

READING PRIMARY SOURCES: DARWIN AND WALLACE

INTRODUCTION

How do we know about the history behind Charles Darwin's and Alfred Russel Wallace's voyages and their discoveries? How do we know about the evidence that led them to their revolutionary ideas about the natural origin of species? This knowledge comes from reading Darwin's and Wallace's scientific writings, journals, and letters. In this activity, you will have the opportunity to read first hand several passages of Darwin's and Wallace's writings and extract information from the texts.

Read the excerpts below and then answer the questions that follow.

READING 1: WHO GETS CREDIT?

Darwin's book, *On the Origin of Species*, published in 1859, was the culmination of over two decades of observation, data collection, and thinking. During this time Darwin met and corresponded with Alfred Russel Wallace. Wallace had independently conceived of the theory of evolution by natural selection while traveling the world collecting specimens to sell and asked Darwin for his opinion on his work. Darwin was stunned when he read Wallace's work. Both men had come to the same conclusions based on different sets of observations in different parts of the world.

But who should get credit for the idea? In science, the first scientist or group of scientists to develop an explanation and publish and/or present the evidence typically get the credit. Read the following passage, taken from the letter coauthored by Darwin's colleagues, Sir Charles Lyell and J. D. Hooker, which they read at a meeting of the Linnean Society held in London on July 1, 1858. During this meeting, they also presented papers written by Darwin and Wallace. Use evidence from the reading to make a claim about who Lyell and Hooker think should get credit for the theory of natural selection.

London, June 30th, 1858.

MY DEAR SIR,—The accompanying papers, which we have the honour of communicating to the Linnean Society, and which all relate to the same subject, viz. the Laws which affect the Production of Varieties, Races, and Species, contain the results of the investigations of two indefatigable naturalists, Mr. Charles Darwin and Mr. Alfred Wallace.

These gentlemen having, independently and unknown to one another, conceived the same very ingenious theory to account for the appearance and perpetuation of varieties and of specific forms on our planet, may both fairly claim the merit of being original thinkers in this important line of inquiry; but neither of them having published his views, though Mr. Darwin has for many years past been repeatedly urged by us to do so, and both authors having now unreservedly placed their papers in our hands, we think it would best promote the interests of science that a selection from them should be laid before the Linnean Society.

Vocabulary

Linnean Society—founded in 1788, the society informs the public in all areas of natural history by providing a forum for the discussion and advancement of the life sciences.

viz.—an abbreviation of the word *videlicet*, it's used as a synonym for "namely" or "that is to say"

MS.—manuscript

Ternate—an island in the Maluku Islands of eastern Indonesia

&c. —and so forth

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Taken in the order of their dates, they consist of:—

1. Extracts from a MS. *Work on Species*, by Mr. Darwin, which was sketched in 1839, and copied in 1844, when the copy was read by Dr. Hooker, and its contents afterwards communicated to Sir Charles Lyell. ...
2. An abstract of a private letter addressed to Professor Asa Gray, of Boston, U.S., in October 1857, by Mr. Darwin, in which he repeats his views, and which shows that these remained unaltered from 1839 to 1857.
3. An Essay by Mr. Wallace, entitled "On the Tendency of Varieties to depart indefinitely from the Original Type." This was written at Ternate in February 1858, for the perusal of his friend and correspondent Mr. Darwin, and sent to him with the expressed wish that it should be forwarded to Sir Charles Lyell, if Mr. Darwin thought it sufficiently novel and interesting. So highly did Mr. Darwin appreciate the value of the views therein set forth, that he proposed, in a letter to Sir Charles Lyell, to obtain Mr. Wallace's consent to allow the Essay to be published as soon as possible. Of this step we highly approved, provided Mr. Darwin did not withhold from the public, as he was strongly inclined to do (in favour of Mr. Wallace), the memoir which he had himself written on the same subject, and which, as before stated, one of us had perused in 1844, and the contents of which we had both of us been privy to for many years. On representing this to Mr. Darwin, he gave us permission to make what use we thought proper of his memoir, &c. and in adopting our present course, of presenting it to the Linnean Society, we have explained to him that we are not solely considering the relative claims to priority of himself and his friend, but the interests of science generally; for we feel it to be desirable that views founded on a wide deduction from facts, and matured by years of reflection, should constitute at once a goal from which others may start, and that, while the scientific world is waiting for the appearance of Mr. Darwin's complete work, some of the leading results of his labours, as well as those of his able correspondent, should together be laid before the public.

We have the honour to be yours very obediently, Charles Lyell Jos. D. Hooker.

QUESTIONS

1. a. What words did Lyell and Hooker use to describe Darwin's and Wallace's theory in their letter to the Linnean Society?

- b. How would you rephrase what they wrote in your own words?

2. Make a claim about who Lyell and Hooker thought should receive credit for formulating the theory. Provide evidence from the text to support your claim.

Claim:

Evidence:

3. What reasons do Lyell and Hooker give for wanting to make the writings of Darwin and Wallace public? Provide evidence from the text in your answer.

READING 2: HOW DOES NATURAL SELECTION WORK?

Darwin and Wallace both independently observed variation within species and that individuals compete for limited resources. They reasoned that the differential survival and reproductive success of individuals with different traits cause populations to change over many generations. Darwin identified this process as evolution by means of natural selection. Did Wallace reach the same conclusion?

As you read the following excerpts from two of the papers presented at the meeting of the Linnean Society on July 1, 1858, look for details about variation within a species, competition, and how a population might change over time. Start with Darwin's writing about canines (dogs and foxes).

Excerpt from "On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection," by Charles Darwin [Read July 1st, 1858].

... To give an imaginary example from changes in progress on an island:—let the organisation of a canine animal which preyed chiefly on rabbits, but sometimes on hares, become slightly plastic; let these same changes cause the number of rabbits very slowly to decrease, and the number of hares to increase; the effect of this would be that the fox or dog would be driven to try to catch more hares: his organisation, however, being slightly plastic, those individuals with the lightest forms, longest limbs, and best eyesight, let the difference be ever so small, would be slightly favoured, and would tend to live longer, and to survive during that time of the year when food was scarcest; they would also rear more young, which would tend to inherit these slight peculiarities. The less fleet ones would be rigidly destroyed. I can see no more reason to doubt that these causes in a thousand generations would produce a marked effect, and adapt the form of the fox or dog to the catching of hares instead of rabbits, ... So would it be with plants under similar circumstances. If the number of individuals of a species with plumed seeds could be increased by greater powers of dissemination within its own area (that is, if the check to increase fell chiefly on the seeds), those seeds which were provided with ever so little more down, would in the long run be most disseminated; hence a greater number of seeds thus formed would germinate, and would tend to produce plants inheriting the slightly better-adapted down.

Rabbit or hare—what is the difference?

- Hares have longer ears, larger feet, and stronger hind legs and are generally larger and faster than rabbits.
- Hares are born with hair and able to see; they can fend for themselves very quickly after birth. Rabbit young are born blind and hairless.

Vocabulary

Organisation—used here, the word refers to the characteristics of a dog

Plastic—changeable; variations are present in the dog population

Plumed—feathered

Dissemination—spreading out

Down—fuzz or fluff

Check—limit or constraint

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Excerpts from “On the Tendency of Varieties to Depart Indefinitely from the Original Type,” by Alfred Russel Wallace [Read July 1st, 1858].

The life of wild animals is a struggle for existence. The full exertion of all their faculties and all their energies is required to preserve their own existence and provide for that of their infant offspring. The possibility of procuring food during the least favourable seasons, and of escaping the attacks of their most dangerous enemies, are the primary conditions which determine the existence both of individuals and of entire species. These conditions will also determine the population of a species; and by a careful consideration of all the circumstances we may be enabled to comprehend, and in some degree to explain, what at first sight appears so inexplicable—the excessive abundance of some species, while others closely allied to them are very rare. ...

Vocabulary

Faculties—senses/abilities

Diminution—decrease

... It is also evident that most changes would affect, either favourably or adversely, the powers of prolonging existence. An antelope with shorter or weaker legs must necessarily suffer more from the attacks of the feline carnivora; the passenger pigeon with less powerful wings would sooner or later be affected in its powers of procuring a regular supply of food; and in both cases the result must necessarily be a diminution of the population of the modified species. If, on the other hand, any species should produce a variety having slightly increased powers of preserving existence that variety must inevitably in time acquire a superiority in numbers. ...

QUESTIONS

4. Complete the following chart for the excerpt from Darwin’s paper. Provide examples of evolution by natural selection that Darwin used in his writing. Describe the species, the variations among individuals, the selective pressure, and how species change over time.

Darwin—Natural Selection		
	Example 1	Example 2
Species		
What trait varies within the species?		
What is the selective pressure? (In other words, what causes some individuals to produce more offspring than others?)		
How would the population change over time?		

5. Complete the chart below for the excerpt from Wallace’s paper. Provide examples of evolution by natural selection that Wallace used in his writing. Describe the species, the variations among individuals, the selective pressure, and how species change over time.

Wallace —Natural Selection		
	Example 1	Example 2
Species		
What trait varies within the species?		
What is the selective pressure? (In other words, what causes some individuals to produce more offspring than others?)		
How would the population change over time?		

READING 3: VARIATION AS A SOURCE OF EVIDENCE FOR NATURAL SELECTION

In the two excerpts that follow, Darwin and Wallace compare variations present in domestic species with those present in their wild counterparts. Read both selections and answer questions 6 and 7.

Excerpt from *On the Origin of Species*, Chapter 3, by Charles Darwin

... 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. ...

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Excerpt from a letter by A. R. Wallace printed in the journal *Nature* 44: 518-519, 1891).

... *The proof that there is a selective agency at work is, I think, to be found in the general stability of species during the period of human observation, notwithstanding the large amount of variability that has been proved to exist.*

If there were no selection constantly going on, why should it happen that the kind of variations that occur so frequently under domestication never maintain themselves in a state of nature? Examples of this class are white blackbirds or pigeons, black sheep, and unsymmetrically marked animals generally. These occur not unfrequently, as well as such sports as six-toed or stump-tailed cats, and they all persist and even increase under domestication, but never in a state of nature; and there seems no reason for this but that in the latter case they are quickly eliminated through the struggle for existence—that is, by natural selection. ...

Vocabulary

Sports—mutants or anomalies

QUESTIONS

6. How is variation in wild and domesticated species evidence for natural selection?

7. According to Wallace, why do domesticated species exhibit more variability than wild species? Support your answer with evidence from the passage.

READING 4: WHAT IS A SPECIES?

In the passages below, Darwin and Wallace both clearly define what a species is based on their observations of the natural world. They then provide explanations for how new species arise.

Excerpt from "The Origin of Species and Genera (S322: 1880), January 1880 issue of Nineteenth Century," by Alfred R. Wallace

... A species may be defined as a group of individuals of animals or plants which breed together freely and reproduce their like; whence it follows that all the individuals of a species, now living or which have lived, have descended from a few common ancestors, or perhaps from a single pair. Thus all horses, whether Shetland ponies, racers, or cart-horses, form one species, because they freely breed together, and are known to have all descended from a common stock.

By the same test the common ass, the kiang, the quagga, and the zebra, are each shown to be distinct species; for though sometimes two of these species will breed together, they do not do so freely, they do not reproduce their like but an intermediate form called a mule, and these mules are not capable of reproducing their kind, as are the offspring of any pairs of a single species.

Excerpt from "On the Origin of Species," by Charles Darwin, 1859

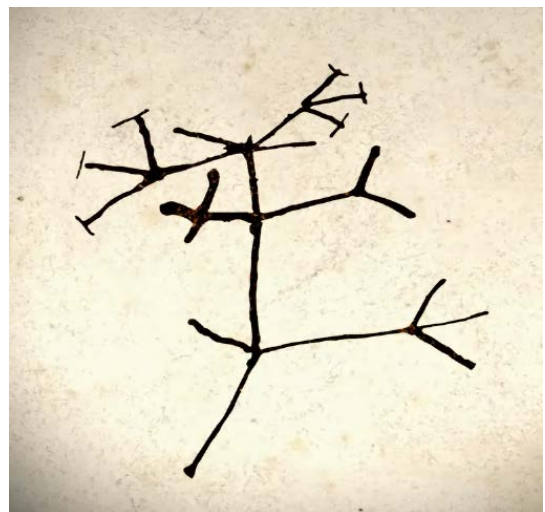
... So with natural species, if we look to forms very distinct, for instance to the horse and tapir, we have no reason to suppose that links ever existed directly intermediate between them, but between each and an unknown common parent. The common parent will have had in its whole organisation much general resemblance to the tapir and to the horse; but in some points of structure may have differed considerably from both, even perhaps more than they differ from each other. Hence in all such cases, we should be unable to recognise the parent-form of any two or more species, even if we closely compared the structure of the parent with that of its modified descendants, unless at the same time we had a nearly perfect chain of the intermediate links. ...

Vocabulary

Common parent—
common ancestor

Excerpt from *On the Origin of Species, Chapter 4*, by Charles Darwin, 1859

... On the view that each species has been independently created, I can see no explanation of this great fact in the classification of all organic beings; but, to the best of my judgment, it is explained through inheritance and the complex action of natural selection, entailing extinction and divergence of character, as we have seen illustrated in the diagram. ...



QUESTIONS

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8. a. In your own words, define "species" based on the excerpt of Wallace's writing.

b. Based on this definition, how does the infertility of mules argue that the common ass, the kiang, and the zebra are separate species?

9. a. Darwin writes that the tapir and horse are different species but share a common ancestor. What does he predict this common ancestor would have looked like?

b. Using the horse and tapir, make a diagram similar to the one shown in the film. Be sure to label the ancestor.

10. From all these readings, is there evidence that both Darwin and Wallace independently formulated the theory of evolution by natural selection? Support your answer.
