BIOLOGICAL FRAMEWORKS FOR ENGINEERS

Graduate Project ["Tiny Workhorses"]

General Objectives:

- ✓ Develop knowledge using literature search engines and library resources
- ✓ Design a mechanical system using nano-biotechnology components
- ✓ Improve technical communication ability

Central Framework:

- ✓ Motor proteins generate motion for biological tasks. Their operating parameters have been highly evolved and can efficiently transduce chemical energy to mechanical work. For this project, you will study a motor protein in depth and devise a system that utilizes it to produce movement or power at the nanoscale.

Activity:

You and one or two partners will give a short presentation to the class and write a compact, but clear report. For both deliverables, you will communicate your biological knowledge of your chosen motor protein and describe how it can be used for engineering applications. The list below contains the key points to cover.

I. Introduction – what is the protein, what makes it run?

   a. Biological Use – Briefly detail how this motor protein is used in its natural environment.

   b. Regulation – One or more molecule(s) power it, many signal proteins regulate its activity, and structural proteins associates with it to give it direction, e.g. filament track.

II. Mechanical Analysis – what does it look like and how does it perform?

   a. Motor parts – Each motor protein has a unique structure that defines its function. What are the protein subunits that generate motion and how do all the parts come together?

   b. Specs – there have been many experiments to measure the force and frequency of motor proteins. Results vary so summarize the range of values for the mechanical aspects of motor proteins where possible.

III. Design – how can we use this protein?

a. Past designs – your protein may have already been used for nano-biosystems. Briefly list and describe the different ways it has been used.

b. Your invention – clearly describe your design and application for your system. Give attention to the manufacturing and operation.

Deliverables:

- ✓ 12-15 minute in-class presentation – PowerPoint. Due: Nov 27
- ✓ 2-pg report - 2 columns, 10 pt Times New Roman, 0.5" margins, figures, endnote citations (does not count towards page limit). Due: Nov 25.

Recommended Readings:

van den Heuvel MG, Dekker C., "Motor proteins at work for nanotechnology." *Science*. 2007 Jul 20;317(5836):333-6

H. Hess, "Engineering Applications of Biomolecular Motors", *Annual Review of Biomedical Engineering*, 2011, 13:429-50.

D. Spetzler, J. York, *et al.*, "Recent developments of bio-molecular motors as on-chip devices using single molecule techniques." *Lab on a Chip*. 2007, **7**, 1633-43