

Lesson on Proteins



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GOAL: The following is a game designed to help engage students in their understanding of protein importance, function, synthesis, structure, and molecular make-up.

Standards:

Cell Biology

1. Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.

Genetics

4. Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
5. Students know proteins can differ from one another in the number and sequence of amino acids.

Organic Chemistry and Biochemistry

10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:
 - a. *Students know* large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
 - b. Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
 - c. Students know amino acids are the building blocks of proteins.
 - f. Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

Procedure:

Materials

Web access

Template boards (one per team)

Molecule markers (see below)

Trivia questions

Cut out markers

Use either black and white (can be colored by groups) or color template

This may take only one day to play but build-up and extensions may take up to a week each.

Rules

Students will watch videos on-line at folding.stanford.edu and be asked to take notes to later compete in a game about proteins and amino acids. Students will be assigned to

teams of 3-4 that will answer questions in a *Jeopardy* fashion from the videos and class lectures. Correct answers earn points that will enable them to “buy” molecules to fill up their **amino acid template** game board. **First team to purchase all 10 molecules wins.**

Point values to questions are assigned by relative difficulty.

Point values for molecular markers should be varied and equal to their relative representation in the amino acid. A suggestion might be:

Hydrogen = 50 points each

Carbon = 75 points each

Oxygen = 100 points each

Nitrogen = 200 points

“R” Group = 250 points

A bonus question that perhaps requires a bit more thought can be asked for the “R” group marker. A research extension from this can be made by providing unique “R” groups that represent each of the 20 different acids.

Questions:

100 points

Which of these is **ONLY** found in proteins and **not** in carbohydrates and lipids?

- A. Nitrogen
- B. Carbon
- C. Hydrogen
- D. Oxygen

How many unique amino acids are there?

20

How many amino acids are essential?

8

What is the name of the molecule that grabs the amino acid to be later attached at the ribosome?

tRNA

What is the first state of protein folding called?

Primary state

Which portion of amino acids gives them their unique qualities?

The "R" group

What is a long chain of amino acids called?

Polypeptide chain

Where do we get amino acids from?

Protein-rich foods

What molecule codes for protein function?

DNA

Define what a chaperone is.

Simply helper proteins

How quickly can a protein fold?

In milliseconds

How quickly can a ribosome link amino acids together?

1-10 per second

Where do proteins fold?

Either in the ribosome or cytoplasm

Name 2 common proteins.

(Answers will vary) amylase, hemoglobin, myoglobin, skin, hair, muscles, etc.

DNA gets transcribed into what molecule?

mRNA

What is the tertiary state also called?

Confirmed state

About how many cells are in the human body?

~100 trillion

200 points

Define Protein

A polypeptide chain of macromolecules called amino acids

What does the Latin root *prota* mean?

Of primary importance

List the 4 basic elements that make up proteins.

Nitrogen, oxygen, carbon, hydrogen

What are amino acids?

They are the building blocks of proteins.

List the 3 main amino acid sections.

amine group, the "R" group, carboxyl group

Which amino acid groups link together?

amine group and carboxyl group

Once digested, what does the body do with amino acids?

Re-sequences amino acids to make what the body needs.

Name the 2 muscle fibers in the body.

Actin and myosin

What must a protein do before it becomes functional?

Fold into a tertiary or quaternary state

What does the secondary state appear like?

Phone cord and sheets

Define quaternary state?

2 or more proteins combined together

Name 2 of 3 things that determine a protein's shape.

length, type, and sequence of amino acids

What are 4 factors that affect protein folding?

temperature, pressure and changes in pH, chaperones, entropy, electrostatics

What does a chaperone do?

They keep proteins from misfolding and sticking together which can lead to disease

List 3 functions of proteins.

Structure, transport, disease fighting, movement (muscles), enzymes, cell signaling (hormones)

How is a chaperonin different from a chaperone?

They engulf proteins to help them fold

What happens when proteins misfold?

Diseases include: Mad Cow, Cancer, Alzheimer's, and Parkinson's

About how many cells do we have in our body?

300 points

Why do we need essential amino acids?

We cannot synthesize them within our bodies.

Why is a ribosome considered like a small factory?

It is the place where proteins are translated from mRNA and assembled into peptide chains.

What do you think might happen to an organism that stopped making copies of its DNA?

The DNA would become damaged and the organism would have a difficult time producing proteins, it would eventually die.

Why are proteins considered polymers?

They are made from repeating sub-units that are linked together.

Why do peptide chains fold?

They want to achieve their most relaxed state

Explain how humans can have fewer genes for proteins than some insects and yet still be more complex?

We have several quaternary proteins. By combining 2 or more proteins we have the potential for an enormous amount of protein variety.

Extension:

Students will answer all questions in Section I and one in Section II

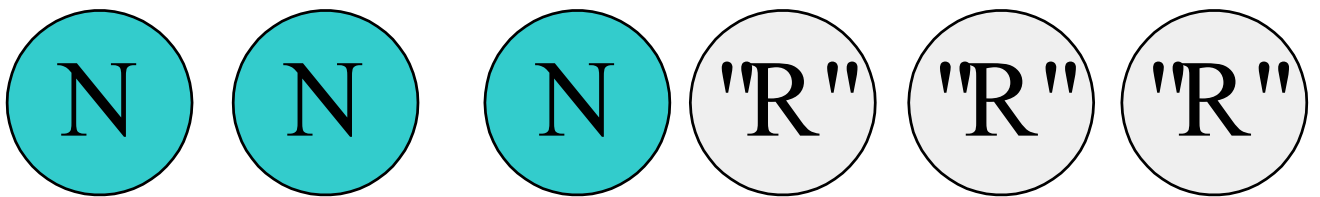
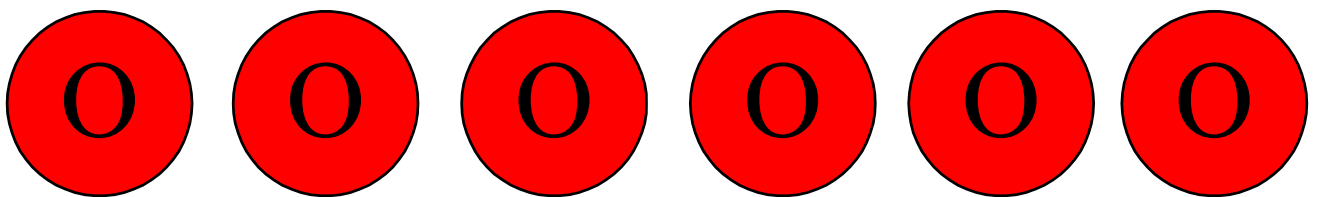
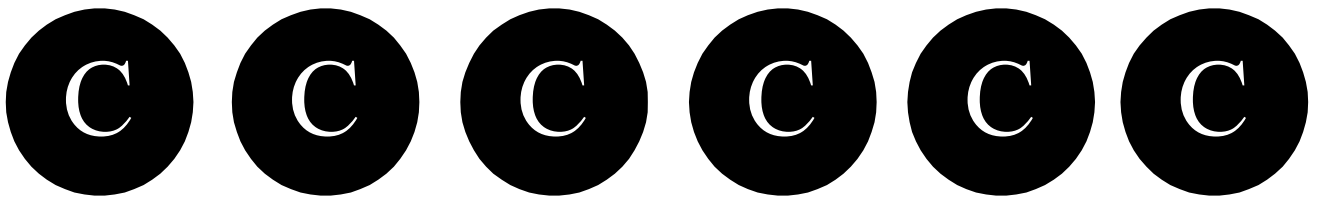
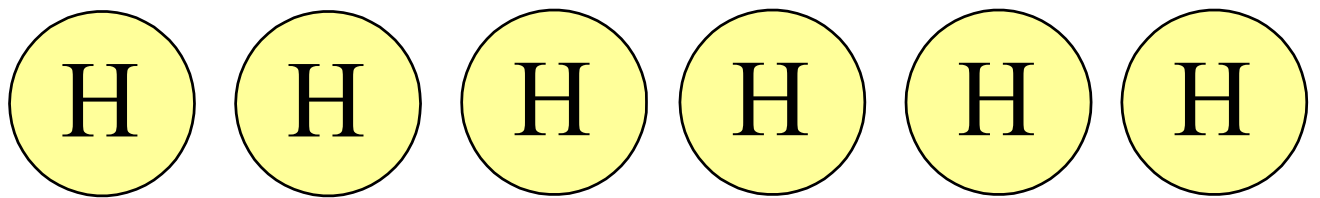
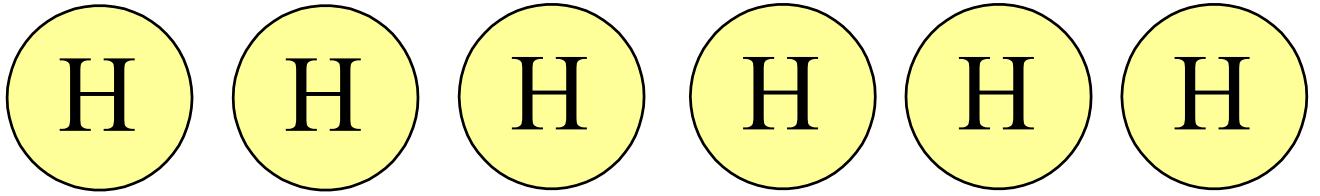
Section I

- How is the "R" group shaped? How many atoms are in it?
- Is it polar or non-polar? Hydrophilic or hydrophobic?
- Discuss where would you expect to find this amino acid once the protein was folded and why?
- What food sources provide this amino acid? Is it essential/non-essential? What does that mean as far as your diet is concerned?
- Discuss why is it so important that the more than 20 amino acids found in nature have uniformity (identical regions)?

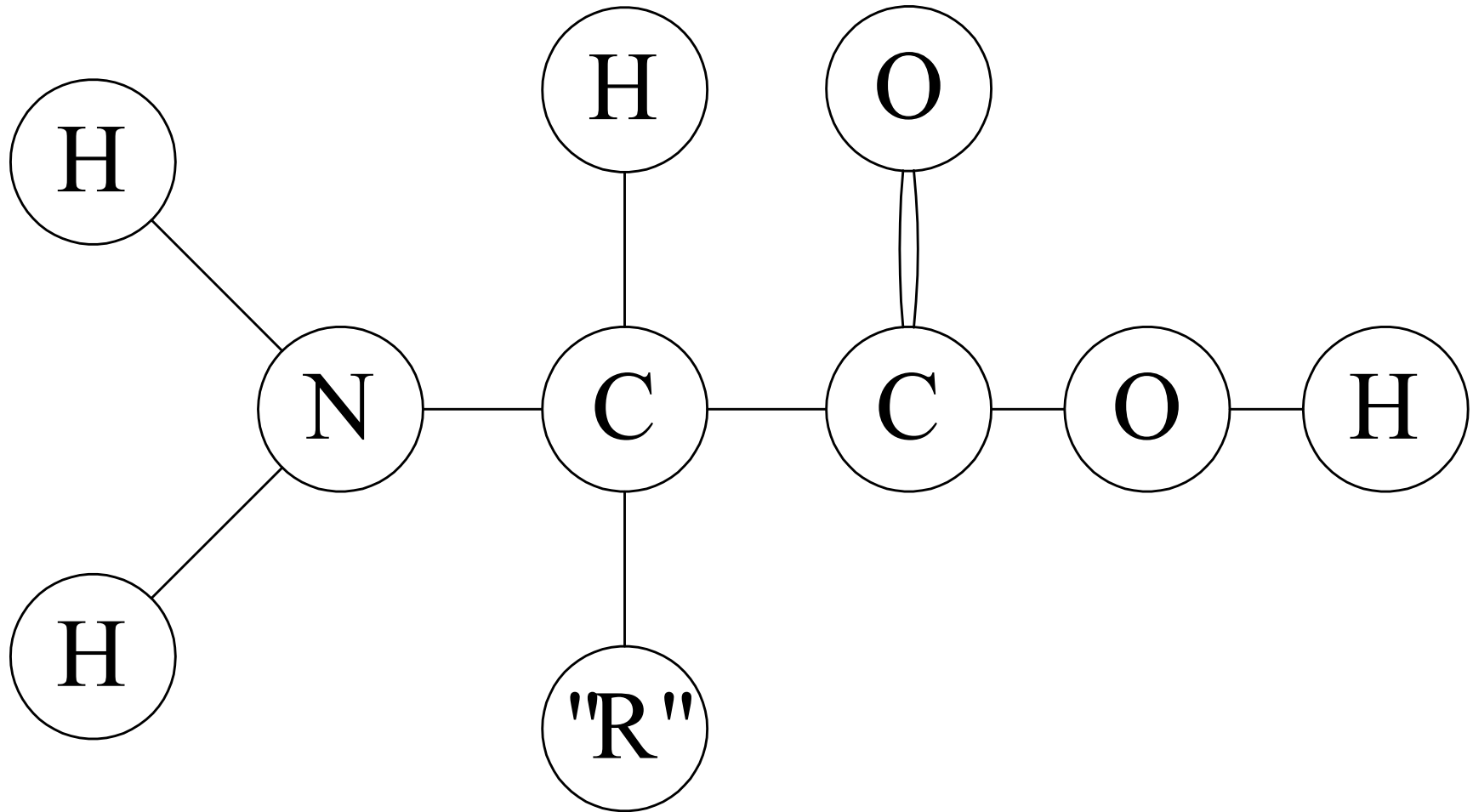
Section II

- How do you suppose life would have evolved if amino acids did not link to form proteins? Describe what life might look like.
- What are the advantages and disadvantages of having quaternary proteins?

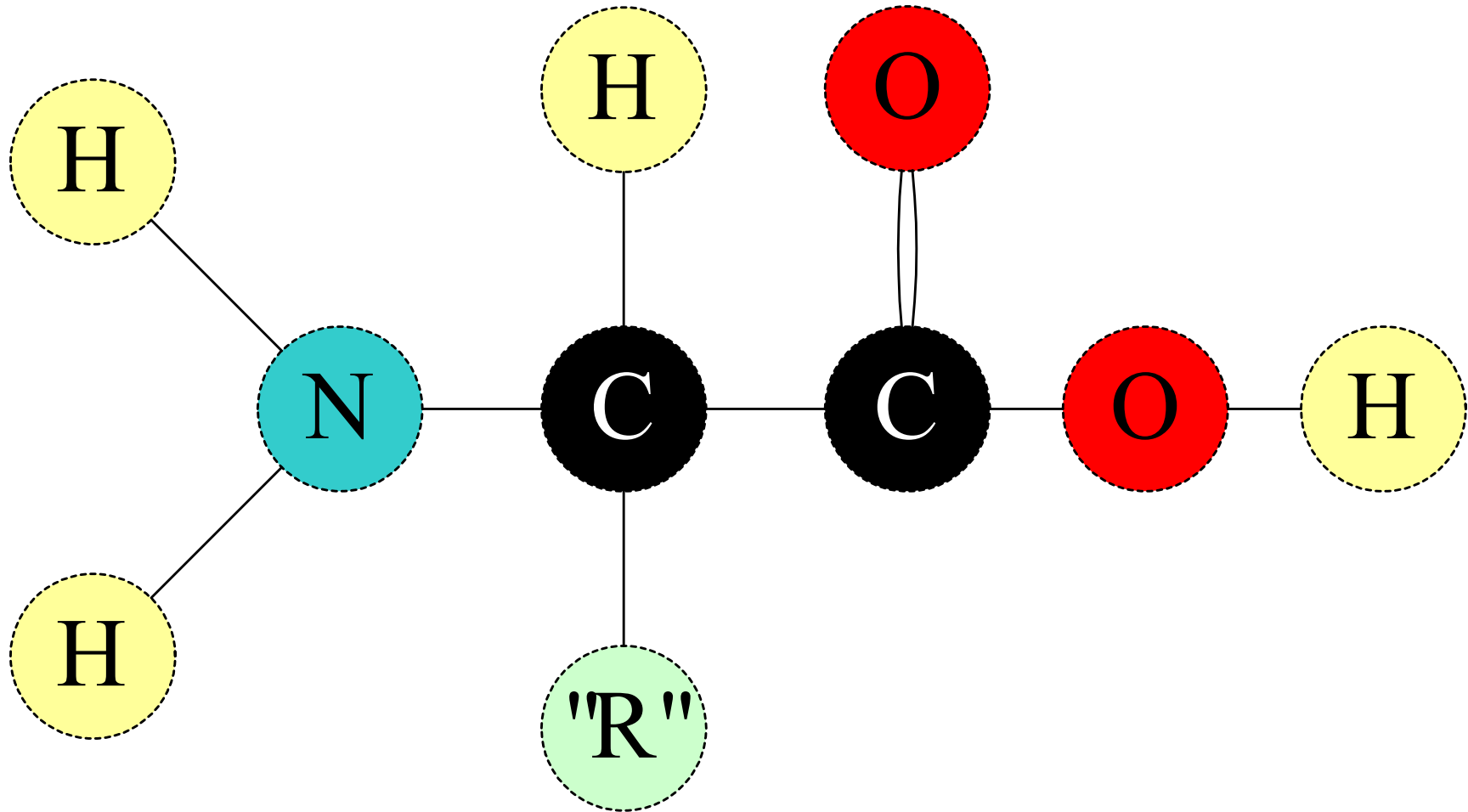
Molecular markers



Amino Acid Game



Amino Acid Game



Research Report : Amino Acids

Teacher Name: **Mr. Paynter**

Student Name: _____

CATEGORY	4	3	2	1
Organization	Information is very <i>organized</i> with well-constructed paragraphs and subheadings.	Information is organized with well-constructed paragraphs.	Information is organized, but paragraphs are not well-constructed.	The information appears to be <i>disorganized</i> .
Quality of Information	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
Diagrams & Illustrations	Diagrams and illustrations are neat, accurate and add to the reader's understanding of the topic.	Diagrams and illustrations are accurate and add to the reader's understanding of the topic.	Diagrams and illustrations are neat and accurate and sometimes add to the reader's understanding of the topic.	Diagrams and illustrations are not accurate OR do not add to the reader's understanding of the topic.

First Draft	Detailed draft is neatly presented and includes all required information.	Draft includes all required information and is legible.	Draft includes most required information and is legible.	Draft is missing required information and is difficult to read.
Sources	All sources (information and graphics) are accurately documented in the desired format.	All sources (information and graphics) are accurately documented, but a few are not in the desired format.	All sources (information and graphics) are accurately documented, but many are not in the desired format.	Some sources are not accurately documented.
Mechanics	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors	A few grammatical spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.
Graphic Organizer	Graphic organizer or outline has been completed and shows clear, logical relationships between all topics and subtopics.	Graphic organizer or outline has been completed and shows clear, logical relationships between most topics and subtopics.	Graphic organizer or outline has been started and includes some topics and subtopics.	Graphic organizer or outline has not been attempted.

Date Created: **Oct 01, 2007 02:21 am (CDT)**