Aeronautical Engineering & Aircraft Design

You can fill out this worksheet as we go along to get the most out of time together, or you can use it as a review exercise at the end of the class to see where your strengths are.

What we're going to cover today:

- Air pressure differences
- Flaps
- Aileron
- Elevator
- Fuselage
- Propeller
- Light
- Weight
- Thrust
- Drag
- Gyroscopic motion
- Slipstream
- Center of pressure
- Center of gravity

Write down two things you really want to know about aerospace engineering and flight:

1._____

2. _____

Do this NOW: Write down WHY you want to learn about the things you mentioned above. What will it give you, or provide you with, or make possible for you if you now understand these things that you wanted to learn?

_____

_____

IMPORTANT: During class, you can either fill out the worksheet, OR just set it aside and fill it out after class is over so you can enjoy watching the class.

Answer key is on the last page, so put it in a place where you won't be tempted to peek at the answers until after you've given it your best shot.

Material List for Experiments:

We will be doing experiments during and after class. Gather as many of the materials as you can. It's fine if you don't have everything. You will be able to choose from several different experiments, so pick experiments that you have the stuff for. If you do not have all of these materials, you can still fully participate.

(Asterisk (*) indicates the materials that are used again in other months)

- Paper
- Index cards (10+)
- String
- Tape
- Scissors
- Paperclips
- Straw
- Hair dryer
- Pencil
- Paper or foam cups (2)
- Balsa wood plane (optional)

Science Experiments: There are so many experiments to choose from! This month we are in Unit 20, so I put together a smaller set (below) to help get you started. You don't need to do all of them, just pick the ones you have time and materials for.

Week 31: Aeronautical Engineering (Airplane Design) Unit 20

- Nakamura Lock
- Hangliders
- Ring Thing
- Butterflying Cups
- Bomber Plane
- Spinning Ring
- Do Airplanes need Wings?
- Tweaking Tips

Name_____

During the Lesson:

You can look over the worksheet so you know what to listen for as you go through the class with me, or you can go through it along with me during class. OR… flip it over and forget about it and just enjoy the class. When class is over, flip it back over and fill it out and be amazed at how much you've picked up and learned!

1. Pressure differences cause gases to _____
2. Higher pressure always _____
3. Four aerodynamic forces of flight:

   _____

   _____

   _____

   _____

4. Faster moving air generates _____

   pressure on the bottom of the ball.

5. Higher pressure on _____ of the ball

   keeps the ball in the funnel.

6. Airflow is _____ over the top of the wing, creating a lower pressure.
7. Airflow is _____ under the wing, creating a higher pressure.
8. Flaps and slats increase the _____ of the wing to generate more _____ at slower speeds.
9. Wings have _____ dihedral angles for stability.
10. Angle of _____: angle between the chord line and the flight direction.
11. As the angle _____, the lift increases and moves forward.
12. _____ stability is when the aircraft attempts to return to straight and _____ flight.
13. Center of pressure is _____ of the center of gravity for _____ stability.

14. In a banked turn, more _____ is generated on the outside (raised) wing.

15. What I didn't know about flight until class today was:

_____

_____

Aviation & Aerospace Engineering
Resource Recommendations

Welcome to our month on Aviation and Aerospace Engineering! Aerospace engineers design and develop aircraft and spacecraft. Aeronautical engineers focus on aircraft that fly through the Earth's atmosphere, and astronautical engineers are the "rocket scientists", dealing with spacecraft and rockets that operate both inside and outside of the atmosphere. Pilots fly both aircraft and spacecraft, and study aviation. Aviation includes fixed-wing (airplanes), rotary wing (helicopters), lighter-than-air (hot air balloons) and airships. We're going to learn about both sides: how to design and develop flying craft as well as how to fly.

I've put together a list of books that supplement our labs. The first thing you'll notice is a list of scientists that really made a contribution to the field. To be honest, there are hundreds of scientists that we could list here, so instead of overwhelming you with options, I will provide you with a few well-known scientists as well as some which may be new to you.

Take this list with you to your local library and see if you can find books, either biographical or historical, and enjoy reading and learning. I also see if I can find an autobiography, because I learn so much more about the scientist when they share their thoughts and tell me their personal story.

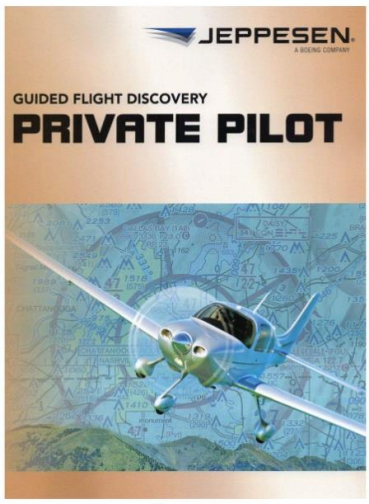
I also recommend skimming the bibliography or "suggested reading" list (usually listed near the back of a book). I've read some amazing books this way that I would never have found on my own. It's like following an unknown path through a forest on your nature walk!

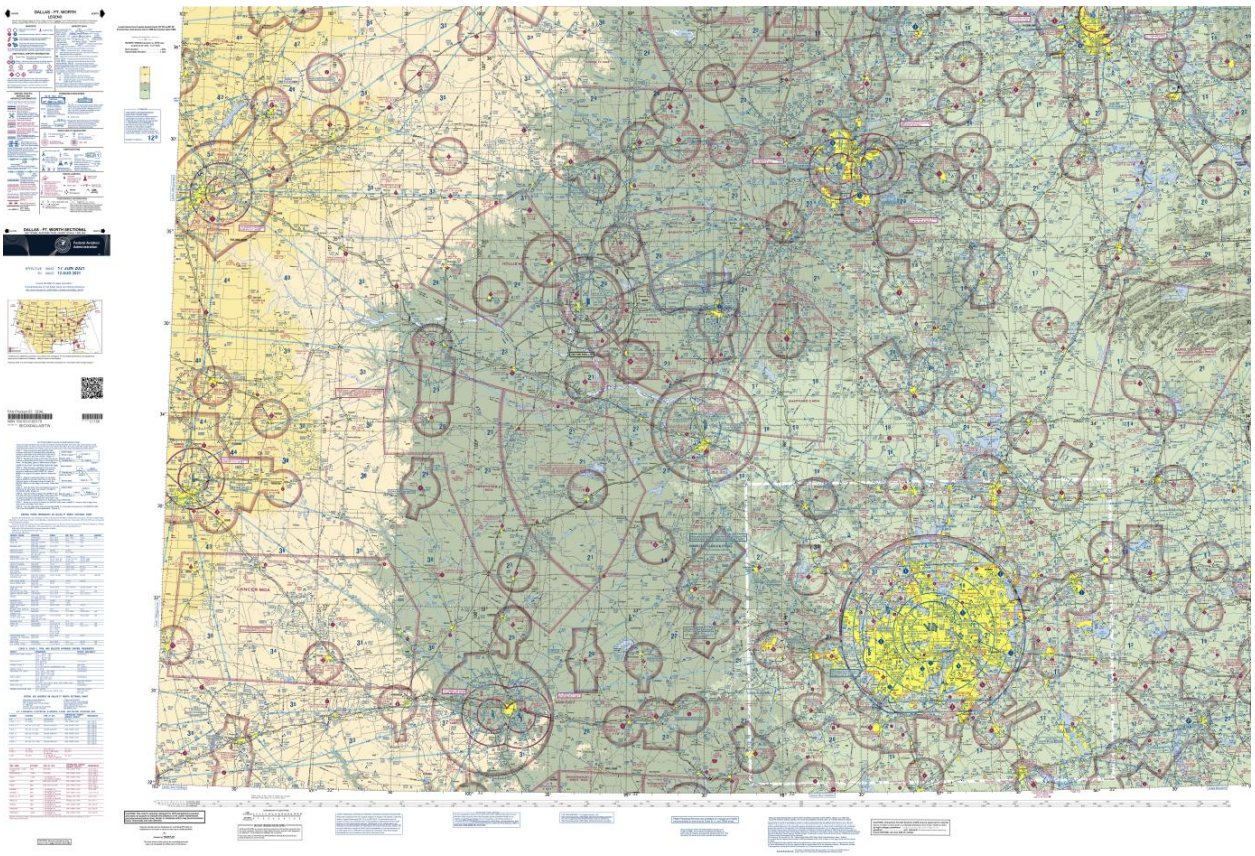
<u>List of Scientists/Engineers/Pilots:</u>

1. Wright Brothers
2. Robert Goddard
3. Kelly Johnson
4. George Cayley
5. Hans von Ohain
6. Chuck Yeager
7. Patty Wagstaff
8. Charles Lindbergh
9. Bob Hoover
10. Jacqueline Cochran

Book Recommendations:

1. *Private Pilot* by Jeppesen (for students with a serious interest in aviation)
2. *Pilot's Handbook of Aeronautical Knowledge* (for serious interest in aviation)
3. *Experience Flight* by DK (for younger readers)
4. *Pilot Maps* (FAA Sectionals) also download here





Vocabulary Words:

Air pressure – Describes the weight of air molecules pressing down on the Earth.

Airflow – Describes the motion of air, particularly in relation to the surface of an object, such as an airplane.

Angle of attack – In aviation, it describes the angle (or difference of direction) between the airplane's reference line and the oncoming flow of air.

Atmosphere – Describes the layer of gas that surrounds a planet or other celestial body.

Aviation – The act, practice, or flying of airplanes.

Center of gravity – The point at which the entire weight of a body may be thought of as centered so that, if supported at this point, the body would balance perfectly.

Center of pressure – In regards to flight, the average location of where the force from air pressure is applied. It is where the forces of lift and drag are exerted.

Dihedral – In regards to flight, the upward angle of an aircraft's wings from root to tip, as viewed from directly in front of or behind the aircraft.

Drag – A force which tends to slow the movement of an object through a liquid or gas.

Fin – A flat part which sticks out of the body of an object such as an airplane or rocket which is intended to help control its movement.

Flaps – Hinged parts that the pilot adjusts to increase the size of the wing surface.

Flight instruments – Devices which give the pilot information about the aircraft, such as altitude and airspeed.

Force – Describes the push or pull exerted on an object.

Gravity - A force of attraction that pulls together all matter. The more matter something has, the greater the force of its gravity.

Great circle distance – The largest possible circle that can be drawn on a sphere, one that divides the sphere into equal halves. In navigation, great circles can be used to determine the shortest surface distance between two points on the Earth.

Lift – In aviation, the sum of all forces on a body that force it to move perpendicular to the flow of air.

Navigation – The process or activity of determining one's position and planning and following a route to a destination.

Pressure – The continuous physical force exerted on or against an object by something in contact with it.

Stability – In flight, describes condition of an airplane where it will keep going the same direction even when exposed to uneven air pressure.

Surface area – The measurement of all space that the surface of a three-dimensional shape takes up.

Thrust – A forced or push intended to accelerate (change direction or speed) an object.

Wing – A part of an animal, aircraft, or spacecraft intended to produce lift.

Answer key:

1. The atmosphere is a layer of gases surrounding Earth held by gravity.
2. Pressure differences cause gases to move.
3. Higher pressure always pushes.
4. Four aerodynamic forces of flight: light, weight, thrust, drag.
5. Faster moving air generates lower pressure on the bottom of the ball.
6. Higher pressure on top of the ball keeps the ball in the funnel.
7. Airflow is faster over the top of the wing, creating a lower pressure.
8. Airflow is slower under the wing, creating a higher pressure.
9. Flaps and slats increase the size of the wing to generate more lift at slower speeds.
10. Wings have positive dihedral angles for stability.
11. Angle of attack: angle between the chord line and the flight direction.
12. As the angle increases, the lift increases and moves forward.
13. Positive stability is when the aircraft attempts to return to straight and level flight.
14. Center of pressure is aft of the center of gravity for positive stability.
15. In a banked turn, more lift is generated on the outside (raised) wing.