Catapult

Students explore the concepts of science, engineering and technology as they build a device that can launch small paper balls over a long distance.

Prepare the materials

Necessary materials	Optional materials
Food stick	Cardboard
Popsicle sticks	Construction paper
Cotton string	Eraser(shared)
Bottle caps	
Rubber bands	
Plastic straws	
Masking Tape	
Scissors	

Note: Underlined materials are to be shared among the students

Curiosity

Get students interested in the activity they are going to do. You can tell a story that provides context for this activity and presents students with a problem to solve. Because we shall be working with simple, non-electric materials in this session, setting up such a context in the story can be helpful. An example of story is as follows:

"Suppose Ramayana is a real event but the superpowers mentioned there are only fictional. Ram, Lakshman and Hanuman are humans like us, only braver, stronger and wiser.

Ram, Lakshman and their army reach the kingdom of Lanka. The kingdom is surrounded by strong, high walls. There are archers placed on the wall who will shoot arrows at anyone who goes near the walls.

Ram's army cannot attack Lanka and rescue Sita without breaching the walls. So Lakshman asks their engineers Nal and Neel to think of a way to break through the walls without having to go near it.

After some days of thinking and discussion with Hanuman, Ram and Lakshman, engineers Nal and Neel design a device that can throw huge rocks at the walls and take them down.

Now suppose you are the engineers. Build such a device for Ram's army so that they can breach the walls, defeat Ravan and rescue Sita. For the ease of our activity, your device can throw paper balls instead of rocks.``

Ask students to build a prototype of a device that will allow Ram's army to hurl rocks at the walls of Ravan's fort and bring them down, without having anyone to get within the range of Ravan's archers.

Activity

Sketching ideas

Ask students to go through this lesson in the student guide..

Ask them to do a quick sketch of their catapult. To help with the process, allow them to have a look at the materials available.

Scaffolding

Support students when they are stuck. Ask leading questions or hint at ideas for starting. Some examples are given below:

- What will make your catapult throw paper balls?
- What material will you use to build the body of your catapult?

Point out the good ideas generated so that other students can learn from it. Connect groups that are struggling with the groups that have overcome that specific challenge.

Experimentation

Encourage students to experiment with their catapult. Ask leading questions to support their thinking.

- I wonder what happens if _____
- What would you like to try with your catapult?

If students have built their prototypes of catapult, ask them to try the challenges provided in the student guide.

Suggestions for the facilitator

We found these insights and tips to be helpful while facilitating this session.

- This activity provides students with an opportunity to make mischief, which can cause distractions from learning.
- Catapults need strong frames to work properly. Triangular shapes are incredibly strong. Students can design their frames using triangles to make them sturdy.

Thinking

Reflection

Ask questions to help students reflect on their learning.

- How did the design of your catapult evolve throughout the activity?
- What challenges did you face while building your catapult? How did you overcome them?

You can also provide structures to support their thinking.

- Two things I learnt are _____
- I used to think _____ and I now think _____
- The most interesting part for me was _____ because _____

Think like a . . .

Ask thought provoking questions to make students think from the perspective of a professional

Think like an engineer

- How can you change the range and height of the projectile fired?
- Firing a catapult exerts reaction force on it and can cause it to jerk or even topple. How can you improve its stability?

Think like a physicist

- Where does the projectile get the energy to travel its distance?
- Why does the catapult jerk when it's fired?

Think like a historian

- What can you tell about the science and technology of ancient times from the weapons they used?

Concepts and skills

This lesson can also be used to emphasize on scientific concepts and skills.

Some concepts and skills students explore in this lesson are:

- **Potential energy**
  The catapult stores energy in its stretched or "loaded" position and that energy is transferred to the paper ball when the tension is released.

- **Stability and the center of gravity**
  A light catapult can topple over while shooting due to the reaction force within itself. Making the base heavy or wide can improve the stability of the device.

Sample lesson plans

1. A 60 minute class

Learning Objectives

To get students to experience the play based learning approach through building a toy catapult. The emphasis is on getting them to communicate their ideas and collaborate with peers.

Classroom context

This sample lesson is designed for grade 7 students. The time available is 60 minutes.

Lesson Flow

Curiosity (5/5 mins)

Divide students into groups of 2. Have an engaging conversation on catapults to get them curious.

"You have all seen tanks in movies, games or news right? Tanks are a recent invention. Before tanks

there were cannons powered by gunpowder. But more than a thousand years ago, before the invention of gunpowder, there were weapons that could throw rocks over a long distance. They were known as catapults."

Present them with the problem statement.

"In today's class, we shall build small prototypes of catapults that can throw paper balls over a large distance. You can think about your own use for your catapult.

To make things fun, we shall exchange the designs and build the catapult for our friends. This should be really fun. Let's see if you can build what your friends had in mind."

Activity (45/50 mins)

Sketching ideas

Ask students to go through the lesson in the student guides. Give them 10 mins to sketch the design of their catapults. Once designs are ready, ask students to exchange them and build catapults for their friends.

Safety precautions

Before handing them the material packs, warn them about food sticks and scissors. Emphasize on safety concerns. Remind students about teamwork and sustainability as they build.

Building the prototype

Give them 20 minutes to build the first draft of the catapult.

Provide suggestions and ask questions to support their thinking.

- How far do you want your catapult to fire? How will you manage that?
- How will your catapult be stable? What will it stand on?

Sharing and feedback

Ask students to show their work to their neighbors and exchange feedback, where they talk about something they liked and something that can be improved.

Final iteration

Ask students to implement the feedback to improve their catapults. Give them 10 minutes for this.

Thinking (10/60 mins)

Use structures or questions to get students to reflect on their learning experience.

- What was frustrating during the activity? Why was it so?
- What new questions do you now have?

2. Two 45 minutes classes

Learning Objectives

To get students to experience the play based learning approach through building a toy catapult. The emphasis is on getting them to understand the scientific concepts and skills associated with this activity.

Classroom context

This sample lesson is designed for grade 8 students. The time available for the lesson is two 45 minutes classes, not necessarily consecutive.

Lesson Flow

Class I

Curiosity (10/10 mins)

Divide students in groups of 2 each. Ask students if they are familiar with the story of Ramayana. Ask a few students to summarize the story of Ramayana in a sentence. Then provide them with the prompt given above in the curiosity section of this educator guide.

Activity (30/40 mins)

Safety precautions

Before handing materials, remind students about safe use of sharp, pointed objects such as food sticks and scissors.

Sketching ideas

Ask students to go through this lesson in the student guide. Ask them to do a quick sketch of their catapult. Emphasize on sketching and not using more than 3 words in their design. Allow students to have a look at the materials to help them get ideas for the design.

Building

Distribute the materials. Give them 15 minutes to build their catapults based on their design sketch.

Many groups will not be able to complete their project in this class. Inform them that they shall continue in the next class(if the classes are taking place after a gap.) If there is a storage space in the classroom or school, ask students to leave their projects there.

Thinking (5/45 mins)

Ask questions to help students reflect on their learning experience.

- What challenges did you face while building your catapult? How did you overcome them?
- What role did the sketch play in your design? What might have been different had you built directly without sketching?

Class II

Recalling (5/5 mins)

Get students to sit in the same groups from the last class. Ask them to discuss among group members and recall their work from the previous class.

Activity (30/35 mins)

Completing the project

Ask students to get the sketches of their catapults from the previous class. Give them 15 minutes to complete their project.

Additional challenges

For students who have completed their projects, ask them to try the challenges. Some ideas for additional challenges are:

- Ask students to improve the range of their catapult. You can also provide them a challenge to build a catapult with adjustable range.
- Ask students to investigate a scientific phenomenon associated with their catapult and develop a hypothesis. Some ideas are:
    - Why does the catapult jerk while shooting?
    - How can they change the range and power of the catapult?
- Ask guiding questions to support their thinking.
    - What difference would the number of rubber bands make to the catapult?
    - What might happen if the length of the arm is changed?
    - Complete this sentence: I wonder what happens if _____

Encourage them to reach out to peers for assistance and ideas.

Thinking (10/45 mins)

Ask questions to help students reflect on their learning experience.

- How does the transformation of energy take place in a catapult?
- What factors caused the design of your catapult to change?