Note: This lesson plan is adaptable in several ways depending on what standards the educator is trying to cover:

1. It can be solely an art enhanced lesson with learning about cameras and drones
2. It can be a science-oriented lesson with the biology of plastic litter and drones
3. It can be a computer science lesson on what it takes to use a drone and why it is important for many potential jobs
4. Lastly, it could be a combination of all three, Art, Science and Computer Science lessons, about how each area of study can enhance the other areas when reasoning “Is this Water Safe?”

| **Lesson Name** | Drones, Photography and Data Collection  |
| --- | --- |
| **Grades and Contents:** | Middle GradesScience, Computer Science, Art |
| **Topic** | * IEcology: Human Impacts on Aquatic Environments
* Researching Water Quality
* Drone Operation
 |
| **Essential Questions** | * How can humans use machines to support research/their occupations?
* How the art of photography can aid data collection processes
* How observation, data collection and analysis is a cornerstone in the scientific process
 |
| **Primary Standards/Indicators** | National Academy of Sciences Standards* MS-LS2-4-LS2.C: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in its populations.
* MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

CSTA K–12 CS Standards* 2-DA-08- Collect data using computational tools and transform the data to make it more useful and reliable.

National Core Arts Standards* Anchor Standard #9. Apply criteria to evaluate artistic work.
 |
| **Secondary Standards/Indicators** | Reading Standards* RST.6-8.8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text or media.
* RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
* RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually
 |
| **Objective** | 1. Students construct a theory that can provide explanatory accounts of features of the world using drone footage.
2. Students will plan field-research procedures using drone technology
3. Students will analyze photography artistically.
4. Students will identify gaps and strengths in drone technology data collection.
 |
| **Academic Language**Vocabulary | From How’s my water website* Watershed
* Ecosystem
* Population
* Impact

From The Citadel Stem Center Video Lessons * UAV
* FAA
* TRUST
* Fleer
* Drone
* Mydar
* Shutter
* Lens
* Aperture
* ISO
* Perspective
* Line
* Shape
* Form
* Space
* Color
* Value and Light
* Texture
* Pre-production pellets
* Microplastics
 |
| **Assessment Plan** | * Pre-Assessment-
	+ Short Discussion- What do you already know drones do?
* Post-Assessment-
	+ Exit Ticket: How can drones and the visual elements of photography help environmental scientists?
* Criteria for Mastery-
	+ Students speak of new way that drones can travel to locations and capture evidence (photography or live) that make data collection easier for scientists.
	+ Students mention data collection as a component of the scientific process.
 |
| **Materials** | 1. Personal computer/Device
	1. w/Internet access
2. [Guided Notes from The Citadel Stem Center](https://drive.google.com/file/d/1cyYXKjEpokiVBb7aTtWBYC5kvnKQhZpn/view?usp=sharing)
3. [Photo Analysis Set](https://drive.google.com/file/d/1Y4PPVRGKko4oKcqZ511BnylhX86_q4g6/view?usp=sharing)
4. Drone (optional extension, recommendations include having student go on location to take photos of the bodies of water themselves (need to take roughly 200 drone photos))
 |
| **Teacher Preparation** | * Review Lesson Plan
* Review [Google Presentation](https://docs.google.com/presentation/d/1j10JicJzby3ASJi1I_PsGNP1nZPt353E8hUV4aTNh2s/edit?usp=sharing) “Is this water safe?” slides:
 |
| **Lesson Sequence*** Video Lessons from College Professors in conjunction with [The Citadel Stem Center](http://www.citadelstemcenter.org/lesson-1-capturing-images.html)

Check out materials<https://www.youtube.com/watch?v=LnsJydJ6zE4> | * **Hook**
1. Explain to students the following scenario:

You are vacationing with your family in the SC Lowcountry. You have rented a boat and have found a great spot to put out an anchor and hang out. What are some recreational activities you may do?EXTENSION SCIENCE ACTIVITY OPPORTUNITY: Explore Mywaterway.epa.gov which provides a unique map with bodies of water and their contamination level answering the question “Is this water safe?” -[Extension Activity link](https://drive.google.com/file/d/1ck61uDFIbNvTo7pAHwpaCaOLuRiYxBgG/view?usp=sharing)1. As a family vacationing, you might not have a microscope, but your guardians have a drone to scope out the area for the dangers that might lurk there.

 * **Brainstorm**
	+ What might lurk in the water that would make a person not want to swim in it?
		- Are they creatures?
		- Is it manmade items?
		- What about things we can’t see?
	+ How might a drone help in understanding what might lurk above and in the water?
* **Prototype**
	+ Students watch and synthesize what new developments in drones have helped in the scientific and natural world
		- Watch Video(s) from [The Citadel Stem Center Website](http://www.citadelstemcenter.org/lesson-1-capturing-images.html)
			* How Drones Work
			* Types of Drones
			* Drones in Forensics
			* A Camera is Like an Eye
			* Visual Elements in Photography
			* Microplastics in the Environment
		- [NOTE: Each of The Citadel Stem Center Videos has Guided notes to aid students in their learning.](https://drive.google.com/file/d/1cyYXKjEpokiVBb7aTtWBYC5kvnKQhZpn/view?usp=sharing)
		- Optional Learning:

Article: [Drones in science: Fly, and bring me data](https://www.nature.com/articles/498156a)* + - * Video: [Stanford researchers develop drone technology to study secrets of San Francisco Bay](https://www.youtube.com/watch?v=WRbE78YHciA)

[How Drones Gather Samples From Inside Active Volcanoes](https://www.youtube.com/watch?v=js7PIii0d9w)[Check Out The Loon Copter: A Flying Drone That Swims Underwater!](https://www.youtube.com/watch?v=rG4IfgXJgHI)Recommended: [USDA-ARS Monitoring Water Quality Using Drones](https://www.youtube.com/watch?v=bAm3xDpDqNw)[Major benefits of using drones in construction](https://www.youtube.com/watch?v=Tm3NXhGLvuU)* + Students with teacher watch a drone video
		- Make predictions about different environmental data that this drone collected in a video
		- Analyze: Perspective, Line, Shape Form, Space, Color, Value, and Texture of Drone Footage
* **Share**
	+ Students complete the [Artistic Analysis of Drone Footage guide](https://drive.google.com/file/d/1Y4PPVRGKko4oKcqZ511BnylhX86_q4g6/view?usp=sharing) in a small group and then analyze 5 different photos for Perspective, Line, Shape Form, Space, Color, Value, and Texture of photos taken from the drone
* **Synthesize**
	+ For final wrap up, students from share out 1 of the more important artistic perspectives from each of the drone photos of their potential vacation spot
 |
|  | * **Additional Support**- Students who need more support with language acquisition could have the guided notes translated into their home language and paired side by side with the English notes. Students who need more support with note-taking could use the guided notes as a resource. Students who need more support with analysis of the photographs could benefit from the small group analysis of the 5 drone footage or be pulled in a small group with teacher guidance.
* **Grade Level adaptations**- For middle grades, the hook activity using “Mywaterway.epa.gov” could be completed as a partnership, but for high school level students, it could be an individual assignment. Further, in the video lesson portion of this lesson, each note could have the [guided notes](https://drive.google.com/file/d/1cyYXKjEpokiVBb7aTtWBYC5kvnKQhZpn/view?usp=sharing) as a scaffold for the middle level or cp high schoolers, but in an honors environment could be adapted to have only headings, and the responsibility of note-taking falls to the student. Also, in the Synthesize activity, for middle grades, a scaffold as in the google presentation: “Is this Water Safe” slides FILL IN SLIDES HERE, the teacher could/should analyze 1 photo for the artistic elements first, which would help learners struggling to understand the concepts, or pull a small group led by the teacher to finish analyzing all 5 photographs whereas high schoolers might understand the concepts and could solely work in a partnership or small group.
* **Advanced students**- On the Artistic Analysis of Drone Footage guide, the wording could be changed to “Rank the ‘visual element of photography’ depicted in each of the five photos from most prominent to least prominent explaining your ranking for the highest and lowest position.
	+ Extension question: Why might the Visual Elements in photography be important in Forensics, in scientific research etc.?
 |
| **Discussion Guides*** Hook
* Synthesis-
 | * **Brainstorm Discussion Ideas**
	+ What might lurk in the water that would make a person not want to swim in it?
		- Are they creatures?
		- Is it manmade items?
		- What about things we can’t see?
	+ How might a drone help in understanding what might lurk above and in the water?
* **Prototype**
	+ How Drones Work Video
		- What safety items are in place surrounding the usage of drones?
			* Why are those items in place?
		- How do drones help with safety on a campus or with safety officers?
			* What safety items could drones help with that were not mentioned?
	+ Types of Drones
		- What is the importance of having different types of drones?
	+ Drones in Forensics
		- What are some items that drones help with forensics?
		- Extension: What artistic applications is important for forensic scientists to consider in drone footage?
	+ A Camera is Like an Eye
		- How does relating a camera to an eye help you comprehend the different pieces of the tool?
	+ Visual Elements in Photography
		- What element is the most important to consider when examining a photograph of the vacation spot your family wants to attend?
	+ Microplastics in the Environment
		- How might an individual tell photograph that there are microplastics in the environment?
 |
| **More to Explore (Resources)** | 1. Inspection of Water (Science Extension Activity)
	1. <https://thewaterproject.org/resources/>
		1. Has games on water quality, free lesson plans, documentaries, and experiments
		2. Examine/ implement the Case Study on Waterborne Diseases
		3. Examine/Implement the hands-on activity demonstrating groundwater contamination
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