing why. The richer diversity of phenomena you know, the better modeler you have a chance to be. People have been mesmerized by how slick arguments in [8] are; I suggest you use these lectures rather as a reasoned catalogue, to get acquainted with lots of physical phenomena; they are comprehensive on optics and electromagnetism, sketchy on mechanics and statistical physics. [9] gives a more systematic guidance than [8] on how to use mathematics. For fluid phenomena, look at [10], a beautiful album of photos and simple models. [11] analyses most of these phenomena mathematically; it is strong on waves and instabilities, weak on vorticity. (By the way, I have no vested interest in advertising Cambridge books. Their numerous presence on the list is fortuitous.) For elasticity throughout nature and engineering, do not miss [12], another beautifully illustrated book. For biological modeling beyond [7], try the bulky yet locally friendly [13]. [14] does what this course hoped to do, only much better, in astrophysics.

Tadashi Tokieda, August 2012