Question: "What is Irreducible Complexity?"

Answer: Irreducible complexity is a term used to describe a characteristic of certain complex systems whereby they need all of their individual component parts in place in order to function. In other words, it is impossible to reduce the complexity of (or to simplify) an irreducibly complex system by removing any of its component parts and still maintain its functionality.

Professor Michael Behe of Lehigh University coined the term in his seminal work *Darwin's Black Box*, 1996. He popularized the concept by presenting the common mousetrap as an example of irreducible complexity. A typical mousetrap is made up of five integral parts: a catch, a spring, a hammer, a holding bar and a foundation. According to Behe, if any of these parts are removed without a comparable replacement (or at least a significant restructuring of the remaining parts), the entire system will fail to function. Professor John McDonald of the University of Delaware has disputed the irreducible complexity of the mousetrap. McDonald has created an online flash presentation to illustrate his argument (see A reducibly complex mousetrap at http://udel.edu/~mcdonald/oldmousetrap.html). Behe has published a rebuttal to McDonald's polemic, also online (see A Mousetrap Defended: Response to Critics at http://www.arn.org/docs/behe/mb_mousetrapdefended.htm). And so the debate over the mousetrap rages on. But this is beside the point. Whether or not the mousetrap is truly irreducibly complex is not the heart of the issue. The heart of the issue is the concept of irreducible complexity itself.

The otherwise benign concept of irreducible complexity incites fierce controversy when it is applied to biological systems. This is because it is seen as a challenge to Darwinian evolution, which, needless to say, remains the dominant paradigm in the field of biology. Charles Darwin conceded, "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down" (*Origin of Species*, 1859, p. 158). Behe argues, "An irreducibly complex system cannot be produced directly (that is, by continuously improving the initial function, which continues to work by the same mechanism) by slight, successive modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a part is by definition nonfunctional" (*Darwin's Black Box*, 1996, p. 39).

It should be noted that by "nonfunctional" Behe does not mean that the precursor cannot serve any function – a mousetrap missing its spring can still act as a paperweight. It just cannot serve the specific function (catching mice) by means of the same mechanism (a spring-loaded hammer slamming down upon the mouse).

This leaves open the possibility that irreducibly complex systems can evolve from simpler precursors which serve other unrelated functions. This would constitute indirect evolution. Behe has conceded that "if a system is irreducibly complex (and thus cannot have been produced directly), however, one can not definitely rule out the possibility of an indirect, circuitous route" (ibid, p. 40).

In keeping with the mousetrap analogy, while a five-piece spring-loaded mousetrap couldn't evolve directly from a simpler, nonfunctional version of itself (and remain in line with Darwin 's concept of evolution by means of natural selection), it might evolve from a four-piece paperweight. Thus, according to Behe, a more effective, more complex mousetrap evolving from a simpler version of itself would constitute direct evolution. A complex mousetrap evolving from a complex paperweight would constitute indirect evolution. Irreducible complexity is seen as a challenge to direct evolution.

It should also be noted that evolution by means of natural selection does not solely act to complicate precursory systems. It can also simplify them. Thus, Darwinian evolution can

produce irreducible complexity by working backwards. Consider the popular game Jenga, a game wherein players remove wooden bricks from a tower until it collapses. The tower begins with 54 wooden bricks. As players remove the bricks, the tower reduces in complexity (that is, there are fewer and fewer parts) until it becomes irreducibly complex (that is, if any more bricks are removed the tower will collapse). This illustrates how an irreducibly complex system might evolve indirectly from a more complicated system.

Behe argues that the less complicated an irreducibly complex systems is, the more likely it is that it could have evolved along an indirect route (that is, either by evolving from a simpler precursor which served a different function or from a more complicated precursor which lost parts). Conversely, the more complicated an irreducibly complex system is, the less likely it is that it could have evolved along an indirect route. According to Behe, “As the complexity of an interacting system increases, though, the likelihood of such an indirect route drops precipitously” (ibid, p. 40).

Behe cites the e coli bacteria’s flagellar system as an example of a complicated irreducibly complex system which he believes could not have evolved directly (because it is irreducibly complex) and most likely did not evolve indirectly (because it is extremely complicated). The e coli flagellar system is an incredible microscopic outboard motor which e coli use to move around in their environment. It is made up of 40 individual, integral parts including a stator, a rotor, a driveshaft, a u-joint, and a propeller. If any of these parts are removed, the entire system will fail to function. Some of the flagellum's components exist elsewhere in the microscopic world. These parts also function as part of the Type III transport system. Thus, they could have been borrowed from a Type III transport (a process known as cooption). However, the majority of the e coli's flagellar components are unique. They require their own evolutionary explanation, which, as of yet, s enigmatic.

There has been tremendous opposition to irreducible complexity from within the Darwinist camp. Some of this criticism is valid, some is not. Likewise, one must be careful to investigate the claims made by proponents of irreducible complexity. Some of the biological examples which proponents cited early on appear now to be reducible. This does not nullify the concept itself, nor does it negate actual examples of irreducibly complex biological systems (like the e coli bacterial flagellum). It just goes to show that scientists can make mistakes, just like everyone else.

In summary, irreducible complexity is an aspect of the Intelligent Design Theory that argues some biological systems are so complex and so dependent upon multiple complex parts, that they could not have evolved by chance. Unless all the parts of a system all evolved at the same time, the system would be useless, and therefore would actually be a detriment to the organism, and therefore, according to the "laws" of evolution, would be naturally selected out of the organism. While irreducible complexity does not explicitly prove an intelligent Designer, and does not conclusively disprove evolution, it most definitely points to something outside of random processes in the origin and development of biological life.