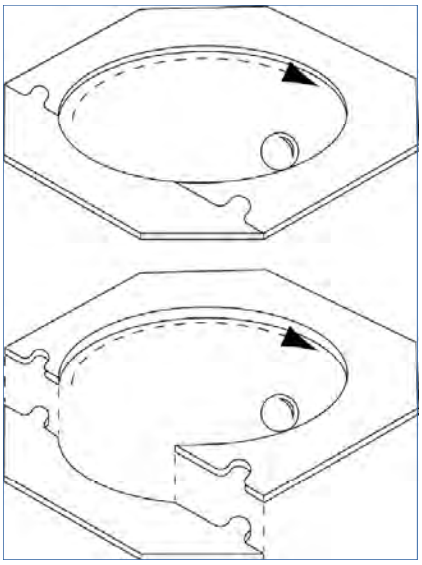
14020 CENTRIFUGAL CIRCLE

Purpose:

To help dispel a popular misconception, a two-part circular track causes a ball to move in a circle or tangent to that circle, but never radially.



Demonstration:

Having interlocked the two parts to make a circular track, the demonstrator gently hurls the ball along the inside of the track and calls attention to the following features of the motion.

The ball moves in a circle.
The ball can be made to travel the circle at different speeds.
The ball slows over time.
The ball behaves the same way while going in either direction.

The demonstrator would then ask for speculation on what makes the ball move in a circle, and might elicit the following typical responses:

The wooden track won't let it get away.
The wood forces it.
Etc.

The demonstrator asks for speculation on how or why the wooden track makes the ball move in a circle. The purpose of this line of questioning is to enable each observer to commit to a mental image of cause and effect and to prepare them to respond to the final question based on their personal concepts and convictions. The demonstrator then removes the smaller part of the wooden track and sets it aside. Making a motion as though to hurl the ball again. The demonstrator poses a series of questions and asks each observer to commit, in some way (voting on paper for example) to a specific outcome and reason for that outcome.

These questions might take the following form, or something similar:

Does the track "train" the ball to move in a circle, so that removing a part of the circle will still mean that the ball continues as before?

Does the ball experience a centrifugal force and can't wait to get away from the center of the circle so that when the gap appears in the track, the ball will move directly away from the center?

Will the ball get such a spin from going around the track that something strange will happen?

Is something else going to happen and why will it happen?

The key ideas are, first to provide a tactile experience involving a common textbook illustration. Next, to not place "the right answer" among the possible outcomes described at first. And finally, to have observers commit to an explanation before actually seeing what will happen. One way of "voting" on possible outcomes is to use the stickers, included with the original apparatus, or something similar, to actually place a mark that will be traversed by the ball after it leaves the larger portion of the wooden track.

Finally, the ball is hurled. The outcome is observed. The notions of cetripetal and centrifugal are anchored in the recollections of the observers by this vivid demonstration.

Additional Notes:

Uniform motion in a straight line needs no explanation — that is the way matter behaves. Any deviation from that needs to be explained and the search would be on for the force causing and acceleration that is changing the magnitude or the direction of the velocity, or perhaps both the magnitude and the direction. Uniform motion in a circle results when a force of constant magnitude is acting on a moving body in a direction always aimed at the center of the circle. When this happens, the speed does not change, only the direction as the centripital force changes the velocity. It is important to notice that the observer of this behavior is in an inertial frame of reference.

If the observer is in an accelerated frame of reference, let's say the observer is somehow inside the ball, then the observer feels the reaction to the centripetal force and genuinely feels drawn to the outside of the circular path. If this were a real force in the inertial frame of reference, all observers of the demonstration would see the ball move along a radial of the circle as soon as the track ends.

It is perhaps beyond the scope of this demonstration, but still worthy of notice, that the outcome of centripetal force, centripetal acceleration and velocity at any instant are independent of how one describes the position of the ball at that instant. It is not necessary to deal only with a radius of the circle. Visualize a rubber band somehow linking a selected point (anywhere) with the

position of the ball at an instant. That rubber band continues to change length and direction as the ball moves, but the values of acceleration and velocity derived from instantaneous position are still the same.

Time Allocation:

To prepare this product for an experimental trial should take less than two minutes. Actual experiments will vary with needs of students and the method of instruction, but are easily concluded within one class period.

Feedback:

If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.