BROOKLYN AERODROME FLIGHT SCHOOL

LESSON 1.1

ENTRY EVENT: *PAPER AIRPLANE COMPETITION*

LESSON CONTENT

Technical Skills	Academic Standards	21st 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
		Day 1

5	**Pre Lesson**	• Ask the students what makes an airplane fly?
		• Have a short discussion about some of the student's ideas.
		• Tell the students that we are going to have a competition to see who can design and build the airplane that:
		  ○ Can stay in the air the longest
		  ○ Come the closest to the center of a target
		  ○ Can fly the furthest.
		• Before we get to the competition, we need to do some research and experimentation.

10	**Engage**	• Hand one sheet of paper to each student.
		• Take them through the folding of the Classic Dart
		  ○ Go Through the directions step by step
		  ○ Fold an airplane along with them
		  ○ Circulate to make sure students aren't having trouble
		  ○ Tell them they will be able to throw their airplanes, but not yet.
		  ○ Make sure they write their name on their airplane

15	**Discover/Explain**	• Give out one Research Journal to each student.
		• Have them turn to 1.1 Research. They should add notations to the diagrams on this page while you go over this section.
		• While everyone is holding their airplanes, take the students through and demonstrate the three axes of flight.
		  ○ Pitch – Nose Up/Down
		  ○ Roll – Wings Up/Down

		○ Yaw – Nose Left/Right • Introduce the students to the four forces of flight. ○ Gravity – Pulls the plane to the ground (drop the plane) ○ Lift – The force that the airplane must provide to counteract gravity ○ Drag – Slowing down the airplane with wind resistance. ○ Thrust – The push given by the engine or your arm • Ask the students how airplane engineers modify the forces. Be sure to illicit responses about: ○ Weight of the plane using light materials. It's easier to pick up a lighter plane ○ 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 ○ Bigger engines, or a harder throw gives more thrust • Go over the relationship between lift and thrust: ○ Bigger wings: more lift, needs less thrust ○ Small wings: less lift, needs more thrust • Fold the *Bullet* with the students. Again be mindful of folding difficulties. • Have students complete the Hypothesis and Method sections of their research journals. ○ In later lessons, students will be expected to provide more of the detail on their own. ○ Make sure that students have read the Variable and Setup Sections ○ Review the data that is to be collected, and how it is going to be collected
25	**Practice**	• Students should be paired so that one person can write while the other person is throwing. • 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. ○ Everyone will throw their planes after the Launch direction ○ You may only cross a solid line with permission ○ You may cross a dotted line on your own ○ They should get their planes, and go back to their spot on the flight line. • The thrower should stand on the flight line, the recorder should be three feet behind them. • Take the students through the four test flights, record the data each time ○ Dart thrown softly

		○ Dart thrown hard ○ Bullet thrown softly ○ Bullet thrown hard • Switch roles (recorders throw, the throwers record) and repeat the experiment • Have the students return to their seats (tell them they will get a couple more throws at the end if there is time)
10	**Wrap Up**	• Have the students finish the Analysis section of their journals • Students should talk with their partner about the results of the experiment • Remind students that it's perfectly OK if they didn't have a proven hypothesis.
		Day 2
5	**Engage**	Tell the students about the challenge to create a plane that will win in one of three challenges: ○ Can stay in the air the longest ○ Come the closest to the center of a target ○ Can fly the furthest.
5	**Discover/Explain**	In engineering there are always constraints, it is important for students to review the constraints for each of the upcoming challenges. Go over the design process for this challenge in the journal Show students the area of the room set aside for testing (this should not be the flight line area) Give students paper. Tell them they will have 20 minutes to test their planes and fill in the detail in their journal
40	**Practice**	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. After 20 minutes have the students go to the flight line. 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)
10	**Wrap Up**	Recognize the winner in each event Have the students share their experiences in their journals

ASSESMENT:	ADAPTATION/DIFFERENTIATION:
• Review student research journals between Day 1 and Day 2. • Review the experiences written on Day 2	• If necessary, have a couple of pre-folded airplanes for students that may have trouble folding