How High Can You Jump?

Physics of Jumping

Human motion, such as jumping, is governed by natural laws described by Sir Isaac Newton.

http://www.aasd.k12.wi.us/staff/thalmanntegwen/Isschooltough.htm

1. An object will stay in motion or rest unless acted on by a push or a pull.

2. Force = mass x acceleration
   - Force is a push or pull
   - Mass is how much of you there is!
   - Acceleration is any time you speed up, slow down or turn.

3. Every action has an equal and opposite reaction. A push or pull in one direction is always paired with an equal push or pull in the opposite direction.

http://biomech.byu.edu/steeplechase/hurdling.html

Gravity

1. A gravitational force pulls any two objects in the universe together. The strength of this force depends on the masses of the two objects and the distance between them

2. The gravitational force that Earth exerts on you is greater than the gravitational force that any other object exerts on you. This gravitational force pulls you towards Earth.

3. The gravitational force for Earth is defined as your mass x Gravitational Constant (-9.8m/s^2). To be able to jump, we need to exert a force to counter the effects of Earth's gravitational force.

http://www.webdesign.org/photoshop/drawing-techniques/globe-logo.13831.html

How We Jump

To understand how we jump, we have to know all the forces that act on us when we jump.

http://starsacademy.tv/fr_intropage.cfm

1. Gravitational force acts on us when we jump, pulling us towards the Earth.

2. To exert a force against the ground, we release the stored energy in our muscles. The force that comes from our muscles is called the internal force.

3. The force that propels us in the air is called the ground reaction force. The ground reaction force is equal to the internal force.

To jump we need to generate an internal force that is greater than the gravitational force.

Here are two factors that effect how high you can jump:

1. Weight. If you and your friend are able to generate the same amount of internal force, the person who weighs less will be able to jump higher.
2. Internal Force. If you are the same weight as your friend, the person who is able to generate more internal force will be able to jump higher. You can generate more internal force by strengthening your muscles and increasing the amount of energy they can store.

How the Force Pad Works

When in the air, a human body acts as a projectile. Projectile motion in the vertical direction is described by Equation 1

$$y = y_0 + v_y + \frac{1}{2} g t^2$$

From Equation 1 we can derive equations for flight time (FT) and max height (MH).

Substituting terms in the equations for FT and MH gives the equation:

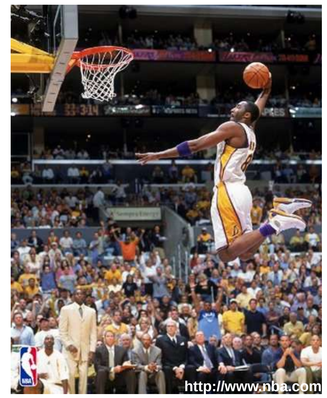
$$FT = \frac{2v_y}{-g}$$

$$MH = \frac{-v_y^2}{2g}$$

MH = 48.23t^2

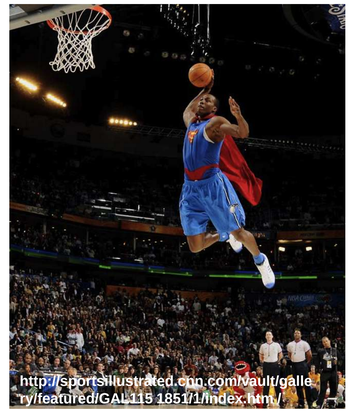
The Force Pad measures how long you are in the air, and then estimates the vertical jump height in inches using the equations shown above.

What the Pros Do

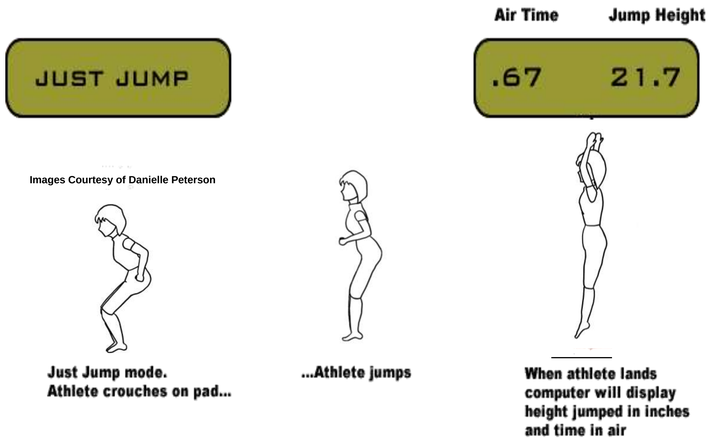


Kobe Bryant 38”

Nate Robinson 46”



Dwight Howard 38”

Lebron James 39”

*An average person can jump 18”