Principles of Flight

Lesson Plan: Paper Dart Airplane

Grade Level: 3-4

Subject Area: Science

Time Required: ***Preparation:*** 1 hour
Activity: 2-4 hours

National Standard Correlation:

Science (grades K-4)

- Science as Inquiry Standard: Abilities necessary to do scientific inquiry.
- Unifying Concepts and Processes Standard: Evidence, models and explanation.
- Unifying Concepts and Processes Standard: Change, constancy, and measurement.
- Physical Science Standard: Properties of objects and materials.
- Science in Personal and Social Perspectives: Science in technology in local challenges.

Summary:

Students will construct a paper airplane called the “Paper Dart”. The paper airplane will be used as a model to identify and discuss various principles of flight (such as lift, drag, gravity, air pressure, weight, thrust, airfoil and friction). The students will experiment with different aileron configurations and determine how these changes affect the flight of the paper dart.

Objectives:

Students will:

- Build a paper dart following written and verbal instructions
- Investigate how various alterations to the ailerons on the paper dart affect the distance and path of flight
- Reach a conclusion about the most successful placement of the ailerons to achieve maximum flight distance
- Measure and record distance flown by paper dart
- Make a bar graph to represent distances flown by the paper dart
- Reinforce knowledge and understanding of previously introduced terminology

Materials:

You will need:

- Paper (8½" x 11")
- Paper clips
- Tape
- Scissors
- Tape measure (metric or standard)
- Notebook paper
- Pencil and colored pencils
- Graph paper
- Paper Dart pattern

Safety Instructions:

Do not fly paper gliders directly at another person because the pointed tip could cause injury. Use caution when flying the paper airplanes. Create a single direction flight zone. Be sure that students stop flying their airplanes when other students are retrieving airplanes that have already landed.

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Procedure:

A. Warm-up

1. Explain the function of the wing on an airplane. The best wing has a curve along the upper surface and a flatter lower surface. The wing on the dart is curved toward the top and flatter on the bottom. The ailerons at the back of the paper airplane will alter the flight pattern.

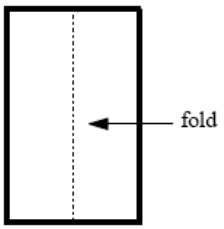
2. Review the four forces of flight (lift, drag, thrust, gravity).

3. Review measuring skills (using a tape measure).

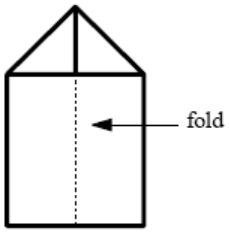
B. Activity I

1. Using the Paper Dart airplane pattern, construct a paper airplane using the following instructions:

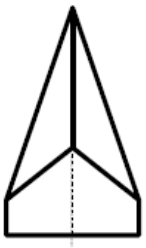
   a. Fold the pattern in half lengthwise and open.



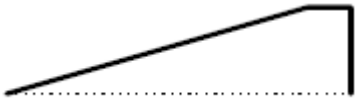
   b. Fold down the top two corners of the paper so they meet together at the center line. Make folds as neatly as possible. Rub with the side of a pencil to make the fold nice and crisp.



   c. Fold the entire right-hand top edge to the center line. Now fold the entire left-hand top edge to the center line. The two folds will meet in the middle.



   d. Fold plane in half along the center line.



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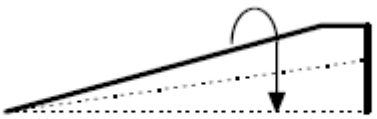
e. Now take one of the open edges and fold it back to the "folded" center line.



f. Turn the paper over and repeat. Gently pull up on the wings and tape them into place.

g. To make the ailerons, cut on the solid lines and fold on the dotted lines, as indicated on the master pattern.

2. Go to a large indoor area (gymnasium) and practice flying the paper dart airplanes.

3. Using masking tape, mark a line for the students to stand behind when flying their darts.

4. Students will fly their darts a total of four times, each time with a different aileron configuration.
   1st flight - no ailerons
   2nd flight - both ailerons up
   3rd flight - both ailerons down
   4th flight - one aileron up and one aileron down

5. Measure the distance flown during each flight. Note: You may want to mark the gym floor (with masking tape) at 1 meter intervals to make it easier for students to measure.

6. Record distance flown during each flight on the Dart Chart.

7. Students will determine which aileron configuration provided their paper dart the longest flight distance.

8. Use the aileron configuration that provided the longest flight, to now accomplish Activity II.

C. Activity II

1. Students will fly their paper dart (with aileron configuration from Activity I) a total of five times.

2. Measure and record the distance flown during each of the five flights.

3. Make a bar graph to show the five flights.

D. Wrap-up

1. Have students take time to compare their results with other students. Discuss the results.

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Assessment/ Evaluation:

Students can be evaluated by teacher observation of students' participation in the activity. Evaluate graphs for accuracy.

Extensions:

1. Using the bar graph, visually and mathematically determine the average distance flown by the paper dart.

2. After a brief discussion of the meaning of "controlled experiment," have students work in pairs to set up a controlled experiment using the paper dart design, but changing one variable. Variables to change could include:
   - Material used in making the dart (i.e. aluminum foil, heavy paper, lightweight paper)
   - Use the paper dart from Activity I, but vary the weight of the glider by adding paper clips
   - Use different sizes of paper to construct the paper dart

   During each controlled experiment, students should fly their darts a set number of times and record their results.

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The Dart Chart

FLIGHTS	DISTANCE IN CENTIMETERS
NO ailerons	_____cm
Both ailerons UP	_____cm
Both ailerons DOWN	_____cm

CONCLUSION:_____

_____

_____

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Made by ____________________

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THE DART

AILERON

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