

# BIOMECHANICS

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## 1. Balance or equilibrium

**Equilibrium is a state of rest of the body either at stationary or in moving position.**

**activities equilibrium** is called as balance, poise, position or stability the body movement of kind any involves some aspect of equilibrium

e.g. (sitting standing) (walking running).

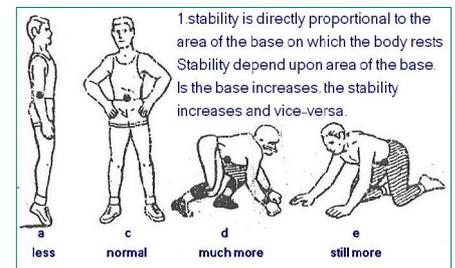
## 2. Factors of equilibrium

### 1. stability is directly proportional to the area of the base on which the body rests.

Stability depend upon area of the base. Is the base increases, the stability increases and vice-versa.

e.g.

- a. a person standing on toes has - **very less degree of stability unstable.**
- b. both feet together - **little more.**
- c. both feet apart - **further more.**
- d. the person with both hands and feet on the ground (four point football stance) - **much more.**
- e. wrestler's defensive down position - **still more.**
- f. a person lying on the floor with the arms and feet spread- **very high.**

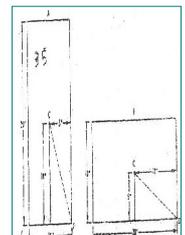


### 2. stability is indirectly proportional to the distance of the center of gravity of the body above the base.

As the height of the center of gravity (C.G) increases the stability decreases and vice-versa.

**The centre of gravity of a body** is the point from which the body can have perfect balance It can be considered as the centre of weight of the body.

Normally in an adult man the C.G. in a standing position will be at **56.18 %** of the height from the ground. and it will be at **55.14 %** in adult women.

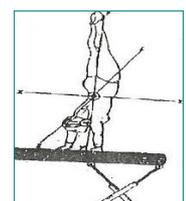


e.g.; (If standing person raises his hands upwards, the C.G. will move high and stability decreases)

### 3. for equilibrium to exist the center of gravity must fall within its base.

The stability will be more when the C.G. falls within the base of the body, or object a gymnast in performing the hand stand should keep his body vertical so that C.G. falls between his hands and has more stability

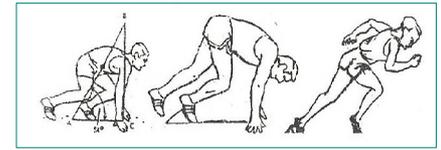
e.g.; (in the low crouch in basketball dribbling the C.G. drops within the base it creates wider base and closer to the ground. hence, the stability will be more)



#### 4. stability is directly proportional to the horizontal distance of the centre of gravity to the edge of the base in a given direction of movement

In the above picture when an athlete is in his starting position the C.G. falls at the centre of the base and when he acquires the 'set' position his C.G.

will be moved toward the direction of the movement and the horizontal distance from the edge of the base in that direction and the stability is also decreases.



In the above picture, a basketball player rapidly..

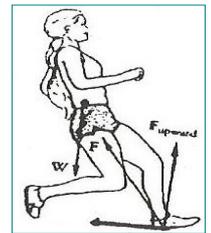
Then he leans backward and brings the C.G. away from the direction of movement.

**e.g.;** (when a person bends or leans towards the direction of movement, his stability will be less)

#### 5. stability is directly proportional to the weight of the base.

**e.g.;** (the heavy body will have more stability)

If two individuals of different weights are standing, it is difficult to move the equilibrium of a heavier person.

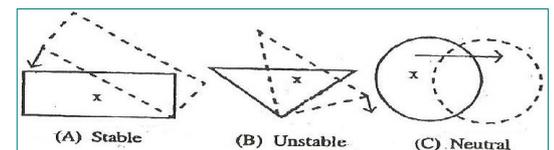


### 3. types of equilibrium

All objects at rest are in equilibrium. That means all the forces acting on them are equally balanced.

and sum of all the forces and of all torques equal zero..

But all the objects are not equally stable



The following are the types of equilibrium:-

#### a. stable equilibrium

If the position of an object is slightly altered and the object tends to return to its original position, the object is said to be in stable equilibrium

(Fig. A) (the stable equilibrium occurs when an object is placed in such a way that an effort to disturb it would require its centre of gravity to be raised)

#### b. unstable equilibrium

It exists when it requires only a slight push to disturb the equilibrium.

**e.g.;** The swimmers of sprint runners "set" position. (Fig. B).

#### c. neutral equilibrium

The object is said to be in neutral equilibrium when it is disturbed without either raising or lowering the centre of gravity.

**e.g.;** a ball lying on a table is said to be in neutral equilibrium (Fig. C).

#### **4. Guiding principles ( degree) of equilibrium**

##### **Following are the guiding derived from the factor of equilibrium:-**

1. to start quickly in one direction, keep the **C.G.** as high as possible and as near as possible to the edge of the base in the direction of movement.

**E.g. Set position in sprints and swimming.**

2. a body is said be in equilibrium when is **C.G.** falls within its base and loses its equilibrium when the **C.G.** falls outside its base.

**E.g. wrestler's lying position and dribble low in basketball.**

3. to stop quickly during rapid motion, drop the **C.G.** as low as possible, create greater area of base as possible and move the **C.G.** away from the edge of base nearest to the direction of movement.

**E.g. sudden stop of moving basketball player.**

4. in all arm support activities the **C.G.** of the body should be as near as possible over point of support.

**E.g. vaulting horse and exercises on bar.**

5. when the body is free of support and the air the movement are not affected by the height of **C.G.**, but the **C.G.** within the body can be changed by the body movement.

**E.g. sergeant jump.**

6. when the body is free in the air, and head and feet move down, the hips move up and vice-versa. Principle of end and middle is involved.

**E.g. crossing the hurdle.**

7. when either hands or feet and supported, if one moves up, the hips move down and vice versa.

**E.g. crossing the bar in pole-vault.**

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