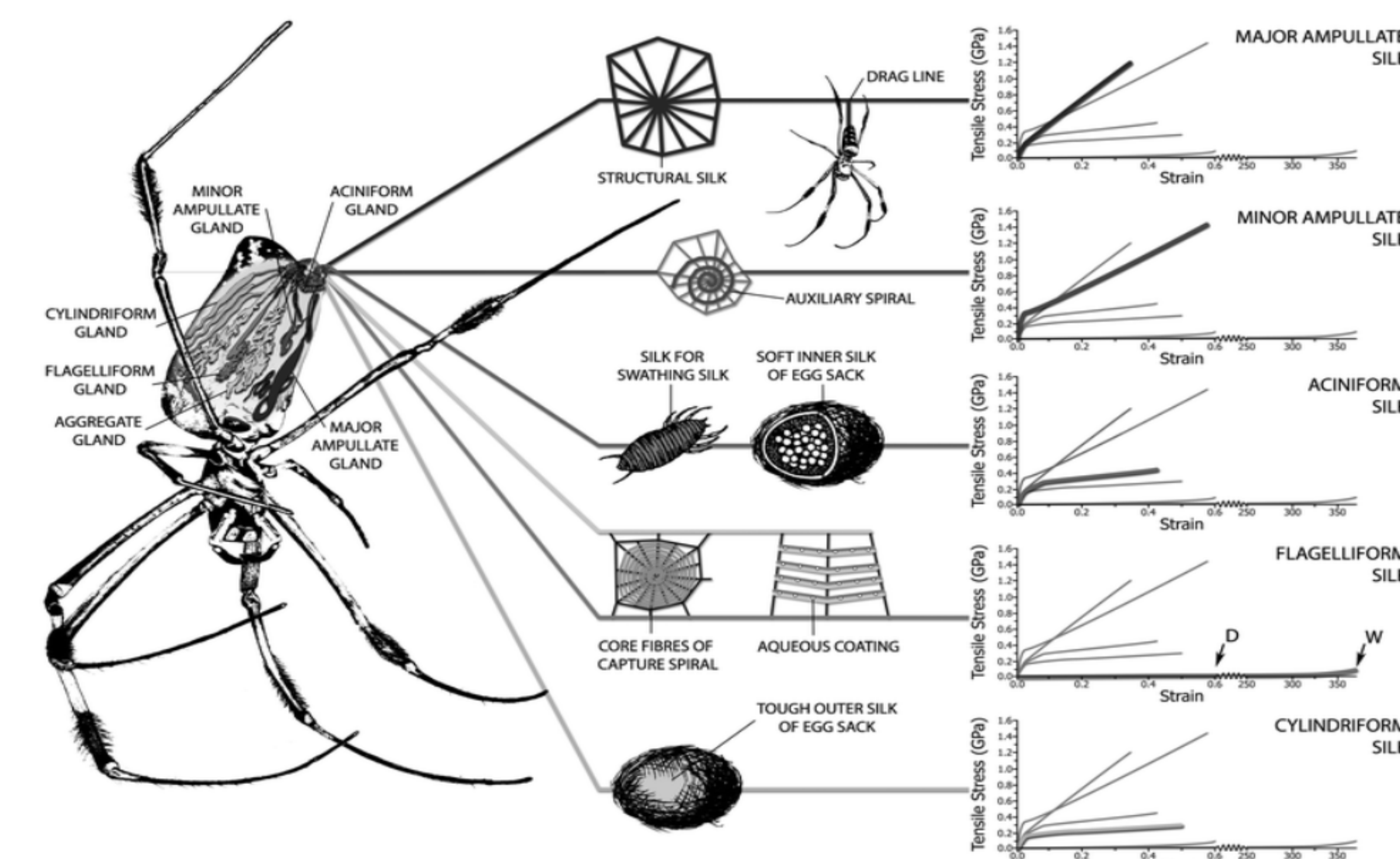
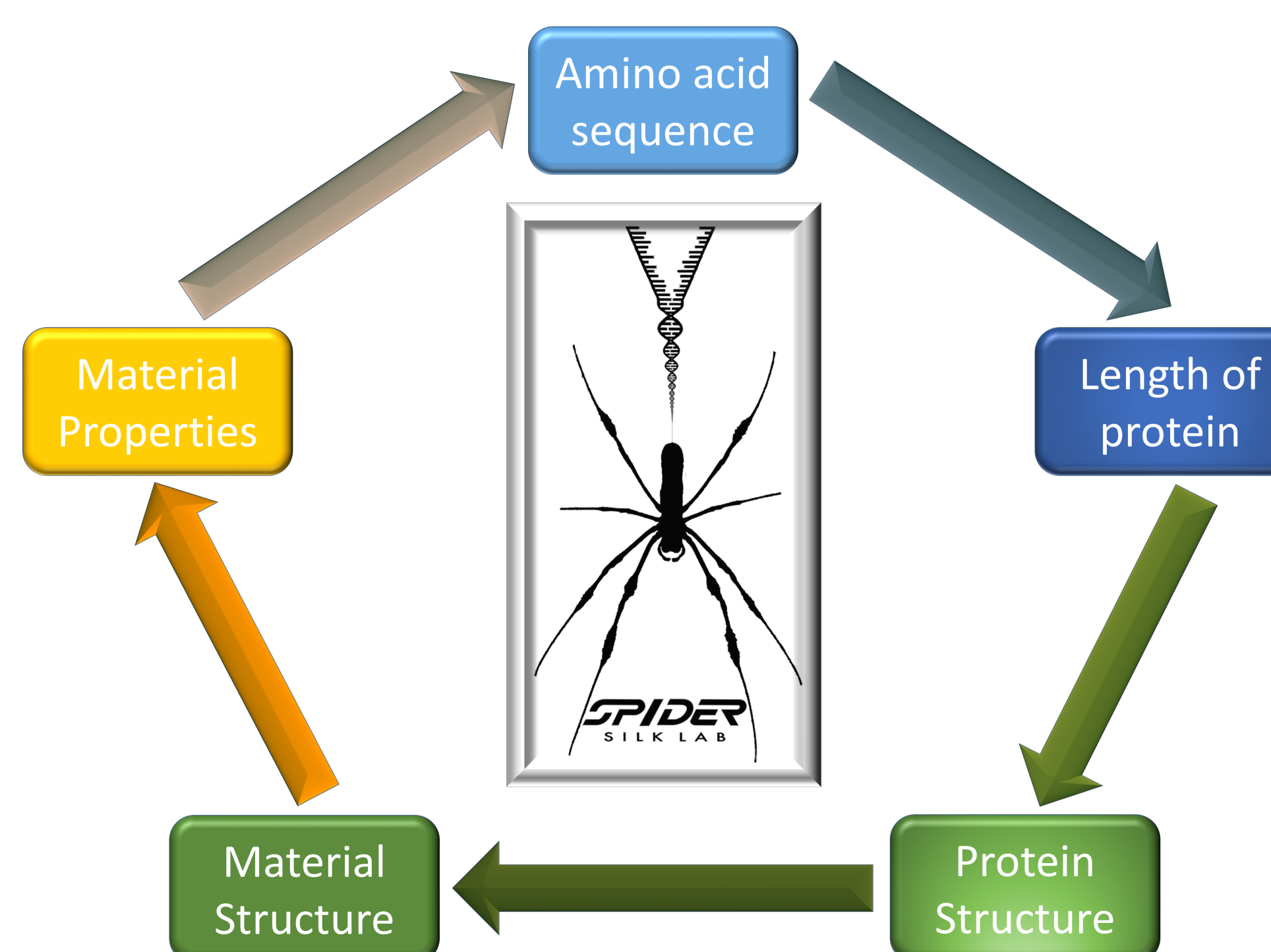


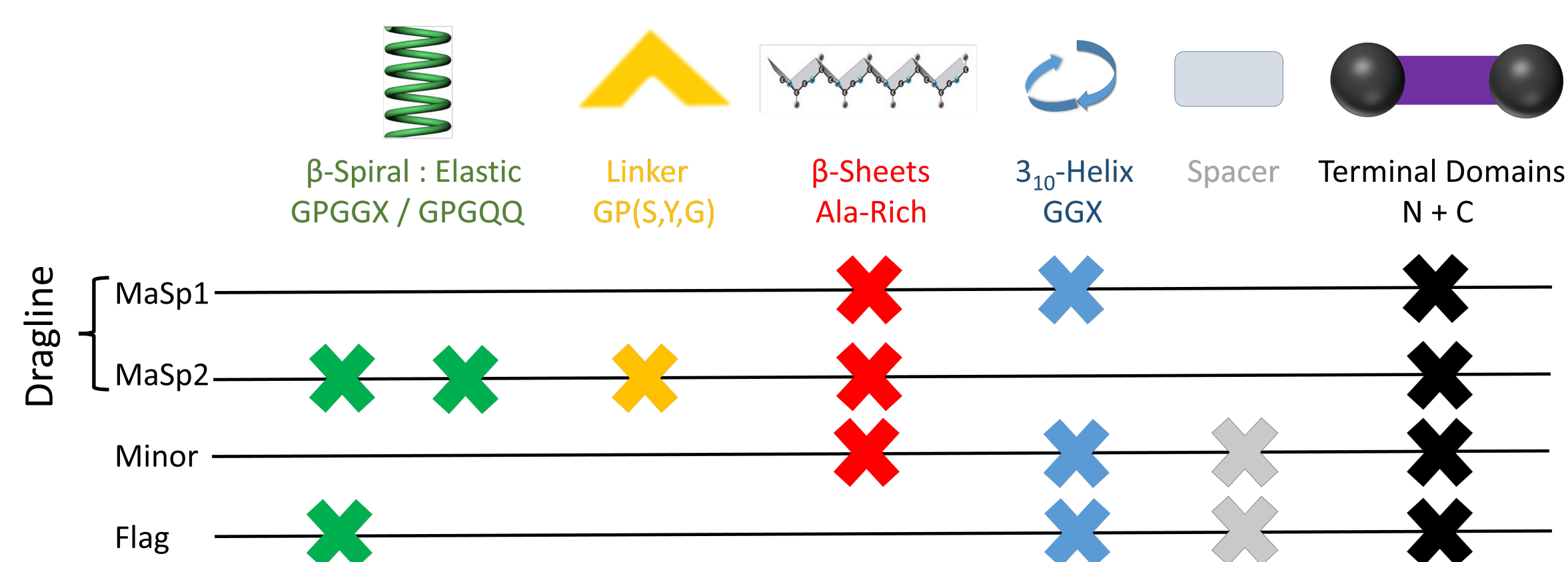
## Why Do We Study Spider Silk, Silkworm Silk And Hagfish Thread Keratins?

- To create new knowledge of protein structure
- To create new biomaterials
- We have complete control of the chemical structure

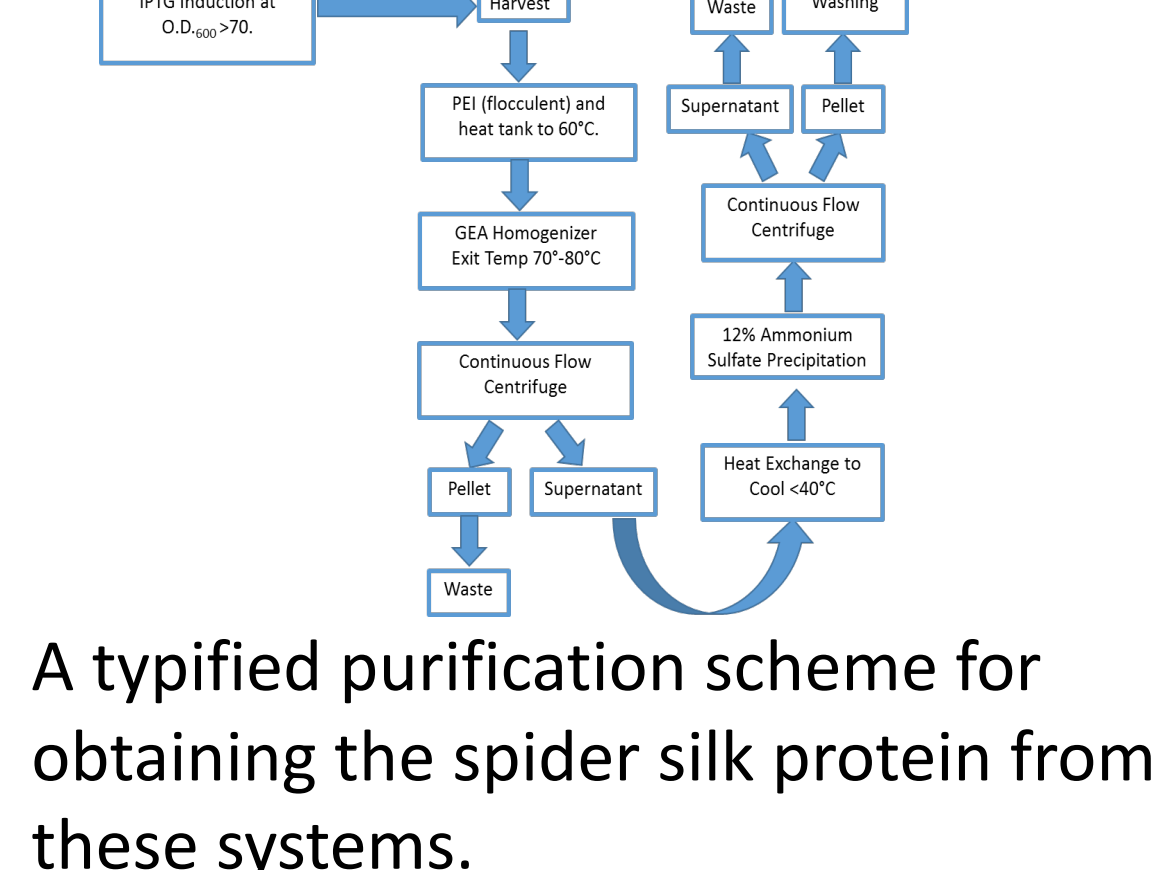


Spiders produce seven different types of silk, six of which are fibers. My laboratory's focus is on the dragline silk which is comprised of two proteins, MaSp1 and MaSp2, and is one of the strongest natural materials known. As the research has evolved, my group has begun to broaden our scope to some of the other fiber forming proteins.

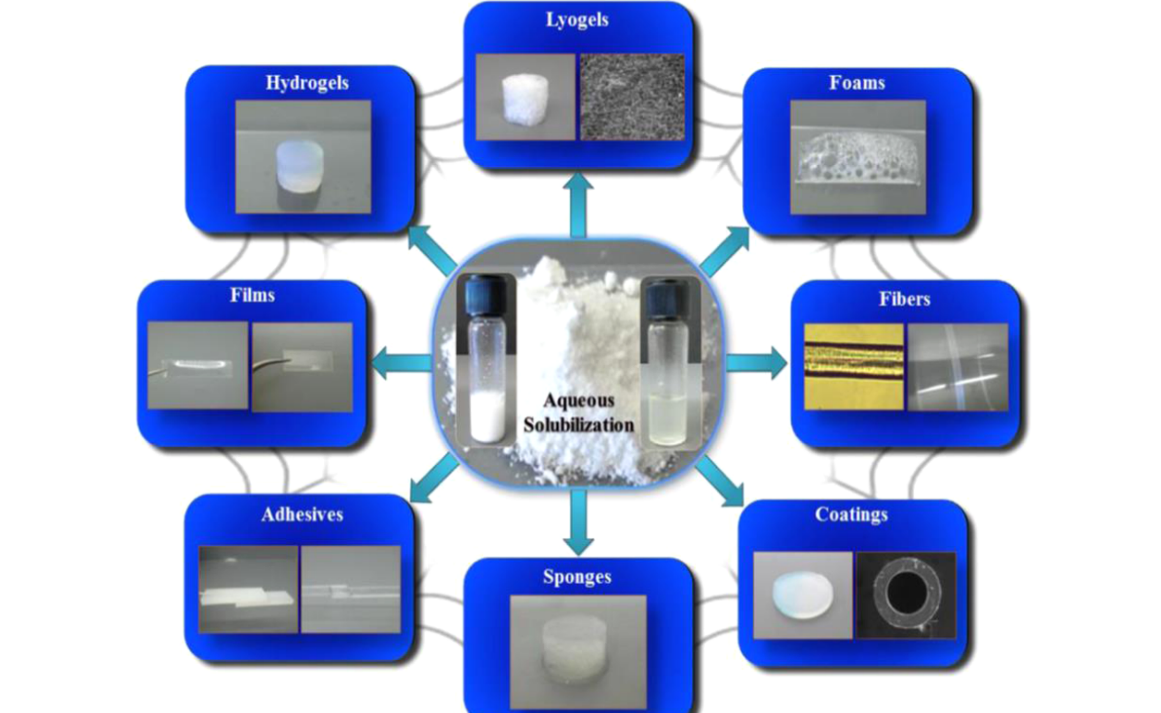
Reprinted with permission from: Vollrath and Porter, "Spider Silk as Archetypal Protein Elastomer." DOI: 10.1039/B600098N. Confirmation no. 11789234.



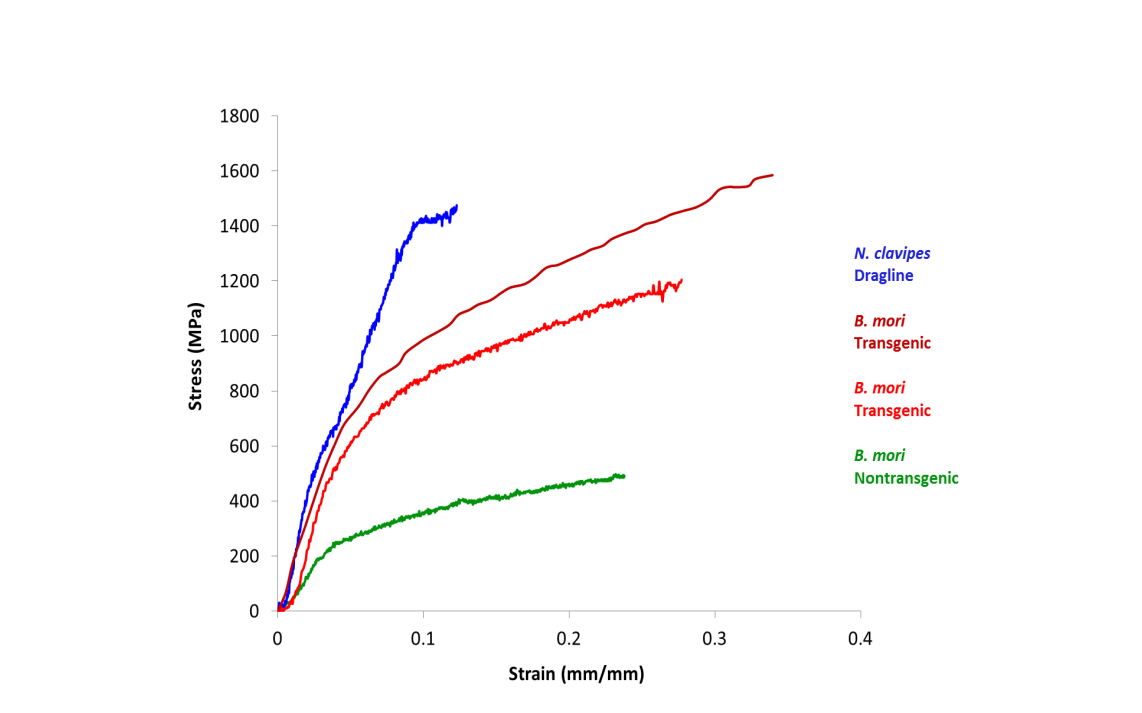
Understanding the underlying protein structures, and how they relate to function, allows us to create a diversity of silks not found in nature.



Silkworm cocoon unwrapping is well established and commercialized.



Many material forms, beyond a fiber, can be produced from these purified proteins!



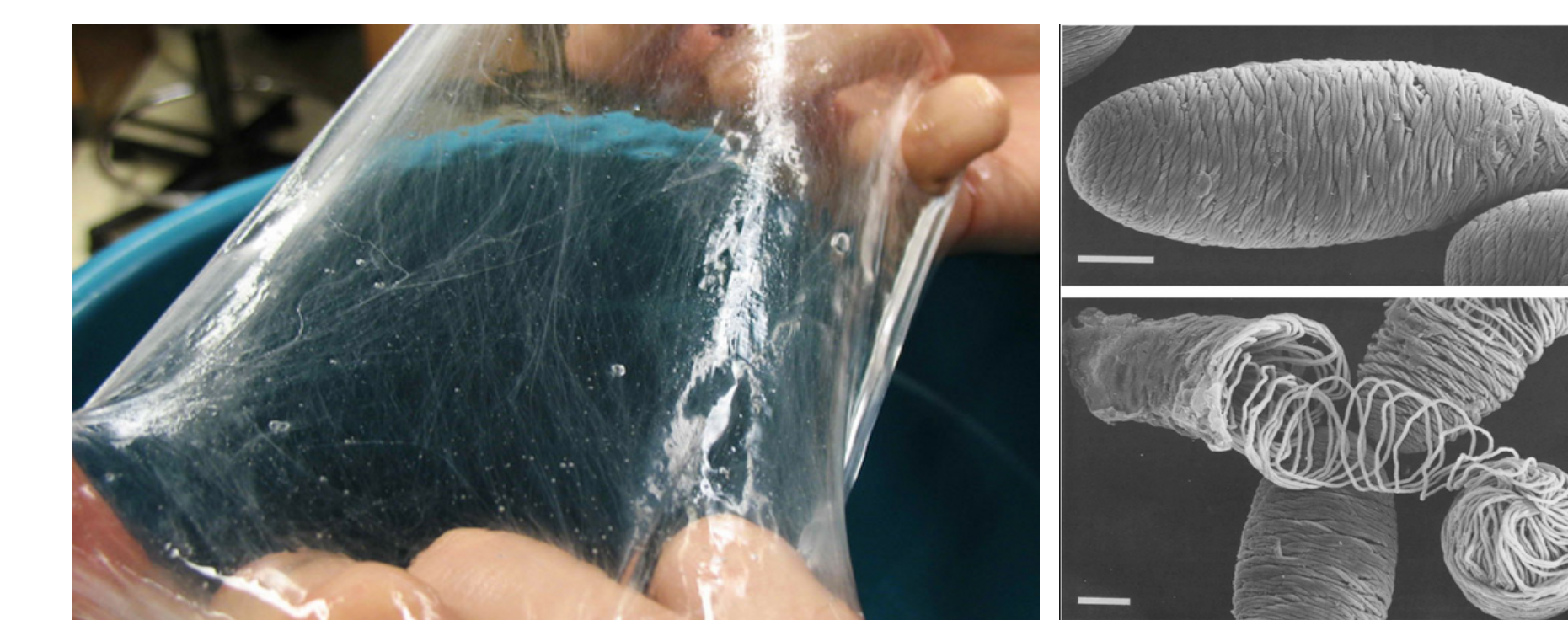
Mechanical properties of our silkworm/spider silk resemble native spider silk!

## Spiders and hagfish cannot be farmed like silkworms.

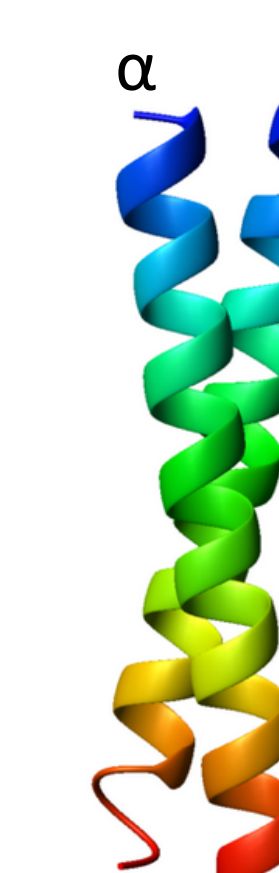
- Spiders are territorial and cannibalistic
- Harvesting silk by manual reeling is impractical
- Harvesting webs in nature is also impractical and it would also contain all 7 types of silk and therefore the "material" would be a combination of all 7 materials properties
- Farming hagfish for their slime is impractical
  - Thread would have to be separated from the slime component
  - Not a continuous thread

## Other heterologous hosts must be used to produce the spider silk and hagfish thread keratins.

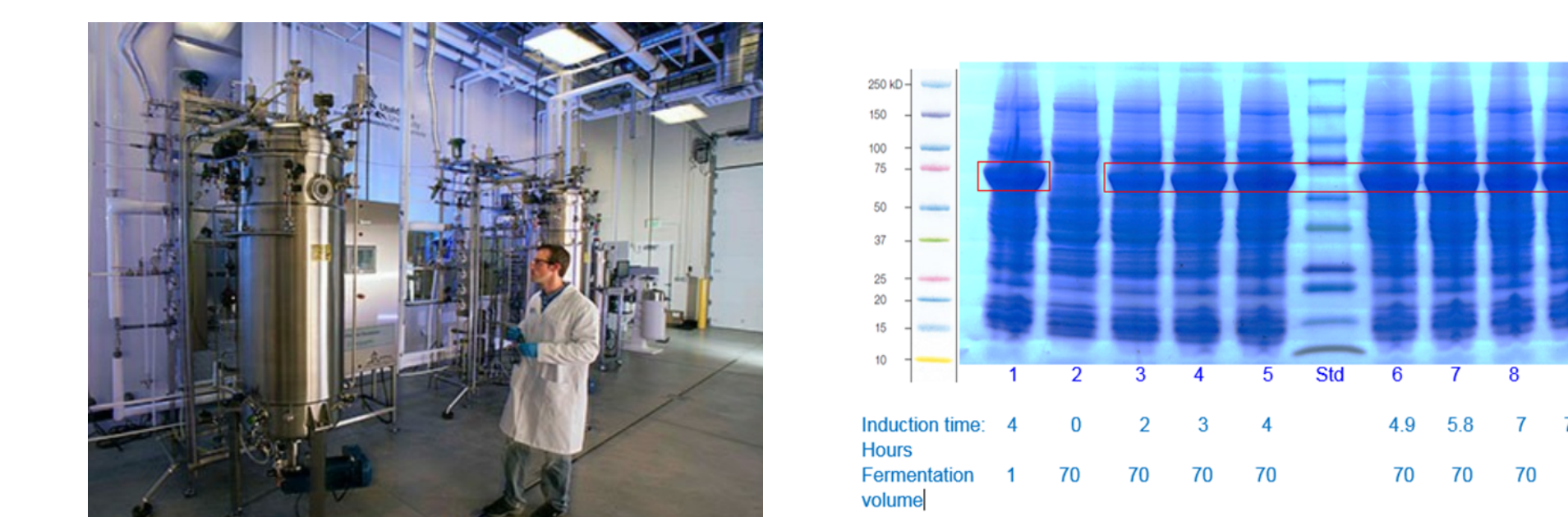
Host	Advantages	Disadvantages
Goats	High production	\$\$, difficult to scale, have to spin a fiber or make other material forms
Bacteria	Good production, scalable	Have to spin a fiber or make other material forms
Alfalfa	Scalable	Have to spin a fiber or make other material forms
Silkworms	Fiber, scalable	Other material forms not readily available



Top: Hagfish. Bottom Left: Hagfish slime with reinforcing thread keratins visible. Bottom Right: Hagfish thread skeins. Journal of experimental biology by Company of Biologists. Reproduced with permission of COMPANY OF BIOLOGISTS LTD. In the format Republish in presentation/slides via Copyright Clearance Center.



The hagfish thread keratins are composed of two proteins denoted alpha and gamma. Each alpha and gamma forms an alpha helix. Those two helices are then coiled around each other in a coiled-coil conformation. When the fiber is stretched, the coils convert to beta sheets giving the fiber remarkable strength. The question is, how can we recreate these proteins and structures synthetically?



Using synthetic biology, E. coli can be made to produce the hagfish alpha and gamma proteins. Left: 500L bioreactors. Right: SDS-PAGE demonstrating abundant production of the synthetic alpha and gamma proteins. Fiber generation, and other material forms are currently being explored!

## For More Information On:

Jones Lab

Spider Silk

Hagfish

