

Evolution - The Big Picture

Charles Darwin found an answer to three of history's most baffling questions about diversity, unity and adaptation: How do species form? Why do species have similar traits? And How do species become adapted to their surroundings? He published his answers in the *Origin of Species* in 1859.

What did the voyage of the ship named the Beagle have to do with Darwin's work?

Before his voyage, Darwin believed that *Special Creation* was the reason for the diversity of life - God had created all living species separately with traits just right for surviving and reproducing in the environment it lives in. Darwin began to consider the possibility that new species come from previously existing species because of observations he made on the Beagle.

Observation 1 – Some species in the Galapagos islands were similar to, but distinct from, species on neighboring islands in the Galapagos. They were also similar to, but distinct from, species found in South America.

Observation 2 – The fossil remains of extinct animals in South America were similar to, but distinct from, species currently living in South America.

Explain Darwin's alternative explanation to Special Creation, Evolution:

Charles Darwin wasn't the only one thinking about these ideas. In 1831 Patrick Matthew published a small obscure book on shipbuilding and growing trees for ship construction. In the appendix, Matthew summarized his ideas that if humans can produce new varieties of animals through artificial breeding, then Nature could produce new species over the long course of the Earth's history. He didn't provide evidence for his idea and nobody read his book.

Another person who was thinking about these ideas of how species arise, is Alfred Russel Wallace. He too took a voyage – to the islands in the western Pacific. His famous *Wallace Line* is pictured below. What does it show and what does it indicate about species diversity?



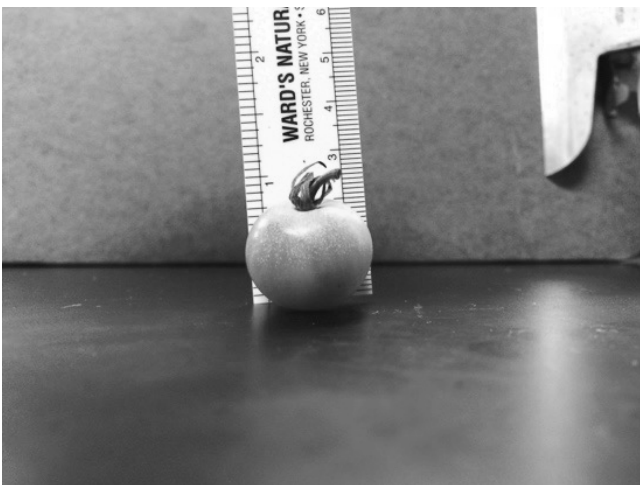
The Wallace Line is the invisible boundary Wallace discovered running through the center of Indonesia and separating two entirely different animal worlds. Photo credit: Courtesy of Sean Carroll, created by Leanne Olds

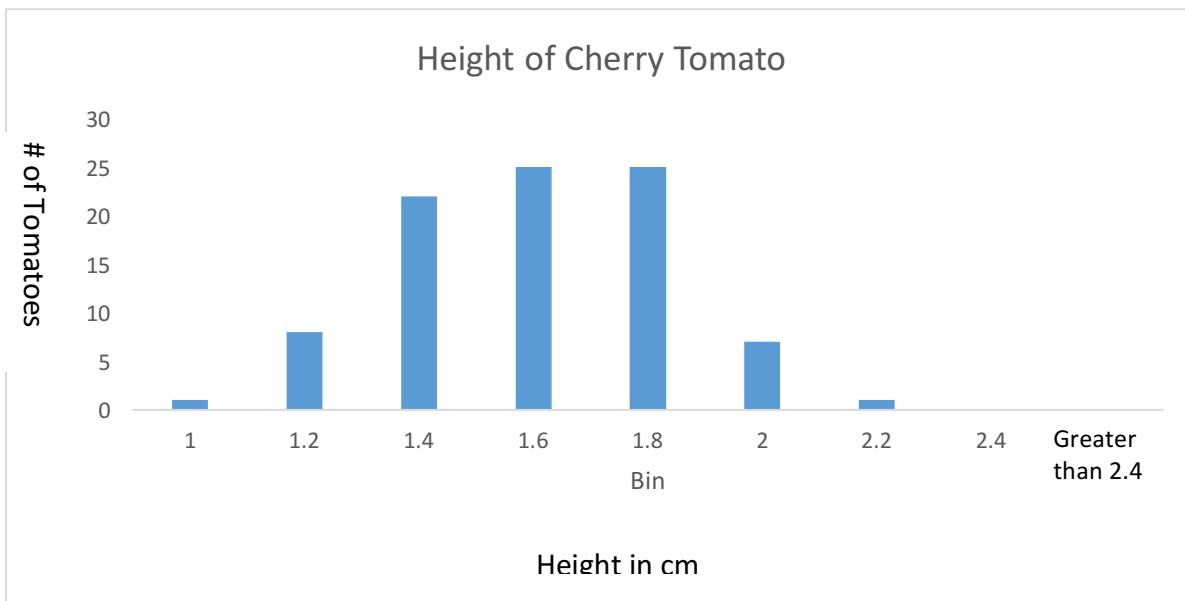
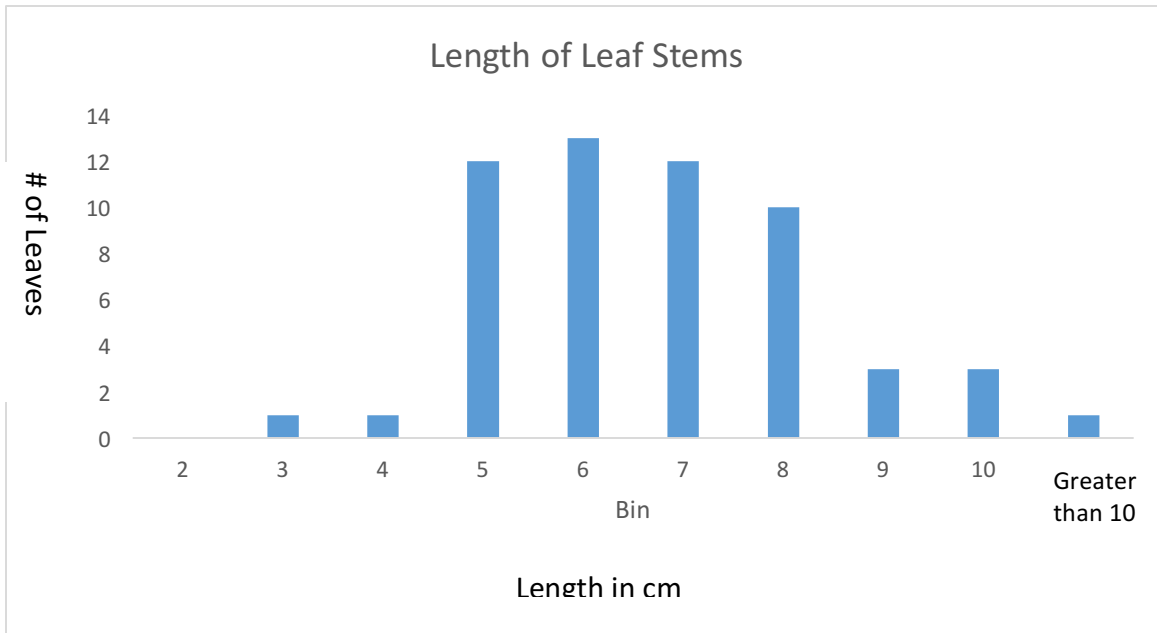
Natural Selection

In the *Origin of Species*, Darwin postulated that evolution happens because of *natural* selection, which he called *descent with* modification. Alfred Russel Wallace also came up with this idea at about the same time. Both had come to this conclusion through observations that organisms were adapted to their surroundings. Natural selection is a process that adjusts populations to changing environmental conditions. The characteristics of a population change over time as the population becomes better and better adapted to its environment. Over long periods of time, a population can change enough to become a new species.

1. Populations: When we looked at and counted the seeds from the green peppers, pomegranates, grapes and tomatoes, we found each of those common fruits had a tremendous amount of seeds. We also know that we don't ever have the number of new plants that the number of those seeds suggest we should. Why?

2. Individuals in a population: Students looked at two different populations of two different organisms. One was a population of cherry tomatoes and the other was a population of maple leaves. For each population, students measured one feature for each member of the population. The data was collected and combined into a histogram for each organism. Look over the data on the next page.





What overall pattern, if any, do you see with the measured characteristics?

What does this say about a population?

3. Individuals in a population over time: The pocket mouse populations in the Sonoran Desert helped us look at mutations in a population. What was the mutation and was it an inheritable or non-inheritable trait?

How did it affect the population of pocket mice? Was the mutation an advantage, a disadvantage (deleterious) or neutral for the population? Why?

4. Conclusion: In 1858, the work of Charles Darwin and Alfred Russel Wallace was presented in a joint presentation to the Linnean Society in London, England. They shared the process they believed explained how organisms change over time. We call this process *Natural Selection*. There are three conditions (sometimes called observations) which lead to a conclusion about the process. Each condition is related to the ideas in the same numbered question above.

Natural Selection

Condition #1

Condition #2

Condition #3

Natural selection is a process where ...

We Mean what We Say and We Say What We Mean (Vocabulary)

Population

Trait

Homologous structures

Mutation

Adaptation

Selective pressure

Species

Old –

Ecological species -

Speciation

Geographic isolation –

Reproductive isolation -

Extinction

Evolution

- 1.
- 2.
- 3.
- 4.
- 5.

Natural Selection

Conditions

- 1.
- 2.
- 3.

Evidence for Evolution

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.