



Smithsonian

SCIENCE
for Makerspaces



MATCH THE PITCH!

Match the Pitch is tied to our Smithsonian Science for Makerspaces, and this lesson plan booklet is geared for and written to guide teachers and students in using this education tool provided by the Smithsonian Science Education Center.



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MATCH THE PITCH!

Next Generation Science Standards

K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change, to define a simple problem that can be solved by developing a new or improved object or tool.

K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Introduction

Student teams will be introduced to the phenomenon of how stringed instruments can create sounds through vibrations. They will observe how the tightness or looseness of a string will affect an instrument's pitch. At the end of this challenge students will be able to distinguish between high pitch and low pitch sounds by modifying a 3D printed guitar model.



Kaycco/iStock / Getty Images Plus

Observe It!

Teacher will share the following passage with students

Do you like music? What instruments make music? There are many instruments that make music. Have you heard the guitar, piano, and violin play music? Did you know all of these instruments make sounds with strings? How do strings make sounds? When a string moves back and forth very quickly, it creates a sound. This is called vibration. Sometimes a guitar can make a high sound, like a squeaky mouse. Other times it can make a low sound, like a roaring bear. If the guitar makes a high sound, that is called a high pitch. If the guitar makes a low sound, that is called a low pitch. A guitar string that is loose will have a low pitch and a string that is tight will have a high pitch. The guitar can make both high pitch and low pitch sounds.

Make It!

Safety

Remind students to keep the guitar model and rubberband away from their face. The rubberband needs to be secured in a guitar peg when stretched. Strums to the rubberband are to be soft.

Makerspace Technology and Materials

- 3D printer with filament
- 3D printer design software
- USB drive

Teacher will print off the Guitar Kit for each student group

Link to the Guitar model can be found on the resource website.

Smithsonian Connections

For additional examples of
stringed instruments and music
with various pitches,
visit Smithsonian Folkways:
folkways.si.edu.

Steps to Print

1. Download the Smithsonian Guitar Kit STL file.
2. Open your 3D printer design software.
3. Start a new project and Import the Smithsonian Guitar Kit Model.
Optional: Scale and Rotate the models as needed.
Optional: Apply printing supports as needed.
4. Export and Open the project on your 3D printer. This may require a USB drive if your printer is not hooked up to your computer.
5. Print the model.

Approximate about **10 hours** of printing time for each kit.

Additional Materials for Each Student Group

- 1 new rubber band
- 2 small pieces of cardboard with small holes in the middle
- 1 deck of pitch cards for each group

Supplemental Setup

Teacher will tie a double knot at one end of the rubber band and string it on one piece of cardboard. Then the rubber band will be fed through the slot at the base of the guitar. A second cardboard piece will be fed onto the other end of the rubber band. Then a second double knot will be tied at the front end of the guitar. The second knot should be tied so that when the second cardboard piece is stretched to the top two pegs of the guitar, it makes a high-pitch sound.



Teacher Tip: Adding drawer liner to the cardboard pieces can keep them from slipping out of the guitar peg slots.

Design It!

Students will distinguish between high and low pitch sounds

Teacher will give each student group a Match the Pitch worksheet

The Design It! stage will have students listen to audio files played by the teacher. They will listen to all of the sounds once. Then students will listen to the sounds again and label each as high pitch or low pitch.

- Teacher will ask students, “What does a mouse sound like? What does a bear sound like? Which of those sounds is high? Which of those sounds is low?”
- Teacher will play the audio files of different guitar notes found on the resource website. Students will just listen.
- Teacher will ask students what is different in the sounds, focusing on the fact that some sounds are higher and some are lower.
- Students will fold the Design It! paper in half along the dotted line.
- Teacher will play the audio clips again. After each note students will vote on whether it is high pitch or low pitch by holding up the corresponding side of the paper

Test It!

Students will modify a 3D printed guitar model to match pitch sounds

The Test It! stage will have student groups create music using high pitch and low pitch cards. For each turn a different student will act as the musician, while the other students in the group will select a low or high pitch sound from their Design It! exercise. The students will place their high or low pitch sheets down in order. The musician will need to use the 3D print Guitar model to play through the pitches found on the cards. After successfully completing the pitch order, another student will act as the musician in the next round.

Teacher Tip: To better hear the pitches of the guitar, have students hold the base of the guitar next to their ear when they pluck the rubber band.

- Students will place the 3D print guitar model in the middle of one Test It! worksheet.
- Students will place up to four different cards around the Test It! worksheet.
- The musician will try to memorize the order of the four cards (high pitch versus low pitch).
- The team members will flip over the cards so the musician can't see them.
- The musician will play the pitches on the cards from memory.
- Remind the students: The top two guitar pegs are for high pitch. The bottom two are for low pitch.
- After the musician has completed the pattern successfully, he or she will pass the guitar to another team member who will be the musician for the next round.

Assessment Questions

What pitch does a tight rubber band make?

What pitch does a loose rubber band make?

How do string instruments make different sounds?