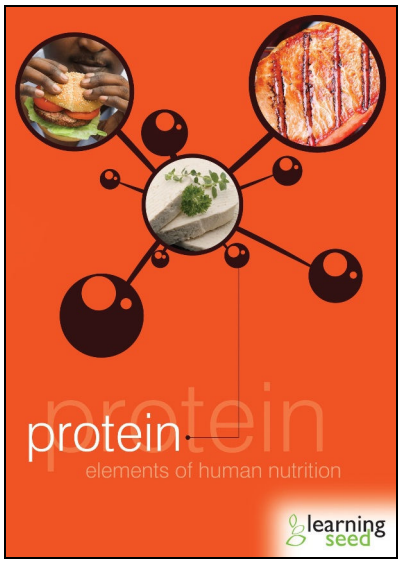
Protein
Elements Of Human Nutrition



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Legal Niceties

The Video

This Teaching Guide

Credits

The Video

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Summary

This program will explore protein and its role in the human body and the impact it has on overall health. The word “protein” actually comes from the Greek word proteios, which means “of prime importance”. The human body needs protein to build muscle, bone, and skin. Protein also helps to create enzymes, hormones, and antibodies.

This program will specifically explore what a protein is, the foods that provide it, how the human body processes it, the difference between high quality and low quality proteins, the recommended intakes, and the impact protein has on vegetarian and weight loss diets.

Key points:

- Proteins are made up of amino acids which have unique sizes and shapes due to their side chains of atoms.
- Eleven amino acids make up a group of nonessential amino acids due to the fact that the human body can make them on its own. Nine amino acids make up a group of essential amino acids because the only way to get them is through eating foods that contain protein.
- Some foods are high quality proteins because they contain all of the essential amino acids. Some foods are low quality proteins because some of the amino acids are missing.
- The human stomach contains both hydrochloric acid and digestive enzymes which break down protein-rich foods into amino acids.
- Too little protein intake will cause the body to break down amino acids for energy instead of the intended functions. Too much protein intake will build up as fat.
- The Recommended Daily Allowance of protein is based on age, height, weight, and gender, and is calculated while eating a balanced diet and staying active.
- Those who suffer from PEU can be starving. Their bodies begin to take protein away from their muscles.
- Research has suggested that too much animal protein can contribute to heart disease and other health concerns.
- Vegetarians are able to get the protein they need through other sources. Even vegans can satisfy their needs by eating products like textured vegetable proteins, and food items that are fortified with protein nutrients.
- Low-carb, high protein weight loss diets used by many people have short term weight loss effects, side effects from ketosis, and do not provide dieters with balanced nutrition.

Chemistry

Our bodies have tens of thousands of proteins, yet scientists have studied only a few thousand. Proteins are composed of smaller molecules called amino acids, often called the building blocks of proteins. All amino acids have the same basic molecular structure, which includes Carbon, Hydrogen, Oxygen and Nitrogen. What differentiate amino acids are unique collections of atoms called side groups. Some amino acids have only one atom in their side group while others can have many atoms linked together. Therefore, amino acids vary in size and shape; these differences determine their function in the body. Some amino acids have the function of replacing skin cells or creating scar tissue, while others carry oxygen from the lungs to other parts of the body. Amino acids are connected to each other with peptide bonds, which connect end-to-end to form links in a chain of proteins.

Eleven of the amino acids are called nonessential amino acids. They are amino acids that the body can make, or synthesize on its own. There are nine essential amino acids, or those that the body must get from eating foods that contain protein. The nine amino acids are Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine.

Food

High quality proteins contain all of the essential amino acids in the appropriate amounts that the body needs. Some even contain some nonessential amino acids as well. Foods that come from animals generally provide high quality proteins, such as meat, fish, poultry, milk, cheese, and yogurt.

We do get some protein from vegetables, grains, and legumes as well. Soy beans are an example of a high quality plant protein. Generally though, proteins from plants are low quality proteins, and are lacking in one or more of the essential amino acids. The only way to get complete protein from most plants is to combine them with other plant foods that contain complementary proteins. These are two or more proteins that provide the amino acids that other protein is lacking. A specific example of this is the combination of black beans and rice. It is not essential to find the perfect combination for every meal. If you eat a variety of proteins, the body will take whatever it needs from everything you eat.

Food Digestion

The human body needs a daily supply of protein. When proteins are eaten, they come in contact with hydrochloric acid and digestive enzymes in the stomach. Hydrochloric acid begins to uncoil the peptide chains, and the digestive enzymes work on breaking down the peptide bonds. In the small intestine, enzymes continue to break down protein even further. Once the individual amino acids are isolated they are absorbed into the cells, then transported and released into the bloodstream. Depending on the type of amino acid, the broken down nutrient can work with the body to repair, grow, and maintain muscles, bones and organs.

Sometimes there are pieces left over after the protein is broken down to its amino acid. These pieces can be used as energy, changed to fat, or rid from the body as nitrogen in urine.

The body generally uses lipids and glucose as energy, which come from foods containing fats and carbohydrates. If glucose is not available to use for energy the body will begin to break down protein in tissue and use the amino acids for energy. Too little protein will cause the body to break down amino acids for fuel instead of using it for more important functions. Too much protein ingestion will build up as fat.

Food Recommendations

The Recommended Daily Allowance for protein varies according to age, gender, and weight. Infants, children, and pregnant women need higher amounts of protein because the amino acids help create new tissue during growth. The recommended intake of food energy as a whole is divided in such a way that 20-25% should come from fat, 45-60% should come from carbohydrates, and 10-35% should come from protein. Therefore for a 2000 calorie diet, 200-700 calories should come from protein, which is 50-175 grams. The RDA is calculated assuming that people will be getting enough carbohydrates and fats to meet their energy needs. It also assumes that the person is getting a balance of high and low quality proteins.

For adults, the RDA for protein is 0.8 grams per kilogram of weight per day. To calculate an RDA for protein, first use height to find the healthy range of weight. If your weight falls above the healthy range then use the middle healthy weight to do the calculations. Convert pounds to kilograms by dividing your weight by 2.2. Then multiply the kilograms by 0.8. This number is the recommended daily allowance of protein in grams. (For example: a 5'4" adult weighing 140 pounds would have an RDA of 51 grams of protein per day. 140 divided by 2.2 multiplied by 0.8)

Infants from 7-12 months need 11 grams of protein. Teen males need 52 grams of protein. Teen girls and adult women need 46 grams of protein.

Extremes

Protein-Energy Undernutrition occurs when people do not consume enough protein and calories to satisfy the body's needs. Without protein and other nutrients the body's muscles, including the heart, become weak, and your metabolism slows down in order to save itself from starvation. The amino acids that the body would normally use to fight infections and create blood proteins are used for other functions, causing susceptibility to infections.

Too much protein can also cause medical problems for the body. Research is currently looking at the connections between high animal protein diets and weight gain, heart and kidney disease, and even some cancers. There have been no proven positive results to taking in more protein. Many athletes believe they will build more muscle quicker if they take protein and amino acid supplements. Exercising a muscle is the only way to make it grow, so without exercise or weight training, no amount of protein above normal will increase muscle mass or strength.

Some people do choose to take amino acid supplements. The human body is designed to process the amino acids that we get from the protein in food that we eat. If higher levels of those amino acids are ingested, or in unusual combinations, amino acid levels may reach toxicity and cause health problems.

Vegetarians

There is a misconception that vegetarians do not get the daily protein that they need. Because there are different types of vegetarians, the sources of protein differ. Those who do not eat meat, but do eat foods that come from animals are called lacto-ovo-vegetarians. Eggs, milk, cheese, and yogurt give this type of vegetarian the protein they need. Vegans are those who choose not to eat any foods derived from animals. Vegans can get the necessary amount of protein by eating a diet consisting of complementary proteins. Peanut butter, tofu, and fortified soy milk are protein-rich sources for vegans.

A popular way for vegetarians to meet their protein needs is to use textured vegetable proteins. This is processed soybean protein used to make products called meat replacements. These products look and taste like meat, fish, or poultry but are also fortified with vitamins and minerals found in animal proteins.

Diets

Many popular weight loss diets are high in protein and low in carbohydrates. One main health benefit from this type of diet is the restriction of refined carbohydrates found in such food as white bread, white rice, white pasta and sweets. Reduction in the refined carbohydrates may result in weight loss as well as help to control blood sugar and insulin levels. However, good carbohydrates like those found in fruits, vegetables and whole grains are not eaten when people adopt a high protein diet. Dieters replace all carbohydrates with protein.

Dieters who follow a high protein diet regimen believe that they will lose a significant amount of weight without reducing the amount of calories they eat, correct an imbalance of carbohydrates by severely limiting their carbohydrate intake, and more efficiently burn calories from protein. The typical result from this type of diet is short term weight loss. Most subjects following a high protein diet experienced initial weight loss up to six months in, but after a year the weight loss benefits disappeared. The quick weight loss is due to water loss from not storing carbohydrates.

- This type of diet is cause for health concerns because it is low in essential vitamins, minerals and fiber. Severe restrictions of carbohydrates result in ketosis. Ketosis takes place when the body uses fat stores for energy because glucose is not available. Nausea, headache and fatigue are some side effects of ketosis. Ketosis can also worsen preexisting kidney conditions.

Review

- Proteins are made up of amino acids; thousands of different proteins exist in the human body and perform important functions.
- Nonessential amino acids are made by the body and essential amino acids need to come from food.
- In choosing foods, combining high quality, low quality, as well as complementary proteins with help to achieve the RDA that is needed according to age and gender.
- Too little as well as too much protein can become a health concern for many people.
- Vegetarians can get their RDA of protein through complementary proteins and meat replacement products.
- Low-carb, high protein diets have not been proven to help long term weight loss.

Questions For Discussion

1. What are some of the functions of proteins? What happens to our body if we do not get enough protein? What happens if we take in too much protein?

   Some of the functions of protein are building muscle, bone, skin, and creating enzymes, hormones, and antibodies to help with immune functions. If we do not eat enough protein, our bodies will begin to break down amino acids for energy. This can lead to PEU and muscle deterioration and starvation. Too much protein can start to build up as fat.

2. Does taking protein supplements cause muscles to grow and get stronger quicker?

   Many athletes believe that dieting and taking protein supplements such as shakes, bars, or pills will cause their muscles to grow quicker. The only way to build muscle is to exercise it. Without exercise or weight training, no above normal amount of protein will increase muscle mass or strength.

3. What are the differences between the various types of vegetarians? Do they get enough protein in their diets? How?

   A vegetarian does not eat meat. A lacto-ovo-vegetarian does not eat meat but does eat other by-products of animals. A vegan does not eat any animal products. Lacto-ovo-vegetarians can get their protein from foods like eggs, milk, cheese, and yogurt. Vegans can get protein from eating complementary proteins such as nuts, seeds, and legumes.

4. Do high-protein, low-carb diets work? What are the health benefits or concerns?

   Dieters who follow a high protein diet regimen believe that they will lose a significant amount of weight without reducing the amount of calories they eat, correct an imbalance of carbohydrates by severely limiting their carbohydrate intake, and more efficiently burn calories from protein. The typical result from this type of diet is short-term weight loss.

   One main health benefit from this type of diet is the restriction of refined carbohydrates found in such food as white bread, white rice, white pasta and sweets. Reduction in the refined carbohydrates may result in weight loss as well as help to control blood sugar and insulin levels.

Suggested Activities

1. Calculate your personal Recommended Daily Allowance for protein. Use a BMI chart to begin, which can be found at: http://www.consumer.gov/weightloss/bmi.htm (Do not forget the conversions from pounds to kilograms)

2. Create a breakfast lunch, snack, and dinner menu for the different types of vegetarians (including lacto-ovo-vegetarians and vegans).

Research Project

Research the extent of protein supplements used in professional athletics as well as amateur athletics. Describe the different methods used. Research a specific supplement and describe its claims and ingredients. Read the medical warnings and compare to the effects of steroids, often used in athletics as well.

Protein: Elements Of Human Nutrition
Fill-In-The-Blank

Fill in the blanks with the correct words from the bank at the bottom of the page.

The word _____ comes from a Greek word meaning “of prime importance”. Protein is made up of _____, often called the building blocks of protein. Differences in the functions of amino acids are due to each one’s _____. Amino acids are connected to each other with _____. _____ amino acids are those which the human body produces itself. _____ amino acids are those which we can only get from food. There are _____ nonessential amino acids and _____ essential amino acids. _____ proteins contain all of the essential amino acids, while _____ proteins do not, and _____ proteins are needed to fulfill the body’s protein needs.

Word Bank:

Peptide bonds	high-quality	protein	amino acids	side-group
low-quality	nonessential	nine	essential	eleven
complementary				

Protein: Elements Of Human Nutrition

Fill-In-The-Blank *Answer Key*

The word **protein** comes from a Greek word meaning “of prime importance”. Protein is made up of **amino acids**, often called the building blocks of protein. Differences in the functions of amino acids are due to each one’s **side-group**. Amino acids are connected to each other with **peptide bonds**. **Nonessential** amino acids are those which the human body produces itself. **Essential** amino acids are those which we can only get from food. There are **eleven** nonessential amino acids and **nine** essential amino acids. **High-quality** proteins contain all of the essential amino acids, while **low-quality** proteins do not, and **complementary** proteins are needed to fulfill the body’s protein needs.

Protein: Elements Of Human Nutrition

Multiple Choice Worksheet

Circle the best available answer for each of the following:

1) This type of vegetarian does eat some animal products:
   a) vegan
   b) activist
   c) carnivore
   d) lacto-ovo vegetarian

2) Proteins' building blocks are:
   a) nitrogen
   b) blood cells
   c) amino acids
   d) peptide bonds

3) Which would a vegan not eat:
   a) nuts
   b) cheese
   c) peanut butter
   d) tofu

4) Amino acids are connected by:
   a) neurons
   b) peptide bonds
   c) magnetism
   d) proteins

5) The RDA for protein is not based on:
   a) age
   b) weight
   c) gender
   d) heredity

6) Quick weight loss from a high protein diet is due to:
   a) loss of water weight
   b) motivation
   c) quicker metabolism
   d) eating more meat

7) Which is not a high-quality protein:
   a) meat
   b) legume
   c) fish
   d) cheese

8) Which is not a function of protein in the body:
   a) carries blood cells
   b) build skin
   c) build antibodies
   d) carry oxygen

9) Which is not a refined carbohydrate:
   a) white bread
   b) cucumber
   c) spaghetti
   d) pound cake

10) For a 2000 calorie diet, the RDA for protein is:
   a) 20-100 grams
   b) 50-175 grams
   c) 100-200 grams
   d) 30-90 grams

Protein: Elements Of Human Nutrition

Multiple Choice Worksheet *Answer Key*

Circle the best available answer for each of the following:

1) This type of vegetarian does eat some animal products: a) vegan b) activist c) carnivore **d) lacto-ovo vegetarians**	6) Quick weight loss from a high protein diet is due to: **a) loss of water weight** b) motivation c) quicker metabolism d) eating more meat
2) Proteins' building blocks are: a) nitrogen b) blood cells **c) amino acids** d) peptide bonds	7) Which is not a high-quality protein: a) meat **b) legume** c) fish d) cheese
3) Which would a vegan not eat: a) nuts **b) cheese** c) peanut butter d) tofu	8) Which is not a function of protein in the body: **a) carries blood cells** b) build skin c) build antibodies d) carry oxygen
4) Amino acids are connected by: a) neurons **b) peptide bonds** c) magnetism d) proteins	9) Which is not a refined carbohydrate: a) white bread **b) cucumber** c) spaghetti d) pound cake
5) The RDA for protein is not based on: a) age b) weight c) gender **d) heredity**	10) For a 2000 calorie diet, the RDA for protein is: a) 20-100 grams **b) 50-175 grams** c) 100-200 grams d) 30-90 grams

Protein: Elements Of Human Nutrition
Matching Quiz

Match the words in the first column to the best available answer in the second column.

_____	Results when the body does not get enough protein	1) peptide bonds
_____	Word in Greek that means “of prime importance”	2) lacto-ovo vegetarian
_____	Found in the stomach and helps break down eaten protein	3) complementary proteins
_____	Carbon, Hydrogen, Oxygen, and Nitrogen make up this	4) protein
_____	This type of vegetarian would eat yogurt	5) nonessential amino acids
_____	Amino acids are connected by these	6) PEU
_____	This is calculated according to age, weight, and gender	7) hydrochloric acid
_____	Vegans can satisfy their protein need by consuming these	8) RDA
_____	There are eleven of these which the human body produces on its own	9) proteios

Protein: Elements Of Human Nutrition
Matching Quiz *Answer Key*

Match the words in the first column to the best available answer in the second column.

6) PEU	Results when the body does not get enough protein
9) proteios	Word in Greek that means “of prime importance”
7) hydrochloric acid	Found in the stomach and helps break down eaten protein
4) protein	Carbon, Hydrogen, Oxygen, and Nitrogen make up this
2) lacto-ovo vegetarian	This type of vegetarian would eat yogurt
1) peptide bonds	Amino acids are connected by these
8) RDA	This is calculated according to age, weight, and gender
3) complementary proteins	Vegans can satisfy their protein need by consuming these
5) nonessential amino acids	There are eleven of these which the human body produces on its own

Glossary

Complementary proteins	Two or more proteins that provide amino acids that the other protein is lacking
High-quality proteins	Proteins which contain all of the essential amino acids in the approximate amounts that our bodies need
Ketosis	Takes place when the body uses fat stores for energy because glucose is not available
Lacto-ovo-vegetarian	Those who do not eat meat, but do eat foods that come from animals
Low-quality proteins	Proteins that lack one or more essential amino acids
Protein-Energy Undernutrition (PEU)	A condition that occurs when people do not consume enough protein and calories to satisfy the body's needs
Side-Group	A unique collection of atoms in amino acids
Vegan	Those who do not eat any foods derived from animals

General Nutrition Websites

American Dietetic Association – Eat Right
http://www.eatright.org

American Heart Association
http://www.americanheart.org

Arbor Nutrition Guide
http://arborcom.com

Centers for Disease Control and Prevention – Healthy Living
http://cdc.gov./HealthyLiving

Gatorade Sports Science Institute
http://www.gssiweb.com

Harvard – School of Public Health
http://www.hsph.harvard.edu/nutritionsource

Kids Health - Kids
http://kidshealth.org/kid

Kids Health - Parent
http://kidshealth.org/parent

Kids Health - Teen
http://kidshealth.org/teen

Mayo Clinic - Food And Nutrition
http://www.mayoclinic.com/health/food-and-nutrition/NU99999

National Dairy Council
http://www.nationaldairycouncil.org

United States Department of Agriculture – My Pyramid
http://www.mypyramid.gov

WebMD
http://www.webmd.com