**Carbohydrate Consumption, Athletic Performance and Health**

**– Using Science Process Skills to Understand the Evidence[[1]](#endnote-1)**

**I. Can athletic performance be improved by consuming carbohydrates during sports events? How do we know?**

To begin, you will design an experiment to test the following hypothesis:

Athletes who compete in high intensity sports events that last at least an hour can improve their performance by consuming small amounts of carbohydrates several times an hour during the sports event.

Answer questions 1-5 to describe your experiment.

Hint: To test a hypothesis that an independent variable (e.g. carbohydrate consumption) has an effect on a dependent variable (e.g. athletic performance), you can test the same group of participants at two different times under identical conditions except for a difference in the independent variable.

1. Who will participate in your experiment? What will they do and for how long?

2. What will your independent variable be? How will you vary the independent variable to test the hypothesis?

3. What will your dependent variable be? What will you measure to evaluate your dependent variable?

4. Briefly describe the sequence of steps you will include in your experiment to test the hypothesis.

5. What results from your experiment would support the hypothesis?

 What results would provide evidence against the hypothesis?

A research study to test the effects of carbohydrate consumption during high-intensity, long-duration physical activity had ten physically active college-age men and women participate in practice sessions, followed by two experimental trials on different days. During each trial, the participant engaged in an hour of vigorous physical activity; each 15-minute period in this hour included running, jumping, a sprint, and a motor skills test. After the hour of vigorous activity, the participant ran for as long as he or she could maintain a specified very fast pace.

During one trial the participant drank sports drink that contained carbohydrates and some salt, and during the other trial the participant drank a flavored water placebo which tasted the same as the sports drink. Half the participants drank sports drink during their first trial and half drank placebo during their first trial. Neither the participant nor the person who tested athletic performance knew which drink the participant was consuming in each trial.

The researchers compared the study participants' performance in the trials when they drank sports drink versus placebo. For the first three 15-minute periods of the hour of vigorous physical activity, athletic performance was similar for the sports drink and placebo trials. During the fourth 15-minute period, the participants took less time to complete the sprint and the motor skills test during the sports drink trials. After the hour of vigorous physical activity, the subjects could keep up a very fast running pace for longer in the sports drink trials.

6. What was the independent variable in this experiment?

7. How was the dependent variable measured in this experiment?

8. What conclusions are supported by the results of this experiment?

9. Compare the experimental design for this research study vs. your experiment. Describe at least one advantage of the experimental design for the research study and explain how each advantage contributes to greater confidence in conclusions about the effects of carbohydrate consumption on athletic performance.

**II. Do low-carbohydrate, high-protein diets have harmful effects on health? What is the evidence?**

*Read* the article "Low carb, high protein diets linked to women's heart disease" on p 5 and then answer questions 10-14.

To answer these questions, you will need to distinguish between two basic kinds of studies:

* experimental studies in which the researcher actively controls the conditions for the participants in the study; all variables should be the same for the different groups of participants or different trials, except for one experimental variable that differs between the groups or trials; this allows the researcher to evaluate the causal effect of the experimental variable (the independent variable) on the outcome (the dependent variable).
* observational studies in which the researcher observes people or nature as they are without making any changes; observational studies allow the researcher to identify associations or correlations between variables, but observational studies cannot demonstrate causal effects because it is impossible to fully control for possible confounding factors. For example, women who eat low-carbohydrate diets may have other risky behaviors such as eating unhealthy types of fats and smoking, and these other risky behaviors could be the cause of any health problems these women may have.

10. Is the study described in the article an experimental study or observational study? Explain your reasoning.

11. Briefly state the hypothesis that the researchers tested in this study.

12. Summarize the results of this study.

13. Briefly describe an experimental study that could test the hypothesis that low-carbohydrate, high-protein diets increase the risk of heart disease.

What would be one advantage of doing an experimental study instead of an observational study?

13 (continued). Why do you think that the researchers decided to do an observational study instead of an experimental study?

14. State two reasons why the findings from the observational study described in the article you read cannot be used to definitely conclude that low-carbohydrate, high-protein diets cause increased risk of heart disease or cardiovascular disease.

**III. Understanding the Scientific Method**

15. The previous questions illustrate that the process of science is more complicated than the typical textbook description of the scientific method. Based on this information, revise the following diagram of the scientific method to make it more accurate, complete and realistic.



(Figure from <http://static.ddmcdn.com/gif/scientific-method-17.jpg>)



Posted by John Bonifeld - CNN Medical Producer

Available at <http://thechart.blogs.cnn.com/2012/06/27/atkins-style-diets-linked-to-womens-heart-disease/>

Note: "Cardio" refers to the heart and "vascular" refers to blood vessels, so cardiovascular disease includes diseases of the heart and blood vessels. Heart disease is the main type of cardiovascular disease, but cardiovascular disease also includes stroke (due to damaged blood vessels in the brain) and some other smaller categories.

1. This activity was written by Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania, © 2012. Teachers are encouraged to copy this Student Handout for classroom use. A Word file (which can be used to prepare a modified version if desired), Teacher Notes, and comments are available at <http://serendipstudio.org/exchange/bioactivities/sciproc>. [↑](#endnote-ref-1)