The vibrating universe: Making astronomy accessible to the deaf

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Astronomers at the University of California, Riverside, have teamed with teachers at the California School for the Deaf, Riverside, or CSDR, to design an astronomy workshop for students with hearing loss that can be easily used in classrooms, museums, fairs, and other public events.

The workshop utilized a sound stage that allowed the CSDR students to "feel" vibrations from rockets, stars, galaxies, supernovae, and even remnants of the Big Bang itself. The members of the team have made their materials public and written up their experiences to help teachers and other educators worldwide to similarly engage the deaf community in STEM activities.

Since 2015, Gillian Wilson, senior associate vice chancellor for research and economic development and a professor of physics and astronomy at UCR, and Mario De Leo-Winkler, director of the National System of Researchers of Mexico and a former postdoctoral scholar at UCR, have developed astronomy outreach activities - astronomy photography competitions, traveling astronomy exhibitions, K12 workshops, interdisciplinary honors thesis projects, hands-on undergraduate astrophotography—that have touched 40,000 people.

They have worked closely with CSDR teachers before, ensuring American Sign Language, or ASL, at public astronomy events, but had never developed an activity targeted for the deaf community.

Around 360 million people worldwide suffer from hearing loss. In the

United States, about 11 million citizens are functionally deaf or report some trouble hearing. The city of Riverside contains a large concentration of deaf students because it is home to CSDR, the only public school for the deaf in Southern California.

"Designers of informal STEM education and public outreach activities often overlook people with hearing loss," De Leo-Winkler said. "For our workshop we decided to focus on astronomy -a gateway to science- because of the breathtaking imagery it offers, the big questions it tackles, and its increasingly interdisciplinary nature. We used storytelling, videos, and images in the workshop to bring meaning to the sounds of the universe—all of which made for a very engaging experience for the students."

"The students clearly loved the experience," said Wilson, "and that's the whole point."

De Leo-Winkler and Wilson presented the workshop multiple times over three days at CSDR, using feedback from the teachers and students not only to better convey the scientific concepts, but also to improve the students' experience. Their presentation took the students on a cosmic voyage: the students "traveled" from Earth, where thunderstorms were raging, to the sun, where they experienced a solar storm. The voyage continued to Jupiter, flew through the rings of Saturn, and continued on to stars Alpha Centauri A and B. The students flew past the Large Magellanic Cloud galaxy and encountered a supernovae explosion. The voyage ended by encountering the Cosmic Microwave Background, the radiation leftover from the Big Bang. Temperature variations in this radiation were sonified to allow the students to experience them as vibrations.

"Deaf individuals have a more developed sense of touch than hearing people due to their brain 'rewiring' in a process called neuroplasticity,"

De Leo-Winkler said. "We paid close attention to this when designing the workshop. The students sit on a special interlocking wooden floor and face a TV screen. When sounds are played, they are transmitted by the sound system onto the floorboard as vibrations. Meanwhile videos and images that provide information are displayed on the screen. We tell the story and an interpreter signs what we say in American Sign Language."

The workshop opens a new way of communicating cosmic phenomena, related to sound, to the deaf community, and opens the door for further developments in public outreach using vibrations to engage and excite students.

"It was very important to us to make our materials publicly accessible," Wilson said. "There are dozens of these sound stages in the U.S. alone. Our workshop could easily be adapted to include other astronomical phenomena or to focus on another scientific discipline. I hope knowing that this was such a positive experience for us will inspire others."

Continuing their collaboration with CSDR, De Leo-Winkler and Wilson are now developing another workshop for the deaf entitled, "Smells of the Universe".

The paper is published in the *Journal of Science Education and Technology*.

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