

Submission Guidelines

Collaborate with your team on your case study presentation. When it is complete, the team leader is responsible for submitting it in the Assignment Lab, or for making sure that another team member submits it. Please note that all learners should visit the assignment lab and provide feedback on at least 2 other team presentations, before the deadline.

As a reminder, your presentation should:

1. Be limited to no more than 750 words
2. Engage the materials in the case studies, lectures, and text.
3. You are free to import material from outside the course, but this is not necessary and may detract you and teammates from the task. Don't go overboard!

Instructions

Step 1: Read the case study introduction, background information, and the primary sources below.

Step 2: Work with your team to answer the challenge question for this case study.

Step 3: Go to the Assignment Lab to post your response, and to read and comment on other learners' submissions.

Track B, Case study 4: Charles Darwin and a new understanding of life

STEP 1

Case Study Introduction

Here we will focus on some of the contributions and impacts of British naturalist Charles Darwin, whose ideas profoundly shaped not only science, but every sphere of life. Darwin's descriptions of change over time and evolution showed that life developed through increasing complexity and diversity over millions of years. This raised questions about the basis of knowledge, belief, and understanding, and challenged the idea that faith alone could lead to enlightenment. It also showed the web of interrelated life, with humans a part of the animal kingdom rather than divinely appointed. Darwin's writings also had unintended consequences: some of his ideas were used to justify social inequalities and imperialism. This foregrounds the question of how science is sometimes used for political and socio-economic ends.

Background Information

In 1831 Charles Darwin (1809-1882), a British scientist, set sail as the ship's naturalist of the HMS *Beagle*. The nearly five-year journey by ship, with extensive land exploration, would change both Darwin and scientific understanding of the world we inhabit and the complex interrelationships of living species. Darwin visited diverse lands and people and came to see the world in new ways.

Based on his explorations, collections, experiences, and observations, Darwin would upon his return to Britain propose a cogent argument that would refocus scientific understanding and method. In his 1859 book *The Origin of the Species by Natural Selection* and in later works, Darwin showed that species evolve to best survive the environments in which they exist, that current species have developed from different forms of life spanning the distant past, that humans are a part of this wider evolutionary tree, and that natural selection leads to the survival of those life forms that adapt most successfully. The voyage of the *Beagle* remains one of the most renowned and impactful scientific journeys in history.

Back in Britain, fueled by new ideas, informed by the detailed daily observations he had written while travelling, and equipped with thousands of natural specimens of flora, fauna, and fossils that he had collected from around the world, Darwin sat down to formulate his thoughts and communicate his discoveries. He was convinced that life evolved over time based on natural laws and had not come into being in a single,

anthropocentric act of creation by God. Darwin argued that every living thing is part of the organized complexity of life: if we think rationally we can derive its origins from simple beginnings by comprehensible, universal means.

Central to Darwin's argument was the idea of abundance: populations will produce more individuals that can be supported by the available food supply, a 'struggle for existence' that will lead the inevitable death of the less adaptable species (and, within species, members of the species). This 'economy of nature' is a reality that allows the fittest to survive.

Darwin's ideas caused passionate and widespread debate shortly after the publication of his book. Indeed, they still resonate today, with faith-based 'creationists' arguing against science and vehemently against the theory of evolution. Unfortunately, even while Darwin was still alive certain people saw the opportunity to misappropriate and use his theories to justify labor exploitation and imperialism, beliefs refuted by Darwin himself.

In considering the world-changing significance of Charles Darwin's contributions, we should also consider how science, and anti-science, is used for political and financial purpose. Darwin's new understanding of the world allowed for a deeper, more complex, profound, and interrelated scientific engagement with knowledge and life to emerge. It unseated religion from its position of interpreter of the origins and meaning of life and situated humans within a broader web of life. Darwin brought a sample of the range, abundance, and magnificence of the natural and fossil world back to Europe; ironically he also equipped Europeans with a new world view and belief system that would justify, for some nations, the conquest, subjugation, and exploitation of the very world that had inspired him.

The Case Study

This case study shows how the insights and experiences of an inquisitive globe-travelling scientist fundamentally changed human conceptions of the history of the world, and of our place in the universe. It asks you to think about how scientific discoveries can threaten established social arrangements and power hierarchies, and what the stakes are for political and religious elites in supporting or refuting particular world-views. You can contrast this with the attempt of science to seek rational, universal, provable answers to questions about existence. This case study should inspire you to think of your own beliefs about the origins of life and complex interrelationships of species. Perhaps you will think of how and when your beliefs and opinions were formed, about whether they are based on faith or reason, and about what differentiates science from less objective world-views, and why differences of belief continue to polarize people today. You can think about these questions particularly in light of historical developments, questioning how belief in science or faith may have influenced the decisions, actions and interactions of communities and individuals.

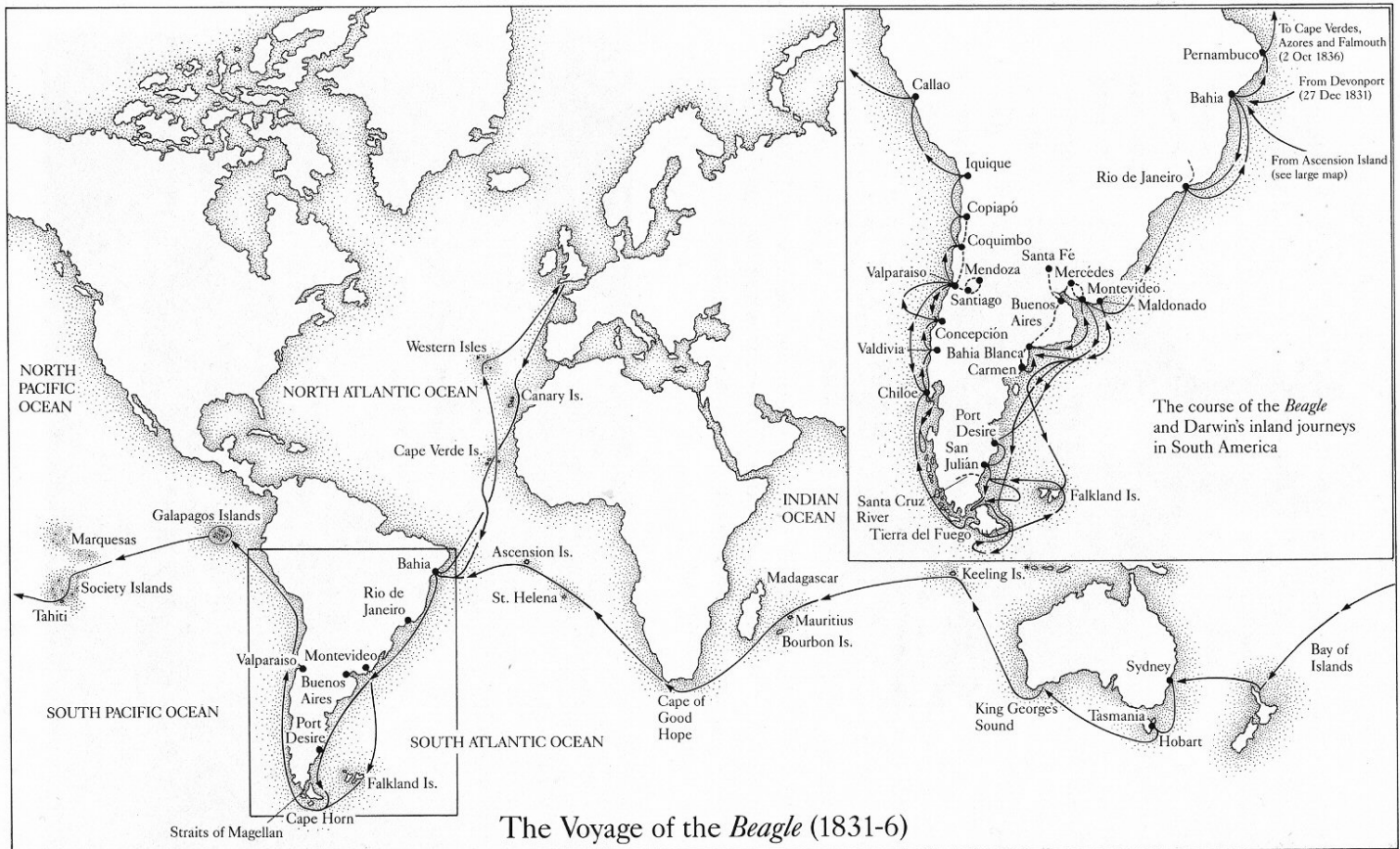
Primary Sources

Please refer to these primary sources, provided below, for this case study:

1. The Voyage of the HMS Beagle (route map), 1831-36
2. “Quarter Deck of a Man of War on Diskivery [*sic*] or interesting Scenes on an Interesting Voyage” by Augustus Earle, 1832
3. Darwin’s writings on natural selection based on observation of Galápagos finch species
4. ‘Tree of Life,’ from the notebooks of Charles Darwin, 1837
5. *Man Is But a Worm*, Linley Sambourne's 1881 cartoon for *Punch's Almanack* for 1882
6. Extracts from Charles Darwin’s 1859 book, *The Origin of Species by Means of Natural Selection*

Primary Source One: The Voyage of the HMS Beagle (map), 1831-36

This map shows the route taken by the HMS Beagle for its voyage of 1831-1836 with Charles Darwin serving as the ship's naturalist.



Source: Steven Carr, http://www.mun.ca/biology/scarr/Voyage_of_the_Beagle.jpg. Public domain.

COMPASS POINTS

- Note the number of stopping points (indicated by black dots along the route). Think about how experiencing each of these places would have exposed Darwin to an increasing diversity of plants, animals, people, landscapes, and ecosystems, and how this would have shaped Darwin's thinking.
- Many stopping points were disembarkation points from which Darwin left the ship to explore inland, sometimes for weeks at a time.
- Look at the number of islands that the ship stopped at. These presented unique eco-systems as they were 'worlds apart' and their isolation led to the evolution of unique and well-adapted species, which Darwin noted.

Description

This image is a world map tracing the voyage of the ship, the HMS Beagle, from 1831 to 1836. Starting in Britain, the map indicates a route past the Canary Island and the bulge of Africa, stopping at the Cape Verde Islands and then going to Bahia in Brazil. From Bahia the Beagle sailed to Rio de Janeiro, Monte Video, Buenos Aires, Port Desire, and down to Cape Horn and the Starits of Magellan at the southern-most tip of South America. An inset map in the top right-hand corner of the larger image shows the multiple times that the Beagle stopped in destinations around the southern cone of Latin America, traversing the area along the coasts of Argentina and Chile extensively and repeatedly, then travelling up the coast past Peru, Ecuador, and on to the Galápagos Islands. From this famous stopping-point of Darwin's the Beagle travelled to the Marquesas, the

Society islands and Tahiti and then into the South Pacific and the Bay of Islands. From there the journey passed through the north island of New Zealand, Sydney, Australia, Australia's island of Tasmania, King George's Sound in Western Australia, and on to Saint Helena and Ascension Island. The Beagle then returned to Bahia, from whence it departed for Britain, again stopping at Cape Verde and then sailing to the North Atlantic's Western Isles en route.



Source: Augustus Earle, “Quarter Deck of a Man of War on Diskivery [sic] or interesting Scenes on an Interesting Voyage,” Ink and Watercolor painting of the quarterdeck of The Beagle, Bahía Blanca, Argentina, on or around September 24, 1832, Sotheby’s.

COMPASS POINTS

- A young Charles Darwin is portrayed in the center of the image dressed in a top hat. To his left is a liveried butler, painted in a deferential or even obsequious pose. This strongly suggests that Darwin is richer than his shipmates, an English gentleman from the British upper class.
- Pay attention to the many natural specimens surrounding Darwin’s servant: note that some are labelled. Which people are interested in these natural specimens?
- While the script makes it hard to read the labels, one says ‘Anti-Diluvian.’ This is a pun: the fossils Darwin collected were not only very old (antediluvian), but also evidence against the Christian argument regarding the age of the earth and the great Biblical flood (deluge).
- There is some discontent depicted: One man, believed to be 1st Lieutenant John Clements Wickham, says: “There is no such thing as walking the deck for all these cursed specimens.” This shows the relative value of the specimens to Darwin compared to other men of his time.
- Compare the portrayal of Darwin to the other members of the voyage: his face and clothing makes him stand out and suggests that he is not a regular sailor. Think about how his designated role as ‘naturalist’ would have caused him to look at the world around him in a different way and with a broader purpose than someone designated, for instance, a sailor.

Primary Source Three: Darwin's writings on natural selection based on observation of Galápagos finch species

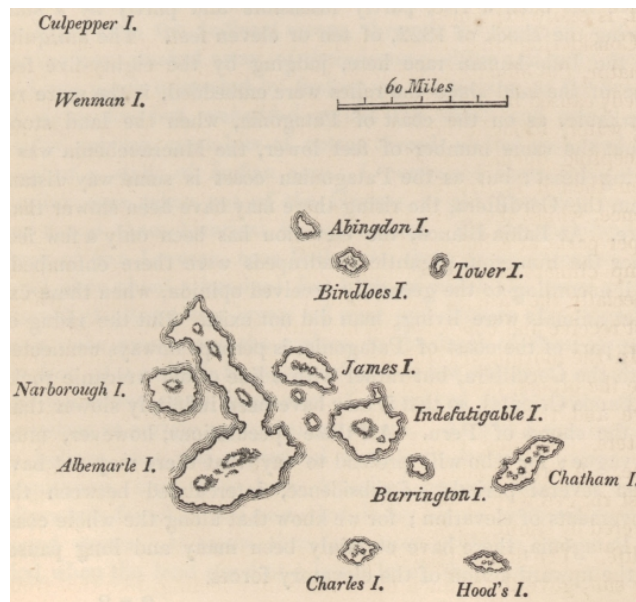
Background

From the route map (primary source one) you will remember that, after spending much time in South America, the HMS Beagle sailed West and arrived in the Galápagos archipelago. Darwin's explorations on these islands were key to his development of the theory of natural selection. He noted both the similarities and the differences between species on the islands and the South American mainland that he had recently visited. In the archipelago itself Darwin was intrigued that unique creatures were similar on different islands, but perfectly adapted to their specific environments. He questioned the origin of each species, and the reasons that they differed from one place and environment to another. The Galápagos finches, of which he collected many specimens, were an especially interesting species due to their similarities and divergences.

Excerpt from Origin of Species

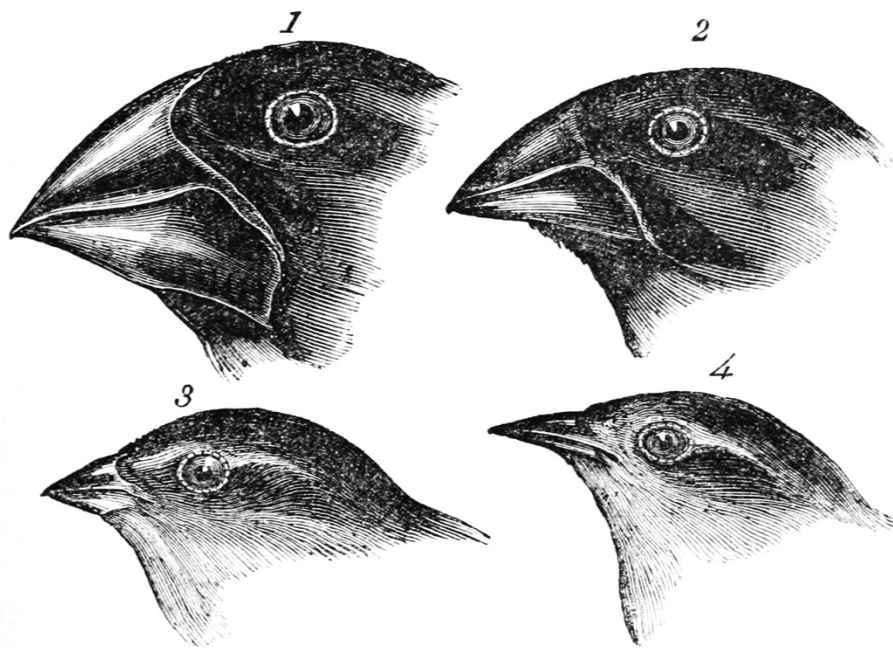
The most striking and important fact for us in regard to the inhabitants of islands, is their affinity to those of the nearest mainland, without being actually the same species. [In] the Galápagos Archipelago ... almost every product of the land and water bears the unmistakable stamp of the American continent. There are twenty-six land birds, and twenty-five of these are ranked by Mr. Gould as distinct species, supposed to have been created here; yet the close affinity of most of these birds to American species in every character, in their habits, gestures, and tones of voice, was manifest. ... The naturalist, looking at the inhabitants of these volcanic islands in the Pacific, distant several hundred miles from the continent, yet feels that he is standing on American land. Why should this be so? Why should the species which are supposed to have been created in the Galapagos Archipelago, and nowhere else, bear so plain a stamp of affinity to those created in America? There is nothing in the conditions of life, in the geological nature of the islands, in their height or climate, or in the proportions in which the several classes are associated together, which resembles closely the conditions of the South American coast: In fact there is a considerable dissimilarity in all these respects. On the other hand, there is a considerable degree of resemblance in the volcanic nature of the soil, in climate, height, and size of the islands, between the Galápagos and Cape de Verde Archipelagos: But what an entire and absolute difference in their inhabitants! The inhabitants of the Cape de Verde Islands are related to those of Africa, like those of the Galápagos to America. I believe this grand fact can receive no sort of explanation on the ordinary view of independent creation; whereas on the view here maintained, it is obvious that the Galápagos Islands would be likely to receive colonists, whether by occasional means of transport or by formerly continuous land, from America; and the Cape de Verde Islands from Africa; and that such colonists would be liable to modification — the principle of inheritance still betraying their original birthplace.

Source: Charles Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859), 397-98.



Galapagos Islands

I have stated, that in the thirteen species of ground-finches (in the Galápagos Islands), a nearly perfect gradation may be traced, from a beak extraordinarily thick, to one so fine, that it may be compared to that of a warbler. I very much suspect, that certain members of the series are confined to different islands; therefore, if the collection had been made on any *one* island, it would not have presented so perfect a gradation. It is clear, that if several islands have each their peculiar species of the same genera, when these are placed together, they will have a wide range of character. But there is not space in this work, to enter on this curious subject.

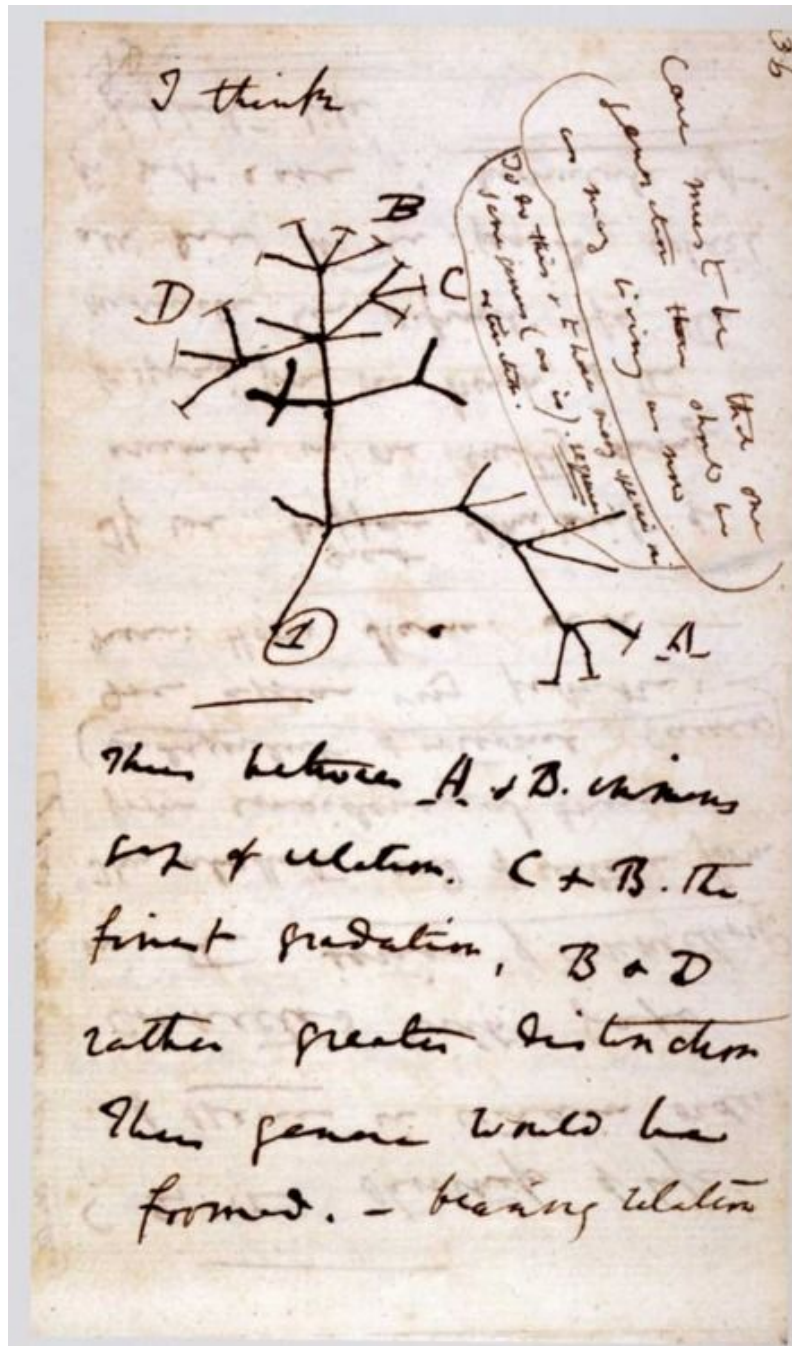


1. *Geospiza magnirostris*.
3. *Geospiza parvula*.

2. *Geospiza fortis*.
4. *Certhiidea olivacea*.

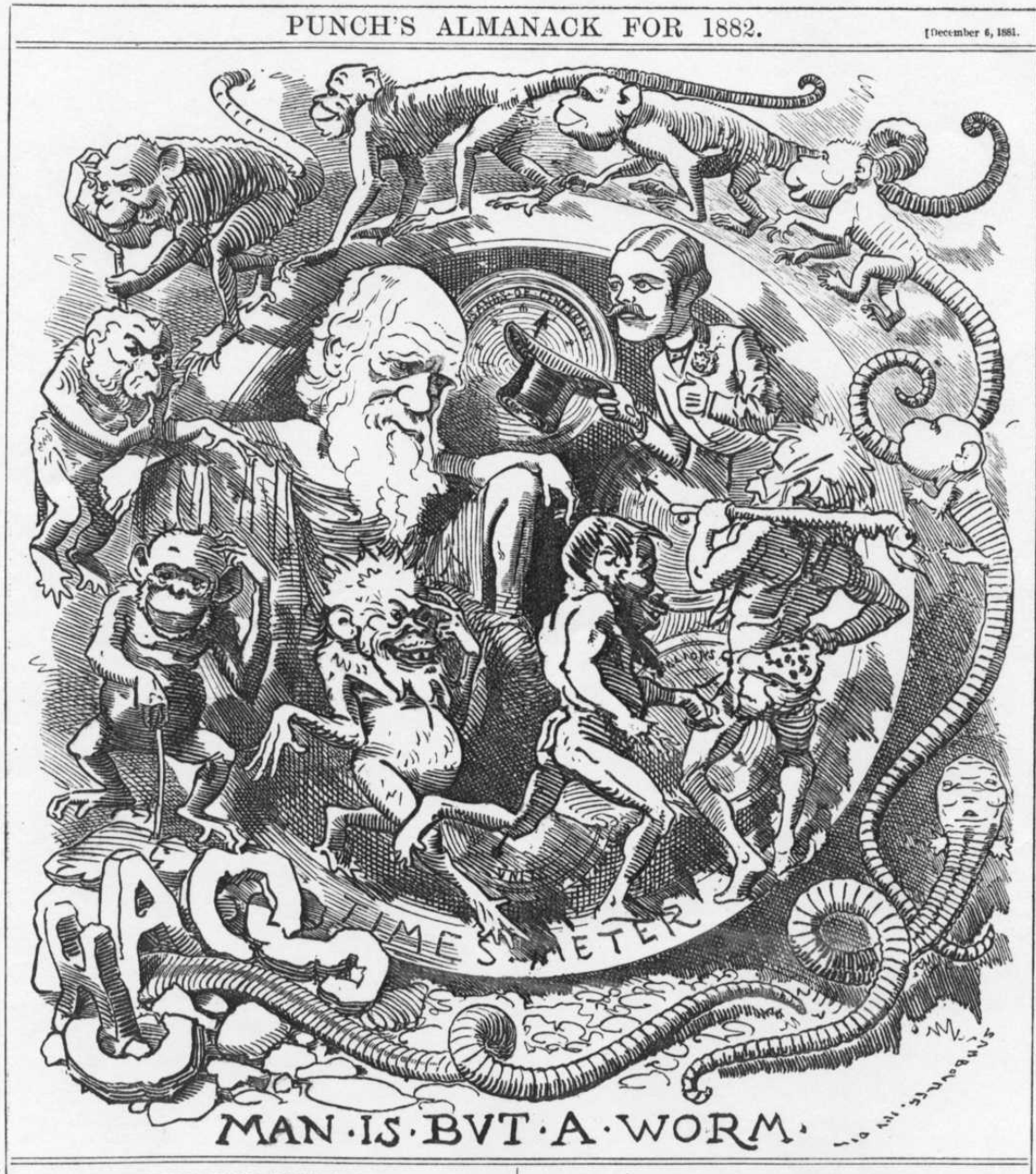
Primary Source Four: 'Tree of Life,' from the notebooks of Charles Darwin, 1837

This is the first-known depiction of an evolutionary tree showing the relationships among groups of organisms. In it Darwin illustrates his ideas on the phylogenetic relationships among species. Note how some 'branches' terminate, while others develop and grow. Later Darwin would write: "The affinities of all the beings of the same class have sometimes been represented by a great tree... As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch, so by generation I believe it has been with the great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever branching and beautiful ramifications." (From Charles Darwin, *The origin of species by means of natural selection* (New York: Thomas Y. Crowell Company Publishers, 1860), "Chapter IV. Natural Selection; Or the Survival of the Fittest.")



Source: Sketch showing tree of life, Page from Darwin's notebook, 1837, Cambridge University Library.

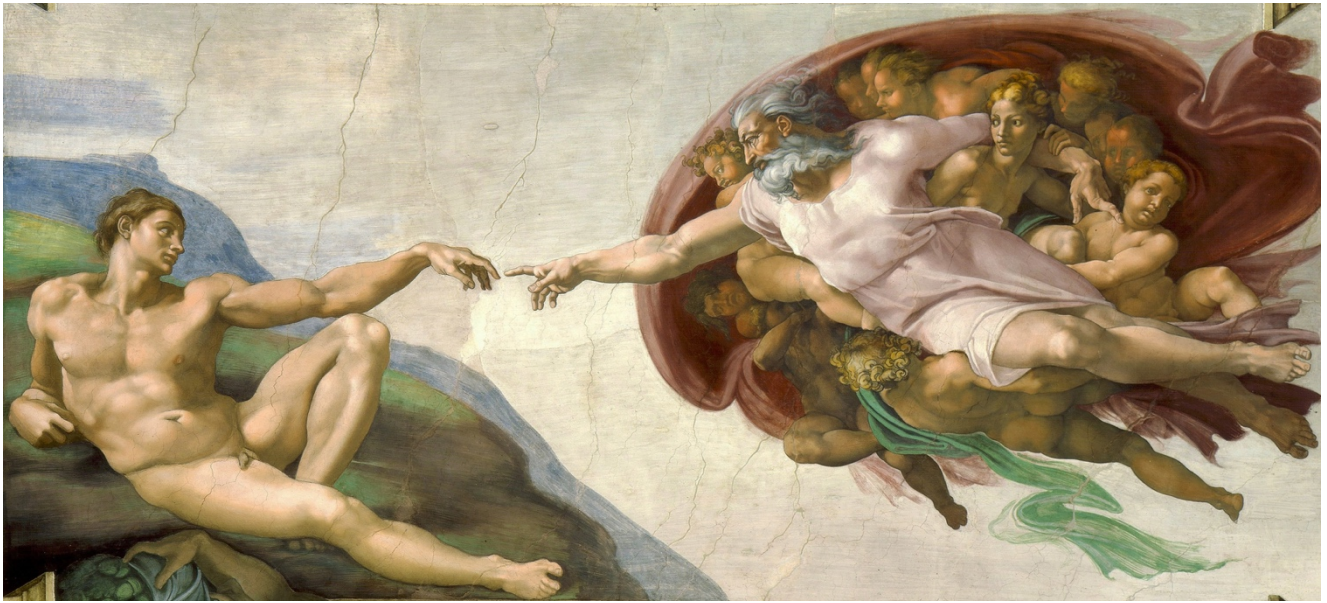
Primary Source Five: Linley Sambourne's cartoon, *Man Is But a Worm*, *Punch's Almanack* for 1882.



Source: Linley Sambourne's cartoon, *Man Is But a Worm*, "Punch's Almanack for 1882," *Punch*, December 6, 1881 Public domain.

COMPASS POINTS

- Note how the progression of images circles inwards, with Darwin at the center.
- Look at how Darwin is depicted. The arrangement of his body echoes that of how Adam is painted in Michaelangelo's famous painting, "The creation of Adam." (included below for comparison purposes). Note that the key difference is that Darwin is not looking towards God, while Adam is.



Source: Michelangelo, section from *The Creation of Adam*, Public Domain.

Primary Source Six: Extracts from Darwin's *The Origin of Species by Means of Natural Selection* (1859)

From Chapter 3, Struggle for Existence

Again, it may be asked, how is it that varieties, which I have called incipient species, become ultimately converted into good and distinct species, which in most cases obviously differ from each other far more than do the varieties of the same species? How do those groups of species, which constitute what are called distinct genera, and which differ from each other more than do the species of the same genus, arise? All these results, as we shall more fully see in the next chapter, follow inevitably from the struggle for life. Owing to this struggle for life, any variation, however slight and from whatever cause proceeding, if it be in any degree profitable to an individual of any species, in its infinitely complex relations to other organic beings and to external nature, will tend to the preservation of that individual, and will generally be inherited by its offspring. The offspring, also, will thus have a better chance of surviving, for, of the many individuals of any species which are periodically born, but a small number can survive. I have called this principle, by which each slight variation, if useful, is preserved, by the term of Natural Selection, in order to mark its relation to man's power of selection. We have seen that man by selection can certainly produce great results, and can adapt organic beings to his own uses, through the accumulation of slight but useful variations, given to him by the hand of Nature. But Natural Selection, as we shall hereafter see, is a power incessantly ready for action, and is as immeasurably superior to man's feeble efforts, as the works of Nature are to those of Art.

We will now discuss in a little more detail the struggle for existence. In my future work this subject shall be treated, as it well deserves, at much greater length. The elder De Candolle and Lyell have largely and philosophically shown that all organic beings are exposed to severe competition. In regard to plants, no one has treated this subject with more spirit and ability than W. Herbert, Dean of Manchester, evidently the result of his great horticultural knowledge. Nothing is easier than to admit in words the truth of the universal struggle for life, or more difficult at least I have found it so than constantly to bear this conclusion in mind. Yet unless it be thoroughly engrained in the mind, I am convinced that the whole economy of nature, with every fact on distribution, rarity, abundance, extinction, and variation, will be dimly seen or quite misunderstood. We behold the face of nature bright with gladness, we often see superabundance of food; we do not see, or we forget, that the birds which are idly singing round us mostly live on insects or seeds, and are thus constantly destroying life; or we forget how largely these songsters, or their eggs, or their nestlings are destroyed by birds and beasts of prey; we do not always bear in mind, that though food may be now superabundant, it is not so at all seasons of each recurring year.

I should premise that I use the term Struggle for Existence in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny. Two canine animals in a time of dearth, may be truly said to struggle with each other which shall get food and live. But a plant on the edge of a desert is said to struggle for life against the drought, though more properly it should be said to be dependent on the moisture. A plant which annually produces a thousand seeds, of which on an average only one comes to maturity, may be more truly said to struggle with the plants of the same and other kinds which already clothe the ground. The mistletoe is dependent on the apple and a few other trees, but can only in a far-fetched sense be said to struggle with these trees, for if too many of these parasites grow on the same tree, it will languish and die. But several seedling mistletoes, growing close together on the same branch, may more truly be said to struggle with each other. As the mistletoe is disseminated by birds, its existence depends on birds; and it may metaphorically be said to struggle with other fruit-bearing plants, in order to tempt birds to devour and thus disseminate its seeds rather than those of other plants. In these several senses, which pass into each other, I use for convenience sake the general term of struggle for existence.

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product. Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. Although some species may be now increasing, more or less rapidly, in numbers, all cannot do so, for the world would not hold them.

From Chapter 4, Natural Selection

It may be said that natural selection is daily and hourly scrutinising, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. We see nothing of these slow changes in progress, until the hand of time has marked the long lapses of ages, and then so imperfect is our view into long past geological ages, that we only see that the forms of life are now different from what they formerly were.

From final chapter, book's concluding paragraph

It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone circling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.

Source: Charles Darwin, *The origin of species by means of natural selection* (New York: Thomas Y. Crowell Company Publishers, 1860).

COMPASS POINTS

- Note how Darwin explains the divergence of species.
- Darwin argues that through struggle all living beings fight for survival. The abundance of nature will then allow those individuals most suited to survival in their environments to thrive, leading to diversity within and between species and the development of new traits.
- It is interesting to note that the phrase “by the Creator” in the book’s concluding paragraph (the last section of text given above) was not in the first edition of Darwin’s book, published in November 1859. Public pressure to acknowledge the hand of the divine caused the phrase to be inserted in the 1860 and subsequent editions of the book.

Case study challenge question

Please answer the following question (750-word response):

How did Darwin's scientific ideas of evolution challenge earlier thinking of the place of humans in the world, and how was this supported by new thinking of rational proof and evidence rather than religious faith?