GRACE Education Curriculum Satellites	
Teachers	Grades 3-5
Science & Technology	

Blast Off

Background Information: Rockets use powerful engines to boost spacecraft and satellites out of the Earth's atmosphere and into space. Rockets are filled with fuel that burns and causes gases to stream out and force the rocket upwards. You can see how this works if you blow up a balloon and let it go. This is an example of Newton's Third Law of Motion, "For every action, there is an equal and opposite reaction." The air rushes out of the balloon, which causes the balloon to shoot all over the place. Rockets move in a straight line because of their heavy weight and design. The satellite or spacecraft is attached to the rocket. It is called the cargo or payload. The cargo or payload is very small in comparison to the rocket. GRACE will be launched into space by a rocket from Plesetsk, Russia.

Objectives: At the end of the lesson, students will be able to:

- Define rockets as powerful engines that boost spacecraft into space.
- Understand the purpose of a rocket and the difference between rockets and their cargo or payload.
- Make a rocket.

Standards: Science: unifying concepts and processes; earth and space science; science as inquiry; science and technology; physical science.
Math: geometry

Vocabulary: Cargo Payload Rocket

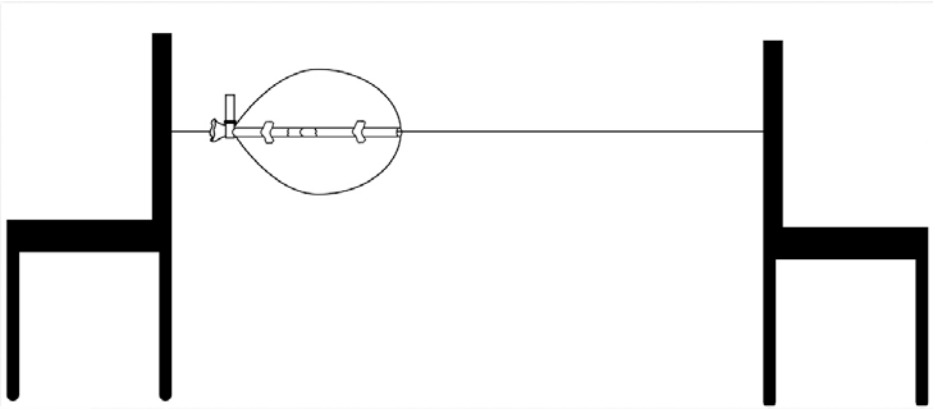
Materials:

One Balloon	2 Straws
Flour	Clothespin or paper clip
Heavy duty string (15-20 feet)	Tape (masking or duct)
Ruler	

Directions to the Teacher:

Review the included background information. The teacher should show images of rockets taking off which will demonstrate the amount of fuel that needs to be burned (see websites below). The teacher will explain to the students that the GRACE rocket will be carrying both satellites (double cargo or payload). The teacher will also explain that the students will be making their own rockets using the above materials. The rockets that will be made in class will help us see how rockets are pushed forward and by what force. It may be helpful to have the students work in pairs.

1. Tie one end of the string to a chair. The chair will be the launching pad and the string will act as the orbit path for the rocket.
2. Tape two straws together with masking tape end to end to make one long straw.
3. Place 1 tablespoon flour in the straw. The flour will represent the special effect of gas burning (smoke).
4. Blow up the balloon. Do not tie the end. Use the clothespin or paperclip to close the end. Make sure no air is leaking out. The balloon acts as the rocket.
5. Lay the straws end to end from the top of the rocket (balloon) to the stem. Cut the straw so it is the same length as the balloon.
6. Thread the string through the straws. This is tricky because you don't want to eliminate all your flour. Stretch the string tightly and tie it to another chair in the classroom.
7. Use masking tape or duct tape to attach the rocket to the straws (be careful not to tape to the string). The straws will act as the frame and boosters for the rocket.
8. Make sure the balloon stem is against the chair or launching pad.
9. On the count of three, pull the clip from the balloon stem. **3-2-1 BLAST OFF!** The rocket should race along the orbital path (string). The force of the air should push the flour out of the bottom of the straw causing a smoke effect.



Extensions:

- Draw a picture of the experiment and label the parts.
- Find a picture of the space shuttle on the launch pad. http://kids.msfc.nasa.gov/rockets/shuttle/launch.asp Label its parts.
- Compare the two pictures. Write a paper comparing and contrasting the two launches.
- Research the history of NASA and its launch program. Draw a poster describing the United States launch history.

References / Resources:

Oxford Science and Technology. Oxford University Press, Oxford, 1993.

The Complete Book of Science. American Education Publishing, 1998.

NASA Space Shuttle Launches websites:

http://www.ksc.nasa.gov/shuttle/missions/missions.htm

http://spaceflight.nasa.gov/sitemap/index.html

http://spaceflight.nasa.gov/spacenews/releases/n99-15.html

http://www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/u2l4a.html