Problem & Solution: Circulation — *Insert Miracle Here*

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If you want to water your grass, any number of sprinklers or branching sprinkler systems would work just fine. But let's say you wanted to water every blade of grass individually and to the same extent. That would be a problem that needed a very specialized and meticulous engineering solution.

This problem is similar to the one faced by the human body which needs to continuously provide oxygen and nutrients to and remove waste from every one of its one hundred trillion cells. We are told that the solution to this problem, a closed circulatory system under positive pressure from the heart that branches into minute vessels called capillaries, came about by unguided chance and natural selection. But this idea seems even more miraculous than the actual solution provided by the Creator which so wonderfully meets our needs.

A branching network from a single large aorta to smaller and smaller arteries, arterioles, and finally microscopic capillaries permits the surface area for gas and waste exchange to become very large while occupying a small volume. Thus, virtually every cell in the body can be reached by blood. In about 30 levels of branching, the surface area of the aorta compared to that of the capillaries increases 1000-fold, and the pressure and speed of blood flow decreases by 1000-fold.[1] This provides sufficient surface area and time for gas and waste exchange to occur efficiently. So, a branching network is the first key design element of the solution to our problem.

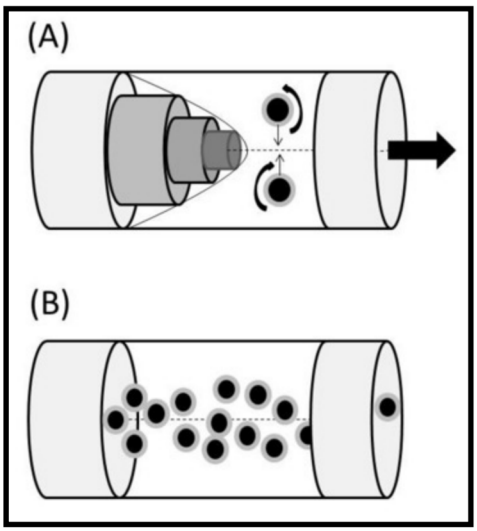

FIGURE 1. (A) Illustration of fluid dynamics. Because of friction at the inner surface of the blood vessel, blood-flow velocity is greater at the center. As a result, the individual blood cells spin. (B) Axial streaming arises as a consequence of the accumulation of blood cells at the center of the vessel.
After Denny and McFadzean, 2011, page 53 (ref. 1).

The other key element of the solution is blood. Blood is composed of 45% by volume of cells. This makes the viscosity of blood about twice that of water to begin with, accentuating the problem of flow in small vessels. But even if blood were just pure water, like our example of a sprinkler system, the turbulence caused by branching and the cumulative friction of water molecules against the large capillary surface area would require a pump with power far beyond that of our heart. Instead, — *insert miracle here* — because blood behaves as a non-Newtonian fluid containing cells, and because of how these cells flow through small vessels, the resistance to flow in these small vessels actually goes ***down*** rather than up!

In small blood vessels water flows more swiftly in the center than at the edges, which causes blood cells to spin. This spin, in turn, causes blood cells to group along the centerline of the vessel, away from the friction-generating vessel wall. Called the *Magnus effect*, the result is axial streaming of blood cells which actually ***reduces*** blood viscosity in very small diameter vessels.[1] This is a very good thing for us, and somewhat miraculous when appreciated as both the elegant and precise solution to the problem of using blood flow in tiny vessels as the means of gas and waste exchange. This perfect physiologic solution is, in my view, yet another evidence of the Creator's magnificent engineering prowess, as well as His great love for us.

Reference

1. Denny, M and A McFadzean. 2011. *Engineering Animals – How Life Works.* The Belknap Press of Harvard University Press. Cambridge, MA.

Spider Food

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and Design in the World of Spiders. Coachwhip Books, Landisville, PA.

Brown, F, S.R. Driver, and C. Briggs. 1906. BDB-GESENIUS *Hebrew-Aramaic and English Lexicon of the Old Testament*. Complete and unabridged. BibleWorks v. 7 (2007).

Eggs, B. and D. Sanders. 2013. Herbivory in spiders: the importance of pollen for orb-weavers. *PLoS One* 8(11):e82637.

Harris, R. L., G.L. Archer, and B.K. Waltke. 1980. TWOT — *The Theological Wordbook of the Old Testament*. BibleWorks v. 7 (2007).

Holladay, W.L. (ed). 1997. *A Concise Hebrew and Aramaic Lexicon of the Old Testament, Based upon the Lexical Work of Ludwig Koehler and Walter Baumgartner*. BibleWorks v. 7 (2007).

Lightner, J.K. 2009a. Karyotypic and allelic diversity within the canid baramin (Canidae). *Journal of Creation* 23(1):94–98.

Lightner, J.K. 2009b. Curious patterns of variation within the Anatidae monobaramin and implications for baraminological research. *Occasional Papers of the BSG* 13:5.

Lightner, J.K. 2009c. Gene duplications and nonrandom mutations in the family Cercopithecidae: Evidence for designed mechanisms driving adaptive genomic mutations. CRSQ 46(1):1–5.

Lightner, J.K. 2010. Gene duplication, protein evolution, and the origin of shrew venom. *Journal of Creation* 24(2):3–5.

Lightner, J.K. 2015. Matters of Fact … Are insects alive? *Creation Matters* 20(1):4–5.