The effect of classical music on plant growth.

To what extent are the heights of pea plants and Vinca Vines influenced by classical music?

Biology

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Introduction

Living organisms, such as plants, animals, and humans, are constantly exposed to the world around them. They adapt to their surroundings based on different changes that happen within their environments. Their exposure to some variables, such as abundance of food in the area or the ability to be camouflage, can assist in their development and reproduction, whereas other variables hinder their growth. For example, sudden changes in temperature can be either beneficial or disadvantageous for a living organism. If a region usually has a sudden shift in temperature, many crops and plants can be killed off and it can also be harmful for animals, specifically in relation to their health, survival, and shelter. On the contrary, if an animal moves to a new environment or location due to existing problems in their previous environment they lived in, more resources and food may be available to them than in their prior location. This can lead to quicker rates of reproduction and development. Overall, living organisms use the resources around them for their benefit and survival. Living organisms become accustomed to new environments in multiple ways.

Plants are greatly impacted by their surroundings, mainly because they are stationary and are forced to endure various conditions. According to Marcel Vogel in the book *The Secret Life of Plants*, written by Peter Tompkins and Christopher Bird, "the vegetal kingdom seems capable of picking up messages of intent, benign or malicious, that are inherently more truthful than when translated into words" (Bird & Tompkins, 1973, p. 32). As explained by this quote, plants use their senses to detect changes in their environment and try to adapt. Daniel Chamovitz, the author of the book *What a Plant Knows*, describes the different senses plants have and how they use their senses to "know" and understand their external environment. He writes, "Plants must be aware of the dynamic visual environment around them in order to survive" (Chamovitz, 2012, p.

23). A plant has the same senses as a human, but they are not executed the same way because plants have a much different anatomy.

Chamovitz mentions in his book how plants can "hear." They hear sounds by detecting the vibrations in the sound waves and having some physical response to it. Plants usually have drastic responses to music too. One of the most famous studies of this was done by Dorothy Retallack, author of *The Sound of Music and Plants*, in 1973. She tested if music had any effect on plant growth. She tried multiple genres of music with different plants and "reported that the plants exposed to soft classical music thrived…while those exposed to *Led Zeppelin II* or Hendrix's *Band of Gypsys* were stunted in their growth" (Chamovitz, 2012, p. 97). Over the years, her theory has been supported by many other scientists. Plants generally prosper around classical music but not rock or jazz music. Even though plants are mainly stabile, their environments can still greatly influence the way they behave, especially sounds. Plants communicate through vibrations in sounds and music, which "let a plant know when it is safe to grow" (Michelle, 2018) and if there are any dangers around. Just like other living organisms, plants are very responsive to what goes on around them thanks to their senses.

In my investigation, I will be exploring **to what extent are the heights of pea plants and Vinca Vines influenced by classical music?** This research question is worthy of exploration because it will give me more insight into how plants respond to specific sounds and why they behave that way. As mentioned earlier, Dorothy Retallack discovered that the "best music for plant growth is soothing, positive music" (Goodman, 2017) and that better results will arise if music is played for only a few hours at a time instead of continuously. With this in mind, I will also be able to understand how and why living organisms in general are impacted by their environments by doing this experiment. The significance of this investigation is to gain more

appreciation for plants by the end of my investigation, especially since plant life and processes are commonly overlooked among the public. It always fascinates me why living organisms behave the way they do when exposed to different external conditions and how they adapt to those changes, which is the reason I chose to do this experiment.

Hypotheses and Variables

Hypothesis: Classical music will increase the rate of plant growth.

Null hypothesis: Classical music will have no effect on the growth of Vinca Vines and pea plants.

Independent variable: the time the plants were exposed to classical music in the number of days

Dependent variable: plant growth in centimeters

Control group: the plants not exposed to music

Controlled variables: the amount and frequency of water given to the plants, amount of light, location, type of music, and type of seed or plants

Materials

- Plant Hart's Seeds Snap Peas Sugar Ann
- Variegated Vinca Vines, already growing
- 354 mL tap water per day
- Alvin 570M metric ruler
- Bose Wave Radio/CD
- Two 10 cm Dayspot Grow Lights
- Two Hydrofarm 60W incandescent lightbulbs
- Hand Tie Plant Tape by A.M. Leonard
- Black Sharpie
- 24 Jiffy peat pellets
- Liquid measuring tool (example: beaker)

Procedure

1. Obtain a pack of Sugar Ann Snap Pea plant seeds from a gardening or plant store, as well as Variegated Vinca Vines in one large flower flat (6 compartments). Also get the other materials from a store if needed.
2. Add tap water to a large bowl, filling it up halfway. Add each of the Jiffy peat pellets to the bowl, then wait for all of them to expand, which should take approximately 10 minutes.
3. After the peat pellets have enlarged, place 2 pea plant seeds in each one.
4. Choose 24 seeds (12 pellets) to use as the control group and the other 24 to use with the music group.

5. Take the flower flat and cut it to separate each Vinca Vine compartment. 3 compartments will be used with music, and 3 will be used without music.
6. For each group of plants, cut the roll of plant tape into 12 strips (6 for each group – music and no music), then decide which vines within the group will be receiving the tape. The plants you choose to tie the tape onto will be the plants you measure.
7. Tie the tape onto the 6 chosen plants for each group, then label them by writing "1, 2, 3, 4, 5, and 6" with the Sharpie on the tape.
8. Put the 3 Vinca Vine compartments in an area around the house with the peat pellets of pea plants. In another room, place the other 3 Vinca Vine containers and pea plants, far away from the other set of plants. Decide which plants will be exposed to music and which ones will not.
9. Water each plant with 60 mL of tap water.
10. Put each of the 60W incandescent lightbulbs into the 10 cm Dayspot Grow Lights, then plug them in and turn them on to ensure that they are functional.
11. Set up one grow light by each group of plants, and make sure the lights are placed directly facing the plants.
12. Turn the grow lights on at night, but leave them off during the daytime.
13. Place the radio next to the plants receiving music, then turn it on and choose a Classical music station. Turn the volume of the radio up loud enough to ensure that the plants will be able to detect it, but not be so loud where the plants in the other room can hear it. The music should be continuous, meaning that it should be on at all times and never turned off until you are finished with the experiment.

14. Water the plants with 60 mL of water whenever they seem dry. To ensure that they stay alive, water them only when they are dry, usually every other day, while also making sure you water every plant in both groups at the same time.
15. Measure the marked plants from each group every other day with a ruler, starting from the day you set up the experiment. Measure from the top end of the tape to the end of the plant (where the bud is at). Use centimeters. Measure not only the Vinca Vines, but also the pea plants, from the very bottom of the plant to the top.
16. Record your data and observations for each plant in your notebook, both for the plants exposed to music and for the unexposed plants. General observations include plants leading towards or away from the radio or the light, any uniqueness you see in their appearance, or overall plant behavior.
17. Make a table on a piece of paper or in your notebook documenting the data for each group of plants. A suggestion to make the table is to include the labelled plant name at the top (i.e. 1, 2, etc.) and the number of days on the left side of the paper, then fill in the required information for each.
18. Graph the results in your notebook from step 17, with time in days as the x-axis, or the independent variable, and the total growth of the music-receiving and non-music-receiving Vinca Vines in centimeters as the y-axis, or the dependent variable. Do the same for the pea plants.
19. Compare the results for the control group (the plants that did not have music playing for them) to the results of the plants with the music, and determine if music has a significant effect on plant growth. If it does, what is the effect, and is it positive or negative? You

may need to refer to your tables and/or graphs for this step. Write your data in your notebook to think about and look back at in the future.

Results and Data Collection

Table 1: The average change in heights of each of the Vinca Vines, tested with and without music for 31 days. Each measurement is in centimeters.

Vinca Vines Music		**Vinca Vines No Music**	
Day	**Average Change in Height (cm) ±1 mm**	**Day**	**Average Change in Height (cm) ±1 mm**
1	0.000	1	0.000
3	0.9333	3	0.000
5	1.850	5	1.117
7	3.292	7	2.508
9	5.167	9	7.658
11	8.825	11	9.725
13	10.28	13	11.30
15	11.96	15	12.63
17	12.85	17	14.05
19	13.88	19	16.45
21	15.40	21	18.03
23	16.03	23	19.24
25	16.63	25	20.08
27	17.24	27	20.63
29	18.12	29	22.01
31	18.86	31	22.01

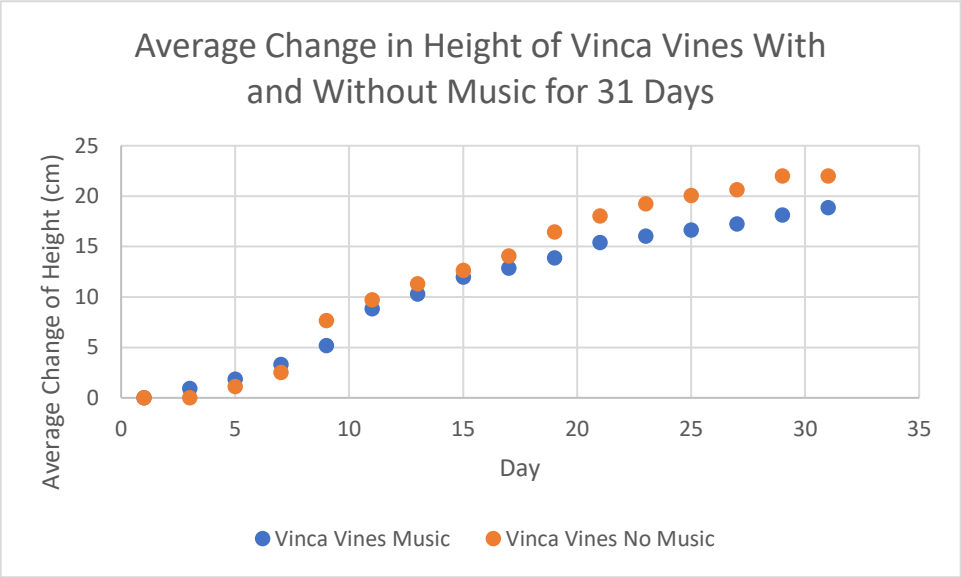

Figure 1: The average change of heights in centimeters of Vinca Vines with and without music for 31 days. The data for this graph was retrieved from Table 1.

Table 2: The average change of heights in centimeters of pea plants exposed to and not exposed to music for 31 days.

Pea Plants Music		**Pea Plants No Music**	
Day	**Average Change in Height (cm) ±1 mm**	**Day**	**Average Change in Height (cm) ±1 mm**
7	0.000	7	0.000
9	1.035	9	1.345
11	3.983	11	4.660
13	6.620	13	7.055
15	8.865	15	9.880
17	11.34	17	11.69
19	11.97	19	12.66
21	13.31	21	13.97

23	14.48	23	14.31
25	15.54	25	14.68
27	16.76	27	14.99
29	17.83	29	15.45
31	18.86	31	15.78

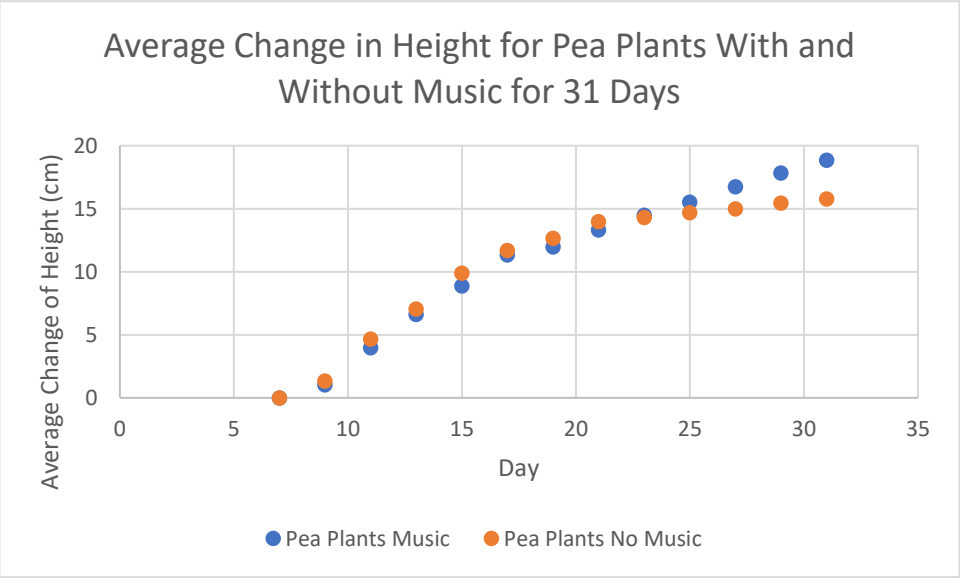

Figure 2: The average change in height of pea plants in centimeters exposed to and not exposed to music for 31 days. The data for this graph was retrieved from Table 2.

Observations

Most of the plants in both groups often did not remain in an upright position for the duration of the experiment. They usually leaned towards the light because that is their source of energy. However, many of the plants that were exposed to music leaned towards the radio as well. This most likely means that the plants enjoyed the music – in other words, they found the music to be beneficial for them – which fostered their growth and production of nutrients.

Throughout the course of the experiment, the Vinca Vines and pea plants exhibited opposite behaviors. As shown by Table 1 and Figure 1, the Vinca Vines that weren't exposed to music grew 3.15 centimeters longer over the 31 days than the ones that had music playing for them. On the contrary, the pea plants that were exposed to music grew 3.08 centimeters longer than the ones that did not have music playing for them, which is demonstrated in Table 2 and Figure 2. This most likely signifies that plants behave respond differently to external influences.

Data Analysis for Vinca Vines

To test the significance of the data, a two-tailed t-test was used for each data set for the Vinca Vines. The p-value for both t-tests were significantly more than .05, or 5%, stating the unlikelihood of the event happening. For Table 1 and Table 2, the groups of Vinca Vines exposed and not exposed to music, the p-values were 0.467 and 0.905, respectively. The null hypothesis, which stated that classical music has no effect on the growth of pea plants and Vinca Vines, is not rejected based on the results of the t-test. Because of this, it can be assumed that classical music does not influence the growth of Vinca Vines.

The total average change of length for the Vinca Vines with music was 18.86 centimeters, as shown in Table 1. This contrasts with the total average change of length for the Vinca Vines without music, which was 22.01 centimeters. Even though my hypothesis stated that classical music affects plant growth, it is not supported by the data for the Vinca Vines. However, part of this may be because one of the Vinca Vines for the non-music group grew abnormally longer than the other Vinca Vines in the same group. By the end of the experiment, plant 4, as it was labelled, was 70.15 centimeters, while the other Vinca Vines were significantly shorter. This means the total change of length for that plant was much greater, 64.15 centimeters, than the other five vines. Therefore, that one vine may have skewed the data to make it appear as though the plants without music grew faster and longer.

The Vinca Vines with classical music had overall drastic growth. The plants grew significantly more each day, while the Vinca Vines without music generally did not grow very long or as quickly each day they were measured, with the exception of one of the plants, which caused the large difference in the two groups.

In this case, my hypothesis is not supported because according to the data, classical music does not cause the Vinca Vines to grow quicker. Classical music did not have much effect at all for these plants. I think that if there was not such a large skew in the data from one of the plants for Table 1, then my hypothesis would be better supported.

Data Analysis for Pea Plants

A two-tailed t-test was also used for the pea plants. For Table 3 and Table 4, which presented the data for the groups of pea plants induced and not induced to music, the p-values were 1.44×10^{-4} and 3.15×10^{-5}, respectively. The null hypothesis, which stated that classical music has no effect on the growth of pea plants and Vinca Vines, is rejected based on the results of the t-test for the pea plants. From this, it can be assumed that classical music does, in fact, affect pea plant growth.

The outcome of the data for the pea plants differed from the results of the Vinca Vines. As shown in Table 2, the measurements of the pea plants with music, the total average change of length was 18.86 centimeters. On the contrary, the total average change of length for pea plants not exposed to music was only 15.78 centimeters, which can be seen in Table 2 as well. Compared to the Vinca Vines, the classical music affected the growth of the pea plants. The pea plants grew longer at a faster rate with the music as opposed to the pea plants without music. In this case, my hypothesis, which states that Vinca Vines and pea plants will grow faster with classical music, is correct. The pea plants that were exposed to music grew roughly 3 centimeters more than the pea plants that were not exposed to music.

Overall, the pea plants thrived with the classical music since there was always significant growth each day the plants were measured. The pea plants that had no music playing for them grew quickly as well, but not not as much as the plants exposed to music. By the end of the experiment, the pea plants with music grew 3.08 centimeters more than the plants without music.

The difference in results of both types of plants shows that some plants respond better to music than others and that music can have a significant effect on plants growth-wise. For instance, classical music contributed to the growth of the pea plants, but it had no effect on the

growth of the Vinca Vines since they grew better without music. Therefore, the pea plants prospered with the music, whereas the Vinca Vines did not, showing that classical music has different effects for different types of plants. The data for the pea plants supports my hypothesis.

Flaws and Improvements in the Experiment

Although my experimental method and procedure can be viewed as successful, there were still flaws involved. For instance, I could have used more plants to achieve better results, since every plant is different and reacts differently to their surroundings. Instead of using 6 Vinca Vines per group, I should have used 10, especially since one of the Vinca Vines in the non-music group was an outlier and grew much faster than the others. If more plants were used, it would limit this inconsistency and allow for better fitting results. I could remove the plants with the highest and lowest amount of growth and only deal with the plants in-between to eliminate any extreme outliers that could skew the data. I also could have continued the experiment for longer than one month to obtain more data and draw a more precise conclusion. To limit the number of variables, other genres of music could have been played for only one type of plant, instead of classical music for two plant types.

Additionally, I was often inconsistent with watering the plants. Instead of watering them every day like I should have, especially later in the experiment, I tried to do it every other day but by that point, the plants were very dry and even starting to wilt. I was worried about overwatering the plants because I did not want them to die, but I realized later that I was actually underwatering them. At first it was fine to water the plants every other day, but as the plants quickly grew, they became dryer and required more water. I watered them every day after that.

Another factor that possibly affected the outcomes of the experiment is temperature. The plants that were exposed to music were up higher than the other plants and closer to natural light, so it was probably slightly warmer for that group of plants than the other group, which were at a lower level and farther away from natural sunlight.

Overall, there were multiple flaws with my experiment that probably affected my results. If I were to repeat this experiment, I would try to not make the same mistakes I made the first time around. Almost every experiment requires repetition and further data collection, which allows the experimenter to form a logical conclusion. Therefore, it would be beneficial to retry this experiment and compare the results.

Conclusion

Plants are very much affected by their environment and are often forced to acclimate to the surrounding conditions. According to *What a Plant Knows* by Daniel Chamovitz, plants essentially have senses that they use to understand and adapt to the world around them. One of the major senses plants utilize is hearing. They obviously cannot hear like humans and animals can, but they are able to decipher the various noises around them through vibrations from sound waves.

Throughout the years, plants have often been tested with music to see how they would behave, and many of the experiments have been successful. The most notorious example of this experiment was conducted in 1973 by Dorothy Retallack, which she goes into more detail about in her book *The Sound of Music and Plants*. She and others afterward have discovered that plants typically behave differently for different genres of music. For example, plants tend to flourish around classical and jazz music but not around rock music. According to Peter Tompkins and Christopher Bird, authors of *The Secret Life of Plants*, "sound waves might produce a resonant effect in the plant cells, enabling the energy to accumulate and affect the plant's metabolism," (Bird & Tompkins, 1973, p. 152), meaning that the vibrations from sound waves may allow the plant to produce more nutrients and energy for itself at a faster rate.

I decided to try this experiment myself and posed the question: **To what extent are the heights of pea plants and Vinca Vines influenced by classical music?** I tested two groups of plants, Vinca Vines and pea plants, both with and without music for 31 days, measured the growth of each plant, and made note of any interesting occurrences. I discovered that classical music does increase the rate of plant growth to a certain extent, but only for specific types of plants. Therefore, hypothesis did not support or refute the data. While the Vinca Vines grew

faster without music, the pea plants did the opposite. This led me to believe that classical music affects the growth of only some plants but not others, since every plant responds differently to their surroundings. Thus, classical music influenced the height of pea plants to a larger extent, but not to any extent for the Vinca Vines since the opposite reaction occurred. However, I could have achieved the expected I wanted if I had used more plants. My experiment was successful, even though there were some flaws, and I mostly received the results I was hoping for. I was surprised with the outcomes from the Vinca Vines, but many scientific experiments do not go as planned. I have learned a lot about plant behavior from this experiment, and it was a very interesting concept. However, like most experiments, this does require more study. I would love to try this experiment again someday or a variation of it and compare the results to my investigation here.

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Appendix

Table 1: The heights in centimeters of Vinca Vines, labeled 1, 2, 3, 4, 5, and 6, that were exposed to music for 31 days.

	Plant 1 Height (cm) ±1 mm	**Plant 2 Height (cm) ±1 mm**	**Plant 3 Height (cm) ±1 mm**	**Plant 4 Height (cm) ±1 mm**	**Plant 5 Height (cm) ±1 mm**	**Plant 6 Height (cm) ±1 mm**	**Average Height (cm) ±1 mm**
Day 1	10.6	5.85	6.20	7.50	6.60	9.90	7.78
Day 3	11.5	6.60	6.55	7.90	9.50	10.2	8.71
Change in Length	**0.900**	**0.75**	**0.35**	**0.400**	**2.90**	**0.300**	**0.933**
Day 5	15.0	7.20	6.60	7.95	10.8	10.2	9.63
Change in Length	**4.40**	**1.35**	**0.400**	**0.45**	**4.20**	**0.30**	**1.85**
Day 7	19.2	7.50	7.10	8.00	13.9	10.7	11.1
Change in Length	**8.60**	**1.65**	**0.900**	**0.500**	**7.30**	**0.800**	**3.29**
Day 9	23.4	8.20	7.50	8.10	19.0	11.5	12.9
Change in Length	**12.8**	**2.35**	**1.30**	**0.600**	**12.4**	**1.55**	**5.17**
Day 11	32.7	8.95	8.10	8.50	26.8	14.6	16.6
Change in Length	**22.1**	**3.10**	**1.90**	**1.00**	**20.2**	**4.65**	**8.83**
Day 13	36.5	11.5	8.20	8.70	28.8	14.7	18.1
Change in Length	**25.9**	**5.65**	**2.00**	**1.20**	**22.2**	**4.75**	**10.3**
Day 15	41.0	15.8	8.40	9.25	29.0	15.0	19.7
Change in Length	**30.4**	**9.90**	**2.20**	**1.75**	**22.4**	**5.10**	**12.0**
Day 17	43.0	18.3	8.50	9.35	29.1	15.5	20.6
Change in Length	**32.4**	**12.5**	**2.30**	**1.85**	**22.5**	**5.60**	**12.9**
Day 19	45.0	20.3	9.00	9.90	30.0	15.7	21.7
Change in Length	**34.4**	**14.5**	**2.80**	**2.40**	**23.4**	**5.80**	**13.9**
Day 21	47.8	23.4	9.30	10.4	31.4	16.8	23.2
Change in Length	**37.2**	**17.6**	**3.10**	**2.85**	**24.8**	**6.90**	**15.4**
Day 23	50.3	24.6	9.80	10.7	31.7	15.8	23.8

Change in Length	**39.7**	**18.7**	**3.60**	**3.15**	**25.1**	**5.90**	**16.0**
Day 25	51.9	25.0	10.4	11.1	32.1	15.9	24.4
Change in Length	**41.3**	**19.2**	**4.20**	**3.60**	**25.5**	**6.00**	**16.6**
Day 27	53.8	25.3	11.0	11.7	32.2	16.1	25.0
Change in Length	**43.2**	**19.5**	**4.80**	**4.20**	**25.6**	**6.20**	**17.2**
Day 29	56.4	25.4	11.8	12.6	32.5	16.7	25.9
Change in Length	**45.8**	**19.6**	**5.60**	**5.10**	**25.9**	**6.80**	**18.1**
Day 31	58.0	25.5	12.6	13.2	33.0	17.5	26.6
Total Change in Length	**47.4**	**19.7**	**6.40**	**5.70**	**26.4**	**7.60**	**18.9**

Table 2: The heights in centimeters of Vinca Vines, labeled 1, 2, 3, 4, 5, and 6 that were not exposed to music for 31 days.

	Plant 1 Height (cm) ±1 mm	**Plant 2 Height (cm) ±1 mm**	**Plant 3 Height (cm) ±1 mm**	**Plant 4 Height (cm) ±1 mm**	**Plant 5 Height (cm) ±1 mm**	**Plant 6 Height (cm) ±1 mm**	**Average Height (cm) ±1 mm**
Day 1	7.85	9.50	15.1	6.00	12.0	6.70	9.53
Day 3	7.85	9.50	15.1	6.00	12.0	6.70	9.53
Change in Length	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Day 5	7.90	9.50	15.1	8.40	12.0	6.90	9.97
Change in Length	**0.0500**	**0.00**	**0.00**	**2.40**	**0.00**	**0.200**	**1.12**
Day 7	7.90	9.50	15.1	11.5	12.1	7.80	12.0
Change in Length	**0.0500**	**0.00**	**0.00**	**5.50**	**0.0500**	**1.10**	**2.51**
Day 9	9.20	9.50	15.2	16.8	12.1	9.45	17.2
Change in Length	**1.35**	**0.00**	**0.0500**	**10.8**	**0.100**	**2.75**	**7.66**
Day 11	15.6	12.0	19.1	26.8	15.1	14.5	19.3
Change in Length	**7.75**	**2.50**	**4.00**	**20.8**	**3.10**	**7.80**	**9.73**
Day 13	18.7	12.1	19.2	33.1	15.3	17.1	20.8

Change in Length	**10.9**	**2.60**	**4.10**	**27.1**	**3.30**	**10.4**	**11.3**
Day 15	20.0	12.3	19.2	38.1	15.4	20.1	22.2
Change in Length	**12.1**	**2.75**	**4.10**	**32.1**	**3.40**	**13.4**	**12.6**
Day 17	20.0	12.3	19.6	43.5	15.7	21.9	23.6
Change in Length	**12.2**	**2.75**	**4.50**	**37.5**	**3.65**	**15.2**	**14.1**
Day 19	20.0	12.3	19.7	48.0	15.8	25.8	26.0
Change in Length	**12.2**	**2.75**	**4.60**	**42.0**	**3.80**	**19.1**	**16.5**
Day 21	20.0	12.3	20.0	54.0	15.8	33.8	27.6
Change in Length	**12.15**	**2.75**	**4.9**	**48**	**3.8**	**27.1**	**18.025**
Day 23	20.2	12.3	20.0	58.6	16.0	38.3	28.8
Change in Length	**12.4**	**2.75**	**4.90**	**52.6**	**3.95**	**31.6**	**19.2**
Day 25	21.4	12.5	20.2	61.3	16.0	41.2	29.6
Change in Length	**13.6**	**3.00**	**5.10**	**55.3**	**4.00**	**34.5**	**20.1**
Day 27	22.7	12.5	20.3	63.6	16.0	42.5	30.2
Change in Length	**14.9**	**3.00**	**5.20**	**57.6**	**4.00**	**35.8**	**20.6**
Day 29	23.3	12.5	20.3	65.8	16.1	42.9	31.5
Change in Length	**15.5**	**3.00**	**5.20**	**59.8**	**4.10**	**36.2**	**22.0**
Day 31	23.7	12.6	20.4	70.2	16.2	46.15	31.5
Total Change in Length	**15.9**	**3.10**	**5.30**	**64.2**	**4.20**	**39.5**	**22.0**

Table 3: The heights of pea plants in centimeters exposed to music for 31 days.

Music Group	**Plant 1**	**Plant 2**	**Plant 3**	**Plant 4**	**Plant 5**	**Plant 6**	**Plant 7**	**Plant 8**	**Plant 9**	**Plant 10**	**Average**
Day 7	2.00	2.00	2.00	1.10	2.20	1.00	1.00	4.00	1.00	2.30	1.86
Day 9	2.00	3.20	3.70	2.10	2.70	1.60	3.70	5.60	1.80	2.55	2.90
Change in Length	**0.00**	**1.20**	**1.70**	**1.00**	**0.500**	**0.600**	**2.70**	**1.60**	**0.800**	**0.250**	**1.04**
Day 11	2.70	7.70	6.75	3.60	3.75	2.00	9.25	11.6	1.90	7.70	5.70

Change in Length	**0.700**	**5.70**	**4.75**	**2.50**	**1.55**	**1.00**	**8.25**	**7.60**	**0.900**	**5.40**	**3.98**
Day 13	5.50	11.8	9.75	4.50	8.00	2.50	12.2	18.0	2.00	10.6	8.48
Change in Length	**3.50**	**9.75**	**7.75**	**3.40**	**5.80**	**1.50**	**11.2**	**14.0**	**1.00**	**8.30**	**6.62**
Day 15	8.45	15.6	11.2	6.30	11.5	3.10	14.3	20.5	4.90	11.4	10.7
Change in Length	**6.45**	**13.6**	**9.20**	**5.20**	**9.30**	**2.10**	**13.3**	**16.5**	**3.90**	**9.10**	**8.87**
Day 17	11.6	18.0	13.0	8.00	15.4	5.30	15.5	21.7	8.30	15.2	13.2
Change in Length	**9.55**	**16.0**	**11.0**	**6.90**	**13.2**	**4.30**	**14.5**	**17.7**	**7.30**	**12.9**	**11.3**
Day 19	12.6	20.0	13.5	8.30	18.9	6.40	17.0	12.1	16.5	13.0	13.8
Change in Length	**10.6**	**18.0**	**11.5**	**7.20**	**16.7**	**5.40**	**16.0**	**8.10**	**15.5**	**10.7**	**12.0**
Day 21	14.5	20.6	14.1	8.90	21.7	7.80	17.6	14.3	18.0	14.2	15.2
Change in Length	**12.5**	**18.6**	**12.1**	**7.80**	**19.5**	**6.80**	**16.6**	**10.3**	**17.0**	**11.9**	**13.3**
Day 23	15.0	21.0	15.2	11.8	22.4	9.20	18.4	16.1	19.3	15.0	16.3
Change in Length	**13.0**	**19.0**	**13.2**	**10.7**	**20.2**	**8.20**	**17.4**	**12.1**	**18.3**	**12.7**	**14.5**
Day 25	16.2	21.9	16.0	14.3	23.2	9.90	19.0	18.0	20.2	15.3	17.4
Change in Length	**14.2**	**19.9**	**14.0**	**13.2**	**21.0**	**8.90**	**18.0**	**14.0**	**19.2**	**13.0**	**15.5**
Day 27	17.1	23.0	16.9	17.2	24.0	10.7	19.5	20.2	21.6	16.0	18.6
Change in Length	**15.1**	**21.0**	**14.9**	**16.1**	**21.8**	**9.70**	**18.5**	**16.2**	**20.6**	**13.7**	**16.8**
Day 29	18.2	24.1	18.0	18.9	25.3	11.6	20.2	21.6	22.4	17.1	19.7
Change in Length	**16.2**	**22.1**	**16.0**	**17.8**	**22.6**	**10.6**	**19.2**	**17.6**	**21.4**	**14.8**	**17.8**
Day 31	19.0	25.3	19.1	20.0	26.2	12.3	20.9	22.9	23.1	18.4	20.7
Total Change in Length	**17.0**	**23.3**	**17.1**	**18.9**	**24.0**	**11.3**	**19.9**	**18.9**	**22.1**	**16.1**	**18.9**

Table 4: The heights of pea plants in centimeters not exposed to music for 31 days.

No Music Group	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Plant 10	Average
Day 7	2.50	1.00	2.00	1.35	1.20	0.700	2.20	1.00	1.60	1.70	1.53
Day 9	5.50	1.60	3.55	1.50	3.60	2.30	4.00	1.50	2.55	2.60	2.87
Change in Length	**3.00**	**0.600**	**1.55**	**0.150**	**2.40**	**1.60**	**1.80**	**0.500**	**0.950**	**0.900**	**1.35**
Day 11	12.3	4.25	8.10	1.80	9.00	4.85	8.40	3.40	5.50	4.25	6.19
Change in Length	**9.80**	**3.25**	**6.10**	**0.450**	**7.80**	**4.15**	**6.20**	**2.40**	**3.90**	**2.55**	**4.66**
Day 13	15.2	7.15	9.80	2.10	14.5	7.00	10.1	3.90	8.90	7.15	8.58
Change in Length	**12.7**	**6.15**	**7.80**	**0.750**	**13.3**	**6.30**	**7.90**	**2.90**	**7.30**	**5.45**	**7.06**
Day 15	20.2	9.70	9.80	5.00	19.1	8.10	14.2	4.20	12.8	11.0	11.4
Change in Length	**17.7**	**8.70**	**7.80**	**3.65**	**17.9**	**7.40**	**12.0**	**3.20**	**11.2**	**9.30**	**9.88**
Day 17	21.5	14.0	9.90	8.10	21.6	8.15	16.8	4.70	14.9	12.5	13.2
Change in Length	**19.0**	**13.0**	**7.90**	**6.75**	**20.4**	**7.45**	**14.6**	**3.70**	**13.3**	**10.8**	**11.7**
Day 19	22.0	14.5	10.1	10.2	22.4	9.00	17.7	5.30	17.7	13.0	14.2
Change in Length	**19.5**	**13.5**	**8.10**	**8.85**	**21.2**	**8.30**	**15.5**	**4.30**	**16.1**	**11.3**	**12.7**
Day 21	22.3	18.0	10.5	14.2	23.9	9.35	17.8	5.8	19.8	13.3	15.5
Change in Length	**19.8**	**17.0**	**8.50**	**12.9**	**22.7**	**8.65**	**15.6**	**4.8**	**18.2**	**11.6**	**14.0**
Day 23	22.3	18.4	10.7	14.7	24.0	9.90	18.5	6.00	20.0	13.8	15.8
Change in Length	**19.8**	**17.4**	**8.70**	**13.4**	**22.8**	**9.20**	**16.3**	**5.00**	**18.4**	**12.1**	**14.3**
Day 25	22.9	19.0	10.8	15.1	24.3	10.2	18.85	6.25	20.4	14.2	16.2
Change in Length	**20.4**	**18.0**	**8.80**	**13.8**	**23.1**	**9.50**	**16.7**	**5.25**	**18.8**	**12.5**	**14.7**
Day 27	23.2	19.3	11.0	15.5	24.6	10.7	19.1	6.40	20.8	14.6	16.5
Change in Length	**20.7**	**18.3**	**9.00**	**14.2**	**23.4**	**10.0**	**16.9**	**5.40**	**19.2**	**12.9**	**15.0**
Day 29	23.6	19.9	11.6	16.1	25.1	11.2	19.5	6.70	21.3	14.8	17.0
Change in Length	**21.1**	**18.9**	**9.60**	**14.8**	**23.9**	**10.5**	**17.3**	**5.70**	**19.7**	**13.1**	**15.45**
Day 31	23.9	20.2	12.0	16.3	25.4	11.6	19.75	7.00	21.5	15.4	17.3
Total Change in Length	**21.4**	**19.2**	**10.0**	**15.0**	**24.2**	**10.9**	**17.6**	**6.0**	**19.9**	**13.7**	**15.8**