The 10 Step Program: Power Generation

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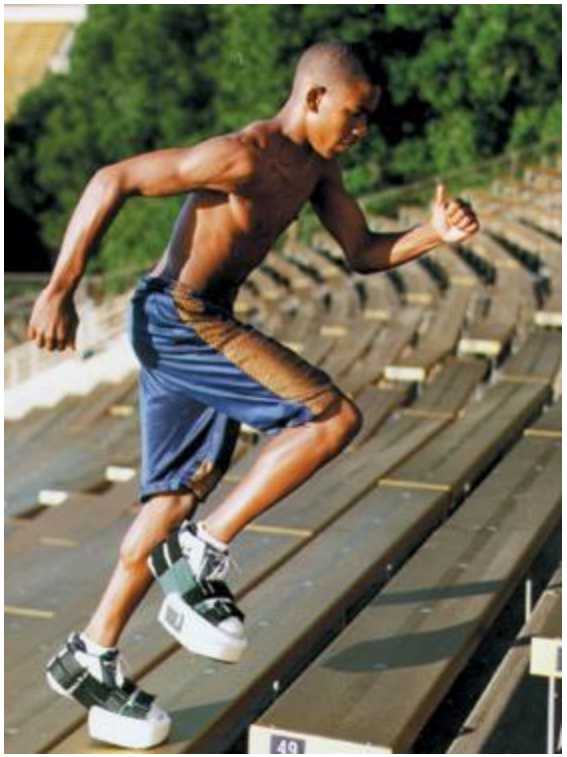
Biol 438
4/14/11

Step 1: What's the Problem

- Measure Power Generation of various people running up stairs
- Attempt to identify a superior technique

Step 2: Background Information

- Major movements:
  - Knee flexion/extension
  - Dorsiflexion/Plantar flexion
  - Hip flexion/extension
  - Elbow flexion/extension
  - Shoulder flexion/extension



Background Continued

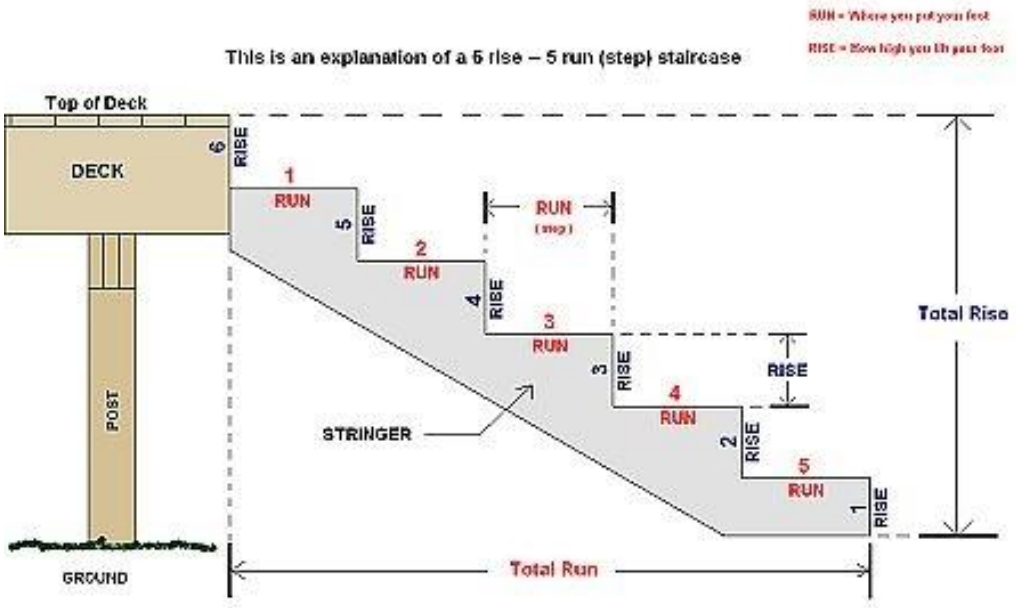
- Major muscles involved (not exhaustive):
  - Knee flexion/extension: hamstrings/quadriceps
  - Dorsiflexion/Plantar Flexion:
    - Tibialis anterior/gastrocnemius
  - Hip flexion/extension: iliopsoas/gluteus maximus
  - Elbow flexion/extension: brachialis/triceps brachii
  - Shoulder flexion/extension:
    - Pectoralis major/latissimus dorsi

Step 3: Form a hypothesis

- Men vs. women (equal athletic ability)
- Athlete vs. non-athlete
- Bipedal vs. quadrupedal techniques
  - Leads to a hypothesis about flight time
    - Applications to skiing

Step 4: Methods

- Measure the steps:
  - Only care about vertical height
    - Each step is 13cm



Measurements Continued

- There are 13 steps in the flight examined
  - 13 steps(13cm/step)=169 cm or 1.69m

How am I going to measure time?

- Stopwatch
  - Concerns about error

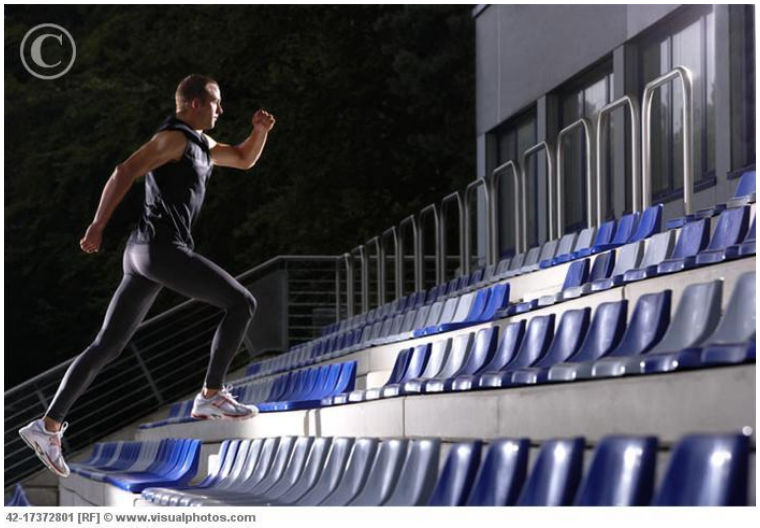
High Speed Camera

- Use LoggerPro and High Speed Camera to confirm my times
  - Surprisingly accurate

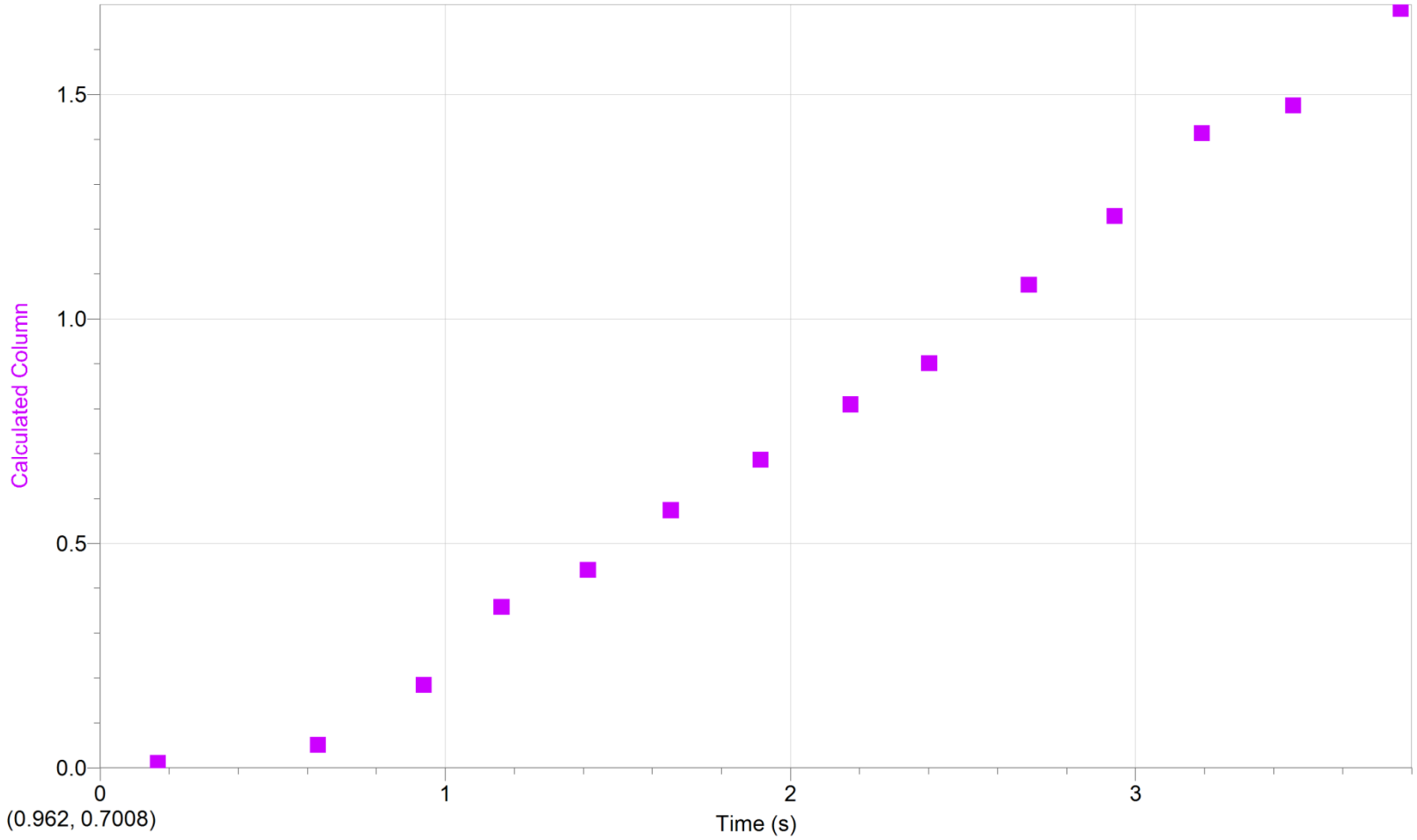
Watch me run!

Step 5: Results

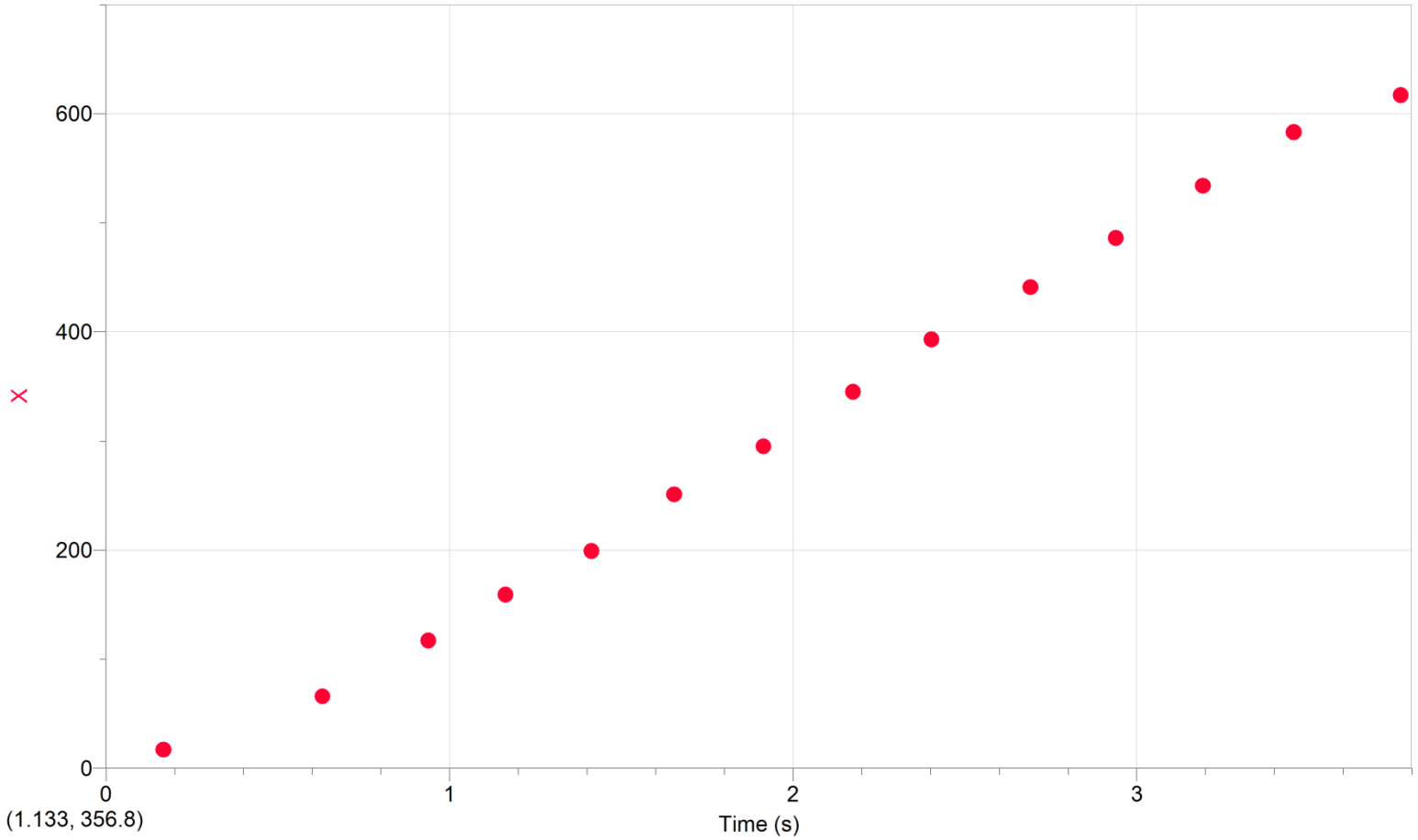
- Men vs. Women (of equal athletic ability)
  - Male: 3.84s
  - Female: 4.13s



Confirming Time



An interesting note about velocity



Step 6: How much power is generated?

- Male:
  - $((78.9kg)(9.8m/s^2)(1.69m))/3.84s = 340.3W$
- Female:
  - $((57.6kg)(9.8m/s^2)(1.69m))/4.12s = 231.5W$

Hypothesis 1 Confirmed

- Discussion of mass and time
  - Is it better to be heavy and slow?
  - Or light and fast?

Step 6: Athletes vs. Out of Shape

- Athletes n=23, average time=3.23s, approximated average mass=68.03kg
  - $P=((68.03kg)(9.8m/s^2)(1.69m))/(3.23s)=348.9W$
- Versus me, average time=3.84s, mass=78.9kg
  - $P=((78.9kg)(9.8m/s^2)(1.69m))/(3.84s) = 340.3W$

Step 7:Quadrupedal vs. Bipedal

- Far too embarrassing to film
- Bipedal
  - Normal Power=340.3W
- Quadrupedal
  - Reduced Time from 3.84s to 3.41s
  - $P=((78.9kg)(9.8m/s^2)(1.69m))/(3.41s) =383.2W$

Step 8: Discussion

- Men vs. Women
  - Weight advantage versus time
- Athletes vs. Non-athletes
  - Weight advantage versus time
- Quadrupedal vs. Bipedal
  - Weight spread, flight time

Step 9: Limitations

- Stopwatch: potentially not a problem because of confirmation with LoggerPro
- Lying: mostly about weight (mostly female?)

Step 10: Further Work

- Film both techniques and measure flight times
- Two stairs/step?
- Varying inclines