

## INTRODUCING YOUR CHILD TO STEM

Science, Technology, Engineering, and Mathematics (STEM) education provides young adults with the opportunity to participate in many themed, **hands-on activities**, including those with connections to sports, history, and other subjects.

Activities involving the Trebuchet construction toys by Hexbug help individuals learn more about **physics** and **engineering** by engaging in activities that are useful and enjoyable while providing them hands-on experiences in those key areas.

This activity with the Trebuchet provides a fun and interesting way for students to learn about **physics**, **testing and data analysis**, and **applied math**.

## VOCABULARY TO KNOW

### VELOCITY

The speed of an object in a specific direction.

### COUNTERWEIGHT

A weight that provides balance and/or stability.

### ANGLE

The space between two intersecting lines and/or surfaces that is typically measured in degrees.

### PROJECTILE

An object moving through the air that has the force of gravity acting on it.

### GRAVITY

The force that causes a projectile to fall down to the ground.

## FORMULAS AND EQUATIONS

$$1 \text{ Inch} = 2.54 \text{ Centimeters}$$

$$\frac{\text{Distance in Feet}}{3.28 \text{ Feet}} = \text{Distance in Meters}$$

$$\frac{\text{Distance in Inches}}{12 \text{ Inches}} = \text{Distance in Feet}$$

## GENERAL SOLUTIONS

<b>High Arc and 4 Weights - Distance Traveled (m)</b>	<b>Low Arc and 4 Weights - Distance Traveled (m)</b>
6.11 m	3.61 m
<b>High Arc and 2 Weights - Distance Traveled (m)</b>	<b>Low Arc and 4 Weights - Distance Traveled (m)</b>
3.82 m	0.91 m

**Storm the Castle:** Answers will vary by player. The first player to knock down all of the cups, wins! Players may knock down all cups on the first attempt, or may require multiple attempts.

## EXTEND YOUR LEARNING

### DISCUSS

What strategies seem to work best for knocking down cups? Think about adjusting the counterweight plates. What do you think would happen if you removed all of the counterweight plates? Would the Trebuchet still work?

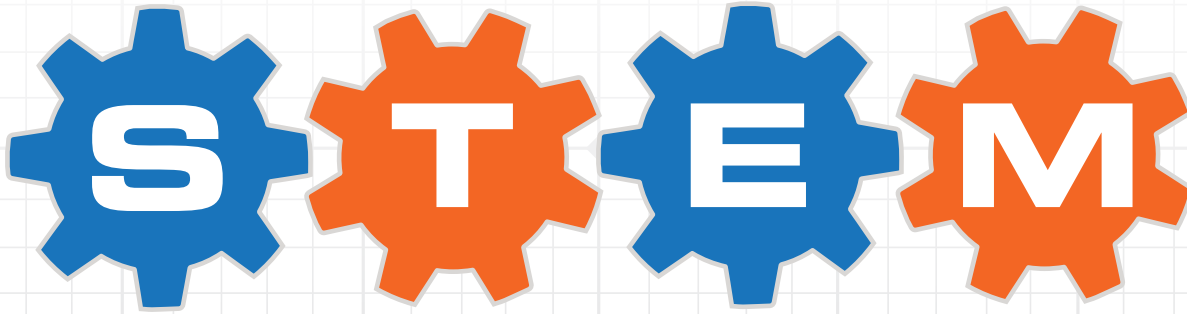
### APPLY

Does the weight of the barrel also affect how far it will launch? Try launching other items of equal size but different weight. Attach a string or use tape if necessary. Does the counterweight need to be heavier than the barrel being launched? Does the weight of the cups also affect how many will be knocked down? Try knocking over a shoe box or other items that are slightly heavier.

### EXPLORE

You can explore additional VEX Hexbug builds and investigations here: <https://www.hexbug.com/vex/build-instructions>

# STEM STANDARDS ADDRESSED



## MS-ESS1-1

Patterns can be used to identify cause and effect relationships.

## HE-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.

## HE-PS3-3

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

## ISTE1.1A

Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them, and reflect on the learning process itself to improve learning outcomes.

## ISTE3.3D

Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

## ISTE4.4C

Students develop, test, and refine prototypes as part of a cyclical design process.

## ISTE4.4D

Students exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.

## ISTE7.7C

Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

## ETS1.A

Defining and delimiting engineering problems.

## ETS1.B

Developing possible solutions.

## ETS1.C

Optimizing the design solution.

## 3-5-ETS1-3

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

## MS-PS3-2

Develop a model to describe unobservable mechanisms.

## MS-ETS1-4

Develop a model to generate data to test ideas about designed systems, including those representing inputs and output.

## CCSS.MATH.PRACTICE.MP1

Make sense of problems and persevere in solving them.

## CCSS.MATH.PRACTICE.MP2

Reason abstractly and quantitatively.

## CCSS.MATH.PRACTICE.MP4

Model with mathematics.

## CCSS.MATH.PRACTICE.MP7

Look for and make use of structure.

## CCSS.MATH.CONTENT.6.SP.B.5

Summarize numerical data sets in relation to their context, such as by reporting the number of observations (5.A), describing the nature of the attribute under investigation (5.B), and giving quantitative measures of center (5.C).

## CCSS.MATH.CONTENT.3.MD.B.4

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.

## CCSS.MATH.CONTENT.5.MD.A.1

Convert among different sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

### STANDARDS REFERENCED

#### MATH

Common Core Standards for Math  
<http://www.corestandards.org/math/>

#### SCIENCE & ENGINEERING

Next Generation Science Standards  
<http://www.nextgenscience.org/>

#### TECHNOLOGY

International Society for Technology in Education  
<http://www.iste.org/standards/>