The following timeline details the one-year Green Drone AZ (GDAZ) Program beginning in September 2021. Module lessons will be instructed in an online environment using Google Classroom utilizing prerecorded presentations and activities. GDAZ will coordinate with each teacher to plan an on-campus visit to engage with students.

September

Module 1: Protect and Conserve: Restoration in Practice

Lesson 1

- Students will be introduced to conservation on public lands, the history of the Lower Salt River Restoration Project (LSRRP), Green Drone AZ and partners involved.
- PRE-SURVEY implemented to Boeing mentors, high school students and teachers.

Lesson 1 Quiz

- Students will complete a short quiz covering topics discussed in the Lesson 1 presentation.

In Class Activity

- Restoration Chalk Talk: This activity leads students with guided questions to express their thoughts regarding topics of conservation, human impact on the natural world, and technology.

Lesson 2

- Students will be introduced to UAV/GIS technology, implementation of these technologies within the LSRRP, and methods of data collection/remote sensing.

Lesson 2 Quiz

- Students will complete a short quiz covering topics discussed in the Lesson 2 presentation.

In Class Activity

- Field Monitoring Data Review
- Remote Sensing Data Collection
    - Students will determine the benefits of utilizing remote sensing vs conventional monitoring.

Inter-Module Activity

- Students will review National Geographic articles and complete a short knowledge check quiz.
    - Erosion: www.nationalgeographic.org/encyclopedia/erosion/
    - Watershed: https://www.nationalgeographic.org/encyclopedia/watershed1/
    - Drought: https://www.nationalgeographic.org/article/understanding-droughts/?utm_source=BibblioRCM_Row
    - Deserts: https://www.nationalgeographic.org/article/deserts-explained/
    - Surface Water: https://www.nationalgeographic.org/encyclopedia/surface-water/
- Students will perform field and remote sensing data collection activities in their local community to compare these methods.

September/October

Boeing Mentor Program: Bridging Learning Between Modules

- Boeing mentors will deliver pre-recorded presentations introducing themselves, detailing their jobs at Boeing, the importance of their jobs, challenges they face, and why the STEM field is so important.

October

Module 2: Lift Off: UAV Technology and Piloting

Lesson 1

- Students will be introduced to UAV technology, basic mechanics of flight, commercial and recreational UAV users, and pilot responsibilities before and during flight.

Lesson 1 Quiz/ In Class Activity

- Students will complete a short quiz covering topics discussed in the Lesson 1 presentation.

Lesson 2

- Students will be introduced to UAV data collection. Students will be introduced to photogrammetry, including the products derived from UAV imagery and how these products are being used in the LSRRP.

In Class Activity

- Students will complete a short quiz covering topics discussed in the Lesson 2 presentation.

Inter-Module Activity

- Students will review National Geographic articles and complete a short knowledge check quiz.
    - Data Drones: https://www.nationalgeographic.org/article/data-drones/
    - Drones in Egyptology: https://www.nationalgeographic.org/article/real-world-geography-dr-sarah-parcak/
    - Drones in Wildfire: https://www.nationalgeographic.org/article/drones-shoot-fireballs-help-control-wildfires/
    - Life in a Volcano: https://www.nationalgeographic.org/video/life-volcano/
    - Drones and Plastic Pollution: https://www.nationalgeographic.org/encyclopedia/great-pacific-garbage-patch/

October/November

Boeing Mentor Program: Bridging Learning Between Modules

- Boeing mentors will discuss career topics such as:
    - What to focus on in your junior/senior year
        - How to gain experience and create a foundational understanding prior to internships
    - Clubs to participate in
    - Internship opportunities
    - Interview strategies
    - Career Opportunities

November

Module 3: Restoration in Action (Lower Salt River Restoration Project)

Lesson 1

- Students will watch a presentation created by Audubon Southwest staff and learn about Important Bird Areas (IBA) and data collection efforts on the LSRRP site (bird surveys and riparian photo point monitoring).
- **Students will plan on attending a field trip to the project site.** Students will interact with GDAZ staff, Tonto National Forest staff and Audubon staff while taking a tour through the site.
- Students will gain knowledge of ecological aspects and the depth of work involved in restoration efforts.

In Class/Post Field Trip Activity

- Students will participate in an activity related to bird diversity and protected/threatened/endangered bird species.

Lesson 2

- ****For those students who could not attend the in-person field trip****
    - Powered by Esri Story Maps, students will partake in a virtual field trip of the Lower Salt River Restoration Project.
- Students will review National Geographic articles and complete a short knowledge check quiz.
    - Understanding Rivers: https://www.nationalgeographic.org/article/understanding-rivers/
    - Freshwater Conservation: https://www.nationalgeographic.org/article/real-world-geography-sandra-postel/
    - To the Ends of Earth: https://www.nationalgeographic.org/article/ends-earth/
    - Taking Flight: https://www.nationalgeographic.org/article/taking-flight/
    - Bird Migration: https://www.nationalgeographic.org/article/ends-earth/

Additional

- Depending on COVID19 circumstances and individual transportation, students can attend an **optional** field trip to the LSRRP site to partake in tree planting and interact with industry professionals. This field trip is planned to occur in November or December.

December/January

ASU Intern Recruitment, Boeing Scholarship Opportunity Announcement and High School Teacher Training

ASU Intern Recruitment:

- GDAZ staff will visit the 2020/2021 ASU MAS-GIS cohort to introduce the GDAZ program. GDAZ staff will encourage interested participants to apply for a GDAZ internship opportunity.
- MAS-GIS students will have until the end of December to submit their application.
- GDAZ staff will interview and select two GDAZ interns in the beginning of January.
- PRE-SURVEY to be completed by ASU interns.

Boeing Scholarship Opportunity Announcement:

- GDAZ staff will announce the Boeing scholarship opportunity in January. Interested high school students will be required to submit a research paper by the beginning of April.

High School Teacher Training:

- GDAZ staff will deliver two in-kind ArcGIS Online (AGO) training sessions to high school teachers to provide basic GIS instruction with AGO.
- This training will help teachers implement geospatial lessons into their curriculum outside of the GDAZ program.

February

Module 4: Intro to Geographic Information Systems (GIS)

Lesson 1

- Students will learn the basic functions of GIS using ArcGIS Online (AGO) including:
    - Data queries
    - Creating/editing data
    - Points, lines, polygons
    - Editing attributes
    - Building a map

In Class Activity

- Students will use AGO to query data and build a thematic map product.
    - Developing Knowledge, Skill, Confidence with ArcGIS Online: https://learn.arcgis.com/en/paths/developing-knowledge-skills-and-confidence-with-arcgis-online/
    - Getting Started with ArcGIS Online: https://learn.arcgis.com/en/projects/get-started-with-arcgis-online/
    - Use species distribution patterns to assess protected areas: https://learn.arcgis.com/en/projects/use-species-distribution-patterns-to-assess-protected-areas/

Lesson 2

- Students will learn how to utilize Collector for ArcGIS, a mobile data collection app.

In Class Activity

- Students will use a tutorial created by GDAZ to learn the start to finish process of setting up and collecting data using the mobile data app, ArcGIS Collector.

Inter-module Activity

- Use this tutorial designed by National Geographic to explore how to manipulate data attributes to tell the story you wish to tell, then take your ArcGIS Online skills further by creating a story map and web app.
    - https://www.nationalgeographic.org/activity/helping-restore-watershed/

February/March

Boeing Mentor Program: Bridging Learning Between Modules

- Boeing mentors will meet with available classes to engage, interact and answer any questions students may have.

March

Module 5: Data Collection on Lower Salt River Restoration Project Site

Lesson 1

- Students enrolled in the program will partake in a data collection field trip on the LSRRP site.
    - Students will use Collector for ArcGIS to assist in ground truthing vegetation data on the project site.
    - Students will observe an autonomous UAV flight over a portion of the project.
    - Audubon will lead students on a bird survey and riparian photo point monitoring.
    - Boeing mentors will be invited to attend and engage with students.

Lesson 2

- Students will complete an activity that uses Landsat 8 satellite imagery and fire data to show differences in vegetation and burn severity. This activity will expand student's GIS skills by utilizing AGO for analysis.
    - https://www.esri.com/content/dam/esrisites/en-us/media/pdf/teach-with-gis/measuring-fires.pdf

April

Module 6: Intro to Remote Sensing and Derivatives of UAV Collected Data

Lesson 1:

- Students will explore the methods behind remote sensing technology, characteristics of aerial imagery, and the benefits and downfalls of different types of imagery.

In Class Activity:

- Students will be led through a remote sensing exercise on AGO.

Boeing Scholarship Submissions:

- Students will submit their scholarship research papers on the date of Lesson 1.

Lesson 2:

- Students will explore concepts of Digital Elevation Models (DEM), multispectral imaging and how these data are used in GDAZ in addition to other fields.

In Class Activity:

- Students will explore how drones are used in various fields of work, the data that is collected, and where drones will likely end up in the future.
- Students will be provided with a set of data and instructions to complete a mapping and analysis exercise.

May

Module 7: ASU Capstone Phase II

- ASU interns will present their capstone project proposal(s) and discuss how they plan to complete the project.
- Students will be encouraged to ask questions, provide ideas/input, and engage in an open conversation.
- POST-SURVEYS implemented for Boeing mentors, high school students and teachers.

Boeing Scholarship Awards:

- GDAZ staff and Boeing mentors will award scholarships to three students.

AZ Educational Standards Addressed

Computer Science:

- **HG.DA.CVT.1** - Create interactive data visualizations using software tools to help others better understand real-world phenomena. People use software tools or programming to create powerful, interactive data visualizations and perform a range of mathematical operations to transform and analyze data. Students should model phenomena as systems, with rules governing the interactions within the system and evaluate these models against real-world observations.
- **HS.DA.S.2** - Evaluate the tradeoffs in how and where data is stored. People make choices about how and where data is stored. Students might consider the cost, speed, reliability, accessibility, privacy, and integrity tradeoffs between storing photo data on a mobile device versus in the cloud. Students should evaluate whether a chosen solution is most appropriate for a particular problem.
- **HS.DA.IM.1** - Analyze computational models to better understand real-world phenomena. Computational models make predictions about processes or phenomena based on selected data and features that can be represented in a spreadsheet or other organizational software. The amount, quality, and diversity of data and the features chosen can affect the quality of a model and ability to understand a system. Predictions or inferences are tested to validate models. Students should model phenomena as systems, with rules governing the interactions within the system. Students should analyze and evaluate these models against real-world observations.

English Language Arts:

Grades 9/10:

- **9-10.RL.4** - Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone.
- **9-10.RI.4** - Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone.
- **9-10.W.1** - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
    - a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
    - b. Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
    - c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
    - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
    - e. Provide a concluding statement or section that follows from and supports the argument presented.

- **9-10.W.2** - Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
    - a. Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
    - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
    - c. Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
    - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic.
    - e. Establish and maintain a formal style and an appropriate tone while attending to the norms and conventions of the discipline in which they are writing.
    - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
- **9-10.W.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
- **9-10.W.5** - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)
- **9-10.W.6** - Use technology, including the internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- **9-10.W.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **9-10.W.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research.
    - a. Apply grades 9-10 Reading standards to literature.
    - b. Apply grades 9-10 Reading standards to informational text and nonfiction.
- **9-10.SL.2** - Integrate multiple sources of information presented in diverse media and formats, evaluating the credibility and accuracy of each source.

Grades 11/12:

- **11-12.RL.4** - Determine the meaning(s) of words and phrases as they are used in a text, including figurative and connotative meanings, while analyzing the impact of specific choices on meaning and tone.
- **11-12.RI.4** - Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text.

- **11-12.W.1** - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
    - a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
    - b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
    - c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
    - d. Establish and maintain a style and tone appropriate to the norms and conventions of the discipline in which they are writing.
    - e. Provide a concluding statement or section that follows from and supports the argument presented.
- **11-12.W.2** - Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
    - a. Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting, graphics, and multimedia when useful for comprehension.
    - b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
    - c. Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
    - d. Use precise language, domain-specific vocabulary, and rhetorical techniques to manage the complexity of the topic.
    - e. Establish and maintain a style and tone appropriate to the norms and conventions of the discipline in which they are writing.
    - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
- **11-12.W.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
- **11-12.W.5** - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12.)

- **11-12.W.6** - Use technology, including the internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **11-12.W.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **11-12.W.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research.
    - a. Apply grades 11-12 Reading standards to literature.
    - b. Apply grades 11-12 Reading standards to informational text and nonfiction.
- **11-12.SL.2** - Integrate multiple sources of information presented in diverse media and formats in order to make informed decisions and propose solutions, while evaluating the credibility and accuracy of each source and noting any discrepancies.

History and Social Science:

- **HS.SP1.3** - Evaluate the significance of past events as they relate to their own lives and the world.
- **HS.SP4.1** - Analyze multiple and complex causes and effects of events in the past and present.
- **HS.C2.1** - Explain the importance of individual participation in civic and political institutions.
- **HS.C2.4** - Analyze the responsibilities of citizens.
- **HS.G1.1** - Use geographic data to explain and analyze relationships between locations of place and regions.
    - Key tools and representations such as maps, remotely sensed and other images, tables, and graphs
- **HS.G1.2** - Use geospatial tools and related technologies to construct relevant geographic data to explain spatial patterns and relationships.
    - Key tools and representations such as Google Earth, story mapping, wayfaring apps, and other geospatial technologies
- **HS.G2.3** - Evaluate the impact of human settlement on the environment and culture of specific places and regions.
- **HS.G2.4** - Evaluate the use and sustainability of natural resources.
- **HS.G3.3** - Evaluate the influence of long-term climate variability on human migration and settlement patterns, resource use, and land uses at local-to-global scales.
- **HS.G4.1** - Take an active stance on a geographic issue reflecting its scale (local, regional, state, national, or global)

Science:

- **HS.P4U1.8** - Engage in argument from evidence that the net change of energy in a system is always equal to the total energy exchanged between the system and the surroundings.
- **HS.E1U3.14** - Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other.
- **HS.L2U3.18** - Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem.

Technology:

- **Strand 1**
  - **Concept 1**
    - **PO 1.** Analyze, evaluate, and synthesize information to generate new ideas, processes, or products.
  - **Concept 2**
    - **PO 1.** Predict and test the relationships amongst interdependent elements of a digital model, simulation or system.
    - **PO 2.** Propose or create a model, simulation, or system.
    - **PO 3.** Predict how one system operates by comparing it to multiple systems, digital models or simulations.
  - **Concept 3**
    - **PO 1.** Analyze patterns and trends and their logical links to form inferences, and forecast possibilities providing novel insights.
  - **Concept 4**
    - **PO 1.** Create innovative products or projects using digital tools to express original ideas.
    - **PO 2.** Use digital collaborative tools to synthesize information, produce original works, and express ideas.
- **Strand 2**
  - **Concept 1**
    - **PO 1.** Collaborate with peers, experts, or others in the global community employing a variety of digital tools to share findings and/or publish in a variety of ways.
  - **Concept 2**
    - **PO 1.** Communicate and collaborate for the purpose of producing original works or solving problems.
- **Strand 3**
  - **Concept 1**
    - **PO 2.** Evaluate diverse information sources.
  - **Concept 2**
    - **PO 1.** Locate and synthesize information utilizing advanced search strategies including a variety of search engines, metadata search engines, deep web searches and databases.
    - **PO 4.** Synthesize research information to create new understanding and innovative solutions.
- **Strand 4**
  - **Concept 2**
    - **PO 1.** Plan and manage an individual learning project that collects multiple data sets from diverse sources, creating planning adjustments and course corrections from the knowledge gained.
- **Strand 5**
  - **Concept 3**
    - **PO 1.** Develop a possible technological solution for a contemporary issue.
- **Strand 6**
  - **Concept 2**
    - **PO 5.** Compose media for the web with interactive capabilities.