

Understanding the neuronal controls behind heart rate and respiration

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Abstract:

Students in the course Physiology and Disease at the Illinois Mathematics and Science Academy learn physiology by designing, executing and evaluating their own experiments based on evidence. This semester, students designed laboratory experiments that involved the use of the same type of exercise to increase both heart rate and respiration rate. Students will collect quantitative data from these experiments to make conclusions regarding the correlation of heart rate and respiration rate. This will be followed by student research into the neuronal controls in the brain that were responsible for these correlations.

Introduction:

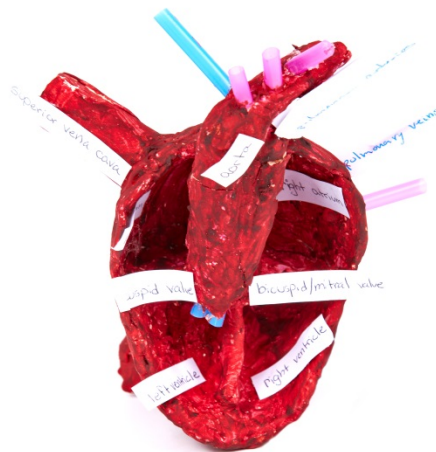
- Physiology and Disease is a one semester Biology elective for juniors and seniors at IMSA, where the students design their own experiments.
- The objective of this experiment was to create a working model of the neuronal controls for heart rate and respiration through experimentation and subsequent research.
- Students performed an activity to increase their heart rate. After completing their activity, students measured their heart rates.
- Students then performed the same activity and measured their lung capacities.
- Research on the neuronal controls for heart rate and respiration will then be conducted and shared by the students.

Materials and methods:

- Students worked in pairs and performed an activity to increase their heart rate.
- Students then repeated the activity to increase their respiration.
- Heart rate was measured manually using the palpation method of the carotid artery.
- Respiration rate was measured using lung volume bags (Ward's Science Item numbers 145051, 145068).



Figure 1: Lung Volume Bag set to measure lung capacity (Ward's Science 145051, 145068, https://www.wardsci.com/store/catalog/product.jsp?catalog_number=145051&sk=1)



Projected Outcomes:

- This project will address the problem of making connections between different body systems and interactions..
- The experiment will be repeated three times by each group for consistency and the data will be analyzed using two-way factorial ANOVA for independent samples (Vassar stats, <http://vassarstats.net/>)
- Together with the results of the blood pressure lab, the results will be used to build a model for understanding the neuronal controls that are responsible for heart rate and respiration. As part of this journey, students will construct accurate life sized heart models.
- Student understanding will be measured through periodic assessments until enough data can be obtained to make a meaningful correlation between the merits of quantitation in physiology and the enhancement of student understanding.



Figure 2: Some examples of heart models constructed by students as part of the heart unit. Students were given 4 weeks and had to get their project design approved before construction. All models were life sized.