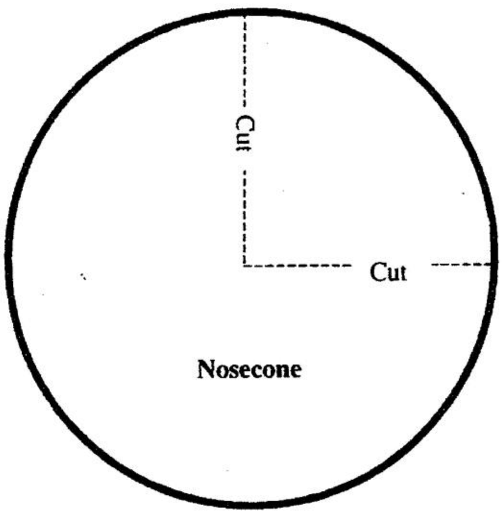
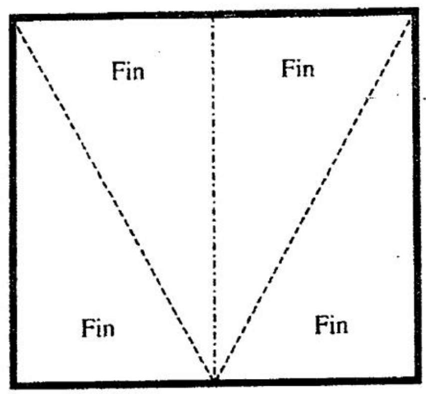
# Bottle Rocket Pattern

Visit this NASA site for Rocket Instructions:
http://spaceplace.jpl.nasa.gov/rocket.htm



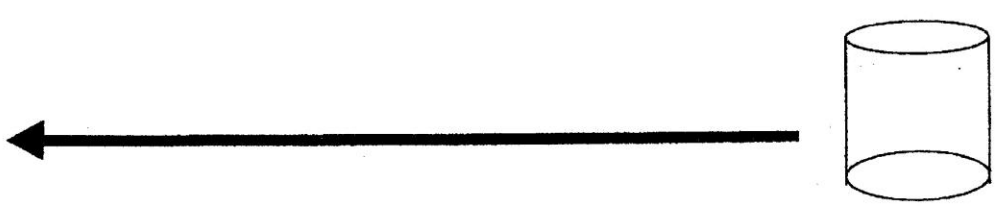




**Cut these 4 triangles for fins.**

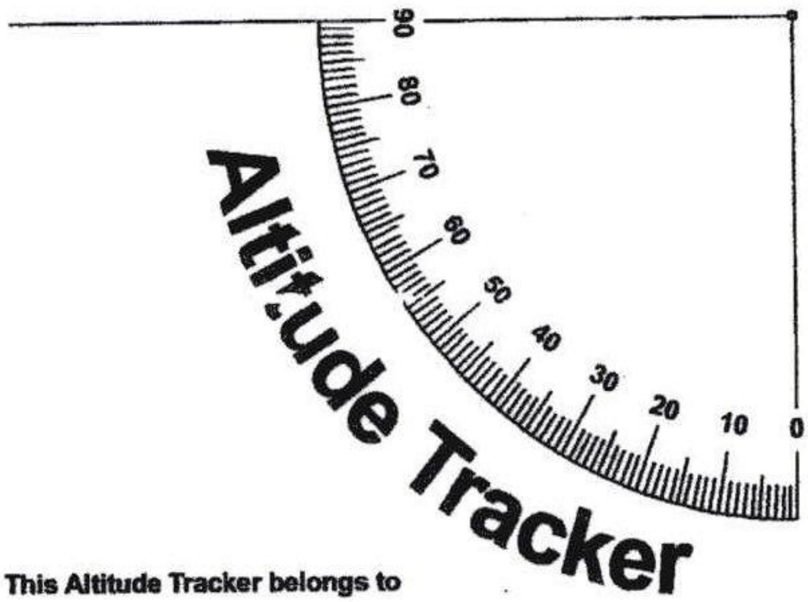
**Cut out specific area of Nosecone.**

Cut

**Roll this long piece around the film canister for the rocket body.**



**Roll this section over and tape the upper edge to the dashed line. Shape the section into a sighting tube.**




**This Altitude Tracker belongs to**

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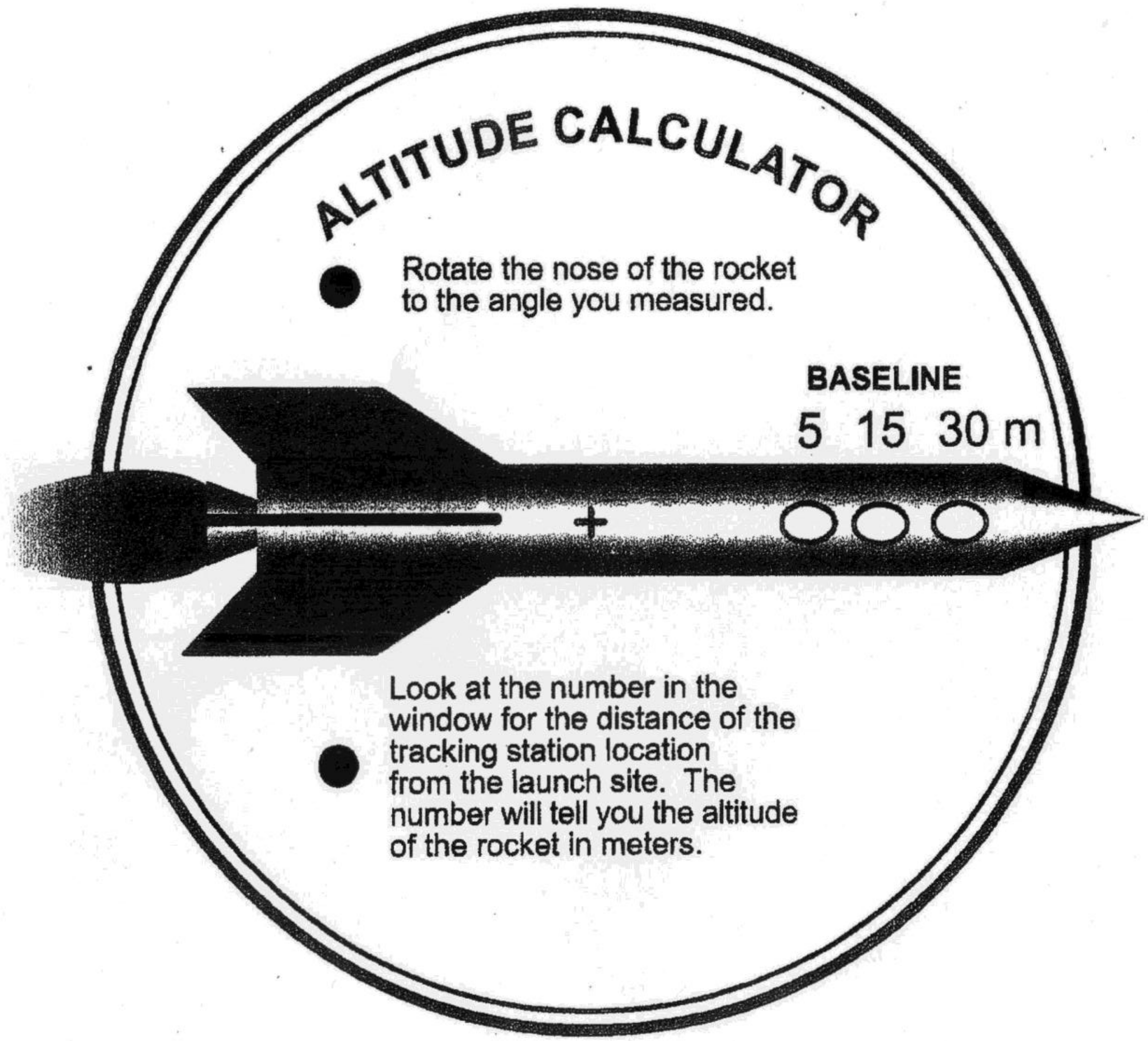
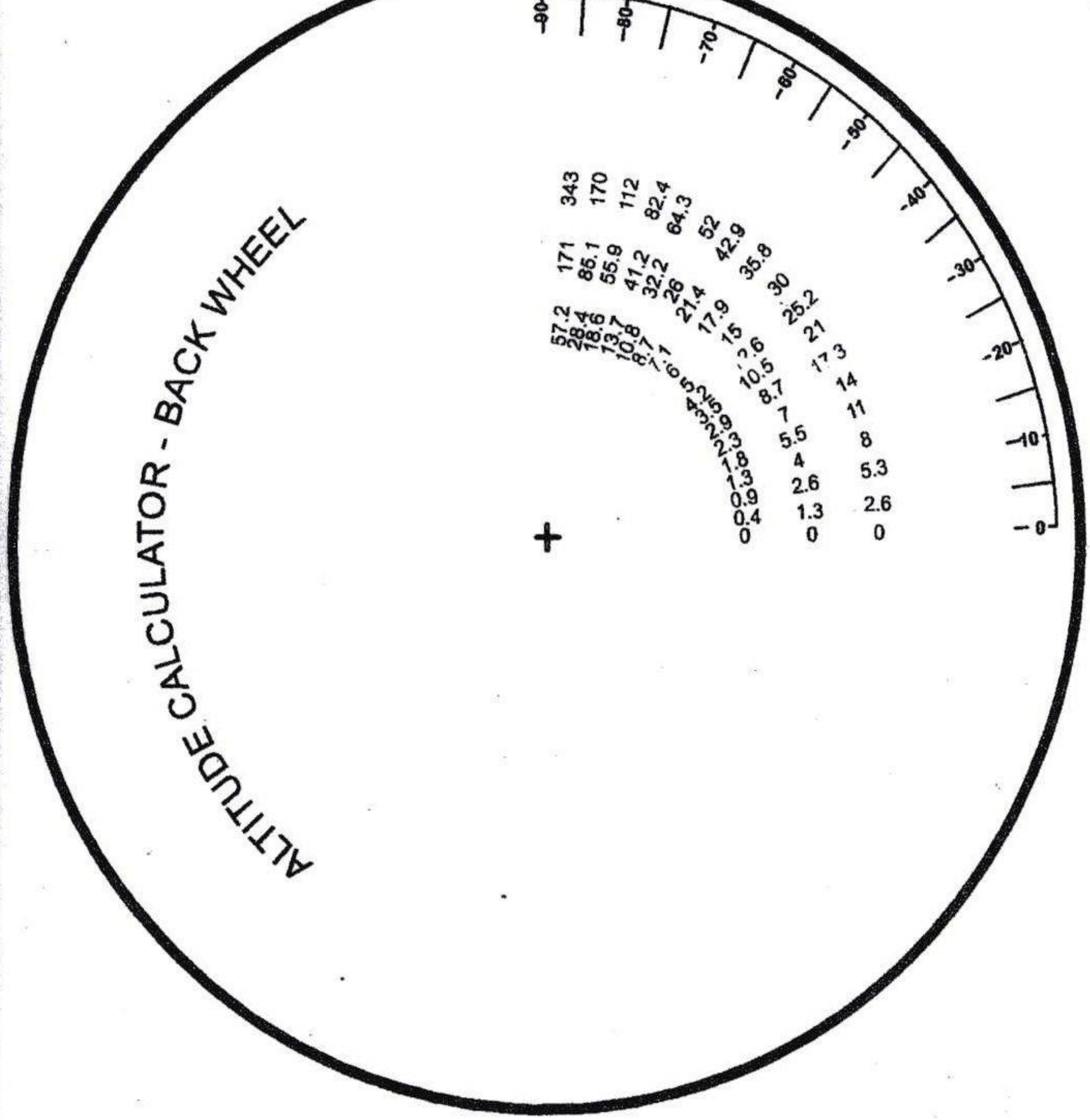

ALTITUDE CALCULATOR
Rotate the nose of the rocket to the angle you measured.
BASELINE
5 15 30 m
Look at the number in the window for the distance of the tracking station location from the launch site. The number will tell you the altitude of the rocket in meters.


ALTITUDE CALCULATOR - BACK WHEEL

# Tangent Table

| Degree | Tan | Degree | Tan | Degree | Tan |
|---|---|---|---|---|---|
| 0 | 0.0000 | | | | |
| 1 | 0.0174 | 31 | 0.6008 | 61 | 1.8040 |
| 2 | 0.0349 | 32 | 0.6248 | 62 | 1.8807 |
| 3 | 0.0524 | 33 | 0.6494 | 63 | 1.9626 |
| 4 | 0.0699 | 34 | 0.6745 | 64 | 2.0603 |
| 5 | 0.0874 | 35 | 0.7002 | 65 | 2.1445 |
| 6 | 0.1051 | 36 | 0.7265 | 66 | 2.2460 |
| 7 | 0.1227 | 37 | 0.7535 | 67 | 2.3558 |
| 8 | 0.1405 | 38 | 0.7812 | 68 | 2.4750 |
| 9 | 0.1583 | 39 | 0.8097 | 69 | 2.6050 |
| 10 | 0.1763 | 40 | 0.8390 | 70 | 2.7474 |
| 11 | 0.1943 | 41 | 0.8692 | 71 | 2.9042 |
| 12 | 0.2125 | 42 | 0.9004 | 72 | 3.0776 |
| 13 | 0.2308 | 43 | 0.9325 | 73 | 3.2708 |
| 14 | 0.2493 | 44 | 0.9656 | 74 | 3.4874 |
| 15 | 0.2679 | 45 | 1.0000 | 75 | 3.7320 |
| 16 | 0.2867 | 46 | 1.0355 | 76 | 4.0107 |
| 17 | 0.3057 | 47 | 1.0723 | 77 | 4.3314 |
| 18 | 0.3249 | 48 | 1.1106 | 78 | 4.7046 |
| 19 | 0.3443 | 49 | 1.1503 | 79 | 5.1445 |
| 20 | 0.3639 | 50 | 1.1917 | 80 | 5.6712 |
| 21 | 0.3838 | 51 | 1.2348 | 81 | 6.3137 |
| 22 | 0.4040 | 52 | 1.2799 | 82 | 7.1153 |
| 23 | 0.4244 | 53 | 1.3270 | 83 | 8.1443 |
| 24 | 0.4452 | 54 | 1.3763 | 84 | 9.5143 |
| 25 | 0.4663 | 55 | 1.4281 | 85 | 11.4300 |
| 26 | 0.4877 | 56 | 1.4825 | 86 | 14.3006 |
| 27 | 0.5095 | 57 | 1.5398 | 87 | 19.0811 |
| 28 | 0.5317 | 58 | 1.6003 | 88 | 28.6362 |
| 29 | 0.5543 | 59 | 1.6642 | 89 | 57.2899 |
| 30 | 0.5773 | 60 | 1.7320 | 90 | ------------ |

# Altitude Tracker

## Constructing the Scope:

1. Either copy the altitude tracker on card stock or glue it onto cardboard.  If using thick cardboard do not glue the dotted portion of the tracker above the dashed line.
2. Cut out the pattern along the outside edges.
3. Roll the part of the pattern not glued to the cardboard into a sighting tube and tape it If this is a problem tape a fat straw to the top.
4. Punch a tiny hole in the apex of the protractor quadrant.
5. Slip a thread or lightweight string through the hole. Knot the thread or string on the back side.
6. Complete the tracker by hanging a small washer from the other end of the thread.

**Procedure:**

1. Set up a tracking station location a short distance away from the rocket launch site. A 5 meter distance is sufficient for bottle rockets.
2. As the rocket launches, the person doing the tracking will follow the flight with the sighting tube on the tracker. The tracker should be held like a pistol and kept at the same level as the rocket when it is launched. Continue to aim the tracker at the highest point the rocket reached in the sky. Have a second student read the angle the thread or string makes with the quadrant protractor. Record the angle.

## Constructing the Calculator:

1. Copy the two patterns for the calculator onto heavy weight paper. Cut out the patterns.
2. Place the top pattern on a cutting surface and cut out the three windows.

3. Join the two patterns together where the center marks are located. Use a brass paper fastener to hold the pieces together. The pieces should rotate smoothly.

## Determining the Altitude:

1. Use the Altitude Calculator to determine the height the rocket reached. To do so, rotate the inner wheel of the calculator so that the nose of the rocket pointer is aimed at the angle measured in step 2 of the previous procedure.
2. Read the altitude of the rocket by looking in the window. If you use a 5 meter baseline, the altitude the rocket reached will be in the window beneath the 5. To achieve a more accurate measure, add the height of the person holding the tracker to calculate altitude. If the angle falls between two degree marks average the altitude numbers above and below the marks.
3. Once you determine the angle of the rocket, use the following equation to calculate altitude of the rocket:
   Altitude = tan<x baseline
4. Use the tangent table to solve the problem.
   For example if the measured angle is 28 degrees and the baseline is 15 meters the altitude is:
   Altitude = tan 28degrees x 15 m
   Altitude= 0.5317 x 15m = 7.97 m

*All patterns and directions can be found in ROCKETS, A Teacher's Guide with Activities in Science, Mathematics, and Technology, NASA, Office of Human Resources and Education, Washington, DC February 1996.*