Aviation For Kids: A Mini Course For Students in Grades 2-5

Adopted from AvKids for use by the EAA

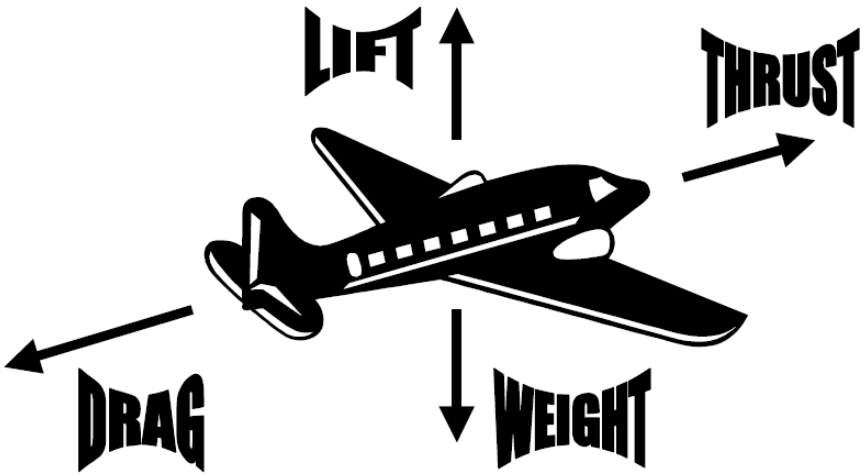
The **AvKids Program** developed by the *National Business Aviation Association* (NBAA) represents what may be the best short course in aviation science for students in grades 2-5. The following pages represent a slightly modified version of the program, with additions and deletions to provide the best activities for the development of the four forces of flight. In addition, follow up activities included involve team work problem solving in geography, writing, and mathematics. In addition, what may be the best aviation glossary for young students has been included.

Topics Covered in The Mini-Course

1. The Four Forces of Flight
2. Thrust
3. Weight
4. Drag
5. Lift
6. The Main Parts of a Plane
7. Business Aviation: An Extension of General Aviation
8. Additional Aviation Projects
9. Aviation Terms

The Four Forces of Flight

An aircraft in straight and level, constant velocity flight is acted upon by four forces: lift, weight, thrust, and drag. The opposing forces balance each other; in the vertical direction, lift opposes weight, in the horizontal direction, thrust opposes drag. Any time one force is greater than the other force along either of these directions, an acceleration will result in the direction of the larger force. This acceleration will occur until the two forces along the direction of interest again become balanced.



Drag: The air resistance that tends to slow the forward movement of an airplane due to the collisions of the aircraft with air molecules.

Weight: The name given to the gravitational force exerted on an object by a large celestial object such as a planet, moon, or star. This force is directed toward the center of the celestial body, or in the case of planes, downward, toward the center of the earth.

Lift: The upward force that is exerted on an airfoil created by the movement of air above and below the wing. This may be explained using the Bernoulli Effect, where faster air moving over the top of the airfoil exerts a lower pressure than the slower air moving across the bottom of the airfoil and/or Newton's third law, where the airfoil pushes air downward, resulting in the air pushing the airfoil upward (equal and opposite force pairs).

Thrust: ***the force that moves a plane forward through the air. Thrust is created by a propeller or a jet engine.***

INVESTIGATING THRUST ACTIVITY I

PROBLEM: How does varying the thrust affect the flight of a plane?

MATERIALS:

- Full size foam plate
- Scissors
- Masking tape
- Large paper clips
- Rubber bands
- Non-bendable straws
- Rulers
-

BACKGROUND:

Thrust is the force that moves a plane through the air. Because airplanes fly in a three-dimensional environment, the following terms refer to the various directions and airplane can move.

Pitch – to move the airplane up or down
Roll – to tilt one wing up and the other wing down
Yaw – to point the nose of the airplane left or right while remaining level with the ground
Bank – to tilt the airplane inward while making a turn

Airplanes use a variety of "control surfaces" to change the speed and direction in which they fly. These control surfaces include:

Ailerons – movable sections, hinged near the rear edge of the wing near the wing tip, that cause an airplane to roll

Flaps - moveable sections hinged on the rear of the wing, which can be lowered to increase lift and drag during takeoff or landing.

Stabilizer – the vertical stabilizer is the upright portion of the airplane tail, while the horizontal stabilizer is the small wing usually located on the back of the airplane.

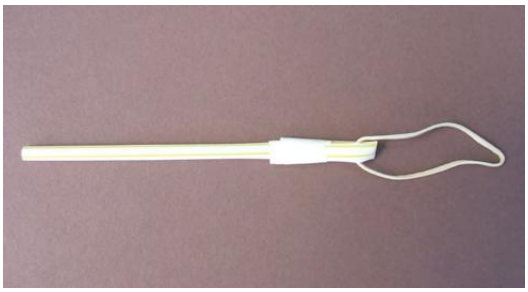
INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes
2. Have each student construct a small plane
3. Launch outside or in a large open area. Have students work in groups, so that only one member of the group launches at a time. Make sure the planes are launched away from people and objects.
4. Technical Terminology: thrust, weight, lift, drag, wings, nose, fuselage, ailerons, flaps, pitch, roll, yaw, bank

CONSTRUCTION DETAILS:

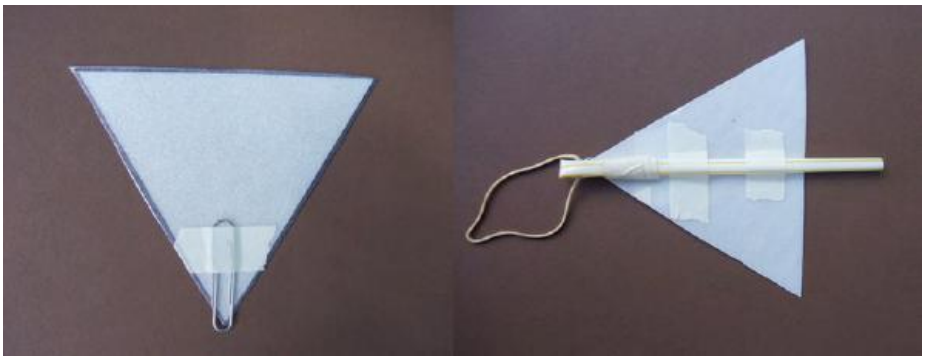
1. Give each student materials.

2. Instruct students to fold back the top three centimeters of the straw and insert the rubber band into the fold.
3. Fold the straw over the rubber band and secure the end with masking tape. This creates the launcher for the flyer.

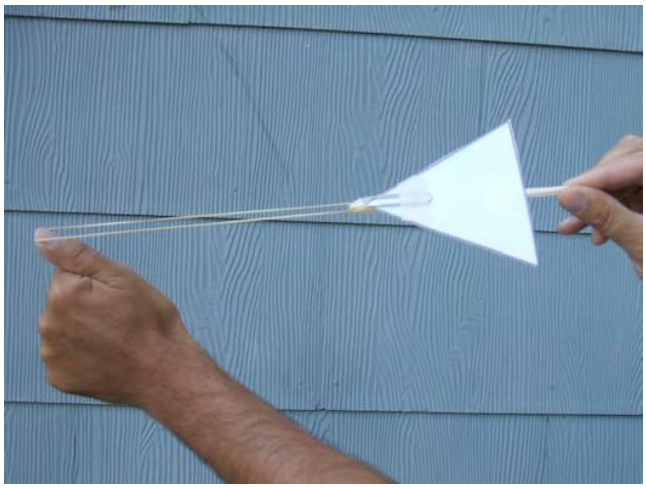


4. Instruct students to cut an equilateral triangle out of the flat side of the plate. A good size to start with is 12 cm x 12 cm x 12 cm.

5. Tape the paper clip to the top of the foam wings. Then tape the wings to the top the launcher so that it extends slightly over the tip



6. Hook the rubber band around the tip of your thumb and pull back on the opposite end of the flyer. Release the straw and the flyer will fly forward.



7. Students should vary the thrust of their planes by varying the initial stretch of the rubber bands. Using a ruler or meter stick would allow students to double the stretch and see how the distance of flight changes, all else constant

DISCUSSION:

1. How does thrust affect the flight of the plane?
2. What other factors affect how the plane flew?
3. Was your flyer successful or unsuccessful?
4. How is the thrust of your different from the thrust of a propeller plane? A jet plane? A rocket?

EXTENSIONS:

1. Students can cut flaps and ailerons into the back of the foam wings to observe changes in flight.
2. Students can alter the weight of the plane and observe changes in flight by adding paper clips behind the wings.

3. Students can add stabilizers and rudders using the left over foam and observe changes in flight.
4. Students can try varying the size of the equilateral triangle, given a constant thrust, to observe changes in flight.

INVESTIGATING THRUST ACTIVITY II

PROBLEM: How does varying the design of a straw jet, given a constant thrust, affect the distance the straw jet will travel?

MATERIALS:

- Two straws with different diameters
- Scissors
- Masking tape
- Index cards
- Tape measures
- Rulers
-

BACKGROUND:

Airplane designers try to increase airplane thrust by making more powerful jet engines and propellers. In addition, airplane designers try to get the most out of a given jet engine by working with the size, shape, and position of control surfaces, and the aerodynamic shape of the airplane.

INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes
2. Have each student construct a straw rocket
3. Launch outside or in a large open area. Have students work in groups, so that only one member of the group launches at a time. Make sure the rockets are launched away from people and objects.
4. Set up a runway using tape measures for students to launch their jets.
5. Technical Terminology: thrust, wings, nose, fuselage, ailerons, stabilize

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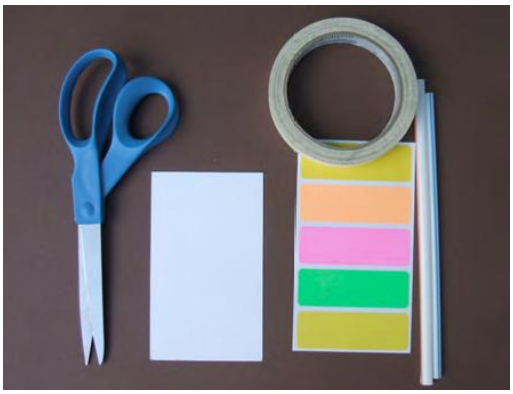
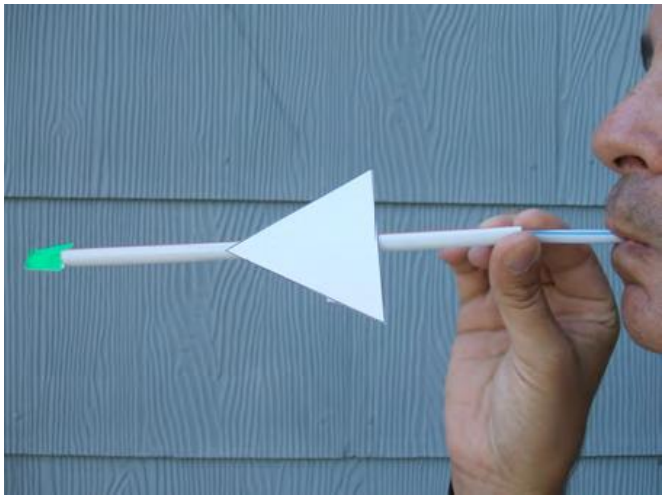


2. Wrap a piece of tape around the front end of the straw with the larger diameter so that the opening is taped shut.
3. Allow students to experiment by placing wings on different parts of the straw.
4. Insert the smaller straw into the larger straw, leaving an inch at the end of the smaller straw.
5. Demonstrate thrust by blowing into the smaller straw. This projects the jet forward/



6. If the front of the jet rises, wrap some tape near the front of it until it flies level. If the front of the jet falls, wrap some tape around the straw just behind the wings.
7. Students can practice flying the different jets within their group.

DISCUSSION:

1. What force was used to propel your jet?
2. Did your jet fly in a straight line?
3. What, if any, changes did you make to help your jet fly straighter?
4. What design feature increased the distance?

EXTENSIONS:

1. Students can put their best design in a competition to see who wins the distance award.
2. Different levels of thrust can be used to see how this affects the stability of flight.

INVESTIGATING THRUST ACTIVITY III

PROBLEM: What causes a balloon to move forward?

MATERIALS:
- Balloon (tubular works best) straws
- Spool of fishing line (4 lb test is fine)
- Scotch tape

BACKGROUND:
Thrust is the force created by a power source that moves a plane forward, either from a propeller or a jet engine. When the thrust is greater than the drag, the airplane will accelerate forward. This activity demonstrates Newton's 3rd Law of Motion: For every action, there is an equal but opposite reaction (forces ALWAYS occur in pairs). The balloon pushes the exiting air backwards, while the exiting air pushes forward on the balloon. The forward push of the air on the balloon is what we label thrust.

INSTRUCTIONAL DETAILS:
1. Time Allotment: 45-60 minutes
2. Have students work in groups of 3-4.
3. Fishing line should be cut to run the length of the room
4. Each group should have a designated "balloon inflator" to try to control the inflation levels of the balloon.

CONSTRUCTION DETAILS:
1. Thread fishing line through a straw and attach both ends of the fishing line securely to a wall or other object. The line should be taut.
2. Instruct students to blow up their balloons to the desired size, measure its length, and pinch off the end of the balloon so that no air is released.
3. Tape the balloon to the straw.

4. Students should release the balloon from a designated spot and measure and record the distance the balloon travels.
5. Repeat the procedure two more times with balloons that are inflated to the same size (vary balloon sizes from group to group, if possible).
6. After all groups have completed the activity, compare the results (tabulate on a chalk board of dry erase board so all may view the data)

DISCUSSION:

1. What makes the balloon jet travel forward?
2. Does the length of the balloon jet make a difference as to how far it travels? Why?
3. What else could affect the distance a balloon jet will travel?

EXTENSIONS:

1. Students could repeat the activity using different size or shape balloons.
2. The tautness of the line could be altered.
3. The angle of the line can be changed to show the effect of forward thrust.
4. Students can insert different sized straws into the opening of the balloon to observe and measure changes in the distance the balloon jet travels.

The Four Forces of Flight

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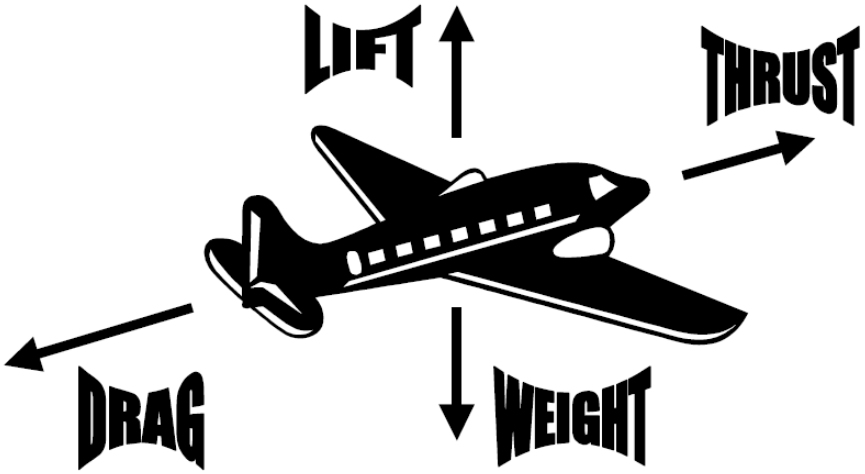

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Lift: The upward force that is exerted on an airfoil created by the movement of air above and below the wing. This may be explained using the Bernoulli Effect, where faster air moving over the top of the airfoil exerts a lower pressure than the slower air moving across the bottom of the airfoil and/or Newton's third law, where the airfoil pushes air downward, resulting in the air pushing the airfoil upward (equal and opposite force pairs).

Thrust: the force that moves a plane forward through the air. Thrust is created by a propeller or a jet engine.

INVESTIGATING DRAG ACTIVITY I

PROBLEM: How does a parachute create drag for a falling object?

MATERIALS:
- One plastic grocery bag with handles
- One clothespin

BACKGROUND:
Drag is the force that acts against the relative motion of an object with respect to air due to the collisions between air molecules and the object. This force acts in a way such that it decreases the relative motion of the object with respect to air.

INSTRUCTIONAL DETAILS:
1. Time Allotment: 30 minutes
2. Have students work in pairs.
3. Have students take turns dropping the parachutes.
4. Have students release from an open stairwell or up on the counter top to get more starting height.
5. Technical Terms: drag, parachute, weight, descent, streamline, paratrooper, drag chute.

CONSTRUCTION DETAILS:
1. Bring the handles of a grocery bag together and secure with a clothespin.

2. First, the students drop the parachute from a chair-standing height. With the grocery bag first crumpled up, observe the descent of the clothespin.
3. Next, students open up the parachute fully and drop it from the same height. Observe the descent of the clothespin.

DISCUSSION:

1. How does a parachute create drag for a falling object? What is the direction of the "drag force" acting on a parachute?
2. What were the differences they observed between the two drops?
3. How does drag affect the flight of an airplane? What is the direction of the "drag force" on a horizontally flying airplane?
4. Would increased weight require a larger parachute? Why?
5. How does drag affect the launch of the space shuttle? What is the direction of the "drag force" during the initial launch of the space shuttle?

EXTENSIONS:

1. Have students try different sized parachutes, using one clothespin (weight constant).
2. Using coffee filters, compare the following situations:

Simulating more weight, constant surface area
1 filter vs. 2 filters (nested) vs. 3 filters (nested) vs. 4 filters (nested)

Simulating more weight and more surface area
1 filter vs. 2 filters (side-by-side) vs. 3 filters (side by side) vs. 4 filters (side by side)

INVESTIGATING DRAG ACTIVITY II

PROBLEM: How does a drag-chute create drag for a moving object?

MATERIALS:
- Garbage bags (large, heavy duty bags work best)
- Tape
- Stopwatch

BACKGROUND:
Drag is the force that acts against the relative motion of an object with respect to air due to the collisions between air molecules and the object. This force acts in a way such that it decreases the relative motion of the object with respect to air. This activity lets students feel the force of drag. Airplanes are designed to be sleek so that drag is reduced, allowing easier movement through the air.

INSTRUCTIONAL DETAILS:
1. Time Allotment: 45-60 minutes
2. Have students work in groups of four, taking turns running and timing.
3. Construct the drag chutes in the classroom. Running will take place outside on a 20-30 m “runway”.
4. Garbage bag chutes should be at least one square meter. This may require the taping of bags together.

CONSTRUCTION DETAILS:
1. Each group should make a garbage bag chute. To do this, cut along one side and the bottom of the bag. This will make one flat sheet. Make sure it is at least one square meter. If it is not, tape another bag to it.
2. Two students run from the starting line, side by side, holding the drag chute that is rolled up between them. The timers measure and record how long it takes the pair to cover the designated distance.

3. The same two students now repeat the run with the drag-chute unfurled. The timers measure and record how long it takes the pair to cover the designated distance.

DISCUSSION:

1. Explain how the different situations felt while running?
2. Do you think a larger chute would cause you to run even slower? Why?
3. What caused the force which slowed you down?
4. How are airplanes designed to keep the drag force in mind?

EXTENSIONS:

1. Have students try different sized drag chutes and/or run at different speeds

INVESTIGATING DRAG ACTIVITY III

PROBLEM: How does drag affect the motion of the balloon rocket?

MATERIALS:
- Balloon (tubular works best)
- Straws
- Spool of fishing line (4 lb test is fine)
- Scotch tape
- Paper plates (8-1/2” diameter)
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BACKGROUND:
This activity is the same as Investigating Thrust Activity III, but emphasizes how drag slows down the jet.

INSTRUCTIONAL DETAILS:
1. Time Allotment: 45-60 minutes
2. Have students work in groups of 3-4.
3. Fishing line should be cut to run the length of the room
4. Each group should have a designated “balloon inflator” to try to control the inflation levels of the balloon.

CONSTRUCTION DETAILS:
1. Thread fishing line through a straw and attach both ends of the fishing linesecurely to a wall or other object. The line should be taut.
2. Instruct students to blow up their balloons to the desired size, measure its length, and pinch off the end of the balloon so that no air is released.
3. Tape the balloon to the straw.
4. Students should release the balloon from a designated spot and measure and record the distance the balloon travels.
5. Repeat the procedure two more times with balloons that are inflated to the same size (vary balloon sizes from group to group, if possible).
6. Repeat procedure 2-5, adding a paper plate to the front of the balloon jet (be sure the paper plate does not get caught on the line).

7. After all groups have completed the activity, compare the results (tabulate on a chalk board of dry erase board so all may view the data)

DISCUSSION:

1. Which jet configuration went the shorter distance? Why?
2. Why is it important for an airplane to have less drag?
3. How are airplanes designed to overcome drag?

EXTENSIONS:

1. Students could repeat the activity using different sized plates.
2. Students could repeat the activity using different shapes.

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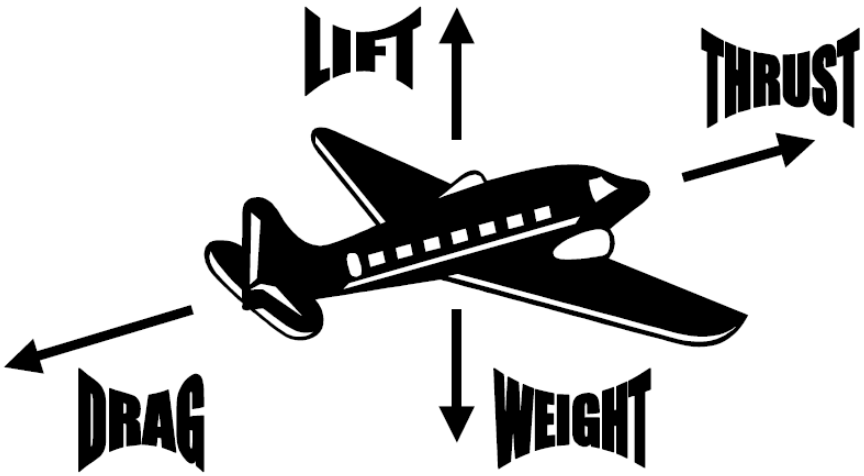

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INVESTIGATING WEIGHT ACTIVITY I

PROBLEM: How does lift act against weight?

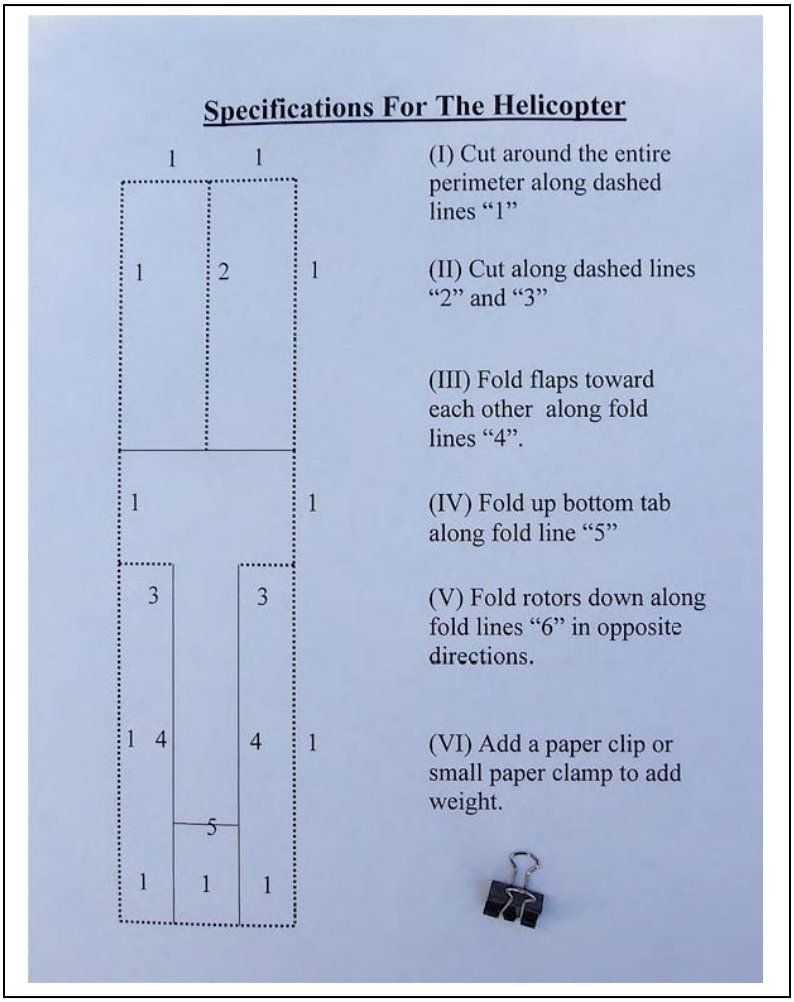
MATERIALS:
- Scissors
- Staplers
- Stopwatch
- Diagram of paper rotary craft

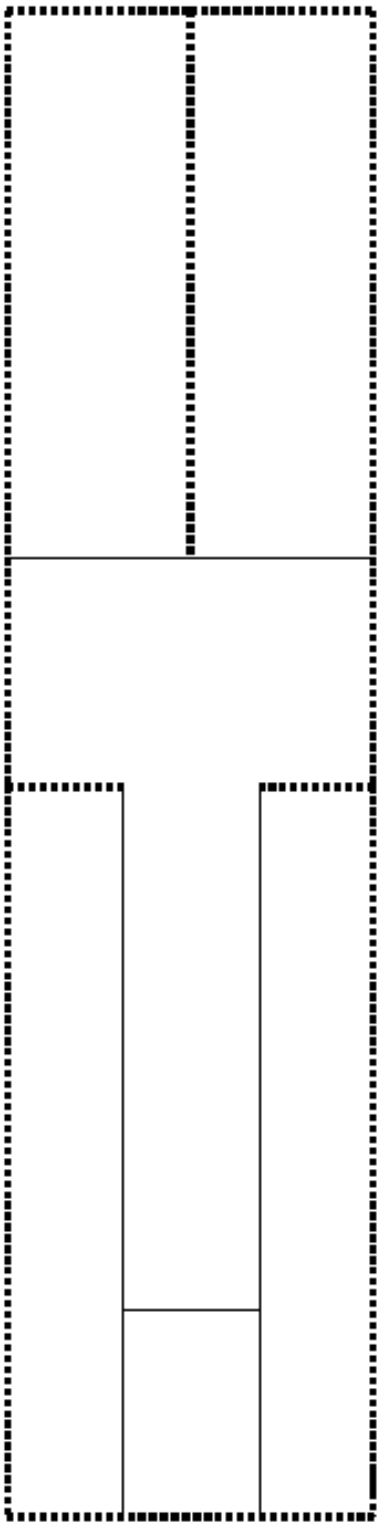
BACKGROUND:
Weight is the force pulling the plane down (ultimately, toward the center of the earth). When weight (down) is greater than lift (up), the plane accelerates downward. Helicopters are really airplanes with moving wings called rotors, which replace the fixed wings and propellers on an airplane. A helicopter rises for the same reason an airplane flies: the movement of the air results in a pressure on the bottom of the rotor blades (wings) that is greater than the pressure on the top of the rotor blades (wings).

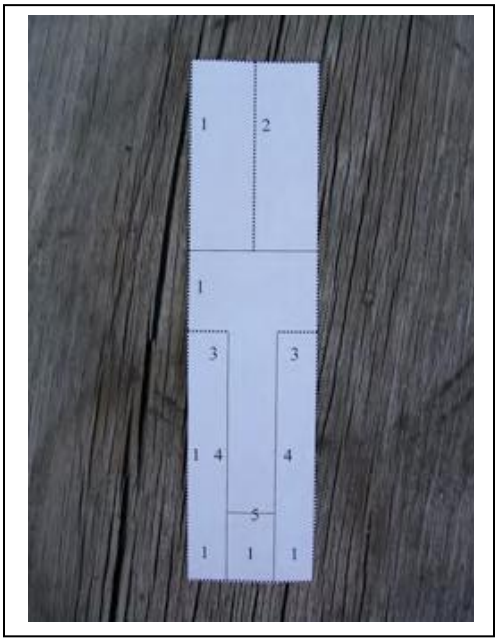
INSTRUCTIONAL DETAILS:
1. Time Allotment: 45-60 minutes
2. Have students work in groups of 3-4.
3. Each student should make his or her own paper rotary craft.
4. Technical Terms: weight, rotation, rotary wing, pull, aloft, descent, air-traffic controller.

CONSTRUCTION DETAILS:
1. Using the diagram of the paper rotary craft with directions, each student should construct their individual paper rotary crafts.

Duplicate or construct the template shown below.

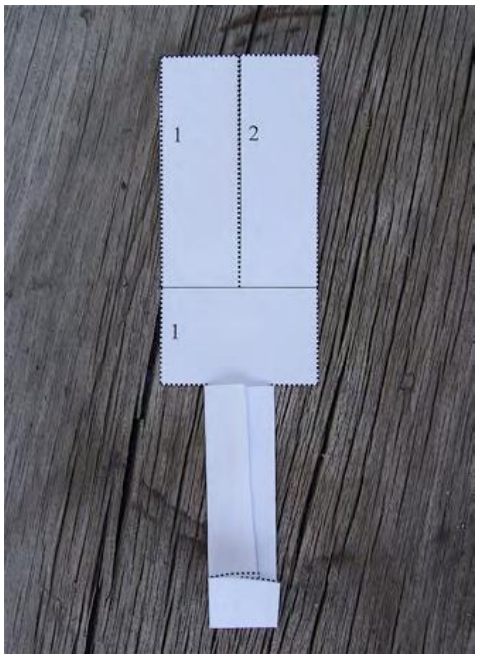






- Cut around the entire perimeter along dashed lines “1”.

- Fold along dashed lines “2” and “3”. Fold flaps towards each other along fold lines “4”. Fold up bottom tap along fold line “5”.



- Fold Blade 1 back and Blade 2 forward.

2. Within each group, students should test their paper rotary crafts by dropping from an elevated height. Students should time the descent of each person’s craft.
3. Each group should choose the paper rotary craft that has the longest descent time for the remaining activities.

4. As a group, decide on a “dropper”, “timer”, “recorder”, and “spokesperson”.
5. Measure and record the time it takes the paper rotary craft to fall from a designated height above the ground. Run several trials and average the times.
6. Add a paper clip to the bottom of the paper rotary craft and repeat #5.
7. Add two paper clips to the bottom of the paper rotary craft and repeat #5.
8. Continue adding paper clips to the bottom of the paper rotary craft, until a total of 10 paper clips have been added.

DISCUSSION:

1. How did the paper clips affect the paper rotary craft?
2. What has to be true of lift and weight when a helicopter hovers at a constant altitude?
3. What has to be true of lift and weight when a helicopter accelerates upward?
4. What has to be true of lift and weight when a helicopter accelerates downward?

EXTENSIONS:

1. Students could try various designs and/or materials for their rotary craft?
2. Students could vary the drop height and see if doubling the height results in a doubling of the drop time, etc.

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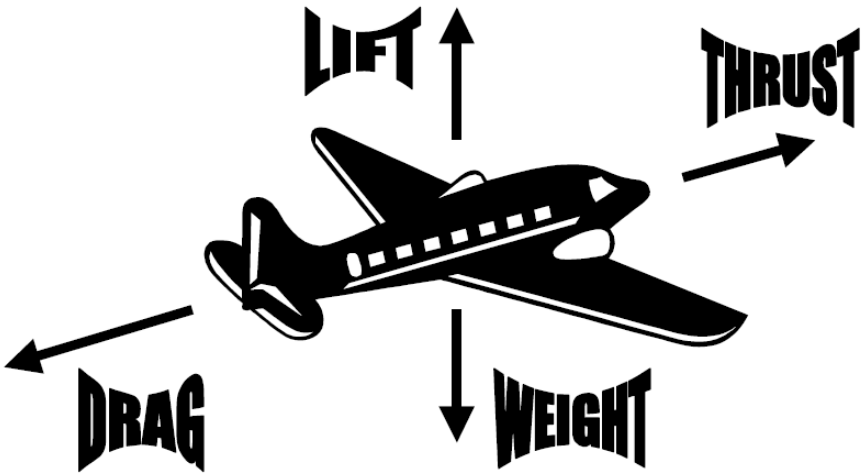

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Thrust: the force that moves a plane forward through the air. Thrust is created by a propeller or a jet engine.

INVESTIGATING LIFT ACTIVITY I

WING ON A STRING

(Modified from the Rochester Museum and Science Center, Rochester, New York for the EAA)

MATERIALS:

- Paper
- Transparent tape
- Sharp pencil
- Drinking straw
- Thread or very thin string
- Tape
- Hairdryer
- Template of air foil to be cut out

BACKGROUND:

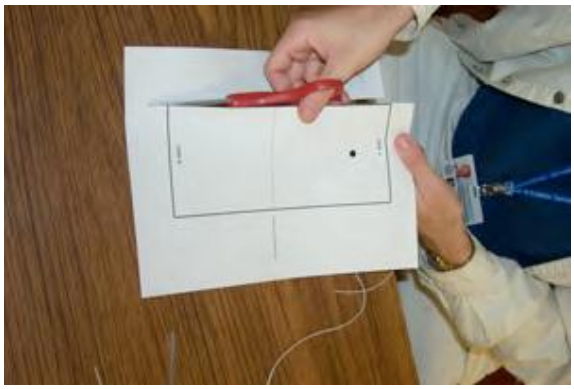
Lift is created by the curved shape of the wing, which causes the air to move faster over the top of the wing than the bottom. According to the Bernoulli principle, this results in the air pressure above the plane's wing being less than the air pressure below. Thus, there is a net upward force on the wing due to the motion of air over both surfaces of the wing. Provided the lift on both wings of an airplane is greater than the weight of the plane, the plane will accelerate upward. If the lift due to the wings is equal to the weight of the plane, the plane neither accelerate upward, nor accelerate downward.

INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes
2. Have students work individually.
3. Each student should make his or her own airfoil
4. Technical Terms: air foil, Bernoulli Effect, pressure

CONSTRUCTION DETAILS:

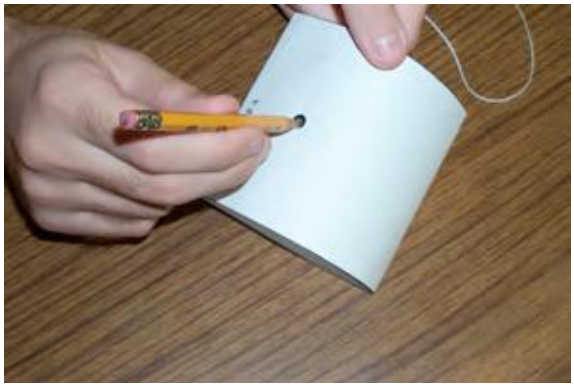
1. Cut out the wing's shape along the dark solid line. (Template at the end of the instructions)



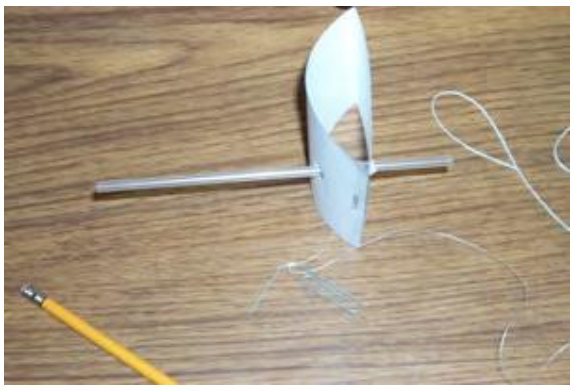
2. Fold along the dotted line. One half is 1/2” shorter than the other.

3. Tape Side 1 to Side 2, such that, the bottom side is flat and the top is curved like an arch.

4. Use a pencil to make a hole where the black dot is, and poke straight through to the other side of the wing, so that the pencil can slide in one end and out the other.



5. Push a straw through the hole and attach it to the top and bottom of the wing with two small pieces of tape.



6. Cut the straw so as little of the straw is above or below the wing as possible.

7. Feed some thread through the straw and tie the end that is on the flat side of the wing (Side 2) to a paper clip.

8. Tie the end of the string with the paper clip to the arm of a chair or another secure spot.

9. Hold the other end of the string in the air so that the string is up tight and pointing up and down.

10. Experiment with the hair dryer and/or a box fan pointed at the wing on a string and observe what happens.
11. Trying holding both the top and bottom of the string and
    a) Run down the hall
    b) Spin very quickly in place

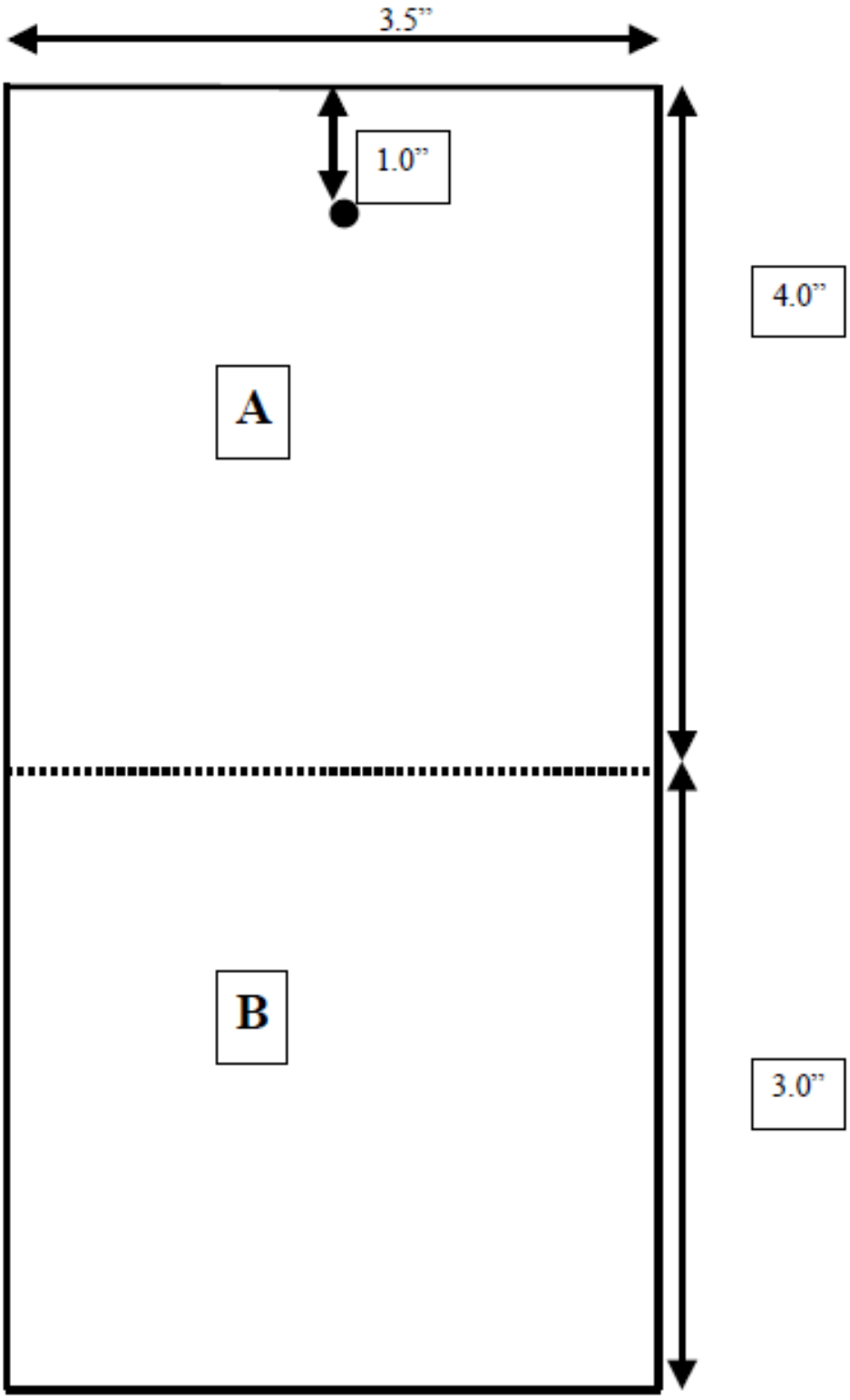
DISCUSSION:

1. Did the wing behave the way you thought it would?
2. What are other everyday examples of the Bernoulli Effect?

EXTENSIONS:

1. Another explanation for lift occurs utilizing Newton's 3rd Law and the downward deflection of oncoming air by the airfoil, resulting in an upward reaction force. Try constructing an airfoil that could demonstrate a Newton's 3rd law Lift.

Wing on a String Template



INVESTIGATING LIFT ACTIVITY II

PROBLEM: How does the design of the airplane affect the lift?

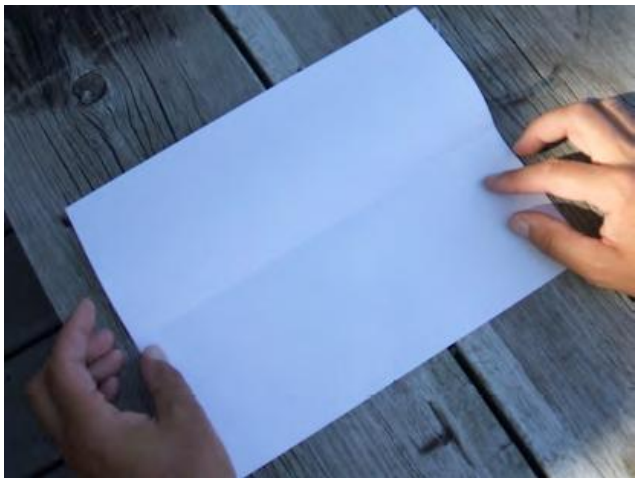
MATERIALS:
- Several 8 ½ x 11 sheets of paper
- Stopwatch
- Instructions for two different paper airplanes

BACKGROUND:
Lift is created by the shape of the wing, which makes the air pressure above the plane's wing less than the pressure below. This causes the plane to lift upward. When the lift is greater than gravity, the plane goes up.

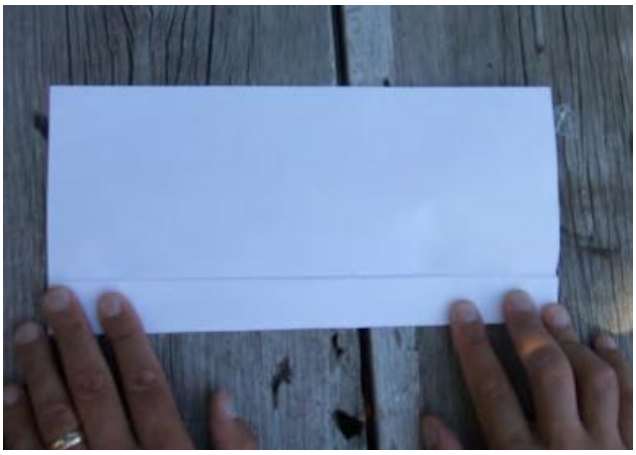
INSTRUCTIONAL DETAILS:
1. Time Allotment: 45-60 minutes
2. Have students work in pairs. While one student pilots the flight, the other student times the flight.
3. Technical Terms: lift, descent, ascent, landing, aloft, design, fuselage, wing, nose, elevators, rudder

CONSTRUCTION DETAILS:
1. Each pair constructs the two different designs of airplanes.

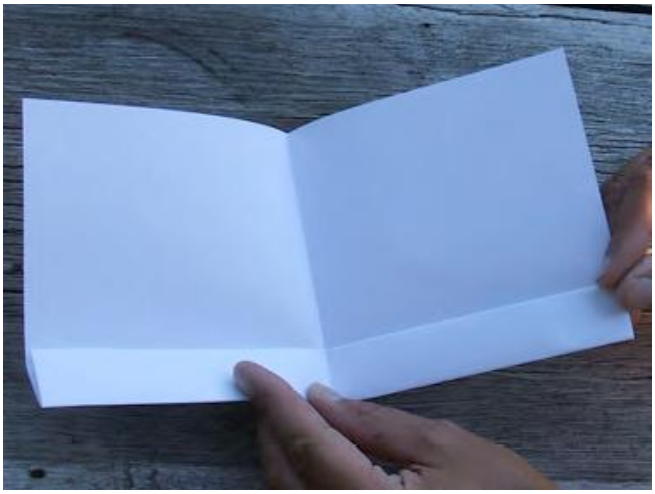
   Paper Plane Model #1 (Courtesy AvKids)
   - Take an 8- ." x 11" sheet of paper, fold it in half lengthwise and open it flat again



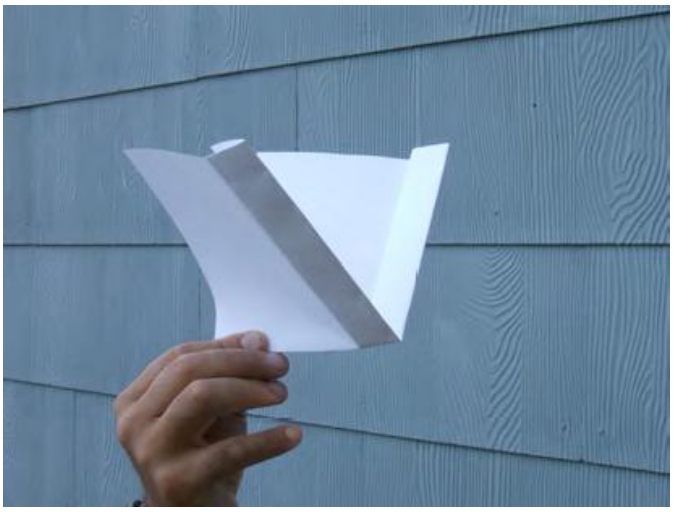
- Fold the bottom edge to the middle crease. Fold it again making four thicknesses.



- Crease the folded part at its midpoint, causing a slight angle in the wing.

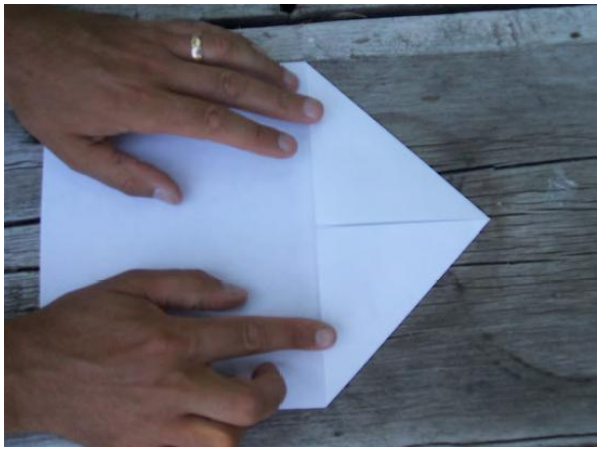


- Hold at the back of the wing and launch with a gentle forward thrust.

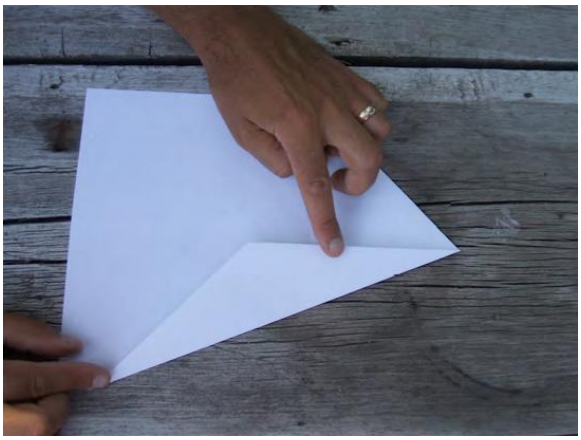


Paper Plane Model #2

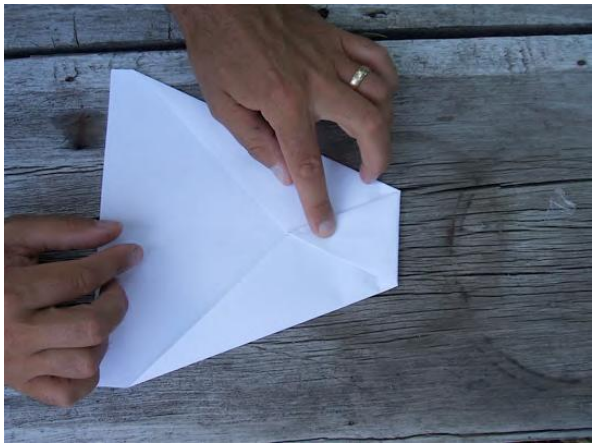
- Fold the top left and top right corners, such that, they meet at the mid-line of the 8-1/2” x 11” sheet of paper



- Fold the left and right folds over again, such that, they again meet at the mid-line.



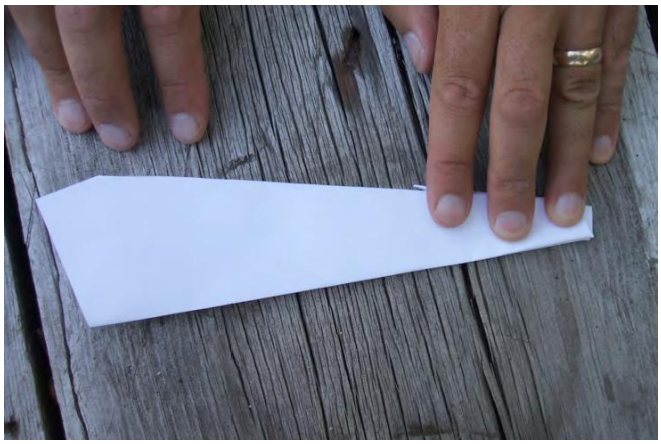
- Fold the tip down, such that, the tip ends up at the vertex of the other two sides.

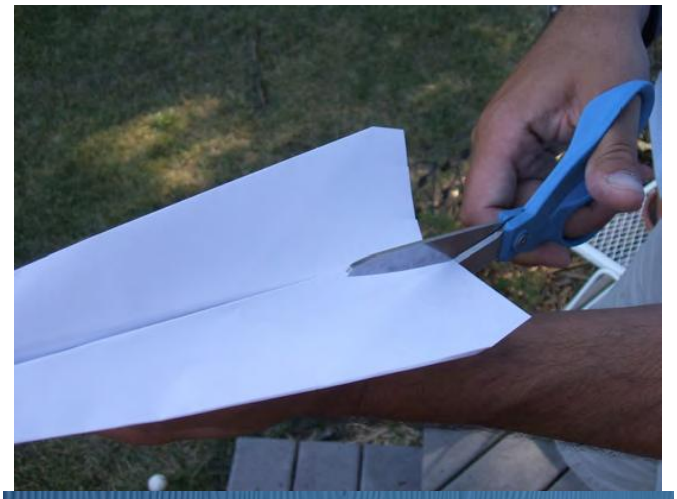


- Flip the paper over and fold the left side to the right side, such that, the outside edges of the wings line up.

- Fold the wings down, such that, the outer edge of the wing lines up with the base of the center section. Cut two slits, one inch apart, along the

back edge of each wing for elevator adjustments. You can add wing dihedral by tilting the wings slightly upward. Now, you are ready to fly.





2. One pilot will fly his or her design at the timer's signal.
3. The timer starts at release and stops upon landing.
4. As a group, decide on a "dropper", "timer", "recorder", and "spokesperson".

5. Measure and record the time for each of five trials for both planes. Calculate the average time aloft for each type of plane.
6. Determine a class average for each type of plane.

DISCUSSION:

1. How does the design of the plane affect lift?
2. What features of the plane kept it aloft the longest?
3. What features of the plane kept the plane from staying aloft?
4. How does this activity show how a plane stays aloft?

EXTENSIONS:

1. Students can add elevators to their planes and observe changes in flight.
2. Students can add rudders by folding the base of the fuselage.
3. Challenge students to design an airplane that will remain aloft the longest.

INVESTIGATING LIFT ACTIVITY III

PROBLEM: Compare and contrast loop planes and tube planes.

MATERIALS:

- One straw
- Design patterns
- Several 8 . x 11 sheets of paper
-

BACKGROUND:

The loops cause enough lift to keep the plane in air. As it descends, the top part of the loop catches the air and helps the plane stay aloft.

INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes
2. Have students work individually.
3. Technical Terms: lift, thrust, weight, drag, loop, tube

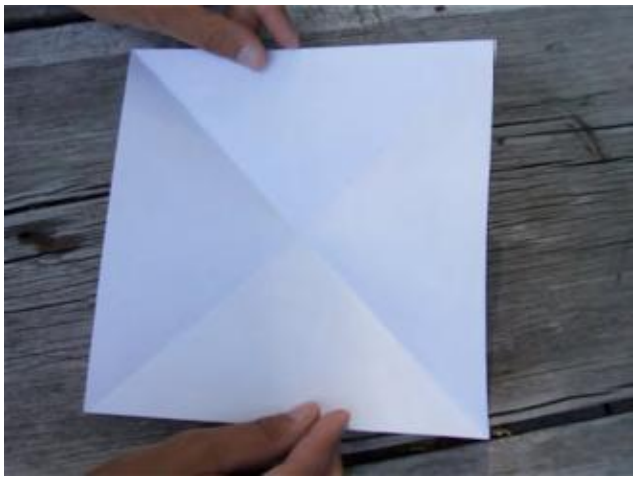
CONSTRUCTION DETAILS:

1. Give each student the materials and have them construct the loop and tube planes.

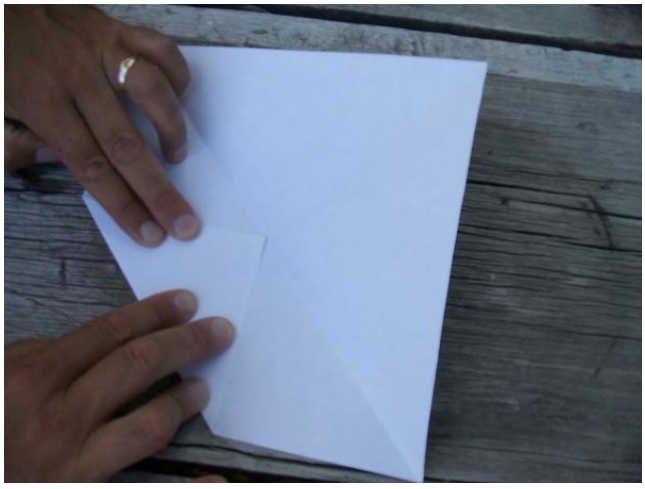
Flying Cylinders/Tubes

Tube Plane (Courtesy AvKids)

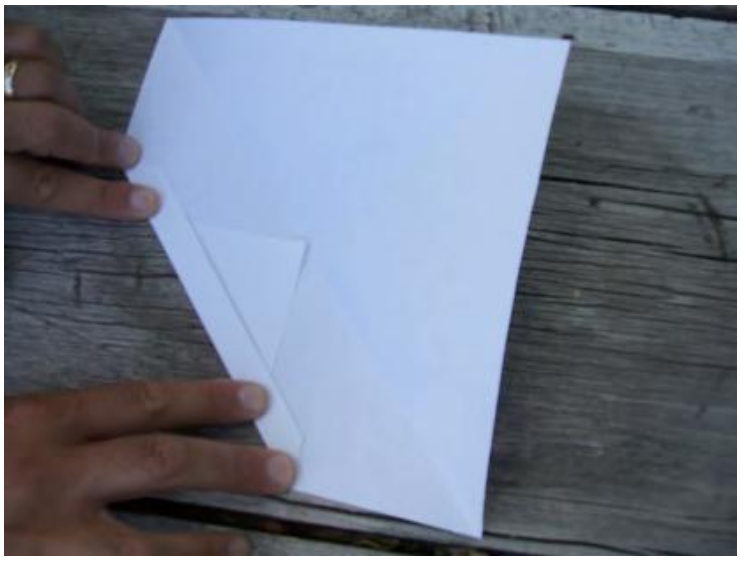
Fold a piece of 8- .” x 8- .” paper diagonally to find the center point.



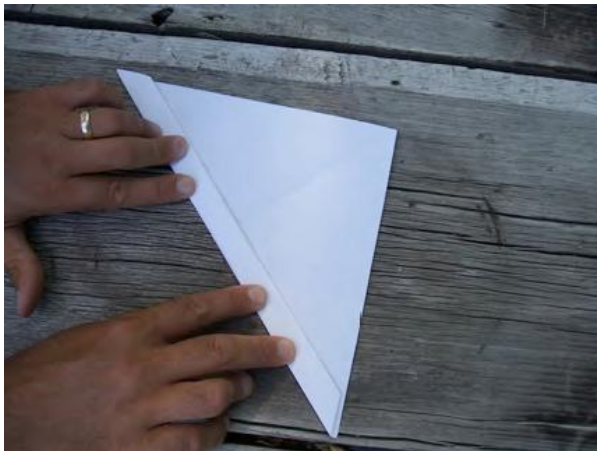
- Open the paper and fold one corner to the center point.



- Continue folding this side to the center using 1.0 cm folds.

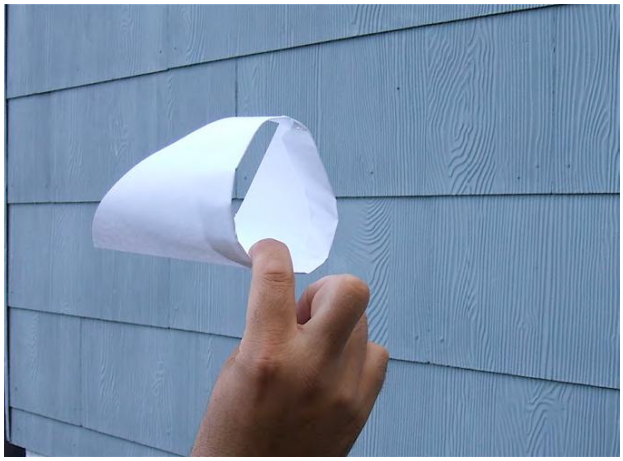


- Fold once more past the centerline.

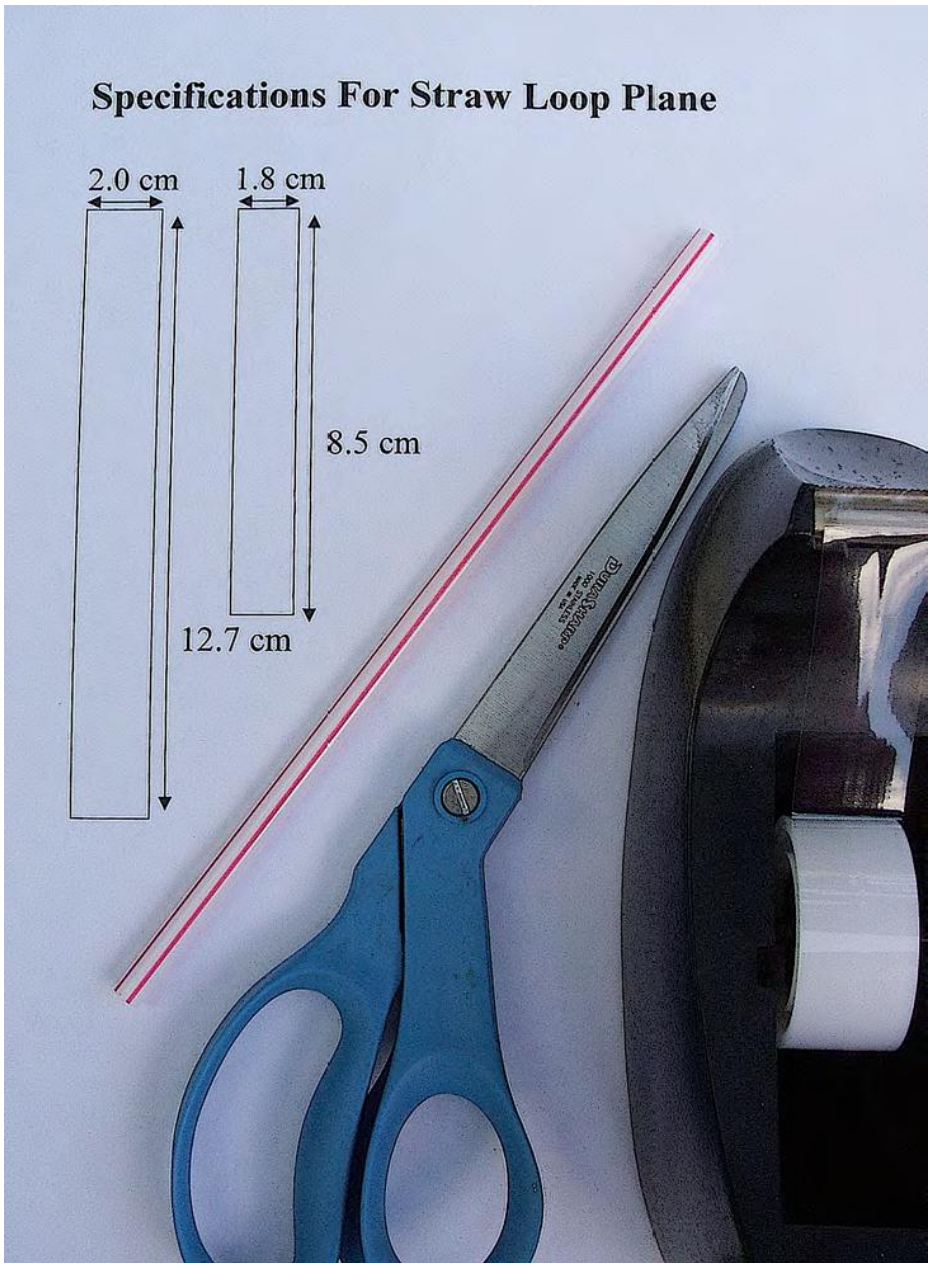


- With the fold up, run the paper over the edge of the tale several times to establish a curve. Tape the overlapped ends to forma tubular structure.

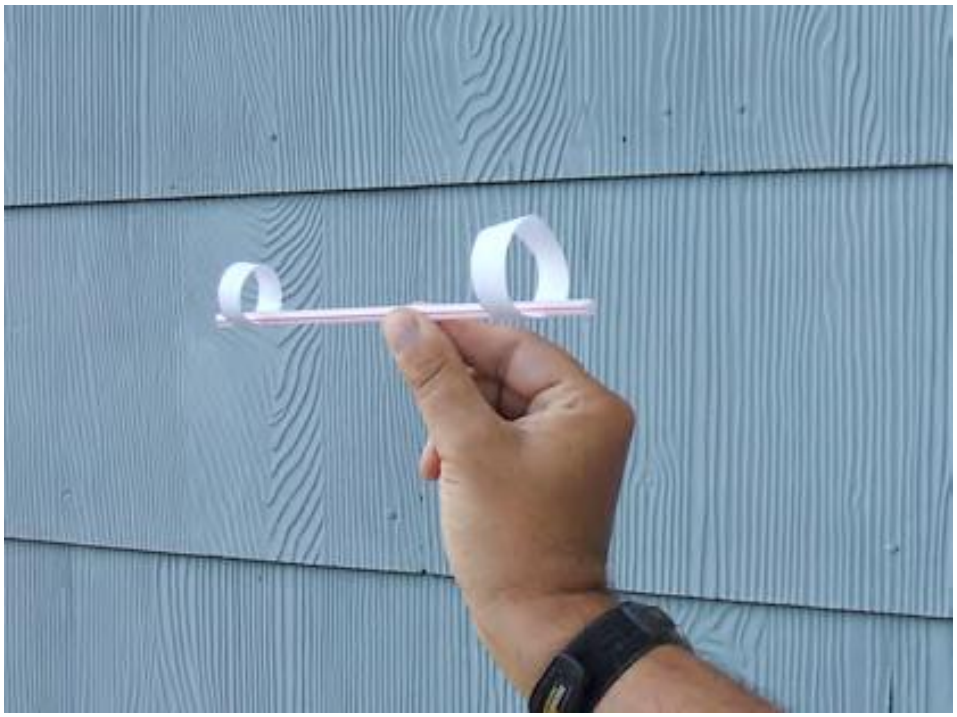
- Pinch at the folded end and gently toss.
-



Straw Loop Planes (***Courtesy AvKids***)



- Cover both ends of a straw with pieces of tape
- Cut out two rectangular pieces of paper (one is 2 cm x 12.5 cm, and the second is 2 cm x 8.5 cm). Loop each piece of paper and secure with cellophane tape.
- Tape the small loop about.” from one end of the straw and the large loop about.” from the other end of the straw.



2. Experiment with the two planes. Have students observe similarities and differences in both flight and design.

DISCUSSION:

1. How are the two planes similar? How are they different?
2. How do lift, thrust, drag, and weight affect these two planes?
3. Have you ever seen an airplane that is similar in design to the loop and tube planes?

EXTENSIONS:

1. What happens if you use different sized tubes instead of a straw, as the loop plane's fuselage?
2. What happens if you use different sized sheets of paper to make the tube plane?

INVESTIGATING THE PARTS OF A PLANE ACTIVITY

OBJECTIVE: Familiarize students with the parts of a general aviation aircraft?

MATERIALS:

- Clay
- 4 cups flour
- 1 cup salt
- 1-1/2 cups warm water
- Bowl spoon
- Toothpicks
- File folder labels
- Assorted materials for each student
-

INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes
2. Have students bring in assorted materials for their plane designs
3. Each student should make his or her own clay model.
4. Technical Terms: ailerons, engineer, rudder, elevator, wing, cockpit, propeller, flaps, fuselage, horizontal stabilizer, vertical stabilizer, landing gear.

CONSTRUCTION DETAILS:

1. Set-up the materials and mix the clay following the directions below:
   - Combine flour and salt in a bowl.
   - Pour in the water.
   - Mix the dough with your hands.
   - If the mixture is too wet, add flour.
   - If the mixture is too crumbly, add water.
2. Allow the students to construct their own models. They must include the ten basic parts of an aircraft from the diagram page.
3. Have the students use the toothpicks and the file folder labels to label the ten parts.
4. Have students discuss their models.

DISCUSSION:

1. As a class, discuss the main parts of the plane and the function of each part.

EXTENSIONS:

1. Take a field trip to a local airport. Point out the ten main parts of the plane on an actual small aircraft.
2. Encourage the students to include other parts on their models

TEN MAIN PARTS OF GENERAL AIRCRAFT

Ailerons: Moveable outside edges of the wing that turn the plane.
Cockpit: Where the controls are and the pilot sits
Elevator: Moves to make the plane pitch up or down
Flaps: They can only move down. They act as brakes when landing and create lift on takeoff.
Fuselage: Body of the plane for passengers and cargo
Landing Gear: The wheels
Propeller: Turning blade that pulls the plane through the air
Rudder: Moves left or right to help steady the plane
Stabilizers: Balance the plane
Wings: Provide lift and support the weight of the plane

Image above: This drawing shows the parts of a light airplane called a Piper Cherokee.

Credit: World Book illustration by Tom Morgan

BUSINESS AVIATION: AN EXTENSION OF GENERAL AVIATION

OBJECTIVE: Familiarize students with the part of General Aviation known as Business Aviation.

MATERIALS:

- Paper
- Art Materials
- U.S. Maps
- Aircraft POH or performance information
- Student handouts (Included)
- E6B (if students are taught how to use one)

BACKGROUND: General Aviation includes all aviation except the airlines or the military. Business Aviation is one of the most important segments of General Aviation. It consists of companies and individuals that use aircraft as tools to conduct their business.

INSTRUCTIONAL DETAILS:

1. Time Allotment: 45-60 minutes for two to three days
2. Break students into seven groups of 3-4 students. Assign each group to a company.
3. Procedure:
    a. Day 1
        i. Distribute the instruction sheet appropriate for each company
        ii. Distribute aviation alphabet to each group
    b. Day 2
        i. Distribute worksheets to each group
        ii. Decide how many questions need to be answered during the allotted time in order for each company to be successful.

Teacher Reference Details

Citrus Company Flight: Your Company will be transporting the corporate president and his staff to a Citrus Convention to make business contracts and market their products.

Life Flight: Your aircraft will be transporting a heart to a waiting transplant patient.

Charter Flight: Your Aircraft will be flying a sports team to the National Championship.

Toy Company: Your aircraft will be transporting what is hoped to be the hottest-selling toy of the year to distribution centers around the country.

Airplane Manufacturing Company: Your aircraft will be transporting an aircraft that was designed at their plant to their buyers.

Machinery Parts Company: Your aircraft will be rushing a needed part to a candy factory so that production can continue.

Electronic Game Company: Your aircraft will be transporting the employees from one plant to another (across the country).

Business Aviation in Action

-Citrus Company Flight-

Your company will be transporting the corporate president and his staff to a Citrus Convention to make business contracts and market their products.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Business Aviation in Action

-Life Flight-

Your aircraft will be transporting a heart to a waiting transplant patient.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Business Aviation in Action

-Charter Flight-

Your Aircraft will be flying a sports team to the National Championship.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Business Aviation in Action

-Toy company-

Your aircraft will be transporting what is hoped to be the hottest-selling toy of the year to distribution centers around the country.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Business Aviation in Action

-Airplane manufacturing company-

Your aircraft will be transporting an aircraft that was designed at their plant to their buyers.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Revised Dec. 2015

Business Aviation in Action

-Machine Parts Company-

Your aircraft will be rushing a needed part to a candy factory so that production can continue.

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

Revised Dec. 2015

Business Aviation in Action

-Electronic Game Company-

Your aircraft will be transporting the employees from one plant to another (across the country).

1. Name your company.

2. Choose the aircraft your company will be using.

3. Create an identification number for your plane.

4. Design a logo for your company.

CHALLENGE:
Design an advertisement for your company to read over the local radio station.

-Aviation Alphabet-

A	**ALPHA**	**N**	**NOVEMBER**
B	**BRAVO**	**O**	**OSCAR**
C	**CHARLIE**	**P**	**PAPA**
D	**DELTA**	**Q**	**QUEBEC**
E	**ECHO**	**R**	**ROMEO**
F	**FOXTROT**	**S**	**SIERRA**
G	**GOLF**	**T**	**TANGO**
H	**HOTEL**	**U**	**UNIFORM**
I	**INDIA**	**V**	**VICTOR**
J	**JULIET**	**W**	**WHISKEY**
K	**KILO**	**X**	**X-RAY**
L	**LIMA**	**Y**	**YANKEE**
M	**MIKE**	**Z**	**ZULU**

Give your plane an Identification Number. N is for the United States. Your Identification Number should start with N; followed by up to six numbers and letters.

EXAMPLE: N2554F(NOVEMBER 2554 FOXTROT)

Business Aviation in Action

-Citrus Company Flight-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and flying path he or she will be flying to ensure the quickest route. You are flying from Orlando, Florida to Los Angeles, California. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure the corporate president arrives on time. Using the map scale, calculate the miles between Orlando and Los Angeles.

_____ Miles

3. You've traveled _____ miles. It took you 7 hours of flight time. What was your airspeed?

4. The passengers need to keep the time zones in mind when traveling cross-country to ensure prompt arrival. If you depart Orlando at 9:00 a.m., what time will you arrive at the Citrus Convention in Los Angeles, California?

Business Aviation in Action

-Life Flight-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and flying path he or she will be flying to ensure the quickest route. You are flying from a hospital in Columbus, Ohio to a hospital in Flagstaff, Arizona. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure the transplant arrives on time. Using the map scale, calculate the miles between Columbus, Ohio and Flagstaff, Arizona.

_____ Miles

3. The medical team is awaiting the arrival of the Life Flight. A human heart can only exist outside the body for three hours. You've traveled _____ miles. You have only 3 hours. How fast would you need to travel?

4. The medical assistants need to keep time zones in mind when calculating arrival time so the doctors can schedule surgery. You depart Columbus at 9:00 a.m. What time will you arrive in Flagstaff?

Business Aviation in Action

- Charter Flight-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and flying path he or she will be flying to ensure the quickest route. You are flying from Green Bay, Wisconsin to Salt lake City, Utah for the National Championship event. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure the athletes arrive in time. Using the map scale, calculate the miles between Green Bay, Wisconsin and Salt Lake City, Utah.

_____ Miles

3. The fans, media, and competition are awaiting the arrival of your team. You've traveled _____ miles. It took you 5 hours of flight time. What was your air speed?

4. The passengers need to keep the time zones in mind when traveling cross country to ensure prompt arrival at the event. You depart Green Bay at 10:00 a.m. What time will you arrive in Salt Lake City?

Business Aviation in Action

-Toy Company-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and flying path he or she will be flying to ensure the quickest route. You are flying from El Paso, Texas to Baltimore, Maryland. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure that the toys arrive on time. Using the map scale, calculate the miles between El Paso, Texas and Baltimore.

_____ Miles

3. Each airplane has an optimal air speed in order to use the fuel most efficiently. You've traveled _____ miles. It took you 5 hours of flight time. What was your airspeed?

4. Your crew needs to keep the time zones in mind when traveling cross country to ensure the prompt arrival of the toys to the distributor. If you depart El Paso at 9:00 a.m., what time will the toys be delivered?

Business Aviation in Action

-Airplane Manufacturing Company-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and path that he/she will be flying to ensure the quickest route. You are flying from Wichita, Kansas to Buffalo, New York. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled in order to deliver the airplane to the buyer on time. Using the map scale, calculate the miles between Wichita, Kansas and Buffalo, New York.

_____ Miles

3. Each airplane has an optimal air speed in order to use the fuel most efficiently. You've traveled _____ miles. It took you 8 hours of flight time. What was your airspeed?

4. Your pilot needs to keep the time zones in mind when traveling cross country to ensure the prompt delivery of the aircraft. If you depart Wichita at 10:00 a.m., what time will you arrive in Buffalo?

Business Aviation in Action

-Machinery Company –

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and flying path he or she will be flying to ensure the quickest route. You are flying from Seattle, Washington to Rockford, Illinois. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure that the factory part arrives at the candy factory as quickly as possible. Using the map scale, calculate the miles between Seattle, Washington and Rockford, Illinois.

_____ Miles

3. The candy factory cannot continue production until the factory part arrives. You've traveled _____ miles. It took you 5 hours of flight time. What was your airspeed?

4. Your pilot needs to keep the time zones in mind when traveling cross country to ensure the prompt delivery of the factory part. If you depart Seattle at 1:00 p.m., what time will the part arrive in Rockford?

Business Aviation in Action

-Electronic game Company-

Company Name: _____

Crew Members:

Captain: _____

First Officer: _____

Flight Attendant: _____

Passenger: _____

1. Your pilot needs to note the direction and path he or she will be flying to ensure the quickest route. You are flying from St. Paul, Minnesota to Baton Rouge, Louisiana. List each state, at least five cities, and two major landforms that you will fly over.

2. Your pilot needs to know the mileage to be traveled to ensure that your employees will make the brainstorming meeting for the newest video game. Using the map scale, calculate the miles between St. Paul, Minnesota and Baton Rouge, Louisiana.

_____ Miles

3. Each airplane has an optimal air speed in order to use the fuel most efficiently. You've traveled _____ miles. It took you 3 hours of flight time. What was your airspeed?

4. The passengers need to keep the time zones in mind when traveling cross country to ensure the prompt arrival at the meeting. If you depart St. Paul at 10:00 a.m., what time will you arrive in Baton Rouge?

-ADDITIONAL AVIATION PROJECTS-

1. Create an Aviation Dictionary using new terms.
2. Research famous pilots, inventors, and important contributors to aviation.
3. Create a mobile, collage, or mural of aviation.
4. Design a three-dimensional airport.
5. Create an aviation timeline.
6. Have students research the opportunities and challenges faced by the airline industry.

AVIATION VOCABULARY

Aviation Vocabulary (Credit: FAA Kids Corner, Grades 5-9 and AvKids, Modified for the EAA by Jeff Elmer)

Aerobatics
Spectacular stunts, such as rolls and loops, performed in general aviation aircraft specially designed to withstand the stresses of such maneuvers.

Aerodynamics
Factors such as resistance, pressure, velocity, that affect the movement of air around moving objects, such as aircraft.

Aeronautical Charts
Maps of the airspace designed to help pilots navigate.

Aileron
Control surfaces hinged at the back of the wings, which by deflecting air up or down, help to bank the airplane.

Aircraft
Any man-made object that flies, including airplanes, blimps, and helicopters.

Airfoil
Any surface designed to provide lift from the air through which it moves, including wings, control surfaces, and propeller blades.

Airframe
The structure of the aircraft, not including the power plant or engine.

Airline
A company that is in the business of providing scheduled transportation.

Airplane
A mechanically driven, fixed wing, heavier-than-air craft.

Airport
A tract of land or water used for the landing and takeoff of aircraft. Facilities for the shelter, supply, and repair of airplanes are usually found there.

Airspace
The part of the atmosphere above a particular land area.

Airspeed
The speed of an aircraft relative to the air.

Air Taxi
A company that provides on-demand commercial air transportation

Air Traffic Control (ATC)
The system of ground based facilities that coordinate the movement of aircraft by tracking their progress using radar and communicating with pilots via radio.

Air Traffic Controller
A person who communicates with a pilot, usually by radio, directing the movement of aircraft, especially close to an airport.

Airway
An air route marked by aids to air navigation, such as beacons, radio ranges, and direction-finding equipment, along which airports are located.

Altimeter
An instrument for measuring in feet the height an airplane is located above sea level.

Altitude
Vertical distance from a given level (sea level) to an aircraft in flight.

Anti-Icing
A substance applied to the exterior of an aircraft before flight to prevent the formation of ice, which can impair the ability of an aircraft to fly. Also, a system that is used on board an aircraft to prevent the formation of ice on the wings, propellers, engine inlets, and control surfaces.

Approach
The phase of flight in which an aircraft has started its descent toward its destination airport.

Attitude
Position of an airplane relative to the horizon.

Autopilot
Short for automatic pilot, this is a control system that keeps an aircraft on a set course or speed so that the pilot does not have to steer or add power to the aircraft. Autopilots are most often used during the level, cruising portion of a flight.

Aviator
A person trained and qualified to fly an aircraft; a pilot.

Avionics
Short for aviation electronics, any electrical system used on an aircraft, primarily for navigation and communication.

Bank
To tilt an aircraft laterally and inwardly during forward flight.

Captain
The pilot in command or aviator in charge of the flight, who usually sits in the left seat of the cockpit.

Ceiling
Height above ground of a cloud base.

Chart
An aeronautical map showing information of use to the pilot in going from one place to another.

Checklist
A written list of procedures used by pilots to ensure that all items that need to be accomplished during a flight are actually performed.

Clearance
Permission granted by an air traffic controller that allows a pilot to taxi, land, or takeoff an air craft.

Certification
Official approval granted by a government agency qualifying a pilot or aircraft to fly.

Cockpit
The forward compartment of an aircraft where the pilots sit.

Cockpit Voice Recorder
An audio system that records all the sounds made in the cockpit. Enclosed in a crashproof container, this “black box” is used by accident investigators to help determine why an aircraft crashed.

Collision Avoidance System
A device that can detect when one aircraft might be flying too close to another and tells a pilot which direction to turn in order to avoid a collision.

Compass
An instrument indicating direction.

Control Surfaces
Moveable parts of an aircraft's wing and tail (or empennage) that are used to make an aircraft climb, descend, or turn.

Control Tower
The building from which air traffic controllers direct the movement of aircraft on and around the airport.

Copilot
A second pilot, who usually sits in the right seat of the cockpit assisting the captain (or pilot in command).

Cowling
A removable cover or housing placed around a section of the aircraft, usually an engine.

Crosswind
Any wind that blows across the intended course of an aircraft, causing it to drift off course.

Cruising Speed
A steady, moderate speed considered optimum for long-range flight.

Deicing
A system or substance that removes ice that has formed on an airborne aircraft.

Downwind
Moving in the same direction as the wind is blowing.

Drag
The component of the total air force on a body parallel to the relative wind and opposite to thrust.

Elevation
The height above sea level of a given land prominence, such as airports, mountains, etc.

Elevators
Control surfaces hinged to the horizontal stabilizer, which control the pitch of the airplane, or the position of the nose of the airplane relative to the horizon.

Empennage
The rear portion or tail of the aircraft.

Empty Weight
The weight of the aircraft alone, not including fuel, passengers, or baggage.

Engine
The part of the airplane which provides power, or propulsion, to pull the airplane through the air.

Enroute
On or along the way.

Federal Aviation Administration (FAA)
The U.S. governmental agency that establishes and enforces rules for aviation.

Fixed Base Operator (FBO)
An airport based fueling and service center for aircraft, similar to a gas station for cars.

Flaps
Hinged or pivoted airfoils forming part of the trailing edge of the wing and used to increase lift at reduced airspeeds.

Flight Attendant
A person whose job is to help ensure the safety and comfort of aircraft passengers by providing meals, beverages, and instructions on what to do in case of an emergency.

Flight Data Recorder
A system that records the airspeed, altitude, heading, and other characteristics of an aircraft in flight. Enclosed in a crash-proof container, this “black box” is used by accident investigators to help determine why the aircraft crashed.

Flight Manual
A guide issued by an aircraft manufacturer that contains official information regarding the speed, operating limits, and other essential guidelines for safely operating an aircraft.

Flight Plan
A formal document that describes the intended course of a planned flight.

Flight Service Station (FSS)
An official aviation information center that pilots use to obtain up-to-date information on weather and airport conditions before beginning a flight.

Force
A push or pull interaction between an agent and an object.

Fuselage
The streamlined body of an airplane to which are fastened the wings and tail.

General Aviation
All flying activities other than commercial (airline) and military aviation. General aviation aircraft, which includes everything from two-seat training airplanes to intercontinental business jets, can fly to about 10 times the number of airports that airliners can.

Guide Slope
The part of the instrument landing system that provides a radio beam so that the pilot can follow a standard descent path to land at an airport.

Gravitational Force (sometimes referred to as gravity)
Force of attraction between any two objects due to their mass.

Gross Weight
The maximum weight that an aircraft is designed to carry when taking off.

Hangar
Building at the airport in which airplanes are stored or sheltered

Heading
The course or direction in which an aircraft is moving, generally expressed in degrees of a circle (from zero to 360).

Headwind
A wind blowing directly against the course of an aircraft.

Helicopter
A type of aircraft that uses a rotor or propeller mounted on top of the fuselage to take off and land vertically, which allows it to operate without using a runway or airport.

Helipad or Heliport
A small structure or paved area that is used by helicopters to take off and land vertically.

Holding Pattern
To fly in a circle until an air traffic controller clears a pilot to proceed toward his destination.

Instrument Flight Rules (IFR)
The regulations for flying an aircraft when clouds, fog, or other weather conditions make it difficult or impossible to fly by sight alone.

Instrument Landing System (ILS)
Electronic navigation equipment that uses a radio beam to guide pilots of descending aircraft along a standard path so they can land on a runway.

Instrument Panel
The section of the cockpit located in front of the pilot that houses all the instruments, gauges, and indicators that tell the pilot important information such as airspeed, altitude, and heading. The instrument panel is similar to an automobile dashboard.

Jet
A type of aircraft power plant that uses a turbine, which increases the flow of air through an engine, for power.

Knot
A measure of speed, with one knot being one nautical mile per hour, which is equivalent to 1.151 miles per hour.

Land
The act of making an airplane descend, lose flying speed, and make contact with the ground or water, thus ending the flight.

Landing Gear
The understructure of an airplane which supports the airplane on land or water: wheels, skis, or pontoons. Retractable gear folds up into the airplane in flight. Gear that does not retract is called “fixed”.

Lift
The upward force on a aircraft caused by differences in pressure above and below the aircraft due to differences in air movement or air densities.

Logbook
A book that contains a record of flights made by a pilot or maintenance procedures performed on an aircraft during its lifetime.

Maintenance Technician
A person who is trained and certified to maintain or repair an aircraft.

Multiengine
An aircraft that has more than one engine.

Nacelle
The streamlined housing that encloses the engine.

N-Number or Tail Number
The license plate of an aircraft that contains a series of numbers and or letters that are painted on the fuselage near the tail of an aircraft. All aircraft registered in the United States have registration numbers that begin with the letter “N”.

National Transportation Safety Board (NTSB)
The agency of the U.S. government that is responsible for the investigation of aircraft accidents.

Nautical Mile
The standard unit of distance used in aviation. It equal 6080 ft or 1.151 miles.

Navaids
A shortened form of the words “navigational aids”. It refers to any system or device used to help guide a pilot when flying an aircraft.

Navcom
A shortened form of the words “navigation-communication”. It refers to any piece of aircraft equipment used by the pilot for navigation or communication purposes.

Payload
The total weight of passengers and cargo that an aircraft carries or can carry.

Pilot
Person who controls the aircraft

Pitch, Roll, and Yaw
Terms to describe the three dimensional movement of an aircraft. Pitch is the rotation of an airplane around its lateral axis. Roll is the motion of an aircraft around its longitudinal axis. Yaw is the movement of an airplane around its vertical axis.

Power Plant
An engine used to power an aircraft. There are four basic types of power plants: a piston engine, which is similar to the engine used in a car, turns a propeller, which propels an aircraft by pulling air over the wings. A jet engine uses a turbine to accelerate the flow of air without using a propeller. A turboprop uses a jet engine combined with a propeller. A turboshaft engine uses a jet engine and a rotor (or horizontally mounted propeller) to lift a helicopter and allow it to take off and land vertically.

Preflight
The testing procedure a pilot uses before flying to ensure that an aircraft’s equipment and systems are working properly.

Propeller
An airfoil which an engine turns to provide thrust, pushing the airplane through the air.

Pressurization
A system designed to maintain normal air pressure in an aircraft at higher altitudes, where air is too thin to allow proper breathing.

Radar
Beamed radio waves for detecting and locating objects. The objects are seen on the radar screen or scope.

Ramp
The paved area, usually located next to a hangar, where aircraft can be loaded, unloaded, or parked.

Range
The maximum distance an aircraft can fly without being refueled.

Rivet
A small metal pin that is used to attach the various sheet metal parts of an aircraft.

Rotorcraft
An aircraft that uses rotor: a helicopter

Rudder
Control surface hinged to the back of the vertical fin which is used to control the yawing movement of an aircraft.

Run-Up
The process of increasing the power of an aircraft engine before takeoff to check and see
that the power plant and propeller are operating properly.

Runway
A surface or area at the airport designated for airplanes to take off and land.

Skin
The outer covering of an aircraft, usually made of sheet metal, but also can be fabric, wood, or composite.

Spin
A maneuver in which the aircraft, after experiencing an aerodynamic stall, descends with its nose pointing toward the ground while turning rapidly around its vertical axis.

Stabilizer
A fixed (non-movable) horizontal or vertical part of the tail that keeps the aircraft stable as it flies.

Stall
The reduction of speed to the point where the wing stops producing lift.

Stick
The control and steering wheel of an airplane, sometimes called the “yoke”.

Streamline
An object shaped to make air flow smoothly around it.

Tail
The part of an airplane to which the rudder and elevators are attached. The tail has vertical and horizontal stabilizers to keep the airplane from turning about its lateral axis.

Tailwind
A wind that is blowing from behind the aircraft, helping it fly faster.

Take-Off
The part of the flight during which the airplane gains flying speed and becomes airborne.

Taxi
To operate an airplane under its own power; other than in actual take off or landing.

Taxiway
A paved strip on the airport that leads from the ramp to the runway.

Throttle
The cockpit lever that increases engine power, allowing an aircraft to takeoff or accelerate if it is already airborne.

Thrust
Forward force caused by the pushing of air or exhaust gases backwards.

Touchdown
The moment when the wheels of the a landing aircraft touch the surface of the runway.

Traffic Pattern
A low altitude course, usually an oval, around an airport that airplanes must follow in order to ensure the safe flow of aircraft to the runway.

Transponder
A transmitter-receiver that sends a unique, coded signal to ground radars, thus allowing air traffic controllers to identify and track individual aircraft.

Trim
A device that allows the pilot to adjust the attitude of the aircraft without having to constantly move the elevators.

Turbulence
A disturbance or uneven flow of air that causes an aircraft to bounce in flight.

Turn
Maneuver in which the airplane makes changing its direction of flight.

Upwind
Flying an aircraft in the opposite direction the wind is blowing.

Vector
A heading given to a pilot by an air traffic controller via a radio communication.

Velocity
Speed in a particular direction.

Visibility
Distance toward the horizon that objects can be seen and recognized. Smoke, haze, fog, and precipitation hinder visibility.

Visual Flight Rules (VFR)
The regulations for flying an aircraft in clear weather by sight alone.

Waypoint
A reference point in the airspace used for navigational purposes.

Weather Briefing
The official forecast information that a pilot gets from a flight service station before departing on a flight.

Weight
The gravitational force exerted on an object by the earth, which is directed toward the center of the earth.

Weight and Balance
The mathematical calculations done to determine if the cargo and/or passengers aboard an aircraft are loaded properly.

Wind
Air in motion, which is important to aviation because it influences flight to various degrees.

Wing
Part of an airplane shaped like an airfoil and designed in such a way to provide lift when air flows over it.

Yoke
The control and steering wheel of an airplane, sometimes called the “stick”.