###### Experiment 20 – POWER OF THE HUMAN BODY

The media often report about races up tall buildings around the world. Contestants start on the bottom floor and run up the stairs to the top floor. New York holds one up the Empire State Building. In Western Australia competitors climb the BankWest Tower. This exhausting competition demands that the winning athletes have both power and endurance. In this activity you will measure the power your body develops as you climb a single flight of stairs.

## Equipment needed

3 stop watches

1 flight of stairs. Each step should be identical in height and width

I set of bathroom scales

1 metre ruler

# Procedure

1. Choose three volunteer climbers and three time-keepers.
2. Measure the mass of each person who will climb the stairs.
3. Measure the step height.
4. Record the number of stairs in the flight.
5. Time each volunteer’s climb of the flight of stairs. Use three time-keepers.
6. Allow a run-up. Ensure the competitor steps on every stair. Start timing when a climber’s foot strikes the third stair and stop timing when the climber reaches the last stair.

+ −

Individual step height \_\_\_\_\_\_\_\_\_\_m

No of steps in flight \_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Volunteer No | Mass (kg) | Time 1 (s) | Time 2 (s) | Time 3 (s) | Average (s) |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |

**Processing the results.**

1. Calculate the height each person climbs from the third stair up.
2. Deduce each climber’s gain in potential.
3. Calculate the average power each person exerted while they climbed the stairs.

# Questions

1. In carrying out this investigation, what assumptions do you make about each climber’s kinetic energy?
2. Basal metabolic rate is a term human biologists use to describe the minimum energy your body needs per unit time to stay alive. You can roughly calculate the basal rate of energy expenditure for the average human body from the following formulae:
   1. Basal rate for men in watts = (2.1 x body mass in kg) – 21
   2. Basal rate for women in watts = (1.1 x body mass in kg ) + 2.2

Use the appropriate formula to determine how much power each climber is exerting in addition to their basal metabolic rate.

1. If each stair climber had eaten half a regular pizza earlier that day, they would have gained 1.68 x 106 J of chemical energy each. How long must each of the three climbers continue to climb the stairs to ‘burn off’ this energy? Assume your body is 50% efficient at converting chemical energy to kinetic energy.