



Civil Air Patrol's ACE Program

Foam Flyer Grade 3 Academic Lesson #4

Topics: motion, forces, basic airplane parts, vocabulary (science, language arts)

Length of Lesson: 45 minutes

Objectives:

- Students will identify and describe three forces acting on the plane: thrust, gravity, and lift.
- Students will identify basic parts of the plane: fuselage, wings, cockpit, propeller, and tail.
- Students will experiment with flight.
- Students will read a passage and answer questions relating to the forces that act on an airplane.



Next Generation Science Standard:

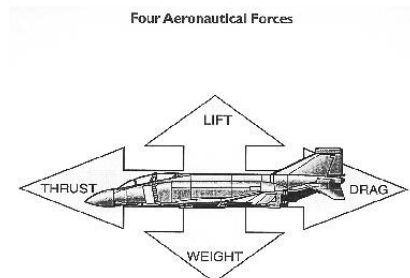
- 3-PS2-1-Plan and Conduct an investigation to provide evidence of the effects of balance and unbalanced forces on the motion of the object.
- 3-PS2-2-Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

CCSS ELA:

- RI.3.1-Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- RI.3.4-Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.
- RI.3.10-By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2-3 text complexity band independently and proficiently.

Background Information: (from NASA Quest at ["What Is Aerodynamics?"](#))

Can you think of examples of force? If you push a door closed, your push is a force. If you pull a drawer open, your pull is a force. A force actually has two parts. One part is the strength of the force. When you push a door closed, do you push it gently or does



it slam shut? How hard the door is pushed is called the strength or magnitude of the force. The other part is the direction of the force. Let's say you are pulling on a rope. Pull it to the right, then to the left. Pull it upwards and then pull it downwards. Where you pulled the rope is the direction of the force. A force has both magnitude and direction.

In aeronautics, there are four important forces. These four forces are called lift, weight, thrust and drag. Each force works in a specific direction. The magnitude of each force can vary from weak to strong. All of these four forces are hard at work when an airplane is in flight. They often work in opposite directions from each other, but together they make flight possible.

Gravity/Weight: An airplane has weight, just like every other object that exists around Earth. We know that Earth exerts a gravity force on us. We call that force weight. When you weigh yourself, you are actually measuring the force of Earth's gravity on your body. Remember that there are two parts to a force: magnitude and direction. The direction of your weight force is toward the Earth. The magnitude of your weight force is how heavy you are.

Airplanes have a weight force, too. Even as they fly many feet above the ground, their weight force is pulling them toward the ground. Since they are so heavy, the magnitude of their weight force is very great.

Lift: When objects lift off the ground, it means that the lift force is stronger than the weight force. If the weight force were stronger, then the object would not lift into the air. If an airplane can create enough lift force to overcome the weight force, then the airplane will fly. Such a great lift force is generated by the air flowing over the wings of the airplane, as well as the angle of the wings in relation to the airflow (angle of attack).

Thrust: We make air flow over the wings by moving the wings through the air. As the wing moves through the air, the air molecules flow over and under the wing, which generates lift. Somehow we need to get the airplane moving forward so that the air can begin flowing over the wings. To do this we need thrust. Thrust is provided by the propulsion system. Engines can be mounted on the wings or fuselage. They propel the airplane along the runway and forward through the air. The force that is created by the engines is called the thrust force. The direction of the thrust force is based on where the engines are pointing.

Drag: As an airplane is thrust through the air, it must push aside all those air molecules that are moving around in the space in front of it. As a wing moves through the air, the air separates and some of the molecules follow along the top of the wing while others flow underneath the wing. The same thing happens with the rest of the airplane. The air molecules must separate so that the airplane can move through the air. Air molecules resist being separated by the airplane. This resistance is called drag. Drag can slow the forward motion of the airplane.

(In this lesson, drag is not presented.)

You may wish to watch this video for background information (or share it with your class): ["How Do Airplanes Fly?"](#) by MinutePhysics.

Materials:

- an assembled foam flyer
- dry erase board (or chalkboard) and marker (or chalk)
- foam flyer glider kits (provided by CAP)
- markers
- Teachers need a free account with [Newsela.com](https://www.newsela.com) in order to meet the ELA standards attached to this lesson. The Newsela article "Four Forces on an airplane" was used in Lesson # 2. There are short answer questions on the website that can be used for further assessment if the students have already completed the multiple choice questions.

Lesson Presentation:

1. Draw a picture of an airplane on the board to which students can refer and you can label.
2. Reread/discuss "The Four Forces on an Airplane" article to review the forces acting on planes and preview the parts of a plane.
3. Show students your assembled foam plane.
4. Ask students if they know any parts of the plane and the purpose of the part identified. Allow volunteers to come forward to point to the part of the model that they think they know and allow them to try to tell its purpose.
5. Confirm that students know the following airplane parts by pointing to them on your model airplane and labeling the plane on the board. (When referring to the propeller, point where the propeller would be on the foam flyer if the flyer had a propeller.) Explain each part to the students:
 - **Wings** help keep the plane lifted in the air. The angle at which the wings move through the air plays an important role in the airplane staying lifted in the air. Also, when air blows over the special shape of airplane wings, it helps it stay lifted in the air. Ask students to recall the "Bernoulli's Tongue" activity (if you presented this activity to the students prior to this lesson). Remind students that just like the air they blew over the paper strip tongue caused the tongue to rise, the same type of thing happens with airplane wings. Air moving over the top of the wings is actually moving faster than the air beneath the wings. So, when slower moving air is on the bottom of the wing, it creates a high pressure that helps push the wings up. (Provide pressure information if students do not understand the term "pressure." For example, tell them to lightly touch their arm. Now tell them to press

down really hard on their arm. Explain that when they press harder, they are applying more pressure.) There is additional science happening with the wings, but explain that as long as they understand that wings help keep the plane lifted into the air because of air flowing over the wings and pressure that is created, they've got a good 3rd grade understanding of wings.

- The **propeller** is made of blades that spin. This spinning is caused by a motor that gives energy to the propeller to spin. When the propeller is spinning, it provides a force that causes the plane to move forward. This force is called thrust. Thrust is what makes a plane move forward, and the spinning propellers that get energy from a motor create the thrust for the airplane. Tell students to remember to associate the word "thrust" with "power" and "forward motion." Point out that your foam airplane does not have a propeller. Ask the students what will give the foam flyer thrust (forward motion). Confirm that the thrust power will come from their hand and arm as they toss it forward.
 - The **cockpit** is the area in the plane where people who fly the plane sit. There are lots of instruments in the cockpit that the pilot and copilot can use to fly the plane.
 - The **tail** of the airplane helps to keep the plane balanced. On a real airplane, there are moveable parts on the tail and the wing that help turn the plane left, right, up, and down.
 - The **fuselage** (pronounced few-suh-lodge) is the body of the airplane. All other parts of the airplane connect to the fuselage. Besides all parts connecting to the fuselage, the main purpose of the fuselage is to hold people and cargo (or luggage).
6. Tell students that after having discussed all of the parts of the plane, they can probably name 3 forces that affect the airplane. A simple definition for "force" is a "push or pull." It is important to associate direction when referring to a force.
- **Thrust:** Ask students what force causes the plane to move forward. This was discussed when discussing propellers and your arm and hand with the foam flyer. (thrust) Explain that thrust is a force that keeps the plane moving forward. Draw an arrow pointing forward in front of the propellers drawn on the board and write "thrust."
 - **Lift:** Ask students what force helps keep the plane up in the air. The wings help with this. Explain that the name of the force is "lift." Lift is the force that helps the plane stay up in the air, and lift is possible because of the wings. Draw an arrow pointing up above the wings and write "lift."
 - **Gravity:** Tell students that there is a third force that wants to pull the plane back to the ground. Ask students what force this might be. Confirm that gravity is the force that allows the plane to land on the ground. Draw an arrow pointing down below the airplane on the board and write "gravity."

7. Tell students that they have now learned about the parts of the plane and the forces that cause the plane to move the way it does. So, now it's time to make the foam flyer!
8. Distribute a foam flyer kit to each student. Direct them through the process of assembling the foam planes using the instructions provided in each kit.
9. Once students have assembled their planes, have each student write his/her name on his/her plane using a pen or marker.
10. Call out the parts of the airplane and have students point to the specified part on their planes.
11. Tell students that they are going to practice flying their foam flyers.
12. **SAFETY:** Go over safety rules with students. You may wish them to wear safety goggles. Additionally, ask students to leave plenty of space between themselves and other students who are flying their planes. Remind students to be aware of their surroundings and watch for planes that may be coming their way.
13. Go outside or into a gymnasium to fly the foam flyers.

Summarization:

Ask students to share some things they learned today. Tell students that a real plane has a motor that runs to give the propeller energy to spin. Ask students to identify the "motor" for their airplane. (their hands and arms)

Review parts of the plane and the 3 forces of flight they learned and demonstrated with their airplane. Show a picture of a plane and ask students to identify the propeller, cockpit, fuselage, and tail. A picture to use/worksheet is linked below:

[Airplane Parts Identification & Functions Worksheet](#). Tell the students definitions of the three forces discussed and ask them to identify either lift, thrust, or gravity.

Character Connection: Remind students that to soar high and be successful in life, they must take their time, follow directions, learn as much as they can, apply what they have learned, and always do their best in everything. Sometimes, we learn by making mistakes. Remind students to make good choices and to learn from their mistakes, trying not to repeat mistakes, in order to be an ace (top-notch) student!

Drug Demand Reduction (DDR) Connection: Available on page 9.

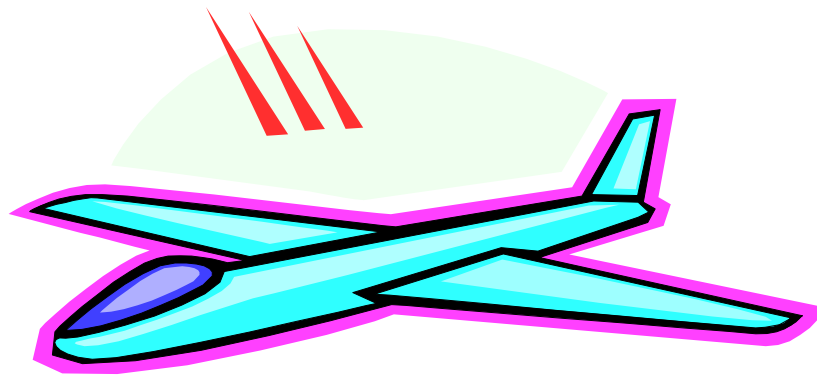
Assessment:

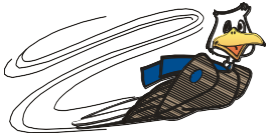
- teacher observation
- answers to class discussion questions

- assembled airplanes
- "All About Airplanes" worksheet (included - optional)
- Newsela short answer questions/multiple choice questions (if not used for lesson #2)

Additional activity ideas to enrich and extend the primary lesson (optional):

- Have students complete the "All About Airplanes" worksheet.
- Allow students to use markers or water color paint to color their airplanes.
- Lead students in the following activities using their airplanes:
 - See whose plane can fly the farthest distance.
 - See whose plane can hit a designated target.
 - See whose plane can stay in the air the longest.



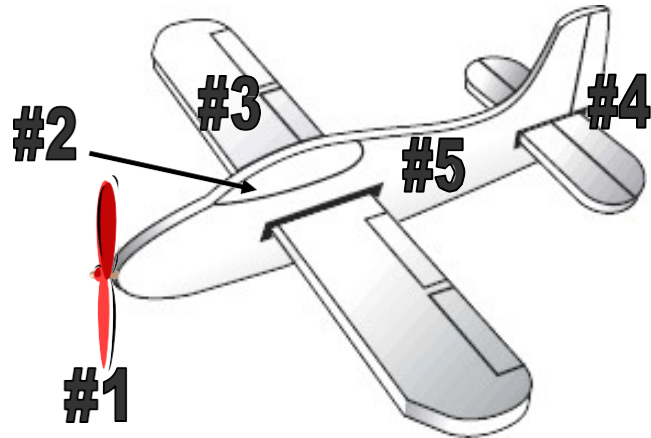


ALL ABOUT AIRPLANES

NAME _____

Write the correct name for each numbered airplane part in the picture.

1. _____
2. _____
3. _____
4. _____
5. _____



Write the correct letter of the answer in the blank to the left of the question.

- _____ 6. What is a force?
A. a passenger B. a push or pull in a certain direction C. an airport
- _____ 7. What force brings an airplane back to the ground?
A. thrust B. gravity C. lift
- _____ 8. What force helps hold the plane up in the air?
A. thrust B. gravity C. lift
- _____ 9. What force makes the airplane move forward?
A. thrust B. gravity C. lift
- _____ 10. What is responsible for creating thrust on an airplane?
A. a motor and propellers B. wings C. fuselage D. cockpit E. tail
- _____ 11. What part of the plane is responsible for lift?
A. propellers B. wings C. fuselage D. cockpit E. tail
- _____ 12. What part of the plane is considered the body of the plane that holds people and cargo?
A. propellers B. wings C. fuselage D. cockpit E. tail

