



PUMPKIN CHUNKIN' DESIGN CHALLENGE

CURRICULUM OUTLINE



OVERVIEW:

Through Pumpkin Chunkin', students are faced with a real-world design challenge and progress through the engineering design process to create a pumpkin launching device for competition. The project is focused around the essential question: How can we use the design process to solve an engineering problem?

LESSON FORMAT:

Lessons and objectives were generated with Bloom's taxonomy in mind, and material is scaffolded to make it accessible to students. The Bloom's level reached in the lesson is indicated at the end of each individual lesson plan. Most lessons aim to reach "application" or above to ensure deep student understanding.

Lesson plans are formatted using the 5-E structure. All lessons follow a similar organization:

1. **ENGAGE:** Lessons begin with a 5-minute drill. An engaging question or two is posed on the board for students to begin answering from the moment they enter the classroom.
2. **EXPLORE:** Students brainstorm, sketch and build as they progress through the 12 stages of the engineering design process.
3. **EXPLAIN & ELABORATE:** Students are provided definitions and clarification for new vocabulary. Class discussion is used for the group to come to consensus on major design decisions. In some lessons, students will be challenged to apply new vocabulary/skills by generating a product for assessment (e.g. design briefs, data tables). Examples and rubrics are provided for students. These examples and rubrics model what is expected in the product.
4. **EVALUATE:** Lessons end with a 5-minute exit ticket that assesses students' understanding of a key concept or vocabulary word presented in class, or provided time for reflection on the design process.

A breakdown of the content presented, the recommended timeframe and the formative/summative assessment (if applicable) for each lesson is detailed below:

| LESSON | OVERVIEW | ASSESSMENT/ PRODUCT | TIMEFRAME |
|--|--|------------------------|---------------------|
| Lessons 1 and 2: Defining the Problem and Brainstorming | Students are introduced to the Pumpkin Chunkin' design challenge, the competition rules and the evaluation process. Students begin generating initial design ideas through individual brainstorming. Students are introduced to pictorial and multi-view sketches. | | 1 - 2 class periods |
| Lesson 3: Research and Generate Ideas | Students research different launching devices in order to generate new ideas for their design solution. | | 1 - 2 class periods |
| Lesson 4: Identifying Criteria and Constraints | Students identify the criteria and constraints for the Pumpkin Chunkin' design challenge. Students write a design brief outlining a problem statement, design statement, constraints and deliverables for the design challenge. | Design brief* | 1 - 2 class periods |

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| Lesson 5: Exploring Possibilities | Students revisit pictorial and multi-view sketches. Students generate drawings of pumpkin launchers incorporating ideas from the initial brainstorming session and research gathered. Students participate in a “stepladder method” of brainstorming in order to decide which design ideas should be pursued further. | | 1 – 2 class periods |
| Lesson 6: Select an Approach | Students create a decision matrix, which they use to evaluate the design ideas they identified as worth pursuing further. Students identify which pumpkin launcher design will proceed to the development stage. | Decision matrix | 2 – 3 class periods |
| Lesson 7: Develop a Design Proposal | Students specify the materials, dimensions and construction process required for building a model or prototype of their pumpkin launcher. Students generate a design proposal consisting of CAD drawings (optional), text descriptions and/or hand drawings. | Design proposal* | 2 – 3 class periods |
| Lesson 8: Making a Model or Prototype | Students construct a model and/or prototype which will be used to test and evaluate the pumpkin launcher | Pumpkin launcher model or prototype | 3 – 5 class periods |
| Lesson 9: Test and Evaluate | Students determine how they will assess their pumpkin launcher’s precision and accuracy. Students collect and display data in organized tables. Students evaluate whether their design is meeting the criteria and constraints identified earlier in the design process. | Data Table* | 1 – 3 class periods |
| Lesson 10 and 11: Refining the Design and Creating or Making | Students use the data they collected in Lesson 8 to evaluate the quality of their pumpkin launcher design. Students propose a rationale for modifications to their design. Students modify their machine. | | 1 – 3 class periods |
| Lesson 12: Communicating the Process and Results | Students communicate their design process by creating a final design document containing all necessary charts, graphs, calculations, CAD drawings, hand drawings modeling, simulations and text descriptions that, taken as a whole, represent their final design. | Final design document website or video*^ | 1 – 3 class periods |
| TOTAL TIME FOR MINI UNIT | | | 14 – 28 class periods |

* Indicates a grading rubric is provided for the assignment

^ Indicates the summative assessment for the project

CONNECTIONS TO DISTRICT, STATE AND NATIONAL STANDARDS

Pumpkin Chunkin’ curriculum has been designed to align with both ITEA and NGSS standards. Standards addressed include:

ITEA, STL 11-M. Identify the design problem to solve and decide whether to address it.

ITEA, STL 11-N. Identify criteria and constraints and determine how these will affect the design process.

ITEA, STL 11-O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.

ITEA, STL 11-P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.

ITEA, STL 11-Q. Develop and produce a product or system using a design process.

ITEA, STL 11-R. Evaluate final solutions and communicate observations, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

NGSS, HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

NGSS, HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

A breakdown of standards addressed through this project by individual lesson is provided below.

| ITEA AND NGSS STANDARDS ADDRESSED IN INDIVIDUAL LESSONS | | | | | | | | |
|--|---------------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|
| LESSON | STANDARDS ADDRESSED | | | | | | | |
| | ITEA, STL 11-M | ITEA, STL 11-N | ITEA, STL 11-O | ITEA, STL 11-P | ITEA, STL 11-Q | ITEA, STL 11-R | NGSS, HS-ETS1-2 | NGSS, HS-ETS1-3 |
| Lesson 1 & 2: Defining the Problem and Brainstorming | X | | | | X | | X | |
| Lesson 3: Research and Generate Ideas | X | | | | X | | X | |
| Lesson 4: Identifying Criteria and Constraints | X | X | | | X | | X | X |
| Lesson 5: Exploring Possibilities | | X | | X | X | | X | X |
| Lesson 6: Select an Approach | | X | | X | X | | X | X |
| Lesson 7: Develop a Design Solution | | | X | | X | X | X | |
| Lesson 8: Making a Model or Prototype | | | X | X | X | | | |
| Lesson 9: Test and Evaluate | | | X | | X | | X | X |
| Lessons 10 & 11: Refining the Design and Creating the Final Solution | | | X | | X | | X | X |
| Lesson 12: Communicating the Process and Results | | | X | | X | | X | X |

CONNECTIONS TO DISTRICT HIGH SCHOOL TECHNOLOGY EDUCATION SLO:

Students' final design documentation (Lesson 12) and/or performance throughout the design challenge can be evaluated using the HCPSS Engineering Design Rubric to provide the midyear or final data point for the Tech Ed HS SLO.

LITERACY STRATEGIES AND IEP MODIFICATIONS:

Many lessons provide students a writing frame and/or graphic organizer in which to develop their thoughts. Rubrics and exemplars are provided for most formative assessments throughout the unit. Some lessons incorporate text annotation and encourage teachers to model and/or use "Think-Alouds" to help students pull out key points from the text. Vocabulary is introduced on a "need to know" basis, and is utilized throughout the lesson as appropriate to encourage vocabulary retention. Modified handouts are provided for students with IEPs who require additional support. These handouts are marked (MOD) for easy identification by teachers.