AEROSPACE™
Center For Excellence

Middle School Aerospace Curriculum
Year 2: Aerospace Technology

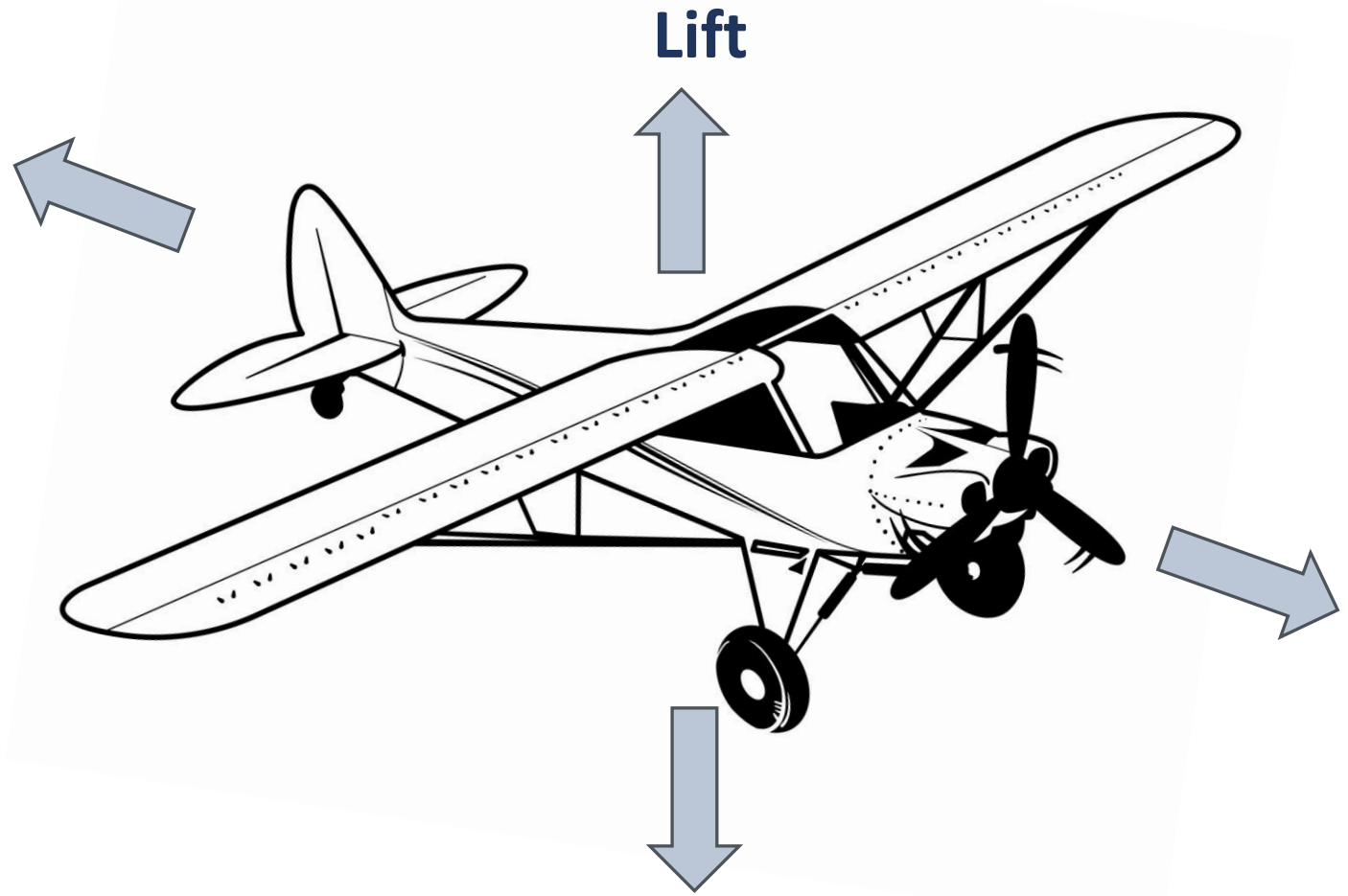
AERODYNAMICS: HEAVIER THAN AIR

UNIT 3 | LESSON 2 | PRESENTATION

Learning Objectives

- Define and explain terminology associated with aerodynamics.
- Identify and describe basic forces acting on an object in flight.
- Explain how Bernoulli's principle applies to an object in flight.
- Explain how Newton's Third Law applies to an object in flight.

Forces of Flight



Bernoulli's Principle

As the speed of a fluid increases, the pressure within that fluid decreases.

A fluid is a substance that has no fixed shape and gives easily to external pressure – a flowing substance. This can be a gas or liquid.

Bernoulli’s Principle Demonstrations

Newton's Third Law of Motion

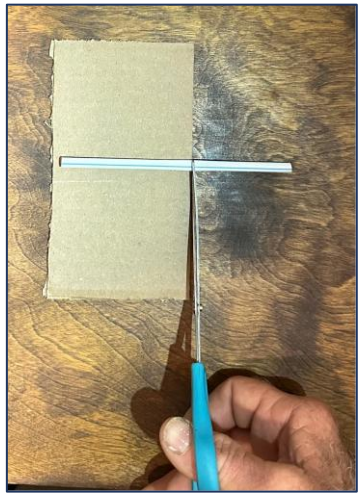
For every action, there is an equal and opposite reaction.

Newton’s Third Law of Motion

Objective: Demonstrate Newton’s Third Law of Motion by making and operating a balloon car.

Newton's Third Law of Motion

1. Lay one non-bendable straw horizontally across the cardboard. Cut the ends of the straw so they are even with the edge of the cardboard (9 cm). Cut the other straw the same length.



2. Assemble axle: insert skewer into straw. Attach skewer end to bottle cap through the hole. Repeat on the other side. Test that wheels spin freely by rolling axle along the ground. If they do not, make sure that the skewer is longer than the straw. Repeat with other skewer, straw, and 2 bottle caps.

Newton's Third Law of Motion

3. Measure 4 cm from one short end of the cardboard. Draw a horizontal line on the cardboard. Repeat on the other end. This is where you will tape the axles and wheels down.

4. Place the cardboard on a slightly raised surface to allow room to tape wheels on. Using two pieces of tape, tape one of the axle/wheels combinations to the cardboard on one of the horizontal lines you drew. Repeat for the other axle/wheel combination on the other horizontal line.

Newton's Third Law of Motion

5. Attach the balloon to longer end of a bendable straw by twisting a small rubber band around the end of the balloon and the straw 4-5 times. Air should be able to go in the balloon but not leak out where it is attached to the straw.

6. Take the car off the raised surface and turn over. Tape straw with balloon to the car as shown.

Newton's Third Law of Motion

7. Place the car on a flat surface. Blow up the balloon using a balloon pump if you have one, or your mouth if not. Hold your finger over the end of the straw.

8. Predict which way your car will travel.

9. Release your finger from the end of the straw and watch what happens to the car.

10. Answer the questions on your student think sheet.

Newton's Third Law of Motion

1. What happened to the air in the balloon when you moved your finger off the end of the straw? (describe direction of motion of the air)
2. What happened to the car when you moved your finger off the end of the straw? (describe direction of motion of the car)
3. Which force was the air in the balloon providing?
4. Which force was the structure of the car providing?
5. How does this demonstrate Newton's Third Law of Motion?

How Does A Wing Actually Work

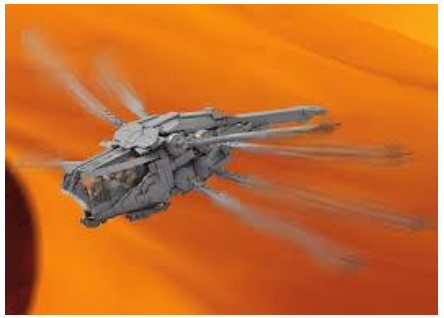
Winglets

Is Flight in the Atmosphere Possible with these Vehicles?

Look at the pictures of fictional aircraft. Choose one and explain why or why it would not have been able to fly in a planet's atmosphere. Explanations must include the terms *lift*, *Bernoulli's Principle, Newton's Third Law* and *drag.*

Millenium Falcon – Star Wars

Razor Crest– The Mandalorian



Ornithopter– Dune

Hornet – Halo Video Game