LATHROP ENGINEERING

Name:

UNIT 2: GLIDERS

Aerospace Engineering Unit Due Date: **September 26, 2019**

Welcome to the second unit of *Aerospace Engineering*! This unit is all about gliders. Since we've talked about aerodynamics briefly and introduced some of the basic vocabulary, it's time to put that knowledge to the test as we try to build gliders that can fly farther and farther. You'll need to take some good notes about what works and what doesn't throughout this unit, and work together to get your gliders flying smooth! 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 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 26, 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: **Beginning Gliders** *(30 pts) Approx. 2 days*		
The first part of this unit is about gliders and how they fly. We talked about aerodynamics and control surfaces in the last unit, and we'll return to that again here. You'll start by building a simple glider from a basic kit and throwing it 10 times. Collect data on how far it goes each time and add it to the spreadsheet. We'll finish up with some notes on gliders!		Build Basic Glider
		Glider Data Collection
		Notes on Glider Topics
		Complete Glider Assignment
		Check-off from Mr. Benshoof

Part 2: **Designing Gliders** *(40 pts) Approx. 3 days*		
In this part of the unit we'll learn how to use AERY – a computer simulation for designing gliders of all different shapes and sizes. You'll take some notes on how to design and build your own balsa wood gliders, and then practice with AERY. Finally, you'll get to design, build, test, and evaluate your own glider. It needs to go at least 50 feet, but the best gliders will be able to go over 75 feet!		Notes on the AERY Simulation
		Design 2 AERY Activity Gliders
		Design Your Own AERY Glider
		Build Your Own Glider
		Check-off from Mr. Benshoof
Achievement: Get your balsa glider to travel 75 feet down the hallway		

Part 3: **Long Distance Challenge** *(30 pts) Approx. 4 days*		
In the last part of this unit, you and your fellow Aerospace Engineering students need to work together to build a single glider that can travel 100 feet down the hallway. This will require some careful planning, building, troubleshooting, and engineering to be successful!		Take Revit & Framing Quiz
		Design Long Distance Glider
		Build Long Distance Glider
		Document Glider Build Process!
		Check-off from Mr. Benshoof

(30 pts) Approx. 2 days

The first part of this unit is about simple gliders. Here we'll need to learn a little vocabulary and a dew of the basic concepts surrounding gliders. Then we'll build a simple one from a kit and adjust control surfaces until it flies well. We'll also use those gliders to collect some data on glider flights and compute some basic statistics. As the unit progresses, you'll need to accomplish the following tasks:

1. Start by following the directions printed on the glider kit to build your first basic glider.
2. Then, get your glider trimmed out and flying well. Consider making these modifications to improve its flight:
    a. Move the position of the main wing forward/backward along the fuselage
    b. Sand the leading edges of the wing and stabilizers to make it more like an air foil
    c. Add control surfaces like elevators or rudder to adjust the flight path
    d. Add weight (play-dough) to the nose to balance it out
    e. Add small amounts of weight (play-dough) to the ends of the wings to balance it out
3. When you're happy with your glider's flying ability fly it 10 times in a row and record the length of each flight.
4. Add your data points to the class spreadsheet. Also, use the built in =AVERAGE() and =STDEV() functions to calculate the average and standard deviation of your flight distances.
5. Now take some time to watch the presentations on *Glider Data, Glider Types, and Glider Principles*. Take a full page of notes on those three presentations combined. Most of the notes will probably come from the *Glider principles* presentation.
6. Finally, get the *Glider Assignment* from the website or the paper copy from Mr. Benshoof. Complete this short assignment before moving on to Part 2!

Part 1: Tasks	*5-4 points*	*3-2 points*	*1-0 points*
Build Basic Glider	+You built your glider following the kit instructions + You used weight, shaping of wings, and/or control surfaces to get it flying well	- Your glider flew very inconsistently	- You did not build your glider
	10-9 points	*8-5 points*	*4-0 points*
Glider Data Collection	+ You collected 10 data points on flight distances with your glider + You shared your data on the class spreadsheet + You calculated the average/std dev of your flights	- You did not collect/share all 10 data points - You did not compute the average/std. dev	- You did not collect or share any data
	5-4 points	*3-2 points*	*1-0 points*
Notes on Glider Topics	+ You took a full page of notes on the part 1 presentations that include: *Glider Data* *Glider Types* *Glider Principles*	- You took less than a full page of notes on the presentations for this part of the unit	- You took no notes on this part of the unit.
	10-9 points	*8-5 points*	*4-0 points*
Complete Glider Assignment	+ You completed the entire Structures Assignment + You checked your work with the answer key	- You did less than the entire assignment - You did not check your work with the key	- You did less than half of the assignment

(40 pts) Approx. 3 days

This second part of the unit is all about simulations and designing gliders. You'll start working with a program called AERY that is used to design and simulate balsa wood gliders. As you get started, you'll need to get used to the different options you have available and how to work with the AERY interface. Once you've got that under control, you'll design 2 basic gliders by playing with the AERY options, and then you'll design one final glider of your own creation. When you get an AERY NUMBER OF AT LEAST 150, you'll build it out of balsa wood and we'll get it flying! In this part of the unit, you'll need to focus on some notetaking as you do the following:

1. Watch the presentation on getting started in AERY, and take good notes. Feel free to include the "AERY Simulation" image as a reference for what menu options are available.
2. Complete the first AERY Challenges wherein you start with some basic parameters as given in the challenge, and then work to make your glider flyable *with an AERY number over 150*.
3. Now design your own glider! You can make it look like whatever you want **as long as it fits on one piece of wood** – which is a parameter you can set in the AERY design options. Design a glider with the highest AERY number you can get. Once you get a glider your happy with *and the AERY number is over 150*, then we'll print the plans and start building!
4. Watch the presentations on *Building Your Glider* and on *Trimming Your Glider*. Take some good notes.
5. Build your glider out of balsa wood. We have specific pieces of wood for the fuselage, and nice balsa wood to measure and cut for wings, tails, and stabilizers. You can add weight at the front of the glider with some clay, and you can add control surfaces (elevator/rudder) if you want as well.
6. Get your glider flying nice and straight down the hallway, and trim it out so it goes ***at least 50 feet*** on a single throw. Earn an achievement by getting it to 75 feet! (I've seen these gliders get close to 100 feet).

Part 2: Tasks	*5 points*	*4-3 points*	*2-1-0 points*
Notes on AERY	+ Take a full page of notes on building your glider and the related topics	- Less than a full page of notes on glider building	- Very brief or no notes.
Design 2 AERY Gliders	+ You made 1 standard glider starting with the given AERY parameters and got the AERY number over 150 + You made 1 canard style glider starting with the given values and got the AERY number over 150	- You only designed 1 of the 2 gliders - Your gliders did not get to an AERY number of 150	- You did not design the gliders - None of your gliders reached an AERY number over 150
	10 points	*5 points*	*0 points*
Design Your Own AERY Glider	+You designed your own glider in AERY + Your design had an AERY number over **150**	- You designed a glider in AERY with an AERY number between 130 and 150	- Your glider had an AERY number under 130
Build Your Own AERY Glider	+ You built your glider following the AERY plans and using the proper materials	- You mostly followed the AERY plans	- Your glider did not follow the plans at all - You did not build one
Get Your Glider Flying	+ Your glider can fly at least 50 feet on a single throw	- Your glider can fly more than 25 feet, but less than 50 feet	- Your glider can't fly 25 feet.
Achievement: Get your balsa wood glider to go 75 feet			

(30 pts) Approx. 4 days

The last part of this unit is all about giving you the time and freedom to work with your fellow Aerospace students to create a long-distance glider using your knowledge of AERY, airfoils, and different building materials we have here in the lab. This part of the unit will require some good communication, brainstorming, and perserverence if you want it to be successful! In addition, this part of the unit will be very time intensive as you work through the following:

1. Take the Unit 2 Quiz: Gliders on or before the deadline of **September 20**! The link is on our class website!
2. Watch the video *Long Distance Glider Challenge* with your Aerospace team.
3. Talk to your team about how to design your glider. Consider different materials and methods of construction available.
4. Research different ideas online, brainstorm different solutions, and talk with Benshoof about any ideas he has.
5. BUILD YOUR GLIDER! You can build your glider with any materials we have in the lab, and using any tools we have that might be useful.
6. Trim your glider! It's going to have to fly very straight down the hallway – that doesn't give much room left/right for the flight to drift. Trim carefully, and consider control surfaces.
7. Get your glider flying 100 feet. This is the big challenge, but I have personally seen student-built gliders made of balsa wood and foam travel more than 175 feet down very similar hallways. I know it's tough, but it's definitely doable.
8. Make sure you write notes in your engineering notebook about your design and build process!

Part 3: Tasks	*10-9 points*	*8-5 points*	*4-0 points*
☑ Take Unit 2 Gliders Quiz	+ You took the Unit 2 Quiz on the website by the Quiz Due Date + Grade is based on number correct	N/A	(0 pts) You did not take the Unit 2 Quiz
	5 points	*4-3 points*	*2-1-0 points*
⊕ Design Glider	+ You and your team have an actual (written) plan for construction + Your plan applies some of the information from our last few weeks	- Your plan is not well thought out - Your plan does not incorporate ideas from the last few weeks	- No plan - Plan not recorded in notebook
⊕ Build Glider	+ You and your team work together to build your glider + Your construction is appropriately precise + You at least considered control surfaces (even if you chose not to use any)	- Your glider build is sloppy, but we can tell it's a glider	- You did not build a glider
⊕ Glider Flight	+ Trim your glider to fly straight + Get your glider flying 100 feet down the hallway	- Your glider only makes it 75 feet down the hallway	- Your glider makes it less than 75 feet down the hallway
Document Your Process	+ You have at least 2 pages of notes in your engineering notebook about your long distance glider + Your notes include brainstorming + Your notes include pictures + Your notes include occasional progress updates on the build + Your notes include your construction plan	- Your notes are missing some of the elements listed on the left - Your notes are less than 2 pages long	- Your notes are significantly lacking - Your notes are less than 1 page long