National Aeronautics and Space Administration

Helicopters and Airplanes

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Lesson 5: Helicopters and Airplanes

Helicopters and airplanes provide young children with the opportunity to conceptually **synthesize what they learned about in previous lessons** with the addition of **thrust** as one of the four forces of flight (**lift, weight, thrust, drag**). In this module, children read about airplane flight and the construction of aircraft in *Clorinda Takes Flight*. Afterward, children participate in a movement-based song and then construct paper airplanes to look at the effect of surface area and mass on flight distance.

Focus Storybook

Clorinda Takes Flight

Learning Goals

Language	• Vocabulary: airplane, helicopter. • Writing: Practice writing the letters "A," "H," and "Z."
Math	• Use visual guidance to fold a glider.Identify objects as having more or less mass/weight. • Measure the distance flown by a glider.
Science / Engineering	• Design and launch a glider. • Compare how wing area affects the distance flown by a glider.

Key Q's

What is the difference between a helicopter and an airplane? What is the difference between a glider and an airplane? What is thrust?

Materials

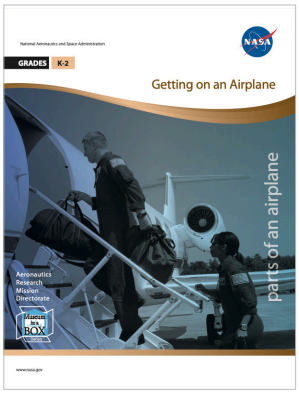
Model airplane
Audio source (for playing song)
Fan/hair dryer
Pie pan
Pencils
Notecards
Glue
Tape
Wood (6" x 12")
Large nails (2)
Hammer
Rubber band
Paper clips
Printer Paper
Rubber band airplane
Plastic whirly-bird (optional)
RC helicopter (optional)

Resources

High Flyers e-Book

Science / Engineering: Pre-Reading Activities

"Getting on an Airplane"

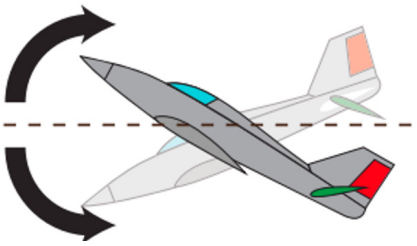


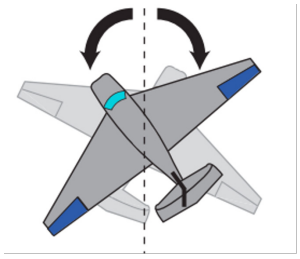
Download from NASA's Museum in a Box "Getting on an Airplane" lesson.

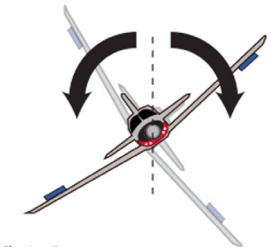
Begin the lesson by listening to the "Getting On an Airplane" song, and encouraging children to sing along to the chorus.

Before listening to the song again, have children pretend to be airplanes. Ask them to move around the room as if they were airplanes. Carefully observe their moments for examples of pitch, yaw, and roll.

When a good example of pitch, yaw, or roll is observed, ask the children to freeze. Ask the child using the appropriate motion to demonstration his/her motion to the rest of the children while the teacher explains what the movement is called. Have all children practice pitch, yaw, and roll, and explain how the motion affects flight.







Technical Term	Airplane Movement	Use of Airplane Part
Pitch	The nose of the airplane slants up or down	Pilots use the elevators on the vertical stabilizers to control pitch.
Yaw	The nose of the airplane moves side to side on the horizontal axis.	Pilots use the rudder on the horizontal stabilizer to control yaw.
Roll	The entire airplane tilts to the left or the right.	Pilots use the ailerons to control roll.

Verbal instructions for each movement can be found below:

Airplane Movement	Body Movement (from airplnae pose)
Pitch	Have each student stand with their arms outstretched, pretending they are wings. Next, have them bend forwards and backwards at the waist while keeping their head upright. This demonstrates the effect the elevator has on the airplane.
Yaw	Have one student in each pair (Student A) stand with his or her arms outstretched, representing wings. Have the other student in the pair (Student B) place his or her hands on Student A's waist. Now, have Student B twist Student A around the waist. This demonstrates the effect the rudder has on the airplane.
Roll	Place both students' chairs together so that Student A can lay face down on them, again with his or her arms outstreched. Have Student B hold the arms of Student A, rolling them from side to side on the chair. This demonstrates the effect ailerons have on an airplane.

Before listening to the song again, teach children some motions to the song lyrics:

Song lyrics: "I'm getting on an airplane" — children march

Song lyrics: "How does the plane fly?" — children tap finger to chin with questioning look

Song lyrics: "There are many parts to an airplane" — children use right index finger to point in front of them, bouncing finger in the air from right to left

Song lyrics: "To keep it moving through the sky" — children place arms in wing position, tilting up and down

Song lyrics: "It carries people and cargo" — put one hand out in front of body, slightly cupped, then with the other hand do the same

Song lyrics: "The pilot sits in the cockpit..." — pretend to grip steering wheel

Interactive Demonstration: Gliders, Planes, and Helicopters

Show students the following items:

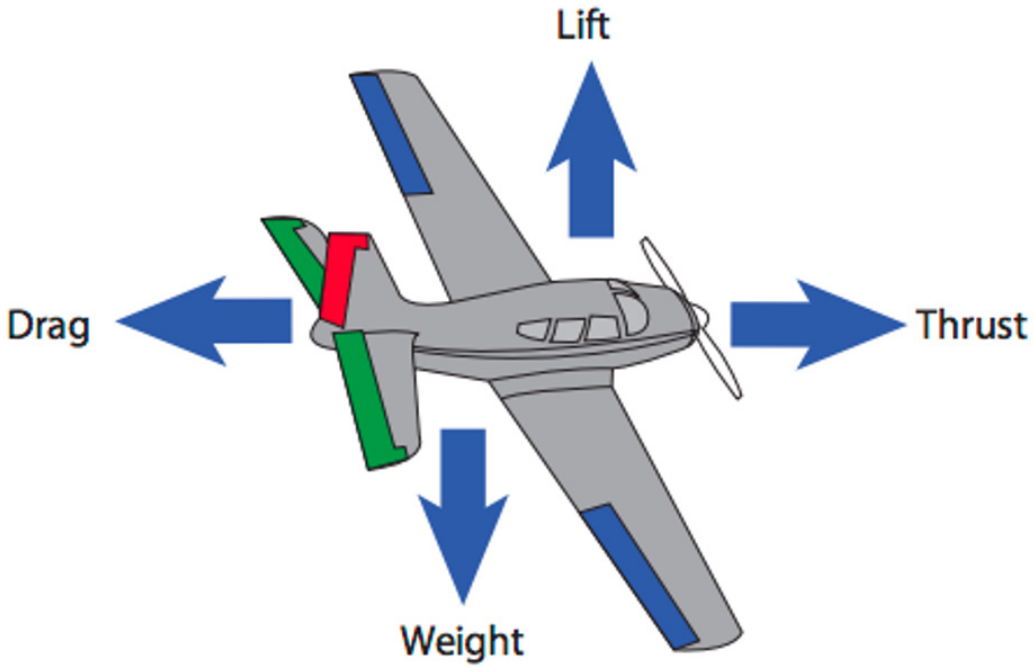
1. Paper "airplane"
2. Rubber-band airplane
3. Plastic whirlygig OR remote-control helicopter

Ask students what they view as the differences between each of these objects:

Children should notice the following:

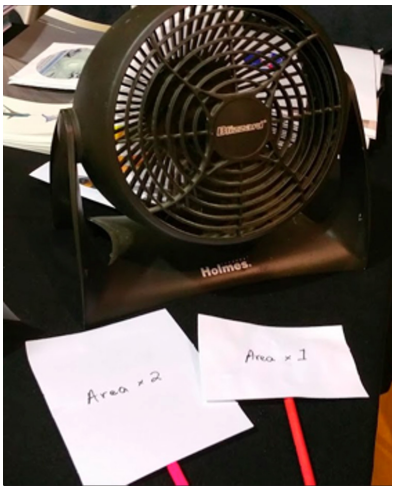
1. A paper airplane does not have a propeller (as a result, it is actually a glider, not an airplane).
2. The rubber-band airplane has a propeller (however, some airplanes have jet engines in place of propellers)
3. Helicopters have propellers, but they face up to generate lift, instead of forward on an airplane.

Help children to understand that airplanes have propellers (or jet engines) *and* wings. Propellers generate **thrust** on an airplane, while the wings generate lift.



Science/Engineering: Pre-Reading Activities

Inquiry Experiement: Surface Area, Thrust, Angle, and Distance

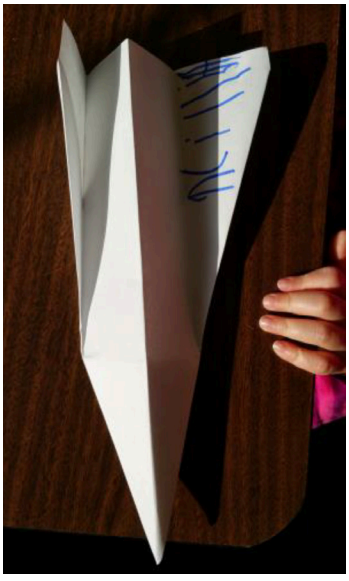


Good airplanes also tend to be good gliders. Based upon their experiences building a variety of gliders, ask children to think about what might make a good airplane. To help them see that "size" (surface area) makes a difference, have them hold two prepared pencils mounted with two postcards. Children should fee a real difference in lift, as evidenced by how far up each pencil goes before stabilizing.

Alternatively, simply ask students to hold the edge of a pie pan between their thumb and forefinger, and ask them to observe what happens to the pan when held in front of the fan. If possible, change the speed of the fan, then ask students to explain what happens to the amount of lift experienced by the pan when the air is moving more slowly or quickly. (In turn, the use of propellers on airplanes allow the plan to move faster with respect to the wind, so it generates more lift!)

Inquiry Experiement: Surface Area, Thrust, Angle, and Distance

Demonstrate and have children fold a paper airplane. Remind children that it is actually a glider, because it does not have any propellers or engines. The only thrust the paper airplane gets is during its launch phase.



Children can investigate surface area and the effect on lift (measured via the distance it goes) by launching it from an equal-thrust platform. To create paper airplanes of different surface area, consider providing children with pre-folded airplanes *before wings have been folded down*. Allow the children to choose if they want their airplane to have large or small wings. Paperclip together the central portion of the airplane (perpendicular to the ground) and then fold down the corresponding amount of paper for the wings (horizontal to the ground).

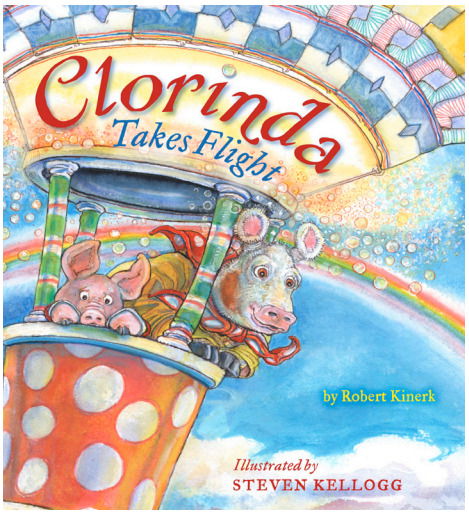
There are many different ways to fold a paper airplane, and a variety of templates can be found online. Children can test their paper airplane by simply throwing them. However, in order to fairly test paper airplanes' distance based upon differences in wing surface area, it is important that they all be launched with the same initial launch force, at the same height, and at the same angle.

Optionally, help children launch their glider from a prepared launch pad (wood, nails, rubber band, paper clips). A paper clip can be easily inserted through a hole in the nose of a paper airplane, and then hooked onto the rubber band and pulled back equal amounts for each launch. Alternatively, paper airplane launchers can be commercially purchased online for a relatively low cost.

If appropriate, have children practice using a measuring tape or counting floor tiles to quantify how far their glider went.

Allow children to change a number of variables – one at a time – to see the net result on the distance traveled. Some variables might include gliders of different surface areas (with the same mass), different amounts of initial thrust (depending upon the distance the rubber band is pulled back from its neutral position), angle (depending upon the angle of the launch pad), and the resulting distance.

Reading: Clorinda Takes Flight



Read *Clorinda Takes Flight*. Engage children throughout the story by asking them to:

- Identify the types of flying machines built by Clorinda (airplane, helicopter, rocket, hot air balloon).
- Explain the differences between each flying machine. *Airplanes and helicopters use propellers, rockets use fuel, and hot air balloons use the principle of flotation.*
- Help students to consider the engineering process:
  - How many "failures" did Clorinda experience before she was successful? What should you do when something you want to do breaks or fails the first time you try? *Clorinda's airplane*

crash-landed, her helicopter broke up, and her rocket fizzled out before take-off. Clorinda gives a great example of someonewho both tries again and is willing to continually try new ideas until one of them works.

- What was Clorinda's response when she was told by the pig that *"Cows can't fly"? Clorinda refused to give up, and found friends who were willing to support her dreams of flying. She wasnot afraid of being the first cow to fly!*
- Which of Clorinda's friends supported her efforts?

Science/Engineering: Book-Based Activities

If possible, introduce students to actual airplanes and helicopters that propel their own flight. (Rubber-band airplanes are adequate, and fairly cheap remote-controlled helicopters can be purchased from toy stores or electronic stores.) Ask students:

- How is an airplane different from a glider? (Airplanes propel themselves throughout their flight, whilegliders only get pushed initially. Paper airplanes are actually gliders, not airplanes!)
- How is an airplane different from a helicopter? (Airplanes have propellers in the front to pull themselvesforward, while helicopters have their main propellers mounted on top to pull them primarily upward.)

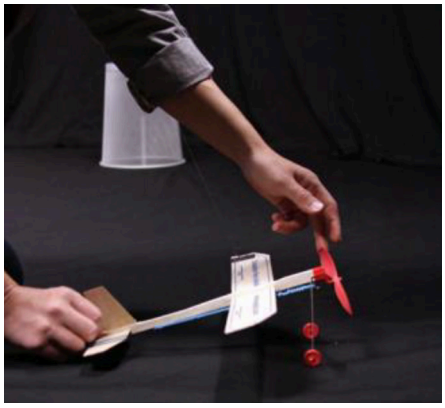
If appropriate, allow children to launch rubber-band airplanes and to practice flying a remote-control helicopter. Help students to note that, like real helicopters, remote-control helicopters can be a challenge to control/pilot. Airplane and helicopter pilots must go through a lot of training in order to learn how to safely fly.

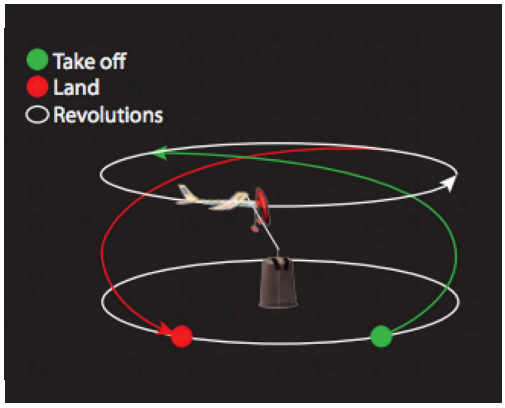
Interactive Demonstration: Aerolab

Use NASA's Museum in a Box: Aerolab activity to set up a fun interactive demonstration for students.

The use of a rubber-band airplane can be demonstrated as it flies in a straight line from ground-level in a room.

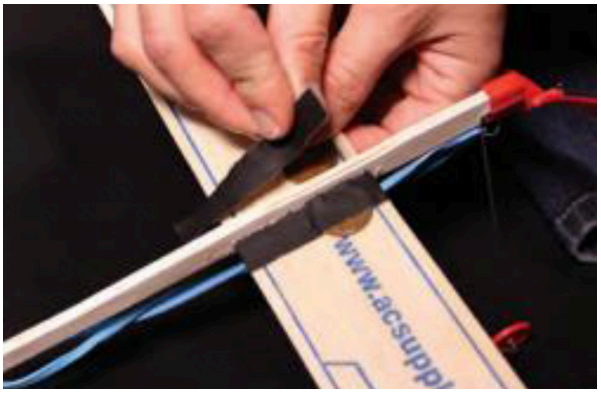
Alternatively, children can observe a rubber-band airplane as it goes in a circle, if it is mounted by a string to a heavy object, such as an inverted trash can.

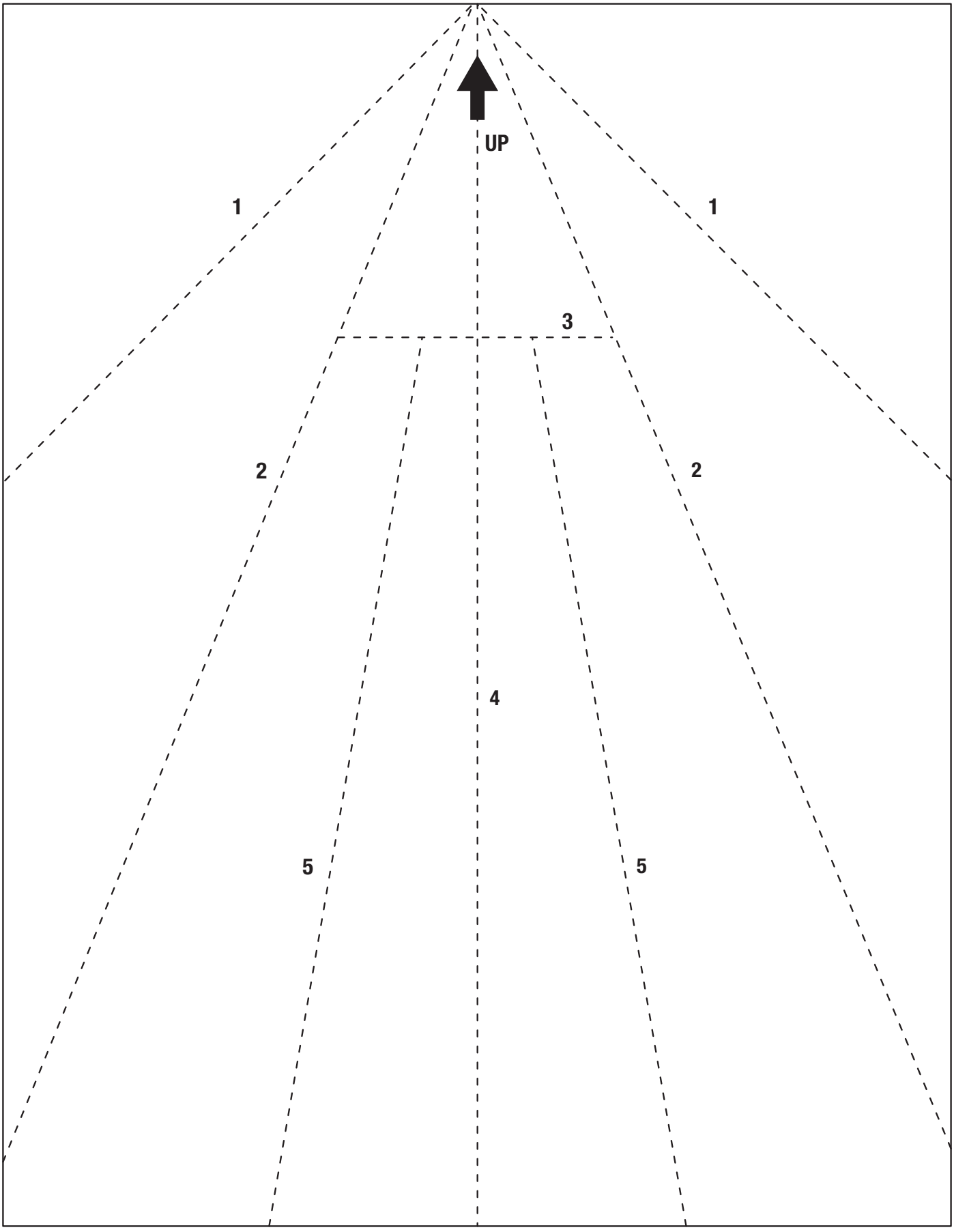




Help children to practice counting the number of revolutions taken by a rubber-band airplane. Ask children to consider what might influence how many times it flies around (a "better" plane will fly further). Consider the following:

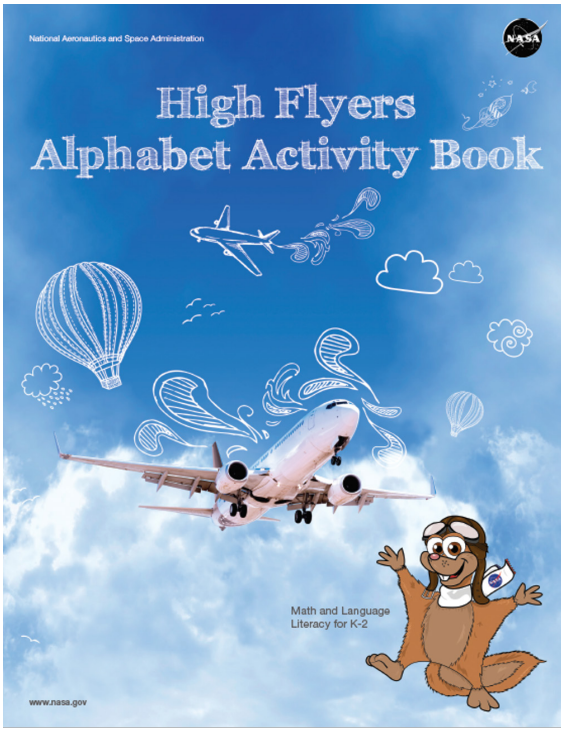
- The number of times the rubber band is twisted before release
- The amount of mass carried by the airplane (tape pennies to the wings)
- The amount of drag on the airplane (tape bits of yarn to the edges of the wings to induce drag)

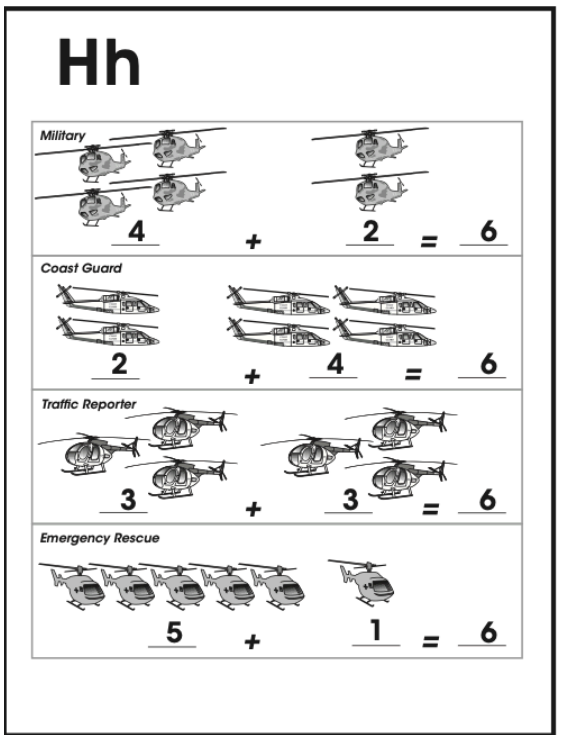


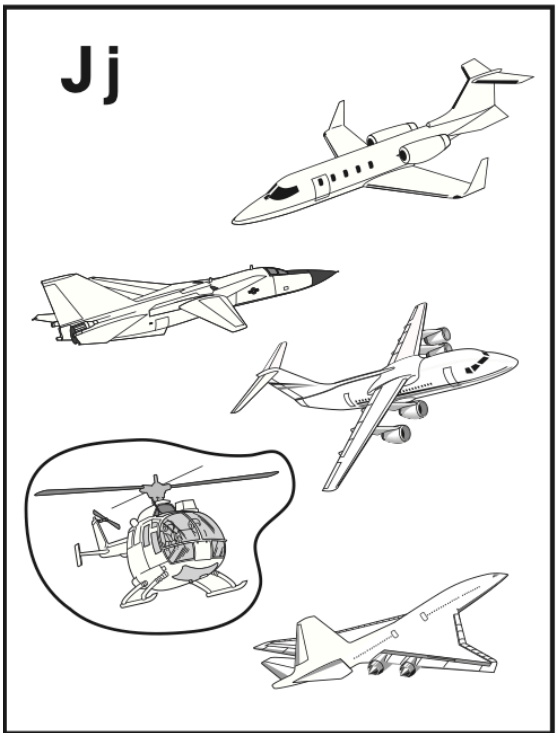

UP
1
1
3
2
2
4
5
5

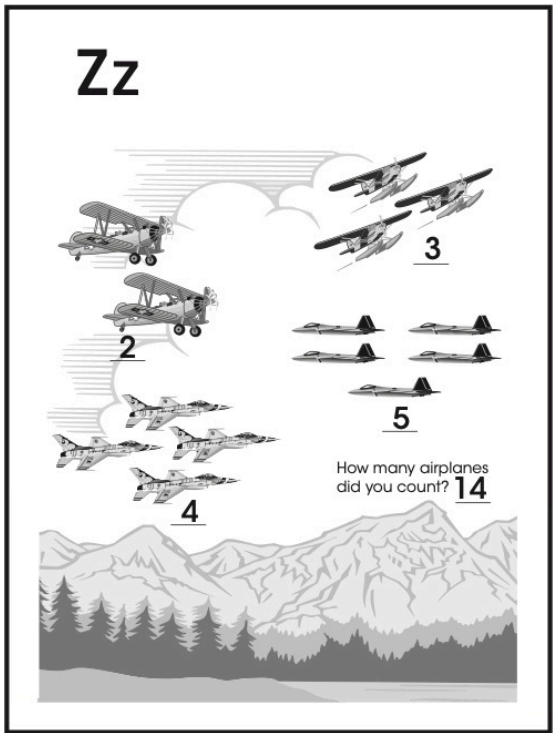
Writing: “H,” “J,” and “Z.”

Practice writing the letters H, J, and Z. Use NASA’s [High Flyers Alphabet Activity Book].







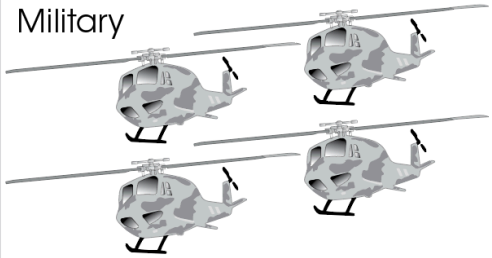


Hh Hh

helicopters

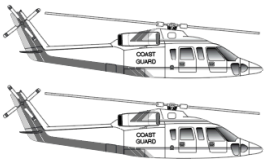
Add the **helicopters** in each group.

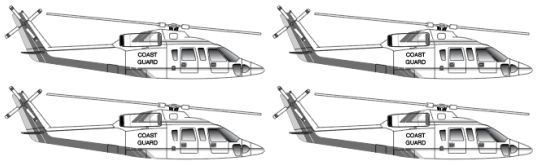
Military



____ + ____ = ____

Coast Guard





____ + ____ = ____

Traffic Reporter

____ + ____ = ____

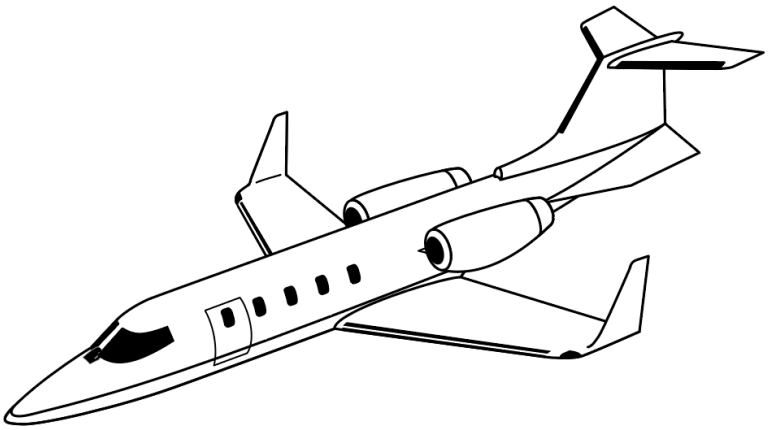
Emergency Rescue

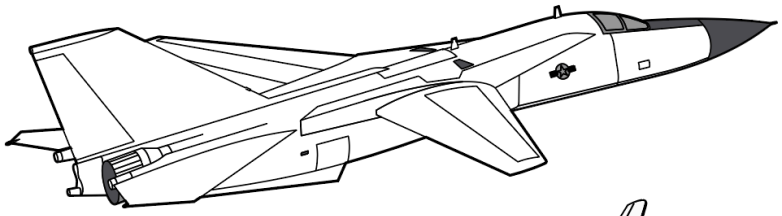
____ + ____ = ____

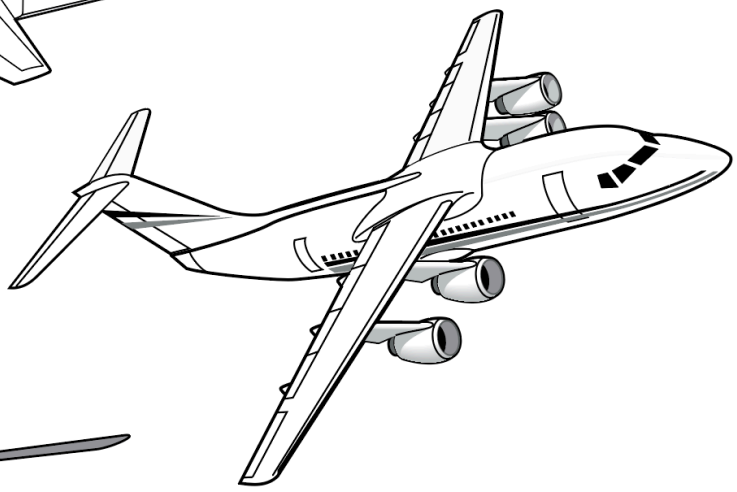
Jj Jj

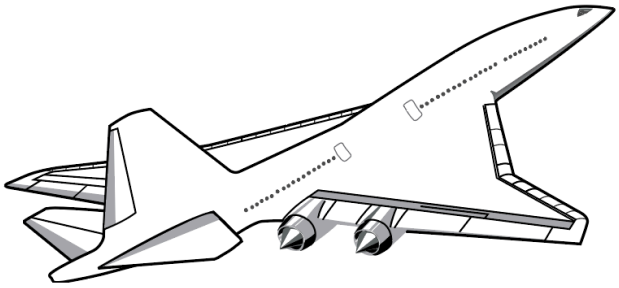
jet

Circle the aircraft that is *not* a **jet**.





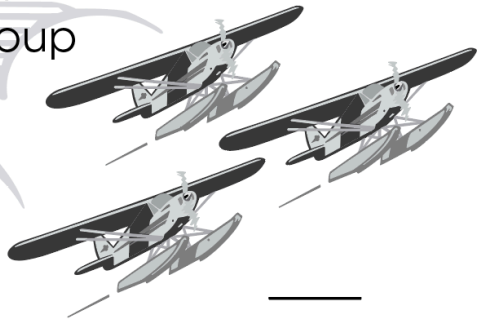


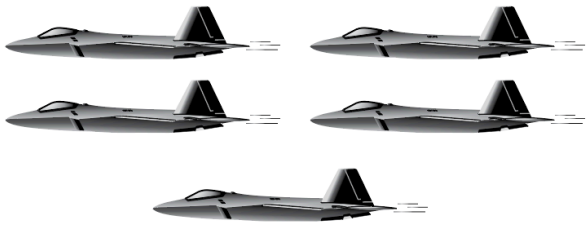


Zz Zz

zoom

Count the number of airplanes in each group as they **zoom** by.





How many airplanes did you count in all?

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