I’ve got the power

How much power do my muscles generate?

Prediction
How much power, in watts, do you think you can generate by doing stepping exercises for 1 minute? How do you think the power generated by your leg muscles will change if you double your rate of stepping?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Obtaining the evidence

1 Use bathroom scales to measure your body mass in kg if you haven’t brought this information with you to the lesson. You do not have to share this data with the class.

2 Work in pairs. Measure the height of your step, bench, or stair in metres. Record your results in Table 1.

3 Practise stepping onto and down from the step. Step onto the step with one foot, followed by the other foot, and then step down from the step with one foot followed by the other. This whole cycle is one step. You can choose which foot to lead with and this can be changed during the test if you wish.

4 One of you acts as time-keeper. The other partner steps on and off the step approximately once every 2 seconds. Count how many steps you do in 1 minute. Record your results in Table 2.

5 Swap roles. This will allow the exerciser to rest and recover.

6 Repeat stages 4 and 5. This time, step approximately once every second. Record your results in Table 2.

7 Repeat stages 4 and 5 but this time step on and off the step as fast as you can. Record your results in Table 2.

Presenting your results
Use the notes on the next page to help you complete the tables using the results you have collected.

Table 1

<table>
<thead>
<tr>
<th>Body mass (kg)</th>
<th>Force (N)</th>
<th>Height of one step (m)</th>
<th>Work done for one step (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation 1</td>
<td>Calculation 2</td>
<td></td>
</tr>
</tbody>
</table>
**Calculation 1: Force**

Convert body mass (kg) to weight (N) by multiplying your mass by 9.8 ms\(^{-2}\) (the acceleration due to gravity). This tells you your body weight in newtons (N), which is the force you are stepping against.

\[
\text{Body mass (kg)} \times 9.8 \text{ (ms}\ ^{-2}\text{)} = \text{force (N)}
\]

**Calculation 2: Work done**

To calculate the work done for one step:

\[
\text{Work done} = \text{force (from calculation 1)} \times \text{distance moved (height of step)} \text{ in m}
\]

The units for work done are newtons \(\times\) metres (Nm), which is the same as joules (J).

This only gives the work done for one step. Note that no external work is done when stepping down.

**Table 2**

<table>
<thead>
<tr>
<th>Step test</th>
<th>Actual number (S) of steps in 60 s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (approx. 1 step every 2 seconds)</td>
<td></td>
</tr>
<tr>
<td>2 (approx. 1 step every 1 second)</td>
<td></td>
</tr>
<tr>
<td>3 (as many steps as possible)</td>
<td></td>
</tr>
</tbody>
</table>

You will use the data in Tables 1 and 2 later, to calculate the total work done and your power for each rate of stepping.