Muscular strength, endurance, and flexibility have been combined into one broad fitness category because the primary consideration is determining the functional health status of the musculoskeletal system. It is equally important to have strong muscles that can work forcefully and over a period of time and to be flexible enough to have a full range of motion at the joint. Musculoskeletal injuries are often the result of muscle imbalance at a specific joint; the muscles on one side may be much stronger than the opposing muscles or may not be flexible enough to allow complete motion or sudden motion to occur.

It is important to remember that the specificity of training bears directly on the development of musculoskeletal strength, endurance, and flexibility. The movements included in these test items are only a sampling of the many ways in which the body is required to move and adjust during physical activity.

The upper body and the abdominal/trunk region have been selected as areas for testing because of their perceived relationship to activities of daily living, correct posture, and the development/maintenance of a healthy, well-functioning back.

The goals for a healthy back include proper alignment of the vertebrae and pelvis without excessive disc pressure and the ability of the pelvis to rotate forward and backward without strain on the muscles or connective tissue. To accomplish these goals an individual must have sufficient, but not excessive, flexibility of the low back, hamstring, and hip flexor muscles and strong, fatigue-resistant, abdominal and trunk extensor muscles. Although most students will be able to achieve the criterion standards for one or two of the included test items, it is important to educate them regarding the importance of muscular strength, muscular endurance, and flexibility in preventing problems as adults. It is especially important to make students aware of correct postural alignment and body mechanics in the event that they are developing scoliosis, which is a problem for teenage youth. The school nurse, a local physician, or a physical therapist is a good source of information about scoliosis.

Need Additional Resources?

For complete information about FITNESSGRAM, visit www.fitnessgram.net. To order the FITNESSGRAM
Abdominal Strength and Endurance

Strength and endurance of the abdominal muscles are important in promoting good posture and correct pelvic alignment. The latter is particularly important in the maintenance of low back health. In testing and training the muscles of this region, it is difficult to isolate the abdominal muscles. The modified sit-up, which is used in many fitness tests, involves the action of the hip flexor muscles in addition to the abdominal muscles. The curl-up assessment used in FITNESSGRAM is a safer and more effective test since it does not involve the assistance of the hip flexor muscles and minimizes compression in the spine, when compared to a full sit-up with the feet held. The protocol has been adapted from a version reported by Massicote (1990).

Curl-Up ➩ Recommended

This section provides information on the curl-up assessment used in FITNESSGRAM. The curl-up with knees flexed and feet unanchored has been selected because individually these elements have been shown to a) decrease movement of the fifth lumbar vertebra over the sacral vertebrae, b) minimize the activation of the hip flexors, c) increase the activation of the external and internal obliques and transverse abdominals, and d) maximize abdominal muscle activation of the lower and upper rectus abdominals relative to disc compression (load) when compared with a variety of sit-ups.

Few results are available on the consistency and accuracy of the curl-up. Reliability is higher for college students than for children but the values are acceptable for this type of assessment. Determination of validity has been hampered by the lack of an established criterion measure. Anatomical analysis and electromyographical documentation provide the primary support for the use of the curl-up test to determine abdominal strength and endurance.

Test Objective

To complete as many curl-ups as possible up to a maximum of 75 at a specified pace.

Equipment and Facilities

Gym mats and a measuring strip for every two students are needed. The measuring strip may be made of cardboard, rubber, smooth wood, or any similar thin, flat material and should be 30 to 35 inches long. Two widths of measuring strip may be needed. The narrower strip should be 3 inches wide and is used to test 5- to 9-year-olds; for older students the strip should be 4.5 inches wide.

Test Instructions

Allow students to select a partner. Partner A will perform the curl-ups while partner B counts and watches for form errors.

Partner A lies in a supine position on the mat, knees bent at an angle of approximately 140°, feet flat on the floor, legs slightly apart, arms straight and parallel to the trunk with palms of hands resting on the mat. The fingers are stretched out and the head is in contact with the mat. Make sure students have extended their feet as far as possible from the buttocks while still allowing feet to remain flat on floor. The closer the feet are positioned in relation to the buttocks, the more difficult the movement.

After partner A has assumed the correct position on the mat, partner B places a measuring strip on the mat under partner A’s legs so that partner A’s fingertips are just resting on the nearest edge of the measuring strip. Partner B then kneels down at partner A’s head in a position to count curl-ups and watch for form breaks. Partner B places a piece of paper under partner A’s head. The paper will assist partner B in judging if partner A’s head touches down on each repetition. The observer should watch for the paper to crinkle each time partner A touches it with his or her head.

Before beginning the curl-up, it is a good practice for partner B to pull on partner A’s hands to ensure that the shoulders are relaxed and in a normal resting position. If partner A is allowed to hunch (continued)
Curl-Up (continued)

PHOTO © Human Kinetics. Starting position for the curl-up test.

PHOTO © Human Kinetics. Position of the student in the “up” position for the curl-up test.
the shoulders before beginning the test, he or she may be able to get the fingertips to the other side of the testing strip by merely moving the arms and shoulders up and down. Keeping heels in contact with the mat, partner A curls up slowly, sliding fingers across the measuring strip until fingertips reach the other side; then partner A curls back down until his or her head touches the piece of paper on the mat. Movement should be slow and gauged to the specified cadence of about 20 curl-ups per minute (1 curl every 3 seconds). The teacher should call a cadence or use a prerecorded cadence. A recorded cadence should be used to ensure accurate testing for students. Partner A continues without pausing until he or she can no longer continue or has completed 75 curl-ups.

**When to Stop**

Students are stopped after completing 75 curl-ups, when the second form correction is made, or when they can no longer continue.

**Form Corrections**

- Heels must remain in contact with the mat.
- Head must return to the mat on each repetition.
- Pauses and rest periods are not allowed. The movement should be continuous and with the cadence.
- Fingertips must touch the far side of the measuring strip.

**Scoring**

The score is the number of curl-ups performed. Curl-ups should be counted when the student’s head returns to the mat. For ease in administration, it is permissible to count the first incorrect curl-up. It is important to be consistent with all of the students and classes when determining whether or not you will count the first incorrect curl-up.

**Suggestions for Test Administration**

- The student being tested should reposition if the body moves so that the head does not contact the mat at the appropriate spot or if the measuring strip is out of position.
- Movement should start with a flattening of the lower back followed by a slow curling of the upper spine.
- The hands should slide across the measuring strip until the fingertips reach the opposite side (3 or 4.5 inches) and then return to the supine position. The movement is completed when the back of the head touches the paper placed on mat.
Muscular Strength, Endurance, and Flexibility

Curl-Up (continued)

- The cadence will encourage a steady, continuous movement done in the correct form.
- Students should not forcibly “reach” with their arms and hands but simply let the arms passively move along the floor in response to the action of the trunk and shoulders. Any jerking, kipping, or reaching motion will cause the students to constantly move out of position. When students first begin to use this test item, many will want to “reach” with their arms and hands, especially if they have previously done a timed sit-up test.
- This curl-up protocol is quite different from the one-minute sit-up. Students will need to learn how to correctly perform this curl-up movement and be allowed time to practice.

Trunk Extensor Strength and Flexibility

A test of trunk extensor strength and flexibility is included in FITNESSGRAM because of its relationship to low back health, especially proper vertebral alignment. Musculoskeletal fitness of the abdominal muscles, hamstrings, and back extensors works in concert to maintain posture and helps maintain low back health. The item is included in the assessment in part because of the educational value of simply doing the assessment. Students will learn that trunk extensor strength and flexibility is an important aspect of maintaining a healthy back.

Trunk Lift

- Recommended

It is important that attention be given to performance technique during this test. The movement should be performed in a slow and controlled manner. The maximum score on this test is 12 inches. While some flexibility is important, it is not advisable (or safe) to encourage hyperextension.

Test-retest studies of the trunk extension test (done without limiting the lift to 12 inches) have reported high reliability in high school and college aged students. There are no data on the consistency results for younger children.

Research results have shown that isokinetic trunk endurance, torso length, body weight, passive trunk extension, trunk extension endurance, trunk strength, and flexibility all contribute to performance of the trunk lift. However, as a single repetition, partially body weight limited, restricted range item, this test is a minimal assessment of the components of trunk strength and flexibility. Most school-aged individuals will pass this test easily.

Test Objective

To lift the upper body off the floor using the muscles of the back and hold the position to allow for the measurement.

Equipment and Facilities

Gym mats and a measuring device are required to administer this test. A yardstick or 15-inch ruler is preferred; however a 12-inch ruler could be used if care is taken to make certain that the ruler is not placed directly under the student’s chin. If students are measuring each other, the “rulers” should be made of some pliable material such as poster board. It is helpful to mark the 6-, 9-, and 12-inch marks with tape. Rope cut to 12 inches with the inch marks taped can also be used as a measuring device.

Test Instructions

The student being tested lies on the mat in a prone position (facedown). Toes are pointed and hands are placed under the thighs. Place a coin or other marker on the floor in line with the student’s eyes. During the movement, the student’s focus should not move from the coin or marker. The student lifts the upper body off the floor, in a very slow and controlled manner, to a maximum height of 12 inches. The head should be maintained in a neutral (straight) alignment with the spine. The position is held long enough to allow the tester to place the ruler on the floor in front of the student and determine the distance from the floor to the student’s chin. The ruler should be
Trunk Lift (continued)

PHOTO © Human Kinetics. Starting position for the trunk lift.

PHOTO © Human Kinetics. Student in the “up” position for the trunk lift.


(continued)
Muscular Strength, Endurance, and Flexibility

Trunk Lift (continued)

placed at least an inch to the front of the student’s chin and not directly under the chin. Once the measurement has been made, the student returns to the starting position in a controlled manner. Allow two trials, recording the highest score.

Scoring
The score is recorded in inches. Distances above 12 inches should be recorded as 12 inches.

Suggestions for Test Administration
- Do not allow students to do ballistic, bouncing movements.
- Do not encourage students to raise higher than 12 inches. The Healthy Fitness Zone ends at 12 inches, and scores beyond 12 inches will not be accepted by the software. Excessive arching of the back may cause compression of the spinal discs.
- Maintaining focus on the spot on the floor should assist in maintaining the head in a neutral position.
- Partner B should make the reading at eye level and, therefore, should assume a squat or lying down position.

Upper Body Strength and Endurance
Strength and endurance of the muscles in the upper body are important in activities of daily living, maintaining functional health and promoting good posture. The role of upper body strength in maintaining functionality becomes more evident as a person ages. It is important that children and youth learn the importance of upper body strength and endurance as well as methods to use in developing and maintaining this area of fitness. The 90° push-up is the recommended test item. This 90° push-up has been adapted from assessments reported by Massicote (1990). Alternative tests include the modified pull-up, pull-up, and flexed arm hang. It should be noted that although all of these items are intended to measure upper arm and shoulder girdle strength and endurance, they do not all involve the same muscle groups to the same extent and handling body weight is more of a factor in some than others.

90° Push-Up
⇒ Recommended
The 90° push-up to an elbow angle of 90° is the recommended test for upper body strength and endurance. Test administration requires little or no equipment; multiple students may be tested at one time; and few zero scores result. This test also teaches students an activity that can be used throughout life as a conditioning activity as well as in self-testing.

The 90° push-up has generally been shown to produce consistent scores but reliability depends on how it is administered. Lower values have been reported for elementary aged students using partners to count the repetitions. Objectivity, or the ability of different observers to attain the same results, is a factor in this item because of the necessity of judging the 90° angle. Scores from student partners are consistently higher than adult counts because students tend to simply count each attempted 90° push-up and not evaluate whether it was done correctly. As with several of the other neuromuscular fitness items, determining the accuracy of the 90° push-up as a test of upper body strength and endurance is made difficult by the lack of an agreed upon criterion measure. Specific validation data are available for the 90° push-up in only two studies conducted on college age students. Validity coefficients against a 1-RM bench press were the highest when the criterion test was the number of repetitions (endurance) at an absolute, but sex-specific, load.

Before test day, students should be allowed to practice doing 90° push-ups and watching their partner do them. Teachers should make a concerted effort during these practice sessions to correct students who are not achieving the 90° angle. In this manner all students will gain greater skill in knowing what 90° “feels like” and “looks like.”
Test Objective
To complete as many 90° push-ups as possible at a rhythmic pace. This test item is used for males and females.

Equipment and Facilities
The only equipment necessary is having the correct cadence. The correct cadence is 20 90° push-ups per minute (1 90° push-up every 3 seconds). A recorded cadence should be used to ensure accurate testing for students. The 90° push-up may be performed on a mat. Squares of cardboard or anything else that has a 90° angle may assist students in judging 90°.

Test Instructions
The students should be paired; one will perform the test while the other counts 90° push-ups and watches to see that the student being tested bends the elbow to 90° with the upper arm parallel to the floor.

The student being tested assumes a prone position on the mat with hands placed under or slightly wider than the shoulders, fingers stretched out, legs straight and slightly apart, and toes tucked under. The student pushes up off the mat with the arms until arms are straight, keeping the legs and back straight. The back should be kept in a straight line from head to toes throughout the test.

The student then lowers the body using the arms until the elbows bend at a 90° angle and the upper arms are parallel to the floor. This movement is repeated as many times as possible. The student should push up and continue the movement until the arms are straight on each repetition. The rhythm should be approximately 20 90° push-ups per minute or 1 90° push-up every 3 seconds.

When to Stop
Students are stopped when the second form correction (mistake) is made. Only one form correction is allowed.

Form Corrections
- Stopping to rest or not maintaining a rhythmic pace
- Not achieving a 90° angle with the elbow on each repetition
- Not maintaining correct body position with a straight back
- Not extending arms fully

Scoring
The score is the number of 90° push-ups performed. For ease in administration, it is permissible to count the first incorrect 90° push-up. It is important to be consistent with all of the students and classes.
when determining if you will count the first incorrect push-up.

**Suggestions for Test Administration**

- Test should be terminated if the student appears to be in extreme discomfort or pain.
- Cadence should be called or played on a player device or CD.
- Males and females follow the same protocol.

**Modified Pull-Up**

**Alternative**

The modified pull-up shares the advantage of few zero scores and a wide range of scores with the 90° push-up. However, it does not, as commonly believed, negate the effect of body composition/weight on upper body performance. For schools with access to equipment, and desiring to test students individually, the modified pull-up is a very good test item to use.

The modified pull-up has been found to be a reliable test in primary, middle, and high school students. The modified pull-up has not been validated against a criterion measure but it has logical validity based on anatomical principles.

**Test Objective**

To successfully complete as many modified pull-ups as possible.

**Equipment and Facilities**

A modified pull-up stand, elastic band, pencil, and score sheet are necessary for administering this test. It is suggested that this assessment be performed on a mat or other soft surface. Modified pull-up stands can be constructed.

**Test Instructions**

Position the student on his or her back with shoulders directly under a bar that has been set 1 to 2 inches above the student’s reach. Place an elastic band 7 to 8 inches below and parallel to the bar. The student grasps the bar with an overhand grip (palms away from body). The pull-up begins in this “down” position with arms and legs straight, buttocks off the floor, and only the heels touching the floor. The student then pulls up until the chin is above the elastic band.
Modified Pull-Up (continued)

The student then lowers the body to the “down” position. Movement continues in a rhythmic manner.

When to Stop
Students are stopped when the second form correction is made. There is no time limit, but movement should be rhythmical and continuous. Students should not stop and rest.

Form Corrections
- Stopping to rest or not maintaining a rhythmic pace
- Not lifting the chin above the elastic band
- Not maintaining straight body position with only heels in contact with the floor
- Not fully extending arms in the down position

Scoring
The score is the number of pull-ups performed. For ease in administration it is permissible to count the first incorrect pull-up. It is important to be consistent with all of the students and classes when determining if you will count the first incorrect pull-up.

Suggestions for Test Administration
- The test is terminated if the student experiences extreme discomfort or pain.
- Males and females follow the same protocol.

Pull-Up
⇒ Alternative

The pull-up test is not the recommended test item for the vast majority of students because many are unable to perform even one pull-up. This test item should not be used for students who cannot perform one repetition. However, for those students who are able to perform correct pull-ups this is an item that can be used throughout life as a conditioning activity as well as a self-test.

Reliability of the pull-up has been shown to be acceptable for elementary boys and girls. Attempts at validating the pull-up as a measure of strength against a 1-RM latissimus pull-down have generally not been successful. Validity is equally poor when evaluated against a percentage (50-60% typically) of a 1-RM latissimus pull-down as an indication of upper arm and shoulder girdle endurance, ranging from only .09 to .25. As with the other measures of upper body strength and endurance, at least part of the problem may be the lack of a real criterion test.

Test Objective
To correctly complete as many pull-ups as possible.

PHOTO © Human Kinetics. Student in the “up” position for the modified pull-up test.
Muscular Strength, Endurance, and Flexibility

Pull-Up (continued)

**Equipment and Facilities**
This test uses a horizontal bar at a height that allows the student to hang with arms fully extended and feet clear of the floor. A doorway gym bar may be used.

**Test Instructions**
The student assumes a hanging position on the bar with an overhand grasp (palms facing away from the body). Shorter students may be lifted into the starting position. The student uses the arms to pull the body up until the chin is above the bar and then lowers the body again into the full hanging position. The exercise is repeated as many times as possible. There is no time limit.

**When to Stop**
Students are stopped when the second form correction (mistake) is made.

**Form Corrections**
- The body should not swing during the movement. If the student starts to swing, the teacher or assistant should hold an arm in front of the student’s thighs to prevent swinging. Swinging of the body or excessive movement is a form correction.
- The pull-up must be performed smoothly with no kicking or jerking. Forceful bending of the knees or kipping of the body is not permitted.
- To be counted, a pull-up must result in the chin being lifted over the bar, and the student must return to the full hanging position with elbows fully extended.

PHOTO © Human Kinetics. Starting position for the pull-up test.

PHOTO © Human Kinetics. Student in the “up” position for the pull-up test.

(continued)
Scoring
The score is the number of complete pull-ups performed. For ease in administration, it is permissible to count the first incorrect pull-up. It is important to be consistent with all of the students and classes when determining if you will count the first incorrect pull-up.

Suggestions for Test Administration
- A stack of mats off to the side of the hanging bar may be used to help students grasp the bar.
- The teacher may help the student into position and make certain that the body is in the proper position before beginning the test.

Flexed Arm Hang
⇒ Alternative
A third alternative to the recommended 90° push-up is the flexed arm hang. The flexed arm hang is a static test of upper body strength and endurance.

Consistency in times for the flexed arm hang has been shown to be acceptable in both 9- and 10-year-olds and college aged students. Two studies, which have attempted to validate the flexed arm hang against the 1-RM arm curl for endurance have shown weak correlations. Thus, only anatomical logic validates this item, as with most of the other upper body tests.
Muscular Strength, Endurance, and Flexibility

Test Objective
To hang with the chin above the bar as long as possible.

Equipment and Facilities
A horizontal bar, chair or stool (optional), and stopwatch are required to administer this test item.

Test Instructions
The student grasps the bar with an overhand grip (palms facing away). With the assistance of one or more spotters, the student raises the body off the floor to a position in which the chin is above the bar, elbows are flexed, and the chest is close to the bar. A stopwatch is started as soon as the student takes this position. The position is held as long as possible.

When to Stop
The watch is stopped when one of the following occurs:

- The student’s chin touches the bar.
- The student tilts his or her head back to keep the chin above the bar.
- The student’s chin falls below the bar.

Scoring
The score is the number of seconds for which the student is able to maintain the correct hanging position.

Suggestions for Test Administration
- The body must not swing during the test. If the student starts to swing, the teacher or assistant should hold an extended arm across the front of the thighs to prevent the swinging motion.
- Only one trial is permitted unless the teacher believes that the pupil has not had a fair opportunity to perform.

Flexed Arm Hang (continued)

Flexibility
Maintaining adequate joint flexibility is important to functional health. However, for young people, decreased flexibility is generally not a problem. Many of your students will easily pass the flexibility item; therefore, the flexibility item has been made optional. If you decide not to administer the flexibility test, remember that you should teach students about flexibility and inform them that maintaining flexibility and range of motion will be important as they age.

Back-Saver Sit and Reach
⇒ Optional
The back-saver sit and reach is very similar to the traditional sit and reach except that the measurement is performed on one side at a time. By testing one leg at a time a determination can be made of any asymmetry in hamstring flexibility, and hyper-extension of both knees is avoided. The sit and reach measures predominantly the flexibility of the hamstring muscles. Normal hamstring flexibility allows rotation of the pelvis in forward bending movements and posterior tilting of the pelvis for proper sitting.

The back-saver sit and reach has been shown to provide extremely consistent scores when administered under standardized conditions. The back-saver sit and reach has also been shown to be a reasonably accurate measure of hamstring flexibility. When compared with criterion measures of hamstring flexibility, the correlations for both right and left legs have been moderate to high. Conversely, the back-saver sit and reach has been shown to correlate poorly with criterion tests.
of low back flexibility. Therefore, the back-saver sit and reach cannot be considered a valid measure of low back flexibility and should not be interpreted as such.

**Test Objective**

To be able to reach the specified distance on the right and left sides of the body. The distance required to achieve Healthy Fitness Zone is adjusted for age and gender.

**Equipment and Facilities**

This assessment requires a sturdy box approximately 12 inches high. A measuring scale is placed on top of the box with the 9-inch mark parallel to the face of the box against which the student’s foot will rest. The “zero” end of the ruler is nearest the student. Instructions for construction of a special measuring apparatus are available. However, a wooden box and yardstick will suffice.

Tape the yardstick to the top of the box with the 9-inch mark at the nearest edge of the box. The “zero” end of the yardstick is nearest the student.

**Test Instructions**

The student removes his or her shoes and sits down at the test apparatus. One leg is fully extended with the foot flat against the face of the box. The other knee is bent with the sole of the foot flat on the floor. The instep is placed in line with, and 2 to 3 inches to the side of, the straight knee. The arms are extended forward over the measuring scale with the hands placed one on top of the other. With palms down, the student reaches directly forward (keeping back straight and the head up) with both hands along the scale four times and holds the position of the fourth reach for at least 1 second. After one side has been measured, the student switches the position of the legs and reaches again. The student may allow the bent knee to move to the side as the body moves

(continued)
Muscular Strength, Endurance, and Flexibility

Back-Saver Sit and Reach (continued)

forward if necessary, but the sole of the foot must remain on the floor.

Scoring
Record the number of inches on each side to the nearest 1/2 inch reached, to a maximum score of 12 inches. Performance is limited to discourage hypermobility. To be in the Healthy Fitness Zone, the student should meet the standard on both the right and the left sides.

Suggestions for Test Administration
- The bent knee moves to the side, allowing the body to move past it, but the sole of the foot must remain on the floor.
- Keep the back straight and the head up during the forward flexion movement.
- The knee of the extended leg should remain straight. Tester may place one hand above the student’s knee to help keep the knee straight.
- Hands should reach forward evenly.
- The trial should be repeated if the hands reach unevenly or the knee bends.
- Hips must remain square to the box. Do not allow the student to turn the hip away from the box while reaching.

Shoulder Stretch
⇒ Optional
The shoulder stretch is a simple test of upper arm and shoulder girdle flexibility intended to parallel the strength/endurance assessment of that region. If used alternately with the back-saver sit and reach, it may be useful in educating students that flexibility is specific to each joint and that hamstring flexibility neither represents a total body flexibility nor is the only part of the body where flexibility is important.

PHOTO © Human Kinetics. Shoulder stretch on the right side.

PHOTO © Human Kinetics. Shoulder stretch on the left side.
Shoulder Stretch (continued)

Test Objective
To be able to touch the fingertips together behind the back by reaching over the shoulder and under the elbow.

Equipment and Facilities
No equipment is necessary to complete this test item.

Test Description
Allow students to select a partner. The partner judges ability to complete the stretch.

To test the right shoulder, partner A reaches with the right hand over the right shoulder and down the back as if to pull up a zipper or scratch between the shoulder blades. At the same time partner A places the left hand behind the back and reaches up, trying to touch the fingers of the right hand. Partner B observes whether the fingers touch.

To test the left shoulder, partner A reaches with the left hand over the left shoulder and down the back as if to pull up a zipper or scratch between the shoulder blades. At the same time partner A places the right hand behind the back and reaches up, trying to touch the fingers of the left hand. Partner B notes whether the fingers touch.

Scoring
If the student is able to touch his or her fingers with the left hand over the shoulder, a “Y” is recorded for the left side; if not, an “N” is recorded. If the student is able to touch the fingers with the right hand over the shoulder, a “Y” is recorded for the right side; otherwise an “N” is recorded. To achieve the Healthy Fitness Zone, a “Y” must be recorded on both the right and left side.