

Engineering Design in the Next Generation Science Standards



Anne Catena, Princeton University
Kim Feltre, Hillsborough
Martha Friend, Princeton

The What -> Engineering at grade level

The How -> lessons, curriculum &
professional learning

Disciplinary Core Idea: Engineering

- ❖ Physical Sciences
- ❖ Life Sciences
- ❖ Earth and Space Sciences
- ❖ Engineering Design



Disciplinary Core Idea: Engineering

Engineering is embedded in

- all content
- all grade levels

FOR ALL STUDENTS

Be a Super
Problem Solver



**Are we understanding our world?
If yes, it's SCIENCE.**



**Are we solving a problem
(a human want or need)?
If yes, it's ENGINEERING.**

Science Lessons begin with phenomena - ocean waves move sand and water



Engineering lessons begin with scenario -oceanfront homes destroyed by waves



SAVE
ME!

Engineering lessons focus on a **scenario** that allows students to define the problem.

Science Phenomena >> **ocean waves
move sand and water**

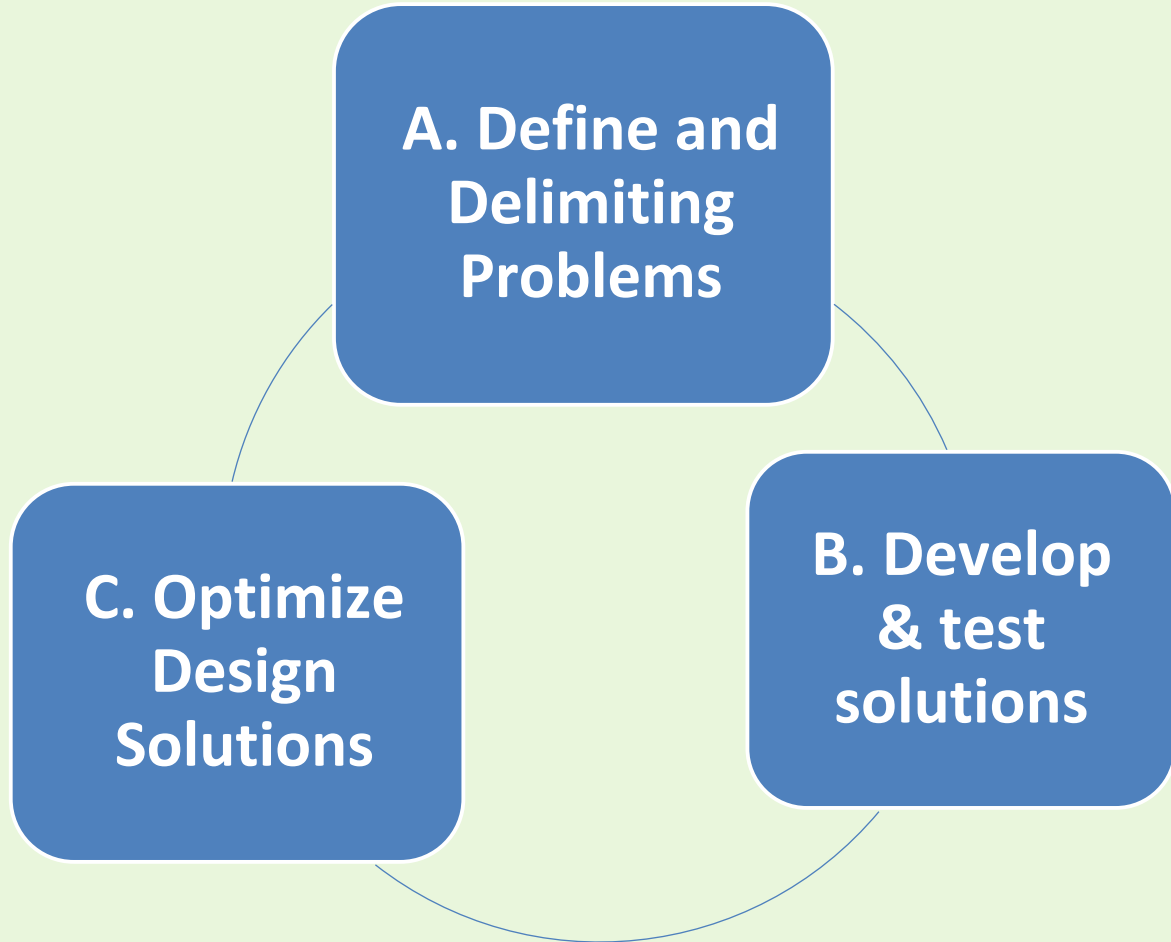
Eng'g Scenario >> **oceanfront homes are
destroyed by waves**

**A. Define and
Delimiting
Problems**

**B. Develop
& test
solutions**

**C. Optimize
Design
Solutions**

Putting the pieces together



Read each of the pieces

Put sets of 3 elements of NGSS Eng'g Design in grade band order:

➤ **K-2**

➤ **3-5**

➤ **6-8**

➤ **9-12**

Begin with an **engineering scenario: a situation we want or need to change.**



Eggs break during shipping.



Fish are dying in the lake.



Cell phone battery needs frequent recharging.

Students Define Problem

Eggs are breaking because

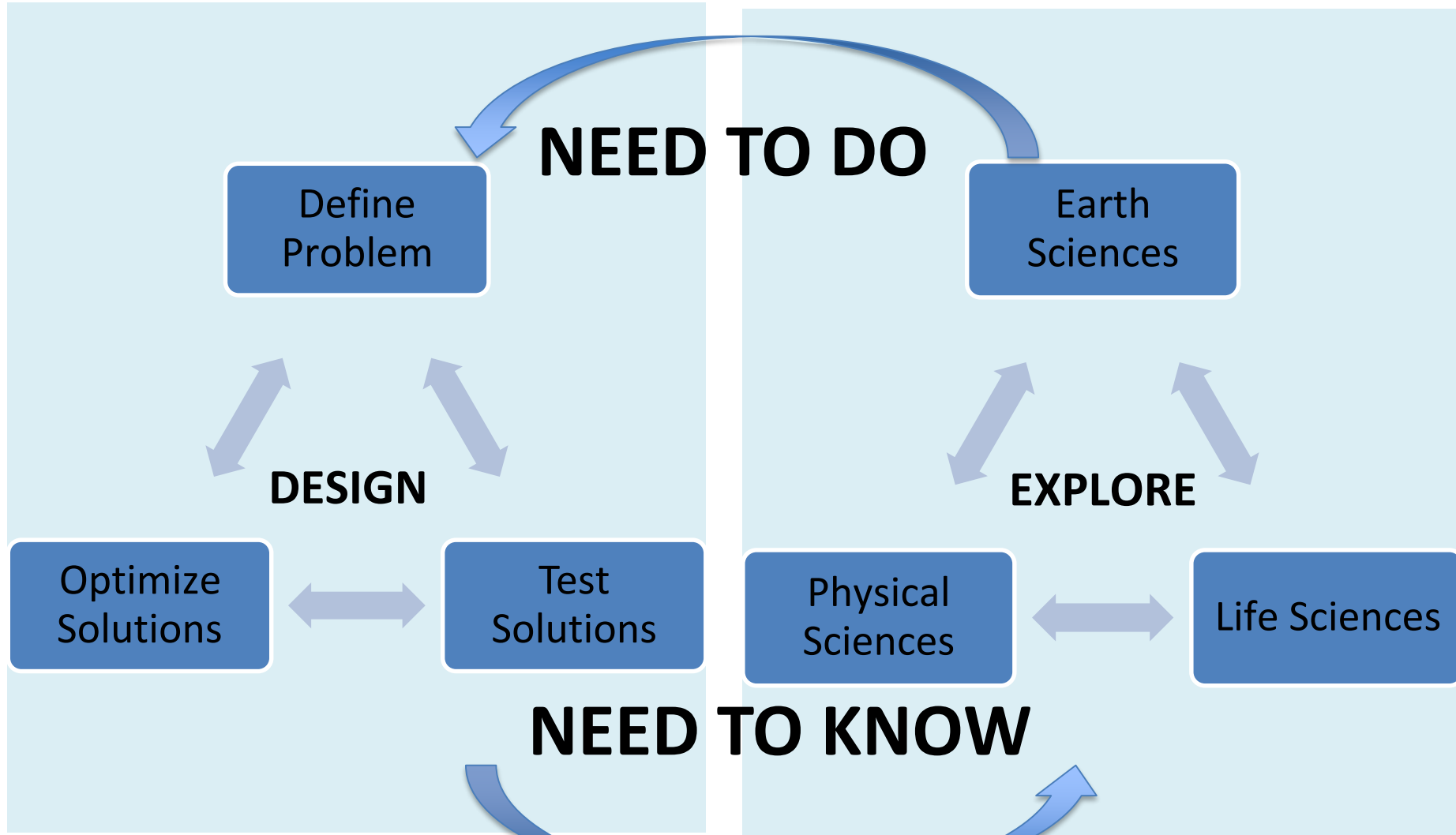


- shells are too thin (Life Science)
- packing is faulty (Physical Science)
- potholes (Earth Science)

Engineering Scenario -> Causes -> Engineering Problem(s)

- **Problems** are expressed as statements that describe what we want to do about a given cause.
- **Criteria** describe what the solution should do so that we will know when our solution is acceptable.
- ❖ **Constraints** describe the limitations under which we must solve the engineering problem.

Engineering Design and Science



HOW?



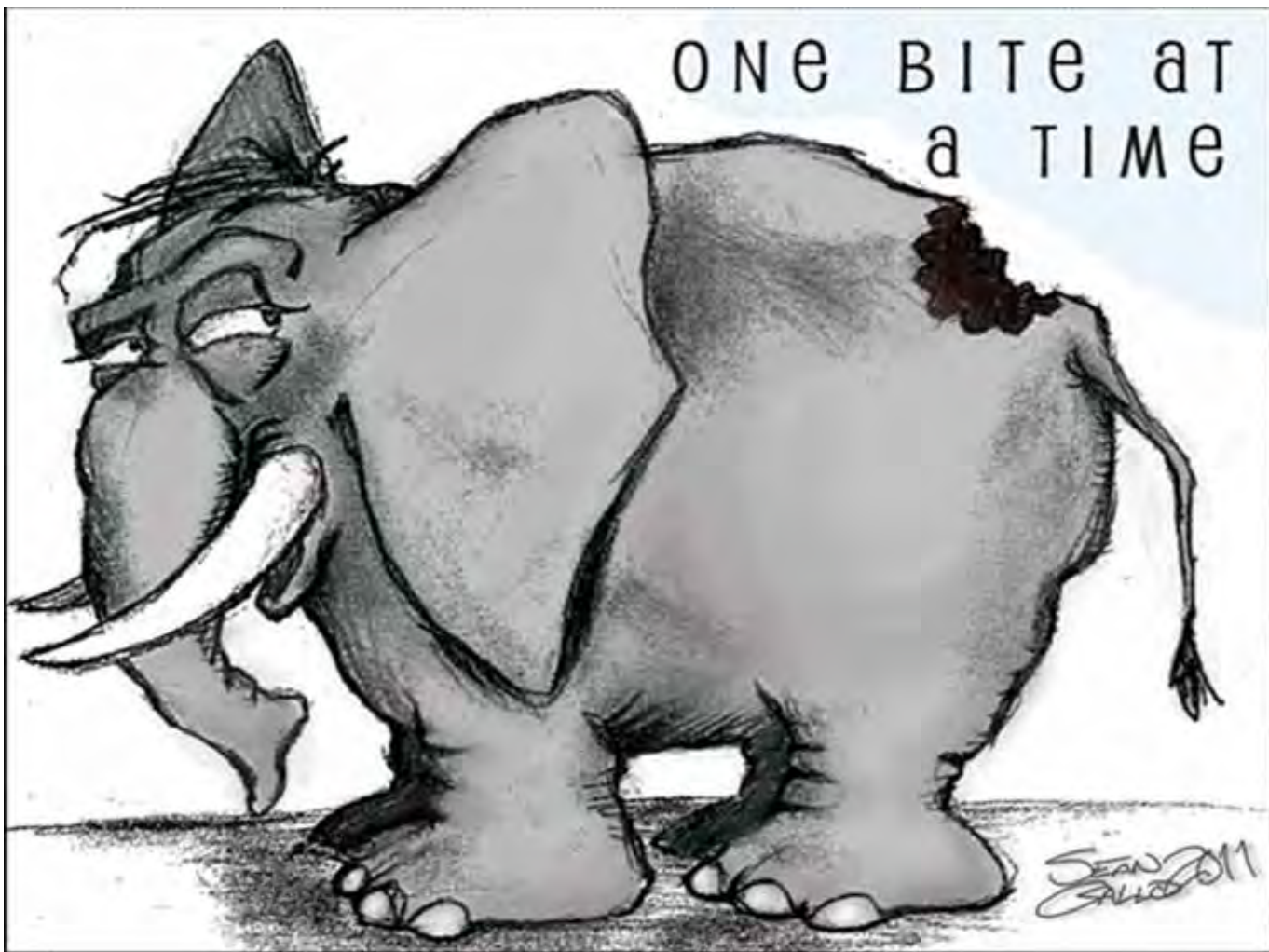
Engineering Design Goals

Curriculum Writing

- Defining and Delimitating an Engineering Problem
- Developing Possible Solutions
- Optimizing the Design Solution

- Defined STEM
<http://www.definedstem.com>
- Engineering Design Resources in the Google Drive
- Teach Engineering
- STEM Jobs - lesson plans

Identify at least one engineering design project per grade level/subject. Physics lends itself to more than one. Keep in mind that the engineering project should drive the learning of the content, NOT be a culminating project (even if the actual building occurs at the end of the unit). Provide time for optimizing the design.



acatena@princeton.edu