



Repeat the Beat: a STEAM-based Program for Junior Composers

Created by Leilani Dade, UCR Music Gluck Fellow

ldade001@ucr.edu

Abstract:

In this elementary school program, students will learn the fundamentals of coding and digital composition. With the help of a Gluck fellow (and a few robot musician friends!), students will acquire the skills necessary to compose their own looped beats, convert their musical compositions into code, and showcase their creations for their friends and family. Using Legos to represent note values, students will learn how to compose a measure of musical code using long and short beats as well as how to convert that measure into code using Tynker coding blocks. This program will help prepare students for a lifetime of enjoyment and employment in both arts and technology-related fields.

Keywords: STEM, STEAM, music, block coding, Tynker/Scratch, coding, digital composition, music notation

Lesson 1:

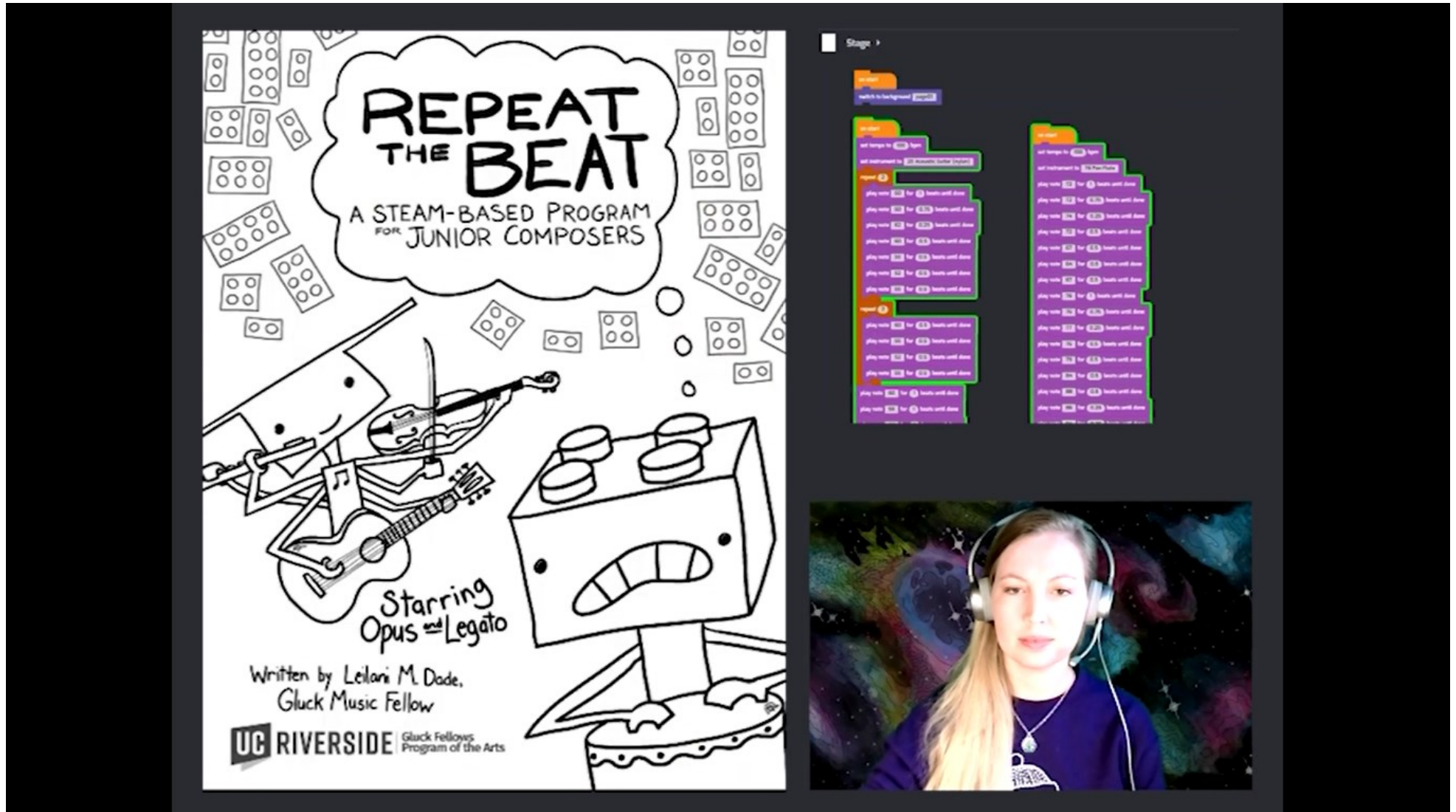
Understanding Rhythm with Whole Beats and Half Beats

Lesson 1 Video:

Lesson 1 Activity:

<https://www.tynker.com/play/lesson-1-activity-understanding-rhythm-with-whole-beats-and-half-beats/6020b467ea60f2656530a889-532956Xs0jS8MGkZwzUE8rOKEp0t8k>

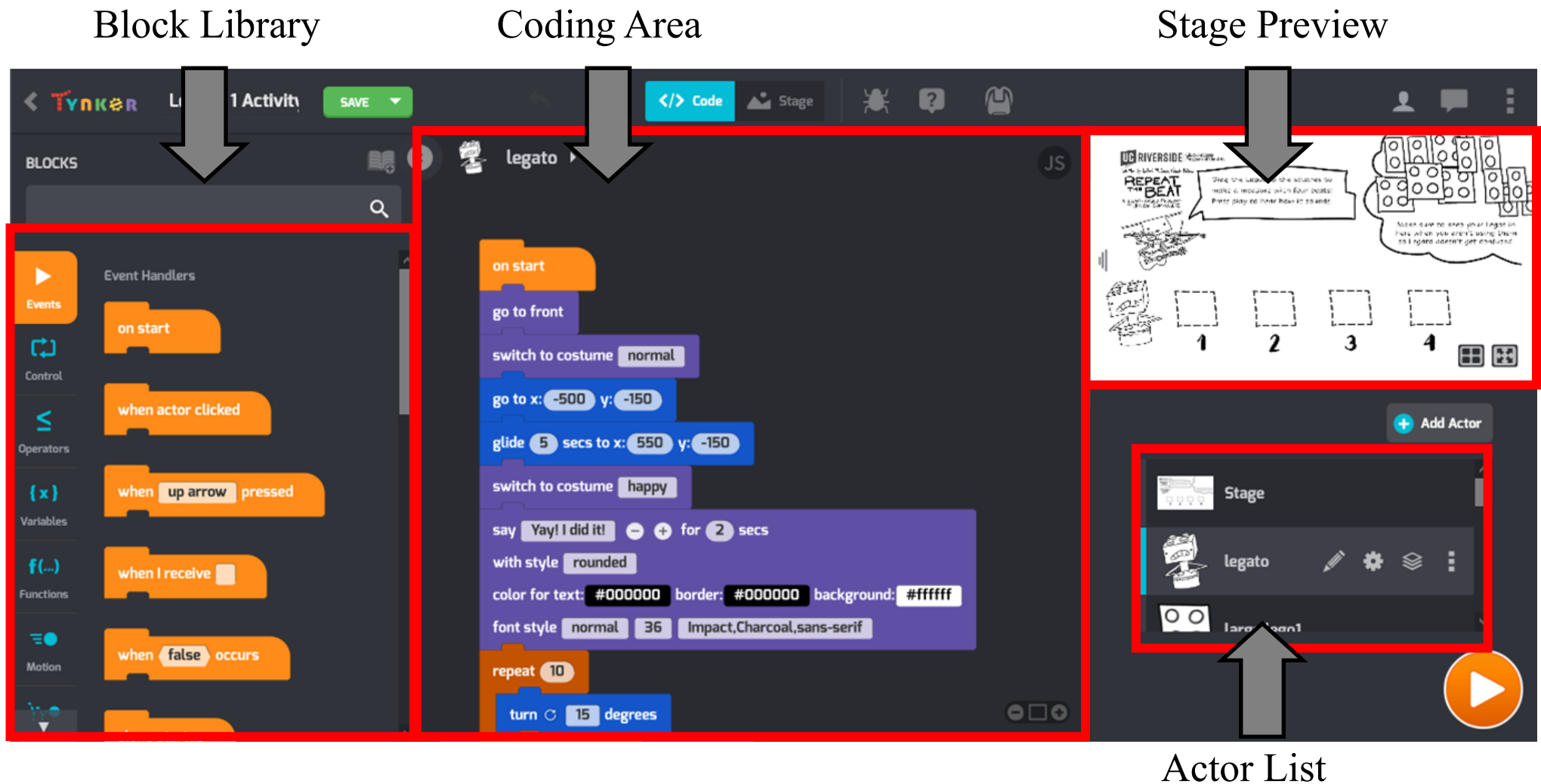
Step 1: Click on the link for “Lesson 1: Video.” This will direct you to a short video that introduces our two main characters, Opus and Legato. Legato wants to play drums but he isn’t sure how to start. Opus explains that most music has a beat that repeats and shows him how to represent beats with Legos. The code used to create the animation and accompanying music is shown in the upper right corner.



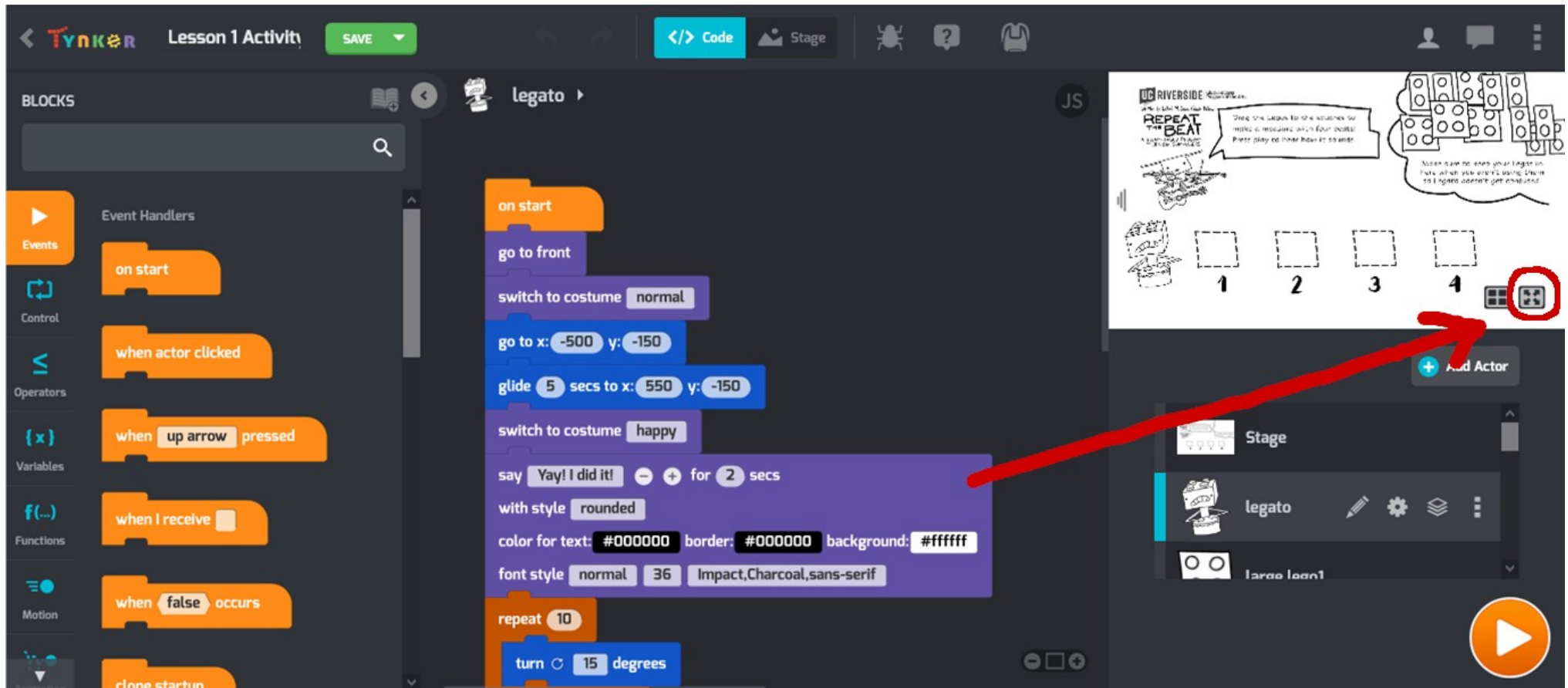
Step 2: Click on the link for “Lesson 1: Activity.” This will take you to tynker.com, a free website where kids can learn how to code. If you have an existing Tynker account, you can click “sign in” in the upper right hand corner of the screen. If you’d like to create a free student account, click “sign up for free” and follow the directions (You can complete the activity for free without an account but creating one will allow you to save your work). You should see a page that looks like this:

The screenshot shows the Tynker website interface. At the top, there is a navigation bar with the Tynker logo, links for 'CODE NOW', 'HOME COURSES', 'TUTORING', and 'K-12 SCHOOLS', and buttons for 'SIGN IN' and 'START FOR FREE'. Below the navigation bar, the page title is 'HOME / PROJECTS / LESSON 1 ACTIVITY: COMPOSE A BEAT'. The main content area features a project preview for 'Lesson 1 Activity: Compose a Beat' by UCR Gluck Music Fellow. The preview includes a play button, a character named Legato, and four dashed boxes labeled 1, 2, 3, and 4. A text box above the boxes says 'Drag the Legos to the squares to make a measure with four beats! Press play to hear how it sounds.' Another text box below the boxes says 'Make sure to keep your Legos in here when you aren't using them so Legato doesn't get confused.' To the right of the preview, there is a 'REMIX PROJECT' button and a 'Share' button. Below the preview, there is a 'Description' section that reads: 'Lesson 1 Activity: Compose a Beat, a project made by UCR Gluck Music Fellow using Tynker. Learn to code and make your own app or game in minutes.' At the bottom of the page, there is a 'Text Snippets' section with '35 acoustic bass drum' and an 'Images' section with three images: 'background scene - Lesson 2 background', 'legato - normal', and 'legato - happy'.

Step 3: Click “Remix” to create a copy of the project (the original project will be unaffected). You should see a block library on the left, a coding area with a few lines of code in the middle, and a stage preview along with a list of “actors” (objects that can be assigned code) on the right. Leave the code where it is for now (you’ll get to change the blocks later, we promise!) If you do alter the code and need to start over, just click on the link again to open up a new copy of the project.

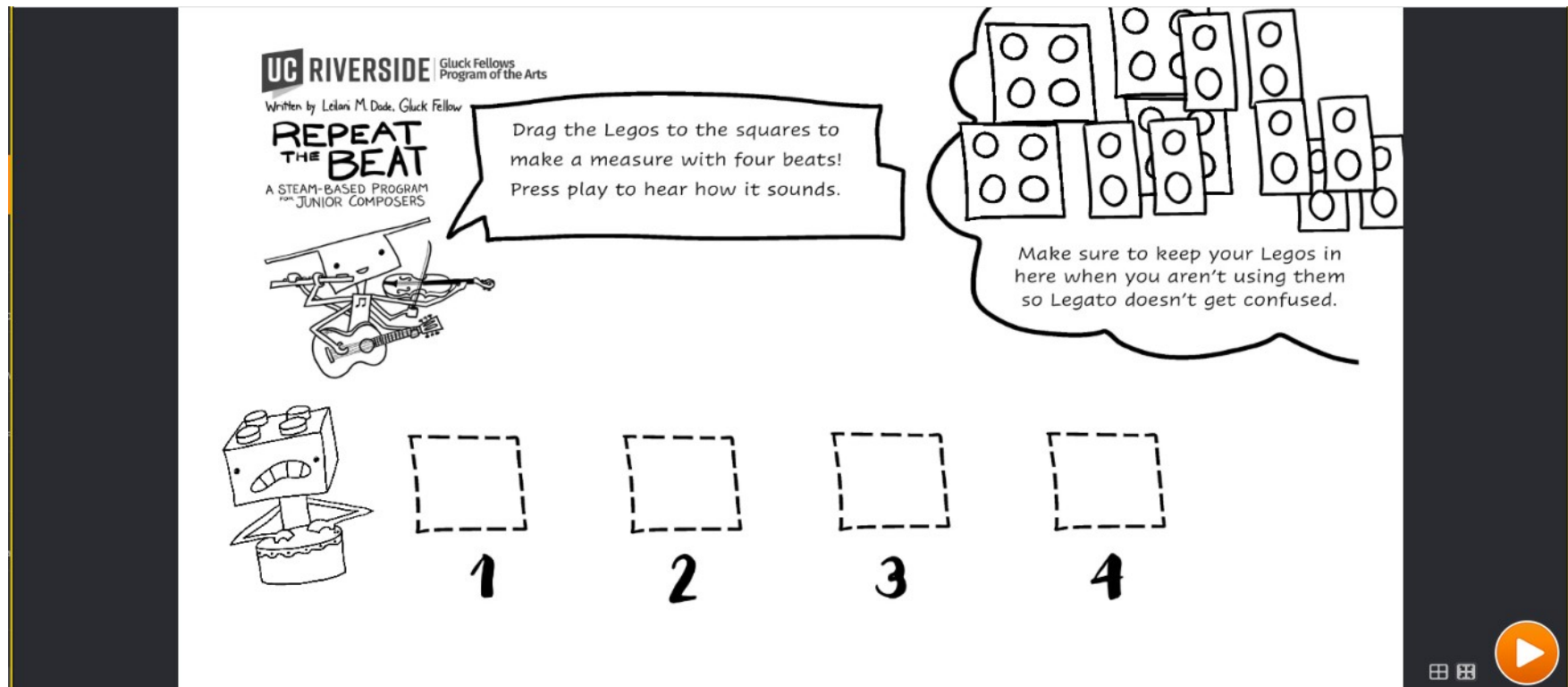


Step 4: Click on the full screen icon at the bottom right of the stage preview.

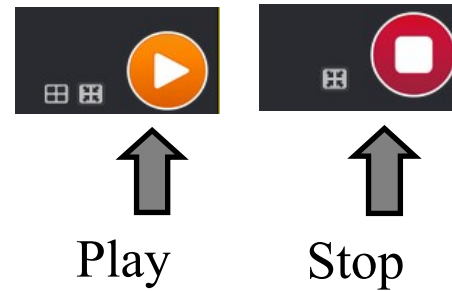


Step 5: In this activity, we will create a measure for Legato to play. To do this, we'll need to drag and drop the Legos from the top right hand corner of the screen into the squares in front of Legato. You'll notice that there are four blank spaces. Each space represents one beat. Each large Lego equals one beat. Each set of small Legos equals two half beats. Mix the beats and half beats however you like!

Try to place the Legos inside the dotted lines. If the placement is not correct, it's okay! You'll have a chance to adjust them once we run the program. Be sure to leave any unused Legos in the top right corner so that they do not interfere with the code.



Step 6: When you're ready, press play! This button starts the program and sends Legato gliding over the blocks. When Legato passes over the blocks, they will turn yellow and play a sound. If it's a large Lego, you should hear a drum playing one beat. If it's two small Legos, you should hear a drum playing two half beats. If the placement of the blocks is incorrect or you'd like to change the beat, you can stop the program and try again by pressing the red stop button.



A screenshot of a mobile application interface. At the top left, it says "UC RIVERSIDE" and "Gluck Fellows Program of the Arts". Below that, it says "Written by Leilan M. Dade, Gluck Fellow" and "REPEAT THE BEAT" in large, bold letters. Underneath, it says "A STEAM-BASED PROGRAM FOR JUNIOR COMPOSERS". To the right of this text is a speech bubble that says "Drag the Legos to the squares to make a measure with four beats! Press play to hear how it sounds." Below the text is a cartoon illustration of a robot-like character with a guitar and a violin. At the bottom, there are four numbered positions (1, 2, 3, 4) where Lego blocks can be placed. Position 1 has a yellow 2x2 Lego block. Position 2 has two yellow 1x2 Lego blocks. Position 3 has a white 1x3 Lego block with a face and a drumstick, and a white drum. Position 4 has a white 2x2 Lego block. To the right of the numbered positions is a large white speech bubble that says "Make sure to keep your Legos in here when you aren't using them so Legato doesn't get confused." At the bottom right of the screen, there is a red square button with a white stop icon and a small white grid icon to its left.

Lesson 2

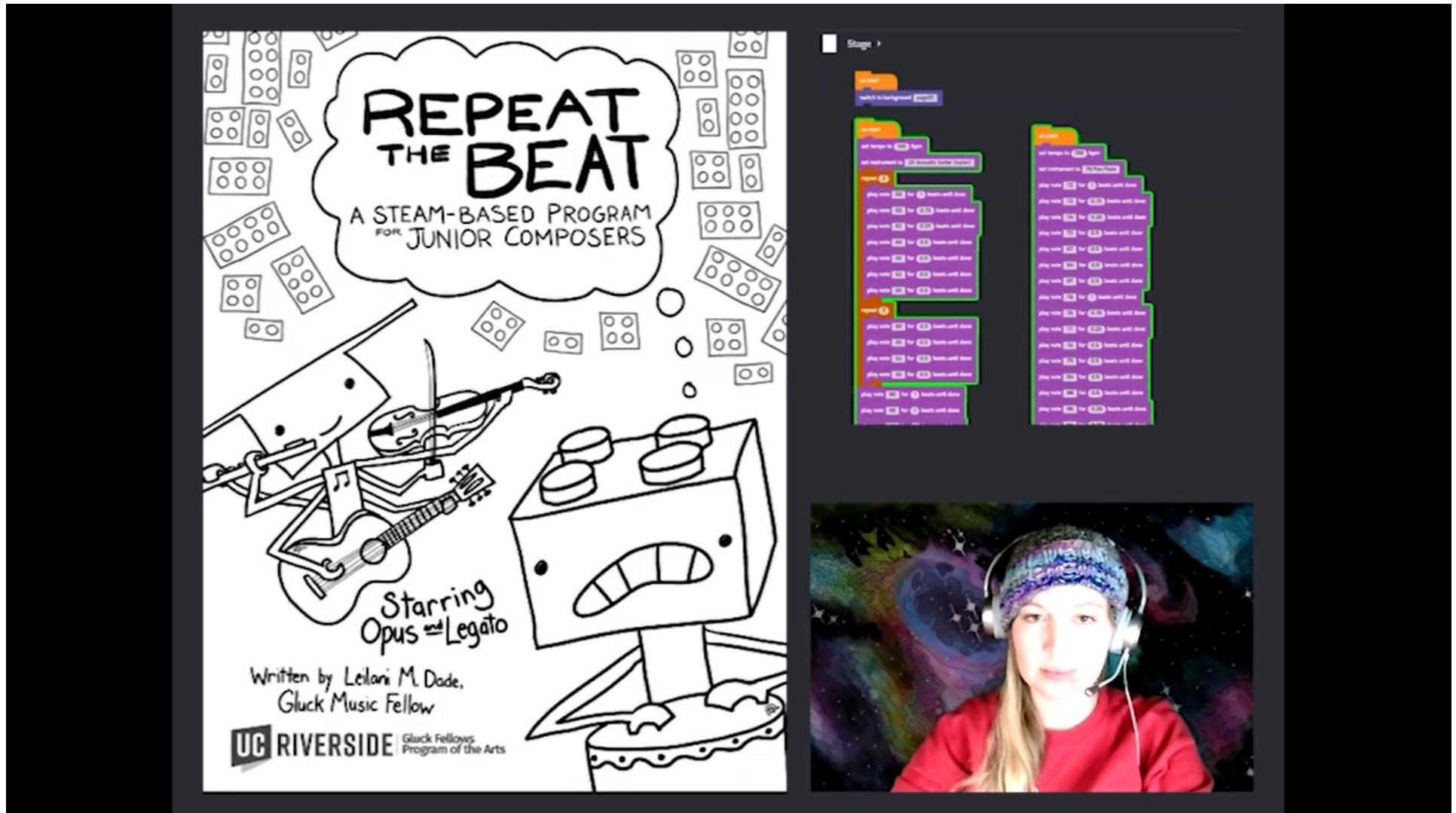
Intro to Looping

Lesson 2 Video:

Lesson 2 Activity:

<https://www.tynker.com/play/lesson-2-activity-intro-to-looping/6020d4255d7ff67f5c244c10-653494XtMx.4sbfOv,J7y1ZVci5p4k>

Step 1: Click on the link for “Lesson 2 Video.” This will direct you to a short video featuring our music robot friends, Opus and Legato. Now that Legato has gotten used to combining beats and half beats into a measure, Opus shows him how to loop or repeat the measure to create an ongoing beat.



Step 2: Click on the link for “Lesson 2 Activity.” This will take you to tynker.com, a free website where kids can learn code. Remember to sign in if you already have a Tynker account. You should see a page that looks like this:

The screenshot shows the Tynker website interface. At the top, there is a navigation bar with the Tynker logo (labeled 'FREE'), 'MY CLASSES', 'MY PROJECTS', 'COURSES', 'HELP', and 'UPGRADE'. On the right, it says 'UCR Gluck Music Fellow' with a profile icon. Below the navigation bar, the breadcrumb trail reads 'HOME / PROJECTS / LESSON 2 ACTIVITY'. The main content area is split into two columns. The left column features a project preview with a speech bubble that says 'Let's repeat the beat! Press play and answer Legato's questions to begin.' Below this is a play button icon and a drawing of a character made of a brick and a cake. The right column has the title 'Lesson 2 Activity' by 'UCR Gluck Music Fellow', an orange 'REMIX PROJECT' button, a 'Share' button, and a 'Description' section that says: 'Lesson 2 Activity, a project made by UCR Gluck Music Fellow using Tynker. Learn to code and make your own app or game in minutes.' A vertical 'Feedback' button is located on the far right edge of the page.

Step 3: Click “Remix” to create a copy of the project. In this activity, Legato will ask you how many times you’d like to loop the beat and which tempo or speed you’d like him to play it. Press play to get started.

The screenshot shows the Tynker Scratch editor interface. At the top, it says "Lesson 2 Activit" and "SAVE". The "BLOCKS" panel on the left is open, showing various event handlers, control, operators, variables, functions, motion, and animation blocks. The main workspace shows a Scratch script for an actor named "legato". The script starts with "on start", followed by "go to front", "switch to costume normal", "go to x: -350 y: -100", and "ask How many times should I loop the measure? with choices 2 3 4". Below the "ask" block, there are "set bubble to rectangular" and "set font to normal 72 Arial,Helvetica,sans-serif" blocks. The script then branches into two "if" blocks: "if answer = 2 then" which sets "# of loops" to 2, and "if answer = 3 then" which sets "# of loops" to 3. On the right, the stage area shows a character named "legato" with a speech bubble that says "Let's repeat the beat. Press play and answer Legato's questions to begin." Below the stage, there is an "Add Actor" button and a list of actors including "Stage", "legato", and "Random Measure1". A large play button is visible in the bottom right corner.

Step 4: When prompted, choose either 2, 3, or 4 then slow, moderate, fast, or VERY FAST.

UC RIVERSIDE Gluck Fellows Program of the Arts
Written by Lelani M. Duke, Gluck Fellow
REPEAT THE BEAT
A STEAM-BASED PROGRAM™
FOR JUNIOR COMPOSERS

How many times should I loop the measure?

2 3 4

This screenshot shows the first question of the interface. On the left is a drawing of a robot made of a brick and a cake. On the right is a drawing of a violin and guitar. A speech bubble asks, "How many times should I loop the measure?". Below the speech bubble is a large empty rounded rectangle for an answer. At the bottom are three orange buttons labeled "2", "3", and "4". A red stop button is in the bottom right corner.

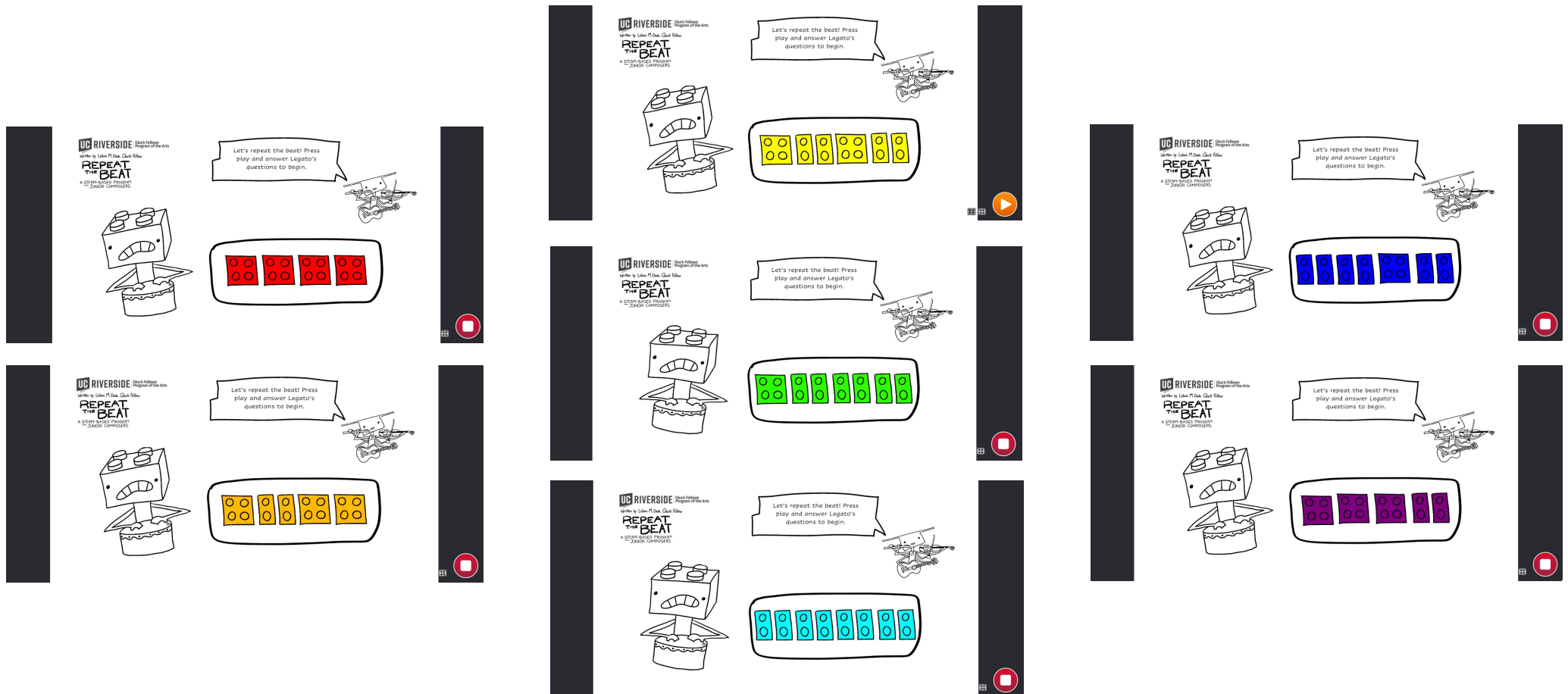
UC RIVERSIDE Gluck Fellows Program of the Arts
Written by Lelani M. Duke, Gluck Fellow
REPEAT THE BEAT
A STEAM-BASED PROGRAM™
FOR JUNIOR COMPOSERS

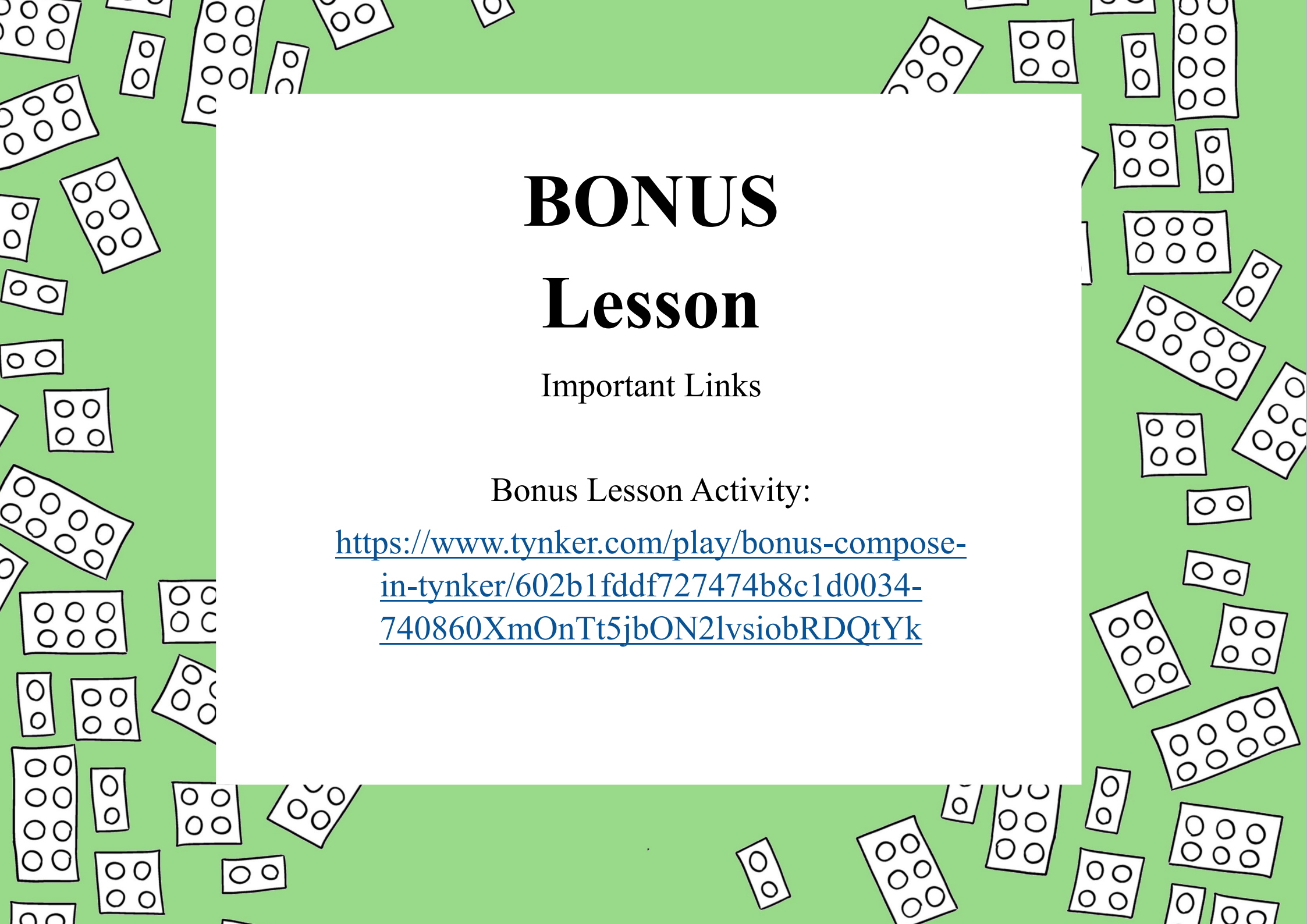
How fast should I play the measure?

slow medium fast VERY FAST

This screenshot shows the second question of the interface. It features the same robot and violin/guitar drawings as the first screenshot. The speech bubble asks, "How fast should I play the measure?". Below it is a large empty rounded rectangle for an answer. At the bottom are four orange buttons labeled "slow", "medium", "fast", and "VERY FAST". A red stop button is in the bottom right corner.

Step 5: Once you've made your selection, the program will randomly select one of seven measures. The default instrument is "Acoustic Bass Drum" with a clap on the first beat for emphasis. You can change the instrument if you'd like by clicking on the "Random Measure" actor and altering the code block. Legato will play the measure the number of times and the tempo that you selected.





BONUS Lesson

Important Links

Bonus Lesson Activity:

<https://www.tynker.com/play/bonus-compose-in-tynker/602b1fddf727474b8c1d0034-740860XmOnTt5jbON2lvsiobRDQtYk>

Step 1: Click on the link for “BONUS: Compose in Tynker.” This will take you to tynker.com. Click “Remix Project” to get started!

The screenshot shows the Tynker website interface. At the top, the Tynker logo is on the left, and navigation links for 'CODE NOW', 'HOME COURSES', 'TUTORING', and 'K-12 SCHOOLS' are in the center. On the right, there are 'SIGN IN' and 'JOIN FOR FREE' buttons. Below the navigation, a breadcrumb trail reads 'HOME / PROJECTS / BONUS: COMPOSE IN TYNKER'. A link 'Learn about Tynker' is also visible. The main content area features a project card with a video player. The video player has a play button and a title 'REPEAT THE BEAT' by UCR Riverside. Below the video, there is a 'REMIX PROJECT' button and a 'Share' button. A 'Description' section follows, stating: 'BONUS: Compose in Tynker, a project made by UCR Gluck Music Fellow using Tynker. Learn to code and make your own app or game in minutes.' A vertical 'Feedback' button is located on the right side of the page.

Step 2: In this bonus activity, you can apply what you learned in Lessons 1 and 2 by creating a measure using Tynker coding blocks. When you click on the link, you should see a coding area with blocks like this. The grey blocks are comment blocks that have no effect on the code but can help guide you through the process of creating your code. You can copy and paste these blocks (click to highlight in white, right click to copy and paste) or find the blocks in the block library (you can type in the library search bar to quickly locate blocks).

The screenshot displays the Tynker coding environment for a project titled "BONUS: Compos". The interface is dark-themed and includes a top navigation bar with a "SAVE" button, a "Code" button, and a "Stage" button. On the left, a "BLOCKS" library is visible, categorized into "Event Handlers", "Control", "Operators", "Variables", "Functions", and "Motion". The main workspace shows a script starting with an "on start" block, followed by several comment blocks (grey) and code blocks (purple and orange). The code includes setting the tempo to 60 bpm, a repeat loop of 4 iterations, and a "play drum" block for a 35 Acoustic Bass Drum for 1 beat. A right-hand panel shows a "Stage" view with an "Add Actor" button and a list of actors including "Legato" and "Opus". A large play button is visible in the bottom right corner.

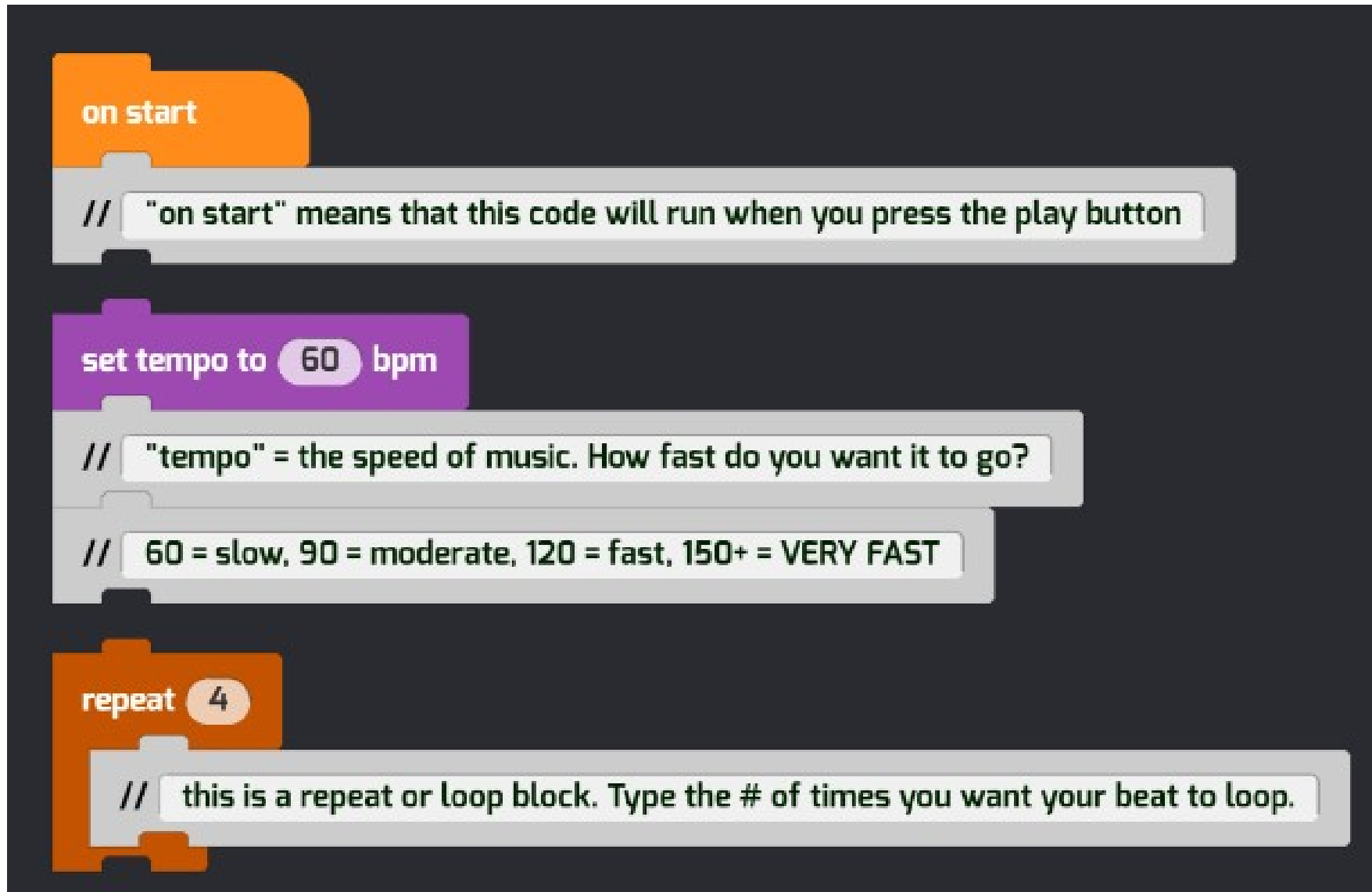
```
on start
// "on start" means that this code will run when you press the play button

set tempo to 60 bpm
// "tempo" = the speed of music. How fast do you want it to go?
// 60 = slow, 90 = moderate, 120 = fast, 150+ = VERY FAST

repeat 4
// this is a repeat or loop block. Type the # of times you want your beat to loop.

play drum 35 Acoustic Bass Drum for 1 beats until done
// Click on the drum type to change it.
```

Let's take a closer look at these blocks. The "on start" block means that this code will run when you press the play button. The "set tempo to _ bpm" allows you to program the tempo or speed of the measure. The "repeat _" block lets you choose the number of times you want your beat to loop.



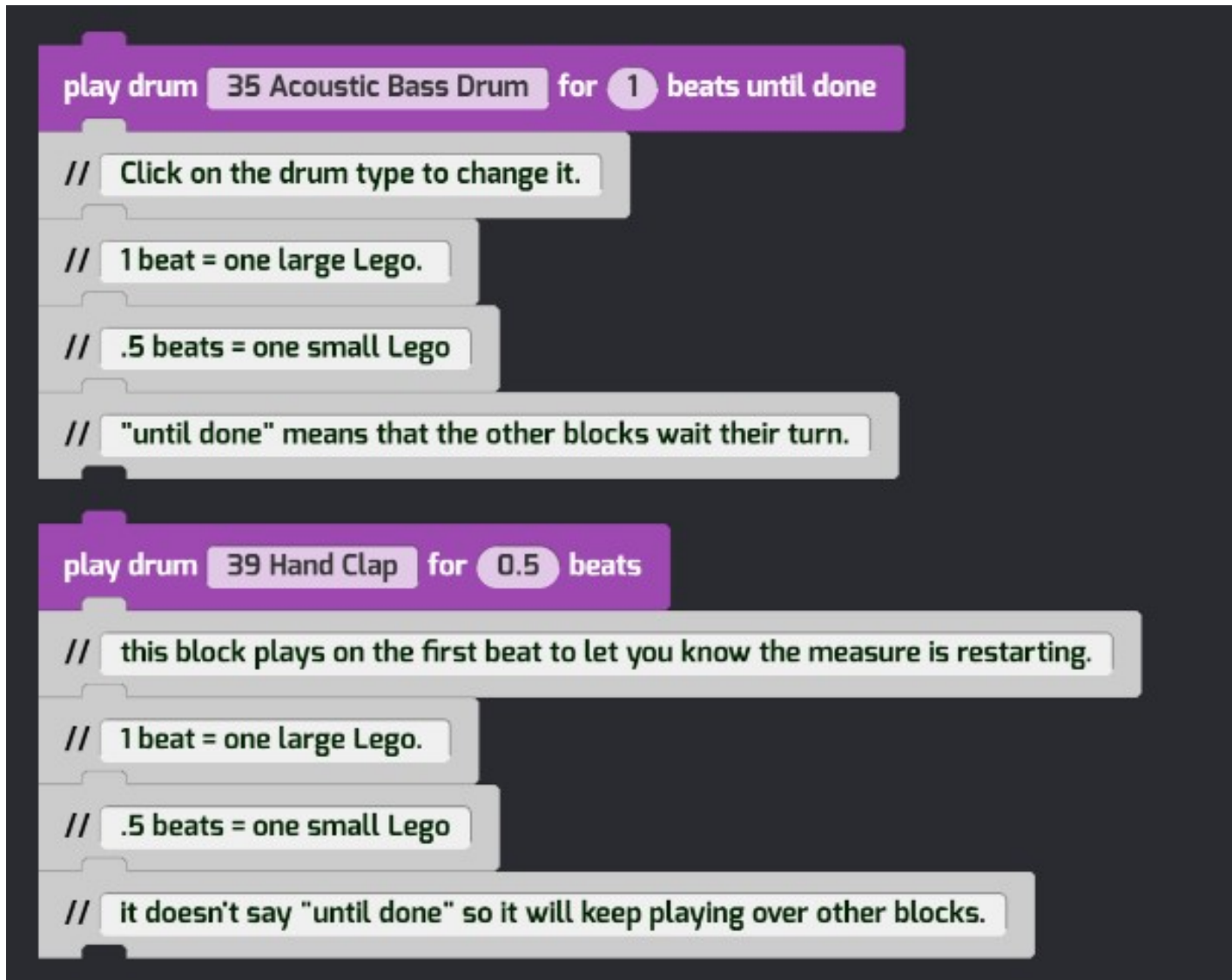
The image shows three Scratch code blocks stacked vertically on a dark background. Each block has a corresponding comment box below it. The first block is orange and labeled "on start". The second block is purple and labeled "set tempo to 60 bpm". The third block is orange and labeled "repeat 4".

```
on start
// "on start" means that this code will run when you press the play button

set tempo to 60 bpm
// "tempo" = the speed of music. How fast do you want it to go?
// 60 = slow, 90 = moderate, 120 = fast, 150+ = VERY FAST

repeat 4
// this is a repeat or loop block. Type the # of times you want your beat to loop.
```


The “play drum” block allows us to choose the percussion instrument and the duration of a beat. Remember that one beat is the same as one large Lego and a half beat is the same as one small Lego. If the block says “until done” this means the other blocks will wait their turn. If it doesn’t say “until done,” it will play over other blocks in the sequence which could be useful if you are trying to play a chord.



If you'd rather program a pitched instrument such as a piano or guitar, you'll need the "set instrument" block to set the instrument for the entire sequence. Once the instrument is set, you can use the "play note _ for _ beats until done" block to choose the pitch and duration of the note. Click on the note number to change the pitch. Click on the note number to change the pitch. A piano keyboard will appear to help you hear and select a note. You can also change the note's duration.

```
set instrument to 25 Acoustic Guitar (nylon)
```

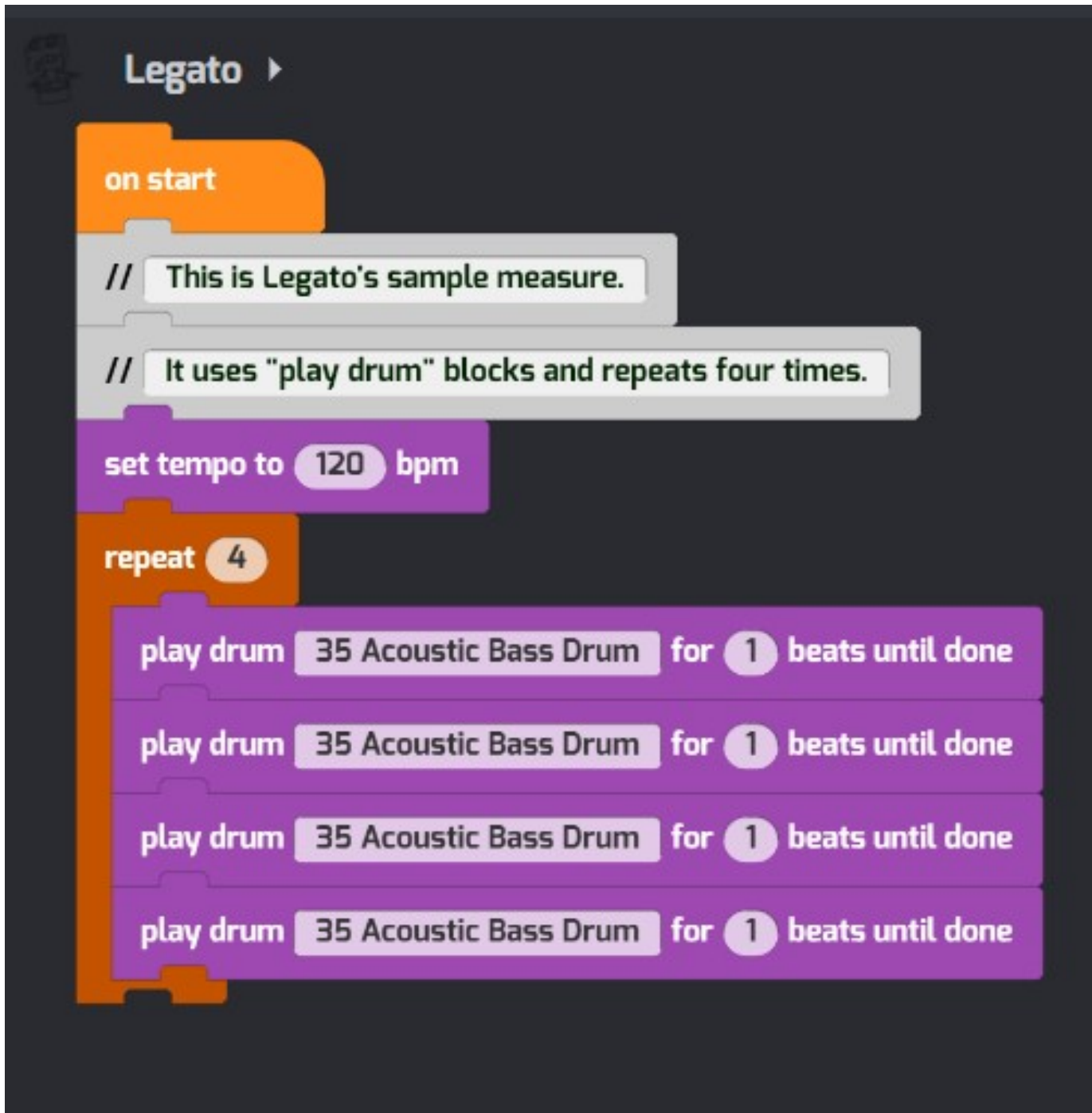
```
// Click on the instrument to change it!
```

```
// The instrument you select will apply to all blocks in the attached sequence.
```

```
play note 60 for 0.5 beats until done
```

```
// when you click on the note #, a piano keyboard will appear.
```

```
// Click on the key to preview the sound!
```

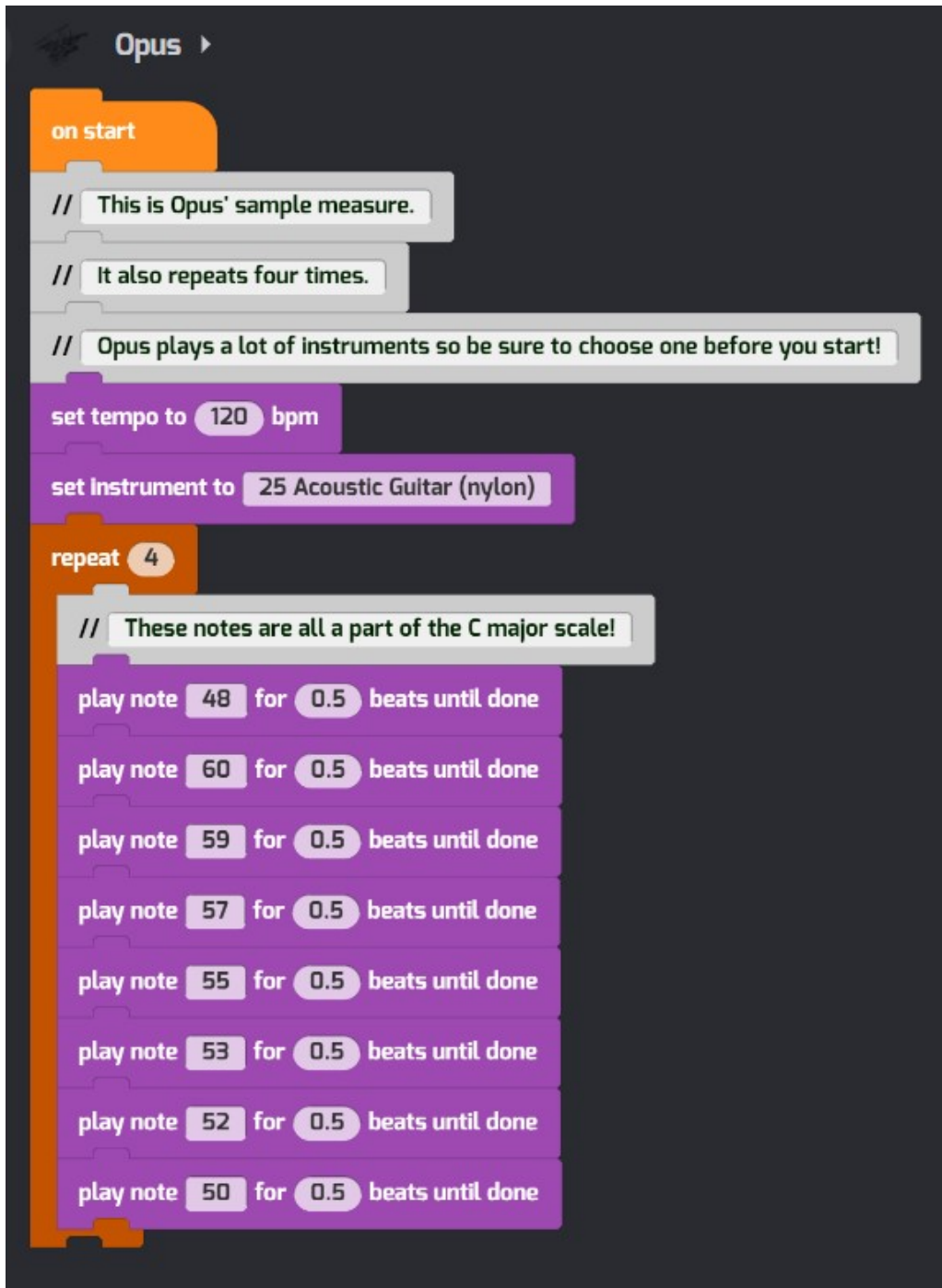


Step 3: Click on Legato in the actor's list to see his sample code.

The first sequence instructs Legato to “dance.” This sequence appears in Opus’ code as well. By giving the two actors identical “dance” sequences, we can ensure that they move together in unison.

The second sequence instructs Legato to play his drum. We set the tempo to 120 bpm. This is twice as fast as the default setting, which is 60bpm.

***Note: 60bpm is one beat per second. This means that “wait 1 secs” block is the same as resting for one beat.



Step 4: Click on Opus in the actor’s list to see his sample code.

The first sequence instructs Opus to “dance.” This sequence appears in Opus’ code as well. By giving the two actors identical “dance” sequences, we can ensure that they move together in unison.

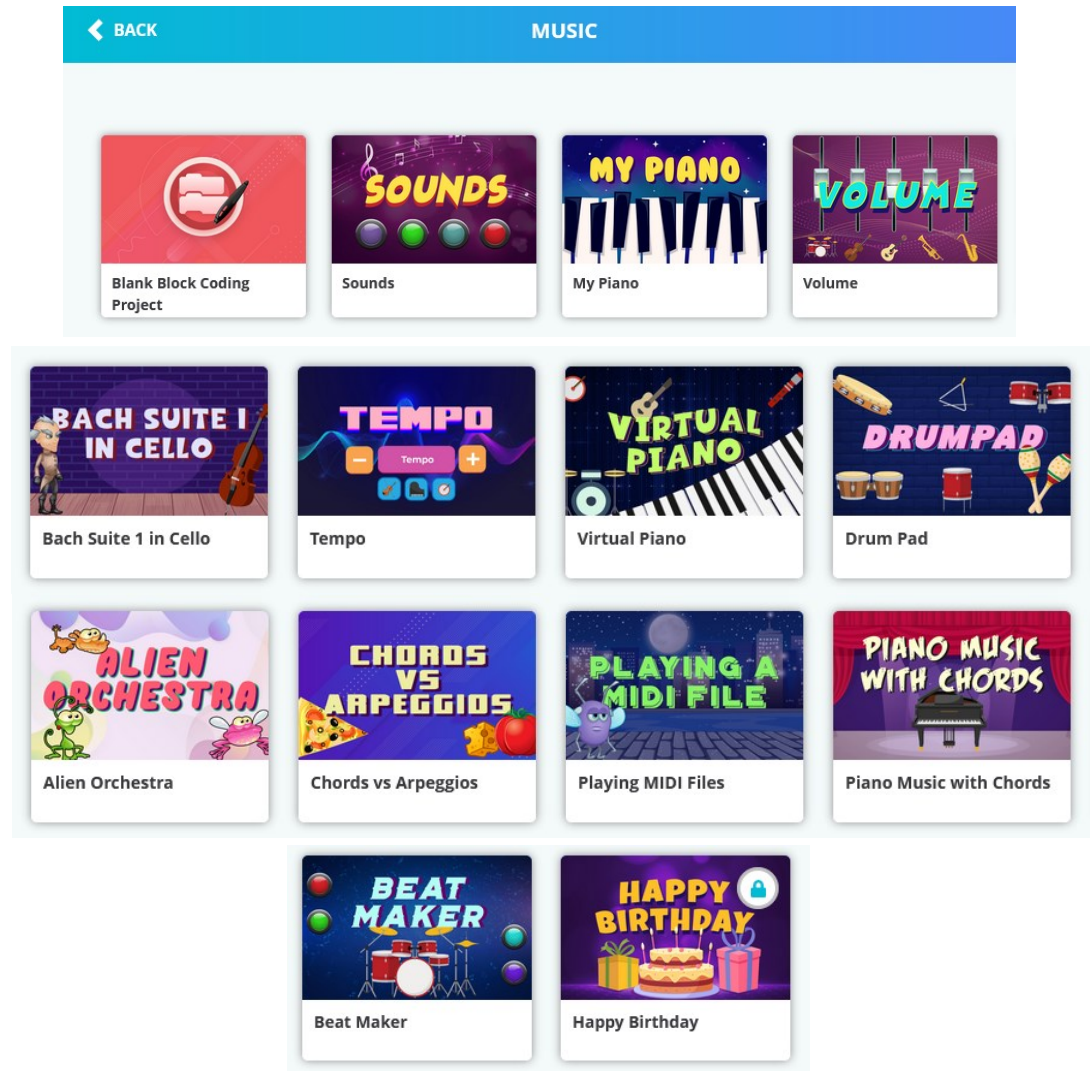
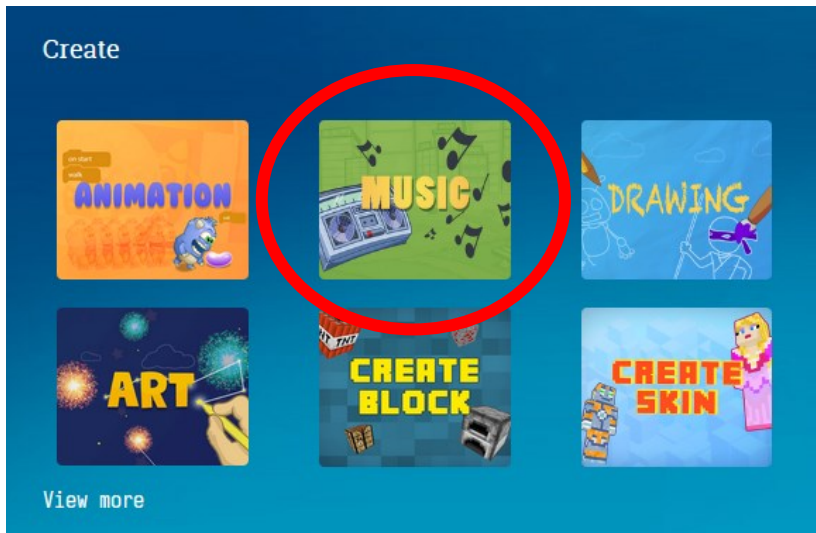
The second sequence instructs Opus to play a pitched instrument. We set the tempo to 120 bpm, the same as Legato’s tempo.

Click on the “set instrument” block and select the instrument that you want Opus to play.

Click on the note number in the “play note” blocks to change the pitch. A piano keyboard will appear to help you hear and select a note. You can also change the duration of the note. The blocks in this sequence are programmed to play the C major scale (and loop it four times) but you can change the notes to whatever you like!

Optional: For more practice, go to [tynker.com](https://www.tynker.com) and check out their selection of musical tutorial projects!

<https://www.tynker.com/dashboard/student/#>



All images on this page © 2021 Tynker.com