TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

LESSON TITLE

Drop the Beat

Guiding Question: How can technology improve our lives?

SUBJECTS

Science
Engineering
Arts and Music

COMPUTATIONAL THINKING PRACTICE

Collaborating
Around Computing

COMPUTATIONAL THINKING STRATEGY

Finding Patterns

MATERIALS

Computer device with access to the online music coding website Beats: Code with Music

Note: This lesson can be modified to have students perform and edit their patterns in real time without the use of a computer.

Comparing Code and Music capture sheet

Code to the Beat capture sheet

Writing utensils

Ignite Curiosity

- How do music artists who are across the globe from one another record separate parts of a song and combine them to make the song sound good?
- How do musicians use "samples," or parts of old songs, to create new songs?
- Can you make music even if you don't play an instrument?

In this lesson, students will utilize the computational thinking strategy of finding patterns to solve a real-world engineering problem: a group of electronic musicians want to record a song together but live in different regions of the globe. In **THINK**, students will analyze the process of audio production and understand how building original works of music is a lot like building computer programs. In **SOLVE**, students will use the computational thinking strategy of finding patterns to address the problems of remote recording. Students will observe how songs are built on patterns and how they can loop these patterns in order to create new music, much like computer coders use loops to create computer programs. In **CREATE**, students collaborate and use the Beats: Code with Music to create musical patterns by looping pieces of code and combine them into an original song. In **CONNECT**, students will explore how commonly available technology for audio production impacts their daily lives, relates to potential careers, and affects the current direction of the global economy.

Students will be able to:

- **Analyze** the process of audio recording in order to identify patterns,
- **Apply** that knowledge to create a digitally recorded pattern of their own and,
- Collaborate in groups to **combine** their patterns into an original song.

Students will act as musicians who are attempting to collaborate and record a song remotely.

1 **Read** the following scenario to students:
Imagine you are a group of talented electronic musicians who have been asked to create a song together. You are excited about combining your unique beats, but you live in different places across the world. Travel costs and busy schedules make it impossible for you all to meet in person to collaborate. Can you use the computational thinking strategy of finding patterns to take many beats and layer them together into a song?

2 **Ask** students to raise their hands if they have experience playing an instrument or participating in music. It is likely that many students will raise their hands. Tell students that regardless of their musical background, they will all be musicians today. Explain to students that advances in audio engineering make it possible for each of us to make music, regardless of our musical experience. Also note to students that the Internet and cloud computing allow musicians to trade audio files back and forth. An audio engineer takes many audio files and uses computers to combine them, using a process called mixing. The audio engineer is responsible for the seamless songs we hear on the radio, most of which are the result of multiple recordings being layered together.

3 **Lead** students to consider the impact of computers on music production by using the following guiding questions:

- Why is it important to be able to record audio in many different locations?
- Can you name ways that computers have changed the music we listen to?
- Why do you think musicians often use pieces of other songs to create new songs? What makes "sampling" these old songs possible?
- How do instruments and songs vary across cultures?

4 **Hand out** the Comparing Code and Music capture sheet to see how much students already know about making music and writing code. When students have completed the capture sheet, have them partner with another student to share their responses. Lead a brief discussion about the similarities and differences in making music and creating computer programs, highlighting the following points:

- Music and computer programming each use their own language: music uses notation, a language of shapes we call notes. Computers use binary code, a language of 0's and 1's.
- Music and computer programming both rely on patterns. In music and computer programming, patterns take bits of data (notes or code) and transform them into a cohesive product that humans can understand and make meaning from. In music, beats are patterns in timing. They are steady, repeating pulses.
- Both songs and computer programs rely on loops. Loops are repetitions of code or notes that play over and over again.
- Musicians and computer programmers often "sample" pieces of songs or computer programs to create original works.

5 **Re-read** the initial prompt to students. Ask them to summarize the problem in the prompt (combining multiple recordings together). Explain to students that computers are programmed to sort through lots of data and identify patterns. The more data a computer sorts, the better it gets at identifying these patterns. Ask students how they could think like computers to find patterns in order to solve this problem.

Students will explore how coding and making music both rely on looping patterns.

1. **Distribute** the Code to the Beat capture sheet and give students access to computers. At this stage of the activity, students may work individually or in pairs.

2. **Guide** students to the Beats: Code with Music website.

3. **Provide** students with 20 minutes to create a loop on Beats: Code with Music and record their steps on the Code to the Beat capture sheet. Explain that the goal of this part of the activity is for each student to create a beat that loops endlessly. The beat should have rhythm, meaning it should have a strong, repeating pattern of sound.

4. **Divide** students into teams of four (you may choose to modify this number depending on the size of your class).

5. **Have** all of the students press "play" on their loops at the same time. The result will likely be a cacophony of sounds that do not make up a song.

6. **Ask** students if the loops they have created work well together. They should answer that they do not. Ask students what needs to happen in order to make the four loops created by their classmates into a cohesive song. Explain that musicians are able to use technology in order to record tracks remotely, but a variety of audio professionals need to use the computational thinking strategy of finding patterns in order to take those recordings and combine them into a cohesive song.

Students will collaborate in teams to combine their individual loops into a cohesive song.

1. **Instruct** each team that they are to take the four original loops created by the four musicians in the group. They must do this while following these guidelines:
   - Beats and loops with the same coding structure may be combined.
   - All four beats must be clearly identifiable in the final song.
   - The final song must have rhythm (a clear pattern) and sound cohesive.
   - The final song must be looped in a way that sounds good.

2. **Tell** students that they will each simulate one of the following four roles to complete this task:
   - Recording engineer: Leads the process of integrating the beats
   - Sound designer: Implements different sounds and effects to make the song cohesive and interesting
   - Music editor: Edits the song and threads the beats and the sound effects together
   - Audio engineer: Loops the final song to make sure it sounds good

3. **Provide** students with 30 minutes to combine their beats, offering assistance as needed.

4. **When** students have completed their songs, have each group play their creation.

5. **After** each group plays its song, ask the following questions:
   - How did the computational thinking strategy of finding patterns help you combine the beats?
   - After completing this exercise, what advice would you give to musicians who are looking to record tracks and combine them remotely?

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1. **Write** the three questions on PowerPoint or flip chart slides, and invite students to share out responses.
2. **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
3. **Assign** one of the questions to three different student groups to brainstorm or research and then share out responses.
4. **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Every day, students hear music (or other audio material) that is produced by computers.

Students who are interested in music can use these technologies to create their own productions. Many tools that were once only available to professionals with access to expensive equipment are now available for free online. This lesson gives students the tools to create their own music and collaborate on original works with their peers.

How does this connect to careers?

Sound Engineering Technicians operate machines and equipment to record, synchronize, mix, or reproduce music, voices, or sound effects in sporting arenas, theater productions, recording studios, or movie and video productions

Musicians and Singers play instruments or sing for live audiences and in recording studios. Understanding the technical processes for recording is not always necessary, but it can help an aspiring artist.

Music Producers work with musicians to create songs for release. They work in a variety of industries, including film, media, and theater. Music producers must have extensive knowledge of music and the technical equipment that is used to create music.

How does this connect to our world?

The music and performance industry has changed drastically in recent decades due to improvements in technology.

A current trend in the music industry is the rapid increase in the number of individuals and groups that are producing their own high-quality music without professional studio access. The widespread availability of apps such as Smule and GarageBand help those with little to no musical experience create original works of art.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.

Crosscutting Concepts

Systems and System Models

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

National Standards

COMMON CORE STATE STANDARDS CONNECTIONS

English Language Arts:

- **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-3)
- **RST.6-8.7:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)
- **RST.6-8.9:** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-3)

Mathematics:

- **MP.2:** Reason abstractly and quantitatively. (MS-ETS1-3)
- **7.EE.3:** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-3)

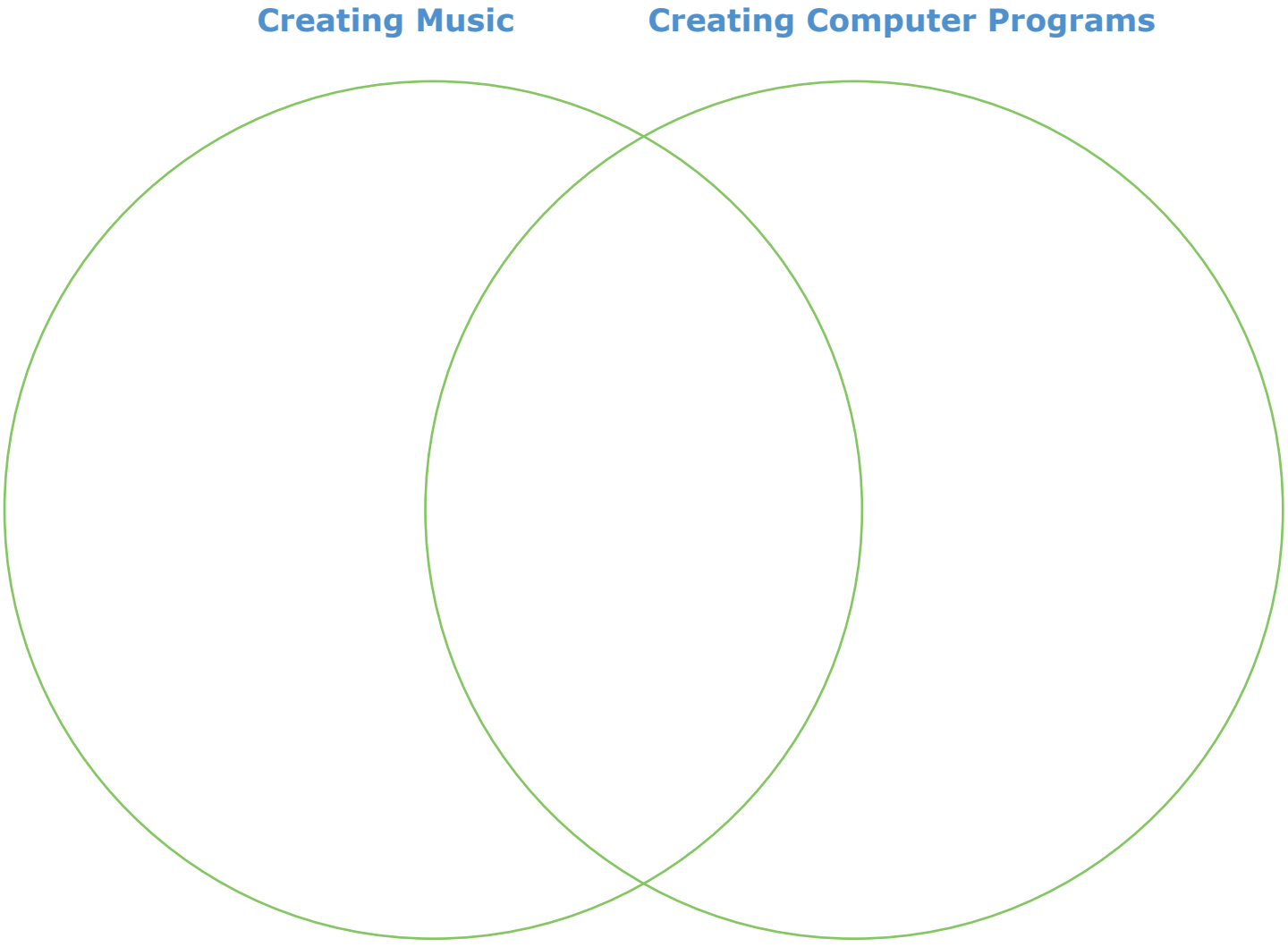
K-12 COMPUTER SCIENCE FRAMEWORK

Practice 2. Collaborating Around Computing

Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to work together effectively and to create complex artifacts.

Comparing Code and Music

There are many similarities between creating music and creating computer programs. Use the Venn diagram below to show the similarities and differences.



Code to the Beat Flowchart

Use Beats: Code with Music to create a looped beat. Record the steps of your coding process in the flowchart below.

1

2

3

4

5

6

7

8