**Enzyme Lab 1**

**What form of pineapple juice contains enzymes that digest protein?**

**Materials:**

For every 3 groups For each group For entire class

1 envelope Knox gelatin 4 test tubes water

Measuring cup 1 test tube rack pineapple juices (below)

1 spoon 4(1ml)disposable pipettes hot plate to heat water

100ml graduated cylinder 10ml graduated cylinder

 Marking pen

**Procedure:**

1. Number and label the test tubes “1-4” and use the initials of a group member to identify your group.
2. Find 2 other groups and prepare 1 package of gelatin in the measuring cup using 90ml of boiling water and 30 ml of cold water. Stir well with a spoon until the gelatin is dissolved.
3. Place 3 ml of the designated pineapple juice into each test tube. **Use a separate pipette for each type of juice**. Failure to do so may result in mixing of the juice types and inaccurate results.
	* Tube 1: water only
	* Tube 2: fresh pineapple juice
	* Tube 3: Canned pineapple juice
	* Tube 4: Concentrated pineapple juice (thawed)
4. Add 10 ml of gelatin mixture to each test tube. Shake well to ensure proper mixing and place your samples in the refrigerator overnight using a test tube rack.
5. On Day 2, check the contents of each test tube for solidification of the contents and record your observations.

**Enzyme Lab 2**

**What effect does temperature have on an enzyme?**

**Materials:**

For every 2 groups For each group For entire class

1 envelope Knox gelatin 6 test tubes water

Measuring cup 1 test tube rack pineapple juices (below)

1 spoon 1 (1ml) disposable pipette

100 ml graduated cylinder 10ml graduated cylinder

 Marking Pen

 Hot plate

**Procedure:**

1. Prepare the Knox gelatin by mixing 1 package of gelatin in the measuring cup using 90ml of boiling water and 30 ml of cold water. Stir well with a spoon until the gelatin is dissolved.
2. Number the test tubes from 1-5. Label the remaining test tube as “RT” (room temperature).
3. Each group will be assigned their own temperature gradient ranging from 40◦C – 100 ◦C. Each group must record the test tube numbers and the corresponding test temperatures for each test tube. Record the temperature of the room for the temperature for the “RT” test tube.
4. Next, add 3 ml of pineapple juice to each test tube.
5. Then heat each test tube to the appropriate temperature as assigned. Leave the test tube “RT” at room temperature. **(HINT: start with all the test tubes in cool water in a glass beaker water bath. Gradually increase the temperature withdrawing the numbered test tubes in 2◦C increments in order as the appropriate temperature level in the bath is reached.)**
6. After the test tubes have been pulled from the water bath, add 10 ml of Knox gelatin (prepared in step 1) to each test tube and mix well.
7. Finally, place the test tubes in the refrigerator overnight.
8. On day 2, check each test tube for solidification or liquidity of the contents and record your observations.

**Enzyme Lab 3**

**What effect does pH have on enzyme activity?**

**Materials:**

For every 3 groups For each group For entire class

1 envelope Knox gelatin 3 test tubes goggles

Measuring cup 1 test tube rack apron

1 spoon 4 (1ml) disposable pipettes water

100 ml graduated cylinder 10 ml graduated cylinder pineapple juice

 Marking pen 1M HCl

 1M NaCl

**Procedure:**

1. Prepare the Knox gelatin by mixing 1 package of gelatin in the measuring cup using 90ml of boiling water and 30 ml of cold water. Stir well with a spoon until the gelatin is dissolved.
2. Label 1 test tube “A” for acid, 1 test tube “B” for base, and the last test tube “C” for control.
3. Place 3ml of pineapple juice into each of the labeled test tubes. Transfer 1 ml of base, 1 ml acid, and 1ml of water into the appropriate test tubes of pineapple juice. HINT: Use a different pipette for each test tube to avoid contamination.
4. Add 10 ml of gelatin mixture to each test tube. Mix well, being careful to not get any of the acid or base on your skin.
5. Refrigerate the test tubes overnight and on day 2 check each test tube for solidification or liquidity of the contents. Record your observations.

**Enzyme Labs 1-3**

**Background Information**

**Pineapples**

Pineapple’s lush, tropical sweetness is reason enough to enjoy it any way you can, but this fruit also contains vitamin C and manganese. This fruit’s most promising nutritional asset, though, may be bromelain, a natural enzyme found in both the fruit and the stem.

Most of the pineapple consumed in the United States is canned (in the form of juice as well as fruit), but fresh pineapple is much more flavorful, and , despite its tough bristly shell, is easy to prepare.

The fruit probably first grew wild in parts of South America and then spread to the Caribbean, where Columbus encountered it. By 1600, early European explorers had carried pineapples as far as China and the Philippines. In the 18th century, pineapples were taken to the Hawaiian Islands, eventually becoming the major fruit crop. Hawaiian pineapple producers were the first to can the fruit.

**Bromelain**

The pineapple plant contains protein-digesting enzymes called, as a group, bromelain. In the health world, these enzymes are regarded as useful in reducing muscle and tissue inflammation (hence the joint pain and wound-healing possibilities), as well as acting as a digestive aid. In the cooking world, on the other hand, bromelain is regarded as the enemy of the gelatin dessert. If you use fresh pineapple in gelatin, the enzyme eats the protein and the gelatin will not gel—in fact bromelain is measured in units called GDU, or gelatin digesting units. The classic kitchen trick for getting around this pineapple-gelatin incompatibility is to cook the pineapple, thus reducing the power of the bromelain.

Recipes that would highlight the benefits of bromelain start with fresh pineapple (which has two to three times the amount of bromelain as canned pineapple does), and is then subjected to as little heat as possible.

Bromelain is used in meat tenderizers, in hill-proofing beer, manufacturing precooked cereals, in certain cosmetics, and in preparation to treat edema and inflammation.

**Gelatin**

Gelatin, a familiar, ingredient in cooking, is obtained by boiling the skin, tendons, and ligaments of animals. As a result, it contains protein called collagen ( a primary component of joints, cartilage, and nails), and various amino acids (histidine, lysine, leucine, tryptophan, and valine, to name a few). Remember: amino acids are the building blocks of proteins.

Gelatin has long been a key ingredient for providing support for “jelled” deserts, salads, frozen drinks, and soft candies such as Gummi Bears. (In fact, the word gelatin is derived from the Latin “gelatus”, meaning stiff or frozen.)

Scientists have been studying gelatin for centuries. It has no smell or taste of its own, adapting to whatever it is added to. During the Napoleonic Wars, the French, desperate for nutrition sources during the English blockade, reportedly first turned to gelatin as a source of protein (albeit a weak one). Gelatin began its long run as a popular consumable, however, in the 1890’s, when it was first developed and then heavily promoted as a commercial product by Charles Knox, founder of the Knox Gelatin Corporation.

In addition to its famous “jiggly” food uses, gelatin with its flexible, dissolvable structure, is also used to manufacture capsules (both hard and “soft-gel”) to hold medications, vitamins, and other dietary supplements. It also has a range of industrial and medical engineering applications: Gelatin is an ingredient in film coatings, medical devices such as artificial heart valves, and in specialized meshes used to repair wounds, to name a few.

**Collagen**

About one quarter of all the protein in your body is collagen. It is a major structural material that forms molecular cables to strengthen the tendons and resilient sheets that support the skin and internal organs. Bones and teeth are made by adding mineral crystals to collagen. Collagen provides structure to our bodies, protecting and supporting the softer tissues and connecting them with the skeleton. But, in spite of its critical function in the body, collagen is a relatively simple protein.

Collagen from livestock animals is a familiar ingredient in cooking. Collagen is a protein, and like most proteins, when heated, it loses all of its structure. The polymer molecule unwinds. Then, when the denatured mass cools down, it soaks up all of the surrounding water like a sponge, forming gelatin.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class Period\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzyme Pre-Lab**

**Directions: Read the background material provided to you. Using this material, your notes, and text, answer the following questions.**

1. By definition, what is an enzyme? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. (a) Describe what happens when a protein denatures. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) Is the denatured protein still able to function? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. (a) What is the name of the enzyme we are using in this lab? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 (b) What fruit is it found in? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. (a) What is the protein we are using in this lab? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 (b) For this lab, what is our food source for the protein? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. In your own words, describe what happens to collagen when it is heated. \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Read the procedure for Enzyme Lab 1. Make a hypothesis regarding which of the four juices (water, fresh pineapple juice, boxed juice, concentrated juice) will be solid and which will be liquid when you examine your results on Day 2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Why is water used as a “juice” in Enzyme Lab 1? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Read the directions for Enzyme Lab 2. Make a hypothesis as to the nature of the contents of each test tube at Day 2; which test tube’s contents will be solid and which will be liquid? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Why do you hypothesize this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Read the procedure for Enzyme Lab 3. Make a hypothesis as to which test tube’s contents (A, B, or C) will be liquid at Day 2 and which will be solid. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Why do you hypothesize this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class Period\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzyme Lab Data Sheet**

**Enzyme Lab 1**

|  |  |  |
| --- | --- | --- |
| **Test Tube** | **Juice** | **State of test tube contents on Day 2** |
| 1 | Water |  |
| 2 | Fresh Pineapple Juice |  |
| 3 | Canned Pineapple Juice |  |
| 4 | Concentrated Pineapple Juice |  |

1. Was your hypothesis supported by the data? Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What caused the contents to stay liquid?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzyme Lab 2**

|  |  |  |
| --- | --- | --- |
| **Test Tube** | **Temperature** | **State of test tube contents on Day 2** |
| 1 | Room Temperature |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

1. Was your hypothesis supported by the data? Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What caused the contents to stay liquid?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzyme Lab 3**

|  |  |  |
| --- | --- | --- |
| **Test Tube** | **Contents** | **State of test tube contents on Day 2** |
| A | Acid |  |
| B | Base |  |
| C | Control (water) |  |

1. Was your hypothesis supported by the data? Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What caused the contents to stay liquid?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_