Correlating Exercise and Heart Rate
Lesson Plan

Subject Area: Science and Health/PE

Grade Levels: The lesson can be adapted for grades 4–12 (ages 9–18).

Time: At least one 50-minute class period; time outside of class as necessary

Lesson Objectives:
Students will:
• Investigate the correlation between performance of the cardiovascular system, exercise, and other lifestyle choices.
• Build data literacy skills by creating dynamic, visual plots.
• Explain their findings in writing and visual slide shows.

Standards:
National Science Education Standards¹:
Science as Inquiry – Content Standard A
All students should develop
• Abilities necessary to do scientific inquiry.
Science in Personal and Social Perspectives – Content Standard G
All students should develop understanding of
• Personal and community health.

Common Core State Standards²:
Common Core State Standards for Mathematics:
Mathematical Practices
• Make sense of problems and persevere in solving them.
• Use appropriate tools strategically.
Measurement and Data
• Represent and interpret data.
Statistics and Probability
• Summarize and describe distributions.

College and Career Readiness Anchor Standards for Writing:
Standard 6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

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Overview:
According to the American Heart Association, a person’s maximum heart rate is about 220 beats per minute (bpm) minus his or her age, or slightly over 200 beats per minute for the average grade 4–12 student. The target for exercise is 50 to 75% of the maximum rate, or 100 to 150 beats per minute. It is recommended that people of all ages get at least 30 minutes of exercise each day at their target heart rate, but how many students do? What are the implications for heart health? What other factors might be contributing to heart health? In this lesson, students will use InspireData to collect heart-rate data and look for correlations with visual plots, explaining their findings in annotated slide shows. The ability to visualize correlations between cardiovascular performance and lifestyle choices helps students to understand and remember the impacts of activities like exercise, in addition to building essential data literacy skills.
Preparation:
- This lesson requires the InspireData® software application published by Inspiration Software, Inc. You can download a 30-day trial at http://www.inspiration.com/InspireData.
- Have stopwatches available (enough to have one for every two to three students) or student smartphones with stopwatch apps.

Lesson:
1. As a literal warm-up to the lesson, have students stand up, and ask for a volunteer to lead the class in one or two minutes of vigorous exercise. The leader can choose jumping jacks, running in place, an enthusiastic game of “Simon Says,” or anything else that can be done in place safely. After the exercise, ask students what happened to their heart rate: did it increase dramatically, or hardly at all? Explain that today they will be exploring heart rate and factors that can influence it.

2. Open the Signs of a Healthy Heart database:
   InspireData Starter>Databases>
   Science>Signs of a Healthy Heart.

3. Examine the data contained in the Sample Data With Plots tab to show students the type of table they will be building. Explain to the class that each student will take his or her own pulse at three intervals. They will use these measurements to build a database on the students' resting heart rates, working heart rates, and recovery heart rates, in addition to survey questions about exercise and lifestyle choices.
4. Select the **Database Template** tab and explain that students will be working with a partner to gather and analyze their own data. Data may be entered directly into the table or by using either the **Survey** or **e-Survey** tools. For this activity, an e-Survey is ideal if Internet connectivity is available because it allows data to be entered into one database from multiple computers simultaneously. For more information, refer to the “Learn to Use Surveys” handout: **InspireData Starter>Learn to Use>Documentation>Handouts>Learn to Use Surveys.**

5. Demonstrate for students how to launch the **e-Survey** tool and enter data. For example, demonstrate how students will use a stopwatch to time their heart rates. Ask for two volunteers, and instruct one of the students to take the other’s pulse for 15 seconds at rest, and multiply that number by 4 to arrive at the total heartbeats per minute (bpm). The student who did the timing can then record the result in the Resting HR (bpm) field. The name of the student could also be added, or if confidentiality is a concern, students can use preassigned or random numbers instead of their names.
6. Explain that to gather data for the Working HR field students will run vigorously in place for 2 minutes. After they stop, they should have their partner count their pulse for 15 seconds and follow the same procedure explained above to calculate the total bpm. Tell students that recovery HR should be recorded after 5 minutes of rest using the same procedure.

7. Divide students into pairs to complete the data collection. Circulate outside among the students, answering questions as they arise.

8. Once all students have entered their data, reconvene the class and demonstrate for students how the data in the e-Survey tool can be downloaded from the InspireData Starter.
9. Demonstrate how to click the **Plot View** button on the **Toolbar** to switch to **Plot View** and analyze the data. Your demonstration should include how to select plot types via the buttons on the **Toolbar**. As you show students how to create plots, they should develop an understanding of how they can be used to answer Possible Investigations such as those listed in the table notes of the *Signs of a Healthy Heart* database. Demonstrate how to define the $x/y$ axes in the plots (e.g., using the **Stack plot** tool, click on **X Axis** and choose a field such as Resting HR), and tell students that they should create at least one plot that will address each question.

10. Demonstrate for students how to record explanations of plots and answers to the questions in the **Notes** area at the bottom of the screen. Click on in the lower right to open the area. Be sure to show students how to capture a slide for each plot, including their notes, by clicking the **Slide Sorter** button and then the **Capture Slide** button.
11. Have one or more student teams share their slide shows, including their analyses of the data, with the class.

12. Conclude with a class discussion of the results and questions such as those listed below. If students are unsure of the answers, do a follow-up analysis of the data as a class to try to answer them.

- A middle school student’s target working heart rate should fall between 100 to 150 beats per minute. How closely does the class data align with that target?
- Is there a difference between the data for males and females?
- What is the relationship between the students who get the most exercise and the differences between their resting and recovery heart rates? Is there a correlation between the hours of exercise and working heart rate?
Adaptations/Extensions:

- Students can add to the database by recording the pulse rates of schoolmates, siblings, and adults and entering this data in the InspireData table. Do the patterns shift with the addition of the new data? Does the average heart rate for adults differ from the student average?
- Students may add additional fields, such as those asking about specific sports, to the database to see if there is a correlation between participation in a particular sport and heart rate.
- For older or more advanced students, provide less detailed plotting and analysis instructions.
- For younger or beginning students, gather and analyze more of the data as a whole class, at least until students understand the process.
- Students can use Inspiration® or Kidspiration® to record their observations and conclusions about the correlation between heart health and exercise, and the amount of time spent in sedentary activities such as watching TV and playing video games.
- Students can enhance their plots by adding other InspireData features and computations. Pass out the “Learn to Use Plots” handout in InspireData for student reference (Help>Documentation>Handouts>Learn to Use Plots).