Topic: Math, Chemistry, and Food

http://www.enzymedica.com/enzymedeficiencytest.pdf

Enzyme properties in food

Grade 9-Adult

An integrated lesson plan covering one session of approximately 1.5 - 2 hours.

Lesson-Planning Approach

Some learners perceive their "world" as a whole, where all things are interconnected and dependent upon each other. These "integrated" students face major challenges in coping with our dominant educational, social, and economic systems, which tend to present information in a linear fashion without the necessity of integration into meaningful context. Integrated students are at-risk of failing as they attempt to grasp information in ways that do not match their experience. Among large populations of at-risk students are many from Native American and similar cultures who do not regard their world as a sum of parts but as a blend of all that they experience.

This lesson plan does include some traditional, linear approaches to delivering information (checklists, rules, analysis, problem solving and organization). In addition to the traditional, linear delivery of information, this lesson plan also includes some of the following strategies, designed to appeal to at-risk students as they learn academic/life skills:

- Integration of technology
- Story telling/anecdotal information
- Non-competitive group and team work
- Performance-based assessment and rubrics
- Visual presentations and practice through technology and other means
- Project-based assignments that integrate family and community
- Activities appealing to multiple intelligences (Gardner)
- Application of Scientific Method to formulate and solve a problem.

Lesson Overview

This lesson is designed to familiarize students with the concept that food and cooking involve many complex chemical reactions that can be measured using basic math. Students will prepare pineapple jell-o with fresh and canned ingredients and compare the enzyme activity.

Lesson Objectives

Project Objectives: When students complete this session, they will be able to…

- Follow a simple recipe
- Explain how enzymes work.
- Combine different ingredients and predict how they will react.
- Design and carry out an experiment to test a hypothesis about enzymes.

Integration of Other Functional/Academic Skills: (Critical thinking is required throughout the lesson.) Students will be able to…

Math: Estimate and accurately measure different ingredients.

Reading: Comprehend the written directions, ask questions and clarify the procedure.

Writing: summarize; define; explain
Listening: Follow the oral directions and safety precautions
Science *A*pply scientific method to design and create another enzyme experiments
Technology: Apply basic features of Microsoft Word and search a site on the Internet

State/National Standards (Complete as Appropriate)

http://www.cde.state.co.us/cdeassess/sci.htm#standards Science
http://www.sssoftware.com/standards/colorado.html Math

Websites

Required:
http://www.enzymedica.com/enzymedeficiencytest.pdf **Enzyme test**

Support:
http://acsinfo.acs.org/journals/jafcau/ Journal of Agriculture and Food Chemistry

Pre-requisites: Read at sixth grade level or above.

Required Materials

- 1 Box lemon Jell-O 1 can pineapple 1 cup of fresh pineapple chunks

Handouts (Included at the end of this document)

- What are enzymes? (Handout 1)
- Lesson Checklist (Handout 2)
- Experimental Design (Handout 3)
- Lesson Rubric (Handout 4)

Required Equipment/Technology

- 1 computer, with Internet connection and a MS Word for every group of 2-3 students
- Balance
- Stove or hot plate to boil water

THE LESSON

Note: Students do not learn from what you do but from what you have them do.

PART I
Preparation

Research Enzymes Purchase enough small boxes	**Show students how to use URL addresses.** **Show students how to look up words and information in http://encarta.msn.com/ , http://dictionary.msn.com/ ,** **Have students practice accessing several different URL's with your help.**

Presentation

Activity	Instructor Notes
Show students how to use URL addresses. Show students how to look up words and information in http://encarta.msn.com/ , http://dictionary.msn.com/ , http://www.howstuffworks.com/enzymes Have students practice accessing several different URL's with your help	**Tell the story of Sisyphus rolling the stone up the mountain. Sis·y·phus** [síssəfəss] *noun* **king of ancient Corinth:** in Greek mythology, a cruel king of Corinth who was condemned for eternity to roll a boulder up a hill only to have it roll down again just before it reached the top.(Enzymes reduce the size of the mountain so that it is easier for the reaction to occur).
Perform the experiment and refrigerate for several hours	**This is a very simple experiment, and I suggest the students set it up and get it into the refrigerator before you discuss enzymes.**
Examine and discuss the results.	**Go through each handout and have students explain enzymes before you discuss the article**

	in depth. They might also like to take the enzyme test to see how their own enzymes are working

Performance and Practice

Instructions for students	Teacher notes
Discuss the results	**The jell-o containing fresh pineapple should not gel because it contains the enzyme that breaks down protein. Discuss how enzymes are killed by heating and processing**
Have students design a second activity that would test enzyme activity	**Possible activities might involve chewing a cracker until it becomes sweet (Starch is converted to sugar in the mouth). Lots of diet pills these days include enzymes. You might want to test them on different food groups to see if they break them down**

Lesson Assessment Strategy (Formative – As the lesson progresses)

Preparation, Presentation and Overall Implementation (Instructor)

1. Are the instructions and expectations for the class clear from the beginning?
2. Am I spending sufficient time on modeling the skills I want students to acquire?
3. Is there enough variety in the lesson to appeal to most learning preferences?
4. How many learning intelligences am I addressing?
5. Are students “connecting” to lesson objectives? How?
6. How is this lesson “integrated?”

Performance and Practice (Student)

1. Do all students have the skills to follow instructions? If not, what measures am I taking to address the challenge?
2. Are all students participating in the activities either by active observation or by voicing their thoughts?
3. Am I identifying the strengths of each student and pairing/grouping people accordingly? What results am I getting?
4. How are students performing? Are all of them able meeting 80% of the lesson objectives? If not, what am I doing to help them achieve more?

Technology

1. Is the technology working?
2. How are students reacting to the technology, and what do I need to remember when I teach this lesson again?
3. How are students applying or wanting to apply their technical skills in other areas?

Activity Checklist (Handout 2)

Discuss the topic.	
Examine and discuss handouts.	
Observe how to find URL's and navigate relevant sites.	
Prepare the two types of Jell-o	
Go to the Internet and visit http://www.enzymedica.com/enzymedeficiencytest.pdf Read and take the test In a group or in pairs, discuss your body type according to the results	
Explain enzymes using pictures and words	
Observe any changes in the refrigerated Jell-o	
Compose a summary paragraph about enzymes and describe another digestive enzyme.	

Procedure (Handout 3)

- Carefully divide a package of lemon jell-o in half using the balance
- Place in two separate bowls or beakers
- Add ½ cup of boiling water to each. Stir until dissolved
- Add ½ cup of Fresh Pineapple to one bowl, and ½ cup of Canned Pineapple to the other bowl.
- Place in a refrigerator or freezer, or in the snow. If not available, add ½ cup of ice to each.
- Complete the rest of the activity while they chill
- Observe after and hour, and check on them the next day if possible.

Article Outline

I. Introduction Print section

Enzyme, any one of many specialized organic substances, composed of polymers of amino acids, that act as catalysts to regulate the speed of the many chemical reactions involved in the metabolism of living organisms. The name *enzyme* was suggested in 1867 by the German physiologist Wilhelm Kühne (1837-1900); it is derived from the Greek phrase *en zyme,* meaning "in leaven." Those enzymes identified now number more than 700.

Enzymes are classified into several broad categories, such as hydrolytic, oxidizing, and reducing, depending on the type of reaction they control. Hydrolytic enzymes accelerate reactions in which a substance is broken down into simpler compounds through reaction with water molecules. Oxidizing enzymes, known as oxidases, accelerate oxidation reactions; reducing enzymes speed up reduction reactions, in which oxygen is removed. Many other enzymes catalyze other types of reactions.

Individual enzymes are named by adding *ase* to the name of the substrate with which they react. The enzyme that controls urea decomposition is called urease; those that control protein hydrolyses are known as proteinases. Some enzymes, such as the proteinases trypsin and pepsin, retain the names used before this nomenclature was adopted.

II. Properties of Enzymes Print section

As the Swedish chemist Jöns Jakob Berzelius suggested in 1823, enzymes are typical catalysts: they are capable of increasing the rate of reaction without being consumed in the process. *See* Catalysis.

Some enzymes, such as pepsin and trypsin, which bring about the digestion of meat, control many different reactions, whereas others, such as urease, are extremely specific and may accelerate only one reaction. Still others release energy to make the heart beat and the lungs expand and contract. Many facilitate the conversion of sugar and foods into the various substances the body requires for tissue-building, the replacement of blood cells, and the release of chemical energy to move muscles.

Pepsin, trypsin, and some other enzymes possess, in addition, the peculiar property known as autocatalysis, which permits them to cause their own formation from an inert precursor called zymogen. As a consequence, these enzymes may be reproduced in a test tube.

As a class, enzymes are extraordinarily efficient. Minute quantities of an enzyme can accomplish at low temperatures what would require violent reagents and high temperatures by ordinary chemical means. About 30 g (about 1 oz) of pure crystalline pepsin, for example, would be capable of digesting nearly 2 metric tons of egg white in a few hours.

The kinetics of enzyme reactions differ somewhat from those of simple inorganic reactions.
Each enzyme is selectively specific for the substance in which it causes a reaction and is most effective at a temperature peculiar to it. Although an increase in temperature may accelerate a reaction, enzymes are unstable when heated. The catalytic activity of an enzyme is determined primarily by the enzyme's amino-acid sequence and by the tertiary structure—that is, the three-dimensional folded structure—of the macromolecule. Many enzymes require the presence of another ion or a molecule, called a cofactor, in order to function.

As a rule, enzymes do not attack living cells. As soon as a cell dies, however, it is rapidly digested by enzymes that break down protein. The resistance of the living cell is due to the enzyme's inability to pass through the membrane of the cell as long as the cell lives. When the cell dies, its membrane becomes permeable, and the enzyme can then enter the cell and destroy the protein within it. Some cells also contain enzyme inhibitors, known as antienzymes, which prevent the action of an enzyme upon a substrate.

III. Practical Uses of Enzymes Print section

Alcoholic fermentation and other important industrial processes depend on the action of enzymes that are synthesized by the yeasts and bacteria used in the production process. A number of enzymes are used for medical purposes. Some have been useful in treating areas of local inflammation; trypsin is employed in removing foreign matter and dead tissue from wounds and burns.

IV. Historical Review Print section

Alcoholic fermentation is undoubtedly the oldest known enzyme reaction.
Continue article...

This and similar phenomena were believed to be spontaneous reactions until

1857, when the French chemist Louis Pasteur proved that fermentation occurs only in the presence of living cells (*see* Spontaneous Generation). Subsequently, however, the German chemist Eduard Buchner discovered (1897) that a cell-free extract of yeast can cause alcoholic fermentation. The ancient puzzle was then solved; the yeast cell produces the enzyme, and the enzyme brings about the fermentation. As early as 1783 the Italian biologist Lazzaro Spallanzani had observed that meat could be digested by gastric juices extracted from hawks. This experiment was probably the first in which a vital reaction was performed outside the living organism. After Buchner's discovery scientists assumed that fermentations and vital reactions in general were caused by enzymes. Nevertheless, all attempts to isolate and identify their chemical nature were unsuccessful. In 1926, however, the American biochemist James B. Sumner succeeded in isolating and crystallizing urease. Four years later pepsin and trypsin were isolated and crystallized by the American biochemist John H. Northrop. Enzymes were found to be proteins, and Northrop proved that the protein was actually the enzyme and not simply a carrier for another compound.

Research in enzyme chemistry in recent years has shed new light on some of the most basic functions of life. Ribonuclease, a simple three-dimensional enzyme discovered in 1938 by the American bacteriologist René Dubos and isolated in 1946 by the American chemist Moses Kunitz, was synthesized by American researchers in 1969. The synthesis involves hooking together 124 molecules in a very specific sequence to form the macromolecule. Such syntheses led to the probability of identifying those areas of the molecule that carry out its chemical functions, and opened up the possibility of creating specialized enzymes with properties not possessed by the natural substances. This potential has been greatly expanded in recent years by genetic engineering techniques that have made it possible to produce some enzymes in great quantity (*see* Biochemistry).

The medical uses of enzymes are illustrated by research into L-asparaginase, which is thought to be a potent weapon for treatment of leukemia; into dextrinases, which may prevent tooth decay; and into the malfunctions of enzymes that may be linked to such diseases as phenylketonuria, diabetes, and anemia and other blood disorders.

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