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| **Connecting to the *Next Generation Science Standards* (NGSS Lead States 2013)** |
| **Standard****3-5 ETS1 Engineering Design***https://www.nextgenscience.org/pe/3-5-ets1-3-engineering-design* |
| * The chart below makes one set of connections between the instruction outlined in this article and the *NGSS*. Other valid connections are likely; however, space restrictions prevent us from listing all possibilities.
* The materials, lessons, and activities outlined in the article are just one step toward reaching the performance expectation listed below.
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| **Performance Expectation****3-5-ETS1-1:** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. |
| **Dimensions** | **Classroom Connections** |
| **Science and Engineering Practices** |  |
| **Asking Questions and Defining Problems****Using Mathematics and Computational Thinking****Developing and Using Models** | Students asked questions regarding the design and function of an enclosure that could safely house an orangutan. They also asked and predicted what sensors and programming sequence were needed to create an alarm system, then changed identified variables in their Crumble program until it worked. From those questions they were able to define the problem and create an alarm system within specified constraints. Students applied knowledge about basic programming commands by recognizing patterns, arranging the commands in the correct sequence or pattern, and debugging variables needed to properly operate the sensors. Students sketched their designs in their STEM notebook, then constructed their enclosure and programmed their alarm system. |
| **Disciplinary Core Ideas** |
| **ETS1.A: Defining and Delimiting Engineering Problems**Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. | Students developed various designs and constructed an enclosure within material and size constraints to ensure the orangutan would be safe. Material constraints also applied to the sensors available and a student’s ability to successfully program them. |
| **Crosscutting Concepts** |
| PatternsSystems and System Models | Students identified patterns then used loops and if/then/else statements to allow their alarm system to continually sense for a missing orangutan.Building a mechanically functioning enclosure, integrated with electrical circuit components and a programmed microcontroller allowed students to see how science and engineering concepts contribute to the operation of a complex system. |