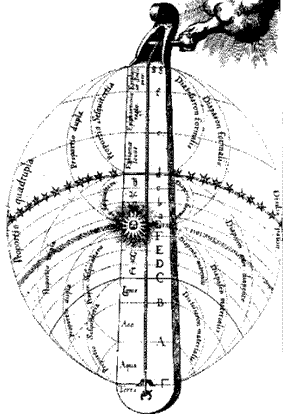
# Unit Three: The Music of the Spheres

**Introduction: Getting Ready to Hear the Music of the Spheres**



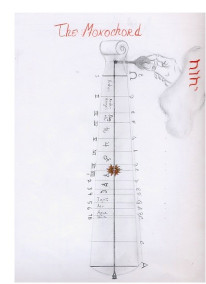
This is an illustration taken from Fludd's Utriusque Cosmi Historia. In the illustration, the universe is compared to a monochord, touching on Pythagoreanism, cosmology, and physics. Renaissance science was nothing if not eclectic and interdisciplinary.

Three to four weeks prior to beginning a unit on sound, the teacher will want to accustom the students (and him- or herself) to hearing the intervals and being able to identify them. This could be done in many ways: with recorders, on the piano, on a guitar. Take five to seven minutes in the morning and build up this exercise over time.

First, simply play the intervals. Starting with the tonic, progress through the scale to the octave. (At first, stay within one octave.) Once the students get used to hearing the intervals, ask them to guess which interval is being played. It should not take long until most if not all of the students get to be pretty accomplished at discriminating between the different intervals. Explore the aesthetics of the intervals: which intervals are consonant? Which dissonant? Is one more beautiful than another? Why is this? Likewise, explore and discuss the affective aspects of the intervals. How does a particular interval make you feel? One could move from here, depending on the class, to a comparison of music written in major or minor keys. (For instance, Bach’s Brandenburg Concerto # 5 as a major key piece and Mozart’s Requiem, at least the “Introit,” as a minor key example).

[**Part 1: The Monochord**](http://www.marygrove.edu/aie/lesson_plans/lessonplans/581361_1.htm)

According to legend, the last words of Pythagoras were, “Study the monochord!” Of course, he said this in Greek. The natural philosophers of the Renaissance, especially the English physician Robert Fludd, took Pythagoras up on his challenge. It is high time our own students did the same!



Seventh Grade Student Monochord Diagram

**Materials needed:** a guitar, a meter stick.

(This is really a duocord, but it is easier for the students). Take a guitar and tune the two lowest strings to the same note, say a G. Since the students can already identify the intervals, play the tonic. After the interval is identified, have one or two students measure the length of the strings. They should be the same length, for a ratio of 1:1. Then move to the octave, which yields a ratio of 1:2. Then proceed to one of the more consonant intervals, like a major third or a fifth. Then do the fourth and the sixth. Finally, measure the second and the seventh. The students will discover that the more consonant the interval, the simpler the ratio; the more dissonant the interval, the more complex the ratio. The intervals you find should be very close to those listed below:

Tonic: 1:1  
Octave: 1:2  
Fifth: 2:3  
Fourth: 3:4  
Major Third: 4:5  
Major Sixth: 3:5  
Major Second: 8:9  
Major Seventh: 8:15

This can lead further into a discussion of musical scales, the construction of musical (non-electronic) instruments, etc.

**Possible artistic activities:**

* **A Diagram of the Monochord.** Robert Fludd includes several diagrams of monochords in his book Utriusque Cosmi Historia (On the History of the Cosmos). True to the interdisciplinary nature of Renaissance science, Fludd’s diagrams are not only scientific (in the modern sense) but also contemplative, imaginative works. Students can do a simplified diagram in the style of Fludd, including Fludd’s application of astronomical and elementary correspondences. It is important, though, in doing this to make sure the intervals are exact. So pick a number that is easy to divide for the tonic (say 20 centimeters). (See student work and example from Fludd).
* **Making a Musical Instrument.** And why not! This could be for older students, but younger children could do modified versions. Possibilities include, but are not limited to, the following: a mountain dulcimer, a pentatonic lyre, a bamboo or reed flute. The important thing is in bringing measurement into the project alongside of craftwork.

**Part 2: The Singing Piano and the Harmony of the Spheres**

Most schools have at least one piano. In this lesson, students will learn about resonance, sympathetic vibration and overtones. **Materials needed:**a piano, ears, voices

* 1. **Resonance and Sympathetic Vibration.** Open the piano is such a way that the strings may be seen. On an upright this entails taking off the front; for a grand or baby grand simply lift the lid. Depress the loudness pedal of the piano while having a student sing a note into the strings. The note will sound back. Repeat this with more students singing the same note. Then you may want to try having the students sing a chord (say, 1-3-5, C-E-G). This demonstration is aesthetically pleasing and also awakens a sense of wonder in the students. Terms to introduce: resonance, resonate, sympathy, acoustic, harmony.

**Possible activity:**

Have students look up the etymologies of the words up in the dictionary. Discuss the denotations and connotations of these words. For instance: What does sympathy mean in a scientific context? What does it mean in a social context?

* **Overtones.** Have the piano’s strings exposed as in part one. Depress the loudness pedal, then softly but sharply strike one of the keys. Have the students listen, paying attention to hearing not only the note struck, but also to any other notes. Try to have them identify which notes. Hold down a note or chord in a like manner so the note or notes don’t sound. Then, using the length of your other arm, crash down on the keys of the piano. The notes will sound. Delicately press down middle C so it doesn’t make any noise. Hit the C an octave below it. The middle C will sound. Depress other notes in the series: G above middle C (2nd overtone), C above middle C (3rd overtone), E above C, etc.

**Print sources:**  
Roberto Trostli, Physics Is Fun!: A Sourcebook for Teachers, Octavo, 1995.

**Part 3: Celestial music**

After resonance, sympathetic vibration, and overtones have been experienced, this is a wonderful conclusion to the unit.

**Materials needed:** A set or two of tuning forks.

Distribute the tuning forks among the students. First starting with all of the C forks, have students strike the forks and then hold the base/handle of the fork firmly to the tops of their desks. The desks will act as resonators and amplify the sound. Then move toward listening to the forks sounded in intervals (thirds, fifths, etc.). Next, experiment with major and minor chords being sounded. Finally, have all the students sound their tuning forks at the same time. The sound throughout is extraordinary, but the culminating demonstration is incredibly beautiful.

**Possible artistic activities:**

* Have students learn the [“Sit, Jessica”](https://marygroveaie.wordpress.com/lesson-plans/lesson-plans/renaissance-part-three/unit-three-the-music-of-the-spheres/the-merchant-of-venice/) speech from The Merchant of Venice. Ralph Vaughn-Williams also has a musical setting of this passage that may be nice to share with students.

# The Merchant of Venice

**From The Merchant of Venice by William Shakespeare**

**Act V. i. 54-65.**

How sweet the moonlight sleeps upon this bank!  
Here will we sit and let the sounds of music  
Creep in our ears: soft stillness and the night  
Become the touches of sweet harmony.  
Sit, Jessica. Look how the floor of heaven  
Is thick inlaid with patines of bright gold:  
There’s not the smallest orb which thou behold’st  
But in his motion like an angel sings,  
Still quiring to the young-eyed cherubins;  
Such harmony is in immortal souls;  
But whilst this muddy vesture of decay  
Doth grossly close it in, we cannot hear it.