



## The Fundamentals of Flight

**Prep Time:**

10 minutes

**Lesson Time:**

55 minutes

**Essential Questions:**

- What are the four fundamental forces of flight?
- What are the main parts of an airplane and how do they help a plane achieve flight?

**Objectives:**

- Students will be able to explain the four fundamentals of flight and how they work together

**Standards:**

- MS-PS3-5: Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from an object.
- MS-ESS1-3: Analyze and interpret data to determine similarities and differences in findings.
- CCSS.ELA-Literacy.RI.6.7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
- CCSS.ELA-Literacy.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

**Lesson Prep:**

- Create a K.W.L. (Know, Want-to-know, Learn) chart and Venn Diagram on chart paper
- Print a copy of the fundamental forces worksheet for each student
- Set up four corners game by printing statement cards and labeling corners
- Make sure that you have enough frisbees for each group of students (1 frisbee to 3-5 students)

**Teacher Notes/Background:**

- It will be helpful to read through all lesson materials, including handouts, before the lesson begins.
- Students who need extra assistance can be paired during any portion of the lesson. If room does not allow for the four corners game, you can modify by printing the four options and having individuals or small groups hold up their answer as you read the statements.
- A key component in this lesson, is the introduction of real careers that require understanding of these essential concepts. For this lesson we recommend connecting the four fundamentals of flight with the following video:

<https://www.youtube.com/watch?v=dEeK384VQyY&feature=youtu.be>



## The Fundamentals of Flight

<p style="text-align: center;"><b>Engage</b> (5 minutes)</p>	<p>“Who knows how birds fly? How about airplanes?”</p> <p>Draw a KWL chart on the board or on a piece of chart paper (chart paper preferred, so that it can remain in the classroom for reference). Ask students to contribute what they “know” about flight. This can include things such as: what flies, how does flight work, different parts of an airplane, etc. Complete the “K” section of the chart. When answers have been exhausted, ask students what they “want” to learn about flight. Complete the “W” section of the chart.</p> <p>You will complete the “L” section of the chart as the students’ final evaluation piece at the end of the lesson.</p>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• KWL Chart – Drawn on board or chart paper</li> <li>• markers</li> </ul>
<p style="text-align: center;"><b>Explore</b> (20 minutes)</p>	<p>“Now that we have some good ideas about what we already know and what we’d like to learn, let’s talk about the four forces that lead to flight. These four forces are thrust, lift, drag, and weight. In order to learn more about each of these forces and their roles in flight, we are going to divide into four groups with each group focusing on one of these four forces. Each group will receive a packet of information pertaining to one of these forces. As a group, find answers to the three main questions on the worksheet. Everyone in your group needs to pay attention as you each will need to teach your fellow students about the particular force.”</p> <p>Divide the class into four different groups. Pass out packets to each student.</p> <p>Give students about 5-10 minutes to complete the worksheet on their subject area. When students have completed the sheet, form new groups. Have one student from each of the original groups (drag, thrust, lift, weight) join to form a new group. Each student will now teach their group about their assigned force. Circulate to check for understanding.</p> <p><b>Show students the First Officer career video.</b></p>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• Forces worksheet</li> <li>• Four forces Powerpoint (to be printed out like a packet for students to explore)</li> <li>• First Officer Career Video</li> </ul>



## The Fundamentals of Flight

### Explain

(15 minutes)

**\*\* Have the four forces chart on the board and label the four corners of the room with the provided signs\*\***

“We’ve learned a lot of new facts about the four fundamentals of flight already; let’s test our knowledge about all of the fundamental forces. We’re going to play a game called four corners. I’ll read a fact and you need to safely, with walking feet, travel to the corner that you think the statement belongs to. Our corner choices are thrust, drag, weight, and lift. If what I say only is talking about thrust, come stand in the corner marked thrust. If what I say only describes an action with drag, come stand in the corner marked drag. If what I say only describes an action about weight, come stand in the corner marked weight. Finally, if it happens to only concern lift, come stand in the corner marked lift. Once we all agree where each statement belongs, I will place that statement in the right category on the board behind me. At the end we’ll look at the board to double check and make sure that all of our statements are placed in the right areas.”

Have students stand behind desks with chairs pushed in for ease of movement.

Read a statement from the four corner cards.

Students will move to the correct corner. If students get an answer incorrect, either have a student at the correct answer share why they chose the correct answer or read the reasoning on the bottom of the statement card.

After reading each card and having students move, tape the statement card to the correct place on the chart on the board.

When all cards have been read, gather students to go over the statements that are now recorded in the chart.

Check for understanding and answer any questions during this review.

#### Materials:

- Four corner statement cards
- [Tip: You may want to put cards in a certain order before starting this lesson to ensure that students are moving around the room.]
- Four corner labels
- Four forces chart





## The Fundamentals of Flight

<b>Elaborate</b> (10 minutes)	<p>“Today we learned about the four fundamentals of flight. These fundamentals do not just impact airplanes or birds, they influence all of us. When I throw this frisbee to my friend it flies through the air. Why do you think that happens? Let’s think about what you’ve learned so far. As you throw your frisbee back and forth with your group, think about the principles of flight and how they affect your frisbee. We’ll talk about it after you have practiced for 5 minutes. When you hear my signal to stop, come back to me with your frisbee so we can discuss your observations. “</p> <p>Bring students and several frisbees outside.</p> <p>Have students divide into smaller groups (about 3-5 kids per frisbee)</p> <p>Have students throw the frisbee back and forth to each other.</p> <p>Quiz the students on their actions on each stage of the frisbee’s flight.</p> <ul style="list-style-type: none"> <li>• What provides the lift?</li> <li>• What is the weight?</li> <li>• What is the thrust?</li> <li>• What is the drag?</li> </ul>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• Frisbees (enough for 3-5 kids to have one)</li> <li>• If you do not have enough frisbees, cut out discs from cardboard for similar results</li> </ul>
<b>Evaluate</b> (5 minutes)	<p>Return to your classroom.</p> <p>Debrief as a group to talk about the forces acting on the frisbee while they were experimenting with them.</p> <p>When students have finished the discussion, have them help you fill out the "L" section of the KWL chart.</p>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• KWL Chart</li> </ul>
<p><b>Extensions and Enrichment</b></p> <ul style="list-style-type: none"> <li>• If time allows, you can use more of the four corners statements to continue to practice their understanding of the concepts.</li> <li>• Have students create their own statements to use for the four corners game based on your classroom discussion or their own research.</li> </ul>		
<p><b>Additional Resources</b></p> <ul style="list-style-type: none"> <li>• Four Forces of Flight <a href="https://www.nasa.gov/audience/foreducators/k-4/features/">https://www.nasa.gov/audience/foreducators/k-4/features/</a></li> </ul>		

# 3,2,1 Sheet

**3 interesting facts:**

**2 things I learned:**

**1 question I still have:**

# 3,2,1 Sheet

**3 interesting facts:**

**2 things I learned:**

**1 question I still have:**



# Four Fundamental Forces of Flight

# THRUST

- Thrust is the force applied to an object that accelerates it in one direction. Think of it like a push.
- Thrust is the force that allows the plane to move in its intended direction. This is usually created by an engine or a similar energy source on an aircraft.
- Thrust is not the force that is directly responsible for the plane's flight. The main purpose of thrust is to counteract, or overcome, one of the other four forces of flight, drag.



# DRAG

- Drag is the force that acts in opposition to thrust. It is similar to friction. It moves against the forward motion of the object.
- Friction is caused by surfaces (think of pushing a heavy object across a floor), while drag is caused by air or fluids (think of running into the wind).
- Drag is the interaction between an airplane and the air surrounding it that slows it down.





# WEIGHT

- Weight is the force caused by the gravitational attraction between any object and the Earth. This attraction pulls the object towards the Earth.
- The force weight that is felt on airplanes is the same force that you may feel everyday. When you step on a scale, the number you see is the amount of gravity acting on you.
- Weight on a plane keeps it from floating into space.



# LIFT

- Lift is created by changes in air pressure. This is the force that allows the plane to counteract the force of weight.
- Lift is what causes objects to fly or glide. An example of lift can be seen when you throw a frisbee. The change in air pressure around the frisbee allows it to continue to hover and not just fall directly to the ground.



# Four Fundamental Forces of Flight

Name of Force: \_\_\_\_\_

In your own words, define the force you researched below:

What role does this force play in the fundamentals of flight?

Give a real-life example of this particular force in action and explain your reasoning.

This force accelerates an object in one direction.

Thrust

This force acts in opposition to the force, thrust.

Drag

This force's main purpose is to counteract the force, drag.

Thrust

This force is caused by gravity.

Weight

This force is created by changes in air pressure.

Thrust

This force is usually created by an engine or similar energy source on an aircraft.

Thrust

This force acts similarly to friction.

Drag

This force acts similarly to a push.

Thrust

.2

Running into the wind or trying to push a heavy object across the floor is a good analogy for this force.

Drag

This force keeps everything from floating into space.

Weight

This force is felt by everyone on Earth everyday.

Weight

A good way to demonstrate that this force is working is by throwing a frisbee.

Lift

This force, when it works with three other forces, leads to lift off from the ground.

Thrust

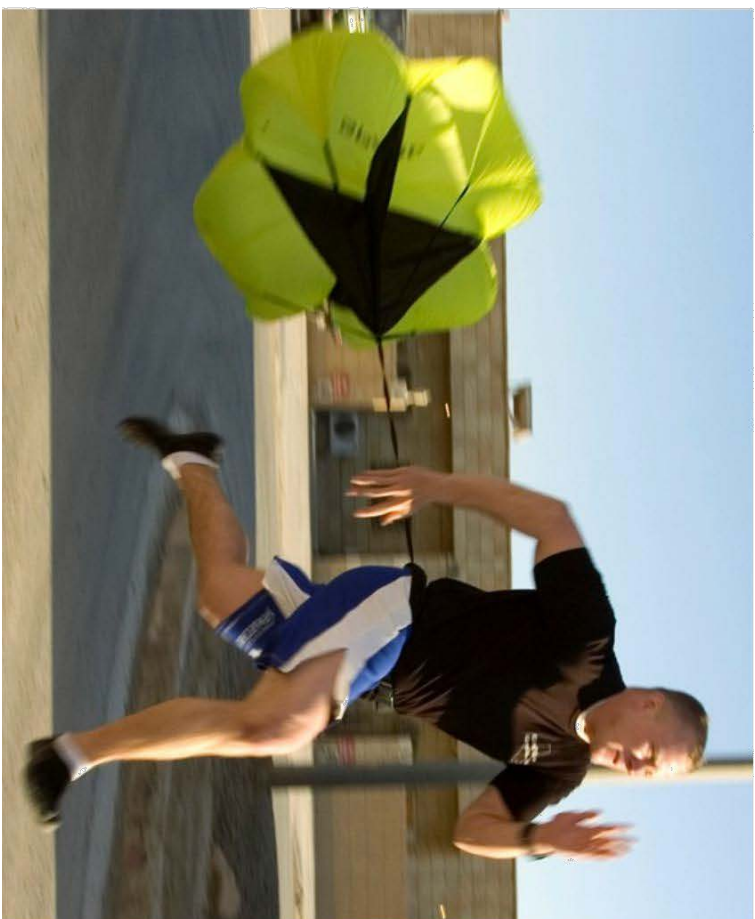
This force directly counteracts the force of weight.

Lift

This force is very similar to friction, but focuses on air rather than physical objects.

Drag

# Dr. So.



# Tip





# Weight



# Turnfirst

