# Break a Sweat!

***Measuring your cardiovascular response to exercise***

**Authors:**

 Caleb Bryce (PhD Candidate, Dept of Ecology & Evolutionary Biology, UC Santa Cruz)

 Ben Higgins (PhD Student, Dept of Ecology & Evolutionary Biology, UC Santa Cruz)

 Sarah Baumgart (Health Academy teacher, Watsonville High School, Watsonville, CA)

**Field tested:** 11-12th grade Anatomy & Physiology, Watsonville High, Watsonville,CA

**Module Type:** In-class exercise activity following preparation in class

**Duration:** ~90 min class time, with student exercises potentially completed outside of class

**Key materials:**

* Stopwatch (phone is sufficient)
* Camera (phone is sufficient)
* Laser IR thermometer (optional)
* Heart rate monitor (optional)
* Clipboard & pencil
* Paper with data collection table (project-specific and student-generated)

**Concepts:** Vital Signs, Exercise, Physiology, Training/Conditioning, Cardiovascular, Heart Rate, Target Heart Rate, Respiration Rate, Pulse, Exercise Intensity And Duration

**Skills:** Critical Thinking, Mathematics/Computational Thinking, Experimental Design, Arguing From Evidence

**NGSS DCI:** HS-LS1: From Molecules to Organisms: Structures and Processes.

**NGSS Practices:** Asking Questions; Plan and carrying out investigations; Analyzing and Interpreting data; Constructing explanations; Engaging in argument from evidence

**NGSS CCC:** 2. Cause and Effect; 6. Structure and Function

Overview:

This project is an opportunity for students to learn:

* What basic vital signs are and how to measure how they change with exercise
* How to calculate their target heart rates
* To design their own workout plans based on their target heart rates
* What types of exercise they prefer
* How exercise duration and intensity affect performance

**Navigate:** [Background](#Background) [Materials &Time](#Materials) [Starting Point](#StartingPoint) [Procedures](#Details) [Standards](#Standards) [Supplemental](#Supplemental)

# Background for Teachers

**Why this matters:**

Are all exercises created equal?  Will walking create the same cardiac response as running?  Which is better for me jumping jacks or walking?

Physical activity is associated with numerous health benefits, and even modest levels of physical activity can have measurable health benefits in high-risk youth (e.g., obese; Janssen & Leblanc, 2010; Strong et al., 2005). However, many students remain largely inactive or do not regularly participate in physical activity that they find enjoyable. This module is designed to promote student-specific physical activity as a health promotion and disease-prevention strategy by introducing the concepts of vital signs and target heart rate training. Ideally, students will discover an enjoyable type of exercise and/or learn how to self-assess their cardiovascular responses (i.e. vital signs) to exercise to most effectively train.

**Assumed background:**

Very little assumed background is needed for this module. Students should be familiar with the term “heart rate” and a variety of types of exercise, though the relative health benefits of these will be discussed in the context of target heart rate training.

**Special context:**

This is a broad yet relevant topic that can doesn’t require too much of a “special context” introduction…

**Scaffolding supplements:** If you developed (or can point to) lectures, worksheets, videos, etc. to help with scaffolding this module, list and briefly describe here.

* HigginsBryce\_Sweat\_presentation.pptx: Powerpoint™ that introduces the vital signs and the importance of routine physical activity
* HigginsBryce\_Sweat\_wksht.docx: worksheet that guides students through the data-collection collection process while still allowing them to design their own exercise regime, data table, and graphical output of results

# Module Description

## Materials:

* Stopwatch (phone is sufficient)
* Camera (phone in sufficient)
* Laser IR thermometer (optional)
* Heart rate monitor (optional)
* Clipboard & pencil
* Paper with data collection table (project-specific and student-generated)

## Preparation:

* Students should work with partners or in groups of three maximum

## Timeline:

1. Introduction (Powerpoint on importance of routine physical activity, vital signs, etc) 20 min.
2. Practice taking vital signs in class 8 min.
3. Worksheet for calculating target heart rate 10 min.
4. In-class demonstration of how to conduct the lab 10 min.
5. Inquiry component & experimental design (incl. graphical hypotheses): find 3 exercises to reach/maintain target HR for 5+min 40 min.

## Starting Point For Inquiry:

Most people are familiar with the notion that appropriate diet and regular exercise are essential elements of maintaining health, but perhaps are less familiar with which types and frequencies of exercise are most beneficial on a personal level. This module briefly introduces the health benefits of routine exercise (particularly for youth) and highlights how measuring vital signs (e.g., heart rate) can be key to personalized cardiovascular training success. Students will learn how to measure several basic vital signs without specialized equipment, how to calculate their own target heart rate, and will have the opportunity to choose different types, durations, and intensities of physical activity to reach and maintain their target heart rate for a minimum of 5 minutes.

## Detailed Procedure:

1. Presentation.pptx (Powerpoint on importance of routine physical activity, vital signs, etc) 20 min.
	1. Briefly covers current statistics on inactivity in youth, and the associated health dangers (e.g., obesity, type II diabetes, depression)
	2. Highlights the importance of regular physical activity (60+minutes/day) to maintaining physical and mental health (in this age demographic in particular)…e.g, Strong et al. 2005, Janssen and Leblanc 2010
	3. Introduces vital signs (e.g., respiratory rate, heart rate, body temperature) and their importance for developing individualized physical training programs
2. Practice taking vital signs in class 8 min.
	1. Students learning appropriate techniques and practice taking the following basic vital signs on themselves and one another
		1. Respiratory rate (RR): partner measures RR by recording chest rises/shoulder displacement over a given timeframe (e.g. per 30s or 60s)
		2. Heart/pulse rate (HR): measured with electronic heart rate monitors or by taking the pulse at conventional body sites (e.g., carotid artery, radial artery)
		3. Body temperature (TB): can be assessed quantitatively by laser IR thermometer at a variety of body sites (e.g., ear drum, axillary (under arm), tongue, or forehead) or more qualitatively by feel on the forehead, axillary region, or other sites of interest (e.g., behind knee, distally in fingers) depending on type of exercise
3. Worksheet.docx. Worksheet for calculating target heart rate 10 min.
	1. Attached worksheet provides “fill-in-the-blank” style questions to assist with student calculations of resting HR and RR, as well as equations for calculating their target heart rate range (HRT ) based on their age, HR, and RR
	2. This worksheet guides students through the data-collection collection process while still allowing them to design their own exercise regime, data table, and graphical output of results
4. In-class demonstration of how to conduct the lab 10 min.
	1. Brief in-class demonstration of one or more types of physical activity (e.g., jumping jacks, burpies, pushups, stationary running)
	2. Models how to collect and record vital sign data during exercise, as well as assess whether HRT is reached and maintained
5. Inquiry component & experimental design (incl. graphical hypotheses): find 3 exercises to reach/maintain target HR for 5+min 40 min.
	1. Students are asked to choose (or create) 3 types of exercise that can be performed, without injury, to elicit their desired cardiovascular threshold (e.g., target heart rate)
	2. Students generate *graphical hypotheses* to guide their investigations (e.g., what type of data to collect, what they predict and therefore expect for results)
	3. Students work in pairs or groups of three to perform and record exercise and the associated vital signs as response variables
6. Assessment: Student write up a concise lab report that includes the following:
	1. Introduction explaining the importance of physical activity to achieving health
	2. Calculations of resting HR & RR as well as HRT range
	3. Graphical hypotheses for predicted results following data collection
	4. Description of the type, duration, and intensity of the three physical activities chosen
	5. Subjective description of how difficult or enjoyable each type of exercise was, and whether the student plans to engage in any of these activities long-term as a result of the project
	6. \*\* Students must provide photographic evidence of themselves actually performing the exercises they describe in their report\*\*

## Assessment Methods:

Projects will be evaluated on the basis of understanding the assignment and its goals, clarity of writing, correctly calculated HRT, and description of the exercises chosen, how they were performed, and how likely they are to be used routinely in the future. Students must provide photographic evidence of performing each exercise as described in their report.

## Possible pitfalls:

The unlikely risk of injury exists in this physical activity project assignment, so the instructor must convey that any activity that causes excessive pain or impact to the body should be discontinued. Students with known medical issues are encouraged to privately speak with the instructor prior to exercise in order to brainstorm medically-safe alternatives should they be needed (e.g., a longer written report about the health benefits of regular and enjoyable activity may substitute the assigned physical activity itself). Providing photographic proof of each student performing his/her three chosen exercises will hopefully circumvent the pitfall of students not actually completing the exercise portion of the assignment.

## Glossary:

**vital signs**: measurements of the body’s most basic functions. The four traditional vital signs are body temperature, pulse rate, respiration rate, and blood pressure.

**exercise**: any bodily activity that maintains or enhances physical fitness and overall health/wellness

**physiology**: a sub-discipline of biology that deals with the normal functioning of living organisms and their parts (more simply, the study of how the body functions)

**training/conditioning**: the development of physical fitness through the adaptation of the body and its various systems to an exercise program

**cardiovascular**: pertaining to a body’s circulatory system (heart & associated blood vessels), which carries nutrients and O2 to the tissues while carrying away CO2 and other waste products

**heart rate (HR)**: the speed of the heartbeat as measured by the number of times the heart beats per unit time (usually beats per minute (bpm))

**target heart rate (HRT**) **zone**: the range of heart rates (typically 60-80% HRMax) to train within for optimized cardiovascular fitness. Deriving this individualized zone is based on age and % effort and assumes that maximum physical fitness is achieved withi exercise levels between 60 and 80% HRMax.

**respiration rate (RR**): the number of breaths taken per unit time (usually breaths per minute)

**pulse**: a measure of heart rate (the number of times the heart beats in a given unit of time). Pulse (aka pulse rate) can indicate heart rhythm and the strength of the pulse in addition to heart rate.

**exercise intensity**: the relative level of physical exertion associated with a given exercise

**exercise duration**: the length of time that an exercises is sustained

# NGSS Standards Addressed

**Disciplinary Core Ideas**

HS-LS1 from Molecules to Organisms: Structures and Processes

 LS1.A. Structure and function

**Science & Engineering Practices**

Asking questions

Planning and carrying out investigations

Analyzing and interpreting data

Constructing explanations

Engaging in an argument from evidence

**Cross Cutting Concepts**

2. Cause and effect

6. Structure and function

# Guide to supplemental materials

**Lectures:** BreakASweat.pptx: IntroductoryPowerpoint™ covering the importance of routine physical activity, vital signs, etc

**Worksheets** Worksheet.docx: worksheet that guides students through the data-collection collection process while still allowing them to design their own exercise regime, data table, and graphical output of results

Filename: HigginsBryce\_Sweat\_wksht.docx

**References**

Janssen, I., and A. G. Leblanc. 2010. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. T*he International Journal of Behavioral Nutrition and Physical Activity* 7:40.

Strong, W. B., R. M. Malina, C. J. R. Blimkie, S. R. Daniels, R. K. Dishman, B. Gutin, A. C. Hergenroeder, A. Must, P. a Nixon, J. M. Pivarnik, T. Rowland, S. Trost, and F. Trudeau. 2005. Evidence based physical activity for school-age youth. *The Journal of Pediatrics* 146:732–737.