Proteins & Miraculin, Teacher Resource

Goals	1. Understanding the basics of what proteins are, their structure, and their function in the body. 2. Learning about different types of proteins and the important roles they play in the body. 3. Investigating how Miraculin affects taste perception and exploring the chemical properties of Miraculin. 4. Conducting a hands-on experiment to observe the effects of Miraculin on different foods, and analyzing the results. 5. Developing scientific inquiry skills, such as making hypotheses, designing experiments, and drawing conclusions based on data. 6. Encouraging critical thinking and problem-solving skills by asking open-ended questions and facilitating class discussions. 7. Connecting scientific concepts to real-world applications, such as the use of Miraculin in food products and the importance of a balanced diet that includes protein-rich foods.
Introduction	Imagine that you're building a house out of Legos. Each individual Lego piece is like a protein molecule, and when you put them together, you can create all kinds of things, like a roof or a wall. Our body uses protein molecules to create things like muscles, which help us move, and bones, which give us structure and support. So just like Legos are important for building structures, protein molecules are important for building things in our body.
Topic	**Coverage**
What is protein?	Protein is something that our body needs to stay healthy. It is made up of many small parts called amino acids, and these amino acids are like building blocks that help our body do important things like move our muscles, fight off germs, and keep our body strong.
What types of protein are there?	• **Antibodies**: These are special proteins that help our immune system fight off germs like bacteria and viruses. • **Contractile**: These proteins help our muscles move and contract so that we can walk, run, and jump. • **Enzymes**: Enzymes are proteins that help our body break down food and turn it into energy. • **Hormonal**: These proteins act like messengers in our body and help regulate things like growth and mood. • **Structural**: These proteins help keep our body strong and in shape. For example, collagen is a protein that helps keep our skin and bones healthy. • **Storage**: These proteins store extra amino acids and release them when our body needs them.

	• **Transport**: These proteins help move things around our body, like oxygen in our blood.
Protein vs GlycoProtein	Glycoproteins are a special type of protein that have something extra called carbohydrates. These carbohydrates help the protein do its job, which can include things like making hormones or helping our body fight germs.

Go over questions on worksheet:

Give an example of a protein? ***We should be able to talk about not only food, but where protein can be found in the body. (Hair, nails, muscles, skin, tummy enzymes)***

What different types of proteins are there? List at least 3: ***We should be able to talk about not only food, but where protein can be found in the body. (Hair, nails, muscles, skin, tummy enzymes)***

Experiment

- Build a hypothesis together and explain the scientific process.

Materials Needed:

- 2 spoons per student
- 2 slices of lemon or 1 teaspoon lemon juice per student
- 2 slices of grapefruit per student
- 3 drops of Tabasco per student
- 2-3 Salt & Vinegar chips per student
- 1 packet of ketchup per student
- 1 packet of yellow mustard per student
- 1 teaspoon of apple cider vinegar per student
- 1 mberry Freeze Dried Miracle Berry per student
- 1 paper plate per student

*You can also use a big bottle of ketchup and mustard to put some on their plates instead of packets. If you do not have these foods available, visit our website to see a list on best foods to try with mberry in our blog

Experiment Notes

While everyone will have different perceptions to taste with mberry, here are the normal changes:

Lemon	Lemonade
Grapefruit	Sugar covered grapefruit
Tabasco	Donut Glaze
Salt & Vinegar Chips	Sweet and Salty Snack, less bite
Ketchup	SWeet tomatoes
Mustard	Sweet mustard

ACV	Apple juice

Begin to explain the Miracle Berry once students have completed the experiment **Where can a glycoprotein be found?**	Did you know that there is a special fruit in West Africa called the Miracle Berry that has a glycoprotein called Miraculin? This protein is different from other glycoproteins because it can change the way things taste! If you eat something sour, like a lemon or grapefruit, after trying the Miracle Berry, it will taste sweet!

Finish up by collaborating the following questions:

1. How do you think Miraculin works to make sour or bitter foods taste sweet? ***This is just a guess game for students and to think critically. Once this question is done, you can reveal the way Miraculin changes our taste. Miraculin changes shape when exposed to acids, it causes corresponding changes in the way the receptors on our tongue respond to these acids. In this way, miraculin in the miracle berry rewires the sweet receptors to identify acids as sugars instead.***
2. What could this mean for people who have difficulty tasting certain foods, or for the food industry as a whole? Use your creativity to come up with innovative solutions. ***It is important to think creatively to see what other foods or people they can change. For example, someone who has difficulty tasting certain foods could be someone undergoing chemotherapy or someone who is a non-taster (just a lower threshold to flavors). This could even be for people who don't like veggies, bleh! Are there any favorite foods they would like to try it with? Any foods they dislike?***