

Breaking Down Barriers

Construct a battering ram capable of knocking over other teams' walls. Construct a wall to withstand the forces of other teams' battering rams.

Subjects and Skills

- ◆ The history of battering rams, castles, and walls
- ◆ Geometry

Materials

- | | |
|--|---|
| <ul style="list-style-type: none"> ◆ String ◆ Spools ◆ Straws ◆ Three unsharpened pencils per team | <ul style="list-style-type: none"> ◆ Paper cups ◆ Paper plates ◆ Egg cartons |
|--|---|

Vocabulary

- ◆ Battering ram

Purpose

Students will learn and apply the structural concepts associated with castle design. These concepts will enhance their understanding of structural integrity, the utilization of simple machines, and how gravity can be used to generate force.

Objectives

Students will gain a better understanding of:

- ◆ the various modes of protection incorporated in castles' designs,
- ◆ military inventions and the design and purpose of the battering ram,
- ◆ how simple machines (wheels) can be used to solve design problems, and
- ◆ how gravity can be used to generate force.

Activity Preparation

1. Run off activity sheets.
2. Gather materials and place them in two separate areas of the room.

3. Bookmark websites to be used in class.
 - a. http://www.youtube.com/watch?v=o_w4FGgOVsM
 - b. <http://www.castles.me.uk/battering-ram.htm>
 - c. <http://science.discovery.com/videos/what-the-ancients-knew-the-battering-ram.html>
 - d. <https://vimeo.com/38339356>

Activity Procedure

1. Show the video (02:54) on medieval castle design at Link a.
2. Ask students to discuss the various modes of protection included in the design of the castle. (They might mention the tall outer wall, the moat, high towers for surveillance, built-in bows and places to fire arrows, arrow slits and notches, a drawbridge, heavy wooden doors protected by a thick metal grate, murder holes in which to dump oil and large rocks on enemies, and enclosed courtyards.)
3. Ask students to brainstorm ways to get through the walled barriers. Lead the responses toward a method to weaken the walls (e.g., a battering ram, a trebuchet, or some other wall-breaking method). For more information on the battering ram, go to Link b.
4. Distribute the activity sheets. Students will read information and respond to Question 1.
5. Discuss information and students' responses (e.g., add wheels, put it on a cart). Show the video (00:36) at Link c. This battering ram was used for naval warfare against the Greeks; however, the concept is the same as the one used in land versions.
6. While students are sketching their rams, select teams for the team challenge, and assign team numbers.
7. Students will continue through Question 3. Show the video (00:16) on castle stonework at Link d. Explain that cement has been around since ancient Macedonia.
8. Ask students to think about how skyscrapers were engineered to withstand the elements of wind, rain, and earthquakes. Using these ideas, ask students to respond to Question 4. Answers might include adding wire to the bricks, doubling the bricks, using stronger adhesive, and so on.
9. Explain that the team challenge will include two parts: making a battering ram and building a wall able to resist another team's battering ram. Discuss the materials available for building both the wall and the ram.
10. While students are designing their rams and walls, decide which teams will battle each other (create a bracket). Teams will alternate turns using their rams against the other teams' walls. Each team will have only five tries to destroy the other team's wall. Remind students that they will not

be able to touch the other team's wall with anything other than the swing of the timber piece of the battering ram. The goal is to destroy the opponent's wall in five tries or fewer. Teams will keep track of the result of each attempt. You may allow teams to rebuild their walls to learn from design mistakes, if you wish. If there is enough time, you may decide to continue rounds for victorious teams to compete against other victorious teams until one wall remains standing.

11. Review the team challenge, answering any questions students may have, and assign teams (of four or five students each) and team numbers.
12. Once the challenge is over, have students complete the activity sheets.
13. If you wish, use Extend the Learning With Medieval Construction: Google SketchUp Project to guide students in designing their own castles.

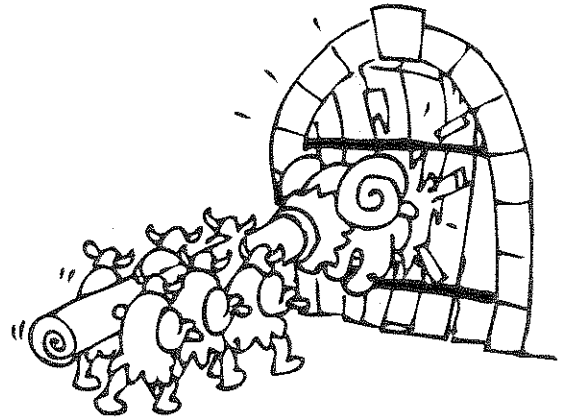
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GOAL

- Construct a battering ram capable of knocking over other teams' walls. Construct a wall to withstand the forces of other teams' battering rams.

MATERIALS

- | | |
|--------------------------------------|----------------|
| ➤ String | ➤ Paper cups |
| ➤ Spools | ➤ Paper plates |
| ➤ Straws | ➤ Egg cartons |
| ➤ Three unsharpened pencils per team | |



TIME TO CREATE

- 20 minutes

INDIVIDUAL ACTIVITY

Read the following, highlighting important information, and then answer the questions.

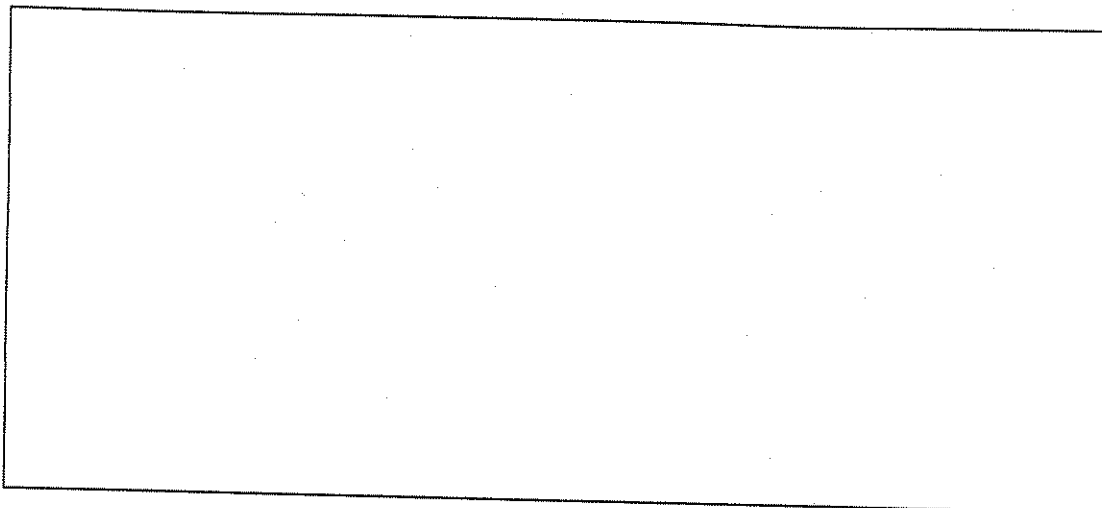
One of the earliest sophisticated military inventions was the battering ram. Military engineers in 2500 B.C. designed the battering ram to batter, pummel, pound, and basically destroy the walls and gatehouse doors of medieval castles.

The battering ram consisted of a long, heavy beam of timber with a tapered trunk. Its point was capped with iron, which made it look similar to the head of a ram. Due to its weight, the battering ram needed a way to be transported to various sites.

Soldiers swung the trunk of the battering ram back and forth; the forward end of the trunk moved in and out like a tortoise's head, battering its target. Battering rams enabled armies to pry stones loose from walls in order to weaken the structure and tear it down. Castle defenders would try to burn the battering ram down with flaming arrows; however, a blanket made of animal pelts or mud was able to protect the battering ram against the flames.

1. How might battering rams have been designed in order to be mobile?

2. On the next page, sketch a battering ram using the description above. Include the means for transportation and protection.



3. How were builders able to create castle walls in which the stones stayed in place? _____

4. Thinking like an engineer, how would you build a wall today strong enough to resist a battering ram? _____

TEAM ACTIVITY

Participants will work together in teams of four or five for 20 minutes to make a battering ram that is able to knock down another team's wall and to build a wall capable of resisting another team's battering ram.

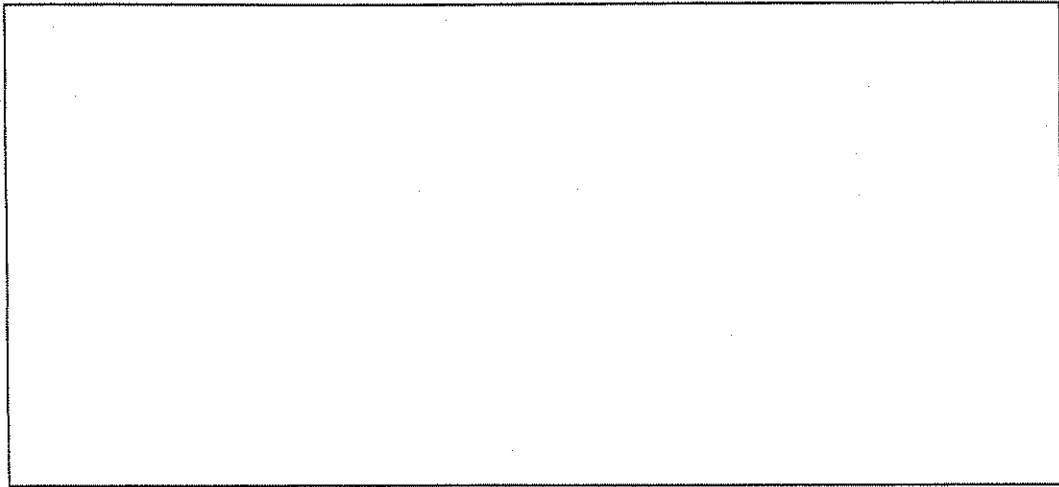
Your team will be paired with another team, and each team will have five opportunities to try to knock down the other team's wall with its battering ram using **only** the gravity of the swing of the timber piece of the battering ram. Members may not push or manipulate other components of the structure. No team member may touch the opponents' or their own wall at any point during the competition. Failure to follow these rules will automatically result in victory for the opposing team.

When the teacher starts the time, your team will have exactly 20 minutes to gather your materials and build your battering ram and wall. Once the teacher signals that time is up, stop working immediately and proceed to the challenge site. Any team that continues to work after time is up may be disqualified.

Start Time _____ : _____ + 20 Minutes = _____ : _____ End Time

Before the challenge, complete the following items:

1. Draw a sketch of what your team's battering ram will look like (using the available materials).



2. What materials will your team use for the wall? _____

3. Decide which members will make the battering ram and which will build the wall.

Ram: _____

Wall: _____

During the challenge, complete the following chart (the results of each attempt must be completed):

Was the wall unscathed, weakened, or destroyed in each attempt?

Attempt 1

Your team's wall: _____

Opponent's wall: _____

Attempt 2

Your team's wall: _____

Opponent's wall: _____

Attempt 3

Your team's wall: _____

Opponent's wall: _____

Attempt 4

Your team's wall: _____

Opponent's wall: _____

Attempt 5

Your team's wall: _____

Opponent's wall: _____

After the challenge, complete the following questions:

1. Summarize the results of what took place during this event. What did you notice? What contributed to the results? _____

2. How would you modify your team's wall to provide more stability? _____

3. How would you modify your team's battering ram to generate more power? _____

EXTEND THE LEARNING WITH MIEVEAL CONSTRUCTION: GOOGLE SKETCHUP PROJECT

Build a castle. Google SketchUp enables you to create 3D models of everything from simple geometric forms to complex communities. You will design a virtual medieval castle scene complete with towers, defensive walls, inside buildings, and so on. The scene will include people, trees, and weapons as seen during medieval times. For an example, go to <http://sketchup.google.com/3dwarehouse/details?mid=bf531fd815ae2bbeb6befb2adbdfbf5>.

Follow these directions to get started:

- ◆ Download and install the Google SketchUp Viewer from <http://sketchup.google.com>. The Google application will prompt you through the installation process. This is a one-time setup that installs the Google SketchUp Viewer to enable you to view Google 3D SketchUp models.
- ◆ Go to <https://support.google.com/sketchup/bin/answer.py?hl=en&answer=95079&topic=1700331&rd=1> and select detailed instructions and information for either Mac or PC users.
- ◆ Examples of castles available to download are available at <http://sketchup.google.com/3dwarehouse/cldetails?clid=71f153d8dd5b41e8897467e55536c415&scoring=r>.
- ◆ The Google 3D Warehouse (<http://sketchup.google.com/3dwh/>) is a free, online repository where you can find, share, store, and collaborate on 3D models.

Your model must look realistic and be modeled to scale. Include a variety of 3D shapes: rectangular and circular towers, walkways, and arch-shaped openings. Include human figures, trees, and appropriate weapons (these may be downloaded).