7th Grade

Phase Change Engineering Internship

Portable Baby Incubators

Driving Question: As chemical engineering interns at Futura Engineering, **how can we design and create an incubator with consideration of given criteria**

Content: Students act as chemical engineering interns and design an incubator that addresses the needs of their target population by keeping the baby's average temperature close to 37℃, minimizing the time outside the health temperature range, and keeping costs low. Students use the BabyWarmer Design Tool to collect and analyze data about their designs, complete iterative tests, and learn about optimizing designs. By the end of this unit, students will compose a written proposal that supports their optimal designs for making an effective portable incubator, while managing the trade-offs among the project criteria.

Standards: NGSS: **MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.**

Major Products: Students will design an optimal incubator, create a written proposal, and create a proposal presentation.

Public Presentation: Projects will be presented in class and open to the public for viewing. Presentations will be filmed as well. Students will present to peers, staff, family members, and other community stakeholders, such as chemical engineers, or hospital staff.

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