Evolution Final

Ana Perez

California State University, Stanislaus

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Dr. Jeanette Pirlo

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When one defines evolution, it is important to keep in mind that this concept plays a role in multiple subjects and understanding each one of these is necessary to comprehend what evolution really is. Organisms evolving into different species and surviving through endless obstacles does not occur out of nowhere, subjects like microevolution, macroevolution, fossil records, adaptation, molecular evolution and many others are the cause of evolution. Equally important, evolution is a topic where we learn and discover new things everyday, which will forever be changing the way we understand it. Evolution can be defined by the modification of organisms into new, better adapted species that are surviving in their current environment.

For starters, microevolution is affected by many factors but a main one is natural selection acting on a population, making the frequency of alleles change over a period of time. These changes occur due to the environment that the organisms live in and the most fitted individuals will be able to survive and reproduce to pass on their genes to their offspring (Reznick and Ricklefs, 2009). Natural selection will act in all types of organisms, an example of this mechanism is how the immune response of different populations react to a variety of pathogens. We are able to see more of the genes that transcribe for stronger immunity to pathogens in African countries versus Europeans countries (Nédélec et al, 2016). Over a period of time, natural selection acted upon the genes that were not capable of surviving and preferred those who were the most fitted, thus changing the frequency of alleles in the population of Africa. Second, macroevolution is different in the fact that it is acting above the species level. A factor contributing to macroevolution is the speciation of organisms bringing to life the wide variety of diversity seen on earth (Ranosky, 2013). Though speciation occurs over a long period of time, we often find this mechanism occurring on organisms that frequently disperse, specifically animals like birds. These flying vertebrates are capable of multiple behaviors that not

many organisms can do, making their drive for speciation much higher (Uy J. et al, 2018). Aves are a taxonomic group with one of the biggest diversity, setting an example for macroevolution.

Identically, the adaptation of organisms to their environment reveal how their evolutionary lineage allowed them to thrive in the daily challenges they encountered. Organisms are constantly exposed to changes in their environment and population, and only those capable of rapidly adapting will be able to pass on their genes (Bähler, 2008). A major example of adaptation that we see everyday is organisms adapting to climate change. As time progresses, all life forms, including humans, must adapt to the increasing heat and solar radiation that penetrates planet earth (Atkins and Travis, 2010). Since climate change is one of the biggest threats in our daily life, we will see many species go extinct, but we will also encounter species that quickly adapt to these changes. In addition, our understanding of evolution has improved ever since the discovery of molecular genetics. This important characteristic has explained and proved many theories rewarding how and why today's organisms function the way they do (Clark and Otto, 2002). A significant example of molecular evolution is the way mutations have helped bacteria and viruses quickly adapt to their everyday changing environment. As humans try their best to stop bacteria from affecting us, these amazing yet very dangerous microorganisms are able to adjust to our antibacterial drugs and keep reproducing to pass on their now, better fitted genes (Hershber, 2015). Mutations are a factor in evolution that accounts for the adaptation of organisms to suit their environment, but they are also the reason why many species are not successful in their population and eventually go extinct.

In the same way, our knowledge in evolution would be nowhere without the incredible fossil records of past organisms. Without these pieces of evidence, the theory of evolution would be almost impossible to prove. Studying the history of evolution through paleontology helps us

understand how today's organisms came to be and more importantly, it informs us about those extinct creatures that used to walk the earth way before we got here (Wilson, 2013). The fossil record shapes the evolution of phenotypic traits, and while it cannot answer every question, it is the development of most theories in evolution. As humans, the drive of knowledge has led us to be one of the best fitted organisms on earth, with an incredible advantage to others. It is for this reason that discovering where our old ancestor's center of origin is, will help shape our grasp of human evolution and might help resolve many health related issues, as well as others (O'Higgins et al, 2006). As we can see, fossil records are a contributing factor to defining evolution and we have yet to find more of these pieces in order to complete the different puzzles that our ancestors have left behind.

In general, our concept of evolution has changed as time has progressed. The first ideas began with the influence of Aristotle, where he stated that living things progressed in a linear fashion, from most simplest to most complex and reflected the actions of a higher power. As time went on, more theories talked about the possibility of spontaneous generation, where organisms were created due to "powers of nature", without any meaning to them (Pirlo, 2023a). The theory of evolution was not really understood until Charles Darwin and Alfred Russel Wallace, two incredible naturalists that traveled around the world and were able to observe and differentiate organisms in completely opposite sides of earth. Most importantly, they were the ones who discovered and explained one of the most important mechanisms in evolution; natural selection (Pirlo, 2023b). Even though Darwin and Wallace made one of the greatest impacts in evolutionary science, once again the fossil record has also been one of the most and greatest contributions to our concept of evolution, an example of this is the development and adaptations of horses. Evolution was thought to happen in a linear fashion, meaning that speciation only

occurred one organism at a time, this is also known as orthogenesis. Due to the incredible and well preserved fossils of horses, these helped us understand that speciation does not occur in a linear manner, but occurs in a way where many organisms speciate from a single individual at the same time (MacFadden et al, 2012). Overall, understanding how and why evolution is happening has helped us answer many questions in science and for this same reason is important to continue our curiosity to discover unresolved issues in evolution.

Furthermore, while evolutionary science has come a long way and many ideas were resolved because of it, there are a lot more things yet to be discovered and answered. For starters, in spite of the fact that we have found much evidence and hypotheses for the origin of life, we are still unsure how life on earth first originated. There are many suppositions as to what was the very first source that gave rise to every organism that has evolved until now and if life started simply from organic matter and how did something so microscopic bring us to where we are now (Orgel, 1998). Though questions like these are important, they are difficult to answer due to the fact that there are not many fossil records from when earth first was created, and if there are, they have yet to be discovered. As technology continues to advance, there's the possibility that this might help us understand more of the origin of life, and answer the question; who is our very first ancestor that started it all? (Woese, 1998).

In conclusion, in order to define evolution multiple ideas have to be explained to truly understand how living organisms have evolved throughout the years since earth first originated. Evolution can be defined as the adaptation and speciation of living things to better fit their environment in order to continue passing on their genes. Multiple mechanisms play a role in evolution, including microevolution, macroevolution, molecular evolution, fossil records and

adaptations. Ultimately, our concept of evolution has changed and will continue to change overtime as we discover greater ideas that result in the process of evolving into better life forms.

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Extra Credit

The most interesting topic covered this semester was learning about molecular evolution! It never occurred to me that due to mutations, organisms were able to change their phenotypes so drastically. I now understand that evolution does occur very slowly, and that multiple mutations and other factors about genetics have to accumulate in order to speciate a new organism. My question is, if mutations didn't occur at all, would there be any evolution at all? I believe the answer to this question is no; there is no other way for organisms to adapt into better beings; everything about evolution revolves around genetics and how every gene in our cells will code for crucial traits in order to survive. Overall, natural selection, genetic drift, genetic flow and adaptations are all due to our genetic code. There are no known organisms today (I believe) that have never had mutations happen to them, therefore mutations are crucial to evolution.