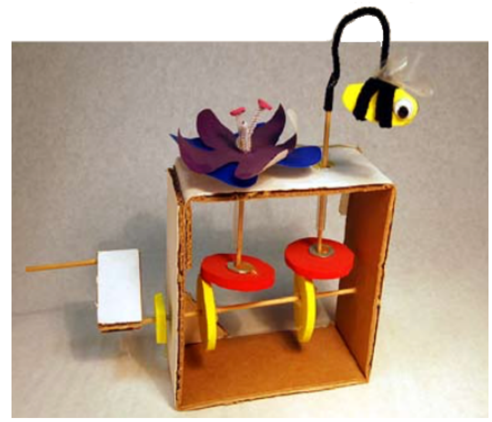
Kinetic Sculpture/ Simple Machines Project

5th grade Science, Art, and Library Science



The Kinetic Sculpture/Simple Machines curriculum has been a project-based collaboration between the 5th grade classroom teacher, the art teacher, the library/media specialist and the technology teacher. Students work in teams of two.

Objectives:

1. Students will know and be able to identify the engineering process and design.
2. Students will experience sketching and diagrams to describe a problem or solution to a problem.
3. Students will experience building a prototype/model, testing, and redesign of a specific product with a design challenge.
4. Students will discuss and compare natural and mechanical designs.

Resources and tools:

- Drinking straws
- 6”x6” cardboard boxes – cut off box flaps and cut boxes in half length-wise
- Hot glue gun and hot glue sticks
- Bamboo skewer sticks
- Thick (6mm) foamies (foam sheets)
- Nut or washer (optional – or you can make these out of extra foam)
- Materials for decoration: markers, feathers, pipe cleaners

Lesson 1: Intro to simple machines

The classroom teacher introduces the concept of simple machines during the first few science blocks of the unit. Students document and explain every day simple machines found in the kitchen on a worksheet (see below link) – teacher brings in: a can opener, knife, pizza cutter, etc. Students also watched and discuss a 10 minute video detailing the work of kinetic artist Reuben Margolin, which can be seen here: https://www.youtube.com/watch?v=dehXioMIKg0.

Simple Machine Kitchen Items Lesson plan found at: http://tryengineering.org/sites/default/files/lessons/simplekitchenmachines_2.pdf.

Lesson 2: Intro to engineering

Teachers set up an engineer "gallery walk" where students walk around classroom (in this case, our makerspace) and read about over 20 types of engineering. Students are then tasked with finding two types of engineering they were interested in and taking notes, and sharing out why there were interested in those careers.

Lesson 3: Simple machines in the world

The project officially kicked off with a field trip to the MIT Museum to explore a kinetic sculpture exhibit called "5,000 Moving Parts." After the gallery tour, students engaged in a hands-on workshop where they built their own kinetic sculptures led by museum education staff and two local kinetic artists. Comparable field trips might be to visit a local construction site, auto repair shop, or even a bicycle shop, where there are many examples of working simple machines at play. Ideally, students would have a chance to have a QnA with a professional artist, mechanic or engineer to discuss the application of simple machines in the world.

Lesson 4: eBook and brainstorming

Back in the art room, teachers share the eBook template (see Addendum 2) with each student via Google Drive, and students begin by taking a pre-assessment and brainstorming solutions to design problems based on "storage, shelter, or convenience" (based on the Massachusetts State Engineering and Design Standards – see Addendum 1).

Lesson 5: Building and testing

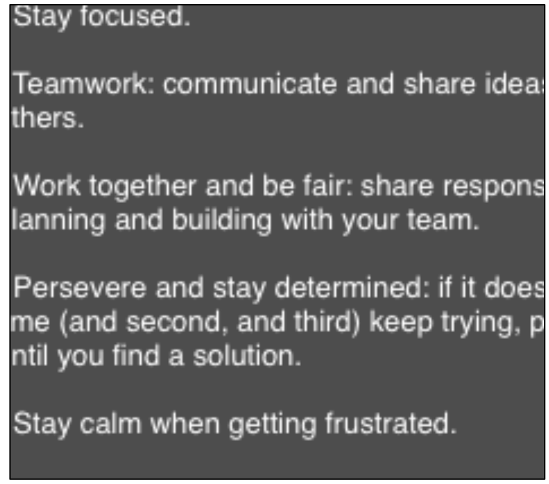
Students then progress through developing prototypes and testing their kinetic sculptures/simple machines, documenting their outcomes in their eBooks through writing prompts, images and video. The full building instructions can be found here: http://www.exploratorium.edu/pie/downloads/Cardboard_Automata.pdf.

Lesson 6: Sharing their designs

Once the simple machine/kinetic sculptures were finished, the final step of the project are student developed public service announcements (PSAs), facilitated by the library media specialist. Student teams work collaboratively to write storyboards and film their videos in front of the green screen, editing their videos on iMovie, and presenting their work to their peers and teachers.

Lesson 7: Reflection

Students reflect upon their work throughout the project. Before the project even begins, they identify things that will support them in both working together and doing their personal best, based on a prompt in their eBook. Reflection strategies also include an ongoing "How is the Weather" check in, specifically reflecting on teamwork and cooperation. The teacher sets up various cut outs on the floor based on different weather patterns: stormy, sunny, partly cloudy, etc" and students get up and stand on the weather pattern they most relate to by the end of the class block. Each student has an opportunity to explain his or her choice. An end of project reflection is embedded into the end of the eBook template, and the teacher also asks students to share out as a group: "What worked best for you? What would you have done differently if you had more time? What was a challenge for you and your partner?"


Stay focused.

Teamwork: communicate and share idea
thers.

Work together and be fair: share respons
lanning and building with your team.

Persevere and stay determined: if it does
me (and second, and third) keep trying, p
ntil you find a solution.

Stay calm when getting frustrated.

Excerpt from eBook.

Addendum 1

Massachusetts Science and Technology/Engineering Curriculum Framework October 2006 (Current standards being used by Cambridge Public Schools)

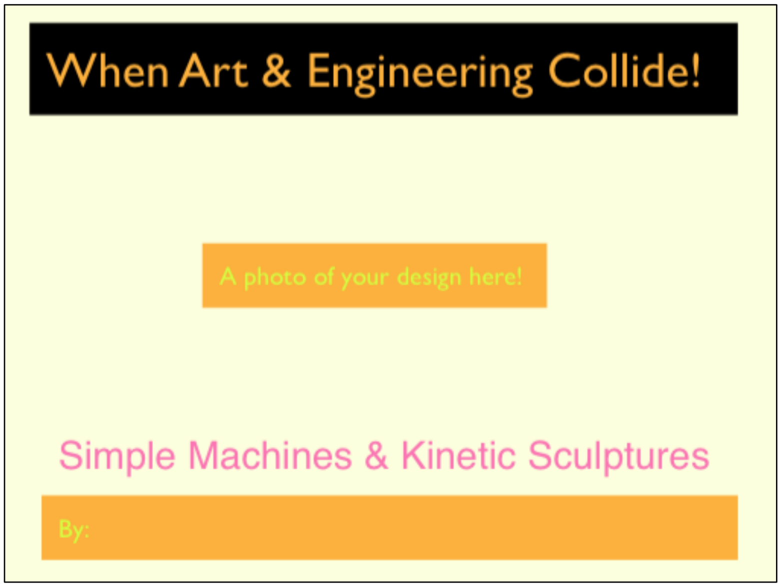
Grades 3–5

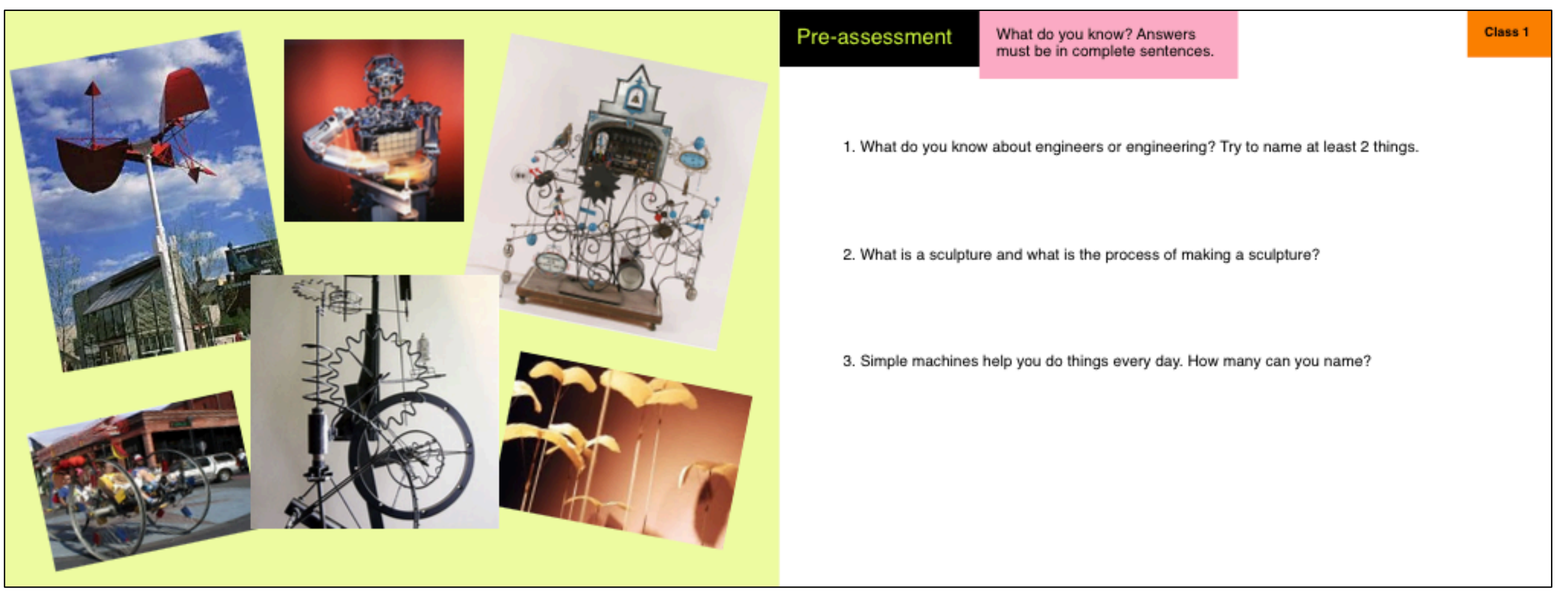
MATERIALS AND TOOLS
Central Concept: Appropriate materials, tools, and machines extend our ability to solve problems and invent.
1.1 Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
1.2 Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
1.3 Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge, gear, and lever.

ENGINEERING DESIGN
Central Concept: Engineering design requires creative thinking and strategies to solve practical problems generated by needs and wants.
2.1 Identify a problem that reflects the need for shelter, storage, or convenience.
2.2 Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
2.3 Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.
2.4 Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird’s wings as compared to an airplane’s wings.

Addendum 2

eBook Template, created in Book Creator.
The full template can be downloaded as an ePub at: http://bit.ly/klosxsw.





Class 1

Engineer:
An engineer is a person who designs and builds complex products, machines, systems, or structures. Engineers want to know how and why things work. They have scientific training that they use to make practical things.

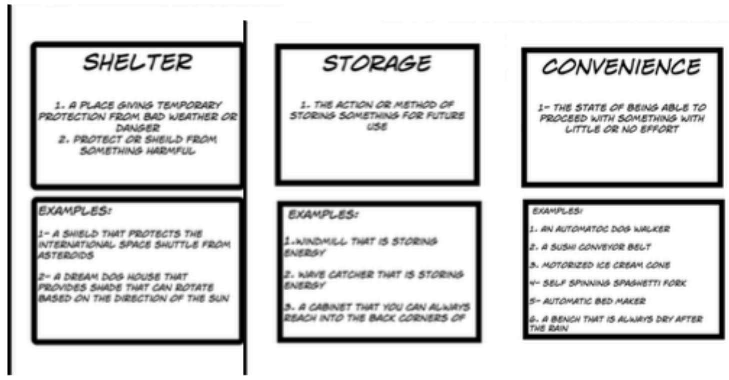
Activity

Take 10 minutes to walk around the room and learn about the different types of engineering. Then sit down and write (on a large index card): what kind of engineering do you find most interesting and why?

Class 1

Engineering and design challenge topics

Class 1



Field trip to MIT Museum

Class 2

Both fifth grades will walk to the nearby MIT museum where you will have a 1.5 hour workshop to explore kinetic art and engineering. Kinetic art is a form of art that depends on movement for its effect.

The current exhibit at MIT is called "5000 Moving Parts" and it "melds art, science, history and technology."

Here are a couple sculptures we might see on our visit:

John Douglas Powers
ialu; Wood, steel, plastic and electric motor; 2011.

Arthur Ganson, Untitled Fratile Machine.

Kinetic sculpture video

Class 3

"Reuben Margolin, a Bay Area visionary and longtime maker, creates totally singular techno-kinetic wave sculptures. Using everything from wood to cardboard to found and salvaged objects, Reuben's artwork is diverse, with sculptures ranging from tiny to looming, motorized to hand-cranked. Focusing on natural elements like a discrete water droplet or a powerful ocean eddy, his work is elegant and hypnotic. Also, learn how ocean waves can power our future. Learn more about Reuben at reubenmargolin.com."

We will watch this video as a class and discuss: http://m.youtube.com/watch?v=dehXioMIKg0.

1) What are some connections you see between the engineering process and the art making process?

2) What did you notice about the materials the artist uses in his sculptures?

Expectations

Class 1

Turn and talk with a partner. Then write down on the small index card:

What do you expect from yourself and from others to be the best engineer and artist you can be? Write down at least 3 specific expectations for yourself.

Expectations

Class 1

These are the most frequent expectations you choose as a class:

- Stay focused.

- Teamwork: communicate and share ideas. Listen to others.

- Work together and be fair: share responsibility for the planning and building with your team.

- Persevere and stay determined: if it doesn't work the first time (and second, and third) keep trying, problem solving until you find a solution.

- Stay calm when getting frustrated.

Identify a problem

Identify a problem that is related to: storage, shelter, or convenience. Who or what is your design helping?

Class 3

Design

Sketch a rough draft of your design on paper or book creator. Be as detailed as possible. Label all parts using the Book Creator drawing tools. Explain what each part does.

Class 4

Brainstorm

How will your design help solve this problem?

Design

Design kits: get your kit and design the outside of your structure using your choice of tissue paper and glue.

Class 5

Build

Construct the simple machine part of your sculpture (just the part that is inside the box with the straw, cams, and skewers.) Remember: if your machine isn't working, check in with 2 other people/teams before asking a teacher.)

Class 6

Place your video here!

Test & Evaluate

Build

Build the top part of your sculpture. Keep craftsmanship in mind as you design and build.

Class 7

How heavy is your sculpture? Explain why weight consideration matters in engineering/design. Does the weight of your kinetic sculpture affect how the simple machine works? Explain why and adjust as needed.

State Engineering & Design Standards

State Standard: Engineering & Design
• Identify a problem that reflects the need for shelter, storage, or convenience.
• Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
• Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.
• Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.

Big Idea:
Engineering design requires creative thinking and strategies to solve practical problems generated by needs and wants.

Essential/Guiding questions
1. What is the design engineering process and how is it used?
2. How do we design and test products that solve problems or fulfill needs that people have?

Lesson Content Goals
1. Students will know and be able to identify the engineering process and design
2. Students will experience sketching and diagrams to describe a problem or solution to a problem
3. Students will experience building a prototype/model, testing, and redesign of a specific product with a design challenge
4. Students will discuss and compare natural and mechanical designs

2008 by Michael Klentschy and Laurie Thompson, from Scaffolding Science Inquiry through Lesson Design

State Engineering Technology Standards: Materials and Tools

State Standard Being Addressed:
Engineering & Design: Materials and Tools (3 standards)
• Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
• Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
• Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge, gear, and lever.

Big Idea:
Appropriate materials, tools, and machines extend our ability to solve problems and invent.

Essential/Guiding questions
1. What is a simple machine and how does it work?
2. What tools do engineers use to build models/products safely?
3. What materials can be used to accomplish specific design task?

Definitions: Taken directly from draft *Next Generation Science Standards*
Technology is: any modification of the natural world made to fulfill human needs or desires
Engineering is: a systematic and often iterative approach to designing objects, processes and system to meet human needs and wants
Application of Science is: any use of scientific knowledge for a specific purpose, whether to do more science, to design a product, process, or medical treatment, to develop a new technology or to predict the impacts of human actions.

2008 by Michael Klentschy and Laurie Thompson, from *Scaffolding Science Inquiry through Lesson Design*

Mass State Art Standards

1.5 Expand the repertoire of 2D and 3D art processes, techniques, and materials with a focus on the range of effects possible within each medium, *such as: 2D – transparent and opaque media, wet, dry, stippled, blended, wash effects; relief printmaking effects; 3D – mobile and stabile forms, carved, molded, and constructed forms.*

1.6 Create artwork that demonstrates an awareness of the range and purpose of tools *such as pens, brushes, markers, cameras, tools and equipment for* ***printmaking*** *and* ***sculpture,*** *and computers.*

1.7 Use the appropriate vocabulary related to the methods, materials, and techniques students have learned and used in grades PreK–8.

1.7 Maintain the workspace, materials, and tools responsibly and safely.

2.11 For space and composition, create unified 2D and 3D compositions that demonstrate an understanding of balance, repetition, rhythm, scale, proportion, unity, harmony, and emphasis. Create 2D compositions that give the illusion of 3D space and volume.

3.7 Create artwork that shows knowledge of the ways in which architects, craftsmen, and designers develop abstract symbols by simplifying elements of the environment

4.4 Produce work that shows an understanding of the concept of craftsmanship.

4.5 Demonstrate the ability to describe preliminary concepts verbally; to visualize concepts in clear **schematic layouts;** and to organize and complete projects.

4.6 Demonstrate the ability to articulate criteria for artistic work, describe personal style, assess and reflect on work orally and in writing, and to revise work based on criteria developed in the classroom.

4.7 Maintain a portfolio of sketches and finished work.

4.8 Create and prepare artwork for group or individual public exhibitions.

Engineering Glossary

Draw a diagram that illustrates the definition for each term.

Ongoing

Ramp:
A slope or inclined plane for joining two different levels, as at the entrance or between floors of a building.

Wheel:
A circular object that revolves on an axle and is fixed below a vehicle or other object to enable it to move easily over the ground.

Cam:
A projection on a rotating part in machinery, designed to make sliding contact with another part while rotating and to impart reciprocal or variable motion to it.

Pully:
A pully is a simple machine that uses grooved wheels and a rope to raise, lower or move a load.

Axle:
A rod or spindle (either fixed or rotating) passing through the center of a wheel or group of wheels.

Inclined Plane:
A slanted surface connecting a lower level to a higher level.

Lever:
A stiff bar that rests on a support called a fulcrum, which lifts or moves loads.

Wedge:
An object with at least one slanting side ending in a sharp side, which cuts materials apart.

Screw:
An inclined plane wrapped around a pole which holds things together or lfts materials.

Post assessment

Final class

1) What is an engineer?

2) How do engineers decide what they need to build?

3) Why is experimentation important for engineers?

4) How is the engineering process similar to the art making process?

Reflection

Answer these questions on video with your partner:

Final class

1) What went well for your team? For example: sketching, the commercial, building...explain why this felt successful.

2) What was the most challenging part of this project? Explain what was challenging. Did you overcome specific challenges?

3) If you could do it again, what would you change about your design?

4) How did this project make you think differently about engineering and art?

Place video here.

Commercial

Create a short video (between 1-2 minutes) that will serve as the "commercial" for your new design/art piece. Include why it is valuable, what it does, and how it does it.

With Ms. Moynihan

Place video here.