

Letters to the Editor

TO THE EDITOR,

Please consider printing our Letter to the Editor suggesting revised instructions for an activity published in *JMBE* that is no longer applicable in its published form. In this Letter we describe a retooling of a sound analysis activity (1) that now requires the uncoupling of sound archives from the sound analysis software because the Raven Viewer software required to visualize sounds is discontinued and no longer supported by Macaulay Library. Free Raven Lite software (Center for Conservation Bioacoustics at The Cornell Lab of Ornithology; <http://ravensoundsoftware.com/software/raven-lite/>) can be substituted in place of Raven Viewer.

In the original paper, the value of the Macaulay Library archives was introduced (1), and strategies for integrating authentic animal sound recordings in biology courses to facilitate student understanding of speciation and animal behavior were described. The authors provided several examples of how the Macaulay Library digital sound archives (<https://www.macaulaylibrary.org/>) were being used in diverse college classrooms around the country to analyze sound spectrograms (sonograms) by visually analyzing sounds in real time. Raven Viewer was a convenient platform to introduce students to these digital collections and to visualize the sound files directly from the library archives, but the quantitative analysis and exploration of sound characterization and data reproducibility were approximate and unreliable. The characterization of sound using Raven Viewer was limited and not designed to teach students new software tools or data analysis techniques.

Our revised strategy for integrating sound in general biology or animal behavior courses permits sound archives to be independently captured and studied using Raven Lite software (<http://ravensoundsoftware.com/software/raven-lite/>). Raven Lite permits sound variables like frequency, amplitude, voltage, and duration of song sound elements of any single sound archive to be dissected and independently examined. The primary objective of encouraging the use of Macaulay Library archives by students remains true (1). Instructors can continue to introduce the Macaulay Library and can continue to have students explore authentic video and sound files that correspond to authentic field records and data. These sounds can be played from within the Library accounts, and spectrograms can be visualized, but Raven Lite is required to dissect and study elements in sound archives.

Under our retooled approach, instructors navigate the Macaulay Library archives to identify the appropriate sound

files needed for lessons, and request the sound files from the library well in advance of class (6 weeks) (<https://support.ebird.org/en/support/solutions/articles/48001064551-requesting-and-downloading-media#RequestMedia>). To avoid quantitative measurement errors, instructors should use uncompressed (e.g., .wav or .aiff) sound formats. Along with the sound files, instructors may obtain metadata files containing information for each sound file (i.e., date, location, time, sex, age, recordist, and if video is available). The Macaulay Library is capable of sending the sound and metadata files digitally to the instructors. The instructors then work with their Information Technology department to determine how the sound files will be made available to students for remote learning. At Western Connecticut State University (WCSU), the files are uploaded to Blackboard (<https://www.blackboard.com/>), which is the remote instructional platform accessible to students.

In this age of remote learning and technological disparities (2), we believe that our retooled instructional strategy calling for the use of Raven Lite continues teaching behavior and species concepts with authentic data and quality software and introduces rarely taught concepts in bioacoustics. Furthermore, the importance of natural history collections in classrooms cannot be overstated (3); thus, retooling provides engaging biodiversity content with authentic data analysis experiences to investigate biological phenomena remotely for all learners. The Macaulay Library now includes recordings and contributions from citizen scientists participating in volunteer programs, providing students access to the scientific community that are not obvious and were not accessible previously.

WCSU uses Macaulay Library resources to introduce species concepts and sound and compares and contrasts multiple sounds inter- and intraspecifically along with videos of bird sister clades (i.e., Eastern and Western meadowlarks, and Blue-winged and Golden-winged warblers). Sound files of the same sister species are used to discuss vocalization and test species delineation hypotheses. Students analyze sounds by downloading free Raven Lite software at <http://ravensoundsoftware.com/software/raven-lite/> that lets users record, save, and visualize sounds as spectrograms and waveforms. Raven Lite is intended for students, educators, and hobbyists and can be used for learning about sounds, as an aid in birdsong recognition, and in musical instruction.

Available background reading introducing students to the basics of sound (i.e., frequency, voltage, amplitude, and patterns of frequency and amplitude over time) can be

helpful as students compare these basic sound variables across species sound files. Sound can be used to enrich biological principles and theories and to help students discover new career opportunities and STEM interests. We also stress the importance of free access to these tools and resources in an ever-expanding age of remote learning. Revising the activity from its originally published form facilitates student gains that include a deeper understanding of sound that in turn can be applied to future independent research studies driven by student interest (4). Furthermore, this age of online teaching requires that we develop virtual lab activities that are authentic, free, and provide opportunity for extended student exploration and discovery. Thus, the blending of Macaulay Library natural history video and sound collections archives with the visualization and dissection of digital sound archives helps make principals of physics approachable to students who may otherwise be reluctant to explore sound waves. Most biology students never learn about sound visualization, yet many animals produce sound or vibration, and we hope that this Letter offers new STEM training possibilities for our students.

Shortcut to instructional preparation

1. Scan Macaulay Library to identify the sound records needed.
2. Order sound files, and metadata excel file (i.e., date, location, time, sex, age, recordist, and if video is available).
3. Work with IT department to determine how the files will be made available to students.
4. Download Raven Lite on student computers: <http://ravensoundsoftware.com/software/raven-lite/>.
5. Prepare resources to introduce students to the basics of sound.

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