Mind Trekkers

Loop-the-Loop Lesson Plan

Amount of time Demo takes: 1-2 minutes

Materials:
1. Loop the loop track
2. Loop the loop platform
3. 1 large metal ball
4. 1 small metal ball
5. Marbles

Set up instructions:
1. Lift up the crochet ring that catches the ball (it is on a hinge).
2. Line up the track with the screw in front of the ring, squeeze the circle part of the track, and place it between the two screws in the middle of the platform.
3. Test out the track -- the ball should go right into the pocket.
4. Keep track inside the plastic bin to ensure the balls are not lost.

SAFETY! Glass marbles can and will break when being hit from the metal ball. Clean them up if they break and make sure all glass shards are thrown out.

Lesson’s big idea
● It is a basic principle of the universe that total system energy is conserved -- it cannot be created or destroyed. Rather, it is simply transformed from one kind of energy to another, leaving the amount of energy in a given system constant. This demonstration shows the transformation of potential energy to kinetic energy.
● Students can experiment with different starting points to find the minimum height (and thus minimum energy) needed for the ball to make its way around the loop.

Background information
1. Energy is transformed from potential (the ability to do work) to kinetic (the energy of motion) as the ball changes height and traverses the length of the track. As the ball’s initial height is changed, the initial amount of energy in the system changes - directly proportional the the height of the ball. Given this initial energy, it can be found whether or not the ball will be able to travel around the entire loop without falling off the track.
2. It can be shown that the minimum height needed (in an ideal, frictionless world) is 5/4 the diameter of the loop. This results from the conversion of potential energy to kinetic, and that energy’s need to overcome gravity.

Instructional Procedure
1. Invite the participants to release the ball from different points on the track and have them predict what will happen from each point they choose.
   a. Predict what will happen when you release the ball from a high point on the track.
   b. Predict what will happen when you release the same ball from lower on the track.
2. Have the participants compare the two different sized balls and predict what will happen.
3. Be mindful! If participants don’t drop the ball from high enough, it will not have enough energy to make it all the way around the loop -- it will fall short. Don’t let them roll away!
4. After testing both metal balls, add in a marble. Put it at the bottom of the ramp and watch the energy from the metal ball transfer to the marble!

Assessment and sample questions you can ask:
1. Why did the ball released lower on the track do what it did?
2. Why did the marble roll up the loop after being struck by a ball bearing?
3. From how high do you need to release a ball to ensure it will go around a loop?

Clean Up
● Place items in kit, put balls in crochet pouch, take apart track.

References
● NASA, conservation of energy: http://www.grc.nasa.gov/WWW/k-12/airplane/thermo1f.html
● Wake Forest Univ. Physics: http://www.wfu.edu/physics/demolabs/demos/1/1m/1M4020.html
● Arbor Scientific: http://www.arborsci.com/loop-the-loop

National K-12 Science Standards
● K-4: Physical Sciences -- Position and motion of objects
● 5-8: Physical Sciences -- Forces and motion
● 9-12: Physical Sciences -- Conservation of energy and increase in disorder