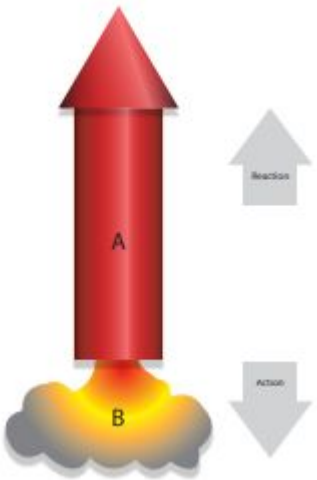
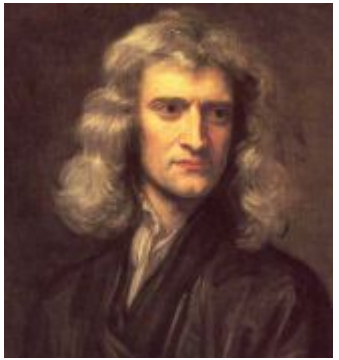
Lab Practicum- The Four Principles of Flight



Corinne De Keukelaere



Lesson Overview: Four Forces from NASA

By using hands on stations the students experimented with force and motions, the transfer of energy and the 4 forces of flight. The first station demonstrates the thrust provided by an inflated balloon. The second station demonstrates the drag created by air resistance. The third station demonstrates the effects of gravity and air resistanceon objects dropped at the same time. The fourth station demonstrates the lift produced by their own hands in a stream of air.
https://www.nasa.gov/sites/default/files/atoms/files/four_forces_5_8.pdf

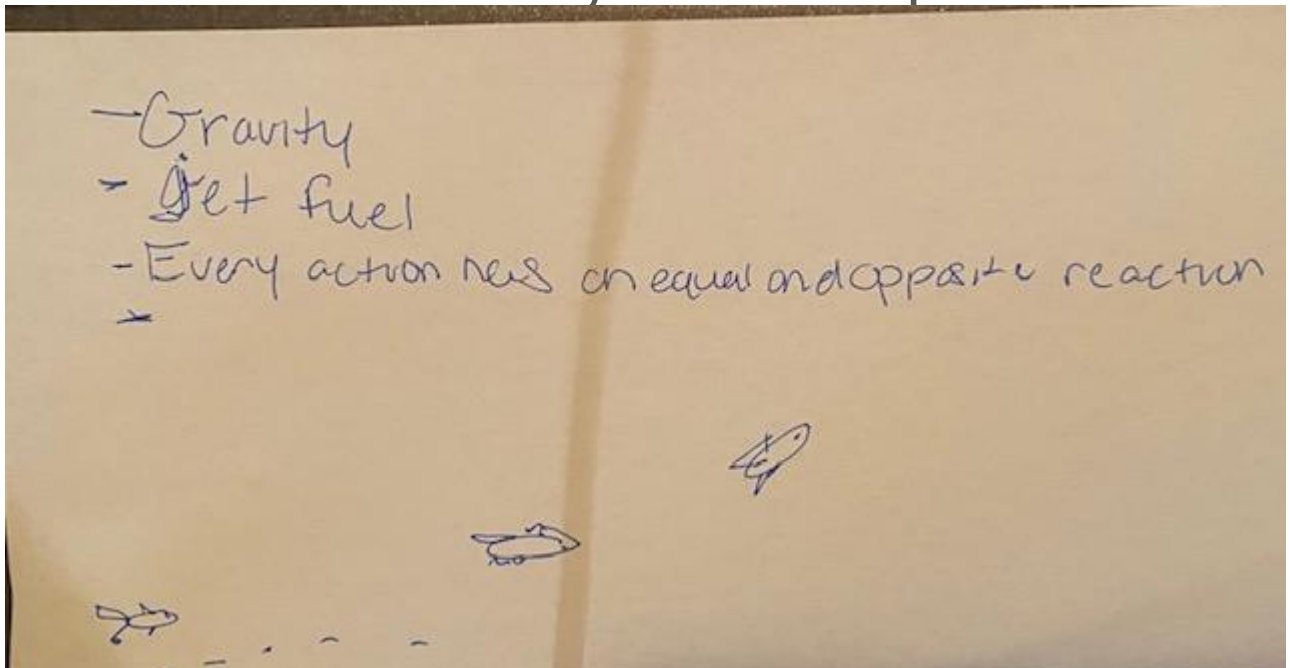
Prior Knowledge Question

What are the four forces that allow an airplane to fly?

Draw & describe how you think a plane is able to fly

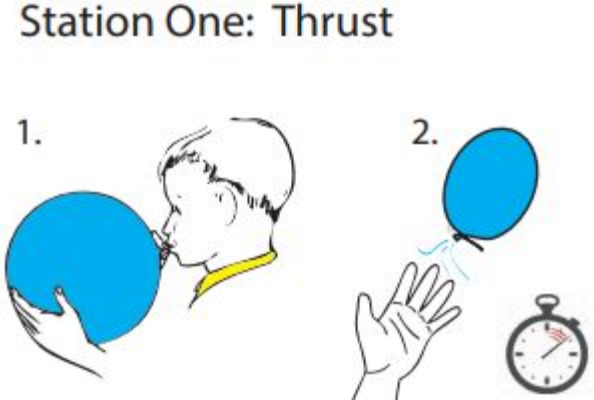
Prior Knowledge Question- Sample Work

What are the four forces that allow an airplane to fly?
Draw & describe how you think a plane is able to fly



Station One: Thrust

Inflate the balloon using either four breaths or four pumps of a balloon pump. ·Let go of the balloon while another student times the length of the flight. · Record the time the balloon spent airborne on the worksheet. · Repeat the experiment multiple times with various levels of inflation, recording the number of breaths and the flight time for each trial.

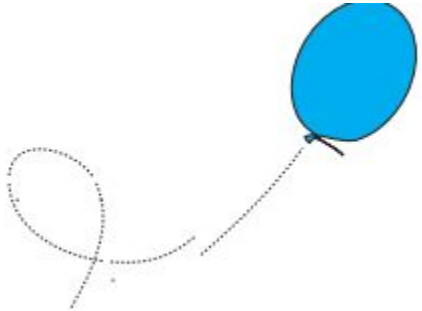


Thrust Summary Questions

What is thrust and how is it produced?

What correlation was there between the amount of air in the balloon and its flight time?

In what direction did the balloon move?



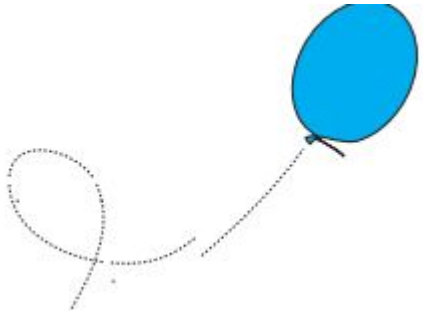
Number of breaths	Flight Time

Thrust Summary Questions- Sample Work

What is thrust and how is it produced? Thrust is how much power- produced from air blown into the balloon

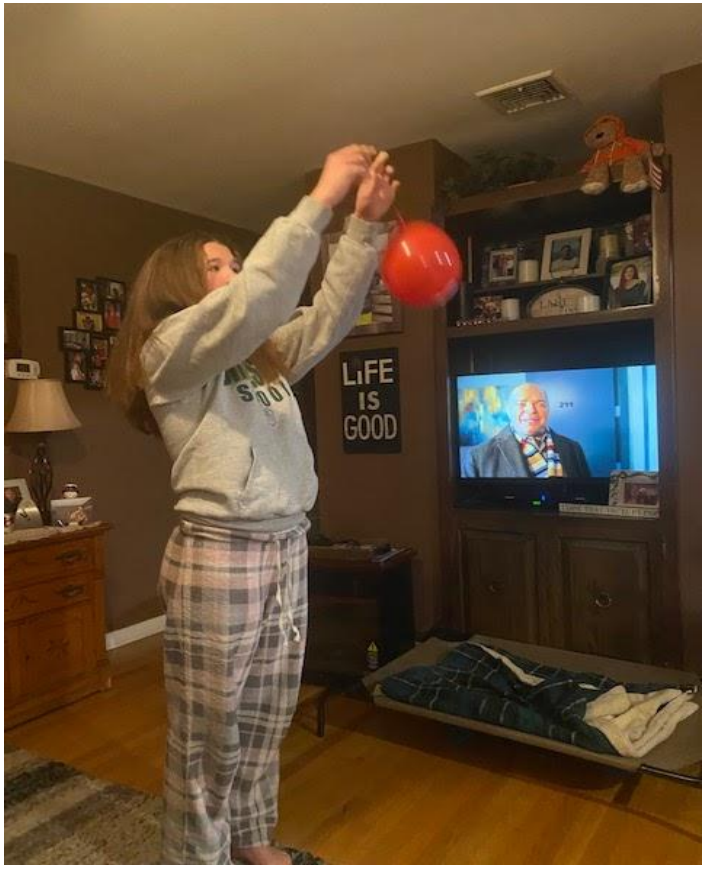
What correlation was there between the amount of air in the balloon and its flight time? The more breaths the longer the flight time

In what direction did the balloon move? UP propels in opposite direction



Number of breaths	Flight Time
4	4 sec
2	3 sec
1	2 sec

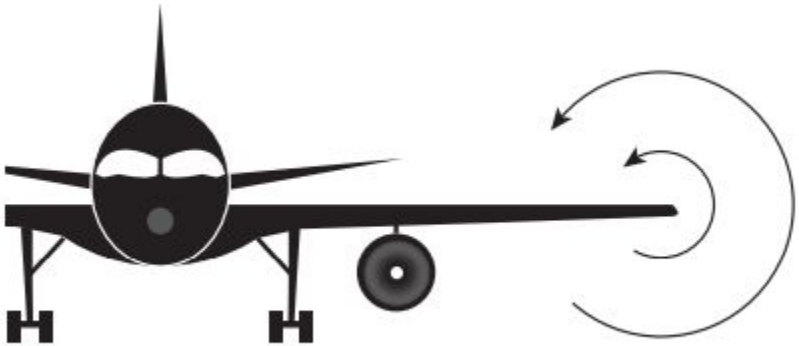
Thrust Station Pictures



Station Two: Drag

Run at a steady pace from the designated one point to the other, while another student times how long it takes· Then run again at the same pace as before, but this time holding the open umbrella behind you, while another student times how long it takes.

Drag Summary Questions

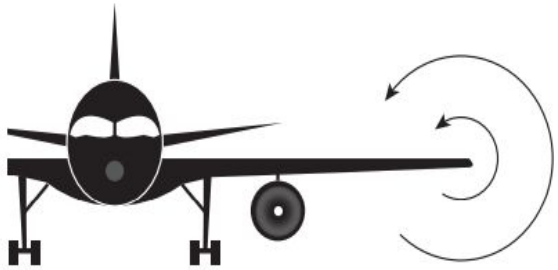


What is drag?

Why was it significantly harder to run with the open umbrella? Why were the sprinting times longer with the umbrella than without?

Time running without umbrella	Time running with umbrella

Drag Summary Questions- Sample Work



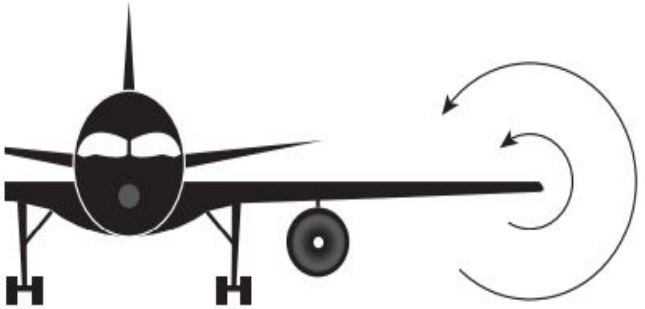
What is drag? When something causes resistance- like a loose swimsuit slows you down and a tech suit has no drag so it helps you drop time

Why was it significantly harder to run with the open umbrella? The umbrella caught air and made it harder to run

Why were the sprinting times longer with the umbrella than without? The air added time

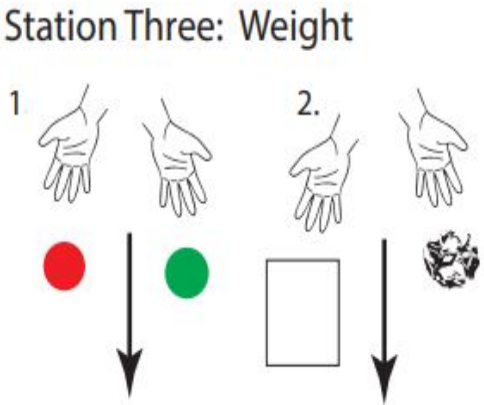
Time running without umbrella	Time running with umbrella
2 seconds	4 seconds

Drag Station Pictures

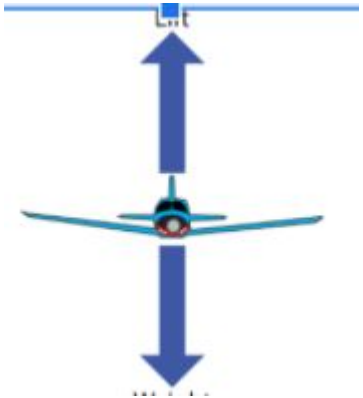


Station Three: Weight:

Compare the weight of the tennis ball and the golf ball and then weigh them on the scale and record their weights. . Hold the two balls at arm's length and at equal height and drop the balls at the same time·. Repeat the experiment 3 times and record what happened. Then take two sheets of identical copy paper · Scrunch up one sheet into a tight ball, leaving the other untouched. Predict what will happen when both sheets of paper are dropped at the same time. Then drop both sheets of paper at the same time. Remind the students that both sheets of paper weigh the same. Repeat the experiment three times and record what happens.



Weight Summary Questions



What is gravity?

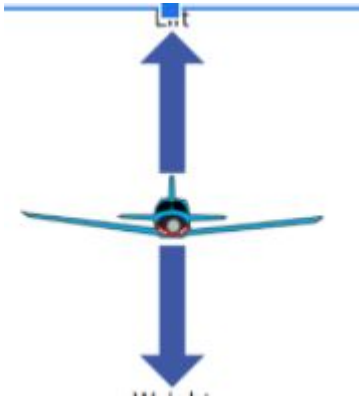
What is weight?

Why did both balls fall to the floor at approximately the same time even though one was heavier?

If the speed of gravity is the same for all objects, why did the ball of paper drop much quicker than the sheet?

Results dropping the 2 balls	Results dropping the 2 pieces of paper- 1 scrunched in a ball 1 untouched

Weight Summary Questions- Sample Work



What is gravity? The force pulling objects to earth

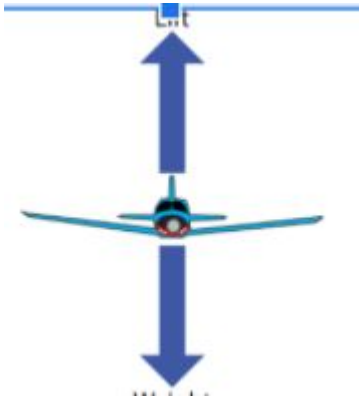
What is weight? The force going down due to gravity

Why did both balls fall to the floor at approximately the same time even though one was heavier? Gravity

If the speed of gravity is the same for all objects, why did the ball of paper drop much quicker than the sheet? The flat paper caught air so it couldn't fall with gravity

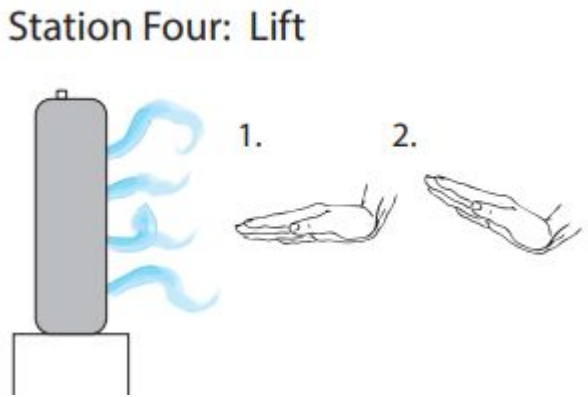
Results dropping the 2 balls	Results dropping the 2 pieces of paper- 1 scrunched in a ball 1 untouched
Both balls hit ground at same time	Crumbled paper hits first. Flat paper catches air

Weight Station Pictures



Station Four: Lift

· Using the fan- hold one hand flat against the blowing stream of air. Then tilt the front of your hand slightly.Describe what you feel happening to your hand.



Lift Summary Questions

What is lift?

Why did your hand rise when you turned it upwards slightly?

Results hand flat in front of fan	Results hand tilted in front of fan

Lift Summary Questions- Sample Work

What is lift? When air causes something to go up

Why did your hand rise when you turned it upwards slightly? The air was caught under the hand and the pressure caused the hand to go up

Results hand flat in front of fan	Results hand tilted in front of fan
The hand does not change	The hand pushes up

Lift Station Pictures

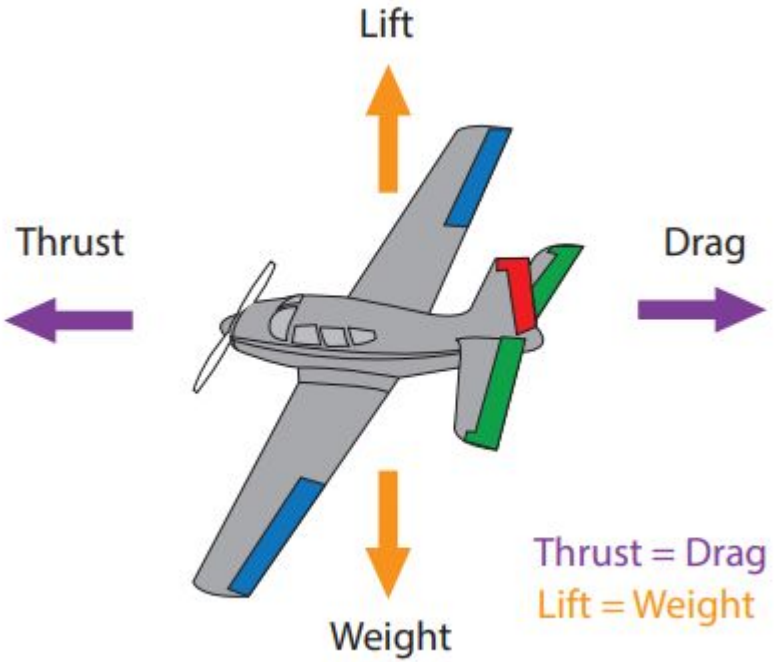
Exit Question-Describe the four forces that allow a plane to fly- use examples from the stations to help explain the principles

Thrust-

Drag-

Weight-

Lift-



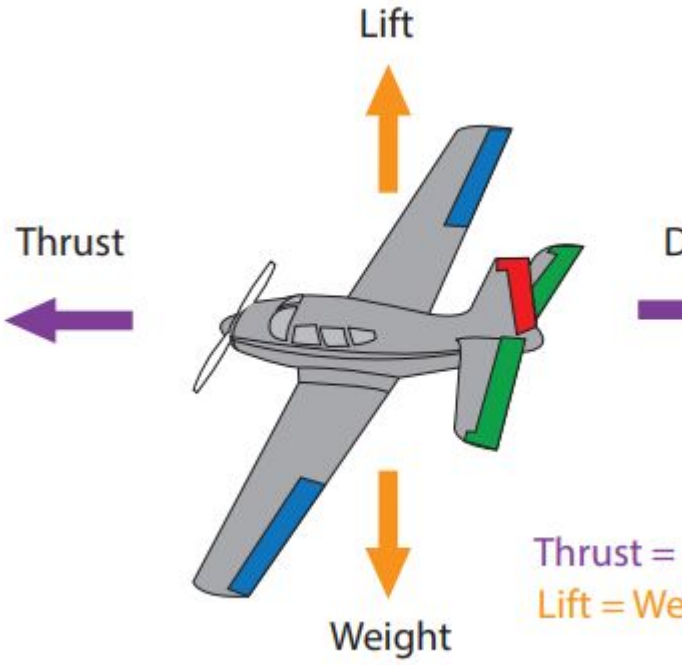
Exit Question-Describe the four forces that allow a plane to fly- use examples from the stations to help explain the principles- Sample Work

Thrust- force propelling plane forward- force goes in opposite direction from plane motion

Drag- the resistance force slows plane down- opposite of thrus

Weight-downward force by gravity

Lift- upward force that created when air causes plane to go up



Teacher Reflection

At first I thought these activities in this lab were too simple for my 8th graders. As we start to explore Newtonś Laws and then eventually cumulate the activities with rocket and then launching the rocket I would like the students to understand the basic principles of flight. This lab is a good introduction to learning the basics. I tested this out with my 9th grade daughter and was surprised that she had no idea of the principles of flight The simple experiments clearly demonstrated thrust, drag, weight, and lift. She was able to understand the 4 principles better after performing these activities and reading the background information provided in the lab. The concepts of weight and gravity had to be discussed more from the reading, the the principles of thrust, drag, and lift were easily understood from just doing the activities. I think these simple activities will be successful when I introduce them to my 8th graders. My daughter thought the activities were too young at first, but saw how the simple activities demonstrated the 4 principles. She can now describe how a plane is able to fly!!!