

Phase I – Research and Planning – Due Date: Midterm 1. Identify the “Big” concept to be covered by the engineering design challenge. 2. Research appropriate learning standards associated with the topic. 3. Identify and discuss the different types of problem solving and declarative/procedural knowledge needed. 4. Explore objectives and ancillary concepts/content covered by the project. 5. Identify possible activities. 6. Select the best activity for your classroom.

I. Big Concept

- A. How can we design portable baby incubators that use phase change to keep babies at a healthy temperature?

II. Learning Standards

- A. The Phase Change Engineering Internship unit provides students with opportunities to engage in multiple science and engineering practices as they design a portable baby incubator. This unit emphasizes all eight practices:

1. Practice 1: Asking questions and defining problems
2. Practice 2: Developing and using models
3. Practice 3: Planning and carrying out investigations
4. Practice 4: Analyzing and interpreting data
5. Practice 5: Using mathematics and computational thinking
6. Practice 6: Constructing explanations and designing solutions
7. Practice 7: Engaging in argument from evidence
8. Practice 8: Obtaining, evaluating, and communicating information

- B. Next Generation Science Standards Performance Expectations: MS-ETS1-1; MS-ETS1-2; MS-ETS1-3; MS-ETS1-4; MS-PS1-4; MS-PS3-3; MS-PS3-4

- C. Science and Engineering Practices: Practice 1; 2; 3; 4; 5; 6; 7; 8

- D. Disciplinary Core Ideas: ETS1.A; ETS1.B; ETS1.C; PS1.A; PS3.A; PS3.B

- E. Crosscutting Concepts: Energy and Matter; Systems and System Models; Cause and Effect; Structure and Function

III. Types of problem solving and declarative/procedural knowledge needed

- A. In the first phase, the Research phase, students are introduced to the Engineering Internship. They learn about the baby incubator project and new concepts needed to address three project criteria: keep the baby’s average temperature as close to 37°C as possible, minimize the time the baby spends outside the healthy temperature range, and keep costs low

- B. In the Design phase, students use the BabyWarmer Design Tool as a part of The Design Cycle. BabyWarmer is a digital model that allows students to plan baby incubators, build and test them, analyze the results, and then plan another iteration of tests.

- C. In the Proposal phase, students gather evidence to support their optimal designs and write their Final Proposals, using scientific communication skills to present and support their claims about the best solution.

IV. Objectives and ancillary concepts/content covered

- A. Phase Change Materials

- B. Temperature plateau.
 - C. Melting of PCMs.
 - D. Freezing of PCMs
 - E. Incubators and Premature Infants
 - F. Insulation and insulating materials
 - G. Phases of Matter
 - H. Phase Changes
 - I. Energy Transfer
- V. Identify possible activities
- A. Test thermal transfer of newly designed cups
 - B. Design medical friendly insulating baby clothes
 - C. Designing Portable Incubators
 - D.
- VI. Best Activity for Classroom
- A. Design Portable Incubator