

STUDENT GUIDE

EXPLORE 1B LESSON 17



Part 1: Our Motivation

Record what we were trying to figure out that led to this investigation.

We were trying to figure out why we breathe faster during exercise. We were able to confirm that we do breathe in more oxygen during high-intensity exercise than at rest.

We have a related question about carbon dioxide: Do we exhale more carbon dioxide during high-intensity exercise than at rest? This seems like a logical next question to answer. If we can confirm an answer, it would help us to look at questions about energy later.



Part 2: Planning and Carrying Out an Investigation

Make a claim to predict the relationship between the amount of carbon dioxide exhaled and high-intensity exercise vs. rest.

The amount of carbon dioxide exhaled increases during high-intensity exercise vs rest.

Plan an investigation to test your claim. Use the Lesson 17 Experiment Design Tips handout as a supplement to help you design your investigation.

Materials Available:

Bromothymol Blue Indicator	3 transparent cups or flasks	Straws	Timer (accuracy to seconds)
----------------------------	------------------------------	--------	-----------------------------

For this investigation, the independent variable is the amount of exercise done, and I will be measuring to see if these affect the dependent variable, which is the amount of carbon dioxide. This will be indicated by the color of the indicator. I can measure if carbon dioxide is what I breathe out using the BTB chemical. If carbon dioxide is present, it goes from a blue color to more of a green-yellow color.

A couple of variables I am controlling are the time and intensity I breathe into each cup, covering the cup to limit exposure to outside air, and carefully measuring materials to keep conditions as similar as possible between the three cups. I will use a control group to make sure my results are sound. This will be a cup with an indicator in it that I do not blow any air into. I will look for the color differences between the three cups. I can compare the colors of the rest cup to the intense workout cup and both to the color of the control cup. This will tell me if rest or intense exercise made a change to the color of the BTB compared to the control.

I will note my observations, and I could also take pictures of the cups to more-accurately show the colors after the lab has been completed. If anything changes during the procedure, I will write it down on my paper.

After you have created your first draft of your experimental design, reflect on how well you think it meets the goals of the investigation:

- Will your investigation be able to fully evaluate the claim you made?
- Did you eliminate all confounding variables? What other confounding variables may be present that you did not consider?

Revise your experimental design as necessary to be confident you are achieving the purpose of the investigation and that you are eliminating confounding variables.

My investigation should be able to answer if I breathe out carbon dioxide and if I breathe out more of it after high-intensity exercise because I used a control to compare my results to and I tried to control confounding variables.

I think I am eliminating the major confounding variables by covering the cups when not blowing into them and following the exact same procedure for both. There could be small differences in the amounts of materials, but I will do my best to measure carefully.

Analyze the data you have collected. Does this data support the claim you made in Part 1? Support your answer with evidence from the data that you gathered.

We breathe out more carbon dioxide during high-intensity exercise than at rest. Our data supports this claim. We can see that the colors for the start and after blowing bubbles for rest and intense exercise are similar. However, it took about $\frac{1}{2}$ of the time (amount of air) for the exercise sample to get to the same color of green as the control cup. (I thought the water would eventually turn clear, but after 15 seconds of blowing bubbles, it stayed the same shade of light green. So, I decided to change the procedure a little and time how long it took the exercise cup to turn the same shade of green.

From comparing the colors of the samples to the result indicator colors, as more carbon dioxide is added to the mixture, it turns from blue toward green and greenish-yellow.

Be prepared to share the claims you made and the evidence you used to support your claim with your peers. Record similarities and differences in your findings below.

We all saw that the amount of carbon dioxide produced was greater during high-intensity exercise than at rest. There were some variations in the colors in our data, but they still indicate the same thing.



Part 3: Constructing Explanations

Use the findings from your investigation to construct an explanation to the Module Questions, *Why are there so many changes to my body during exercise? How does milk help with recovery from these changes?*

To bring air into and out of the body, we have to breathe. If we are producing more carbon dioxide during exercise, we have to breathe more often to get it out of our body. The faster we breathe, the more carbon dioxide we have to exhale.

I know that we need oxygen in our blood. If we are breathing faster, then we are also bringing in more oxygen. The heart pumps blood, so if there is more oxygen in the blood and it needs to get to our brain or muscles, the heart would need to pump faster to get it to those places quicker.

We aren't really sure yet what the increases in oxygen and carbon dioxide consumption would have to do with muscles burning and fatiguing or how milk helps in recovery.