Semester 1 – Launching into Aviation

Unit 1 – Aviation 101

Section A – Intro to Aviation and Aerospace

Lesson 2 – Engineering Practices in Action

Activity 2 – Heavy Lift Rocket

Alternate Activity – While this activity was designed as a group activity, teachers can ask students to try it as a solo activity if they have the materials available at home. Students could take videos of their own trials and share them with the teacher or class.

For students who do not have the materials available at home to complete the activity, consider having them use the online rocket launch simulation found here (https://www.sciencelearn.org.nz/embeds/132-rocket-launch-challenge) to complete one or more challenges to help them better understand the relationship between lift, thrust, weight, and drag. The challenge is shown on the site: "Make your rocket go as high as possible and launch the payload 400km above the ground." Have the students do this first with the drag and mass change buttons in the "off" position. Have them record the settings they used for the best performance. Then have them conduct the same test, using the same settings, with the drag button on. Have the students answer the following questions: How did this change the rocket's performance? What adjustments need to be made to thrust to achieve the same results as when the drag button was off? What conclusions can you draw about how drag affects performance?

Lesson 3 – Aviation Careers Are for You!

Activity – Presentation on Importance of Aviation and Aerospace

Alternate Activity – Have students work alone or in small groups to produce a slide presentation that can be sent to the teacher or shared with the class in a video call or chat. Have students provide a slide-by-slide script either in the slide notes or in a separate document.

Section C – Introduction to Unmanned Aircraft Systems

Lesson 1 – UAS Fundamentals

Activity 2 – Real-World UAS Applications

Alternate Activity – This is listed as a small-group activity. If having small groups interact in an online environment is difficult, based on the technology limitations of the school and the students, the activity may be completed individually. Students may share their responses in a large group online discussion or via a shared forum or posting area.

Lesson 2 – UAS Operation and Safety

Slide 18 – UAS Operation and Safety Presentation

Alternate Activity – Unless students have their own drones, this activity is not possible as written. Instead, consider having students use a drone simulator to conduct the same activity. Have students begin by observing how the propellers spin with different control deflections. Have students maneuver the controls to move forward, back, up and down. Have them test their skills by using the maps/courses provided in the apps to fly a precise course. Encourage students to fly more than one type of drone in the simulation. Then, have students write two or three paragraphs describing their experience. The following questions can be used as a guide: Did the drone operate as you expected it to? Did anything about flying the simulation surprise you? Which drone types did you fly? What difference did you notice in their performance? Which map or course did you use? What maneuvers were the most difficult in attempting to fly a precise course? What safety considerations should you make when flying a real drone that are not required when flying a simulation?

There are several drone simulator apps that students can download for this activity. They include, but are not limited to:

RC Drone Flight Simulator
iPad/iPhone
https://apps.apple.com/us/app/rc-drone-flight-simulator/id1399899660
Google Store
https://play.google.com/store/apps/details?id=com.tnt.rc.drone.real.flight.simulator&hl=en_US

Sky Viper Flight Simulator
iPad/iPhone
https://apps.apple.com/us/app/sky-viper-flight-simulator/id1135441810
Google Store
https://play.google.com/store/apps/details?id=com.newskyviper&hl=en_US

Quadcopter FX
iPad/iPhone
https://apps.apple.com/us/app/quadcopterfx-simulator/id884782635
Google Store
https://play.google.com/store/apps/details?id=com.Creativeworld.QuadcopterFX&hl=en_US

A simulator that is available for download to a PC is the Real Drone Simulator.
http://realdronesimulator.com

Section D – Introduction to Space Exploration

Lesson 1 – Current and Future Space Exploration

Activity – Secret Space Mission

Alternate Activity – This activity may be completed in an online environment where each small group collaborates on the Secret Space Mission document electronically. The presentation mentioned at the end of the activity may also be created and presented online.

Unit 2 – Taking Flight – Early Aviation Innovations

Section A – Aviation's Primitive Beginnings

Lesson 2 – Da Vinci and His Flying Machines

Activity 2 – Da Vinci's Design Dilemma

Alternate Activity – With the exception of the digital scale or balance, most students should have all the materials they need to conduct the experiment at home. Students who have a food scale at home may be able to measure the mass of their designs using it. For students who do not have a scale, simply have them indicate whether they increased or decreased the mass and describe what they did to increase or decrease the mass when making their "design improvements." For example, "I decreased the mass by making the parachute out of a thin grocery bag instead of a paper file folder." Students can use any stopwatch as a timer. Because students will be working alone rather than in a group, teachers may need to either modify the time allocated for the activity or modify the number of trials conducted.

Section B – Lighter than Air

Lesson 1 – Hot Air and Gas Ballooning

Activity – Hot Air and Gas Ballooning Presentation

Alternate Activity – Students can build a hot air balloon at home without tissue paper, etc., by using a very thin plastic material for the balloon, such as a dry-cleaning clothes bag and using a hair dryer as a source of heat in lieu of an open flame. Students can try this experiment with a variety of different bags—such as a plastic grocery bag, a trash can liner, and others, to observe how the mass of the bag affects how high it travels or how long it remains aloft.

Also as an alternative, teachers can create an experiment using the following online balloon simulator https://theyardgames.org/game/balloon.html. In standard mode, the students can monitor outside air temperature, temperature of the air in the balloon, weight, volume of balloon, and fuel remaining. For more precision flying, students should try the Refuel game. Students may be asked to write a reflection about the challenges they faced trying to control the balloon.

Section C – Gliders

Lesson 2 – Glider Flight and Early Innovator

Activity – Build and Test Your Own Glider

Alternate Activity – As written, this activity requires a balsa wood glider kit, one kit per student. At home, students can do this hands-on activity substituting with paper airplanes. Designs for various paper airplanes can be found at https://www.foldnfly.com/#/1-1-1-1-1-1-1-1-2. To ensure that student observations are as consistent as possible, it will be important to select one style of aircraft/set of folding instructions for all students to use and modify. Teachers may choose to extend the activity by having students fold several different types of paper airplanes and observing how the characteristics of these different designs affect the flight characteristics of each aircraft.

Section D – Powered, Controlled Flight

Lesson 2 – Build and Test a Wind Tunnel

Activity – Wind Tunnel

Alternate Activity – This activity is probably not replicable at home as written or even with modifications. As an alternative, teachers can consider building a lesson around an online wind tunnel simulator, such as NASA's FoilSim, at https://www.grc.nasa.gov/www/k-12/airplane/foil3.html. Students can change airfoil shape, angle of attack, and camber. They can then collect lift and drag data for each type. Teachers will need to write notes for how they want their students to use the simulation in lieu of building their own wind tunnel and testing airfoils. For example, have students click on the "shape" and "gages" tab. Using the shape "airfoil," have students adjust camber to find the most efficient combination of lift and drag as shown by the chart. Have them record their settings. Then have students adjust the angle of attack and answer the following questions: What angle of attack creates the greatest lift? At what angle of attack does drag exceed lift? Then have students change the camber on the airfoil. How does this change the impact of specific angles of attack?

Unit 3 – From Theory to Practical Reality – Rapid Developments in Powered Flight

Section A – First Practical Applications of Airplanes, Commercial and Military

Lesson 1 – Beginnings of U.S. Commercial Airline Service

Activity – Think/Pair/Share

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student a given topic and having them complete the assignment. Upon submission, teacher can collate all results and share them with the class.

Lesson 2 – Aviation and World War I

Activity 1 and 2 – Group Presentation

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student a given topic and having them complete the assignment. Upon submission, the teacher can collate all results and share them with the class.

Section B – Women in Early Aviation

Lesson 1 – Women in Early Aviation

Activity – Women Aviator Jigsaw Exercise

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student a given topic and having them

complete the assignment. Upon submission, the teacher can collate all results and share them with the class.

Section C – World War II

Lesson 1 – Aviation and Innovation in World War II

Activity – Strategies

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student with a given topic and having them complete the assignment. Upon submission, the teacher can collate all results and share them with the class.

Unit 4 – To the Stars – Making Jet and Space Travel Possible

Section A – The Jet Age

Lesson 1 – Development of the Jet Engine

Teaching Aid 1 and 2 – Jet Engine Lab

Alternate Activity – The setup for this lab is too complex for home use. Instead, consider making this a research and writing activity in which students learn about and explain each stage inside a jet engine. Some resources include:
Inside a Jet Engine – https://animagraffs.com/inside-a-jet-engine/
How a Jet Engine Works – https://www.youtube.com/watch?v=p1TqwAKwMuM

Lesson 2 – Commercial Air Travel

Activity 2 – Commercial Aviation Grows

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student a given topic and having them complete the assignment. Upon submission, the teacher can collate all results and share them with the class.

Section B – The Space Race

Lesson 1 – The Space Race Begins

Activity (Going Further) – Rocket Launch!

Alternate Activity – Download and run OpenRocket (http://openrocket.info/), a downloadable Java applet that will allow students to design model rockets by selecting components and learning estimated flight times and maximum heights based on specific rocket and motor configuration.

Lesson 2 – To the Moon

Activity 1 – To the Moon Jigsaw Activity

Alternate Activity – This activity, like other group activities, can be altered to fit non-collaborative technology situations by assigning each student a given topic and having them complete the assignment. Upon submission, the teacher can collate all results and share them with the class.

Lesson 3 – The Space Race Winds Down

Activity – Let's Dock!

Alternate Activity – Students can build this activity using items from around the house. If students have enough members of their household available, they may be able to execute the activity as designed. Students with smaller households can try the activity with as few as two people, standing back to back and attempting to maneuver the two spacecraft. They may add additional positions as they are able. In a situation like this, the idea is to demonstrate that both the actions and the communications needed to accomplish this task are challenging and require precision. Alternatively, teachers may be able to address the communications element of this activity by using a common communications exercise, such as having the teacher (or a student) describe a random object in generic terms while the remainder of the class attempts to draw that object based only on the teacher's description. Variations among the student drawings should demonstrate the challenges associated with complex communications. The teacher can then describe different objects using more precise terms, with the students once again attempting to draw the object. There should be much less variation in the drawings the second time, demonstrating the value of precision in complex communications. Students with internet access can then experience the complexity of docking by using the SpaceX docking simulator for the ISS (https://iss-sim.spacex.com/) via browser.

Lesson 4 – The Shuttle Program

Activity – Space Race Quiz Show

Alternate Activity – Teachers may want to consider alternate online game platforms such as Kahoot! (www.kahoot.com) or any of a large number of alternative sites (see https://solutionsuggest.com/kahoot-alternatives/ for alternatives). A Kahoot game may be run during a synchronous teaching session; however, you will need to prepare the questions and answers in Kahoot ahead of time.

Unit 5 – Creating the Future – What's New and Next in Aviation and Aerospace

Section A – Modern Aircraft Design

Lesson 2 – Aircraft Navigation

Activity 1 – VFR Chart Practice

Alternate Activity – Students can complete this activity by downloading a PDF version FAA Sectional Chart of their (or the teacher's) choice at https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/vfr/. Students may also use www.skyvector.com to access a free seamless sectional aeronautical chart online.

Lesson 3 – Composites and Structures

Activity 2 – Build Your Own Composite

Alternate Activity – While this is an activity that students could try on their own at home using household materials, the teacher may choose to offer an alternative. Video to potentially substitute: NASA 360 – Composite materials (https://www.youtube.com/watch?v=tZhH2B-EI1I)

Section C – End of Semester Project

Lesson 1 – End of Semester Project

Activity – Aviation Innovation Exhibit

General Notes:

The end of semester project was clearly written for implementation in a classroom environment. In the project, teams of students create visually compelling museum exhibits that are well-researched and documented. The classroom literally becomes a museum, its visitors are the students themselves, and the learning becomes communal and meaningful to all students.

All the things that make this such a compelling classroom activity make it a seemingly daunting task in an online environment. How teachers choose to modify this activity will depend greatly on numerous factors, including but not limited to the technology and online resources available to students, the amount of synchronous instruction time available, and the level of skill students have at collaborating in online environments.

Some resources that may be available to schools include online productivity and collaborative software, such as Microsoft Office Online and Google Docs.

Taking inspiration from museum websites, consider asking the students to create pre-recorded slide shows in PowerPoint.

There are myriad possibilities for adapting this culminating lesson of the semester to the online learning environment. It will ultimately be up to each teacher to find a pathway that works for them. Use the AOPA Curriculum Facebook group to share any ideas or reach out for advice for your specific circumstance. We will all be struggling with similar problems, so the more support we can provide each other, the better our students' final products will be.