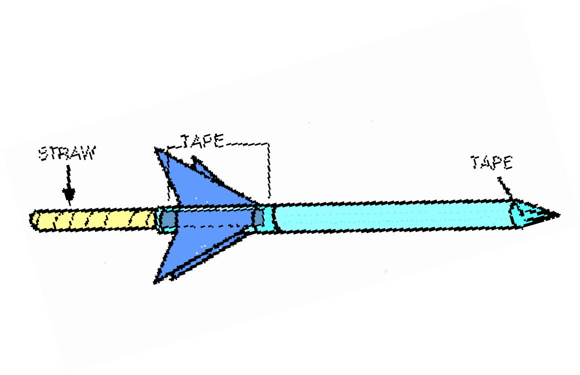
# Strawkets and Quadratics



**Summary**

In this activity, the students will develop a quadratic function for their rocket flight. Each student will construct a paper rocket that he/she will launch by blowing through a straw called a "strawket". The students will collect and graph the data to create a parabola. In addition, they will suggest other design improvements or variables that affect the flight of the rocket (e.g., less weight, high pressure air blower, fixed launch position, wing/fin design).

**Time Required:** 50 minutes

**Materials List**

Each student should have:

- 1 half-sized piece (measuring 8.5" × 5.5")
- 1 letter-sized piece of paper
- 1 pencil
- 1 drinking straw
- 1 pair of scissors

Each pair of students should share:

- tape dispenser
- stopwatch

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**Procedure**

1. Have students wrap one piece of paper (measuring 8.5"× 5.5") around a pencil starting from the eraser and working toward the tip. The paper should make a cone shape. (It can be done by holding it tighter at the eraser end and wrapping upward.) See Figure 1.

Figure 1. Photograph of a cone-shaped paper tube.

2. Have students tape the tube of paper near each end so it keeps its shape then remove the pencil. (Note: Make sure the final length of paper tubing is a few centimeters shorter than the straws, or students will have nothing to hold onto for the launch. Cut the paper tubing with scissors, if necessary.)
3. Have students pinch and fold the smaller end of the tube over and tape it so it is airtight. This end is the "nose" of the strawket.
4. Have students design and fasten a set of wings or fins to their strawket using a piece of letter-size paper and tape. Maximum height of the wings should be 8.5 inches. Minimum height of the fins should be 2 inches. Remind the students that the center of pressure should be behind (nearer to the tail) than the center of gravity for stable flight See Figure 2.

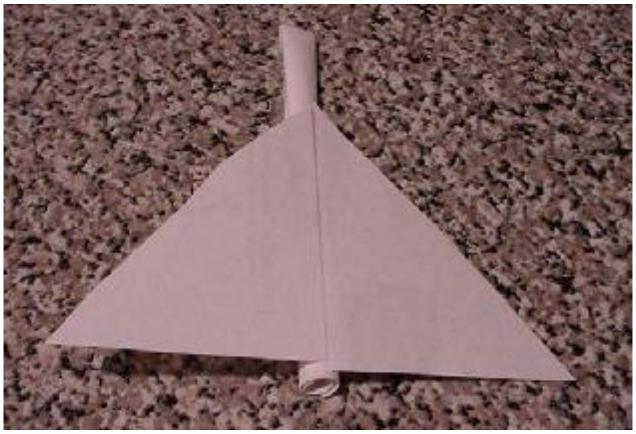

Figure 2. A cone-shaped strawket with fins

6. Have students personalize their strawkets. Suggest that they write their names on them or draw a design so they can identify their rocket.

## Safety Issues

- No strawkets may be launched while the previous student retrieves his/her strawket.
- No strawkets should be launched at another person.

## Troubleshooting Tips

- Make a strawket or two ahead of time to confirm your materials will be suitable.
- If you do not have access to enough pencils, extra drinking straws can be used instead to help wrap the paper cone.
- It is also a good idea to have some extra strawkets made in case a student's is lost or crushed during the activity.
- Make sure students are not holding onto the strawket when they blow through the straw; they should hold onto the straw only.

## Activity Extensions

- Ticket Out of the Door :

  What variables or design improvements could affect this activity other than initial velocity and initial height? (e.g., less weight, fixed launch position, wing/fin size).

Name ______________________________ Date ______________

# Strawkets and Quadratics

**Blast Off Procedure**

1. Insert the straw into the strawket — *holding onto the straw, not the paper part of the strawket* — aim at the 8 foot mark, and blow.

2. While one buddy is launching, the other buddy collects and records the following data:

- Time (in seconds – round to the nearest tenth) when the rocket reached 8 feet
- Launching height (in inches)

**To convert inches to feet with decimals, divide the number of inches by 12. Round to the nearest hundredth.

3. Repeat process but switch roles.

| | Buddy A | | Buddy B | |
|---|---|---|---|---|
| | Height | Time (to the nearest tenth of a second) | Height | Time (to the nearest tenth of a second) |
| Initial | (launching height) | 0 sec. | (launching height) | 0 sec. |
| Maximum (vertex) | 8 ft. | | 8 ft. | |

**Analysis**

After collecting the data:

1. Exchange the data.

2. Use your launching height and time for the vertex to write a quadratic function, $h(x) = -16t^2 + v_o t + h_{o.}$

A. Plug in vertex's time and launching height.

$$-16(\underline{\qquad\quad})^2 + v_o\,(\underline{\qquad\quad}) + (\underline{\qquad\quad}) = 8$$

vertex's time launching height

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B. Solve for the initial velocity ($v_o$).

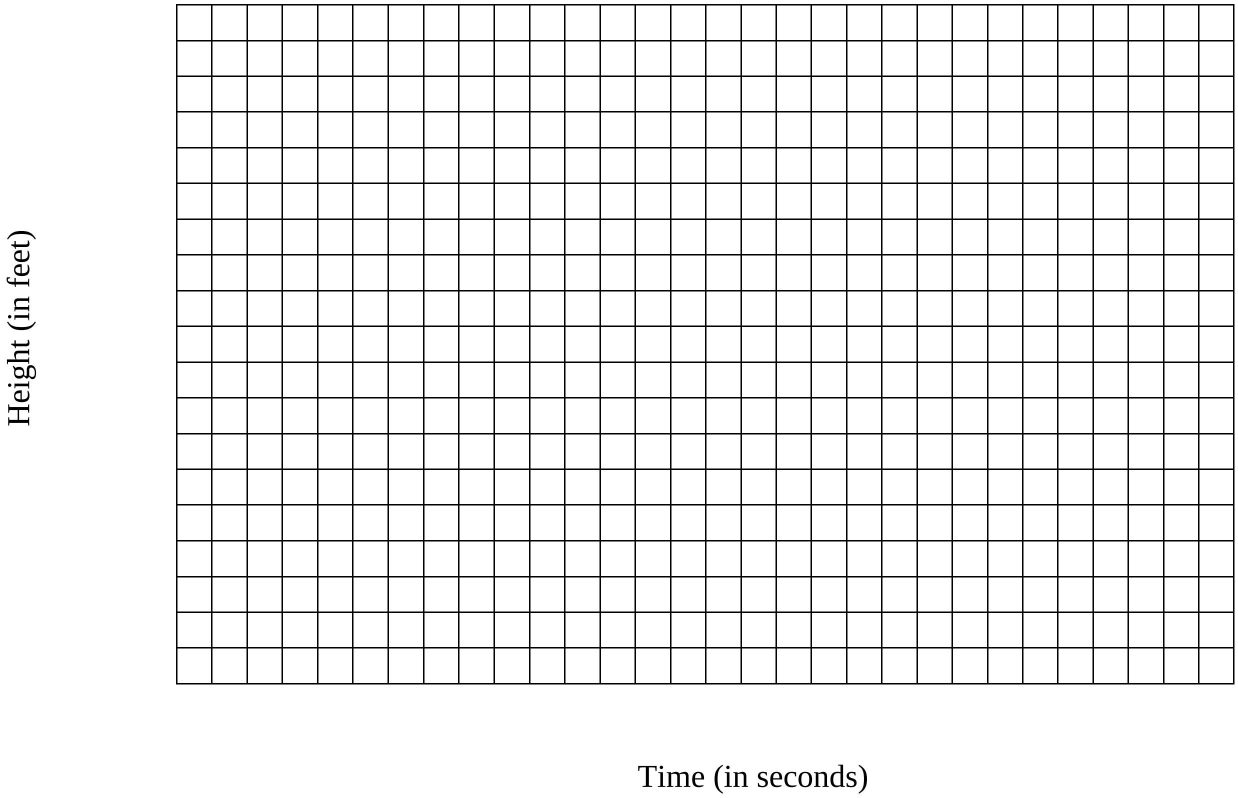
C. Plug in initial velocity and launching height to write a quadratic function for your strawket.

$$h(t) = -16t^2 + (\underset{\uparrow}{\_\_\_\_\_\_\_\_})\, t + (\underset{\uparrow}{\_\_\_\_\_\_\_\_})$$

initial velocity launching height

3. Use the quadratic formula to determine the time when the strawket hit the ground.

4. Graph both sets of data (including initial, maximum, and landing points).



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## Strawkets & Quadratics

What variables or design improvements could affect this activity other than initial velocity and initial height? ______________________________________________________________

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