



AOPA 10th Grade Aviation STEM Curriculum Materials – Semester 1

Materials needed throughout the semester (included in 4 lessons)

- Poster board or rolled paper
- Markers
- Scissors
- Paperclips
- Post-it notes
- Clear tape

Unit 2 – How Aircraft Are Made

- *Unit 2.A Lesson 1 – Manned Aircraft Components*

- Modeling an Airplane's Components (per student)

- Cardboard
 - Paper towel or toilet paper rolls
 - Scissors
 - Tape or Glue
 - Markers

- *Unit 2.A Lesson 2 – Unmanned Aircraft Components*

- Drone Flying Activity (one per class)

- Drone options for the classroom
 - Tello Quadcopter Drone- \$99 (Amazon)
 - SYMA X5C 2.4G 6 Axis Gyro HD Camera RC Quadcopter with 2.0MP Camera- \$36 (Amazon)
 - DROCON Drone For Beginners X708W Wi-Fi FPV Training Quadcopter With HD Camera - \$80 (Amazon)

- *Unit 2.B Lesson 1 – Aircraft Structural Materials*

- Build-A-Plane Activity

- Rolled paper or poster board
 - Markers

MATERIALS LIST



- *Unit 2.B Lesson 2 – Aircraft Safety Features*

Propose A New Safety Innovation Activity (per team)

- Poster board
 - Markers
 - Post-it notes
-

Unit 3 – Understanding Air

- *Unit 3.A Lesson 1 – Air is a Fluid*

Honey Demonstration (per class)

- Two jars of honey
- One or two large bowls

Viscosity Activity (per group)

- One marker
- One basin to catch fluids; the basin should be wide enough to hold the incline
- Vertical Support for incline (such as stack of books or a clamp and stand)
- One stopwatch
- Three different inclines, each approximately 15 cm wide x 50 cm long
 - One of the inclines should have a smooth surface, such as glass
 - One incline should mimic the smooth aluminum metal of airplanes (e.g. a sheet of aluminum from hardware store)
 - Other materials to consider include wood, sandpaper, aluminum foil, velcro, or plastic wrap
- Four different fluids for students to test (e.g. water, glue, syrup, oil)
- Four 100 mL beakers (or other small containers such as paper or plastic cups)

Honey Demonstration (per class)

- Strip of paper approximately 5 cm x 25 cm. The paper should not be too flimsy as it needs to hold a convex shape.
- Two paper, plastic, or foam cups
- Tape or glue
- Four long rubber bands

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM

MATERIALS LIST



- *Unit 3.A Lesson 2 – Air Density*

Visualizing Density Demonstration (per class)

- Balance scale
- Metal counterweights
- Styrofoam cube or slab, at least 4 x 4 x 2 inches
- Large glass or clear plastic jar, at least 8 inches high (e.g. an empty pickle jar)
- Rocks of such a size to be able to fill the jar with 4 or 5 of them
- Small pebbles or river rocks (enough to fill the space between the larger rocks)
- Sand (enough to fill the space between the pebbles)
- Water (to fill the rest of the jar)
- Beaker graduated in liters

Layering Water Activity (per group)

- Two identical clear baby food jars
- Hot water (about 50 °C, colored red)
- Cold water (about 5 °C, colored blue)
- Water-resistant card (from a deck of cards or laminated index card)
- Paper towels
- Cookie sheet or something similar to catch drips and spills

- *Unit 3.B Lesson 1 – Density Altitude*

Flight Simulation Activity

- Computer with flight simulation software or flight simulator
- Joystick or yoke
- Optional: Throttle quadrant, rudder pedals, additional monitors

Unit 4 – Forces of Flight

- *Unit 4.A Lesson 1 – Understanding Motion*

Egg Inertia Demonstration (per class)

- One hardboiled egg
- One raw egg

Pop Can Hero Activity

- Empty aluminum pop cans with pull tabs intact (one per team)
- Carpenter nails
- Small nails
- String or fishing line (about 20 inches per team)
- Water tub (one or two per class)
- Towels

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM
MATERIALS LIST



- *Unit 4.A Lesson 2 – Four Forces*

Dart Paper Airplane Test (per team)

- Sheet of 8 ½" x 11" paper
- Paperclips
- Measuring tape
- Scissors

- *Unit 4.A Lesson 3 – Vectors of Flight*

Flight Vector Analysis Activity (per student)

- Protractor

- *Unit 4.B Lesson 1 – Theories of Lift*

Floating Ball Demonstration (per class)

- Hair Dryer
- Ping pong ball
- Optional: one bendable straw and ping pong ball for each student

Magic Balloon Experiment (per team)

- Two balloons
- Two (2) 12" pieces of string
- Tape
- Straw

Airfoil Designs Test (per team)

- Several Pieces of 8 ½" x 11" paper
- Tape
- Plastic straw
- String
- Scissors
- Single-hole punch
- Electric box fan or other small variable speed fan (per class)

- *Unit 4.B Lesson 3 – Calculating Lift*

Lift Equation Scenarios (per student)

- Calculator

Airfoil Simulation Activity (each group)

- iPads with "Wind Tunnel" application downloaded (\$4.99)
<https://itunes.apple.com/us/app/wind-tunnel-for-ipad/id450980034?mt=8>

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM MATERIALS LIST



- *Unit 4.B Lesson 4 – Aerodynamic Stalls*

Adventures in Stalls Activity

- Markers and/or colored pencils
- Rolled paper or poster board (optional)

Flight Simulation Activity

- Computer with flight simulation software or flight simulator
- Joystick or yoke
- Optional: Throttle quadrant, rudder pedals, additional monitors

- *Unit 4.C Lesson 1 – Aircraft Weight and Balance*

Balancing Act Activity (per group)

- 12-inch ruler
- Three identical binder clips

Paper Airplane Balancing Activity (per group)

- 8 ½" x 11" piece of paper
- Four paper clips

Flight Simulation Activity

- Computer with flight simulation software or flight simulator
- Joystick or yoke
- Optional: Throttle quadrant, rudder pedals, additional monitors

- *Unit 4.D Lesson 1 – In Thrust We Trust*

As The Prop Turns Activity

- Rubber band-powered balsa wood airplane with wheels
- Recommendations - Guillow's Jet Stream (<https://www.guillow.com/jetstream.aspx>)
- Guillow's Balsa Wood Flying Machine Kit (<https://amzn.to/2QrnHRo>)

Gyroscopic Action Demonstration (Optional)

- Chair that swivels
- Bicycle wheel that students can grasp by the axle

Engineering a Jet Engine Activity

- iPads with "Rolls-Royce Trent XWB" application downloaded (free)
<https://itunes.apple.com/us/app/rolls-royce-trent-xwb/id988798634?mt=8>

MATERIALS LIST



- *Unit 4.E Lesson 1 – What a Drag!*

Warm-Up Demonstration (per student)

- Two 8 ½ x 11-inch pieces of paper

Drag Race (Per Group)

- Rubber band-powered propeller assembly (recommend using the propellers and rubber bands from the balsa wood airplane activity in lesson 4.D.1)
- Size #117B rubber band (if not included in the assembly above)
- Two drinking straws (recommend not using flexible drinking straws)
- Cardstock or manila file folders cut to size
 - One (1) - 5" x 7"
 - One (1) - 1 ½ " x 7"
 - One (1) - 3" diameter circle
- One brass fastener (brad fastener) size 1"
- 1 hook or pin to secure far end of rubber band propeller assembly (can use a paperclip)
- Transparent or masking tape
- Ruler/straight edge
- Protractor
- Tape measure or meter stick
- 5 meters of fishing line
- Permanent marker
- Scissors
- Hole punch (one per class)

Unit 5 – Aircraft Stability and Control

- *Unit 5.A Lesson 1 – Stability in Aircraft Design*

Stability In Action Activity (Per Pair)

- Marble
- Bowl with a rounded bottom and curved sides (the bowl should not have a lip on bottom of the outside surface)
- A key with a hole in the top
- A 10-inch length of string

- *Unit 5.A Lesson 2 – Rotorcraft Lift and Stability*

Flight Controls Explanation

- Small Model Helicopter (Optional)

AOPA FOUNDATION HIGH SCHOOL AVIATION STEM CURRICULUM
MATERIALS LIST



- *Unit 5.B Lesson 1 – Primary Flight Controls*

Flight Simulation Activity

- Computer with flight simulation software or flight simulator
- Joystick or yoke
- Optional: Throttle quadrant, rudder pedals, additional monitors

- *Unit 5.B Lesson 2 – Secondary Flight Controls*

Explore the Effects of Secondary Flight Controls (Optional)

- iPads with “Wind Tunnel” application downloaded (\$4.99)
<https://itunes.apple.com/us/app/wind-tunnel-for-ipad/id450980034?mt=8>

- *Unit 5.B Lesson 3 – Flight Controls for Unmanned Aircraft*

Drone Flying Challenge! Activity (one per class)

- Quadcopter drone and controller (with standard controls if possible) - drone options provided in Unit 2, Section A, Lesson 2
- 2 hula hoops (optional)

- *Unit 5.C Lesson 1 – Turns and Turning Flight*

Rate of Turn and Radius of Turn Equations (per student)

- Calculator

- *Unit 5.C Lesson 2 – Load Limits in Aircraft Design*

Simulating G-Forces Activity

- Small hanging scale (a scale for measuring fish or luggage is appropriate and affordable). Be sure to choose a scale that records the highest weight achieved between resets.
 - AccuDial No Batteries Accurate Easy Reading Analog Compact Handheld Luggage Scale (Amazon \$9.99)
 - Travel Smart by Conair Compact Luggage Scale (Amazon \$9.97)
- Object to serve as an approximately 1 lb. weight (such as a small bag of rice or sand)
- String or S-hook (for hanging the weight from the scale)

Teacher Demonstration: High G-Forces And A Pilot’s Blood Supply

- Water balloon, half-filled with water
- String or yarn
- Smartphone or camera with slow motion video capability
- Towel or paper towels (optional)



Unit 6 – Career Skills

- *Unit 6.A Lesson 1 – Job Application Practice*

Sample Job Application Activity

-One highlighter (per student)

- *Unit 6.A Lesson 3 – Building/Revising Your Career Portfolio*

Portfolio Materials (each student)

-Three-ring binder

-Tabs (as needed per student based on table of contents)

-Plastic or vinyl sheet protectors

PROPRIETARY