# Notes for using the force plate

- Start LoggerPro before plugging in the force plate
- There are two ranges that can be toggled by a switch on the side:
    - (-200N and +800N): This is used for pushing or pulling forces. Has a 12-bit resolution with a 1.2N to 0.3N resolution.
    - (-800N and +3500N): This is used for forces like jumping, standing, or running onto the force plate. his is used for pushing or pulling forces. Has a 10-bit resolution with a 4.8N to 1.2N resolution.
- The force plate is pretty sturdy but any force larger than 4500N in compression and 900N in tension can permanently damage the sensors. To prevent forces this level of force being applied to the force plat, **DO NOT STOMP, LAND JUMP STRAIGHT LEGGED, OR DO ANY EXTREME PULLING ONTO THE FORCE PLATE**.
- When getting ready to do a data collection session, make sure to zero out the plate.
- To change the collection time and sampling rate go to Experiment -> Data Collection or Ctrl+D
- To adjust the sampling rate, collection time, the collection mode, and triggering go to Experiment -> Data Collection or press the Data collection Icon to the left of the zeroing icon.

## For simply jumping on the force plate, here are somethings you can identify and figure out from looking at the data:

a. Identify the point on the graph corresponding to each of the following

(1) The start of the crouch preceding jump (this one has been labeled for you)
(2) The highest point of the jump
(3) The jumper's center of mass reaches its maximum downward velocity during the crouch
(4) The jumper's center of mass reaches its maximum upward velocity
(5) The lowest point of the crouch
(6) The jumper's feet touch the ground at the end of his jump

b. Estimate the jumper's approximate mass from the graph.

c. Estimate the height of the jump (the distance by which the jumper raised his center of mass) from the graph. Explain your reasoning.

## Experiments you can do:

- Analyze a crouched jump. Start with knees bent, hands on hips. Do NOT lower your body further; jump up only. Do not move arms. This very artificial jump is easier to analyze than a natural jump.
    a. Use the impulse of the force to find the change in momentum; find the jumper's velocity at take-off to estimate the jump height.
    b. Use the flight and kinematics to find the jump height.
    c. From the force *vs*. time graph, determine an acceleration vs. time graph. Integrate to find velocity and position vs. time graphs. Construct a plot of force vs. position and use that to determine the work done on the jumper's center of mass by the floor. Since that work shows up as kinetic energy, use the energy to find the velocity at take-off.
- Repeat the above analysis for a natural jump, beginning with standing straight, crouching down, and then jumping. You will be able to jump higher this way, but the analysis will be more complex.
- Investigate the forces involved during the technique known as "unweighting" during ski or snowboard turns. Can you easily cut your apparent weight?

- Take the Force Plate on an elevator ride. Stand on the Force Plate and record the force of the elevator floor on your feet as a function of time. Explain. Can you determine the speed of the elevator from the data?
    - For this you will need to download LoggerPro onto a laptop so you can collect data while in the elevator. The force plate itself doesn't store data.
- Start the default data collection. Once the graph begins, step down onto the Force Plate from a chair or one of the packing cases. Store that run then repeat, landing either softer or harder as you wish. Compare the two - forces during landing, time taken to come to a stop, etc.
- Start the default data collection. Once the graph begins, run and jump upwards off the force plate, landing on the floor past the Force Plate. Store this run. Then repeat the procedure, but this time step softly onto the Force Plate and do a standing high jump but land off the Force Plate. Compare the two.
- Set up Triggering so you can capture the Force vs. Time for a baseball that is dropped onto the Force Plate. Cushion the drop with various objects like foam, cardboard, etc., comparing the maximum forces in each case and the time taken to bring the baseball to a stop.
- Start the default collection. Once the graph begins, run across the force plate. There should be two peaks, one from impact and the other from pushing off. You may need to adjust the sampling rate to see both. Test to see if there is any difference between the heal striking and the ball of your foot striking when running.