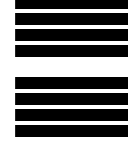


# LESSON 1.1



## ENTRY EVENT: PAPER AIRPLANE COMPETITION

### LESSON CONTENT

Technical Skills	Academic Standards	21 <sup>st</sup> Century Skills (p21.org)

### MATERIALS & RESOURCES:

- Directions for folding the Classic Dart & Bullet
- 2 Sheets of 8 ½ x 11 paper per student
- 1 Research Journal per student

### SEQUENCE OF INSTRUCTION

Time	Section	Description of Instructional Activity
<b>Day 1</b>		
5	<b>Pre Lesson</b>	<ul style="list-style-type: none"> <li>• Ask the students what makes an airplane fly?</li> <li>• Have a short discussion about some of the student’s ideas.</li> <li>• Tell the students that we are going to have a competition to see who can design and build the airplane that:               <ul style="list-style-type: none"> <li>○ Can stay in the air the longest</li> <li>○ Come the closest to the center of a target</li> <li>○ Can fly the furthest.</li> </ul> </li> <li>• Before we get to the competition, we need to do some research and experimentation.</li> </ul>
10	<b>Engage</b>	<ul style="list-style-type: none"> <li>• Hand one sheet of paper to each student.</li> <li>• Take them through the folding of the Classic Dart               <ul style="list-style-type: none"> <li>○ Go Through the directions step by step</li> <li>○ Fold an airplane along with them</li> <li>○ Circulate to make sure students aren’t having trouble</li> <li>○ Tell them they will be able to throw their airplanes, but not yet.</li> <li>○ Make sure they write their name on their airplane</li> </ul> </li> </ul>
15	<b>Discover/Explain</b>	<ul style="list-style-type: none"> <li>• Give out one Research Journal to each student.</li> <li>• Have them turn to 1.1 Research. They should add notations to the diagrams on this page while you go over this section.</li> <li>• While everyone is holding their airplanes, take the students through and demonstrate the three axes of flight.               <ul style="list-style-type: none"> <li>○ Pitch – Nose Up/Down</li> <li>○ Roll – Wings Up/Down</li> </ul> </li> </ul>

		<ul style="list-style-type: none"> <li>○ Yaw – Nose Left/Right</li> <li>● Introduce the students to the four forces of flight. <ul style="list-style-type: none"> <li>○ Gravity – Pulls the plane to the ground (drop the plane)</li> <li>○ Lift – The force that the airplane must provide to counteract gravity</li> <li>○ Drag – Slowing down the airplane with wind resistance.</li> <li>○ Thrust – The push given by the engine or your arm</li> </ul> </li> <li>● Ask the students how airplane engineers modify the forces. Be sure to illicit responses about: <ul style="list-style-type: none"> <li>○ Weight of the plane using light materials. It's easier to pick up a lighter plane</li> <li>○ Increasing the wings size generally increases lift. Sleeker airplanes go through the air better, use example of have out the window of a car or moving through water</li> <li>○ Bigger engines, or a harder throw gives more thrust</li> </ul> </li> <li>● Go over the relationship between lift and thrust: <ul style="list-style-type: none"> <li>○ Bigger wings: more lift, needs less thrust</li> <li>○ Small wings: less lift, needs more thrust</li> </ul> </li> <li>● Fold the <i>Bullet</i> with the students. Again be mindful of folding difficulties.</li> <li>● Have students complete the Hypothesis and Method sections of their research journals. <ul style="list-style-type: none"> <li>○ In later lessons, students will be expected to provide more of the detail on their own.</li> <li>○ Make sure that students have read the Variable and Setup Sections</li> <li>○ Review the data that is to be collected, and how it is going to be collected</li> </ul> </li> </ul>
25	<b>Practice</b>	<ul style="list-style-type: none"> <li>● Students should be paired so that one person can write while the other person is throwing.</li> <li>● Establish a flight line (See Diagram). A Flight line will be used throughout the program, and it will help ensure safety. Establish the ground rules now, when it's only pieces of paper. <ul style="list-style-type: none"> <li>○ Everyone will throw their planes after the Launch direction</li> <li>○ You may only cross a solid line with permission</li> <li>○ You may cross a dotted line on your own</li> <li>○ They should get their planes, and go back to their spot on the flight line.</li> </ul> </li> <li>● The thrower should stand on the flight line, the recorder should be three feet behind them.</li> <li>● Take the students through the four test flights, record the data each time <ul style="list-style-type: none"> <li>○ Dart thrown softly</li> </ul> </li> </ul>

		<ul style="list-style-type: none"> <li>○ Dart thrown hard</li> <li>○ Bullet thrown softly</li> <li>○ Bullet thrown hard</li> <li>● Switch roles (recorders throw, the throwers record) and repeat the experiment</li> <li>● Have the students return to their seats (tell them they will get a couple more throws at the end if there is time)</li> </ul>
10	<b>Wrap Up</b>	<ul style="list-style-type: none"> <li>● Have the students finish the Analysis section of their journals</li> <li>● Students should talk with their partner about the results of the experiment</li> <li>● Remind students that it's perfectly OK if they didn't have a proven hypothesis.</li> </ul>
<b>Day 2</b>		
5	<b>Engage</b>	<p>Tell the students about the challenge to create a plane that will win in one of three challenges:</p> <ul style="list-style-type: none"> <li>○ Can stay in the air the longest</li> <li>○ Come the closest to the center of a target</li> <li>○ Can fly the furthest.</li> </ul>
5	<b>Discover/Explain</b>	<p>In engineering there are always constraints, it is important for students to review the constraints for each of the upcoming challenges.</p> <p>Go over the design process for this challenge in the journal</p> <p>Show students the area of the room set aside for testing (this should not be the flight line area)</p> <p>Give students paper.</p> <p>Tell them they will have 20 minutes to test their planes and fill in the detail in their journal</p>
40	<b>Practice</b>	<p>Allow the students to work on their designs. If they are struggling, suggest starting with either the dart or the bullet and modify it from there in an interesting way.</p> <p>After 20 minutes have the students go to the flight line.</p> <p>For each of the events, have groups of eight students throw at once, measure the best of that flight, and repeat (that way you take fewer measurements)</p>
10	<b>Wrap Up</b>	<p>Recognize the winner in each event</p> <p>Have the students share their experiences in their journals</p>

<b>ASSESSMENT:</b>	<b>ADAPTATION/DIFFERENTIATION:</b>
<ul style="list-style-type: none"> <li>● Review student research journals between Day 1 and Day 2.</li> <li>● Review the experiences written on Day 2</li> </ul>	<ul style="list-style-type: none"> <li>● If necessary, have a couple of pre-folded airplanes for students that may have trouble folding</li> </ul>