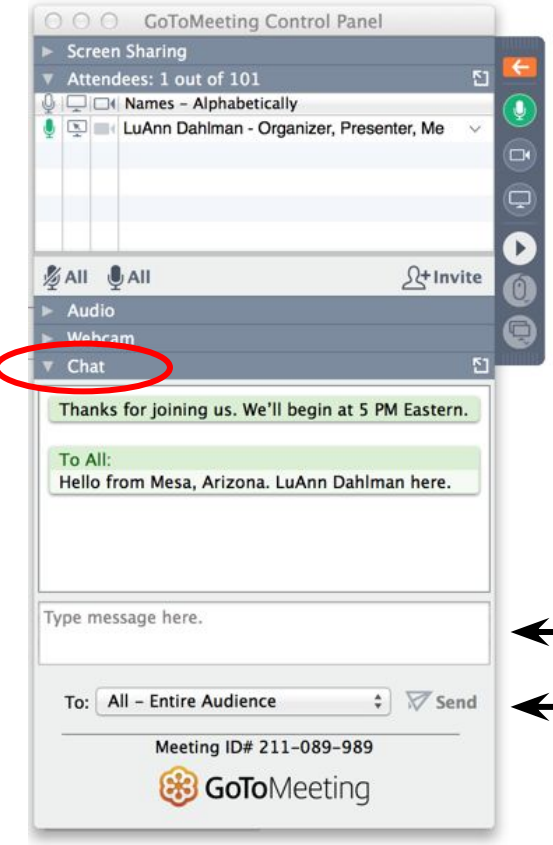
Plan, Fly, Review: Documenting Drone Data

Get organized so you can learn something from every UAV flight. Learn best practices for documenting your flights, images, and science data.

SIP

MAKING DATA MATTER

GoToMeeting Tips



← To find the control panel, be sure you are in the GoToMeeting application (not your browser)

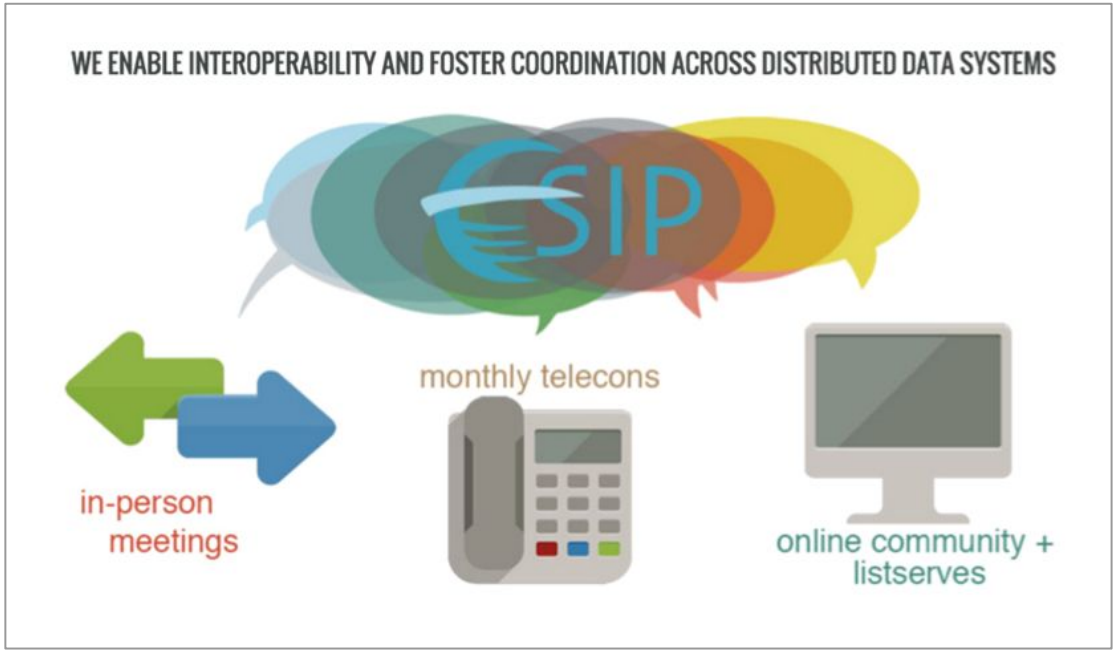
← Type your message

← Select recipients

Click send

← If you closed your control panel, click the orange arrow, or choose View › Control Panel

The **Earth Science Information Partners (ESIP) Federation:**
Our community spans the range from researchers and instrument builders, to data providers and stewards, to communicators and educators.



Our common interest: Promote the use and understanding of Earth Science data.

ESIP's Education Committee includes curriculum developers, instructors, evaluators, and educators who focus on the use of Earth Science data for learning.

Two Webinars and a Workshop

Webinar 1: March 22 4 EDT	Webinar 2: April 26 4 EDT	Workshop: July 19, Durham, NC
UAVs 4 STEM Learn about real-world uses of drone technology for science and humanitarian efforts. Find out how you and your students can use recreational drones for STEM learning.	**Plan, Fly, Review: Documenting Drone Data** Get organized so you can learn something from every UAV flight. Learn best practices for documenting your flights, images, and science data.	**Test and Refine STEM Learning Activities** Fifteen successful applicants will receive a drone and a $200 stipend to test and refine activity ideas, and then use them with youth in the fall. The workshop will prepare attendees to facilitate drone-based STEM learning in clubs, classrooms, or science fair activities.

Potential Outcomes

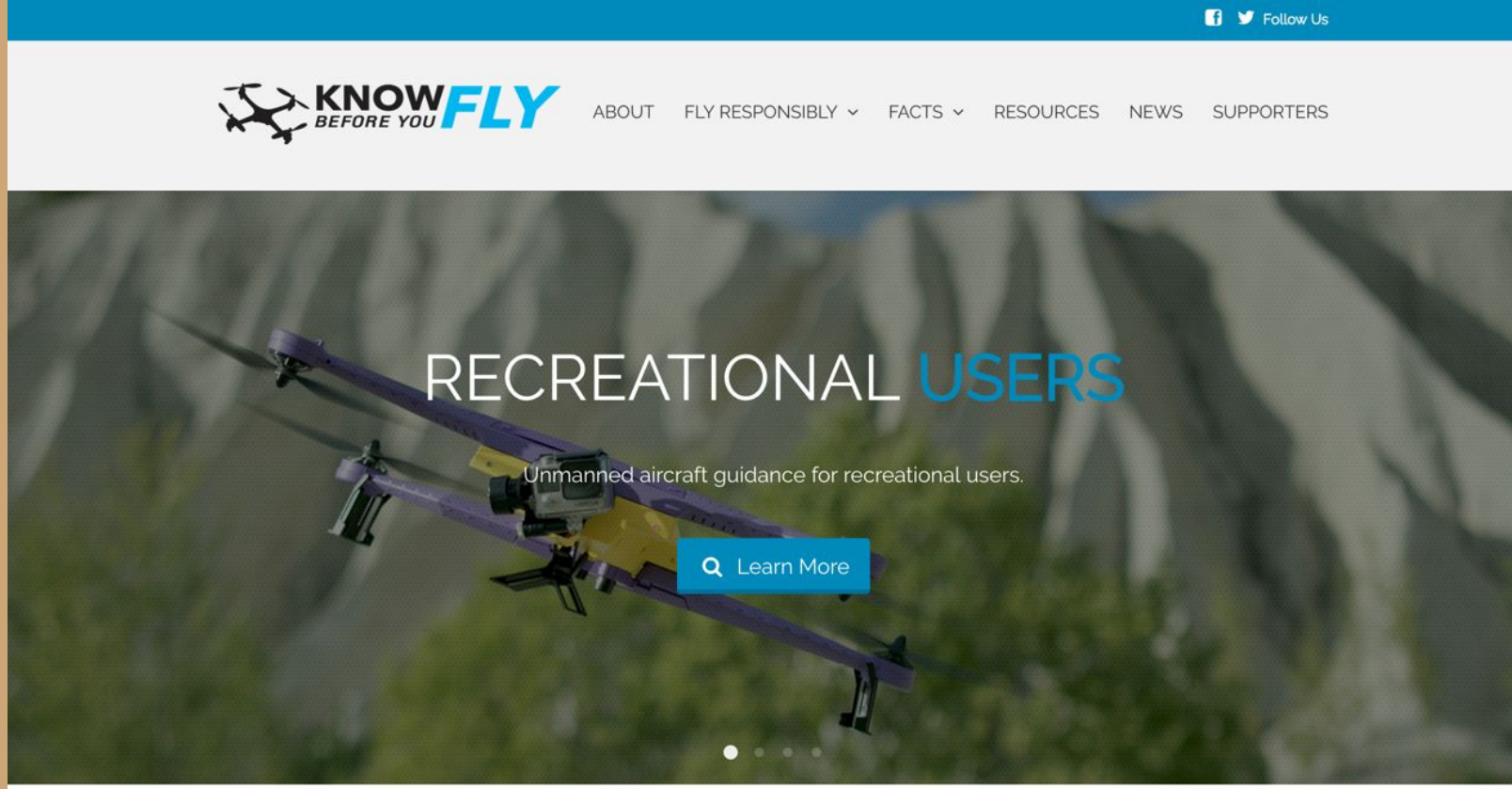
- Downloadable e-book of STEM activity suggestions for recreational drones
- Cadre of educators ready to facilitate activities and data management strategies
- Opportunities for follow-on data explorations involving other ESIP members

Clarifying what we mean by recreational drones

“Recreational drones”

- weigh less than a half pound
- do **not** need to be registered with the Federal Aviation Administration (FAA)
- usually cost less than $100
- can be considered as “toys”
- can not range beyond controller’s sight

Everyone involved in flying recreational drones should visit



http://knowbeforeyoufly.org/

Sample Activity Idea:

What payload can my UAV carry?

Materials: Set of washers or bolts
String
Balance, or a food or postal scale

Small sensors that measure environmental conditions such as temperature, air pressure, and location are becoming widely available. Can your drone carry these into flight?

Design and conduct an experiment to find a practical limit on the payload mass your UAV can carry. Consider the Sample Data Table at right: expand as necessary to capture data from multiple trials. Use graphics, videos, or photographs to document your results.

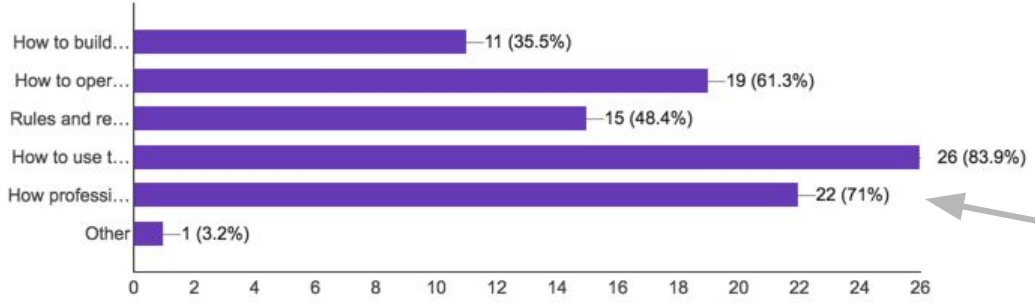
Sample Data Table

	UAV only	UAV + Payload #1	UAV + Payload #2
Mass			
Ability to launch (good, fair, poor, fail)			
Ability to maneuver (good, fair, poor, fail)			
Payload mass			

QUESTIONS RESPONSES 31

1. What topics would you be most interested in covering about drones? (Check up to three)

(31 responses)

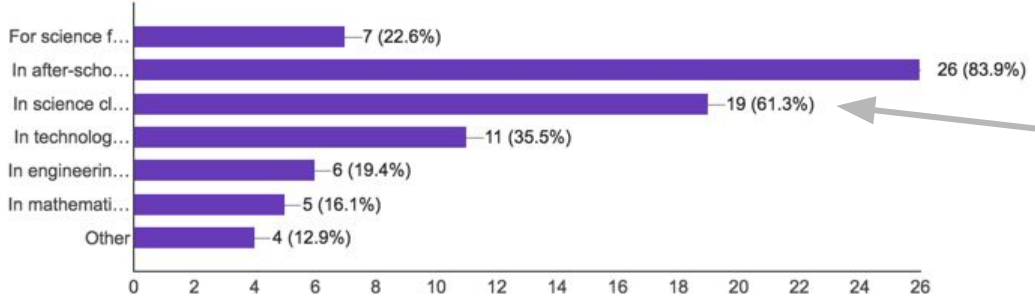


How to use them to collect images or other data

How professionals are using them in various fields

If you were going to teach about drones, in which situations would you be most likely to use them? (Check up to three)

(31 responses)



In after-school clubs

In science classes / sessions

Please respond to our 3-question survey.

Click the live link in the Chat pane of
GoToMeeting Control Panel, or type in this URL:

http://goo.gl/forms/evBbHncYvi

After you click Submit, click the See previous responses link
to see all answers

Shelley Olds

UNAVCO

Question:

STEM science & engineering: Will flying quadcopters really benefit my students? How?

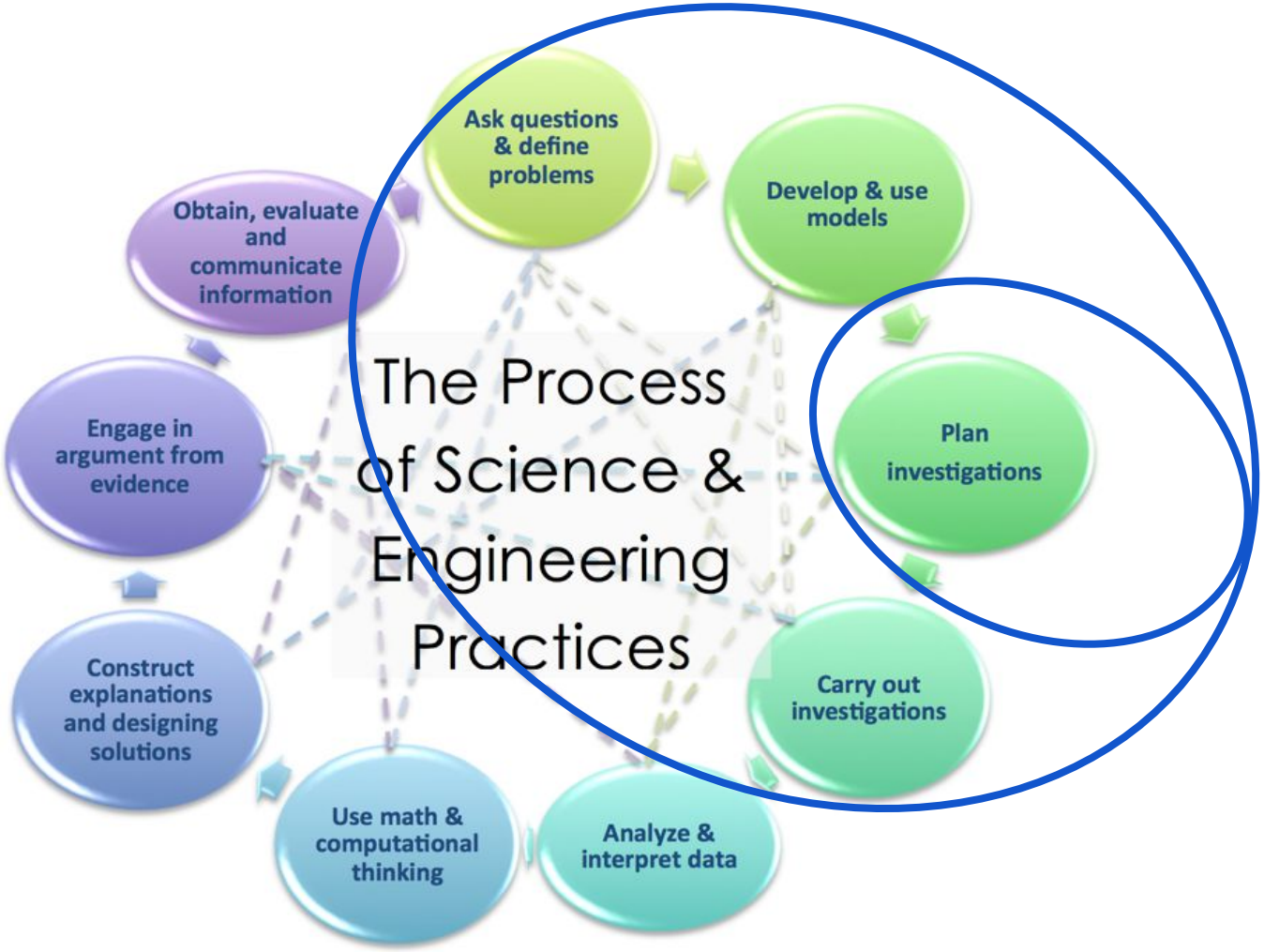
(Please share your thoughts in the chat window)

STEM science & engineering:

Will flying drones really benefit my students?

Some thoughts...

- ❏ **Experience new perspectives** and new challenges : Merges science, technology, and data science
- ❏ **Build critical thinking skills** by asking questions, brainstorming ideas, planning & carrying out investigations, analyzing & explaining the data
- ❏ **Work in a team**: each person has a role
- ❏ **Provide hands on experiences** about science and reproducibility of results - translates to abstract thinking
- ❏ **Fail safely** and l**earn from every flight**


The Process of Science & Engineering Practices
Ask questions & define problems
Develop & use models
Plan investigations
Carry out investigations
Analyze & interpret data
Use math & computational thinking
Construct explanations and designing solutions
Engage in argument from evidence
Obtain, evaluate and communicate information

Why should we plan when using a drone?

Drone cameras can generate mountains of data

Static images:

1 drone
5 minutes of flight
1 image per minute
x 20 flights

---

100 images

Drone cameras can generate mountains of data

x

Video:

1 drone
5 minutes of flight
24 frames per second
20 flights

2400 images

Before going outside: Ask questions -> Make a plan

NGSS: Ask questions and define problems

Pick a question that you want to try answering with your drone.

NGSS: Developing and using models

Draw a diagram illustrating your hypothesis.

NGSS: Planning and carrying out investigations.

What do you want to accomplish this flight session?

Before going outside: Ask questions -> Make a plan

NGSS: Ask questions and define problems

Pick a question that you want to try answering with your drone.

NGSS: Developing and using models

Draw a diagram illustrating your hypothesis.

NGSS: Planning and carrying out investigations.

What do you want to accomplish this flight session?

Where do you plan to fly?

Know Before You Fly & B4UFly

http://knowbeforeyoufly.org/

What equipment do you need?

- Safety glasses,
- Drone(s),
- Extra batteries,
- Repair kit,
- Hand-held camera, other sensors,
- Science notebook / Log-book, etc.

Science Teams:

pilot / spotter / data recorder

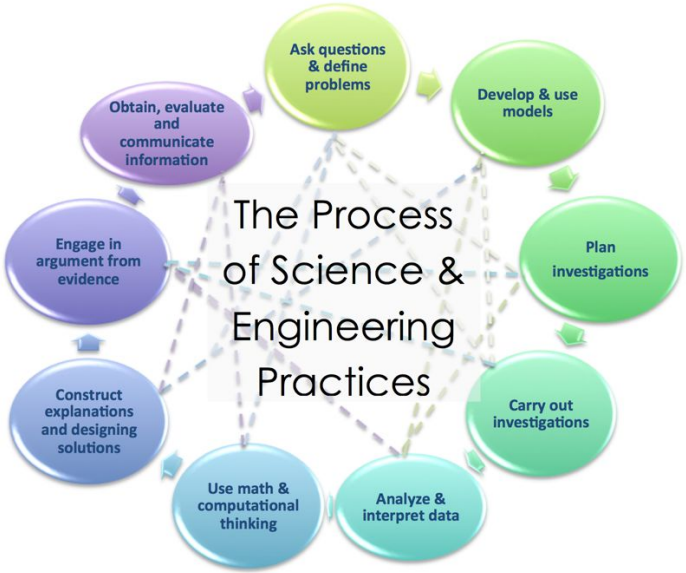
Question:

When your students conduct a science / engineering investigation, research project, what information do you always have them include?

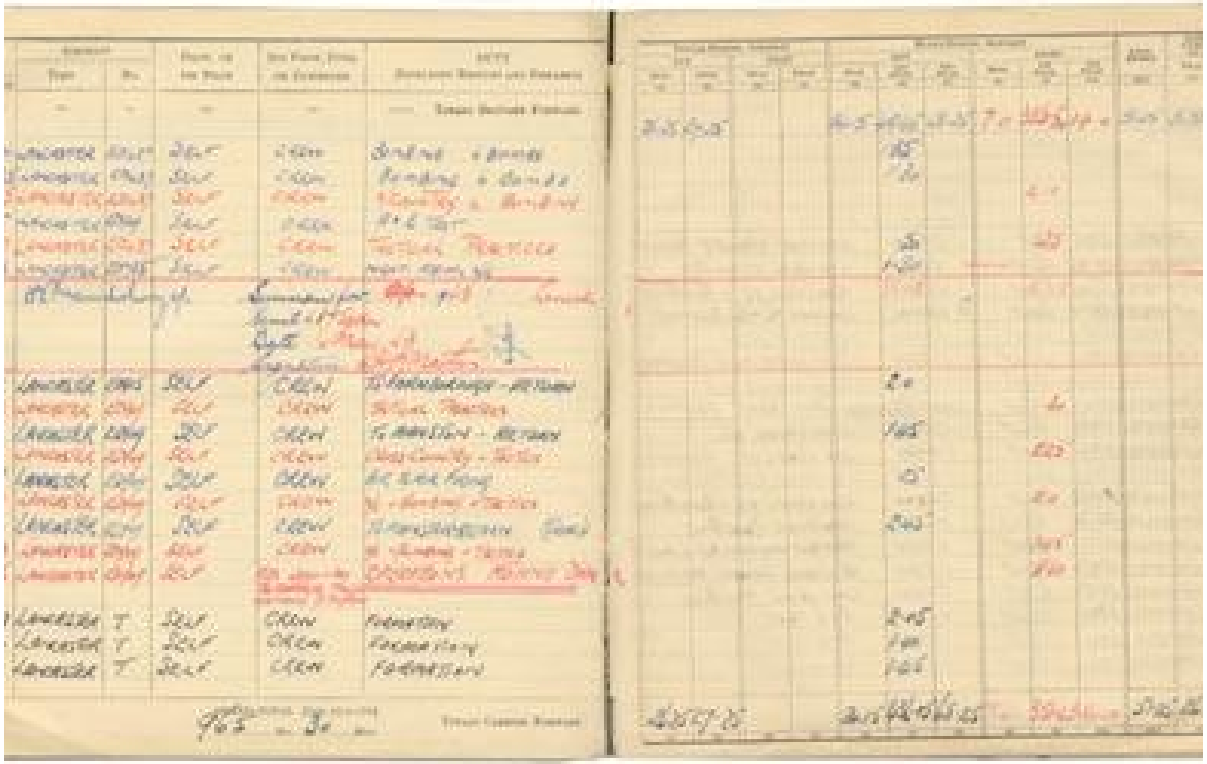
(Please respond in the chat window)

Being a scientist is …

… being able to reproduce results



The flight log book …



Information to collect: **Flight data sheet**

Session Number:

Date:

Instructor:

Location: Address/City/State , football field, south playground etc.)

Describe your site - Flat/slope? trees - shrubs

GPS location (optional): lat, long, elevation

Drone & transmitter information: Make / model / battery type & number

Weather conditions: Cloud Cover (%), Temperature, wind direction, speed, variability, sun direction, humidity (optional)

Potential dangers and plan for handling each.

Flight Number:

Time of takeoff:

Names: Pilot / Spotter / Data recorder:

Goal for this flight:

Battery number /

Flight duration:

File names / Folder name of images/video taken from ground / in-flight.

Observations:

How did flight end? (Crash/soft/etc)

Flight path / altitude description:

Sample Activity Idea: [Drone-only experiment, testing physical properties]

What payload can my UAV carry?

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Balance, or a food or postal scale

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Ability to launch (good, fair, poor, fail)			
Ability to maneuver (good, fair, poor, fail)			
Payload mass			

Information to collect: **Science data sheet**

Investigation:

What payload can my drone carry?

Equipment list for this investigation: drone, battery, washers / small weights, string, scale

Info from flight data sheet +

Trial number: Payload _____

Payload Mass:

Ability to launch (quick, slow, struggle, fail):

Ability to maneuver (good, fair, poor, fail):

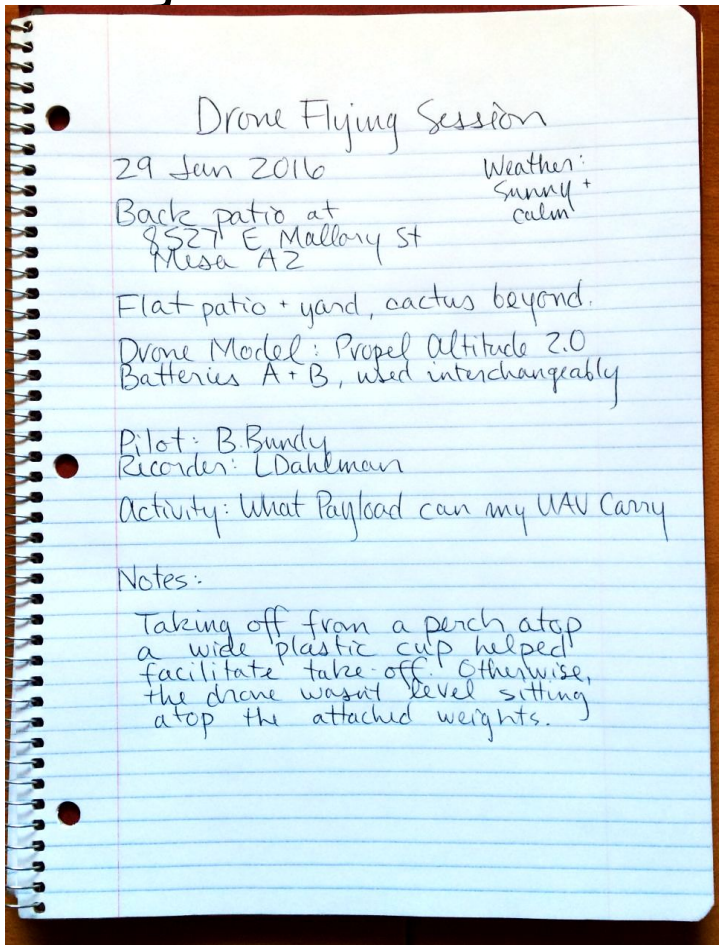
Initial measurements

Drone + battery Mass:

Ability to launch:

Maneuverability:

Flight session data



Drone Flying Session

29 Jan 2016

Weather: Sunny + calm

Back patio at
8527 E Mallory St
Mesa AZ

Flat patio + yard, cactus beyond.

Drone Model: Propel Altitude 2.0
Batteries A + B, used interchangeably

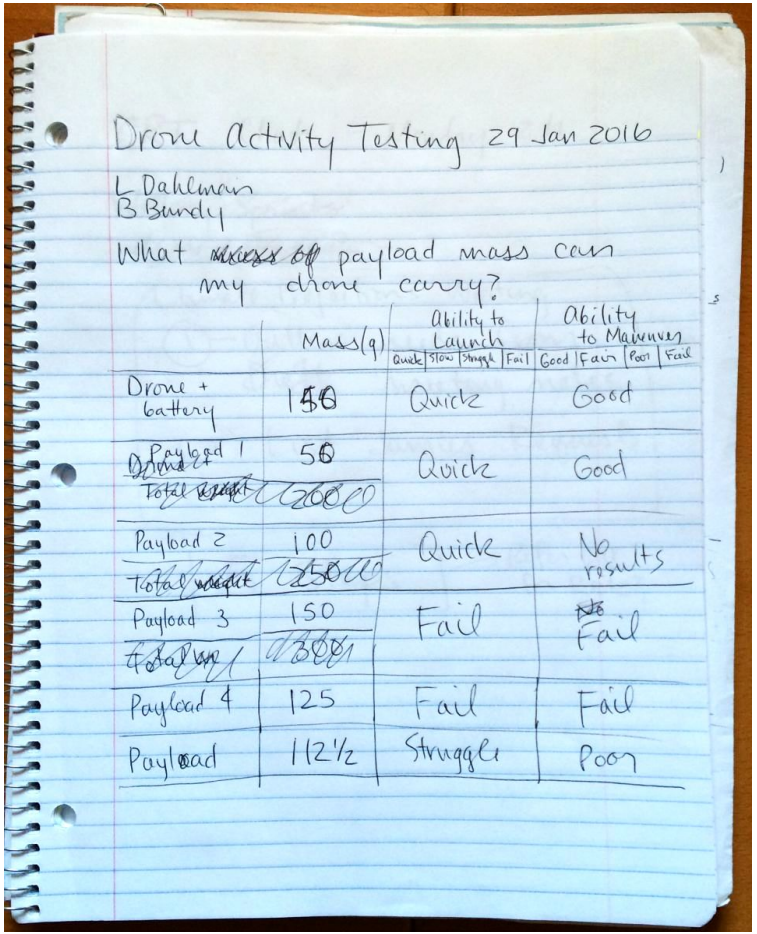
Pilot: B Bundy
Recorder: L Dahlman

Activity: What Payload can my UAV carry

Notes:

Taking off from a perch atop a wide plastic cup helped facilitate take-off. Otherwise, the drone wasn't level sitting atop the attached weights.

Science data



Drone Activity Testing 29 Jan 2016

L Dahlman
B Bundy

What ~~mass of~~ payload mass can my drone carry?

	Mass(g)	Ability to Launch				Ability to Maneuver			
		Quick	Slow	Struggle	Fail	Good	Fair	Poor	Fail
Drone + battery	~~150~~	Quick				Good			
~~Drone~~ Payload 1	50	Quick				Good			
~~Total weight~~	~~200~~								
Payload 2	100	Quick				~~No~~ results			
~~Total weight~~	~~250~~								
Payload 3	150	Fail				~~No~~ Fail			
~~Total weight~~	~~300~~								
Payload 4	125	Fail				Fail			
Payload	112½	Struggle				Poor			

The Science / Flight Team & Roles

Data Recorder Roles:

Pre-flight

- Calls out pre-flight checklist items
- Completes the Flight Datasheet

In-flight

- Reads out investigation instructions
- Fills in data collected during flight

Post-flight

- Calls out post-flight checklist

Spotter/Safety Lead Roles:

Pre-flight

- Describes weather data
- Checks surroundings for obstacles & hazards

In-flight

- Keeps drone in site
- Scans surroundings
- (optional) Reads off data to recorder

Post-flight

- Retrieve the drone.

Pilot Roles:

Pre-flight

- Checks the drone
- Checks instruments/ sensors

In-flight

- Flies the drone - follows investigation instructions from Data Recorder
- Keeps drone in site & lands safely

Post-flight

- Turns off drone, etc.

Pre-flight checklist: before every flight

Pre-flight checklist: before every flight

Data Recorder: Read this checklist aloud, asking for the confirm / data from Spotter & Pilot.

Spotter/Safety Lead:

- ❏ **Weather conditions of flying area:** (Cloud Cover (%), Temperature, wind direction, speed, variability, humidity (optional))
- ❏ **Hazards present?** (yes/no/describe)
- ❏ **Takeoff/landing area established?**

Science focused checklist: TBD by the investigation

Pilot:

- ❏ **Drone checks:** Spin your props - secured? Check for loose parts. Battery is charged & connected. (opt) Payload secured?
- ❏ **Transmitter checks:** Battery is charged, Joy-sticks work.
- ❏ **Instrument checks:** Camera: Connected to power? SD card inserted? Sufficient storage available? Other instruments?
- ❏ Other sensors & equipment: Power on? memory card inserted? Sensor working? Secured to drone? Meter-circle in place?

Before you fly

Safety - Step Back 5x5 for Safety

- ❑ **STOP**
  - ❑ Put your drone down.
- ❑ **Take 5 steps back.**
- ❑ **Look around for 5 seconds.**
  - ❑ Look behind you too!
  - ❑ IDENTIFY & ASSESS hazards, MAKE CHANGES if needed , SAFELY – complete your flight

Instructor: Data scribe - see anything? Spotter- see anything? Pilot - See anything?

Stop to address anything you see.

Instructor: Team, start your flight!

Time to Fly!

What can you learn from Drone flying experiments?

What patterns can you find in your data or metadata?

How long were you able to fly? How has this changed?

Have you crashed less often?

How have your landings changed?

What are you doing different now that has improved your flights?

What kinds of data were collected?

Sensor / Topical data:

- Environmental - Weather / ground cover
- Math - Scale w/ meter circle
- Physics - flight characteristics
- Engineering - designing & modifying

Reflection - how could you have perform this experiment from the ground? How did a different perspectives add value?

Question

Think about:

Which of the categories of activities we've suggested seem most useful for **your** teaching environment?

Categories of investigations

I) Drone physical properties experiments & data from learning to fly

II) Photos & Videos

III) Fly with purchased sensors

IV) Build your own sensors to fly/ Modify your drone

V) Program the drone (beyond our scope)

Sample Activity Idea: [Drone-only experiment, testing physical properties]

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Sample Activity Idea: (Taking photos / videos)

How can drone images enhance GLOBE's land cover classification protocol ?

Materials: UAV with camera
GLOBE's Climate and Land Cover Project

Could using images from a drone help you classify more land, or do so with greater accuracy, than the current GLOBE protocol?

1. Select a study site and gather field measurements as directed by GLOBE's Climate and Land Cover Project.
2. Modify the protocol for use with a drone, and then gather similar measurements.
3. Compare your efforts and results

Sample Comparison Chart

	GLOBE protocol	Modified Protocol
Enacted procedures		
Land area classified		
Time and Resources required		
Advantages		
Disadvantages		

Sample Activity Idea (Taking photos / videos)

How are UAV images the same as and different from Google Earth satellite images?

Materials: Google Earth image of your location
UAV with a camera

Take a close look at a satellite image of a place where you can fly your UAV. What can you see? What can't you see?

Use your UAV to take images of the area you examined: compare and contrast what you see in the two images. Prepare a graphic showing the satellite view and a UAV view of the same place, and document the qualitative and quantitative differences between them. Use a chart, a Venn diagram, and/or a graph to explain differences and similarities in the two kinds of images.

Sample Comparison Chart

	Google Earth Image	UAV Image
Extent of image (area covered)		
Smallest visible feature (spatial resolution)		
Cost to capture image		
Practical temporal resolution		
Examples of effective uses for each platform		

Sample Activity Idea

Study an object from all sides: 3D images

Materials: UAV with camera

Building 3D images of an object from photos from a drone. How can this help you make better observations?

Identify an object to study (tree etc). Make a flight plan and gather photos. Display digital images from your drone, making 3D image from overlapping images

Resources:

- https://photosynth.net - make the 3d image
- https://synthexport.codeplex.com/ - export tool

Data

	Object 1	Object 2
Is everything visible?		
Direction of image collection (Panorama, Walk, Spin, Wall)		
Planned collection path - sketch of photos to take		
Description of special photos of interest		
Number of photos + filename sequence		

Sample Activity Idea (Taking photos/ videos + analysis)

Quantifying the spatial density of saguaro cactus

Materials: UAV with camera
1-meter circle on ground (cloth or tarp)
Image Analysis Software, for example:
Digital Earth Watch (DEW)

Identify multiple sites of similar extents. Make a flight plan and gather photos of the extent of each site. Display digital images from your drone, set a distance calibration, and measure distances in the images in real-world units.

Data

	North-facing slope	South-facing slope
Flight		

Sample Activity Idea: (Flying with purchased sensors)

Land cover and temperature

Materials: UAV with camera
1-meter circle on ground (cloth or fabric)
Image Analysis Software, for example:
Digital Earth Watch (DEW)

Identify multiple sites of similar extents. Make a flight plan and gather photos of the extent of each site. Display digital images from your drone, set a distance calibration, and measure distances in the images in real-world units.

Data

	North-facing slope	South-facing slope
Flight		

Question

Which of the categories of activities we've suggested seem most useful for **your** teaching environment?

(Please respond in the chat window)

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I) Drone physical properties experiments & data from learning to fly

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III) Fly with purchased sensors

IV) Build your own sensors to fly/ Modify your drone

V) Program the drone (beyond our scope)

We've paid attention to your feedback via the chat window. We also want to give you the opportunity to provide anonymous feedback on this pair of Webinars:

Click the long link in the Chat window,
or type in this URL:

http://goo.gl/forms/ctdLcWazEY

Webinar 1:
UAVs for STEM

Webinar 2:
Plan, Fly,
Review

Are you interested in participating in our workshop
July 19
Durham, NC ?

Webinar 1: UAVs 4 STEM: Using recreational drones for learning

Slides are available (no recording)

Webinar 2: Plan, Fly, Review: Documenting Drone Data

Slides and recording will be available

Recordings and slides: https://goo.gl/sHQVc4

Thank you for attending!

Sample Activity Idea

How are UAV images the same as and different from satellite images?

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UAV with a camera

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Sample Comparison Chart

	Satellite Image	UAV Image
Extent of image (area covered)		
Smallest visible feature (spatial resolution)		
Cost to capture image		
Practical temporal resolution		
Examples of effective uses for each platform		

Investigations by complexity of resources needed

Categories of investigations

I) Drone physical properties experiments & data from learning to fly

II) Photos & Videos

III) Fly with purchased sensors

IV) Build your own sensors to fly/ Modify your drone

V) Program the drone (beyond our scope)

Time to fly!

Data scribe:

1. Call off take out list
2. Start a stopwatch (app)
3. Take notes
4. Keep an eye on the drone too

Spotter:

5. Move around so you can always see the drone.
6. Continually scan the flight and ground areas for potential hazards.

Pilot:

1. **Announce out loud – “CLEAR PROPS”.**
2. Make sure the throttle (left stick) is all the way down.
3. Turn on the transmitter.
4. Back away 3 or 4 steps (or to a safe distance).
5. Bind & calibrate drone
6. Take test photo and video
7. **Announce out loud – “TAKE OFF”.**
8. Launch drone
9. Keep facing the quadcopter the entire time.
10. Maintain a safe altitude when flying over buildings / obstacles
11. Keep a direct line of sight at all times when flying

Information to collect: example **Science data sheet**

Science data for investigation: How are UAV images the same as and different from satellite images?

Equipment list for this investigation:

Info from flight data sheet + UAV/drone image 1:

File name:

Width of meter circle 1 (in pixels):

Height of meter circle 2 (in pixels):

Area covered by photo:

Smallest visible feature:

etc.

Google Earth / Satellite image:

Satellite type:

Date of image:

Location of image: (coordinates)

File name:

Spatial resolution:

Area covered by image:

Smallest visible feature:

etc.