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

- *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

- *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

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- *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

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- *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

- *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)

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- *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)

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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