# Bottle Rockets: Mechanical Engineering Lesson Plan

*This lesson plan has Bottle Rockets and Paper Rockets. Paper rockets are easier to do with big classes or younger students.*

## Objective

This lesson introduces students to forces and how they affect the maximum height of a rocket. In this activity, students will build a rocket, launch it, and calculate the maximum height using angles, distance, etc.

## Learning Outcomes

Students will learn:

1. That trigonometry can be used to determine the height of object
2. That the more pressure applied to a rocket will make the rocket go higher
3. That fin design affects the rocket's ability to travel higher
4. Design of the the find and cone will determine the distance

## Essential Questions

1. How can you make a rocket fly higher?
2. Does the fin and cone design affect the final height of the rocket?
3. How can you tell how high your rocket traveled?
4. How can you tell how far your rocket traveled?
5. How would you improve your rocket after each trial?

## Time Required (Itemized)

1. Explanation of forces and introduction to fin and cone design (30 minutes)
2. Time to work on rockets and introduction to launch process (45 minutes)
3. Testing the rockets (30 minutes) recommend doing more than one trial, at least two to allow for changes to be made. Add in another 20-30 minutes
4. Discussion (10 minutes)

## Assessments

Have students submit the sketch of their rocket design and calculations for final height.

## Materials

1. Launcher (Can be checked out from the COE)
2. Bike Pump (Can be checked out from the COE)

*Ways to build the launcher can be found online or using other sources to make your own*

3. Empty 20oz plastic bottles (enough for each group of 2-3)
4. Card stock for fins and cone
5. Glue (hot glue gun is best for fast drying)

*alternative option would be duct tape*

6. Scissors (one pair per group)
7. Protractor (this will help with the angle being the same for all fins)

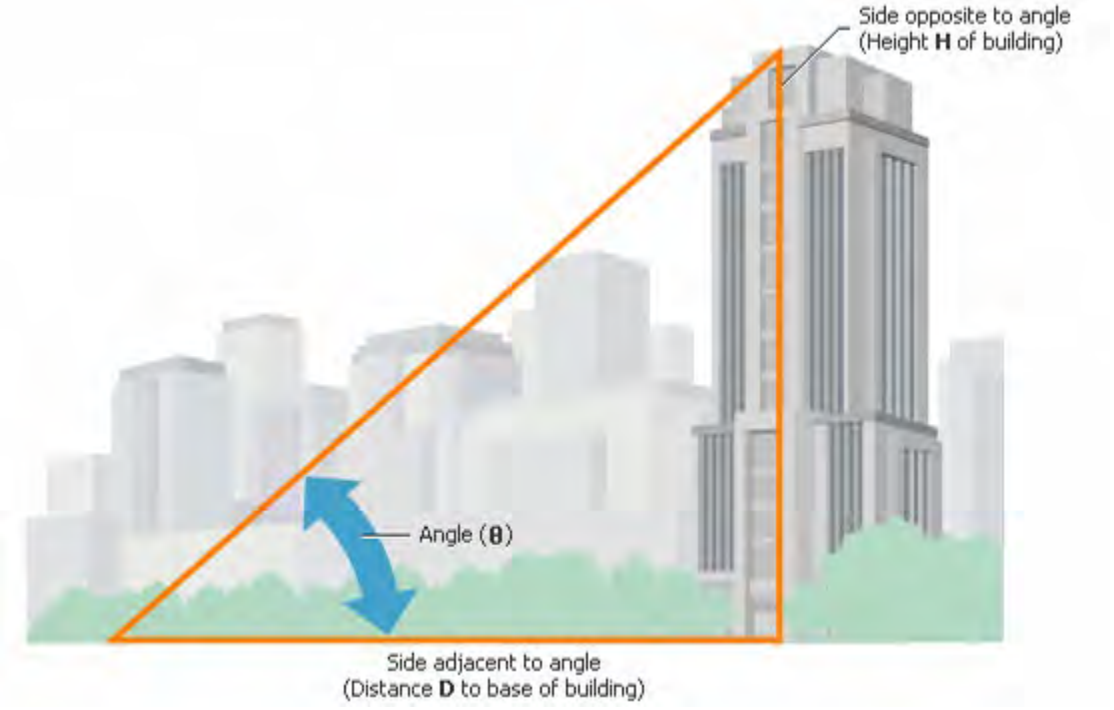
Lesson Description

Have the students bring an empty 20oz bottle to class. Show students different fin designs for rockets and cone designs.

Tips for fins: In case students are young or students are having a difficult time deciding the type of fins. There can be 4 fins at the bottom of the rocket, 2 fins halfway up the rocket (like an airplane), and a rocket with no fins.

Ask students if design and placement will affect the flight and height and distance for the rocket.

Teach students how to solve for height by knowing the distance from launcher and angle.




In their groups of two-three have them brainstorm (sketch) their design for find and cone.

Remind them that the materials being used for the rocket will add weight to the rocket which will affect the launch, i.e. keep in mind the size of fins/cones along with how much duct tape or hot glue is used.

Once students are done brainstorming they have them built. When rockets are finished and ready to launch, direct the students outside.

To see who has the best distance, measure the starting point and the distance for the rockets. After each student launch, have them leave the rockets on the ground for students to properly measure the distance from the launcher to where the rocket landed. This will be the best way to measure the angle and height the rockets reached. For younger students you could have them leave the rockets where they are and after all rockets have been launched just have the students measure the distance to determine whose rocket went the furthest.

Once measurements are completed, bring the students back to class and discuss the effective and ineffective designs of the fins, placements and design of the cones.

If there is time in class or wish to make the activity a 2 day activity, students can improve on their designs by fixing the fins and cone; if redesigning is going to be done it is highly recommended that duct tape is used instead of hot glue.

For measurements, paper and pen or pencil will work. If desired to continue the lesson, students can research rockets, types of rockets and present.

Tutorial Video
Tutorial: Rockets

Paper Rocket Lesson Plan is on the next page.

# Paper Rockets Lesson Plan

Objective

This lesson introduces students to forces and how they affect the maximum height of a rocket. In this activity, students will build a rocket, launch it, and calculate the maximum height using angles, distance, etc.

Learning Outcomes

Students will learn:

1. That trigonometry can be used to determine the height of object
2. That the more pressure applied to a rocket will make the rocket go higher
3. That fin design affects the rocket's ability to travel higher
4. Design of the the find and cone will determine the distance

Essential Questions

1. How can you make a rocket fly higher?
2. Does the fin and cone design affect the final height of the rocket?
3. How can you tell how high your rocket traveled?
4. How can you tell how far your rocket traveled?
5. How would you improve your rocket after each trial?

Time Required (Itemized)

1. Explanation of forces and introduction to fin and cone design (30 minutes)
2. Time to work on rockets and introduction to launch process (45 minutes)
3. Testing the rockets (30 minutes) recommend doing more than one trial, at least two to allow for changes to be made. Add in another 20-30 minutes
4. Discussion (10 minutes)

Materials

8. Launcher (Can be checked out from the COE)
9. Bike Pump (Can be checked out from the COE)

*Ways to build the launcher can be found online or using other sources to make your own*

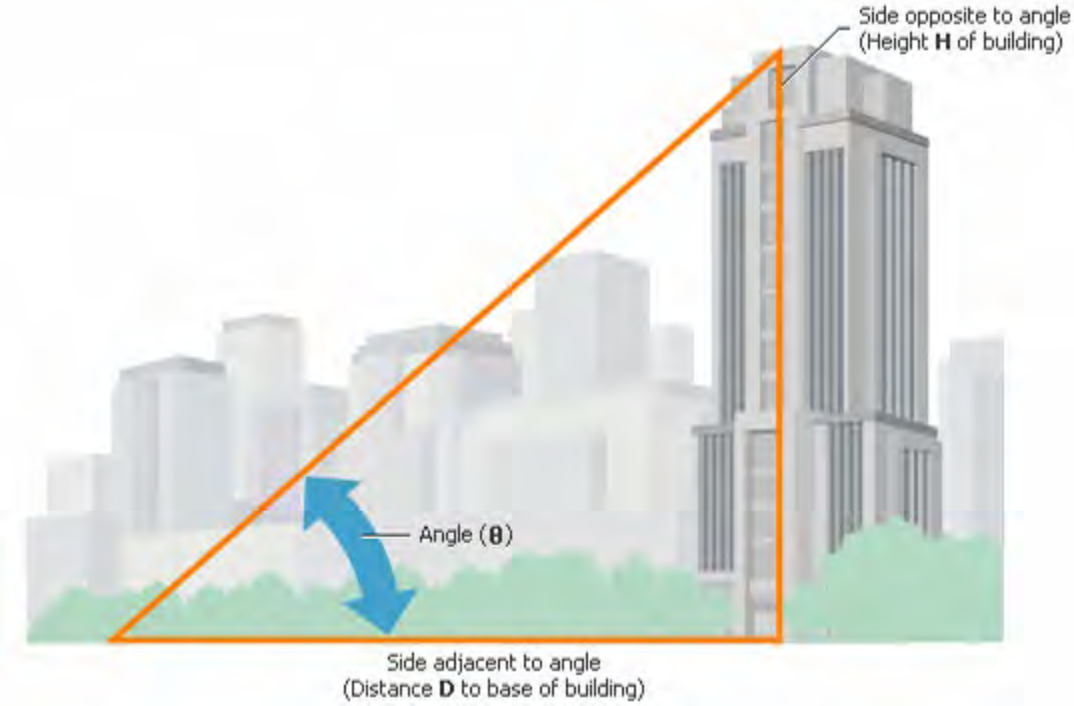
10. Paper Rockets (tube) take one cardstock paper and roll it to fit the launcher. Keep one end open to sit on the launcher, other end will be folded atop each other and tape down. Each group will be 2-3 students.
11. Card stock for fins and cone
12. Blue masking tape or duct tape for fins/cone
13. Scissors (one pair per group)
14. Protractor (this will help with the angle being the same for all fins)

Lesson Description

- Have the students make their tube, this can be individually if it is a small class or in groups of 2-3. Show students different fin designs for rockets and cone designs.

Tips for fins: In case students are young or students are having a difficult time deciding the type of fins. There can be 4 fins at the bottom of the rocket, 2 fins halfway up the rocket (like an airplane), and a rocket with no fins.

- Ask students if design and placement will affect the flight and height and distance for the rocket.
- Teach students how to solve for height by knowing the distance from the launcher and angle.




- In their groups of two-three have them brainstorm (sketch) their design for find and cone. Remind them that the materials being used for the rocket will add weight to the rocket which will affect the launch, i.e. keep in mind the size of fins/cones along with how much duct tape or hot glue is used.
- Once students are done brainstorming they have them built. When rockets are finished and ready to launch, direct the students outside.
- To see who has the best distance, measure the starting point and the distance for the rockets.
- After each student launch, have them leave the rockets on the ground for students to properly measure the distance from the launcher to where the rocket landed. This will be the best way to measure the angle and height the rockets reached. For younger students you could have them leave the rockets where they are and after all rockets have been launched just have the students measure the distance to determine whose rocket went the furthest.

- Once measurements are completed, bring the students back to class and discuss the effective and ineffective designs of the fins, placements and design of the cones.

If there is time in class or wish to make the activity a 2 day activity, students can improve on their designs by fixing the fins and cone; if redesigning is going to be done it is highly recommended that masking or painters tape is used instead of duct tape so paper tube of the rocket is not damaged.

For measurements, paper and pen or pencil will work. If desired to continue the lesson, students can research rockets, types of rockets and present.

Tutorial Video
Tutorial: Rockets