>>> "Tamara Gonzalez" 10/13/10 9:20 AM >>>

I want to do a different activity for Newton’s 3rd Law of Motion.  Somewhere I read about a balloon race, does anybody have any idea how it works?  I would like to do the activity with my 11th grade conceptual physics class.

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We did that a few years ago. Blow up identical balloons, fold end and hold with clip or clothespin, tape a straw to the top, run a string through the straw, and tape the ends of the string to opposite sides of the classroom. After the first race, students were allowed to make changes, like reducing the length of the straw, or cutting it into two small pieces and spacing them at the ends of the balloon. Discussion ensued about what made the balloon go, would different balloons work differently, reducing friction, etc.

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To avoid misconceptions, I prefer to initially consider Newton's 3rd only in static situations, e.g. a book on a desk, or a person leaning against a wall. With dynamic situations, the students form all sorts of misconceptions, especially about how rockets work.

The balloon rocket (and real rockets) accelerates as a consequence of Newton's 2nd Law. The 3rd law is always present when there are forces involved, but the students will too easily attribute the forward acceleration of the rocket to the backward flow of the exhaust. It's really the pressure differential, with more force acting at the \*front\* of the balloon that pushes it forward.

Students will also imagine that the air rushing out of the balloon is pushing against the outside air, and the air pushing back is what propels the rocket.

The 3rd law is very important, but students need to know that any change in motion is accompanied by a net force, not some magical law. Finding that net force is not always so easy. You need to choose the balloon as the system, and then find the external forces that result in its acceleration. And it's just the skin of the balloon that is the system, not the contents, and that makes it harder to draw the force/pressure diagram.

Especially in Conceptual Physics, the students need to be clear about the qualitative reasons for what they see, not necessarily the quantitative reasons.

If the answer to the question "How does a rocket work?" is "Newton's Third Law," there's no useful knowledge there. The students should be able to show specific, detailed applications of Newton's laws.

     Scott

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I plan on doing the project so that includes all of the three laws plus momentum.  I am trying to add a section where they have to make calculations but the only calculation I can come up with is speed.  Does anybody have any other idea of what calculation I can ask them for?

Thanks in advance!!

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**From:** Robinson Paul [mailto:pablo@laserpablo.com]   
**Sent:** Wednesday, October 13, 2010 2:57 PM  
**To:** Scott Orshan  
**Cc:** Tamara Gonzalez; physics@list.nsta.org  
**Subject:** Re: Activity for Newton's 3rd Law

Although you correct there are always more details that appear on the surface, I would maintain that a rocket exhaust gases are forced out the nozzle of the rocket engine. Doing so requires a force which is supplied by the rocket. Rocket on gases, gases on rocket--Newton's 3rd Law. It is the upward (for a rocket going up) unbalanced force of the gases on the rocket that propel it. Newton's 2nd Law tells us how much acceleration that unbalanced (net) force will provide.

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Hi,

I am getting in on this late, so I am not sure who asked the question, but I will give an answer also. The fuel in the rocket explodes in all directions. Some gases goes out the back and do nothing. Some gases hit either sides of the combustion chamber, and they cancel each other out. But some gases go forward and hit the front of the chamber. They hit and rebound. They hit the chamber in the forward direction. That force must be greater than the downward or backward forces if there is to be a net forward force. Now, as to the 3rd Law aspect of this. The forward gases hit (active force)the chamber in the forward direction. The chamber hits (reactive force) the gases in the backward direction with a force equal and opposite to the force with which it was hit. The 3rd law always involves two objects; and the action-reaction forces are equal in size, on the two objects, and in opposite directions.

Jane Nelson