Mathematics

Altitraking

GRADES 9-12
Two Class Lesson Plan

STEP 1. LEARN (First class session: 20-25 minutes)

Objectives

- Students will identify what data should be collected to use for calculating how high their rocket launched.
- Students will use the Estes Altitrak™ to obtain data for altitude calculations.
- Students will use the launch data collected to calculate the altitude of all class rockets.
- Each student will build and launch an Estes model rocket.

Materials

1. Generic E2X®, Alpha III® or UP Aerospace™ SpaceLoft ™ Rocket Lab Pack™ (12 pack) - 2 or more
2. Rocket Engine Lab Pack™ (24 pack) – 1 or more. Use A8-3 engines to launch the Alpha III® and Generic E2X® and 1/2A3-2T or 1/2A3-4T engines for the SpaceLoft™.
3. Electron Beam® Launch Controller - 1 or more
4. Porta-Pad® II Launch Pad - 1 or more
5. Paper, pencil, white or carpenter's wood glue or plastic cement, scissors, modeling knife, ruler and masking tape for each student
6. History of Rockets PowerPoint
7. Model Rocket Flight Profile, Model Rocket Safety Code, Launch Data Sheet, Table of Tangents for each student
8. Measuring Tape
9. Altitrak™ - 3 or more
10. Tennis Balls - 5 or more

Time

Two class session

NATIONAL STANDARD

Standard 6
Understands and applies basic and advanced concepts of statistics and data analysis

Benchmark 1
Selects and uses the best method of representing and describing a set of data

Background

This is an altitude prediction, data collection and calculation activity. Students should be familiar with how a model rocket launches and all safety procedures that should be followed. The safety requirements can be found in the Model Rocket Safety Code of the National Association of Rocketry (NAR).

Model Rocket Flight Profile

1. Electrically ignited model rocket engine provides rocket liftoff.
2. Model rocket accelerates and gains altitude.
3. Engine burns out and rocket continues to climb during the coast phase.
4. Engine generates tracking smoke during the delay/coast phase.
5. Rocket reaches peak altitude (apogee). Model rocket ejection charge activates recovery system.
6. Recovery systems are deployed. Parachutes and streamers are the most popular recovery systems used.
7. Rocket returns to Earth.
8. Rocket touchdown! Replace the engine, igniter, igniter plug and recovery wadding. Rocket is ready to launch again!

KEY WORDS

accelerates
altitude
apogee
baseline
coast phase
data
ejection charge
igniter
predicted
recovery system
recovery wadding
tangent
tracking smoke

Activity

1. Using discussion, discover the knowledge of rockets your class has.
2. Hand out Model Rocket Flight Profile and Model Rocket Safety Code sheets to all students. Review both sheets with students.
3. Students will review the two handouts prior to the rocket launch and data collection activity.
4. Discuss what launch data will be helpful for figuring rocket launch altitudes and speed.
5 Practice using the Estes Altitraks. When students track the launched rocket, they will track a moving object. To practice tracking a moving object, students will use a tennis ball. One student will throw the ball up in the air while the other student tracks with the Altitrak™.

STEP 2. BUILD (First class session: 35 - 40 minutes)

Activity

1. To learn how to record appropriate launch data to use for calculating rocket altitude and speed, students will build and launch an Estes model rocket.
2. Build the Alpha III®, Generic E2X® or UP Aerospace™ SpaceLoft™ together with students, using step-by-step procedures. E2X® rocket kits contain parts that are colored and easy to assemble. Glue the parts together as per the instructions, apply the self-stick decals, attach the recovery system and you are ready to launch.
3. Hand out the Launch Data Sheet so students can list all students in the class, predict and complete the Predicted Altitude for each rocket.

STEP 3. LAUNCH (Second class session)

Activity

1. Assign and post launch jobs for students. Launch jobs are in the *Estes Educator Guide for Teachers & Youth Group Leaders.*
2. Prepare rockets for launching inside before going out to launch. Follow the Engine Preparation steps located in the rocket instructions.
3. Launch rockets outside at a soccer field, football field, baseball field, green grass area or blacktop area.

HOW HIGH DID IT GO?

All students need to have a launch partner. They can pair up or you can assign partners. When one partner launches their rocket, the partner will use the Estes Altitrak™ to collect the launch data for their partner's rocket launch.

1. Measure and mark 152 meters (500 feet) from each launch pad. The partner (tracker) using the Altitrak™ will stand here.
2. The tracker will hold the Altitrak™ at arm's length, pointed at the rocket. Next, the tracker will pull and hold the trigger then signal for the launch.

3. Tracker will track rocket through forward sight. When the rocket reaches maximum altitude (apogee), they will release the trigger. Apogee is usually when the ejection charge goes off and the recovery system is deployed. If rocket begins to descend before the ejection charge, lock the Altitrak™ at this time.
4. Partners will record the angle in degrees from the Angle Scale on the Altitrak™. Also record the meters from the Altitude in Meters Scale.
5. Make sure the Predicted Altitude is filled in before each rocket launches.
6. Partners will switch places and repeat the launch procedure.
7. All students not launching will observe the other launches and fill in the Angle Scale (Angular Distance) and Altitude in Meters.
8. Students will calculate the altitudes of all rockets. The formula to use is: Altitude = Angle Tangent times Baseline Distance

Example

30° Angle reading: Tangent = .58
Baseline = 152 meters
.58 X 152 m = 88 meters

The rocket's altitude is 88 meters.

Note: *Instructions with illustrations on how to use the Alititrak™ are on the package back.*

Wrap Up - Touch Down & Recovery

1. Students will calculate all rockets' altitudes and determine whose rocket or rockets were the highest flyer(s).
2. Students will compare the calculated answer to the Altitude in Meters reading. Were the answers the same? Which Altitraking method do you think is more accurate – calculating with the launch angles or the altitude in meters reading on the Altitrak™?

Extensions

1. Students will change the meters recorded from the Altitude in Meters Scale into feet.

   CONVERT METERS TO FEET:

   1 meter = 3.28 ft./m
   Feet = Meters times 3.28 ft./m

Example
210 m X 3.28 ft./m = 688.8 ft.

2. Students can calculate how fast their rocket traveled when it was launched. See the *Science and Model Rockets Curriculum*, Activity Sheet #5 - Determining Average Speed for information on how to calculate the speed.

Evaluation/Assessment

- Students will predict, collect and record launch data using the Altitrak™.
- Students will calculate the altitude of all class rockets to determine which rockets went the highest.
- Students will make and launch an Estes model rocket to obtain launch data.

References

- *Estes Educator™ - Guide for Teachers and Youth Group Leaders*
- Estes Educator™ Website – www.esteseducator.com
- Estes Educator™ - *Science and Model Rockets Curriculum*
- Estes Educator™ - *Elementary Mathematics of Model Rocket Flight*
- NASA – *Rockets-A Teacher's Guide with Activities in Science, Mathematics, and Technology*