Fitness Testing Protocols

A coach's guide for selecting tests, running testing sessions and reporting results back to youth and junior athletes

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Use these fitness tests to engage your skiers in good fundamental motor skill and fitness development. The tests are intended to be an easy way of assessing the junior athlete and their conditioning program.

These tests provide measures of fundamental motor skills and various fitness components used in alpine skiing. The testing is determined by developmental phase as outlined in the Alpine Training System. The phase 1 and 2 tests are designed to encourage good all round skill development. Phase 3-6 tests get more skiing specific and more demanding as the athlete progresses. The results from these tests allow coaches to monitor fitness progression of young skiers and implement specific training programs based on their individual strengths and weaknesses.

Before the testing session

1. *Training*: Training sessions on the day prior to the testing session should be light in nature to avoid unnecessary fatigue that may alter the validity of the results. Be consistent with the training sessions you are doing prior to the testing session to allow more valid test data.
2. *Diet*: No food should be eaten immediately prior to the testing session (<2 hours) in order to minimize discomfort. The athlete should have a pre-test meal (>2 hours) prior to the testing session consisting mainly of carbohydrates (similar to a pre-competition meal).
3. *Footwear*: Footwear of consistent quality should be worn at all sessions. Shoes of varying weight or traction may have adverse effects on the time to exhaustion or execution of movements.
4. *Venue surface*: Recommended surface is a non-slip indoor court in order to avoid variation of turf, environment and wind conditions.
5. *Warm Up*: For phases 1-2, use a fun, general activity, circuit or game that uses each of the fundamental motor skills to prepare the athletes for the testing session. For phases 3-6, see Appendix 1 – sample warm up for fitness testing.
6. *Injury or illness*: Athletes should seek professional medical advice if they are injured or ill before participating in fitness testing.

What tests should you do?

Phases 1-2:

Fitness Component	Badge Name	Test Name and Order
Hand-eye	"Catch"	1. Catch technique
Eye-foot	"Kick"	2. Kick technique
Coordination	"Throw"	3. Overhand tennis ball throw technique
Coordination	"Run"	4. 15 meter running technique
Coordination	"Jump"	5. Vertical jump coordination
Coordination	"Leap"	6. Standing long jump technique
Balance	"Balance"	7. Balance beam walking
Coordination	"Forward Roll"	8. Forward roll

Phases 3-6:

Fitness Component	Badge Name	Test Name and Order	Phase 3	Phase 4	Phase 5	Phase 6
Growth and Development	(No badge)	1. Height	■	■	■	■
		2. Sitting Height	■	■	■	
Balance and Coordination	"Balance"	3. Balance Beam Progression Test	■	■	■	■
Functional Movement	"Movement"	4. Overhead Squat	■	■	■	■
		5. Single Leg Squat			■	■
Strength & Power	"Vertical Jump"	6. Vertical Jump Test	■	■	■	■
		7. Triple Jump Test			■	■
Anaerobic Capacity	"Box Jumps"	8. 40 sec. Box Jump	■	■		
		60 sec. Box Jump			■	■
Aerobic Capacity	"Beep Test"	9. 20 m Shuttle Run	■	■	■	■

How to determine which phase your athletes are in

Young athletes develop at different rates, particularly around the growth spurt phases (3-5). We recommend that you consider the biological age, chronological age and training age to classify the phase of each athlete. The first testing item, standing height and sitting height, can give the coach information to help them determine the athlete's phase. See the table below for a guide.

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Biological Age Pre puberty **Age** 2-6 years old **Play Age** 1-4 years in sport	**Biological Age** Pre puberty **Age** 6-10 years old **Training Age** 1-4 years in sport	**Biological Age** Pre puberty (before growth spurt) **Age** Girls: 10-13 Boys: 11-14 **Training Age** 4-8 years in sport	**Biological Age** Puberty (during growth spurt) **Age** Girls 11-14 Boys: 12-15 **Training Age** 5-9 years in sport	**Biological Age** Post puberty (after growth spurt) **Age** Girls 12-16 Boys: 14-17 **Training Age** 6-11 years in sport	**Biological Age** Matured **Age** Female 16+ Male 17+ **Training Age** 10+ years in sport

TEST PROCEDURES – Phases 1 and 2

CATCH

KICK

THROW

RUN

JUMP

LEAP

BALANCE

FORWARD ROLL

CATCH

- Equipment checklist: 6 tennis balls per station. Bucket. Cones.
- Rationale for inclusion: Catching is a core fundamental motor skill involving hand-eye coordination.

Protocol: 6 tennis ball catches

1. Mark out a square for the child to stand in (approx 2m square).
2. Demonstrate the test requirements of the catch.
3. Ask one or two athletes to stand behind the catching square. Ask the child to stand in the middle of the square, catch the tossed balls and place them on the ground. Instruct the child to leave any missed catches. Allow a pause between each catch and use a friendly and enthusiastic approach between the six attempts.
4. Score the test according to the performance criteria in Appendix 2.

KICK

- Equipment checklist: 6 soccer balls per station. Cones.
- Rationale for inclusion: Kicking is a core fundamental motor skill involving foot-eye coordination.

Protocol: 6 soccer ball kicks

1. Mark a cross on a flat non-slip surface for placement of the ball. Draw a line 3m back from the mark as a starting point for the child. Make sure the kicking target is towards a safe area.
2. Demonstrate the requirements of the kick.
3. Place the ball on the spot and ask the athlete to kick the ball hard towards a target 10-20m away and return to the starting line after each kick. Allow a pause between each kick and use a friendly and enthusiastic approach between the six attempts.
4. Score the test according to the performance criteria in Appendix 2.

THROW

- Equipment checklist: 6 bean bags per station. Cone or hoop for target.
- Rationale for inclusion: Throwing is a core fundamental motor skill involving sequential body and limb coordination.

Protocol: 6 x bean bag overhand throw

1. Mark a 2m square denoted by cones at each corner. Mark a start line in the square. Place a target (e.g., cone) 10m away. Place 6 bean bags next to the starting line.
2. Demonstrate the requirements of the overhand throw.
3. Ask the athlete to throw the bean bag overhand and hard towards the target. Pause between each throw and use a friendly and enthusiastic approach between the six attempts.

4. Score the test according to the performance criteria in Appendix 2.

RUN

- Equipment checklist: Tape measure. Cones.
- Rationale for inclusion: Running is a core fundamental motor skill involving whole body coordination.

Protocol: 4 x 20m run

1. Measure a 20 m flat straight line and place cones at each end. Allow for safety margins at each end (at least 10 m).
2. Demonstrate the requirements of the run.
3. Ask each child in turn to run as fast as they can from one cone until they have gone past the other cone. Turn and run back to the start. Repeat once more. Allow a pause between each trial and use a friendly and enthusiastic approach.
4. Score the test according to the performance criteria in Appendix 2.

JUMP

- Equipment checklist: Marking tape
- Rationale for inclusion: Jumping is a core fundamental motor skill involving whole body coordination and sequential summation of force.

Protocol: 2 x vertical jumps

1. Mark a cross on a flat-non-slip surface.
2. Demonstrate the requirements of the vertical jump
3. Ask the child to jump as high as possible vertically. Pause between each jump and use a friendly and enthusiastic approach. Repeat once more.
4. Score the test according to the performance criteria in Appendix 2.

LEAP

- Equipment checklist: Cones, tape measure, marking tape
- Rationale for inclusion: Leaping is a core fundamental motor skill involving single leg coordination and sequential force summation.

Protocol: 2 x leaps

1. Mark a one meter takeoff square using marker cones to denote corners on a non-slip surface. Place a mark 3m back from the takeoff square to mark the starting point.
2. Demonstrate the requirements of the jump.

3. Ask the child to begin at the starting line and approach the takeoff box and leap maximally from within the square as far as they can. Repeat.
4. Score the test according to the performance criteria in Appendix 2.

BALANCE

- Equipment checklist: Foam (low) balance beam or a 4"x2" piece of wood at least 6 feet in length that is stabilized at both ends.
- Rationale for inclusion: Balance is a core fundamental motor skill involving whole body coordination and control.

Protocol: Balance beam walk

1. Place the balance beam on the floor. If you have protective foam mats, place them beside the beam.
2. Demonstrate the requirements of the balance beam test.
3. Ask the athlete to walk along the beam. When the end of the beam is reached, ask the athlete to walk back again. Repeat.
4. As children progress, repeat the test with no arms out the side.
5. Score the test according to the performance criteria in Appendix 2.

FORWARD ROLL

- Equipment checklist: Foam mat
- Rationale for inclusion: A forward roll is a motor skill involving coordination and body awareness.

Protocol: Forward Roll

1. Place the mat on the floor.
2. Demonstrate the requirements of a forward roll.
3. Ask the student to do a forward roll.
4. Score the test according to the performance criteria in appendix 2.

TEST PROCEDURES – Phases 3-6

HEIGHT

BALANCE BEAM PROGRESSION TEST

OVERHEAD SQUAT

SINGLE LEG SQUAT

VERTICAL JUMP TEST

TRIPLE JUMP TEST

40/60 SECOND BOX JUMP

20 M SHUTTLE RUN

Height

- Equipment checklist: Wall stadiometer or tape measure stuck to a wall and ruler. You can also install a wall-mounted stadiometer for improved reliability (recommended).
- Rationale for inclusion: Height is a key marker of growth and development.

Protocol: Height

1. Ask the athlete to stand with their back against the wall/tape. Feet are together and all the way back against the wall.
2. Ask the athlete to take a deep breath in and hold it to ensure they are standing up nice and tall.
3. Quickly place a ruler on the head such that it is level and meets the tape measure.
4. Record the value in cm.

Sitting height

- Equipment checklist: Wall stadiometer or tape measure stuck to a wall and ruler. You can also install a wall-mounted stadiometer for improved reliability (recommended). Wooden box approximately 50cm tall.
- Rationale for inclusion: Height is a key marker of growth and development. As growth begins in the extremities during the adolescent growth spurt, comparing standing height and sitting height can help determine the athlete's physiological development phase.

Protocol: Sitting Height

1. Ask the athlete to sit on a box with their back against the wall/tape.
2. Ask the athlete to take a deep breath in and hold it to ensure they are sitting up nice and tall.
3. Quickly place a ruler on the head such that it is level and meets the tape measure.
4. Record the value in cm.
5. Peak Height Velocity can be calculated by totaling the total growth height of the torso for the entire year/season.

Balance Beam Progression Test

- Equipment checklist: Foam (low) balance beam or a 4"x2" piece of wood that is stabilized at both ends. The beam should be at least 6 feet in length.
- Rationale for inclusion: Balance is a core fundamental motor skill involving whole body coordination and control.

Protocol: Balance Beam Progression Test

1. Place the balance beam on the floor. If you have protective foam mats, place them beside the beam.
2. The following progression is completed with the athlete keeping both hands on their head:

a. Walk along the beam (0-3)
b. Walk along the beam, half turn and walk back (4-6)
c. Walk along the beam with eyes closed (be sure to let the athlete know when they have reached the end of the beam) (7-10)

3. Record a score out of 10 based on how far the athlete progressed in the test and the technique.

Overhead Squat (with broomstick)

- Equipment checklist: Broomstick or piece of PVC pipe and piece of 4x2 wood for placing under the heels if needed.
- Rationale for inclusion: Overhead squat is an assessment of functional movement, strength and flexibility in the ankles, hips and shoulders.

Protocol: Overhead Squat with broomstick

1. Position the broomstick above the head with arms angled out at 45 degrees. Feet should be slightly wider than hips with toes pointed slightly outward. Start with holding the stick on the head and elbows at 90 degrees then raise the stick up and lock out elbows.
2. Keeping the bar in line with the ankles, ask the athlete to squat down as far as he/she can go, then stand up and repeat up to 5 times if necessary. Instruct the athlete to keep the chest up and back flat. Keep the elbows locked out. If the athlete cannot perform the squat correctly, place the 4x2 under the heels and repeat the test.
3. Assess and score the technique according to the following criteria:
    a. 0 = athlete has pain or cannot get into the squat position
    b. 1 (bronze) = poor technique if any of the following are observed: tibia and upper torso are not parallel, femur is not below horizontal, knees are not aligned over feet, lumbar flexion (stick comes forward over feet).
    c. 2 (silver) = good technique, but 4x2 under heels is needed. Upper torso is parallel with tibia or toward vertical, femur is below horizontal, knees are aligned over feet, stick is aligned over feet.
    d. 3 (gold) = no 4x2 under heels is needed. Upper torso is parallel with tibia or toward vertical, femur is below horizontal, knees are aligned over feet, stick is aligned over feet.

Single Leg Squat (Phases 5 & 6)

- Equipment Checklist: Broomstick or piece of PVC pipe and piece of 4x2 wood for placing under the heels if needed.
- Rationale for inclusion: This test is a progression for those athletes who are consistently scoring gold on the overhead squat test. It is harder and requires more strength. It also assesses any imbalances between left and right side strength.

Protocol: Single Leg Overhead Squat with broomstick

1. Repeat the above test assessing the ability to squat on single leg comparing right and left. This is best done by standing on the edge of a tall box so the foot of the non-testing leg has room to hang down. Place a foam mat on the floor next to the box in case the athlete loses balance.
2. Position the broomstick above the head with arms angled out at 45 degrees. The testing leg should be on the edge of the box with the non-testing leg hanging over the edge. Start with holding the stick on the head and elbows at 90 degrees then raise the stick up and lock out elbows.
3. Keeping the bar in line with the ankle, ask the athlete to squat down as far as he/she can go, then stand up and repeat up to five times, if necessary. Instruct the athlete to keep the chest up and back flat. Keep the elbows locked out. If the athlete cannot perform the squat correctly, place the 4x2 under the heels and repeat the test. Test both right and left leg.
4. Assess and score the technique according to the following criteria:
    a. 0 = athlete has pain or cannot get into the squat position
    b. 1 (bronze) = poor technique if any of the following are observed: tibia and upper torso are not parallel, femur is not below horizontal, knees are not aligned over feet, lumbar flexion (stick comes forward over feet).
    c. 2 (silver) = good technique, but 4x2 under heel is needed. Upper torso is parallel with tibia or toward vertical, femur is below horizontal, knees are aligned over feet, stick is aligned over feet.
    d. 3 (gold) = no 4x2 under heels is needed. Upper torso is parallel with tibia or toward vertical, femur is below horizontal, knees are aligned over feet, stick is aligned over feet.
    e. Assess and score each leg independently. The athlete's total score is the average of the right leg trial and the left leg trial.

Vertical Jump Test

- Equipment checklist: Vertec; or chalk board with 1cm markings on it
- Rationale for inclusion: Vertical jump is a measure of anaerobic power

Protocol: Vertical Jump

1. Athlete stands next to the vertec or chalk board and reaches up with their dominant arm as high as they can reach. The tester should help pull their hand upwards into a maximial reach position. Zero the vertec or make a mark on the chalk board.
2. The athlete is then instructed to jump as high as possible and either hit the vertec fingers or slap the chalk board at the highest point of the jump. The jump is from a stationary start and no stepping into the jump is allowed.
3. Repeat 3 times. Record the score in cm. Score the highest jump.

Triple Jump Test (Phases 5 and 6)

- Equipment checklist: Tape measure
- Rationale for inclusion: The triple jump test is a measure of explosive power. It can be done as an optional extra test to further evaluate power development in young athletes.

Protocol: Triple Jump

1. Mark a start line and run the tape measure out for 10 meters.
2. Athlete is asked to place the back of the heels on the start line and perform three double-footed jumps for maximum distance.
3. Record the distance at the back of the heels when the feet land on the third jump. If the athlete falls backwards, repeat the test. The best out of two trials is recorded.
4. No step or run-up is allowed prior to the jumps.
5. Record the distance in cm. Score the longest jump.

40 Sec. Box Jump (Phases 3-4) / 60 Sec. Box Jump (Phases 5-6)

- Equipment checklist: Either a 30 or 40 cm box should be used (see appendix 3), depending on which box is closer to the top of the athlete's knee cap. A line may be marked at the 35cm point on the 40cm box for assessing this. If the top of the knee cap is above the 35cm line, use the 40cm box.
- Rationale for inclusion: The box jump is a measure of anaerobic capacity. The 40 second box jump is for athletes in phases 3 and 4. The 60 second box jump is for athletes in phases 5-6.

Protocol: 40/60 sec. Box Jump Test

1. Athlete stands on the box. On "go", he or she is to perform as many box jumps as possible. The jumping goes from the top of the box, jumping up and down alternating between left and right sides.
2. The athlete is instructed to jump and land in the middle of the box to ensure maximum safety.
3. One jump is recorded when the athlete lands back on top of the box. Count the number of jumps before the tester yells, "stop". Incomplete jumps are not counted.
4. Optional: Record how many jumps the athlete has completed at each ten second interval (:10, :20, :30 and so on) as well as the total number of jumps.

20 m shuttle run

- Equipment checklist: Beep test CD (included with the USSA Physical Assessment CD) and CD player/sound system. Marking cones. 20m tape measure. Tape or other marking for 20m line.
- Rationale for inclusion: The 20m shuttle run is a test of aerobic power.

Protocol: 20m shuttle

1. Mark out two lines, 20m apart on a non-slip surface – preferably an indoor court surface.
2. Check that the athlete has good footwear. If the floor surface is slippery, spray some sports drink on their shoes – it works!
3. The test starts with a countdown beep. The athlete runs along the 20m track and gets to the line in time with the beep. The athlete then turns and runs back, getting back to the start line in time with the next beep. The beeps get closer together as the test progresses, so the athlete has to run faster to stay in time. The test is a maximal test and the athlete is encouraged to run in time with the beeps for as long as possible.
4. When the athlete can no longer keep in time with the beep and falls behind the beep by more than 1 meter, a verbal warning is given. If they do not make it back in time with the beep on the next lap, the athlete is asked to stop and the score for the stage/level is recorded. The score is the last level that the athlete successfully achieved in time with the beep.
5. The athlete may miss the beep multiple times as long as they are back to the other line on the next beep. Missing two consecutive beeps ends the test.
6. It is important that the athletes run in time with the beep and do not run ahead of it. This will cause additional fatigue.

Appendix 1: Sample warm up prior to testing (Phases 3-6)

This is a sample warm up done by U.S. Ski Team members prior to fitness testing sessions. Adapt and modify it to the level of fitness and development of your athletes.

1	10 min bike or jog	Get the muscles warm
2	Prone spine rotation	X 8 each way
3	Supine spine rotation	X 8 each way
4	Torso rotation	X 8 each way
5	Straight leg hip flexion	X 8 each leg
6	Quadriceps stretch	1 x 8 each leg alternating. Pay special attention to keeping the knees together and the gluteus muscles contracted.
7	Lunge	1 x 6 each leg alternating. Take your time and feel a great hip stretch at the bottom of the lunge.
8	Lateral lunge	1 x 6 each leg alternating. Take your time and feel a great groin stretch at the bottom of each lunge.
9	Deep squat	X 15
10	A-skip	X 20 meters
11	Carioca	X 20 meters each way
12	Run through	Build ups – 2 x 20 meters. Progress from a jog to a sprint, changing gears every step. 2 min rest in between.
13	Acceleration	2 x 10 meters. After accelerating, use 10-20 meters to jog to a stop. 2-3 min rest in between.
14	Broomstick squat jumps	2 x 3 jump with a broomstick on your shoulders. Minimum 3 minutes rest in between.

Disclaimer: Performing exercises incorrectly may pose a risk to your health. Do not undertake this warm up or fitness testing if you are injured or ill – seek medical advice before participating.

Appendix 2: Phase 1 & 2 Assessment Criteria

Use the following criteria when assessing the performance in the Phase 1 and 2 fundamental motor skill tests. Athlete earns 1 point for each element achieved. Different tests have different score totals.

Catch

1. Eyes are focused on the ball throughout the catch
2. Preparatory position with elbows bent and hands in front of body
3. Hands move to meet the ball
4. Hands and fingers positioned correctly to catch the ball
5. Catch and control the ball with hands only
6. Elbows bend to absorb force of the ball

Kick

1. Eyes are focused on the ball throughout the kick
2. Step forward with non-kicking foot placed near the ball
3. Bend knee of kicking leg during the backswing for the kick
4. Hip extension and knee flexion of at least 90^{o} during preliminary kicking movement
5. Contact the ball with the top of the foot
6. Forward and sideward swing of arm opposite kicking leg
7. Kicking leg follows through towards the target after ball contact

Throw

1. Eyes are focused on the target throughout the throw
2. Stand side-on to the target
3. Throwing arm nearly straightened behind the body
4. Step towards the target with foot opposite throwing arm during the throw
5. Marked sequential hip to shoulder rotation during the throw
6. Throwing arm follows through down and across the body

Run

1. Eyes focused forward throughout the run
2. Knees bend at right angles during the recovery phase
3. Arms bend at elbows and move in opposition to legs
4. Contact ground with front part of foot
5. Body leans slightly forward

Jump

1. Eyes focused forward or upward throughout the jump
2. Crouch with knees bent and arms behind body
3. Forceful upward thrust of arms as legs straighten to take off
4. Contact ground with front part of feet and bend knees to absorb the force of landing
5. Balanced landing with no more than one step in any direction

Leap

1. Forward movement sustained throughout the leap
2. Eyes focused forward throughout the leap

3. Take off from one foot and land on the opposite foot
4. During flight legs are straightened with the arms held in opposition to legs
5. Controlled landing without losing balance

Balance
1. Eyes focused forward
2. Movement along the beam was fluent
3. No wobbles or falls from the beam

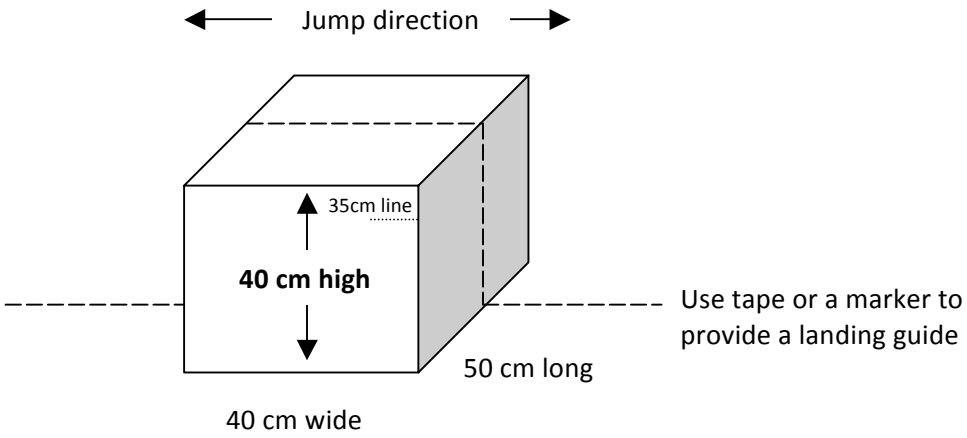
Forward Roll
1. Hands flat on the ground
2. Tuck head and place back of head between hands
3. Maintain a rounded back and smooth moment through the roll
4. Stand up onto feet facing forward
5. Roll should be in a straight line

Reference:
Fundamental Motor Skills (1996), Victorian Government.
https://www.eduweb.vic.gov.au/edulibrary/public/teachlearn/student/fmsteachermanual09.pdf

Appendix 3: How to construct the box jump boxes

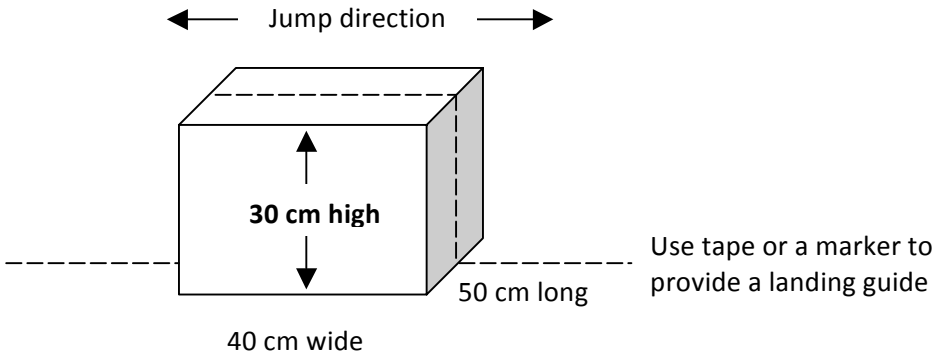
Box 1:

Dimensions: 40cm wide x 50cm long x 40cm high



Box 2:

Dimensions: 40cm wide x 50cm long x 30cm high



Note: We recommend making the boxes out of wood. Reinforce the inside of the boxes with metal brackets so they are secure.