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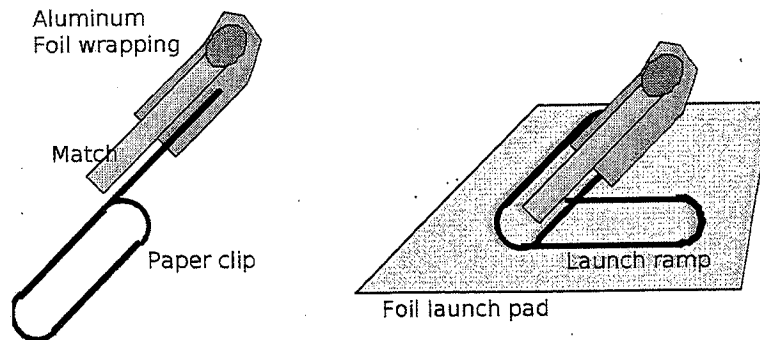
Match Rockets

PURPOSE: To examine how Newton's three laws of motion apply to rockets.

MATERIALS: Three matches (enough for 3 trials), 2 paper clips, a small sheet of aluminum foil (~10 x 10 cm), safety goggles

PROCEDURE:

1. Wrap a wooden match in foil, airtight with one end of an opened paper clip against the match stick, as shown in the diagram. Once the foil has been wrapped tight, carefully slide the paper clip out. This open space will be the "exhaust pipe" for the rocket.



2. Use a second paper clip (opened as shown in the diagram) as a launching ramp. Place this ramp on a piece of foil (the launching pad), and lay the rocket against the ramp.

3. Heat the wrapped match head with the lighter and watch your rocket launch!

4. Construct a series of 3 match rockets. Each time you construct a rocket, carefully record the following notes in a data table as shown below:

a) **CONSTRUCTION NOTES** -- How did you construct the rocket? (For example, did you use a lot of foil or a little? Did you cover the entire match with foil, or just the top part?) If a digital scale is available, weigh the rocket and record the weight.

b) **PERFORMANCE NOTES** -- Record the approximate distance your rocket flew. If it didn't fly, tell what it did. (For example, "Rocket flew 10 cm", or "rocket went in circles", or "rocket fell over and didn't go anywhere")

Trial #	Construction Notes	Performance Notes
1		
2		
3		

QUESTIONS:

1) What makes the match rocket shoot up? Draw a diagram of a rocket "engine" (combustion chamber), and include force vectors where appropriate.

2) What would happen if we constructed a rocket without an exhaust tube? Draw a free-body diagram of the force of the fuel combustion acting on the rocket.

3) How does Newton's First law apply to your match rocket?

4) Explain how you can apply Newton's second law to improve the performance of the rocket.

5) How does Newton's third law explain the actions of the match rocket?