

## Educators Guide - Paper Planes (STEM To-Go)

<u>Grade(s)</u> : Grade 6	<u>Time needed</u> : 40 minutes
<u>Curriculum Area(s)</u> : Structures and Mechanisms	<u>Lesson Topic</u> : Paper Planes and Flight
<p><u>Learning Goal(s)</u>: By the end of the activity, students will be able to:</p> <ul style="list-style-type: none"> <li>- Create a paper model of an airplane</li> <li>- Understand the four forces of flight using the paper planes</li> </ul>	

<p><b>Overall Expectation(s)</b> <i>Take this directly from Ontario Ministry of Education documents.</i></p> <p><b>D2. Exploring and Understanding Concepts</b> demonstrate an understanding of the ways in which properties of air can be applied to the principles of flight and flying machines</p>	<p><b>Related Specific Expectation(s)</b></p> <p><b>D2.1</b> identify flight-related applications of the properties of air</p> <p><b>D2.2</b> describe the relationships between the four forces of flight – lift, weight, thrust, and drag – that make flight possible</p> <p><b>D2.3</b> describe ways in which flying machines and various organisms use balanced and unbalanced forces to control their flight</p> <p><b>D2.4</b> describe ways in which the four forces of flight can be altered</p>
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**Safety**  
The tips of paper airplanes can sometimes be very pointy. Never shoot a paper airplane towards another person!

<p><b>Instructions For the Activity</b></p> <ol style="list-style-type: none"> <li>1. Fold the template paper in half on line 1.</li> <li>2. Open the paper up. Fold the top corners in on lines 2A and 2B.</li> <li>3. Fold the slanted edges to the center line on lines 3A and 3B.</li> <li>4. Fold in half on line 1.</li> <li>5. Keep it folded, and Fold the wings out on lines 5A and 5B.</li> </ol> <p><u>Tip</u>: Try folding the wings in different ways to see how it flies!</p> <p><u>Tip</u>: Flight Instruction - Hold near the back of the paper plane and throw with a quick motion.</p>	<p><b>Materials</b></p> <ul style="list-style-type: none"> <li>• 8.5" x 11" cardstock paper (can also use regular paper)</li> <li>• Paper Plane Template</li> <li>• Optional: Rubber band and Paperclip</li> </ul> <p><b>Videos</b></p> <p>Play the video to show your students how to construct the paper plane if possible. <a href="https://www.youtube.com/watch?v=1PVA2nPU60U">https://www.youtube.com/watch?v=1PVA2nPU60U</a></p> <p>Play the video to show your students how to construct a launcher for their paper plane. This is part of Extension #2. <a href="https://frugalfun4boys.com/file-folder-paper-airplane-launcher/">https://frugalfun4boys.com/file-folder-paper-airplane-launcher/</a></p> <p><b>Appendix A</b> STEM To-Go Activity Sheet - Paper Planes</p> <p><b>Appendix B</b> Paper Plane Template</p>
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**The Science Behind It All**  
Use Appendix A as a handout. There are provided illustrations to help further explain the content.



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# Educators Guide - Paper Planes (STEM To-Go)

There are **four forces** that act on object in flight - drag, lift, gravity, and thrust. When all of these forces are balanced, planes are able to fly for long distances.

1. If you want your plane to fly as far as possible, you need a plane with as little **drag** as possible. The pointy nose of your paper plane gives it an aerodynamic shape meaning it moves through the air easily.
2. **Lift** is created when the air below the plane's wings is pushing up harder than the air above it is pushing down. It is this difference that enables a plane to fly.
3. You need to keep your plane's weight to a minimum to help fight against **gravity's** pull to the ground.
4. **Thrust** is the forward movement of the plane. The thrust comes from the muscles of the "pilot" as the paper airplane is thrown.

## Extensions

The following extensions can be done using Appendix A: STEM To-Go Activity Sheet - Paper Planes. The extension sections have a drawing and observation section for students to fill in.

### Extension #1

Grade(s): Grade 6

Curriculum Area: Structures and Mechanisms

Overall Expectations	Specific Expectations
<b>D2. Exploring and Understanding Concepts</b> demonstrate an understanding of the ways in which properties of air can be applied to the principles of flight and flying machines	<b>D2.2</b> describe the relationships between the four forces of flight – lift, weight, thrust, and drag – that make flight possible <b>D2.3</b> describe ways in which flying machines and various organisms use balanced and unbalanced forces to control their flight <b>D2.4</b> describe ways in which the four forces of flight can be altered

- Are you looking for more power? With the help of an adult, use a sharp pencil to make a hole at the front of the plane under the wings. Put the rubber band through the hole and loop it through itself. Use your finger to launch your plane and watch it soar!
- Consider adding a paper clip to the front of your plane OR fold your plane in different ways to see how it flies.

### Extension #2 (Launcher)

Grade(s): Grade 6

Curriculum Area: Structures and Mechanisms

Overall Expectations	Specific Expectations
<b>D2. Exploring and Understanding Concepts</b> demonstrate an understanding of the ways in which properties of air can be applied to the principles of flight and flying machines	<b>D2.2</b> describe the relationships between the four forces of flight – lift, weight, thrust, and drag – that make flight possible <b>D2.3</b> describe ways in which flying machines and various organisms use balanced and unbalanced forces to control their flight <b>D2.4</b> describe ways in which the four forces of flight can be altered

- Play the video to show your students how to construct a launcher for their paper plane.  
<https://frugalfun4boys.com/file-folder-paper-airplane-launcher/>

1. Fold the cardstock in half.
2. With the help of an adult, use a sharp pencil to make a hole into the cardstock in the corner 1 cm from the folded edge.
3. Fold one side of the cardstock to the folded edge. Flip it and do the same thing on the other side.
4. Create flaps by folding one side of the cardstock in half to the folded edge. Flip it and do the same thing on the other side.
5. Put the rubber band through the hole and loop it through itself.
6. Place the end stretched the rubber band to the opposite diagonal corner of the launcher.



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- Slide the paper plane into the folded opening.
- Pull on the launcher's flaps under the rubber band to launch the airplane.

### Extra Resources

Build a Paper Airplane Launcher - Lesson Plan & Instructions:

<https://www.scientificamerican.com/article/build-a-paper-airplane-launcher/>

Paper Airplane Launcher - Instructions: <https://frugalfun4boys.com/paper-airplane-launcher>

Make a Paper Airplane Launcher - Lesson Plan & Science Background:

<https://www.sciencebuddies.org/stem-activities/paper-airplane-launcher>

Into the Wild Blue Yonder: The Science of Launching an Airplane by Catapult - Science Background:

[https://www.sciencebuddies.org/science-fair-projects/project-ideas/Aero\\_p048/aerodynamics-hydrodynamics/launching-an-airplane-by-catapult](https://www.sciencebuddies.org/science-fair-projects/project-ideas/Aero_p048/aerodynamics-hydrodynamics/launching-an-airplane-by-catapult)

Benson, T. (2010, September 9). Four Forces on an Airplane. Retrieved October 3, 2011.

### Appendix A: STEM To-Go Activity Sheet - Paper Planes

Activity sheet includes materials, instructions, tips and the science behind this activity.

Paper Planes Activity - Blog Post: <https://www.stemovation.org/post/paper-planes>

Paper Planes Activity Sheet - Student Copy:

[https://www.stemovation.org/files/ugd/8444cc\\_8aac02b21de484388904c1469505663.pdf](https://www.stemovation.org/files/ugd/8444cc_8aac02b21de484388904c1469505663.pdf)

### Appendix B: Paper Planes Template

The template for the Paper Plane structure is provided with the numbered steps. To fold the paper plane, follow the instructions provided with the pictures.

Paper Planes Template - Student Copy:

[https://8444cc5c-82a2-4fe8-844a-2131bc9088e3.usrfiles.com/ugd/8444cc\\_20e5073d5df84ad5875c6a9dd6db12bb.pdf](https://8444cc5c-82a2-4fe8-844a-2131bc9088e3.usrfiles.com/ugd/8444cc_20e5073d5df84ad5875c6a9dd6db12bb.pdf)



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STEM TO-GO ACTIVITY

# PAPER PLANES

## MATERIALS

- 8.5" x 11" cardstock paper (can also use regular paper)
- Template
- Optional: Rubber band and Paperclip

## INSTRUCTIONS

1. Fold the template paper in half on line 1.
2. Open the paper up. Fold the top corners in on lines 2A and 2B.
3. Fold the slanted edges to the center line on lines 3A and 3B.
4. Fold in half on line 1.
5. Keep it folded, and Fold the wings out on lines 5A and 5B.

! Try folding the wings in different ways to see how it flies!



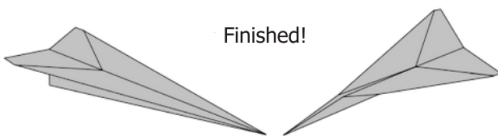
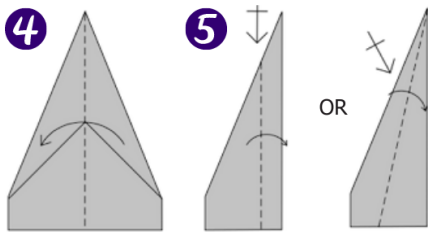
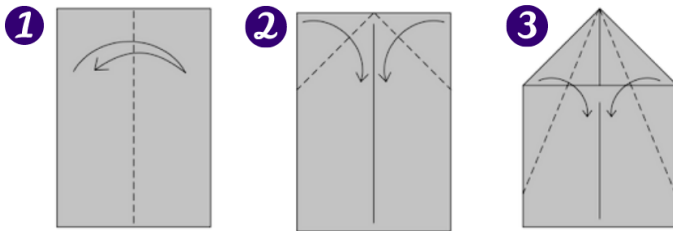
The tips of paper airplanes can sometimes be very pointy. Never shoot a paper airplane towards another person!

We recommend you watch the following video to construct your airplane if possible:



<https://www.youtube.com/watch?v=1PVA2nPU60U>

Try one of the extensions!



**FLIGHT INSTRUCTIONS**  
Hold near the back of the paper plane and throw with a quick motion.



## EXTENSION #1

Are you looking for more power? With the help of an adult, use a sharp pencil to make a hole at the front of the plane under the wings. Put the rubber band through the hole and loop it through itself. Use your finger to launch your plane and watch it soar!



Consider adding a paper clip to the front of your plane OR fold your plane in different ways to see how it flies.

## STEM TO-GO ACTIVITY

# PAPER PLANES

## EXTENSION #2 (LAUNCHER)

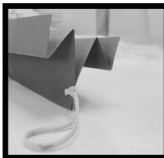
1. Fold the cardstock in half.
2. With the help of an adult, use a sharp pencil to make a hole into the cardstock in the corner 1 cm from the folded edge.
3. Fold one side of the cardstock to the folded edge. Flip it and do the same thing on the other side.
4. Create flaps by folding one side of the cardstock in half to the folded edge. Flip it and do the same thing on the other side.
5. Put the rubber band through the hole and loop it through itself.
6. Place the end stretched the rubber band to the opposite diagonal corner of the launcher.
7. Slide the paper plane into the folded opening.
8. Pull on the launcher's flaps under the rubber band to launch the airplane.

We recommend you follow the instruction on this website to construct your launcher if possible:

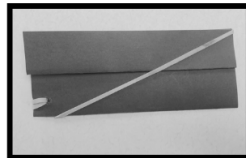


<https://frugalfun4boys.com/paper-airplane-launcher/>

1-5



6



7

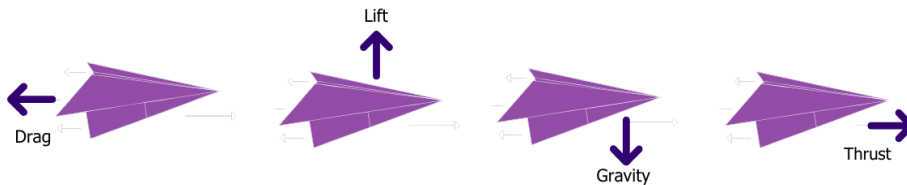


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## THE SCIENCE BEHIND IT ALL

There are **four forces** that act on object in flight - drag, lift, gravity, and thrust. When all of these forces are balanced, planes are able to fly for long distances.



If you want your plane to fly as far as possible, you need a plane with as little **drag** as possible. The pointy nose of your paper plane gives it an aerodynamic shape meaning it moves through the air easily.

**Lift** is created when the air below the plane's wings is pushing up harder than the air above it is pushing down. It is this difference that enables a plane to fly.

You need to keep your plane's weight to a minimum to help fight against **gravity's** pull to the ground.

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