The Impact Of Backpacks On The Cardiovascular System

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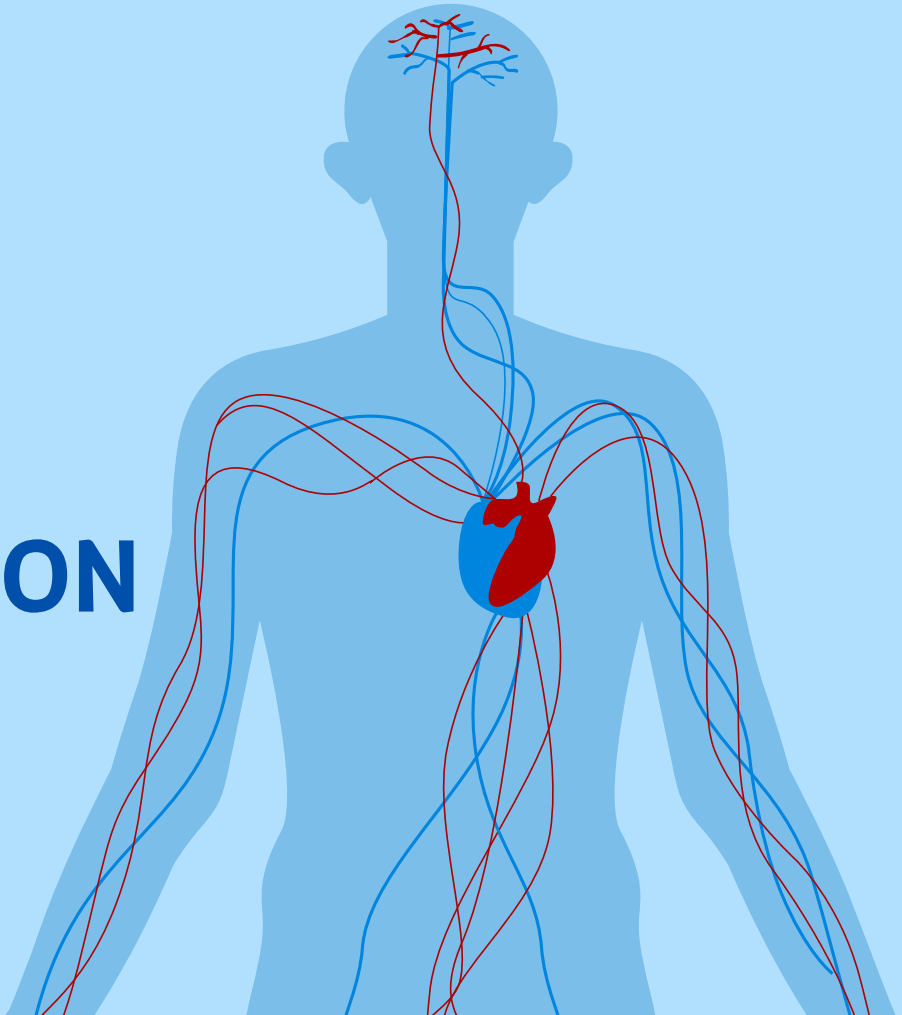
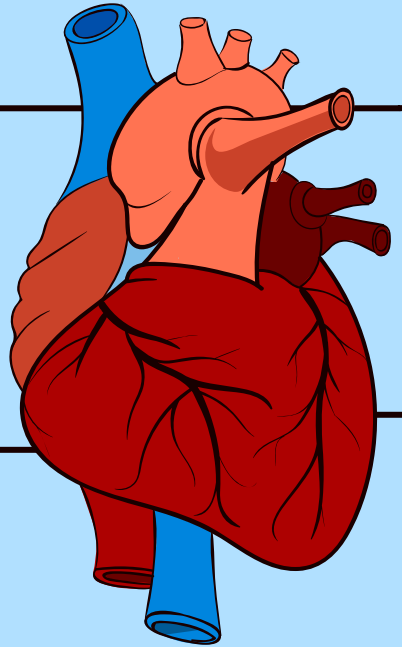
INTRODUCTION



CARDIOVASCULAR SYSTEM

Delivers oxygen to all parts of the body

Controls rhythm and speed of heart rate



Controls blood pressure

Contractions are controlled by electrical signals

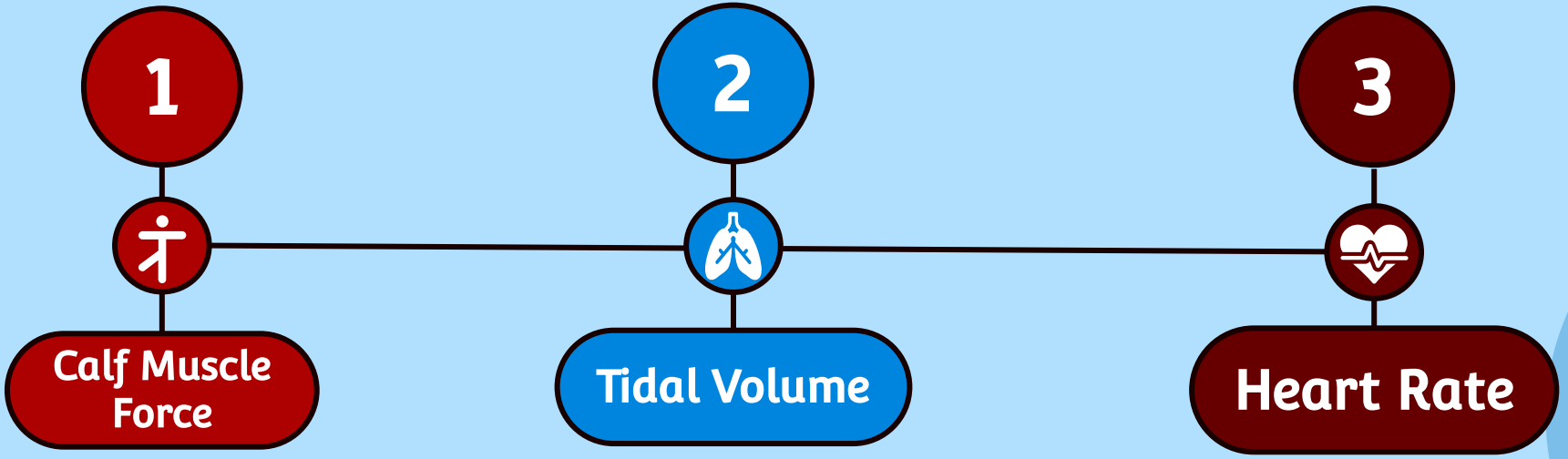
The Backpack

- Children in America wear an average of 12-20lbs in their backpack
  - We can say this stems from middle to high school

BIOPAC

- Device that records heart signals, brain waves, muscle activity, eye movement, and more
- We used it for all 3 measurements relevant to our study

Three Measurements



The amount of force the calf muscle exert from the body

The amount of air inhaled and exhaled during one respiratory cycle

The increase or decrease of your heart beat per minute.

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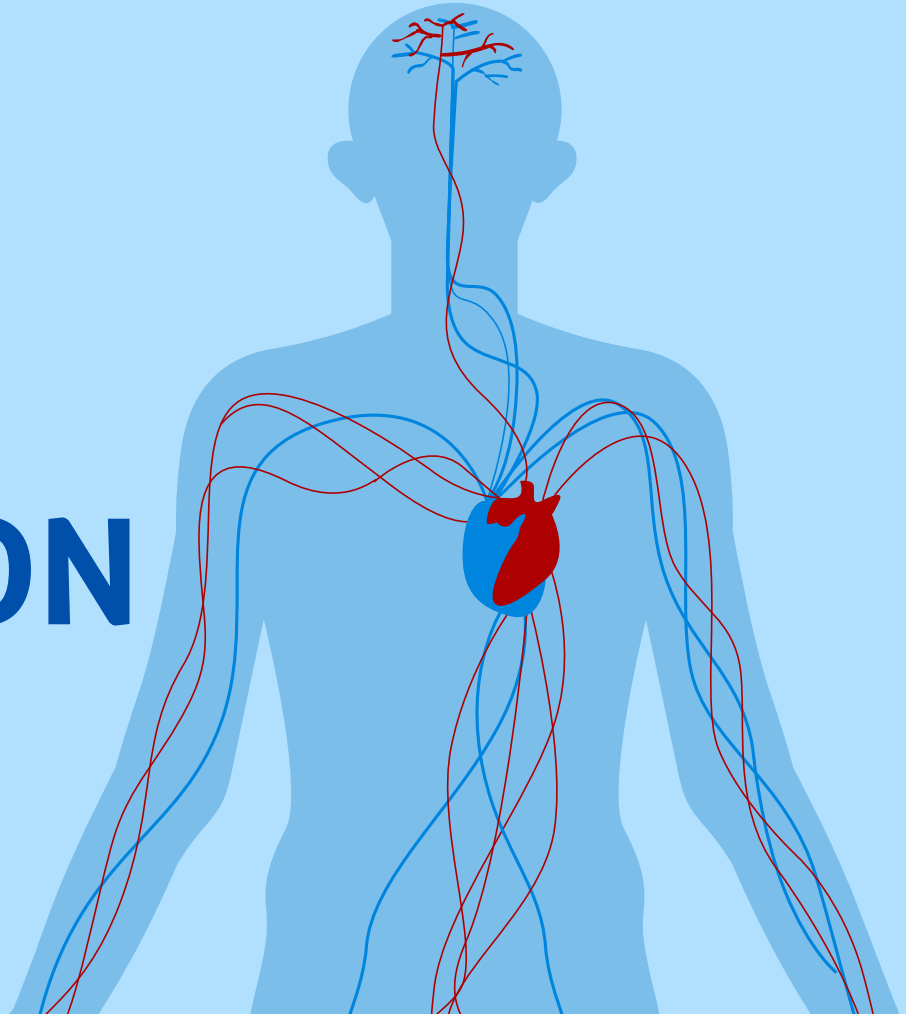
QUESTION



QUESTION

DOES WEARING A BACKPACK UP STAIRS INCREASE CALF MUSCLE FORCE, TIDAL VOLUME, AND/OR HEART RATE?

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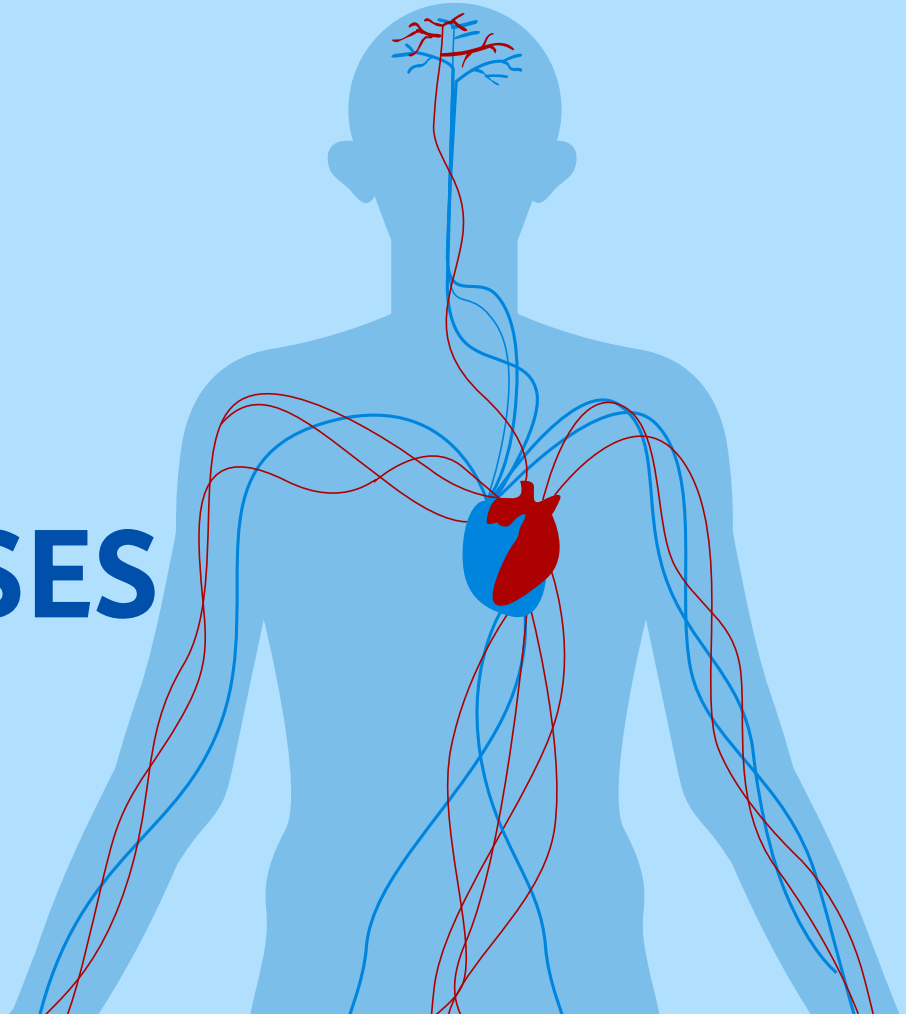
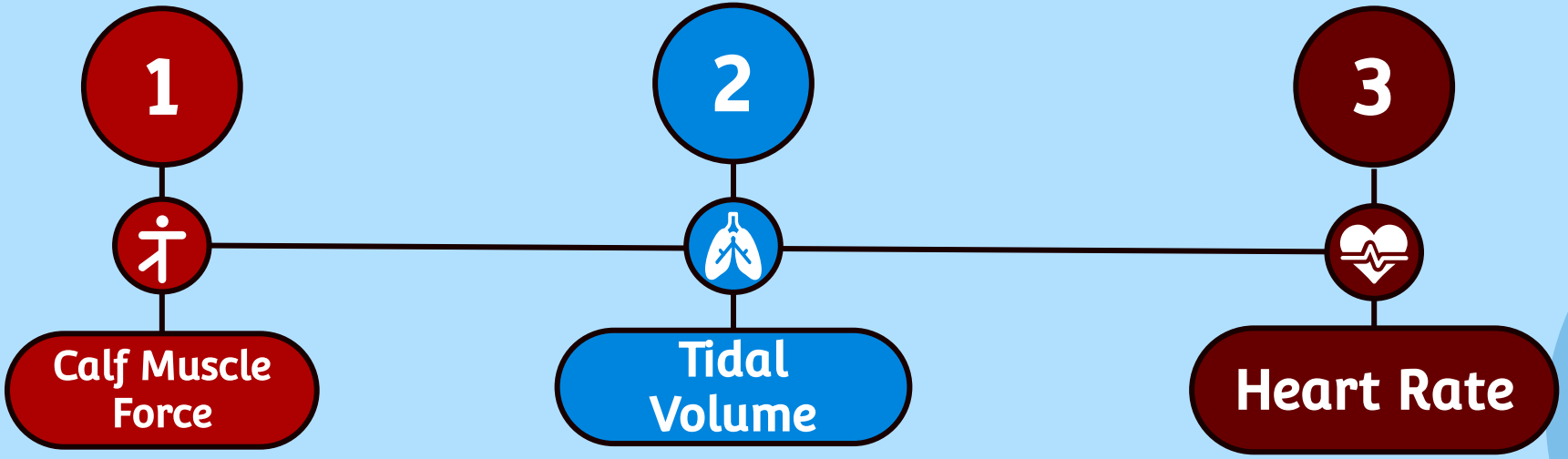
HYPOTHESES



Hypotheses



If a weighted vest is added while doing calf raises, then the muscle force will increase.

If a weighted vest is added while going up the stairs, then tidal volume will increase.

If a weighted vest is added while going up the stairs, then heart rate will increase.

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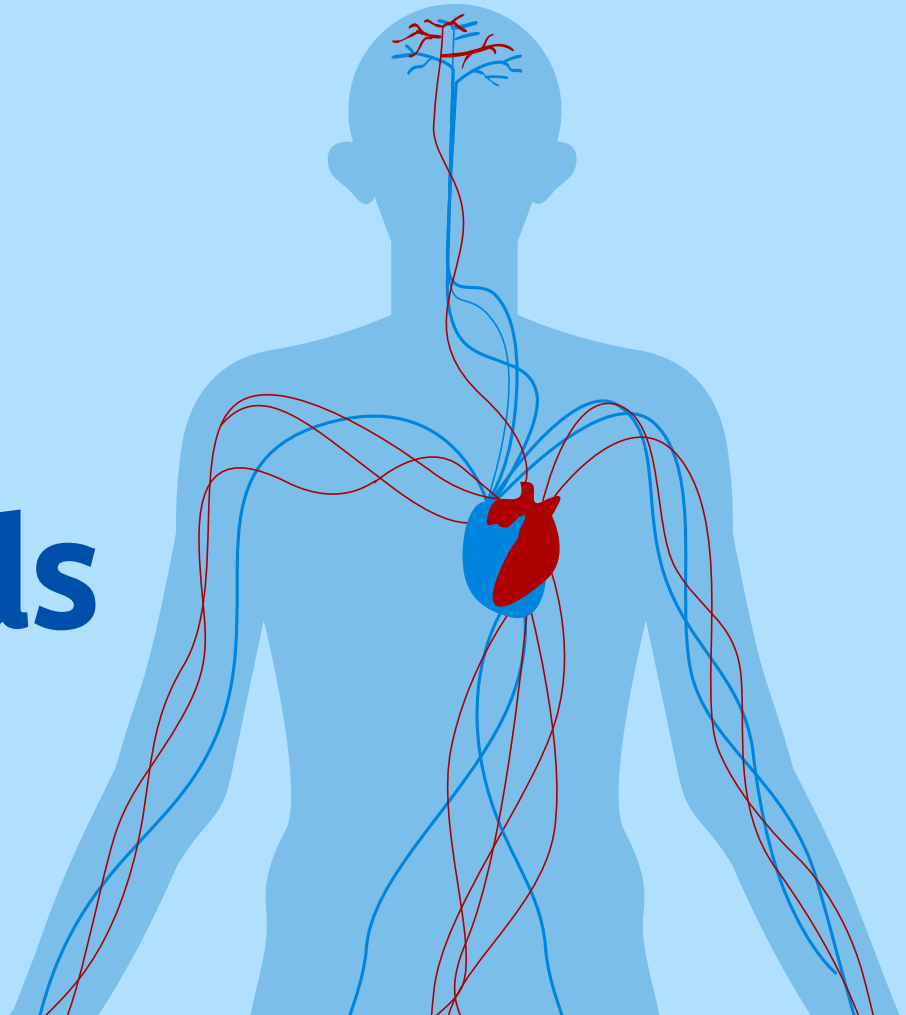
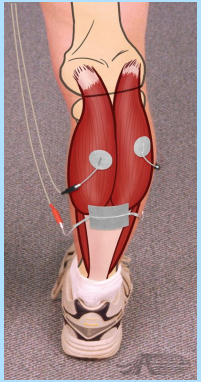
Methods

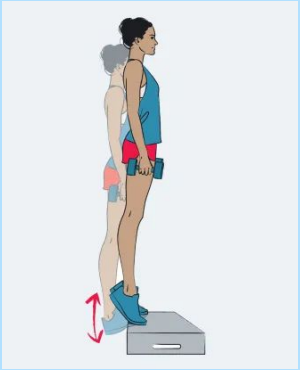


Muscle Force



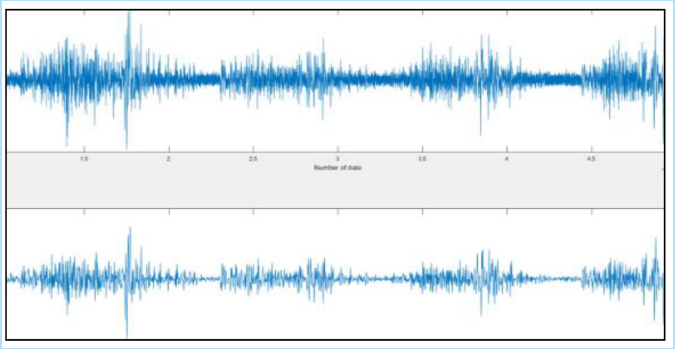
Step 1

Connect the Electrodes to 3 spots on the calf and connect it to a BIOPAC.



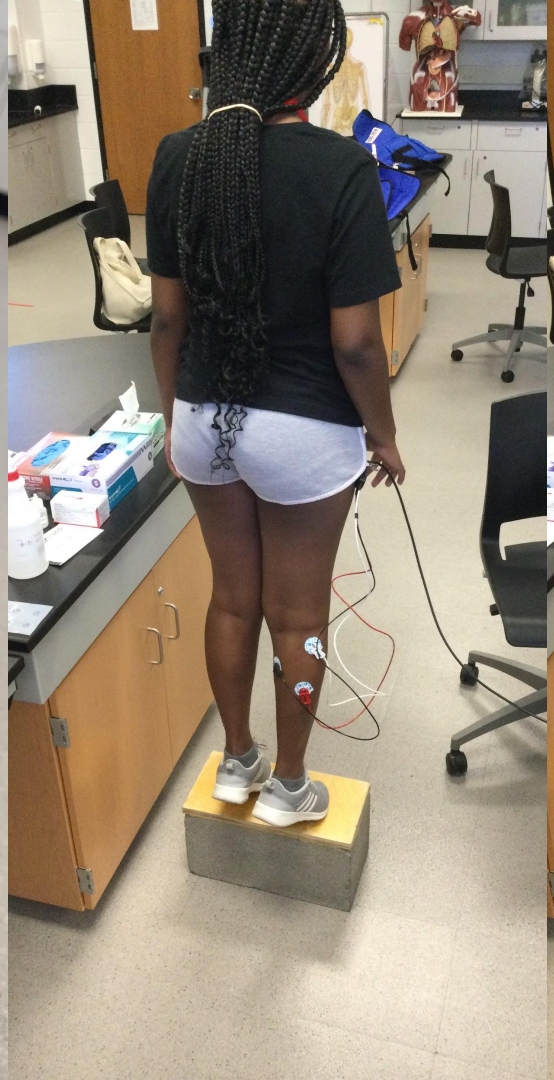
Step 2

Instruct the subject to stand on the cinder block and make the subject do 5 calf raises with and without the vest.



Step 3

Use the recorded EMG (electromyography) to find each subject's maximum muscle force.


BIOPAC


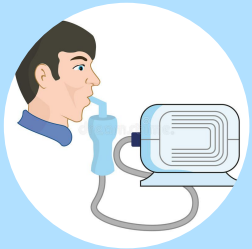

Tidal Volume

STAGE 1

Put together respirometer and breathe naturally

STAGE 3

Subject walks up and down the stairs for 1 minute with no weight
Subject breathes through apparatus for 2 minutes

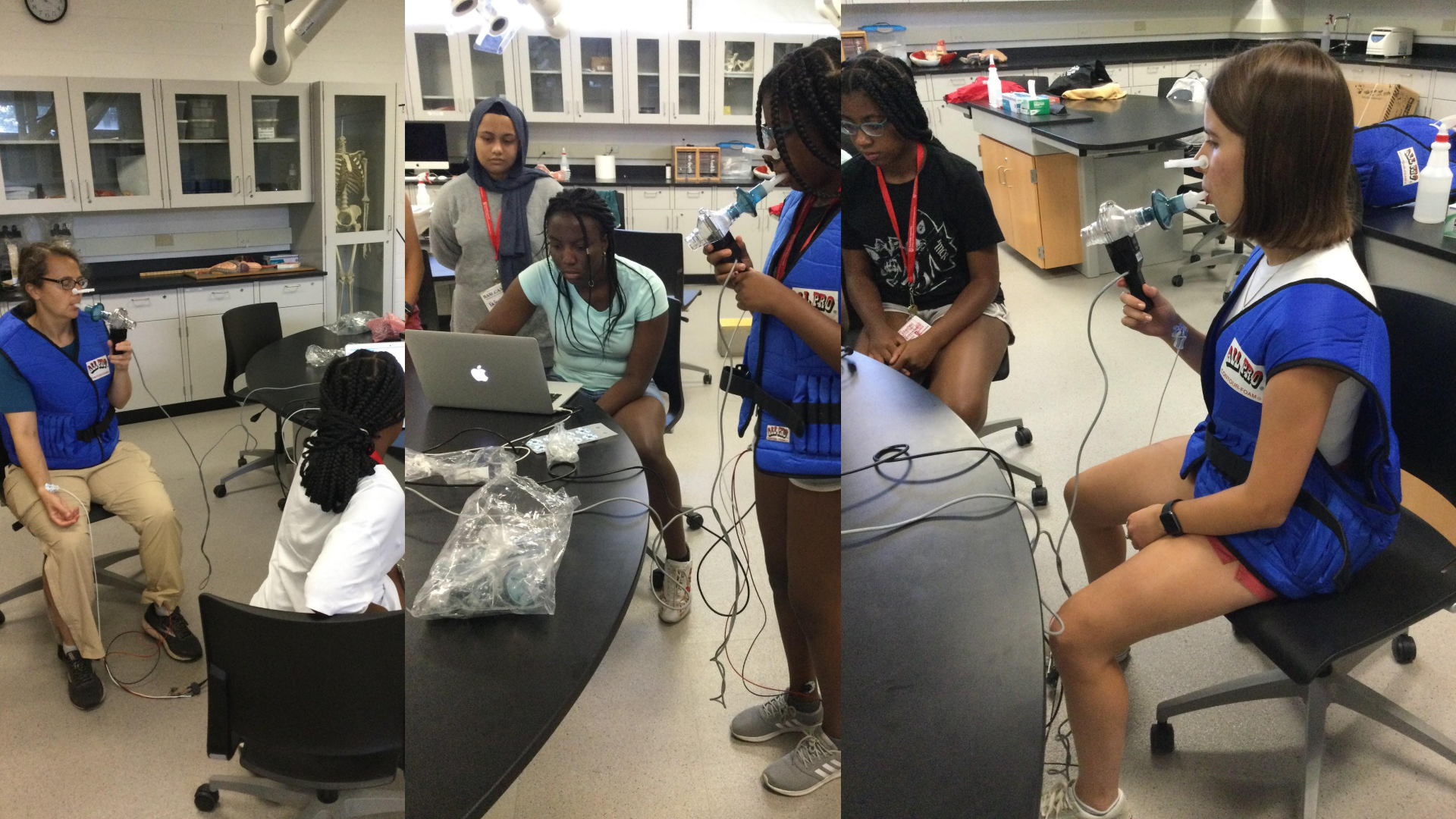


STAGE 2

Calibrate the Biopac while wearing unweighted vest

STAGE 4

Subject walks up and down the stairs for 1 minute with weight
Subject breathes through apparatus for 2 minutes



Heart Rate

STAGE 1

Connect the electrodes to the right wrist, and inner ankles.

STAGE 2

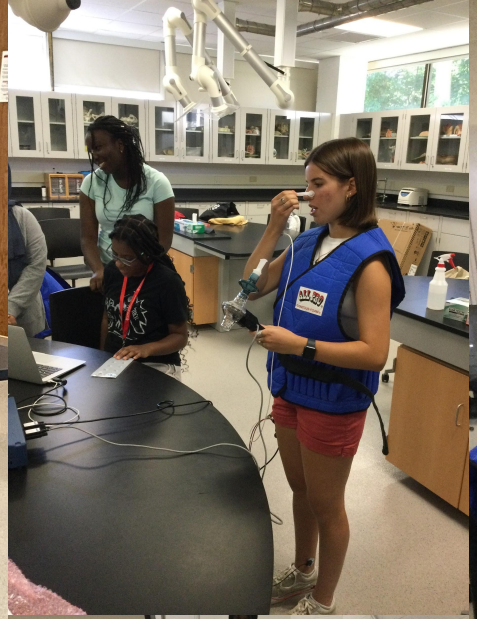
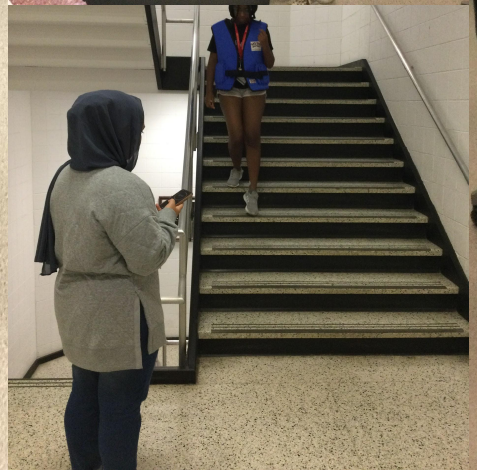
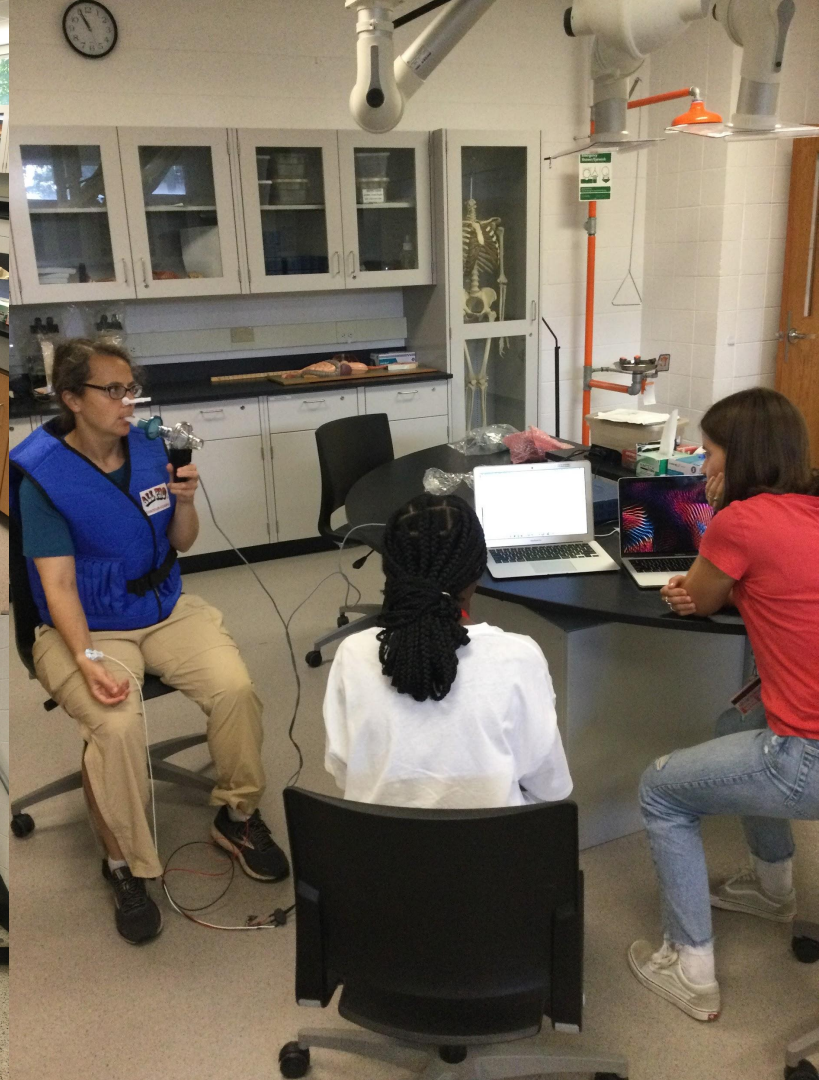
Once electrodes are connected, places the unweighted vest on and walk up and down the stairs for one minute.

STAGE 3

After going up the stairs, sit and rest for two minutes. After resting, put 20 pound weighted vest on.

STAGE 4

Once again, walk up and down the stairs this time with the weighted vest on. After walking, rest again for two minutes.

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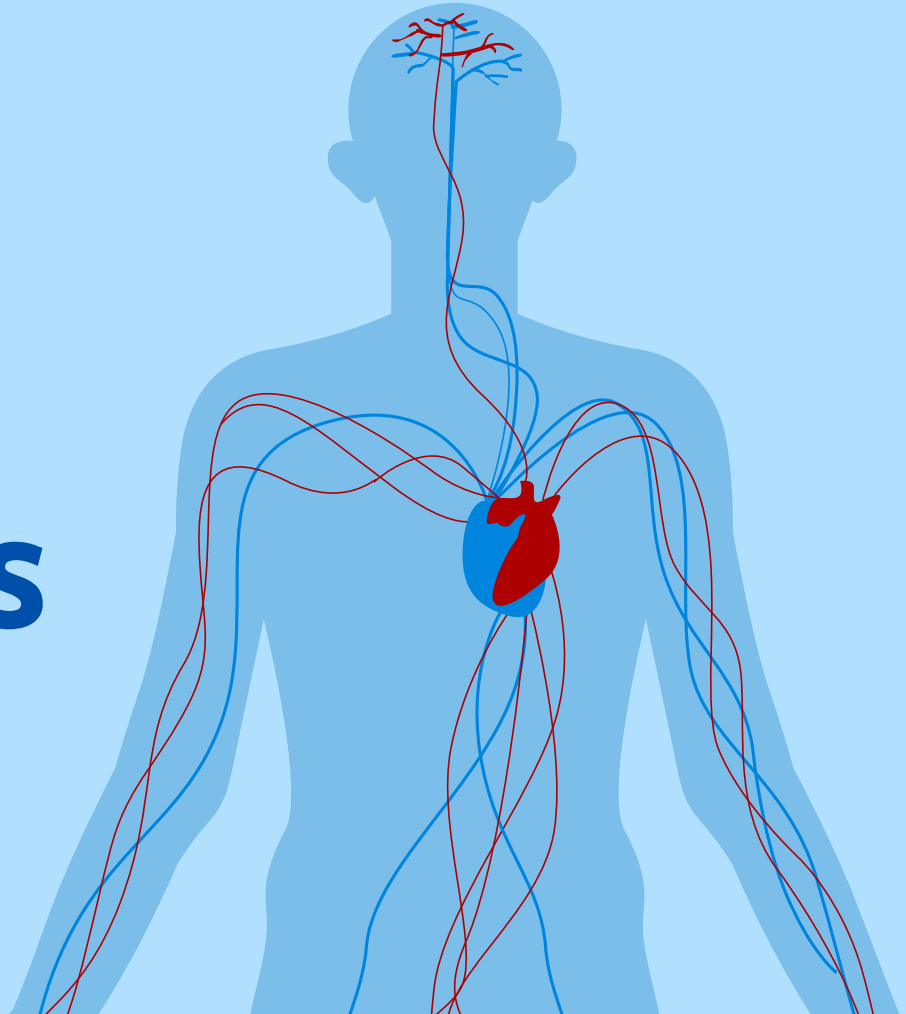
Results



Muscle Force

Mean

Without Weight: **0.813 mV**

With weight: **0.869 mV**

Standard Deviation

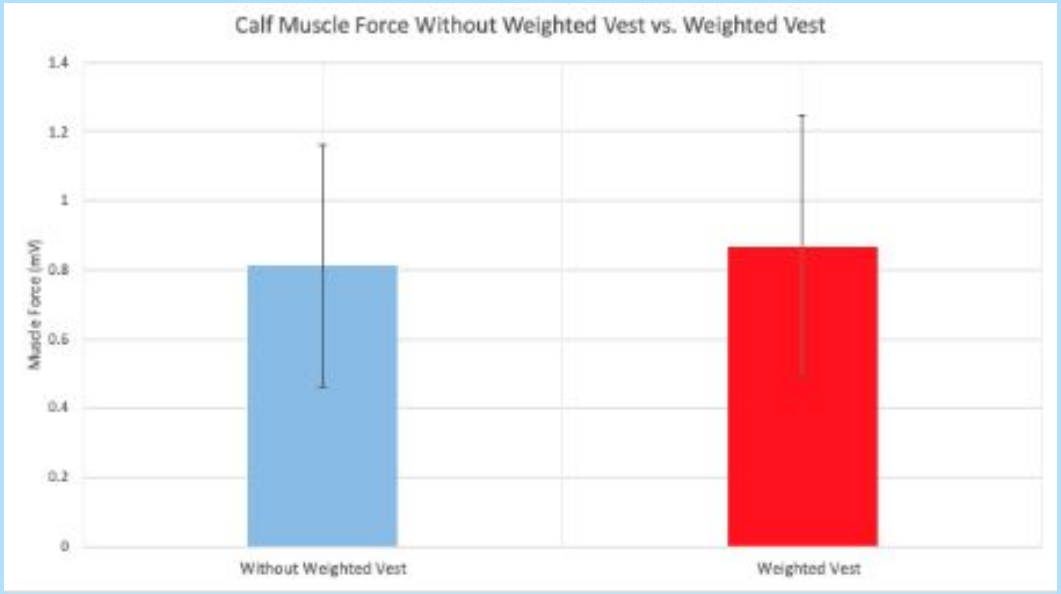
Without Weight: **0.351**

With weight: **0.376**

P–Value

P<.05 (not chance) P>.05 (chance)

0.04839



Tidal Volume

Mean

Without Weight: 1.900 L/sec

With weight: 2.245 L/sec

Standard Deviation

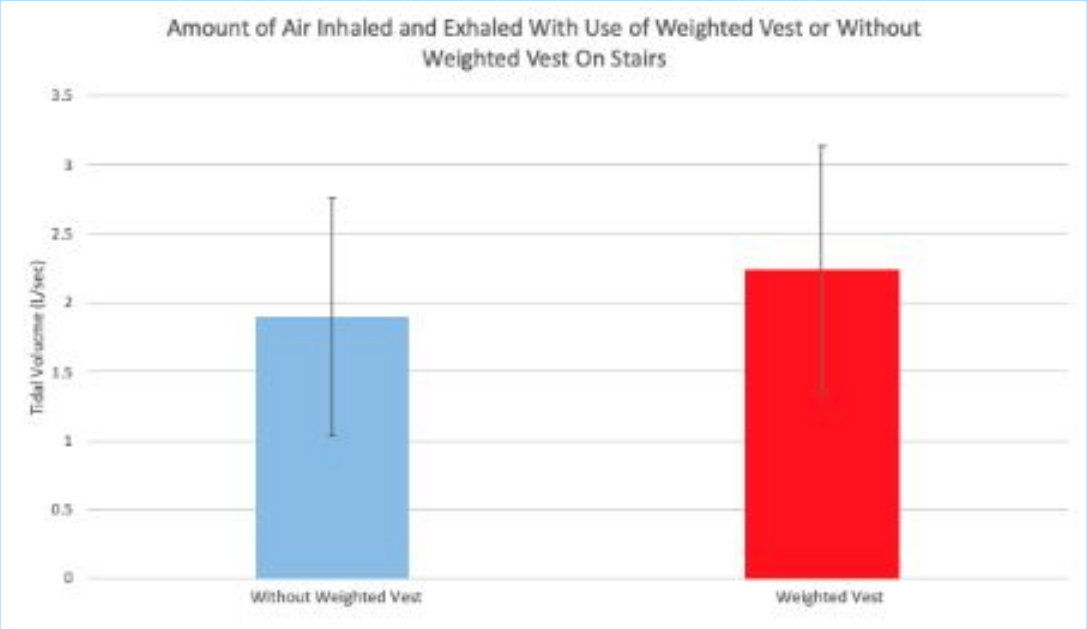
Without Weight: 0.860

With weight: 0.895

P–Value

P<.05 (not chance) P>.05 (chance)

0.0003



Heart Rate

Mean

Without Weight	With weight
99.266 BPM	117.567 BPM

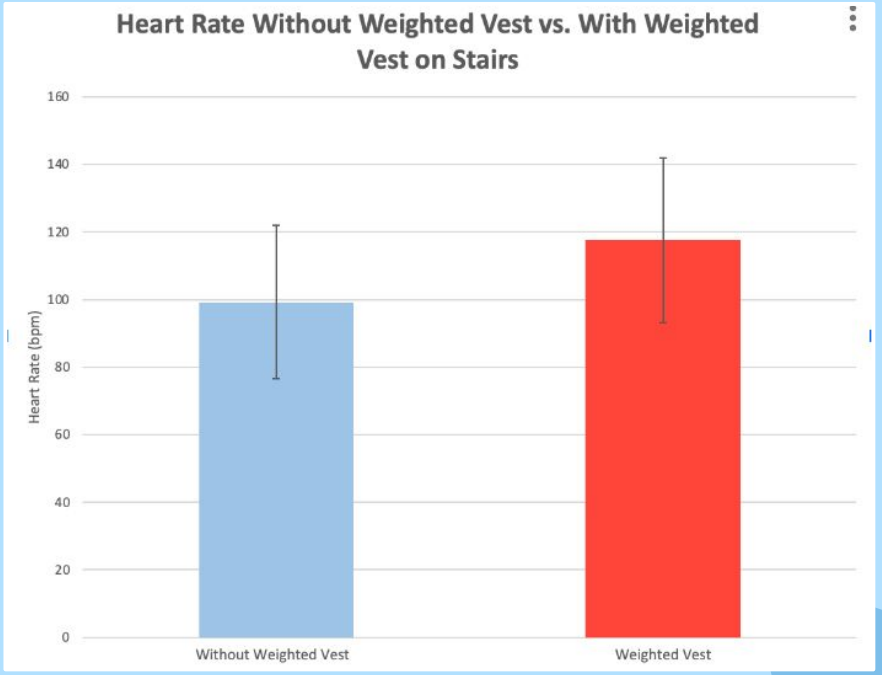
Standard Deviation

Without Weight	With weight
22.651	24.415

P–Value

P<.05 (not chance) P>.05 (chance)

0.00004



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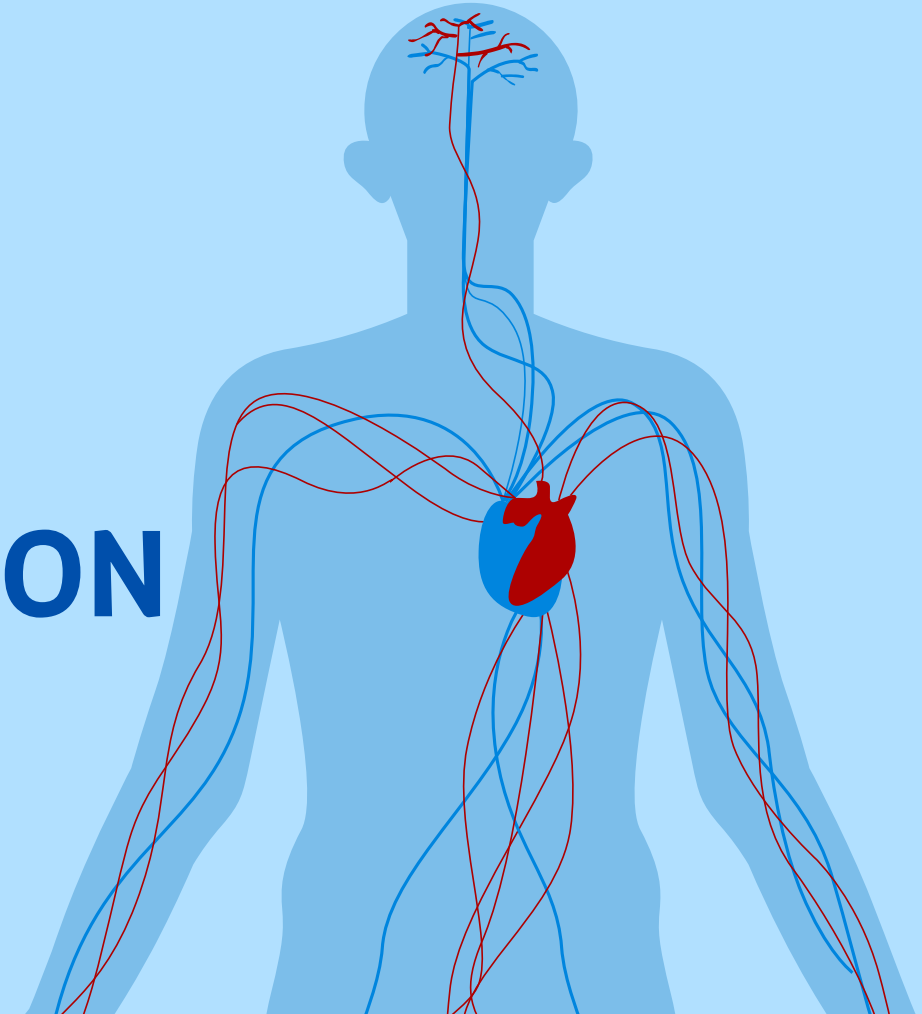
CONCLUSION



Conclusion

Question

Does wearing a backpack up stairs increase calf muscle force, tidal volume, and/or heart rate?

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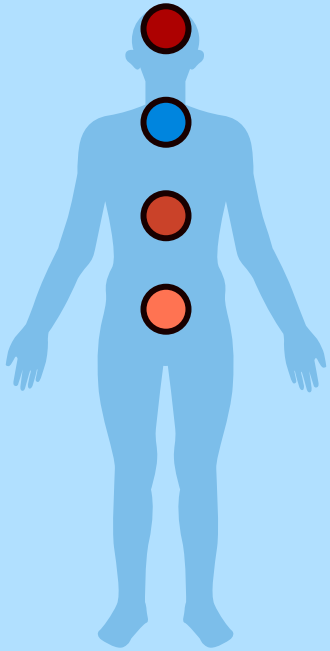
Error

2

- Socks
- Shoes
- Body hair
- Summer v. winter
- Too focused on breathing



How to fix error

3

- Standardized people's shoes
- Disposable socks
- Test during school year

Future experiments

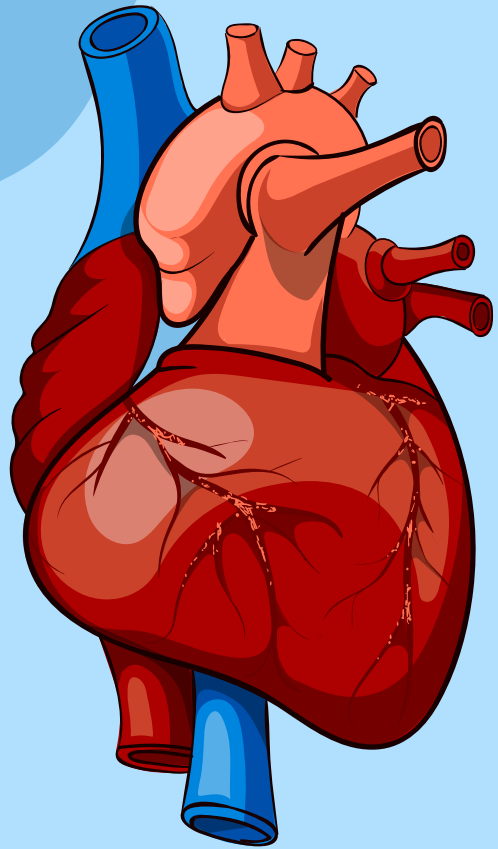
4

- Different muscles to test
- Implications in schools

LITERATURE CITED

https://www.medicinenet.com/what_are_the_four_main_functions_of_the_heart/article.htm

https://www.hopkinsallchildrens.org/Patients-Families/Health-Library/HealthDocNew/Backpack-Safety#:~:text=They%20might%20develop%20lower%20and,proportion%20to%20their%20body%20weight



THANKS!

Thank you to all of the campers for participating, to our TA's, and to our professor.

Do you have any questions?