

# Using Recreational Drones in STEM

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Earth Science Information  
Partners (ESIP)  
Education Committee

Day 1

Unboxing your drone



Remove wires from back



Disentangle wires from legs without disturbing gears



Battery

Manual

USB Charger

Extra gears

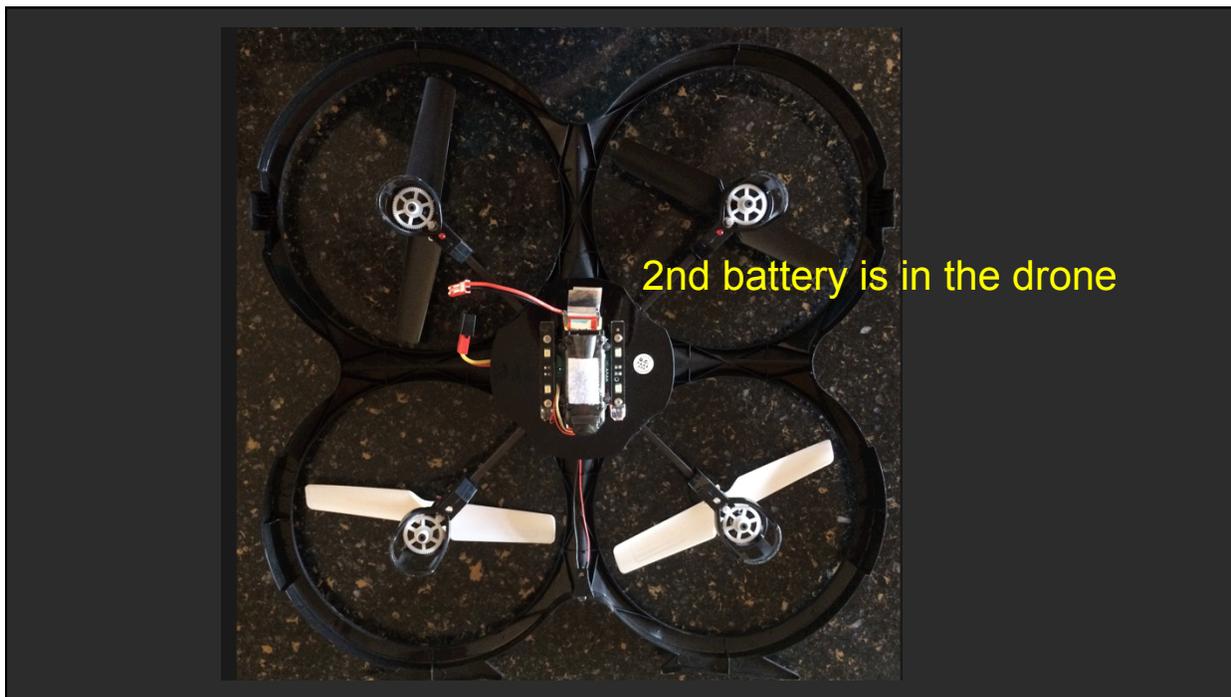
Controller

Card & reader

Extra blades

Screwdriver





**Please do all you  
can to keep your  
stuff together!!**

## Tasks before we start Ground School

- Trade your signed release form for your boxed drone.
- Put your name on your box and manual. Save all packaging.
- Put your name or initials on a sticker and place it on top of your drone.
- Install 4 AA batteries in your controller.
- Put your initials on two different colored dot stickers and place these on your two batteries.
- Use dots to label your transmitter and charger.
- Connect batteries to your charger and plug into a USB outlet.

## Safety & Civility first!

Avoid wind.

Fly only in safe places: set and observe boundaries that keep you and your drone clear of traffic and other hazards.

Be alert! Don't let enthusiasm overcome common sense.

Whenever you perceive potential dangers, stop and change the situation.

Follow the Golden Rule when choosing a location to fly.

Consider if you would (or could be concerned about seeing a drone in particular situations)

If the site of a drone is likely to disturb people or wildlife, don't fly there.

## B4U Fly Smartphone App : FAA app

### Know Before You Fly

Free for  
iOS & Android.

Check for specific restrictions in parks, near sensitive facilities, and places where you might disturb wildlife.



- Fly below 400 feet
- Keep your drone in eyesight always
- Stay clear of planes, helicopters, etc.
- Do not fly over people, wildlife, or vehicles
- Contact the airport & control tower before flying within five miles of an airport or heliport
- Check and follow all local laws and ordinances before flying

## 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!



## The Science / Flight Team & Roles

### Data Collector/ Photo Roles:

#### Pre-flight

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

#### In-flight

- Reads out investigation instructions
- Records 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
- Reads off data to Data Collector (optional)

#### Post-flight

- Checks area for hazards
- Retrieves with photo/sensor data from drone (optional)

### Pilot Roles:

#### Pre-flight

- Checks the drone
- Checks instruments/sensors attachment

#### In-flight

- Flies the drone – follows instructions from Data Collector
- Keeps drone in site & lands safely

#### Post-flight

- Turns off drone
- Retrieves drone

## Pre-flight checklist: before every flight

**Data Scribe:** 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?**

### Investigator Lead: 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:

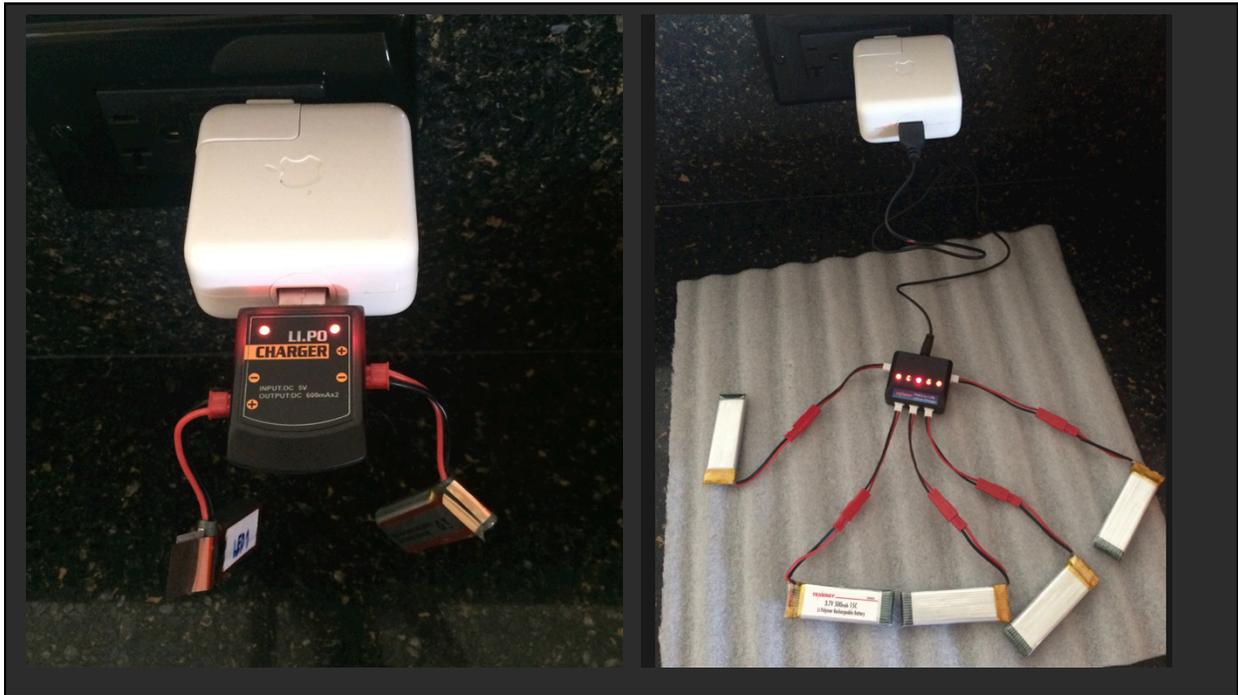
Battery is charged, Joy-sticks work.

#### Instrument checks:

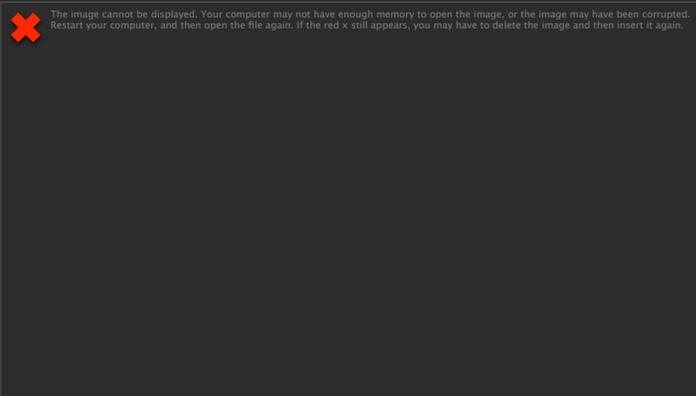
Camera: Connected to power? SD card inserted? Sufficient storage available?  
Other sensors & equipment: Power on? memory card inserted? Sensor working? Secured to drone? Meter-circle in place?

### Everyone:

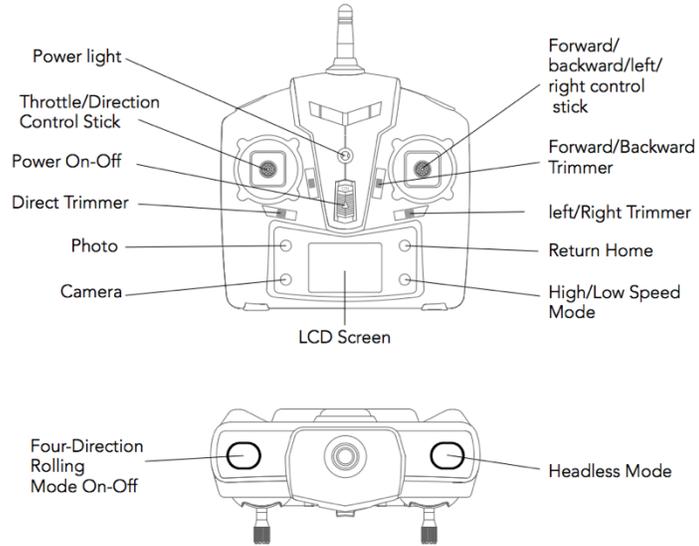
- Step back 5x5 for safety**



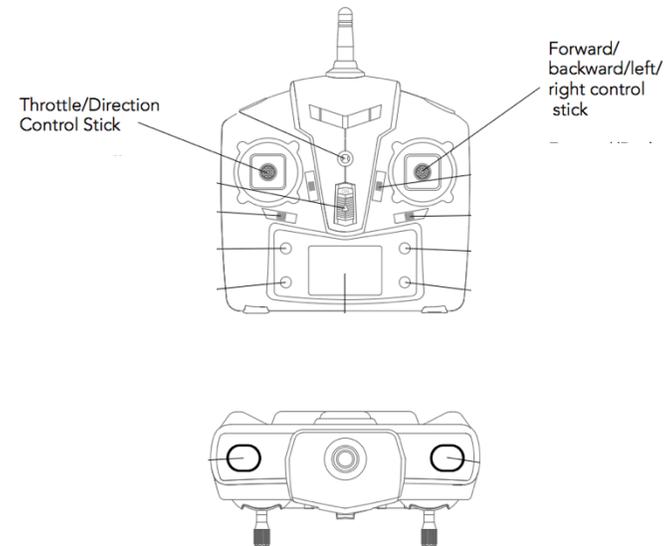
## 5-minute Ground School

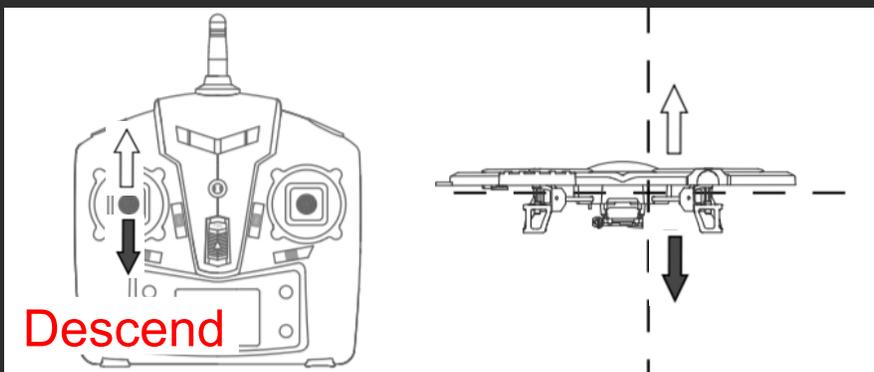
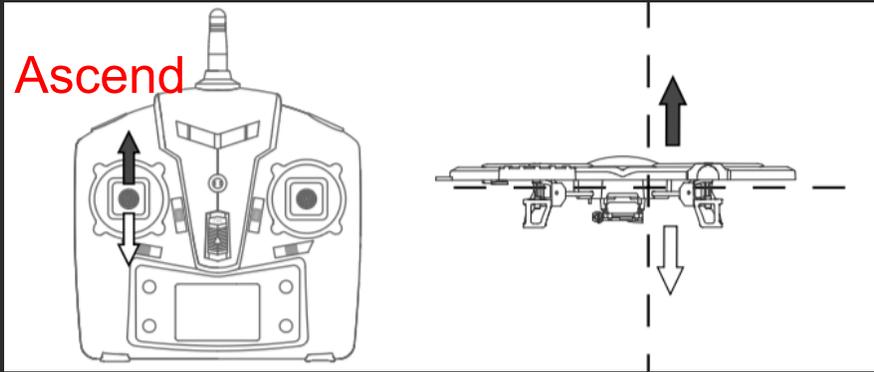


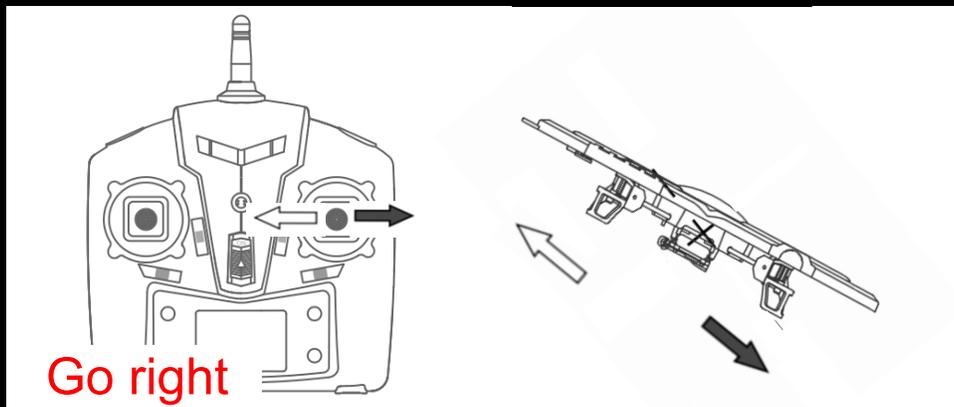
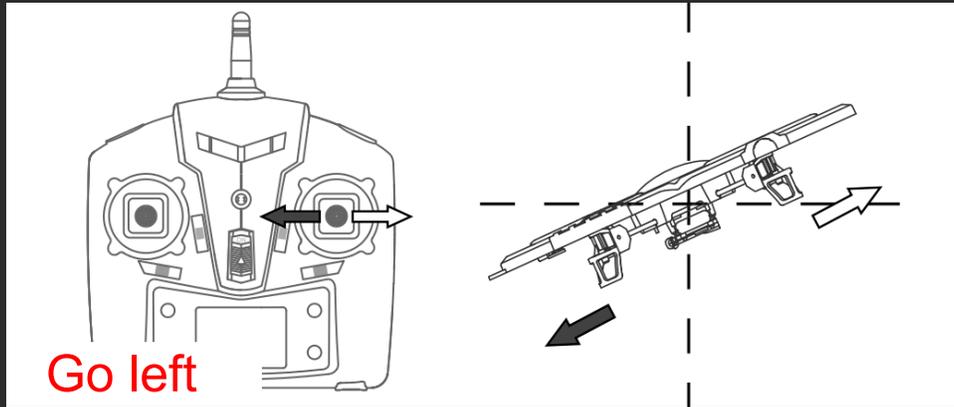
## 2. Transmitter

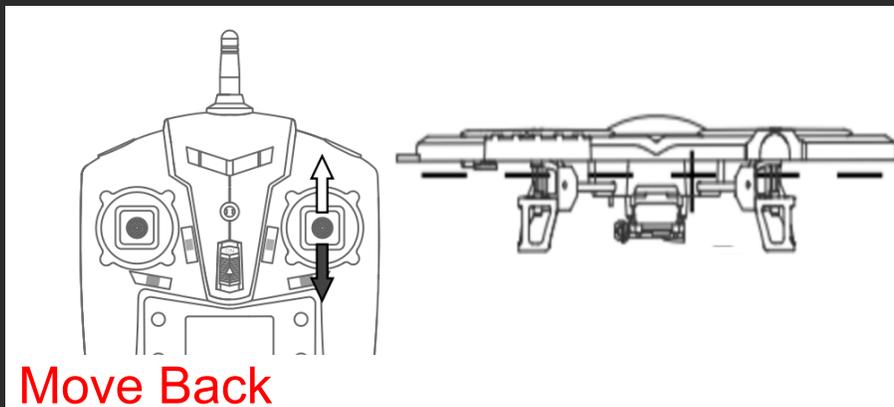
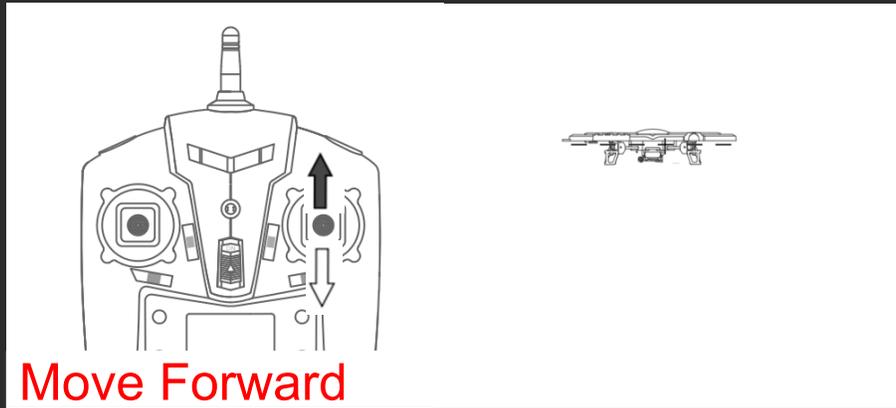


## 2. Transmitter

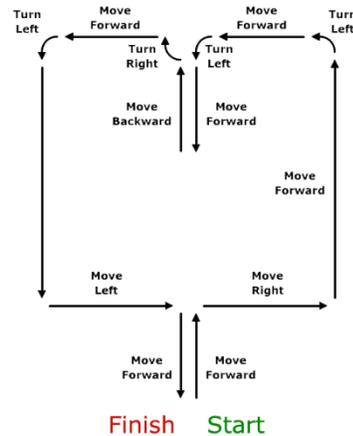








## Navigation Practice with your transmitter



1. To "Move Forward," push the **right** joystick forward, causing the Drone to pitch down. To "Move Backward," pull the right joystick back, causing the Drone to pitch up.
2. "Move Right" and "Move Left" are accomplished by moving the **right** joystick right or left, causing the Drone to **roll** right or left.
3. "Turn Right" and "Turn Left" are accomplished by moving the **left** joystick right or left, causing the Drone to **yaw** right or left.

## Pairing your transmitter and drone

From the UDI818 drone manual:

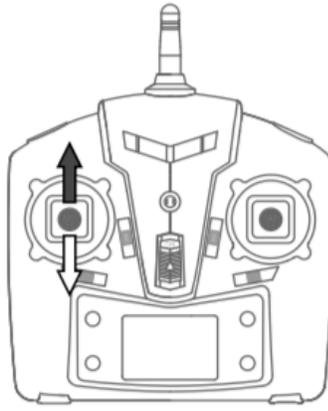
- (3) Please strictly obey the order of turn-on, turn-off before operation. When starting your flight, first turn on the transmitter, and connect power cable of quadcopter last; When finishing your flight, please disconnect the power cable of your quadcopter first, then turn off transmitter last. A change in the order of connection may cause your quadcopter to lose control and threaten your safety and others'. Please cultivate a correct habit of turn-on and turn-off.

Message:

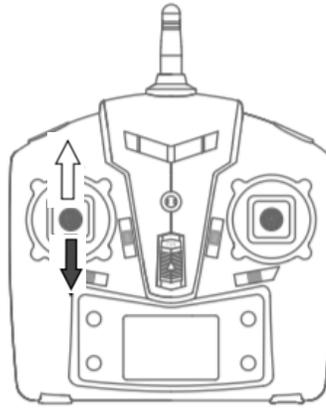
Use the transmitter to control your drone.

- Turn transmitter on first
  - Plug battery into drone
    - Place drone on level surface
    - Pair the two
    - Fly!
  - Unplug battery from drone
- Turn transmitter OFF last

1

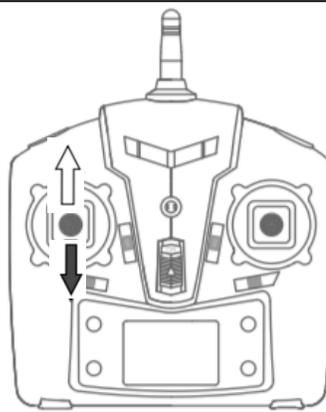
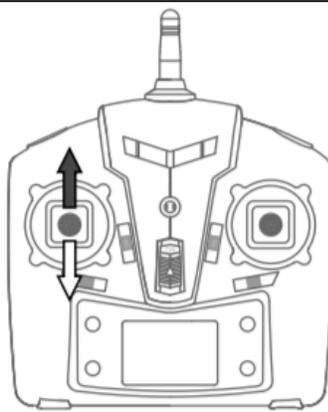


2



## Pairing the transmitter with your drone

To pair: Move the left stick all the way to top, then all the way to the bottom.  
You should hear a beep, light on the transmitter & drone will go from flashing to solid



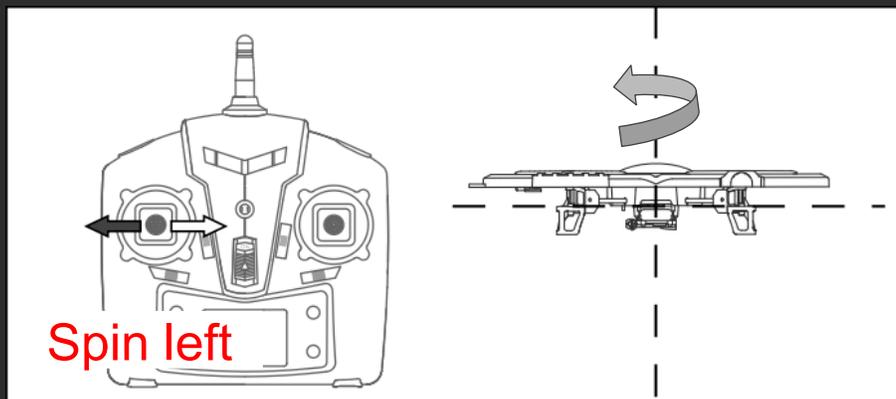
## Pairing the transmitter with your drone

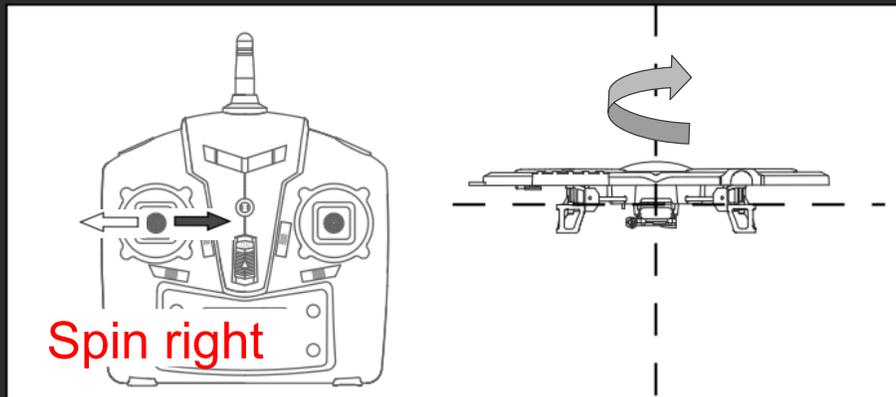
Once paired, the transmitter's flashing blue light turns steady

You're ready to fly!

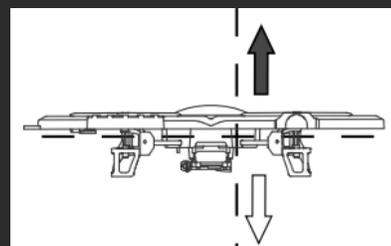
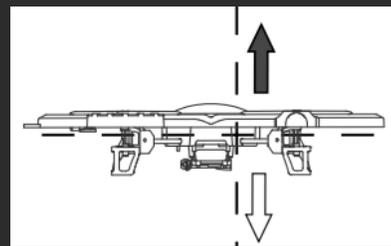
This model is fairly sensitive. Achieving a steady hover may require continual small adjustments.

And here's one more  
move you can make...  
when you're ready



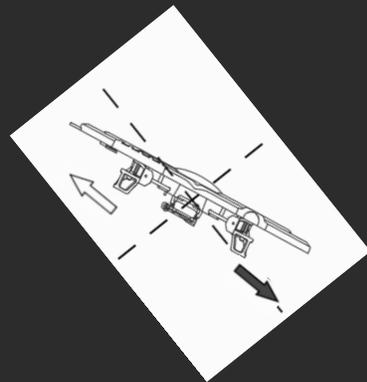
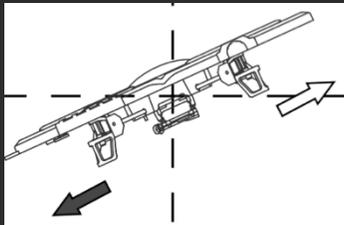


- Flying practice time!
- Take off - Hover - Land
    - Fly left - Fly right
    - Fly away - Fly back
  - Repeat until comfortable

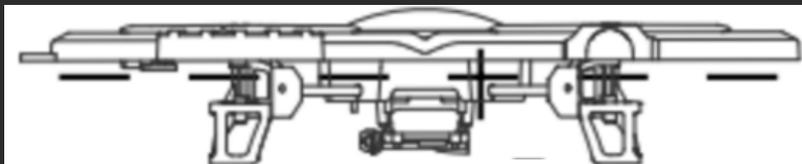
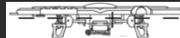


Flying practice time!

- Fly left - Fly right



- Fly away - Fly back



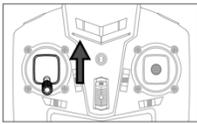
What if my drone  
won't fly straight?

Calibrate!

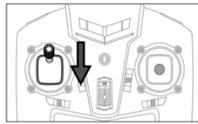
#### Calibration instructions:

When the quadcopter takes off hovering can't be adjusted by trim and causes difficult operation, then please adjust the quadcopter according to below steps:

1. Pull out the power of quadcopter, power off the transmitter;
2. Power on the transmitter, push the throttle stick to utmost and then back to lowest position.( see pic 1/2),then the transmitter is ready to code pairing.



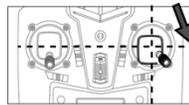
Picture 1



Picture 2

3. Power on the quadcopter and put it on a level surface, about 3 seconds later, you will hear "di,do,di ", and it shows code pairing successful.

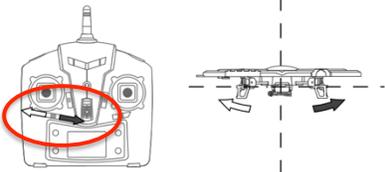
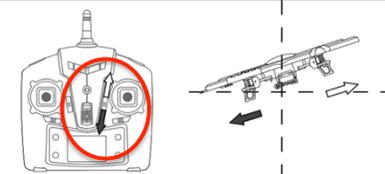
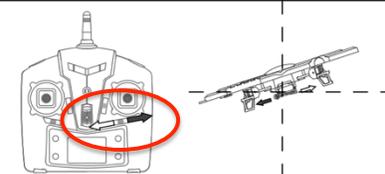
4. It's not allowed to push the throttle stick before adjustment. Operate the transmitter stick forward and backward/ left and right to the lower right corner (see pic 3), then quadcopter gets a solid light and no more flashing, it shows adjustment finished and quadcopter is ready to fly.



Picture 3

#### Calibration steps

- Turn transmitter off & unplug battery on drone.
- Turn transmitter on
- Push throttle up then down
  - Plug battery into drone
    - Place drone on level surface
    - Don't move the throttle.
    - Push right control forward and back, left and right, and into lower right corner

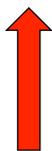
	<p>When taking off, the body head drifts to left, then adjusts right rudder trim, otherwise left rudder trim.</p>	<h2 style="margin: 0;">Adjusting Trim</h2> <p style="margin: 10px 0 0 0;">Figure out which direction the drone drifts.</p> <p style="margin: 10px 0 0 0;">In a low flight adjust the appropriate trim button.</p>
<p>5. Adjust left and right rudder trim</p> 	<p>When taking off, the body drifts forward, then adjusts backward trim, otherwise forward trim.</p>	
<p>6. Adjust forward and backward trim</p> 	<p>When taking off, the body drifts to left, then adjusts right trim, otherwise left trim.</p>	
<p>7. Left &amp; right trimmer</p>		

Set up an obstacle course

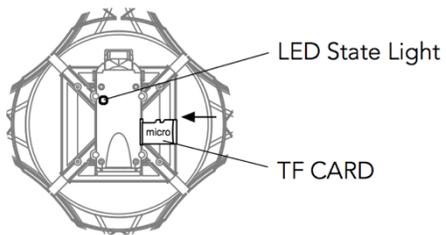
Help each other master skills

Consider how you will help learners learn  
(instructors may want to adopt a hands-off transmitters rule)

## Taking photos and videos with your drone



Front of drone  
(headlight)



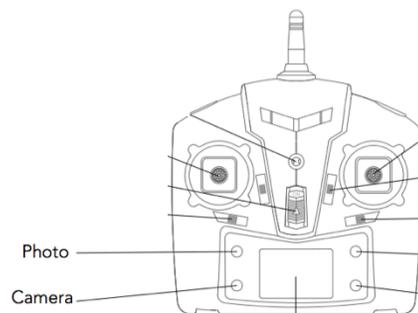
## Inserting your TF (Micro SD) card



**Inserting your TF (Micro SD) card**



**Modifying your camera to point down**



## Day 2

Start charging your batteries

Choose a group and upload photos to the participant pages:  
[http://serc.carleton.edu/earth\\_rendezvous/2017/program/  
morning\\_workshops/w4/workspace/index.html](http://serc.carleton.edu/earth_rendezvous/2017/program/morning_workshops/w4/workspace/index.html)

## 9:00 Work in small groups through a classroom-ready learning activity

*Engineering problem or activity:*

How much weight can my drone carry?

<https://scied.ucar.edu/activity/uav-test-carry-payload>

How high is my drone flying?

<https://scied.ucar.edu/activity/uav-test-altitude>

## The Science / Flight Team & Roles

### Data Collector/ Photo Roles:

#### Pre-flight

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

#### In-flight

- Reads out investigation instructions
- Records 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
- Reads off data to Data Collector (optional)

#### Post-flight

- Checks area for hazards
- Retrieves with photo/sensor data from drone (optional)

### Pilot Roles:

#### Pre-flight

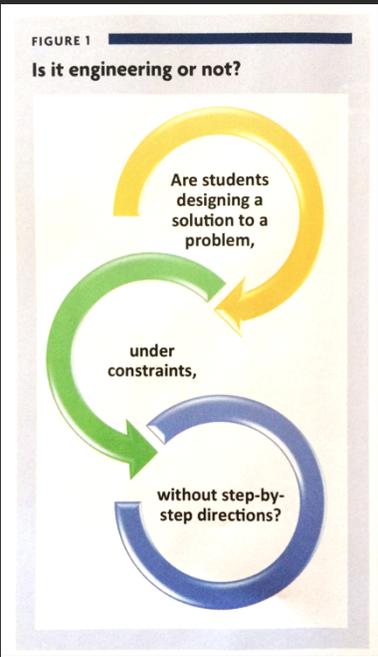
- Checks the drone
- Checks instruments/sensors attachment

#### In-flight

- Flies the drone – follows instructions from Data Collector
- Keeps drone in site & lands safely

#### Post-flight

- Turns off drone
- Retrieves drone



**FIGURE 1**  
**Is it engineering or not?**

Are students designing a solution to a problem,

under constraints,

without step-by-step directions?

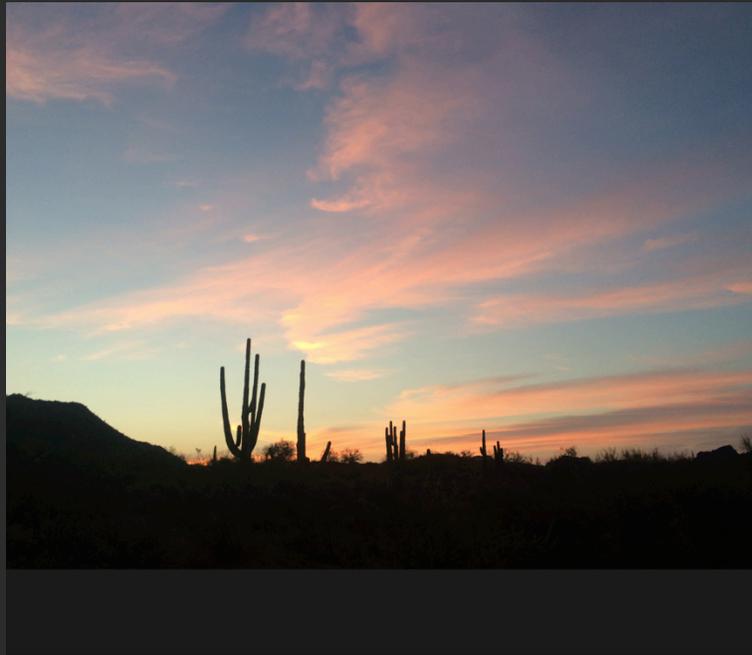
Is it Engineering or Not?  
*The Science Teacher*  
Summer 2017  
Brooke A. Whitworth and Lindsay B. Wheeler

10:00 Guest Speaker, via GoToWebinar:

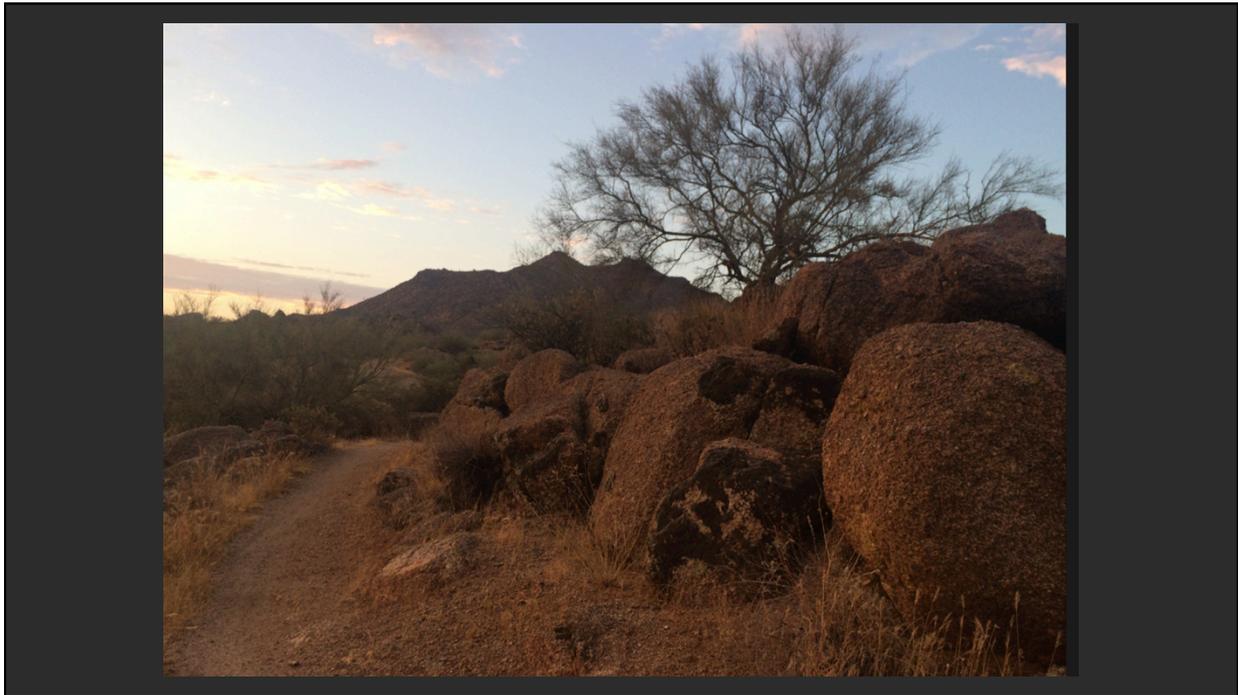
Lindsay "Bar" Barbieri,

PhD Student in Natural Resources, University of Vermont

Presentation: Drones, From First Step to Science



Measuring microclimates



Temperature Sensor

Humidity Sensor

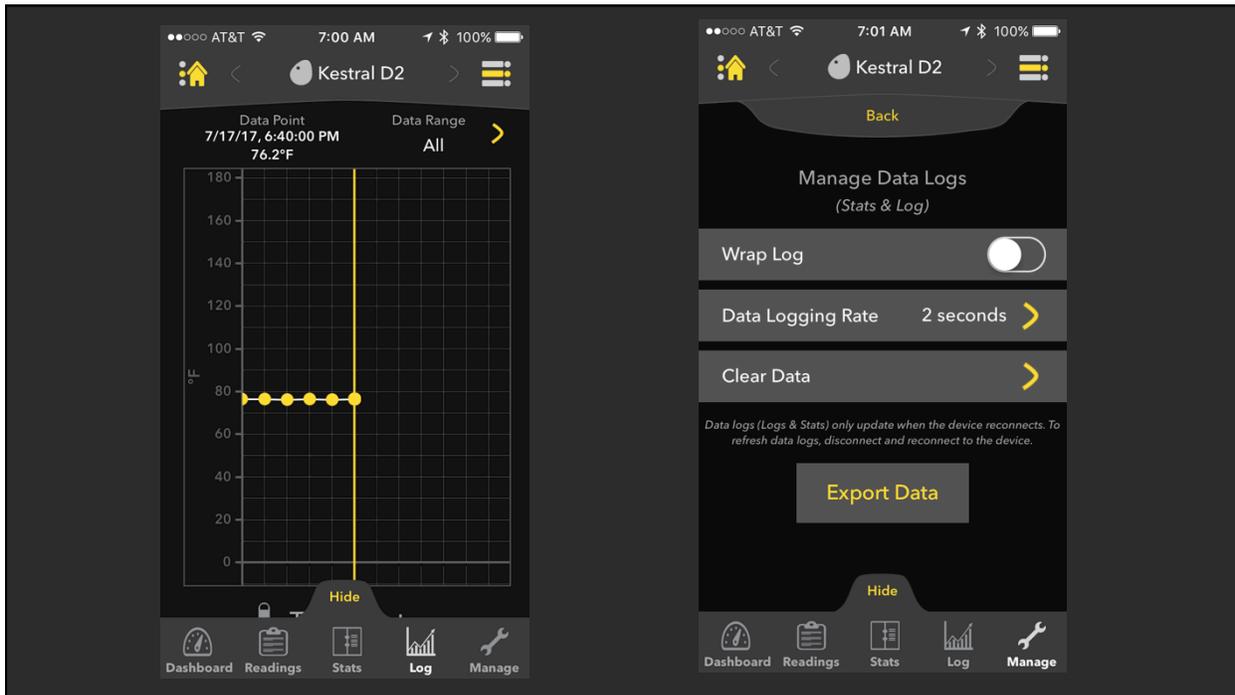
LED Location

Status Button

Readings	
Reading Date	Refresh Rate
9/2/14, 2:15:08 PM	5 seconds
Temperature	79.1°F
Relative Humidity	57.8%
Heat Stress Index	79.7°F
Dew Point	63.0°F

Hide

Dashboard Readings Stats Log Manage



## Tiny cameras:

Press On/Off for 3 seconds:  
Solid blue light = standby mode

Mode button toggles between  
Blue: 720 p video  
Blue+Red: 1080 p video  
Red: Photo

Press on/off to start and stop video or  
take a photo

When starting video, light flashes 3  
times, then goes out.



## The PocketLab: [pic.twitter.com/uDIKjxw695](https://pic.twitter.com/uDIKjxw695)

	PocketLab One	PocketLab Weather	PocketLab Voyager
Acceleration	●		●
Angular Velocity	●		●
Magnetic Field	●		●
Rangefinder			●
Altitude	●	●	●
Pressure	●	●	●
Ambient Temperature	●	●	●
Temperature Probe		●	●
Humidity		●	●
Light		●	●
Dew Point		●	●
Heat Index		●	●
Bluetooth	●	●	●
On-Board Memory		●	●
<b>Price</b>	\$98	\$98	\$148
<b>Activities</b>	70+	20+	90+



## Brainstorming: Using drones & sensors in classroom

Day 3:  
Refine / Design / Customize / Practice a  
learning activity for use with your learners

Create an Action Plan  
(you keep this, we'll take a picture of it)

## Flying with your drone - eg on a plane in the United States

Place the batteries in your CARRY ON luggage.

These are lithium ion batteries

Carry on luggage. Not checked. Not gate checked. Etc :)

Check TSA regulations before taking your drone

## Back-up slides

Resources: UAV Flight School <https://scied.ucar.edu/activity/uav-flight-school>

Resources: Learning the aerodynamics of flying

[Learning the aerodynamics of flying](#)