7.1 - Curves and Hills - Activity Directions

Speed in Curves Experiment - How Speed, Vehicle, and Load Affect

Control Props Needed:

- Whiz Ring
- Small Model Car
- Speed Scale—Back of Playbook
- Small Bolt
- Rubber Band

Conducting the Activity

Part One: Speed and Traction Scale

1. Using the table, stand the Playbook on end with the speed scale at the bottom of the page.
2. Take the Whiz Ring and turn it upside down so the concave side is up - it is a curve with a negative camber.
3. Hold one side of the Whiz Ring against the speed scale at the 15 mph line.
4. Hold the other side of the Whiz Ring on the table. The ring will be at a slight angle.
5. Place the car in the groove of the Whiz Ring next to the Playbook or about 12 o'clock and let it go.
6. What happens? Car stays in the groove.
7. Increase the height of the top end of the Whiz Ring by 2 ½ mph on the speed scale. Do this by approximating ½ way between the lines. Mark your results gradually moving up the scale.
8. When can the vehicle no longer maintain contact with the road?
9. Then try a higher profile vehicle – van or pickup at the same speed levels and mark your results. Students will note the higher profile vehicle leaving the "roadway" at a much lower rate of speed than the car.

Make this Point

All vehicles will go out of control when the traction envelope is exceeded. The higher profile the vehicle, the sooner it will exceed its center of gravity.

Part Two:

1. Using the rubber band, attach the bolt to the top of the vehicle or in the pickup bed. Wrap it a few times on the bed of the truck close to the cab to prevent it from rubbing against the truck's tires. Show how the truck with an empty bed is able to safety travel through a left or right curve at 30mph (or whatever speed is proper for your set-up). Then place the bolt in the center of the bed of the truck with the head near the cab, secured by the elastic band. Now begin with the 30mph speed to see how the weight causes a change in control at the same speed. The bolt can represent passengers in a car or cargo in a pick-up truck. Adding weight changes the balance of the vehicle. You can repeat this activity by placing the bolt to the left side of the bed of the truck.
2. Find the top speed at which negotiating a right curve, with passengers on the left side of the vehicle, will result in success. Then, at the same speed, have the truck go into a left curve. Failure will occur.

Questions:

- What happened to the car, van, or truck as you increased the speed of the vehicle?
- At what point did it leave the Whiz Ring?
- Was it different for different types of vehicles?
- What happened when you added the load to the vehicle?
- What speed did it leave the Whiz Ring?
- Why do you think that happened?

- What does that tell you about controlling your speed in a curve with different vehicles and loads?
- How does this relate to the vehicles the students drive?
- Do they have vehicles they have altered, put lift kits on?
- How will that change the vehicle's center of gravity?
- What roads near their location have multiple crashes?

Make These Points

There are many variables that could cause a vehicle to go out of control at a curve in the road. The most deadly single vehicle crashes, when no other vehicle is involved, occur at curves in the road. Most of the time when drivers are alone in the vehicle, they feel they are in control as they speed into curves. Then when there are occupants in the vehicle, the driver fails to realize that the car is out of balance from what he/she is accustomed to. Also, there are all the other psychological and emotional risk factors that may cause a teen driver to travel faster than normal while entering a curve when there are passengers in the vehicle. And, with a few additional risk factors present, it is sure to lead to failure.

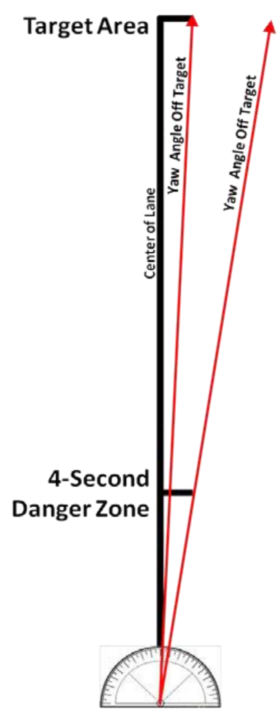
Keep in mind, the majority of teen deaths occur with passengers in a vehicle that failed to negotiate a curve. The driver made a wrong decision on speed selection.

Walking Car Performance

Recruit student volunteer. Have the student walk around the room at a fast pace. While the student is walking, tell him/her to continue walking and close their eyes. Ask the class what they observed. Did the student slow down? If student did slow the pace, ask why and discuss. Make sure that the fact they were unable to see what was ahead of them was a reason for their slowing. Make the point that driving over a hillcrest or into a curve requires the same action. A lack of ability to see ahead requires a speed reduction. Losing one's ability to see in the classroom and slowing down should illicit the same response in one's vehicle. (For more information on why it often does *not* illicit the same response, see "ok expectancy" in this chapter.)

If the student did not slow down, discuss why. Could they visualize their intended path? Did they know where everyone in the class was and that they were seated and did not pose a threat? Ask them if they could be assured of the same thing on the roadway? Ask them what the potential consequences would be in classroom versus on the roadway.

7.5 - Skid Avoidance and Control - Activity Directions



Student Demonstration: See the Off-Target Condition

Objective:

Students will be able to see how much easier it is to detect and correct a skid early when the driver is aiming all the way out to the target area.

Props needed:

Length of string equal to the longest length or width of your classroom Four student volunteers

Set up:

Have two students stretch string across the longest dimension of the classroom. Student #1 will represent the car and driver, and will stand in place. Student #2 will represent the driver's line-of-sight and the vehicle's yaw angle, and will move in and away from the driver and to the side as needed, holding the string tautly. Have the third student act as the "Target Area," standing at the far side of the room facing the driver, and the fourth stand in the "4-Second Danger Zone" also facing the driver.

Conducting the Activity:

Explain to the class that the driver is using a low aim when his/her car begins to skid off-target. Have student #2 move to the side until the string is just touching the shoulder of "4-Second Danger Zone" volunteer. Point out the depth of the off-target yaw angle. (It is not necessary to give the actual angle at this point.)

Then ask the 4-Second Danger Zone volunteer to move out of the way for a moment. Explain to the class that now the driver is aiming all the way out to the target area when his/her car begins to skid off-target. Again, have student #2 move to the side until the string is just touching the shoulder of "Target Area" volunteer. Ask if the depth of the off-target yaw angle is larger or smaller. Explain that a driver has a better chance to see and correct a skidding action when the off-target deflection is very small as compared to the larger off-target condition. The farther off-target the vehicle gets, the harder it is to correct. Larger steering actions must be made, which increases the chances of a secondary skid. If the angle of deflection goes beyond the transition pegs, correcting the skid may not be a possibility. Tires are limited in how far they turn - about 25-30 degrees.

Make this Point: To see and correct a skidding action at the earliest possible moment, one must be in the habit of aiming at the target area.

Variation - Can be done with a protractor and laser

pointer Props needed:

Protractor, laser pointer, and a flat surface to make marks on (desk w/whiteboard marker or a piece of paper)

The laser pointer represents the driver's central vision and the protractor is used to measure how off-target the vehicle is (the yaw angle). Tape the laser pointer to the protractor so it is aligned with zero degrees (top center of the protractors arc), and place it on a horizontal surface, shining toward a nearby wall (a whiteboard is ideal). Start with this set up about six feet from the board, representing the 4-second danger zone. Mark the point the laser is shining on - this is the center of your intended path lane, 4-seconds ahead, and mark the zero degree point on the desk or paper upon which the protractor is placed. Then make a mark 3-5 feet to the left and right of the laser's center point to represent the left and right edges of a lane.

Conducting the Activity:

Now explain to students that when the car gets off-target to the transition peg, control cannot be regained unless the tires are turned enough to point them towards the target. Therefore, the driver must recognize when the front of the car begins moving off-target and decisively turn the steering wheel to get the car pointing back on target. From the time the car begins moving off-target until it reaches the transition peg is a very small opportunity for the driver to regain car control. It is a race between the car's skidding movement and the driver's actions to determine if the car gets back on target or continues to skid out of control.

Start with the laser pointed at the center of the lane. Ask the students to focus on the light and to tell you when it's clear that they are moving too far off target. Rotate the pointer/protractor to the right until they tell you to stop. Using your zero mark, note how many degrees you rotated the laser (the yaw angle) before they stopped you and share that with your students.

Return the laser to center, and re-mark the edges of the lane as if you were looking out as far ahead as you can see (you can use the students to help determine how wide the lane should look, but it should be less than a foot wide). Students get the same job as before, and so do you. They watch the light and you rotate it slightly until they say stop. Note the degrees of rotation. The off-target yaw angle will be significantly less than the first time. This gives the driver more time to correct the skidding action and get the car back on target.

Physical Practice Activity: Skid Detection and

Correction Props Needed:

Simulated steering wheels - Parts one and two
Office chair that can be rolled and swiveled - Part two

Set up

Give all students a simulated steering wheel. Direct the students to stand and hold the “steering wheel” in a 9-3 position. Tell the students that you represent a target.

Conduct Part One

Have all students first turn their heads to look directly at you, then have them move the steering wheel and their bodies until you appear in the center of it. Move your position to the left or right side of the room. Have students turn their head to look directly at you. Then have them turn their steering wheel to get on target. Walk to the back of the classroom. Tell the students to turn their heads to see you as the target. Then tell them to turn the steering wheel and turn their bodies until they are in alignment with you. (In some situations they may not be able to initially see the target until steering occurs.) Repeat this activity several times. Give the students positive feedback.

Conduct Part Two

Now have the students experience how to detect a rear-wheel skid and how to use targeting skills to determine the direction, extent, and speed of steering actions.

Ask for several student volunteers. Have one student sit in the office chair with a simulated steering wheel. Have him/her pretend to be in a car. Establish a targeting path that the student is heading towards (e.g., doorway of the classroom). Tell the student that as soon as the car gets off-target, he/she is to turn the steering wheel to get the front of the car back on target. When the car moves very slightly off-target, a slight steering action would be needed. When the car begins to move very quickly off-target, then very rapid and full turning of the wheel would be necessary to get the tires pointing back on target. Stand to the rear of the chair, and swing the chair slightly off-target in one direction or the other. Observe how the student responds with steering and head movement. Give feedback to the student by swiveling to represent what effects their action would have upon the car. If they don’t respond quickly or correctly, spin the chair 360 degrees. Increase the trials, changing the direction and the quickness of the “skid.”

Demonstrate how a “secondary skid” occurs

In response to a skid, the student takes the correct steering action, with head turned to look at target, and his/her body pointing 30 degrees off-target. Now, rather than swivel the chair immediately back on target, roll the chair towards the target. After moving a few feet, swivel the student’s body towards the target. The student should take a rapid steering action that will allow the tires to be pointing straight when the front of the car is on target.

Make these Points

Visualization of the target and knowing where to steer is vital. Explain that when the rear skidding action is stopped but the front of the car is not pointing towards the target area, there is a high risk for a secondary skid to occur. Often, when the skidding action has momentarily stopped, the car is at a 30-degree angle to the targeting path with its tires fully turned pointing towards the target. (It was necessary to fully turn the tires towards the target to stop the skidding action.) During this brief pause of skidding, all four wheels are -sliding with the front of the car off-target. As the sliding action reduces the car’s speed, the front wheels regain traction and are able to grip the road. With the tires fully turned, the car begins to move very violently towards the target. The driver must be aware that at the beginning of the car’s movement towards the target, rapid counter- steering must straighten the tires before the front of the car swings past the target and into a surprise "secondary skid."

Optional Instructor Demonstration: 3 Skid

Types Props Needed:

Commercial or homemade traction board with curve painted on one side 6" model car with front tires that turn
Slick masking tape to keep wheels from rolling

Loss of Traction to Front Wheels (also known as "Understeer")

Lift roadway end of traction board approximately 6-8 inches to cause an incline for the car to roll down. The higher the incline, the greater the car's speed will be. Turn the tires of the model car to have the car steer to the right.

Place the car at the top of the incline and have it roll down and to the right (be ready to catch it before it goes off the board). Ask the class, "What happens to the car when traction to the front wheels is lost and the tires are not able to grip the road?"

To prevent the front tires from rotating, turn the black plastic "patches of ice" to cover the footprint of the front tires. (Or use slick masking tape to stop the wheels from rolling.) Turn the tires to the right. Now, while pointing out to the students that although the tires are turned, they are not able to rotate, place the car at the top of the incline to have students see the car sliding straight down the incline in an understeer condition.
Repeat the sequence two or three times. Turn the black plastic to allow the front wheels to rotate. Have the car roll down the incline with tires turned to emphasize that tires must rotate for steering to take place.

Explain that the most common cause for a driver losing traction to the front wheels is hard braking that causes the front wheels to stop rotating. The action a driver must take if this happens is to release braking pressure slightly, just enough to get the tires rolling again, while still braking. A car with ABS brakes will be able to retain its steering with hard braking because the computer system of the ABS brakes releases pressure and reapplies
braking forces automatically about 15 times per second. Therefore, it is very important that the driver of a car with ABS brakes keeps the foot on the brake.

Loss of Traction to the Rear Wheels (also known as "Oversteer")

Have the car roll down the incline with tires straight. Ask: "What effect does it have upon the car when traction is lost to the rear wheels?" Turn the black plastic "patches of ice" to cover the footprint of the rear tires. Elevate the board about 6-8 inches to allow the car to slide down the incline. The rear of the car will rotate 180 degrees into a rear-wheel skid. (If the car doesn't rotate, change the elevation of the board, more or less.) You can also, in addition to tilting the board up, tilt it slightly to one side to represent a camber to the road. Repeat sequence two or three times. Have discussions.

Make these Points

Traction is needed on the drive wheels to make the vehicle go, on the front wheels for steering, and on both front and rear wheels for directional control and braking. A spinning wheel does not provide as much traction as a rolling wheel. It takes more force to start a vehicle moving than it does to maintain movement. Normally, a vehicle moves in the direction the wheels point, because the rolling friction of wheels moving forward or backward is much less than the sliding friction of side movement. An exception is when inertia while entering a turn is greater than the frictional force of the tires (the tires will slide sideways), preventing a centripetal effect from pulling the car into the curve.

Loss of Traction Front & Rear Wheels

On the backside of the board, there is a painted curve. Turn the car's tire to the right. Elevate the board with the car's rear tires at the top edge of the board. Allow the car to roll down the incline with the proper speed so that the car stays within the painted "roadway". Take note of the board's elevation.

Hold the board at the same elevation that will allow the car, with its tires fully turned to the right, to stay within the painted “roadway”. Roll the car down two or three times. Then increase the elevation of the board and call out to the students the effects more speed has upon keeping the car in control. Note how the car goes outside the curve line. (The more the incline of the board, the faster the car is traveling.) Repeat while continuing to increase the elevation of the board and discuss with students the effect speed has upon the car.