TAKE FLIGHT

with STEM

Table of Contents

Bernoulli's Bag

Grade Level: 2—3

Objective: Students learn that a fast moving stream of air results in an area of low pressure that pulls surrounding air of higher pressure to it. This is commonly referred to as the Bernoulli Effect after scientist Daniel Bernoulli.

Common Core: CCSS.ELA-Literacy.RI.3.1; RI.3.3; RI.3.4; W.3.1; W.3.5

Next Generation Science Standards: Structure & Properties of Matter.2-PS1-2. Engineering Desing.K-2-ETS1 -3. Forces & Interactions.3-PS2-2.

Directions:
1. Have students guess how many breaths it takes to blow up a large plastic bag. Determine the amount by having a student blow into the bag using the traditional method of blowing into a small opening at the bag's opened end. Based on the sample, have the students approximate how many breaths it would take to fill the bag completely.
2. Ask the students if they think it might be possible for someone to blow the bag up using just one breath.
3. Have students demonstrate that it is possible by having each of them hold the bag open approximately 1-3 feet away from his or her mouth.
4. Using only one breath, ask the students to blow as hard as they can to fill it up, then quickly squeeze the bag's end closed with their hands.
5. You can also have two groups race to fill a bag.

Background:
In the 1700s, a scientist named Daniel Bernoulli discovered that the faster air travels, the lower the pressure it exerts.

In this example, the stream of moving air creates an area of lower pressure, which attracts high pressure air next to the stream of air from your lungs. As a result, it is not just a single breath of air that fills the bag, but rather air from the surrounding area also.

Our atmosphere is always trying to maintain steady air pressure. As a consequence, an area of high pressure will move toward an area of low air pressure in an attempt to restore balance. Pressure will never be steady around the Earth, however, no matter how hard the atmosphere tries to balance itself. This is due to the sun's uneven heating of the Earth's surface, creating changing areas of high and low pressures.

Bernoulli's principle plays a significant role in weather patterns and predictions. A weather system is a set of temperature, wind, pressure, and moisture conditions that exist for a certain region and moves as a unit for a period of days.

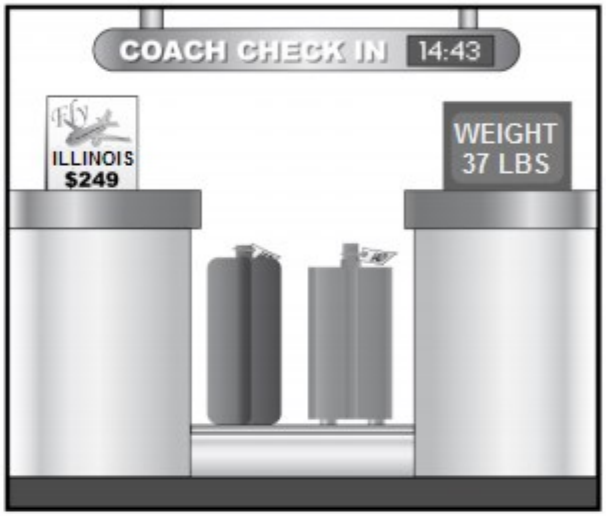
Writing Prompts:
1. Write a few sentences explaining how a single breath of air can fill the bag.
2. Do you think the same experiment will work with a smaller grocery store bag? Why or why not? **Try it.** Were your predictions correct?
3. Do you think the same experiment will work with a small and/or slow breath of air? Why or why not? **Try it.** Were your predictions correct?
4. Write a paragraph analyzing whether the large plastic weather bags worked better than the smaller grocery store bag. Use information from the experiment to support your opinion.
5. Bernoulli's principle helps to understand movements of weather systems. Why might this knowledge be crucial in agriculture? Write a paragraph to explain.

Numbers in Flight

Grade Level: 2—3

Objective: Students will observe the four airport scene images to gather information and complete activities that follow.

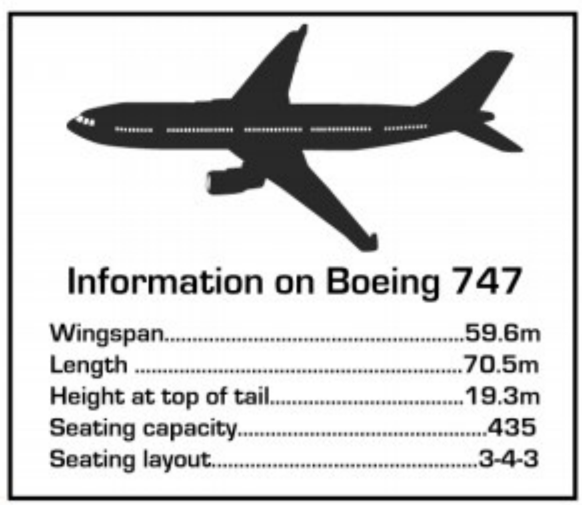
Common Core: CCSS.ELA-Literacy.RI.2.3; RI.2.7; W.2.2; RI.3.5; RI.3.7



a.

b.

c.



d.

1. For a, b, and d, write about the ways numbers are used and identify why the numbers are important to include. For c, describe what you see.
   A.
   B.
   C.
   D.

2. In scene c, there are no numbers. But the image shows something used in agriculture called "crop dusting." From the picture, write a few sentences explaining what you think this means.

Ag Takes Flight

Grade Level: 3—4

Objective: Students who read the information and complete the activity below will learn about agricultural aircrafts, their use, and an introduction into their history.

Common Core: CCSS.ELA-Literacy.RI.3.1; RI.3.4; W.4.2; W.4.2b; SL.4.1

Background: An agricultural aircraft is an aircraft built for aerial application of pesticides or fertilizer. In these roles, they are referred to as "crop dusters" or "top dressers." Crop dusting with insecticides began in the 1920s in the United States. After more insecticides and fungicides were developed in the 1940s, agricultural aircrafts became more common.

In the United States, the aircrafts are typically small, simple, and rugged. Most have spraying systems attached to the trailing edges of their wings and pumps are driven by wind turbines. When spraying, agricultural pilots attempt to fly just above the crops being treated to reduce drift of the sprayed materials. Agricultural airplanes have strengthened cockpits to protect the pilot if an accident occurs.

Words to Define:

Read the text above and use details to determine the meaning of the words below.

______Aerial	1. a compartment for the pilot and sometimes also the crew in an aircraft or spacecraft.
______Application	2. a substance used for destroying insects or other organisms harmful to cultivated plants or to animals.
______Cockpits	3. having a broken, rocky, and uneven surface.
______Fertilizers	4. existing, happening, or operating in the air.
______Insecticides	5. a chemical or natural substance added to soil or land to increase its fertility.
______Pesticides	6. the action of putting something into operation or applying.
______Rugged	7. a substance used for killing insects.
______Turbines	8. a machine for producing continuous power in which a wheel or rotor, typically fitted with vanes, is made to revolve by a fast-moving flow of water, steam, gas, air, or other fluid.

Lesson Extender:

- Write a paragraph about the influence of aircrafts and flight on agriculture. Use some of the vocab words from above.
- Read paragraphs aloud and engage in a class discussion including students' opinions and ideas about aircrafts in agriculture.

The "Candy Bomber"

Grade Level: 3—4

Objective: Students will learn how air resistance plays a role in flying. They will discover techniques for designing a parachute that falls slowly and will test different types of material to determine which works best.

Common Core:
CCSS.ELA-Literacy.RI.4.1; RI.4.3; RI.4.10; W.4.2; W.4.4; W.4.7

Next Generation Science Standards:
Earth's Systems.5-ESS2-1
Engineering Design.3-5-ETS1-1; 3-5-ETS1-2; 3-5-ETSI-1-3

Introduction:
Gail Halvorsen was a young pilot in the U.S. Army Air Corps. He was assigned as a cargo pilot to the Berlin Airlift, in which U.S. forces flew in supplies to a Soviet-blockaded Berlin. He noticed the German children gathering by the fences of Tempelhof Air Base and knowing that they had very little, he offered them some chewing gum. From that, he decided he would "bomb" Berlin with candy. He and his crew sent small parachutes floating down as they approached the Berlin airport. He wiggled his wings of the C-54 as a signal to the children that their anticipated cargo would soon arrive. He became well known to the children in Berlin as "Uncle Wiggly Wings" or "The Candy Bomber." His small idea became a great symbol of hope not only to the German children but to all that yearned for freedom.

A parachute is a umbrella-shaped item used especially for making a safe jump from aircraft. Due to the resistance of air, a drag force acts on a falling body (parachute) to slow down its motion. Without air resistance, or drag, objects would continue to increase speed until they hit the ground. The larger the object, the greater its air resistance. Parachutes use a large canopy to increase air resistance. This gives a slow fall and a soft landing.

Suggested Reading:
Christmas From Heaven by Tom Brokaw ISBN-13: 9781609077006

Materials Needed:
- 1 sheet of tissue paper, 24" x 24"
- 2 pieces of string/yarn, approximately 48" long each
- 4 pieces of tape, about 2" long each
- 1 piece of candy

Directions:
1. Tape the ends of one string to opposite corners of the tissue paper.
2. Tape the ends of the second string to the remaining two corners.
3. Pull the strings together, bringing the four corners of the paper together, and find the middle of the strings. Tie an overhand knot in the middle of the strings, creating a small loop. Attach candy to loop.
4. Hold the parachute from the center top and drop.

Lesson Extender:
- Have the students write a biography about Colonel Gail S. Halvorsen, "The Candy Bomber."
- Try making a parachute using other types of materials. Perhaps a plastic bag, or paper towel. Use this as a variable to discover what types of materials work best.

Hang Time

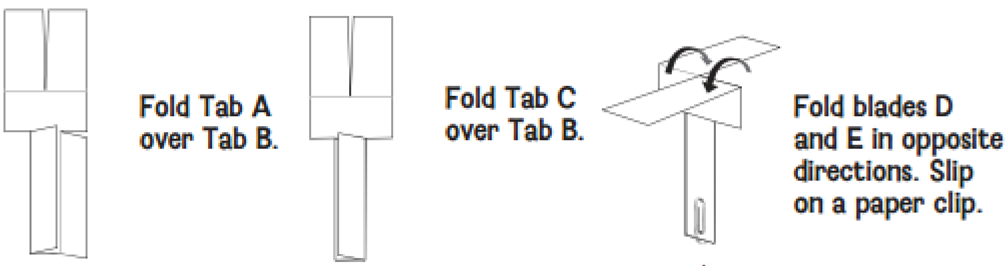
Grade Level: 3—4

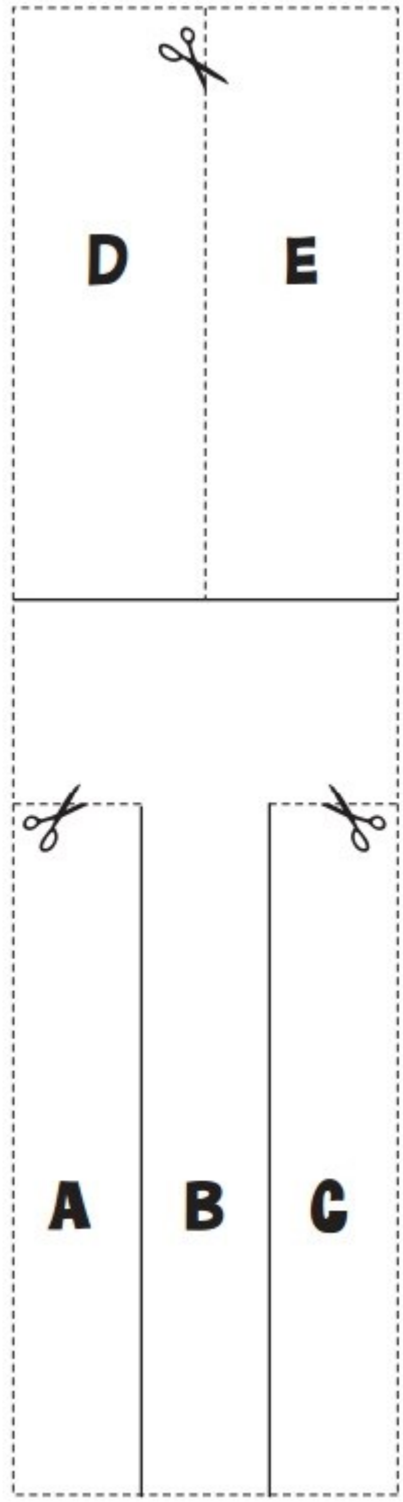
Objective: Students will investigate and experiments to appreciate gravity as a force.

Common Core:
CCSS.ELA-Literacy.RI.4.3; RI.4.5

Next Generation Science Standards:
Forces and Interactions.3-PS2-1; 3-PS2-2

Directions:
1. Cut out the copter printed on this page. Cut along the dotted lines. Assemble as shown.
2. Hold your copter as high as you can. Let go and watch as it falls. Does it spin to the ground?
3. Build a second copter of your own design. This time, change a feature, such as the copter's size or shape of the blades. Try using more or fewer paper clips. Then launch both the new and original copter designs and compare how they fall. What kind of difference did your change make?





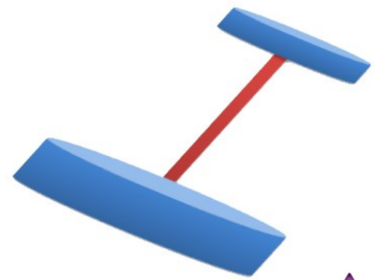
Background:
Igor Sikorsky designed the first successful helicopter in the late 1930s. His inspiration came from drawings of an aircraft with a spinning wing, drawn by Leonardo da Vinci nearly five hundred years before.

When you drop your copter, its blades hit the air. The air pushes back on the blades, giving each one a little push forward. Notice how the blades are not exactly across from each other. This means that one blade is nudging one side of the copter around while the other blade is nudging the other side around. These two pushes work together to spin the copter around its center point. The spinning blades hit a lot of air on the way down, and all this air pushes back on the blades. The more air you can get to hit your blades (i.e., the more push-back you can create), the slower your copter will fall.

Lesson Extender:
- Experiment with the size of your copter. How big or small can you make it and still have it spin as it falls to the ground?
- Does your copter always spin in the same direction? Mark one blade with a bold color. Then watch as your copter falls to the ground. Now, figure out how to make it spin in the opposite direction.
- Have you ever observed the seeds of a maple tree as they fall? These distinctive fruit are called samaras, "maple keys", "whirlybirds" or "polynoses". These seeds occur in distinctive pairs each containing one seed enclosed in a "nutlet" attached to a flattened wing of fibrous, papery tissue. They are shaped to spin as they fall and to carry the seeds a considerable distance in the wind. Watch these videos: http://www.youtube.com/watch?v=ZUEXKapAVcY & http://www.youtube.com/watch?v=r4urT74yq6c After observing the videos, write a few paragraphs describing how this activity is similar to what occurs when maple tree fruit (samaras) fall.

"O-Wing" Experiment

Grade Level: 3—4



Objective: Students will follow the instructions accurately, identify the variables affecting the flight of an O-Wing, control as many variables as possible for each test flight of their O-Wing gliders, measure and record the length of each test flight, record their qualitative observations of each test flight, draw conclusions about the effect of wing size on the O-Wing's performance, and make suggestions for how their experiment could be improved to yield more accurate results.

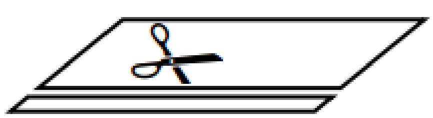
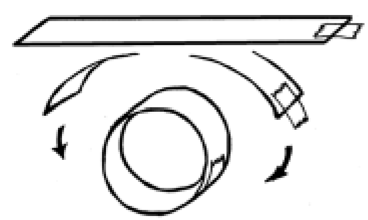
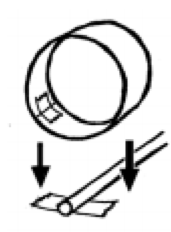
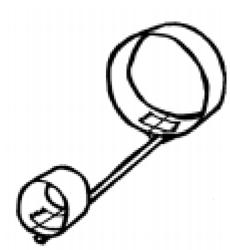
Common Core:
CCSS.ELA-Literacy.RI.3.1; RI.3.3; RI.3.7; W.3.1; W.3.2
Mathematics.3.OA.1; 3.MD.4

Next Generation Science Standards:
Forces and Interactions.3-PS2-1; 3-PS2-2

Materials Needed:
- Plastic drinking straws
- 1 roll of tape or glue
- Pencils
- Stiff cards (e.g. manila folder)
- Tape measure
- Scissors

Introduction: Demonstrate the construction of an O-Wing and ask the class if they expect it to fly. Discuss the experiment and logistics of test flying. Ask students to identify and discuss variables that might affect each test flight and specify which variables are controlled.

Making an O-Wing:

1. Carefully cut a strip of card to size required. 	2. Put a piece of sticky tape on the end of the strip. Curl it over so the ends overlap a little and stick down. It helps to tape down the inside of the wing too. 
3. Lay a piece of tape on the table, sticky side up. Stick the straw onto the middle of the tape. Push the wing onto the tape and secure it carefully. 	4. Center both wings on the straw carefully like this. 

Adapted from ABC Science Online (abc.net/au/science)

“O-Wing” Experiment

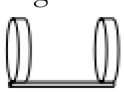
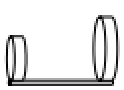
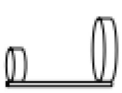
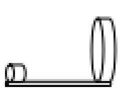
(continued)

You are going to conduct a scientific experiment to find out if O-Wings fly better with different size wings, or wings that are the same size. You will make and test fly several O-Wings and record the results of each test flight.

Variables

For the results of your experiment to be useful, each test flight must be conducted under the same conditions. This means you need to control the variables that affect an O-Wing’s flight as best you can. Write down all the variables you can think of that might affect the O-Wing. How can you control each of these variables?

Make four O-Wings as described below.
Use strips that are 1 inch wide for ALL wings. (Both large and small)

O-Wing Number	Small wing length	Large wing length
1 	10 in	10 in
2 	8 in	10 in
3 	6 in	10 in
4 	4 in	10 in

“O-Wing” Experiment

(continued)

Conduct the test flights and record your results in the table below. There is also space below to write down any observations about how well each O-Wing flew (e.g. did it glide, or spin out of control).

O-Wing test flight results

Small Wing Size	Distance Flown			
	Test 1	Test 2	Test 3	Average
10 inches				
8 inches				
6 inches				
4 inches				

Observations

What conclusions can you draw from the results of the experiment?

Lesson Extender:

Did you know your O-Wing comes from Agriculture? Corn is used to make drinking straws, soybeans are used to make glues, trees are used to make the paper used for your O-Wing, and even the pencil you used. Most of the products that we use every day come from agriculture.

Write a paragraph that identifies something you used today and explain how it links to agriculture. How reliant do you think we are on agriculture? Explain your answer.

Plane Games—Time Flies

Grade Level: 3—4

Objective: Tell students that they are aeronautical engineers for NASA for the day. Their mission is to design and construct a paper airplane that will stay in the air for the greatest amount of time using Bernoulli's Principle. Students can use the Internet, textbooks, library resources and their cooperative learning group to design three paper airplanes using a sheet of 8 1/2 inch X 11 inch copy paper and four inches of tape. Students will be divided into groups of three. The cooperative group whose plane has the longest flight in the air will get the most points. Check out these websites for some ideas: http://www.10paperairplanes.com/ & http://www.paperaeroplanes.com/

Common Core:
CCSS.ELA-Literacy.RI.3.1; W.3.1; W.3.2; SL.3.2; SL.3.3
Mathematics.3.MD.4

Next Generation Science Standards:
Forces and Interactions.3-PS2-1; 3-PS2-2

Materials Needed:
- 3 sheets of 8.5 in x 11 in paper (per group)
- 1 stopwatch (per group)
- 3 pieces of 4 inch long tape (per group)
- Data sheet for recording times

Procedure:
1. Each group will be given 3 tries to beat the record for the longest time in the air flight. Before flying, the recorder will check to see if the name is visible on the plane.
2. The timing for each group will begin at the moment the plane leaves the student's hand, and will stop when the plane touches down. If a plane skids across the floor, it will be considered down when it first touches the floor. The timekeeper will announce the time, and the recorder will write down the time and circle the longest time for the group. After each group completes their three attempts, the recorder will decide the longest time for all the groups. In the event of a tie for 1st place, a deciding flight will take place.
3. All students will remain seated and will not throw any paper airplanes while the contest is in progress unless directed to do so.

Writing Prompt: On a separate sheet of paper, each group should write a paragraph reflecting on the activity.
- Have a class discussion reflecting on the activity. Discuss the forces that act on your plane while in flight.
- How did the task of flying your plane the longest amount of time influence how you built your plane?
- Explain how the shape of your plane helped.
- What changes occurred in each attempted flight? Were your planes different styles? Did you throw them differently?
- Think back to the uses of planes and flight in agriculture. After building a plane that is designed to last in flight the longest, write a paragraph explaining why this might be important for agricultural purposes.

Plane Games—Time Flies

(continued)

Longest Time in the Air for a Paper Airplane

Name of Group	Trial 1	Trial 2	Trial 3	Longest Flight

Plane Games—Far Traveler

Grade Level: 3—4

Objective: Tell students that they are aeronautical engineers for NASA for the day. This time, their mission is to use Bernoulli's Principle to design and construct a paper airplane that will travel the farthest. Students can use the Internet, textbooks, library resources and their cooperative learning group to design three paper airplanes using a sheet of 8 1/2 inch X 11 inch copy paper and four inches of tape. Students will be divided into groups of three. The cooperative group whose plane travels the farthest will get the most points.

Common Core:
CCSS.ELA-Literacy.RI.3.1; W.3.1; W.3.2; SL.3.2; SL.3.3

Next Generation Science Standards:
Forces and Interactions.3.PS2-1; 3-PS2-2

Materials Needed:
- 3 sheets of 8.5 in x 11 in paper (per group)
- 1 tape measure (per group)
- 3 pieces of 4 inch long tape (per group)
- Data sheet for recording distances

Procedure:
1. Each group will be given 3 tries to beat the record for the longest distance. Before flying, the recorder will check to see if the name is visible on the plane.
2. The distance will be measured from the student's foot to the point where the plane stops moving. If a plane skids across the floor, it will be measured at the point it stops moving. The measurer will announce the distance, and the recorder will write down the distance for the group. After each group completes their three attempts, the recorder will decide the longest distance for all groups. In the event of a tie for 1st place, a deciding flight will take place.
3. All students will remain seated and will not throw any paper airplanes while the contest is in progress unless directed to do so.

Writing Prompt: On a separate sheet of paper, each group should write a paragraph reflecting on the activity.
- Have a class discussion reflecting on the activity. Discuss the forces that act on your plane while in flight.
- How did the task of flying your plane the farthest distance influence how you built your plane?
- Explain how the shape of your plane helped.
- What changes occurred in each attempted flight? Were your planes different styles? Did you throw them differently?
- How did the task from longest in the air to farthest in flight change how your group built your planes and completed the activity?
- Think back to the uses of planes and flight in agriculture. Suppose you were building a plane that is designed for precision. Write a paragraph explaining why this might be important for agricultural purposes. Which do you think is more important: length of flight or precision? Why?

Plane Games—Far Traveler

(continued)

Longest Distance for a Paper Airplane

Name of Group	Trial 1	Trial 2	Trial 3	Longest Distance

Lesson Extender:

The Illinois Agricultural Aviation Association states: "The aerial application industry in the U.S. is an integral part of American agriculture. Without these aircraft available as tools in food production, one third of Americans would go to bed hungry. Without crop dusters to treat cotton, yields would be substantially reduced and you would be forced to pay higher prices for a simple cotton T-shirt. You may not even see agricultural aircrafts where you are from, but you would surely be affected if they weren't allowed to fly."

After reading the above paragraph, work with a group to brainstorm ways that you might be impacted here in Illinois without ag aviation. Write a one page paper that elaborates how you would be impacted. Engage in a class discussion to share your thoughts.

<u>Answers</u>

Page 4: 1a. Check in times. Counting weight of baggage. Advertisement with the price of the flight.
1b. Boarding times. Date. Gate numbers.
1c. Crop dusting plane.
1d. Plane model number. Size of the plane. Metrics / dimensions of plane.

Page 5: Top to Bottom: 4, 6, 1, 5, 7, 2, 3, 8

<u>Links</u>

http://www.agaviation.com/index.htm
http://www.agaviation.org/
http://www.agaviation.org/content/agricultural-aviation-curriculum-guides
http://www.agairupdate.com/

Illinois Agriculture in the Classroom[SM]

THE IAA FOUNDATION

facebook.com/agintheclassroom

twitter.com/ilagclass

pinterest.com/iaitc