frontiers FOR YOUNG MINDS

HEALTH
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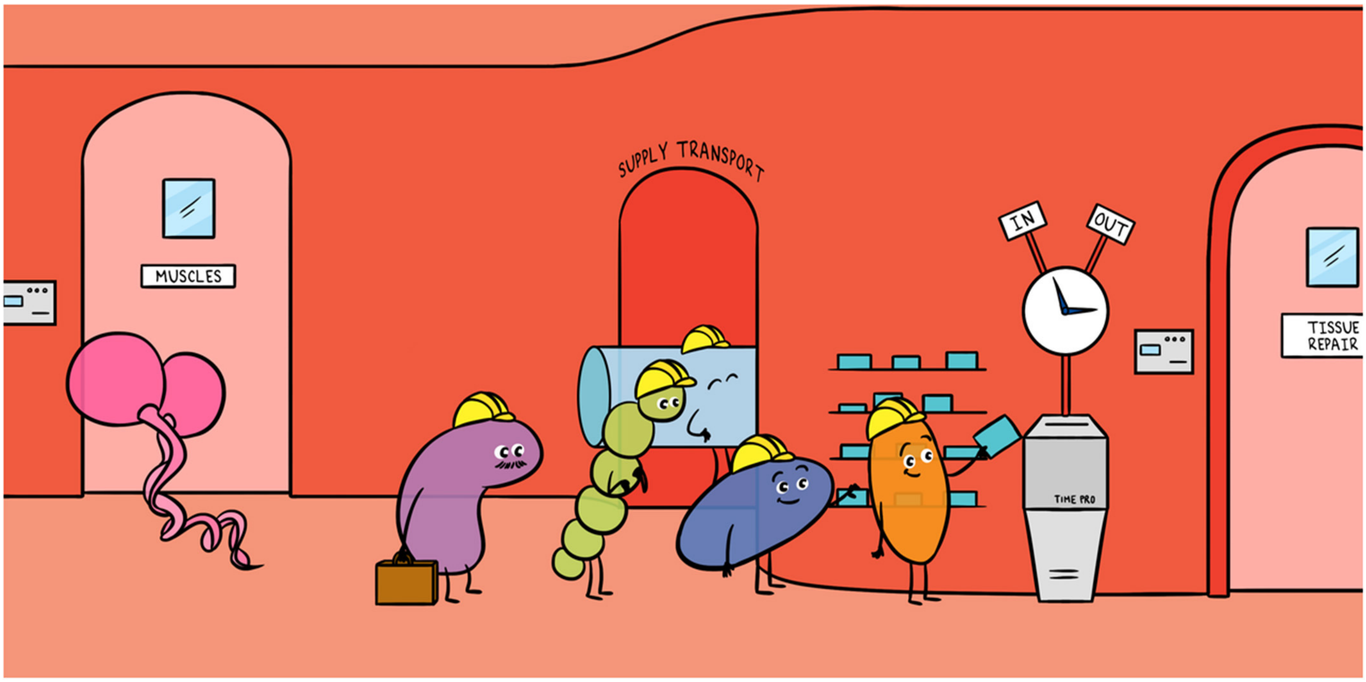

PROTEIN—NOT JUST A FOOD GROUP!

Stephanie Batalis * ***and Thomas Hollis***

Wake Forest School of Medicine, Winston-Salem, NC, United States

YOUNG REVIEWERS:

ALEXA
AGE: 11

LUKE
AGE: 10

Eating protein is important to help us grow strong and stay healthy. However, protein is more than just a food group! Proteins are the workers inside of our busy cells. These proteins have some amazing jobs to do, and thousands of proteins work together every day to keep our bodies healthy. In this article, we will discuss how proteins are made and why we need protein to keep our bodies running smoothly.

You have probably heard an adult in your life tell you that protein is brain food or say something like, "Eating protein makes you strong!" Protein is an important part of our diets. There is even a section on the food pyramid called "Protein," full of meat, beans, peanut butter, and eggs. Protein is all around us, but do you know what a protein is? Are proteins only found in the foods we eat? Why do we need to eat protein to stay healthy?

WHAT IS A PROTEIN?

You may already know that your body is made up of trillions of smaller units called cells. Each cell is like a tiny factory. Inside these factories,

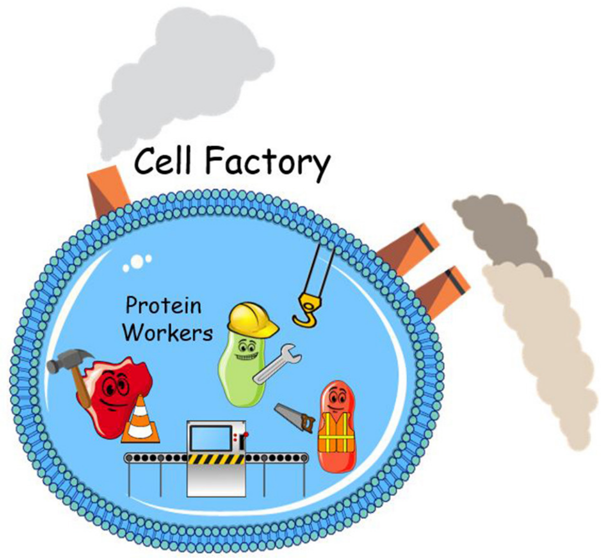

Figure 1

Figure 1

Proteins are the workers inside your cells. Cells are very busy places! They have lots of jobs to do to keep your body healthy. Cells are kind of like factories, and proteins are like the workers that do the important jobs inside the cells.

cells are hard at work doing everything your body needs to stay healthy. For example, cells can turn the food you eat into energy, protect you from germs, and send signals from your brain to the rest of your body. These are just a few of the hundreds of jobs that your cells are doing every second of the day! These action-packed cells are very busy places. Luckily, factories and cells both have workers to get the jobs done.

PROTEINS

Molecules that act as "workers," doing the various jobs inside cells.

Proteins are the workers inside of cells (Figure 1). Every protein has its own special job to do [1]. These jobs are what keep cells running smoothly. Some proteins move around inside the cell. Some proteins grab on to other proteins. Some proteins are even like shapeshifters—they can change size and shape to do their jobs! These thousands of proteins all work together to power those busy cells. Each and every one of these proteins makes the factory run and keeps your body healthy.

HOW ARE PROTEINS MADE?

Imagine using a pile of building blocks, like Legos®, to build a castle. You can follow the instructions to build a tower, or you can make your own design. You can even combine the blocks in different ways to make a car or a bridge. It is up to your imagination—one set of building blocks can be used in a million different ways!

AMINO ACIDS

The basic building blocks that make up proteins.

The cells in your body do not build towers out of blocks, but they do build proteins out of **amino acids**. Just like Legos® are the building blocks for your castle, amino acids are the building blocks for your proteins (Figure 2). The same basic set of amino acids can be combined to make lots of different proteins. Cells learn how to combine the

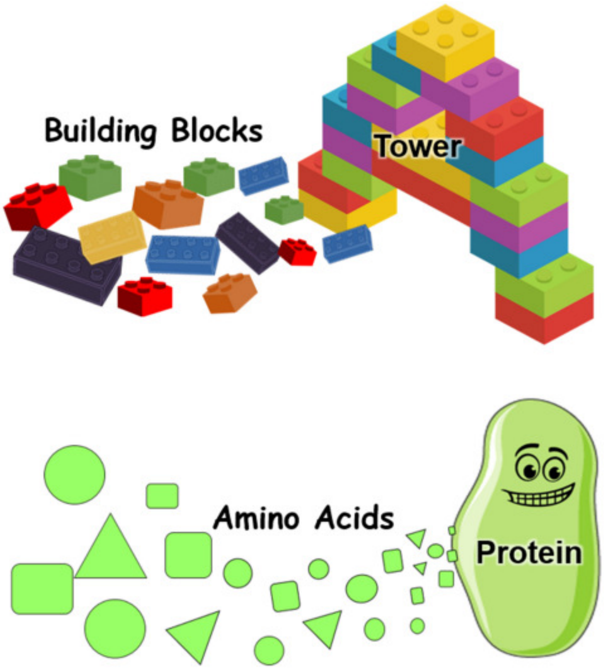

Figure 2

Figure 2

Proteins are made of amino acids. Proteins are made by combining amino acids in a certain pattern. This is kind of like making a tower by combining Legos®. The basic amino acid building blocks can be combined in many ways to make different proteins.

amino acids into proteins by following an instruction manual called the **DNA code**. The DNA code tells the cell how to combine amino acids in the correct order. Special machinery inside the cell reads the DNA code and uses it to combine amino acids into a pattern. The pattern of amino acids is what gives the protein its unique shape and size, just like your pattern of Legos® makes a unique shape. The end result is a protein ready to do one of the many interesting jobs inside the cell.

DNA CODE

Information that acts like an instruction book, telling the cellular machinery how to combine amino acids into proteins.

SOME PROTEINS USE MOVEMENT TO DO THEIR JOBS

Have you ever thought about what makes your muscles move? Your brain tells your muscles to move, but your muscles need help to spring into action. This help comes from an important protein called **myosin**. Myosin is an example of a protein that uses movement to do its job (Figure 3A) [2]. Myosin has just the right shape to grab onto your muscle. Then, the myosin protein holds tight and pulls hard on the muscle. When enough myosin proteins are working together, this pull is strong enough to make the muscle move! This amazing protein gives you motion when you run and jump.

MYOSIN

A protein that attaches to muscle fibers and helps our muscles to move.

SOME PROTEINS HAVE THE RIGHT SHAPES TO DO THEIR JOBS

Cells do not get to take a break from their hard work. The cell factories are running all the time, and all that work takes a lot of energy! Cells

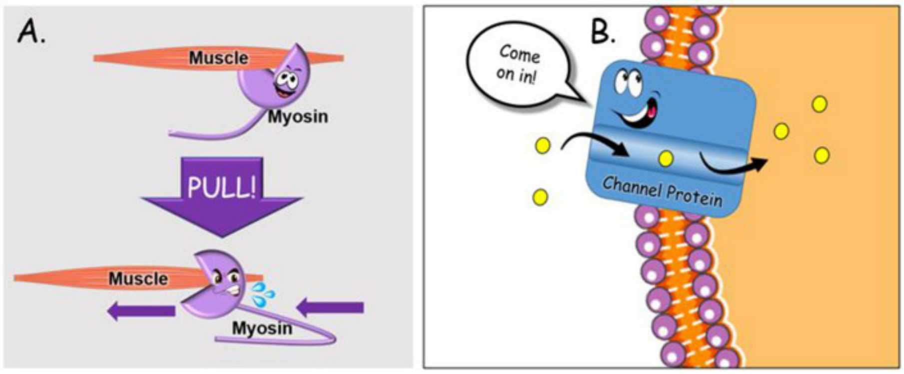

Figure 3

Figure 3

Proteins have special jobs. **(A)** A protein called myosin powers the muscles in your cells by grabbing onto the muscle and pulling hard! **(B)** Channel proteins have a shape that looks like a tunnel. This shape lets supplies travel through the channel protein and into the cell.

need extra supplies to power the constant action. Your body is full of supplies like water and nutrients, but they are stuck outside of the cell. Those supplies need to get into the cell to give the cell energy. A special type of protein called a **channel protein** is perfect for this job [3]. Channel proteins are shaped like a tunnel (Figure 3B). This tunnel connects the inside of the cell to the outside environment, so supplies can pass right through the tunnel and into the cell. This job is extremely important because cells need those supplies to power that busy factory!

CHANNEL PROTEIN

A type of protein that acts like a tunnel into the cell.

WHAT HAPPENS WHEN YOU EAT PROTEIN?

Remember those amino acids? Your body uses amino acids as building blocks to make proteins. Your cells build thousands of proteins every day. That means you need a lot of blocks! There are 22 types of amino acids. You need all of them to build proteins, but there are nine of them that the body cannot make. These are called the **essential amino acids** because you can only get them from food. When you eat foods with lots of protein, like meat or beans, your body breaks those proteins apart into amino acids. Then, your body can use those amino acids to build other proteins. Imagine taking apart your Lego® castle to have the parts you need to build an airplane. Your body does the same thing, by taking apart the proteins you eat and using the parts to build new proteins that you need.

ESSENTIAL AMINO ACIDS

The nine amino acids that the human body cannot make. We can only get these amino acids through the foods we eat.

Now you may have a better understanding of why it is important to get plenty of protein in your diet. The essential amino acids from the proteins in foods help you to build all the cellular proteins that keep your body running smoothly! Meat-eaters will find lots of protein in foods like chicken, beef, pork, fish, dairy, and eggs. Vegetarians can find protein in peanut butter, beans, nuts, seeds, and green vegetables like broccoli [4]. No matter what your favorite kind of protein is, remember: proteins are more than a food group!

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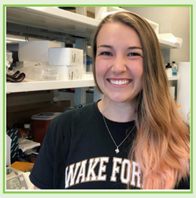
CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

ALEXA, AGE: 11
Alexa enjoys science and creative writing. She has been recognized for both in school. She also enjoys playing softball, singing, debate team, running track, and learning piano.

LUKE, AGE: 10
Luke enjoys playing tennis, piano, and video games. He is a math wiz and a total anime fan.

AUTHORS



STEPHANIE BATALIS

I am a graduate student studying biochemistry. I am interested in learning about how a protein's structure influences its function. To do this, I use laboratory techniques like enzymatic assays and X-ray crystallography. When I am not in the lab, I enjoy hiking in the beautiful North Carolina mountains. Thank you to the Young Reviewers for their feedback and excitement about science! *sbatalis@wakehealth.edu

THOMAS HOLLIS

I am a biochemist interested in understanding how proteins interact with DNA to carry out biological processes. Protein–DNA interactions are necessary for normal cell growth and division and can also contribute to diseases, such as cancer and autoimmune disease. By understanding this biology, my hope is that we can eventually develop treatments for diseases caused by improper protein–DNA interactions.