

Machine Learning & Catapults – Teacher Guide

Lesson Summary:	Lesson Objectives:
Students are introduced to the concept of machine learning and the iterative engineering design process through the design, construction, and testing of a catapult. They will then experiment with the catapult in order to develop a mathematical model that can be used to make predictions of how the system will perform. Curriculum Connections: - Physics: 2D-Motion; Projectile Motion - Freshman Computing: Predictive Analysis - Statistics: Plotting Trendlines; Modelling	Students will be able to- - Define machine learning and provide real world applications for where it is used. - Describe the engineering design process and apply it to the design and construction of a catapult. - Develop a mathematical model that describes the performance of the catapult. - Create an algorithm based on the performance analysis of the catapult.

Essential Questions/Hook to Prompt Discussion:

- Have you ever wondered how apps like Siri or machines like Alexa learn from their users?
- How is iteration used to improve ideas and processes and make life better?

Teacher Notes:

- Students will work through the [Machine Learning/Catapult Interactive Student Workbook](#) slideshow presentation.
 - When assigning this lesson on Google Classroom, first make a copy of the slides to save within your Google Drive, then make a copy for each student.
 - Alternatively, download the file as a powerpoint and rename.
- The slideshow is designed in order to be interactive, this way students can type directly on the slides.
- Each slide of the presentation provides an activity for students to complete (reading, watching a video, inserting images, answering questions, etc.)
- Students may work individually or within groups.

Assessment:

- Informal assessments can be completed by looking at the interactive slides within the slideshow, especially within the final reflection slide.
 - An **answer key** for the interactive student slides can be given upon teacher request.
- Assessments outside the interactive slides are suggested below as Pre and Post Work Ideas.

Pre Work Ideas:

- [Machine Learning intro assignment as Google Form](#) - Note: teacher may make a copy of this form by clicking on the three dots on the right hand side of the screen to access the editing and sharing options.
- [Machine Learning intro assignment Google Doc](#)

Pre Work- Introduction to the Engineering Design Process:

- Students should complete the [Engineering Design Process Introduction Activity](#) before beginning the lab
 - NOTE: This activity only needs to be completed before the student's **first** ET lab, not repeated for every lab

Post Work Ideas:

- Summary Assignment: [Prototype Evaluation and Introduction to Flowchart Algorithms](#)
- Applied Assignment: [Data Analysis and Graphing in Google Sheets/Excel](#)
- NOTE: When assigning these lessons on Google Classroom, first make a copy of the document to save within your Google Drive, then make a copy for each student. Alternatively, download the file as an Excel or Word document and rename.

Extension Activities:

- Play [Quizlet](#) or [Kahoot](#) to review concepts concerning catapults
- Read this [article](#) or watch the [video](#) to learn more about the physics of catapults
- Read this [article](#) to learn about machine learning and artificial intelligence

Engineering Design Standards:

- **Next Generation Science Standards:**

HS-ETS1-3 Engineering Design: Evaluate a solution to a complex problem based on prioritized criteria and trade-offs that account for a range of constraints.

HS-PS3-3 Energy: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

- **Computer Science Standards:**

3A-AP-13: Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.

3B-AP-08: Describe how artificial intelligence drives many software and physical systems.