Spider Silk Entangles Evolution

By Hope
Age 18
Lives in Michigan
Home Schooled

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Introduction

Spider silk appears to the eye as delicate, fragile, and easy to destroy, but a closer look reveals the opposite. In reality, spider silk is one of the strongest natural materials on earth.[1] Spiders use silk for many different purposes, its remarkable properties have fascinated and intrigued man, and its origin defies evolution. This article will discuss the use of silk by spiders; its properties, composition, and production; and finally its origin. Could blind, biological chance create such a marvel of engineering or was a Marvelous Engineer involved? Examining the evidence will lead to the answer.

Spider Silk

All spiders produce silk. Some spiders can produce up to seven different kinds of silk, each for a different purpose.[2]Spiders use silk for a myriad of uses. The most familiar applications are in construction of webs, underwater homes, and egg sacs. It is also used for hunting, wrapping prey, as a lifeline for escaping predators or dispersing young spiders, and even as a source of food in some cases.[3, 4, 5] Spider silk is antimicrobial, hypoallergenic, and biodegradable.[6]

[1] "Why spider silk is stronger than steel," https://www.hamiltoncaster.com/Blog/EntryId/2099/Why-spider-silk-is-stronger-than-steel (Accessed April 29, 2023).

[2] "Spider silk," https://en.wikipedia.org/wiki/Spider_silk (Accessed January 16, 2023).

[3] Ibid.

[4] Tanveer Malik & Shyam Barhanpurkar, "Spider Silk - Properties and Uses," https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

[5] Lindzi Wessel, "Sticky Science: the Evolution of Spider Webs," https:/ /www.scientificamerican.com/article/sticky-science-the-evolution-of-spider-webs (Accessed February 23, 2023).

[6] Lin Römer & Thomas Scheibel, "The elaborate structure of spider silk," Prion 2(4) (October/November/December2008):154-161.

Although spider silk seems delicate and fragile, a closer look reveals that it possesses incredible strength, toughness, resilience,[7] ductility, and elasticity.[8] With strength defined as how much weight a material can bear and toughness the amount of kinetic energy a material can absorb without breaking, spider silk is, on a weight to weight basis, five times stronger than steel and three times tougher than Kevlar,[9] the strongest synthetic fiber.[10] Spider silk can absorb more than 100,000 joules of kinetic energy without breaking.[11] Its elastic and ductile properties allow it to stretch up to 40 percent of its original length, breaking only when stretched 2-4 times its length. It retains this incredible strength even at temperatures below -40 degrees F.[12]

Most spider silk is composed of proteins called spidroins.[13] Spidroins contain large amounts of the hydrophobic and nonpolar amino acids glycine and alanine.[14] The glycine and alanine amino acid pattern in the sequence is repeated over and over,[15] which confers toughness to spider silk.[16]

[7] "Spider Silk," https://www.kraiglabs.com/spider-silk (Accessed February 23, 2023).

[8] Tanveer Malik & Shyam Barhanpurkar, "Spider Silk - Properties and Uses," https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

[9] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

[10] Jonathan Sarfati, "God's web spinners give chemists free lessons," https://creation.com/god-s-webspinners-give-chemists-free-lessons-creation-magazine-spider-silk# (Accessed January 16, 2023).

[11] "Spider Silk," https://www.kraiglabs.com/spider-silk (Accessed February 23, 2023).

[12] Tanveer Malik & Shyam Barhanpurkar, "Spider Silk - Properties and Uses," https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

[13] Tyasning Kroemer, "Synthetic Spider Silk Production: Finding the Eco-Friendly Biofactory," https://goldbio.com/articles/synthetic-spider-silk-production-finding-the-biofactory (Accessed April 6, 2023).

[14] Lin Römer & Thomas Scheibel, "The elaborate structure of spider silk," Prion 2(4) (October/November/December 2008):154-161.

[15] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

[16] Tyasning Kroemer, "Synthetic Spider Silk Production: Finding the Eco-Friendly Biofactory," https://goldbio.com/articles/synthetic-spider-silk-production-finding-the-biofactory (Accessed April 6, 2023).

The structure of spider silk is a core surrounded by concentric layers of tiny strands called nanofibrils. Depending on the kind of spider silk, the nanofibrils may be parallel to the core or they may coil and spiral around the core.

Within the nanofibrils is an amorphous (shapeless) matrix made of tangled protein chains. Within this matrix, tiny protein crystals are electrically charged and keep the chains from slipping. This gives spider silk its strength. The matrix itself is rubbery, providing elasticity.[17]

The system in which this amazing silk is produced is located in the rear part of the spider's abdomen.[18] It consists of four main parts: the tail, the sac or ampulla, the S-duct, and the spinnerets.[19, 20]

Spider silk starts out as proteins, called spidroins, which are secreted from special cells in the tail. They are then stored in the ampulla, where other components are added.[21] From there, this pre-silk substance passes into the S-duct, where cells draw water away from the silk proteins. It then passes through an acid bath and from there into the spinneret glands, where it becomes a solid fiber.[22] The "spinning" of the silk occurs when this solid fiber is pulled out of the

[17] Jonathan Sarfati, "God's web spinners give chemists free lessons," https://creation.com/god-s-webspinners-give-chemists-free-lessons-creation-magazine-spider-silk# (Accessed January 16, 2023).

[18] Tyasning Kroemer, "Synthetic Spider Silk Production: Finding the Eco-Friendly Biofactory," https://goldbio.com/articles/synthetic-spider-silk-production-finding-the-biofactory (Accessed April 6, 2023).

[19] Lukas Eisoldt, Andrew Smith, & Thomas Scheibel, "Decoding the secrets of spider silk," Materials Today 14(3) (March 2011):80-88.

[20] Gordon Ramel, "Spider Silk 101: What's It Made Of And How Strong Is It?," https://earthlife.net/chelicerata/silk (Accessed April 11, 2023).

[21] Lukas Eisoldt, Andrew Smith, & Thomas Scheibel, "Decoding the secrets of spider silk," Materials Today 14(3) (March 2011):80-88.

[22] Remy Melina, "How Do Spiders Make Silk?," https://www.livescience.com/32582-how-do-spiders-make-silk.html (Accessed April 11, 2023).

spinnerets, either by the spider's legs, the weight of its own body when falling, or other methods.[23]

The spinnerets are crucial to the production of silk. Spiders possess from two to eight spinnerets, which usually appear in pairs.[24] Most spinnerets are very complex structures possessing microscopic spigots out of which comes the silk. Each spigot dispenses one filament of silk. These spigots can be singular or found in pairs, which enables spiders to combine several filaments in different ways to produce different kinds of silk. Without spigots, the necessary orientation of protein molecules in the silk would not occur, resulting in weak and useless silk. Without spinnerets, the pre-silk material would never become silk.[25]

Replicating spider silk

Due to its remarkable properties, spider silk has caught man's attention. With its strength, toughness, elasticity, etc., spider silk could prove valuable in the manufacture of cables,[26] bullet-proof vests, parachutes, fishing nets,[27] and many other useful items. It also has properties that would make it a suitable material for wound patches, sutures for internal wounds, and artificial tendons.[28, 29] Because of these possibilities, spider silk has been a target of industrial research.[30]

[23] "Spider silk," https://en.wikipedia.org/wiki/Spider_silk (Accessed January 16, 2023).

[24] Remy Melina, "How Do Spiders Make Silk?," https://www.livescience.com/32582-how-do-spiders-make-silk.html (Accessed April 11, 2023).

[25] "Spinneret," https://en.wikipedia.org/wiki/Spinneret (Accessed April 15, 2023).

[26] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

[27] Tanveer Malik & Shyam Barhanpurkar, "Spider Silk - Properties and Uses," https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

[28] Ibid.

[29] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

If there were a way to obtain large amounts of the silk, it could be used in commercial, industrial, and consumer applications to the benefit of mankind. However, spiders are cannibalistic and it is impossible to raise them in large quantities on farms to harvest silk from them.[31] Consequently, many attempts have been made to create spider silk artificially.

The most common method used to create artificial spider silk is genetic engineering and recombinant technology. These methods include putting the silk production genes of a spider into another living organism, so the genetically manipulated organism will produce spider's silk. Silk worms, bacteria such as *E. coli*, goats, plants such as the potato, tobacco, and alfalfa, yeast, and insect cells have all been used as hosts for creating spider silk by these methods.[32, 33, 34] Some of these, like silk worms and *E. coli*, have proven successful because usable silk has been produced by them.[35, 36]

This artificial silk, however, is not entirely equivalent to natural spider silk. It has been revealed that "Although synthetic spider silk is already being produced on an industrial scale and used in various products, it is not yet capable of mimicking the excellent mechanical properties of the

[30] Tanveer Malik & Shyam Barhanpurkar, "Spider Silk - Properties and Uses," https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

[31] "Spider Silk," https://www.kraiglabs.com/spider-silk (Accessed February 23, 2023).

[32] Ibid.

[33] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

[34] Lin Römer & Thomas Scheibel, "The elaborate structure of spider silk," Prion 2(4) (October/November/December 2008):154-161.

[35] "Spider Silk," https://www.kraiglabs.com/spider-silk (Accessed February 23, 2023).

[36] Alex Scott, "Spider Silk Poised For Commercial Entry," https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

natural blueprint."[37] In regards to one attempt, the silk was said to have "acted much like the real thing" but "it had lower toughness and tensile strength than its natural counterpart."[38]

Another attempt was made with raw natural materials instead of using a plant or animal host as in previous tries. Researchers at the University of Cambridge used hydrogel, which consists of 98 percent water and 2 percent silica and cellulose. They created an extremely strong fiber like spider silk, but it was still "not quite as strong as the strongest spider silks."[39]

In addition to the fact that artificial spider silk has not exactly replicated natural spider silk in its amazing properties, most of these artificial silks were created by genetic engineering and recombinant technology. This means that man has produced a material that mimics natural spider silk by using nature itself. And it was said concerning the silk that man created entirely synthetically, "The fibers are extremely strong—though not quite as strong as the strongest spider silks."[40]

Origin of Spider Silk

Spider silk is a remarkable and stunning marvel of nature. The silk-producing system is complex and highly specialized. Where did the spider get the ability to create silk stronger than steel and tougher than the toughest synthetic fiber? Where did the masterfully-designed silk-producing system come from? Most scientists would have you believe the spider and its ability to produce

[37] University of Würzburg, "New Research Finally Explains Why Spider Silk Is So Incredibly Tough," https://scitechdaily.com/new-research-finally-explains-why-spider-silk-is-so-incredibly-tough (Accessed March 23, 2023).

[38] Tia Ghose, "Strong, Flexible Spider Silk Created in Lab," https://www.livescience.com/57458-strong-spider-silk-produced.html (Accessed March 22, 2023).

[39] Emily Matchar, "New Artificial Spider Silk: Stronger Than Steel and 98 Percent Water," https://www.smithsonianmag.com/innovation/new-artifical-spider-silk-stronger-steel-and-98-percent-water-180964176 (Accessed April 5, 2023).

[40] Ibid.

silk was all the result of blind biological processes led by evolution. But another view is that God created and designed the spider.

Both views will be explored here. Then an analysis will be made to discover which view best fits the information and evidence.

Evolutionary Hypothesis

According to the evolutionary hypothesis, the first spiders possessing silk-producing spinnerets appeared around 310 million years ago (MYA). These spiders had eight spinnerets that were centered on the bottom of the abdomen, instead of being at the rear of the abdomen as in today's spiders. About 60 million years later (250 MYA), the first modern spiders appeared.[41] It is proposed that the first spiders used silk only in wrapping eggs and creating sperm webs. After that, they began lining burrows and making trip-lines with silk.[42] After 85 to 115 million years, modern spiders began to climb trees and other foliage in order to create webs to capture prey. Sometime during this time period, the spinnerets moved to the rear of the abdomen.[43]

Concerning the silk-producing system of spiders, evolutionists have little definite to say on its evolution. In the article "Evolution of Spiders and Silk Spinning," the author said, "In spite of the relevance of spinnerets, there is scarce knowledge about their development and evolution."[44] Despite this, several hypotheses have been proposed regarding the origin of spinnerets. One

[41] Thomas Swan, "The Evolution of Spiders and Their Remarkable Adaptations," https://owlcation.com/stem/Spider-Evolution-Adaptations-and-Ancestors (Accessed March 22, 2023).
[42] Gordon Ramel, "Spider Webs 101: The Evolution & Types Of This Engineering Marvel," https://earthlife.net/chelicerata/web-evolve (Accessed February 23, 2023).
[43] Thomas Swan, "The Evolution of Spiders and Their Remarkable Adaptations," https://owlcation.com/stem/Spider-Evolution-Adaptations-and-Ancestors (Accessed March 22, 2023).
[44] Pedro Mariano-Martins, Nancy Lo-Man-Hung, & Tatiana Teixeira Torres, "Evolution of Spiders and Silk Spinning: Mini Review of the Morphology, Evolution, and Development of Spiders' Spinnerets,"

includes the idea that spinnerets evolved from "climbing aids" on the feet.[45] Another suggests they evolved because of reproductive needs. Others propose a possible homology (similarity) between the spinnerets of spiders and the wings of insects and gills of crustaceans. Still others argue there is not enough evidence to infer such homology.[46] There is no evolutionary consensus on how spinnerets came to be. Here are a few more quotes from evolutionists concerning this:

"Unfortunately, the evolutionary origin of the silk producing system is currently poorly understood."[47]

"[T]he research on the origins and evolution of spinnerets is quite sparse, and knowledge gaps are largely open."[48]

"Though we may infer when spiders and their spinnerets arose, there is still no consensus on their morphological origins."[49]

Creation View

The creation view comes from the account in the Holy Bible. It records, "And God said, Let the earth bring forth the living creature after his kind,… creeping thing …after his kind: and it was so. And

[45] "Spinneret," https://en.wikipedia.org/wiki/Spinneret (Accessed April 15, 2023).

[46] Pedro Mariano-Martins, Nancy Lo-Man-Hung, & Tatiana Teixeira Torres, "Evolution of Spiders and Silk Spinning: Mini Review of the Morphology, Evolution, and Development of Spiders' Spinnerets," https://www.frontiersin.org/articles/10.3389/fevo.2020.00109/full (Accessed March 22, 2023).

[47] Maarten Hilbrant, "Development and Evolution of the Spider Silk Producing System," Ph.D. thesis, https://www.semanticscholar.org/paper/Development-and-Evolution-of-the-Spider-Silk-System-Hilbrant/9fee8fa9a17e3e8e55bdecef72614838bffe60bb (Accessed March 22, 2023).

[48] Pedro Mariano-Martins, Nancy Lo-Man-Hung, & Tatiana Teixeira Torres, "Evolution of Spiders and Silk Spinning: Mini Review of the Morphology, Evolution, and Development of Spiders' Spinnerets," https://www.frontiersin.org/articles/10.3389/fevo.2020.00109/full (Accessed March 22, 2023).

[49] Ibid.

God made …everything that creepeth upon the earth after his kind: and God saw that *it was* good." (Genesis 1:24-25)

This means that God, the divine Creator of all things, created the spider and its ability to produce silk. He created the silk itself. He put an instinct into every spider that teaches it how to create the right proteins, assemble them with all the other needed ingredients, turn that into silk, spin the silk, and then use it in many different ways for many different purposes.

God Himself describes the spider this way: "There be four *things which are* little upon the earth, but they *are* exceeding wise:… The spider taketh hold with her hands, and is in kings' palaces." (Proverbs 30:24, 28) The wisdom that this little creature possesses came from the source of all wisdom—Creator God.

Analysis in light of the Evidence

Spider silk shows incredible wisdom in its engineering, and the spider's ability to create silk is complex and specially designed. This masterful engineering, special design, and complexity suggest creation by an intelligent, divine Creator. The evolutionary hypothesis for the spider's origin is not based on fact or evidence but is purely supposition. Frequently, in an article called "Spider origins," the words "probably," "presumably," "perhaps," and "may have been" appear, indicating the great uncertainty surrounding the hypothesis.[50] There is no single theory concerning the evolution of the spinnerets, one of the most vital components of the silk-

[50] Mike Gray, "Spider origins," https://australian.museum/learn/animals/spiders/spider-origins (accessed March 22, 2023).

producing system, because there is no evidence coming from the spider that would indicate an evolutionary history. Even evolutionists admit "A great deal of what circulates out there is merely speculation. Until we find more evidence that we can show as fact the debate and doubts [sic] is going to continue."[51]

The fact that man has had such an extremely difficult time replicating spider silk speaks to its intelligent design. Humans are the most intelligent creatures on earth and they cannot replicate or unravel the secrets of spider silk that is supposed to have been made by blind, unguided biological processes. However, if God designed spider silk, it is no surprise that man has had a hard time replicating it and the evolutionists have had a hard time inventing a plausible evolutionary hypothesis for its origin.

Conclusion

Spiders possess an incredible system with which they create silk. The silk has amazing properties, some of which make it stronger than steel. Man has not yet been able to synthetically replicate spider silk and produce something that is equal to the natural material in all of its remarkable abilities and properties. The evidence from the spider and its silk does not suggest or support an evolutionary history, but it clearly confirms the accuracy of the Bible's account of special design and creation by God. Spiders and their silk glorify and point to their divine Creator.

[51] "Spider Evolution," http://spidersworlds.com/spider-evolution (Accessed April 27, 2014).

Bibliography

"Spider Evolution," http://spidersworlds.com/spider-evolution (Accessed April 27, 2023).

"Spider silk," https://en.wikipedia.org/wiki/Spider_silk (Accessed January 16, 2023).

"Spider Silk," https://www.kraiglabs.com/spider-silk (Accessed February 23, 2023).

"Spinneret," https://en.wikipedia.org/wiki/Spinneret (Accessed April 15, 2023).

"Why spider silk is stronger than steel," https://www.hamiltoncaster.com/Blog/EntryId/2099/Why-spider-silk-is-stronger-than-steel (Accessed April 29, 2023).

Eisoldt, Lukas, Andrew Smith, & Thomas Scheibel, "Decoding the secrets of spider silk," Materials Today14(3) (March 2011):80-88.

Ghose, Tia, "Strong, Flexible Spider Silk Created in Lab," https://www.livescience.com/57458-strong-spider-silk-produced.html (Accessed March 22, 2023).

Gray, Mike, "Spider origins," https://australian.museum/learn/animals/spiders/spider-origins (accessed March 22, 2023).

Hilbrant, Maarten, "Development and Evolution of the Spider Silk Producing System," Ph.D. thesis, https://www.semanticscholar.org/paper/Development-and-Evolution-of-the-Spider-Silk-System-Hilbrant/9fee8fa9a17e3e8e55bdecef72614838bffe60bb (Accessed March 22, 2023).

Kroemer, Tyasning, "Synthetic Spider Silk Production: Finding the Eco-Friendly Biofactory," https://goldbio.com/articles/synthetic-spider-silk-production-finding-the-biofactory (Accessed April 6, 2023).

Malik, Tanveer, & Shyam Barhanpurkar, "Spider Silk - Properties and Uses,"

https://www.researchgate.net/publication/326668967_Spider_Silk-Properties_and_Uses_Spider_Silk-Properties_and_Uses (Accessed February 23, 2023).

Mariano-Martins, Pedro, Nancy Lo-Man-Hung, & Tatiana Teixeira Torres, "Evolution of Spiders and Silk

Spinning: Mini Review of the Morphology, Evolution, and Development of Spiders' Spinnerets,"

https://www.frontiersin.org/articles/10.3389/fevo.2020.00109/full (Accessed March 22, 2023).

Matchar, Emily, "New Artificial Spider Silk: Stronger Than Steel and 98 Percent Water,"

https://www.smithsonianmag.com/innovation/new-artifical-spider-silk-stronger-steel-and-98-percent-water-180964176 (Accessed April 5, 2023).

Melina, Remy, "How Do Spiders Make Silk?," https://www.livescience.com/32582-how-do-spiders-make-silk.html (Accessed April 11, 2023).

Ramel, Gordon, “Spider Silk 101: What’s It Made Of And How Strong Is It?,” https://earthlife.net/chelicerata/silk (Accessed April 11, 2023).

Ramel, Gordon, “Spider Webs 101: The Evolution & Types Of This Engineering Marvel,” https://earthlife.net/chelicerata/web-evolve (Accessed February 23, 2023).

Sarfati, Jonathan, “God’s web spinners give chemists free lessons,” https://creation.com/god-s-

webspinners-give-chemists-free-lessons-creation-magazine-spider-silk# (Accessed January 16, 2023).

Scott, Alex, “Spider Silk Poised For Commercial Entry,” https://cen.acs.org/articles/92/i9/Spider-Silk-Poised-Commercial-Entry.html (Accessed March 22, 2023).

Swan, Thomas, “The Evolution of Spiders and Their Remarkable Adaptations,” https://owlcation.com/stem/Spider-Evolution-Adaptations-and-Ancestors (Accessed March 22, 2023).

University of Würzburg, “New Research Finally Explains Why Spider Silk Is So Incredibly Tough,”

https://scitechdaily.com/new-research-finally-explains-why-spider-silk-is-so-incredibly-tough (Accessed March 23, 2023).

Römer, Lin, & Thomas Scheibel, “The elaborate structure of spider silk,” Prion 2(4) (October/November/December 2008):154-161.

Wessel, Lindzi, “Sticky Science: the Evolution of Spider Webs,” https://www.scientificamerican.com/article/sticky-science-the-evolution-of-spider-webs (Accessed February 23, 2023).