

## Phy 490 – Basic Principles of Biophysics

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MW 10:30 – 11:50 AM, KPTC 105

Course website: [muruganlab.uchicago.edu/teaching.html](http://muruganlab.uchicago.edu/teaching.html)

Textbook: *“Biophysics: Searching for principles”* by W. Bialek, Princeton University Press 2012.

### Course description:

An introductory course to expose students in the physical sciences to conceptual and quantitative questions about biological systems. Course will be structured around a few conceptual themes such as physical limits to biological function, the fine tuning problem and efficient representation (following the textbook 'Biophysics: Searching for principles' by W. Bialek). We will cover a broad range of biological examples illustrating those themes, from vision in flies and developing embryos to swimming bacteria and gene regulation.

Does not assume specialized biological knowledge or advanced mathematical skills. Course will offer the possibility of simple MATLAB/Octave simulations as an alternative to analytic calculations to understand the underlying concepts.

### Themes and topics:

#### **Dealing with noise:**

- Gene expression and regulation. Intrinsic and extrinsic noise.
- Fundamental limits on perception and sensing of one's environment. Concentration sensing, vision, hearing.
- Noise reduction strategies (kinetic proofreading, active cooling in the ear)

#### **The fine-tuning problem:**

- Sensory adaptation and bacterial chemotaxis.
- Gene regulation and specificity of protein-DNA interactions.
- How eyes compensate for head movements.

#### **Efficient representation:**

- Design of sensory organs and structure of natural environment. Laughlin's study of fly vision.
- Patterning during development.

### Course structure / requirements:

5 – 6 Homework sets.

One 30-min presentation.

One 2-page research problem proposal.