



Athletic Capacity Evaluations (ACE)

Modeling Alpine Ski
Physical Capacity

The ACE Model

With an aim to provide Alpine ski coaches and athletes with a sport specific profiling tool, the British Ski Snowboard association (BSS) has created the Athletic Capacity Evaluations (ACE) to assess athletic prowess and physical and movement literacy as it relates to a skiers development.

The development of world-class skiers requires athletes to develop a well-rounded basis of physical literacy from multi-sport practice, which is why each of the ACE evaluations relates to: 1) the movement skill requirements of ski racing, and 2) global movement capacity across a range of athletic skills.

Each athletic capacity evaluation has been carefully selected based on the following criteria:

- Assess global physical movement patterns that relate to specific Alpine skiing activity.
- An evaluation must reflect the metabolic (energy systems), motor control (stability/ strength), and/or neural firing activity (coordination/ time and type of muscle contraction) and muscular (production of force) properties linked to ski racing.
- Must serve as valid measure of gross athletic capacity across environments.
- Requires minimal equipment and resource to run each evaluation.
- User friendly to both coaches and athletes.

Naturally, the quality and validity of any profiling tool is essential when grading physical literacy and athletic capacity of athletes, which is why the ACE evaluations have been selected with reference to over 2 decades of Alpine ski research to optimise the specificity of these measures to ski racing.

Evaluating ACE results:

Upon measuring athletes' *physical literacy* an understanding of **athletic profile** is created and modelled using Excel software, which accompanies this package. See pages 10-11 for examples of: "Data entry" into a table format, and also a graphical illustration of results for reporting and analysis.

From this, further engagement and training recommendations with athletes' are based on continued development with reference to their performance in the ACE model.

Data points collected from each ACE camp are included within the athlete's individual profile, which is shared between athlete, coach and the physical practitioner. Up to 3 sets of data points will be collected on each athlete during a yearly training cycle.

The 7 ACE evaluations are:

Note: Evaluations must be filmed to ensure validity across environments.

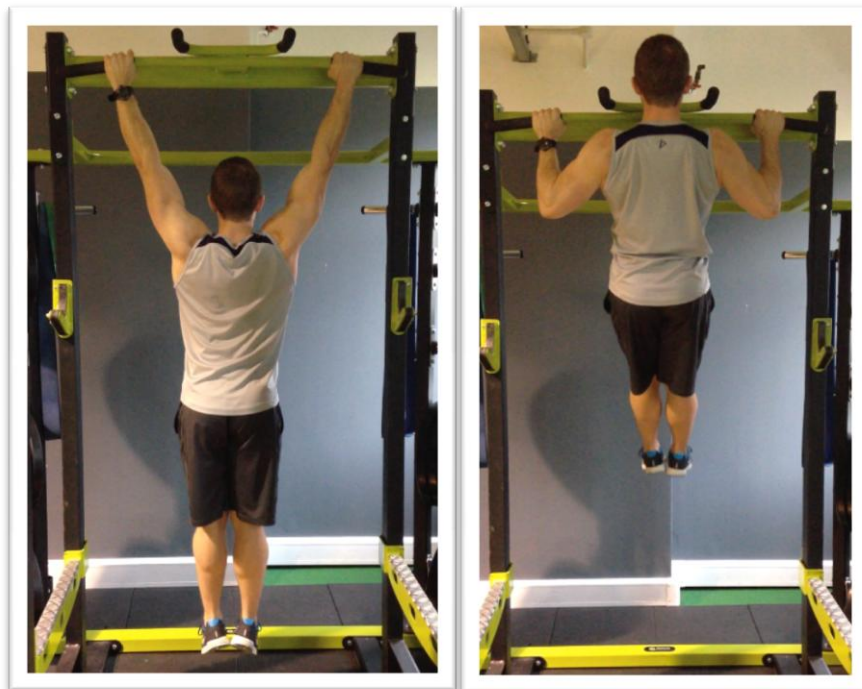
1) Over-hand grip Pull-up on a straight bar – click on the link - [Over-hand grip Pull-up](#)

The Pull-up assessment measures the strength-endurance capacity of musculature and connective tissues acting at the arms, back, shoulder, trunk and pelvis.

A high level of strength throughout the body is essential to withstand high forces and eccentric loads imposed on the body during racing (Turnbull et al., 2009). Furthermore, a high level of strength at the shoulder girdle is shown to be an important factor to reduce the risk of injuries to the shoulder joint, and the head (concussions), which is the heaviest part of the body (Kocher and Feagin, 1996).

How to conduct the Pull-up evaluation:

- Place hands on the bar in an over-hand wider than shoulder width grip position, with the thumb wrapped around the index finger.
- Start from a static hanging position and begin the pull-up until the chin arrives above the bar with the head in neutral and legs in a straightened 'ramrod position'.
- Ensure a pause for a 3 second count is held at the top and bottom of the pull.
- Count total reps completed until either the athlete cannot maintain the 3-second hold, or a knee bend and breaking from the 'ramrod' posture is lost.
- No swinging, or use of a leg 'kick' is permitted.



Regression: If the athlete cannot complete any reps using the over-hand grip Pull-up regress to an under-handgrip style (palms up) pull to achieve a score. This is known as the Chin-up.

For the Chin-up take a shoulder width grip on the bar and complete 2-3 attempts to achieve a best max rep score with a 3-minute rest between attempts. The highest number of reps completed should be taken as the final score. Please state which pulling method was used to collect the score: Pull-up or Chin-up.

2) The Bear Crawl (+ water bottle) – click on the link – [The Bear Crawl](#)

Research has shown that a high level of activation and control of the trunk (torso) along with the ability to dissociate actions at the legs and arms is vital during ski turning (Heikkinen, 2003). Therefore, this evaluation measures the ability to maintain dynamic control at the shoulder, trunk and hips, whilst completing forward and reverse crawling patterns.

To ensure validity is maintained across assessments a filled water bottle should be rested on top of the athletes' lumbar spine (low back) in a horizontal, across body position (as pictured).

The water bottle serves as constant feedback to the athlete that crawling reps must be completed with a neutral spine and good pelvic positioning. If a neutral 'sound' posture is lost the water bottle will drop to floor indicating distance travelled (marked at the hands) and the limit of the athletes dynamic control and capacity.



How to conduct the Bear Crawl evaluation:

First measure a 10m straight line marked with a single cone at the start and end points.

- Begin by setting up on all fours with hands behind the start cone, have a friend place a full 2 Litre sized bottle across the low back region and crawl 10m to the next cone by simultaneously lifting opposing hand and foot, reach forward and place down on the floor ahead of the body, continue this motion with opposite hand and foot repeatedly.
- When *both* hands arrive at the end cone crawl in reverse until both feet reach the 10m start cone, and repeat.
- Dragging or sliding of hands and feet are not allowed.
- Crawling is performed continuously until the water bottle drops to the floor, or the athlete cannot complete further distance.

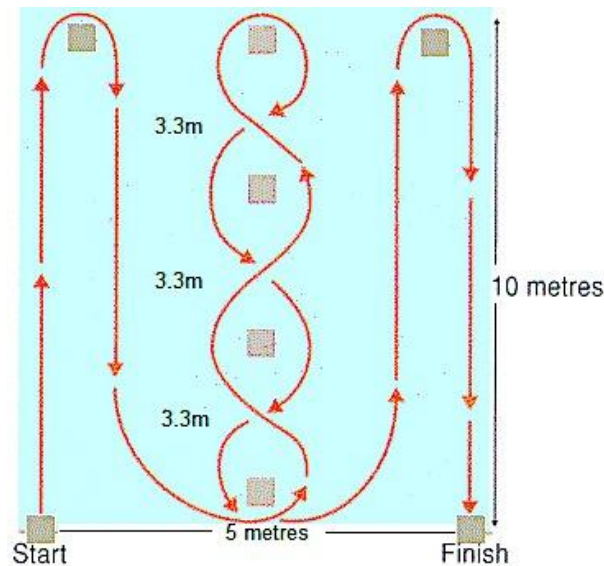
Athletes under the age of 14yrs should complete this evaluation over the same distance without a water bottle on their back. A score is obtained by measuring crawling distance until either loss of form or fatigue occurs.

After practicing crawling technique a couple of times, the athlete is permitted 2 attempts to log a total score with a 30minute rest period permitted between attempts. Total distance covered in forwards and backwards directions is summed as the 'total score' this should be logged in metres (m) and taken from where the hands finish.

3) The Illinois Agility – click on the link - [Illinois Agility](#)

This evaluation measures the ability to express ballistic strength, power and speed in a highly functional context. The multiple sharp changes in direction of the drill replicates the muscular contraction profile imposed on the leg muscles during turning on ski's, and also requires the athlete to show a high degree of control and strength through high knee and hip flexion-extension postures as seen in Slalom skiing (Turnbull et al., 2009).

Build the course (pictured below) and hand time the 10m acceleration phase (being: start to first turn, breaking the line at 10m).



How to conduct the Illinois Agility evaluation:

The evaluation requires the athlete to run the red line route once (as in the diagram) as fast as possible.

- The athlete lies face down (prone) on the floor with their head behind the “Start” cone.
- The assistant gives the command “GO” and starts the stopwatch.
- The athlete jumps to his/her feet and negotiates the course around the cones following the red line route as quickly as possible through to the finish.
- The assistant stops the stopwatch and records the time when the athletes’ body passes the “Finish” cone.

Record the 10m time (acceleration phase) and also the total time taken to complete the course.

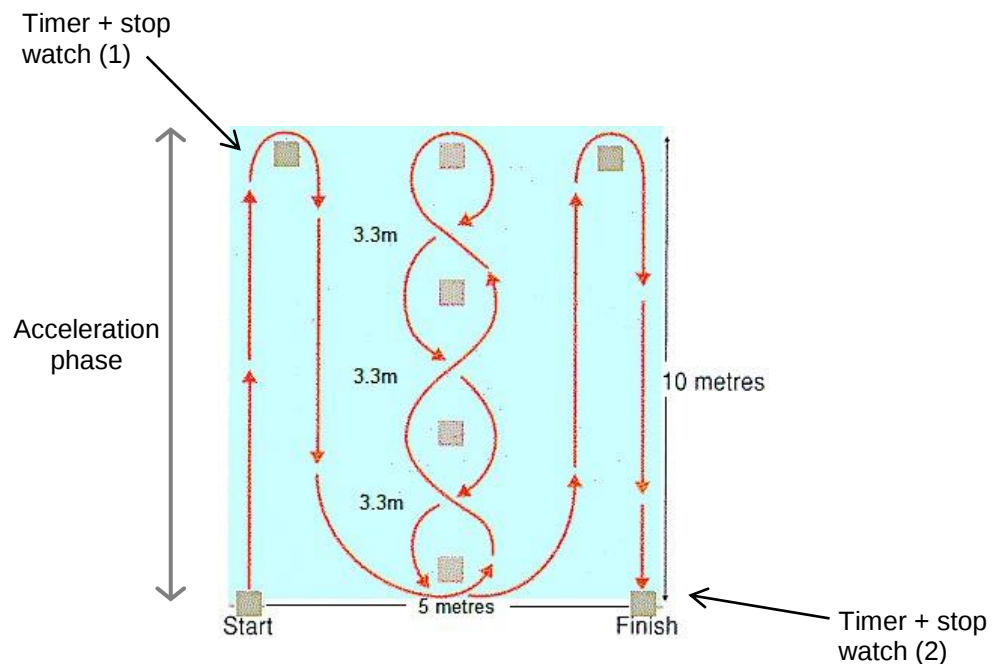
Complete up to x3 runs with 3-minutes rest between each running effort.

Record the best effort (quickest time) from the three runs.

4) 10m Acceleration

This score is obtained by recording the first 10metres of The Agility Illinois evaluation (see page 5) and represents athletes' absolute explosive speed and power. Muscular speed and power are considered to be important qualities of the elite Alpine ski racer (Turnbull et al., 2009).

The image below shows that the first 10meters from “start” cone to first cone is the acceleration phase and the timed distance to record.



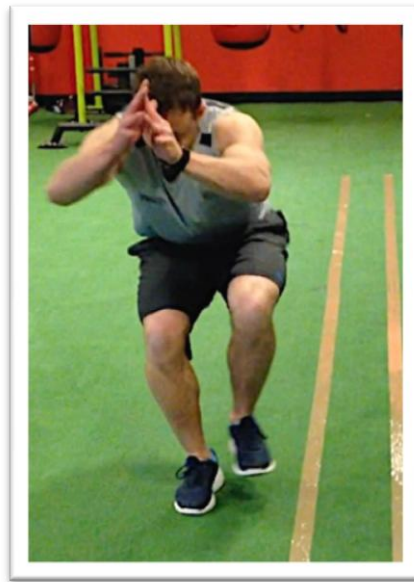
Recording the Acceleration evaluation:

- The 10m Acceleration time should be taken from the quickest time recorded in the 3 Agility Illinois running attempts.
- If you have access to timing gates you may wish to use them instead of handheld stopwatches for ease of data collection.
- Timing gates should be set up at the “start” cone, and secondly in-line with the first cone. See number one (1) reference in the diagram above.
- Up to x3 acceleration times should be collected along with the Agility Illinois timed runs.

Please indicate if a hand-held watch or timing gates have been used.
The evaluation must be filmed.

5) X-Over Hop – click on the link - [X-Over Hop](#)

This evaluation indicates the athlete's ability to express eccentric, isometric, and concentric ballistic strength and power during a directional change. The level of single leg control and ability to complete this task effectively relates to the high level of athleticism required during turning seen in Alpine racing (Turnbull et al., 2009). What's more, a large difference between single leg hop scores can be used to influence programming for injury prevention to the lower-limbs. One of the single most common reasons for ACL and Back injuries is a discrepancy between limb performances. This is also a screening assessment conducted by many professional organisations.



The central line you mark should be 300mm (width) outside edge to outside edge distance between the lines as marked in the image above.

You must complete 4 separate hop efforts: 2 off the left foot, and 2 off the right foot. When jumping with the left foot you should set up on the right hand side of the central line to begin. When jumping with the right foot you should set up on the left hand side of the central line.

How to conduct the X-Over Hop evaluation:

Right foot hopping example:

- Starting on the left side of the central line stood on your right leg only
- Begin by hopping over the 2 lines to the right side,
- Then, quickly across to the left,
- Before finally hopping and landing (with control) over to the right side, and “sticking” the landing for a 2-second count to finish. That is 3 hops in total.
- Measure the total distance covered in metres.
- If you over balance or touch the floor with your foot/ hand it's a ‘no jump’. Also, touching the tape with your foot at any stage is a ‘no jump’.
- The athlete has 2 attempts after a warm up to produce a score.

The recorded score is the furthest distance recorded after 2 attempts on each leg.

This means there should be x2 scores, 1 for the left leg, and 1 for right leg.

Please log both scores in the Excel scoring document to indicate left to right side differences, this is the ‘combined’ score.

6) 150m Decrement Run – click on the link - [the 150 Decrement Run](#)

This evaluation measures the efficiency and capacity of the anaerobic and aerobic energy systems that are taxed during ski racing. Information collected shows the athletes ability to perform an all-out single race effort, and also the body's ability to recover from repeated race efforts, which are shown to be important for ski racing (Steilow, 2010, Turnbull et al., 2009).

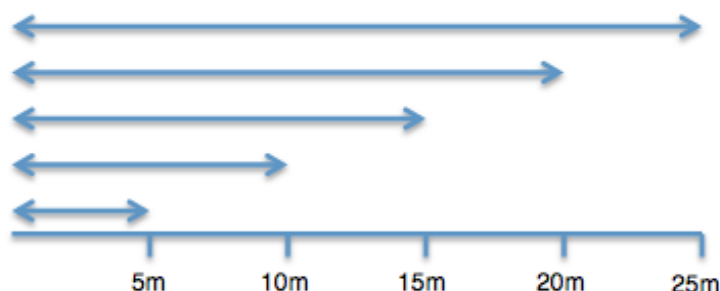
See diagram below for a blueprint of the Decrement run. The total distance should be set at 25 metres in length, with 5 x 5m interval points throughout.

Note: This is the most aerobically demanding of the evaluations therefore you must complete a thorough warm-up before you begin.

Safety Note. If you are carrying an injury or niggle DO NOT attempt this evaluation.

How to conduct the 150m Decrement Run: (The video link shows the protocol to use, but with the following changes as listed).

- Start on your front with your head behind the “start” line.
- On “GO” You have 30-seconds to shuttle 5m and back, 10m and back, 15m and back, 20m and back, and finally 25m and back.
- Your aim is to complete a maximum number of shuttles possible within 30 seconds of running. Then you have a 30 seconds rest to return back to the start position.
- You must complete 6 consecutive 30-second intervals, interspersed with 30-seconds rest = 6minutes of total work.
- At each 5m mark you must pick up a small object (e.g. bean bag or disc cone) and carry it back to the “start cone”. Complete this pick up and put down at each 5m point throughout the 30 seconds (as seen in the video).
- Get a partner to replace the beanbags/ cones to the 5m points after each 30-second trial.



For each trial record the total distance completed to the nearest 5m mark. Only completed 5m marks can be counted.

At the end of the evaluation you should have scores for 6 individual trials, and therefore one overall score summed from the 6 trials.

Lastly, if you are completing this evaluation on your own and not at a supervised ACE event you must film this assessment. Scores will not be accepted without filmed evidence.

Make sure you remain hydrated with a drink of water during and after this evaluation as required.

7) The Hexagon Jump – click on the link - [Hexagon Jump](#)

This evaluation challenges the athlete's ability to complete jumping and landing at high speed, with several changes in direction, which reflects agility, coordination and foot speed.

This evaluation is shown to have high correlation to Alpine ski racing performance (Andersen et al., 1990), and secondly serves as a major ACL prevention screening evaluation by comparing scores between clockwise and anti-clockwise jumping performance, where the skiers inability to decelerate under control repeatedly is a major indicator of ACL susceptibility.

First, click on the video link [how to draw a Hexagon](#) to build the dimensions for the evaluation. Each side of the hexagon should be 24 inches (60.96 cm) in length.



How to conduct the Hexagon evaluation:

- Begin by standing in the middle of the hexagon.
- On "GO" jump over and back across every line around the hexagon in one direction with feet remaining close together (as in above image).
- Complete 3 full revolutions finishing back in the middle of the hexagon, and stop the clock.
- There is a .5 second (1/2 a second) time penalty if you touch a line during any of the 3 revolutions, and a full second (1 second) penalty if a line is missed. Add penalty faults onto the total jumping time.
- Complete up to 4 total efforts; 2 trials travelling around the hexagon in a clockwise direction, and 2 trials travelling in an anti-clockwise direction to show right to left side performance differences.

Take the best time recorded from right to left jumping directions and enter this into the excel worksheet. Both scores are averaged to produce an "average" total evaluation score.

Again, the assessment must be filmed and submitted along with the score.

Equipment you will need:

Pull Up:

- Pull up bar as shown in the evaluation picture, or a standard straight rod bar fixed at 2 points are fine. Avoid using a freestanding pull-up/ dip bar, as this will restrict the correct leg position required.
- Boxes to assist set-up of grip

Bear Crawl:

- 1.5L water bottle (full)
- 2 cones to mark start and finish points
- Measuring tape

Agility Illinois + 10m Acceleration:

- 8 *disc* cones (mark under the cones with duck tape)
- Timing gates (not essential)
- 2/3 stopwatches

X-Over Hop:

- Duck tape (2 lines 10m in length)
- Measuring tape

150m Decrement:

- 12 cones (disc or agility cones) to mark out a channel
- 5 bean bags per channel
- Stopwatch

Hexagon:

- Duck tape
- Stopwatch

Other:

- **'ACE Profile Score sheet'** for recording ACE results, see web page link for download: <http://www.teambss.org.uk/governance/selection/>
- Pens/ pencils
- **'ACE Profile Results & Analysis'** document for data entry, analysis and reporting of results. See web page link for download: <http://www.teambss.org.uk/governance/selection/>

Athlete Database Example – Insertion of results into a table format under the “Data Entry” tab

ACE Profile Results & Analysis.xlsm

HomeLayoutTablesChartsSmartArtFormulasDataReviewDeveloper

1234567891011121314151617181920212223242526272829303132333435363738394041424344454647484950515253

DATA ENTRY

Close Full Screen

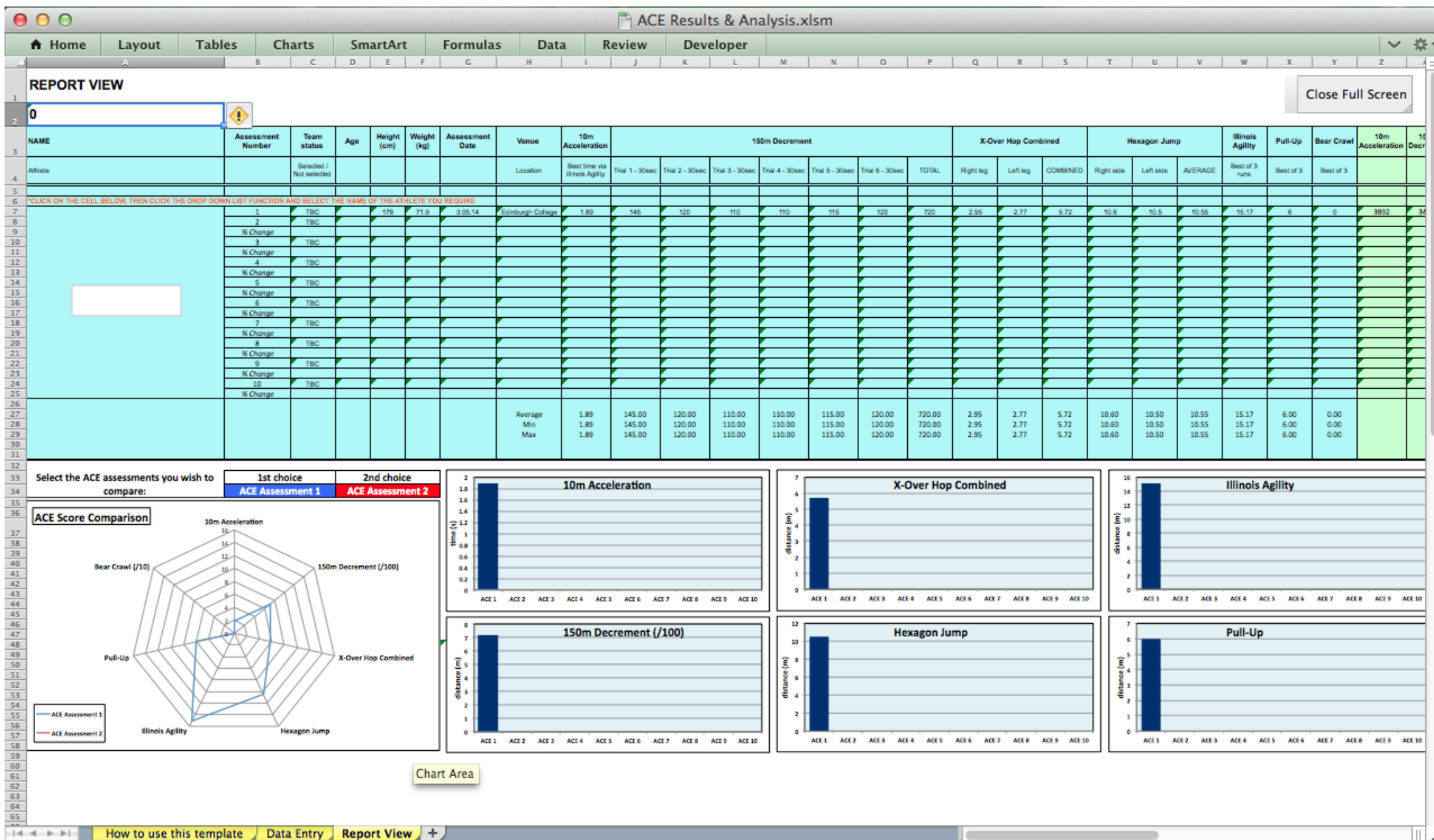
Region/ Group/ Team:

Key:

Injured

NAME	Assessment Number	Team status	Age	Height (cm)	Weight (kg)	Assessment Date	Venue	10m Acceleration (sec)	150m Decrement (m)						X-Over Hop (m)			Hexagon Jump (sec)			Illinois Agility (sec)	Pull (re	
Athlete		Selected / Not selected					Location	Best time via Illinois Agility	Trial 1 - 30sec	Trial 2 - 30sec	Trial 3 - 30sec	Trial 4 - 30sec	Trial 5 - 30sec	Trial 6 - 30sec	TOTAL	Right leg	Left leg	COMBINED	Right side	Left side	AVERAGE	Best of 3 runs	Best after
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Athlete Report Example – Graphical illustration of an individual's results, analysis and reports page ("Report View" tab)



ACE References

- ANDERSEN, R. E., MONTGOMERY, D. L. & TURCOTTE, R. A. 1990. An on-site test battery to assess alpine skiing performance. *Journal Sports Medicine and Physical Fitness*, 30, 276-282.
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