

LATHROP ENGINEERING

Name: _____

UNIT 1: AERODYNAMICS

















Aerospace Engineering

Unit Due Date: **September 6, 2019**

Welcome to the first unit of *Aerospace Engineering*! In this unit, we will learn the basics of flight. Our study will start with airfoils and control surfaces as we learn how planes create and control their flight. Then we'll do some mathematics related to flight, pressure, and aerodynamics. Finally, we'll use a computer simulation to design airfoils of different shapes, then build and actually test some airfoils in our wind tunnel. In the end, the expectation is that you learn the following:

- What creates lift, and the vocabulary used to describe the physics of aerodynamics
- How planes use various control surfaces to control their flight
- How to control the flight path of your own aircraft
- How to design airfoils in a computer simulation
- How to build airfoils out of foam
- How to use Lathrop's TurBlo1000 Wind Tunnel to measure lift & drag

As we move through this unit, you are responsible for making adequate progress through the assignments, and for being done by the Unit Due Date (**September 6, 2019**). You are also responsible for completing each part before moving on to the next. Our unit is broken up into three main parts:

Part 1: Basics of Aerodynamics (30 pts) Approx. 3 days	
Our course starts with an introduction to the vocabulary and concepts surrounding flight and aerodynamics. Here you'll start by investigating how airfoils create lift, and then study what control surfaces are used in giving a pilot control over their flight. Then you'll tackle a tough paper airplane design challenge.	 Notes on Aerodynamic Forces
	 Notes on Control Surfaces
	 4-Part Paper Airplane Challenge
	 Check-off from Mr. Benshoof
Part 2: Physics of Aerodynamics (30 pts) Approx. 2 days	
This second part is very much a lesson in mathematics. Here we'll look at the main equations that govern lift and drag. We'll learn how to calculate various atmospheric pressures as well as aerodynamic forces. Here you'll have our first written assignment on Aerodynamics Calculations. After all that, we'll take our first quiz on basic aerodynamics.	 Notes on Atmospheric Pressure
	 Notes on Aerodynamic Forces
	 Calculations Assignment
	 Unit 1 Quiz (Sept 3)
Part 3: Airfoil Construction (40 pts) Approx. 3 days	
Finally, you'll get to do some simulating and building of actual airfoils. You'll start with some notes about an online simulation called "FoilSim". Then, you'll use FoilSim to investigate the properties of different airfoils. You'll then choose one or two of the airfoil designs and build it with the hotwire and foam. Once it has a good shape, we'll fire up the TurBlo1000 and test your airfoil in the wind tunnel to see what kind of data we get. In the end, you'll share all of your data to the class AE Spreadsheet so that everyone can view and interpret it.	 Notes on Airfoils & FoilSim
	 Airfoil Investigation w/FoilSim
	 Design & Build Airfoil
	 Test Airfoils & Share Data
	 Add Data to AE Spreadsheet
	 Check-off from Mr. Benshoof
 Achievement: Finish your air foil construction and testing by the unit deadline! 	






(30 pts) Approx. 3 days

The first part of our unit is about vocabulary and the big ideas behind flight. As you get started, you'll be asked to watch a few videos and presentations that share the basic ideas that we need to understand. Be sure to take good notes on these topics because they will provide the foundation for our work all year long. As the unit progresses, you'll need to accomplish the following tasks:

1. Start by watching the presentations on *Forces & Surfaces*, as well as *Forces of Flight*; take a full page of notes on these topics. Be sure to include a labeled picture of an airfoil to show how things work.
2. Next, watch the presentation *Control Surfaces*, and again take a full page of notes on the topic. Make sure that your notes include a picture of a plane with the control surfaces labeled. Also note what motion each control surface can create.
3. Finally, complete the **4-Part Paper Airplane Design Challenge** (Start by watching the video)
 - a. Find a type of paper airplane design online and fold it carefully. (I highly recommend "The Moth")
 - b. Trim your paper airplane's flight so that you can make it go STRAIGHT 30 feet and hit the wall/door above the labelled line.
 - c. Adjust your paper airplane so it can fly 6ft, turn right 90 degrees, and then fly 6 more feet.
 - d. Adjust your paper airplane again so it can fly under then over the provided boards
 - e. Finally, adjust your paper airplane one more time so it can repeat the original task of flying STRAIGHT 30 feet and hitting the wall/door above the labelled line.

** Mr. Benshoof wants to be able to confirm that your plane successfully completed each challenge. Help him out by letting him see your successful flights, taking video with your phone, or having a fellow Aerospace student attest to your success.

Part 1: Tasks	10 points	9-5 point	4-0 points
 Aerodynamics Notes	+ Watch the Aerodynamic Forces presentation carefully + Take 1 page of good notes in your engineering notebook, focusing on the vocabulary! + Notes include pictures	- Less than a full page of Aerodynamics notes - Notes do not include pictures	- Very brief or no notes in your engineering notebook
 Control Surface Notes	+ Watch the Control Surfaces presentation carefully + Take 1 page of detailed notes on the vocabulary for control surfaces + Notes include pictures	- Less than a full page of Control Surface notes - Notes do not include pictures	- Very brief or no notes in your engineering notebook
 4-Part Paper Airplane Challenge	+ Paper Airplane flies straight and far + Paper Airplane flies 12 ft around corner + Paper Airplane flies under/over + Paper Airplane flies straight and far	- Only 2 or 3 of the Paper Airplane challenge tasks completed - Tasks must be completed in order with the same plane	- Less than 2 paper airplane tasks completed







(30 pts) Approx. 2 days

This second part of the unit is all about math. If you're in (or have completed) Algebra 2, then these topics won't be too challenging. Here we'll learn which equations get used to calculate lift and drag when aerospace engineers are designing their aircraft. We'll need to use some unit conversions along with the appropriate equations to investigate the physics of aerodynamics. In this part of the unit, you'll need to focus on some notetaking as you do the following:

1. Watch the *Aerospace Mathematics Overview* video and the *Atmospherics* presentation. Take a full page of careful notes on these videos. Be sure to focus on the equations presented in *Atmospherics*, including a clear description of how each equation should be used, what units are needed, and what each variable stands for.
2. Watch the *Aerodynamic Forces* presentation and take another full page of good notes. Again, make sure your notes include details about which equations are relevant, what units are needed, and what each variable stands for.
 ** As a help, the equations can be viewed on our webpage on the "Aerospace Formula Sheet". Feel free to print this sheet and tape it into your engineering notebook!
3. Complete the Physics of Aerodynamics Calculations Assignment. This math assignment is definitely challenging, and might take some actual time to finish. If you get stuck, review the *Calculation Help* video which walks through a few problems step by step.
4. Finally, take our first quiz: Unit 1 Quiz *Aerodynamics*! This quiz is accessed through our class website and is a simple Google Form. You only get one chance to take it, and while you CAN use your engineering notebook, you CANNOT use other resources like the internet or your friends. You will only get one attempt at the quiz, and it will be graded for correctness.

Late quizzes will receive half credit!







Part 2: Tasks	5 points	4-3 points	2-1-0 points
 Atmospheric Pressure Notes	+ Watch the Atmospheric presentation carefully. + Take 1 page of good notes in your engineering notebook, focusing on the equations!	- Less than a full page of Atmospheric notes.	- Very brief or no notes.
 Aerodynamic Forces Notes	+ Watch the Aerodynamic Forces presentation carefully + Take 1 page of good notes in your engineering notebook, focusing on the equations!	- Less than a full page of Aerodynamic Forces notes.	- Very brief or no notes.
	10 points	5 points	0 points
 Calculations Assignment	+ Complete the assignment showing all your work + Check your assignment and make any corrections as needed.	- Assignment not complete or mistakes not corrected.	- Assignment not done.
 Unit 1 Quiz (Sept 3)	+ You took the quiz by the due date! + Your grade on the quiz will be based on the number of questions you get right	N/A	- You did not take the quiz on or before the deadline.



(40 pts) Approx. 3 days

The last part to our unit involves the construction and testing of some actual airfoils. In a later unit you'll use the information from this simulation and data collection to inform your construction of a long-distance glider. To start, we'll learn a little bit about the construction of airfoils, and then learn how to use an airfoil simulation tool called "FoilSim". The results of an investigation will be shared with other Aerospace students through the class spreadsheet before we decide which airfoils to build. Then, we'll create some actual airfoils out of foam and test their drag in our wind tunnel. Again, the data will be shared on our spreadsheet to inform future work. This part of the unit will be very time intensive as you work through the following:

1. Watch and take notes on the *Airfoil Overview* and *NASA's FoilSim III*. Take a full page of notes on airfoils and what FoilSim can do to inform our work.
2. Use FoilSim to complete the FoilSim Investigation, collecting data on different types of airfoils and sharing your results with other aerospace students through the class spreadsheet.
3. Watch the presentation *Building an Airfoil* that walks through the airfoil building process. Take some notes and plan out your construction procedure. Talk with Mr. Benshoof about the details of building your airfoil.
4. Build your airfoil using plans from FoilSim. It is suggested that you build your airfoil from foam. The profile should match (as closely as possible) the profile you tested on FoilSim. The width should be 0.5 inch narrower than the inner width of the TurBlo1000 test chamber.
5. Test your airfoil in the TurBlo1000 wind tunnel. Record your data from the force sensors and share it through the aerospace engineering class spreadsheet.

Part 3: Tasks	5 points	4-3 points	2-1-0 points
 Airfoil Notes	+ You should have 1 full page of notes on airfoils, FoilSim, and the process of building an airfoil.	- Less than a full page of notes, or notes are noticeably lacking.	- Notes missing
 FoilSim Investigation	+ Using FoilSim, find the requested information from the FoilSim Investigation sheet.	- Only some of the data properly collected.	- No data collected, or investigation not done.
20-15 points			
 Build & Test Your Airfoil	+ Use FoilSim results to create airfoil plans. + Cut airfoil from foam with the right dimensions + Test your airfoil in the wind tunnel and record force data.	- You were not able to construct an airfoil - You did not test an airfoil in the wind tunnel	- Nothing was completed.
8-0 points			
5 points			
 Share AirFoil Data in Spreadsheet	+ Your data from the FoilSim investigation is shared to the class spreadsheet. + Your data from the airfoil build and wind tunnel tests is shared to the class spreadsheet.	N/A	0 points only if: - Your data is not all shared to the class spreadsheet.
4-3 points			
 Deadline	+ Your FoilSim investigation and airfoil construction & testing are both complete by September 6, 2019 .	N/A	0 points only if: - Your unit projects are not completed by the unit deadline.
2-1-0 points			
 Achievement	Finish your air foil construction and testing by the unit deadline!		

