Work and Power Lab

Purpose

To calculate the power output of a machine.

Safety

Do not physically engage in this activity if you have an injury or a respiratory or cardiovascular condition!

Materials

Stopwatch/timer, meter stick, stairs, 3 machines (3 humans)

Procedure

1. Find the height of the stairs to be climbed. (in meters)
2. Find the mass of the student that will climb the stairs (2.2lbs = 1 kg)
3. Because the student will be climbing the stairs against the force of gravity, the acceleration is 9.8 m/s^2.
4. The student must run CAREFULLY up the stairs. Measure and record the time that is needed to do this.
5. Repeat step #4 three times and take the average of the three trials for the time of the person doing the climb.
6. Increase your power by repeating steps #1 - #4, by running faster up the stairs.
7. Repeat steps # 1-#6 for Student #2 and Student #3.

Analysis

Formulas Needed:

Mass (kg) = $\frac{\text{your weight (lbs)}}{2.2}$ 760 W (watts) = 1 horsepower (hp)

Work = Force x distance (unit: Joules)

Power = $\frac{\text{W (Work)}}{\text{t (time)}}$ OR $P = \frac{(F)(d)}{t}$ OR $P = \frac{(m)(a)(d)}{t}$

Record and Calculate: Mass, Work and Power

A) "Run"	**Student #1** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

B) "Fast Run"	**Student #1** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

A) "Run"	**Student #2** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

B) "Fast Run"	**Student #2** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

A) "Run"	**Student #3** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

B) "Fast Run"	**Student #3** Mass (kg)	Gravitational Acceleration "a"	Distance Height (m)	Time for climb (sec)	Work (Joules)	Power (Watts)
Trial #1		**9.8 m/s^2**				
Trial #2		**9.8 m/s^2**				
Trial #3		**9.8 m/s^2**				
Average		**9.8 m/s^2**				

Conclusion Questions:

1. How did increasing the mass of the machine (student) influence the power output?

	2. Some students are able to run up the stairs more rapidly than others. How does increasing the speed of the climb influence the power output? 3. Which machine (student) did the most work? (Support your answer) 4. Which machine (student) generates the most power? (Support your answer) 5. Convert the power output (watts) of student # 1, #2, and #3 into horsepower (hp). 6. Which machine (student) has the greatest horsepower? Why? 7. Describe the difference between work and power?