

NASA Rocket Lesson  
**NewsDepth**, December 2, 2008  
Classroom Activities  
Additional Resources



**Overview:**

NASA is working on a new rocket to once again head to the moon. This rocket, Ares I, is part of the new generation of space travel. It has new technology allowing the astronauts' capsule to eject from the rocket in an emergency. They hope they never have to use it, but if they do, they want to be sure they have the proper safety mechanism. The mechanism is a motor connected to the capsule known as the Orion. That mechanism is what was tested recently in Utah and was featured on our NewsDepth show this week. Students will learn in our activities how a rocket functions and its importance to NASA's future space mission.

Image credit: NASA

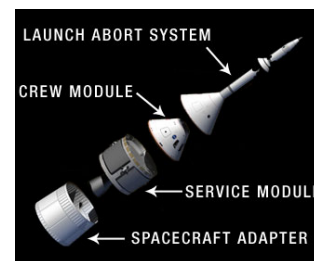
**Grade Level:** 7-8

**Subject:** Science

**Standards:** Forces and Motion

Students will

1. Describe how the change in the position (motion) object is always judged and described in comparison reference point.
2. Explain that motion describes the change in the position an object (characterized by a speed and direction) changes.
3. Explain that an unbalanced force acting on an object changes that object's speed and/or direction.



**Classroom Activities:**

**1. Activity # 1 Balloon Jets (25-20 minutes)**

- Tie a six-foot length of string to the back of a chair. Thread the other end of the string through a drinking straw, and then tie it to another chair back. Move the chairs apart so that the string is taut and the straw is near one end. Inflate a balloon. Hold the nozzle to keep it from deflating while you tape it to the straw. Release the end of the balloon. As the air rushes out, the straw and the balloon will jet across the string.
- Have the students discuss what caused the straw and balloon to move and why it stopped. Lead students to realize that the walls of the balloon pushed the air out. As the air rushed out, it exerted an opposite force pushing the balloon forward. The balloon jet stopped, either because it ran out of air or it ran into the chair when it came to the end of the string.

- It is this opposite force that causes the forward motion of a jet. The engine pushes air out the back. The opposite reaction pushes the aircraft forward. Have students brainstorm ways to make the balloon jet move farther or faster.
- The source for this activity is <http://www.nscdiscovery.org/TeacherTools/Word97/BalloonJetsandBakingSodaRockets.doc> .

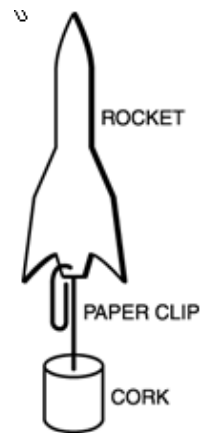
## 2. Activity #2 Newton's Third Law

- Make this statement to your students: For every action there is an equal and opposite reaction. (Newton's Third Law of Motion). Ask them what they think that means.
- Watch <http://www.youtube.com/watch?v=PZfrxUgZSuM> which is an Ares Test flight. Upon completion of the video clip, repeat the above statement. Ask them to apply that statement to the video they just watched.
  - Forces (a push or a pull) always come in pairs - equal and opposite action-reaction force pairs. The direction of the force on the first object is opposite to the direction of the force on the second object.
    - According to George Viebanz, Executive Director of the Ohio Math and Science Coalition, "The longer the force is applied, the more the object accelerates. This is why you have to back off the accelerator on your car. If you kept it floored, the car would continue to accelerate. Once you reach a desired velocity, then it is a matter of using the gas only when you need to get back up to speed. Another example is pushing a wagon. It is difficult to get started, but if you apply the same force after it is moving, then it accelerates and gets "easier" to push. Less force is needed to maintain velocity against friction than is needed to accelerate the wagon. In rocketry, the engines push for a long time, the rocket accelerates, and eventually reaches escape velocity needed for space travel. Sub-space rockets and airplanes only need enough "push" to get them to desired altitude and where you want them to land."
    - "It is a common misconception that rockets "push" off the ground, so they are unable to accelerate in space. The fact is that rockets do accelerate in space and do not need "something" to push against. There is indeed nothing for rockets to push off of in space - at least nothing which is external to the rocket. But that's no problem for rockets." George Viebranz
    - "Rockets burn fuel which creates hot gas under extreme pressure. The pressure accelerates the gas out of the nozzle. (This is Newton's 2<sup>nd</sup> Law of Motion...force = mass x acceleration). The force of the hot burning gases blasting out of the rocket in one direction makes the rocket move in the opposite direction (This is Newton's Third Law of Motion). It's not rocket science, it's physics!" Connor O'Malley, mechanical engineer and thermal analyst.

- Visit <http://www.physicsclassroom.com/Class/newtlaws/u2l4a.cfm> for more detailed information on Newton's 3<sup>rd</sup> Law of Motion.
- For an extension of the above activity, there is a link that presents excellent illustrated examples of Identifying Action and Reaction Force Pairs: <http://www.physicsclassroom.com/Class/newtlaws/U2L4b.cfm>.
- Question #3 in this week's NewsDepth show is, "Rockets carry their own solid or liquid fuel which they burn in order to propel themselves into space. How does this actually make a rocket move?" Ask your students, "After what we have just watched and talked about, how would you answer this question?"  
Answer: The force of the hot burning gases blasting out of the rocket in one direction makes the rocket move in the opposite direction.
- If all goes well, and the tests for the safety mechanism are successful, the motor tested in this week's NewsDepth could be a part of the rocket that goes to the International Space Station and the moon beginning in 2014. That is 6 years away. Why do you think it will take so long for that to happen?

## 2. Activity #2 Baking Soda Rocket: (30-40 minutes)

- Direct students to draw and cut out a rocket from tag board or an index card. The rocket is attached to the cork by using a paper clip with one loop straightened. Stick the end of the clip through the rocket and into the cork. Have each group measure 1 cup of vinegar and pour it along with some water into the soda bottle. Then measure  $\frac{1}{4}$  cup of baking soda on to a small square of paper towel. Wrap it carefully.
- Take the students and their rocket materials outside to an area large enough to launch the rockets. Direct the students to place the bottles on the ground in a designated area. One group at a time is called up to fire their rocket. One person from the group drops the paper towel containing the baking soda into the bottle, another group member loosely inserts the cork into the bottle, and everyone stands clear. It will take a little time for the vinegar and water to soak through the paper towel and react with the soda.
- After each group has shot a rocket, bring them together to discuss what force caused the rocket's motion. The gas produced when the chemicals were mixed increased (the air pressure inside the bottle). You probably will not have to ask whose rocket went the highest. Everyone will likely be talking about that anyway. See if they have any ideas about why some might have gone higher than others. What was different in each case? The directions above said to mix some water. No specific amount of water was given. Did different groups use different amounts of water? Would this make a difference?



- The source for this activity is <http://www.nscdiscovery.org/TeacherTools/Word97/BalloonJetsandBakingSodaRockets.doc> .

### **Additional Resources:**

[http://www.nasa.gov/mission\\_pages/constellation/ares/ares\\_education.html](http://www.nasa.gov/mission_pages/constellation/ares/ares_education.html) NASA's Ares education page: your online source for Ares related educational material.

<http://www.proteacher.com/cgi-bin/outside/site.cgi?id=4313&external=http://www.grc.nasa.gov/WWW/K12/airplane/bgmr.html&original=http://www.proteacher.com/110068.shtml&title=NASA%20Rocket%20Classroom%20Activities> NASA's beginner's guide to Rockets. Includes the Rocket Educator's Guide which is an excellent classroom resource.

<http://www.proteacher.com/cgi-bin/outside/site.cgi?id=5233&external=http://quest.arc.nasa.gov/space/teachers/rockets/index.html&original=http://www.proteacher.com/110068.shtml&title=Rockets> Teacher's Guide with Activities in Science, Math, and Technology

[http://www.nasa.gov/mission\\_pages/constellation/ares/index.html](http://www.nasa.gov/mission_pages/constellation/ares/index.html) NASA's website dedicated to Ares and Orion. There is an excellent recently updated video on the progress of the Ares. There are also additional multimedia clips on testing as well as podcasts about updates on the Ares.

[http://www.nasa.gov/images/content/149770main\\_cev\\_parts.jpg](http://www.nasa.gov/images/content/149770main_cev_parts.jpg) Source for picture of rocket components