 STUDENT NAME:________________________________

Directions: Use this document as a guide with the .tns file on your TI-Nspire CXII calculator.

Student Tasks:	Student Responses/Observations
Getting Ready: Name that Tune On the next page listen to the three songs that are written in Python and played on the TI-Innovator Hub. Can you name that tune? You will learn how to write the song Twinkle-Twinkle Little Star in python and play the song on your calculator and Hub. Stay tuned and listen up to learn how!	Can you name each of the three songs played by the name_that_tune() program?
Science/Music Activity 1: How does a violin make sound? The next page simulates a plucked violin string. Watch the simulation and notice all of the ways the string vibrates. The "fundamental" is the perceived tone—the overtones affect the sound quality of the note.	
Coding Challenge 1: Coding a tone Write a program on the next page using the sound.tone(frequency, time) method. Explore different tones by changing the frequency measured in Hertz, vibrations per second (abbreviated as Hz), and the time. What is your favorite frequency? Give this tone an appropriate name. For example sound.tone(100,5) could be named "Boooooop"!	What is your favorite frequency? Give your tone an appropriate name.

(Optional) Explore More: **Speaker Activity - How does a speaker work?** The next page simulates a 500 Hz electrical voltage wave flowing into a speaker's coil. Notice the air pressure wave in front of the cone increases and decreases as the coil's voltage rises and falls. Try different frequencies.	**How does a speaker produce a sound you can hear?** **A** It makes radio waves that vibrate our eardrums. **B** It pushes and pulls on air molecules producing pressure waves that vibrate our eardrums. **C** It emits light that evokes emotions in our brain. **Look at the back of your Hub. Why are there holes in the Hub's case over the speaker labeled SOUND necessary?** **A** So the speaker's energy, carried by air molecules, can pass freely through the case. **B** To reduce the use of plastics. **C** So an air molecule that comes out of the speaker can hit your eardrum.
Coding Challenge 2: Range of Human Hearing Write a program on the next page using sound.tone(frequency, time) to discover the highest and lowest frequency the Hub can make. Note: If you program the Hub with a frequency that it cannot make, you will receive an error message. Be sure you can hear the difference between two frequencies as you explore the upper and lower limits of the Hub's range.	What is the highest frequency that you can make? What is the lowest frequency that you can make?
(Optional) Explore More: **Ear Activity - How does your ear work?** Sound is changing air pressure that moves as a physical wave. A speaker creates sound by pushing and pulling on air particles to create high and low air pressure waves. We hear by sensing these air pressure waves. The outer ear focuses waves into the ear canal and onto the eardrum. The eardrum vibrates with the same frequency and strength as the wave. Next, three tiny bones in the middle ear transmit the eardrum vibrations to the auditory window. The fine hairs of the inner ear move with the vibrations of the wave. The auditory nerve senses the movement and sends signals to the auditory cortex of the brain. The brain processes the nerve signals into the sounds that we perceive.	**Choose the action that is NOT a step in human hearing.** **A** Sound waves are focused onto the eardrum by the outer ear. **B** The vibration of the eardrum is conducted to the inner ear by small bones in the middle ear. **C** The auditory nerve conducts impulses from the inner ear hairs to the brain. **D** The eye sees the movement of air molecules and perceives a tone.

Optional) Explore More: **Microphone Activity – How does a microphone work?** The next page simulates a 500 Hz air pressure wave hitting the diaphram of a microphone. Notice the voltage wave increases and decreases as the air pressure from the sound rises and falls. Try different frequencies.	**A human ear and a microphone are similar. Each action in human hearing has a match in the microphone. Which pair of statements do NOT match?** **A** The eardrum is like the microphone's diaphragm. **B** The hairs of the inner ear are like the microphone's magnet and coil. **C** The outer ear is like the microphone's floor stand. **D** The impulses in the auditory nerve are like the electrical waves in the microphone's wires.
Science/Music Activity 2: Music Tempo The next page simulates a metronome. Notice the swinging arm and the time required to move back and forth. Listen to the tempo produced. Try tapping your foot to the beat.	
Coding Challenge 3 Calculating Tempo **Background:** To calculate the number of seconds in a beat, divide 60 by the BPM. This calculation will give the number of seconds a beat will last. Calculate the number of seconds for one beat when the tempo is 100 BPM. **Challenge:** Play the orchestral tuning note A4 (440 Hz) for one beat at a tempo of 100 BPM, 60 BPM, and 140 BPM. * Use the sleep(seconds) method so the entire note is played. Then use a second sleep(2) method as a rest between each note.	
Science/Music Activity 3: Duration of a Note The next page simulates three notes, how to code them, and how they sound. Listen to the duration of each note. Do you hear the difference? Notice the calculation of time for each note. You will practice this calculation in the upcoming Challenge 4.	

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Coding Challenge 4: Coding Notes Play orchestral tuning A4 (440Hz) for the following notes with a two second rest between each. quarter note @ 100 BPM half note @ 100 BPM whole note @ 100 BPM quarter note @ 60 BPM half note @ 60 BPM whole note @ 60 BPM	
Coding Challenge 5: Frequency of Notes Use the method sound.note("note", time) to play a whole note of C4 at 100 BPM (2.4 seconds). Now try changing to C5. Do you hear the difference? Try a D4 now; how does it compare with C4?	
Coding Challenge 6: Reading Notes Read the two 1/2 notes from the staff and write a program to play each note at 100 BPM. Separate the two notes with a brief rest of 1/10 second with the method sleep(.1). 	

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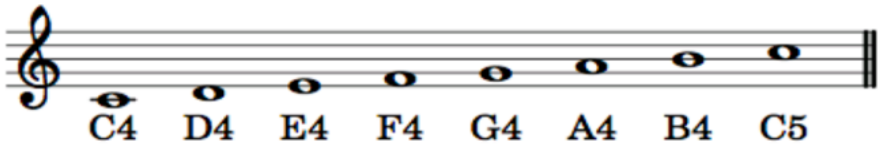
Coding Challenge 7: Do-Re-Mi Write a program to play each note of Do-Re-Mi-Fa-Sol-La-Si-Do as whole notes. This is an entire octave.  Recall at 100 BPM a whole note lasts for 2.4 seconds. The first note Do is "C4" and the last note Do is "C5".	
Coding Challenge 8: Sound Effects Common sound effects are a sequence of notes, each played for a duration of time. For example, a doorbell is the note E4 followed by C4. On the next page, listen to a doorbell sound effect. How does changing the octave to E5 and C5 change the sound? After playing with the example, create and code your own sound effect and give your sound effect a name.	What is the code for your sound effect? What is your sound effect name?
Science/Music Activity 4: Playing Twinkle The next page is a simulation of the song Twinkle Twinkle Little Star playing on the Hub. Watch the simulation, read the staff's notes, and watch the corresponding finger placement on the piano keys.	
Coding Challenge 9: Coding Twinkle Write a program to play the first two bars of Twinkle with a tempo of 100 BPM. Use the two memory aids FACE and **E**very **G**ood **B**oy **D**oes **F**ine. * The ¼ note is .6 seconds and the ½ note is 1.2 seconds at 100 BPM. 	

Optional) **Coding Challenge 10: Play it Again, Sam** On the next page is a way to write the same two bars of Twinkle using Python lists and a for loop. Play and study this program and listen for a mistake. Try to find and fix the mistake in the code. Next, try to change the tempo to 160 BPM.	