What do spider silk tensile properties tell us about spider biology?

Start with an outline of a tensile stress strain test and go on to explain the mechanical property parameters that come out of such a test. Then, using some of the data in the reading list as examples (plus adding your own), go on to explain how these tests can help us answer biological questions about spiders.

Reading list

Before reading, make sure you understand the terms (there's a lot of new stuff):

> Stress, strain, initial modulus, breaking energy, tensile test, elastic, polymer, plastic, viscoelastic, toughness, stiffness, strength, composite. (**start with the Wikipedia page on spider silk –** it's fine, we wrote it). Use these terms in your essay.

Reviews:

> Vollrath, F. and Knight, D. P., (2001), Liquid crystalline spinning of spider silk, *Nature*, 410, pp. 541-548.
>
> Vollrath, F., and Selden, P., (2007), The role of behaviour in the evolution of spiders, silks and webs, *Annual review of ecology, evolution and systematics,* 38**,** pp. 819-846.
>
> Fu, C. *et al.,* (2009), Animal silks: their structures, properties and artificial production, *Chemical Communications*, 43, pp. 6515-6529.

Good figures to consider:

> Porter, D. and Vollrath, F., (2009), Silk as a biomimetic ideal for structural polymers, *Advanced Materials*, 21, pp. 487-492. Figure 1B.
>
> > Spider silk tensile properties for dragline silk in the context of other materials.
>
> Vollrath, F. and Porter, D., (2006), Spider silk as archetypal protein elastomer, *Soft Matter*, 2, pp. 377-385. Figure 1.
>
> > Mechanical properties of different types of spider silk.

Spider biology text book sources:

> Blackledge, T. A. *et al*., (2011), *The form and function of spider orb webs: Evolution from silk to Ecosystem.* Chapter from *Advances in Insect Physiology, Vol 41*, edited by Casas, J. Elsevier.
>
> > Browse through what you think is relevant in the chapter. Don't cite this source, cite the original paper. Good list of primary literature references at the end.
>
> Foelix, R. F., (1996), *Biology of spiders*, 3rd edition. OUP, Oxford.
>
> Brunetta, L. and Craig, C. L., (2010), *Spider silk*. Yale University Press, New Haven.

Picks of other spider silk papers you might find interesting:

Gosline, J. M. Et al., (1999), The mechanical design of spider silks: from fibroin sequence to mechanical function, *Journal of Experimental Biology*, 202, pp. 3295-3303.

Boutry, C. and Blackledge T. (2010), Evolution of supercontraction in spider silk: structure–function relationship from tarantulas to orb-weavers, *Journal of Experimental Biology*, 213, pp. 3505-3514.

Ortlepp, C. and Gosline, J. M., (2008), The scaling of safety factor in spider draglines, *Journal of Experimental Biology*, 211, pp.2832-2840.

Pérez-Rigueiro, J. *et al*., (2005), The effect of spinning forces on spider silk properties, *Journal of Experimental Biology*, 208, pp. 2633-2639.

Be aware there have been a lot of advances in spider silk protein structure and modelling over the years, so make sure you reference recent literature if you are talking about protein primary or secondary (and above) structure.