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PART 1

UNIT 1
THE SCIENCE OF SOUND

ANSWERS FOR THE STUDENT WORKSHEET (MUSIC TECH 101, PG. 14)

1. *Hertz* (Hz) describes the number of vibrations per second of a frequency.
2. 20Hz to 20kHz is the average range of frequencies the human ear can detect.
3. A man's voice has a certain frequency range. A woman's voice occupies another frequency range and vibrates at a faster rate because it is higher.
4. *Ultrasound* is the term for extremely high frequencies.
5. Bats and dolphins can detect the highest frequency sounds.
6. Some practical purposes for ultrasonic waves are cleaning jewelry and detecting babies in the womb.
7. *Infrasound* is the term for extremely low frequencies.
8. Elephants and alligators can detect the lowest frequency sounds.
9. A practical purpose for infrasonic waves is detecting earthquakes. Whales and elephants also use them to communicate.
10. Music is based on blending different frequencies. If a tuning fork vibrates at 1000Hz, another fork would need to vibrate at 500Hz to sound an octave (eight notes) lower.
11. Ears function by collecting vibrations and converting them into electrical signals that the brain interprets as sound.
12. *Decibels* (dB) measure sound intensity or volume level.
13. These are the approximate decibel levels of various situations:

    Quiet conversation: 60dB to 70dB

    Power mower: 100dB

    Pain: 125dB

    Actual hearing loss: 180dB
14. The speed of sound changes depending upon what material it travels through. When a supersonic jet reaches Mach 1, it will be going faster than the speed of sound through air, which is more than 700 MPH (768 MPH, to be specific) or 343 meters per second.

UNIT 2
AMAZING INSTRUMENTS OF TECHNOLOGY

ANSWERS FOR THE STUDENT WORKSHEET (MUSIC TECH 101 , PG. 25)

1. *Wind chimes,* invented 3,000 years ago, are a type of early automatic instrument that could play music without a human's touch.
2. The *hurdy-gurdy,* from the 1400s, was the first instrument to use gear technology. It was cranked.
3. The *telegraph,* invented in 1832, could play a single audible tone using electrical current—and used those tones to communicate with *Morse code.* (It would later inspire electronic keyboards.)
4. The *player piano,* invented in the late 1800s, allowed users to listen to any song at any time by loading rolls of paper into it.
5. The *radio* was created in the early 1900s and could play any kind of music.
6. The *theremin* (from 1920) is unusual because it doesn't have to be touched at all to play. The two metal bars on the theremin control *pitch* (notes) and *volume.*
7. In 1964, Bob Moog invented the first electricity-driven keyboard. Moog's invention was similar to hooking up telegraphs in a row: low voltage = low notes, and high voltage = high notes. In 1971, a portable version of this keyboard was made, called the *Minimoog.* It is still used and can be heard in many hip-hop and dance hits today. Artists that use it include Lil Jon, the Black Eyed Peas, Snoop Dogg, Jay-Z, Madonna, Britney Spears, G-Unit, and Christina Aguilera.
8. The *Fairlight CMI* (1979) was the first digital sampling synthesizer. It had a computer screen, could record any sound with a mic and play it back, and had a touch screen with a light pen.
9. Artists who purchased the Fairlight CMI ($20,000 retail price) include Duran Duran, Stevie Wonder, Peter Gabriel, U2, Prince, David Bowie, Michael Jackson, Madonna, and Queen.
10. *Musical Instrument Digital Interface (MIDI)* was invented in the 1980s, and it let musical instruments connect and play with each other (like an early version of USB).
11. MIDI is used in areas other than music, like theatre lighting, video games *(Rock Band, Guitar Hero,* and *DJ Hero)*, video and audio syncing in movies, and Disney robots.
12. A sequencer is hardware or software that creates, manages, and plays music in a particular order.
13. The *Roland TR-808A* (often simply called an "808") is a drum sequencer that was used in old-school hip-hop / dance music. Artists that still use it to make music include Beyonce, Jay-Z, Sublime, Public Enemy, Britney Spears, Outkast, Lil Wayne, the Black Eyed Peas, and Kanye West (whose album *808s & Heartbreak* featured the 808 extensively).

Bass Drum

Click on "Bass Drum" and you'll see the red indicator light up next to the word "Level" in the bass drum row. Now you can click on any of the numbers 1–16 to add a bass drum sound on that beat. For our first beat, click on numbers 1, 9, and 11. If you're wearing headphones, you will clearly hear the bass drum playing on those beats.

Snare Drum

Click on "Snare Drum" and you'll see the red indicator light up next to the word "Level" in the snare drum row. Now you can click on any of the numbers 1–16 to add a snare drum sound on that beat. For our first beat, click on numbers 5 and 13. If you're wearing headphones, you will clearly hear the snare drum playing on those beats, as well as the bass drum you previously programmed.

Cymbal

Click on "Cymbal" and you'll see the red indicator light up next to the word "Level" in the cymbal row. Now you can click on any of the numbers 1–16 to add a cymbal sound on that beat. For our first beat, click on all the odd numbers (1, 3, 5, 7, 9, 11, 13, 15). If you're wearing headphones, you will clearly hear the cymbal playing on those beats, as well as the bass and snare drums you previously programmed in.

Completed Patterns

Congratulations! You have made your first beat on a drum machine. For this project, this beat will be called "Pattern A1." Now let's build a second pattern, which will be called "Pattern A2." The Pattern dial is located on the middle left of the Beatbox 8. Switch it to Pattern 2, and you will hear the first beat you made disappear. Now you can begin to build another pattern from scratch. Don't worry, you didn't lose Pattern A1—it is still retained in the Beatbox 8 memory. As soon as you switch the Pattern dial back to Pattern 1, you will hear your original beat. Continue to build Patterns like this until you have Pattern A1, A2, A3, and A4.

Additional Music Modules

Next, let's add simple music! Drag the Tonematrix or Bassline from the "Synths" area on the right side into your workspace. You can begin to create patterns with these by clicking the Tonematrix grid or the Bassline keys. Notice that both modules have options to program multiple patterns (A1, A2, etc), just like the Beatbox 8.

Arranging a Simple Song

At the bottom of the sequencer window, click Add Track, then Beatbox 8, and then Pattern Track. The numbers on the Timeline grid indicate measure numbers. Above the Timeline grid, next to the Round Record button is another magnifier. Stretch the magnifier to the right and you will zoom out to see many more measure numbers.

Our simple song requires that Pattern A1 play for four measures. Double-click inside the Timeline window to create one cycle of Pattern A1. Next, drag Pattern A1 all the way through the end of measure 4.

UNIT 7
SOUND EQUIPMENT FOR STUDIOS AND CONCERTS

ANSWERS FOR THE STUDENT WORKSHEET (MUSIC TECH 101, PG. 77)

1. The following is the signal chain of six basic events in sound systems: singer (or instrument)–microphone–mixer–amplifier–speaker–ear.
2. The primary job of a *microphone* is to convert audio signals into electrical signals.
3. A few different kinds of mics are: *handheld, lavalier, boom, headset,* and *wireless.*
4. The purpose of the wire mesh and foam windscreen on a microphone is to protect it from saliva, rough contact, and strong air gusts.
5. The Shure *SM57* and *SM58* are renowned for being built like tanks and are used extensively for live concerts around the world.
6. The primary purpose of a *mixing board* is to combine all mic / line inputs into one output to control the sound.
7. The front-of-house *sound engineer* is in charge of the mixer and makes a live band sound great.
8. The main knobs on a mixer console are: *treble, bass, effects, monitor sends, mic sensitivity,* and *pan*.
9. Another name for the sliders on a mixer is *faders*—they control volume levels of the mics and instruments.
10. The primary purpose of an *amplifier* is to boost the electrical signal on its way to the speaker.
11. Amps are rated according to *watts*—the more watts, the louder they are.
12. Here are a few scenarios and the approximate amount of wattage needed to power them: 1. Car stereo: 40–100 watts, 2. Powerful home stereo: 100–500 watts, 3. Small concert club: 500–5,000 watts, 4. Large arena / outdoor venue: 10,000 watts or more.
13. The primary job of a *speaker* is to convert electrical signals to audio signals (the opposite of a mic).
14. A *monitor* is an onstage speaker that lets performers hear themselves play or sing. Types include floor wedges, drum monitors, and in-ear monitors.
15. A *crossover* is a unit that directs an amplifier's power to drive specific speakers—high, midrange, or low.

PART 3

Music Tech in the Real World

PART 3 PROJECTS

In Part 3, students will complete rigorous, long-term projects relevant to their interests. For example, students interested in English might create multimedia storytelling projects. Students interested in sports might provide a vehicle to write music for gaming events. Students interested in science or biology might explore musical-therapy applications in the medical field. Students interested in social studies might research cultural groups inspired by music made with technology. Students interested in art might work with video / music installations or performance-art pieces. Students interested in computer science or mathematics might explore writing music-making apps. The skills acquired in Part 3 will develop students' creative artistry and expression, and open their minds to new avenues of music-making within their own worlds.

Project Tips

There aren't really many specific project tips for this unit, as all projects will be vastly different. It is up to you as a teacher to guide students individually and to help them navigate the waters of whatever project they have chosen.

Make sure students choose a variety of topics over the course of the semester. Ideally, they complete three to five major projects, with each focused on a different subject area (English, math, sociology, etc.).

Make sure students choose different technology tools over the course of the semester. Ideally, each of their major projects makes use of a different tool of creation (hardware, software, organic materials, non-musical software, etc.).

Make sure students choose different methods to deliver their final product. Ideally, each of their major projects will involve different kinds of creation (video, song, live performance, presentation, etc.).

Pedagogical Tips: Help All Students Succeed!

1. The projects in Part 3 are similar to graduate work or collegiate private readings. They consist of self-designed and self-directed learning. The instructions in *Music Tech 101* provide a framework that can be used for assessment and organization of goals, but they do not give instruction on specific projects.