Logbook

Soaring with the Birds:

Using Biomimicry to Improve The Wings of Modern Aircraft

Phase 1 - Research

October 8

Today's Goals

- Finalize Science fair topic

Today's Achievements

After talking my ideas out to my parents and a wall to organize my thoughts, I settled on combining my interests in aviation and ornithology by using biomimicry to improve the efficiency of aircraft wings. I plan to do this using the little smokie wind tunnel published by NASA to test my designs compared to traditional airfoils, then testing them on simple RC airframes.

Next Steps

I plan to start my background research by answering the following questions:

- What wing shapes, sizes, and characteristics are used by different birds and why?
- What are the differences between traditional airfoils and bird wings?

I am sure that new questions will introduce themself in the course of my research, and I will use these questions as a starting point.

October 9 - October 10

Today's Goals

- Start finding credible sources to answer my research questions.

Today's Achievements

Using JSTOR and Wikipedia citations, I found sources and papers with information that will help me in my research:

- https://www.jstor.org/stable/pdf/2406051.pdf?refreqid=fastly-default%3Af7ed13cd43504c09e8ee635bcddbc0e6&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&origin=&initiator=&acceptTC=1 (Robbins, 2017)
- https://cob.silverchair-cdn.com/cob/content_public/journal/jeb/180/1/10.1242_jeb.180.1.285/3/jexbio_180_1_285.pdf?Expires=1702356617&Signature=LD9BqWifmCfAXZz~Vkiq1graEJpdAf97zBbzxDe4lXmMtrr9Xe-zzil7ScYBja1wAJ2Y3B9BaCs9tiCdiiknzR~l2X3~5lharkN8FGOUaVeKZHCxziXcZXLYfESBkUco27eo9SipavLE2r0FWn7j1N7zMVlrjDVXR7UxLzS5YCAdOQ8LZA2QMeweOlu-0gIxBSsUPW5C7xMfPNbzf7HyxQtmcHeSt9iYft0aDeNNQ5GzNTTKVlsrsNMPeR5~YKIqk0-pP9k8r2X-LyYaCsof66LQkJUfAkhQOZtxoKw~RZxwuoNeNl-OEkGisfqV38cMhlal8X1Vxc9PzQZK0XqVCg__&Key-Pair-Id=APKAIE5G5CRDK6RD3PGA
- https://cob.silverchair-cdn.com/cob/content_public/journal/jeb/202/13/10.1242_jeb.202.13.1725/3/jexbio_202_13_1725.pdf?Expires=1702357177&Signature=yrstCtjLRVF8E0vRRXgEXo0BJWXdFFy8cEC81linzitLaX2fb4cU9Zml7TFjMwZdxAde3ApEwZ2A7aBQ4MBLeixfMPWmq5kqHQ7FK8uWcDxhjp3Qo4k4kKszpIhlkJpaigHz9otI1soesZ0FSFhDqJl1aFhNPOQF11XpJc8KFyh47wZMOlnkMQm1a~cNrDl13HPY~vB26smUL-MCuRLBpMYWExUG8v5FETvpFRe~k9DV8hhgKysJlYyxcobqS2qQqPUEYFDT9hf-hCKC04sPr1pPhT7YOPUm9Bju1aGe1hV2tN~g8p31yCuLTQjXbPUqT1-VxNMt-RWMEEebhx7DOA__&Key-Pair-Id=APKAIE5G5CRDK6RD3PGA

Along with this, I found the book "The Wonder of Birds: What They Tell Us About Ourselves, the World, and a Better Future" at the library.

Next Steps

I plan to print out the papers and read them to help answer my research questions.

November 6 - November 8

Today's Goals

- Print out and annotate the papers to help me answer my research questions

Today's Achievements

- Finished reading paper: *Kinematics of Flap-Bounding Flight In The Zebra Finch Over A Wide Range Of Speeds*
    - Takeaways:
        - At low speeds, large wings offer a decent lift-to-drag ratio, but as speed increases, drag becomes unsustainable
        - The torso of the zebra finch creates enough lift to support 15% of the finch's body weight at high speeds while creating less drag
        - Zebra finch-style flap-bounding could be used for unmanned aerial vehicles because undulating flight paths would be uncomfortable.
- Created new research question:
    - How do birds land in a short distance, and how can we biomimic this to shorten landings?
- Found new papers:
    - From Nature Communications journal: Birds repurpose the role of drag and lift to take off and land https://www.nature.com/articles/s41467-019-13347-3
    - From Scientific Reports journal: The Function of the Alula in Avian Flight: https://www.nature.com/articles/srep09914

Next Steps

November 22-29

Today's Goals

- Write an email to Paul Gies to arrange a meeting
- Write an email to Ivan Pillipson, host of the Science of Birds podcast, and has a masters degree in Biology and a Phd in Zoology

Today's Achievements

- Wrote a draft email to Paul Gies, asking about the plausibility of extra parts in aircraft wings, how to design models for wind tunnel tests, and if anyone would be interested in letting me use a wind tunnel: Paul Gies email draft
- Wrote an email to Mrs.Secord, a teacher who helped me a lot with planning my project in Grade 6, asking about my draft and if she had any suggestions on how to organize my project: Mrs.Secord email draft
-

Next Steps

Phase 2 - Preperation

November 30

Today's Goals

- Write experiment procedure to prove the concept of wing tip slots
- Start outlining background research paper

Today's Achievements

Wrote draft for procedure

1. Build wind tunnel
2. Design 3-d models of a airfoil controlled in size and shape, but with none, 1,2 and 3 triangular wing tip slots
3. Test each airfoil with 1 m/s wind speed
4. Take note of newton scale reading for each airfoil
5. Repeat steps 3-4 with windspeeds 2 m/s, 4m/s, 6m/s, 9m/s, 12m/s and 15m/s
6. Repeat steps 3-5 with 0, 5, 10, 15 and 30 degrees of angles of attack.

Wrote outline draft for research paper

Next Steps

- Start designing wind tunnel (possibly similar to the one found here: https://www.instructables.com/DIY-Wind-Tunnel-3/)
- Revise draft according to wind tunnel
- Ask about obtaining a newton scale for quantified data

December 4

Today's Goals

- Start designing the wind tunnel (possibly similar to the one found here: https://www.instructables.com/DIY-Wind-Tunnel-3/)
- Ask about obtaining a Newton scale for quantified data

Today's Achievements

Initially, I thought of using a design similar to the little smokie wind tunnel, but I realized that it blocks part of the PC fan to increase windspeed, and that would result in my wind tunnel being too small. I decided to try designing a wind tunnel using a honeywell fan. I also determined that a small kitchen scale would be able to measure lift forces accurately enough for the experiment.

Next Steps

- Design wind tunnel using the honeywell fan

December 5

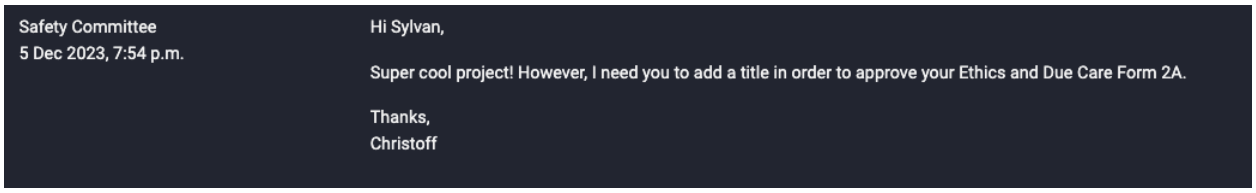
Today's Goals

- Design wind tunnel using the Honeywell fan
- Fill out ethics due care form

Today's Achievements

I filled out the ethics due care form on the CYSF platform, and submitted it for approval.
I also started working on a concept sketch of the wind tunnel

UPDATE:
CYSF has received my submission, but I need a title. Here is the email:



Next Steps

- Continue wind tunnel concept sketch
- Update basic project info with title.

December 6

Today's Goals

- Continue wind tunnel concept sketch
- Update basic project info with title.

Today's Achievements

Resubmitted basic project info with title: The Grace of Birds: Using biomimicry to Improve Aircraft Wings.
I found that the wind tunnel design found on https://www.instructables.com/DIY-Wind-Tunnel-3/ fits many of my requirements, but I need to add access doors and my data collection system.

Next Steps

- Draw individual sketches of the added access doors and my data collection system.
- Find way to trace airflow.

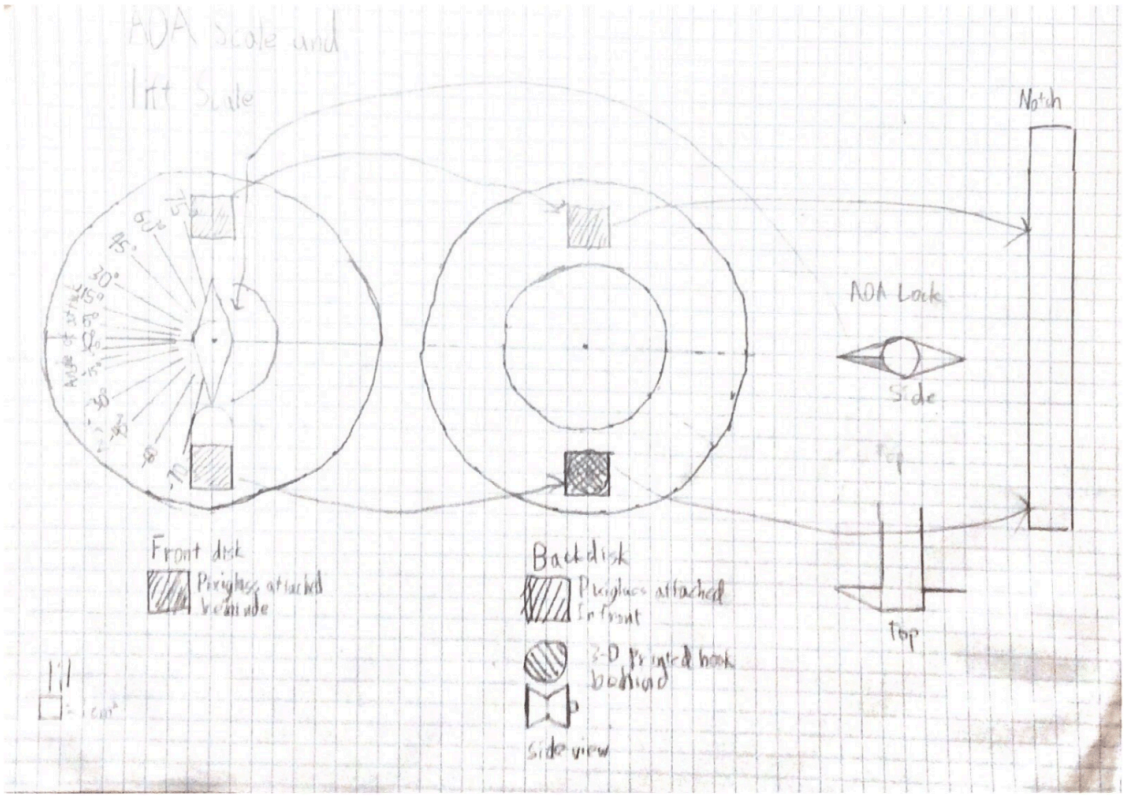
December 7

Today's Goals

- Draw individual sketches of the added access doors and my data collection system.
- Find way to trace airflow.

Today's Achievements

I drew a sketch of my data collection system:



I also found people who used vegetable oil heated with a nichrome wire to make smoke.

Next Steps

- Draw individual sketches of the added access doors.
- Finalize a way to trace airflow

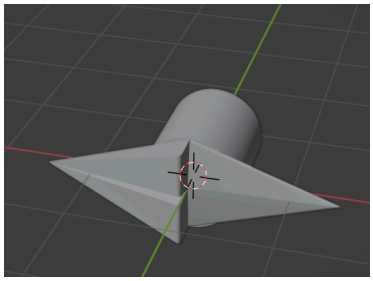
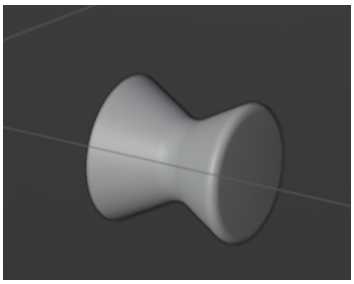
December 8

Today's Goals

- Create 3-D models of the hook and lock shown in the previous sketch

Today's Achievements

Using Blender, I modelled the hook and lock mechanisms for the data collection system, and they are ready for 3-D printing. The lock will act as a base for future airfoil models.

I also looked at the instructable design again and decided that I wouldn't need a front access door, because I could just move the fan.

Next Steps

- Draw individual sketches of the added access door.
- Finalize a way to trace airflow
- Start 3-D modelling test wings.

December 9

Today's Goals

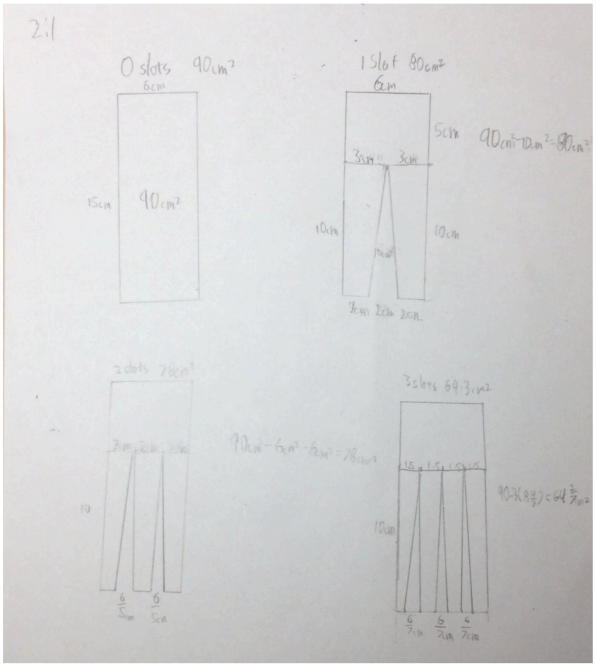
- Generate Variables for the first proof of concept experiment
- Calculate Planform Area of each wing
- Start 3-D modelling test wings according to variables

Today's Achievements

Variables:
Manipulated: Number of wing tip slots (0,1,2,3)
Responding: Lift : Planform Area ratio
Controlled:

- Chord Length: 6cm
- Camber Length: 1.5cm
- Wing Span: 15 cm
- Wing cross section until wing tip slots
- Shape of wing tip slots: Triangular, airfoil splits into smaller, tapered airfoil
- Wing tip slot depth (5cm)
- Airflow in wind tunnel (Max)
- Angle of Attack (0°)
-

I modelled all 4 wings in Blender
I sketched out the wings to calculate the Planform area of the wing, useful for finding the responding variable.



Next Steps

- Draw individual sketches of the added access door.
- Finalize a way to trace airflow

December 11

Today's Goals

- Draw individual sketches of the added access door.
- Finalize a way to trace airflow
- Start writing lab report for first experiment

Today's Achievements

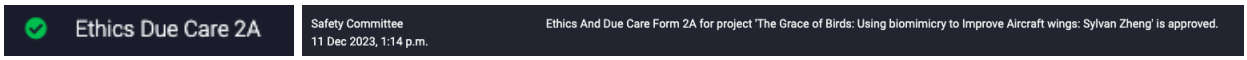
On stack exchange, auto mechanics use baby oil to create smoke for aerodynamic testing, but they use a soldering iron to create the heat, and I need mine for other purposes. Some other small-scale wind tunnels use nichrome wire and vegetable oil to create smoke, but baby oil starts smoking at ~130°C, but vegetable oil needs ~200°C, which means that baby oil can create smoke at lower temperatures. I plan to use a nichrome wire heater and baby oil to create smoke, but the nichrome wire will take time to ship, so I will first experiment with galvanized steel wire I have left over from last year.

Drew sketch of access door:

Handle should be lined up to the data collection system, so that I can switch wing models easily.

Created Document: First Test Lab Report

UPDATE: Ethics due care from approved:



Next Steps

- Start writing lab report for first experiment

December 12

Today's Goals

- Continued writing lab report for the first experiment
- Made data table for recording observations

Today's Achievements

I continued work on the previous document here: First Test Lab Report
The sections after observations are empty because they have to be filled in after the experiment
I also made the data table for recording observations, which can just be filled in during the experiment: First Test Data Sheet.

UPDATE:
I realized that only measuring the net lift force would give me the actual lift - the weight of the wing and data collection system assembly. I decided to counter this by making a rigid link between the scale and the data collection system, so it detects any change in lift

Next Steps

- Start organizing the background research into one document
- Find more ways to generate smoke
- Start planning exactly how to make the wind tunnel
- Draw sketch of rigid force transmitter

December 13

Today's Goals

- Draw sketch of rigid force transmitter
- Start organizing the background research into one document
- Find more ways to generate smoke
- Start planning exactly how to make the wind tunnel

Today's Achievements

I drew a sketch of a rigid force translator that is made from two 3-D printed brackets and a strip of plywood. It is supposed to be mounted on the inside plate of the data collection system where the hook was supposed to be, and it would be directly connected to scale:

Next Steps

- 3-D model the rigid force transmitter
- Start organizing the background research into one document
- Find more ways to generate smoke
- Start planning exactly how to make the wind tunnel

December 14-16: Busy with First Tech Challenge

December 16

Today's Goals

- 3-D model rigid force transmitter

Today's Achievements

I modelled the force transmitter brackets, which can be 3-D printed and mounted to a wood beam.

Next Steps

- Start Building Wind Tunnel

December 17: Full day First Tech Challenge competition as the Cybertronic Penguinz, won first place and going to provincials!

December 18

Today's Goals

- Summarize Background Research
- Start Building Wind Tunnel
- Start Planning out the beginning / Non experimental parts of trifold (Including Background Research)

Today's Achievements

I set up an outline of questions that I should explain, which show how I chose to do this project.
I started this document: Background Research Summary draft

Next Steps

- Continue summarizing Background Research
- Start Building Wind Tunnel
- Start Planning out beginning / Non experimental parts of trifold (Including Background Research)

December 20

Today’s Goals

- Start Building Wind Tunnel
- Continued summarizing background research

Today’s Achievements

I continued on the document created earlier: Background Research Summary draft
I decided that using paper pipes would be simpler than using PVC pipes because I only have a hacksaw and it would take a long time to cut all the PVC.

Next Steps

- Start Building Wind Tunnel
- Continue summarizing background research

December 21

Today's Goals

- Start Building Wind Tunnel
- Continue summarizing background research

Today's Achievements

I wound 40 paper tubes that approximately have the length of 11cm and diameter of 3.5cm, but I expect I will only need 36 of them.
I also started a document to keep track of my progress building the wind tunnel, and make the experiments repeatable: Wind Tunnel Building Procedure

Next Steps

- Start cutting the frame of the airflow straightener and ending
- Continue summarizing background research

December 22

Today’s Goals

- Start cutting the frame of the airflow straightener and ending
- Continue summarizing background research

Today’s Achievements

I built the frames out of cardboard, then added the paper pipes into it, completing the airflow straightener. I also made the fan adaptor. More information can be found in the document I also updated: Wind Tunnel Building Procedure

Next Steps

- Cut the wood panels and make the data collection system from Pixliglas
- Continue summarizing background research

December 23

Today's Goals

- Cut the wood panels and make the data collection system from Pixliglas
- Continue summarizing background research

Today's Achievements

I decided to replace the wood with 2ply cardboard, because I have that at home
I made the cardboard panels, and updated the document: Wind Tunnel Building Procedure

Next Steps

- Paint the cardboard panels, and make the data collection system from Pixliglas
- Continue summarizing background research

December 24

Today's Goals

- Paint the cardboard panels, and make the data collection system from Pixliglas
- Continue summarizing background research

Today's Achievements

I bought a bottle of black acrylic paint and painted two coats onto the cardboard panels, but haven't added them to the document yet.

Next Steps

- Paint the last coat onto the cardboard panels, and make the data collection system from Pixliglas
- Continue summarizing background research

December 25

Today's Goals

- Paint the last coat onto the cardboard panels, and make the data collection system from Pixliglas
- Continue summarizing background research

Today's Achievements

I added the last coat of paint onto the cardboard panels but also realized that Plexiglas is a lot harder to work with than I thought it would be. I cut the two Plexiglas windows, but I still need to find a way to make the data collection system

Next Steps

- Find way to make and mount data collection system
- Continue summarizing background research

December 26

Today's Goals

- Find way to make and mount data collection system
- Continue summarizing background research

Today's Achievements

I found a way to make the data collection out of transparent plastic and foamboard, and my dad gave me the idea to mount the data collection system to the back cardboard panel. I also realized that this solution was a bit flimsy, and I'm thinking of making a fully 3D printed version, with an added support disk on the inside.

Next Steps

- Redesign fully 3D-printed data collection system
- Continue summarizing background research

December 27

Today's Goals

- Redesign fully 3D-printed data collection system
- Continue summarizing background research

Today's Achievements

I designed the new data collection system according to my idea yesterday, and after a few attempts, the pieces fit together perfectly. I haven't mounted it into the wind tunnel yet, but that should be quick.

Next Steps

- Install new data collection system
- Continue summarizing background research

December 28: I broke my arm snowboarding, and won't be able to work on my wind tunnel for a bit.

December 29

Today's Goals

- Revise and send the existing letters to experts
- Continue summarizing background research

Today's Achievements

I edited my earlier drafts with updated information, and then sent the emails to Mrs.Secord and Paul Gies. The emails can be found in the Google Drive folder.

Next Steps

- Continue summarizing background research
- Redesign airfoils into symmetrical airfoils

December 30 - 31

Today's Goals

- Finish wind tunnel
- Redesign airfoils into symmetrical airfoils
- Prepare for the first proof-of-concept experiment
- Continue summarizing background research

Today's Achievements

When preparing to print the previously designed airfoils, they were predicted to take 3 hours each, so when I was redesigning the airfoils to be symmetrical, I also added a 5cm transitional area before the wing tip slots so that the airfoils could be printed hollow and vertically.

I also worked with my parents to attach the new data collection system to the wind tunnel. I edited the lab report to account for these changes.

Next Steps

- Conduct the first proof-of-concept experiment
- Continue summarizing background research

Phase 3 - Testing

January 1

Today's Goals

- Conduct the first proof-of-concept experiment
- Continue summarizing background research

Today's Achievements

I conducted the tests as planned, but the results were a bit inconsistent, and the scale sometimes didn't detect anything at all. I assume that the forces are sometimes too small for the scale to register, so I only recorded the results when the scale detected lift. All the observations are in this spreadsheet: First Test Data Sheet
I also filled in the observation section of First Test Lab Report
I think dry ice in the wind tunnel can assist me in getting qualitative data for my analysis

Next Steps

- Graph out data
- Fill out the analysis section of the lab report
- Continue summarizing background research

January 2

Today's Goals

- Retest with 5 trials
- Graph out data
- Fill out the analysis section of the lab report
- Continue summarizing background research

Today's Achievements

After thinking about the scale issues, I realized that the 3-D prints might be catching on the notch in the cardboard wall, and I can try shifting it around. I re-conducted the tests, with 5 trials for consistency, and graphed the data out all the data and graph can be found on the spreadsheet and lab report First Test Lab Report , Second Test Data Sheet

Next Steps

- Fill out the analysis section of the lab report
- Continue summarizing background research

January 3

Today's Goals

- Find way to track airflow
- Fill out the analysis section of the lab report
- Continue summarizing background research

Today's Achievements

My original plan was to use nichrome wire to heat baby oil to produce smoke for qualitative data, but I had neither. I was thinking of using dry ice, but I remembered that thread also worked. Using sewing thread attached to a stick, I was able to see that the wing diverted the airflow downwards.

Next Steps

- Collect qualitative data with thread
- Fill out the analysis section of the lab report
- Continue summarizing background research

January 4

Today’s Goals

- Collect qualitative data with thread
- Use Tracker to analyze string movements
- Fill out the analysis section of the lab report
- Continue summarizing background research

Today’s Achievements

I set up a camera and recorded a video of the thread behind the wingtip, and I expected the thread to spin, but after processing the video in tracker, the thread's movements seemed random and jagged, and the movement might have been caused by turbulence.

Next Steps

- Fill out the analysis section of the lab report
- Continue summarizing background research

January 5-6

Today's Goals

- Fill out the analysis section of the lab report
- Continue summarizing background research

Today's Achievements

I filled out the rest of First Test Lab Report according to the gathered data. I have ideas for what to do for experiments 3-4, but I first need to test if alulea affects the stall characteristics of the wing.

Next Steps

- Prepare for experiment 2
- Continue summarizing background research

January 7

Today's Goals

- Prepare for experiment 2
- Write an email to Ivan Phillipsen
- Continue summarizing background research

Today's Achievements

I filled out the lab report for my second experiment up to the procedure section, which can be found here: Second Test Lab Report

I also emailed Ivan Phillipsen, who has a Masters degree in Biology, a PhD in Zoology, and hosts the Science of Birds podcast, about the evolutionary aspects of bird wings, and if he knew any other adaptations I could test. The draft can be found here:
Ivan Phillipsen Email Draft

I designed the new wings with 3cm alula, but I assumed it might not be long enough to make a difference. When I finished printing a trial wing, I realized that I designed it backwards, and it wouldn't work with my wind tunnel.

Next Steps

- Redesign 3D models for experiment 2
- Continue summarizing background research

January 8

Today's Goals

- Continue summarizing background research
- Redesign 3D models for experiment 2

Today's Achievements

I flipped all the wings, and while I was at it, I also extended the alula length to 5cm. After printing one out I think it will work.

Next Steps

- Continue summarizing background research
- Conduct experiment 2

January 9

Today's Goals

- Continue summarizing background research
- Standardize experiment procedures

Today's Achievements

After looking at a CYSF-winning project at Louis Riel, I decided to standardize my tests, so for each iteration, I tested the lift in newtons, the lift/m squared, and the stall angle of each wing.

I did a stall angle test for the control and part of the 1 wingtip slot wing, for consistency with the alula tests. The test results can be found here: Stall Angle Data Sheet

I also reviewed "Adaptive Evolution in the Avian Wing", and redesigned the alula to better match those found in birds.

Next Steps

- Continue summarizing background research
- Complete the current stall angle tests.

January 10

Today's Goals

- Continue summarizing background research
- Complete the current stall angle tests.

Today's Achievements

While reading "Adaptive Evolution in the Avian Wing", I decided to narrow down my goal to just improving commercial, recreational and rescue aircraft, because I can test the applicable wings in my wind tunnel, and they benefit more people. So far, the wings I have tested resemble slotted high-lift wings, like on eagles, but I also want to test high-speed wings, like those found in terns, which embark on long migrations much like commercial aircraft. I want to test wings that are swept at the tip, like a tern, because it would reduce the wingtip area and prevent stalling at high speeds, even though we won't be going fast enough. This would be a good safety feature for commercial aircraft. I would also like to see how my alula would act on a swept wing. The slotted high-lift wings that I am experimenting with right now are good for STOL, which rescue aircraft need to be able to do, and gliders, because they can create high lift at the lower speeds of a glider.

I finished testing the wing with 1 wing slot's stall angle, and it performed significantly better than I expected. The data can be found here: Stall Angle Data Sheet

Next Steps

- Continue summarizing background research
- Complete the current stall angle tests.

January 11

Today's Goals

- Continue summarizing background research
- Prepare for experiment 2
- Complete the current stall angle tests.

Today's Achievements

I finished testing the wing with 2 wing slots' stall angle, and the data can be found here: Stall Angle Data Sheet

I also updated the analysis and conclusion sections of First Test Lab Report with the new data.

I 3-D printed the -20° Alula wing, for experiment 2

Next Steps

- Continue summarizing background research
- Complete the current stall angle tests.
- Prepare for experiment 2

January 12

Today's Goals

- Continue summarizing background research
- Complete the current stall angle tests.
- Prepare for experiment 2

Today's Achievements

I formatted the lab report with an added "Ideas" section for the trifold:
Experiment One Trifold Display

I also printed both the 0° and 10° alulea wings.

Next Steps

- Continue summarizing background research
- Combine the standardized procedures for trifold.
- Prepare for experiment 2

January 13

Today's Goals

- Continue summarizing background research
- Combine the standardized procedures for trifold.
- Prepare for experiment 2

Today's Achievements

I created the standardized procedures for trifold, and I'll follow those for every test.
Standardized Procedure

I also changed both lab reports to match

I completed the "Ideas" section for Experiment Two Trifold Display to be put on the trifold
I have printed all the wings required for test two!

I also summarized my background research on the 4 main wing shapes, which can be found here Background Research Summary draft

Next Steps

- Continue summarizing background research (Hummingbird Wings)
- Conduct Experiment 2

January 14

Today’s Goals

- Continue summarizing background research (Hummingbird Wings)
- Conduct Experiment 2

Today’s Achievements

I decided to remove the 20° AOA alula wing from the test, because the alula chokes airflow.
I also did the first trial of the lift tests and the results were pretty consistent

I also added the hovering wings section to Background Research Summary draft.

Next Steps

- Continue summarizing background research
- Continue Experiment 2

January 15

Today's Goals

- Continue summarizing background research
- Continue Experiment 2
- Send follow-up email to Paul Gies and Mrs.Secord

Today's Achievements

I completed the lift testing, and was halfway through the stall angle test when the scale ran out of battery, and I needed to change them out. I might have to redo some of the previous tests because the scale was on low battery.

I also sent follow-up emails to Paul Gies and Mrs.Secord, to update them on my progress and ask some additional questions. The emails are in the Google Drive folder at Mrs.Secord Update and Paul Gies Follow-up

Next Steps

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

January 16

Today's Goals

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

Today's Achievements

Paul Gies replied to my email, suggesting that surveillance drones could also use this technology.

I changed out the wind tunnel's batteries and switched out the cardboard arm for a 3D-printed one while I was at it. I might have to retest some data because of the modifications.

I also continued on Background Research Summary draft.

Next Steps

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

January 17

Today's Goals

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

Today's Achievements

I added the "Environmental Limitations" section to Background Research Summary draft

Next Steps

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

January 18

Today's Goals

- Continue summarizing background research
- Continue (and maybe redo) Experiment 2

Today's Achievements

I finished the stall angle tests for experiment 2, but I might want to redo the lift tests because of the possibility of the battery interfering.

I also changed some of the jot notes in Background Research Summary draft into words.

Next Steps

- Continue summarizing background research
- Prepare for experiment 3
- Maybe redo Experiment 2 lift

January 19

Today’s Goals

- Continue summarizing background research
- Prepare for experiment 3
- Complete experiment 2 lab report

Today’s Achievements

I filled out the rest of Second Test Lab Report, and copied it to Experiment Two Trifold Display

Next Steps

- Continue summarizing background research
- Prepare for experiment 3

January 20

Today's Goals

- Continue summarizing background research
- Prepare for experiment 3

Today's Achievements

I added the stall section to Background Research Summary draft .

I printed two airfoils, one with wingtip slots and one without, that were both bent 5cm from the wingtip. I realized that the wingtip slots wouldn't be useful to increase the stall angle, so I reprinted it with the bend 2.5 cm from the tip

I also set up Third Test Lab Report and the related datasheets.

When testing lift, the second trial differed greatly from all previous tests, sometimes generating downforce, and upon further inspection, the force transmitter snapped. I need to reprint a reinforced version of the force transmitter tomorrow.

Meanwhile, I designed 3 different final airfoils that combine all my findings, depending on the result of experiment 3.

Next Steps

- Prepare for experiment 3
- Repair Wind Tunnel

January 21

Today’s Goals

- Prepare for experiment 3
- Repair Wind Tunnel

Today’s Achievements

I reinforced and reprinted the new force transmitter, which greatly improved the stability of the readings. I also added packing tape on the outer surface of the wind tunnel, to allow the data collection system slider to move smoothly.

Next Steps

- Conduct experiment 3

January 22

Today’s Goals

- Conduct experiment 3

Today’s Achievements

I conducted the stall and lift tests for experiment 3, and surprisingly, the wing with one wingtip slot performed worse than the control wing in the lift test, contrary to previous tests.

I also filled in the rest of Third Test Lab Report.

Next Steps

- Prepare for experiment 4

January 23

Today’s Goals

- Prepare for experiment 4

Today’s Achievements

I printed out and tested the final airfoil, and it consistently performed better than the control airfoil in both tests. I also filled out the analysis in Final Test Lab Report

Next Steps

- Prepare for in-class presentation on Jan. 25

Phase 4 - Presentation

January 24

Today's Goals

- Prepare for in-class presentation on Jan. 25

Today's Achievements

I combined all the documents into one trifold document, and wrote the rest of the final test lab report. I also practiced my speech a bit, even though I didn't have a script.

Next Steps

- in-class presentation on Jan. 25

January 27 - January 28

Today’s Goals

- Prepare trifold for Louis-wide presentation

Today’s Achievements

I added the sky-coloured headings and bird silhouettes to my trifold, and started sticking the pages up. I also started designing the glider, but the spar was too thin to be effective

Next Steps

- Continue preparing trifold for Louis-wide presentation
- Redesign glider spars
- Prepare speech (Cue cards)

January 29-30

Today's Goals

- Continue preparing trifold for Louis-wide presentation
- Redesign glider spars
- Prepare speech (Cue cards)

Today's Achievements

I completed the trifold, and attached all the pages

I also tried redesigning the glider around a bamboo skewer, but it was to heavy. I think I'll leave the glider to CYSF

I decided not to use the cue cards and just to go off my trifold

Next Steps

- Louis-wide science fair

Febuary 1

Today’s Goals

- Louis-wide science fair

Today’s Achievements

I set up the trifold at the school, and practiced my speech more

Next Steps

- Louis-wide science fair

February 2

Today’s Goals

- Louis-wide science fair

Today’s Achievements

Louis science fair, my presentations went pretty well, but could be more fluent

February 2-9: waiting for school decision

February 10

Today’s Achievements

Got into CYSF

Next Steps

- Conduct additional trials

February 16

Today's Goals

- Conduct additional trials
- Write emails to experts

Today's Achievements

I wrote emails to Paul Gies, Ivan Phillipsen and Mrs.Secord-Tomlin, informing them about me getting to CYSF.

I also prepared Fifth Test Lab Report and related spreadsheets for testing

Next Steps

- Conduct trial 5

February 17-23: Preparing for First Tech Challenge Provincials.

February 16

Today's Achievements

Response from Ivan Phillipsen

Ivan Phillipsen
to me

Hi Sylvan,

Congratulations on the success of your project! Very cool.

Yes, the information you have about me is correct. 👍

Sounds like you have some good ideas about testing additional wing shapes. I don't have any amazing ideas at the moment, but will let you know if something comes to mind.

Cheers and good luck at the citywide science fair!

Cheers,

Ivan

February 22

Today's Achievements

Response from Paul Gies

Paul Gies
to me

Sylvan,
I am very impressed with your work. I agree with your process and I would be happy to review your trifold board.

February 23

Today’s Goals:

- Update Trial 5 documents

Today’s Achievements:

I updated Fifth Test Lab Report and associated spreadsheets for testing with new information

Next Steps

- Conduct Trial 5

February 24

Today's Goals:

- Conduct Trial 5

Today's Achievements:

I filled out the spreadsheets associated with the trial, but the force transmitter leg broke and I had to fix the wind tunnel

Next Steps

- Finish Trial 5 Write-up

February 24

Today’s Goals:

- Finish Trial 5 Write-up

Today’s Achievements:

I finished writing the analysis and conclusion of Fifth Test Lab Report
I plan to test different wingtip slot widths in trial 6

Next Steps

- Prepare for Trial 6

March 3

Today’s Goals:

- Prepare for Trial 6

Today’s Achievements:

I prepared Sixth Test Lab Report and associated spreadsheets for testing

Next Steps

- Conduct for Trial 6

March 7-8

Today’s Goals:

- Conduct for Trial 6

Today’s Achievements:

I completed the lift and lift-to-wing-area ratio test on March 7 and the stall angle tests on March 8.

I also wrote the analysis and conclusion sections of Sixth Test Lab Report

Next Steps

- Start moving info to CYSF platform
- Record video

March 9-11

Today's Goals:

- Start moving info to CYSF platform
- Record video

Today's Achievements:

I pasted 2 trials and the introduction into the CYSF website, and also started outlining the video

Next Steps

- Continue moving info to CYSF platform
- Record video

March 12-13

Today's Goals:

- Start moving info to CYSF platform
- Record video

Today's Achievements:

I recorded all parts of the video and uploaded two more trials along with the background research to the CYSF website

Next Steps

- Finalize info in CYSF platform
- Edit video

March 14

Today's Goals:

- Finalize info in CYSF platform
- Edit video

Today's Achievements:

I filled in all remaining sections of the CYSF platform and edited and uploaded the video. The project page can be found here: https://platform.cysf.org/project/56824cab-e8cc-4015-b9bc-5effbfb3cd35/

Next Steps

- Finalize info in CYSF platform
- Edit video