Title: **Demonstrating Newton's Third Law**

Objective: To simulate the action – reaction forces created in Newton's Third Law of Motion.

Standards: EALR 4 Physical Science: Big Idea: Force and Motion

Materials: Large balloon for demonstration, smaller balloons for students to work with. (Make sure that rules or guidelines are reviewed before allowing students to perform the demonstration.)

Procedure: Display a large-size balloon and blow it up. Hold the opening of the balloon closed with your fingers for a moment. (Elicit a question as to what they think will happen.) Then release your fingers and let the air rush out of the balloon. The balloon should be propelled into the air and travel a short distance before it falls to the ground. Extra balloons should be available so students can also perform the demonstration, especially at lower grade levels.

Student Questions for Inquiry:

1 a. Where does the energy come from that causes the balloon to fly through the air? (From the air that was blown into the balloon by the person.)

b. What caused the balloon to move? (Air escaping from the balloon nozzle.)

c. What caused the balloon to stop moving? (The air inside the balloon reached the same pressure as the air in the room.)

Science Behind It: Newton's Third Law of Motion states that to every action force there is an equal and opposite reaction force. Even though this law is probably the most often quoted of the three, it is the least intuitive. It is obvious that a pitcher exerts a force on the ball, but less obvious that the ball pushes back on the pitchers hand with an equal and opposite force. When you stand up, your shoes apply a force to the earth just as large as the force the earth's gravity exerts on you. When you try to open a screw-top bottle that is stuck, your left hand twists one way while the right hand is twisting the opposite way. You cannot touch someone without feeling his or her touch in return.

The Third Law says that forces always come in equal and opposite pairs, but that the forces in the pairs act on (and therefore accelerate) different objects. You are pushing down on the chair in which you are sitting. The Third Law says that the chair is exerting an equal upward force on you. You really can learn Newton's Laws by the seat of your pants.

Newton's Third Law also explains how a rocket can fly in space, even when there is nothing to push against. It works like this: the rocket motor heats gases, which are accelerated out through the engine nozzle. (Like in the balloon demo above.) The First Law tells us that in order to accelerate gas, we must exert a force on it. That force must, of course, be exerted on the gas by the ship. The Third Law then tells us that an equal and opposite force must be exerted by the gas on the ship. That's what makes the ship go. A rocket ship in space is similar to someone standing on roller skates and shooting a gun. Both recoil in one direction as they throw something out in the other.