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Storylining a middle school engineering module that addresses the NGSS science standards (Resource Exchange)

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Students investigate how to solve the pre-term infant problem in developing countries

Access the lesson here

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Joseph Muskin and Jessica G. Perez

Storylining Approach

Students will often engage more robustly when they have a hand in driving the investigation into a real-world problem. When the lessons form a coherent sequence where each step arises from the students' questions and serve to move closer to the solution, students see the process of engineering first-hand. This is facilitated by the storyline method to deliver lessons aligned to the Next Generation Science Standards (NGSS) (See: https://www.nextgenstorylines.org/what-are-storylines)

Using the storylining approach we have developed a series of lessons in which students address the problem of premature infant mortality in the developing world. Students look at why the infant mortality rates are much lower in developed countries, even if the premature birth rate is similar, such as between the US and sub-Saharan Africa. They discover that access to infant incubators might help address this problem in the developing world, but that access to electricity is a limiting factor. They then set out to design an infant incubator using chemical reactions to provide the heat. They learn about chemical reactions, insolating and conducting materials, and phase change materials to regulate the heat in an organic way as they address problems that arise while designing their incubator.

Curriculum Features

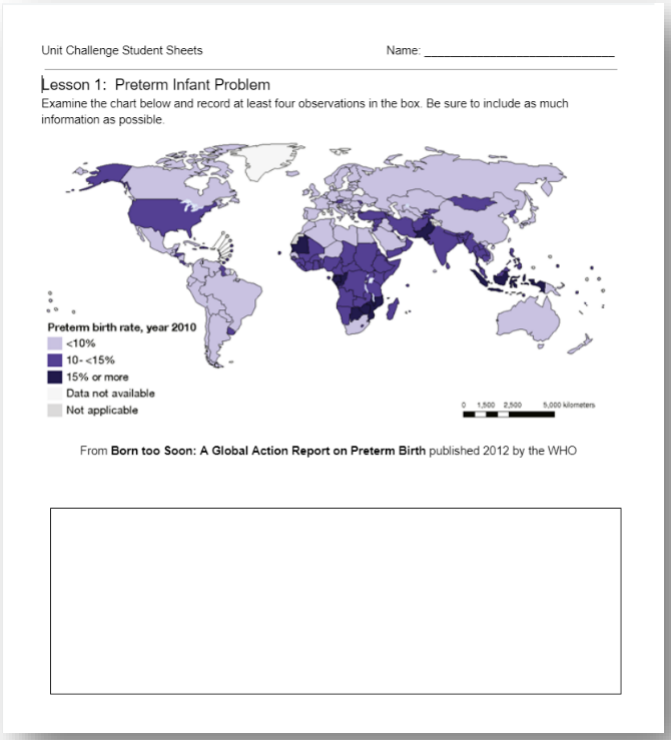
- 17 activities, up to 6 weeks of content
- Covers majority of chemistry standards!
- MS NGSS: PS-1, PS-2, PS-4, PS-5, PS-6, ETS-1, ETS-3, ETS-4
- Inclusive engineering design approaches
- Robust, multi-year tested curriculum

Benefits to students

- Tractable real-world problem
- Students design to a set of criteria with multiple possible solutions vs engineering design competition
- Every student can succeed and be an engineer

Lesson 1	**Preterm Infant Problem**	**2 class periods**
Lesson 2	What do we know about babies?	1 class period
Lesson 3	How is heat produced?	1 class period
Lesson 4	What happens when chemicals combine?	2 class periods
Lesson 5	What patterns are present when a chemical reaction occurs?	2 class periods
Lesson 6	Are the atoms at the beginning of a reaction there at the end?	2 class periods
Lesson 7	What happens to the chemicals when they combine?	1 class period
Lesson 8	How can we produce heat?	2 class periods
Lesson 9	What chemical ratios ca new use to promote the most heat?	1 class period
Lesson 10	How does heat move?	2 class periods
Lesson 11	How does temperature affect particle movement?	1 class period
Lesson 12	How does thermal equilibrium impact incubators?	1 class period
Lesson 13	What are the requirements for our prototype?	1 class period
Lesson 14	What materials will work best to build the incubator?	2 class periods
Lesson 15	How will we design/build the incubator?	3 class periods
Lesson 16	Build it!	1 class period
Lesson 17	What needs to be changed about our design?	1 class period

Sample pages from Lesson #1

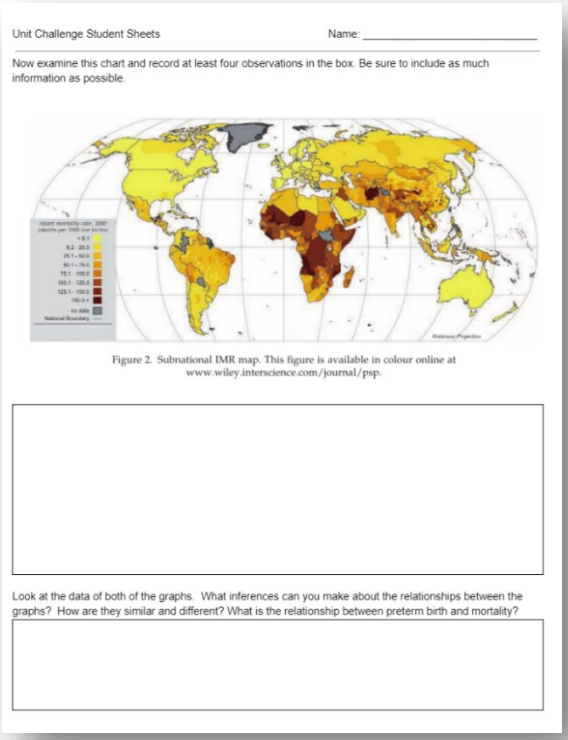


Unit Challenge Student Sheets Name: _____

Lesson 1: Preterm Infant Problem

Examine the chart below and record at least four observations in the box. Be sure to include as much information as possible.

From **Born too Soon: A Global Action Report on Preterm Birth** published 2012 by the WHO



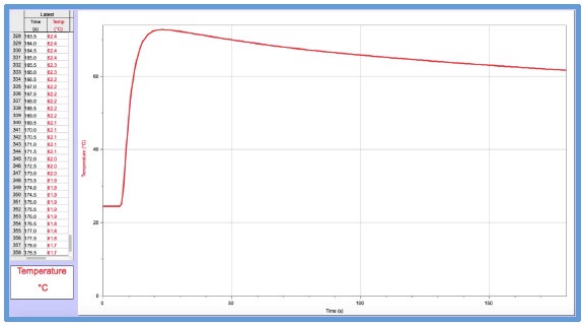
Unit Challenge Student Sheets Name: _____

Now examine this chart and record at least four observations in the box. Be sure to include as much information as possible.

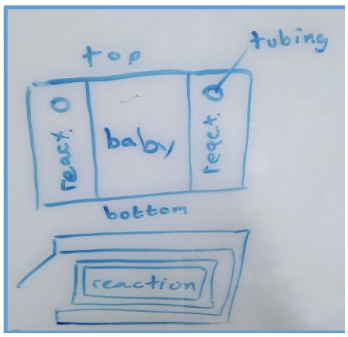
Figure 2. Subnational IMR map. This figure is available in colour online at www.wiley.interscience.com/journal/psp.

Look at the data of both of the graphs. What inferences can you make about the relationships between the graphs? How are they similar and different? What is the relationship between preterm birth and mortality?

Sample student artifacts

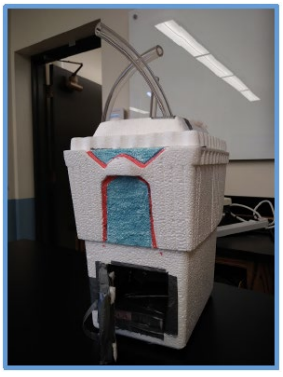


Data showing how the design maintained temperature over time.



Preliminary design of an idea for a prototype from one group.

Constructed prototype inspired by a sleeping bag to allow the infant to be easily held while being kept warm. Chemical warming packs placed in pockets for this design.



Each student group came up with their own prototype, with ideas very wide ranging.

For the curriculum, see: https://poets-erc.org/infant-incubator or contact jmuskin@illinois.edu

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