Centripetal Tray Trials
Investigation #7

Description
Don’t get wet as you use this awesome centripetal system!

Materials
• Tray or box with a shallow lip
• Drill
• Drill bit
• Safety goggles
• String
• Scissors
• Plastic cup
• Pitcher of water
• Blocks
• Coins
• Golf tee in a block of wood
• Golf ball or ping-pong ball

Procedure
1) Drill a small hole in each corner of the tray or lip of the box.
2) Cut four lengths of string, each about 30 inches long.
3) Insert a string end through a corner hole and tie securely.
4) Repeat with the additional three corners.
5) Set the tray on a level surface. Bring the four strings together above the tray’s center so the strings are taut. Tie the strings together in a tight knot.
6) Tie another string about 30 inches long to the knot you just made. Adjust this string so that it comes out of the middle of the knot, for balance.
7) Pour a half cup of water into the cup. Place the cup on the tray.
8) Be sure to stand outdoors or in a large space. Hold the system by the upper string. Slowly begin to sway the tray and cup like a pendulum.
9) When ready, rotate the tray completely around in a vertical circle.
10) When you are ready to stop, move your hand and body toward the tray as the tray comes out of the bottom part of the swing.
11) What did you notice about the cup?
12) Can you do this action horizontally or on an angle?
13) Remove the water glass and try different objects, a stack of blocks, a stack of coins, or a ball on a golf tee.
14) Could you keep the objects on the tray when the tray was rotating?

My Results
Explanation
Swinging the tray gets the system moving in a circular path. If the tray were released or bumped into something, the cup or other objects would fly off in a straight line tangential to the circular motion. However, the strings are under tension and apply a centripetal or center-seeking force toward the hand on the tray and objects, and that force keeps the tray and objects together. The faster the tray rotates, the stronger the centripetal force. The combination of both gravity and the centripetal force acts on the objects in the same way throughout the motion, so the objects keep their relative positions. The higher acceleration of the tray ensures that the circular motion is greater than the force of gravity, even when it is fully upside down.
Force = Mass times Acceleration

Think and extend: We have seen how tetherballs, the Earth’s gravity on the moon, and amusement park rides are clear examples of centripetal force. Other examples are less obvious, like when a car makes a turn, or when you gradually turn on roller skates. In those cases, the wheels on the car or skates have friction against the surface and a net force pushing back toward a central point. So, remember, the net force that causes that circular motion is a centripetal force that is both predictable and fun!

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