The beginning student may ask; where does one obtain the power to create the devastating results attributed to Taekwon-Do? This power is attributed to the utilization of a person’s full potential through the mathematical application of Taekwon-Do techniques. The average person uses only 10 to 20 percent of their potential. Anyone, regardless of size, age, or sex who can condition themselves to use 100 percent of their potential can also perform the same destructive techniques.

Though training will certainly result in a superb level of physical fitness, it will not necessarily result in the acquisition of extraordinary stamina or superhuman strength. More important, Taekwon-Do training will result in obtaining a high level of reaction force, concentration, equilibrium, breath control and speed; these are the factors that will result in a high degree of physical power:

**Reaction Force**

According to Newton's Law, every force has an equal and opposite force. When an automobile crashes into a wall with the force of 2,000 pounds, the wall will return a force of 2,000 pounds; or forcing the end of a seesaw down with a ton of weight will provide an upward force of the same weight; if your opponent is rushing towards you at a high speed, by the slightest blow to his head, the force with which you strike their head would be that of their own onslaught plus that of your blow.

The two forces combined; theirs, which is large, and yours, which is small are quite impressive. Another reaction force is your own. A punch with the right fist is aided by pulling back the left fist to the hip.

**Concentration**

By applying the impact force onto the smallest target area, it will concentrate the force and therefore, increase its effect. For example, the force of water coming out of a water hose is greater if the orifice is smaller. Conversely, the weight of a man spread out on snow shoes makes hardly any impression on the snow. The blows in Taekwon-Do are often concentrated onto the edge of the open palm or to the crook of the fingers.

It is very important that you should not unleash all your strength at the beginning but gradually, and particularly at the point of contact with your opponent's body, the force must be so concentrated as to give a
knock-out blow. That is to say, the shorter the time for the concentration, the greater will be the power of the blow. The utmost concentration is required in order to mobilize every muscle of the body onto the smallest target area simultaneously.

In conclusion, concentration is done in two ways: one is to concentrate every muscle of the body, particularly the bigger muscles around the hip and abdomen (which theoretically are slower than the smaller muscles of other parts of the body) towards the appropriate tool to be used at the proper time; the second way is to concentrate such mobilized muscles onto the opponent's vital spot. This is the reason why the hip and abdomen are jerked slightly before the hands and feet in any action, whether it is attack or defense. Remember, jerking can be executed in two ways: laterally and vertically.

**Equilibrium**

Balance is of utmost importance in any type of athletics. In Taekwon-Do, it deserves special consideration. By keeping the body always in equilibrium, that is, well balanced, a blow is more effective and deadly. Conversely, the unbalanced one is easily toppled. The stance should always be stable yet flexible, for both offensive and defensive movements.

Equilibrium is classified into both dynamic and static stability. They are so closely inter-related that the maximum force can only be produced when the static stability is maintained through dynamic stability.

To maintain good equilibrium, the centre of gravity of the stance must fall on a straight line midway between both legs when the body weight is distributed equally on both legs or in the centre of the foot if it is necessary to concentrate the bulk of body weight on one foot. The centre of gravity can be adjusted according to body weight. Flexibility and knee spring are also important in maintaining balance for both a quick attack and instant recovery. One additional point; the heel of the rear foot should never be off the ground at the point of impact. This is not only necessary for good balance but also to produce maximum power at the point of impact.

**Breath Control**

Controlled breathing not only affects one's stamina and speed but can also condition a body to receive a blow and augment the power of a blow directed against an opponent. Through practice, breath stopped in the state of exhaling at the critical moment when a blow is landed against a pressure point on the body can prevent a loss of consciousness and stifle pain. A sharp exhaling of breath at the moment of impact and stopping the breath during the execution of a movement tense the abdomen to concentrate maximum effort on the delivery of the motion, while a slow inhaling helps the preparation of the next movement. An important rule to remember; Never inhale while focusing a block or blow against an opponent. Not only will this impede movement but it will also result in a loss of power.

Students should also practice disguised breathing to conceal any outward signs of fatigue. An experienced fighter will certainly press an attack when he realizes his opponent is on the point of exhaustion. One breath is required for one movement with the exception of a continuous movement.

**Mass**

Mathematically, the maximum kinetic energy or force is obtained from maximum body weight and speed and it is all important that the body weight be increased during the execution of a blow. No doubt the maximum
body weight is applied with the motion of turning the hip. The large abdominal muscles are twisted to provide additional body momentum. Thus the hip rotates in the same direction as that of the attacking or blocking tool. Another way of increasing body weight is the utilization of a springing action of the knee joint. This is achieved by slightly raising the hip at the beginning of the motion and lowering the hip at the moment of impact to drop the body weight into the motion.

In summarizing, it is necessary to point out that the principles of force outlined here hold just as true today in our modern scientific and nuclear age as they did centuries ago.

I am sure that when you go through this art, both in theory and in practice, you will find that the scientific basis of the motions and the real power which comes out a small human body cannot fail to impress you.

**Speed**

Speed is the most essential factor of force or power. Scientifically, force equals mass times acceleration: \( F = MA \) or \( P = MV^2 \), where \( P = \text{Power} \), \( M = \text{Mass} \) and \( V = \text{Velocity} \).

If you drop a large stone gently on a double pane of glass from a height of three inches its effect will be minimal. On the other hand, if you throw a small stone against the same glass with great speed it will smash.

If you pass your hand through a candle flame the flame will carry on burning, you can however extinguish the flame with a controlled punch or kick by stopping the technique one inch from the flame. The force of displacement of the air in front of your attacking tool is enough to extinguish the flame.

According to the theory of kinetic energy, every object increases its weight as well as speed in a downward movement. This very principle is applied to this particular art of self-defense. For this reason, at the moment of impact, the position of the hand normally becomes lower than the shoulder and the foot lower than the hip while the body is in the air.

Reaction force, breath control, equilibrium, concentration, and relaxation of the muscles cannot be ignored. However, these are the factors that contribute to the speed and all these factors, together with flexible and rhythmic movements, must be well coordinated to produce the maximum power in Taekwon-Do.
Principles of Reaction Time/Reflex Time

Reaction time (RT) is the elapsed time between the presentation of a sensory stimulus and the subsequent behavioral response. RT is often used in experimental psychology to measure the duration of mental operations, an area of research known as mental chronometry. The behavioral response is typically automatic and can also be an eye movement, a vocal response, or some other observable behavior.

RT is fastest when there is only one possible response (simple reaction time) and becomes slower as additional response options are added (choice reaction time). According to Hick’s law, choice reaction time increases in proportion to the logarithm of the number of response alternatives. The law is usually expressed by the formula $RT = a + b \log_2(n+1)$, where “a” and “b” are constants representing the intercept and slope of the function, and “n” is the number of alternatives.

Reaction time is quickest for young adults and gradually slows down with age. It can be improved with practice up to a point and it deciles under conditions of fatigue and distractions.

A reflex action, also known as a reflex, is an involuntary and nearly instantaneous movement in response to a stimulus. In most contexts, in particular those involving humans, reflex actions are mediated via the reflex arc.

Principles of Physical Motion

Newton’s Laws of Motion:

1st Law: A body in rest tends to stay at rest, and a body in motion tends to stay in motion, unless the body is compelled to change its state. The evidence supporting the first part of this statement is easily seen. We know that a wheel will not begin rolling by itself. However, we do not see the proof of the second half in our world. That is because there is an ever present inhibiting force known as “friction” that acts as the external force resisting perpetual motion.

2nd Law: The second law is a formula--- $F_{net} = ma$ or $A = F/m$. The product of the object's mass (m) times its acceleration (a), is equal to the net force ($F_{net}$). Acceleration and force are vectors; in this law the direction of
the force vector is the same as the direction of the acceleration vector. The acceleration of a body is dependent upon both the mass of the object (not its weight) and the net force perpetuating the motion (total force in the direction of the motion minus the force resisting motion). In the formula, a resisting force would be written as negative to produce a negative acceleration, which means the object would be slowing down.

**3rd Law:** For every action there is an equal and opposite reaction. This means that if I push you, I will be slightly pushed back in the process. This is the principle at work behind how jet planes and rockets propel themselves. They expel gases in the opposite direction, are pushed themselves in the process, and therefore move forward.

Motion, or a change in motion, occurs when a force is applied to an object. Motion has two components, speed and direction. A change in motion may mean a change in an object’s speed, direction, or both. An object is said to be in motion only if it is changing its position with respect to a point of reference whose position is fixed.

**Principles of Force**

"Force" is one of those words that gets used both in everyday speech and in physics, but in this case, the technical meaning isn't all that far removed from the everyday meaning. When you think of forces in an everyday sense, you think of things that you do to try to change the behavior of objects (or people)-- pushing them, pulling them, hitting them, threatening to hit them, etc. The basic idea carries over-- forces are things that change the motion of objects.

Force is the quantification of an interaction between two objects. If you have two objects that interact with one another in some way, you describe the size and effect of that interaction in terms of a force. Force, in turn, is related to the motion of the object via Newton's Laws of Motion, of which there are three, because 3 is the magic number:

1. An object at rest tends to remain at rest, and an object in motion tends to remain in motion in a straight line at constant speed, unless acted on by a force.
2. The net force on an object is equal to the time rate of change of the momentum, or $F_{\text{net}} = \frac{dp}{dt}$ (which is equal to mass times acceleration for reasonable-size objects at speeds much lower than the speed of light).
3. If one object exerts a force on a second object, the second object exerts a force on the first that is equal in magnitude to the first force, and in the opposite direction.

These can be summarized as "1) Inertia, 2) $F = ma$, 3) Action-Reaction," and anybody who has ever taken physics has seen them. They can be understood a little better by thinking in terms of force as the quantification of interaction. The first law is just the codification of common sense: objects don't change their motion unless some interaction causes them to do so. If you see a change in the motion of some object, you can deduce that there must've been an interaction to cause that change, and indeed that's how we detected all the forces we know.

The second law is just the quantification of the first law: it tells you how big a force you need to get a given change in motion. The units of force are defined in terms of the second law: a one-Newton force is the result of an interaction that causes a one-kilogram object to accelerate at one meter per second.

The third law tells you that interactions always go both ways. If player X interacts with player Y, player X is also affected by that interaction. You determine the motion by adding up the forces due to all possible pairs, and then applying the second law.
Principles of Stability/Center of Gravity

Understanding the concepts of the stability and center of gravity is enormously important. These concepts are interrelated and have a profound effect on the success or failure of your movement or technique. Loss of balance or poor balance is an indication of a lack of training.

The center of gravity is an imaginary point around which body weight is evenly distributed. The center of gravity of the human body can change considerably because the segments of the body can move their masses with joint rotations. This concept is critical to understanding balance and stability and how gravity affects your stances and techniques.

Balance is the ability to control equilibrium or stability. As an Instructor, you need to know and understand two types of balance:

1. **Static balance:** The ability to control the body while the body is stationary.
2. **Dynamic balance:** The ability to control the body during motion.