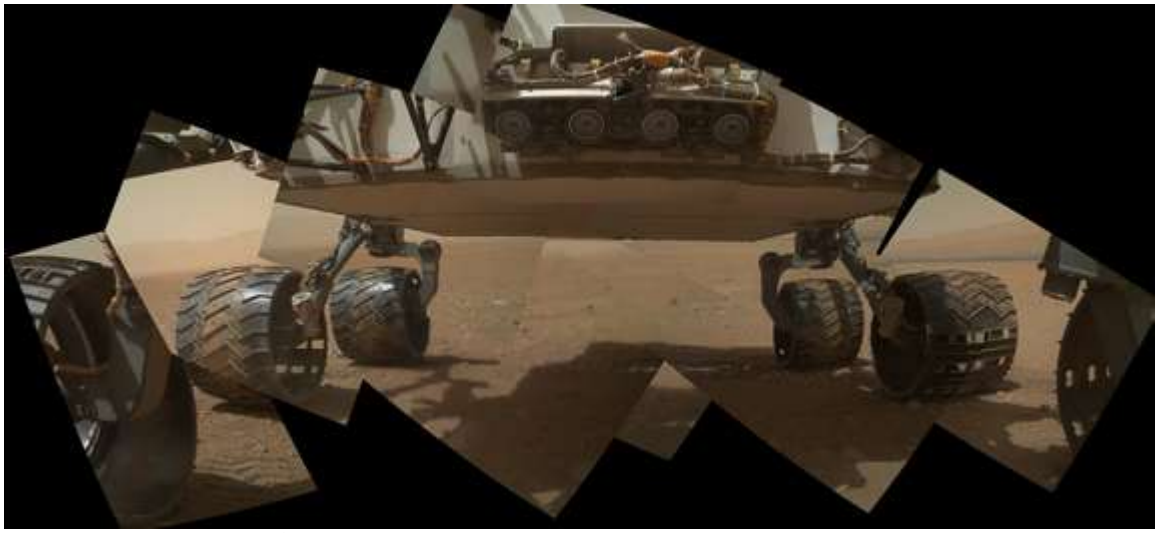
PROJECTILE MOTION LAB

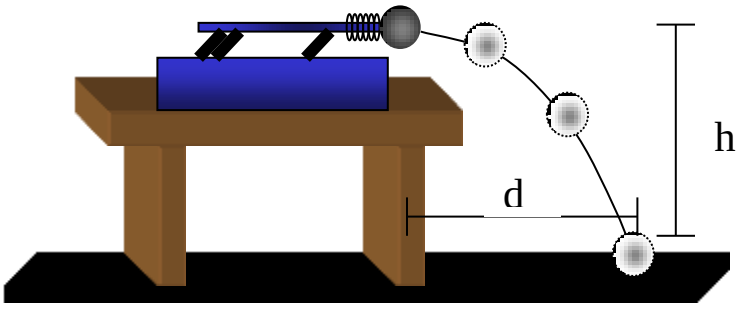


Picture retrieved from http://www.space.com/17518-mars-rover-curiosity-latest-red-planet-photos.html on 9-28-12

The Mars rover Curiosity, touched down upon the red planet on August 5th, 2012. Despite a nuclear battery expected to last 14 years, Curiosity only has a two year mission – to explore the surface of Mars and, in particular, look for signs of both water and life. To place Curiosity on the surface cost $2.5 billion. Its successful landing has ushered in a new model and new age of planetary exploration. The horizons of our understanding are expanding and, with this expanding horizon comes new goals. At present, NASA hopes to have astronauts on Mars by 2030.

As you know by now, if one knows the instantaneous position, velocity, and acceleration of an object, then one can predict the object's future location. (Of course this assumes that the forces acting on the object are predictable and constant – i.e. gravity). NASA physicists used the same concepts of motion, and in particular concepts of projectile motion, to send Curiosity to Mars. This is comparable to hitting a hole-in-one from over a billion kilometers!

Your job here, while not quite as ambitious, still embraces many of the same principles and techniques used to get Curiosity to its destination. You will be assigned a small ball launcher. As a group, you will be allowed to work with your launcher to obtain some information about your launcher. Then your teacher will give you an arbitrary angle above the horizontal. Once you know this angle, you are to determine the proper placement of a hoop and a cup, each spaced at least 30cm apart. Then, with your instructor observing, you will launch the ball so that it flies through the hoop and lands in the cup.



Ground Rules:

- You must not detach the launcher from the table.
- As a group, you must determine a set of calculations that your group will use to "quickly" determine the proper placement of the hoop and the cup so that the ball that is fired from your launcher passes through the hoop and lands into the cup. Both the hoop and the cup are to be placed on the floor.
- You will need to collect some information associated with your launcher *before* you can complete your calculations that will determine the proper placement of both hoop and cup.
- You only get one chance to hit your targets. Make sure your calculations are correct, that you are using the proper relationships of uniformly accelerated motion as we have learned in class, and that all group members agree with the plan before you receive your firing angle.
- The teacher must observe your group's first attempt to hit the cup and pass through the hoop. There will be no test shots!!
- Groups cannot adjust the firing angle from the horizontal position prior to their "real" attempt. However, groups are welcome to fire their launchers in the horizontal position as much as they wish in order to obtain any information they feel they need to implement their "plan" when attempting to hit the cup.
- The content you have learned in this first unit is all that is required in order to determine the proper placement of both cup and hoop.
- **Any group that succeeds in having their ball go through the hoop and land in the cup on the first attempt will be awarded full credit on this lab – no lab write-up is required.**
- Should the ball fail to go in the cup or through the hoop, the members of the group are to submit individual lab write-ups.
- If the ball fails to go into the cup or hoop, make adjustments until you are successful. Record your necessary changes and include them in your write-up.

Possibly Helpful Hints:

1) What is different (in terms of variables) about a launcher set horizontally vs. one that makes an angle with the horizontal?
2) How are you sure the the launcher is horizontal when you want it to be?
3) Can you record more information than you need? If so, which measurements will yield the most accurate results? In other words, which of your measurements are most uncertain? THIS CAN HAVE A HUGE IMPACT – THINK ABOUT THIS!!
4) Do you need to take the height of the cup into account?
5) Does the mass of the ball matter?
6) Is this uniformly accelerated motion? In how many dimensions?

Write-Up:

- Complete calculations, including diagrams and a list of variables, used to determine the placement of both the cup and the hoop. EXPLAIN EACH STEP OF YOUR CALCULATIONS FOR FULL CREDIT!
- Discuss whether or not you were able to land the ball into the cup. If the ball did not make it through the hoop(s) and/or the cup in the first try, explain how you corrected the problem.
- So long as the write-up is neat, it may be handwritten. If in doubt, word-process your write-up. Remember – you will be explaining what you are doing so there will be a good amount of text – not just numbers!!