AOPA 10th Grade Aviation STEM Curriculum Materials – Semester 2

Unit 7 – Propulsion

- **Unit 7.A Lesson 1 – Reciprocating Engines**

  **Build a Stirling Engine**
  - 1 - Glass test tube, preferably 20 x 200mm (20 x 150mm may be substituted, if needed)
  - 1 - Rubber test tube stopper with a hole in it
  - 6 - Glass marbles to fit in the test tube (Note: They don’t have to fit perfectly, as they are used for ballast.)
  - Two-sided tape
  - 1 - Glass Syringe, 5ml (Note: Using glass is essential.)
  - 1 - Wood pencil with graphite lead
  - 1 - Sterno (Note: A tea candle may be substituted, but may not provide enough heat.)
  - 1 - Block of wood, approximately 6” x 3”
  - 1 - Piece of clear acrylic tubing, 3” in length and measuring 9/32” OD x 5/32” ID
  - 1 - Wire pant hanger, approximately 12” long (Note: Dry cleaner hangers work perfectly.)
  - Pliers
  - Ruler


  **Venturi Model Activity (per group)**
  - Clear vinyl tubing 5/8” outside dimension, 1/2” inside dimension
  - Two stainless steel adjustable hose clamps, 5/8” or larger
  - Glass of water
  - Screwdriver
  - Coffee straw/stirrer (smallest straw you can find)
  - Utility knife
  - Ruler
  - Awl or tool to create a hole in the tubing (as small as the straw)

Updated 7.20.21
**Unit 7.A Lesson 4 – The Power Cycle – Combustion and Exhaust**

*Air or Water? Activity (per group)*
- Two small cups
- Two large cups (such that the small cups fit into the larger ones)
- Hot water
- Water at room temperature (may dye with food coloring)
- Two thermometers
- Stopwatch

**Unit 7.A Lesson 5 – Turbochargers and Superchargers**

*Air for Ignition Demonstration*
- Lighter
- Candle that can stand on its own (votive, tea light, or pillar candles work well)
- Clear glass container large enough to completely cover the candle without touching the wick (A glass, jar, or vase will work well)
- Tongs or a hot pad that will allow the glass container to be placed over the candle and removed without burning the demonstrator
- Safety goggles

**Unit 7.C Lesson 1 – UAS Engines and Fuel**

*Build a DC Motor Activity (per group)*
- Sandpaper
- Magnet
- Two (2) alligator clip electrical connections
- Wire cutters
- Drill with a 1/16 drill bit
- Two (2) paper clips
- Screwdriver with a thin shaft
- One (1) 12-inch piece of 20 gauge magnet wire
- One (1) AA battery (larger batteries such as C or D cells also work)
- Block of wood (recommend a 6-inch length of 2 x 4)
Unit 8 – Airframe Systems

- **Unit 8.A Lesson 2 – Electrical Systems**

  **Build a Model Electrical System (per group)**
  - Ten (10) alligator leads
  - One (1) sheet of florist foam (approximately 1” x 12” x 18”)
  - Seven (7) greening pins (or similar metal pin; metal must be exposed or insulation removed)
  - Three (3) 2”-long pieces of 12 gauge (or thinner) solid copper wire
  - One (1) small electric drone motor (with propeller)
  - Two (2) LED bulbs
  - Two (2) AA batteries
  - Battery holder with leads for two AA batteries
  - Multimeter capable of reading 2000u amp

- **Unit 8.A Lesson 3 – Hydraulics and Landing Gear**

  **Syringe Hydraulics Activity (per group)**
  - 2 plastic syringes
  - Plastic tubing of a size to fit snugly on the syringe nozzle
  - Colored water

  **Build a Hydraulic System Activity (per group)**
  - 2 plastic syringes
  - Plastic tubing of a size to fit snugly on the syringe nozzle
  - Colored water
  - Cardboard
  - 8 thick popsicle sticks
  - 8 small dowel rods
  - 16 beads that fit on the dowel rods
  - 8 plastic straws, cut down to fit
  - Needle or drill
  - Hot glue gun and glue sticks
  - Scissors

  **Hydraulic Car Jack Demonstration (Optional)**
  - Hydraulic car jack
  - Something heavy to lift (cinder blocks or a box of books)

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**Unit 8.B Lesson 2 – Anti-Icing Systems**

**Ice in Flight (per group)**
-2 small, inexpensive model gliders, foam or balsa wood will work  
-water  
-sink sprayer or water bottle  
-access to a freezer  
-a scale  

**Deice, Ice Baby (per group)**
-4 large ice cubes  
-3 bowls  
-water  
-glycol or antifreeze  
-plate  
-moderately heated surface, such as coffee warmer, candle warmer, or crockpot

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**Unit 9 – Avionics and Flight Instruments**

- **Unit 9.A Lesson 1 – Altimeter and VSI**
  
  **Flight Simulation Activity**
  
  -Flight simulator capable of inputting different altimeter settings

- **Unit 9.A Lesson 2 – Airspeed Indicator**
  
  **Balloon Warm-Up Demonstration**
  
  -One (1) latex balloon per student  

  **Flight Simulation Activity**
  
  -Flight simulation equipment
**Unit 9.B Lesson 1 – Gyroscopic Instruments**

Make a Bottle Gyroscope (per student or group)
- 2 plastic soda bottles (1–2 liters) with smooth sides
- Sharp knife or scissors for cutting the bottle
- Cutting surface
- Electrical tape
- Ruler
- Safety glasses

Flight Simulation Activity
- Flight simulator capable of simulating failures of gyroscopic instruments
- Stopwatch

**Unit 9.B Lesson 2 – The Magnetic Compass**

**Warm-Up**
- Several magnetic compasses (1 per group)
- Several handheld magnets (1 per group)

**Induce Compass Errors**
- Sealed magnetic compass (1 per group) (can reuse from Warm-Up)

Flight Simulation Activity
- Flight simulator with magnetic compass
- Stopwatch or timing device

**Unit 9.C Lesson 1 – Electronic Flight Displays**

Flight Simulation Activity: Electronic Flight Displays Student Activity 2 (optional)
- Flight simulator capable of displaying both analog and electronic flight instruments
- Clock, timer, or stopwatch
Unit 10 – Required Documentation

● Unit 10.A Lesson 3 – Inspections

Inspections Student Activity 4
- Cessna 172 Skyhawk Sample Preflight Inspection Checklist; samples can be found online, including at http://www.freechecklists.net/ or purchased through Amazon ($9) or any pilot supply shop

Flight Simulation Activity (optional)
- Flight simulation software with add-on for walkaround preflight inspection, such as X-Plane Cessna 172SP Skyhawk, designed by AirfoilLabs ($34.95)
  https://store.x-plane.org/Cessna-172SP-Skyhawk_p_401.html#tab-1

Unit 11 – End of Semester Project and Career Development

● Unit 11.A Lesson 1 – Design an Airplane

Formative Assessment
- Poster board
- Poster-making supplies (e.g., markers, colored pencils, construction paper, tape, glue)