BROOKLYN AERODROME
FLIGHT SCHOOL

# UNIT 1

## LESSON PLANS

### 15 CONTACT HOURS

### WORLD MAKER FAIRE 2016 EDITION

# UNIT 1 – STUDENT PROGRESSION

## Pilot's License

| Knowledge Requirement | Performance Requirement | Products |
|---|---|---|
| ▪ List and describe the four forces of flight | ▪ Demonstrate the three axes of movement<br>▪ Locate Parts of an airplane | ▪ 2 Pre-Designed Paper Airplanes<br>▪ 1 Student Designed Paper Airplane |

## Glider Endorsement (G)

| Knowledge Requirement | Performance Requirement | Products |
|---|---|---|
| ▪ Explain Rules of Flight Line | ▪ Show Launches<br>▪ Build Plank | ▪ Plank Small Glider (SG)<br>▪ Brooklyn Aerodrome Designed Small Glider |

## Experimental Glider Endorsement (XG)

| Knowledge Requirement | Performance Requirement | Products |
|---|---|---|
| ▪ Describe Importance of Center of Gravity (CG) | ▪ Calculate Center of Gravity and Balence with weight | ▪ Student Designed Experimental Small Glider (XSG) |

# UNIT 1 - LESSONS

| Lesson | Description | Hours |
|---|---|---|
| 1. Entry Event: Paper Airplane Competition | Students will fold and fly paper airplanes to begin to understand properties of flight | 2 |
| 2. Building Planks | Students build a basic square glider to learn the basic processes and to act as a control | 3 |
| 3. Center of Gravity (CG) | Students develop an understanding of Center of Gravity, how it effects the glider, and how to control it. | 1 |
| 4. Analysis of Glider Design | Students work as a class to build and test a variety of pre-tested glider designs | 3 |
| 5. Glider Competition | Students design, build and compete in three different events distance, accuracy and cargo capacity | 6 |

# UNIT 1 - OBJECTIVES

| Students will be able to: | Measure | Covered Under |
|---|---|---|
| Work and operate safely around tools, gliders, and others | Glider Endorsement Test | G Endorsement |
| Read a technical drawing | Build a Plank / Build a BA Design | SG Airworthiness |
| Translate a half-scale design into a full scale model | Build a Plank / Build a BA Design | SG Airworthiness |
| Measure in MM | Build a Plank / Build a BA Design | SG Airworthiness |
| Describe the importance of Center of Gravity (CG) | XG Endorsement Test | XG Endorsement |
| Find the CG experimentally | Balance the Plank | SG Airworthiness |
| Find the CG mathematically | X Glider Test Design Sheet | XSG Airworthiness |
| Predict how a plane should fly | X Glider Test Design Sheet | XSG Airworthiness |
| Follow Engineering Process | Build a X Glider to enter into competition | Participate in competition |
| Demonstrate the three axis of movements | Pilot License Test | Pilot License |
| List the four forces of flight | Pilot License Test | Pilot License |

# UNIT 1 – STANDARDS

## Common Core State Standards for English Language Arts in Technical Subjects 6-12

### WHST Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects 6-8

**Text Types and Purpose**

1. Write arguments focused on discipline specific content
2. Write informative/explanatory text, including the narration of historical events, scientific procedures/experiments or technical processes

**Research to Build and Present Knowledge**

7. Conduct short research projects to answer a questions.
9. Draw evidence from informational texts to support analysis reflection and research

## Common Core State Standards for Math

### Grade 6

**6.G Geometry** **Solve real-world mathematical problems involving area, surface area and volume**

1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems

### Grade 7

**7.RP Ratios and Proportional Relationships** **Analyze proportional relationships and use them to solve real-world and mathematical problems**

2. Recognize and represent proportional relationships between problems

**7.G Geometry** **Draw, Construct, and describe geometrical figures and describe the relationships between them.**

1. Solve problems involving scale drawings of geometric figures.
2. Draw geometric shapes within giving conditions.

REFERENCE: http://www.corestandards.org

# Next Generation Science Standards

## Middle School Physical Science Standards

**MS-PS2: Motion and Stability: Forces and Interactions**

| | |
|---|---|
| MS-PS2-2 | Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. |

**MS-PS3: Energy**

| | |
|---|---|
| MS-PS3-1 | Develop a model to describe that when the arrangement of objects interacting at a distance change, different amounts of potential energy are stored in the system. |
| MS-PS3-2 | Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. |
| MS-PS3-5 | Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. |

## Middle School Engineering Design

**MS-ETS1: Engineering Design**

| | |
|---|---|
| MS-ETS1-1 | Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions |
| MS-ETS1-2 | Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. |
| MS-ETS1-3 | Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. |
| MS-ETS1-4 | Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved. |

REFERENCE: http://www.nextgenscience.org

# 21st Century Skills

## Learning and Innovation Skills

**Creativity and Innovation**

Think Creatively

- Use a wide range of idea creation techniques (such as brainstorming)
- Create new and worthwhile ideas (both incremental and radical concepts)
- Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others

- Develop, implement and communicate new ideas to others effectively
- Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work
- Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas
- View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes

Implement Innovations

- Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur

**Creative Thinking and Problem Solving**

Reason Effectively

- Use various types of reasoning as appropriate to the situation

Use Systems Thinking

- Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions

- Effectively analyze and evaluate evidence, arguments, claims and beliefs
- Analyze and evaluate major alternate points of view
- Synthesize and make connections between information and arguments
- Interpret information and draw conclusions based on the best analysis
- Reflect critically on learning experiences and processes

**Communication and Collaboration**

Communicate Clearly

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- Communicate effectively in diverse environments (including multi-lingual)

Collaborate with Others

- Demonstrate ability to work effectively and respectfully with diverse teams
- Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

REFERENCE: http://www.p21.org

# LESSON 1

# ENTRY EVENT: PAPER AIRPLANE COMPETITION

| STANDARDS | | | MATERIALS |
|---|---|---|---|
| Next Generation Science Standards | Common Core | 21st Century Skills | |
| **MS-ETS1: Engineering Design**<br>MS-ETS1-1<br>MS-ETS1-3 | **WHST**<br>**Research to Build and Present Knowledge** | **Creativity and Innovation**<br>Think Creatively<br>Implement Innovations<br>**Creative Thinking and Problem Solving**<br>Reason Effectively<br>Use Systems Thinking<br>Make Judgments and Decisions | • Directions for folding the Classic Dart & Bullet<br>• 2 Sheets of 8 ½ x 11 paper per student<br>• 1 Research Journal per student |

| LEARNING OBJECTIVES | EVIDENCE OF LEARNING |
|---|---|
| Illustrate the basic parts of a plane<br>Describe the engineering process<br>List the four forces of flight<br>Demonstrate the three axis of movements | In class demonstrations<br>Workbook Reflections<br>Earning Pilots License |

| UNIT 1 | LESSON/DAY |
|---|---|
| **ENTRY EVENT: PAPER AIRPLANE COMPETITION** | **1.1** |

## SEQUENCE OF INSTRUCTION

| Time | Section | Description of Instructional Activity |
|---|---|---|
| 15 | Engage | • Talk about what makes an airplane fly<br>• Talk about the competition, students will need to design an airplane that can<br>  ○ Fly the furthest<br>  ○ Come the closest to the center of a target on the ground<br>• Distribute 2 sheets of paper per student<br>• Help students fold the *Classic Dart*<br>• Make sure they write their name on their planes |
| 15 | Discover/Explain | • Students should fill in <xxxx> in the workbook<br>• While everyone is holding their airplanes, work on three axes for flight:<br>  ○ Pitch – Nose Up/Down<br>  ○ Roll – One Wing Up/The Other Down<br>  ○ Yaw – Nose Left/Right<br>• Introduce the students to the four forces of flight.<br>  ○ Weighty – Pulls the plane to the ground (drop the plane)<br>  ○ Lift – The force that the airplane must provide to counteract gravity<br>  ○ Drag – Slows down the airplane via interaction with air<br>  ○ Thrust – The push given by the engine or your arm<br>• Ask the students how airplane engineers modify the forces. Be sure to illicit responses about:<br>  ○ Weight of the plane using light materials. Lighter planes need less lift<br>  ○ Increasing the wings size generally increases lift. Bigger wings increase drag. |

| | | |
|---|---|---|
| | | ○ Bigger engines, or a harder throw gives more thrust<br>• Fold the *Bullet* with the students<br>• Have students complete the Hypothesis and Method sections of their research journals. |
| 20 | Practice | • Pair Students (one person throws, while one person writes)<br>• Review Rules of the Flight Line<br>• Each student makes four throws<br>○ Dart thrown softly<br>○ Dart thrown hard<br>○ Bullet thrown softly<br>○ Bullet thrown hard |
| 10 | Wrap up | • Have students finish Analysis section of their journals<br>• Students should talk about their results with their partner<br>• Remind students that a wrong hypothesis is OK |

| UNIT 1 | LESSON/DAY |
|---|---|
| **ENTRY EVENT: PAPER AIRPLANE COMPETITION** | **1.2** |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | • Challenge the students to create a plane that will win one of two challenges<br>  ○ Fly the furthest<br>  ○ Come the closest to the center of target |
| 5 | Discover/Explain | • Have students work on creating their designs<br>• Make sure they fill in their journals as they work<br>• Tell them they will have 20 mins. to work and 20 mins. to test |
| 40 | Practice | • Allow students to work on designs<br>• For throwing section, allow eight students to throw at once, measure the best flight, then repeat (that way you take fewer measurements |
| 10 | Wrap up | • Recognize the winner in each event<br>• Have the students reflect in their journals |

# LESSON 2

# BUILDING PLANKS

| STANDARDS | | | MATERIALS |
|---|---|---|---|
| Next Generation Science Standards | Common Core | 21st Century Skills | |
| **MS-PS2: Motion and Stability: Forces and Interactions**<br>MS-PS2-2<br>**MS-PS3: Energy**<br>MS-PS3-1<br>**MS-ETS1: Engineering Design**<br>MS-ETS1-1<br>MS-ETS1-2<br>MS-ETS1-3. | **WHST**<br>Text Types and Purpose<br>Research to Build and Present Knowledge<br><br>**MATH**<br>**7.G Geometry**<br>Draw, Construct, and describe geometrical figures and describe the relationships between them. | **Creativity and Innovation**<br>Think Creatively<br>**Communication and Collaboration**<br>Communicate Clearly<br>Collaborate with Others | 1 Plank Drawing per student<br>1 Piece of Foam per student<br>1 Paper Clip per student<br>1 Set of Washers per student<br>1 Roll of Tape per four students<br>1 Ruler Per Pair<br>1 Pair of Scissors per Pair<br>1-2 Test Areas<br>2 Launchers |

| LEARNING OBJECTIVES | EVIDENCE OF LEARNING |
|---|---|
| Work and operate safely around tools, gliders, and others<br>Read a technical drawing<br>Translate a half-scale design into a full scale model<br>Measure in MM | Student Workbook<br>Glider Endorsement<br>Airworthiness Certification |

| UNIT 1 | LESSON/DAY |
|---|---|
| **BUILDING PLANKS** | **2.1** |

## SEQUENCE OF INSTRUCTION

| Time | Section | Description of Instructional Activity |
|---|---|---|
| Before Lesson | Prepare | Build a sample plank<br>Setup the test area in the classroom. Ideally it should be 2 meters x 5 meters. If you can get two test areas on spread apart, that's even better.<br>Setup launcher (pointed away from students) |
| 15 | Engage | • Show students the sample plank<br>• Go over the parts of the plank with the student, and have them label the diagrams in their workbook<br>  ○ Body, Elevons, Vertical Stabalizer, Weight, Launch Hook<br>• Show students the test area<br>  ○ Review safety rules<br>  ○ Demonstrate the two hand launch & launcher launch<br>  ○ Show them a launch with and without the weight on the front (it'll come up later)<br>• Tell them about the Glider Endorsement |
| 15 | Discover/Explain | • Hand out the design, materials<br>• Take students through 1:2 scale and 1:1 scale activity in workbook<br>• Review measurements of Plank |
| 20 | Practice | • Have students make a plank<br>• While they are working meet with each student individually to get their glider endorsements in the test area<br>  ○ Have each one come up and demonstrate the two hand launch on the sample plank in the test area<br>  ○ Make sure the look before they drop<br>  ○ Have them practice a launcher launch with verbal commands<br>  ○ Make sure they do the right thing during the right command.<br>  ○ Any students who correctly show the launches, should be signed off in the pilot record<br>• Students can decorate their planes with extra time |
| 10 | Wrap up | • Remind them, they will be flying their planes tomorrow<br>• Have students fill in reflection in their workbooks. |

| UNIT 1 | LESSON/DAY |
|---|---|
| BUILDING PLANKS | 2.2 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| Before Lesson | Prepare | Setup the test area in the classroom. Ideally it should be 1 meters x 3 meters. If you can get two test areas on spread apart, that's even better. |
| 5 | Engage | • Show students the tail numbers, review the criteria for receiving a tail number |
| 40 | Practice | • Give out airworthiness certification forms AW-SG<br>• All students should weigh their planes<br>• Students should fill in the form, as well as continue to decorate their planes<br>• Call them over in groups to the test area.<br>  ○ Tape 16g of washers onto each plane<br>  ○ Adjust the elevons until straight flight is achieved<br>  ○ Re-weigh the planes<br>• As students finish the AW-SG, they should have you verify the information and give out tail numbers<br>• Add a nose hook to the planes |
| 5 | Wrap up | • Have the students carefully compare their planes to a partners and log differences in their workbooks. |

| UNIT 1 | LESSON/DAY |
|---|---|
| BUILDING PLANKS | 2.3 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| Before Lesson | Prepare | Setup the test area in the classroom. Ideally it should be 1 meters x 4 meters. If you can get two test areas on spread apart, that's even better. |
| 5 | Engage | • Have students prepare their planes for flight |
| 40 | Practice | • Hold a Safety briefing<br>  ○ Review flight line procedures<br>  ○ Review movement and non-movement areas<br>• Pair students up so one person can write while the other flies<br>• Each student should get two test flights in, record date in workbook.<br>• Bring materials for quick repairs or adjustments |
| 5 | Wrap up | • Students should reflect on their experiences in their workbooks |

# LESSON 3

# CENTER OF GRAVITY

| STANDARDS | | | MATERIALS |
|---|---|---|---|
| Next Generation Science Standards | Common Core | 21st Century Skills | |
| **MS-PS2: Motion and Stability: Forces and Interactions**<br>MS-PS2-2<br>**MS-ETS1: Engineering Design**<br>MS-ETS1-2<br>MS-ETS1-3 | **WHST**<br>Text Types and Purpose<br>Research to Build and Present Knowledge<br>**MATH**<br>6.G Geometry<br>7.RP Ratios and Proportional Relationships<br>7.G Geometry | **Creativity and Innovation**<br>Think Creatively<br>Work Creatively with Others<br>**Creative Thinking and Problem Solving**<br>Reason Effectively<br>Use Systems Thinking<br>**Communication and Collaboration**<br>Collaborate with Others | 1 wire coat hanger<br>1 Plank glider without nose weight<br>1 Straw<br>Packing tape<br>1 fan |

| LEARNING OBJECTIVES | EVIDENCE OF LEARNING |
|---|---|
| Describe the importance of CG<br>Find the CG experimentally<br>Find the CG mathematically | Student Workbook<br>Airworthiness Certification |

| UNIT 1 | LESSON/DAY |
|---|---|
| CENTER OF GRAVITY | 3.1 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| | Prep | • Cut out the standard Plank wing and tape a small soda straw at the 50% chord point.<br>• Take a coat hanger and bend to create a wind vane bearing.<br>• Insert coat hanger into straw<br>• Draw suggestive wind vane image on side of plank |
| 5 | Engage | • Have students recall what happened when you tried to fly the plank without any weight on the front.<br>• Tell the students that today we are going to figure out why there is a difference |
| 20 | Discover/Explain | • Show the students the wind vane demonstrator that you built<br>• Have them write a hypothesis about what will happen when the fan is turned on in their journals and provide evidence<br>• Turn on the fan, and show them how it just spins.<br>• Have them update their hypothesis on why that is and more importantly, how can we fix it.<br>• Demonstrate moving the pivot point or decreasing the surface area toward the front can be effective.<br>• Force is a function of surface area and if we have more surface area aft of the pivot then the wind vane will be self-righting into the wind.<br>• Have students write about how we changed the plank to make it more stable. |
| 15 | Practice | • Have students find the balance point of their planks<br>• Have them draw a line and measure the surface area fore and aft of that line (roughly 25% fore/75% aft)<br>• Have them draw the CG sign on the plane<br>• Demonstrate the CG of a differently shaped glider, Note that the same ratio applies<br>• Have them mark the target CG of the practice planes in their workbooks |
| 10 | Wrap up | • Have  students compare their target CG problems with a partner and resolve any discrepancies |

# LESSON 4

# ANALYSIS OF GLIDER DESIGNS

| STANDARDS | | | MATERIALS |
|---|---|---|---|
| Next Generation Science Standards | Common Core | 21st Century Skills | |
| **MS-PS2: Motion and Stability: Forces and Interactions**<br>MS-PS2-2<br>**MS-ETS1: Engineering Design**<br>MS-ETS1-1<br>MS-ETS1-2<br>MS-ETS1-3<br>MS-ETS1-4 | **WHST**<br>Research to Build and Present Knowledge<br>**MATH**<br>6.G Geometry<br>7.RP Ratios and Proportional Relationships<br>7.G Geometry | **Creativity and Innovation**<br>Think Creatively<br>**Work Creatively with Others**<br>Creative Thinking and Problem Solving<br>Reason Effectively<br>Use Systems Thinking<br>**Make Judgments and Decisions**<br>Communication and Collaboration<br>Communicate Clearly<br>Collaborate with Others | 1 BA Template per student<br>1 Piece of Foam per student<br>1 Paper Clip per student<br>1 Set of Washers per student<br>1 Roll of Tape per four students<br>1 Ruler Per Pair<br>1 Pair of Scissors per Pair<br>1-2 Test Areas<br>2 Launchers |

| LEARNING OBJECTIVES | EVIDENCE OF LEARNING |
|---|---|
| Describe the importance of CG<br>Find the CG experimentally<br>Find the CG mathematically<br>Predict how a plane should fly | Student Workbooks<br>Airworthiness Certifications |

| UNIT 1 | LESSON/DAY |
|---|---|
| # ANALYSIS OF GLIDER DESIGNS | 4.1 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| | Prepare | • Build a second model<br>• Setup the testing area, if it isn't already setup. Again two is better than one if you have the space. |
| 20 | Engage | • Hold up the two planes. Lead a discussion on "Which one will fly better?"<br>• After you get some feedback, lead them to create a definition on what 'better' actually is.<br>• Ask the students to sketch the planes in their workbooks and to make a hypothesis |
| 5 | Discover/Explain | • Hand out materials to students<br>• Remind the students the planes are in 1:2 scale<br>• Tell them they are to build this glider, get it airworthy and be ready to test it on the flight line<br>• They need to be extra careful, because the other students in the class need the data to be accurate |
| 20 | Practice | • Students should build their gliders<br>  ○ Do the weight, balance & trim<br>  ○ Fill in the AW-SG worksheet<br>  ○ Get a tail number<br>  ○ Use extra time for decoration |
| 5 | Wrap up | Have students estimate where the CG will fall on their design sheets just by looking. Have the students with the same designs pair up and compare answers. |

| UNIT 1 | LESSON/DAY |
|---|---|
| **ANALYSIS OF GLIDER DESIGNS** | **4.2** |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 15 | Engage | • Students should do a gallery walk of the planes in whatever the current state is.<br>• Have them fill in the hypothesis for each design in their workbooks |
| 30 | Practice | • Students should build their gliders<br>  ○ Do the weight, balance & trim<br>  ○ Fill in the AW-SG worksheet<br>  ○ Get a tail number<br>  ○ Use extra time for decoration |
| 5 | Wrap up | • Students should write about their glider building experience. Focus on what they did well on and what was challenging about the more complicated designs |

| UNIT 1 | LESSON/DAY |
|---|---|
| **ANALYSIS OF GLIDER DESIGNS** | **4.3** |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | Have each of the students show their plane, and predict whether it will go further the same or closer than the plank |
| 5 | Discover/Explain | Before you leave for the flight line, review the flight line procedures in the pilot's handbook |
| 40 | Practice | • Each student should launch their plane twice, recording the distances in their workbooks. If they are in pairs, one can launch while the other writes<br>• Students should be watching the launches of other designs for their characteristics<br>• If there is time left, try and get another round of flights for each student in. |
| 10 | Wrap up | • Students should respond to their prediction about their specific plane.<br>• There will be time for data sharing and discussing as we move into the next lesson. |

# LESSON 5

# SMALL GLIDER CHALLENGE

| STANDARDS | | | MATERIALS |
|---|---|---|---|
| Next Generation Science Standards | Common Core | 21st Century Skills | |
| **MS-PS2: Motion and Stability: Forces and Interactions**<br>MS-PS2-2<br>**MS-PS3: Energy**<br>MS-PS3-2<br>MS-PS3-5<br>**MS-ETS1: Engineering Design**<br>MS-ETS1-1<br>MS-ETS1-2<br>MS-ETS1-3<br>MS-ETS1-4 | **WHST**<br>Text Types and Purpose<br>Research to Build and Present Knowledge<br>**MATH**<br>6.G Geometry<br>7.RP Ratios and Proportional Relationships<br>7.G Geometry | **Creativity and Innovation**<br>Think Creatively<br>Work Creatively with Others<br>Implement Innovations<br>**Creative Thinking and Problem Solving**<br>Reason Effectively<br>Use Systems Thinking<br>**Make Judgments and Decisions**<br>Communication and Collaboration<br>Communicate Clearly<br>Collaborate with Others | 3 Pieces of Foam per student<br>3 Paper Clip per student<br>3 Sets of Washers per student<br>1 Roll of Tape per four students<br>1 Ruler Per Pair<br>1 Pair of Scissors per Pair<br>1-2 Test Areas<br>2 Launchers |

| LEARNING OBJECTIVES | EVIDENCE OF LEARNING |
|---|---|
| Predict how a plane should fly<br>Follow Engineering Process | XSG Endorsement<br>Airworthiness Certifications<br>Workbook |

| UNIT 1 | LESSON/DAY |
|---|---|
| SMALL GLIDER CHALLENGE: BRAINSTORM | 5.1 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | • Have a discussion about the students designing their own gliders<br>• Tell them they are switching from scientists to engineers. The focus here is on the switch from collecting data to applicaiton<br>• Introduce the competition & events |
| 15 | Discover/Explain | • Take the students through the Engineering Process as it is in the Pilot's handbook<br>• They will be following this process as they prepare to enter the competition<br>• Have each student hold up their BA Glider and say:<br>  ○ How it performed<br>  ○ What challenge they think it would do best in and why. |
| 20 | Practice | • Set the students to brainstorming. They should fill their pages with ideas, and not worry about whether they are good or bad.<br>• They can't just use BA design, but they can modify one<br>• They can be simple or crazy |
| 10 | Wrap up | • Each student should have 5 minutes to share their designs with their partner and talk about how they might fly.<br>• Switch, and have the other student talk about their designs. |

| UNIT 1 | LESSON/DAY |
|---|---|
| SMALL GLIDER CHALLENGE: EXPLORE | 5.2 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | • Have each student share the primary competition they want to enter with the class |
| 10 | Discover/Explain | • Students should review the rules for the event they want to focus on.<br>• Review the purpose of the Explore stage |
| 20 | Practice | • Students should pick three of their ideas from brainstorming to develop further<br>  ○ They should do a more accurate drawing<br>  ○ Figure out the measurements<br>  ○ Verify the data from the glider design lesson<br>  ○ Answer the questions about each design |
| 15 | Wrap up | • Students should meet in larger groups to discuss the 12 designs. Each designer should take 1 minute to show their deisgn, and get feedback from the group. They will only be prototyping two of their three designs |

| UNIT 1 | LESSON/DAY |
|---|---|
| SMALL GLIDER CHALLENGE: PROTOTYPE 1 | 5.3 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | • Have a couple students share how their designs have changed after the one minute discussions |
| 5 | Discover/Explain | • Go over the Certification rules for Experimental Small Gliders as well as the XG Pilot endorsement |
| 40 | Practice | • Students should pick two of their developed ideas to prototype. They will have two days to get the prototypes built and ready to fly on the flight line<br>  ○ Complete the Weight, Balance and trim<br>  ○ Test them in the test area<br>  ○ Fill in the AW-SG form (XSG Class)<br>  ○ Make modifications as necessary<br>• While the students are working, you should meet with students to get their XG Endorsements |

| UNIT 1 | LESSON/DAY |
|---|---|
| # SMALL GLIDER CHALLENGE: PROTOTYPE 2 | 5.4 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 5 | Engage | • Have a couple students share how their designs have changed after they started testing the prototypes |
| 15 | Practice | • Allow students to finish building their prototypes, and get them airworthy.<br>• If the students are entering the cargo competition, add the bolt at the CG with three washers<br>• Take the students to the flight line, have them test both their planes as time allows |
| 25 | Practice 2 | • Students should get back in their groups of four to compare the designs to the prototypes for each person |
| 5 | Wrap-Up | • Have the students sit with their partner and discuss what happened to during the protype testing, and what they are going to chage on the final design. |

| UNIT 1 | LESSON/DAY |
|---|---|
| SMALL GLIDER CHALLENGE: REFINE | 5.5 |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 10 | Engage | • Have each student share what prototype they are choosing, and how they are going to change it, if at all |
| 5 | Discover/Explain | • Review the Refine step of the engineering process |
| 30 | Practice | • Students will build the final design they plan to enter into the competition.<br>  ○ It should be tested and airworthy |
| 5 | Wrap up | • Review the plan for the competition with the students |

| UNIT 1 | LESSON/DAY |
|---|---|
| **SMALL GLIDER CHALLENGE DAY**<br>**2 HOUR LESSON** | **5.6** |

| SEQUENCE OF INSTRUCTION | | |
|---|---|---|
| Time | Section | Description of Instructional Activity |
| 10 | Engage | • Students should preflight and check their aircraft one more time before the competition |
| 40 | Practice | • Hold the three events, students can enter their plane into two events. |
| 10 | Discover/Explain | • Give out the prizes for the challenges<br>• Have a discussion about the properties of each aircraft that made them successful/failures in their events |
| 40 | Wrap up | • Have students answer the last set of questions in the workbook and the final reflection. |