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Paper Airplanes: A Critical Thinking Model

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PAPER AIRPLANES: A CRITICAL THINKING MODEL

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What upper elementary school teacher during his or her career hasn't had to deal with the occasional illicit flight of a paper airplane? Children show an interest in airplanes--from the paper variety to model planes to the real thing. From an educational standpoint, it would seem beneficial to make use of this interest. One possibility within the arena of the science class would be to use the paper airplane as a vehicle (no pun intended) for hands-on activities utilizing such sophisticated critical thinking skills as controlling variables, hypothesizing and experimenting.

One such hands-on activity might begin with the teacher posing the following question to the class: If increasing numbers of paper clips were attached to a paper airplane, what would happen with respect to the distance the plane would fly? After a class discussion, each student would be asked to generate a testable hypothesis based on his or her answer to the above question. Two such hypotheses might be:

1. As the number of paper clips attached to a paper airplane increases, its flight distance will decrease.
2. As the number of paper clips attached to the paper airplane increases, its flight distance will increase.

Prior to the testing of the students' hypotheses, the class needs to discuss variables which need to be controlled so as not to confound the results of the experiments. The teacher should be sure that the discussion includes such variables as the height from which the planes are flown, the amount of energy with which the airplanes are launched and the size of the paper clips attached to the planes.

In order to help the experiment proceed smoothly, a plane like the one shown in Figure 1 may be used. After folding a piece of standard paper (students should be encouraged to recycle old worksheet papers) into the plane (see Figures 2a-2f for a suggested plane design), a piece of tape is placed across the wings to hold them together. Then, a small notch is cut into the plane's body about nine centimeters back from the nose of the plane. Finally, a thin rubber band approximately 16 centimeters in circumference is taped into the notch.

This paper airplane allows the experimenter to control the amount of energy with which the plane is launched. By placing the rubber band over the end of a ruler and pulling the plane back so that its nose reaches the same distance (ten centimeters) each time before letting go and launching the plane, the energy factor is controlled (Figure 3).

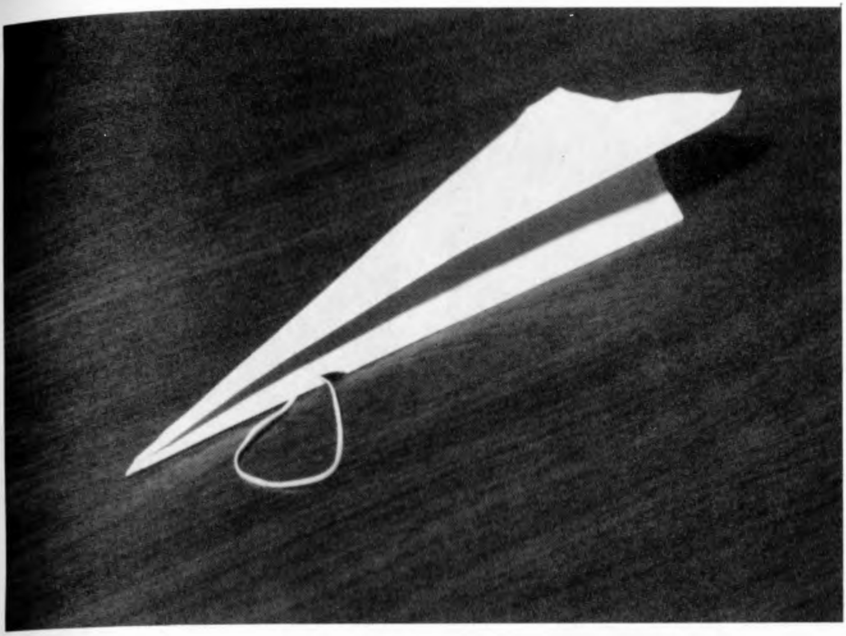

Figure 1

Since the procedures associated with the collection of the data involve a number of jobs, children can work effectively in cooperative learning groups of two, three or four members. The actual launching of the paper airplanes should be done from the top of a desk or table (Figure 4). One student should be responsible for this task. Another student should watch the launching ruler to make certain that the plane is launched with the same amount of energy for each trial. One or two students, using meter sticks or tape measures, should measure the actual horizontal distance the plane travels during each flight. The students may collect data as a group, or they may rotate jobs and allow each student to gather his or her own data.

To help the students collect similar data for the experiment, the teacher should provide them with a data collection sheet such as that in Figure 5. As the sheet indicates, the students should attach varying numbers of paper clips to their planes and make multiple trials for each number of paper clips. Computing the mathematical average of the trials helps to obtain a more accurate flight distance for each number of attached clips.

After collecting the data and calculating the average flight distances, the students may interpret their data. A good leading question might be: Is there a pattern in the data? That is, was there a direct relationship (as clips increase, flight distance increases) or an inverse

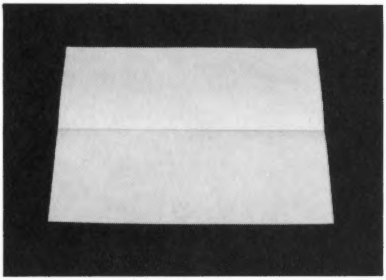

Figure 2a

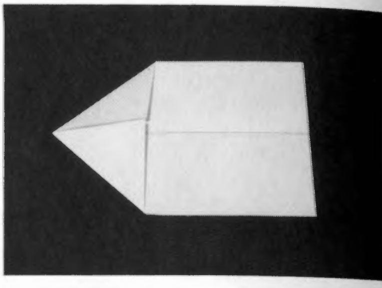

Figure 2b

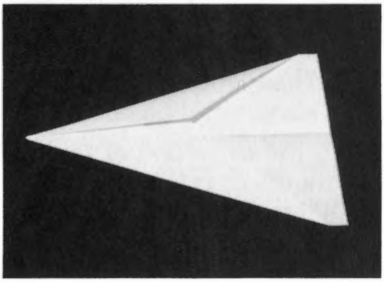

Figure 2c

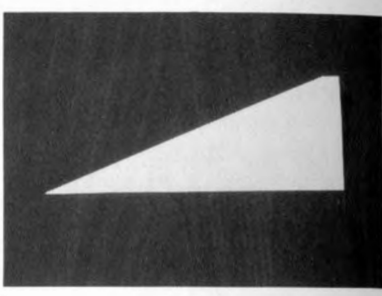

Figure 2d

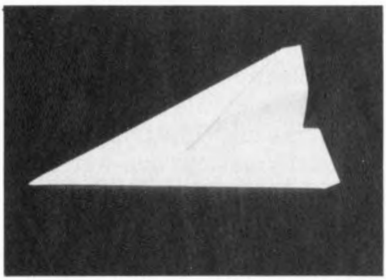

Figure 2e

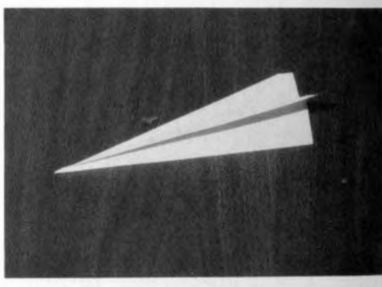

Figure 2f

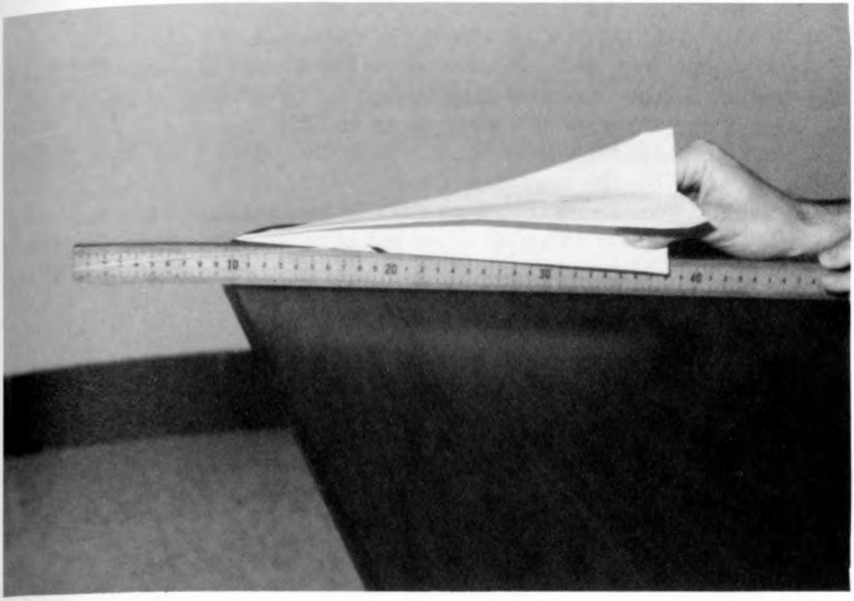

Figure 3

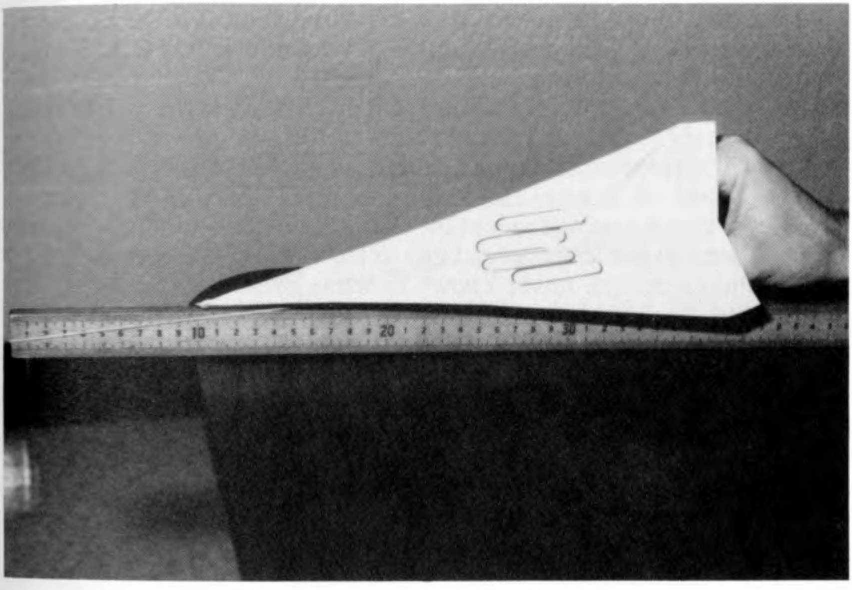

Figure 4

relationship (as clips increase, flight distance decreases)? Or was there no pattern at all to the data? Perhaps as the number of clips was increased, the distance went down and up and down again.

The hypothesis decision should be based on the students' data interpretation and how well they thought they controlled extraneous variables. For example, if the students had orderly data and thought they had good control, they could accept or reject their hypothesis depending on how the hypothesis was stated.

However, even though orderly data should prevail, if the students thought they did not do an effective job of controlling variables, they might decide to suspend judgement and redo the experiment, making a better attempt to control variables. On the other hand, if the students' data were not orderly and the students thought they were successful at controlling variables, they could reject their hypothesIS. Or, if their data were not orderly and they felt they had not controlled extraneous variables well enough, they could suspend judgement and decide to perform the experiment again with an eye toward better control. The teacher may choose to discuss the hypothesis decision possibilities prior to the students making their actual decisions if he or she deems such a discussion necessary to clarify the procedure for the children.

At the conclusion of this activity, the teacher may encourage the students who want to redo their experiment to do so. A spin-off activity based on a student's data would be to make a line graph depicting the relationship between the number of clips and the associated average flight distance. Another possible follow-up activity might be to predict flight distance when the paper clips are placed at different locations on the plane and, subsequently, design and perform an experiment to test the hypothesis. Moreover, different possibilities exist for integrating the topic of airplanes into other subject areas, such as language arts and social studies. As an example, students could do some research and write reports concerning the history of paper airplanes and their direct contributions to the knowledge base in the field of aeronautics.

Furthermore, one never knows to what heights he or she might soar for being knowledgeable about flying paper airplanes. For example, one large midwestern university in cooperation with Rotor and Wing Association of America and a local aerospace education committee sponsored its third annual "Paper Airplane Throwing Contest" in the autumn of 1990. Preschoolers through eighth graders were allowed to participate in the contest. The wide array of prizes for the winners included t-shirts, flights in real airplanes, introductory flight lessons at a local airport and even brightly colored classroom desks in the shape of an airplane!

NAME ____________________

HYPOTHESIS: ____

____

____

DATA COLLECTION

NUMBER OF CLIPS	DISTANCE TRAVELED IN METERS			AVERAGE OF TRIALS
	TRIAL 1	TRIAL 2	TRIAL 3	
0				
2				
4				
6				

DATA INTERPRETATION: ____________________________________

____

____

HYPOTHESIS DECISION
(CHECK ONE)

ACCEPT _____

REJECT _____

SUSPEND JUDGEMENT _____

Figure 5