Unit 2 Drone Flight Training

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Belleville Public Schools

Curriculum Guide

INTRODUCTION TO DRONE FLYING, GRADES 10 TO 12

DRONE FLIGHT TRAINING

Belleville Board of Education

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Board Approved:

Unit Overview

- This unit will introduce the student to the flight simulator, the Syma drone, and the Tello drone.
- It shows basic, intermediate, and advanced exercises that can be done with each of them.
- It gives students the opportunity to work at their own pace and improve their skills for each exercise.
- The simulator has different scenarios for the students to fly in.
- For the drones, there are both vertical and horizontal obstacles that can be combined into courses for students to practice.

Enduring Understanding

Enduring understandings:

- Simulators allow drone pilots to practice landing, turns and other maneuvers when there is a lack of space or the weather conditions are not ideal.
- Simulators give allow drone pilots to get evaluated on their ability to complete specific skills.
- Simulators provide drone pilots an easy change of scenery without using additional equipment.
- Tello drones are good for beginners to use, because of its ability to remain in one position while the pilot is deciding what to do next.

- Tello drones require the use of a bluetooth connection in order to operate.
- Students who use Tello drones will be able to see a first person view of their flight.
- Syma drones are more difficult for drone pilots to use because of their inability to remain in a fixed position.
- Because of this, Syma pilots must be able to think fast and make extremely precise moves.
- When using Syma controllers, pilots need to be very careful in making gentle movements to avoid hitting the ceiling or flying too rapidly in a specific direction.

Essential Questions

- What effect do speed and altitude have on the simulator pilot's ability to land?
- What strategies have you learned to achieve high evaluations on each of the simulator skills?
- What skills do you think are the most difficult to perform on the simulator?
- What are the advantages/disadvantages of Tello drones over Syma drones?
- In what ways do you think that the simulator resembles the Tello drone?
- In what ways do you think that the simulator resembles the Syma drone?
- What strategies have you learned to fly smoothly and precisely on the Tello and Syma drones?
- What suggestions would you use to teach drone flying to a beginner drone operator?

Exit Skills

By the end of Unit 2, the student should be able to:

- Use a drone flight simulator for vertical movement, horizontal movement, and landing.
- Connect a Tello drone to a phone with wifi.
- Pair a Bluetooth remote to a Tello drone.
- Pair a Syma drone with a remote controller.
- Change and charge the batteries of both a Syma and a Tello drone.
- Use the yaw, pitch, throttle, and roll of a Tello drone, for vertical movement, horizontal movement, and landing maneuvers.
- Use the yaw, pitch, throttle, and roll of a Syma drone, for vertical movement, horizontal movement, and landing maneuvers.
- Fly through horizontal and vertical obstacles with the Syma, Tello, or both drones.

New Jersey Student Learning Standards (NJSLS-S)

SCI.HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.
SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
SCI.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems.

SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
SCI.HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

Interdisciplinary Connections

MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.K-12.6	Attend to precision.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RI.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.L.11-12.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
CS.9-12.8.1.12.CS.4	Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.
CS.9-12.8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
SOC.6.3.12.CS1	Determine the credibility and value of information, while also considering context, point of view, and multiple perspectives.
SOC.6.3.12.CS4	Critically analyze information, make ethical judgments, and responsibly address controversial issues.

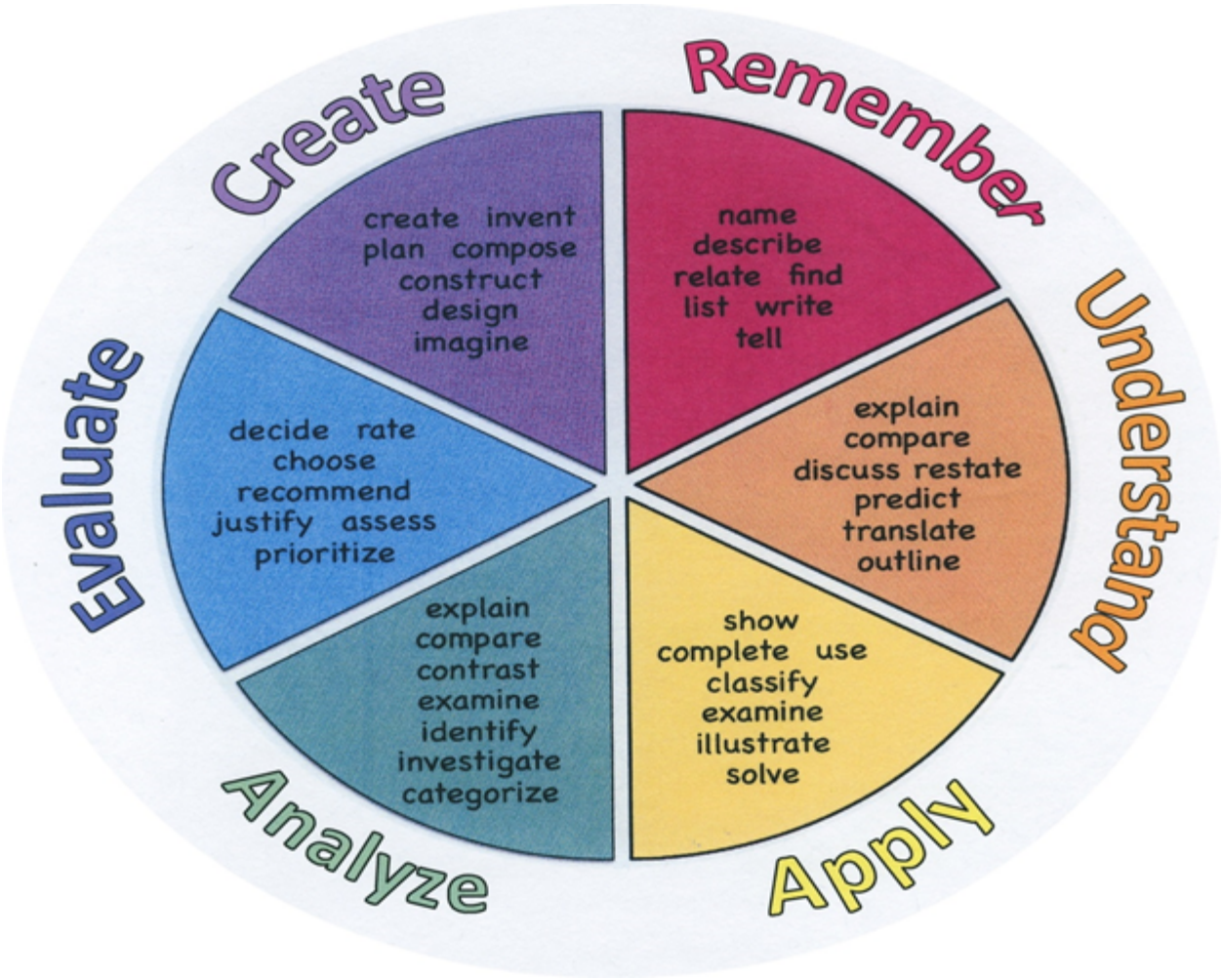
Learning Objectives

- Point out the weather conditions that would be least optimal for drone use.
- Explain the strategies and controller motions that are used for landing, turning, etc. when flying with the simulator.
- Compare and contrast flight with the Syma drone to flight with the Tello drone.
- Explain what first-person view is, and how it can be used when operating the simulator and the Tello drone.
- Assess your connection of the Tello drone to wifi, and conclude what needs to be done to correct any problems.

- Detect whether or not there is a connection between the Tello drone and the Bluetooth remote.
- Operate a drone and a simulator by manipulating the controller to use the yaw, pitch and roll.
- Develop a plan to have the maximum number of batteries available for use during flight.
- Design an obstacle course for drone flight with horizontal and vertical obstacles.
- Explain why African Americans have been underrepresented in technology careers, and some of the measures that they have taken to remedy this.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



Suggested Activities & Best Practices

Best Practices:

- Use of scaffolded notes, where students fill in blanks
- Station activities, based on interest and level of understanding
- Hands-on activities to familiarize with parts of a drone and the control station
- Google Classroom organized around units of study.
- Repetition and review of concepts, especially sample Part 107 test questions.

Exemplars:

- Have written instructions or online instructions with illustrations to connect the drone to the wifi.
- Have the students fly the Tello drones (more stable, easier to control) before the Syma drones.

- Examples of stations: flying with Tello, answering review questions, working with simulator

Assessment Evidence - Checking for Understanding (CFU)

- edulastic.com - for practice exercises and assessment (Formative and Summative)
- whiteboard.fi/ - to present notes and questions (Formative)
- Jamboard - for group work (Formative)
- Google Forms - for Do Nows, Exit Tickets and Assessment activities (Formative)

Performance Task Example (Alternate):

Review the suggested articles and websites about African American owned companies.

Write a short description of the owner and the drone instruction services that his/her company provides.

You may choose an African American owned company that was not listed in the suggested articles/websites.

- Google Slides - for Notes and Drag and Drop activities (Formative)
- Google Classroom - for open-ended questions (Formative)
- quizizz.com - for content practice in a game format (Alternate)
- oncourse.com - for benchmarks (if applicable) (Summative/Benchmark)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Illustration
- Learning Center Activities
- Multimedia Reports
- Outline
- Question Stems
- Quizzes
- Self- assessments
- Study Guide

- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Materials:

- Syma XSC-1 2.4G drone
- Ryze Tello Drone
- FS-i6S drone simulator
- computer or chromebook

Resources:

- skyop.com - readings, notes and films about the simulator, the Tello, and the Syma
- https://www.symatoys.com/down/manuals/2.html - User Manual of the Syma X5C drone
- https://dl-cdn.ryzerobotics.com/downloads/Tello/20180404/Tello_User_Manual_V1.2_EN.pdf - User Manual of the Tello drone
- https://www.gamesir.hk/pages/tello-tutorial - Game Sir controller tutorials and manual

Ancillary Resources

Resources for Beginner Drone Flyers:

- https://dronenodes.com/how-to-fly-a-quadcopter-beginner-guide/
- https://www.youtube.com/c/DRONR/playlists (DRONER TECH)
    - https://www.youtube.com/watch?v=5jNcDTxfCnc - What to do When People Approach
    - https://www.youtube.com/watch?v=m2dddNUPMSA&t=203s - 7 EPIC drone fails!
- https://www.youtube.com/c/Uavcoach (UAV Coach)
    - https://www.youtube.com/watch?v=ixYnzcZZu9g&t=227s - Use These 15 Drone Training Exercises to Learn How to Fly a Drone

Resources for Flying the Tello/Syma:

- https://www.youtube.com/watch?v=itCnZHJCjoM - The Basics on How to Fly the Syma X5C-1
- https://www.youtube.com/watch?v=DbEJJdHddn0 - (Drone Mania) Game Sir Bluetooth Controller | Very Easy | In-Depth Pairing Tutorial With Tello Drone

Resources for Using the Zephyr Simulator:

- https://www.youtube.com/watch?v=rB7-iJdcaEk - (Aerial Solutions of Wyoming Drones) Zephyr Introduction
- https://www.youtube.com/watch?v=TDcRAayNbqg - (Little Arms Studios) Zephyr Drone Simulator FS-i6S Setup
- https://www.youtube.com/watch?v=TBKWmqLaOz8 - Zephyr Demo & Review

African Americans and Drones

- https://www.hstoday.us/industry/industry-news/americas-only-black-owned-drone-company-commemorates-20th-anniversary-of-9-11-by-offering-free-drone-pilot-training-for-first-responders/#:~:text=Specifically%2C%20Aquiline%20Drones%2C%20a%20progressive,the%20end%20of%20the%20year. - (Aquiline Drones)
- https://tnj.com/barry-alexanders-aquiline-drones-makes-its-mark-in-the-drone-and-cloud-tech-space/ - (The Network Journal)
- https://rbsdronetech.com/2022/02/11/pioneers-leading-the-drone-industry-black-history-month-edition/ - (RBS Drone Tech)
- https://flyvekter.com/ - (Fly Vekter, LLC)
- https://www.blackenterprise.com/modern-man-jae-s-brown/ - (Black Enterprise)

Weather Affect on Drone Flying

- https://www.droneblog.com/weather-affects-drones/
- https://social-innovation.hitachi/en-eu/stories/technology/drones-new-heights-climate-change/ - Drones to fight climate change
- https://www.oneearth.org/drones-an-unexpected-tool-in-the-climate-change-fight/ - Drones, an unexpected tool in the climate change fight
- https://enterprise-insights.dji.com/blog/drones-sustainable-future-earth - How drones are saving the planet

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Technology;

WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.DC.4	Explain the privacy concerns related to the collection of data (e.g., cookies) and generation

	of data through automated processes that may not be evident to users (e.g., 8.1.12.NI.3).
TECH.9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
TECH.9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
TECH.9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).

21st Century Skills/Interdisciplinary Themes

Exemplars:

- Review websites about African American drone companies and compare their services.
- Locate additional websites about climate change and determine their reliability.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

Exemplars:

- Students read/locate articles to determine what compounds in the air are causing pollution.
- Students research drones based on their future needs and determine which brands seem to be worth the cost.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy

Technology Infusion

- zephyr-sim.com - for Zephyr simulation flying exercises
- Android, iPhone, or smartphone - for connecting the Tello drone to a wifi source
- use of the internet - for articles and websites about weather and African-American owned drone companies
- edulastic.com - for practice exercises and assessment
- whiteboard.fi/ - to present notes and questions

- Jamboard - for group work
- Google Forms - for Do Nows, Exit Tickets and Assessment activities
- Google Slides - for Notes and Drag and Drop activities (Formative)
- Google Classroom - for open-ended questions (Formative)
- quizizz.com - for content practice in a game format (Alternate)
- oncourse.com - for benchmarks (if applicable) (Summative/Benchmark)

Differentiation

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Center-based instruction
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Learning contracts
- Leveled rubrics
- Multiple intelligence options
- Project-based learning
- Problem-based learning
- Stations/centers
- Tiered activities/assignments
- Tiered products

Lo-Prep Differentiations

- Choice of books or activities
- Flexible grouping
- Goal setting with students
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Exemplars:

- Allow multiple-choice assignments, written assignments, and quizzes to be submitted late
- Convert article to PDF and highlight important ideas for students
- When learning to fly, have students concentrate on one stick of the controller at a time (The teacher manipulates the yaw/throttle stick while the student works with the roll/pitch stick.)

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments

- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Exemplars:

- Have all notes, activity directions, and assessment items translated into Spanish.
- Place students next to Spanish-speaking peers.
- Have individual interaction with students to make sure that they understand the content and expectations.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- providing study guides
- tutoring by peers
- using computer word processing spell check and grammar check features

At Risk

Exemplars:

- Minimize the amount of reading that needs to be done.
- Make multi-colored notes, and provide drag/drop notes instead of requiring students to write the information down.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be

determined prior to giving the test.

- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- providing study guides
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Exemplars:

- Have students to work ahead when using the simulator and drone exercises.
- Have students to design their own obstacle courses and practice flying them.
- Have students research Asian American contributions to the drone industry.

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit Name: Drone Flying and Climate Change

NJSLS: Linked Below

Interdisciplinary Connection: English Connection: This activity contains reading scientific literature and written communication.

Statement of Objective: The student should be able to: gather evidence from websites on the

internet to see how drones have been used to combat climate change.

Anticipatory Set/Do Now: Explain what climate change is

Learning Activity: Do Now.

Present articles of drones combatting climate change - students can work in pairs or groups

Students write their findings as a Performance-Based Assessment (essay or slide presentation)

Students discuss their findings with the class

Student Assessment/CFU's: observation, questioning

Materials: articles on internet, Chromebooks/computers, Google Classroom

21st Century Themes and Skills: communication, critical thinking, information literacy

Differentiation/Modifications: try to translate articles to Spanish, have main ideas highlighted for at-risk/IEP students

Integration of Technology: use of the internet, use of Google Classroom, use of Chromebooks/computers

LA.RL.11-12.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
LA.W.11-12.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
LA.SL.11-12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.