

PAPER ROCKETS

Duration: 15-30 minutes

Institution: COSI

Skill level/Age Level: All Ages

Group size: Varies based on materials and facilitators

INTRODUCTION

Participants will use the engineering design process to create paper rockets. Then, they will use compressed air launchers to send the rocket through one of two large rings, suspended from the ceiling.

KEY CONCEPTS AND/OR SUBJECT AREA

Encourage guest to build paper rockets that will eventually fly through the rings that are suspended from the ceiling. Fin/nosecone design can greatly influence the flight of a rocket; encourage guests to try different designs.

MATERIALS AND TOOLS

- Compressed air rocket launcher(s), with PVC tube that is removable.
- Bike pump(s)
- Access to electricity
- Masking tape
- Masking tape holder(s)
- Paper (cut into 4.25" x 11" strips as well as 4.25" x 5.5" pieces)
- Scissors
- Pencils or pens
- Stencils for fin and nose cone design
- Extra PVC pieces (to help with body tube design)
- Orange cones to block off launch area.

Paper Rocket launcher parts list

- 1 Standard-Wall White PVC Pipe Fitting, 1/2 Pipe Size, Male Adapter, Pipe End x NPT Male, \$.56 each
- McMaster-Carr item number: 4880K651
- <http://www.mcmaster.com/-catalog/120/83/=tjrwnv>
- 1 Standard-Wall White PVC Pipe Fitting, 1/2 Pipe, Male Adapter, NPT Male x Socket Female, \$.27 each
- McMaster-Carr item number: 4880K61
- <http://www.mcmaster.com/-catalog/120/84/=tjrx1u>
- 1 Brass Air Fill Valve, Straight, 1/8 NPT, 1-5/16" Overall Length, \$3.57 each
- McMaster-Carr item number: 8063K41
- <http://www.mcmaster.com/-catalog/120/481/=tjs5xv>

- 1 Brass Ball Valve with Gauge Port, 1/2" NPT Female Connections, \$15.01
- McMaster-Carr item number: 4085T21
- <http://www.mcmaster.com/#catalog/120/444/=tjs7qn>
- 1 Miniature Chrome-Plated Brass Ball Valve, Lever Handle, 1/2" NPT Female x Male Connections, \$8.32 each
- McMaster-Carr item number: 4912K9
- <http://www.mcmaster.com/-catalog/120/447/=tjry89>
- 1 Standard-Wall White PVC Pipe Fitting, 2 x 3/4 x 2 Pipe Size, Reducing Tee, \$2.41 each
- McMaster-Carr item number: 4880K508
- <http://www.mcmaster.com/-catalog/120/82/=tjryr4>
- 1 Standard-Wall White PVC Pipe Fitting, 3/4 Pipe End Male x 1/2 NPT Female, Hex Bushing, \$.50 each
- McMaster-Carr item number: 4880K201
- <http://www.mcmaster.com/-catalog/120/83/=tjr6i>
- 2 Standard-Wall White PVC Pipe Fitting, 2 Pipe Size, Cap, \$.94 each
- McMaster-Carr item number: 4880K56
- <http://www.mcmaster.com/-catalog/120/82/=tjs0qx>
- 1 Compact Stainless Steel-Case Gauge, 1-1/2" Dial, 1/8 NPT Male Center Back, 0-100 PSI, \$7.17 each
- McMaster-Carr item number: 40565K51
- <http://www.mcmaster.com/-catalog/120/82/=tjrzgr>
- 1 Extend-Life ASME Pop-Safety Valve with Test Ring, Brass, Medium Flow, 1/8 NPT Male, 75 PSI, \$5.26 each
- McMaster-Carr item number: 48435K71
- <http://www.mcmaster.com/-catalog/120/499/=tjs156>
- 1 Orbit 57100 3/4-Inch Female Pipe Threaded Auto Inline Sprinkler Valve, \$12.58 each
- <http://www.amazon.com/Orbit-57100-4-Inch-Threaded-Sprinkler/dp/B00004S1V2>
- Balance carts

SET UP

- Plug in the rocket launchers to a power strip and then into the floor outlet.
- Add the PVC tubes to the rocket launchers (screw-on)
- Attach bicycle pumps to the rocket launchers
- Use the orange cones to block off the rocket launching area

HOW TO OR STEP-BY-STEP

Rocket Design

Design and construct a rocket here.

1. Wrap paper around the blue tube to create your rocket's body.
2. You may use the stencils for the rocket's fins and nose cone.
3. Next, make your way over to the rocket launchers!

- When you're finished, please return the materials to the appropriate bins.

Rocket Launch

To design a rocket that flies through the hoop.

- Place your rocket on the PVC tube.
- Use the bike pump so the gauge on the rocket launcher reads 20 psi.
- Stand back and press the red button.
- When you're finished, please recycle your rocket.

FACILITATION PROMPTS AND QUESTIONS

- Can you adjust your design to improve the rocket's flight path?
- Why did you decide to build fins like that? What do you think would happen if you changed the fin design?
- Here are some sample fin designs that can be tested
- What is the purpose of fins on a rocket? Can you alter the fins to create spin?
- Why would what you explored here be important to engineers?

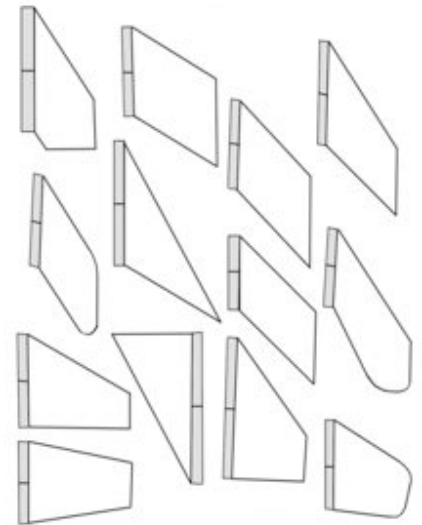
DESIGN CYCLE

For the Rocket Design:

- The extra PVC pieces are available so guests can design rocket body tubes that fit on the rocket launcher. Guests should wrap a long piece of paper around the PVC and then use tape to create a tube.
- There are also stencils available that can be used to create the nose cone and fins for the rockets but, these do not have to be used.
- Once the rocket is ready, the guests can launch them with the compressed air launchers. To launch the rocket, they will place its body around the PVC tube. Next, they can adjust the angle of the launcher and also swivel the launcher to aim for a ring. Then, they should use the bike pump to increase the air pressure in the launcher to 20 psi. Finally, they can stand back and press the red button to launch their rocket.

For the Rocket Launch:

- If desired, guests can re-design their rockets until they successfully soar through one of the rings. When completed with the station, guests should recycle their rockets (or could take them home). The variables they should focus on changing include: rocket design (fins, nose cone, rocket body) and angle and direction of launch.
- You can also recommend that guests decrease the air pressure when they launch, to see how that influences the rocket's path. The rocket launchers can't exceed 20 psi due to the type of valve we used so decreasing the air pressure is the only option!
- Note: Please monitor guests' safety while picking up their launched rockets.



GENERAL FACILITATION TIPS

- Clean up:
 - Make sure all paper rocket creations are recycled.

- b. Return all materials to their bins and boxes.
- c. Return all equipment and tables to their original locations.

Why this experience?

- This experiment will be a perfect fit for design based learning because it: (1) gets big results, (2) requires minimal consumables and (3) allows participants to alter only a few variables, which result in very different results.
- Collaboration will occur as participants study each other's designs, and improve upon them to make their own.

MORE INFORMATION

- Depending on the space available, rockets could be designed for maximum height or distance traveled, rather than accurately hitting a target.
- Templates for fins and cones (or prebuilt examples) are fine as a jumping off point, but sometimes seemed to stifle the creative design process. Perhaps participants assumed such examples were optimized and would give the best results, though this was not necessarily the case.
- Depending on number and enthusiasm of participants, the launcher(s) may need more or less supervision.

KEYWORDS

- Outdoor
- Needs a lot of space
- Safety issues for children using hand-tools
- Arty
- Crafty