Technology

Rocket Noses

STEP 1. LEARN (First class session: 15 minutes)

Objectives

- Students will discover why rockets are designed to have a nose cone and will identify the best shape for a nose cone.
- Students will test a model rocket's nose cone design by building and launching an Estes model rocket.
- Students will use the Estes Altitrak™ to track rocket altitudes.
- Students will decide if the rocket's nose cone design should be modified.

NATIONAL STANDARD

Standard 11
Students will develop the abilities to apply the design process.

Benchmark I
Students should learn to specify criteria and constraints for the design.

Benchmark K
Students should learn how to test and evaluate the design in relation to pre-established requirements , such as criteria and constraints, and refine as needed.

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
3. Electron Beam® Launch Controller – 1 or more
4. Porta-Pad® II Launch Pad – 1 or more
5. Paper, pencil, white or carpenter's glue or plastic cement, scissors, modeling knife, ruler and masking tape for each student
6. Visuals/Overheads: Pressure Drag, What is Drag?, Friction Drag and Nose Cone Shapes
7. Estes Altitrak™ - 3 or more
8. Tennis balls – 5 or more
9. Sandpaper - small sheets for each student

Time

Two class sessions

Background

All rockets have a nose. The rocket's nose is called a nose cone. The nose cone helps the rocket overcome two of the four aerodynamic forces that affect its flight performance negatively – gravity and drag. The other two aerodynamic forces, thrust and lift, help the rocket's flight in a positive manner. Thrust and lift help the rocket propel upwards while drag and gravity pull it downward.

The nose cone is the leading edge of a model rocket, generally tapered in shape to allow for streamlining and is usually made of plastic. The primary purpose of a nose cone on a model rocket is to streamline the rocket and reduce drag. Full-sized commercial and military rockets carry payloads, such as satellites and warheads, in their nose cones.

Aerodynamics is the study of the interaction between air and moving objects. Drag is friction or resistance between the surface of a moving object and air. A model rocket in flight encounters two types of drag while in flight – friction and pressure. Frictional drag is the resistance between a fluid (the atmosphere behaves as a fluid) and the surface of a moving object. Pressure drag is the retarding force determined by the shape of an object. Nose cone shapes are designed to reduce both frictional and pressure drag.

KEY WORDS

aerodynamic
drag
friction
frictional drag
gravity
lift
nose cone
payloads
pressure
pressure drag
resistance
satellites
streamline
thrust

Activity

1. Discuss the primary purpose of a nose cone on a model rocket. Is this the same for full-sized military or commercial rockets?
2. Review the concept of drag. Drag is the frictional force or resistance between the surface of a moving object and air. The visual/overhead What is Drag? illustrates the effects of drag on a hand placed into moving air (wind). Because the palm of the hand has a greater surface area coming in contact with the moving air, it produces greater drag than the edge of the hand.
3. Show the Pressure Drag visual/overhead first. In the first picture the ball is at rest and the atmospheric pressure is equal all around the ball. This balance of pressure results in no drag on the ball. However, in the second picture the ball is moving as a result of being hit by a bat. There is a greater atmospheric pressure on the forward portion of the ball as compared to the rear portion. This imbalance of pressure is known as pressure drag. Pressure drag is determined in large part by the shape of an object.
4. The Friction Drag visual/overhead will illustrate this type of drag. Frictional drag is the resistance between a fluid, such as air, and the surface of a moving object, such as a nose cone. Give each student a small sheet of sand paper. The sandpaper will represent the surface of the nose cone. The student's hand will represent the air coming in contact with the moving

nose cone. Ask each student to place the sandpaper flat on the desktop with rough surface face down. As they slowly slide their hands across the surface, ask them to describe what they feel. Repeat this procedure with the rough surface face up. Compare the two procedures. This is an example of frictional drag.

5. Show the visual/overhead Nose Cone Shapes. Ask students what nose cone shapes would be best to reduce pressure and frictional drag (more aerodynamic).
6. Students will practice using the Altitraks to lock in the altitude in meters. 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™. Instructions on how to use the Altitrak™ are on the back side of its package.

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

Activity

1. Each student will build and launch a model rocket to test the rocket's nose cone design.
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.

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.
4. Using an Altitrak™, partners will track and record the height of each other's rocket.

Wrap Up - Touch Down & Recovery

1. Post altitude data from the class and discuss if the rockets launched as high as students thought they would.
2. After examining the class data, ask students if it indicates that their nose cone shape was the most efficient design.
3. Students will draw sketches of several new nose cone shapes that might make their rocket more aerodynamic.

Extensions

1. Students will conduct a web quest on the history of the rocket nose. They will include what the early nose cones looked like and how they have changed over the years.
2. Trial and error testing played a huge role in determining the best nose cone in subsonic flight. Students can test different nose cones on their rocket to determine which nose cone shape is best for higher flights. (Interesting fact: The best nose cone in subsonic flight is a rounded nose cone.) Nose cone assortments that are a variety of shapes are available from Estes. Find them in the Model Rocket Accessories section of the catalog and website at www.estesrockets.com. Make sure they are the right size for the rocket's body tube.

Evaluation/Assessment

- Students will build and launch an Estes model rocket.
- Students will use the Altitrak™ to track and record data on their rocket's altitude.
- Students will use launch data to decide on the most efficient nose cone design.
- Students will draw several nose cone shapes that might make their rocket more aerodynamic.

References

- *Estes Educator™ - Guide for Teachers and Youth Group Leaders*
- Estes Educator™ Website – www.esteseducator.com
- Estes Educator™ *- Industrial Technology and Model Rockets Curriculum*