GRADES 3-5
One Class Lesson Plan

Science

What Goes Up, Must Come Down

STEP 1 ■ LEARN (15 minutes)

Objectives

- Students will gain a knowledge of Newton's Third Law of Motion.
- To understand and observe how Newton's Third Law Motion works, students will build and launch an Estes model rocket.
- Students can apply how Newton's Third Law of Motion affects their rocket launch and rockets sent into Space.

Materials

Picture of Sir Isaac Newton
Firestreak SST™ Rocket Lab Pack™ (24 pack) - 1 or more
Rocket Engine Lab Pack™ (24 pack) - 1 or more
Electron Beam® Launch Controller - 1 or more
Porta-Pad II® Launch Pad - 1 or more

Time

One class session

Background

Sir Isaac Newton

Modern rocketry information can be traced back to the time of Sir Isaac Newton (1642-1727). After "being struck on the head by a falling Apple," Newton described the motion of objects falling to the Earth in his book *Philosohpiae Naturalis Principia Mathematica*, published in 1687, where he described three universal laws of motion. Although Newton was merely describing principles of nature, Newton's Laws apply to the physics of rocketry. His laws are simple statements regarding the physics governing motion and can be used to provide precise explanations of rocket flight.

NATIONAL STANDARD

Standard B
Physical Science

Standard 10
Understands forces and motion

Benchmark 5
Knows when force is applied to an object, the object might go in a different direction

Newton's Third Law of Motion
For every action there is an equal and opposite reaction.

With model rockets, the action is the expelling of gas out of the engine. The reaction is the movement of the rocket in the opposite direction. The rocket is pushed by the escaping gases and will continue to accelerate until all of the propellant in the rocket engine is used up. The casing of a model rocket engine holds the propellant. At the base of the engine is a heat-resistant nozzle that the igniter is inserted into. The igniter is heated by an electric current from a battery powered launch controller. The hot igniter ignites propellant inside the engine which produces gas while it is being consumed. This gas causes pressure inside the rocket engine, which must escape through the nozzle. The gas escapes at a high rate of speed and produces thrust.

KEY WORDS

action
forces
igniter
kinetic energy
motion
pressure
propellant
reaction
Sir Isaac Newton
Third Law of Motion
thrust

Activity

1. Discuss Sir Isaac Newton and describe his Third Law of Motion.
2. Explain how a model rocket lifts off from a launch pad using Newton's Third Law of Motion Theory.
3. Demonstrate how the forces and energy of a balloon relate to those of a rocket engine. Ask students to blow up a balloon and hold the nozzle tightly so the air does not (potential energy). The air in an inflated balloon is like the fuel in a rocket (stored energy). Let go of the nozzle to release the air. The air escapes from the balloon and it will fly about the room. When the air is released it is simulating the burning fuel of a rocket (kinetic energy). The balloon and the rocket are at rest until the release of energy forces them into motion in the opposite direction of the released energy – Newton's Third Law of Motion.
4. A skateboard can also be used to show action-reaction. Start with a skateboard and a rider that are in a state of rest (not moving). Have the rider jump off the skateboard (the action). The skateboard will react to that action by traveling some distance in the opposite direction (reaction). Students may notice that the skateboard had much greater reaction than the action of the rider. This is not true. The skateboard traveled farther because it has less mass than the rider. Let each student have a chance to try the skateboard activity.

STEP 2 ■ BUILD (15 minutes)

Activity

1. Explain that to see Newton's Third Law of Motion in action, students will make and launch their own model rocket.
2. Build the Firestreak SST™ together with students, using step-by-step procedures. This is a snap together rocket that needs no gluing or cutting.

STEP 3 ■ LAUNCH (30 minutes)

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 in your classroom before going outside to launch. Follow the Engine Preparation steps located in the Firestreak SST™ Instructions.
3. Launch rockets outside at a soccer field, football field, baseball field, green grass area or blacktop area.

Wrap Up - Touch Down & Recovery

1. Students will summarize how Newton's Third Law of Motion explains how their rockets lifted off the launch pad.
2. Students will draw a picture to illustrate Newton's Third Law of Motion. Make sure they label the action-reaction (exhaust and thrust).

Extensions

1. Read about the Space Shuttle's main engines, solid rocket boosters and maneuvering jets. Determine how Newton's Laws apply to them.
2. Discuss other ways of producing thrust needed to move a mass such as wind, water, solar and nuclear energy.

Evaluation/Assessment

1. Students will be able to explain and demonstrate Newton's Third Law

of Motion.

2. Students will successfully build and launch the Firestreak SST™ model rocket.
3. Students will draw and correctly label a picture to show Newton's Third Law of Motion.

References

- *Estes Educator™ - Guide for Teachers and Youth Group Leaders*
- Estes Educator™ Website - www.esteseducator.com
- *Estes Educator™ - Newton's Laws of Motion and Model Rocketry*