Because you increase speed by increasing stride length, developing a technique that allows you to easily achieve a high stride rate without limiting the potential for adjustments in stride length as you run faster is advantageous. Again, any technique improvements along these lines should occur quickly with short-distance performance improvements.

### Measuring Technique Efficiency

#### Swimming

*Distance per stroke:* Distance swum divided by the number of strokes taken in that distance.

*Stroke rate:* Time taken to swim a distance divided by the number of strokes taken in that distance.

#### Cycling

*Cadence:* Measured with an odometer.

*Inertial force applied to pedals:* Evaluated with a stationary cycle that creates noise.

#### Running

*Stride frequency:* Number of steps taken over a certain time.

*Stride length:* Distance run divided by the number of strides taken in that distance.

### Technique Model for Swimming

An assumption made by many competitive triathletes is that the stroke of choice for competition will always be the crawl stroke, or freestyle (as it is commonly, although inaccurately, referred to in the United States), because this stroke is generally the fastest. The term *freestyle* actually refers to the use of any style in competition; however, the term is used here in place of the crawl stroke. For some athletes with inefficient technique or poor conditioning, it might not be possible to sustain the freestyle stroke through a complete race. For such athletes, a combination of strokes, particularly backstroke or breaststroke, provides the best opportunity to finish the swim safely and in comfort. Numerous texts address the principles associated with those strokes, so the focus here is on the freestyle. Most people learn most easily by using the part–whole method. This means that you break the movement down into logical parts and learn those parts progressively, eventually merging the parts into the whole.
Balance

By creating and maintaining a balanced horizontal body position, you expose a smaller surface area to the water as well as reduce the kicking energy necessary to keep the legs up. Many swim coaches and teachers consider this the most fundamental aspect of swimming skill to develop first. Optimal body balance in freestyle swimming creates a position as close to horizontal as possible. You achieve this by balancing the body across its central rotation point, or center of buoyancy; in this case the center of buoyancy is the lungs because you are floating in water. You can picture this by imagining the way a teeter-totter is balanced by creating equal forces on each end and placing the fulcrum, or rotation point, in the center. However, in swimming, the teeter-totter is inherently unbalanced because one lever is longer than the other. Because your center of buoyancy is in the chest, your legs are a longer and heavier lever; this is why they tend to sink. In freestyle swimming you can offset this with the position of your head and an extended arm. By keeping your head down and an extended arm forward at all times, you tend to balance the system and stay horizontal in the water more easily. Some coaches and athletes refer to this as creating pressure forward, or “pressing the T.”

➤ BASIC BALANCE

You can test balance easily by first attempting to float facedown with your arms at your sides. You’ll notice that your legs tend to sink unless you kick. Then experiment with pressing forward with your head to offset the sinking effect. You can then extend this concept to achieve the same floating ability as you roll from side to side. Increase the difficulty of this drill as you become better at it by placing a successively greater number of kickboards under the chest. This creates an inherently less stable situation, further developing your balancing skills.

➤ SIDE BALANCE

You’ll move to the classic extended arm position on your side, which is used as a basic drill for balance. You make approximately a quarter turn from a flat position in the water to achieve the correct alignment (see figure 3.2). Note that your head should maintain its neutral alignment except when you are breathing. You can easily evaluate the effectiveness of your balance by your ability to minimize kicking while maintaining your body position in the drill. It’s easiest to do this drill with flippers on. It becomes progressively more challenging when you remove the flippers and then when you reduce the kicking frequency.

Figure 3.2 Side balance.
The most common error in balancing is to lift the head too much, which forces your legs down, increases the work required of kicking, and increases drag. These things in turn increase the rate of fatigue. If you exhibit this error, improved balance will immediately increase distance per stroke and reduce stroke count at a given effort. Even very effective swimmers often lose balance somewhat while breathing. You must seek to maintain your balance throughout the complete stroke cycle. Further, in a race, when lifting the head to sight the next buoy (or other mark) in open water, teach yourself to rebalance quickly by dropping the head again immediately.

Another related error is to use a stroke in which the arm movements are always in opposition to each other. This creates a substantial period in each stroke cycle during which no arm is extended forward and tends to inhibit body roll during the stroke. Many swimmers achieve their best short-sprint times this way because it allows for a very rapid stroke rate, which is easy to learn. However, drag is greatly increased, and so many of the great freestyle sprinters use the optimal mechanics described earlier in the chapter, albeit at a very high stroke rate and with less rolling range of motion than when swimming longer distances.

In open-water triathlons, these errors begin to surface, even in those with well-developed balance otherwise. If you do not learn to deal with this in training, you will gradually lose balance and lose stroke effectiveness. The use of a wet suit might further aggravate this process by improving buoyancy (so the head can be held up too long too easily) and inhibiting the natural roll.

**Streamlining**

In the freestyle stroke, you can achieve effective streamlining by using the side balance body position described previously. The extended arm, lowered head, and quarter-turn position create both a horizontal position and a long, tapered alignment that reduces drag by presenting a smaller and smoother surface for water molecules to move past, encouraging smooth laminar flow. Imagine the long, sleek lines of a speed boat to visualize this concept.

Competitive triathletes also use both wet suits and body shaving to improve laminar flow. Each allows the surface of the skin to create less turbulence in the water molecules moving past. The wet suit also enhances buoyancy, making it easier to sustain a horizontal position in the water.

➤ **SIDE BALANCE WITH FLIPPERS**

The side balance drill is also effective for practicing streamlining. You can further augment it by using flippers to move through the water rapidly in the position—this enhances the sensation of drag when inappropriate body positions occur. You then learn to move from side to side, rolling between opposite-side streamline positions and spending as little time as possible in the less streamlined, flat position in the water. If the drill works in transferring the streamlining skill to your stroke mechanics, you should notice a reduction in your stroke count for a given distance.
Force Production

Forward motion in swimming results from effective applications of the force you create to the water. This works best when you create force using the powerful trunk muscles and then transfer that force to lateral movements of your hands and forearms, which are your paddles. However, the rotational movements involved must also be counterbalanced by an efficient kick. Each of these aspects of force production is discussed in greater detail in the following sections.

Transfer of Momentum From the Core Muscles

This concept can be described by relating it to the use of a hand saw. When you begin to make a cut in wood, you use small movements coming largely from your shoulder. But this fatigues the small muscles of the arm and forearm, so you quickly adopt a technique that allows you to move the saw by rotating the torso. The larger muscles of the torso doing the work do not fatigue as easily, and you become more relaxed in your movements. The torso begins moving first. Then the movement is transferred sequentially into each of the joints leading out to your hand, which is holding the saw. When possible, you also brace your legs by holding on to something with the opposite arm, allowing you to apply more force to the saw more easily through stabilization.

This analogy can be extended further for those familiar with kayaking. In kayaking you create each stroke by placing the paddle in the water in the best alignment and then sweeping it laterally by using a sequential movement that begins in the torso. This allows you to create stroke after stroke at increasingly higher rates with minimal fatigue in the arm or local muscle. In freestyle swimming, the same principle can be applied. By initiating movements in your powerful torso muscles and then transferring them to the arms, which act as paddles in the water, you can achieve a powerful and nonfatiguing swimming stroke that resembles what a skilled kayaker achieves. The key to success is linking the hips and torso to the arms in stroke-power production as a means of lengthening the kinetic chain (that series of interconnected muscles and bones that extend the trunk movements out to the limbs) from which each stroke’s hand speed and power are derived. You do this by placing the hand forward in the water with the fingertips pointing down and then rolling laterally to move the hand laterally. This causes the elbow to rise and creates an effective lift position whereby the hand and forearm act as a propeller as they are swept sideways. When moving from the starting position (the quarter-rotation balance position described earlier) to the midpoint of the roll (a flat position in the water), the shoulder is moving out from the midline of the body (see figure 3.3a).

As a result, the hand is also sweeping out from the midline of the body because the arm and hand are moving with the torso rather than independently of it. This is often called the outsweep or downsweep. It is achieved not
by moving the arm laterally but by rolling and maintaining the current orientation of the arm to the torso, which sweeps the arm, forearm, and hand (the paddle) laterally as the body rolls. As this sweep occurs, you create a propeller by pointing the fingers down, keeping the underwater elbow high or forward, and angling the little-finger side of the hand forward. As you pass the midpoint of rotation, your shoulder begins to move back toward the midline of the body. This allows you to naturally reverse the direction of your arm, forearm, and hand to create an inward sweeping motion most often referred to as the insweep or upsweep (see figure 3.3b). This inward motion is achieved without the need for conscious thought because the shoulder continues to follow the torso rotation with the forearm and hand following in turn. The only necessary adjustment is a repositioning of the hand and forearm to create a propeller. This is done by angling the thumb side of the hand forward (see figure 3.3c). These sweeping motions provide for effective anchoring of the paddle (your hand and forearm) so that the large muscles of the back can be used to flex the shoulder simultaneously to pull the body forward over and past the anchoring point.

However, as you complete the trunk rotation, you must achieve further lateral motion of the hand outward or movement backward by using the smaller muscles of the arm, particularly the triceps. Because pushing backward at this point relies primarily on drag to anchor the hand, to do so you would use lots of muscular effort for very little payback in forward impulse. In addition, this wasted movement reduces your potential stroke rate and results in deceleration and loss of your current inertial state. Consequently, you want to rapidly remove the hand from the water at this point without fully extending the elbow to quickly initiate your recovery.

You recover the arm by drawing it forward in a high elbow position while on your side and then allow it to fall easily into the extended arm position forward of the body. This falling, if done by relaxing the arm rather than by forcing it into the water, allows you to use the elevated part of your body to capture gravity and help in initiating the next consecutive rolling action of the body. If the opposing extended hand is allowed to relax and sink slightly into