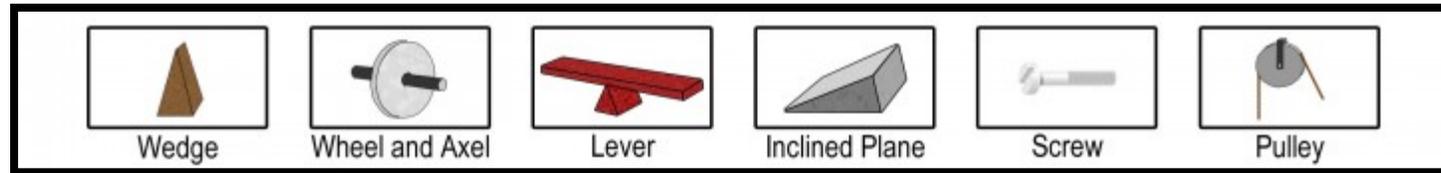


Colleen Hinrichsen  
The Arts in STEM  
Hinrichsen Integrated Art STEM Lesson Plan FINAL  
July 30, 2018



*The Art of*

# Simple Machines

**TOPIC:**

Simple Machines

**GRADE LEVEL:**

Grade 6

- INTENDED USE: STEAM Class (in conjunction with Project Based Learning Teams)

**TIME:**

Six Class Periods – (in addition to PBL TEAM classes - Science, Math, Library, and ELA teachers)

- As the STEAM Teacher, I will see classes once-a-week for 40 minutes.
- Students will study given standards more in-depth with classroom teachers, while the lesson(s) in STEAM class will provide students with the opportunity to apply the knowledge they gain from classroom teachers.

# STANDARDS:

|  |   |  |  |
|--|---|--|--|
| <b>S</b><br>Science  | <b>NGSS: MS.Forces and Interactions</b><br>MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.   |  |  |
|  | <b>Science &amp; Engineering Practices</b><br>Constructing Explanations and Designing Solutions <ul style="list-style-type: none"> <li>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</li> <li>Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)</li> </ul> Connections to Nature of Science <ul style="list-style-type: none"> <li>Scientific Knowledge is Based on Empirical Evidence</li> <li>Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)</li> </ul> | <b>Disciplinary Core Ideas</b><br>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)  | <b>Crosscutting Concepts</b><br>Stability and Change <ul style="list-style-type: none"> <li>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)</li> </ul>  |
| <b>PA Core Standards:</b> 3.2 Physical Sciences: Chemistry and Physics<br>(Eligible Content) - S7.C.3.1.3 Explain the mechanical advantages of simple machines.                            |   |  |  |
| <b>T</b><br>Technology   | <b>PA Standards:</b> 3.2 Technology and Engineering Education<br>3.4.6.B4. Demonstrate how new technologies are developed based on people’s needs, wants, values, and/ or interests.  |  |  |
| <b>E</b><br>Engineering  | MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.   |  |  |
|  | <b>Science &amp; Engineering Practices</b><br>Asking Questions and Defining Problems <ul style="list-style-type: none"> <li>Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)</li> </ul>   | <b>Disciplinary Core Ideas</b><br>ETS1.A: Defining and Delimiting Engineering Problems <ul style="list-style-type: none"> <li>The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)</li> </ul> | <b>Crosscutting Concepts</b><br>Influence of Science, Engineering, and Technology on Society and the Natural World <ul style="list-style-type: none"> <li>The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)</li> </ul> |
| <b>NGSS: MS.Engineering Design</b><br><b>PA Standards:</b> 3.4 Technology and Engineering Education<br>3.4.6.D1. Apply a design process to solve problems beyond the laboratory classroom. |   |  |  |

|   |   |
|---|---|
| <p style="text-align: center;"><b>A</b><br/>Art</p>                           | <p><b>National Art Core Standards:</b><br/>Media Art - Anchor Standard 4: Select, analyze, and interpret artistic work for presentation.</p> <ul style="list-style-type: none"> <li>MA: Pr4.1.6 Validate how integrating multiple contents and forms can support a central idea in a media artwork, such as media, narratives, and performance.</li> </ul> <p>Visual Art - Anchor Standard 1: Generate and conceptualize artistic ideas and work.</p> <ul style="list-style-type: none"> <li>VA:Cr1.1.6a Combine concepts collaboratively to generate innovative ideas for creating art.</li> </ul> <p><b>PA Standards:</b> 9.1 Visual Arts<br/>9.1.8.E. Communicate a unifying theme or point of view through the production of works in the arts.</p> |
| <p style="text-align: center;"><b>M</b><br/>Math</p>                          | <p><b>PA Core: Standards for Mathematical Practice (Focus Practices)</b></p> <ul style="list-style-type: none"> <li>Make sense of problems and persevere in solving them.</li> <li>Construct viable arguments and critique the reasoning of others.</li> <li>Attend to Precision</li> </ul>   |
| <p style="text-align: center;"><b>E</b><br/>English<br/>Language<br/>Arts</p> | <p><b>PA Core:</b> 1.4 Writing<br/>CC.1.4.6.G. Write arguments to support claims.<br/>CC.1.4.6.H. Introduce and state an opinion on a topic.</p>  |

**ENGAGING CONTEXTS** – How can we solve a problem in our school using simple machines? What do we need to consider to make our invention something people would want to buy?

Students will watch the PBS Video, “Science Trek: Simple Machines” to see how simple machines are used in real life. Students will use Sketchnoting in small groups to show the different examples of simple machines in real life.

- Teacher will model Sketchnoting process as students take notes on their chart papers.
- Each student in the group will be in charge of a different type of simple machine and will take sketchnotes about real life examples of it.
- Students share and discuss sketchnotes to see if they agreed on how they categorized the example real life simple machines.

Once everyone experienced the above phenomena (video + discussion), the challenge will be presented. Identify a problem in the school, and create an invention to solve the problem using at least one type of simple machine. The invention will be presented in a “Shark Tank” style way, so students will need to create a solid product, make it attractive to consumers, and create marketing to explain how it works and encourage “sharks” to invest.

## **JUSTIFICATION**

Through this project, students will create a design that will solve a problem in our school. This lesson plan is the glue for the integration of science, technology, engineering, art, math, and English language arts. The PBL nature of the unit allows for an authentic application of the standards.

- Science: Students will use understandings from science about forces and motion to identify problems and create solutions.
- Technology: Students will use multimedia to create the marketing presentation.
- Engineering: Students will use the NASA engineering design process to create a model of their designs.
- **Art: Students will create a multimedia presentation to the “Shark Tank” that will attract investors. The model of their design will be included, and they will choose various forms of art to include that help to showcase the characteristics of their design. For example: both stop motion animation and digital animation can be used to show how the simple machine works or how it solves the problem. By creating an animation, frame by frame, the students will thoroughly demonstrate their understanding of how their simple machine can apply principles of motion and design previously learned in their science unit.**
- Math: Students will apply the standards for mathematical practice throughout the process.
- ELA: Students will be required to write the “voice over” part of the multimedia presentation to the “Shark Tank”.

## **MEASURABLE OBJECTIVES**

Students will:

- Analyze a problem around the school that could be solved by an invention using a simple machine.
- Following the given engineering design process, create both physical and virtual models of the design that meet a list of criteria and constraints.
- Write an explanation of how the invention works, and describe how the invention solves a problem in the school.
- Create a multimedia presentation that includes three or more art forms to both describe how the invention works and attract “investors” for their product.

## LESSON PROCEDURE

|   |   |
|---|---|
| <p><b>E</b></p> <p>Engage</p> <p><u>TIME</u><br/>One<br/>40-min.<br/>class</p>    | <p>Day1 - Students will:</p> <ul style="list-style-type: none"> <li>• With classroom teachers, watch the PBS Video, “Science Trek: Simple Machines” to see how simple machines are used in real life (to prepare to speed through video again to do the following activities).</li> <li>• Use Sketchnoting in small groups to show the different examples of simple machines in real life as video replays.             <ul style="list-style-type: none"> <li>○ Teacher will model Sketchnoting process as students take notes on their chart papers.</li> <li>○ Each student in the group will oversee a different type of simple machine and will take sketchnotes about real life examples of it.</li> </ul> </li> <li>• Share and discuss sketchnotes to see if they agreed on how they categorized the example real life simple machines.</li> <li>• Restate the challenge that is presented by the teacher and that is listed on the Project Challenge Overview page.             <ul style="list-style-type: none"> <li>○ <b>CHALLENGE:</b> Identify a problem in the school and create an invention to solve the problem using at least one type of simple machine. The invention will be presented in a “Shark Tank” style way, so students will need to create a solid product, make it attractive to consumers, and create marketing to explain how it works and encourage “sharks” to invest.</li> </ul> </li> </ul> |
| <p><b>E</b></p> <p>Explore</p> <p><u>TIME</u><br/>Two<br/>40-min.<br/>classes</p> | <p>Day 2 - Students will:</p> <ul style="list-style-type: none"> <li>• In groups, identify at least one problem in the school (ASK),             <ul style="list-style-type: none"> <li>○ Brainstorm ideas for solving that problem (IMAGINE).</li> <li>○ Choose one idea and begin to research ways the problem can be solved using at least one simple machine (PLAN).</li> </ul> </li> <li>• [FORMATIVE ASSESSMENT] Exit Ticket: In Engineering Design Process (EDP) notebooks, write the final problem. Show the ideas of how the problem could be solved.</li> <li>• <i>Note: At this stage, students will have the opportunity to go back to their classrooms and research (given time in library class). They will also work during science time to test some of their ideas.</i></li> </ul> <p>Day 3 - Students will:</p> <ul style="list-style-type: none"> <li>• Finish the first iteration of the design sketch and assess materials that will be used in the model construction (PLAN).</li> <li>• Build, test, and redesign the model. (CREATE, EXPERIMENT, IMPROVE).</li> <li>• Make the final model look appealing for investors (visual art).</li> <li>• [FORMATIVE ASSESSMENT] Exit Ticket: Engineering Design Process (EDP) notebooks show the process of redesigning, testing, and improving (with photos).</li> </ul>   |

|  |  |
|--|--|
| <p><b>E</b><br/>Explain</p> <p><u>TIME</u><br/>Three<br/>40-min.<br/>classes</p> | <p>Day 4 &amp; 5 - Students will:</p> <ul style="list-style-type: none"> <li>• Write the voice over for the explanation of: <ul style="list-style-type: none"> <li>○ What the problem is around the school,</li> <li>○ How the product works (including the simple machine),</li> <li>○ How the product solves the problem in the school.</li> <li>○ Why people should buy the product.</li> </ul> </li> <li>• Each student in the group will have a role in choosing or creating one of the works of art that is in the multimedia presentation (combined video). Group members choose from: <ul style="list-style-type: none"> <li>○ Stop Motion Animation – Students will use stop motion animation to show how the product works or to demonstrate how the problem is solved.</li> <li>○ Digital Animation (DoInk Animation App or Scratch.mit.edu) – Students will use digital animation to show how the product works or to demonstrate how the problem is solved.</li> <li>○ Background music – created w/ GarageBand app to match the different moods in the video (from problem to solution).</li> <li>○ Drama and/or Dance – Students will perform a brief skit and/or dance to help combine the animations and explain the product in a persuasive way to the “Shark Tank” panel.</li> </ul> </li> <li>• The group will work together to piece together the video clips and produce the movie with voice over.</li> </ul> <p>Day 6 – Students will:</p> <ul style="list-style-type: none"> <li>• [SUMMATIVE ASSESSMENT] Present the group’s model (video) to the class as if they are presenting to a “Shark Tank” of investors.</li> </ul> |
| <p><b>E</b><br/>Extend</p>   | <p>Students may:</p> <ul style="list-style-type: none"> <li>• Brainstorm ways the invention would solve a problem outside the school.</li> <li>• If necessary, think of ways the invention could be modified to solve problems outside of school (i.e., at a nursing home).</li> <li>• Playing “devil’s advocate”, create a list of questions about possible design flaws in the invention.</li> <li>• Using Hummingbird robotics kits to make the simple machine move on its own.</li> </ul>  |
| <p><b>E</b><br/>Evaluate</p>   | <p>Students will:</p> <ul style="list-style-type: none"> <li>• [SUMMATIVE ASSESSMENT] Individually self-assess the group’s project based on the given Student Self-Assessment Checklist as the teacher uses the Project Assessment Rubric.</li> <li>• As a whole class, complete an Experience Assessment <ul style="list-style-type: none"> <li>○ Complete “Rose, Thorn, Bud Activity” &amp; turn into the “Experience Diagram” <ul style="list-style-type: none"> <li>▪ Fill out pink sticky notes – for “Rose” positive experiences</li> <li>▪ Fill out blue sticky notes – for “Thorn” negative experiences</li> <li>▪ Fill out green sticky notes – for “Bud” experiences that have potential</li> <li>▪ As a class, place sticky notes in the “Experience Diagram” where they belong at specific durations of the project (i.e., beginning, middle, end).</li> <li>▪ Discuss ways the project could be better in the future.</li> </ul> </li> </ul> </li> </ul> <p>PBL Team Teachers will:</p> <ul style="list-style-type: none"> <li>• Complete the same process as students with the “Rose, Thorn, Bud Activity” &amp; turn into the “Experience Diagram”</li> </ul>   |

## **ASSESSMENT/RUBRIC**

Formative Assessments (informal checks) take place throughout.

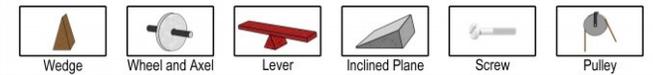
**Project Assessment Rubric (Page 8)** will be completed during group presentations (Week 6).

**Student Self-Assessment Checklist (Page 9)**

## **LESSON MATERIALS**

- Video (PBS) “Science Trek: Simple Machines” - <https://www.pbs.org/video/science-trek-simple-machines/>
- Large pad of paper for each group + Markers for Sketchnoting
- Project Challenge Overview Page (Page 10)
- Sample simple machines around the room with labels so students can test them or use them as models.
- Research Resources (district subscriptions – World Book Online, PowerLibrary, Discovery Education)
- NASA Engineering Design Process poster (displayed)
- Group Engineering Design Process Notebooks or OneNote Group Notebooks
- Makerspace Supplies
- iPads
- OneNote App – for Engineering Design Process Notebook (photos + typing)
- Stop Motion Studio App
- DoInk Animation App
- Garage Band App
- Green Screen App
- iMovie
- Hummingbird Robotics Kit
- Scratch – [scratch.mit.edu](https://scratch.mit.edu)
- Poster Board
- Pink, Blue, Green Sticky Notes
- Chart Paper & Marker

*The Art of*  
**Simple Machines**



**PROJECT ASSESSMENT RUBRIC**

| <p><b>Group Members</b></p> <p>1.</p> <p>2.</p> <p>3.</p> <p>4.</p> | <b>3</b>  | <b>2</b>   | <b>1</b>  |
|---|---|--|---|
| <b>Solving a Problem</b>  | Identified a problem in the school and clearly explained a solution to the problem.   | Either identified the problem or explained the solution to the problem, but somewhat unclear.  | Did not clearly identify the problem or explain the solution.   |
| <b>Simple Machines</b>  | At least one simple machine was used in the invention, and the explanation of how it works was clear.   | At least one simple machine was used in the invention, but the explanation of how it works was somewhat unclear.   | At least one simple machine was used in the invention, but there was no explanation of how it works.  |
| <b>Arts Integration</b>   | The invention design consists of contributions from all group members, and the multimedia presentation (video) contains at least three art forms.   | The invention design consists of contributions from multiple group members, and the multimedia presentation (video) contains at least two art forms.   | The invention design consists ideas from only one group member, and/or the multimedia presentation (video) contains less than two art forms.                                  |
| <b>Engineering Design Notebook</b>                                  | Thoroughly documents the following areas of the design process: <ul style="list-style-type: none"> <li><input type="checkbox"/> Plan (diagram(s) &amp; notes)</li> <li><input type="checkbox"/> Create (labels materials used for each part)</li> <li><input type="checkbox"/> Experiment (records problems encountered)</li> <li><input type="checkbox"/> Improve (notes solutions to problems)</li> </ul> | Documents most of the following areas of the design process: <ul style="list-style-type: none"> <li><input type="checkbox"/> Plan (diagram(s) &amp; notes)</li> <li><input type="checkbox"/> Create (labels materials used for each part)</li> <li><input type="checkbox"/> Experiment (records problems encountered)</li> <li><input type="checkbox"/> Improve (notes solutions to problems)</li> </ul> | Fails to document the design process or missing engineering design notebook   |
| <b>Presentation</b>   | Presentation includes the problem identified in school, a clear explanation of how the invention works, and a description of how the invention solves the problem.  | Presentation includes partial information about the problem identified in school, a clear explanation of how the invention works, and a description of how the invention solves the problem.   | The presentation fails to include the problem identified in school, a clear explanation of how the invention works, or a description of how the invention solves the problem. |

**Name:**

**Group:**

*The Art of*

# Simple Machines



## SELF-ASSESSMENT CHECKLIST

### Solving a Problem

- We explained **one problem in school** that can be solved by our invention.
- Optional: We described how our invention could solve other problems outside of school.

### Simple Machines

- We used **at least one** simple machine in our design.
- Our presentation **accurately explains** how the invention works with a focus on the simple machine(s).

### Arts Integration

- For our invention's artistic design, we combined ideas collaboratively to generate innovative ideas.
- Our multimedia presentation (video) contains at least three art contents/forms (choose from):
  - Stop Motion Animation
  - Digital Animation
  - Background Music
  - Drama
  - Dance
  - Other (approved by teacher)

### Engineering Design Notebook

Our notebook thoroughly documents these parts of the Engineering Design Process:

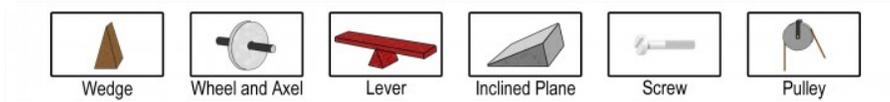
- Plan (We used detailed diagram(s) & notes in all iterations.)
- Create (We labeled materials used for each part of our design.)
- Experiment (We recorded problems encountered when testing the design.)
- Improve (We noted solutions to problems.)

### Presentation

- Our presentation explains the problem we identified in school.
- Our presentation shows and explains how the invention works.
- Our presentation describes how the invention solves the problem.

# *The Art of* **Simple Machines**

## **PROJECT CHALLENGE OVERVIEW**



|                       |  |  |  |  |
|-----------------------|--|--|--|--|
| <b>Group Members:</b> |  |  |  |  |
|-----------------------|--|--|--|--|

### **THE CHALLENGE**

- ✓ Your group is responsible for identifying a problem in the school and creating an invention to solve that problem.
- ✓ You will create a video that contains at least three art forms to present your design to a “Shark Tank” of investors who may want to buy your product.
- ✓ The group must keep use the OneNote Engineering Design Notebook to document (in detail) these parts of the design process:
  - Plan – Include detailed diagram(s) & notes in all iterations
  - Create - Label materials used for each part of our design
  - Experiment - Record problems encountered when testing the design
  - Improve - Note solutions to problems
- ✓ Your physical model will include at least one simple machine.
- ✓ Your final video will be produced using iMovie.