Teacher Guide to 3.1

Changing Motion

Objectives: The students will describe and demonstrate at least two methods for changing the speed only, the direction only, and both direction and speed of a moving object. The students will use the terms *speed* and *velocity* properly.

Process Skills Addressed: Observing, classifying, communicating, designing investigations, acquiring data

National Science Education Standards Addressed: Content standard B: Position and motion of objects; Properties and changes of properties in matter; Motions and forces

Position in the Learning Cycle: *Explore*. You are having the students do activities that will set them up for understanding the definition of acceleration. The students have a fair amount of freedom in meeting three challenges. This is not the time to introduce the concept of acceleration. You can, however, use this activity as an elaboration of the concepts of speed and velocity.

Relevant Pages in *Force and Motion Stop Faking It!* Book: Pages 17–21

Suggested Group Size: 2 or 3

Materials: 1 golf ball (or similar) per group. Various other materials from around the room. You might leave Hot Wheels tracks and rolls of masking tape lying around.

Approximate Time: 45 minutes

Procedure:

1. **Ask the students to give examples of objects that are changing their motion.** Examples are cars speeding up and slowing down, people walking and then stopping, and someone falling off a skateboard. Although some of the students might give examples of objects changing direction, don't expect everyone to see that as a change in motion. The purpose of this initial discussion is to get the students to think about changing motion, not to refine their thinking. Remember that this is an Explore activity, meaning the students gain experiences from which to understand concepts to be introduced later.

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2. **Introduce the three tasks,** which are: (A) change the speed of a golf ball without changing the direction it moves, (B) change the direction a golf ball moves without changing its speed, and (C) change both the direction the golf ball moves and the speed at which it's moving. They're to provide two ways of meeting each challenge and record them on the sheet provided. They can use anything available in the room to meet these challenges as long as they don't break things—throwing a golf ball through a window is not a viable option.
3. Once the students are working on their challenges, **circulate around the room and help focus the students on the task.** Things that might help you:
   - One common mistake in challenge C is for the students to first change the direction and then to change the speed. These are to be accomplished in one instance.
   - Students don't always pay attention to detail. They might bounce the ball off a wall and claim that this is simply a change in direction, but in the process of bouncing off the wall, the ball slows to a stop and then speeds up again. Thus, while this meets challenge C, it doesn't meet challenge A or B.
   - Students might roll the ball down a curved track (Hot Wheels track) or curved surface in order to speed it up, but because the track is curved, the ball also changes direction. If the track or surface is straight (supported by a book, maybe), though, then the ball doesn't change direction.
   - Changing the speed of the ball without changing its direction is often simpler than it seems. If you drop a ball straight down, it is speeding up but not changing direction. Simply rolling a ball across a carpet causes the ball to slow down while not changing direction.
   - For most students, changing the direction of the ball while not changing its speed is the most difficult challenge. They can accomplish this by striking the ball from the side while it's rolling along the floor, by spinning it so it curves as it moves along the floor, or by causing the ball to move in a circular path. For a circular path, rolling the ball along a curved section of track while the track is on its side works, as does putting the ball in the middle of a roll of masking tape and swirling the roll of tape so the ball moves in a circle. Perfectionists in your class might argue that it's virtually impossible to keep the ball from slowing down during any of these actions, and that's true. As long as they can "pretty much" keep the ball at constant speed, that's good enough.
   - Keep in mind the purpose of the activity, which is for your class to experience various changes in velocity. As such, it's okay for one group to see what another group is doing and copy it.
4. **Have the students record their methods on the sheet provided.**
5. **Discuss with the class how they met the challenges.** Use the opportunity to deal with any methods that did or didn't meet the challenge exactly. For example, why does bouncing the ball against the wall not just change the direction of

motion, but also the speed (the ball slows to a stop and then speeds back up as it hits the wall)? Remember that all you're doing at this point is debriefing the activity. Don't explain acceleration and how it applies to what the class did. Of course, it's perfectly fine to clear up any misconceptions on what speed and velocity are. Even though you've dealt with those concepts, it's quite probable that many students don't have a solid grasp of them at this point.

Student Activity 3.1

Changing Motion

You are to meet the following challenges in any safe way you can. Safe means no one and nothing gets hurt in the process. Here are your challenges:

A. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change speed but not direction.

B. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change direction but not speed.

C. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change both speed and direction. Do this with one action. That means you haven't met the challenge if you change the ball's speed and then start the ball rolling again and this time change its direction.

1. List two ways you changed the speed of the ball without changing its direction.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

Changing Motion

Student Activity 3.1

2. List two ways you changed the direction the ball was moving without changing its speed.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

3. List two ways you changed both the speed and the direction of the ball.

   a. _____

   _____

   _____

   b. _____

   _____

   _____