



## Science Observations: How could Darwin think of such a thing!

Shortly after Darwin published his book On the Origin of Species in 1859, a firestorm of controversy raged around the world in the scientific community, which was to spread into everyday life. Darwin's book introduced his theory, the "principle of natural selection," into the debate about biological evolution occurring throughout the world of his day.

Not many people realize today that the evolution debate had been going on for well over a century before Darwin's book. Supernatural and mostly untestable (in the 1700s and early 1800s) natural explanations had been offered, many times with a mixture of the two. Darwin's theory marked a new era in biologic science. It is interesting to note that his theory was based upon observations of life around him and not as much on fossils and the fossil record, and with no supernatural element at all.

Just what did he observe that led him to think of such a idea? Actually his theory embodied no fundamentally new ideas, but combined previously discussed biological concepts in a fresh and convincing way, carrying them out to their logical conclusion. There were four concepts of life which were the basis for his over-all theory that explained the process of evolution in his eyes, and they were:

1. Organisms produce more offspring than will survive to reproduce.
2. Individuals of a species vary more or less among themselves in form (*variability - no two individuals are exactly alike, each having differences from others*).
3. Competition for survival, food, living space, and mates (*eat-survive-reproduce*) results in the relentless elimination of the weaker and less well-adapted individuals.

*(The three observable concepts above account for the principle of natural selection, which has also been called "survival of the fittest.")*

4. The "favorable" traits of the survivors are inheritable, passed on to their offspring. Darwin could observe this inheritability, but could not explain the biological mechanism that allowed this. Today we call that mechanism "genetics."

The four concepts above you can readily observe in the world today. Working together, they logically led Darwin to his theory for a totally natural explanation for evolution which accounted more realistically for the gradual changes in the characteristics of a population. Over time, these changes might result in a population's transformation into a new and different species. This totally natural explanation, with evidence, accounted for the initial firestorm of reaction. Still, how did this natural process begin? Darwin did not try and explain that, just a natural process that is part of our world.



## **An Intriguing Idea!** (Inspired by the book Darwin's Dangerous Idea, by Dale Dennett)

**Algorithm – (broadly put) a step-by-step procedure or process for solving a problem, or accomplishing some end, that frequently involves repetition of an operation.**

A recent idea about Darwin's famous theory, biological evolution via the process of natural selection, seems fantastic at first glance. Natural selection may act as an algorithm! (No way!) ... Okay, let's consider an example of an algorithm. In math, each time you do long division you input some numbers and follow a very specific process of calculation to determine an outcome. This process of long division is an algorithm. The process is not dependent on which numbers you wish to divide. Its purpose is to divide numbers. And guess what? Algorithms are not confined to mathematics.

Expanding our notion of algorithms - some could be based entirely on chance. Suppose you gather a group of people together (1,024 in fact) with the purpose of finding the one and only person in that group who will win ten coin flips in a row. How would you find that person? Use an algorithm. Set up tournament brackets, split the group into pairs and have 512 head-to-head coin flips where the winners move on to the next bracket in the tournament and the losers are out. You will conduct ten rounds (or brackets) of flipping the coin, the winners moving on in the tournament. The last bracket in this algorithm will pit two people against each other, the winner the person you were looking for – someone who will win ten coin flips in a row.

Do you suppose that winner (in this case, Sally) has a special ability that would allow her to continue to win coin flips? (Sally is probably thinking she has a special ability or gift.) If you ran the tournament again from the start would Sally end up as winner again? What are her chances, high, or very low? The results of this tournament algorithm were affected primarily by chance.

Now suppose we set up a tournament for tennis with the same number of people participating as above. We want to find the person who will win ten tennis matches in a row. Is this tournament based upon pure chance or could some skill play a part in the outcome? If the 1,024 people we start with have several tennis professionals mixed in, along with baseball players, lawyers, teachers, some of your classmates and relatives, and others ... what people are most likely to make it to the final few brackets, or win the tournament? Sure, your little brother has a chance of winning this tournament, but how likely is that? Does his skill at tennis have anything to do with his chances? This tennis tournament's bracket is an algorithm where a skill or ability gives an individual an advantage. It's not up to pure chance, and the winner is not a sure thing. Even if the number one tennis player in the world participated that person is not guaranteed to win (everyone has a bad day now and then).

So if life evolved over time subject to "natural selection" (sometimes called "the survival of the fittest"), and this natural selection process is an algorithm, what might be the characteristics, the specific process, of this particular algorithm. Is it based purely on chance? ... Hardly. Perhaps the algorithm is as simple as a process for determining what organisms can best ... eat and survive until they successfully reproduce, mixed with a certain element of chance (sort of a "tournament of life"). The prize for success is species survival. Over time, the losing populations may face extinction.

Scientists are studying this new idea, but the process of evolution as an algorithm, if accurate, does beg a question. Do you realize how fortunate you are to be alive? (that unique individual with your name) That means that for the last 3.5 billion years of life, from the first single-celled organism to you, every parental ancestor you had was successful at reproducing or competing for a mate to produce a descendent! Countless generations of your lineage have "won" each of their "brackets" within the algorithm of natural selection, resulting in you. Was it all just dumb luck, or did other factors play a part? Was that result a given from the start? Can we really answer those questions?