Variation in Anoles

Lesson Objectives: After completing the lesson, you will be able to

- describe different ways to represent variation,
- conduct an online investigation to characterize variation among anoles, and
- use a spreadsheet program to calculate descriptive statistics related to variation in a population.

What is Variation?

Discrete, or "one or the other" traits:

We typically start learning about variation in traits when we learn about genetics, which often starts with the work of Gregor Mendel. Mendel monitored traits that were measured in a "one form or the other" way. He used either purple or white pea plant flowers. Seed coat color was yellow or green. In other words, the traits were recorded in a binary way. That's because these traits are determined by variations in **single genes**, and Mendel was exploring the effects of only two alleles.

Continuous, or a "spectrum" of forms:

The vast majority of traits are not simple binary traits but instead occur along a spectrum. Traits that show what is called "continuous" (as opposed to discrete) variation are called quantitative traits. Most traits of interest to biologists are quantitative traits.

Why does measuring variation matter? It helps us better predict and interpret patterns in nature. Instead of expecting traits to be in one form another, a more realistic expectation is that traits will vary subtly among individuals.

DEFINING VARIATION

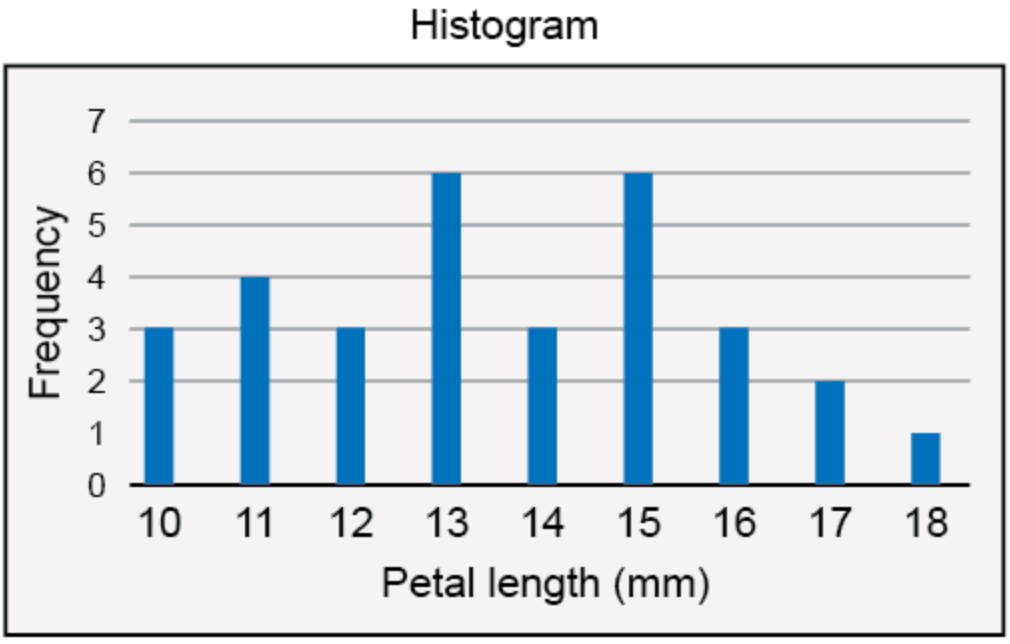
Variation can be defined as a description of the differences among the units in some defined group. Biologists describe and often quantify different types of variation, such as variation among different

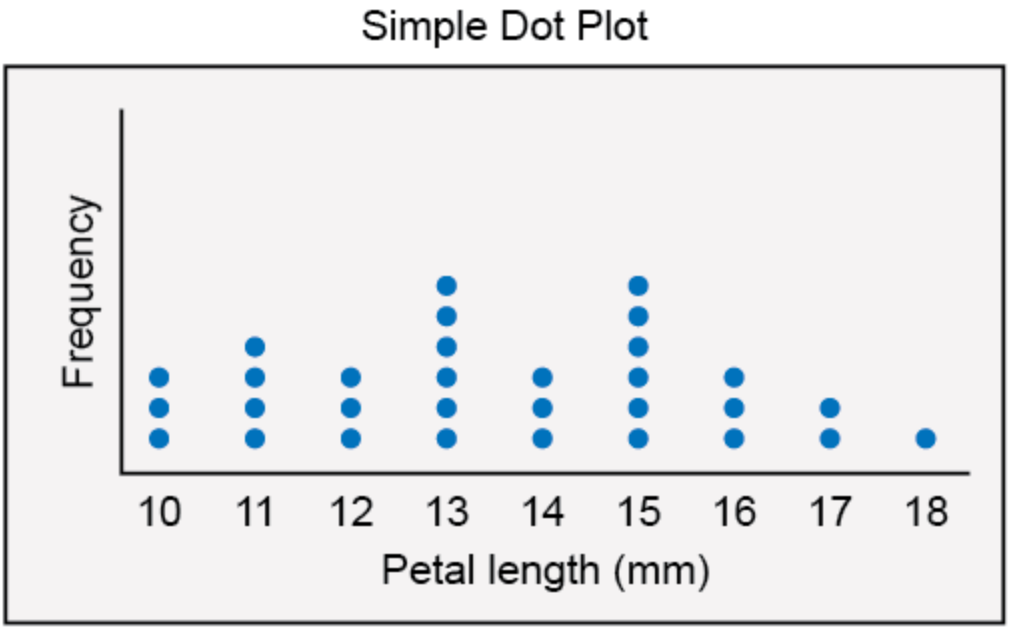
ecosystems, species, populations of the same species, individuals within a population or species, cells within an individual, or even molecules within cells.

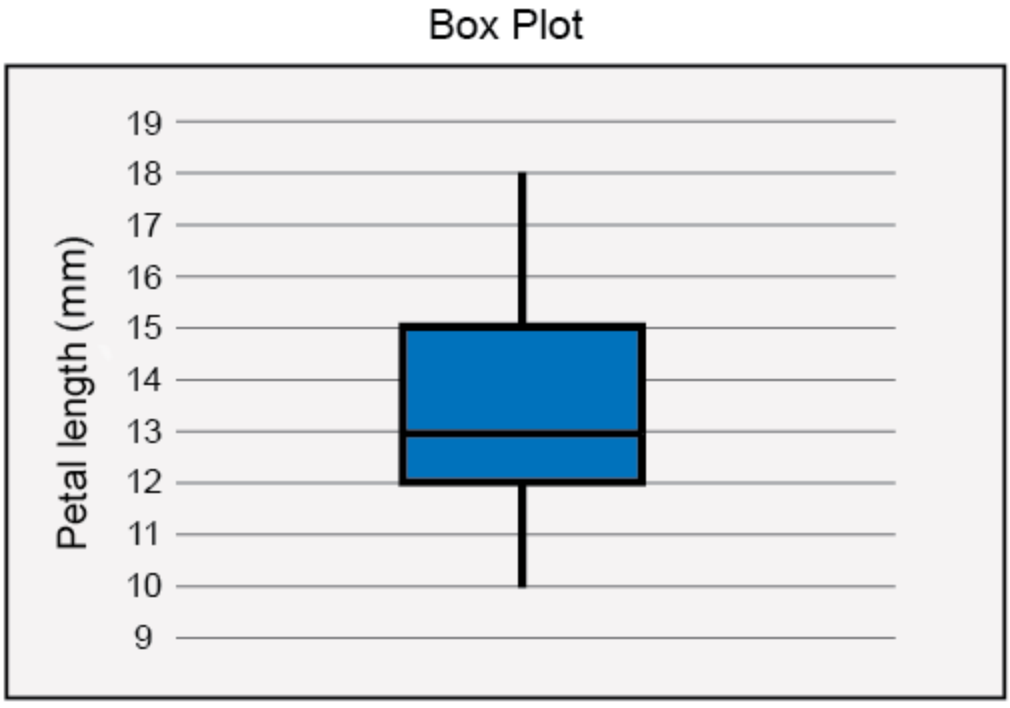
A researcher measured the length of flower petals in 31 plants to the nearest millimeter, as shown in the data table.

13	16	15	18
15	15	13	17
10	13	12	16
14	10	13	13
10	14	16	17
11	12	11	15
13	15	15	12
11	11	14	14

The three figures below show some of the ways that variation can be represented graphically: a dot plot, histogram, and box plots.







You can also describe variation with commonly used descriptive statistics, such as standard deviation or standard error of the mean.

In the activities that follow, you will practice generating your own graphical and statistical descriptions of variation among living organisms.

Meet the Anoles

The more than 700 islands of the Caribbean are home to about 150 species of anoles, a group of lizards of the genus *Anolis*. These lizards live in diverse habitats and vary greatly in size and other physical characteristics, such as leg and tail length and skin color and pattern.

Watch the following video to learn more about the Caribbean anoles and an experiment that researchers conducted to learn more about how evolution works. As you watch the video, record differences in traits among the species of lizards that are highlighted by the researchers. Be prepared to describe how those differences in traits might be adaptations to the species' habitat.

https://www.youtube.com/watch?v=Q7TwNegYKTc

- Record three traits that differ among the anoles shown in the video.
- Describe how the specific form of the trait found in a species is an adaptation to the species' habitat.

Measuring Individual Anoles Within a Population

To learn how these lizards change over time in response to different environmental variables, the scientists planned an experiment. They placed pairs of lizards (male and female) from a large island called Iron Cay onto a number of small islands that had been swept clear of lizards by hurricanes. A key difference between those environments is that:

- the large island had varied vegetation, including large trees, whereas
- the small islands had only small bushes and grass.

The scientists wanted to know whether the average leg length for the anole populations that established themselves on the small islands would change over time.

But first they wanted to determine the variation in leg length for anoles within the Iron Cay population. Why is this important? If there is no variation within a population for a trait, there would be nothing for natural selection to act on.

Complete the activity to answer the research question: **To what extent does leg (or more precisely hindlimb) length vary in anoles from Iron Cay?** In the activity, you will measure hindlimb and body length, then analyze and display the data to highlight variation.

Begin the experiment by watching a video on measuring hindlimb length and body length on x-rays of anoles. The video also shows the measurement of tail length, but to keep things simpler, you will not measure this trait.

https://www.youtube.com/watch?v=PiiQlBxKGLM

Get Out Your (Virtual) Rulers

Start the activity below to measure hindlimb length and body length on x-rays of 10 anoles from Iron Cay. After you measure the first three lizards, the rest of the measurements will be completed for you. Remember that your research question is "To what extent does hindlimb length vary in anoles from Iron Cay?"

http://media.hhmi.org/biointeractive/vlabs/online_course_lizard_lessons/index_lesson2.html

- Describe how your measurements of the anoles compare with those of experts. The comparison is shown on the “Compare Your Results” screen in the Lizard Lab.
- Enter the values you calculated for the mean, standard deviation, standard error, and 95% CI for relative hindlimb length. Alternatively, you can take a screenshot, save the file, and then upload the “Congratulations!” page which has your calculations.
- Does hindlimb length vary among anoles from Iron Cay? Describe your evidence.
- If long-legged lizards survived better than short-legged ones, how would you expect the mean leg length of the population to change over time?

Why calculate relative hindlimb length? (hindlimb length / body length)?

Mean

SD

Common Patterns of Trait Variation

For natural selection to act, there needs to be variation in traits within a population. In all populations, there are virtually always some differences that can be measured.

Summarizing Variation

Differences among individuals' traits, especially those that affect survival and reproduction, are important for evolution to occur. No variation means no change over time for that trait. Knowing the amount of variation in a trait allows biologists to predict whether the trait could change in the future (more variation means that traits can change in different ways depending on the environment) and whether it might have changed in the past (low variation can serve as evidence for selection in the past).

To make an argument that natural selection has occurred, scientists need evidence of variation in a population. To obtain this evidence, scientists measure a trait across a large enough sample of individuals from a population. From these data, scientists compute statistics to describe the trait in the population, such as the mean value, the most common value (mode), and the amount of variation (values such as the standard deviation and the standard error of the mean).

On your own, write your best answers to the following question: **Describe the degree to which you achieved the objectives of this lesson.**

The Lesson Objectives stated that at the end of the lesson you will be able to

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