Elasti-Launcher: Mission to Mars

The CoolStuff Newsletter

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Goal: Using their own projectiles created from BIC™ pens or straws (see instructions on the last 2 pages), students will perform multiple test launches and collect data on multiple variables: Angle, Power, and Mass. From these trials and test data, students will produce Final Launch Settings in order to hit a specified target with a rocket of a specific Mass.

Grade Levels: 8-Adult

Method: Have your students work as individuals or in groups depending on time and number of Elasti-Launchers.

1. Give each group a piece of clay with a mass of about 30 grams. They will use this piece of clay to add mass to their rocket by wrapping the clay around the tip of the pen tube without covering the open end of the tube.
2. Give your students enough time to complete 20 test launches. They should complete half of the test launches with the added 30 gram mass and half with no added mass. They must record the following data for each launch: mass, power, angle, and distance. Allow your students to select their own powers and angles for all of their launches.
3. Once the groups have completed their 20 test launches, take back the 30 gram piece of clay, and give them a 15 gram piece of clay. They must add this mass to their rocket for the final launch.
4. Place a hula hoop or other target of similar size at a reasonable distance from the Launcher. This target represents Mars. Base this distance on how far the test flights were able to travel with the 30 gram mass. You don't want to place the target farther away than the rockets are able to travel with the 15 gram mass. Somewhere around 10m is usually good in an unrestricted space.
5. Students must now analyze their test launch data and decide on the appropriate settings for a single Final Launch to reach "Mars". Have the students write down their Final Launch Settings: mass, power, and angle.
6. Students may launch their final rocket using their Final Launch Settings and record the distance of impact.

Variations: After their first Mission to Mars, place Mars at a new distance and have the teams decide on new settings to hit the new target with the 15 gram mass still added to their rocket.

Keep Mars at the same distance and give them another mass of clay to add to their rocket, 40 grams or 50 grams.

Make copies of the second page for student worksheets.

Elasti-Launcher: Mission to Mars

Team Members: _____

Mission Date: _____

Directions:

- **A.** Your teacher will give you a piece of clay with a specific mass. You will perform a total of 20 test launches and record the data from each launch. You must perform 10 launches with the mass added to your rocket, and 10 launches with no added mass.
- **B.** After completing the 20 test launches, your teacher will place "Mars" at a specified distance from your Elasti-Launcher. Write down this Distance to Mars in the Mission Data box.
- **C.** Your teacher will collect the first two pieces of clay give you a third piece of clay. Add this new clay to your rocket and write down the mass of this rocket.
- **D.** Analyze your test launch data and decide upon the Angle and Power for your Final Launch Settings.
- **E.** Explain your reasoning for selecting your Final Launch Settings.
- **F.** Launch your rocket at Mars using your Final Launch Settings and record the Impact Distance.

Test Launch Data

	Mass (g)	Angle (°)	Power Setting	Distance
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

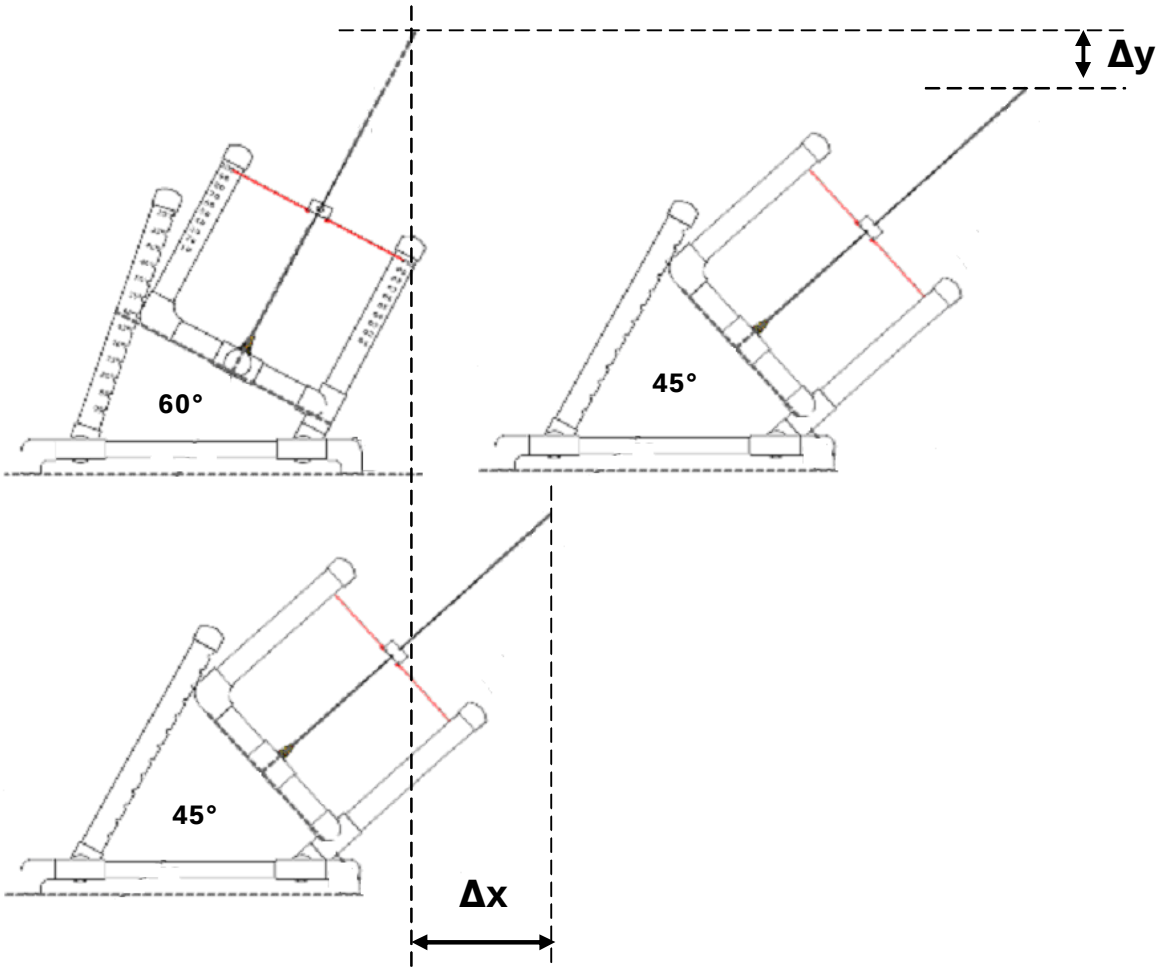
Mission Data

Distance to Mars:				
Final Launch Settings:	Mass:	Angle:	Power:	Impact Distance:
Explanation for Final Launch Settings:				

Perceived Error Source – True Launch Point

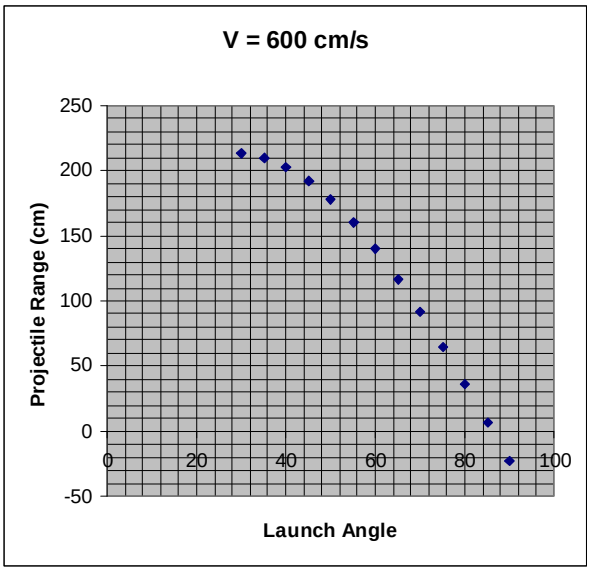
Students may notice some discrepancies in their results, especially if they test many different launch angles. They may have already learned that a launch angle of 45° should yield maximum range. Here, for low launch speeds, the longest range may appear to result from the 35° launch angle! This discrepancy is caused by the launcher design. Students can find the error source with careful observation.

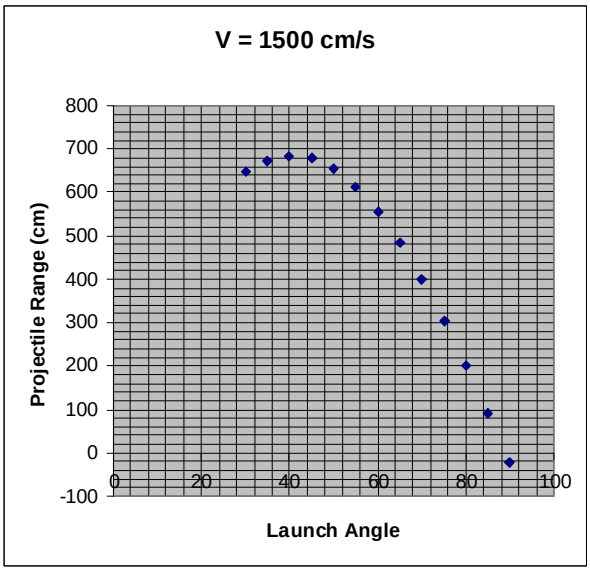
Examine these diagrams of the launcher at two different angles.



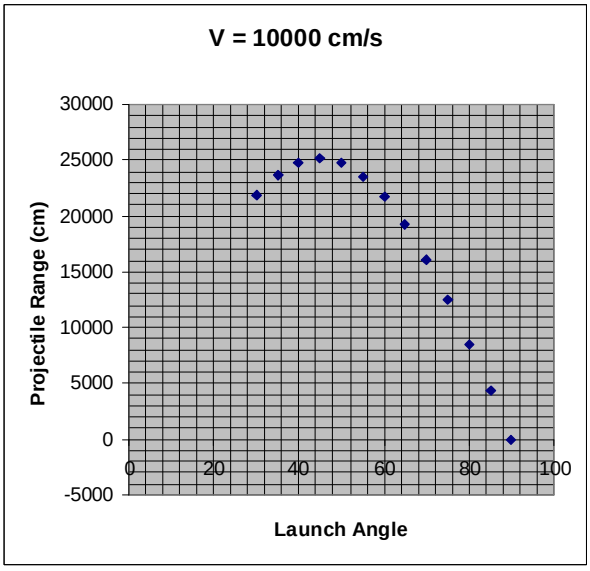
Notice that when the launcher is adjusted from 60° to 45°, the launch point at the end of the rod moves down by a distance Δy and forward by distance Δx.

The charts below show theoretical results for two different launch velocities, calculated using measurements of the launcher along with projectile formulas. Range distances are measured from the pivot point of the launcher.





When the launch velocity is very low (600 cm/s), the maximum range appears to occur for the lowest angles. But if we account for the change in launch point, the results become what we expect, with maximum range at 45°. For a higher launch velocity (1500 cm/s), the discrepancy is less, with the maximum range appears to occur about 40°. If we could make the launcher work at a very high velocity, the discrepancies caused by the shape of the launcher become inconsequential.



Make Your Own Projectiles

Simply use the template provided (next page) or have students create their own fin or wing designs. Attach the fins with glue or tape to the body of a pen with the with the writing section and end cap removed. Standard BIC™ pens or Papermate™ pens with the white housings work great. Just be sure that the pen housing you use can easily slip unrestricted on to the launch guidance rod.

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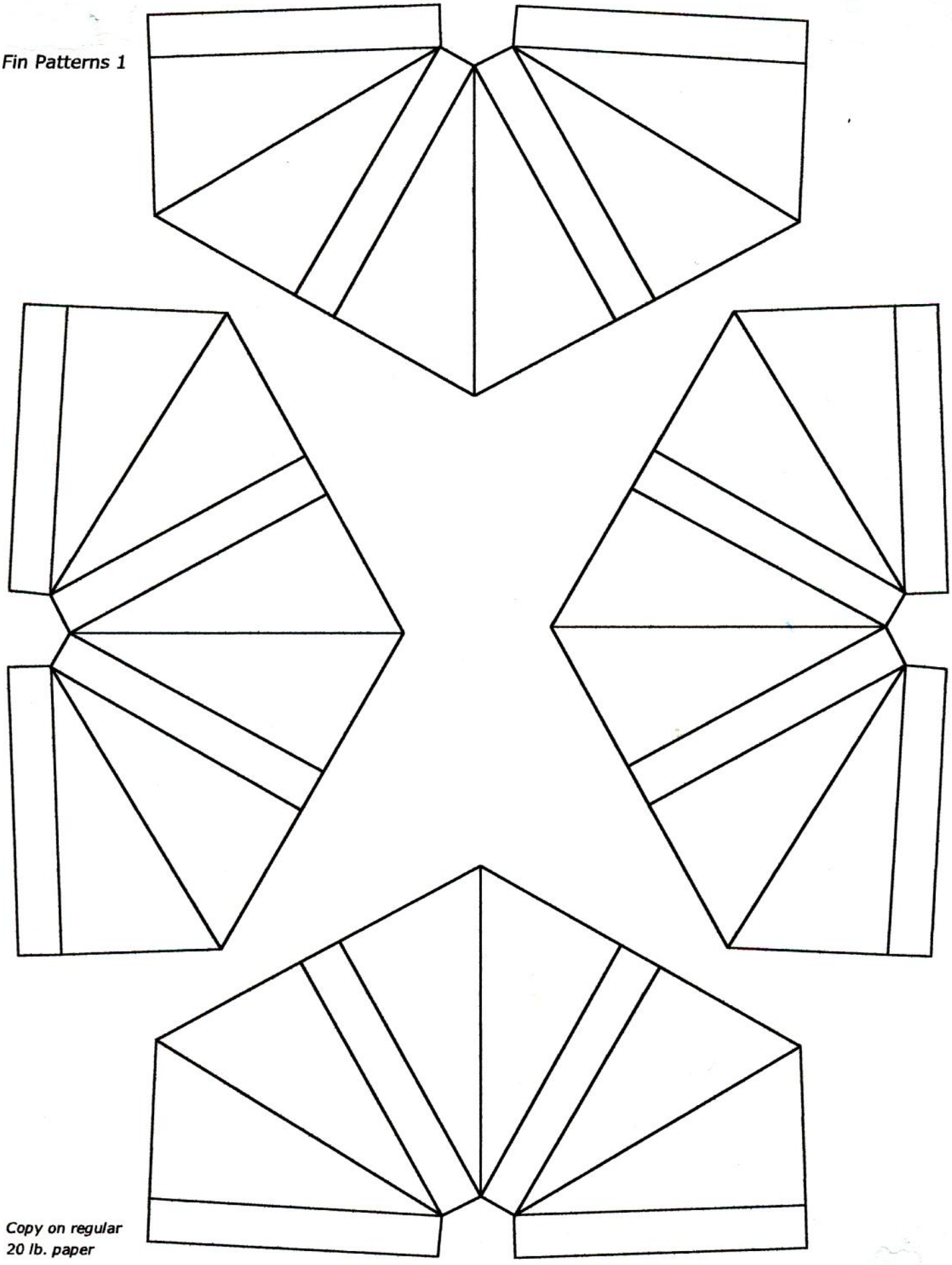
Fin Patterns 1



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