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| **Name: Molly Hamilton** | **Contact Info:** [**hamilmo@cpsboe.k12.oh.us**](mailto:hamilmo@cpsboe.k12.oh.us) | **Date: 2/28/18** |

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| **Lesson Title : How loud is too loud?** | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: Where do you hear the loudest sounds?** |

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

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| **Setting:** | **Classroom** |

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| **Activity Objectives:** |

* Generate questions about sound, volume, and hearing.
* Generate questions about how math applies to quantifying sound.

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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 and what do they mean?

What sounds can I hear?

How can I protect my hearing?

What characteristics of sound are measurable?

| **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) |

[**https://hearingtest.online**](https://hearingtest.online)

[**http://www.starkey.com/online-hearing-test**](http://www.starkey.com/online-hearing-test)

**Loudest and Quietest Places**

**Unit 4 Pre-assessment**

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| **Teacher Advance Preparation:** |

Check links to make sure they still access the hearing tests.

Make copies of Loudest and Quietest Places handout.

Make copies of pretest.

Review essential questions.

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| **Activity Procedures:** |

Day 1

1. Students will take an online hearing test. See <http://www.starkey.com/online-hearing-test> or <https://hearingtest.online/>.
2. Students will develop the essential questions and generate ideas for the challenge.

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6MjkyNDc4MTYxOGY0YzZkMQ>

1. Pretest

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6NzMyOGI3YmU2OWExYjgwMA>

Day 2

1. Students will create a list of the places they are in during the course of their day that are the loudest and quietest. Students will rank these places from loudest to quietest.

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6MzY3ODhjOWEzYmI4YjNjZg>

1. Students will download a sound meter to their phone.
2. The assignment is to collect sound levels in the environments from number 1.

Day 3

1. Consolidate data students collected on the loudest places in their day/week. Discuss any surprises or expected results

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

Collection of data from Loudest and Quietest Places handout.

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6MzY3ODhjOWEzYmI4YjNjZg>

**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.

<https://docs.google.com/a/cpsboe.k12.oh.us/viewer?a=v&pid=sites&srcid=Y3BzYm9lLmsxMi5vaC51c3xtb2xseS1hLWhhbWlsdG9uLTIwMTd8Z3g6Zjc3M2MxN2JjYmYxMmFl>

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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.
* Selected groups to maximize student participation.
* Students will be worked at their own pace.

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

The hearing test was a good hook. Many students brought in earbuds that would only connect to their I-phone and wouldn’t connect to the laptops. Also, a few students didn’t bring in earbuds or headphones, so they weren’t able to complete the hearing test in class. Peardeck was a great way to collect the students ideas for the Essential Questions and Guiding Questions. Students did identify some guiding questions that I didn’t anticipate, such as how does sound travel, what sizes and shapes absorb sound, and what materials absorb or amplify sound. Some students weren’t able to download a sound meter to measure the decibel level in their loudest and quietest places. Also, I would change the table for the students to only record the highest intensity and remove the lowest intensity and average intensity.