Course Title: Parallax Educator’s Course - Small Unmanned Aerial Vehicles/Systems (sUAS/sUAV) Systems in Education

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Prerequisites:
Basic computer skills required include installing software, connecting peripherals to a USB port, navigating between applications, and using a mouse. A steady hand for remotely operating an sUAV. No RC flying, programming or electronics experience is absolutely required, but some is definitely helpful.

Course Description:
This course will give educators the opportunity to assemble, fly, and experiment with the ELEV-8 v3 Quadcopter, a small unmanned aerial vehicle purpose-built for education. Participants will assemble a quadcopter and learn about each of its components, their composition and their function. Participants will then learn safety, legal, and ethical considerations regarding unmanned aerial vehicles, and then practice flying their quadcopters in a controlled environment. Participants will then learn about possible application-specific modifications that can be made to the ELEV-8 v3 and how it can be used as a tool to teach and use in real-world applications across different disciplines and industries.

Applicable Standards:
- CCSS ELA anchor standards for Science and Technical Subjects
- CCSS Standards for Mathematical Practice
- NGSS Standards for MS/HS Physics and Engineering & Design
- California CTE Standards:
  - Numerous standards can be met through discussion of potential applications in a large variety of fields such as agriculture, photography, geology, ecology, archeology, logistics, construction/inspection, engineering, computer science, and physics.

Primary Learning Outcomes:
Participants will be able to:
- Understand the safety concerns, laws, and ethics related to unmanned aerial vehicles.
- Assemble a small unmanned aerial vehicle (ELEV-8 v3 Quadcopter); identify and understand the function of each of its component parts.
- Understand flight dynamics including lift, drag, thrust, weight, roll, pitch, yaw, altitude, heading, speed, and acceleration.
- Safely fly and land an ELEV-8 v3 Quadcopter.
- Use the ELEV-8 Ground Station software to calibrate, configure, and monitor the ELEV-8 v3 Quadcopter.
- Use the ELEV-8 Ground Station software as a teaching tool to illustrate control systems and flight dynamics.
- Know current and potential real-world applications for unmanned aerial vehicles.
- Make simple, application specific modifications to the ELEV-8 v3 Quadcopter.
Course Materials:
Bring your own:

- Laptop computer.
  - Install the ELEV-8 Ground Station (Windows only at this time) Software and SimpleIDE (Windows, Mac, or Linux) plus required drivers.

Parallax will supply:

- ELEV-8 v3 Quadcopter Kit
- ELEV-8 Accessories:
  - Transmitter & Receiver
  - Battery
  - Battery Charger
  - Battery Bag
- Instructional Materials and curricular components (learn.parallax.com)

Course Requirements:

- Participants will complete a series of activities that will introduce and familiarize them with microcontrollers and UAV systems. In between hands-on activities, educators will participate in question & answer sessions as well as discussions about the underlying STEM concepts and how they can be taught to students.
- The written homework assignment will be described and discussed at the end of day 1, and will be due 1 week after the completion of the course.
- Grades will be based on attendance and participation (35%), successful completion of in-class activities (35%), and on a written implementation plan (30%).
- Grades are Credit/No Credit (CR or NC). Credit is equivalent to a B grade or above. Letter grades are not issued.

Evaluation Criteria for Credit:

- Attendance and participation, including in-class discussion (35%)
- Instructor appraisal of performance: successful completion of building and configuration stage (35%)
- Written paper on classroom implementation (30%) that will:
  - Describe the teacher’s audience (grade level, school and community context, class size)
    - Outline a plan for teaching physics, engineering and computer science concepts with UAVs
    - OR
    - Identify what industries and careers are available in their district’s economic region that could integrate or be aided by UAV systems
    - Outline a plan for tailoring a UAV course to those applications
  - Identify physical, human, and professional development resources available to the teacher
  - Outline a plan for managing the materials
  - Outline a plan for assessing and grading students
  - Anticipate and list potential problems that may need to be addressed
    - Special attention given to FAA laws and liability concerns for UAVs in schools
  - Articulate how students could use/apply/showcase their acquired skills beyond the classroom (competitions, maker events, science fairs, performing arts, etc.)
Schedule of topics and assignments:

- **Day 1: Introduction to UAVs**
  - Overview of the ELEV-8 v3 Quadcopter System
    - Airframe
    - Electrical system
    - Control system
  - Building the ELEV-8 v3
  - Introduction to the Ground Station Software
    - Flight physics and viewing sensor output
  - Discussion of student learning and classroom implementation
  - Description of written assignment

- **Day 2: Flight School**
  - UAV safety for operators and observers
    - KnowBeforeYouFly.org
  - Transmitter controls
    - Throttle (Thrust), Rudder (Yaw), Elevon (Pitch), Aileron (Roll), Gear (Mode), Aux (User defined)
  - Pre-flight checklists
  - Power-up procedures
  - Flight basics
  - Post-flight checklists
  - Battery charging and safe storage
  - Discussion of the written assignment - classroom implementation
    - What insights were gained after flying?

- **Day 3: UAVs in the Workforce and Community**
  - Review Laws
  - Hobby/Recreational use
  - Potential commercial applications
    - Aerial Imaging/Photography
    - Surveying/Mapping
    - Agriculture
    - Delivery/Logistics
    - Inspection
    - Search and Rescue
    - Wildlife/Biome Monitoring
    - Archaeology
    - Security and Surveillance
  - ELEV-8 v3 modification and customization
    - Camera Mounting and control
    - Lighting
    - Servo Actuator