

## Physics – Electricity & Magnetism – Headphone Engineering

| Culminating Activity – Headphone Engineering |   |  |   |
|--|---|--|---|
|  | Speaker Dissection  | Prototype & Elevator Pitch   | Headphone Construction and Design Brief   |
| Student Experience                           | Students are introduced to the Culminating Activity (if not done at the beginning of unit).<br><br>Students dissect a speaker and hypothesize the role of each component. | Students experiment with magnets, wire, and paper, plastic, or Styrofoam cups to prototype a single headphone speaker.   | Students build headphones using T4T materials.<br><br>Students prepare design brief defending their design and documenting the engineering design process.  |
| T4T Material                                 | Speaker   | 2 <sup>nd</sup> Speaker<br>Thin-gauge wire<br>Paper, plastic, or Styrofoam cups or plates  | 2 speakers (if not already provided)<br>Additional wire (enough for ~35 loops in voice coil in each headphone speaker)  |
| Big Idea                                     | What is required to create a speaker? What does each component do?  | Alternating current through a wire produces an alternating magnetic field, and therefore force, acting on the speaker cone. The speaker cone transfers the vibrations from the voice coil to the air, producing sound. | To maximize volume and clarity, speaker cone should be made from a lightweight material (low mass → high acceleration, for a given force).<br>Speaker cone and voice coil assembly must vibrate freely.<br>Mono vs. stereo designs. |
| Next Generation Science Standards            | HS. PS-FM a<br>Asking questions and defining problems.  | HS. PS-FM d, e<br>Asking questions and defining problems.<br>Constructing explanations and designing solutions.<br>Engaging in Argument from Evidence  | HS. PS-FM d, e<br>PS2.A:b, c<br>Asking questions and defining problems.<br>Constructing explanations and designing solutions.<br>Engaging in Argument from Evidence   |
| Time   | One 55-min period   | Two 55-min periods   | Four 55-min periods, plus time (~1 week) for students to work on projects at home.  |

### CA Standards:

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| PH5. f. | Students know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources. |
| PH5. g. | Students know how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.  |
| PH5. h. | Students know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.  |