SPRING 2020

THE PULSE of Science Pathways

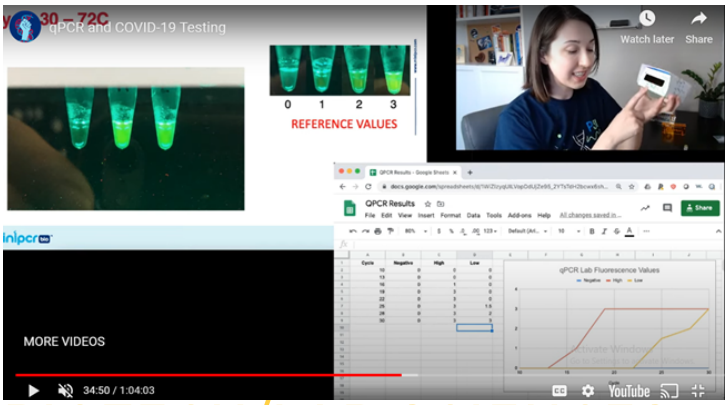
PASSAIC ACADEMY FOR SCIENCE AND ENGINEERING

BIOTECH/LAB SCIENCES

LEARNING UPDATE

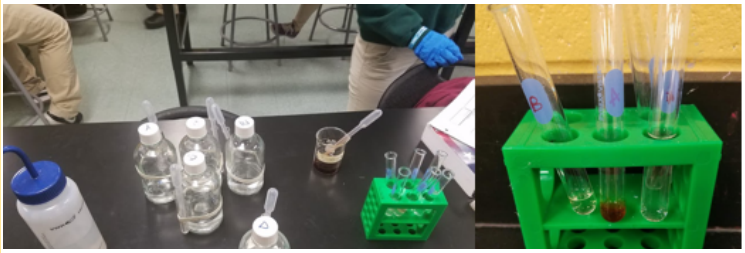
Students in Biotechnology (year 2) moved into DNA work with simulated gel electrophoresis and a live online demo of qPCR, a technique that allows for measuring the amount of genetic material that a sample has. The technique was discussed as one means for measuring the amount of SARS CoV-2 virus that an individual has in their system. Students learned how to use the mini-PCR system that we have on campus to simulate qPCR (without the virus of course!) which is a cutting edge biotechnology application [Continued, Pg. 2]

WHAT'S NEW?



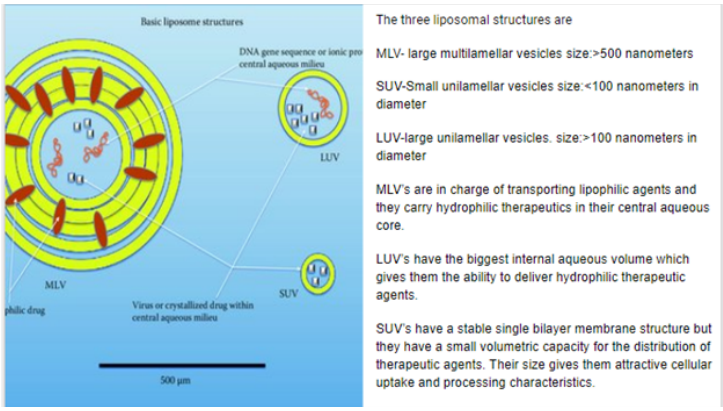
BIOTECH/LAB SCIENCES CONTINUED

Organic and Biochemistry is the third course in the Lab Science: Biotechnology Pathway. This school year there was not a class at the Passaic Academy for Science and Engineering.However, typically during the spring, students will have now made their way into the Biochemistry portion of the course. Last year, we started the unit about carbohydrates with information about the laboratory investigation and researched our way to learn about monosaccharides, disaccharides, glycosidic bonds, Fischer and Haworth projections, reducing sugars, and much more. Using this information students determined a process for how to determine five unknown carbohydrates, starch, glucose, fructose, lactose, and sucrose by completing a series of qualitative tests. When we are in school we perform these tests in the laboratory. The result of a previous Seliwanoff test is shown below on the right. We also studied real life applications of carbohydrates including how they relate to blood types.

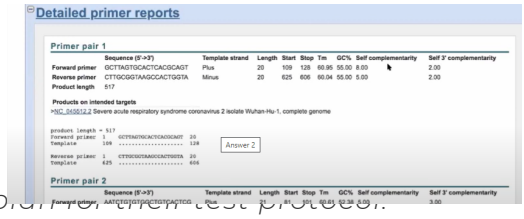


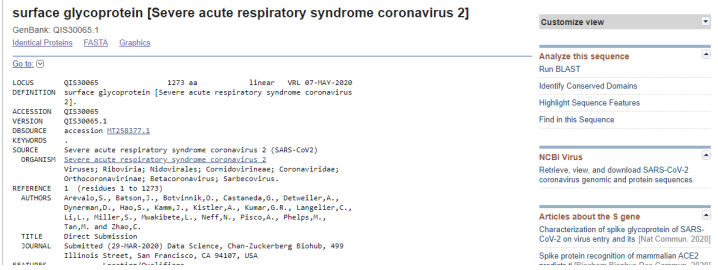
After carbohydrates came the lipid unit. We started with nutrition label information where we examined the different types of fats and related these terms to prior organic chemistry knowledge: saturated fats, trans fat, monounsaturated fat, polyunsaturated fat. double bonds.

In the lab for this unit students examined common fats such as corn oil, coconut oil, and cholesterol to determine properties such as solubility in water and hexane as well as if it contained.We also studied real life applications of lipids including how micelles and liposomes are being used for drug delivery to the central nervous system. Students each presented a page of a chapter in a biochemical text. Here is an example from one student's slide show:



Students in Genetic Engineering (year 4) have picked up where they left off in the lab. We are working on understanding and manipulating DNA sequences using the National Center for Biotechnology Information GenBank database. As they develop proficiency in using the server, a tool used by all geneticists to share research data, they will begin to address the question, "Was SARS CoV-2 created in a lab?"
They will be able to look at the growing number of virus samples sequenced to see evolutionary relationships and mutations within the virus and collect evidence to support their hypotheses on the virus origins. They will then design primers that could be used to develop a test for the virus and develop a practical diagnostic test process.





COMPUTER SCIENCE

LEARNING UPDATE

In CSE, the students' transition from the traditional classroom to remote learning was seamless. Students are using the same programming platform and grade submission program that was being used prior to leaving. The format is similar to the environment that students will encounter in college, requiring independent learning and self motivation. Some of the students excelled at this, even producing the winner of the first zero zero challenge winner:

Congratulations, Gary Cala!

The students are continuing to learn more Python concepts and are continuing to work in labs that support the instruction. Students have been working with For and While loops, Strings and Lists. The course work is moving forward to combine the elements into a final programming project.

Below is an example of student work that has students code the Ceasar Cipher, which is one of the most widely known encryption techniques used today. It is a type of substitution cipher in which each letter in the plaintext is replaced by a letter some fixed number of positions down the alphabet:

main (6).py Download

```
#(c) A+ Computer Science
#www.apluscompsci.com

def cipher( x, dist ):
  alpha = "abcdefghijklmnopqrstuvwxyz"
  shift = alpha[-dist:] + alpha[0:-dist]
  ans = ""
  for var in x:
    ans += shift[alpha.find(var)]
  return ans



print ( cipher("abcdef", 1) )
print ( cipher("abcdef", 2) )
print ( cipher("abcdef", 3) )
print ( cipher("dogcatpig", 1) )
print ( cipher("dogcatpig", 2) )
print ( cipher("dogcatpig", 3) )
```

In CyberSecurity the students just finished up unit 3 on the technical aspects of a highly networked world and the risks to information we all share. They learned about operating system and networking concepts, security frameworks, and packet analysis, ending with the types of malware that can attack systems on a network and how to secure and protect a system against them. Now the students are moving on to unit 4, in which they will explore cybersecurity in an applied field. The students will learn methods of cryptography and practice basic tenets of digital forensics. As well as processing a crime scene to solve a mystery and explore the possible consequences of crime.

DATA ANALYTICS

LEARNING UPDATE

AP Computer Science Principles

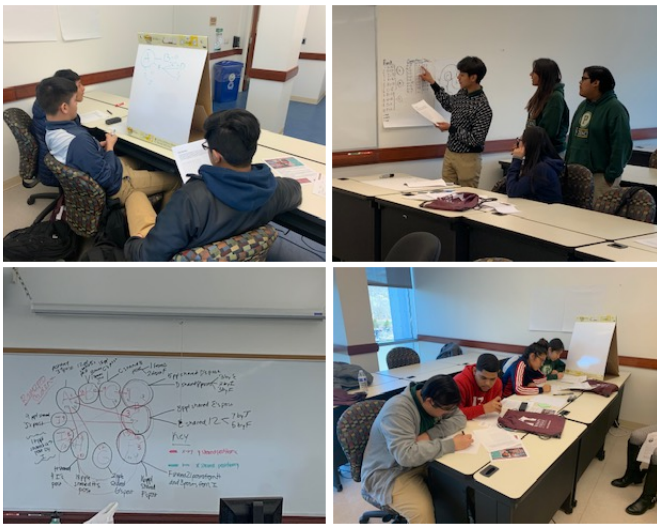
We have come to the end of our preparation. In the last few months, we have learned the basics of Python and then moved into project time for the AP Exam. This year, the exam will actually not include an exam, just the two performance tasks. Most students already completed the Explore Task (which analyzed new technology) and we started the Create Task. This happened just as we moved to online learning. Students reviewed the basic structures in programming using Khan Academy's AP CSP curriculum. In addition to those guided lessons and videos, we conducted a few video conferences to go over the requirements for the task and reviewed sample submissions from last year. Students evaluated the past submissions and used the scoring guidelines to see how projects like the

DATA ANALYTICS CONTINUED

one they create will be scored. Students also watched videos from the College Board and a AP CSP teacher in Florida to review various topics to give them ideas and support for their project. During this last month before their final submission deadline on May 26th, students have worked daily on their programming project while maintaining a work diary to track their progress and struggles. Students have also been given opportunities to get technical and coding assistance from their teacher via Google Meet. Students are using their past experience to create their programs, apps, or games using Scratch, App Inventor, Python or any other language they are familiar with. We can't wait to see what they have come up with!

AP Statistics

Some students in AP Statistics have been diligently preparing to take the AP exam on Friday, May 22. They have attended College Board lectures offered on YouTube, attended virtual review sessions with their teacher to further practice and enhance their mastery over course material, and worked on a substantial amount of previous AP exam free response questions to hone their knowledge. Some students have demonstrated an impressive amount of mastery of challenging statistical concepts and reasoning, and should hopefully be well-placed to be successful on the AP exam. After the AP exam has been completed, students will expand their current knowledge about least-squares linear regression from earlier in the course by learning how to infer mathematically whether a line is the best way to model a set of data, and will learn to transform data mathematically to convert data to a linear form and make a data set easier with which to work. They will also complete a final project tying together the various modules learned during the course. Additionally, if time permits, they will learn about ANOVA F tests, a widely used statistical procedure applicable to a variety of fields.



Ramapo Field Trip

Shortly before remote learning commenced, a group of about 20 data analytics and statistics students participated in a field trip at Ramapo College, generously hosted by Dr. Amanda Beecher, Associate Professor of Mathematics, and two of her undergraduate students. Our students were able to explore a handful of topics in network science and graph theory in the context of the social network LinkedIn. They were provided with a long series of interactions among members of the network and were posed the open-ended question of determining the "most important" person in the network. They were further tasked with clearly explaining their methodologies; ranking the members of the network from most important to least important; and creating and presenting a poster of their findings. Each group of students came up with different methods to try to answer this question, with one group considering up to seven variables simultaneously.

DATA ANALYTICS CONTINUED

Overall, the students came away with the positive message that math is more than just memorizing and regurgitating formulas, and can be used to describe aspects of the world around us. They also stated that, while the task was challenging, it was interesting, and further opened their eyes to the fact that not every problem has one correct answer. We are looking forward to potentially participating in more field trips to Ramapo in the future!

Future Business Leaders of America (FBLA)

Our Future Business Leaders of America were able to learn a lot as they prepared for this year's State Leadership Conference. They practiced their presentation skills, examined FBLA competition criteria and rubrics, rehearsed public speaking skills, and created original designs for their first competition. Although unable to compete in March as we had hoped, the experience and research has given our students a stronger understanding of how they can continue to improve and grow in order to be successful next year!

BIOMEDICAL SCIENCE LEARNING UPDATE

In Principles of Biomedical Science, students conducted simulated experiments to explain poor blood glucose regulation alters the structure and functions of cells, as well as interconnected organ systems. As we moved into investigating Sickle Cell Disease, students conducted webquests to learn how to diagnose the disease using microscopy and hematocrit testing. They were able to demonstrate their ability to use models to explain the pathology of disease by using paper models to explain how a single gene mutation can cause the formation of hemoglobin fibers and cell sickling.

Figure 2: Paper models of hemoglobin fiber formation in a Sickle Cell Patient

In addition to learning how to diagnose Sickle cell and explain its pathology, students were invited to attend the screening of a Kidney Transplant. During the event, students were able to ask questions about the procedure, as well as learn about the importance of becoming organ donors. Later, we took a virtual field trip to AstraZeneca labs in Maryland. We were able to appreciate the process of creating biological drugs, such as insulin and vaccines. Students engaged in the activity through a virtual screening of the tour where they learned about all the steps involved in producing a biological drug and the associated professions of the field. In addition, a current college level researcher at TCNJ joined the conference call to provide students with advice to prepare for a career in Biomedical Engineering or Biotechnology.

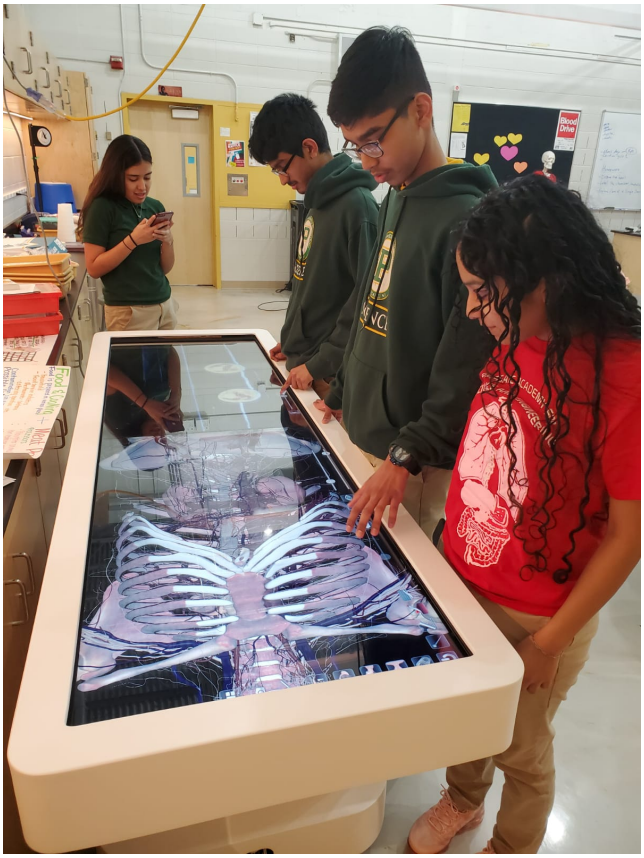
BIOMEDICAL SCIENCE CONTINUED

In Medical Intervention, students evaluated the design of gene therapy treatments for patients with genetic disorders. The also explored IVF and Reproductive cloning as they evaluate the applications of these techniques and its associated ethical issues. They voiced their opinions about Reproductive cloning by creating comic strips that described the steps and complications of cloning a human.

Figure 3- Student example of "How to Clone a Human?" ComicStrip

In Anatomy, students learned the nervous and cardiovascular system. They learned how information is initiated, propagated, processed and transmitted throughout the body. The students learned how to read and analyze EKG's. We dissected the sheep's brain and studied it on the Anatomage virtual table. As for the cardiovascular system, we learned how the heart functions, it's structure and how the heart contracts. We will continue learning about the blood, it's characteristics and functions and blood pressure, how it is measured, and the reasoning behind blood pressure.

In Biomedical Innovation, we have been working on environmental concerns that affect water quality. We analyzed water samples from various ponds around Passaic foer common water contaminants, learned how to detect the contaminant, how water treatments occur and how we can reclaim contaminated waters for better use.



ENGINEERING LEARNING UPDATE

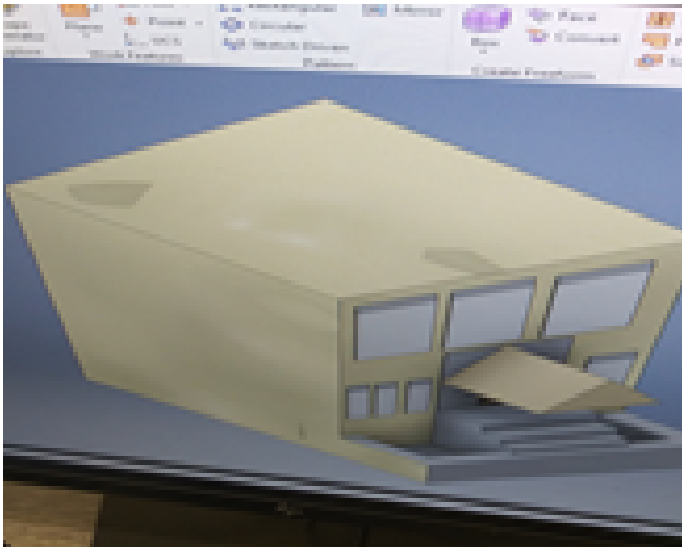
IED classes continued building an individual 3D model of their houses. To build up these models, students use cardboard, glue, scissors, wood sticks, paint, construction paper, hot glue guns, rulers, calculators and protractors. Students followed the following sequence:

ENGINEERING CONTINUED

1. *Build the basement (foundation) of the structure,*

2. *Build walls of the structure*

3. *Build the inside of the structure: since houses are different, students must use a personalize design to model the distribution of walls*



4. *Build the roof of the structure: the roof will be glued to the structure after the inside of the house has been graded.*

5. *Build the peripherals: windows, doors, stairs, balconies, patios, porch.*

The last step of the activity consisted in painting and decorating the structure. For this step, students had to replicate as best as possible the actual colors and decoration of their individual houses.

Washington Bridge Project

In IED students are presently in the application of four design techniques previously learnt: Isometric projection; Isonometric projection; Oblique projection and vanishing points.

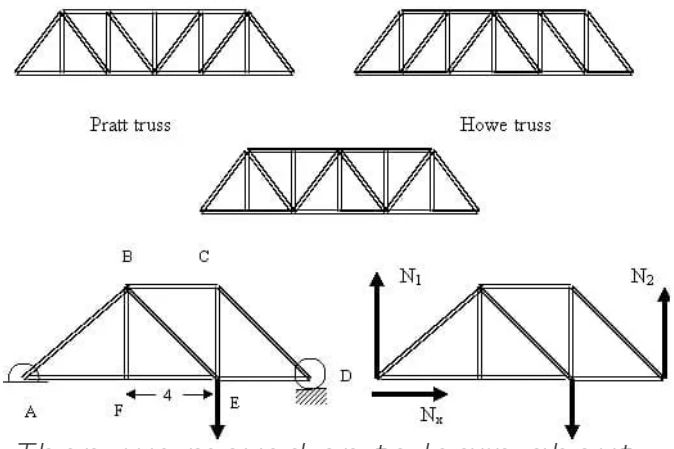
ENGINEERING CONTINUED

During the first phase, students designed the outer skeleton of the bridge:

Only the structure of the bridge is hinted (almost 100% of the IDE students finished this part). The second phase requires to incorporate both isometric and axonometric elements of the design. Students had to workout the contour lines and capture details of the possible volume, weight, orientation and size of the strutcure:

Since this phase involved the combination of geometrical approaches with detailed sketching isometric techniques,, it was completed, successfully, by 72% of the combined students. For the third phase (students are working on it now), elements of volumen(through shadows) and high approximations must be captured. Students must design and sketch the frontal, site and top views of the bridge. Also students must sketch the peripherals of the structure including (hanging cables, rode, fences, towers). Students will spend two weeks completing the third face.

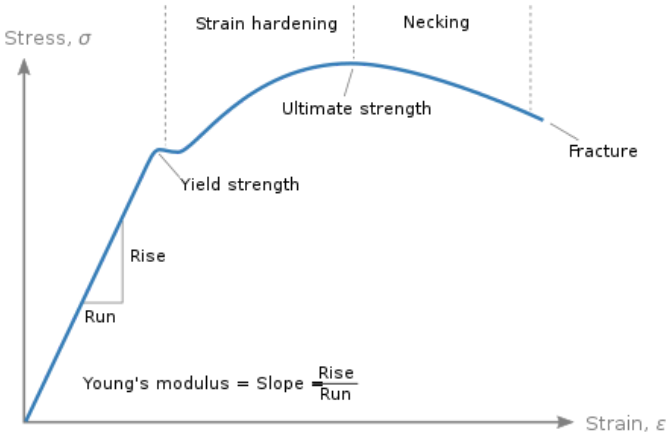
In Principles of Engineering, students finished the unit on statics by carrying out analyses of trusses. We first studied two equilibrium conditions: sum of forces and torques add up to zero in a body that experiences no acceleration. We then solved different truss problems, like the ones shown to the right. We started by solving for the reaction (external) forces. We then used the joint method to solve for the internal forces of tension or compression in each member.



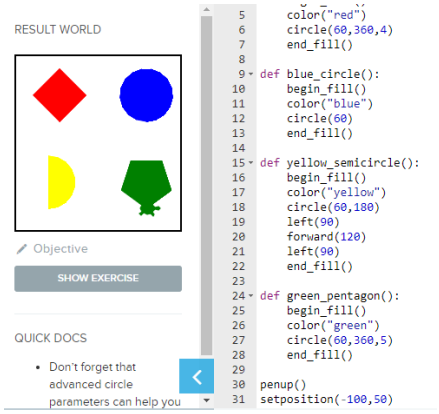
Then, we moved on to learn about the Product Life Cycle. We started studying raw materials, then manufacturing, and finally disposal / recycling. Students explored different manufacturing processes and different manufacturing plant structures. Students were able to assess what machinery and type of factory would be best suited for different products. Finally, they studied the importance of recycling and the ways in which different materials can be processed once they reach the end of their Life Cycle. Before the year is over, we will also cover material testing.

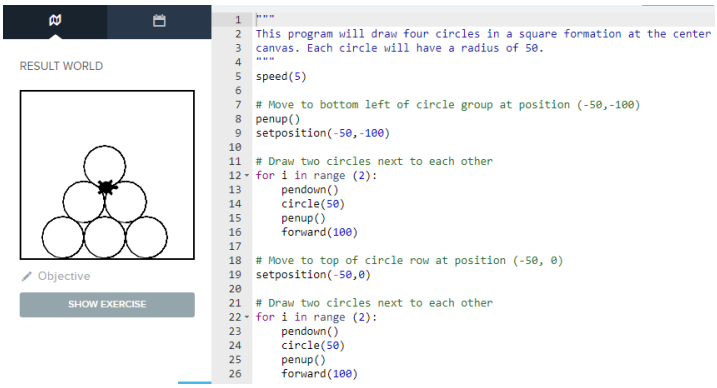
ENGINEERING CONTINUED

We will explore how materials change when enduring stress and strain, how we can quantify these changes, and what these results say about how a material behaves in the real world.

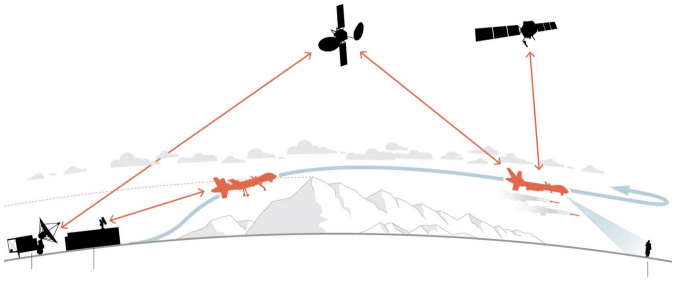


During our time in Remote Learning, students in Aerospace Engineering are learning about Computer Science! The CodeHS Introduction to Computer Science in Python course teaches the fundamentals of computer programming as well as some advanced features of the Python language. Students have been learning how to program Tracy the Turtle to draw shapes like circles, squares, and hexagons in different colors, sizes, and configurations. While this may not seem like typical programming exercises, throughout these lessons students are learning about For Loops, While Loops, Functions, Variables, and If/Else Statements.

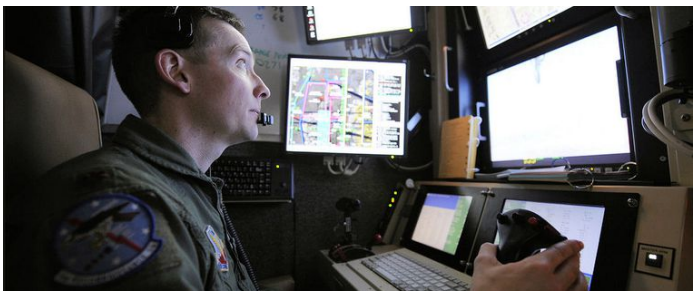




At the Unmanned Aircraft Systems class, students are tackling the last 3 modules before the end of the course. Module 11 deals with datalinks, which is the hardware and software used to create and maintain a connection between the Ground Control Station and the Unmanned Air Vehicle. Students reviewed also what to do in case of emergencies where the connection is broken (lostlink).



Module 12 is about the infrastructure of the Ground Control Station (GCS). We explored different types of GCSs, their advantages and disadvantages, and which kind of GCS best suited different missions. Students analyzed the different roles with the GCS crew, specifically that of the Remote Pilot in Command (RPIC) and the Payload Operator. They studied how these two crew members have to work very closely to ensure the best angles for image capturing. We also reviewed specialized GCS subunits that operate during more complex operations, such as Launch and Recovery Elements and Mission Control Elements.



ENGINEERING CONTINUED

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Module 13 deals with Payloads, or the other equipment that drones carry but are not essential for maintaining the drone in the air. For example, students will learn about the different types of cameras that can be affixed to drones and the different kinds of missions that can be carried out with them. Payloads go beyond cameras.They also include sensors that might be essential for different types of research or commercial purposes.

The class will culminate with taking both the Part 107 drone certification test and the USI drone safety certification test. Obtaining both licenses will enable our students to be eligible to work on the drone field after graduation. We are currently exploring how to offer these testing opportunities while adhering to the social distancing parameters in place due to COVID-19.

SPECIAL

TO THE CLASS OF

The Pulse of Science Pathways, Spring 2020, is Brought to You By:
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