

### Introduction

Think of some games that require you to toss, kick, or launch an object into a goal to earn points. They're not only fun to play, but they also involve many different science and engineering concepts. In this challenge, you'll use household materials to build a simple arcade game where players launch an object to earn points.

Here are the engineering constraints for this challenge:

- The catapult must be able to launch objects repeatedly during a two-minute "round."
- The launched object must travel a distance of at least 12 inches.

To be successful, your design must meet the following criteria:

- The game must include at least one target.
- The game must launch an object toward the target(s) using a catapult.
- The game must include point values for hitting the target(s).

### Brainstorm

Mechanical engineers design machines that involve force, energy, motion, and power. In 400 BCE, engineers in Greece designed a machine to launch arrows and stones during warfare—the catapult. A catapult is a type of lever that consists of three essential parts: a stable base, a launching arm, and a source of tension. When the arm of a catapult is

### Materials

- Cardboard box to house your game (at least 12 inches in length)
- Container to hold the object to be launched
- Multiple quantities of an object to launch (ping-pong balls, small beanbags, cotton balls, etc.)
- Timer (can be shared by several students)
- Variety of building materials that you have on hand, such as:
  - Cardboard tubes
  - Craft sticks
  - Disposable cups (paper, plastic)
  - Glue
  - Markers
  - Paper (white, construction, cardstock)
  - Plastic containers, small
  - Plastic spoons
  - Rubber bands
  - String or yarn
  - Tape

pulled backwards, the tension creates potential energy, or the energy that is stored in the arm because of its position. When the arm is released, the potential energy becomes kinetic energy and is transferred to the object, which sends it flying through the air. Kinetic energy is the energy the object has while it's in motion.

Your challenge is to design an arcade game that uses a catapult to launch an object and hit a target.

**1** Watch the Challenge Video to review the parameters of the activity.

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**2** Before you start brainstorming designs, consider:

- How many targets will you have? Will the targets have different point values? If so, how will you decide which targets are worth more points and which are worth less?
  - What object will players launch? How can you construct the arm of your catapult to hold and launch the object?
  - Will the catapult need to move or swivel to align with the targets? If so, how will that work?
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**3** Take a look at your materials. Think about which materials might be useful as you build your arcade game.

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**4** Sketch some designs or jot ideas.

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## Build, Test, Redesign

**1** Experiment with materials and build your arcade game. Be sure you test as you build, and redesign as needed. If something is not working the way you imagined, try a different material or make changes to your design.

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**2** Remember to test your game in two-minute rounds. You'll need a good supply of launchable items at the ready.

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**3** Think of a creative name for your arcade game. Decorate a sign and attach it to the outside of your game.

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**4** Did you meet the success criteria? If not, make changes to your design and try again.

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## Reflect

- What could you add to your arcade game to make it more fun or challenging?
- What did you like and dislike about the challenge?
- What problems did you have when building, testing, and redesigning? How did you solve them?
- How did you use the concepts of potential and kinetic energy in your arcade game?
- Be sure to recruit a few friends to play your game. Keep score and create a leader board to fuel the competition!

Did your design meet the success criteria? Nice job! Share your results with a family member, teacher, or DiscoverE! You can also share photos and videos on social media and tag @DiscoverEorg.