Short Track Speed Skating

In short track speed skating, competitors race each other around an oval track at speeds of up to 40 miles per hour. How do speed skaters lean so sharply during turns without falling over? The athlete pictured below isn't supporting any of his weight on his left hand at all! Remember when we looked at how skiers push on the snow to turn? The force that pushes back is called **centripetal force** because it causes an object to move along a curved path instead of a straight one. Speed skaters turn using this same force, exerted by pushing against the ice with their skates.

Centripetal force leads to an equal and opposite **centrifugal force**. Centrifugal force comes from **inertia**—the tendency of an already-moving object to want to continue moving in a straight line. As the skater turns, he has to work hard to fight against this tendency. Check out the diagram below:

Need an example of how inertia works? Think about braking really hard in a moving car. Your torso gets "thrown" forward into the seat belt, but this feeling just comes from the fact that your torso wants to keep moving, even though the car is stopping!

Here, we can think of gravity and centrifugal force adding up to one big diagonal force (the dashed green arrow) that pulls on the athlete's **center of gravity** (g). As long as the athlete uses his skates to push back up through the ice with an equal and opposite force (the blue arrow), he'll remain perfectly balanced during the turn.

Imagine you're riding as a passenger in a car. When the car makes a really sharp turn, why do you feel like you get yanked in the opposite direction? Use the explanation of centrifugal force provided to help you come up with your answer.

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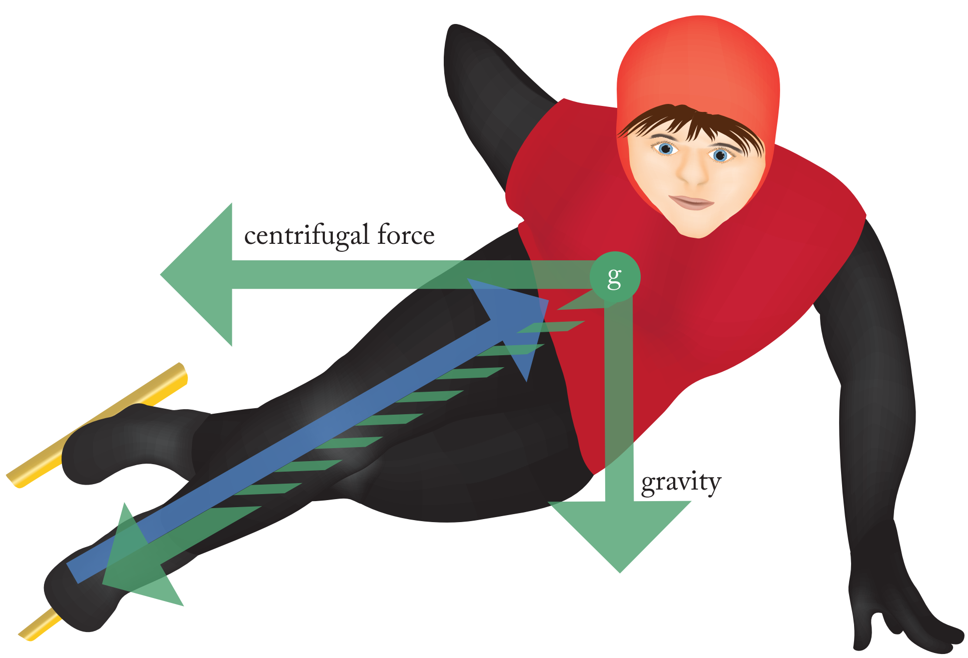

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Try This!

Get a feel for how centripetal and centrifugal forces work! Remember: centripetal force is a push or pull that causes an object to move in a curved path, but because objects have inertia, they resist this pull (remember--moving objects prefer to move in straight lines). We call this resistance centrifugal force.

Procedure

1. Use your permanent marker to mark three evenly spaced points along the edge of your frisbee.

2. Using the hot glue gun, attach one end of each length of fishing line or string to each marked point on the frisbee.

3. Place the plastic cup on the center of the frisbee. Don't glue it down.

4. Tie the loose ends of each string together in a knot.

5. Add about 2 inches of water to the cup. You can add a drop of food coloring if you want—this will make it easier to observe the level of the water as you conduct your experiment.

6. Hold the knot you made in step 4 between your thumb and forefinger.

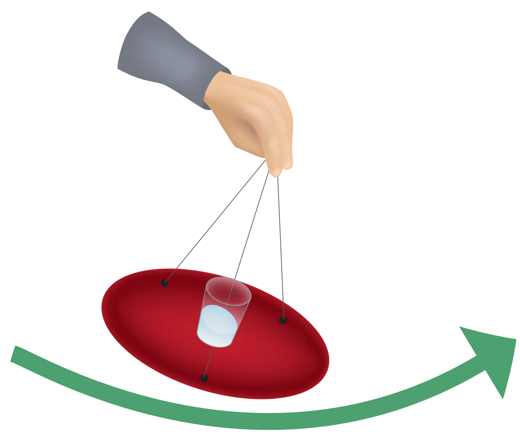
7. Swing the apparatus back and forth, slowly increasing the velocity after each swing. Have a friend observe the level of the water. What happens?

8. Try swinging the apparatus so that the string is parallel to the ground. Why doesn't the water spill out? What's responsible for holding the water in the bottom of the cup?

9. If you're feeling particularly confident, try swinging the apparatus around in a complete circle. If you do it right, the water shouldn't spill out! How come?

Materials

- Three 16" lengths of string or fishing line
- Frisbee
- Hot glue gun
- Plastic cup
- Water
- Food Coloring (optional)
- Permanent marker



Record your observations below, and try to explain the behavior you saw. How can you compare what you observed to how a speed skater keeps his balance during a turn?

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