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| **Name:Marcia Roth** | **Contact Info:mroth@ccirish.org** | **Date: Oct 5-6, 2016** |

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| **Lesson Title : The Hook; Essential Questions; Natural Hazards** | **Unit #: 1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: The Hook: UAVs; Essential Questions** |

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| **Estimated Lesson Duration:** | **6 class periods** |
| **Estimated Activity Duration:** | **2 class periods (45-50 min)** |

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| **Setting:** | **9th grade Integrated Science Classroom** |

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| **Activity Objectives:** |

ETS1.A Defining and Delimiting Engineering Problems

Cross-Cutting Concept: Cause and Effect

“New Technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.”

I can identify a major global challenge (natural hazards).

*Optional:* I can identify three ways UAVs are used today. (recreation, video and photo surveillance, missiles, ...)

*Optional:* I can identify possible risks and benefits of future developments in UAVs

I can write essential questions about the Big Idea: Natural Disasters

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| **Activity Guiding Questions:** |

Day 1: (Optional)

What is a UAV, and how are UAVs used today?

How can UAVs benefit our society?

What are some possible future developments in UAVs?

Day 2:

What is a natural hazard?

How do natural hazards affect local and global societies?

How can UAVs help?

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| **Next Generation Science Standards (NGSS)** | |
| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| X☐ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | X☐ Cause and effect |
| ☐ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| X☐ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function. |
| X☐ Engaging in argument from evidence | X☐ Stability and change. |
| X☐ Obtaining, evaluating, and communicating information |  |

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| **Ohio’s New Learning Standards for Science (ONLS)** |
| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| X☐ Demonstrating Science Knowledge **(D)** |
| X☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

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| **Common Core State Standards -- Mathematics (CCSS)** | |
| **Standards for Mathematical Practice (Check all that apply)** | |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, ONLS and/or CCSS):** |

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

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.

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

**Day 1 - Optional** - Guest Speakers on UAV’s

Guest speaker #1: Pilot, Ohio ANG Predator MQ-1 RPI (Remotely Piloted Aircraft)

Other guest speaker options: Aerospace Engineering Professor or student from local university, local amateur UAV pilot

**Day 2 - Handout: From the Big Idea -> to Essential Questions**

Video links and handout

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| **Teacher Advance Preparation:** |

Preview video links.

Copy handout 1.1.1a Optimization Essential Question Worksheet

(optional) contact guest speakers from the community to share about UAVs

If guest speakers are coming, spend some time with students brainstorming questions. First, spend about 5 minutes explaining the guest speaker’s background and work. Have students write questions in their notebooks and make sure each student has multiple questions. Write several questions on the board to make sure there are not too many duplicates. Possible themes for questions:

How are UAVs used today?

For ANG Pilot:

How many MQ-1s are here in Springfield? Where are the other MQ-1’s you fly?

What is a typical day for an MQ-1 pilot?

What are some ways UAVs may be used in the future? What are some of the risks and benefits? What are career opportunities in these fields?

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| **Activity Procedures:** |

**Day 1 - Optional - Guest Speakers on UAV’s**

**Guest speaker: Pilot, Ohio ANG Predator MQ-1 UAV**

Discussion: Teacher will introduce the guest speakers. Speakers will share their presentation for 15-20 minutes and then the students will take turns sharing their questions.

**Day 2 - Hook and Essential Questions**

Introduce the Big Idea on the board: ***Disaster Relief.*** Watch 2-3 videos and have students jot down a few words of their impressions or questions after each.

[**https://www.youtube.com/watch?v=fW2qCK0I6cw**](https://www.youtube.com/watch?v=fW2qCK0I6cw)5 min: Top 10 Infamous Natural Disasters - Last 100 Years

<https://www.youtube.com/watch?v=9yEl0-bCA9M>

Andreas Rastopolous: No Roads? There’s a Drone for That (9 minutes)

<https://www.youtube.com/watch?v=sBzHhUnPhRg> Red Cross statistics: disasters last year

Pass out the handout: Big Idea -> Essential Questions -> Challenge

Students will list essential questions - 2 min individually,

10 min in small groups

15 min - large group - *How do we pick out the one essential question that drives the Challenge and the rest of the instruction?*

1. Grouping the “like questions” and eliminating duplicates
2. Evaluate - criteria for EQs, evaluate too broad/narrow, How long it takes to answer a question (30 seconds=bad vs 3 decades=good)

Post the Essential Question for the remainder of the Unit.

Tell the class that the Challenge will be announced at the beginning of the following lesson.

If time permits, continue on questions and videos on the back side of the handout.

Homework: Watch the following video and summarize: How can robots help after a disaster?

<https://www.ted.com/talks/robin_murphy_these_robots_come_to_the_rescue_after_a_disaster#t-64544>

Robin Murphy: Disaster Relief Robots Ted talk

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

Handout: Our Challenge (Big Idea --> Essential Questions)

**Summative Assessments: End of Activity 2 and End of Unit**

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| **Differentiation:** |

For this unit, students with an additional interest in the topic can be directed to the additional websites (below). Student can watch the videos or read the information and summarize what they learned in a brief written response or presentation to the class. Large group and small group brainstorming of questions will allow students of varying readiness levels to contribute to the class essential question and challenge**.**

Additional websites for students with extra time or interest in the topic:

<http://www.ainonline.com/aviation-news/defense/2013-10-04/predator-uav-helps-fight-fires-california> Article to read about Predators Wildfire CA - What can MQ-1 UAVs do to minimize losses from disasters?

<http://www.rescue.org/blog/drones-r-us-reflections-use-uavs-humanitarian-interventions> UAVS in humanitarian interventions? What are some of the challenges and advantages?

<https://www.youtube.com/watch?v=d6hmDaLWFBg> 27 sec of Predator surveying to prep for Forest Fire mission

<https://www.youtube.com/watch?v=u7K2aJgvpdw> Amazon Testing Delivery by Drone

<https://www.youtube.com/watch?v=WRrxOfgwFyw> Why Amazon Delivery Drones Won’t Work

<http://crasar.org/wp-content/uploads/2009/10/best-practices-missions.pdf>

Best practices Disaster Relief UAV Missions:

1. reconnaissance / situational awareness
2. structural inspection
3. search for people
4. debris estimation

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| **Reflection:** |

Beginning the unit with a guest speaker from our local Air National Guard base was definitely one of the highlights of the unit. The students were very appreciative about her presentation on Remotely Piloted Aircrafts, including real life elements, how they work, capabilities, and limitations. Using the real-world context of Disaster Relief for the unit Big Idea also increased student interest. They considered the human costs and elements as well as objective considerations such as locations, distances, UAV limitations, etc. I especially liked the TED talk by Andreas Rastopolous about the potential for UAVs to carry needed medical supplies, although the students found his accent distracting. By the end, I was pleased that my students had identified an Essential Question (“How can technology help disaster sufferers faster?”) and a Challenge (“Design a plan to help disaster sufferers faster with UAVs.”) which fit my goals for the unit and allowed us to move forward.