III...Getting a Satellite Into Space

Introduction:

How does a satellite get into space? Most students will know that to get something into space, you need a rocket, but they may not realize that rockets do not have to "push off" of the atmosphere to get into space. Also, you do not have to keep pushing a satellite to keep it moving in space because there is no friction in space to cause things to slow down. In this activity, students will learn how Newton's Laws of Motion can be applied to the launching of rockets: "Every action has an equal and opposite reaction." Students will explore how a satellite is placed in orbit. The students will explore how a satellite remains in orbit.

Objectives:

- Students will explore Newton's Laws of Motion and their application to rocket launching.
- Students will explore Newton's Laws of Motion and their application to satellite orbits.

Materials:

Balloon (any size or style)

Glitter

Skateboard (optional)

Outdoor swing set

Books

Ball –tennis with a length of string attached
(a yo-yo works well too)

Several Balloons
(3 inches by 12-24 inches long)

Drinking straws

Tape

Nylon fishing line

Stopwatch or timer

Key Terms:

Newton's First Law of Motion - if an object is at rest, it takes unbalanced forces to make it move. Conversely, if an object is moving it takes an unbalanced force to make it change its direction or speed. *It is a common misconception among students and adults that you have to keep exerting a force on a body to maintain its speed. This is only true when friction is important.*

Newton's Third Law of Motion – for every action there is an opposite and equal reaction. *The exhaust gases are expelled and cause an opposite force which moves the rocket forward in the opposite direction.*

Procedure:

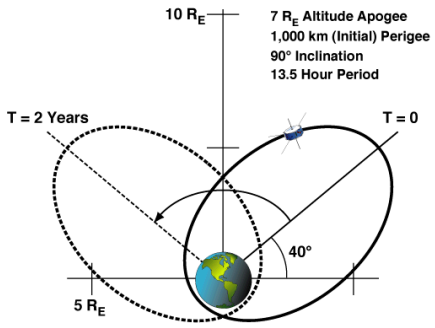
How does a satellite get into an orbit?

- Place some glitter inside a balloon. Blow up the balloon and hold the open end. The students should predict what would happen when the balloon is released. The children will need to observe carefully to see what happens when you let go. After the observation, discuss that the air being released was traced by the glitter that came out. The glitter went in one direction while the balloon went in the opposite direction. This is an example of Newton's Third Law of Motion.

- Have the students imagine that they are going to ride a skateboard or bring in one for a student demonstration. The skateboard and the rider are both still. The rider jumps off the skateboard, representing an action. The skateboard responds to this action by traveling in the opposite direction of the rider. This is another example of Newton's Third Law of Motion. When launching a rocket, the action is the expelling of gas out of the engine. This action or thrust must be stronger than the weight of the rocket to start it moving off the launch pad and into space. The Saturn V moon rocket had energy that provided a thrust of 6 million pounds to lift a rocket weighing a few hundred tons.

- If you have a set of swings available, you may use a swing to demonstrate that "for every action, there is an equal and opposite reaction." Have a student sit on the swing with his or her legs dangling free and not swinging, with one or two books in his or her lap. When the swing is still, have the student thrust the weight (books) forward. The students should discuss the action and reaction observed. Students should write their own version of Newton's Third Law of Motion. The students can draw and write about their experiences in their learning logs.

How does a satellite stay up?



- Attach a ball to a string or use a yo-yo where the string has been tied tightly to the center of the yo-yo. Swing the ball around in a circle. Have the students observe that the path of the ball stays in a circular pattern and that the force on the string is the ball (centrifugal) has to be balanced by your tugging on it (gravity) to keep it going in a circle. This is the way that a satellite remains in orbit. A satellite has its forward thrust, which is offset by the pull of gravity towards the earth. This keeps the satellite circling in its orbit. Newton's First Law of Motion explains how the satellite remains in orbit. The students should write their own version of Newton's First Law of Motion.

Which Law of Motion is Being Applied?

- The students should begin by tying one end of the nylon string to an anchored object in the room that is approximately four to five feet off the ground. Then a plastic straw should be threaded onto the string. Blow up the balloon 1/3 full of air, twist the end without tying it and carefully tape it to the straw so that the long side of the balloon is parallel to the straw and its head is pointed toward the anchored end of the string. A student will need to hold the other end of the string up so that it is taunt and at an even height across its length. Before the balloon is released, have a stopwatch ready to record the time and a meterstick ready to measure the distance traveled. Students can repeat the activity two more times so that an average time and distance can be obtained. The students should record their observations in their learning logs.

- The students should then inflate the balloon 2/3 full and repeat the activity three times to get the average time and distance. Then the students should inflate the balloon completely and repeat the activity three times to get the average time and distance. The students should record their observations in their learning logs.

- Have a class discussion about the data collected. Which balloon went the farthest and why? Why did the balloons stop moving? If there were no friction between the s traw and the string and no wall in the way, how would the students expect the balloon to behave? If there were no friction between the straw and the string, no wall in the way and no air resistance against the deflating balloon how would the balloon behave when it ran out of fuel? Which Law(s) of Motion explains the results and why do the s tudents feel this way? The students should write a persuasive letter to a teacher or nother student stating which law of motion was represented and why.

Conclusions:

A rocket works by ejecting gas, and because of Newton's Third Law of Motion, this produces an equal and opposite force in the direction the rocket travels. Scientists, while designing satellites, have to be very careful of the total weight of the satellite. Heavy satellites may give the scientists more data, but they are are also much more expensive to place into orbit with a rocket.