

Physics of Flight Investigation

Grade level: 6-8

Unit of study: Scientific Process, Physics

MI Grade Level Content Expectations:

- Inquiry Process

S.RS.03.11 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

S.IA.03.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences.

S.IP.03.11 Make purposeful observation of the natural world using the appropriate senses

S.IP.03.12 Generate questions based on observations.

S.IP.03.13 Plan and conduct simple and fair investigations.

S.IP.03.14 Manipulate simple tools that aid observation and data collection (for example: hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer).

S.IP.03.15 Make accurate measurements with appropriate units

Key concepts: Lift, drag, thrust, weight, pressure, scientific process

Resources & Materials needed:

- Paper Airplane Investigation Worksheet
- Meter sticks/tape measures
- Scissors
- Glue
- Paper
- Stop watches
- Hair Dryer
- Ping Pong ball

Abstract: In this lesson students will learn the physics which make flight possible. They will become familiar with and able to use the terms lift, drag, weight, pressure and thrust. Using their knowledge of these terms and the scientific process students will conduct a paper airplane investigation. Students will create an original airplane design with the goal of having it fly as far as possible. They will record data (distance, time in the air, etc.) and complete several trials, after which they will consider their original design and create a new one based on initial results. At the end of the lesson students will evaluate their designs and results. They will briefly explain why and how their designs flew the way they did using physics.

Big Ideas: In flight there are four basic components acting upon the object flying they are drag, thrust, weight, and lift. Objects which fly and have wings such as birds or airplanes get lift from the shape of their wings. Wings have an airfoil shape which creates an unequal length at the top and bottom of the wing. The top surface of the wing is curved upward and longer than the bottom surface of the wing. As air hits the leading edge of the wing it is deflected over and under the wing. The air deflected over the top of the wing takes longer to rejoin the air deflected under, creating a pressure difference. An area of high pressure is created below the wing, and an area of low pressure is created above the wing which in turn produces lift. In order for an object to overcome gravity the amount of force created by lift must be greater than that created by gravity. Thrust is required to move the object forward fast enough to overcome drag and to help create lift. Air is considered a fluid and the object in flight must be moving fast enough for the air to deflect around the wings and create the pressure difference required for lift. Drag or air resistance is friction between the moving object and air that is an opposite force of thrust. Objects that fly

MICHIGAN STATE UNIVERSITY | Kellogg Biological Station
Kellogg Bird Sanctuary

Created by Education Intern, Sean Morgan, Summer 2013
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must create enough thrust to overcome drag and initiate lift, and enough lift to overcome gravity.

Figure 1: Principles of an Airfoil

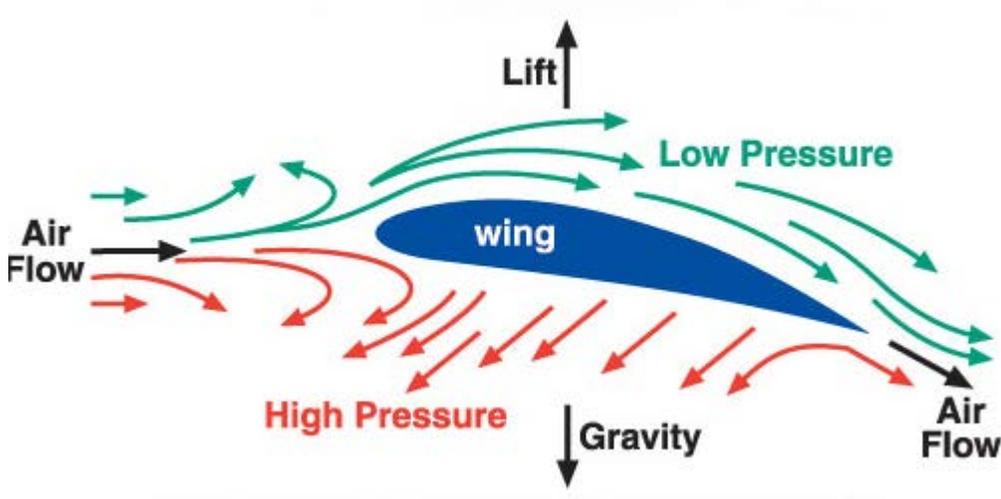
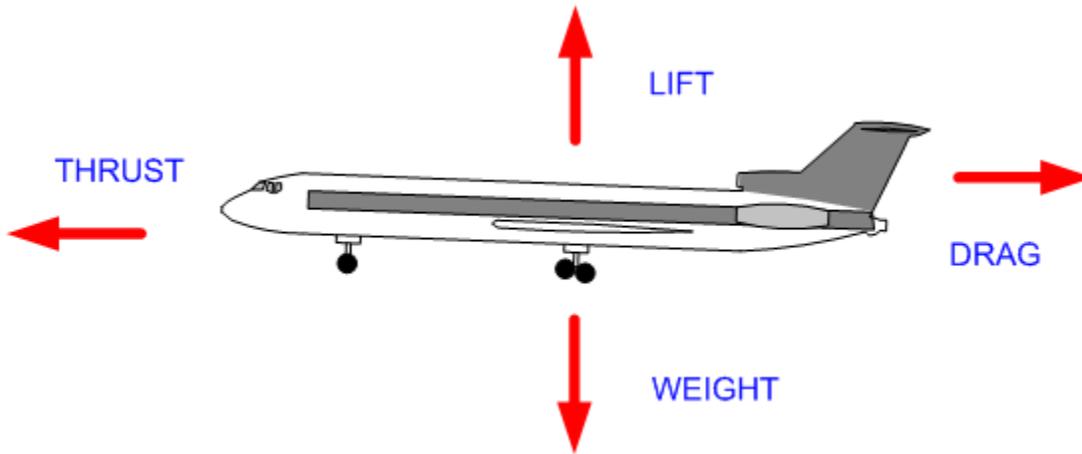


Figure 2: Forces in Flight



Further information can be found at:

<http://www.portageinc.com/community/pp/flight.aspx>

<http://www.ucmp.berkeley.edu/vertebrates/flight/physics.html>

<http://www.dot.state.mn.us/aero/aved/pdf/history%26physics.pdf>

Classroom Activities

Warm-up: Tennis Ball Pressure Demonstration

Procedure

1. Begin class with a demonstration of lift using a hair dryer and ping pong ball. Position the hair dryer so that it is blowing straight up. Place the ping pong ball in the stream of air produced by the hair dryer so that it hovers.
2. Have students develop a hypothesis to explain how the ping pong ball is able to stay in the stream of air created by the hair dryer.
3. Utilize "Think, Pair, Share", have students individually think about the question and then pair up with a nearby neighbor to discuss their ideas. Ask for pairs to then share out with the whole class.
4. On the whiteboard or chalkboard write any keywords, ideas, or principles mentioned by pairs of students while sharing their hypotheses.
5. Explain that the ping pong ball is able to float above the hair dryer in one place because as the air travels around the ball it creates an area of high pressure below the ball and an area of low pressure above the ball. The air meeting the ball is diverted evenly around it and recollects above the ball, this keeps the ball from blowing from one side or the other.
6. Proceed to explain the 4 main components of flight: thrust, drag, lift and weight.

Main Classroom Activity (Take it Outside!): Paper Airplane Investigation

Procedure

1. Inform students they will be working in pairs to complete a paper airplane flight investigation.
2. Pass out the accompanying investigation worksheet, and explain the directions
3. Pairs will create an initial paper airplane design with which they run 5 trials, will make adjustments/improvements to the design and run an additional 5 trials, and repeat one final time

4. Students will follow along with the paper airplane investigation worksheet recording results and answering questions.

Conclusion: Paper Airplane Showdown

1. After completion of the paper airplane investigation worksheet have pairs share out to the class their findings.
2. Ask them to explain their best design and why it worked the best making sure to use new terms they have learned today.
3. Have the class line up for the paper airplane design distance contest and have them all fly their paper airplanes at the same time.

Name:

Partners Name:

Paper Airplane Investigation

Airplane Design 1

	Trial 1	Trial 2	Trial 3	Trial 4	Average
Distance (meters)					
Flight Time (seconds)					

Make an adjustment to your original airplane design that you think will improve its flight. How/why do you think this adjustment will improve the airplanes flight?

Airplane Design 2

	Trial 1	Trial 2	Trial 3	Trial 4	Average
Distance (meters)					
Flight Time (seconds)					

Did the design adjustments you made improve your airplanes flight? Why or why not?

Make an adjustment to your original airplane design that you think will improve its flight. How/why do you think this adjustment will improve the airplanes flight?

Airplane Design 3

	Trial 1	Trial 2	Trial 3	Trial 4	Average
Distance (meters)					
Flight Time (seconds)					

Did the design adjustments you made improve your airplanes flight? Why or why not?

Which of your airplane designs worked the best and why?

Draw a diagram of your airplane in flight. Draw and label arrows with the forces acting upon the airplane in flight. Make sure to include the terms thrust, lift, weight, and drag.