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| **Lesson Title : Can you hear it?** | **Unit #:****1** | **Lesson #:** **1** | **Activity #:** **2** |
| **Activity Title: How loud can you make it?** |

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| **Estimated Lesson Duration:** | **Four 45 minute classes** |
| **Estimated Activity Duration:** | **One and a half 45 minute classes** |

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| **Setting:** | **In class** |

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| **Activity Objectives:** |

* Explain the difference between frequency and decibel levels.
* Apply logarithms to data.

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| **Activity Guiding Questions:** |

When is my music too loud?

How can I measure sound?

What are the units of sound measurement (intensity, frequency) and what do they mean?

What sounds can I hear?

How can I protect my hearing?

How do we use logarithms to analyze data?

| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| ☐ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☒ Cause and effect |
| ☒ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☒ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☐ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function.  |
| ☒ Engaging in argument from evidence | ☐ Stability and change.  |
| ☒ Obtaining, evaluating, and communicating information  |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☒ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or** **Common Core State Standards -- Mathematics (CCSS)** |
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| **Standards for Mathematical Practice (Check all that apply)** |
| ☒ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☒ Reason abstractly and quantitatively | ☒ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☒ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

LE.A.4 For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

IF.C.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law V = IR to highlight resistance R.

REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

[www.sciencebuddies.org/science-fair-projects/project\_ideas/HumBio\_p011.shtml](http://www.sciencebuddies.org/science-fair-projects/project_ideas/HumBio_p011.shtml)

<https://www.youtube.com/watch?v=-_YR1jnGyMY> or <http://pbskids.org/dragonflytv/show/extremesounds.html>

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| **Teacher Advance Preparation:** |

Check link to make video is accessible.

Make copies of Can you hear it? data table.

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| **Activity Procedures:** |

Day 3-4

1. Can you hear it? Students will determine what frequencies they can hear and when they can no longer hear them. [www.sciencebuddies.org/science-fair-projects/project\_ideas/HumBio\_p011.shtml](http://www.sciencebuddies.org/science-fair-projects/project_ideas/HumBio_p011.shtml)
2. Consolidate data students collected on the loudest places in their day/week. Discuss any surprises or expected results.
3. Extreme sounds video from <https://www.youtube.com/watch?v=-_YR1jnGyMY> or <http://pbskids.org/dragonflytv/show/extremesounds.html>. This video will be used to begin the discussion about the students’ consolidated data.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

Class discussion on what frequencies they can hear.

Data collection and analysis for Can you hear it.

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6N2ZkNzgwZWIxNGVhMGU4>

Semilog Graph

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6NTMxNWU5N2MwNjE3NzA0OA>

Class discussion on results from data collection.

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

Unit 4 Post-assessment.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.Refer to Activity Template for details. |

* Extended time for IEP students.
* Creating selected groups to maximize student participation.
* Students will be working at their own pace.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

Can you hear it? was a good activity. Some students struggled with the calculated threshold. The best part of the activity was graphing the results on the semi log graph paper. This stood out to students when they were learning about the calculations to convert an intensity in W/m2 to dB. I forgot to show the students the Extreme sounds video.