Curriculum by Design:

A Design Unit
Modeling the
Engineering Process
Using
Lego Building Blocks
The Mousetrap
Grade 3

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Summer 2004
Tufts University

Curriculum by Design:

A Design Unit Modeling the Engineering Process Using Lego Building Blocks

The Mousetrap Lessons for Grade 3

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Grade 3
Modeling the Engineering Process
Building a Mousetrap
Unit Overview

Lesson Goal:
Using the engineering design process, third grade students will build a kinetic sculpture Mousetrap out of Lego building blocks. The Mousetrap will have at least nine different parts with each of these parts using at least one motor, and either a touch sensor or a light sensor. The parts all connect together to produce a large moving sculpture whose final goal is to trap a Lego mouse. This lesson is modeled after the Mousetrap Game by Milton Bradley

The Process:
Day 1 (45 minutes):

The lesson is introduced in a large group discussion modeled after a new toy development team. Introduce the idea by explaining that the students work for of a toy company & have been asked to develop a Mousetrap Lego building toy. Have the game Mousetrap set up ahead of time in the classroom. If possible, have the children play the game before they start this design project. Begin by asking each child which part of the Mousetrap game they enjoy the most. Make connections to the simple machine in each part. The class is then instructed to brainstorm ideas on what kind of parts might be included in the mousetrap. All ideas are accepted and written out on chart paper. The goal is to have at least 25 different ideas to start with.

Day 2 (45 minutes):

Next the class brainstorms a list of criteria for each part of the mousetrap so that the ideas can be rated or crossed out. This list is written out on chart paper. Things to include are: must connect to other parts, must be easily attached & taken apart, must be sturdy, must have a motor and a sensor, must catch the mouse. etc. The class then rates the 25 different ideas for the project, crossing out ones that won't work.

The class is then divided into small groups of 2 or 3 students. Each small group is given one of the parts to design, draw, and write about. Each student should complete the recording sheet, "Designing a Better Mousetrap" to complete. This should be completed prior to building.

Each team will need to use Robolab to program their part of the mousetrap. Review the "Mindstorm for Schools Using Robolab" manual (in kits) for help on programming. The CEEO Curriculum Website- http://www.ceeo.tufts.edu/robolabatceeo/ is also helpful.

Days 3-9
Build, test & redesign. Unveiling of final project.
Time Frame:

Day 1	Introduce Lesson
Day 2	Complete "Designing a Better Mousetrap" Begin Building
Day 3	Building
Day 4	Building
Day 5	Attach Parts; Test; redesign
Day 6	Test & redesign
Day 7	Test & redesign
Day 8	Unveiling of Mousetrap; Party
Day 9	Evaluation & clean up & sorting

Materials:

- Lego Team Challenge kits for each group of 2-4
- Computer with Robolab, IR tower
- Mindstorm for Schools Using Robolab manual (in kits)
- Mousetrap Game by Milton Bradley
- Poster of the design process
- Various kind of balls (tennis, golf, marbles, etc.)
- Dominoes
- Twine, string or rope
- Extra Lego pieces for building, Lego people , Lego animals
- Paper, tape, cardboard, oaktag, markers

Building Tip

This building project works best with extra adults in the room to work with small groups of students. This is a great opportunity to get parent or other adult volunteers in the classroom.

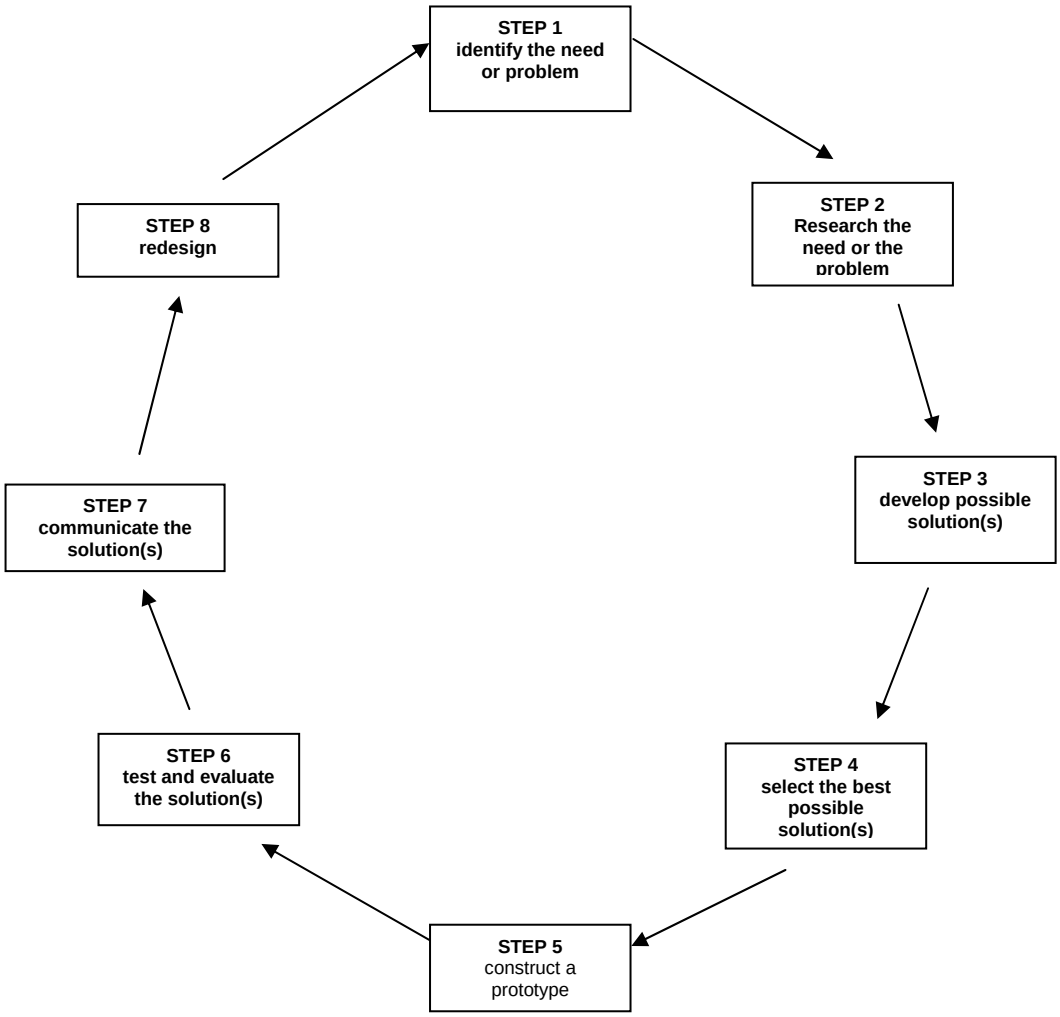
Resources:

- CEEO Curriculum Website – http://www.ceeo.tufts.edu/robolabatceeo/
- The Massachusetts Science and Technology/Engineering Curriculum Framework (May 2001) - http://www.doe.mass.edu/frameworks/current.html

Background Material About the Engineering Process

The Massachusetts Science and Technology/Engineering Curriculum Framework (May 2001) shows the Engineering Design Process below. They can be accessed at:
http://www.doe.mass.edu/frameworks/current.html

Figure 1
Steps of the Engineering Design Process



Steps of the Engineering Design Process

1. Identify the need or problem
2. Research the need or problem
   - Examine current state of the issue and current solutions
   - Explore other options via the Internet, library, interviews, etc.
3. Develop possible solution(s)
   - Brainstorm possible solutions
   - Draw on mathematics and science
   - Articulate the possible solutions in two and three dimensions
   - Refine the possible solutions
4. Select the best possible solution(s)
   - Determine which solution(s) best meet(s) the original requirements
5. Construct a prototype
   - Model the selected solution(s) in two and three dimensions
6. Test and evaluate the solution(s)
   - Does it work?
   - Does it meet the original design constraints?
7. Communicate the solution(s)
   - Make an engineering presentation that includes a discussion of how the solution(s) best meet(s) the needs of the initial problem, opportunity, or need
   - Discuss societal impact and tradeoffs of the solution(s)
8. Redesign

Overhaul the solution(s) based on information gathered during the tests and presentation

Grade 3
Modeling the Engineering Process
Building a Mousetrap
Lesson 1: The Problem

Lesson Objective:
- To identify, research and brainstorm possible solutions to the design challenge.

Learning Objective:
- To understand the steps in the engineering design process.

Time:
- Two 45-50 minute periods

Challenge:
- The class is part of a team whose challenge is to brainstorm various movable parts to a kinetic sculpture called the Mousetrap.

Materials:
- Mousetrap Game by Milton Bradley
- Poster of the design process

Vocabulary:
- engineer

Day 1:
Procedure
(Prior to the start of this lesson, have the children play the Mousetrap Game in small groups.)
In a large group discussion format, open the discussion by asking if anyone knows an engineer? Ask what an engineer does? Spend 5-10 minutes discussing what an engineer might do, what kinds of jobs use engineers.
Display the poster Figure 1 Steps in the Engineering Design Process. Explain that over the next 8-10 class periods the students will be working like engineers during the challenge. Go over each step on the poster, discussing what each step means.
Now discuss the Mousetrap game (you may want to have a game set up in front of the class as you talk about it). Find out who has had time to play the game. Ask individuals to share their favorite moving part of the game. If possible, make connections to the simple machines making up these favorite parts. Ask how they think an engineer might be involved when the game was first thought up.

Next set the scene for the challenge. Pretend that the class is a team of engineers who work for a toy company. They have been asked to design a new toy to be modeled after the Mousetrap Game. The new toy will be a kinetic sculpture made out of Lego building pieces. Explain that you (the teacher) have already completed step 1 & 2 of the Engineering Design Process:

Identify the need or problem

Research the need or problem

- Examine current state of the issue and current solutions
- Explore other options via the internet, library, interviews, etc.

As a class we are now going work on step 3:

Develop possible solution(s)

- Brainstorm possible solutions
- Draw on mathematics and science
- Articulate the possible solutions in two and three dimensions
- Refine the possible solutions

Using an easel to record ideas, brainstorm possible ideas for different parts of the mousetrap. Accept all ideas, encourage students to give a name to the part they are proposing. The goal is to have a list of 25 or possible parts of the mousetrap. Save these ideas for the next class.

Day 2:

Procedure

In a large group discussion review the list of possible parts of the Mousetrap using the easel lists from last class. Review what each part was suppose to do.

Explain that the next step in the engineering process is to select the best possible solutions to the problem. To do this, engineers set a list of critera for the parts final products. All parts must meet the criteria. Brainstorm with the students a list of criteria for their mousetrap. A sample list is included.

After creating a list of criteria, the class then should go through their original list of parts of the Mousetrap, crossing out ones that don't meet the criteria. The final list will be the ones that the teams can choose from to build.

Set up teams of students (teams of 2 work best if you have enough materials). Have each team talk about the different parts, deciding on 2-3 ones they would like to build. Allow 5-10 minutes for this discussion. As a large group decide which team will build which part, writing their names on the easel next to that part of the mousetrap.

Assessment:

- Teacher observations

Resources:

- CEEO Curriculum Website – http://www.ceeo.tufts.edu/robolabatceeo/
- The Massachusetts Science and Technology/Engineering Curriculum Framework (May 2001) - http://www.doe.mass.edu/frameworks/current.html

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Criteria for Parts of the Mousetrap

- Must connect to other parts
- Must be easy to attach
- Must be sturdy
- Must be easy to build
- Must have a motor to move something
- Must have a sensor
- Must trap the mouse

Background up for Teacher

The Massachusetts Science and Technology/Engineering Curriculum Framework (May 2001) shows the Engineering Design Process below. They can be accessed at:
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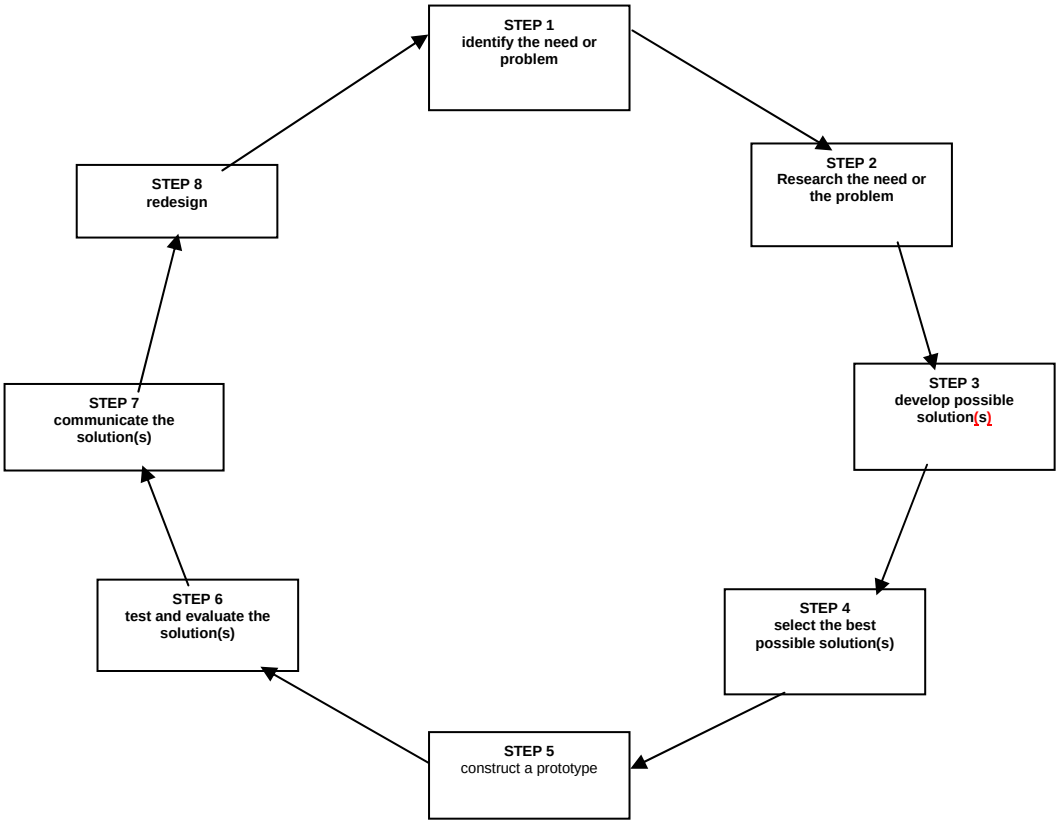

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8. Redesign

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Grade 3

Modeling the Engineering Process

Building a Mousetrap

Lesson 2: Building, Testing & Redesigning

Lesson Objective:

- To construct a prototype of a part of the Mousetrap Lego sculpture, including testing, evaluating and redesigning of the part.

Learning Objective:

- To have experience with and to understand the steps in the engineering design process.

Time:

- Three-Five 45-50 minute periods

Challenge:

- The class is part of a team whose challenge is to construct various movable parts to a kinetic sculpture called the Mousetrap.

Materials:

- Lego Team Challenge kits for each group of 2-4
- Computer with Robolab, IR tower
- Mindstorm for Schools Using Robolab manual (in kits)
- Designing a Mousetrap Sculpture Response Sheet
- Mousetrap Game by Milton Bradley
- Poster of the design process
- Various kind of balls (tennis, golf, marbles, etc.)
- Dominoes
- Twine, string or rope
- Extra Lego pieces for building, Lego people , Lego animals
- Paper, tape, cardboard, oaktag, markers

Vocabulary:

- Prototype
- Design
- Evaluate

Procedure

Open the class by asking the small groups to sit next to each other. Review the charts from last class in which each team agreed to build one of the parts of the Mousetrap Sculpture. Give each student a copy of the Designing a Mousetrap Sculpture Response Sheet. Explain that before any building starts, engineers draw and write their ideas down so that they can come back to them later in the project. Explain that the groups will be completing the sheets together, each writing their ideas down. When they have completed the response sheet, review it with the team and save them for later review.

Teams can begin building after that.

Plan on having a designated space for storage of the parts being built. During the building phase of the project it is important for the teacher to check in with each group at the start of the class. Some groups may need redirection or help in building some ideas. It is important half way through the project to have a check in with the whole class, setting clear time limits on finishing the project. At this time decide as a class the order of the parts of the mousetrap. The groups will need time to plan connections to the part before and the part after the one they are building. Set a designed time for all parts to be completed and for the presentation.

Assessment:

- Teacher observations
- Designing a Mousetrap Sculpture Response Sheet

Resources:

- CEEO Curriculum Website – http://www.ceeo.tufts.edu/robolabatceeo/
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Engineer: _____ Date: _____
Partner(s): _____

Designing a Mousetrap Sculpture

Our part of the mousetrap is called _____.
Draw what you are thinking:

Describe how it works:

_____
_____
_____
_____

How will it connect to the big Mousetrap?

_____
_____

How will it move?

_____
_____

We will be using a light or touch sensor (circle one).
Where is the sensor? _____What does the sensor do?

Grade 3

Modeling the Engineering Process

Building a Mousetrap

Lesson 3: Presenting a Movable Mousetrap

Lesson Objective:

- To present the Mousetrap Lego sculpture, including a connected part from each team.

Learning Objective:

- To have experience with and to understand the steps in the engineering design process.

Time:

- One-two 45-50 minute periods

Materials:

- Lego Team Challenge kits for each group of 2-4
- Computer with Robolab, IR tower
- Mindstorm for Schools Using Robolab manual (in kits)
- Mousetrap Assessment Response Sheet
- camera

Procedure

Day 1:

This class is for presentation of the final, Mousetrap sculpture. Allow 10-20 minutes for the groups to connect and test their part of the sculpture. Plan on running the Mousetrap many times. Assign a designed photographer.

Day 2:

Give each students a Mousetrap Assessment Response Sheet and their copy of the Designing a Mousetrap Sculpture Response Sheet. Allow 20-30 minutes for students to reflect on their learning and complete the assessment.

Plan on enough time for clean up.

Assessment:

- Teacher observations of workable Mousetrap
- Mousetrap Assessment Response Sheet

Resources:

- CEEO Curriculum Website – http://www.ceeo.tufts.edu/robolabatceeo/
- The Massachusetts Science and Technology/Engineering Curriculum Framework (May 2001) - http://www.doe.mass.edu/frameworks/current.html

Engineer: _____ Date: _____

Mousetrap Assessment

1. Compare your final product with the picture you drew at the start of this challenge. Complete the chart below:

How is the picture similar to the final product	How is the picture different from the final product

2. Look at the things your wrote in the different box above. Why did you build it **differently** from what you drew?

3. What would you have done **differently** so that you were not so rushed at the end?

4. If you had more time, what would you do with it?

5. What strategies did you use (or would you use) with your partners to help you work better together?

The Lego Mousetrap Challenge:

- To design and build a mousetrap sculpture that has at least nine movable parts, which are connected together.
- Each part must use
  - one motor and
  - one sensor.