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Elasti-Launcher

P4-1963

ASSEMBLY INSTRUCTIONS:

A. Launch Angle Arm
B. Launch Base
C. Launcher Tube
D. Large Rubber bands
E. Left and Right Launch Arms
F. Guidance Rod
G. (2) Projectiles

1. Identify each of the components listed above when unpacking your new Elasti-Launcher
2. Set The Launch Base (B.) on a flat, stable surface with the Launch Trigger facing you. **(See figure 2)**

Fig. 2

3. Insert Launch Angle Arm (A.) into the Launch Angle Arm housing located on the left end of the Launcher Base (B.), so that the small metals pins on the arm slide into the slots in the housing. **(See Figure 3)**

4. Insert The Left and Right Launch Arms (E.) into the two housings of the movable arm of the Launch Base. **(See Figure 4)** Twist the Launch Arms so that the small metals pins on the arm slide into the slots in the housing.

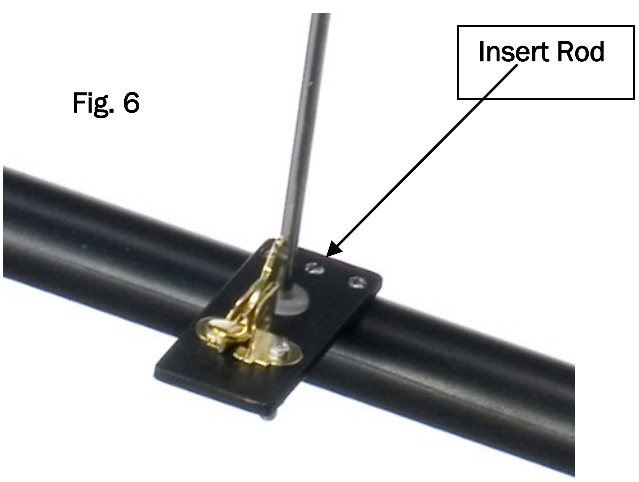
Fig. 4

Fig. 3

5. Attach each of the Rubber bands (D.) to the Launcher Tube (C.) by slipping one end of the Rubber band through the holes at each end of the Launcher Tube and pull them through the trailing loop of the Rubber band and pulling them tight. **(See Figure 5)**

Fig. 5

Fig. 6



6. Insert the Guidance Rod (F.) into the white plastic housing insert located on the launch trigger plate. **(See Figure 6)**

7. Slide the Launcher Tube (C.) onto the Guidance Rod (F.) using the two parallel holes, Keeping the large single hole in the middle of the Launcher Tube facing you. (See Figure 7)

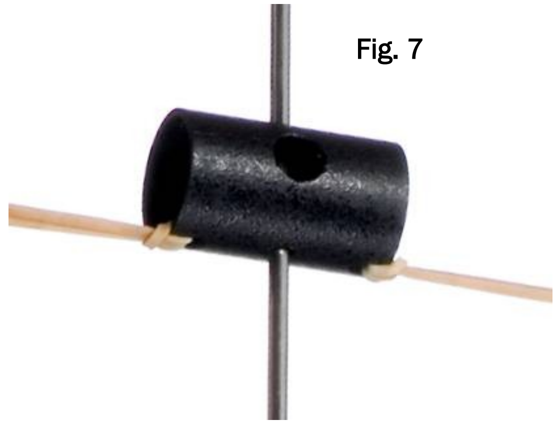


Fig. 7

8. To prepare for the launch of a projectile; slide one of the provided projectiles onto the guidance rod. Pull the launcher tube down towards the base until it engages the trigger at the large hole on the launcher tube. Do not lean over the launcher when setting a projectile for launch

9. Different power settings can be obtained by changing the rubber band locations on the launch arms. Be sure to match the setting indicators on the rubber band pegs. Mis-matching the setting indications will cause uneven tension in the rubber bands and induce friction and possible binding in the launch tube assembly.

STUDENT ACTIVITIES:

The following pages contain three complete student activities for the Elasti-Launcher. These may be reproduced as needed for use with this equipment set.

I. Launch Predictions: Students will predict the point of impact when launching a rocket at a specific power and angle.

II. Study of Angles: Students will use the angle of the steel rod in relation to the ground and in relation to a second steel rod and apply knowledge of interior, exterior, adjacent, and opposite angles to calculate unknown angles.

III. Mission to Mars: 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.

ELASTI-LAUNCHER: LAUNCH PREDICTIONS:

Goal: Students will predict the point of impact when launching a rocket at a specific power and angle.

Grade Levels: 4-Adult

Method: Students will be given a specific Power and Angle by their teacher. We'll call this the Final Launch Settings. They may perform two Test Launches using any combination of Powers and Angles other than their Final Launch Settings. Students must give reasons for how they selected their Test Launch Settings. After completing their test launches and recording their distance, students must predict the point of impact when launching with the Final Launch Settings.

Grouping and Variations: You may have each student work as individuals or place them in small groups. This may be determined by time and the number of Elasti-Launchers you have. You might give every team the same Final Launch Settings, or use a variety of settings. You could also give each team 2 or 3 Final Launch Settings so they can modify their methods of choosing their Test Launch Settings as they go.

Sample Final Launch Settings:

Power	Angle
8	35°
5	50°
3	45°
7	15°

Make copies of the second page for student worksheets.

ELASTI-LAUNCHER: LAUNCH PREDICTIONS:

Team Members: ____

Mission Date: ____________________

Directions:

A. Write down the Final Launch Settings as your teacher gives them to you.
B. Select two Test Launch Settings that will help you predict where your rocket will land when it is launched using the Final Launch Settings. Do not use the exact Final Launch Settings for your Test Launch Settings. One number may be the same, but not both.
C. Explain why you selected your Test Launch Settings.
D. Launch two rockets using your Test Launch Settings and record their Distance.
E. Based on the results of your Test Launches, predict and write down where you think the rocket will land when launched using the Final Launch Settings.
F. Launch your rocket using the Final Launch Settings and record the Distance.

Mission #1		
Test Launch 1	Angle Setting Power Setting	Distance
Test Launch 2	Angle Setting Power Setting	Distance
Explanation		
Final Launch Settings	Angle Setting Power Setting	Predicted Distance Actual Distance

Mission #2		
Test Launch 1	Angle Setting Power Setting	Distance
Test Launch 2	Angle Setting Power Setting	Distance
Explanation		
Final Launch Settings	Angle Setting Power Setting	Predicted Distance Actual Distance

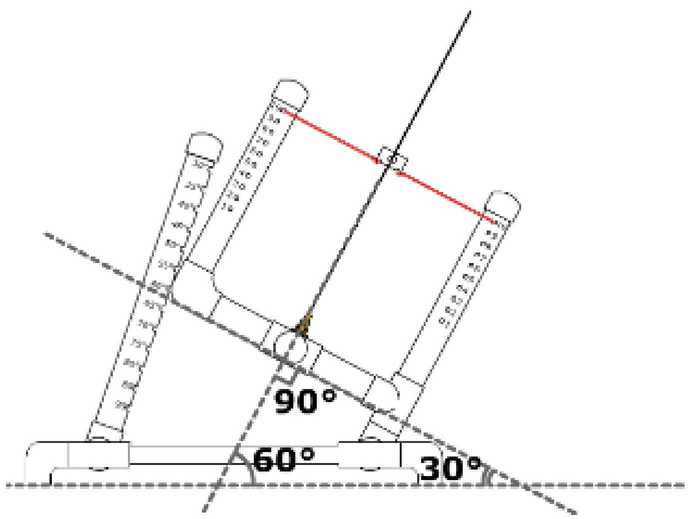
ELASTI-LAUNCHER: STUDY OF ANGLES

Goal: Students will use the angle of the steel rod in relation to the ground and in relation to a second steel rod and apply knowledge of interior, exterior, adjacent, and opposite angles to calculate unknown angles.

Grade Levels: 6-Adult

Method: Setting the Elasti-Launcher at different angles creates other angles at the various joints as well as a few "virtual angles" when comparing the steel rod to the ground or the PVC pipes of the launcher, or even a second Elasti-Launcher set so their steel rods cross each other. Images will clarify this later on.

1. Begin by establishing why the Angle Arm is marked with degrees ranging from 30° to 90° (it is the angle of the steel rod in relation to the ground). For example: When the Launcher is set at 60°, the measurement is determined by the extended line from the base of the steel rod to the ground.



2. Applying the "sum of the angles of a triangle add up to 180°", we can determine the 3rd angle of the triangle formed, the 30° angle in the example above. Sketch the setup on the board or overhead and label the 3 angles as in the image above so your students can visualize the angles.

3. Set the launcher to a new angle and have the students sketch the setup in #1 of the worksheet, as you did on the board, labeling the 3 angles.

4. Place a second Launcher facing the opposite direction. Set the two launchers at different angles, steep enough so their steel rods cross one another. Have your students complete #2 of the worksheet, identifying all the labeled angles. You will give them the angles for B and H.

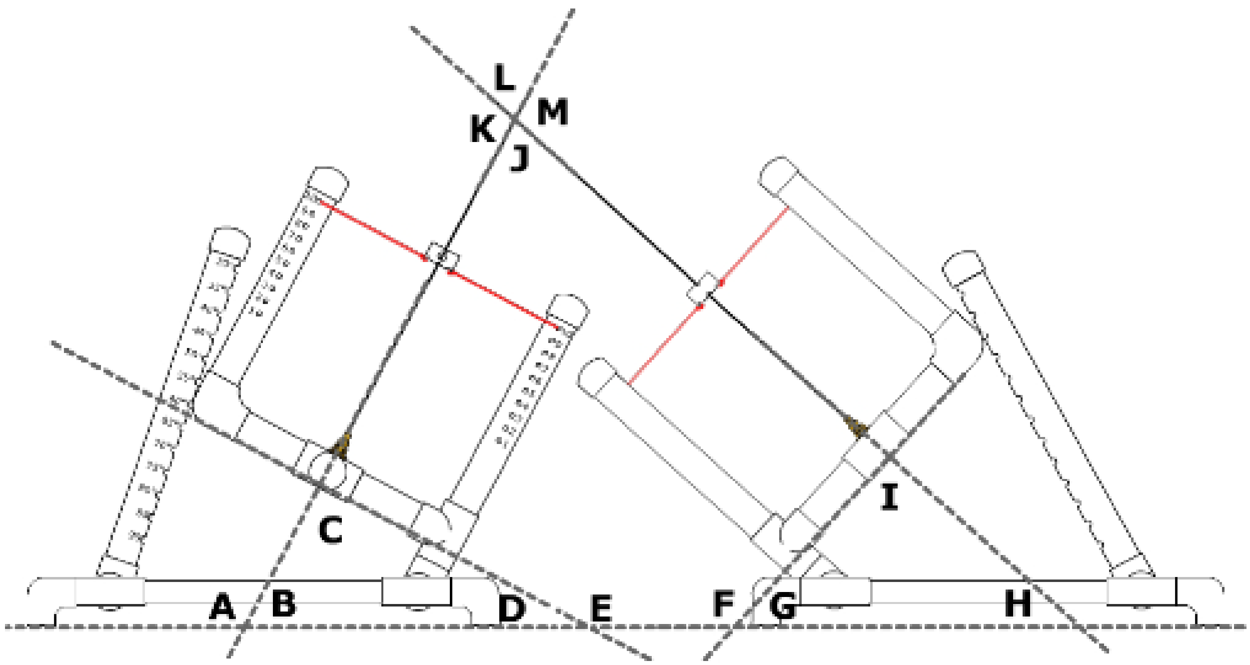
Make copies of the second page for student worksheets.

ELASTI-LAUNCHER: STUDY OF ANGLES

Name: ____ Date: _____________________

1. Sketch the launcher and label the 3 angles of the triangle as shown in your teacher's example.

2. Write the degrees for each angle:



A		B		C		D		E	
F		G		H		I		J	
K		L		M					

ELASTI-LAUNCHER: MISSION TO MARS

Goal: 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: 5-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				

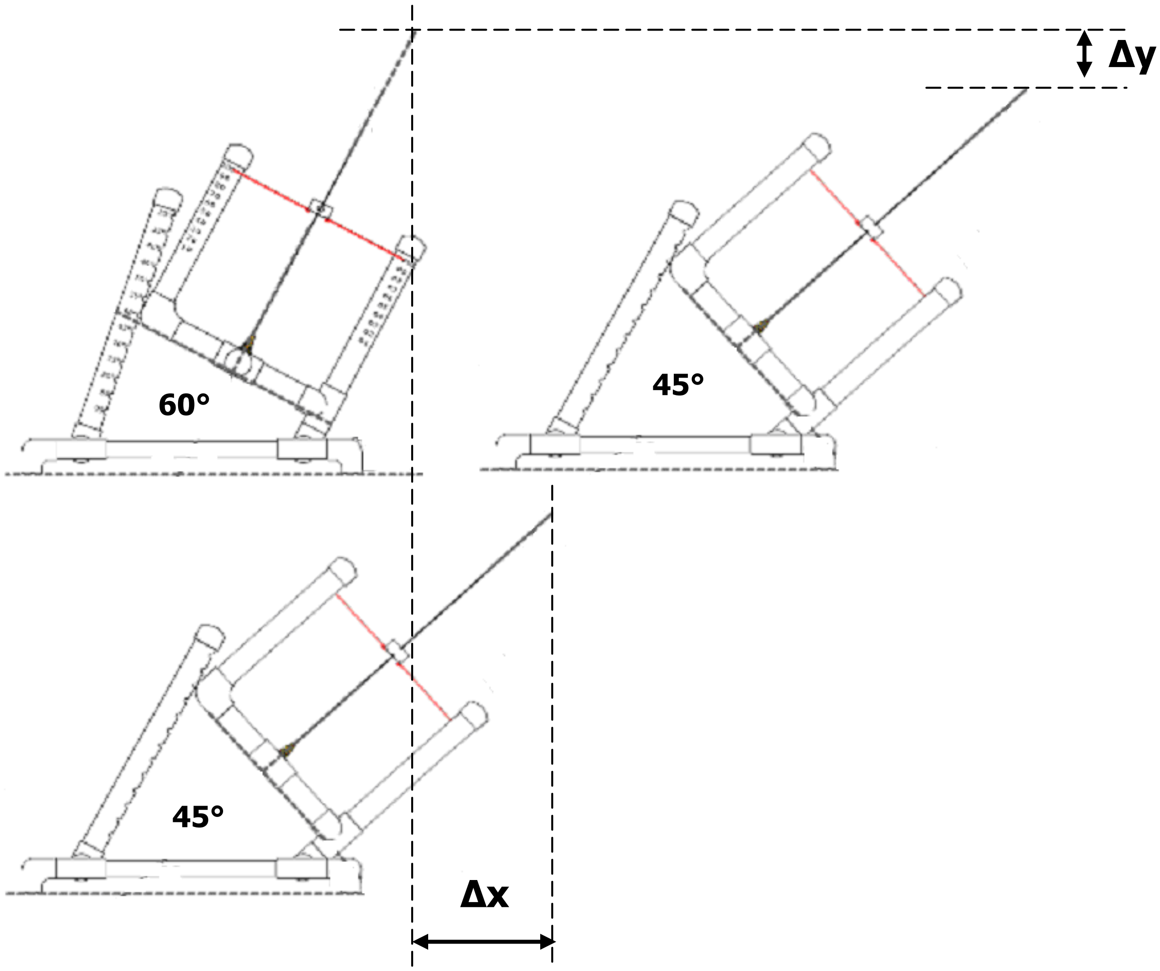
Mission Data

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

PERCEIVED ERROR SOURCE – TRUE LAUNCH POINT

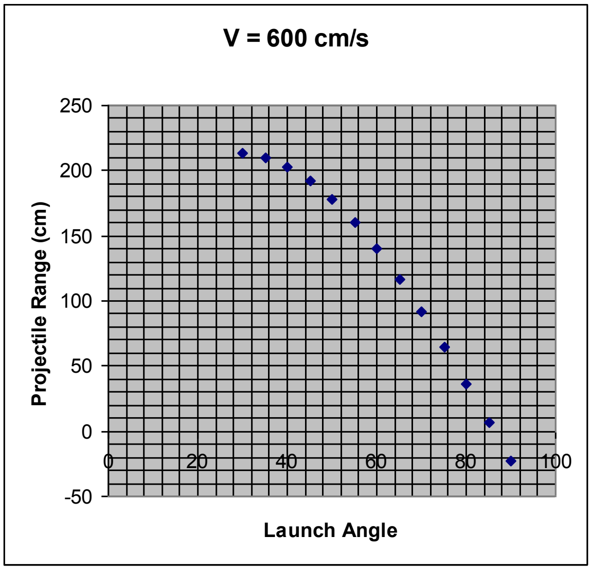
Students may notice some discrepancies in their results, especially if they test many different launch angles. They may have already learned that a launch angle of 45° should yield maximum range. Here, for low launch speeds, the longest range may appear to result from the 35° launch angle! This discrepancy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

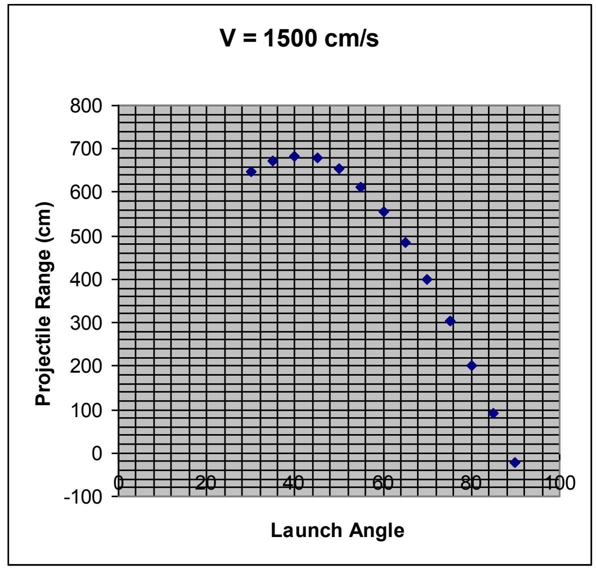
Examine these diagrams of the launcher at two different angles.

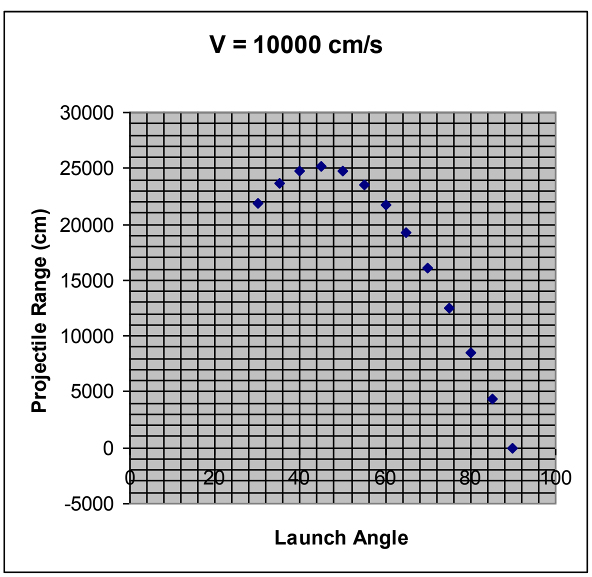


Notice that when the launcher is adjusted from 60° to 45°, the launch point at the end of the rod moves down by a distance Δy and forward by distance Δx.

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.







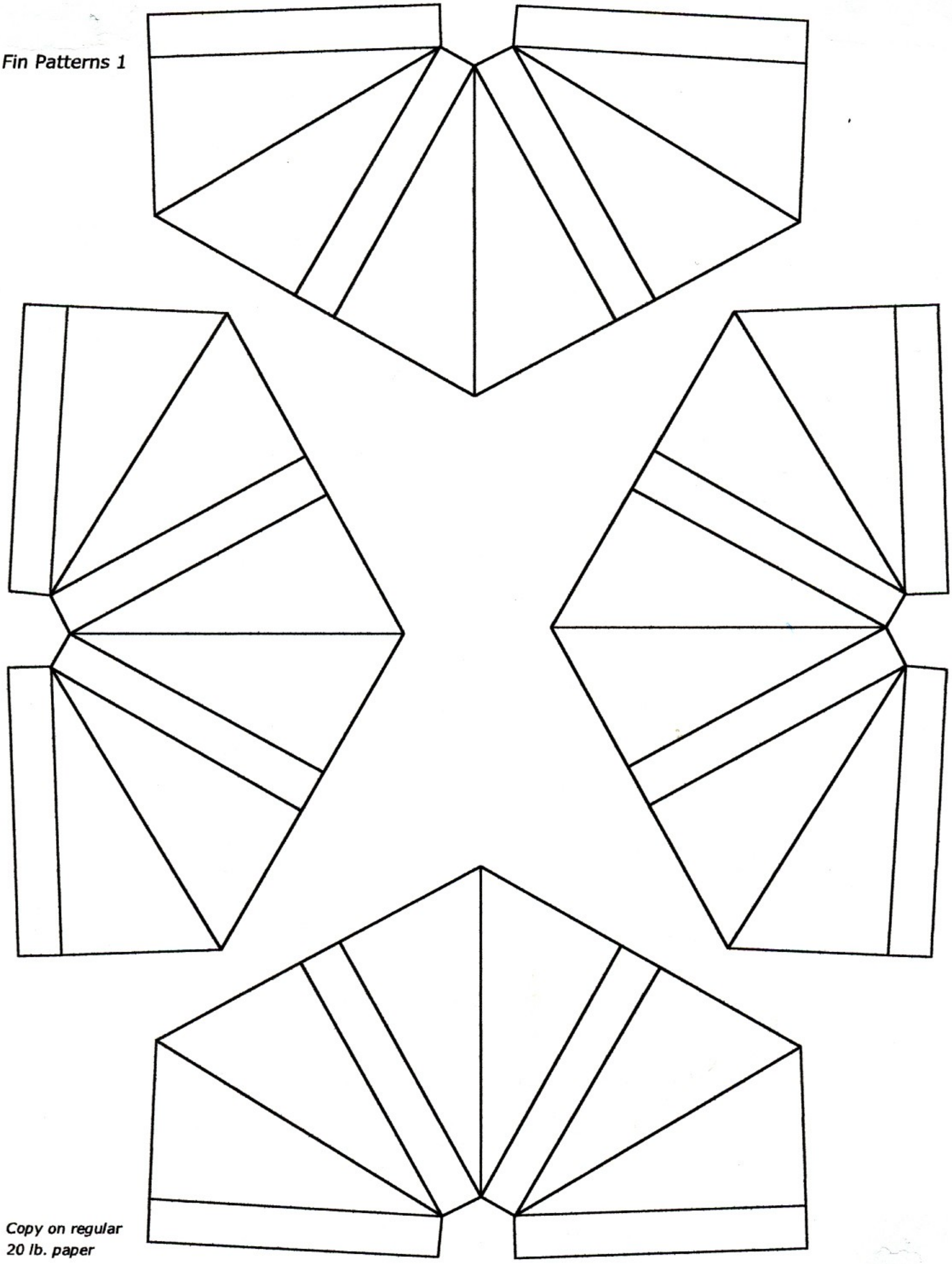
When the launch velocity is very low (600 cm/s), the maximum range appears to occur for the lowest angles. But if we account for the change in launch point, the results become what we expect, with maximum range at 45°. For a higher launch velocity (1500 cm/s), the discrepancy is less, with the maximum 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

Students can explore further by making their own projectile. Simple use the template provided 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.

See Fin Template on the next page.

Fin Patterns 1



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