Please write out three well thought out questions about the literature paper to ask the presenters (and to hand in).

For the first two problems, you will consider assemblies made from 4096 monomers, where each monomer is a cubical bricks measuring 2 nm on a side. Assume assemblies of these monomers have a Young’s modulus of 2 GPa.

1. Spring constants of molecular assemblies. Determine the resistance to stretching along the largest linear dimension of the following assemblies:
   (a) cube
   (b) linear polymer (one monomer wide)
   (c) two-stranded polymer (two side-by-side protofilaments)

   Compare your answers to each other and to the measured spring constant of kinesin of 0.3 pN/nm. Are these spring constants large or small?

2. Bending of molecular assemblies. Determine the effective spring constant for bending along the widest axis of a
   (a) linear polymer (one monomer wide)
   (b) two-stranded polymer (two side-by-side protofilaments)

   How do the spring constants you calculate compare to spring constants you found in problem 1 for the same structures?

3. Entropic elasticity. Consider a freely jointed chain with contour length 1 µm and segment length 10 nm at room temperature.
   (a) Determine the spring constant for small forces of this chain. How does it compare to the spring constants from the previous two problems? Is this spring constant large or small?
   (b) What happens to the spring constant if the temperature increases by 20°C? Explain qualitatively and quantitatively.
   (c) What happens to the spring constant if the segment length decreases to 1 nm? Explain qualitatively and quantitatively.

**Graduate student problem**

4. Buckling of molecular assemblies. Using the monomer same properties as in the first two problems, determine the critical buckling force of a
   (a) linear polymer (one monomer wide)
   (b) two-stranded polymer (two side-by-side protofilaments)
(c) Compare the buckling forces you calculate to forces that can be generated by a single motor protein.

(d) What length would these polymers need to have to resist buckling by a single motor protein?