Statistics: the t-test is a test of statistical significance

During the first week each compared two sets of data: for example, pulse rate between males and females, or mass-to-length ratios of two different kinds of bean.

How can we quantify our confidence that these sets of data truly reflect a difference?

We call this quantified confidence "statistical significance," and we use the following parameters to calculate it. The (so-called "two-tailed Student's") ***t*-test** allows us to distinguish between the "null hypothesis" and an "alternative hypothesis:"

H_0: There is **no difference** between the observed data sets (or **no effect** experimentally).

H_A: There **is a** "statistically significant" **difference** between the two data sets.

x, y	**Measurements, data points, samples**. *N* is the **sample size**, the number of subjects or specimens you examined.
$\bar{x} = \frac{\sum x}{N}$	**Mean** (or average). Σ (Sigma) simply means "sum."
$x - \bar{x}$	**Deviation** is simply the **difference** between a measurement and the mean.
$S_x^2 = \frac{\sum (x-\bar{x})^2}{N-1}$	**Variance** S_x^2 is a **combined measure** of (the square of) **all the deviations**. *N* – 1 is the **degrees of freedom**, in this case the number of ways you can compare any measurement with all the others.
$\mathrm{SD}_x = \sqrt{S_x^2}$	The **standard deviation** is the square root of the variance. Think: why would you square the sum of the deviations and then take the square root?
$\mathrm{SE} = \sqrt{\frac{S_x^2}{N_x} + \frac{S_y^2}{N_y}}$	The **standard error** is a measure of the **combined variances of two collections of data**.
$t_s = \frac{\lvert \bar{x} - \bar{y} \rvert}{\mathrm{SE}}$	The ***t*** value for your two sets of samples is a measure of the **difference in means compared to the standard error**.
$t_{c,\ \alpha = 0.05,\ \mathrm{df} = 8} = 2.306$	*You select* the **"critical" *t* value** from a table based on the total degrees of freedom of both data sets, and the confidence level that you choose.

If $t_s > t_c$, then it is appropriate, with the selected confidence level, to **reject the null hypothesis**.