**MINI DRONES UNIT PLAN**

**Teacher: Date:**

**School:**

**Lesson Topic:**

3D Design and Fabrication of Mini Drones

**Background:**

As society places more emphasis on engineering, students should be introduced to the critical concepts that encompass engineering. 3D printing is a relatively new and exciting technology that has increased in popularity within recent years. If expert predictions are correct, every household could have a 3D printer within the next 10 years. 3D printers also demonstrate a unique process which quickly exemplifies the transition from design to reality.

**Standards:**

* ITEEA STL #3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
* ITEEA STL #4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.
* ITEEA STL #8: Students will develop an understanding of the attributes of design.
* ITEEA STL #9: Students will develop an understanding of engineering design.
* ITEEA STL #10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
* ITEEA STL #11: Students will develop the abilities to apply the design process.
* ITEEA STL #16: Students will develop an understanding of and be able to select and use energy and power technologies.
* ITEEA STL #18: Students will develop an understanding of and be able to select and use transportation technologies.
* ITEEA STL #19: Students will develop an understanding of and be able to select and use manufacturing technologies.
* NGSS 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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**Objectives:**

Students will be able to:

* Identify safety procedures for using drones or unmanned aviation vehicles (UAV).
* Compare and contrast the benefits and consequences of using drones.
* Design a drone within specific constraints utilizing 3D modeling software.
* Describe additive manufacturing processes such as 3D printing.
* Apply the Engineering Design Process to design, fabricate, and test an operational drone.
* Identify electronic components and solder them to produce a functional drone.
* Examine math and science concepts related to flight.

**Materials:**

* 3D printer and design software.
* 3D printed chassis and battery clip. Files can be downloaded from: http://www.thingiverse.com/thing:681232
* 1x Radio transmitter: Hubsan H107C-19 4-Channel 2.4GHz [$24]
* 1x Radio receiver+flight control: Hubsan H107-A34 [$19]
* 4x Motors: Hubsan 7x20mm (2x CW, 2x CCW) for H107L [$7]
* 4x LED: Hubsan H107L & H107C LED (2x Red, 2x Blue, 3mm diameter) [$6]
* 4x Propellers: Hubsan H107-A02-PRO (2x TypeA, 2x TypeB) [$2]
* 1x Battery: HUBSAN HS-H107-A24 3.7V 380mAh Li-Po Battery [$9]
* 1x Charger: Hubsan 3.7V Usb Charger [$2]
* 2x screws: Hubsan Part H107-A07 Screw set [$2]
* Total cost (without transmitter): $47
* \*Retrieved from: http://www.instructables.com/id/Super-Light-Quadcopter/?ALLSTEPS

**Engage:** (1 day)

Demonstrate a working mini drone or show a video of one that is similar. Ask students what they know about drones and other UAVs.

**Explore:** (3 days)

Assign students to research designs of structures, materials, and drones. They will be prompted to examine all attributes needed to design a successful drone (weight, balance). Students will then brainstorm some initial designs from their research. Additionally they will research the real world applications of drones and UAVs. Lastly, students will prepare a presentation of their findings for the class.

**Explain:** (1 day)

The instructor will facilitate a class discussion centered around content from student presentations related to drone laws, regulations and ethical impacts, real world drone applications, design attributes, materials, and other critical information needed for the design challenge. Hartman and Bland (2016) and the FAA are sources that will be used to discuss laws and regulations <http://www.faa.gov/>.

**Extend:** (2 weeks)

Students will first be introduced to the design challenge criteria. Following the brainstorming of multiple drone designs, the instructor will demonstrate how to use the desired 3D modeling software, including the assembly of multiple parts and converting a design into an STL file to 3D print. Students will then be given time to design a drone meeting the design brief constraints using desired 3D modeling software.

The design phase may take longer than expected based upon students’ experience with the 3D modeling software and the number of 3D printers available. Once printed, students will extend their knowledge by soldering the proper components together and testing their designs. It is important to follow all safety policies and establish flight procedures prior to any testing (see Hartman and Bland, 2016). Students will be encouraged to test and redesign for optimal drone flight performance. As students test their drone they will collect data to calculate variables such as lift and acceleration (see Maley, 1984).

**Evaluate:**

After each drone has been flown, students will be formatively assessed through a class discussion about what they observed and what they would change if they did this unit again. Additionally students will be prompted to discuss the feasible applications of drones in the future. All calculations and 3D modeling designs will be submitted and assessed for accuracy. The Evaluation Metric criteria from Sutton, Busby, and Kelly (2016) will be used to evaluate the finished drone.

**References:**

Hartman, C., & Bland, G. (2016). Aviation practices for safer drone flights: Understanding and mitigating the risks. *Technology and Engineering Teacher, 76*(2), 13-15.

Maley, D. (1984). *Math/science/technology projects for the technology teacher*. Reston, VA: ITEA. Retrieved from https://www.umes.edu/Tech/Maley1984MathScienceTech.pdf

Sutton, K. G, Busby, J. R., & Kelly, D. P. (2016). Multicopter design challenge: Design, fly, and learn. *Technology and Engineering Teacher, 76*(2), 8-12.