



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

- *Unit 7.A Lesson 3 – The Power Cycle – Intake Systems*

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)

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MATERIALS LIST



- *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)

MATERIALS LIST



- *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

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

MATERIALS LIST



- *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)