# **INTRODUCTION:**

# **Why Music and Plants?**

Jon Arbuckle from the comic series Garfield seemed to always be talking to his plants while Garfield the cat connives ideas to eat the plant. Someone once said that if you talk positively to your plants, they would grow stronger and healthier. But plants that received bad vibration, mostly deteriorated. The idea of plants with emotions and treating plants like humans interested the both of us and we took that idea a little farther. We decided to shape our idea of plants and sound frequencies/vibrations after careful thoughts and research. But after some research, we did not find much information or experiments that dealt with talking to plants. Instead, we found that music has a strong impact on the human body and physiology. Music could affect growing children and the health of many individuals. If our idea for the AP bio project was to treat plants like humans, we wondered if music could also affect the growth of plants and its conditions. We explored the idea of using music to grow bigger and healthier fruits, vegetables, and other plants. In our experiment, we would place radishes in environment with classical music, rock music, and just plain silence. We hoped that the radishes would respond to a certain type of music and its growth would be significant. We believe that if music has an influence over human bodies, it would definitely have some sort of effect on plants as well.

### **Music... pain reliever?**

“Whenever the spirit from God came upon Saul, David would take his harp and play, then relief would come to Saul; he would feel better, and the evil spirit would leave him” (1 Samuel 16:23). Even from the ancient times, music has been a great influence on society as a whole. Music was found in every civilization, country and nation. From ancient Greece to modern day America, music surrounds life and integrates with human and the different aspects of their existence.

Music has a great therapeutic effect on all people, young or old. For example, Matteo, a young four year old with speech problems learned to express himself with music (Westley 103). Some effect could be stronger than others. Music can alter a person’s emotion, mental state, spiritual, and even physical states. It can help in physical sickness, stress, mental illness, and even to brighten up a mood. Because music revolved around lives for so long just as a source of entertainment, many have forgotten that music was once used to treat illnesses.

In the United States, music therapy became more and more popular. Music was found to trigger the brain to react to music almost as if it were medicine. Music is often used with many patients with strokes, Alzheimer, Parkinson’s, or even in labor (Westley 103). For example, a 79-year-old man learns to reuse his legs by listening to “Battle Hymn of the Republic” (Harrar 101). In other cases, pregnant women who choose to listen to music while in labor use less anesthesia (Marwick 731). Hospital patients have learned that simple relaxation or listening to music can greatly reduce pain after a major surgery (Stephens 632). As Beethoven stated, “I leave my music to heal the world” (Economist 85).

**What is music?**

Music is by definition an organized movement of sounds that travels by time. It plays a strong role in society and has many different variations, styles, and characteristic according to each culture and nation (Encarta). Music was used in many ways but those ways are not as familiar to many individuals. Music is used as emotional expression to show our feelings, pure enjoyment of beauty and harmony, entertainment to draw us away from life’s hardships, communication, symbol of our unity or individualism, and even as medicine (Scarantino 23).

**How does music affect life?**

As many researchers found, music has a significant effect on all aspects of health. Although scientists and researchers cannot specifically explain *how* music influences the body but they are positive that music *has* strong control over the body. Musical beat has certain rhythms that can stimulate the brain’s motor systems. Listening to music directly affects blood pulse, pressure, and even electrical activity of muscles (Westley 103). Music catches attentions of the minds and help with body functions. It can distract pain, boost moods, revive memories, and promote activity of muscles (Harrar 103).

In many cases, music stimulates hormones and brain chemistry. For instance, music affects three parts of the brain: the emotional (limbic), functional (brain stem), and thinking part of the brain. Music helps hormones produce endorphins, which are the “feel good” chemicals of the body (Scarantino 71). Music can help nurture and grow the connections between nerve cells in the brain (Westley 103). Through that, music can help lower blood pressure, stabilize heart rate, and tune the mind with bodily sensations (Scarantino 71).

#### **How does rock music affect humans?**

Research has shown us that music affects our brains and enables it to react to music to synchronize motor skills, incite the mind and even makes us more intelligent. Humans hear music not just with their ears but with their body as well (Scarantino 32). Each body has their own rhythm and beat but because our own bodies also qualify as musical instrument, it can adjust to it surrounding. Rock music tends to have unnatural beats that are unnatural to our body’s rhythm.

Beats that are unnatural tend to cause problems in the human body. If the unnatural beat is prolonging, it can cause the atrophy of the muscle. Those types of beats also can cause significant damage. The brain has two hemispheres that one controls the imaginative aspect and the other controls the intelligent aspect. If the abnormal beats are played continuously, the brain will be thrown into confusion and the two hemisphere would lose contact (Scarantino 33). It will also cause the mind and body with learning disabilities, fatigue, and poor work performances.

Rock music also tends to addictive and extremely loud. Our bodies could become caught in a trance. Rock music and beats can pull the mind into a loud and vibrating musical environment that can throw our homeostasis into a unstable state (Scarantino 34).

Sound waves are produced when the pressure of air that move in waves and travel off of a vibrating object (Tortora 260). Our ears have a certain level of frequency. The greater the vibration, the higher the pitch (Tortora 260). When the high pitches get louder and louder, it can cause a problem not just to the ears but also to the whole body. The vibration can affect the body inside and out. The body does not have a defense mechanism to the vibrations and it can take as little as 15 minutes to cause damage(Scarantino 40).

#### **Cherry Belle Radishes**

Cherry Belle radishes are commonly known as the garden radish. Its physical appearance varies on seasons and regions. Radishes can be small and round, thin and long, and its color can go from white to red or to yellow. Radishes are of the mustard family and originated from China. It’s grown in the northern region in the temperate zone. Most of the time, radishes are eaten raw and are usually in salads (Encarta).

Radish seeds sprout and the root then slowly turns color and hardens. Radish itself is the root from the whole plant. The root consists with xylem and phloem that carry out special function such as transportation and nutrition. Roots are important sources of food and have numerous and abundant amount of nutrients(Encarta).

**Management**

To manage the cherry belle radishes, you must sow them in stone free soil. It’s better to plant radishes in early summer or spring. You should cover them with at least half inch of fine soil. Try to keep them evenly moist. The seedlings should sprout in seven to fourteen days, which depends on soil and weather. For the best possible results, radishes thrive in cooler weather.

**Problem:**

Will different energy frequencies from various types of music have varied effects on the growth of roots, leaves, and stem of radishes?

**Hypothesis:**

Energy frequencies will have a significant effect on the physiology of radish plants.

**Prediction:**

If plant metabolism is influenced by the energy frequencies of music, then plants subjected to music will have varied growth than plants that are not subjected to music.

**Materials:**

You will need:

* Three 15½diameter plant pots with 9 ½ diameter on the bottom that is 1 ft high.
* Three base holders for the pots
* Manure Blend that is 28.32 L (1 cubic foot) because radishes must be planted in rock free soil
* 4 cups of water for each pot at every watering time
* Cherry Belle radish seeds (30 in each so at least 90 seeds)
* Gardening Tools such as mini shovel, hose, watering bucket, gloves
* Post-it tabs
* Ruler in cm and inches
* 4 sticks of wood (length: 17 inches)(width: 1 inch)(height: 1 ½ cm)
* Digital Camera or any other camera
* Music ( i.e. Classical and Rock) We picked violin version of Cannon in D by Pachebel and Last Resort by Papa Roach
* 4 Speakers (height: 8 ½ inches)(width: 3 ½ inches)(depth: 5 inches)
* 2 Compact Disc Players
* 8 extra AA batteries
* 2 Extension cords for the speakers along with an outlet.
* Clock or wrist watch with a timer
* Pie Pan
* Digital Oscilloscope

Procedure

“GETTING IT JUST RIGHT”

1. Obtain all needed materials listed
2. Pick 3 locations where the environment and exposure to sunlight are equal. Make sure there are no lurking variables such as extra water from sprinklers, shade, and amount of bugs.
3. Make sure the pots are spaced evenly and far enough from each other to not be exposed to the frequencies of the other music. A good spacing is about 15 feet between each pot.
4. Fill the three pots with the manure blend up to 6 inches from the bottom. Stick a ruler perpendicular to the pot base and have partner fill pot until the soil level reaches 6 inches. Then remove the ruler and patch up any hole in soil made by it.
5. Make 5 marking that are all 5 cm off from the walls of the pot and 8 cm between each hole.

*PICTURE*

1. Put tabs on those 5 spots and make holes 5 centimeters deep at each spot. Place 6 cherry belle radish seeds in the holes and cover up firmly with soil.

*PICTURE*

“TIME TO USE OUR GREEN THUMBS AND OUTLETS”:

1. After planting, put 4 cups of tap water in the plant feeder and dispense evenly to first pot. Repeat this step for other two pots.
2. Check on plants daily until first sprout appears from any pot.
3. While waiting for sprouts to appear, begin the set up of music
4. Choose two songs. One with higher frequencies such as rock and the other with lower frequencies such as classical. Using the Digital Oscilloscope, determine which songs have high and low frequencies. Have them on two separate CD’s.
5. Assign each pot to a music type and the control will grow under silence (or no influence from music).
6. At first sprout, set up two speakers and compact disc players at each pot (except the control pot)
7. Place one wooden stick 3.75 inches from the left rim side of the pot. Place the other stick 3.75 inches from the right rim side of the pot. The two sticks should be 6 inches apart from one another. The stick itself would be one inch thick.
8. Place the speaker across the two boards with the speakers facing down. The two speakers would be 3 inches apart from each other.

The compact disc player would be set on the ground. Do this for both group one and group two.

*PICTURE*

1. Set the wrist watch timer for two hours
2. Start the music (rock and classical) both at the same time and put the two songs on repeat mode.
3. Set the timer for two hours.
4. After two hours stop the music and remove the speakers so as to not block the plant from sunlight exposure until the next music exposure.
5. Water the plants every other day (Monday, Wednesday, Friday, Sunday……), repeating step 7.
6. The days following the watering days (i.e. if the plant was watered on Monday, this step should be done on Tuesday), repeat steps 10.a. through 10.g.

“GETTING ALONG JUST FINE, I HOPE?”:

1. After three weeks, or 21 days, it is time to pull out a few radishes for a developmental “check up”. Do this in order to check on the plants development and to make certain the plants are growing strongly. (If the plants are not developing, we strongly urge you to start investigate the causes for the plant’s developmental halt and start again using new procedures).
2. Pull out one of the “batches” (a cluster of 6 growing radishes planted in one of the 6 holes) from Group 1, Group 2, and the Control Group.
3. Using the mini shovel to dig, pull out the clusters carefully by digging out the surrounding soil also. Make sure not to pull off any leaves or disturbing the other batches. Cut a 4 cm radial circle around the plant and 10 cm deep.

*PICTURE*

1. Gently remove any loose soil surrounding the roots.
2. Fill the pie pan with water and carefully wash off any excess soil attached to the roots in it.
3. Slowly and carefully separate the roots from each other, and you should have six different root systems from the six seeds initially planted.

“TAKING DOWN THE DATA”:

1. Straighten the roots as much as possible without tearing them. Measure the length of the roots and record results in the data table.

*PICTURE*

1. Count the number of leaves per radish plant and record the results.
2. Measure the length and width of the first type of leaf. Length should be from the beginning of the leaf to the topmost tip of the leaf. The width should be taken from the widest part of the leaf. Record the data.

*PICTURE*

20) Measure the length and width of the second type of leaf. Lengths should be from the beginning of the leaf to where the point at which the top of the leaf concaves. The width should also be taken from the widest part of the leaf. Record the results.

*PICTURE*

1. After all the measurements have been made, disperse of those recorded plants properly. There is no need to keep them anymore.

“…..CONTINUING ON….

1. Continue to care and experiment on the plants by repeating steps 11 and 12.

“HARVEST TIME”:

1. After 5 weeks , or 35 days, it is time to pull out the rest of the radishes.
2. Repeat Steps 14-22 until all the batches from all three groups has been pulled and recorded.
3. Take your findings and time to analyze…….

**DATA:** (excel files)

**CONCLUSIONS:**

*“The hills are alive with the sound of music….”* Well, music may make Julie Andrew’s hills come alive, but not the cherry belle radishes in our experiment. After reviewing the graphs and data comparisons, we have concluded that certain types of energy frequencies emitted by music does not in fact have any effect on plant physiology and it’s metabolism.

To come to this conclusion, we used correlation, which is used when analyzing bivariate data. It is a mathematical measure to determine the strength of a relationship. If there were to be a strong relationship, the result of the correlation equation using the data would equal 1. A correlation of 0 would show no possible relationship at all. The relationships we used were between the Control Group and Group 1, the Control Group and Group 2, and Group 1 and Group 2. Correlation would help us determine whether the data from two groups were associated. If the correlation showed a strong association between the data, then that would indicate that the growing patterns of the plants were not significantly different. Thus, plants growing under separate and different energy frequencies as opposed to silence do not have any physiological effect on them.

In our data, we found that most of the correlations fell between .89 to as high as .95. After comparing the Group 1 plants, which were grown under the influence of the popular rock song “Last Resort” by Papa Roach, with the Control Group, we saw that the correlation in their root lengths were .94. For the leaf lengths and widths, the correlations were .94 and .92. The result in root length correlation between the Control Group and Group 2, which were exposed to Pachebel’s Cannon, was .90. The leaf length and width outcomes were both .95. Since these numbers are reasonably close to 1, we can conclude that the growing patterns of the plants subjected to the varied music types are not distinct and unusual from the control grown under silence. Therefore, hush or no hush, the plants grew at the same rate. Musical influences, in our experiment, did not show any sign of giving the radishes any metabolic advantages over one another. It did not encourage the plant to have greater photosynthetic ability or promote better and faster growth.

Music may not help a plant’s life, but it certainly still does play a great role in the daily lives of humans. There is the theory that playing classical music to a fetus and newborn babies may encourage greater intellectual strength, but let’s leave that to other experiments. There are so many variables that cause the variations in human metabolism and growth. The way we were brought up to eat, the sports we play, and even the laziness that has caused many buttocks to be implanted on a couch for hours on end. Almost every activity we take part in effects us emotionally and physically in some way, so it is near impossible to test the sole influence of music on an individual. The benefits of song and harmony benefit different individuals in unique ways, just not with plants. For that reason, the best promotion for better plant growth is the gardener’s own shadow.

#### **Recommendations**

Although we believed this project to be simple with no complications, we were wrong and had some difficulties. We needed to be prepared for the worst so to speak. For the future group of experimenters, we hope to provide some insight that might be of help.

* It is always great to be well organized. No matter how small the task, be organized and clean. Organization also deals with diligence and it’s always a good idea to be diligent. Procrastination is definitely ticket to stress.
* Be aware of the weather. Make sure that the rain will not conflict with your speakers. It’s a great idea to put some sort of cover on all the plants to protect them from access rain and wind.
* Measure the soil as precisely as possible. The soil can throw off the data when it comes to the nutrition that each plant is accessible to. Be sure to measure the water accurately as well. Each group of plants should get the same amount of water, nutrition and amount of sunlight.
* Find land that is flat and with the same environmental condition. Try to eliminate as much lurking variables as possible. No shade, extra bugs, or sprinklers. (i.e. Do not have one group be under a tree and another group next to the sprinklers)
* It’s a good idea to place the pots in a line north to south. Because the sun rises and set from east to west, you don’t want one group to receive more sunlight than the other. Try to make all the conditions the same for each group of plants.
* Make sure that the experiment is done well ahead of time so as to insure that if there are any problems, the plants could be planted and grown again within time.
* The spacing between the pots should be wide enough to avoid other plants from hearing unassigned music. Once again, eliminate as much lurking variable as possible.
* The music should have the same volume with both classical and rock. The more accurate your detail in the experiment, the more accurate the data will be and your results will be a reflection.

#### **Bibliography**

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#### **Daily Log**

Months before February: Began research on the effect of talking to plants. Found very little information. Found research on music affecting humans. Discussed with each other on our bio project topic. Decided to experiment with the effect of music on plants. Research on plants and music effects but found that there was no apparent connection or supportive evidence.

February 5: Katrina and Dahye organize and talk about the needed materials.

February 10: Katrina and Dahye go to Home Depot to buy materials such as soil, wood sticks, pots, and pot bases. Decided to put all material at Katrina’s house until we found large plot of land.

February 18: Dahye meets Katrina at her house and decide on Katrina’s back yard. Her back yard has a little section on the side of the yard that has enough space for the three pots. We researched on different types of vegetables with roots and choose to plant radishes.

February 20: Go to Dahye’s house to work on introduction. Had to go to the library to check out some research books.

February 27: Go to Dahye’s house to finish introduction. Finished introduction.

March 3: Katrina and Dahye once again travel to Home Depot and buy Cherry Belle Radishes. Return to Katrina’s house and began planting. Whoopee. After planting all three pots, we watered them and set them up in their appropriate spots.

March 5-13: Katrina waters the pots every other day. (Except on the days that rained)

March 13: Sprouts appear! Hallelujah! Katrina calls Dahye to rush over to set up music.

March 15-23: Katrina waters the pots every other day. (Except on the rainy days.)

March 16-24: Katrina (and Dahye on non-working days) play music to plants.

March 25: Katrina and Dahye pull out one bunch of radishes from each pot to make sure the plants were growing healthy and correctly. This was just in case it didn’t work and we had to replant.

March 31: Katrina is out of town and Dahye has to come over to water the plants.

April 1: No WORK! Katrina’s OLD! Happy 18th B-day!! (Just kidding…Dahye goes over to play music.)

April 2-6: Water plants every other day. (Except on rainy days)

April 3-5: Played music to plants every other day.

April 7: Play music for the last time. Afterwards, we harvested and pulled out the plants. We PAINSTAKINGLY and FRUSTRATINGLY took down every single data from each seedling. (89 seedlings!!!!)

April16: Finish up with procedures, materials, and hypothesis/prediction. Analyze all the data at Katrina’s house.

April 17: Make charts and graphs. Organize our images and pictures.

April 19: Finish conclusion, recommendations, and bibliography. Examine our finished project and do some polishing up in necessary areas. Afterwards……bathe in freedom after our project is done.

April 20: Go out and celebrate.