ESSENTIAL QUESTION

How did synthesizers allow musicians to create new sounds and how did those sounds reflect American culture throughout the 20th century?

OVERVIEW

The earliest attempts to combine electricity and musical instruments date to the mid-18th century. In both Europe and the United States, several pioneering inventors created “hybrid” electronic instruments in which electricity was used to modify the sound created by an acoustic instrument. Many hybrid instruments, such as electric string instruments like the guitar and bass, remain in use today.

The first “pure” electronic instruments, those in which sound is generated only with the use of electricity, were invented in the late 19th century. Among the first of these instruments was Thaddeus Cahill’s “Telharmonium,” a massive set of keyboard-controlled tone generators that weighed several tons. Though the Telharmonium, which could be moved only by train car, never became a common instrument, Cahill’s tone generator technology was a blueprint for many instruments to come. The much smaller “Theremin,” patented in 1928 by an inventor of the same name, is often considered the first “pure” electronic instrument to gain some notoriety. The eerie whine created by the Theremin found a home as a sound effect in early film music, but, like many early pure electronic instruments, the Theremin was largely considered a novelty.

Whether because of their design, size, or the amount of scientific knowledge required to use them, throughout the first half of the 20th century, pure electronic instruments were used primarily in the realm of the experimental. By the 1960s, however, engineer Robert Moog compressed the basic functionality of his previously massive “synthesizer” into a portable, suitcase-sized unit controlled by a piano-style keyboard. The guitar had “gone electric” years earlier and piano players responded to that development by putting microphones at their instruments. Now they too could just turn up the volume.

More than offering just an increase in volume however, the Moog and other early synthesizers gave a single performer access to a sonic spectrum that ranged from notes below those on an electric bass to tones that soared in a register above the upper frets of an electric guitar. The instrument’s tone generators create “pure” sound waves and with the twist of a knob the
performer routes those waves through filters that alter them, creating sounds that were, at the time of the Moog’s introduction, entirely new. As producer Bob Margouleff says in episode four of Soundbreaking, “The synthesizer is every instrument, it depends on how you want to use it.”

The Moog was successful partly because it introduced a consumer synthesizer. The new sounds the instrument could create, and the fully electronic way in which they were created, struck many as “futuristic,” giving the Moog and other early synthesizers a place among technologies that were part of an emerging American vision of the computerized future.

This lesson introduces students to the Telharmonium, the Theremin, the Moog and the component on which all of their sound syntheses are formed: the sound wave. Students learn what a sound wave is, how it travels and how our bodies convert it into intelligible sound. Using the Soundbreaking Sound Wave TechTool, students learn to recognize four basic waveform shapes by sound and sight. This lesson also explores the role the synthesizer played in relation to people’s perceptions of technology and culture in the 1970s, 80s and beyond.
Upon completion of this lesson, students will:

1. KNOW (KNOWLEDGE):
   - What a sound wave is
   - How sound travels
   - The difference between “hybrid” and “pure” electronic instruments
   - About Robert Moog and his advancements in analog synthesis technology
   - About cultural conceptions of technology in the 1980s and 1990s
   - How music can reflect broader cultural issues

2. BE ABLE TO (SKILLS):
   - Analyze statements from historical materials to arrive at a better understanding of the past
   - Understand connections between popular culture and the time, place and social circumstances in which it was created
   - Evaluate the effects of technology on history and culture
   - Make connections between popular music and historical events
   - Integrate and evaluate information presented visually, quantitatively, and orally in diverse media and formats

MOTIVATIONAL ACTIVITY:

1. Ask your students:
   - Do you ever use a laptop or even your phone to make music? How do you think the sounds you hear are made?

2. Play Clip 1, Soundbreaking - Robert Moog and the Modular Synthesizer. Direct your students to pay attention to the music they hear and the instruments they see used throughout the clip. Ask your students:
   - How would you describe the music that accompanies this clip? How do you think the music was made? (Students may say that the music is “spacey,” it is comprised mostly of textural sounds generated by the synthesizers like those seen in the clip.)
   - What did Bob Margouleff say he liked about being at the instrument? Why do you think the image of a “spaceship” might have appealed to him in the 1970s?
   - Do you think you could make music like you heard in this clip on a guitar or a violin? Why or why not?
   - How do you think someone might make music that sounds like this today? (Students will likely suggest laptops.)
   - Why do you think Margouleff suggests that synthesizers “create a new sound from nothing?” In what ways do you think the synthesizer is different from an instrument like the guitar? (Encourage your students to recognize that unlike instruments such as electric guitar in which the sound is made by strings and then amplified using electricity, the synthesizer generates all of its sound using electricity. Unplugged, a synthesizer can make no sound at all.)
PROCEDURE:

1. Tell your students that the Moog is a “pure” electronic instrument, meaning that it generates all of its sound from electricity, and that one of the earliest “pure” electronic instruments was Thaddeus Cahill’s “Telharmonium.” Show your students Slides 1-3, pictures of the more than seven ton instrument taken in 1907. Slide 1 is the keyboard at which the musician performed, Slide 2 is a small section of the vast machinery of the instrument and Slide 3 is a cover of a Scientific American magazine from 1907 featuring the instrument. Ask your students:

- Do you think the Telharmonium became a household musical instrument? Why or why not?
- The Telharmonium Hall was built to house the instrument, and performances there drew large crowds. Why do you think audiences might have been attracted to the Telharmonium?
- Why do you think the Telharmonium would have been placed on the cover of a magazine about science?

2. Tell your students that the Telharmonium was among a handful of “pure” electronic instruments of the early 20th century, none of which became commonplace. A more lasting “pure” electronic instrument was the Theremin, patented by Leon Theremin in 1928. Show Clip 2, Leon Theremin Playing the Theremin and ask students:

- Try to imagine yourself as a person in 1928 who had heard no electronic instruments. How would you describe the sound of the Theremin?
- Does Theremin’s body language suggest that he is thinking of his instrument as similar to any other instruments? (Students may suggest he looks as if he is conducting or playing the violin.)
- The Theremin was much smaller than the Telharmonium and was used in soundtracks and some performances soon after its invention, however it never became a common instrument. Why do you think this might be? (Encourage students to consider the Theremin’s lack of connection to any other instruments. It may sound like a violin, but it has no strings or fingerboard, nor does it have a keyboard or any connection to piano instruments.)

3. Break your students into small groups and distribute Handout 1 - Sound Waves. Have students read the handout in their groups and follow the prompts to experiment with the Soundbreaking Soundwave TechTool. Once the groups have completed the handout do the following as a class:

Play the sine wave and then play the sawtooth wave. Ask your students:

- How would you describe the sound of the sine wave?
- How would you describe the sound of the sawtooth wave?
- Thinking back to what you just read, how does the way the wave looks reflect the way it sounds?
**PROCEDURE: (CONTINUED)**

- Why do you think that none of the wave forms found on this widget are naturally occurring sounds in nature? (Help your students recognize that their “perfect” shapes are the process of the machinery that made them. “Natural” sounds will all have variations such as the one seen in the guitar sound wave.)

- In what ways do you think people might interpret these synthesized sounds that had never been heard previously? What things do you think they might suggest or cause people to imagine? (Encourage your students to imagine a similar situation now. They might imagine being in space, or a fantasy world because they are hearing something that sounds totally alien and perhaps “futuristic.”)

4. Show your students Slide 4, the cover of Time Magazine from January 3, 1983. Discuss with the class:

- What does the title “The Computer Moves In” suggest is happening in America at this time?

- How might you interpret the sculptures of people in this image? What does their coloring, their postures and positioning suggest to you?

- What do you think looks most “alive” in this image?

5. Tell your students that the late 1970s and early 1980s were a time when electronic technology was rapidly becoming part of Americans’ daily lives in new ways. Consumer electronics such as computers, portable phones and cassette “walkmen” were becoming household items. Show your students the following three images. Slide 5 is a poster for the 1982 movie Tron, in which a programmer is transported into his computer and forced to cooperate with his own programs to escape. Slides 6 and 7 are for music products from the same time period. Ask your students:

- Do you see in similarities between the movie poster and the other advertisements? Is so, what? What do these similarities suggest?

- What do these three images suggest about the possibilities of people and machines co-existing? (Encourage your students to recognize that in these images people and machines are becoming inseparable or even physically connected.)

- How might you connect these advertisements with the 1907 Scientific American cover you viewed earlier? (Encourage students to discuss the ongoing sense that technology is changing our culture and people can all be connected to it.)

6. Tell your students that synthesizers were used in many ways, but that some artists embraced the technology to create music that sounded intentionally robotic or futuristic. Play Clip 3, Soundbreaking - Devo and the Synthesized Future. Have your students write down their impressions of Devo’s sound and the way they move and dress and then discuss the following as a class:

- Do you know what happened at Kent State College in Ohio while Devo’s Mark Mothersbaugh was a student there? (Inform student that on May 4, 1970, the Ohio National Guard opened fire on unarmed Vietnam War protestors at Kent State College.)
PROCEDURE: (CONTINUED)

• In what ways does Mothersbaugh suggest that being a student at Kent State and witnessing footage of the Vietnam War affected his ideas of sound? How do you think the synthesizer helped him realize these ideas? (Students should recall how he hoped to emulate the sound of industrial war machinery in music; the synth allowed him to create something like them.)

• In what ways do you think Devo’s music, clothing and style of movement might reflect a connection to the advertising images you just viewed? What do you think Devo might have been suggesting about the connections between humans and machines?

SUMMARY ACTIVITY:

Ask your students:

• Overall, how do you think the technology of synthesizers connected with 20th century American ideas about the future?

• Are there any current technologies that make you feel like you are experiencing something “futuristic”? Is there any music that currently sounds “futuristic” to you? Why?

• Do you think that the idea of people and technology growing closer together has come true in any ways? Can you think of any current technologies that have further blurred the lines between people and machines? (Students will likely suggest iPhones and Siri and other such intuitive technology.)

EXTENSION ACTIVITY:

Further Research:

Choose another instrument and research how it has been advertised. Can you find connections between the way the instrument is marketed and broader currents in American culture? Look for other cultural products, such as TV shows, movies and consumer goods that might somehow suggest a broader connection between how the item is marketed and larger cultural trends.
STANDARDS

NEW JERSEY STATE LEARNING STANDARDS FOR ENGLISH LANGUAGE ARTS: READING

NJSLSA.R1: Read closely to determine what the text says explicitly and to make logistical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

NJSLSA.R7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

NJSLSA.R10: Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

NEW JERSEY STATE LEARNING STANDARDS FOR ENGLISH LANGUAGE ARTS: WRITING

NJSLSA.W2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

NJSLSA.W4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

NJSLSA.W7: Conduct short as well as more sustained research projects, utilizing and inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

NJSLSA.W8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

NEW JERSEY STATE LEARNING STANDARDS FOR ENGLISH LANGUAGE ARTS: SPEAKING AND LISTENING

NJSLSA.SL1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively.

NJSLSA.SL2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

NJSLSA.SL3: Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric.
NJSLSA.SL4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience

NJSLSA.SL6: Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate

**NEW JERSEY STATE LEARNING STANDARDS FOR ENGLISH LANGUAGE ARTS: LANGUAGE**

NJSLSA.L1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

NJSLSA.L2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

NJSLSA.L4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

NJSLSA.L5: Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

NJSLSA.L6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**SOCIAL STUDIES – NATIONAL COUNCIL FOR THE SOCIAL STUDIES (NCSS)**

- Theme 1: Culture
- Theme 2: Time, Continuity, and Change
- Theme 3: People, Places, and Environments
- Theme 7: Production, Distribution, and Consumption
- Theme 8: Science, Technology, and Society

**NATIONAL STANDARDS FOR MUSIC EDUCATION**

*Core Music Standard: Connecting*

Connecting 11: Relate musical ideas and works to varied contexts and daily life to deepen understanding. Demonstrate understanding of relationships between music and the other arts, other disciplines, varied contexts, and daily life.
Enduring Understanding: Understanding connections to varied contexts and daily life enhances musicians’ creating, performing, and responding.

Essential Question: How do the other arts, other disciplines, contexts and daily life inform creating, performing, and responding to music?

RESOURCES

VIDEO RESOURCES
- Soundbreaking – Devo and the Synthesized Future
- Soundbreaking – TRobert Moog and the Modular Synthesizer
- Leon Theremin Playing the Theremin

HANDOUTS
- Handout 1: Sound Waves