SI Chemistry - Full Discipline Demo

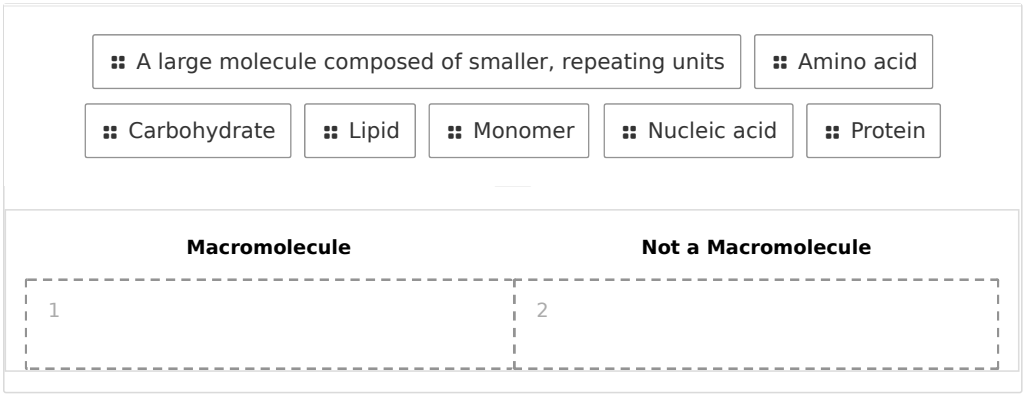
Macromolecules of Life - Amino Acids

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Categorize each substance as a macromolecule or not a macromolecule.

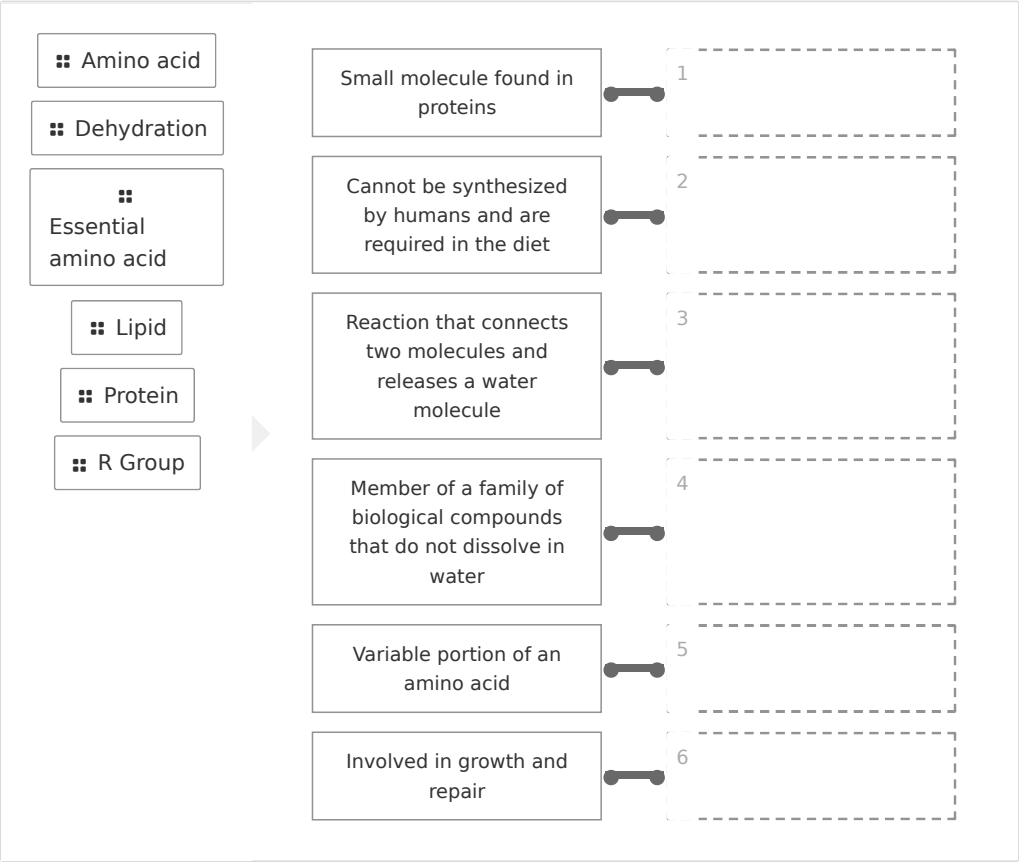


Correct answers:

1 A large molecule composed of smaller, repeating units Carbohydrate Lipid Nucleic acid Protein

2 Amino acid Monomer

Match each term with the best description.

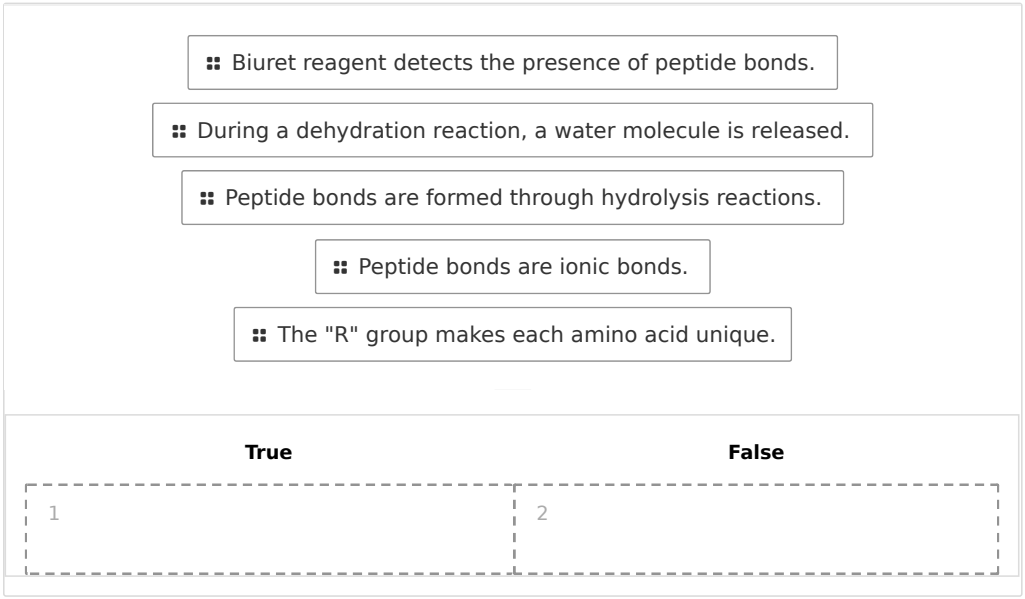


Correct answers:

1 Amino acid 2 Essential amino acid 3 Dehydration 4 Lipid

5 R Group 6 Protein

Categorize each statement as true or false.



Correct answers:

1 Biuret reagent detects the presence of peptide bonds.

The "R" group makes each amino acid unique.

During a dehydration reaction, a water molecule is released.

2 Peptide bonds are formed through hydrolysis reactions.

Peptide bonds are ionic bonds.

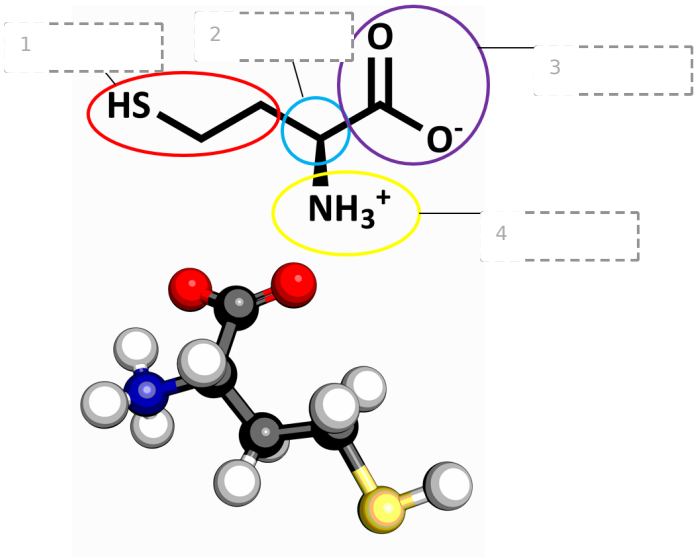
Label the structures of the amino acid.

Amino group

Carboxyl group

Central carbon

R group



Correct answers:

1 R group 2 Central carbon 3 Carboxyl group 4 Amino group

Exploration

All four classes of macromolecules are composed of smaller, monomer (single) units, that are bound together through _____ reactions.

- hydration
- dehydration ✔
- combination
- carboxylation

Essential amino acids are synthesized in the body.

- True
- False ✔

Proteins are long chains of amino acids, linked together with covalent, peptide bonds.

- True ✔
- False

Proteins are _____.

- composed of nucleic acids
- formed from ionic reactions
- involved in growth and repair ✔
- All of the above

Exercise 1

Did both the egg white and beaten egg white yield the same results? If so, research the structure of egg whites and devise an experiment you could perform that would yield different results from the unbeaten egg white. If not, research the structure of egg whites and explain your results. Cite all sources used.

Student answers may vary. Both the egg white and beaten egg white should yield a positive result. The egg white is a protein that becomes denatured by whisking, which disrupts tertiary and secondary bonds, but not generally primary peptide bonds. It is very unlikely that students will whisk the egg white sufficiently to hydrolyze the proteins, breaking the peptide bonds, and producing a negative result for the whisked egg. Hydrolysis, leading to a negative result, can be achieved by the addition of a strong acid or base in the presence of heat, or the addition of proteolytic enzymes.

Did the mayonnaise provide the result that you had predicted? Research the ingredients in the mayonnaise that you used to explain why your prediction was correct or incorrect. From your research, which of the remaining macromolecules (lipids, proteins, carbohydrates) would you expect the mayonnaise to contain?

Student answers will vary. However, the student should mention that the nutritional data for mayonnaise indicates that it does not contain any protein or carbohydrates, but does contain cholesterol and should test positive for lipids. Students may also note the presence of egg and egg whites in the ingredients list, indicating protein is actually present, which may explain a possible mild positive result.

Liquid Coffee Mate has many ingredients including corn syrup solids, vegetable oil, and sodium caseinate (a milk derivative). Classify each of these substances into the following categories of macromolecules: carbohydrates, lipids, or proteins. Which substance(s) is/are responsible for the result you obtained with the biuret reagent?

Corn syrup solids are carbohydrates, vegetable oil is a lipid and sodium caseinate is a protein. The protein sodium caseinate is responsible for the positive result obtained with the biuret reagent. If students used a non-dairy creamer or other type of creamer, their test may be negative for protein, and their ingredient lists may vary from the named ingredients here.

Research the substance pepsin. What is it used for? If you were to test the enzyme amylase, what result would you expect with the biuret reagent? Why?

Student answers may vary. Pepsin is a digestive enzyme, used to break down proteins into smaller peptides. Amylase is an enzyme, and therefore a protein, so it should test positive using the biuret reagent.

You enjoy the following snack one afternoon: a can of Pepsi, pretzels, and sliced apples with peanut butter. Would any of these four food items yield a positive result with biuret reagent? If so, which one(s) and why?

The peanut butter, and possibly the pretzels would yield a positive result because they contain protein. Pepsi and apple contain carbohydrates, primarily.

Data Table 1: Protein Tests with Biuret Reagent
(SAMPLE ANSWER BELOW)

Test Tube Number	Substance	Peptide Prediction (Yes or No)	Color (Observation)	Test Results for Peptide Bonds (Conclusion)
1	Distilled Water	Student answers will vary.	Blue	Negative
2	Pepsin Solution		Purple	Positive
3	Liquid Coffee Creamer		Purple	Positive
4	Mayonnaise		Blue	Negative
5	Egg White		Purple	Positive
6	Beaten Egg White		Purple	Positive

Competency Review

A macromolecule is _____.

- [x] a large molecule composed of smaller molecules
- [ ] similar to a monomer
- [ ] an organic compound with an amino group and carboxyl group
- [ ] an essential amino acid

Macromolecules include lipids, proteins, carbohydrates, and nucleic acids.

- [x] True
- [ ] False

Peptide bonds link _____ together to form _____.

- nucleic acids; proteins
- amino acids; proteins ✔
- nucleic acids; amino acids
- amino acids; nucleic acids

Amino acids that are not created by the body, and therefore must be obtained through diet are called _____.

- essential ✔
- non-essential

An amino acid is an inorganic compound containing an amino group and a carboxyl group.

- True
- False ✔

There are 20 amino acids; _____ that are essential and _____ that are nonessential.

- 12; 8
- 10; 10 ✔
- 8; 12
- 5; 15

Mayonnaise is blue in the presence of biuret reagent because it _____.

- contains proteins
- does not contain proteins ✔

A beaten egg white is purple in the presence of biuret reagent because it _____.

- [x] contains proteins
- [ ] does not contain proteins

A biuret test is _____ when testing distilled water for the presence of proteins indicating a _____ result.

- [ ] purple; negative
- [ ] blue; positive
- [x] blue; negative
- [ ] purple; positive

Extension Questions

Conduct research to find 4 different food sources that could be part of a high protein diet. For each food source indicate the major amino acids and other nutritional benefits that are present, and indicate the recommended minimum daily intake of protein for adults. Cite the sources of your research. (SAMPLE ANSWER BELOW)

Foods such as lean meats, seafood, beans, soy, low-fat dairy, eggs, and nuts and seeds should be researched. Animal sources of protein deliver all of the essential amino acids we need, and fruits, vegetables, grains, nuts, and seeds usually lack some essential amino acids. Two examples of additional nutritional benefits include that seafood is rich in omega-3s, and beans give you fiber. The Institute of Medicine recommends that adults get a minimum of 0.8 g of protein for every kilogram of body weight per day (or 8 g of protein for every 20 pounds).