LESSON 13:
RISE OF AVIATION

Students will learn about the principles of flight and test out prototypes of paper airplanes.

SUPPLIES

MAIN BIN

- Masking Tape - 4
- Ziploc
- Rubber Bands - 15

PENCIL BOX

- Pencils - 20
- Rulers - 6
- Scissors - 15
- Clear Tape - 2

BIG FOLDER

- Plain paper - 30
- Cardstock - 15

HANDOUT FOLDER

- Rise of Aviation Worksheet -15

OBJECTIVES

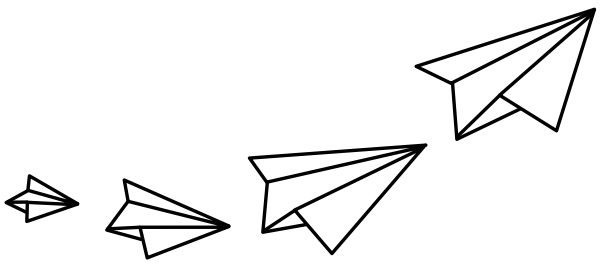
- ☑ Learn about the principles of aerodynamics
- ☑ Build paper airplanes and experiment to see how far they can travel.

HOOK

3-5 min

What do you think helps a plane fly? (Discuss.)

If you were to build a paper airplane, what elements would you want to make sure that it stayed in the air for as long as possible? (Discuss.)



INTRODUCTION

3-5 min

Before people dreamed of exploring space, they needed to get their feet off the ground and explore the skies! While the first rocket ship was built and launched in 1926, 23 years earlier in 1903 the Wright brothers were the first to successfully launch a plane off the ground. To do this, they studied birds to help them understand the mechanics of wings and aerodynamics. Aerodynamics is the study of how air moves around objects. It's a type of science called physics that focuses on the forces and the motion of objects as they travel through the air.

Thrust: When you throw your paper airplane, you are using a force called thrust. Today, you will be using a plane launcher to increase your thrust.

Lift: This is the force that keeps the plane up as the air moves around it. Airplane wings are designed to create lift, which helps the plane rise off the ground.

Drag: This is the resistance a plane faces as it moves through the air. Think about when you put your hand out the window of your car. You can feel the drag pushing your hand back.

Gravity: This is the force that pulls everything down toward the Earth. For an object to stay in the air, lift must overcome gravity.

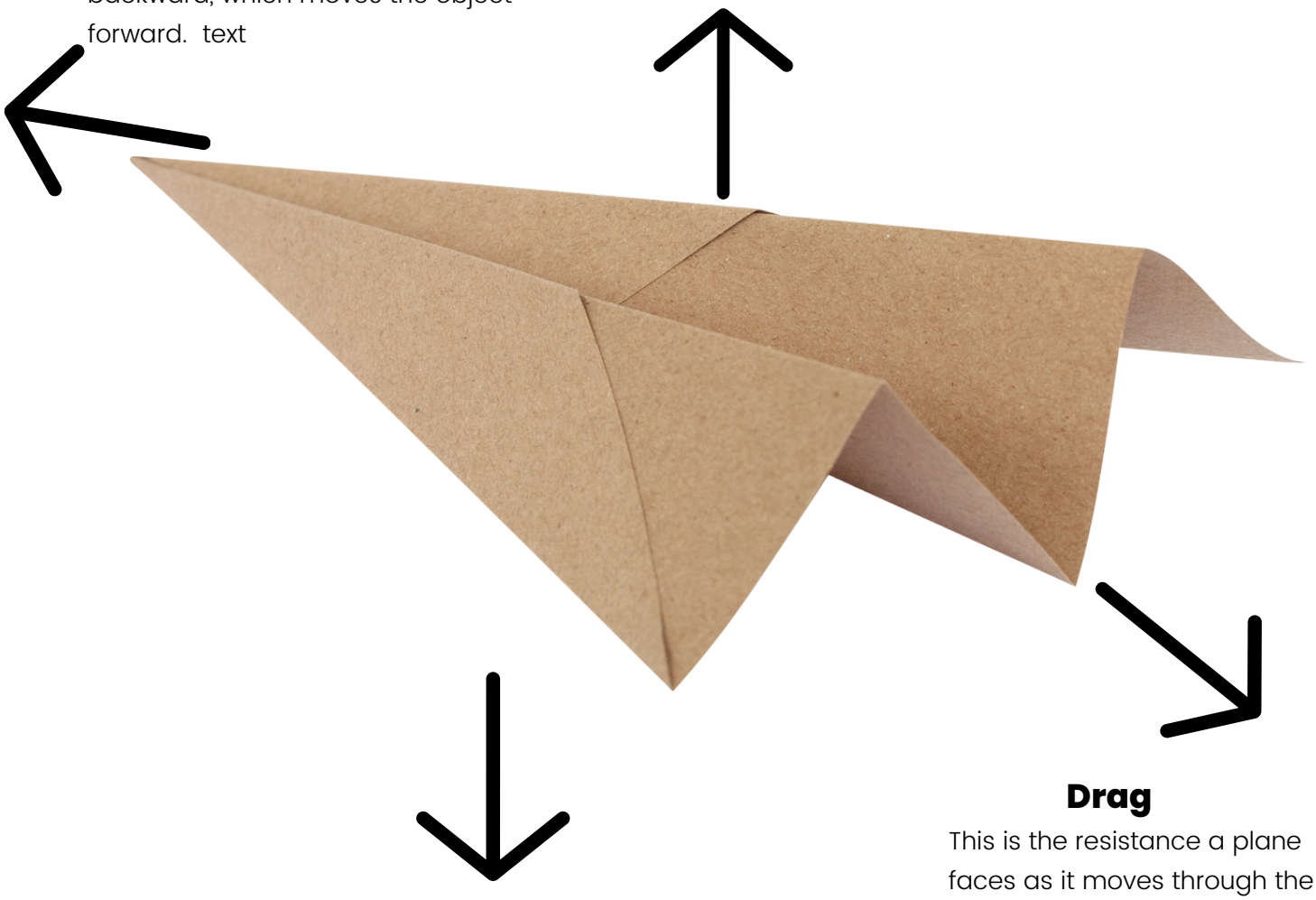
RISE OF AVIATION

Thrust

When you throw your paper airplane, you are using a force called thrust. Today, you will be using a plane launcher to increase your thrust. Engines or propellers create thrust by pushing air backward, which moves the object forward. text

Lift

This is the force that keeps the plane up as the air moves around it. Airplane wings are designed to create lift, which helps the plane rise off the ground. If the wings are aerodynamic, they allow a plane to glide smoothly and stay in the air longer.



Gravity

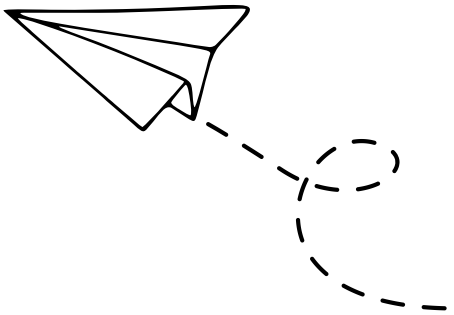
This is the force that pulls everything down toward the Earth. For an object to stay in the air, lift must overcome gravity.

Drag

This is the resistance a plane faces as it moves through the air. Think about when you put your hand out the window of your car. You can feel the drag pushing your hand back.

RISE OF AVIATION

ACTIVITY DIRECTIONS: 20-30 min



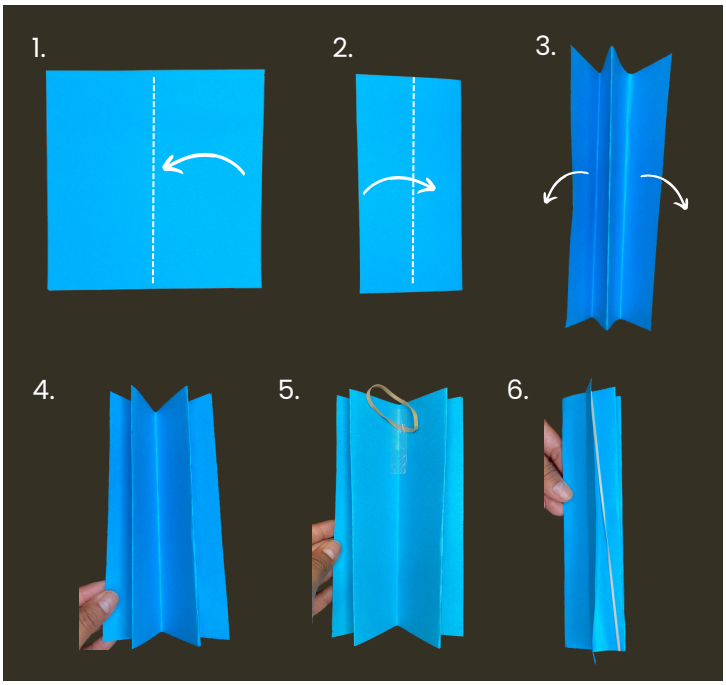
Prepare the Materials

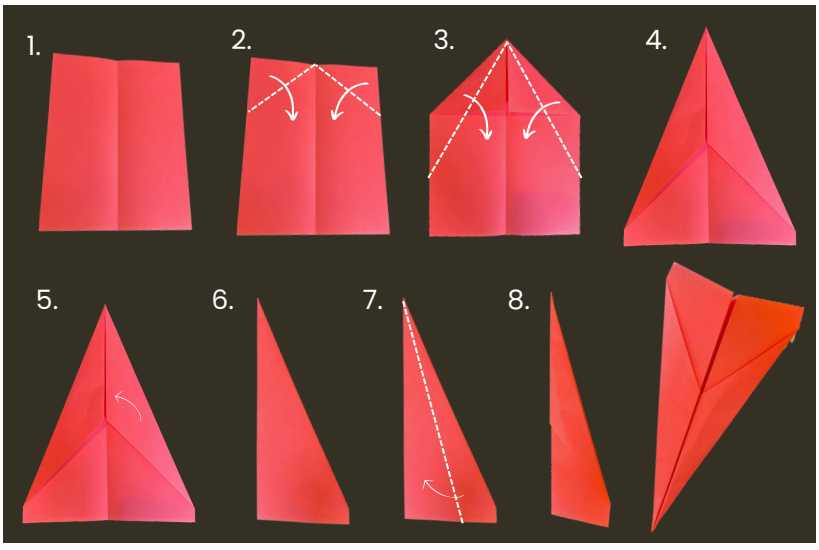
Students will be working in groups of 3 with the following materials:

- 1 ruler
- 3 pencils
- 3 scissors
- 3 rubber bands
- 6 inch piece of masking tape
- 3 sheets of plain paper
- 3 sheets of cardstock
- Clear tape (groups will need to share)

Building Your Launcher

1. Cut the cardstock into a 20 cm x 20 cm square. Then, fold the square in half.
2. Next, fold both sides from the bottom up to meet the center crease.
3. Fold the outer flaps halfway down
4. Gently open the launcher, maintaining the folds.
5. Tape the rubber band at the top center of the launcher. This will be the front of the launcher.
6. Pull the rubber band over the top of the inner fold and hook it to the back. Make sure to keep it near the top edge of fold.
7. Now that the launcher is complete, students will build their paper airplane





Building Your Paper Airplane

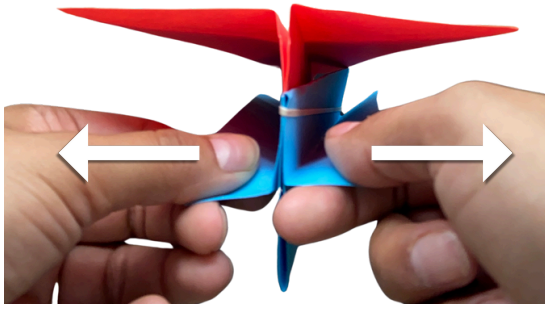
- Follow the steps pictured on the left to build a paper airplane.
- Older students can experiment with more challenging designs.
- Students can now place their paper airplane in the launcher.

RISE OF AVIATION

ACTIVITY DIRECTIONS (CONT.):

Launch

- Assign groups testing areas in the room
- Have students mark the starting point for their launcher testing with masking tape on the ground.
- Each student will perform 3 trials with their paper airplane.
- Launch the airplane with consistent force and angle each time.
- Students will measure the distance their paper airplane travels for each trial and record the data on their worksheet
- If students are able, have them calculate the average distance of their airplane's flights from the three trials.



To launch, students will need to pull the outer flaps apart.

EVALUATE AND REDESIGN

- Have students identify any issues based on their observations (e.g., instability, short distance).
- Students can brainstorm changes to make any necessary improvements.

For the Paper Airplane:

- Adjusting the wing shape or size. (To increase lift.)
- Modifying the body length or width by making small cuts or folds.

For the Launcher:

- Place the plane differently in the launcher (more towards the back or front)
- Pull more gently or more forcefully on the flaps to launch the plane.)

- After students have made modifications, they can perform another three trials following the same testing procedure listed in the "launch" section.
- Record data and observations: Measure the distances and note any improvements or new issues.

TIPS

- Aim to launch the airplane at an upward angle between 10 and 20 degrees. This angle helps the airplane gain altitude and maximize its flight distance
- Pull the outer flaps apart smoothly and quickly to achieve a more powerful launch.
- Ensure the rubber band is taut and positioned near the top edge of the inner fold.

EXTENSION

If there is time available, arrange a competition where students compete in the following categories:

- longest flight distance
- longest time aloft
- most stable flight

RISE OF AVIATION

3-5 min

OBSERVE & EXPLAIN

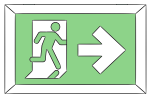
Facilitate a discussion about students' results:

- Compare results: Compare the average distances and stability between the original and redesigned airplanes.

Ask students the following questions. After they've given their answers, follow up with the explanations.

- Q: What were key engineering elements that made your design effective?

- Q: What was the ideal design for your paper airplane in terms of distance and stability, and why?
  - Reflect on the following aspects to answer this question:
    - Wing Shape and Size: Did a larger or smaller wing span lead to better flight? Was a particular shape more effective?
    - Weight Distribution: How did adding or shifting paper clips impact stability and distance?
    - Body Length and Width: Did a longer or shorter body improve the flight characteristics?
    - Material Adjustments: Were any additional materials, like tape or paperclips, beneficial in achieving the ideal design?
    - Flight Technique: Did changes in what angle you launched the airplane affect its performance?



Exit Ticket

Ask each student one of the following questions as they walk out the door.

- What similarities can you find between a rocket ship and an airplane? What are some differences?
- What is one element of flight?
  - (Lift, thrust, gravity, drag)
- Why is it important?
  - Lift helps the plane stay in the air
  - Thrust is the force that moves it forwards
  - Gravity brings the plane down
  - Drag adds more resistance.

RISE OF AVIATION

Instructions:

Measure the distance your paper airplane travels. If there is time, make modifications to your paper airplane or launcher, and test it once again.

	Trial 1	Trial 2	Trial 3	Average
Plane 1				
Revised				

Observation Notes

What part of your design worked well?
Draw or write your ideas.

What design changes can you make?
Draw or write your ideas.