

Castles & Catapults Design Challenge

Students will work together to solve two design challenges. This can be set up as a competition or as a collaborative effort.

Challenge 1: Design a castle tower that can remain standing through at least three launches of a catapult from at least 3 feet away.

Challenge 2: Design a catapult (launcher) that can launch a ping pong ball or marshmallow accurately in order to knock down the tower in 3 or fewer tries.

Castle Tower Design Challenge:

Students work in small teams to explore strategies for building a freestanding Castle Tower using the materials provided.

Criteria:

Tower must be at least 12" tall

Tower must stand up without leaning or being attached to anything for support

***Optional challenge element: The castle tower must also support a small object such as a small toy or large marshmallow, etc. This can be an addition to the challenge for older students, or for students during a second round of the activity.*

Constraints:

- Time (**Teacher can opt to give time limits or to leave activity open ended)

- Materials
Dixie Cups

(**Teacher may set a specified number, such as 25 Dixie cups, or allow unlimited, depending on supply)

Or

Index Cards – 100 per team

Activity Instructions:

1. Introduce students to Engineering (if you have not already explored engineering), explaining that engineers work to solve problems. Give examples and ask students to think of other examples.
2. Explain that they will have a chance to be engineers and solve some engineering design challenges.
3. Introduce the idea of Castles or Towers. Ask students what they know about building a structure so that it will be strong and not fall down. Tell them they will be building a castle tower out of (the materials you plan to use, such as index cards). What do they know about this kind of material. (For example, paper can

- tear or bend.)
4. Present the Castle Tower Design Challenge, explaining the CRITERIA and CONSTRAINTS.
 5. Give students time to draw and brainstorm ideas individually before passing out materials and forming groups.
 6. Place the students in groups of 3-5, and encourage them to select one idea to start with. Let them begin building and testing their designs.
 7. Depending on time available, you can stop at certain times and do a “gallery walk” to observe other groups’ ideas. If doing the Castles and Catapults challenge over multiple days, students will build the castle tower to be tested with the catapults on a later date, so have them draw or write about their best designs so they will be able to remember later.

Catapult Design Challenge:

Students work in small teams to explore strategies for building a catapult (launcher) that can be adjusted for distance and accuracy using the materials provided.

Criteria:

Catapult must launch an item (ping pong ball or marshmallow) at least 3 feet
Goal is to launch item accurately and with sufficient force to knock down Tower target.
Goal is to knock down tower in 3 tries or less.

Constraints:

- Time (**Teacher can opt to give time limits or to leave activity open ended)
 - Materials needed per group (best if in ziplock bags, 1 bag per group)
- **Basic catapult design can be done with plastic spoons, craft sticks, tape, rubber bands; the list below includes additional items which can lead to greater exploration and creativity

- Wooden craft sticks (popsicle sticks – 15-20)
- Masking tape – 1 roll per group, or measure off 2-3 ft per group
- Straws – 3-4
- Rubber bands – 15-20
- Plastic spoons -- 3
- Cardboard base – 1 per group or paper plate base **optional
- Cardboard tubes – 1-2
- Paper cups, small cups
- Foil to make launch “bowl” -- approx. 5 inch square
- Markers (to decorate the catapult)
- Marshmallow or ping-pong balls – 1 or 2 per group.

Each group will also need a practice target such as bucket or book.
Optional: images of catapults for students to examine.

Activity Instructions:

1. Introduce students to Catapults, present a variety of images. Discuss what a catapult is, and explore terms such as: force, target, launch, precise or accurate, fulcrum, and lever. Discuss how catapults work.
2. Explain that students will be engineers, designing catapults in teams that can launch a marshmallow or ping pong ball at least 3 feet to knock down a Castle Tower in 3 tries or less. Explain the CRITERIA and CONSTRAINTS, and discuss the materials they will use.

****Emphasize that this activity requires them to be careful and to follow safety rules, especially when testing their catapults. Brainstorm together what the agreed rules will be. For example, only launch the approved item (ping pong ball, marshmallow) – Nothing else! Only launch in the approved safe direction, with no students in the area near the target. Everyone launches from one side of the room, with targets on the opposite side. Use safety goggles if available.**

3. Give students time to individually brainstorm ideas and draw their designs.
4. Place students in groups. Give them time to select an idea and begin building.
5. Test your catapults where they aren't risking hitting other students.
6. After some initial tests evaluate how well your design solves the challenge.
7. Try to think of ways to modify the catapult to make it even more accurate. If there is time, allow a gallery walk or other ways to share ideas.
8. Continue with the process of testing and redesign until all groups have had at least 1 and ideally two or more rounds of testing and improvement.

Ready, Aim, Test:

Activity instructions:

1. Students build the Castle/Tower target, according to the constraints and criteria established by the teacher for this challenge. Build each Castle Tower target in an area protected from stray catapult launches!
2. Gather groups together. One at a time, have each group test their catapult launcher from a designated safe launch site at least 3 ft (adjust as needed based on space and the results of the preliminary testing! More space may be needed).
3. Each catapult team gets 3 tries to knock the tower down.
4. Based on the results, can teams create stronger towers? More accurate catapults? Try again!

Vocabulary/Definitions in context of this activity:

- **Lever:** A simple machine consisting of a rigid bar or handle pivoted on a fixed point and used to transmit force, as in raising or moving a weight at one end by pushing down on the other.
- **Fulcrum:** The pivot point of a lever
- **Accuracy:** How well the catapult launches the item in the direction of the target and how close it gets to the intended target.
- **Catapult:** A toy/machine that launches a projectile.
- **Projectile:** An object that is launched or thrown, usually in the air, by a force.

