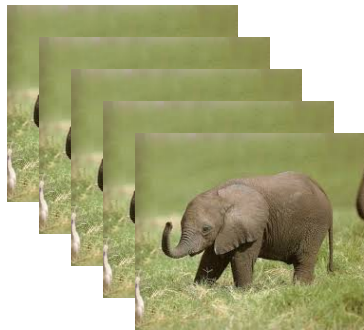


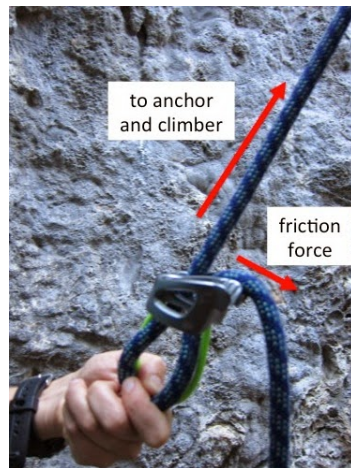
Fall Ratings

- Climbing gear has fall ratings in kiloNewtons, which is a measure of how much force it can withstand
- kiloNewton = weight x acceleration due to gravity
- If you weigh 150 lbs, you will exert a max of 0.6672 kN during a fall
- An example/typical rope may have a fall rating of 9 kN
- An object of approx. 2000 lb is needed to break a rope with a rating of 9kN
- This is $\approx 900,000$ iPhones or ≈ 10 baby elephants



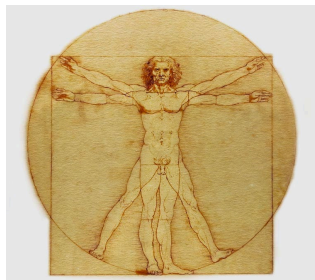
Friction and Belay Devices

- Friction is the resistance force that one surface or object encounters when moving, or trying to move, over another.
- **Implication:** When climbing, you use chalk on your hands and special shoes to maximize the this friction force to prevent slipping
- **Belay devices** are designed to have a greater coefficient of friction than simply your hands, and to transfer the weight from your hands, to your center of mass.



Ape Index

- This is a measure of the ratio of an individual's arm span relative to their height.
- It was thought that having an arm span greater than one's height served as an indicator of one's climbing ability (hence the name!),
 - Discussion question: Is this necessarily true?
- Michael Phelps (swimmer) has an ape index of 1.06
- Shaq (basketball player) has an ape index of 1.0843



- Leonardo da Vinci's *Vitruvian Man* depicts a man with an ape index of 1, and illustrates a connection between math and nature.

Fall Factor

- The impact felt by one's fall can be captured the equation:

$$\text{Fall factor} = \frac{\text{height fallen}}{\text{length of rope in use}}$$

- Maximum fall factor is 2.0, and most equipment is tested with a fall factor of 1.77.
- A good belayer will keep this number **very small** for the climber by keeping the slack in the rope to a minimum

