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Variations of a Paper Organ

Lesson plan



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EMPOWERING TOOLS

Subjects: Music, Physics, Crafts, Technologies

Age group: Secondary school age

Duration: 4 lessons

Learning outcomes:

- Understanding the definition of a musical instrument
- Honing performance skills
- Honing social skills
- Understanding audio physics – sound, resonance, filtering
- Understanding electronics – microphones, loudspeakers, feedback
- Developing patience

You will need:

- Tubes or material to build tubes
- Smartphones
- Group call apps
- WIFI or 4G/5G reception
- Tube based musical instruments for demonstration (woodwind, brass, percussion instruments)

We suggest doing the activities in four parts. Each of these consist of both a theoretical and a practical task, and can either be done individually or in groups. For the experiment every participant needs a mobile phone and a tube that is large enough to hold it. (Finding this tube is one of the activities.)

Suggestions for a lesson plan

Lesson 1: What is an instrument?

The “Variations of a paper organ: Building Guide” contains the information you need to build your own instruments. You are free to build one yourself, though this should only be undertaken by students with some experience in the field of computer music.

Topic introduction

1. Demonstrate a variety of tube-based instruments and note down all the different parts they are made of.
2. Work together as a group to find a common definition of a musical instrument.

In principle, any object that produces sound can be considered a musical instrument—it is through purposeful use that objects become purposeful instruments. A scissor is a cutting instrument, a telephone is a communication instrument, a whistle or a drum possibly too, but those could also be called musical instruments.

Usually, music instruments have a part that produces vibration or sound. For instance, a drum has a membrane paired with a resonator that shapes and amplifies the sound. You also need something to control the instrument, like a stick or a hand that then produces a range of sounds. In electronic music, musical instruments often consist of a combination of technical instruments, devices or tools, like loudspeakers, sound generators, filters, specialist programs, and computers.

For this experiment our instrument will consist of three elements—a tube, a mobile phone, and a conference call function or app. We will experiment with the sounds these make by playing with space and the way we position ourselves and arrange the tubes.

Activity

1. Find or make a tube that will act as the resonator (sound amplifier) of your instrument.
2. Discuss what you think a tube does in the context of sound production.
3. Look for tube-shaped things within the classroom that can be used for this experiment and/or begin the process of making your own tubes eg. by rolling paper (Make sure that the tube you choose or make is airtight, except for the ends.)
4. Listen to its inside with your ear at one end. (These ends can be sharp, so careful not to cut yourself!)
5. Take note of the resonant quality of the sound in the tube and how this shape affects the tone of surrounding sounds.

Lesson 2: Fill the tubes with sound!

The paper organ in this experiment relies on acoustic feedback. Use the chapters “Feedback”, “Loudspeaker/chassis”, “Tube”, and “Microphone” (found in) “Building Guide” to help with your explanation and discussion.

Activity

1. Take the tube and place your smartphone inside while it plays sound.
2. Try different positions and listen for changes in the coloration of the sound.
3. Put the phone on speaker during a call, place it inside a tube and speak to the calling phone or have the caller speak for you.

*Plan enough time for experimenting with this and present the most interesting results.

Lesson 3: What is a musician?

Topic introduction

What is a musician? If someone plays the clarinet, it might look like an easily answered question. If anything coming out of the instrument is music, it must be played by a musician, right? But what if the instrument can play itself without someone blowing, hitting or pressing something? This is often the case in electronic music. Many electronic instruments control themselves in terms of sound and temporal structure, so one could think that people are not needed any longer. But who is responsible for the music, who is playing, who is composing? Is it a musician, a technician? Is it the artist or the instrument builder? Try to find answers to these questions. Don't fear ambiguities; even professionals struggle to find consensus.

Activity

1. Form small groups of two.
2. Make the phones call each other, put them on a speaker and make it loud.
3. Place the phones in tubes and bring them together to create feedback.
4. Think about how moving the tubes affects the playing surface of the instrument.
5. Think about whether this is what musicians are also doing.

*As previously, plan enough time for experimenting and present the most interesting results.

Lesson 4: How to play an instrument as a group?

Activity

1. Place your mobile phones or smartphones inside the tubes while they engage in a conference call. Every phone will pick up surrounding noises and tones, and, because it's inside a tube, the sound will be colored by that. The phones will send this colored sound to all the other devices that are engaged in the call.
2. The phones must be set to speaker-phone, so every phone will also amplify what is sent to them; an amplification that will be colored by each tube/phone combination.
3. These colored amplifications will be picked up by all the smartphones to be colored, dispersed, and transmitted again! That's a proper feedback network. It will also be picked up and heard by you, the listeners, and players.
4. Your task is, besides listening, to learn to hear musical qualities and to try to understand what is happening and why.
5. Also experiment with changing the placement of everything from time to time. Notice that when you rearrange the tubes spatially, and/or change the position of the phones inside the tubes, you will engage with the feedback network, changing its conditions and music. It might tell you how sounds, resonators, devices and the feedback work; all the information is in the sound.
*Only change something after you have spent several minutes listening to the sound as it is. It often takes some time to find out if there are formal variations occurring. If you get bored of listening, we suggest using this as an exercise in patience!
6. To make a conference call, set the phones to a loudspeaker. (If you have smartphones, use an app like Signal or Whatsapp but also experiment with newer/older apps or the "normal" telephone function.)
7. Instead of a conference call you can also establish a live-stream on one device while the others listen to that. (Applications like Zoom that suppress the sound of "silent" or non-speaking conference members are not suitable for this task.)

*Take as much time as needed and repeat the experiment as many times as you wish.



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