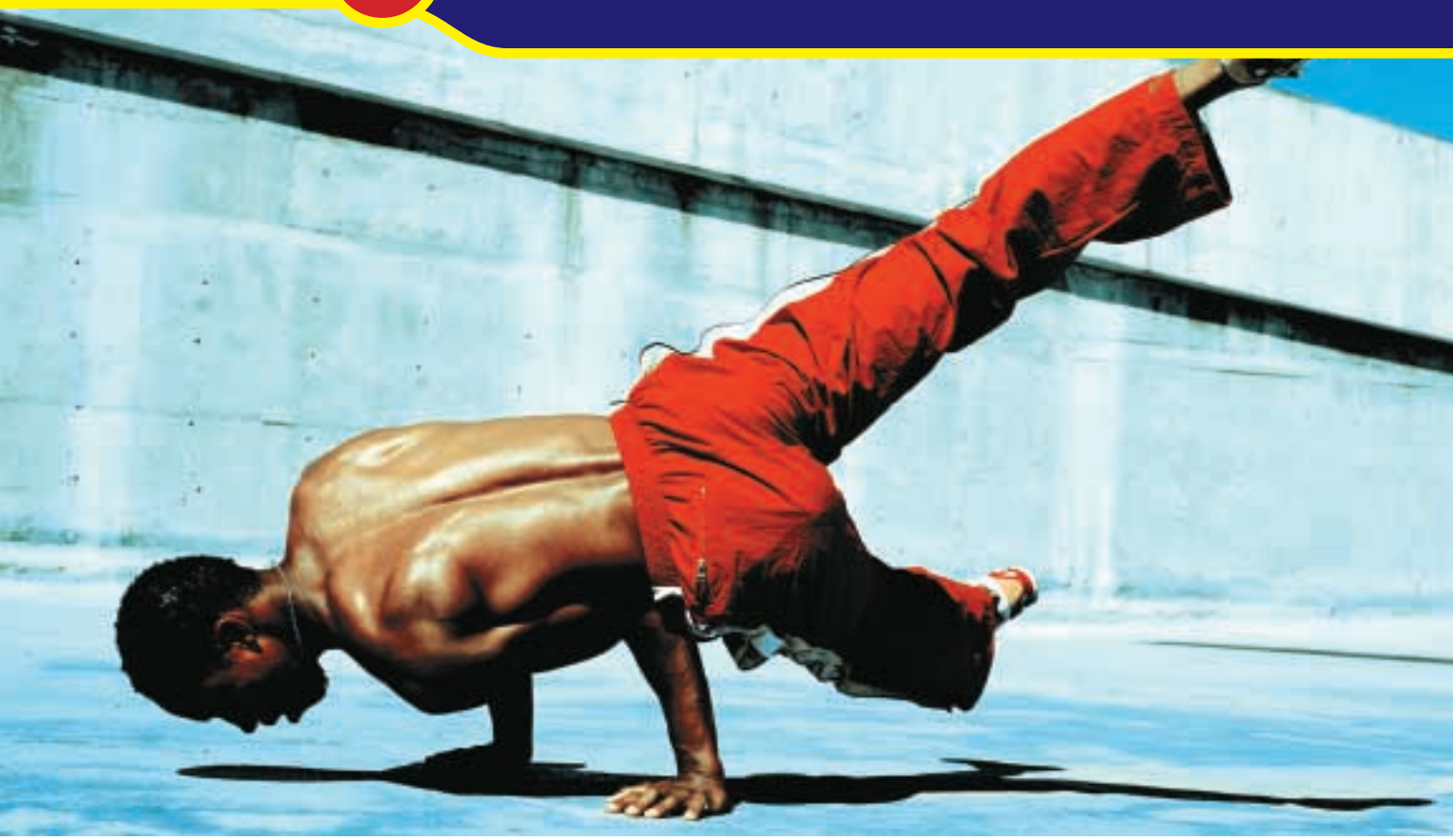
CHAPTER 10

Applications of Forces



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Dancers spin, twist, and swing through the air. Athletes move in constantly changing directions. The details of these complex motions are studied by kinesiologists by tracking the position of sensors fastened to knees, elbows, or other joints. Position-time data gathered from such experiments can be used to produce photo-realistic animations for movies and video games. This data can also be used to study the details of the motion from a physicist's point of view, providing a basis for measurement of changes in speed and direction — accelerations and the forces that cause them.

When you turn while you run, walk, or dance, you are moving in three dimensions. You might change direction suddenly or do it over several steps, following a curved path. In either case, changes in direction are accelerations, and accelerations require an unbalanced force. In this chapter, you will expand your skills in analyzing forces and motion. You will develop more mathematical techniques and apply them to sophisticated problems.

MULTI LAB

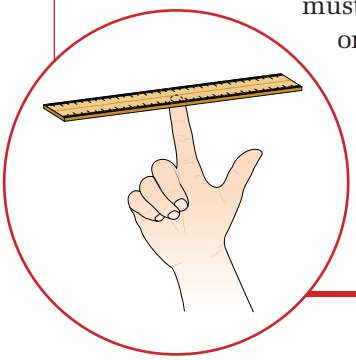
Location of Force Affects Motion

TARGET SKILLS

- Analyzing and interpreting
- Hypothesizing
- Communicating results

Balancing Act

In this activity, you will attempt to determine the criteria for balancing various objects on the end of your finger. First, balance a ruler on your finger as shown in the figure. Mark the point at which your finger must support the ruler in order to balance it. Next, balance a spoon or another similar object on your finger and mark the point where your finger supports the spoon. Cut a piece of cardboard into an irregular shape and find and mark the point at which your finger can balance the cardboard. Choose two other items and carry out the same observation.



Analzye and Conclude

1. Examine each of the items that you balanced and look for some reasons that they would balance at a specific point.
2. Formulate an hypothesis about criteria for balancing any object.
3. Write a clear statement of your hypothesis.

Open the Door

At one time, large ornate doors had the doorknob in the middle of the door because it was esthetically attractive. In this activity, you will determine why this design is not popular. Find a relatively heavy door on a simple hinge. Do not use a door with a spring loaded hinge. With one finger, push on the door at the following places and open the door at a slow constant speed.

- centre of the door
- half way between the centre and the hinged side
- one fourth of the way from the hinged side to the centre
- as close to the hinges as possible and still move the door

Note any differences in the amount of force you had to use to open the door by pushing at the different positions.

Analyze and Conclude

1. Discuss with a partner, the relative amounts of force that you had to use to open the door by pushing at the different positions.
2. Describe the type of motion that the door is undergoing while it is opening.
3. What is the direction of the force relative to the point at which the door is pivoting?
4. Formulate an hypothesis that can explain why different amounts of force are required to open a door depending on the point at which the force is applied.
5. Apply your hypothesis to the design of a wrench that you would need to use to tighten a bolt. What feature of the wrench would be the most important? Explain why.
6. Why do you think that doors with the doorknob in the centre are not popular?