

### Overview

During This lesson student will gain understanding of how stringed instruments make different notes by vary the length of the string thus increasing or lowering the pitch. Students will integrate and exhibit learning by creating and playing a system which mimics a guitar.

### Key Information

Level 3: (Ages 10-11) US Grades 4 or 5

Time: 45 minutes/90 minutes

<a href="#">Warm-Up</a>	5 minutes
<a href="#">Mini-lesson</a>	10 minutes
<a href="#">Worked Example</a>	7 minutes
<a href="#">Challenge 1</a>	7 minutes
<a href="#">Challenge 1 - Debug</a>	5 minutes
<a href="#">Challenge 2</a>	7 minutes
<a href="#">Tidy Up / Exit Ticket</a>	4 minutes

### Lesson Topics

- **Computing**
  - Inputs, outputs and modifiers
- **Music**
  - Use technology to make music
  - Understand pitch
- **Physical Science**
  - Waves, frequency and pitch

### Learning Objectives

- **As a result of this lesson, students will be able to**
  - Understand the working of a stringed instrument
  - Understand that a shorter string vibrates at a faster frequency and produces a higher pitch
  - Understand inputs, outputs and modifiers
  - Make a musical instrument using SAM and play simple melodies

### Materials

- Cardboard
- Markers
- Plasticine
- Small box
- Rubber band
- SAM Labs Kit
- SAM Labs Student Workbook

### Warm Up – What do they have in common?

5 minutes

*What do all these instruments have in common?*

**Objective:** Understand that all string instruments are related. All have:

- Strings
- A means of making the effective length of the string shorter or longer
- A means of plucking, strumming or rubbing the strings

**Procedures:** Teachers asks the students to look at the pictures. Can they see that they are all string instruments? How many strings are there on the guitar (6) violin (4) cello (4) and double bass (4)? How are the strings moved differently (fingers in a guitar, bow on a violin or cello, both on double bass).



**Sample photo ideas:** a cello, a guitar, a violin

**Link forward:** The teacher identifies two requirements of a stringed instrument:

- A means of making the effective length of the string shorter or longer
- A means of plucking, strumming or rubbing the strings

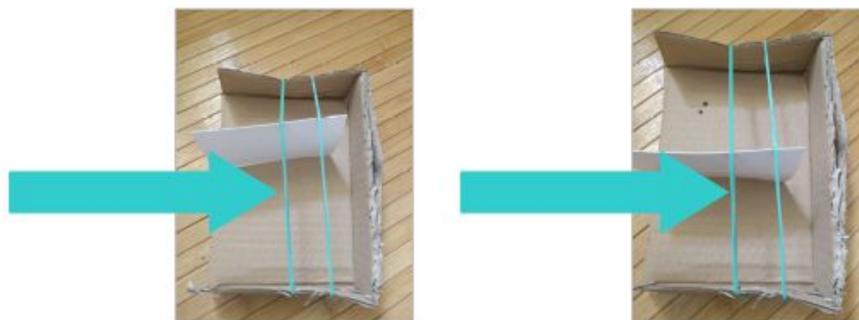
### Mini-lesson

10 minutes

*How stringed instruments work.*

**Objective:** Students learn about how stringed instruments work

**Procedures:** Elicit or explain that in a stringed instrument the sound is made by plucking or rubbing the strings with the fingers or with a bow. If the strings are made shorter on the fretboard then the sound is higher, if the string are longer, than the sound is lower. They can demonstrate this by making a quick guitar using a cardboard box and a rubber band. If we make the string shorter with a piece of card under the string the sound or pitch will get higher as the strings get shorter because a shorter string vibrates at a higher frequency.



lower note

higher note

## Lesson 3.3 Guitar

In a guitar, the left hand is used to press the string onto the fretboard (effectively making it shorter) and the right to pluck the strings. In a violin or cello, the left hand again presses the string onto the fretboard and the right (usually) rubs the string with the bow. Of course there are also left handed guitars, violins and cellos.

### Key Words

- string
- pluck
- pitch
- frequency
- rub

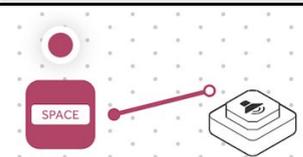
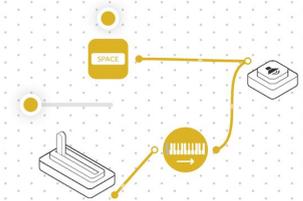
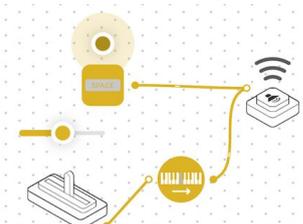
**Let's Discuss:** *How is the string made shorter and longer? How is the string made to sound? How does the length of the string affect the pitch of the sound? In your workbooks or with a partner, record, discuss, or share an example of higher and lower pitched sounds and what causes them.*

**Link forward:** The teacher prepares students to design a system using SAM blocks which replicates a 'guitar'.

### Worked Example

7 minutes

*Make a system to play a sound and to modify its pitch or frequency.*

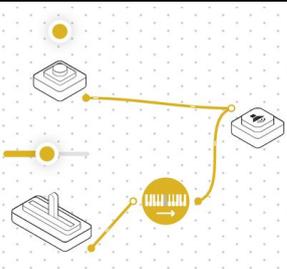
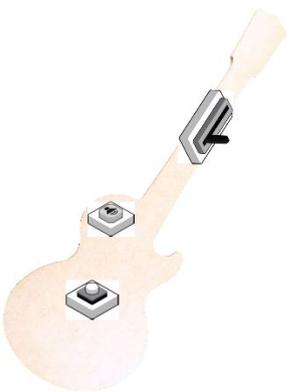
Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> Drag a Key Press block and a Buzzer block onto the Workspace and connect them.</p>		<p>The Key Press makes the buzzer sound. It is like a one-string guitar being played with only the strumming or plucking hand, it only makes one note.</p>
<p><b>Step 2.</b> Drag and connect a Slider block and Note block and then connect this to the Buzzer block.</p>		<p>The Slider modifies the note in the Note block</p>
<p><b>Step 3.</b> Now, press the Key Press and move the Slider, What do you hear?</p>		<p>Teachers says, 'As the slider is moved to higher values the Buzzer will play a higher note and vice-versa'</p>

**Checks for understanding:** *Do they understand how the Slider modifies the notes sent by the Note block to the Buzzer? Do they understand that the Key Press activates the buzzer and makes it sound while the Slider modifies it. Can they see the similarities between this system and a guitar?*

### Challenge 1

7 minutes

Make the system into a guitar.

Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> Cut out a guitar shape from card</p>		<p><i>This can be a separate Arts lesson if you prefer, with students hunting for guitar shapes online, downloading them and cutting them from card which they then decorate</i></p>
<p><b>Step 2.</b> Use a button in place of the Key press.</p>		<p><i>The button is more fun as we can mount it on the guitar and 'play' it in a more realistic fashion. If your students do not have a button they can use a Light Sensor (as a Button) and another Sensor (as a Sensor) to vary the pitch, but this will be more tricky to play</i></p>
<p><b>Step 3.</b> Decide where on the guitar the:</p> <ul style="list-style-type: none"> <li>• Button</li> <li>• Slider</li> <li>• Buzzer</li> </ul> <p>... should be placed to emulate the working of a real guitar.</p>		<p><i>Teacher says, 'The Button make the string sound so it is the same as the finger or hand plucking the string. Therefore it should be in the centre of the body of the guitar'</i></p> <p><i>'The slider modifies the pitch of the string and therefore is the same as the fingers of the left hand pressing the string on the fretboard. Therefore it should go on the neck of the guitar'</i></p> <p><i>'The buzzer should also go on the body of the guitar (as that is where the sound comes from in a guitar)'</i></p>

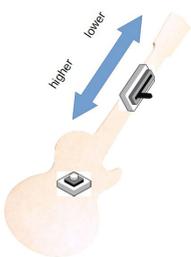
**Checks for understanding:** What does the left hand do? What doe the right hand do.? What does a guitar for a left handed person look like?

### Challenge 1 - Debug it

5 minutes

Is everything the right way up? Which way should the slider slide?

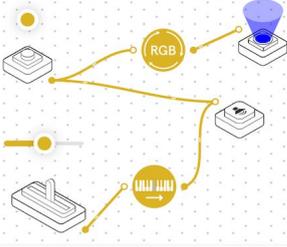
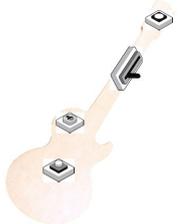
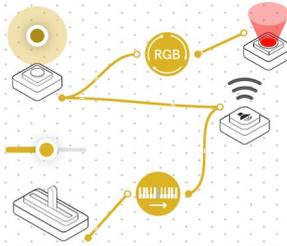
Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> What's wrong with this picture?</p>		<p><i>Teacher says, 'In this picture the left hand should be operating the Slider (as that is what modifies the pitch of the note) and the right hand the button (as that is akin to plucking the string)'</i></p>

<p><b>Step 2.</b> Make sure that, as you move the slider nearer to you, the sound get higher and as you move it further away it gets lower.</p>		<p>Teacher says, 'This will make the playing of the guitar more natural'</p>
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### Challenge 2

7 minutes

Make your guitar more jazzy!

Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> Add a separate system connecting a Cycle Color block and a Light block to the system.</p>		<p><i>This stage isn't strictly necessary, but adds more fun to the activity</i></p>
<p><b>Step 2.</b> Mount the Light on the neck of the guitar.</p>		<p><i>Another position can be chosen but this is quite visible</i></p>
<p><b>Step 3.</b> Now, each time you press the button the light will change color.</p>		<p><i>This stage is not strictly necessary but it is fun!</i></p>
<p><b>Step 4.</b> Play your guitar for the rest of the class.</p>		<p><i>Music: performing with a musical instrument</i></p>

**Extension Ideas:**

- **Music**
  - Do you know any famous guitarists?
  - Can you play a melody with your guitar?
- **Physical Science**
  - Explore frequency and pitch using:
    - Rubber bands
    - Glasses with different amounts of water
    - Longer and shorter bottles
  - Make a thumb piano (kalimba) using straightened metal bobby pins fastened to a piece of wood: <https://www.youtube.com/watch?v=w8tGUMre61g>

**Checks for understanding:** *Why is the Slider on the neck of the guitar and the Button on the body?*

### Tidy Up / Exit Ticket

**4 minutes**

*Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.*