



Navigating Mazes / Challenges with DJI Tello Drones

Grade level(s) I use with: this is primarily a 7th / 8th grade project that we introduce after they have coded both the Edison robots and the Lego EV3's. We find it is not so much a challenge of ability, as it is the crowd control aspect that makes this work well with slightly older middle school students. As an afterschool project we have done this with students as young as 4th grade, but that was with a smaller, more manageable group.

Lesson Overview:

The Tello is a great tool to introduce 3 dimensional motion to your lessons. It is safe to fly indoors (especially if you have everyone wear safety glasses and include the the propellor protector add-on) and is a dependable, fairly rugged drone that can survive the challenges of being controlled by middle school students. It also has multiple means for control, including ipad apps and the Gamesir handset - and with built-in camera it is possible for simple FPV (First Person View) experiences with a camera, simple VR goggles and the Game-Sir handset.

Typically we use the Tello's for two experiences, the first is simply an introduction to flight and basic aerodynamic principles having students control the drones by remote. This also includes a full day on safety and our "air traffic control system" including our red, green, white light system and appropriate safety zones within the airspace. Careful classroom management is critical, and if possible I will have a second adult or responsible older student join the class and serve as primary Air Traffic Control manager - providing guidance, direction and feedback as needed. These flights are simple out, land and back and typically are done with partners where one is the flight safety officer for the pair, then they switch. Tello batteries typically can provide about 8-10 minutes of flight time, so a big supply of batteries and a student accessible charging system are also important to keep everyone in the air.

The next day we will introduce a maze we have created made of hanging foam tubes, standing PVC "pylons" and board mounted hoola hoops. I find labeling each one with a letter allows for better flight management and can assure that mid-air collisions are minimal. It is important to

train students that they can't enter the flight zones to retrieve a downed drone after any collision - this also helps them become much more careful in their obstacle avoidance since they become spectators while their peers are still flying. If a group masters this, I really like to have the flight safety officer become the eyes and either blindfold or have the control pilot close their eyes. This is both a great team-building activity but also really helps to learn the subtle feel of the controls for the drone. I once tried speed races but wasn't my best decision and after replacing lots of broken props from collisions abandoned that idea :-)



Our last activity is usually a coding activity simulating dropping off fire suppressant over a forest fire or delivering supplies after a natural disaster of some kind. We 3D printed this design from Thingiverse:

<https://www.thingiverse.com/thing:3505986> that is designed to hold an egg or other small object - we use small lego blocks to limit the weight and size. Their task is to create a code that can navigate a small maze or one low hoop and one high and then drop the lego piece a bucket before returning to their starting base. We fly it first by remote control, which is difficult on it's own, and then we code using scratch on the

droneblocks app on our ipads. Usually takes about 10 trials to be successful but really satisfying to watch kids finally get teh drop and return.

Materials and equipment I use:

DJI Tello Drones:

<https://www.amazon.com/Tello-Quadcopter-Drone-Beginners-Camera/dp/B0BKB53T3Z>

Extra batteries and charger:

<https://www.amazon.com/Gifi-power-Battery-Compatible-Batteries/dp/B09SY1G94Z>

Gamesir Tello remote control handset:

https://www.amazon.com/Game-sir-Controller-Joystick-CP-PT-00000220-01/dp/B07CPFL5SK/ref=sr_1_12?crd=1D6HF1N6K1382&keywords=dji+tello&qid=1698513519&srefix=dji+tello%2Caps%2C100&sr=8-12

Related links:

AIAA(American Institute of Aeronautics and Astronautics) Classroom Grants - this project initially got “off the ground” thanks to a generous grant <https://www.aiaa.org/get-involved/educators/Classroom-Grants> These are available to teachers nationwide, and AIAA also provides access, in cooperation with Challenger Learning Centers to other STEM related curriculum. Definitely worth checking out!

Australia-based Drone Education Superstars - <https://shemaps.com/> Shemaps has been my go-to resource for learning how to safely incorporate the Tello drones into my classroom. They have a wealth of teacher-focused curriculum and plans that are tested in classrooms all over Australia. They also offer consulting and support around all aspects of drone education and incorporating GIS / drone integration ideas into your curriculum.

Ongoing questions and ideas for the future: the biggest challenges I find are having a safe, dedicated space where a large group of students (up to 20 at one time) can have a great flying experience. A gymnasium is perfect and that is what I use afterschool, but flying them in a classroom with all the “stuff” is really challenging especially for beginners. There also is a fairly steep technology learning curve to get all the pieces of technology to work together smoothly and not interfere - I would love to incorporate more <https://droneblocks.io/> which is another really rich coding / control platform but haven’t found the time to justify the initial cost of testing everything out.