

Create an



Altitude Tracker

(FMA Live! Blast Off Demonstration / Part 2 of 3)

You have before you the makings of a certified FMA Live! Altitude Tracking Device—the second in a series of three activities that teach students how to launch a bottle rocket demonstrating Newton's Third Law of Motion: Action/Reaction.

The Altitude Tracking Device will teach your students just how high they can go with a simple 2-liter bottle rocket!



Here's the deal...

THE OBJECTIVE

- To find out about how high the soaring bottle rocket can really fly.

ACTIVITY DESCRIPTION

- Students construct a simple Altitude Tracking Device to find out the height the bottle rocket reaches while in flight.

SCIENCE STANDARDS COVERED

- Physical Science: Position and motion of objects
- Science & Technology: Abilities of technological design
- Science & Technology: Understanding science and technology

PROCESS SKILLS INCLUDED

- Observing
- Measuring
- Collecting & Interpreting Data

MATHEMATICS STANDARDS COVERED

- Estimation
- Measurement
- Mathematics as Communication & Reasoning
- Mathematical Connections
- Number Sense & Numeration
- Geometry & Spatial Sense
- Trigonometry



HOW TO

Finding out how high the bottle rocket can fly is definitely a team thing. While one group of students work on launching their rocket, another group can measure its altitude from the tracking station. Depending on how many launches you do and how many Altitude Tracking Devices and Calculators you make, the whole shebang could take anywhere from about an hour to almost two.

The Altitude Tracking Device you construct can also be used with the FMA Live! Fizzy Rocket (which you'll see listed on the site as another science demo) and with other commercial model rockets.

The Altitude Calculator is designed for angles in increments of 5 degrees. Young kids may have a tough time getting precise angle measurements with the Altitude Tracker. So, to keep it simple, just round measurements off to the nearest 5 degree mark and read the altitude reached directly from the Altitude Calculator.

Get an adult to cut out the three windows in the Altitude Calculator (a sharp knife or razor and a safe surface to cut it on works best). Have students practice taking angle measurements and using the calculator on common objects such as a building or a flagpole to get in a few tries before calculating rocket altitudes.

MUST HAVE MATERIALS

- Altitude Tracking Device pattern
- Altitude Calculator pattern
- Thread or lightweight string
- Small washer
- Brass paper fastener
- Scissors
- Razor blade knife & cutting surface
- Stapler
- Yard stick
- Rocket and launcher

TIPS FOR GOOD TRACKING

The FMA Live! Altitude Tracker uses simple trigonometry to find out the rocket's height in flight. The common assumption is that a rocket will travel straight up. If the rocket soars away at an angle other than 90 degrees, the accuracy of the tracking is tough. In other words, if the rocket shoots over a tracking station, where the angle is measured, the calculation will read higher than the height that the rocket actually reached. At the same time, if the rocket shoots away from a tracking station, the altitude measurement could be lower than the actual height.

You'll get more accurate results by using more than one tracking station to measure the rocket's altitude. The Altitude Tracker uses a baseline of 5, 15, and 30 meters. It is recommended that multiple tracing stations are set up at these distances. Then, by averaging the altitude measurements between all station, you will reduce individual errors. It can be tricky, but as long as you know what to do ahead of time, you can prepare for whatever path your rocket takes.

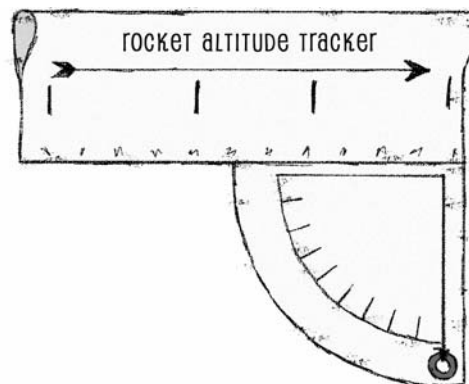
EVALUATION

Students should be able to demonstrate their proficiency with altitude tracking by sighting on a fixed object of known height and comparing their results. If you used two tracking stations, compare measurements from both stations.

FURTHER DISCOVERY

- You might ask students, "Why should the height of the person holding the tracker be added to the measurement of the rocket's altitude?"
- Also, curriculum guides for model rocketry (available from model rocket supply companies) provide instructions for more sophisticated rocket tracking measurements. These activities involve two-station tracking with altitude and compass direction measurement and trigonometric functions.

WHAT YOUR ALTITUDE TRACKER WILL LOOK LIKE



FMA Live! Altitude Tracker

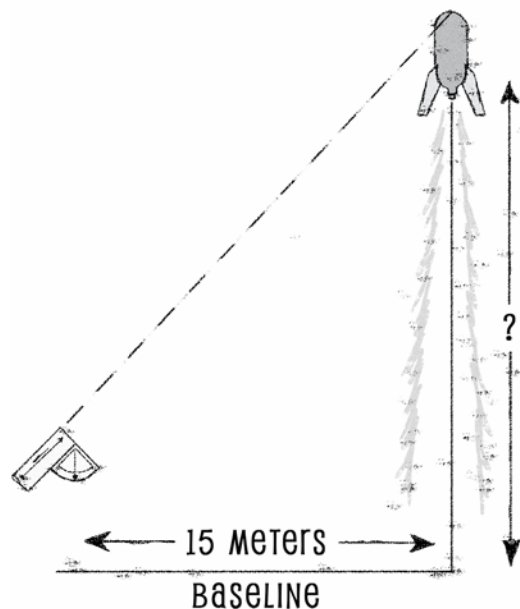
CONSTRUCTION INSTRUCTIONS

Step 1: Making the Altitude Tracker Scope (see page 6)

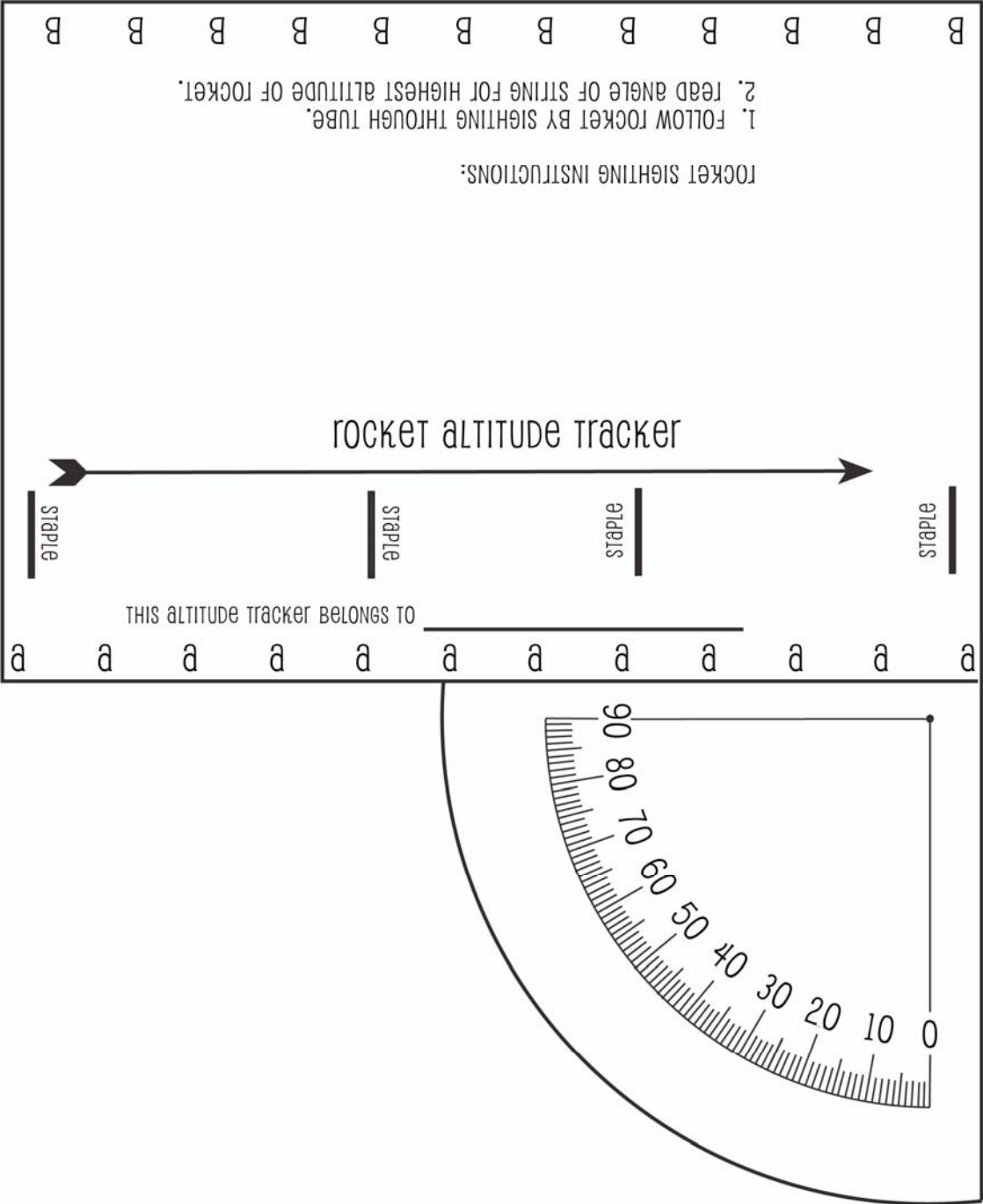
1. Copy the pattern for the altitude tracker on heavy weight paper.
2. Cut out the pattern on the darker outside lines.
3. "Curl" (do NOT fold) the B edge of the pattern to the back until it lines up with the A edge.
4. Staple the two edges together where marked so that the As and Bs will be on the outside of the tracker.
5. Punch a small hole through the apex of the protractor portion of the pattern.
6. Thread a lightweight string through the hole then knot the string on the back side.
7. Finish the job by hanging a small washer from the other end of the thread as shown in the diagram.

Step 2: Using the Altitude Tracking Device

1. Create a tracking station about 50 feet away from the launch site.
2. With the launch of each rocket, your designated tracker will follow the flight with the sighting tube.
3. The tracker should be held like a pistol and kept at the same level as the rocket when it's launched.
4. Aim the tracker at the highest point the rocket reached and have a second student read and record the angle the string makes with the quadrant protractor.



ALTITUDE TRACKER SCOPE



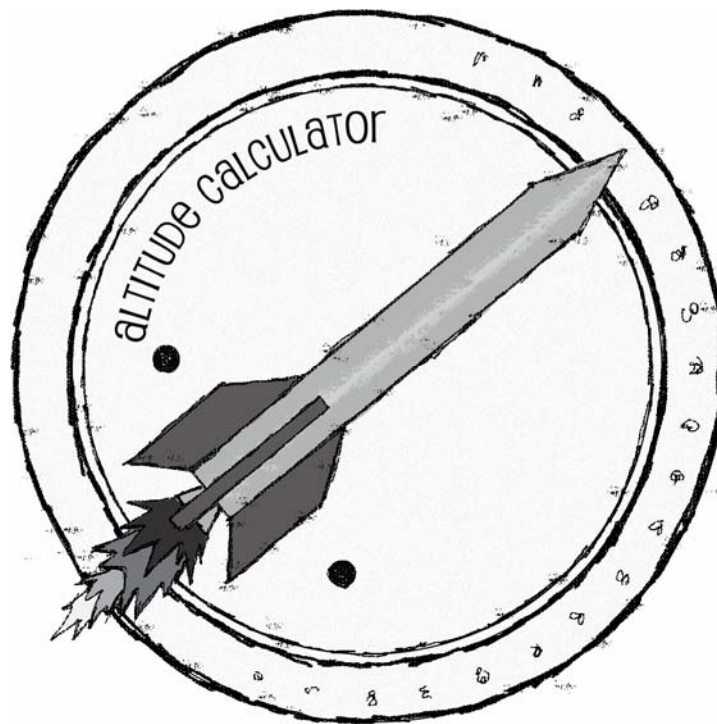
FMA Live! Altitude Calculator

Step 1: Creating the Altitude Calculator (see page 8 and 9)

1. Grab some heavy weight paper.
2. Copy the two patterns for the altitude calculator and cut them out.
3. Put the top pattern on a surface good for cutting and cut out three windows.
4. Join the two patterns together at the center marks. Then, using a brass paper fastener, affix them to each other—both pieces should rotate smoothly.

Step 2: Figuring Out the Altitude

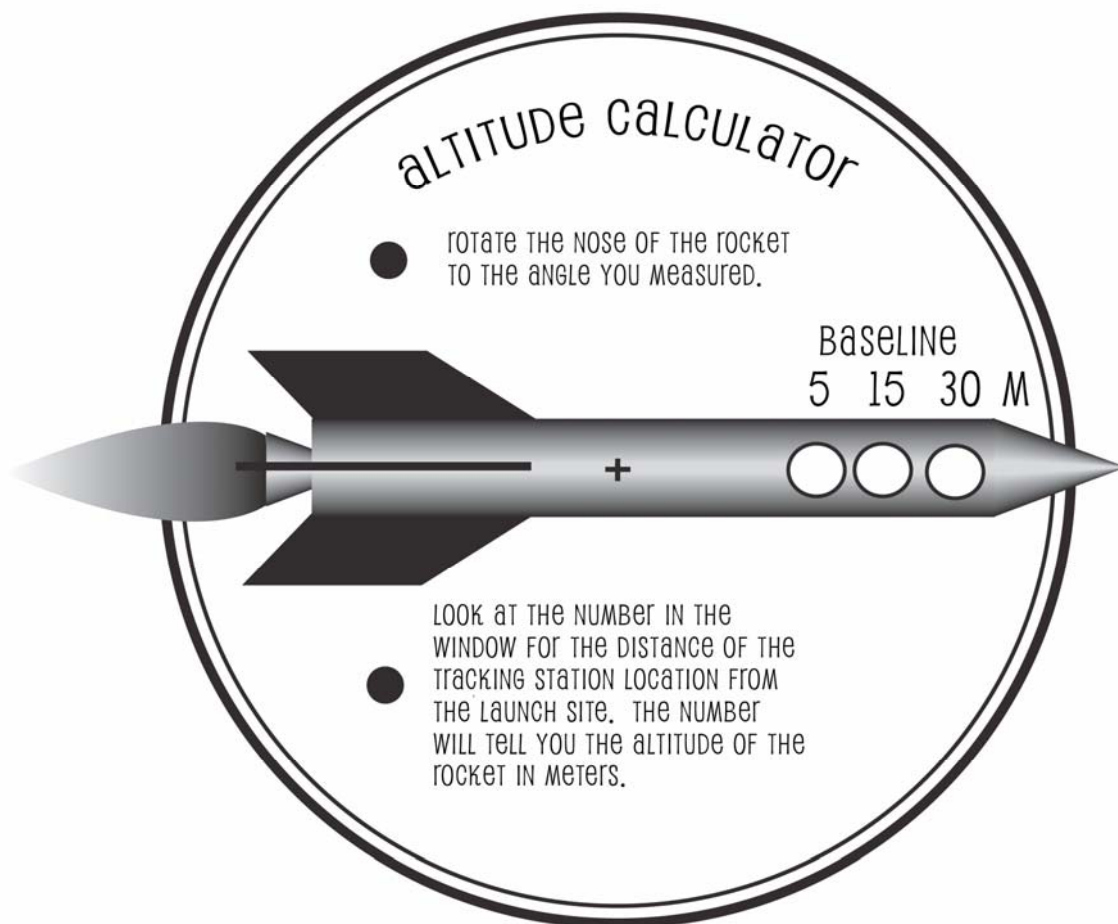
1. The Altitude Calculator will determine the height of the rocket's flight. Just rotate the inner wheel of the calculator so that the nose of the rocket pointer is aimed at the angle measured in step 2 (above).
2. You can read the altitude of the rocket by looking in the window. For more accurate reading, 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.



ALTITUDE CALCULATOR – FRONT WHEEL

Instructions:

1. Cut out the Altitude Calculator (Front Wheel / pg 8)
2. Cut out the Attitude Calculator (Back Wheel / pg. 9)
3. Place the Front Wheel over the Back Wheel and secure them together by inserting a brass paper faster through the +.



Inspiring the next generation

